

**RULES AND REGULATIONS
FOR
WATER AND WASTEWATER SERVICE**



**APPENDIX C
STANDARD SPECIFICATIONS FOR WATER
MAINS**

Last Approved Revision: March 23, 2023

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SECTION I – GENERAL

1.1 Authority

The Standard Specifications for Water Mains as set forth herein (“Specifications”) are promulgated by the following: Arrowhead Metropolitan District, Bachelor Gulch Metropolitan District, Beaver Creek Metropolitan District, Berry Creek Metropolitan District, Cordillera Metropolitan District, Eagle River Water & Sanitation District, Eagle-Vail Metropolitan District, Edwards Metropolitan District, Town of Avon, Traer Creek Metropolitan District (Village at Avon), and Upper Eagle Regional Water Authority (“District”). The interpretation and enforcement of said Specifications is hereby delegated to the Regulations Administrator of the Eagle River Water & Sanitation District.

1.2 Effective Date of Specifications

The Specifications shall become effective immediately upon formal adoption by the District and shall supersede all former specifications for water main construction. The most current version of these Specifications is available at www.erwsd.org.

1.3 Revisions, Amendments, or Additions

The Specifications may be revised and/or amended. Such revisions, amendments, and additions shall be binding and in full force immediately upon formal adoption by the District.

1.4 Definitions

Please reference the Rules and Regulations for Water and Wastewater Service, Article II.

1.5 Development Approval and Infrastructure Acceptance

Please reference the Rules and Regulations for Water and Wastewater Service, Articles VIII and IX, respectively.

1.6 Variance

The District recognizes that the strict and literal interpretation of these Rules and Regulations may not be possible in all cases. Please refer to Article VII for information on the Variance process.

SECTION II – DISTRIBUTION SYSTEM DESIGN AND LAYOUT

2.1 General Requirements

The District requires an Overall Utility Site Plan of the project to be submitted indicating all utilities and their proposed locations for review prior to Construction Plan Approval. All plans submitted shall include a geotechnical report if requested by the District. The design and installation of all facilities shall ensure development of an integrated distribution system and in general shall be the most efficient layout possible to serve the proposed development. All buried pipelines shall be electronically locatable with a tracer wire system as specified in Appendix E

2.2 Corrosion

Corrosive soils are present in the District's service area and may lead to the premature degradation of pipe materials and appurtenances. Please refer to Article IX for corrosive soils procedure.

2.2.1 Dissimilar Materials

Cathodic protection and insulation shall be installed as required by the District. Particular care shall be taken to insulate between dissimilar materials.

2.2.2 Insulating Joints

Whenever it is necessary to join pipe of dissimilar metal, or when designated by the District, a method of insulating against the passage of electrical current, approved by the District, shall be provided. Special care shall be exercised during the installation of these joints to prevent electrical conductivity across the joints.

2.3 Sizing Distribution Mains

All mains shall be sized large enough to provide for domestic, irrigation, and fire protection flows to the area requesting service without exceeding maximum pipe velocities of 8 feet per second. The minimum size of all District mains shall be eight inches (8").

The District reserves the right to request oversized mains to provide service for projected future needs. The additional cost for the oversizing may be negotiated between the District and the Applicant and will be reviewed on a case-by-case basis.

2.4 Fire Protection

The Applicant shall coordinate with the District and local fire protection jurisdiction to determine minimum fire protection flow and shall design line sizes accordingly. The quantity and location of fire hydrants in a given area must be approved by the appropriate governmental agency.

The Applicant shall perform all fire hydrant "flow tests". Results of "flow tests" shall be provided to the District and to the local fire authority. All costs associated with the "flow

SECTION II – DISTRIBUTION SYSTEM DESIGN AND LAYOUT

test” shall be borne by the Applicant. The District shall witness and oversee the “flow test” in conjunction with other appropriate governmental agencies.

2.5 Distribution Regulating Requirements

Regulating installations are required to control pressure, provide pressure relief, and separate pump and gravity zones throughout the distribution system. When main extension plans are submitted for review, the need for regulating installations must be approved by the District as determined by existing and proposed pressure zones, booster pump areas and the existing distribution system piping. Regulating installations shall be categorized as follows:

- (a) Pressure Regulating Station
- (b) Check Valve Station
- (c) Surge Control Station

Location, design, and pressure settings of main line pressure regulating devices will be determined by the District on a case-by-case basis. All regulating installations are considered Major Facilities and will be designed and constructed by the District.

2.6 Layout of the Distribution System

2.6.1 Easement Width Requirements for Main Installations

All mains shall be installed in dedicated public street rights-of-way or, when ROW installation is not possible, a dedicated water line easement. The installation of Public Water facilities on developable lots or tracts intended for private use should be avoided to the extent practicable. The standard easement width for all mains shall be a minimum of 20 feet and depth of cover shall be 7 feet to 9.5 feet. The main shall be generally centered within the easement. The easement width shall be in accordance with Standard Detail C-15.

2.6.2 Fire Hydrants

Fire hydrant branch lines shall be set at right angles to street mains. The fire hydrant shall be set at the end of the branch line and shall face the direction as dictated per local fire authority. No bends or offsets shall be used in installing fire hydrant branch lines unless approved by the District. Under no circumstances shall any size or manner of tap be made on a fire hydrant branch line between the hydrant and hydrant valve. The maximum length of a 6-inch hydrant branch line is 50 feet. All fire hydrant valves shall be attached to the tee off of the main. A fire hydrant shall be installed at the end of all dead-end water mains.

Fire hydrant depths shall be 7-feet to 9.5-feet. All fire hydrants shall be installed within dedicated streets, rights-of-way, or easements as herein above defined. Fire hydrant flange elevations shall be indicated on plans.

Fire hydrants shall be installed at locations approved by the Fire Department, the District and the appropriate governmental agency.

2.6.3 Pipe Bollards

Pipe bollards are required where there is less than three (3) feet clearance to a vehicle drive isle, edge of pavement or back of curb (whichever is less). Pipe bollards must be three feet minimum height. No pipe bollards shall be constructed in front of fire hydrant outlets. Bollard must be painted “traffic signal yellow” or approved equal. See detail C-16

2.6.4 Line Valves

Line valves are required at a minimum of every one thousand (1,000) feet. Additional valves, subject to District approval, are required to further isolate the system at all main branches, and at other locations as determined by the District for operation of the water system. A smaller diameter bypass line and valve may be required to facilitate large diameter valve opening in high pressure applications, as determined on a case-by-case basis. The applicant shall identify all locations on their submittal where line diameters exceed 12” and static pressures exceed 100 psi. The District will then determine the appropriate desired solution (valve type and/or bypass).

2.6.5 Joint Restraint

Water mains require the use of joint restraints such as thrust blocks and mechanical joint restraints. Mechanical joint restraints shall be used in conjunction with all thrust block installations. Thrust blocks may be eliminated at the District’s discretion on a case-by-case basis if joint restraints and restrained pipe lengths have been calculated by a Registered Professional Engineer. In all cases when water mains are installed in a fill condition rather than in undisturbed earth, mechanical or internal joint restraints shall be required.

All thrust blocks shall be constructed per the District’s Concrete Thrust Block details C-03, C-04, and C-05 and Material Specification 3.6. Submitted construction drawings shall identify all thrust blocks with specific station numbers (at valves, fire hydrants, bends & where required). All thrust blocks shall be inspected and approved by the District Inspector prior to backfill.

2.6.6 Groundwater Barriers

Groundwater barriers may be required in areas where the groundwater table is encountered. The presence or absence of groundwater should be determined in the geotechnical investigation. The contractor shall notify the Engineer and District Inspector immediately if groundwater is encountered in an excavation.

2.6.7 Depth of Bury

The depth of cover for water lines shall be a minimum of seven feet (7') and a maximum of nine feet six inches (9'-6") from finish grade to the top of the water line. Any water main that is outside of the required depth of bury must have an approved variance. Under no circumstances may a water main be buried with less than five feet (5') of cover.

SECTION II – DISTRIBUTION SYSTEM DESIGN AND LAYOUT

2.6.8 Location Tape

All lines connected to District mains in any way shall be marked with the appropriate locating tape per Section 3.5.

2.6.9 Abandonment of Existing Water Mains and Valves

All abandoned water mains shall be appropriately terminated at the main connection with a mechanical joint cap, plug or equivalent. The Contractor shall maintain the existing waterline until such time as the new waterline has been disinfected, pressure tested and accepted. Valve boxes on abandoned lines shall be completely removed and backfilled.

2.6.10 Pipe Deflections/Bends

All plans must indicate deflections, elbows, bends, and the degree of deflection. Pipe deflections shall not exceed the Manufacturer's maximum recommended deflection, or the values identified in Tables C-1 and C-2 below, whichever is lower. Joint restraints shall be used in all change of direction fittings. The use of two 45-degree elbows is preferable to the use of 90-degree elbows. The use of 90-degree elbows will be considered on a case-by-case basis.

Normal Pipe Size (in.)	Deflection Angle (deg.)	Max. Offset (inches)		Approximate Radius of Curve Produced by Succession of Joints (feet)	
		L = 18'	L = 20'	L = 18'	L = 20'
4	5	19	21	205	230
6	5	19	21	205	230
8	5	19	21	205	230
10	5	19	21	205	230
12	5	19	21	205	230
14	5	19	21	205	230
16	5	19	21	205	230
18	5	19	21	205	230
20	5	19	21	205	230
24	5	19	21	205	230

Table C-1 - Maximum Deflection Full Length Pipe - Push-On Joint Pipe

SECTION II – DISTRIBUTION SYSTEM DESIGN AND LAYOUT

Normal Pipe Size (in.)	Deflection Angle (deg.)	Max. Offset (inches)		Approximate Radius of Curve Produced by Succession of Joints (feet)	
		L = 18'	L = 20'	L = 18'	L = 20'
4	5	19	21	205	230
6	5	19	21	205	230
8	5	19	21	205	230
10	5	19	21	205	230
12	5	19	21	205	230
14	4	15	17	260	285
16	3 3/4	14	16	275	305
18	3 3/4	14	16	275	305
20	3 1/2	13	15	295	327
24	3	11	12	345	380

Table C-2 - Maximum Deflection Full Length Pipe - Restrained Joint Pipe

2.6.11 Tees/Crosses

All perpendicular main to main connections shall be made by cutting in a tee or cross. Tees and crosses shall be clearly indicated on the plans, and valves shall be installed on each leg. Wet taps shall not be permitted for mainline extensions. Refer to Appendix B for service line connection requirements.

2.6.12 Pressure Reducing Valve Vaults

All pressure reducing valve vaults shall be located out of the roadway, but within the right-of-way or an adjacent utility easement.

2.6.13 Main Insulation Requirements

For every foot of cover that is out of compliance with minimum cover requirements for mains, the District will require the installation of 1-inch of insulation board per Appendix E Section 1.14. In addition to maintaining cover from the ground surface, specified cover is required from storm sewer crossings and other cold air sources.

2.6.14 Air Vac Vaults

At all high points in the distribution system, a combination air vacuum and air release valve shall be installed on the main in a minimum five-foot (5') diameter manhole. A high point is considered to be one pipe diameter in grade differential.

SECTION II – DISTRIBUTION SYSTEM DESIGN AND LAYOUT

2.6.15 Minimum Distance from Structures

All main extensions shall be installed at a minimum distance of ten feet (10') from all structures or at a one foot horizontal to one-foot vertical (1:1) ratio from the bottom of any structural element, whichever is greater. Encroachments of structures into easements are discouraged and shall only be allowed by written authorization from the District.

2.6.16 Encased Piping

If required by the District, CDPHE regulations, or other governing body, water mains may need to be installed in a casing pipe. Refer to Appendix D, 2.6 pipe crossings.

Materials and installation of water mains in casing pipes shall be in conformance with Section 3.8.

2.7 Operating Pressures

Water system materials shall be specified for an operating pressure of 250 psi. The distribution system shall be designed such that the minimum operating pressure at any tap shall be 60 psi and the maximum operating pressure shall not exceed 190 psi.

2.8 Protection of Potable Water Supplies

Please refer to Appendix D, Section 2.6 for design criteria relative to water main installation in proximity to sanitary sewer infrastructure.

2.9 Steep Slope Applications

Slopes with greater than 20% grade require the use of with Anchor Blocks/Cutoff Collars in conjunction with restrained joints. If specifying internally restrained joints: The Joints shall be extended after assembly to minimize joint take-up in test and /or in service. This shall be accomplished by pulling or jacking the spigot away from the socket until firm resistance is encountered. See Detail C-10

SECTION III – MATERIAL SPECIFICATIONS

3.1 General Requirements

All materials shall conform to the District's Specifications. Material substitutions may be considered on a case-by-case basis. Written approval is required prior to furnishing. Applicant must submit shop drawings and specifications for substituted materials considered 'or equal' for review and approval prior to the preconstruction conference. A bill of materials shall be furnished to the District Inspector at the preconstruction conference.

All materials utilized shall be new and undamaged. Everything necessary to complete all installations shall be in accordance with the Specifications and all installations shall be completed as fully operable functioning parts of the District's system. Acceptance of materials, or the waiving of inspection thereof, shall in no way relieve the Applicant of the responsibility for furnishing materials meeting the requirements of the Specifications.

3.2 Pipe and Fittings

All pipe and fittings used in the District's System shall meet or exceed the latest AWWA Specifications and follow the guideline lines set forth below.

3.2.1 Ductile Iron Pipe

AWWA C151, class 52, working pressure 350 psi, with bituminous outside coating (one-mil thick) and cement-mortar lining per AWWA C104. When soil conditions fall in zones 4 or 5 of the DDM Matrix, ductile iron pipe having a layer of arc-sprayed zinc per ISO 8179 may be required. The mass of the zinc applied shall be 200 g/m² of pipe surface area. A finishing layer topcoat shall be applied to the zinc.

Unrestrained pipe joints shall be push-on type utilizing rubber ring gasket in accordance with AWWA C111. Certain conditions may require the use of restrained joint systems. Restrained joint systems will be reviewed on a case-by-case basis and must conform to either 3.2.5, Mechanical Joint Restraint Devices, or Section 3.2.6, Internal Restraint for Ductile Iron Pipe, as appropriate.

