

CITY OF JEFFERSON
Public Works Design Standards

Division 5

Water Distribution

DIVISION 5 WATER DISTRIBUTION

5.1 PURPOSE

- a. In addition to the purposes outlined under Division 1 of these Design Standards, the purpose of these Standards is to ensure the development of a water distribution system which will:
- 1) be of adequate design to meet all expected domestic, commercial and industrial demands including fire flows within the design life;
 - 2) have sufficient structural strength to withstand all external loads which may be imposed;
 - 3) be of materials resistant to both corrosion and erosion with a minimum design life of 75 years;
 - 4) be economical and safe to build and maintain;
 - 5) meet all design requirements of the Oregon Health Authority – Drinking Water Services (OHA-DWS).

Alternate materials and methods will be considered for approval on the basis of these objectives.

- b. These Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by professional design engineers.

5.2 APPLICABILITY

- a. These Standards shall govern all construction and upgrading of all public water distribution facilities in the City of Jefferson and applicable work within its service areas.
- b. Permanent water distribution facilities shall be provided to all properties within the City of Jefferson in accordance with these Standards. This shall generally be interpreted to mean that permanent water distribution facilities shall be provided for existing legal lots of record at the time development occurs, and for new legal lots of record created by a major or minor partitioning or subdivision of land at the time of partitioning or subdivision.

5.3 SPECIAL ITEMS

- a. The design of the following are considered special items and are not covered in detail in these Standards:
 - 1) Water Distribution Pump Stations
 - 2) Reservoirs
 - 3) Wells
 - 4) Treatment Plants
 - 5) Pressure Regulating Devices
 - 6) Flow Measurement Devices
 - 7) Relining of the Existing Water Mains
 - 8) Chemical Addition or pH Adjustment
 - 9) Bridge Crossings
 - 10) Creek or Stream Crossings
- b. Review and approval of the above special items by the Public Works Director shall be required. When requested by the City, full design calculations shall be submitted for review prior to approval. Special items may also require review and approval by the OHA-DWS as applicable.

5.4 APPROVAL OF ALTERNATE MATERIALS AND METHODS

- a. Any alternate material or method not explicitly approved herein will be considered for approval on the basis of the objectives set forth in Paragraph 5.1, Purpose. Persons seeking such approval shall make application in writing to the Public Works Director. Approval of any major deviation from these Standards shall be in written form. Approval of minor matters will be made in writing, if requested. Any and all such requests shall be submitted in writing to the Public Works Director prior to City approval of the design drawings.
- b. Any alternate must meet or exceed the minimum requirements set forth in these Design Standards (*also see "equal" & "substitute" definitions under PWDS 1.4*).
- c. The written application is to include, but is not limited to, the manufacturer's specifications and testing results, design drawings, calculations and other pertinent information.
- d. Any deviations or special problems shall be reviewed on a case-by-case basis and approved by the Public Works Director. When requested by the City, full design calculations shall be submitted for review with the request for approval.

5.5 CONSTRUCTION DRAWINGS

- a. Construction drawings shall conform to the requirements of Division 1 of these Design

Standards.

- b. Detail drawings shall be included on the construction drawings for all water system appurtenances including valves, blowoffs, hydrants, service connections, couplings, etc.

5.6 STANDARD DETAILS

- a. Standard details included in the appendix are supplemental to the text of these design standards and show the City's minimum requirements for the construction of certain standard system components.
- b. In the case of conflicts between the text of these design standards and the standard details, the more stringent as determined by the Public Works Director shall apply.
- c. As required by Division 1 of these standards, all applicable standard details shall be included on the construction drawings.

5.7 DEFINITIONS AND TERMS

- a. In addition to the definitions contained in Division 1 of these Standards, the following definitions may apply particularly to water distribution systems. Unless otherwise defined in these Design Standards, the following definitions and abbreviations shall apply whenever used. Other definitions as outlined in the Oregon Plumbing Specialty Code (OPSC) shall also apply.
 - 1) Abbreviations: Acceptable abbreviations for showing types of new and existing pipe materials on the plans are as follows:
 - a) AC - Asbestos Cement
 - b) CI - Cast Iron
 - c) DI - Ductile Iron
 - d) HDPE - High Density Polyethylene
 - e) PVC - Polyvinyl Chloride
 - f) STL - Steel
 - 2) Air Gap Separation: A physical vertical separation between the free-flowing discharge end of a potable water supply and the rim of any open, non-pressurized receiving vessel.
 - 3) Approved Backflow Prevention Assembly: An assembly that has been investigated and approved by the OHA-DWS for preventing backflow.
 - 4) Backflow: The flow of water or other fluids in a direction opposite to the normal flow. (*See Back-Siphonage.*)
 - 5) Back-Siphonage: The flowing back of used, contaminated, or polluted water from a plumbing fixture or vessel into a water supply pipe due to a negative or reduced pressure in such pipe.

- 6) Building Supply: The pipe carrying potable water from the water meter or other source of water supply to a building or other point of use or distribution on the lot. Building supply shall also mean customer line.
- 7) Cross Connection: Any connection or arrangement, physical or otherwise, between a potable water supply system and any plumbing fixture or any tank, receptacle, equipment or device, through which it may be possible for non-potable, used, unclean, polluted and contaminated water, or other substances, to enter into any part of such potable water system under any condition.
- 8) Customer Water Supply System: The water supply system of a building, premises or private system consists of the all supply pipe from the customer side of the water meter, including water service pipes, and the necessary connecting fittings, control valves, pipe and all appurtenances carrying or supplying potable water in or adjacent to the building premises served.
- 9) Distribution Mains: All mains which are not designated as transmission mains, and which are used for supply the individual consumer. As a general rule these are the smaller mains in the water supply system.
- 10) Distribution System: Distribution main pipelines, pumping stations, valves and ancillary equipment used to transmit water from the supply source to the service line.
- 11) Double Check Valve Assembly: An assembly composed of two single, independently acting check valves, including tightly closing shut-off valves located at each end of the assembly and fitted with properly located test ports.
- 12) Double Detector Check Valve Assembly: A line-sized approved double check valve assembly with a parallel meter and meter-sized approved double check valve assembly. The purpose of this assembly is to provide double check valve protection for the distribution system and at the same time provide partial metering of the fire system showing any system leakage or unauthorized use of water.
- 13) Fire Hydrant Assembly: Fire hydrant, hydrant lead, mainline hydrant valve, mainline tee, and thrust restraint at the hydrant and the mainline tee.
- 14) Fire Protection Services: A connection to the public water main intended only for the extinguishment of fires and flushing necessary for its proper maintenance. All fire services connected to building sprinkler systems shall have a double check detector assembly. The connection of the fire protection service to the public mainline shall be the service connection, and the entire portion of the fire protection service from the isolation valve at the public mainline connection to the building shall be the sole responsibility of the property owner for maintenance and/or repair (*ie. a private service line*). Domestic services taps are not allowed on fire protection services or fire hydrant leads.

- 15) Fixture Unit Equivalents: The unit flow or demand equivalent of plumbing fixtures as tabulated in the Oregon Plumbing Specialty Code (OPSC).
- 16) Hydrant Lead: The line connecting the fire hydrant to the City main or private fire line.
- 17) Irrigation Service: A metered connection intended for seasonal use and delivering water which is not discharged to the sanitary sewer.
- 18) ISO: Insurance Service Office.
- 19) Mainline Hydrant Valve: The isolation valve between the City water main or private fire line and the fire hydrant.
- 20) OHA-DWS: Oregon Health Authority, Drinking Water Services.
- 21) Oregon Plumbing Specialty Code (OPSC): The Uniform Plumbing Code, current edition as revised by the State of Oregon, called the "Oregon Plumbing Specialty Code."
- 22) Potable Water: Water which satisfactory for drinking, culinary and domestic purposes and meets the requirements of the health authority having jurisdiction.
- 23) Private Distribution System: A privately owned and maintained water distribution system serving an industrial or commercial subdivision or a multi-building development on a single lot served through a master meter installed at the approved location. Private distribution systems must have a single entity responsible for the system. Resale of water without written approval of the City shall be prohibited.
- 24) Service Line: The waterline or pipe extending from the distribution main to the water meter, backflow prevention device, or private fire system double check valve.
- 25) Transmission Mains (Supply Lines): Mains which are used for transporting water from the source of supply and storage reservoirs to the centralized point of distribution and distribution reservoirs. Transmission mains may or may not supply individual consumers, but they are sized and located to transport water from centralized points of distribution to various points of interconnection with the grid system and centralized points of consumption.
- 26) Uniform Plumbing Code: The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition as revised by the State of Oregon, called the "Oregon Plumbing Specialty Code."
- 27) Water Main: A water-supply pipe for public or community use.
- 28) Water Master Plan: The Water System Evaluation and Master Plan for the City

of Jefferson, Oregon, most recent revisions.

