

**SUB WATER DEPARTMENT
STANDARD CONSTRUCTION SPECIFICATIONS
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**SECTION 33 11 13.13
DUCTILE IRON PIPE, FITTINGS AND SPECIAL ITEMS**

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PART 1 GENERAL

1.1 Description

Work under this Section applies to the furnishing and installation of ductile iron pipe, fittings and special items for buried service. The Contractor shall furnish and install ductile iron pipe, fittings, valves, special items, and all appurtenant work, complete in place, all in accordance with the requirements of the Contract Documents.

1.2 Reference Specifications, Codes, and Standards

A. Commercial Standards

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
NSF/ANSI Standard 61	Drinking Water System Components – Health Effects
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ANSI/AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Pipe Systems
ANSI/AWWA C110	Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings for Water Service

ANSI/AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
ANSI/AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
ASTM A536	Standard Specification for Ductile Iron Castings

1.3 Submittals

- A. See Section 01 33 00, Submittals, for submittal procedures.
- B. Product technical data and material data; including all pipe, fittings, restrained joint systems, and appurtenance information.
- C. Lining and coating data.
- D. Applicable material certifications and testing certificates.
- E. Manufacturer's handling, delivery, storage, and installation requirements.

1.4 Quality Assurance

- A. Unless otherwise noted, all water works materials provided for the project shall be new, of first class quality, and shall be made by reputable manufacturers. All material of a like kind supplied to SUB shall be provided from a single manufacturer unless otherwise approved by SUB. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage and handling. Where an item is to be used but does not have its quality specified herein, it shall be equal to that specified in the appropriate American Water Works Association (AWWA) Standard Specification.
- B. All references to standards of AWWA or other organizations shall be the latest versions of those standards.

PART 2 PRODUCTS

2.1 General

- A. Ductile iron piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.
- B. Unless otherwise specified herein or shown on the plans, the minimum working pressure rating of all water works materials specified herein shall be 1.5 times the operating pressure or 150 psi and/or 1.5 times the operating pressure as approved by the Engineer.
- C. All coatings and materials specified herein that come in contact with potable water shall be National Sanitation Foundation (NSF) approved.

2.2 Ductile Iron Pipe

- A. Ductile iron pipe for water mains shall conform to AWWA Standard C151 (ANSI A21.51) classes 50 through 56 with joint ends as specified on the Plans. The minimum thickness classes shall be Class 52 for 4-inch pipe and 6-inch pipe, and Class 50 for pipe 8 inches and larger. Under extreme conditions, such as in deep trenches and/or corrosive soils, higher thickness classes may be required as indicated on the Plans. Materials and installation for electrical continuity or bond bars, as may be necessary in corrosive soils, shall be as described in the Special Provisions. **All ductile iron pipes furnished to SUB shall include a minimum of 10% fully gauged pipe.**
- B. Unless otherwise specified, ductile iron pipe shall be cement mortar lined, interior and exterior sealed in accordance with AWWA C104 (ANSI A21.4).
- C. Push-on or mechanical type pipe joints shall conform to AWWA Standard C111. Flanged ductile iron pipe shall conform to AWWA Standard C115.

Acceptable ductile iron manufacturers:

American;

U.S. Pipe;

McWane

- D. Tracer Wire

All water pipe shall have a copper tracer wire installed with it per the Standard Drawings. Tracer wire shall be 14 gauge solid copper with a minimum 40 mil PVC or HDPE insulation, blue in color, rated specifically for direct burial.

2.3 Fittings and Specials

A. Ductile Iron Fittings

1. All tees, crosses, elbows, reducers, combinations thereof, and other miscellaneous iron fittings shall be cement lined ductile iron in conformance with AWWA C110 (ANSI A21.10) or AWWA C153 (ANSI 21.53). Ductile Iron material shall be ASTM A536. Cement lining shall be in conformance with AWWA C104 (ANSI A21.4). Joint ends and lay length of the fittings shall be as specified on the Plans. All joints shall be in full compliance with AWWA C111 except bolts shall be low alloy steel. High Strength Cast Iron Bolts (HSCI) are specifically excluded. Unless otherwise noted on the Plans, all fittings shall have the following minimum pressure ratings:
 - a. 1st Level (elevations below 570 feet) fittings (angle stops; corporation stops) shall have a minimum of 100 PSI rating.
 - b. 2nd Level thru the 4th Level (elevations above 570 feet) fittings shall have a minimum of 300PSI rating.
2. Fitting manufacturers shall be ISO 9000 Certified. Proof of certification shall be submitted prior bidding the manufactures fittings.