3.2.2 Steel Pipe

With recommendation from an engineer, and approved by the District, this pipe may be used as an alternative in high pressure applications. All steel pipe and fittings shall be fabricated in accordance with AWWA C200 Standard for Steel Water Pipe-eight inches (8") and larger; and AWWA Manual M-11 Steel Pipe- A Guide for Design & Installation. Working pressure shall be 350 psi.

3.2.3 HDPE Pipe

With recommendation from the engineer, and approval by the District, this pipe may be used as an alternative in those applications where corrosive soils are determined to be found. HDPE shall conform to AWWA C906 and shall be polyethylene material PE4710 DR-7 (ASTM F714) that conforms to ASTM D3350 with the cell classification of 445574C/E.

SECTION III – MATERIAL SPECIFICATIONS

All HDPE fittings shall meet ASTM D2513, D2683, D3261 and conform to AWWA C906 and ANSI/NSF 61 potable water requirements.

3.2.4 Fittings for Ductile Iron Pipe

Compact fittings shall be made of ductile iron and in accordance with the requirements of AWWA C153, pressure rating 350 psi. Mechanical joints shall conform to AWWA C111. Bolts and nuts shall be low-alloy steel Star Blue Bolts with fluoropolymer coating. All exterior valve body bolting shall be type 304 or 316 stainless steel and shall be provided with hexagonal heads, with dimensions conforming to ANSI B18.2.1. Metric size and/or socket head cap screws or bolts, are not allowed. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. All fittings shall be cement-mortar lined per AWWA C104. Bituminous outside coating shall be a minimum of one-mil thick in accordance with AWWA C151. Fittings must meet or exceed pipe classification.

3.2.5 Mechanical Joint Restraint Devices

Joint restraint devices shall be constructed of ASTM A536, 65-45-12 Ductile Iron. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure proper actuating of restraining devices. Mechanical Joint restraint devices shall be EBAA Iron, Inc., Megalug Series 1100, Uni-Flange Corp. (Ford) UFR 1400 Series or Sigma One-Lok Series for new pipe restraint and EBAA Iron Sales, Megalug Series 1100SD or 1100HD or Uni-Flange UFR1300-C or UFR1390-C for existing pipe restraint or accepted equal. Bell-Spigot Restraint devices shall be Star Pipe Products StarGrip 3100P Series; EBAA Iron, Inc., Megalug Series 1700 or accepted equal. Mechanical joint restraints shall be used at all mechanical joints.

3.2.6 Internal Restraint for Ductile Iron Pipe

Where internal joint restraints are approved or required, joints shall be rated for the specified pressure rating of the pipe. Restrained joints shall be ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. The internal restraint system shall be Flex-Ring joint pipe as manufactured by AMERICAN, TR-Flex® as manufactured by U.S. Pipe/McWane Ductile or approved equal. Transitioning from push on pipe to internally restrained pipe shall be per manufactures recommendation.

3.2.7 Solid Sleeves

Solid sleeves shall be made of ductile iron, mechanical joint, long body. Sleeves shall have a minimum pressure rating of 350 psi. A solid sleeve is to be used to join two pieces of pipe of the same diameter where no bell and spigot are present. A "wedding band" is to be inserted between the two pipes inside of the solid sleeve. No other couplings will be accepted.

3.2.8 Tapping Sleeves

Tapping sleeves and wet taps are not permitted for mainline extensions. Tapping sleeves and wet taps are permitted for service line connections per Appendix B, Section 2.10. Tapping sleeves are not allowed on fire hydrant laterals.

3.2.9 Joint Lubricant

Joint lubricant shall be supplied by the pipe manufacturer. Joint lubricant shall be non-toxic, water-soluble, and certified to meet ANSI/NSF 61 Potable Water Requirements.

3.2.10 Polyethylene Encasement and Bond Breaker

Ductile Iron Pipe shall be encased in V-Bio enhanced polyethylene. The polyethylene encasement material shall be manufactured in accordance with AWWA C105/A21.5, with the following requirements: Polyethylene encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE), fused into a single thickness of not less than 8 mils. The inside surface of the polyethylene wrap shall be infused with a blend of anti-microbial biocide and a volatile corrosion inhibitor. Flat tube material shall be used for pipe and fitting encasement; flat sheet material shall be used for valve encasement. The polyethylene encasement shall be installed in such a way that it shall prevent contact between the pipe and the surrounding backfill and bedding material.

3.3 Valves

The valves shall be the same size as the main and follow the guidelines set forth below:

3.3.1 Gate Valves

Valves 4"-24" in size shall be resilient wedge gate valves with a working pressure of 250 psi. Body components shall be epoxy coated ductile iron or cast iron and shall be manufactured in compliance with AWWA C509 or C515. Valves shall have non-rising stems made of bronze in accordance with ASTM B 763. Valve wedge shall be constructed of ductile iron and provided with protective wedge guide covers in sizes 4"-24". All wedges shall be fully encapsulated with EPDM or SBR rubber.

Valve bodies shall be designed to allow for the lifting of the valves by the bonnet flange, gland flanges, or other appurtenances. All internal and external ferrous surfaces of the valve shall have a fusion-bonded epoxy coating, complying with AWWA C550. End connections shall be mechanical joint. Mechanical joint components shall be in accordance with AWWA C111 with tee-head bolts and hexagon nuts fabricated from a high strength, low alloy steel including Star Blue Bolts with fluoropolymer coating, 304 or 316 stainless steel. Valves shall be capable of operating satisfactorily with bidirectional flows and shall provide zero leakage past the seat. Acceptable gate valves shall be Mueller A-2361, Waterous AFC-2500, or AVK Series 45. Valves shall have 2-inch operating nut with stem seal consisting of two O-rings. In certain large diameter or high pressure applications, geared 'laydown' valves may be required.

Direction of opening: All District valves are to open left (counterclockwise).

Valve openings shall be furnished and installed with valve boxes and covers in accordance with Section 3.3.2.

The valve shall be structurally designed so that if excessive torque is applied to the stem in the closing direction, with the disc seated, failure of the pressure retaining parts does

SECTION III – MATERIAL SPECIFICATIONS

not occur. Stem failure under such conditions shall occur externally at such a point as to enable the stem to be safely turned in the opening direction by use of a pipe wrench.

3.3.2 Valve Boxes

Valve boxes shall be Tyler 6860, D&L M-9042 (with an M-9071-73 Extension), East Jordan 8560 or Castings Inc CI-5000. All buried valves shall be provided with a six-inch (6") cast iron (ASTM A48, Class 35B) valve box, 3-piece adjustable screw type with 16-inch top section, variable extensions and 30-inch bottom and base; with minimum five-inch (5") diameter shaft and a cover marked "Water". The valve box shall be of a design which will not transmit shock or stress to the valve and which shall have enough extension capability to be raised to final street grade.

3.3.3 Air Release/Vacuum Valves

Air Release/Vacuum Valves shall be sized by the engineer and manufactured by ARI, Model No. D-040 Combination Air Valve and Thermal Protection Jacket. The valve shall be designed and manufactured in accordance with AWWA C512. Valve shall have reinforced nylon body and base, with a Foamed Polypropylene float and E.P.D.M. rolling seal. Valve seats shall be Buna-N. The seat shall be fastened into the valve cover, without distortion, and shall be easily removed, if necessary. Air release/vacuum valves shall be installed at all high points in the system on any main line extensions. A four (4) foot diameter manhole is required for this installation. High Groundwater Manholes are required in all areas of high groundwater. (See Combination Air Valve/Vac and Manhole Details C-01 and C-02).

3.3.4 Butterfly Valves

Butterfly valves may be permitted on line sizes 12" or larger on a case by case basis with approval from the District. All butterfly valves shall comply with AWWA C504 class 250B. Valve bodies shall be constructed of ductile iron in accordance with ASTM A126, Class B or ASTM A536 Grade 65-45-12 and shall be coated in accordance with AWWA C504. Valve discs shall have a 316 stainless steel edge and shall be constructed with ASTM A48, Class 40 cast iron, ASTM A536, Grade 65-45-12 ductile iron, ASTM A436, Type 1 Alloy Cast Iron or Bronze in accordance with AWWA C504. Shaft material shall be stainless steel, 18-8, Type 304 or 316.

The seat material shall be NBR (acrylonitrile-Butadiene). End connections shall be mechanical joint ends or flanged ends, drilled to ANSI B16.1 Class 250 standards. Valves shall be capable of operating satisfactorily with bidirectional flows and shall provide zero leakage past the seat. Acceptable butterfly valves shall be Muller Lineseal XP and XP11 or approved equal.

Direction of opening: All District valves are to open left (counterclockwise). Valve openings shall be furnished and installed with valve boxes and covers in accordance with Section 3.3.2.

The valve shall be structurally designed so that if excessive torque is applied to the stem in the closing direction, with the disc seated, failure of the pressure retaining parts does not occur. Stem failure under such conditions shall occur externally at such a point as to enable the stem to be safely turned in the opening direction by use of a pipe wrench.

3.4 Fire Hydrants

Hydrants shall follow the guideline lines set forth below:

3.4.1 Fire Hydrants

Fire hydrants shall be Mueller Centurion A423 Mountain Hydrant, unless otherwise specified in writing by the local fire protection agency. Hydrants shall conform to AWWA Standard C502 with a working pressure of 250 psi. The base provided shall be a six-inch (6") mechanical joint inlet to accommodate 6-inch ductile iron pipe complete with plain rubber gasket, gland, bolts, and nuts in accordance with AWWA C111; minimum 5 1/4 inches barrel, main valve opening three way (two 2 1/2-inch hose nozzles, one 4 1/2-inch pump nozzle), compression-type main valve that closes with pressure, nozzle threads ANSI B26. Nozzles must be easily replaceable in the field with standard tools. Operating and cap nuts must be 1 1/2-inch, Number 17 National Standard hex main valve that open to the left (counter-clockwise). Exposed exterior surfaces below the ground line shall be coated with asphalt varnish in accordance with AWWA C502. The interior of the hydrant shall be coated with an epoxy coating in accordance with AWWA C502. Epoxy paint shall be ANSI/NSF 61 approved. The hydrant shoe and connecting gland shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C116. An arrow cast on top of hydrant shall indicate direction of opening. There shall be a breakable section that permits clean break at or near ground level, preventing water loss in case of breakage. Working parts must be removable for maintenance or repair without excavation. The operating mechanism shall be non-wetting, oil reservoir lubricated, with O-ring seals and dual bronze barrel drain valves mounted with at least two (2) outlets, which operate automatically with main valve. Top of Fire hydrant flange shall be set 6" above finished grade and flange elevation shall be indicated on plans.

3.4.2 Fire Hydrant Extension Sections

New Installations: The use of fire hydrant extension sections is prohibited on new hydrant installations; all fire hydrants shall consist of a single solid shaft. A new installation is defined as a main extension within the two-year (2) warranty period.

Existing Fire Hydrants: No more than one (1), two-foot (2') long, fire hydrant grade extension kit with centering spindle (extension section) compliant with the hydrant specifications in 3.4.1 shall be used or installed on existing fire hydrant assemblies.

3.4.3 Guard Valves

Hydrant guard valves shall be six-inch (6") diameter gate valves in accordance with the requirements in Section 4.13.1.

3.4.4 Fire Hydrant Marker Flags

All hydrants require a Nordic Fiberglass, Inc. Nordic Flexi Flag, FF2-72 inches. No substitutions are permitted.

3.5 Marking Tape

Marking tape is required on all water mains. The tape shall meet the following specifications:

- (a) Five (5) mil thick Polyethylene material.
- (b) Solid "blue" color with black lettering.
- (c) Six inches (6") in width.

3.6 Thrust Blocks and Anchors

3.6.1 General Requirements

Concrete thrust blocks and anchors shall be required to be used in conjunction with mechanical joint restraints and internal restraints and shall be sized for the maximum operating pressure with a 50-psi surcharge and the soil bearing capacity. All thrust blocks shall be formed in accordance with the District's Specifications and Concrete Thrust Block Details C-03, C-04, and C-05. No thrust block shall be smaller than that size required for an eight-inch (8") main fitting. All fittings that require thrust blocks must include a bond breaker utilizing polyethylene encasement, per Section 3.2.10.

All thrust block installations shall be inspected by the District's inspector prior to backfill.

3.6.2 Concrete Material

- (a) Source: All materials shall be furnished from sources agreed to by the District and Engineer.
- (b) Cement: ASTM C-150 for Portland Cement, Type II.
- (c) Aggregate: All fine and coarse aggregate shall conform to ASTM C33.
- (d) Water: Water used in mixing or curing concrete shall be potable water, clean and free from deleterious substances, and free of oils, acids and organic matter.
- (e) Concrete reinforcement: Steel reinforcing bars shall be in accordance with ASTM A 615, Grade 60.

3.6.3 Concrete Mix

Ready-mixed concrete shall be CDOT Class B or D, proportioned, mixed, and transported in accordance with ASTM C94. Any concrete not plastic and workable when it reaches the project shall be rejected.

Job mixed concrete shall be thoroughly mixed to combine aggregates, cement, and water into a uniform mass. and shall contain approximately 5 ½ sacks of Type II Portland cement per cubic yard and have a 28-day compressive strength of not less than 4000 psi when molded and cured in accordance with ASTM C 31. Maximum water/cement ratio 0.45-0.48. Maximum aggregate size ¾", air content 5-7%, maximum 4" slump.

3.6.4 Form material

Forms may be made of wood (3/8" plywood) or other acceptable materials approved by the District. Wooden forms shall be thoroughly wetted except in freezing weather or a form release agent applied.

3.7 Precast Concrete Manholes and Vaults

3.7.1 General Requirements

Concrete: Minimum 28-day strength of 4,500 psi with a minimum of 560 pounds of Type II Portland Cement (ASTM C150) per cubic yard of concrete, 3/4 inch maximum size aggregate #67 (ASTM C33) and a water cement ratio not to exceed 0.48. Water in accordance with the requirements of ASTM C 94. Admixtures that do not contain calcium chloride and are in accordance with ASTM C 494 for concrete may be used. Admixtures shall be compatible with cement and other admixtures.

Concrete reinforcement: Steel reinforcing bars in accordance with ASTM A 615, Grade 60.

3.7.2 Manholes

Concrete, base, riser, conical top sections, flat slab tops, grade rings, and joint sealants between manhole sections shall all be in accordance with ASTM C 478. All concrete manhole components shall be precast, unless approved by the District. The minimum wall thickness shall be 5 inches. High Groundwater Manholes are required in all areas of high groundwater. (See Combination Air Valve/Vac and Manhole Details C-01 and C-02).