5.8 MATERIALS

a. General

- 1) Unless otherwise approved by the City Engineer, materials shall conform to the minimum requirements outlined herein and as shown on the Standard Details. This listing is not intended to be complete nor designed to replace the City's Public Works Construction Standards (PWCS).
- 2) In the case of conflicts between the provisions of these design standards and the PWCS, the more stringent as determined by the Public Works Director shall apply. Acceptable materials shall be as outlined in these Design Standards.
- 3) It is not intended that materials listed herein are to be considered acceptable for all applications. The design engineer shall determine the materials suitable for the project to the satisfaction of the City Engineer.
- 4) All materials or products which will come in contact with or which will be used on material or products which will come in contact with potable water shall conform to the requirements of OAR 333-61-087, Product Acceptability Criteria or the National Sanitation Foundation (NSF) Standard 61, Drinking Water System Components - Health Effects as approved by the OHA-DWS.
- 5) Granular backfill shall be ¾"-0 conforming to OSSC (ODOT/APWA) 02630.10 (Dense Graded Base Aggregate), with no more than 10% passing the #40 sieve and no more than 5% passing the #200 sieve.

b. Pipe

- 1) PVC (AWWA C-900)
 - a) PVC pressure pipe shall conform to the requirements of AWWA C-900 (*design stress of 4000 psi*), NSF approved, with cast iron pipe equivalent (CI) outside diameter dimensions. Pipe shall be PVC pipe with wall thickness equivalent to a standard dimension ratio (SDR) of 18.
- 2) Ductile Iron
 - a) Where ductile iron pipe is used for water distribution, pipe shall be Class 52 ductile iron pipe with push-on joints conforming to AWWA C-151, and cement-mortar lined and seal coated in accordance with AWWA C-104 (*ductile iron pipe threaded for flanges shall be Class 53*).
 - b) All ductile iron pipe and fittings buried underground shall be coated on the outside with a standard coating of black bituminous paint a minimum of 1 mil thick unless otherwise specified.

- c) All ductile iron pipe within a single project shall be of the same manufacturer.
- 3) Rubber-ring gaskets for push-on joints shall be furnished by the pipe manufacturer to ensure compatibility with the gasket groove in the push-on bell end. Gaskets shall be suitable for the specified pipe sizes and pressure.
- 4) Restrained joint PVC pipe shall be used in locations and configurations as required by the City Engineer (*Diamond Lok-21, Eagle Loc 900, TerraBrute CR or approved equal, as approved by the City Engineer and Public Works Director for the specific application*).

c. **Bolts & Nuts for MJ Joints & Flanged Joints**

1) **Mechanical Joints**

- a) MJ joints shall be provided with corten tee-head bolts and nuts (*ASTM A242, high strength, low alloy steel conforming with AWWA C-111*).

2) **Flanged Joints**

- a) All flange joints shall be provided with bolts and nuts (*low alloy steel conforming with AWWA C-111*).
- b) As a minimum, all nuts and bolts used for flanged joints shall conform to the requirements of ASME/ANSI B18.2.1 and shall be low carbon steel conforming to the requirements of ASTM A-307 Grade B, zinc plated steel.

3) **Areas with Corrosion Concerns**

- a) For any areas where required by Public Works, MJ and flanged joints shall be provided with bolts and nuts (*low alloy steel conforming with AWWA C-111*) coated with a zinc base coat and a Xylan fluoropolymer top coating (*or approved equal*) for corrosion control and to control thread friction torque during tightening (*Romac R-Blue, TriPac 2000 Blue or approved equal*).

d. **Fittings**

1) **Mechanical Joint Fittings**

- a) All MJ tees, crosses, elbows, reducers, adapters, combinations thereof, and other miscellaneous fittings 4-inches through 24-inches in diameter shall be ductile iron compact fittings in conformance with AWWA C-153.
- b) The minimum working pressure for all MJ cast iron or ductile iron

fittings 4-inches through 24-inch in diameter shall be 350 psi.

c) Retainer Glands for MJ Joints

- (1) Retainer gland casting bodies shall have all surfaces fusion bond powder coated (*polyester or nylon based*) after pretreatment with a phosphate wash, rinse & sealer coating (*Mega-Bond or approved equal*).
- (2) Retainer gland set wedge bolts and set wedge assemblies shall have all surfaces coated with a minimum of two coats of fluoropolymer coating or approved equal coating (*to control thread friction torque during tightening of set wedges*).
- (3) Retainer glands for use on MJ joints shall be "Mega-Lug" as manufactured by EBAA Iron Inc. (*color coded based on the type of compatible pipe*), or approved equal.

2) Flanged Fittings

- a) All flanged tees, crosses, elbows, reducers, adapters, combinations thereof, and other miscellaneous fittings 4-inches through 48-inches in diameter shall be cast iron or ductile iron fittings in conformance with AWWA C-110.
- b) The minimum working pressure for all flanged cast iron or ductile iron fittings shall be 250 psi.

e. Couplings

- 1) Couplings shall be limited in their application to connection of new pipe work to existing waterlines, temporary installations, and where specifically approved by the City Engineer.
- 2) Mechanical joint couplings shall have minimum pressure ratings that will accommodate maximum pressures which will be experienced during hydrostatic and leakage testing.
- 3) Unrestrained Couplings. Unrestrained mechanical joint sleeve couplings and adapters shall be long-style solid sleeve type couplings consisting of a fusion bond epoxy coated ductile iron sleeve, ductile iron follower rings, rubber gaskets, and corrosion-resistant bolts and hex nuts (*zinc plated*). Unrestrained long sleeve couplings shall be Tyler Pipe, UFCO, Star, Sigma or approved equal. Romac Macro HP extended range couplings are allowed as an alternative to unrestrained MJ sleeve couplings.
- 4) Restrained Couplings. Unless otherwise specifically specified or noted on the drawings, restrained sleeve couplings up to 12-inch diameter shall be Krausz

Hymax Grip Coupling, or approved equal (*Romac Alpha Coupling*), consisting of a fusion bond epoxy coated two bolt coupling with all cast components (*end rings, center ring, bolt guides, gripper teeth*) of ductile iron, NBR gaskets, stainless steel hardware, stainless steel bolts & anti-gall e-coated nuts.

- 5) Dresser type couplings are not an approved option unless specifically approved by the Public Works Director. Applications shall be limited to transitions between pipe types for which mechanical joint couplings are not available.

f. **Mainline Valves**

1) **General**

- a) All mainline valves and appurtenances shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation as specified herein or as shown on the drawings.

2) **Valve Operators**

- a) All valve operators shall be totally enclosed traveling nut type manual operators, sealed and lubricated for underground service.
- b) All buried valves shall be supplied with a 2-inch square operating nut, and shall open to the left (*ie. counterclockwise*). Nuts shall have a flanged base on which shall be cast an arrow at least 2-inch long with the word "OPEN" cast on the nut to clearly indicate the direction of opening.
- c) Extension stems shall be provided for buried valves when the operating nut is four (4) feet or more below finished grade. Extension stem shall extend to within twelve (12) inches (*maximum*) of the finished ground surface and shall be provided with spacers which will center the stem in the valve box.

3) **Valve Boxes (VB)**

- a) All buried valves shall be provided with new valve boxes, including new valves installed by the Contractor, or existing valves which are excavated around as part of the work, and existing valves which are located within newly paved, newly concreted or newly graveled surfaces.
- b) Valve boxes shall conform to Standard Details (*reuse of existing valve boxes will only be allowed if they fully conform with current standard details, are accurately centered on the valve nut, are clean of excess rock or debris around the valve nut, and are approved in writing by the City*). All valve boxes shall be provided with 3034 PVC riser pipes, length as required.

- c) All valve boxes noted above (*new and reused existing valves*) shall be provided with VC212 self-centering valve box bases with integral rubber fingers to exclude rock from around the valve nut, as manufactured by 3 Dimensional Contracting, or approved equivalent.

4) Gate Valves (GV)

- a) For criteria regarding acceptable location for use of gate valves, see Section 5.16.
- b) All gate valves shall be resilient wedge gate valves conforming to the requirements of AWWA C-509, except as herein modified.
- c) Gate valves shall be epoxy coated iron-body, resilient wedge non-rising stem gate valves. The wedge shall be cast iron completely encapsulated in an elastomer covering with polymer guide bearing caps on each side. The valves shall have a full diameter waterway with no grooves or recesses at the valve seat location. Flanges, where required, shall be 125 pound, full faced, drilled per ANSI B16.1.
- d) Valves shall be tested and certified by the manufacturer for shut-off at a working pressure of 200 psi and a minimum test pressure of 300 psi.
- e) Gate valves shall be Mueller A-2360, Waterous Series 500 or approved equivalent.

5) Butterfly Valves (BFV)

- a) For criteria regarding acceptable location for use of butterfly valves, see Section 5.16.
- b) All butterfly valves shall conform to AWWA C-504, except as herein modified. Butterfly valves shall be provided with standard gearing so as to match the same number of turns as a gate valve of the same size (*3 x diameter plus 1 turn to open or closed*).
- c) Butterfly valves shall be epoxy coated short body type AWWA Type-B valves. Flanges, where required, shall be 125 pound, full faced, drilled per ANSI B16.1.
- d) Valve operators shall be enclosed traveling nut type manual operators, sealed and lubricated for underground service, and shall be rated for submerged operation up to 10 psi (± 23 feet).
- e) Valves shall be tested and certified by the manufacturer for shut-off at a working pressure of 150 psi and a minimum test pressure of 300 psi.
- f) Butterfly valves shall be Pratt Groundhog series, or approved equivalent.