Acceptable ductile iron fittings:

American;	U.S. Pipe;	Tyler;
Union Foundry;	Trinity Valley;	Bachman;
Sigma;	Star	

B. Mechanical Couplings

1. Mechanical couplings shall consist of a high strength cast or ductile iron sleeves, ductile or malleable iron follower rings, vulcanized rubber gaskets, and ductile iron or stainless steel bolts and hex nuts. Mechanical couplings shall have a minimum pressure rating of 150 psi.

Acceptable mechanical couplings:

Romac 501 series; Smith-Blair; Romac Macro; Romac Alpha

C. Tapping Sleeves

Tapping sleeves shall have a stainless steel body and flanged outlet. Stainless steel to be thick gauge ASTM A240 Type 304/304L or equal. Bolts and nuts to be Type 304 stainless steel. Unit shall have a Type 304 stainless steel test plug. Outlet shall be SBR per ASTM D2000 and compounded for water service use. Flanges shall be stainless steel, ASTM A240 Type 304, per AWWA C228 Class D plate flange, ANSI Class 150 drilling, with proper recessing for tapping valves. Flanges shall accommodate tapping flanges per MSS SP-60 and meet the requirements of MSS SP-124 and AWWA C223. Sealing shall be accomplished by a single rubber gasket around the full circumference of the pipe including the tap opening.

Acceptable tapping sleeves:

Romac SST III; JCM "SS" models; Ford FTSS

Valves for tapping sleeves shall be resilient wedge tapping valves as specified in Section 33 12 16.

2.4 Pipe Joints

A. Flanges

Threaded flanges shall meet the requirement of AWWA Standard C115 and shall be installed only on pipe with a minimum Class 53 wall thickness. All flanged fittings shall be provided with bolts and gaskets as specified herein. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.

B. Gaskets

Gaskets for flanges shall be 1/8-inch thick premium red SBR rubber, full face, conforming to the pipe manufacturer's requirements. Insulating gaskets for dielectric isolation shall be as specified elsewhere in the specifications and/or as shown on the plans.

C. Bolts and Nuts

Bolts used in the assembly of flanged and restrained mechanical joint ductile iron pipe and fittings subject to operating pressures of 150 psi or less shall be of low-carbon steel composition conforming to ASTM A307, Grade B requirements per AWWA C111 and C115. Nuts shall conform to the specifications of ASTM A563, Heavy Hex. Washers shall conform to the

specifications of ASTM F844. Bolts and nuts shall have product markings to identify material and producer as specified in AWWA C111.

Bolts used in the assembly of flanged and restrained mechanical joint ductile iron pipe and fittings subject to operating pressures greater than 150 psi shall be of a steel alloy composition conforming to ASTM A193, Grade B7. Nuts shall conform to the specifications of ASTM A194, Grade 2H. Washers shall conform to the specifications of ASTM F436. Bolting materials shall have product marking in accordance with ASTM A193 and ASTM A962.

All bolts shall have heavy hex head with heavy hex nuts. Higher strength (Grade A) bolts and higher torque values should not be used with gray-iron

D. Mechanical Joints

All components with mechanical joints shall be in conformance with AWWA C111 (ANSI A21.11) except bolts shall be low alloy steel. High strength cast iron bolts (HSCI) are specifically excluded. Unless otherwise specified, gaskets and glands shall be provided by the manufacturer supplying the pipe or fitting on which they are to be used.

E. Push on Joints

Single rubber gasket push-on joints for ductile iron piping shall conform to AWWA C111 (ANSI A21.11). Unless otherwise specified, gaskets and lubricant shall be provided by the manufacturer for the pipe or fitting on which they are to be used.

2.5 Thrust Restraint

A. Concrete

Concrete for Anchorage and Reaction Blocking shall not be permitted in new construction and shall be approved by the Engineer on all pipe replacement projects.

Concrete for anchorage and reaction blocking shall be a concrete mix, which shall provide a minimum 28-day strength of 3000 psi.

B. Mechanical Joint Restraint Devices

Mechanical joint restraint systems shall be incorporated in the design of the follower gland or gasket and may include a restraining ring which, when actuated by a wedging action with the gland, imparts a restraining force against the pipe that increases as the pressure increases or be completely integral to the gasket. Glands shall be manufactured of ductile iron meeting

ASTM A 536. Dimensions of the gland shall be such that it can be used with the standard mechanical joint bell, gasket, and tee-head bolts in accordance with ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, and ANSI/AWWA C153/A21.53 or the latest revision.

The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1. The restraining system shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11.