Lids, covers and slabs shall be designed for AASHTO HS-20 loading. Flat slab tops shall be a minimum of 8 inches thick. The opening through a flat slab top shall be a minimum of 36 inches in diameter. Manhole access opening shall be 24-inch diameter. Rings and Covers shall be heavy duty castings ASTM A 536 or gray cast iron per ASTM A 48. Manhole lid and frame shall be D&L A-1043 or approved equal. Cover shall be waffle pattern stamped "WATER."

3.7.3 Vaults

Precast concrete vaults shall comply with ASTM C 857. All vault sections shall be precast, unless approved by the District. The minimum wall thickness shall be 5 inches. Lids, covers and slabs shall be designed for AASHTO HS-20 loading. Vault roof slabs shall be a minimum of 8 inches thick and the opening through the roof shall be a minimum of 36 inches in diameter. Precast vault walls shall be connected together by a plate and bolt type arrangement. Precast walls shall be appropriately secured to the floor slab.

3.7.4 Grade Beams

Grade beams shall be utilized on manhole installations on existing pipes or other installations requiring an open bottom. Grade beams shall be appropriately sized for the corresponding manhole diameter. For five-foot (5') diameter manholes, Grade Beams shall be eight feet (8') long by 12" tall by 9" wide (8' L x 12" T x 9" W) and shall be

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precast concrete in conformance with ASTM C478.

3.7.5 Manhole and Vault Appurtenances

Steps: manhole & vault steps shall be ASTM-478, comprised of grade 60 deformed rebar encased in a polypropylene copolymer plastic per ASTM D-14 01 with a tread width of 14 inches. The steps shall be M.A. Industries No. PS2-PF or PS2-PF-DF or equivalent. Steps shall be cast in place during manufacturing of the manhole & vault sections and shall be six inches (6") from face of wall. The maximum distance from the rim of the manhole/vault to the topmost step shall be 24 inches.

Joints: RUB'R-NEK or approved equal flexible gasket-type sealant of partially vulcanized butyl rubber per ASTM C990-09, AASHTO M-198 75 1, placed in all keyways between precast concrete adjusting ring and casting, individual precast concrete adjusting rings, and precast concrete adjusting ring and cone joints. A compatible primer or solvent as recommended by manufacturer of butyl base material shall be used to prepare surfaces prior to application of butyl base material and riser rings. Two gaskets shall be provided on inner and outer lip of manhole or vault wall. For Manholes- the gasket shall have a minimum cross sectional area equivalent to one inch (1") in diameter for 48" diameter manholes. Manholes larger than 48" require the use of 1 ½" diameter gaskets.

Pipe Penetrations: Penetrations through manhole risers and vault walls shall be cored or cast-in. All water pipe penetrations in manholes and vaults require modular mechanical seals with 316 stainless bolts, Link-Seal or equivalent. Utilize one (1) seal for concrete thickness less than 8 inches and two (2) seals for concrete 8 inch thick or greater. Install seals such that bolts are located on the accessible side of the penetration.

3.8 Casing Materials and Spacers

Mains to be installed inside casings shall be installed with self-restraining casing spacers. Casing spacers shall provide axial thrust restraint to prevent pipe joint deflection during and after installation. They shall also provide dielectric insulation between the carrier pipe and the casing and facilitate installation of the carrier pipe into the casing. See Waterline Casing Detail C-12. Pipe casing shall be smooth wall welded steel ASTM A-53 Grade B cylinder fabricated in accordance with AWWA C200. External loading shall be AASHTO HS-20 highway or railroad loading plus jacking load, E-80 railroad loading. Casing joints shall have ends beveled for field welding, be butt welded with complete joint penetration welds around the entire circumference of the pipe, and be formed and accurately manufactured so that when pipes are placed together and welded they form a continuous casing with a smooth and uniform interior surface. Interlocking joints shall be Permalok Interlocking Pipe Joining System.

Casing spacers shall be stainless steel, 2-piece bolt on style, minimum 14 gauge thickness and a minimum length of 11"; casing spacers shall be installed every 6 (six) feet of the pipeline to support the pipe barrel and the weight of its contents. The four runners shall be 11 inches long at a minimum and manufactured of high abrasion resistant, low coefficient of friction, glass filled polymer. Runner heights shall be set to center the carrier pipe in the casing. Risers shall be 10 gauge maximum, and the coating shall be fusion-bonded epoxy or heat fused PVC. Casing spacer models shall be Advance Products and Systems, Inc. SI-12; Pipeline Seal and Insulator, Inc. C12G or approved equivalent.

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Casing end seals shall be performed and designed to prevent entry of water or loss of material from casing. The end seals shall be made of 1/8 inch thick 60 durometer EPDM or neoprene rubber held together with mastic strips to seal the edges. The seals shall overlap the casing pipe by 2 inches and shall be held on with AISI 304L stainless steel worm gear clamps. Casing end seals shall be Advance Products and Systems, Inc. AC or AW; Pipeline Seal and Insulator, Inc. C or W; or approved equivalent.

3.9 Tracer Wire

See Appendix E.

3.10 Automated Flushing Stations

Automated flushing stations, where permitted, shall be installed on dead end mains and shall be Kupferle Eclipse 9800, Mueller Hydroguard HG-4, HG-8 or approved equivalent. Flushing station shall be self-draining, suitable for use in cold climates, and have a minimum bury depth of 7'. Flushing station shall include programmable operation, locking mechanism to prevent tampering, and water meter assembly. Flushing stations shall discharge to sanitary sewer and shall include an approved backflow prevention device to prevent cross contamination of the water system.

SECTION IV – PIPE INSTALLATION AND INSPECTION

4.1 Safety

Job site safety shall be the responsibility of the contractor. The District Inspector may refuse to enter a jobsite if deemed unsafe by Occupational Health and Safety Act (OSHA) standards. Failure to provide a safe jobsite may result inability to conduct inspections.

4.2 Handling of Materials

Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. If, however, any part of the pipe is damaged, the replacement or repair of the damaged pipe shall be done to the satisfaction of the District. Any pipe or fittings that are not acceptable to the District shall be removed from the job site immediately. All pipe-handling equipment and pipe handling methods shall be in accordance with the methods and equipment recommended by the manufacturer.

Under NO circumstance shall forks be inserted into any pipe and or fitting. Pipe Storage-Pipe shall be stored and handled in accordance with manufacturer's recommendations. Any pipe with UV degradation or bowing may be rejected by the District Inspector. All pipe shall be stored with factory applied end caps intact.

4.3 Inspection

New installation, replacement, or repair of any existing facilities in the District's distribution system shall be inspected and approved by a District Inspector. The District Inspector shall ensure that the provisions of the Specifications are carefully complied with, particularly in regard to the quality of workmanship and materials. Problems that may require field judgment, in lieu of strict interpretation of the Specifications, shall be resolved by the Applicant to the satisfaction of the District Inspector.

All work shall be performed in accordance with accepted workmanship practices and the Specifications set forth and referenced herein. Any work not accepted by the District Inspector shall be redone until compliance with District Standard Specifications is achieved.

All appropriate permits and approved construction plans shall be kept on the job site during construction.

The District Inspector shall not supervise, set out work, or give line or grade stakes. A Representative of the Applicant shall be at the project site at all times that construction is in progress. The District Inspector shall discuss the work with the Applicant or Applicant's Representative only. Only the Applicant will give instructions to the project workers. If, at any time during construction, it is found that the Applicant's Representative is not on the project site, the District Inspector may stop work until the Applicant's Representative is present at the project.

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All material used shall be subject to the inspection and approval of the District Inspector at all times. The District Inspector has the right to perform any testing deemed necessary to ensure compliance of the material with said Specifications. Failure on the part of the District Inspector to condemn or reject inferior materials, or work, shall not be construed to imply the District's acceptance should their inferiority become evident at any time prior to completion of a TWO-YEAR (2) warranty period from the date of "Construction Acceptance." Materials rejected by the District Inspector shall be immediately removed from the job site.

No construction shall commence sooner than three (3) business days after receipt of approved plans.

4.4 Inspection and Preparation of Pipe and Fittings

Before placing pipe in the trench, each pipe or fitting shall be thoroughly cleaned of all foreign material, kept clean at all times thereafter, and carefully examined for cracks and other defects before installation. Bell ends and spigot ends are to be free of defects. Following the inspection, end caps shall be replaced prior to placing the pipe in the trench.

All lumps, blisters and excess coatings shall be removed from the pipe and fitting, and the outside of the spigot and the inside of the bell shall be wiped clean, dry and free from oil and grease before the pipe or fitting is installed. Dirt and any other foreign material must be removed from the barrel of the pipe before installation.

4.5 Cutting and Fitting of Pipe

Pipe shall be cut in accordance with manufacturer's recommendations, whenever necessary, to conform to location of fittings, line, or grade. All cuts, when required, shall be straight, true and beveled and may be made with plastic pipe cutters or completed per the DIPRA Guidelines for Field Welding and Cutting Ductile Iron Pipe (August 2015). All burrs shall be removed from the ends of cut pipe and the ends of the pipe lightly rasped or filed.

4.6 Pipe Joints

All pipe joints shall be uniform and smooth transitions shall exist from joint to joint or fitting.

4.7 Pipe Alignment and Grade

Fittings, valves, and hydrants shall be installed at staked locations and elevations; spigots centered in bells; and all valve and hydrant stem plumb. The depth of cover over pipe, measured from finished grade to top of pipe, shall be a minimum of 7 feet. For main installations, a surveyor under the guidance of a Professional Land Surveyor registered in the State of Colorado shall set stakes for alignment and grade.

When installing pipe on horizontal or vertical curves, the intent is to install to the staked alignment. The pipe shall be kept in alignment by installing bends on the curve or deflecting the pipe at each joint. Pipe shall be assembled in a straight line both horizontally or vertically prior to deflection. Degree of deflection must be field verified

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prior to backfill and noted in Record Drawings.

Pipe shall be installed with the bell ends facing in the direction of installation, unless directed otherwise by the District. Where pipe is to be installed on a grade of 10 percent (%) or greater, the installation shall start at the bottom and shall proceed upward with the bell ends of the pipe up grade.

4.8 Temporary Plugs

Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be designed to prevent water, debris, children, and animals from entering the pipe. The Contractor shall provide all temporary plugs. The temporary plug shall be secured in a fashion that it cannot be lost in the pipeline.

4.9 Frost

No pipe or appurtenant structure shall be installed upon a foundation into which frost has penetrated, or if at any time there is danger of ice formation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

4.10 Lowering of Material into Trench

Proper implements, tools, and facilities satisfactory to the District shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece by means of suitable tools or equipment, in such a manner as to prevent damage to main materials and their protective coatings and linings. Under no circumstances shall main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fitting, valves, hydrants or water main accessories in handling, the District inspector may reject damaged material at their sole discretion.

4.11 Installation of Pipe

4.11.1 General

Upon request of the District, the pipe Manufacturer or authorized technical representative shall conduct on-site training before pipe installation begins. The individual conducting the training shall be an experienced competent employee of the pipe manufacturer with authorization to perform such duties. The Contractor, Engineer, and District shall all be invited to attend. The purpose of the training shall be to instruct the various personnel regarding the proper installation of the pipeline. The cost of the pipe school shall be incidental to construction of the pipeline and at no additional cost to the District. During installation operations, no debris, tools, clothing, or other foreign materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe inserted to the manufacturer's recommended depth with a slow steady pressure without jerky or jolting movements and brought to correct line and grade. The pipe shall be secured in place with bedding material tamped under it, except at the bells. Precautions shall be taken to prevent dirt from entering the joint space. No wooden

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blocking shall be left at any point under the pipeline. All pipe joints shall be uniform and smooth transitions shall exist from joint to joint or fitting.

4.11.2 Ductile Iron Pipe

Push-On Joint

The inside of the bell, the outside of the spigot end, and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The rubber gasket shall be flexed inward and inserted into the gasket recess of the bell socket. NSF-61 approved gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe, per the manufacturer's recommendation.

The spigot end of the pipe shall be placed in the bell end with care to prevent the joint from contacting the ground. Pipe furnished without a depth mark on the spigot end shall be marked before assembly to ensure insertion to the manufacturer's recommended depth. The pipe shall be kept in straight alignment and the joint shall be completed by inserting the pipe to the manufacturer's recommended depth with a slow, steady pressure by using a long pry bar, jack, lever puller, or backhoe bucket. A timber header should be used between the pipe and the jack or backhoe bucket to avoid damage to the pipe. No gasket loops or bulges shall protrude into the path of the entering pipe spigot. In cold weather conditions, gaskets shall be warmed before installing.

Upon completion of joining push-on joint pipe, an inspection shall be made to ensure that the gasket is correctly aligned in the gasket recess of the bell socket and not twisted or turned.

Restrained Joint Pipe shall be installed as outlined above and in accordance with the specific joint manufacturer's instructions. Where multiple restraining components are utilized, all components are required to be installed.

Internally restrained Joints shall be extended after assembly to minimize further joint take-up in test or service for applications where axial or lateral movement may be undesirable, such as bridge crossings.

Mechanical Joint Fittings

Before joining mechanical joint ductile iron fittings to cast iron, ductile iron, or PVC pipe, the outside of the spigot, the inside of the bell and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The rubber gasket shall be flexed inward and inserted into the gasket recess of the bell socket. NSF-61 approved gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe, per the manufacturer's recommendation.

The ductile iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland.

The pipe shall be pushed into the bell to the manufacturer's recommended depth. The gasket shall then be pressed into place within the bell evenly around the entire joint. The ductile iron gland shall be moved along the pipe into position for bolting; the bolts inserted and the nuts screwed finger tight, then tightened with a torque-limiting wrench. Torque for

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the various sizes of bolts shall be as follows:

Table C-3: Torque and Bolt Size

Pipe Diameter (inches)	Bolt Size (inches)	Range of Torque (Foot-Pounds)
4 - 24	5/8"	75 - 90
30 - 36	3/4"	100 – 120

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce equal pressure on all parts of the gland.

Marking Tape

The installation of blue marking tape is required on all water mains and service lines. The tape shall be installed approximately 24-inches (24") above the main or line. The tape shall meet the specifications listed in 3.5.