6) Valve Coating

- a) All valves shall be furnished with a fusion-bonded epoxy coating inside and outside conforming to the requirements of AWWA C-550.

g. Service Pipe and Fittings

- 1) For criteria regarding tapping requirements, see Section 5.19.
- 2) All services that are saddle tapped shall use ductile iron service saddles with stainless steel bolts and double strap clamps. All ductile iron service saddles shall be furnished with a fusion bonded epoxy or nylon coating conforming to the requirements of AWWA C-550, Romac 202NS, Ford FC202 or approved equal.
- 3) Unless otherwise approved by the Public Works Director, single residential service pipe shall be a minimum of 1-inch in diameter, and commercial or industrial service pipe shall be a minimum of 1½-inches in diameter (*reducers can be installed at meter location as applicable*).
- 4) Compression Inserts. All service connections to HDPE service pipe shall be compression fittings, with 2-3/8" long inserts provided for all HDPE connections per manufacturer's recommendations (*AY McDonald 6133T CTS insert stiffener or equal*). Any service connections to copper pipe shall be compression fittings.
- 5) No-Lead Service Brass. All service brass shall be manufactured from no-lead alloy conforming with UNS/CDA C89833, and shall have the letters "NL" cast into the body for proper identification.
- 6) Tracer Wire. A continuous 12 gauge solid core copper toning wire (*blue insulation*) shall be installed along all non-copper water service lines from the mainline to the meter box.
- 7) 1-inch Services
 - a) Unless otherwise specified herein, water service lines shall be Driscopipe 5100 Ultra-Line (PE 3408/PE 4710) high density polyethylene pipe, copper tube size OD, SDR 9 (*200 psi working pressure rated*) conforming to ASTM D-2737, with long style compression inserts and compression fittings. All water services shall be continuous HDPE without splices.
 - b) All corporation stops shall be brass ball valve corporation stops rated to 300 psi with iron pipe thread inlet and compression outlet to adapt copper pipe. Corporation stops shall be Ford FB-1100 or approved equivalent.
 - c) Each individual water service line shall be equipped with a locking ball

valve meter stop assembly at the inlet to the meter. All meter stop assemblies shall be brass with copper pipe connector as appropriate and outlet for meter coupling.

- d) Meter stops for 1-inch single meter stops shall be locking angle ball valves with CTS PAC joint inlet. 1-inch meter stops shall be Ford BA43-444W, or approved equivalent.
- e) Service line couplings shall be CTS pack joint style couplings. Couplings shall be Ford C44 coupling or approved equivalent, with long style compression inserts as specified above.

8) **1½-inch & 2-inch Services**

- a) 1½-inch and 2-inch water service lines shall be Driscopipe 5100 Ultra-Line (PE 3408/PE 4710) high density polyethylene pipe, copper tube size OD, SDR 9 (*200 psi working pressure rated*) conforming to ASTM D-2737, with long style compression inserts as specified above and compression fittings. All water services shall be continuous HDPE without splices.
- b) 1½-inch and 2-inch water services shall be provided with high bypass coppersettors for flanged meters, Ford VBB76-12HB-11-66 (1½") or VBB77-12HB-11-77 (2") high locking bypass or approved equivalent conforming to standard details.
 - (1) The coppersetter shall be provided with ball valves on the inlet and outlet, with inlet valve provided with a lockwing and the outlet valve provided with a handle.
 - (2) The bypass line shall be 1-inch diameter minimum, and shall be provided with a lockwing ball valve.
- c) 2-inch and larger services shall have a mainline tee with flanged side outlet and a flange x MJ resilient wedge gate valve conforming the requirements specified herein.
- d) The meter assembly shall include a lockable bypass and may require a backflow preventer if required by Public Works.

9) **3-inch & Larger Services**

- a) 3-inch and larger water service lines shall be reviewed on a case-by-case basis. Pipe and fittings shall be as required by the City Engineer and the Public Works Director.
- b) All services 3-inch and larger shall be Class 52 ductile iron pipe, with ductile iron fittings. Provide retainer glands on all MJ joints, and field-

lock type gaskets on all push-on joints. See PWDS 5.7 for ownership and responsibility for fire protection service from mainline connection to building.

- c) 3-inch and larger services shall have a mainline tee with flanged side outlet and a flange x MJ resilient wedge gate valve conforming to the requirements specified herein.

10) **Fire Services**

- a) All fire service lines shall be reviewed on a case-by-case basis. Pipe and fittings shall be as required by the City Engineer and the Public Works Director.
- b) The portion of all fire services within the public right-of-way or within utility easements to the City shall be Class 52 ductile iron pipe, with ductile iron fittings. Provide retainer glands on all MJ joints, and field-lock type gaskets on all push-on joints.
- c) All fire service connections shall have a minimum 4-inch mainline tee (*or tapping saddle*) with flanged side outlet and a flange x MJ resilient wedge gate valve conforming to the requirements specified herein.
- d) Each fire service connection shall be provided with a double check detector assembly with a City approved meter on the detector loop.

h. **Water Meter Boxes**

- 1) Unless otherwise approved by the Public Works Director, all meter boxes must be as shown below:

WATER METER BOXES¹			
Service Line Size	Non-Traffic Area²	Traffic Area²	Inside Dimensions
3/4-inch & 1-inch	DFW486WBC4-12-BODY DFW486C-4C-LID ¹	Same	11" x 18"
1½-inch & 2-inch	DFW1324WBC4-12-BODY DFW1324C-4C-LID ¹	Same	13" x 24"
3-Inch and larger	Vault built to Public Works requirements, w/ aluminum hatch, OSHA ladder, sump pump & lockable bypass.		
¹ Meter boxes and/or piping which do not provide all required clearances and spacing so as to allow installation of City's standard meter (<i>without removing the box or vault, and without reconfiguring piping</i>) will be required to be reset or replaced by the developer or builder (<i>at their sole expense</i>), prior to installation of the meter. ² – See requirement below for AMR/AMI lid configuration.			

- 2) Meter boxes shall be H20 rated polymer boxes with covers configured for top-mount radio-read AMR sensors and containing an embedded locator magnet.

i. **Fire Hydrants**

- 1) Unless otherwise required by the Jefferson Public Works Director, all fire hydrants shall conform to the following:
 - a) All fire hydrants shall be improved, dry barrel, 5¼-inch compression type valve, traffic model.
 - b) Fire hydrants shall be equipped with two 2½-inch hose ports (NST), one 4½-inch pumper port (NST) with Storz adapter as specified, 1½-inch pentagon nut, and barrel drains.
 - c) Fire hydrants shall be oriented so as to optimize access to ports, or as directed by the Engineer.
 - d) Fire hydrants shall be EJ Watermaster 5CD250 or Mueller Super Centurion 200, Model A-423, and shall be factory painted yellow. Provide Storz adapter & cap per standards details.
 - e) All hydrants within a single project (*including within all phases of a project*) shall be of the same manufacturer.

j. **Mainline Blowoffs**

- 1) Minimum allowable blowoff size shall be as outlined under Section 5.12. Blowoffs shall be sized to provide adequate flushing velocities as approved by the City Engineer.
- 2) Unless otherwise shown or authorized by the City Engineer, all blowoffs shall be provided with valve boxes and/or meter boxes as shown in the Standard Details.

k. **Mainline Tapping Tees**

- 1) Tapping tees used for making connections to existing, in-service lines shall be all stainless steel construction (*including stainless steel flange*) with full perimeter gasket, and shall have Class 125 outlet flanges. In all cases, the tapping tee shall be designed for use with the existing pipe materials and O.D. equivalent.
- 2) All tapping valves shall be resilient wedge gate valves furnished with a fusion bonded epoxy coating inside & outside conforming to the requirements of AWWA C-550.
- 3) Any company performing mainline taps shall be prequalified with the City prior to performing any work on a project.

- 4) Contractors shall coordinate all taps with City Public Works and perform work with Public Works staff present.

l. Underground Warning Tape

- 1) Underground warning tape shall be detectable or non-detectable acid and alkali resistant safety warning tape. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.
- 2) The tape shall be safety blue and shall be provided with the legend "CAUTION BURIED WATER LINE BELOW" or approved equivalent printed continuously down the length of the tape.

m. Toning Wire

- 1) A continuous insulated 12 gauge solid core copper toning wire shall be supplied with non-metallic pipe. Insulation shall be blue in color for potable water piping.
- 2) Additional wire shall be supplied as necessary to allow the toning wire to be looped up at all valve boxes on all lines.

n. Warning Tape

- 1) Warning tape shall conform with the requirements noted on the standard details and standard construction notes (*6-inch width, color & "Caution: Buried _____ Below" wording as required for pipeline being installed*).

o. Concrete (Cast-in-Place) Thrust Restraint.

- 1) All concrete shall conform to the requirements of OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, 3300 psi min @ 28 days, max 5" slump, 4.5% air ($\pm 1.5\%$). Concrete mix design shall be submitted to the City for review and approval prior to use.
- 2) If hand mixed sack-crete type concrete is proposed by the Contractor and approved by the Public Works Director, it shall be a 4000 psi minimum mix (*approved by the City prior to use*), mixed with the minimum amount of water necessary for workability (*5" slump or stiffer*).
- 3) In no case will dry sack-crete (*either in bags or as loose mix*) be considered as an acceptable substitute for an approved concrete mix, placed as specified herein or on the drawing details.

p. **Bore Casings and Accessories**

- 1) Carrier pipe used in bore casings shall meet the minimum specifications contained herein. Casing pipe shall be of a size to permit proper construction of the carrier pipe to the required lines and grades.
- 2) Casing shall be welded smooth steel pipe conforming to the requirements of ASTM A-53 or approved equal, with a minimum yield strength of 35,000 psi.
- 3) Minimum casing size and wall thickness shall as outlined below. Casing wall thickness shall conform to these requirements or the requirements of the agency having jurisdiction, whichever is more stringent. Contractor shall be responsible for verifying the bell OD or casing spacer diameter required of actual carrier pipe provided or bore grades specified, as bell diameters or casing spacer requirements may vary between manufacturers. Casing diameter shall be increased as required to allow trimming of casing spacers on grade critical bores, or where required to provide additional clearance between bells and casing. The fact that certain carrier pipe types are listed in this table does not indicate that such pipe type is approved for any particular application (*ie. to avoid repetition, this table applies to water, sewer and storm drainage as applicable*).