Acceptable restraint devices for Ductile Iron:

EBAA - Megalug;	Romac - Grip Ring;	Romac - RomaGrip;
Romac – Alpha;	Tyler - Tuff Grip	

C. Weldment Ring Restraint Joint

Weldment ring restraint joints shall restrain the spigot end of the pipeline by use of restraining wedges that bear on a weldment ring shop welded to the spigot end of the pipe wall that restrains the joint even with joint deflection.

The weldment ring joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

Acceptable pipe joint types are:

American Flex-Ring;	U.S. Pipe TR-Flex;	McWane Thrust-Lock
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D. Push-On-Joint Restraining Gaskets

Push-on joint restraining gaskets shall be provided by the manufacturer of the pipe being used. In no case are push-on joint gaskets to be used that are not provided by the pipe manufacture or approved in writing by the pipe manufacturer. All gasket materials shall be standard SBR which meets all the material requirements of ANSI/AWWA C111/A21.11. Gaskets provided shall be designed to meet or exceed the pressure rating indicated on the plans and shall have been tested at twice the designated working pressure of the pipe being used.

The restraint provided by the gasket shall be by the development of wedging action between pairs of high-strength stainless steel elements spaced around the gasket. The outer metal element acts as a bearing member for the wedge-shaped inner element, which has sharp teeth on its inner surface for gripping the spigot. The force between the spigot and the socket of the joint shall be

essentially constant at any given pressure thrust regardless of the "tightness" or "looseness" of the joint fit or the joint deflection.

Acceptable push-on joint restraining gaskets:

American; U.S.Pipe; McWane; Romac

PART 3 EXECUTION

3.1 General

- A. All materials, workmanship and installation shall conform to referenced AWWA Standards and other requirements of these specifications. The methods employed by the Contractor in the storage, handling, and installation of pipe, fittings, valves, hydrants, equipment and appurtenances shall be such as to insure that the material, after it is placed, tested and permanently covered by backfilling is in as good a condition as when it was shipped from the manufacturer's plant. Should any damage occur to the material, repairs or replacement shall be made to the satisfaction of SUB.
- B. Ductile iron pipe shall be installed in accordance with AWWA Standard C600, except as modified elsewhere in these specifications. Trench excavation and backfill of ductile iron piping system shall conform with the requirements of Sections 31 11 00 Clear & Grubbing, 31 23 00 Excavation & Backfill, 31 23 19 Dewatering, and 31 23 23 Trenching & Backfill.
- C. Sanitary Sewer Separation: The Contractor shall furnish all labor, equipment and materials required to replace sections of existing sanitary sewers or encase existing sanitary sewers in reinforced concrete as required to comply with Oregon Health Authority – Drinking Water Program requirements for minimum separation of water mains from sanitary sewers.
- D. Sanitary Practice During Construction: Piping shall be prepared and protected from unsanitary conditions as specified in Part 3 of Section 33 10 00, Water Mains and Appurtenances, General.

3.2 Construction/Workmanship

A. Cutting

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in such a manner as to prevent damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. The cut end of the pipe shall be ground smooth and, for push-on joint connections, shall be

beveled in order to remove sharp edges which may damage the gasket. Any lining or coating damaged in the cutting process shall be repaired by the Contractor to the satisfaction of the Engineer.

B. Allowable Deflection at Joints

When push-on or mechanical joint pipe is to be laid on a curve, either in the horizontal or vertical plane, the amount of deflection shall not exceed the maximum limits given in Table I below for each type of pipe joint or as recommended by the manufacturer. Where pipe lines are intended to be laid in a straight line, the deviation from the Plans for each section of pipe shall not be in excess of 0.2 feet for line and 0.1 feet for grade.

C. Jointing

All jointing procedures shall be in strict accordance with the manufacturer's recommendations and as approved by the Engineer. The Contractor shall provide any special tools and equipment necessary for the installation.

The following are given as general guidelines for each type of joint:

TABLE I MAXIMUM DEFLECTION 18 FOOT DUCTILE IRON PIPE LENGTH				
PUSH-ON TYPE JOINT			MECHANICAL JOINT	
PIPE DIAMETER	DEFLECTION ANGLE (Degree)	MAXIMUM DEFLECTION (Inch)	DEFLECTION ANGLE (Degree)	MAXIMUM DEFLECTION (Inch)
3	5	19	8	31
4	5	19	8	31
6	5	19	7	27
8	5	19	5	20
10	5	19	5	20
12	5	19	5	20
14	3	11	3.5	13.5
16	3	11	3.5	13.5
18	3	11	3	11
20	3	11	3	11
24	3	11	2	9
30	3	11	2	9
36	2	7.2	2	8
42	2	7.2	2	7.2
48	2	7.2	2	7.2

D. Flanged Joints

Contact faces and gaskets for flanged connections shall be free of all foreign matter before the connection is made. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then completed by tightening the bolts uniformly. Cast flanges and flanged fittings shall be properly anchored, supported, or restrained after installation to prevent breakage, and care shall be taken to prevent bending or torsional strains from being applied during the jointing procedure.