4.12 Installation of Valves

Valves shall be handled in such a manner as to prevent any injury or damage. All joints shall be thoroughly cleaned before installation.

Valves shall be set and joined to the pipe in the manner previously specified for cleaning, installing and joining push-on and mechanical joint pipe. Valves shall be set in such a manner that the valve stems are plumb. Valves shall be wrapped with polyethylene encasement material in accordance with 3.2.10.

8-inch and larger valves should be provided with support, crushed stone or a thoroughly tamped trench bottom (95% Standard Proctor Density per AASHTO T99).

Valves shall be operated prior to installation to ensure good operating condition.

4.12.1 Valve Box Installation

A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve, with the box cover set to the required elevation. It will be the responsibility of the Applicant to ensure that valve boxes are plumb and raised to finish grade elevation.

4.12.2 Installation of Fittings

All buried fittings in the system shall be mechanical joint applications and joined per 3.2.5 and 3.2.6

4.13 Fire Hydrants

4.13.1 Installation

Fire Hydrants shall be installed in conformance with drawing C-08. The location of all hydrants shall be staked. Final location and grade shall be in accordance with the approved drawings and care shall be taken to set hydrant grade-line marking at the finished grade elevation. Offset stakes not farther than 12 feet from the fire hydrant are acceptable. All hydrants shall stand plumb.

Each hydrant shall be connected to the main by a six-inch (6") branch line. An independent six-inch (6") gate valve shall be installed on the tee off of the water main. The six-inch (6") branch line servicing the fire hydrant shall not be longer than 50 feet. If the length of the branch line extends beyond 50 feet, an eight-inch (8") main with an eight-inch (8") by six-inch (6") concentric reducer shall be used from the main until a point 50 feet from the hydrant is reached. At that point, a six-inch (6") branch line may be extended to the fire hydrant.

No service line connections shall be installed between the fire hydrant and the fire hydrant guard valve, or anywhere on the six-inch (6") branch line servicing the fire hydrant.

4.13.2 Anchorage

The shoe of each hydrant shall be well braced against the un-excavated earth at the end of the trench with a concrete thrust block. Care shall be taken not to cover the weep holes with concrete and bond breaker shall be installed between the concrete thrust block and the hydrant. Hydrants and branch lines shall be wrapped with polyethylene encasement material in accordance with 3.2.10. The bottom of the hydrant bowl and the hydrant valve shall be supported with minimum 18 x 8 x 4- inch precast concrete blocking slabs or a District approved equal. The hydrant assembly shall require megalug or other approved joint restraints.

4.13.3 Drainage

Wherever a hydrant is set, drainage shall be provided at the base of the hydrant by placing approved rock material from the bottom of the trench, to at least 12 inches above the barrel flange of the hydrant, as shown on the typical fire hydrant detail. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be six inches (6"). The minimum of approved uniformly graded gravel, cobble, or crushed rock placed therein shall be 1 cubic yard.

4.13.4 Clearances

The minimum clearances around all fire hydrants shall be: ten feet (10') in the front, seven feet (7') on the sides, four feet (4') on the back, and 20 feet above except where bollards are required.

4.13.5 Operation of Fire Hydrant

The required operational position of a fire hydrant is either fully opened or fully closed. The guard valve shall control any restriction of flow. The restriction of flow, through a fire hydrant, by means of the "operating nut" is strictly prohibited.

4.14 Thrust Blocks and Anchors

4.14.1 Installation

Thrust blocks and/or anchors shall be constructed at all bends, tees, plugs, fire hydrants, and fittings that require reaction support due to unbalanced line thrust. Thrust blocks are to be used in addition to mechanical joint restraint. Care shall be taken not to block outlet or to cover bolts, nuts, clamps, or other fittings or to make them inaccessible. Wrap fittings with V-Bio enhanced polyethylene prior to pouring thrust blocks so that concrete does not come in contact with the joint bolts. Thrust blocks shall be installed so all joints are accessible. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. In every instance, the thrust block or anchor shall bear against undisturbed earth or compacted structural fill.

All debris, water or ice shall be removed from the place to be occupied by the concrete. Concrete shall not be placed on frozen subgrade.

4.14.2 Form Work for Thrust Blocks and Anchors

All concrete thrust blocks and anchors shall be formed. Refer to Concrete Thrust Block details C-03, C-04 and C-05 and Anchor Detail C-10. A plastic bond-breaker must be provided around all portions of the main to keep concrete from adhering to pipe and fittings.

No thrust block shall be smaller than that size required for an eight-inch (8") main fitting.

4.14.3 Concrete and Curing Time

Thrust block and anchor block concrete shall be per Materials Specification Section 3.6.

Minimum curing time prior to line pressurization for concrete thrust blocks and anchors regardless of additives shall be 36 hours for placed concrete containing two (2) cubic yards or less, 48 hours for placed concrete containing more than two (2) cubic yards but less than six (6) cubic yards, and 72 hours for placed concrete containing more than six (6) cubic yards but less than 12 cubic yards. Protect against loss of moisture, rapid temperature change, from rain, and flowing water for not less than curing time from the placement of the concrete.

No water main will be charged or pressurized without the approval of the District. All thrust blocks and anchors must meet the minimum curing time.

4.14.4 Compaction of Fill Over Thrust Blocks and Anchors

Backfill may be placed over thrust blocks and anchors once the surface has set sufficiently to resist the weight of the backfill and compaction.

4.14.5 Mechanical Joint Restraints

Mechanical Joint Restraints (Megalugs or approved equal) or Internal Joint Restraints shall be used in conjunction with all thrust blocks as described in Sections 3.2.5 and 3.2.6

4.15 Air Vac Vaults

The installation of Air Vac Vaults shall be in conformance with Details C-01 and/or C-02. All dimensions, locations and elevations shall be coordinated and submitted by the Applicant and Contractor and meet the District requirements.

4.16 Tie-in to the District System

4.16.1 Tie-ins

Tie-ins shall be inspected and approved by the District. Under no circumstances shall a non-disinfected main, which cannot be isolated, be tied into an existing distribution main in service.

4.16.2 Tapping Existing Mains

Main Line Tie-ins:

Unless otherwise approved by the District, all main line tie-ins shall be made by means of a tee.

Service Taps/Stub outs:

During new main line construction, service line stub outs and service line taps may only be installed by the Contractor after hydrostatic pressure and bacteriological tests have been completed and approved by the District. Stub outs shall terminate at the curb stop valve. Curb stop valves shall be installed at the property line or edge of easement, whichever comes first. The minimum separation distance between service line taps on the main shall be 18 inches. No service line “dry taps” are allowed. Service line “wet taps” will only be allowed after the line has passed the entire District required inspections and tests. The main line Contractor shall perform “wet taps” on all newly constructed lines. Water taps shall be made above the spring line of pipe. Spring line is defined as the horizontal mid-line of any main line.

All tees/taps shall be witnessed and approved by the District. Any tap performed without a District inspection and approval shall be considered "illegal system tampering" and subject to a five thousand dollar (\$5,000) fine.

4.16.3 Service Stub Outs

When Water Service Stub Outs are installed in conjunction with the installation of the Water Main, the stub out shall be valved off and plugged, watertight, with a valve box, the

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top of which is installed at the ground surface, and located by a surveyor. A copy of the lot plan showing the Stub Out locations shall be provided to the District for inspection and location verification. Electronic survey points shall be provided to the District in a format compatible with the District's GIS mapping system as described in Article IX. Stub Outs shall not be buried prior to inspection by the District.

4.16.4 Operation of Valves

When tying in to the District system, it may be necessary to operate existing District valves. Only District personnel will operate valves on the District system. The Contractor shall give the District Inspector 48 hours' notice to arrange for operating valves. Both the Contractor and the District Representative shall be present when the valves are operated.

4.16.5 Interruption of Service

Installation of a connection that will require closing existing valves may cause an interruption of water service to existing District customers. The Contractor shall coordinate all shutdowns at least one week in advance with the District Inspector. The Contractor will be responsible to furnish the District all necessary information as to the date and time that the interruption will begin, and the total time required to complete the installation.

Notification: The District will deliver written notice to all affected customers at least 48 hours prior to the proposed shut down. The notice shall state the date, time, and probable duration of shutdown, the name and telephone number of the Contractor, District, and District Inspector.

The local fire department for the affected area will also be notified 48 hours in advance. A description of the boundaries of the affected area and the location of all fire hydrants in that area will be provided to the fire department.

If, in the process of installing a connection, there exists an industry or building in the area that cannot be out of water, such as a hospital, or other special customers, appropriate means shall be taken to provide and convey water. The District shall approve water conveyance in writing.

The District reserves the right to schedule water system shutdowns that will provide the least inconvenience to the general public.

Tie-In Procedures: Water line tie-in trenches shall be excavated on the day prior to shutdown unless otherwise approved by the District Inspector. The pre-excavated tie-in trench shall be shored and covered with a steel plate to provide temporary surfacing. All required pipeline tie-in materials shall be delivered to the site prior to the shutdown.

SECTION V – TESTING AND ACCEPTANCE

5.1 General Requirements

The following procedures shall apply to all main extensions within the District service area. Pipe extensions shall be chlorinated in accordance with AWWA C600 and C651 Standard for Disinfecting Water Mains, most recent version.

Immediately after main line installation, the Contractor, in the presence of a District inspector, shall conduct a High Chlorine Test, a Low Chlorine Test, two Bacteriological Tests twenty-four (24) hours apart, and then a pressure test of the main line to ensure that the line is not leaking. No more than 1,000 feet of line shall be tested at one time. If it is discovered that the main line is leaking, it shall be the responsibility of the Applicant to make all necessary repairs and retest the main line. No tap shall be made on to the main line until Construction Acceptance has been granted for the main.

The specific tests required by the District are listed on the "Water System Acceptance Procedure Form". The form is located in section VI.

Before the end of the TWO-YEAR (2) warranty period, the District will sound, an acoustical method of leak detection, the main line at working pressure to ensure that the main line is not leaking. The cost of this testing will be borne by the District. If it is discovered that the main line is leaking, it will be the responsibility of the Applicant to make all necessary repairs and retest the main line and services to the curb stops in the presence of a District Inspector.

5.2 Tracer Wire Testing

All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

5.3 Cathodic Protection Testing

Obtain the services of a Corrosion Engineer to inspect and test the installation of the cathodic protection system. The Corrosion Engineer shall be a registered professional engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by the National Association of Corrosion Engineers at the level of Corrosion Specialist or Cathodic Protection Specialist (i.e., NACE CP Level 4). Such a person shall have not less than five years' experience inspecting cathodic protection systems.

Pipe Lead Wire Integrity Tests: After the pipe is buried, the pipe lead wire trenches are backfilled, and the anode test boxes are installed, the Contractor will test each set of pipe lead wires for electrical continuity to the pipe. If more than twice the theoretical resistance of the pipe lead wire lengths is measured, the Contractor shall excavate the pipe and

SECTION V – TESTING AND ACCEPTANCE

replace the pipe lead wires.

Wire Size	Resistance (Ohms/100 feet at 77-degree F)
No. 4	AWG 0.026
No. 6	AWG 0.041
No. 8	AWG 0.065
No. 10	AWG 0.104
No. 12	AWG 0.165
No. 14	AWG 0.262

5.4 Disinfection

Disinfecting by chlorination of the pipe shall be performed prior to acceptance by the District. Before beginning the disinfection process, the pipe shall be clean and free of debris to the satisfaction of the District. The chlorinating agent, and method of application, shall be in accordance with AWWA C651. The Contractor shall provide all material for disinfecting of water mains.

Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals. The quantity of granules shall be as shown in the table below.

The District does not allow the use of calcium hypochlorite tablets due to the cold water and the time it takes to completely dissolve the tablets.

TABLE C-4: Calcium Hypochlorite Granules

To be placed at the beginning of main and at each 500-foot interval.	
Pipe Diameter	Ounces
6"	3.8
8"	6.7
10"	10.5
12"	15.1
14" and larger	$D^2 \times 15.1^*$ *D = diameter in feet

After the pipe is filled with water and chlorine, the chlorinated water shall be held in contact with the pipe for 24 hours or if the water temperature is less than 41°F, the chlorinated water shall remain in the pipe for at least 48 hours. A detectable free chlorine residual (≥ 0.2 mg/L) shall be found at each sampling point after the 24- or 48-hour period. The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water and/or debris. Care shall be taken in flushing the pipeline to prevent property

SECTION V – TESTING AND ACCEPTANCE

damage and danger to the public. Discharge of highly chlorinated water shall not be released directly to any stream, watercourse, or sanitary sewer. The environment to which the chlorinated water is to be discharge shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, sodium thiosulfate shall be applied to the water to be wasted to neutralize the residual chlorine. Refer to ANSI/AWWA C655 Field Dechlorination for dechlorination procedures if required.

After chlorination, the water shall be flushed from the line at its extremity until the replacement water is equal, chemically, and bacteriologically to those of the permanent source of supply (shall be between 0.42 mg/L and 2.0 mg/L residual chlorine).

After flushing and an acceptable chlorine residual is recorded in the new main, a set of bacteriological samples shall be collected from every 1,000 feet of the new water main, plus one set from the end of the line and at least one set from each branch. The samples will be deposited in the laboratory for a 24-hour incubation period. If the results from the first set of bacteriological samples indicate no biological activity, a second set from the same locations shall be collected. If the second set of samples also shows no bacteriological activity, the line is considered to be disinfected. Testing of residual chlorine and bacteriological sampling and testing will be done by the District.

If the initial disinfection fails to produce satisfactory bacteriological results, the new main shall be re-flushed and shall be re-sampled. If check samples also fail to produce acceptable results, the main shall be re-chlorinated until satisfactory results are obtained. The re-sampling and disinfection will be performed at the developer's expense.

If the "continuous feed method" or the "slug method" of chlorination is used, the Contractor is to provide the written procedure to the District Inspector for acceptance of the method at least 48 hours prior to starting the work.

No main, which has been disinfected and flushed, shall stand stagnant for more than 15 days without being re-flushed and a new disinfecting test performed, passed, and approved by the District.

5.5 Hydrostatic Pressure Testing

5.5.1 General

Contractor shall conduct pressure and leakage tests on all newly installed main in the presence of a District Inspector per AWWA 600, 604, and 605 for ductile iron, steel and PVC pipe respectively. Test sections shall not exceed 1,000 feet, unless approved by the District Inspector.