Carrier Pipe Nominal Diameter (Inches)	Minimum ¹ Casing Pipe Diameter (Inches)	Casing Wall Minimum Thickness (Inches)
<6"	10 OD / 9.5" ID	0.250 (1/4)
6" DI (CL 52, push-in joint) (Bell OD = ±8.9")	12" OD / ±11.5" ID	0.25 (1/4)
6" PVC C900 (DR 18) (Bell OD = ±8.43")	12" OD / ±11.5" ID	0.25 (1/4)
6" PVC D3034 (DR 35) (Bell OD = ±7.0")	12" OD / ±11.5" ID (18" min. if slope ≤ 2%)	0.25 (1/4) 0.375 (3/8)
8" DI (CL 52, push-in joint) (Bell OD = ±11.2")	14" OD / ±13.37" ID	0.312 (5/16)
8" PVC C900 (DR 18) (Bell OD = ±11.06")	14" OD / ±13.37" ID	0.312 (5/16)
8" PVC D3034 (DR 35) (Bell OD = ±9.36")	14" OD / ±13.37" ID (20" min. if slope ≤ 2%)	0.312 (5/16) 0.375 (3/8)
10" DI (CL 52, push-in joint) (Bell OD = ±13.25")	16" OD / ±15.37" ID	0.312 (5/16)
10" PVC C900 (DR 18) (Bell OD = ±13.57")	16" OD / ±15.37" ID	0.312 (5/16)
10" PVC D3034 (DR 35) (Bell OD = ±11.7")	16" OD / ±15.37" ID (24" min. if slope ≤ 2%)	0.312 (5/16) 0.50 (1/2)

Carrier Pipe Nominal Diameter (Inches)	Minimum¹ Casing Pipe Diameter (Inches)	Casing Wall Minimum Thickness (Inches)
12" DI (CL 52, push-in joint) (Bell OD = ±15.37")	18" OD / ±17.25" ID	0.375 (3/8)
12" PVC C900 (DR 18) (Bell OD = ±16.13")	18" OD / ±17.25" ID	0.375 (3/8)
12" PVC D3034 (DR 35) (Bell OD = ±13.94")	18" OD / ±17.25" ID (24" min. if slope ≤ 2%)	0.375 (3/8) 0.50 (1/2)
14" DI (CL 52, push-in joint) (Bell OD = ±17.85")	22" OD / ±21" ID	0.50 (1/2)
14" PVC C900 (DR 25) (Bell OD = ±17.94")	22" OD / ±21" ID	0.50 (1/2)
15" PVC D3034 (DR 35) (Bell OD = ±17.05")	22" OD / ±21.2" ID (24" min. if slope ≤ 2%)	0.50 (1/2) 0.50 (1/2)
16" DI (CL 52, push-in joint) (Bell OD = ±20")	24" OD / ±23" ID	0.50 (1/2)
16" PVC C905 (DR 25) (Bell OD = ±20.41")	24" OD / ±23" ID	0.50 (1/2)
18" DI (CL 52, push-in joint) (Bell OD = ±22.2")	26" OD / ±25" ID	0.50 (1/2) 0.50 (1/2)
18" PVC C905 (DR 25) (Bell OD = ±22.87")	26" OD / ±25" ID	0.50 (1/2) 0.50 (1/2)
18" PVC F679 (PS46) (Bell OD = ±20.85")	24" OD / ±23" ID (28" min. if slope ≤ 2%)	0.50 (1/2)
20" DI (CL 52, push-in joint) (Bell OD = ±24.3")	28" OD / 27" ID	0.50 (1/2)
20" PVC C905 (DR 25) (Bell OD = ±25.34")	28" OD / 27" ID	0.50 (1/2)
21" PVC F679 (PS46) (Bell OD = ±24.58")	28" OD / 27" ID (30" min. if slope ≤ 2%)	0.50 (1/2)
24" DI (CL 52, push-in joint) (Bell OD = ±28.5")	32" OD / ±31" ID	0.50 (1/2)
24" PVC C905 (DR 25) (Bell OD = ±30.27")	34" OD / 33" ID	0.50 (1/2)
24" PVC F679 (PS46) (Bell OD = ±27.65")	32" OD / 31" ID (34" min. if slope ≤ 2%)	0.50 (1/2)
27" PVC F679 (PS46) (Bell OD = ±31.16")	36" OD / ±34.75 ID	0.625 (5/8)
30" DI (CL 52, push-in joint) (Bell OD = ±34.95")	38" OD / ±36.75" ID	0.625 (5/8)

Carrier Pipe Nominal Diameter (Inches)	Minimum ¹ Casing Pipe Diameter (Inches)	Casing Wall Minimum Thickness (Inches)
30" PVC C905 (DR 25) (Bell OD = ±37.12")	42" OD / ±40.75" ID	0.625 (5/8)
30" PVC F679 (PS46) (Bell OD = ±35.61")	42" OD / ±40.75" ID (44" min. if slope ≤ 2%)	0.625 (5/8)
36" DI (CL 52, push-in joint) (Bell OD = ±41.4")	46" OD / ±44.75" ID	0.625 (5/8)
36" PVC C905 (DR 25) (Bell OD = ±44.43")	48" OD / ±46.75" ID	0.625 (5/8)
36" PVC F679 (PS46) (Bell OD = ±42.82")	48" OD / ±46.75" ID (50" min. if slope ≤ 2%)	0.625 (5/8)
42" PVC F679 (PS46) (Bell OD = ±49.61")	54" OD / ±52.75" ID (56" min. if slope ≤ 2%)	0.75 (3/4)
48" DI (CL 52, push-in joint) (Bell OD = ±54.71")	60" OD / ±58.5" ID	0.75 (3/4)
48" PVC F679 (PS46) (Bell OD = ±56.62")	60" OD / ±58.5" ID (64" min. if slope ≤ 2%)	0.75 (3/4)

¹ Casing diameter shall be increased as required to allow trimming of casing spacers on grade critical bores.

- 4) The class of casing specified is based upon assumed superimposed loads and not upon the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor.
- 5) Casing Spacers (Skids)
 - a) Casing spacers shall be Model SSI-8 for carrier pipes up to 18 inch diameter and Model SSI-12-2 for larger pipe sizes as manufactured by APS (*Advanced Products and Systems, Inc.*), or approved equivalent.
 - b) Casing spacers shall be bolt-on style with a shell made of at least two halves. The band material shall be manufactured of a minimum 14 gauge T-304 stainless steel. The runners shall be at least 7 inches long for SSI-8 models and 11 inches long for SSI-12 models, and manufactured of high abrasion resistant and low co-efficient of friction, glass filled polymer.
 - c) The spacer shall have a flexible EPDM liner having a minimum thickness of 0.090 inches, with a hardness of durometer "A" 85-90. The liner shall have a rating of no less than 60,000 VPM and water absorption of 1% maximum. All welds are to be chemically passivated

and all hardware to be stainless steel.

- d) All spacers used for grade critical gravity sewer and storm lines shall have field replaceable runners to allow for grade and elevation adjustment.
 - e) A minimum of three (3) casing spacers per length of pipe shall be required, or 6-foot on center maximum spacing, whichever is greater.
- 6) End Seals.
- a) Where casings are filled with sand (*gravity or non-pressure pipelines*), end seals shall be grout/masonry end caps with 4" minimum diameter sand feed and vent tubes at each end. The vent tubes shall be plugged with grout after the casing is filled with sand.
 - b) Where casings are not filled with sand (*pressure pipelines*), end seals shall be Model AC (*pull-on*) or Model AW (*wrap-around with pressure sensitive butyl mastic strips*) end seals as manufactured by APS, or approved equivalent, fastened to the casing and carrier pipe with stainless steel bands.

5.9 GENERAL DESIGN CONSIDERATIONS

- a. Unless otherwise approved or required by the Public Works Director and the City Engineer, the water distribution system shall have sufficient capacity to maintain 40 psi at the building side of the meter for one and two family dwellings. For other development, the distribution system shall have sufficient capacity to provide minimum pressure of 35 psi at the building side of the meter during periods of maximum use, and to provide sufficient volumes of water at adequate pressures to satisfy the maximum expected daily consumption plus fire flows.
- b. Normal working pressure in the distribution system should be approximately 70 psi with a range of 40 psi to 100 psi.
- c. Head loss shall be determined by the Hazen-Williams equation based on the following coefficients.