E. Mechanical Joints

After assuring that all joining surfaces are free from foreign matter, the pipe shall be inserted in the socket and the gasket pressed firmly and evenly into the gasket recess while keeping the joint straight. Bolts shall be tightened so that the gland is brought up evenly toward the pipe flange with the spigot and centrally located in the bell. The normal range of bolt torques for various sizes of bolts shall be given below. Over stressing of bolts to compensate for ineffective sealing or poor installation practice shall be unacceptable. Any required deflection of joints shall be made after the joint is assembled, but before final tightening of the bolts.

BOLT DIAMETER (inches)	TORQUE RANGE (foot-pound)
5/8	45-60
3/4	75-90
1	100-120
1-1/8-3	120-150

F. Weldment Ring

After assuring that all joining surfaces are free from foreign matter, the pipe shall be inserted into the socket and the gasket pressed firmly and evenly into the gasket recess while keeping the joint straight. The pipe shall be rotated as required for wedges to engage the weldment bead on adjoining pipe. All piping shall be jointed in strict accordance with the manufacturer's published procedures and recommendations. Copies of the manufacturer's published procedures and recommendations shall be kept on site by the Contractor for reference for workers and inspectors.

G. Push-on Joint

The plain end of the pipe for push-on joint connections shall be beveled before proceeding with the jointing operation. The plain end shall then be lubricated after dirt and foreign material has been removed from all jointing surfaces and

the gasket has been installed in the bell end. The joint shall be kept straight while pushing the plain end into the bell of the pipe with any required deflection being made after the joint is assembled.

H. Tracer Wire

All water mains and services shall have an electrically conductive tracer wire installed in the trench for locating the pipe in the future. The tracer wire shall be located in the bottom of the trench next to the pipe and run the full length of the installed pipe with each end clearly visible and able to be extended 12 inches above ground in each valve box and meter box. The tracer shall be spliced into the existing tracer wire at water main connection locations in accordance with Standard Drawing W1.16. Tracer wire shall be 14 gauge solid copper with a minimum 40 mil. PVC or HDPE insulation, blue in color, and specifically rated by the manufacturer for direct burial. The wire shall be UL rated for 140⁰ F and specifically rated by the manufacturer for direct burial.

3.3 Assemblies

A. Fittings

Fittings shall be set and joined to the pipe in the manner previously specified for cleaning, laying, and jointing pipe.

All plugs, caps, tees, reducers, and bends deflecting 11 1/4 degrees or more on mains 4 inches in diameter or larger shall be securely anchored as indicated on the Plans, and as shown in Standard Drawing W1.26, by joint restraint to prevent movement due to thrust. Concrete, timbers, or other methods of thrust blocking shall only be used in retrofit piping and as approved by the Engineer. No concrete shall touch pipe or fittings.

All cast and ductile fitting bolt assemblies shall be completely wrapped with 6 mil. polyethylene sheeting and taped with approved PE tape to exclude cement containing backfill material and aid in corrosion control.

B. Tapping Valves

Tapping valves and sleeves shall be installed by the Contractor in accordance with the manufacturer's requirements and as previously specified for installing valves and fittings.

C. Dead-end Mains and Flush Points

Unless otherwise approved by the Engineer, the Owner shall make all taps during working hours and upon being given at least 72 hours notice. Prior to making a tap, the trench shall be excavated to approximately 4 feet by 8 feet to allow room for making the tap, and shall be adequately shored and dewatered as required.

Dead-end Mains and Flush Points

All dead ends on new mains shall be closed with water tight cast iron plugs, caps, or other fittings. A fire hydrant or a minimum 2-inch flush point assembly shall be installed in conformance with Standard Drawings W1.09 to W1.13.3. The dead-end pipe length shall account for the number of restrained joint pipe lengths with approved field-lock gaskets or restrained pipe joints as approved by the Engineer. The flush point pipe shall extend to within 6 inches of finished grade. Access to the flush point pipe shall be provided by a meter box kept free of rocks and debris at all times and installed such that the lid is flush with finished grade. For installations in streets, driveways, or other areas subject to vehicular traffic, a solid cast iron meter box cover shall be supplied. For installations in sidewalks or other areas not subject to vehicular traffic, a cast iron cover and reading lid shall be supplied.