Contractor shall furnish the following equipment and materials for tests, unless otherwise directed by the District Inspector:

- (a) Two (2): Five (5) Gallon Buckets
- (b) Two (2): Pressure gauges, with maximum five (5) psi increments

- (c) One (1): Suitable pump, hose, and suction pipe as required

5.5.2 Testing Procedure

Following the installation of any new main, pipe shall be partially backfilled leaving all fittings, valves, hydrants, and joints exposed for examination of leaks. Pressure test shall not be conducted until minimum concrete cure time for thrust blocks and anchors has occurred in accordance with Section 4.14.3. The test section shall be slowly filled with water to completely expel any trapped air through valves or additional corporation stops at high points as needed. Following air removal, the pipe shall be held at operating pressure to stabilize any line movement that may occur after installation under pressurization. Once the inspector has verified stabilization and examined the pipe for initial leaks, pipe may be pressurized to testing pressure. Refer to pipe material specific AWWA procedure (600, 604, and 605). The specified test pressure shall be 1.5 times greater than the working pressure of the pipe, not to exceed a maximum of 250 psi corresponding to pressure at the lowest elevation of the system. Hydrostatic testing pressure of steel pipe requires verification and approval by the inspector. Test pressure must be maintained within a plus or minus 5 psi variance for a two (2) hour duration by adding makeup water to the pipe. The amount of makeup water shall be accurately measured and shall not exceed the maximum allowable as shown in material-specific tables of AWWA 600, 604, and 605.

5.6 Acceptance of Mains and Release for Taps

A new main shall be accepted by the District and released for taps when Construction Acceptance has been achieved. Construction Acceptance procedures and requirements are detailed in the Rules and Regulations, Article IX.

5.7 Vacuum Testing of High Groundwater Air Vac Vaults

Manhole vacuum testing shall be required on all high groundwater air vac vaults. Refer to Appendix D, Section 5.3.

SECTION VI – STANDARD FORMS AND DETAILS

Form C1: Pre-Construction Checklist for Water Mainline Installations

Form C2: Water System Acceptance Procedure

Form C3: Bill of Sale UERWA – Water Main

Form C4 Bill of Sale ERW&SD-Water Main

Form C5: Water Easement – Eagle River Water & Sanitation District

Form C6: Water Easement – Upper Eagle Regional Water Authority

Form C7: Lender’s Consent

C-01: Combination Air Valve/Vacuum Valve + Manhole

C-02: Combination Air Valve/Vacuum Valve + Manhole (High Groundwater)

C-03: Concrete Thrust Blocks

C-04: Parallel Bends

C-05: Vertical Thrust Block

C-06: Tee Detail

C-07: 90° Cross Detail

C-08: Fire Hydrant Assembly

C-09: Gate Valve and Box Assembly

C-10 Anchor Block Cutoff Collar

C-11: Groundwater Barrier

C-12: Waterline Casing Detail

C-13: Polyethylene Wrap

C-14: Minimum Cover and Culvert Crossing Insulation Detail

C-15: Easement Width Detail

C-16: Fire Hydrant Clearances and Bollards



Form C1: Pre-Construction Meeting Checklist for Water Main Installation

Project: _____ Location: _____

Date: _____ Attendees: _____

☐ **1. Customer Notification**

☐ **2. All licenses and permits are secured for work.**

☐ **3. A bill of materials has been provided and reviewed.**

☐ **4. Site Safety**

- ✓ OSHA safety standards and practices apply.

☐ **5. Survey**

- ✓ Survey layout is complete and surveyor retained for as-built locations.

☐ **6. Minimum Depth of Bury and Bedding**

- ✓ Seven to nine foot six inches (7'-9.5')
- ✓ In cases where minimum bury depth cannot be achieved, one inch (1") of approved insulation will be required per foot of missing cover, minimum 2 inches.
- ✓ Six inches (6") of approved bedding material under the pipe and twelve inches (12") over the top of pipe.

☐ **7. Cutting of Pipe**

- ✓ All cuts will be straight, true and **beveled**. All burrs will be removed from the ends of cut pipe and the ends lightly rasped or filed.

☐ **8. Tracer Wire and Joint Bonding**

- ✓ Tracer wire *#12 AWG 0.1019" diameter copper conductor or copper clad steel insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, blue in color, and rated for direct burial use at 30 volts. Tracer wire will be installed on all water mains and service lines.
- ✓ The Applicant shall submit plans for a complete tracer wire system.
- ✓ All new mainline trace wire installations shall be located by the applicant using typical low frequency (512Hz) line tracing equipment, witnessed by the inspector, contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

Form C1: Pre-Construction Meeting Checklist for Water Main Installation

- ✓ Tracer wire grounding anode at all dead ends
- ✓ Tracer wire splicing/connections shall include two and 3 way lockable connectors or a three way lug connector specifically manufactured for use in underground trace wire installation
- ✓ A No. 4 conductor and cad-welds or continuity straps will be used to bond each joint and fitting.

☐ 9. Marking Tape and Locating Disk

- ✓ Marking tape will be placed twenty-four inches (24") above the pipe for all main and service lines. Marking tape shall be solid blue color with black lettering six inches (6") wide and of five (5)-mil thick PVC material.
- ✓ A 3M disk marker will be placed at all service curb stops with a maximum four foot (4') bury from finish grade

☐ 10. Thrust Blocks and Anchors

- ✓ Concrete thrust blocks and anchors will be used in conjunction with mechanical joint restraints. All mechanical joints require megalugs. Thrust blocks will be poured and formed per District specifications and inspected by the District inspector prior to backfill.

☐ 11. Fire Hydrants

- ✓ Fire hydrants will be Mueller Centurion Mountain hydrants with a fire hydrant marker flag installed. Fire hydrants will be installed to the bury line on the fire hydrant stand pipe and a maximum of six inches (6") below the flange. Fire hydrant extensions are not allowed on new construction.

☐ 12. Testing

- ✓ Allow a minimum of five (5) days for testing for each test segment; 24 hours for high and low chlorine tests, two consecutive sets of bacteriological tests taken 24 hours apart and hydrostatic pressure testing of mains and required assets. Main lines will be disinfected and bacteriological samples approved prior to hydrostatic pressure tests. Disinfection must be per ANSI/AWWA C651 using calcium hypochlorite granules, not tablets. The contractor is responsible for disposal of chlorinated water used for disinfection. No main, which has been disinfected and flushed, shall stand stagnant for more than 15 days without being re-flushed and a new disinfecting test performed, passed, and approved by the District.

☐ 13. Tapping and Service Lines

- ✓ Service lines will not be tapped until the main has passed all testing procedures.
- ✓ Service lines will be tapped above the spring line of the pipe (10 or 2 o'clock position)

☐ 14. Valve and Curb Stop Boxes

- ✓ All curb stop boxes will require extension rods.
- ✓ The top of the shaft will be between 18 and 24 inches below final grade.
- ✓ All valve boxes are to be centered and plumb over the operating nut.

Form C1: Pre-Construction Meeting Checklist for Water Main Installation

☐ **15. Stub Outs**

- ✓ Stub outs will be only allowed to the edge of easement or the property line.

☐ **16. Design Changes**

- ✓ Engineer must submit any design changes to Construction Review prior to implementation. Minor field changes may be approved by the District inspector and must be reflected on as-built documentation.

☐ **17. Water Service Connection**

- ✓ Any type of rebuild or remodel may require the payment of additional tap fees.
- ✓ No service connections will be made until Construction Acceptance is granted.
- ✓ No service line will be extended into the property until Customer Service has been provided the required documents and the account number has been assigned.
- ✓ Service line inspections will only occur after authorization has been granted by the Customer Service Department.
- ✓ Connection prior to the payment of the entire assessed tap fee will result in an "unauthorized connection" assessment.

☐ **18. Construction acceptance includes the following:**

- ✓ Rough grade inspection.
- ✓ All chlorine, bacteriological, and pressure tests approved.
- ✓ All valve boxes, fire hydrants and Air Vac/PRV vaults to grade and operated.
- ✓ Drawings of record submitted and approved.
- ✓ Easement documentation.
- ✓ Project costs.
- ✓ Bill of sale.

☐ **19. Warranty Period-**

- ✓ Will not start until Drawings of Record, Recorded Easement Documents, Project Costs Documents and Bill of Sale are received and approved by the District

Reference: Eagle River Water and Sanitation District Rules and Regulations Appendix C – Standard Specifications for Water Mains

Contractor: _____ **Engineer:** _____

Owner: _____ **Inspector:** _____



FORM C2: WATER SYSTEM ACCEPTANCE PROCEDURE

Location: _____
Project: _____ **Phase:** _____
Engineer: _____ **Applicant:** _____
Contractor: _____ **Excavator:** _____

CONSTRUCTION REVIEW TEAM (CRT)

Plans Approved for Construction: _____ **Date** _____ **Approved By** _____

FIELD OPERATIONS INSPECTOR

Inspection/Test Type	Date	Values	Sign Off
1) Water Assets Inspections	_____		_____
2) Tracer Wire Testing	_____		_____
3) High Chlorine:	_____	_____	_____
4) Low Chlorine:	_____	_____	_____
5) Passed Bac-T #1	_____		_____
6) Passed Bac-T #2	_____		_____
7) Hydrostatic PSI Test	_____	_____	_____
8) Rough Grade and Paving	_____		_____
9) As-Built / GIS Review:	_____		_____
10) Final Grade and Paving	_____		_____

DEVELOPMENT REVIEW COORDINATOR

11) Construction Acceptance _____ **Date** _____ **Sign Off** _____

FIELD OPERATIONS INSPECTOR

12) 2-Year Warranty WO Created _____ **Date** _____ **Sign Off** _____
13) 2-Year Warranty Inspection _____

DEVELOPMENT REVIEW COORDINATOR

14) Final Acceptance _____

BILL OF SALE AUTHORITY – WATER MAIN

KNOW ALL MEN BY THESE PRESENTS, that _____, (“Seller”), for and in consideration of the mutual promises and assurances made herein, the sufficiency of which is hereby acknowledged, and other valuable consideration to be paid by **Upper Eagle Regional Water Authority** (“Authority”), a quasi-municipal corporation of the State of Colorado, has bargained and sold, and by these presents does grant and convey unto the Authority, its successors and assigns, the following property:

The water system, equipment, and related appurtenances and facilities, including all related personal property (the “Improvements”), which are constructed or otherwise acquired by Seller within the property generally known as _____

_____, and described on Exhibit A, attached hereto and incorporated herein by reference.

To have and to hold the same, unto the Authority, its successors and assigns forever, and Seller, for itself, its successors and assigns, covenants and agrees to and with the Authority, its successors and assigns, to warrant and defend the sale of said Improvements, hereby made unto the Authority, its successors and assigns, against all and every person or persons whomsoever, and warrants that the conveyance of the Improvements to the Authority, its successors and assigns, is made free from any claim or demand whatsoever.

The Seller further agrees and assures:

1. That all of the Improvements described herein were installed in substantial compliance with the Authority’s Rules and Regulations and applicable construction standards, and that said Improvements are in first-class working order, free from any defect whatever.

2. That no charges for materials or labor are due and payable on any of the Improvements described herein, and that Seller shall indemnify, defend, and hold the Authority and its agents, employees, engineers, and attorneys, harmless from and against all claims, damages, judgments, losses, and expenses of every nature, including reasonable attorney’s fees, arising at any time out of any act or omission of Seller and its employees, subcontractors and their employees, and all other persons directly or indirectly involved or performing work for Seller on the Improvements described herein.

3. If within **TWO (2) YEARS** after the date of **Construction Acceptance** of the Improvements by the Authority, any Work is found to be defective, Seller shall promptly, without cost to the Authority and in accordance with the Authority’s written instructions, within seven (7) days after the Authority’s issuance of written instructions correct the defective Work at Seller’s cost. If Seller does not promptly comply with the terms of such instructions or in an emergency where delay would cause serious risk of loss or damage,

FORM C3: BILL OF SALE UERWA- WATER MAIN

the Authority may have the defective Work corrected or removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by Seller. Seller shall also pay for any damage done to other work, other property or persons which occurred as a result of the defective Work within the two-year warranty period.

4. Except for any notice required by law to be given in another manner, (a) any notice to Seller provided for in this Bill of Sale shall be in writing and shall be given and be effective upon (1) delivery to Seller or (2) mailing such notice by first class U.S. mail, addressed to Seller to Seller's address stated herein or at such other address as Seller may designate by notice to the Authority and (b) any notice to the Authority shall be in writing and shall be given and be effective upon (1) delivery to the Authority or (2) mailing such notice by first class U.S. mail, to the Authority's address stated herein or to such other address as the Authority may designate by notice.

IN WITNESS WHEREOF, the Seller has caused its name to be hereunto subscribed this _____ day of _____, 20__.

SELLER:

By: _____

(Title)

Mailing Address

STATE OF COLORADO)
) ss.
COUNTY OF EAGLE)

The foregoing instrument was acknowledged before me this _____ day of _____,
20__, by _____
as _____ of _____.

WITNESS my hand and official seal.

(S E A L)

Notary Public

My commission expires: _____

BILL OF SALE DISTRICT – WATER MAIN

KNOW ALL MEN BY THESE PRESENTS, that _____, (“Seller”), for and in consideration of the mutual promises and assurances made herein, the sufficiency of which is hereby acknowledged, and other valuable consideration to be paid by the **Eagle River Water and Sanitation District** (“District”), a quasi-municipal corporation of the State of Colorado, has bargained and sold, and by these presents does grant and convey unto the District, its successors and assigns, the following property:

The water system, equipment, and related appurtenances and facilities, including all related personal property (the “Improvements”), which are constructed or otherwise acquired by Seller within the property generally known as _____

_____, and described on Exhibit A, attached hereto and incorporated herein by reference.

To have and to hold the same, unto the District, its successors and assigns forever, and Seller, for itself, its successors and assigns, covenants and agrees to and with the District, its successors and assigns, to warrant and defend the sale of said Improvements, hereby made unto the District, its successors and assigns, against all and every person or persons whomsoever, and warrants that the conveyance of the Improvements to the District, its successors and assigns, is made free from any claim or demand whatsoever.

The Seller further agrees and assures:

1. That all of the Improvements described herein were installed in substantial compliance with the District’s Rules and Regulations and applicable construction standards, and that said Improvements are in first-class working order, free from any defect whatever.