Hazen-Williams Coefficients	
Pipe Diameter	C Value
8 Inches and Less	100
10 to 12 Inches	110
Greater than 12 Inches	120

- d. Velocities in mains shall normally range from three (3) to six (6) feet per second for average demand to a maximum velocity of ten (10) feet per second for maximum day demand plus fire flow, where pressure headloss is not a concern. In general, maximum headloss for transmission and distribution mains should be limited to 3 feet per 1000 feet and 10 feet per 1000 feet respectively, provided that acceptable pressure can be maintained under maximum design flow conditions.
- e. A 20 psi residual pressure under fire flow conditions shall be maintained at all meter service connections in the distribution system (*OAR 333-061-0025.7 & OAR 333-061-0050.8.e*), and positive pressure at all other locations. Generally, a maximum velocity of ten (10) feet per second under fire flow conditions will govern for sizing mains at all other locations of the service level where this criteria does not govern.
- f. For purposes of calculating projected headloss through a fire hydrant assembly, the maximum headloss values provided in AWWA C502, Table 5 shall be used (*13 psi headloss @ 1500 gpm through large steamer port*). Use of lower headloss values shall be based on a certified headloss curve from the hydrant manufacturer (*ie. based on City approved hydrant*), and the headloss through the 6-inch hydrant lead shall also be accounted for.
- g. Private systems shall limit velocities as required by the Oregon Plumbing Specialty Code (OPSC), Installation Standards.
- h. **Providing for Future Development**
 - 1) To & Through. As a condition of water service, all developments will be required to provide public water mains of sufficient size for fire protection to adjacent parcels, as well as connection (*to the new system*) of existing water lines, hydrants or services crossed or intercepted by or adjacent to the new waterlines, at locations as required by the City Engineer and Public Works Director (*see PWDS also 1.6.e*).
 - 2) This shall include the extension of water mains in easements across the property to adjoining properties and across the street frontage of the property to adjoining properties when the main is located in the street right-of-way. This shall include extension to the far side of streets fronting or adjacent to the development as required to avoid work within or under these streets in the future.
 - 3) This shall include waterlines that are oversized to provide capacity for required fire flows, or as required to meet the minimum sizes required by the PWDS, or by the applicable water master plan, whichever is larger (*see also PWDS 1.6.h*).
 - 4) In general, water distribution systems should be designed for maximum development of the service area with recognition of possible urban renewal, industrial expansion, etc.

5.10 WATER SYSTEM CAPACITY

a. General:

- 1) Waterlines shall be provided as required to meet the minimum sizes required by the PWDS or by the applicable water master plan, or as required to provide the required fire flows, whichever is larger (*see also PWDS 1.6.h*). In areas not addressed in the Water Master Plan, design capacities shall be determined by consideration of the following factors and assumptions:
 - a) Area to be serviced, both immediate and adjacent.
 - b) Current and projected population within the areas to be served.
 - c) Current and projected land use within the areas to be served.
 - d) Commercial, industrial, or institutional users to be served.
 - e) Changes in any of the above factors which are likely to occur within a foreseeable time period.
- 2) In the absence of consumption data or other reliable information, the following factors may be assumed:
 - a) Peak hour demands as follows:
 - (1) 5 gpm per single family residential
 - (2) 2.5 gpm per dwelling unit for multiple family residential
 - (3) 5,000 gal/ac/day for commercial development
 - (4) 10,000 gal/ac/day for industrial development
 - b) Demand for unique commercial installations, industrial users, PUD's, multiple and institutional developments shall be calculated on an individual basis.

b. Fire Flow Requirements

- 1) Unless otherwise approved or required by the local Fire Code Official, the water system shall be designed to convey minimum fire flows as follows:

MINIMUM FIRE FLOW REQUIREMENTS**			
Location		Recommended Fire Flow (gpm)	Duration (hours)
Residential	R-1	1,000	2
	R-2	1,500	2
	R-3	1,750	2
Public (Schools & Institutions)		2,500	3
Commercial/Industrial			
	New Facilities	3,250	3
	Existing Facilities	up to 4,000	4
<p>** These values are general planning values only, and do not supersede or take the place of Oregon Fire Code (OFC) (summarized in OFC Appendix B) or OBC fire flow requirements. Reductions may be allowed by the Fire Code Official for buildings with fire sprinkler systems. Higher values may be necessary based on the OFC, Fire Code Official or ISO requirements.</p>			

- 2) In all cases, all new fire hydrants shall be capable of delivering a minimum of 1,000 gpm at 20 psi residual system pressure. This requirement will apply independently to each phase of multi-phase projects.

5.11 LOOPING

- a. The distribution system mains shall be looped at all possible locations.
- b. All water lines shall be looped and valved such that the removal of any single line segment from service will not result in more than one fire hydrant being taken out of service.
- c. The installation of permanent dead-end mains upon which fire protection depends and areas of large demands on single mains will not be permitted.

5.12 BLOWOFFS

- a. All dead-end mains shall terminate with a blowoff assembly or a fire hydrant.
- b. Permanent dead-ends shall have a permanent blow-off assembly and a permanent thrust restraint system. Permanent blowoffs in cul-de-sacs shall be located in front of the curb within five (5) feet from the curb face.

- c. Mains which can conceivably be extended at some later date shall have a mainline valve (*same size as mainline*) in front of the blowoff assembly, and a thrust restraint system which allows the mainline valve to be connected to without taking the line out of service.
- d. Blowoffs shall be sized to ensure that the water mains can be flushed at a minimum velocity of 2½ feet per second in accordance with AWWA C-650. The following table may be used as a minimum guideline assuming 40 psi minimum residual system pressure under flushing conditions.

MAINLINE BLOWOFF SIZES	
Water Main Diameter	Minimum Blowoff Diameter
6 and 8-inch	2-inch
10 and 12-inch	4-inch
>12	As required

- e. The design engineer shall submit calculations showing that these flushing velocities can be satisfied.
- f. Temporary blowoffs larger than 2-inches in diameter shall have a valve conforming to the requirements contained herein for mainline valves.
- g. Temporary blowoffs, where required for cleaning new water mains, shall be located at the lower end of the line to be flushed whenever possible.

5.13 MINIMUM DEPTH

- a. The standard minimum cover over buried water mains within the street right-of-way or easements shall be thirty six (36) inches from the finished grade, except that a minimum of 40 inches cover shall be required for waterlines in fill slopes.

- b. Finish grade shall normally be determined as follows:

FINISH GRADE	
Mainline Location	Reference Finish Grade
Waterline under sidewalk in right-of-way	Top of curb
Waterline in front of curb	Gutter
Waterline in cut slope (<i>ie. waterline located behind and parallel with curb/sidewalk</i>)	Top of curb (<i>ie. cover depth measured from top of curb grade</i>)
Waterline in cut slope other than parallel with curbline	Perpendicular from pipe to surface
Fill slopes	Perpendicular from pipe to surface
Easement	Finish grade at pipe centerline

- c. Where the waterline is located in the cut side slope, in an undeveloped right-of-way, or along a roadway developed at less than ultimate width (*including sidewalks*), the waterline shall be placed at a depth sufficient to ensure that 36-inches of cover is maintained at the time of final construction of the roadway.

5.14 MINIMUM MAINLINE SIZE

- a. Minimum sizes for water mains shall be as follows, or as required to meet the minimum sizes shown in the applicable water master plan, or as required to provide the required fire flows, whichever is larger (*see also PWDS 1.6.h*):

MAINLINE SIZE REQUIREMENTS	
Min Diameter	Type of Mainline
6-inch	Private fire line supplying either a single fire hydrant or a building fire suppression system. Looping of private fire lines which supply hydrants will be required.
8-inch	Minimum size water main for the public water system. Looping back into the distribution grid shall be at intervals as required by the City, but shall generally not exceed ± 600 feet.
8-inch	Public water distribution mains, and permanently dead-end mains supplying fire hydrants with a required fire flow of 1,500 gpm or less.
10-inch & Larger	As required for transmission mains, distribution mains in industrial subdivisions, and fire lines supplying more than 1,500 gpm.

5.15 WATERLINE ALIGNMENT AND LOCATION

a. General

- 1) Water lines shall generally be parallel to the right-of-way or easement wherein they lie.
- 2) Unless otherwise required by the City Engineer, water lines shall generally be located on the south and west sides of the right-of-way wherein they lie, or on the high side of the right-of-way for hill side streets.

b. Waterline Location in Relation to Sanitary Sewer Lines and Other Utilities

- 1) Water mainlines shall be separated from all other utilities by a minimum of 5 feet between utility centerlines, but in all cases a minimum of 3 foot clear separation shall be provided.
- 2) Water mainlines shall generally be separated from sewer mainlines by a minimum of 10 feet. In no case shall the separation be less than 5 feet or as required by OAR 333.
- 3) Sanitary Sewer Main Crossings
 - a) Where a water mainline crosses below or within 18-inches vertical separation above a sanitary sewer main or lateral, one full length of waterline pipe shall be centered at point of the sewer crossing.

c. Waterline Location in Right-of-Ways

- 1) Unless otherwise approved by the Public Works Director, water mainlines shall generally be located in the street right-of-way along general alignments shown in the standard details.
- 2) The distance between the mainline and the curb shall vary as little as possible. On curved streets, mains may be laid on a curve concentric with the street centerline with deflections no greater than the manufacturer's specifications, or mains may be laid in straight lines along the tangent between selected angle points to avoid conflicts with other utilities. The angle point and tangent section shall not be closer than 5 feet from the right-of-way line, nor more than 3 feet in front of the curb face.

d. **Waterline Location in Easements, Easement Widths, Maintenance Access Requirements**

- 1) Unless otherwise specified or authorized by the City, minimum easements widths for water mainlines (*as well as water service lines to meters or water meters located on private property*) shall be fifteen (15) feet for normal depth lines (*centered on the waterline*).
 - a) Water mainlines with inside diameters larger than 12-inches will require wider easements (*20' minimum*).
 - b) Wider easements may be required for waterlines with cover depths greater than 5 feet, on steep hillsides or where maintenance access concerns exist (*see d.6 below*), as determined by the City Engineer and/or Public Works Director.
- 2) Mainlines in easements will be allowed only in cases where it is required in order to loop a mainline to avoid a permanent dead end condition, and only after all reasonable attempts to loop the mainlines in a right-of-way have been exhausted.
- 3) Offset: When waterline in easements are approved by the City, the waterline shall be offset a minimum of 7½ feet from any property line or easement boundary, or 1/3 the required easement width where wider easements are required (*rounded up to the nearest foot*).
- 4) Easement Limits around Meters, Hydrants, etc. The easement shall be sized to provide a minimum of five (5) foot clear on all sides around any meter box/vault, hydrant, ARV or similar structure located on private property.
- 5) Easement locations for public water mainlines serving a PUD, apartment complex or commercial/industrial development shall be in parking lots, private drives or similar open areas which will permit an unobstructed vehicle access for maintenance by City forces.
- 6) Maintenance Access Requirements. Where required by the Public Works Director, public waterline located outside of developed street right-of-ways will require all-weather maintenance access similar to that required for sewers under PWDS 4.15.d (*ie. all-weather access lanes along mainlines and/or for access to valves, meters, hydrants or other structures; maintenance agreement, etc.*).
- 7) City standards require that easements granted to the City shall not be used for any purpose which would interfere with the unrestricted use for water mainline purposes. Under no circumstances shall a building or structure, trees or ornamental landscaping be placed over a water mainline or easement, nor shall any parallel fences or parallel utilities be constructed within the easement

(access gates acceptable to the City shall be installed in fences which the City allows to be constructed across City easements). Prohibited structures shall include decks, as well as footings or overhanging portions of structures located outside the easement.