3.4 Thrust Restraint/Anchorage

- A. All tees, plugs, caps, bends, offsets, as well as other appurtenances which are subject to unbalanced thrust, shall be properly braced with concrete thrust blocks only where authorized by the Engineer. All new piping shall be mechanically restrained in lieu of thrust blocks. The area in which the blocking is to be placed shall be sufficiently excavated to receive the concrete so that the proper shape and bearing surface is attained. The bearing surface shall be sized and located by the Engineer and shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repair in accordance with Standard Drawing W1.26. Concrete shall in no case extend around more than one half the circumference of the fitting at any point. A 6 mil. plastic barrier shall be placed between the concrete and any portions of the valve, fitting, bolts, or nut with which it comes in contact to prevent dielectric corrosion damage.
- B. Where shown on the plans, specified or when approved by the Engineer, a mechanical joint restraint device shall be installed in accordance with the manufacturer's requirements.

3.5 Installation

- A. Install pipe and accessories in accordance with these specifications and the manufacturer's instructions.

B. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

C. Joints

Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining. Lubricants, primers, adhesives, etc. shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint. Trenches shall be kept water-free and as dry as possible during bedding, laying and jointing. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

D. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb.

E. Lay pipe from the low end toward the high point. Provide a continuous, smooth invert. Bell holes shall be dug where necessary and the pipe shall be placed and supported on bedding material the full length of the barrel.

F. All loose dirt shall be removed from the bottom and the trench backfilled with specified bedding material to pipe laying grade.

G. The open ends of all pipes and special castings shall be plugged or otherwise closed with a watertight plug before leaving the work for the night, and at other times of interruption of the work. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

H. Tracer Wire

1. Tracer wire is to be utilized on all DI pipelines for future locating purposes. Tracer wire shall be installed on the top centerline of the pipe. The wire shall be secured to the top of the pipe at maximum 10 foot intervals using 6-inch strips of 2-inch wide duct tape. The tracer wire shall be routed through all valve boxes (including isolation valves, air release valves, blow-offs and drain valves), meter boxes, fire hydrants, vaults, and listening ports to provide access to terminal ends of the wire. All locations of tracer wire intersections shall have a direct bury splice kit to provide electrical continuity and protected from adverse soil conditions with the use of shrink tubes or other approved waterproof connector devices. The result of the tracer wire installation shall be a continuous wire circuit electrically isolated from the ground. Where there is an extended length of pipeline without surface access for the tracer wire, additional valve boxes and covers shall be installed

as needed and as directed by the SUB Engineer. The distance between tracer wire access locations shall not exceed 1,000 feet. Valve boxes and covers shall be identical to that shown on Standard Drawing W1.16. Cathodic protection for tracer wire shall be installed in accordance with Standard Drawing W1.22.

2. Tracer wire shall be installed in conjunction with all service lines. Tracer wire shall be accessible from within the meter box and shall have electrical continuity with any tracer wire laid in conjunction with the waterline to which the service is tapped.
3. Leave slack in mainline tracer wire equivalent to a 12-inch diameter loop at each valve box and at each service tap to facilitate splicing and waterproofing.
4. Test for continuity and isolation from ground in the wire after all work has been completed on the test section. Perform intermediate testing after backfilling operations and prior to surface restoration work. Test continuity between access locations by use of a temporary wire connecting test points in-line with an ohmmeter. Measure resistance with an approved ohmmeter that has been properly calibrated. The continuity of a test section will be accepted if the resistance of the test section does not exceed 5 ohms for each 500 feet of location wire being tested. Measure isolation from ground with an approved 1,000 volt Megger, applied for one minute. The isolation of a test section will be accepted if the isolation resistance of the test section is at least 10 megohms. Locate and repair all breaks or defects in the wire and re-test until specified results are obtained.

3.6 Testing and Disinfection of Ductile Iron Pipe Mains

- A. Filling, flushing and disinfection of ductile iron pipe mains shall be done in accordance with Section 33 13 00, Pipeline Testing and Disinfection, AWWA Standard C600, and AWWA Standard C651.
- B. All chlorinated water used in disinfection of water mains shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Oregon State Department of Environmental Quality (DEQ) prior to discharge into any storm drainage system or open drainageway. No chlorinated water shall be discharged into a storm drainage system or an open drainageway without a dechlorination plan meeting DEQ's requirements.

END OF SECTION