2. That no charges for materials or labor are due and payable on any of the Improvements described herein, and that Seller shall indemnify, defend, and hold the District and its agents, employees, engineers, and attorneys, harmless from and against all claims, damages, judgments, losses, and expenses of every nature, including reasonable attorney’s fees, arising at any time out of any act or omission of Seller and its employees, subcontractors and their employees, and all other persons directly or indirectly involved or performing work for Seller on the Improvements described herein.

3. If within **TWO (2) YEARS** after the date of **Construction Acceptance** of the Improvements by the District, any Work is found to be defective, Seller shall promptly, without cost to the District and in accordance with the District’s written instructions, within seven (7) days after the District’s issuance of written instructions correct the defective Work at Seller’s cost. If Seller does not promptly comply with the terms of such instructions or in an emergency where delay would cause serious risk of loss or damage, the District may have the defective Work corrected or removed and replaced, and all

FORM C4: BILL OF SALE ERW&SD- WATER MAIN

direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by Seller. Seller shall also pay for any damage done to other work, other property or persons which occurred as a result of the defective Work within the two-year warranty period.

4. Except for any notice required by law to be given in another manner, (a) any notice to Seller provided for in this Bill of Sale shall be in writing and shall be given and be effective upon (1) delivery to Seller or (2) mailing such notice by first class U.S. mail, addressed to Seller to Seller's address stated herein or at such other address as Seller may designate by notice to the District and (b) any notice to the District shall be in writing and shall be given and be effective upon (1) delivery to the District or (2) mailing such notice by first class U.S. mail, to the District's address stated herein or to such other address as the District may designate by notice.

IN WITNESS WHEREOF, the Seller has caused its name to be hereunto subscribed this _____ day of _____, 20__.

SELLER:
By: _____

(Title)

Mailing Address

STATE OF COLORADO)
) ss.
COUNTY OF EAGLE)

The foregoing instrument was acknowledged before me this _____ day of _____,
20__, by _____
as _____ of _____.

WITNESS my hand and official seal.

(S E A L)

Notary Public

My commission expires: _____

WATER EASEMENT- EAGLE RIVER WATER & SANITATION DISTRICT

THIS EASEMENT is made this _____ day of _____, 20__, by and between _____ (hereinafter referred to as "Grantor"), and it's successors, and the **Eagle River Water and Sanitation District**, a quasi-municipal corporation of the State of Colorado within the County of Eagle, (hereinafter referred to as "District").

WITNESSETH, that for and in consideration of the sum of One Dollar (\$1.00) and other good and valuable consideration paid by the District to Grantor, the receipt of which is hereby acknowledged, the Grantor does hereby grant, convey and transfer unto the District, its successors and assigns, a perpetual easement and right to construct, install, remove, replace, add to, maintain, repair, operate, change or alter underground water lines and all underground and surface appurtenances related thereto such as valve boxes, meter vaults and manholes (hereinafter "water lines"), together with any and all water lines situate therein, all necessary rights-of-way for convenient ingress and egress thereto and therefrom, and the right to occupy and use, from time to time, as much of the adjoining land of the Grantor as may be reasonably necessary for any of the aforesaid purposes, over, under and across the following described premises, situate in the County of Eagle, State of Colorado, to-wit:

See EXHIBIT A attached hereto and incorporated herein by reference.

Grantor warrants that the Grantor has the lawful right to grant and convey such easement, rights-of-way, and water lines. Further, Grantor warrants that the water lines are free and clear of all liens and encumbrances.

Grantor will at no time permit, place or construct any structure, building or improvement of any kind, temporary or permanent, on any part of the above-described premises. Any structure, building or improvement located on the above-described premises as of the date of this Easement, may be removed by the District without liability for damages arising therefrom.

Following the completion of the purpose of any entry by the District upon such easement for any of the aforesaid objects, the District shall restore the premises to substantially the same condition existing at the time of the entry thereon, except for shrubs, plants, sidewalks, driveways or parking areas thereon located or damaged thereby.

All provisions of the Easement, including all benefits and burdens, shall run with the land and shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto, subject to the provisions hereof.

FORM C5: WATER EASEMENT- EAGLE RIVER WATER & SANITATION DISTRICT

IN WITNESS WHEREOF, the parties hereto have set their hands and seal the day and year first above written.

GRANTOR:

(Name of Grantor)

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The foregoing Easement was subscribed and sworn to before me this _____
day of _____, 20__, by _____
_____.

WITNESS my hand and official seal.

(S E A L)

Notary Public

My commission expires:

ACCEPTED by the District this _____ day of _____, 20__.

By: _____
General Manager

WATER EASEMENT- UPPER EAGLE REGIONAL WATER AUTHORITY

THIS EASEMENT is made this _____ day of _____, 20__, by and between _____ (hereinafter referred to as "Grantor"), and it's successors and assigns, and the **Upper Eagle Regional Water Authority**, a quasi-municipal corporation of the State of Colorado within the County of Eagle, (hereinafter referred to as "Authority").

WITNESSETH, that for and in consideration of the sum of One Dollar (\$1.00) and other good and valuable consideration paid by the Authority to Grantor, the receipt of which is hereby acknowledged, the Grantor does hereby grant, convey and transfer unto the Authority, its successors and assigns, a perpetual easement and right to construct, install, remove, replace, add to, maintain, repair, operate, change or alter underground water lines and all underground and surface appurtenances related thereto such as valve boxes, meter vaults and manholes (hereinafter "water lines"), together with any and all water lines situate therein, all necessary rights-of-way for convenient ingress and egress thereto and therefrom, and the right to occupy and use, from time to time, as much of the adjoining land of the Grantor as may be reasonably necessary for any of the aforesaid purposes, over, under and across the following described premises, situate in the County of Eagle, State of Colorado, to-wit:

See EXHIBIT A attached hereto and incorporated herein by reference.

Grantor warrants that the Grantor has the lawful right to grant and convey such easement, rights-of-way, and water lines. Further, Grantor warrants that the water lines are free and clear of all liens and encumbrances.

Grantor will at no time permit, place or construct any structure, building or improvement of any kind, temporary or permanent, on any part of the above-described premises. Any structure, building or improvement located on the above-described premises as of the date of this Easement, may be removed by the Authority without liability for damages arising therefrom.

Following the completion of the purpose of any entry by the Authority upon such easement for any of the aforesaid objects, the Authority shall restore the premises to substantially the same condition existing at the time of the entry thereon, except for shrubs, plants, sidewalks, driveways or parking areas thereon located or damaged thereby.

All provisions of the Easement, including all benefits and burdens, shall run with the land and shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto, subject to the provisions hereof.

FORM C6: WATER EASEMENT- UPPER EAGLE REGIONAL WATER AUTHORITY

IN WITNESS WHEREOF, the parties hereto have set their hands and seal the day and year first above written.

GRANTOR:

(Name of Grantor)

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The foregoing Easement was subscribed and sworn to before me this _____
day of _____, 20__, by _____
_____.

WITNESS my hand and official seal.

(S E A L)

Notary Public

My commission expires:

ACCEPTED by the Authority this _____ day of _____, 20__.

By: _____
General Manager

FORM C7: LENDER'S CONSENT

LENDER'S CONSENT

_____ Consents to the foregoing Easement and binds itself, its successors and assigns, the same as though its Deed of Trust, recorded on _____, 20__, at Reception Number _____ of the records of the Clerk and Recorder of _____ County, Colorado, was made specifically subject to said Easement.

By: _____
Title: _____

STATE OF COLORADO)
) ss.
COUNTY OF _____)

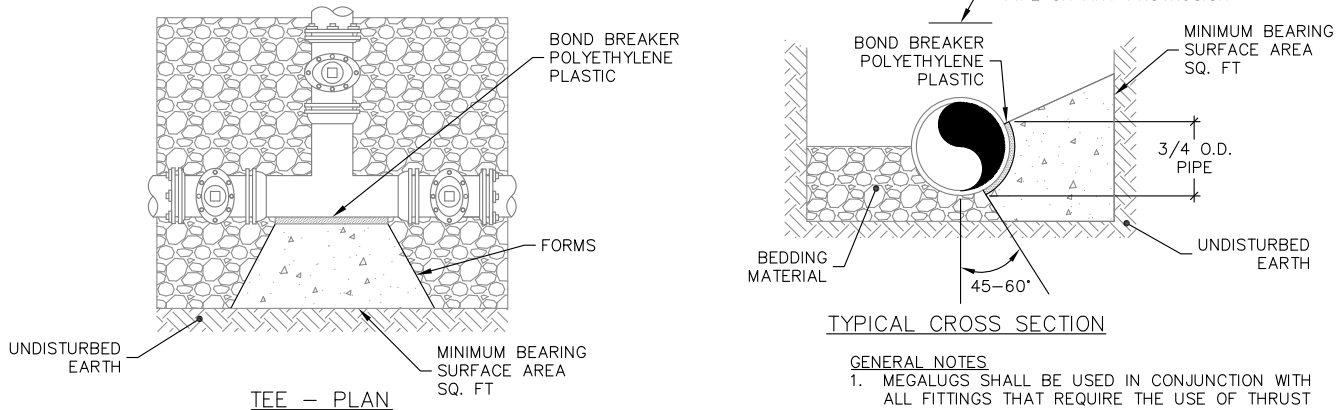
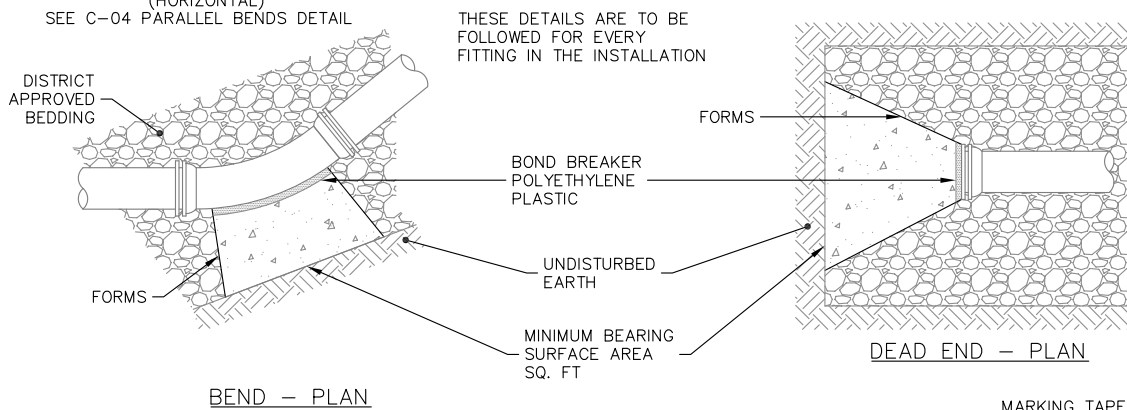
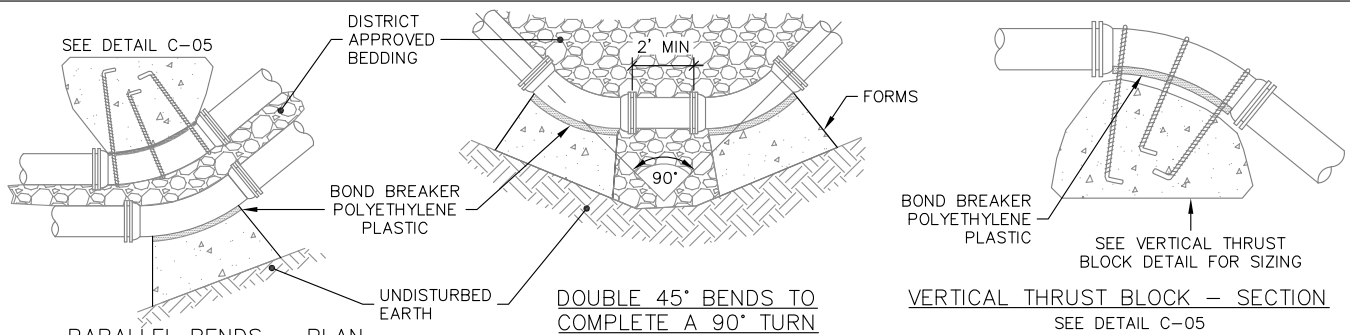
The foregoing Easement was subscribed and sworn to before me this _____ day of _____, 20__, by _____.

WITNESS my hand and official seal.

(S E A L)

Notary Public

My commission expires:



GENERAL NOTES


- MEGALUGS SHALL BE USED IN CONJUNCTION WITH ALL FITTINGS THAT REQUIRE THE USE OF THRUST BLOCK.
- REFER TO DISTRICT STANDARDS IN APPENDIX C SECTION 3.6 FOR REQUIREMENTS.
- THRUST BLOCKS SHALL BE INSTALLED SO THAT ALL JOINTS ARE ACCESSIBLE. POLYWRAP FITTINGS PRIOR TO POURING THRUST BLOCK, EXTEND WRAP TO ENCLOSE ALL FITTINGS AND BOLTS.
- THRUST BLOCKS SHALL BE FORMED AGAINST UNDISTURBED SOIL & FORMS PER APPENDIX C 4.14.
- BLOCK HEIGHT SHALL BE ESTABLISHED SUCH THAT THE CALCULATED BLOCK WIDTH IS BETWEEN ONE AND TWO TIMES THE HEIGHT.
- BOND BREAKER PER APPENDIX C 3.2.10.