- 8) Common placement in the easement of water and sewer or storm drain line may be allowed under certain conditions subject to approval by the Public Works Director. Easements wider than the minimum will be required.
- 9) Franchise utilities shall not be placed in City utility easements unless approved in writing by the Public Works Director, subject to separation requirements in excess of minimums as dictated by Public Works.
- 10) Common easements will be reviewed on a case-by-case basis. Separation of utilities must meet OHA-DWS requirements.
- 11) All easements must be furnished to the City for review and approval prior to recording. All recording costs shall be borne by the Developer.

e. **Waterline Phased Construction**

- 1) Water mains installed by phased construction, which will be extended in the future, shall terminate with a mainline valve, blow off and permanent thrust restraint system which allows the mainline valve to be connected to without taking the line out of service.
- 2) All developments will be required to extend mains across existing or proposed streets for future extensions by the City or other developments. All terminations shall be planned and located such that new or existing pavement will not have to be cut in the future when the main is extended.
- 3) The construction plans for each phase shall be capable of standing alone, including provisions for looping and minimum fire flows.

f. **Waterline Location in Relation to Ditches and Drainage Channels**

- 1) Surface water crossings of mains shall be in accordance with OAR 333 and the requirements outlined herein. Waterline crossings of ditches, streams or other surface water channels shall be ductile iron pipe unless otherwise approved in writing by the Public Works Director.
- 2) Perpendicular. Water mains crossing ditches or drainage channels shall be designed to cross as nearly perpendicular to the channel as possible.
- 3) The following surface water crossings will be treated on a case-by-case basis:
 - a) Ditch or drainage channel crossing for pipes of 12-inch diameter and greater.

- b) River or creek crossings requiring special approval from the Division of State Lands.
- 4) The minimum cover from the bottom of the ditch or drainage channel to the top of pipe shall be a minimum of thirty-six (36) inches unless otherwise approved by the Public Works Director and the OHA-DWS.
- 5) A scour pad centered on the water line will be required for mains where the potential for erosion exists as determined by the Public Works Director. The size and design of scour pads will be reviewed on a case-by-case basis by the Public Works Director.

5.16 VALVES

a. Valve Sizes

- 1) In general, valves shall be the same size as the mains in which they are installed. Reducers for reconnection into existing water mains less than 8-inches in diameter (*or existing mains smaller than the new mainline*) shall be placed between the new valve and the existing line (*ie. the new valves shall be the same size as the larger mainline*).
- 2) Unless otherwise approved or required by the Public Works Director, valves shall conform to the following table.

Required Valves by Size and Operating Conditions		
Valve Size	Static Pressure	Valve Style
10-inch and smaller	< 120 psi	Gate Valve
8-inch & 10-inch	≥ 120 psi	Butterfly Valve
12-inch & larger	All pressures	Butterfly Valve

- 3) Valve types and materials shall conform to the requirements of these Design Standards and the Standard Construction Specifications.

b. Valve Location

- 1) Distribution system valves shall be located at the tee or cross fitting as nearly as possible.
- 2) There shall be a sufficient number of valves so located that not more than four (4) and preferable three (3) valves must be operated to effect any one particular shutdown. The spacing of valves shall be such that the length of any one shutdown in high value areas shall not exceed 500 feet nor 800 feet in other

areas.

- 3) A water mainline tee-intersection shall be valved on two branches and a water mainline cross-intersection shall be valved on three branches (*this requirement does not apply to fire hydrant tees or service connection tees*).
- 4) Hazardous crossings (*ie. creek, railroad, freeway crossings, etc.*) shall be valved on each side of the crossing.
- 5) Distribution branches on transmission mains shall be spaced not more than 800 feet apart where practical and shall be valved and plugged.
- 6) Transmission water mains shall have valves at spacings as required by the Public Works Director.

c. Mainline Tapping Tee & Valve

- 1) A tapping tee & valve to make connection to an existing, in-service line is only allowed in cases where the City determines that water service cannot be interrupted to cut in a tee or cross, and where the additional in-line valve is not needed for system isolation as outlined above.

d. Water Valve Operation

- 1) City forces shall operate all valves, including fire hydrants, on existing public water mains, on the public side of water meters, or at the connection of fire service lines to public water mains.

5.17 FIRE HYDRANTS

a. Hydrant Coverage

- 1) Preferred coverage shall result in maximum hydrant spacing of 500 feet in residential areas, 300 feet in high-value districts including industrial subdivisions and no further than 250 feet from the furthest point of any dwelling, business, garage or building. Hydrant stubs with mainline valves will be required as a minimum in undeveloped areas.

b. Hydrant Location & Availability

- 1) No fire hydrant shall be installed on a main of less than 8-inch diameter unless it is in a looped system of 6-inch mains. The hydrant lead shall be a minimum of 6-inches in diameter.
- 2) Hydrants shall be placed in locations approved by the City Engineer and the Fire Code Official.
- 3) In general, hydrants shall be located at corner of each public & private street

intersection where possible (*unless otherwise approved by the City Engineer and the Fire Code Official*). Hydrants located at points other than intersections shall be located at the extension of property lines (*offset as required only to avoid conflict with survey monuments per ORS 92.044.7*).

- 4) Unless otherwise approved by the City, hydrants shall be placed between the sidewalk and the property line.
- 5) No hydrant shall be installed within eight (8) feet of an existing fence, hedge, utility pole or guy wire nor shall a utility pole or guy wire be placed within eight (8) feet of an existing hydrant (JMC 6.20.030).
- 6) Existing or new hydrant availability for a particular property will be determined by the City and Fire Code Official based on both distance and accessibility (*see also OFC C103.1 & C104*).
 - a) Existing hydrants on City streets are generally considered as available to properties on both sides of the street.
 - b) For purposes of new development, hydrants on the opposite side of an ODOT highway right-of-way are generally NOT considered to be available, unless specific prior written approval is granted by ODOT (*ie. since the Fire Department may need to lay hose across the highway and restrict traffic during emergencies*).
 - c) Hydrants on the opposite side of railroad tracks are NOT considered to be available.
 - d) Hydrants on or across adjacent properties are not considered available unless fire apparatus access roads (*fire lanes*) extend between properties, and easements are recorded to prevent obstruction of such roads (OFC C104.1).

c. Hydrant Valves

- 1) Each fire hydrant shall have a hydrant valve and valve box at the mainline hydrant tee which will permit removal and repair of the hydrant without shutting down the water main supplying the hydrant.
- 2) Hydrant valves shall be resilient wedge gate valves.
- 3) The hydrant valve shall be connected directly to the mainline tee using a flange joint.
- 4) If the length of the hydrant lead is greater than 30 feet, an additional gate valve shall be provided within 3 feet of the hydrant, but under no circumstances shall the valve be attached to the hydrant.

d. Hydrant Leads

- 1) All hydrant leads shall be Class 52 ductile iron, 6" minimum diameter, with retainer glands at both ends.
- 2) Unless specifically approved in writing by Public Works for long hydrant leads, all hydrant leads shall consist of a single piece of pipe without joints. Any joints allowed on hydrant leads shall be provided with fully restrained gaskets (*Field-Lok or equivalent*).
- 3) Service taps on hydrant leads are prohibited.

e. Hydrant Bury & Exposure

- 1) Hydrant bury shall be sufficient to provide a minimum of 36-inches of cover over the hydrant lead. In no case shall the bury be less than the depth of the waterline from which the hydrant is served.
- 2) The hydrant shall be set such that the base of bottom flange bolts are a minimum of 2-inches and a maximum of 6-inches above finish grade following all landscaping and surface restoration.

f. Hydrant Operation & Use

- 1) No person other than Public Works staff shall operate or flow test fire hydrants without first obtaining written authorization from the Public Works Director. This hydrant use restriction shall not apply to fire department/fire district staff in the performance of their regular duties.
- 2) All hydrant flow tests shall be performed with Public Works staff present unless otherwise approved by the Public Works Director.
- 3) Opening or operating fire hydrants with any tool other than a standard hydrant wrench designed for that purpose is prohibited.

g. Fire Department Connections (FDC).

- 1) The distance from a fire hydrant to the fire department connection (FDC) shall not exceed 40 feet unless otherwise approved in writing by the Fire Code Official, but in no case shall a distance of greater than 60 feet be allowed.
- 2) FDCs connections/risers and FDC supply lines shall be installed in conformance with provisions of the Oregon Fire Code and applicable NFPA standards (*including but not limited to installation of accessible ball drip valves, cover depths for freeze protection, etc.*), with specific location and configuration subject to approval by the Fire Code Official.

h. No Parking Designation at Hydrants and FDCs

- 1) Parking is prohibited for 10 feet each way from fire hydrants (*ORS 811.550(16)*) or from FDCs, where such parking would block unrestricted access to the hydrant or FDC from the fire apparatus access way.
- 2) Curbs adjacent to fire hydrants or FDCs shall be painted 10 feet each way per Detail 503. Areas without curbs shall be marked or signed for no parking as approved by the Fire Code Official. .

5.18 AIR RELEASE VALVES

a. **General**

- 1) Provisions for air relief shall be provided at all high points of waterlines. Where possible, location of service taps at high points in the line is preferable to the installation of an air relief valve.
- 2) Where service taps cannot be used, an air release valve shall be permanently installed at high points on all water mains at all location where air can accumulate. An automatic air release valve shall be installed in a meter box or vault outside of the street at a location where flooding of the meter box or chamber will not occur.
- 3) Any ARV installed above grade (*ie. bridge crossings, etc.*) shall protected from freezing with a hotbox insulated enclosure and heat tape/heater, or other approved means.

b. **Air Release Valve Piping**

- 1) The open end of an air release pipe from automatic valves shall extend to the top of the manhole at least twelve inches above grade and provided with a screened, downward facing tee vent. Grade shall mean the existing ground elevation adjoining the meter box or vault (*see also Detail 518*).

5.19 WATER SERVICE LINES

a. **General**

- 1) The use of pumps on a water service line (*between the mainline and the meter*) to provide adequate pressure to a subdivision lot or property located above the pressure level of the supply main shall be prohibited.

Booster pumps installed on private property shall require the installation of a backflow device meeting City and state standards.

- 2) Each legal lot of record shall be provided with a separate water service line

connected to the public or approved private water main. Combined water service lines will be permitted only when the property cannot legally be further divided. An example of this is a residential lot with a house and detached garage or shop with plumbing fixtures.

- 3) An easement shall be recorded for any water service line which encroaches on or crosses any property other than one being served.
- 4) Separate water services and separate meters shall be installed to serve each side of duplex lots, and each unit of triplex residential buildings unless otherwise approved by Public Works. Separate water services and separate meters shall be installed to serve each unit of condominiums or to serve each unit of developments with separate detached dwelling units or single family lots with separate detached accessory dwelling units (*except where otherwise approved by the Public Works Director for RV parks, etc.*).
 - a) Where water service lines beyond the meter are required or shown along flagstem or common use driveways (*or which cross property other than that being served*), the pipe shall be extended to the end of the driveway or to the boundary of the lot being served (*whichever is farther*) in conjunction with the development infrastructure construction. The end of the service line shall be marked with a 2x4 post wired to the pipe stub, extending 18" above grade, with the toning wire stapled to the top of the marker post.
- 5) Additional water service lines must be stubbed into the property lines sufficient to serve all residential parcels which can be further partitioned in the future where such future partition would require that the streets be cut to install such services, or where the service line must cross intervening property to provide such future service.
- 6) Where water service lines are connected to water mainlines in the street, the top of curb and the gutter pan shall be stamped at the point of the service crossing as required by the standard details and standard notes.
- 7) Perpendicular. Unless otherwise approved in writing by the City Engineer and the Public Works Director on a case-by-case basis, water service lines shall be installed from the mainline to the property line perpendicular to the street centerline. Permanent installation of water service lines with the right-of-way is generally prohibited, except where extenuating circumstances exist which meet the variance criteria.
- 8) Private pressure reducing valves (PRV) may be required by Public Works in certain areas (*to be installed on the private side of water meters*). The installation, maintenance and repairs of such devices shall be entirely the responsibility of the property owner.

b. **Water Service Sizes**

- 1) Standard service line sizes are 1-inch, 1½-inch, 2-inch, 4-inch, 6-inch and 8-inch (4" service line required for 3" meters). Service lines will be reviewed for effects on the distribution system and shall not be greater in size than the distribution main.

MINIMUM SERVICE SIZE	
Type of Service	Minimum Service Size
Single residential service ¹	1-inch
Double residential service	Not permitted
Commercial Service	1½" minimum
Notes: ¹ The next larger service size may be required for residential lots large enough to be partitioned into additional lots without a water main extension. ² Commercial service pipe smaller than 1½" require prior approval by the City Engineer & Public Works (with approval from Public Works, reducers can be installed at meter location as applicable if smaller meters are desired, and where maximum demand flows are demonstrated to be within operating limits of the smaller meter).	

- 2) Service piping from the main to the meter shall be equal to or greater than the meter size.
- 3) Commercial services shall not be smaller than 1½-inch (reducers may be installed at the meter location to accommodate a smaller meter). For new streets or streets being cut for service installation, far side commercial services shall be installed in a 4-inch minimum size PVC sleeve.
- 4) For 1½-inch and larger meters, calculations, documentation and drawings as applicable must be submitted with the expected flow requirements and proposed usage.
- 5) Private Water Service Pipe (beyond meter). Typically, the water service line on the private side of the meter may not be larger than one nominal pipe size greater than the meter size. Larger sizes shall be approved by Public Works prior to installation, to ensure that water usage and flowrates do not exceed the recommendations for the meter being provided.

c. **Tapping requirements**

- 1) Tapping requirements for water service lines shall be as outlined below.

WATER SERVICE TAPPING REQUIREMENTS		
Service Size	Mainline Type	Tapping Requirements
1"	All pipe types	Service Saddle
1½"	All pipe types	Service Saddle
2" & larger	All pipe types	Mainline tee (<i>or tapping saddle</i>) with flanged valve

d. **Water Service Location**

1) **Domestic & Irrigation Services**

- a) The service lines shall extend from the main to the meter location shown on the standard details. An angle meter stop and meter box shall be located at the termination of the service line.
- b) The meter stop shall be located such that the front of the meter box is the distance behind the curb or sidewalk as shown on the standard details.
- c) In general, individual service connections shall terminate in front of the property to be served.
- d) Domestic or irrigation service lines shall not be connected to fire protection services, including hydrant leads.

2) **Fire Service**

- a) A backflow prevention assembly (*with detector loop & detector meter*) shall be placed on fire service lines as required by the City (*located on private property outside of the public right-of-way or City easement*). See PWDS 5.7 for ownership and responsibility for fire protection service from mainline connection to the building.
- b) Plans for fire service lines shall meet the requirements outlined in PWDS Division 1 and shall be stamped by a licensed Civil Engineer. The portion of the fire service within the right-of-way or within utility easements to the City shall conform with PWDS 5.8.f.9 (*ie. CI 52 DI pipe*), and the remainder (*on private property*) shall conform with the Oregon Fire Code and referenced standards, and shall be acceptable to the Fire Code Official.

- c) Drawings for fire services shall include vicinity map, adjoining street name, width, curb and property line, location of existing water line referenced to the property line, existing hydrant locations and the distance to property pins where the service crosses the property line (*offset as required to avoid conflict with survey monuments per ORS 92.044.7*).
- d) Service taps on fire service lines are prohibited.

5.20 WATER METERS

a. General

- 1) Except as otherwise required, all water meters within the service area of the City will be furnished and installed by City forces at the request and expense of the customer. The service line, meter box and all piping & fittings within the meter box must be installed by the developer.
- 2) Unless otherwise approved by the Public Works Director, all meters 1½-inches and larger shall be installed by a contractor retained by the developer, under the on-site inspection and subject to the approval of Public Works.
- 3) A backflow preventer meeting City & State standards shall be provided and installed by the Contractor at locations acceptable to Public Works.
- 4) Meter Sizing.
 - a) Fixture unit equivalents and demand curves (*used in determining the design flow rates to size water meters for other than separate single family uses*) shall be established in accordance with the Oregon Plumbing Specialty Code (*OPSC Appendix A, table A103.1 & Charts A103.1(1) & A103.1(2)*). The size of water meter required shall be based on standards determined by the Public Works Director (*based on OPSC fixture unit demand curves unless use of peak design demand flow is required for industrial type uses*), and will be based on use of the City's standard compound water meter for maximum accuracy.
 - b) City meter sizing criteria will include factors to minimize excessive velocities in the water system, including velocities through meters and water service lines (*in order to reduce the risk of water hammer induced pipe breakages on the public and/or private side of the meter, and to maximize the useful lifespan of the water meters installed*). Unless otherwise determined by the Public Works Director, default meter sizing (*and associated SDC charges*) will be based on the "High-Normal Flow Rate" (*for Compound Class II meters*) in Table 6-1 of AWWA M22 3rd Edition (*Sizing Water Service Lines and Meters*) published by the American Water Works Association (*AWWA*). In no

case shall velocities greater the 10 feet per second be allowed through water meters.