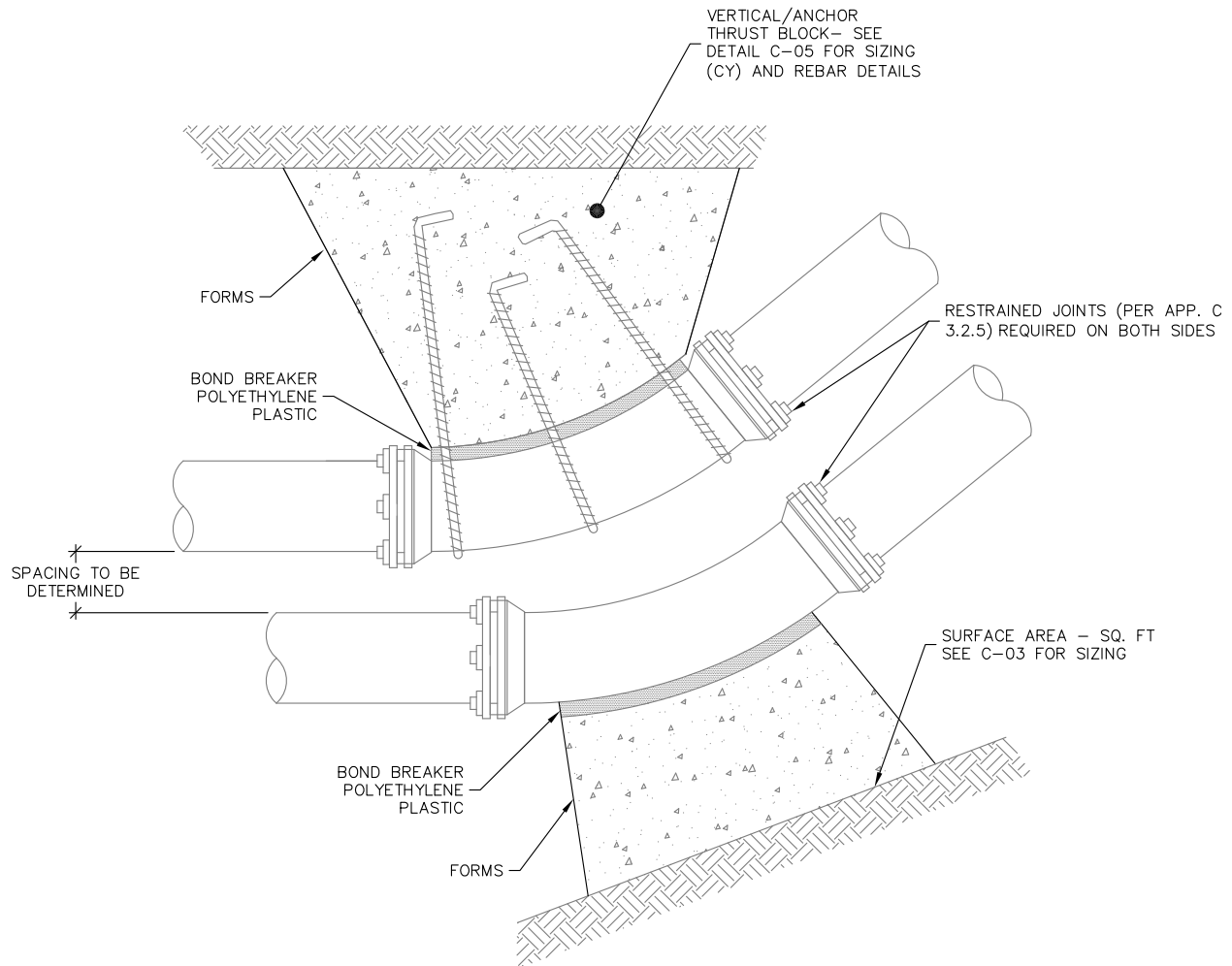
THE MINIMUM BEARING SURFACE AREAS ARE PROVIDED FOR 200 PSI WORKING PIPE PRESSURE + 50 PSI SURGE (250 PSI TOTAL) AND 2,000 PSF SOIL BEARING CAPACITY. IF PRESSURE IS HIGHER OR SOIL BEARING POTENTIAL LOWER, CONSULT DISTRICT.

200 PSI WORKING	REQUIRED MINIMUM BEARING SURFACE AREA (SF)					
	SIZE OF PIPE	BENDS				TEE OR DEAD END
		11-1/4'	22-1/2'	45°	90°	
	4"-8"	1.2	2.5	4.8	8.9	6.3
	10"	1.9	3.8	7.5	13.9	9.8
	12"	2.8	5.5	10.8	20.0	14.1
	16"	4.9	9.8	19.2	35.5	25.1
	18"	6.2	12.4	24.3	45.0	31.8
	20"	7.7	15.3	30.1	55.5	39.3
	24"	11.1	22.1	43.3	80.0	56.5

250 PSI WORKING	REQUIRED MINIMUM BEARING SURFACE AREA (SF)					
	SIZE OF PIPE	BENDS				TEE OR DEAD END
		11-1/4'	22-1/2'	45°	90°	
	4"-8"	1.5	2.9	5.8	10.7	7.5
	10"	2.3	4.6	9.0	16.7	11.8
	12"	3.3	6.6	13.0	24.0	17.0
	16"	5.9	11.8	23.1	42.7	30.2
	18"	7.5	14.9	29.2	54.0	38.2
	20"	9.2	18.4	36.1	66.6	47.1
	24"	13.3	26.5	51.9	96.0	67.9

THE MINIMUM BEARING SURFACE AREAS ARE PROVIDED FOR 250 PSI WORKING PIPE PRESSURE + 50 PSI SURGE (300 PSI TOTAL) AND 2,000 PSF SOIL BEARING CAPACITY. IF PRESSURE IS HIGHER OR SOIL BEARING POTENTIAL LOWER, CONSULT DISTRICT.


	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
<h2>CONCRETE THRUST BLOCKS</h2>	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: 1/21/2020
<h1>C-03</h1>	

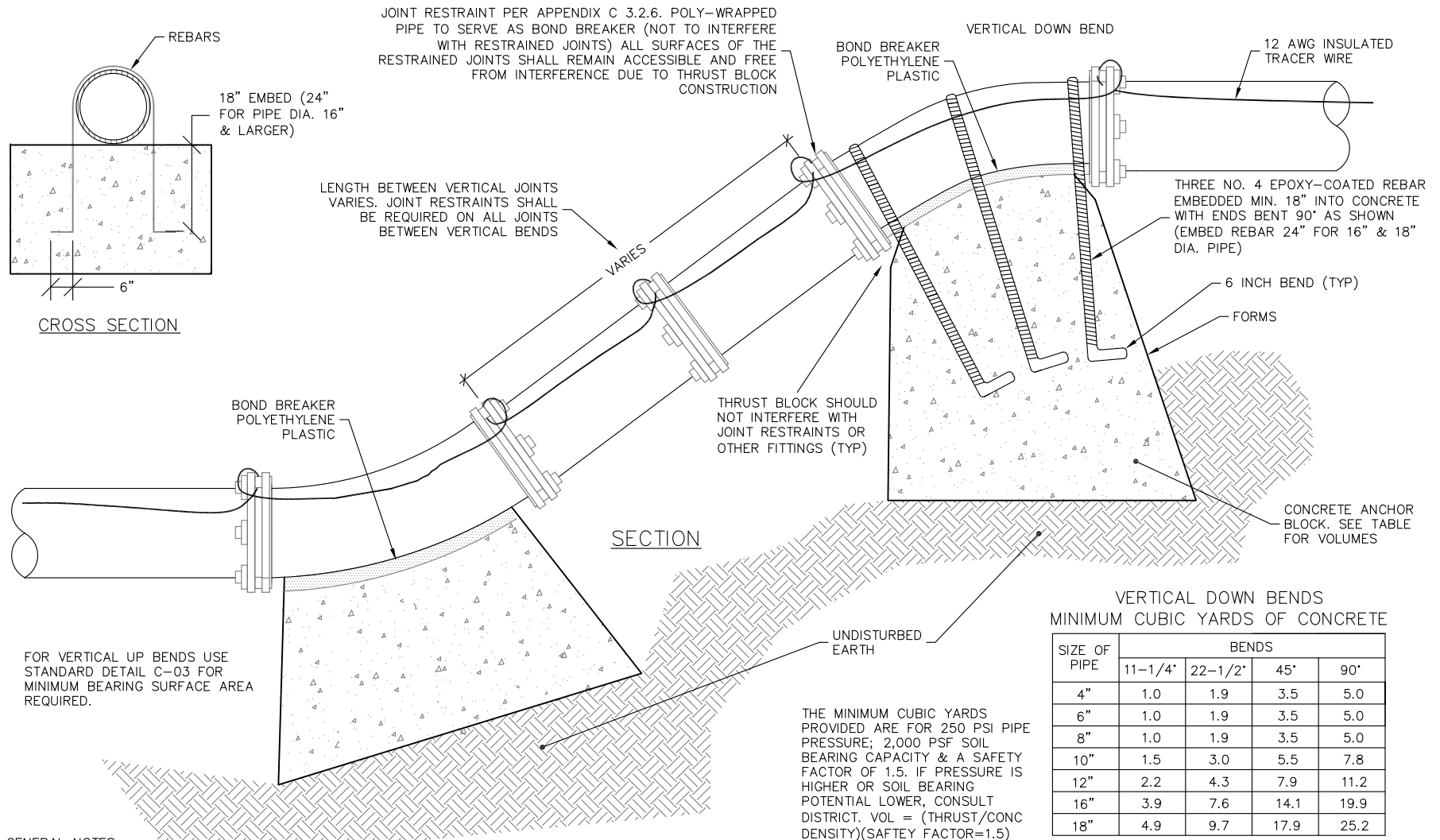


HORIZONTAL PARALLEL BENDS TOP VIEW

GENERAL NOTES

1. USE MEGALUG JOINT RESTRAINT DEVICES PER 3.2.5 OR SIMILAR UPON PRIOR DISTRICT APPROVAL — POLY-WRAPPED PIPE TO SERVE AS BOND BREAKER (NOT TO INTERFERE WITH RESTRAINED JOINTS). ALL SURFACES OF THE RESTRAINED JOINTS SHALL BE ACCESSIBLE AND FREE FROM INTERFERENCE DUE TO THRUST BLOCK CONSTRUCTION.
2. MINIMUM AREA REQUIRED WILL BE THAT OF AN 8 INCH MAIN. PIPE LARGER THAN 12" TO BE SPECIFICALLY DESIGNED BY ENGINEER.
3. ALL THRUST BLOCKS SHALL BE FORMED. FORMS PER 3.6.4.
4. BEARING AREA BASED ON SOIL BEARING PRESSURE OF 2000 LB/SF.
5. SEE DETAIL C-05 FOR VERTICAL/ANCHOR THRUST BLOCK.
6. POLYETHYLENE BOND BREAKER PER APPENDIX C 3.2.9.

 EAGLE RIVER WATER & SANITATION DISTRICT	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
PARALLEL BENDS W/THRUST BLOCKS	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: 1/21/2020
C-04	




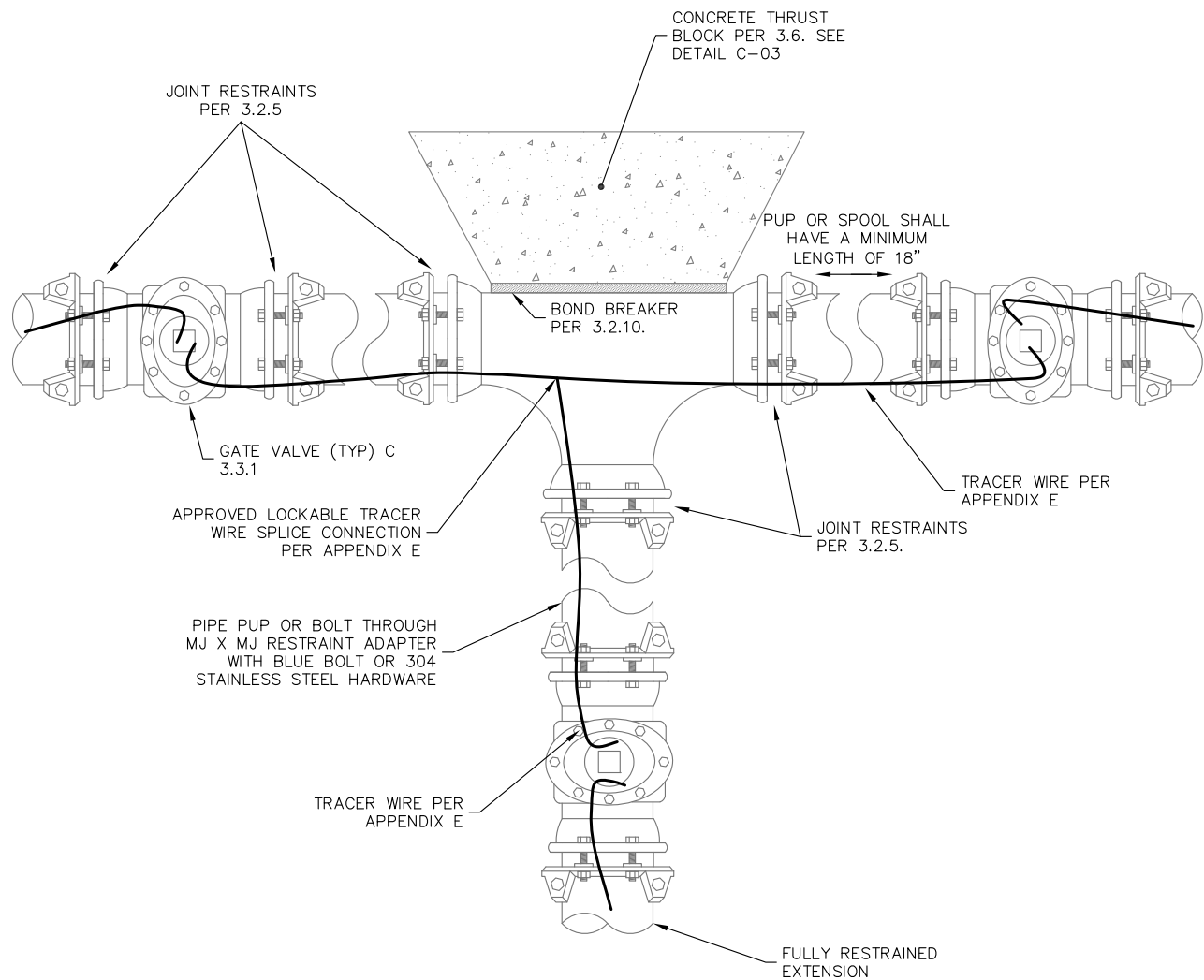
VERTICAL DOWN BENDS
MINIMUM CUBIC YARDS OF CONCRETE

SIZE OF PIPE	BENDS			
	11-1/4'	22-1/2'	45'	90'
4"	1.0	1.9	3.5	5.0
6"	1.0	1.9	3.5	5.0
8"	1.0	1.9	3.5	5.0
10"	1.5	3.0	5.5	7.8
12"	2.2	4.3	7.9	11.2
16"	3.9	7.6	14.1	19.9
18"	4.9	9.7	17.9	25.2

GENERAL NOTES

1. JOINT RESTRAINTS (PER 3.2.5) SHALL BE USED IN CONJUNCTION WITH THRUST BLOCKS.
2. REFER TO DISTRICT STANDARDS IN APPENDIX C SECTION 3.6 FOR THRUST BLOCK REQUIREMENTS.
3. THRUST BLOCKS SHALL BE INSTALLED SO THAT ALL JOINTS ARE ACCESSIBLE. POLYWRAP FITTINGS PRIOR TO POURING THRUST BLOCK, EXTEND WRAP TO ENCLOSE ALL FITTINGS AND BOLTS.
4. THRUST BLOCKS SHALL BE FORMED AGAINST UNDISTURBED SOIL. FORMS PER 3.6.4.
5. BLOCK HEIGHT SHALL BE ESTABLISHED SUCH THAT THE CALCULATED BLOCK WIDTH IS BETWEEN ONE AND TWO TIMES THE HEIGHT.
6. THRUST BLOCK SHALL NOT INTERFERE WITH ACCESS TO FITTING AND JOINT RESTRAINT BOLTS.
7. POLYETHYLENE BOND BREAKER PER 3.2.9.