- c) Turbine style water meters will only be allowed where approved by the Public Works Director on a case-by-case basis (*at his/her sole discretion*), where projected flow patterns support the use of a turbine meter. In cases where the Public Works Director allows the use of a turbine meter in place of a standard compound meter, any reduction in meter size (*due to the use of such turbine meter*) will not result in a reduction of applicable SDC fees. If turbine meters are allowed, and changes in future flow patterns result in reduced meter accuracy, the Public Works Director may require that the turbine meter be changed to a standard compound meter, at the customer's expense.

b. **Water Meter Location**

1) **General**

- a) Meters shall be located at the termination of the City service line, at locations as shown on the standard details. Unless otherwise approved by the Public Works Director, meters shall be located within the right-of-way or easement containing the water mainline (*see PWDS 5.15.d.4 for easement limits around water meters located outside of public right-of-ways*).
- b) All meter locations shall be approved by the Public Works Director (*ie. based on access & maintenance considerations, and to minimize the length of service line between the mainline and meter to the extent feasible*).
- c) Unless otherwise approved by the Public Works Director on a case-by-case basis, meter boxes shall be located outside of driveways or other areas subject to vehicular traffic. Approval by the City for meters and meters boxes set in driveways or areas subject to vehicular traffic shall be contingent upon the Developer, builder or property owner providing a traffic rated meter box, including installation of a concrete collar around the box per City standards in traffic or gravel areas (*concrete is required both to provide lateral support for the meter box and the prevent gravel from covering the box lid*). After initial installation, the property owner shall be responsible to protect the meter box and meter from damage. Damaged meter boxes (*or concrete collars where required*) shall be repaired and/or replaced as directed by the City, at the property owner's expense.
- d) Water meters shall be located outside of buildings being served, at a location approved by the Public Works Director. Meters on fire service detector loops shall be installed at accessible locations acceptable to the

Public Works Director, and reader heads shall be provided as required to allow the meter to be read without entering the building.

- e) Easement around Meter Box/Vault. A public utility and access easement to the City shall be provided to and around any meter boxes or meter vaults set on private property. The easement shall be sized to provide a minimum of five (5) foot clear around the meter box or vault on all sides.
- 2) 3/4-inch through 2-inch Meters
- a) In the right-of-way in a location that allows for easy reading and maintenance, at the location specified herein or shown on the standard details.
- 3) 3 Inch and Larger Meter:
- a) On private property adjacent to the public right-of-way to allow reading and maintenance. It must be accessible with a crane truck to within ten feet of the installation with a ten foot vertical clearance.
 - b) The meter, vault and piping are to be protected from freezing, vandals and vehicles. The area around the vault must be sloped in such a manner to prevent storm water from ponding over or running into the vault.
 - c) A minimum three foot clear space must be provided around the vault to provide ample working space for maintenance.
 - d) All 3-inch and larger meters shall be provided with a remote readout head approved by Public Works which is located such that it can be read without entering the meter vault.
 - e) A sump pump shall be installed and maintained in the meter vault (*of all meters larger than 2-inch*) by the property owner, discharging to a storm drain or other location approved by Public Works. Owner of the property being served shall be responsible for all permits & installation costs associated with providing, installing and connecting conduit(s) and power to the meter vault for the sump pump and/or freeze protection, and for the ongoing power costs.
 - (1) Where conduit(s) connect to building basements, and where conduits are installed flat or slope toward the building, the conduits shall be swept up to an above grade junction box mounted on the exterior wall of the building, to avoid the potential for groundwater drainage into the basement if the buried conduit is cracked or broken in the future.
 - f) The configuration of the lockable bypass shall be acceptable to Public Works.

- 4) The meter, with approval by the City, may be located in the same vault with a backflow prevention device, provided a completed dimensioned design is submitted with a request for variance.

c. **Meter Boxes**

- 1) Meter boxes shall be provided by the Developer for each water service and meter location. Double set meters (*2 meters in 1 box*) are not allowed.
- 2) Meter boxes for water meters 2" & smaller shall be set level to finish grade (*vaults for larger meters shall be set to grades as shown by City standard details*). The Developer, builder or property owner shall be responsible for setting meter boxes and services to finish grade prior to initial installation and approval of water meters by the City.
- 3) Meter boxes that do not provide all required clearances and spacing so as to allow the City to install a standard meter without removing the box, will be required to be reset or replaced by the developer or builder (*at their sole expense*), prior to installation of the meter by the City.

5.21 PRIVATE WATER SYSTEMS

- a. General design considerations for private water systems shall conform to requirements set forth by the OHA-DWS, by the Oregon Plumbing Specialty Code (OPSC) (*Chapter 10*), and these Design Standards.
- b. All public water mains within private developments shall be in public right-of-way or exclusive easements to the City of Jefferson and shall conform to these design standards. Each connection of the private water system to the City system shall be through an approved backflow prevention assembly and meter.
- c. Requirements for capacity, materials, looping, valves, fire protection, service lines and meters shall also be applicable to design within PUD areas.
- d. The resale of water without written approval of the City shall be prohibited. Written authorization from the City shall be required for each service connection and for any sale of water.

5.22 BACKFLOW PREVENTION

a. **General**

- 1) All backflow assemblies shall be testable and include provisions for testing by a certified backflow testing person or organization.

- 2) An approved backflow prevention assembly with an approved metering system shall be required for each use in the following instances:
 - a) As determined by the City Cross Connection Specialist and OHA-DWS requirements.
 - b) When a private line must be extended from or looped between two (2) or more City mains in order to obtain the required flow and the resultant loop is no benefit to the City grid system.
 - c) On all fire services, which shall also include a detector loop & detector meter configuration as approved by Public Works.
 - d) On any private water lines serving multiple buildings or parcels or on a private distribution system attached to the City's distribution system (*with or without a master meter*).
 - e) When an auxiliary water supply exists on the property being served, including but not limited to a domestic or irrigation well, or an irrigation system supplied from a surface water source (*see OAR 333-061 Table 42*).
 - f) Where a booster pump or pressure tank exists on the service line to the property being served, or on any extensions of (*or connections to*) the service line serving the property.
- 3) An approved reduced pressure backflow prevention assembly with an approved metering system shall be required for service connections in high hazard areas as determined by the Public Works Director or City Cross Connection Specialist.
- 4) The backflow assemblies must meet the City approved assembly standards, which standards are taken from the current approved list of assemblies maintained by the OHA-DWS.
- 5) RP backflow devices shall be provided with drains per OHA-DWS standards. Unless installed indoors or in weather proof above grade enclosures, all backflow assemblies shall be installed in a box or vault approved by Public Works. Sump pumps per standard details shall be provided for all double check assemblies installed in vaults (*3" & larger size*). Owner of the property being served shall be responsible for all permits & installation costs associated with providing, installing and connecting conduit(s) and power for required sump pumps and/or freeze protection, and for the ongoing power costs. Conduits required for connecting OS&Y valve tamper switches to fire alarm control unit shall also be the responsibility of the owner of the property being served.
 - a) Where conduits connect to building basements, and where conduits are

installed flat or slope toward the building, the conduits shall be swept up to an above grade junction box mounted on the exterior wall of the building, to avoid the potential for groundwater drainage into the basement if the buried conduit is cracked or broken in the future.

b. Backflow Location

- 1) The approved backflow prevention assembly shall be installed on the property being served in a place accessible for City inspection and for testing and located as follows:
 - a) Before any branch, immediately downstream of the meter; or
 - b) If not metered, at the property line; or
 - c) If in the building, before the first branch or hazard being controlled or as determined by the City Cross Connection Specialist.
- 2) If installed outside the building being served, it shall be placed at or adjacent to the property line or easement line in a vault or structure in accordance with the manufacturer's recommendations and as approved by the Public Works Director. Vaults must have a sump and be watertight.
 - a) Easement around Box/Vault. A public utility and access easement to the City shall be provided to and around any backflow assembly set on private property (*ie. when installed outside of the building being served*). The easement shall be sized to provide a minimum of five (5) foot clear around the box or vault on all sides.

c. Backflow Thermal Expansion Issues

- 1) As noted under OAR 333-061-0070(2.b), “‘Thermal Expansion’ means the pressure increase due to a rise in water temperature that occurs in water piping systems when such systems become "closed" by the installation of a backflow prevention assembly or other means, and will not allow for expansion beyond that point of installation.”
- 2) It is the responsibility of the property owner and/or water user to provide a thermal expansion tank or other means approved by the Oregon Plumbing Specialty Code (OPSC) to address thermal expansion concerns in the private water system piping downstream of any backflow device or pressure regulator where applicable (*see OPSC 608.2&3 for expansion tank requirements*).
- 3) This section shall be considered to be written notice to the premise owner and water user of these thermal expansion concerns, and notice of the responsibility of the premise owner and/or water user to address these concerns (*see OAR 333-061-0070(9.b.A.iii)*).

5.23 UNDERGROUND WARNING TAPE & TRACER WIRE

- a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided along all mainlines not located under sidewalks or paved portions of public streets.
- b. Underground warning tape shall be placed a minimum of 12-inches and a maximum of 18-inches below the finish ground surface, and shall be continuous the entire length of the mainline as specified.
- c. All water pipe (*both public lines and private lines within right-of-way or easements*) shall have an electrically conductive tracer wire, 12 gauge minimum size single strand insulated copper with blue sheathing, installed in the trench for the purpose of locating the pipe in the future. The tracer wire shall run the full length of the installed pipe, with each end extended to within 12-inches of the surface through a valve box or meter box.

5.24 MAINLINE BORED CROSSINGS

- a. Casing size shall be adequate to permit proper construction of the carrier pipe to the required lines and grades. Carrier pipe used in bore casings shall be as specified herein.
- b. All bore crossings shall be provided with casing spacers and end seals. Casing spacer configuration shall conform to the manufacturer's recommendations, but in no case shall less than 3 spacers per length of pipe be used.
- c. In order to prevent over-belling of PVC or other flexible pipe while installing it through the casing, provide a method for restricting movement between the assembled bell and spigot conforming with the manufacturer's recommendations.
- d. The design of the bore crossing shall include the following as a minimum:
 - 1) Casing and carrier pipe materials and dimensions, including outside bell diameters of the carrier pipe.
 - 2) Details for any part of the system which must be changed as a result of the boring operation (*manhole, headwall, etc.*).
 - 3) Bore and receiving pit backfill material and compaction requirements.