 <p>EAGLE RIVER WATER & SANITATION DISTRICT</p> <p>846 FOREST ROAD VAIL, CO 81657 (970) 476-7480</p> <p>WWW.ERWSD.ORG</p>	VERTICAL THRUST BLOCK	
	DRAWN BY: JEC	DATE: 03/01/2017
	SCALE: NONE	REV: 1/21/2020
	C-05	

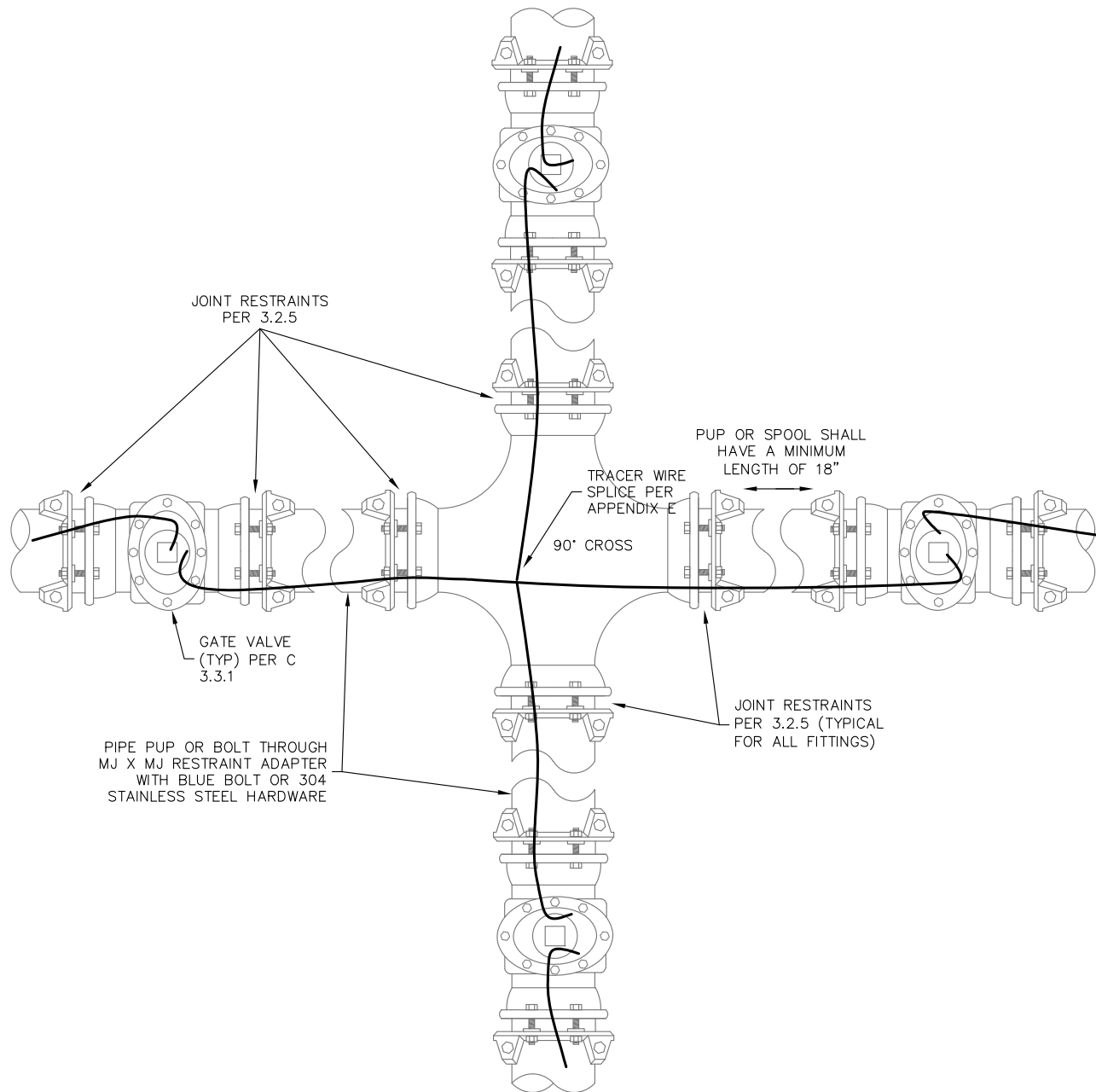


TOP VIEW

GENERAL NOTES

1. TEES SHALL BE CONSIDERED ON AN INDIVIDUAL BASIS. ALL USES OF THIS APPLICATION SHALL REQUIRE PRIOR DISTRICT APPROVAL.
2. JOINT RESTRAINT DEVICES SHALL BE REQUIRED ON ALL TEE APPLICATIONS.
3. THRUST BLOCKS ALONE WILL NOT BE ACCEPTED AS A RESTRAINT.
4. TRACER WIRE ACCESS PER C-09


 EAGLE RIVER WATER & SANITATION DISTRICT	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
TEE DETAIL	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: 1/21/2020
C-06	

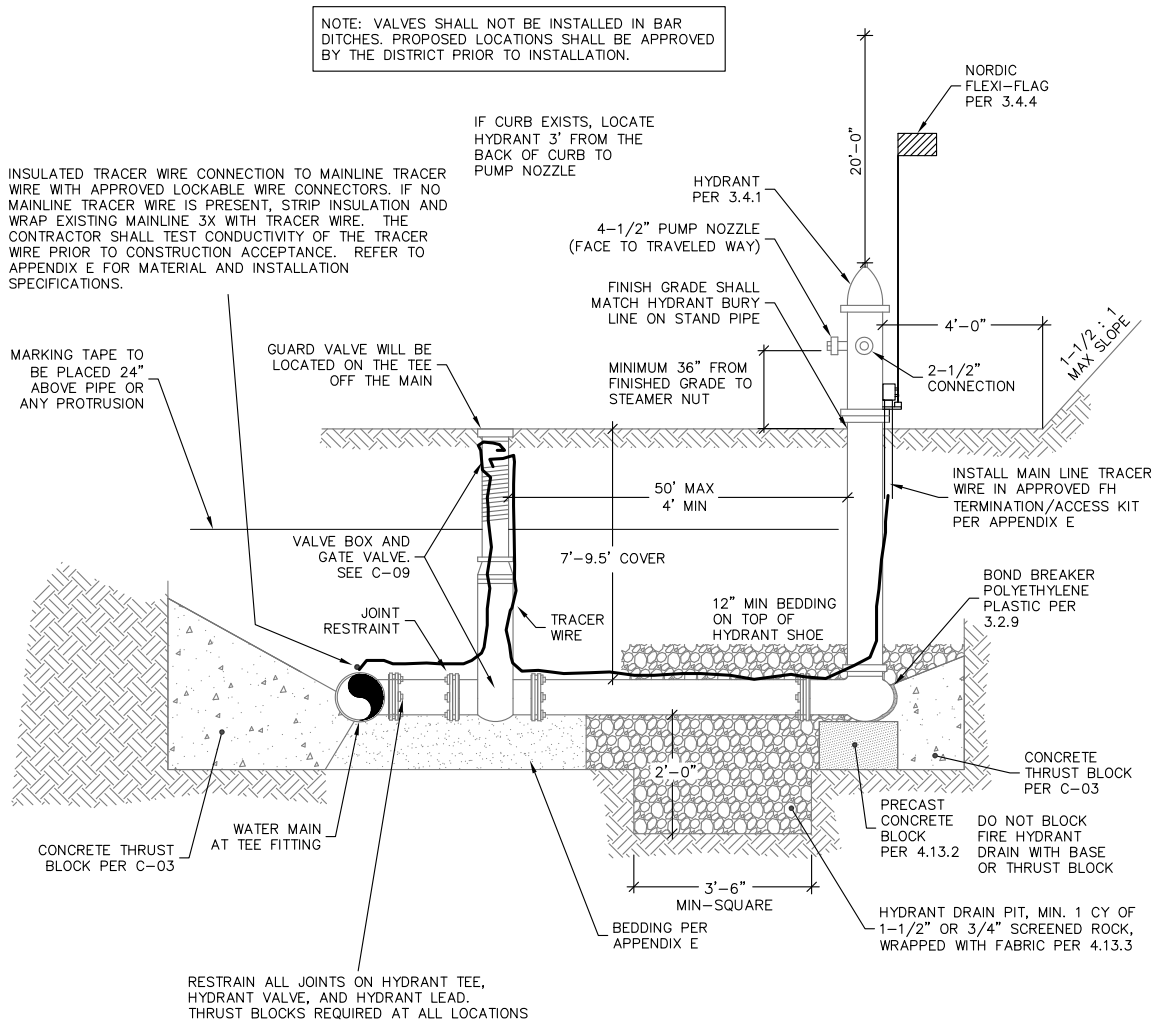


TOP VIEW

GENERAL NOTES

1. CROSSES SHALL BE CONSIDERED ON AN INDIVIDUAL BASIS. ALL USES OF THIS APPLICATION SHALL REQUIRE PRIOR DISTRICT APPROVAL.
2. JOINT RESTRAINT DEVICES SHALL BE REQUIRED ON ALL CROSS APPLICATIONS AND RESTRAINED LENGTH CALCULATIONS SHALL BE PROVIDED BY ENGINEER.
3. TRACER WIRE SHALL BE INSTALLED PER APPENDIX E AND CONNECTED WITH LOCKABLE SPLICE CONNECTIONS. TRACER WIRE ACCESS PER C-09.

 EAGLE RIVER WATER & SANITATION DISTRICT	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
90° CROSS DETAIL	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: 3/31/2023
C-07	

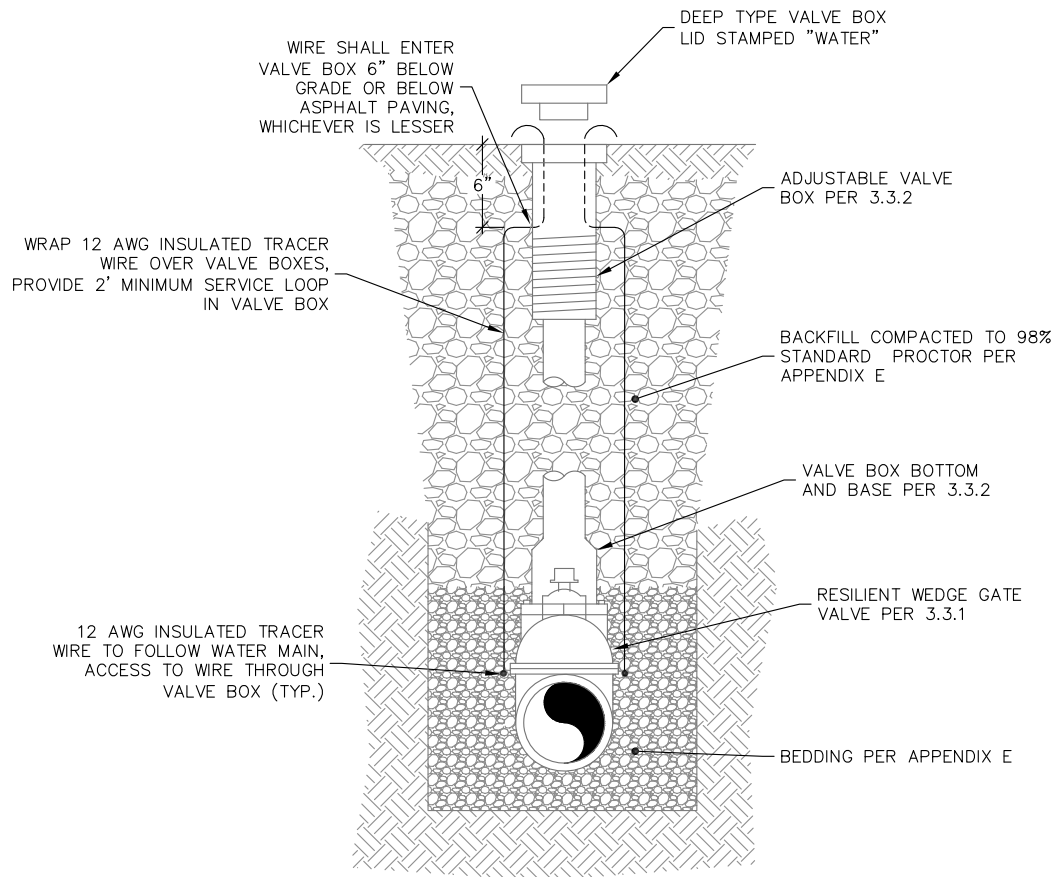


846 FOREST ROAD
VAIL, CO 81657
(970) 476-7480
WWW.ERWSD.ORG

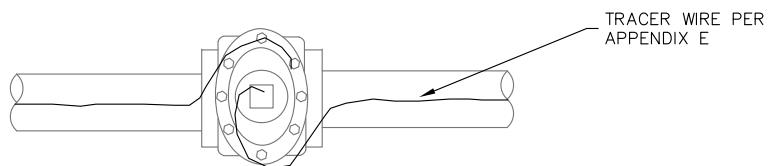
FIRE HYDRANT ASSEMBLY

DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: 3/31/2023

C-08




GATE VALVE – SECTION

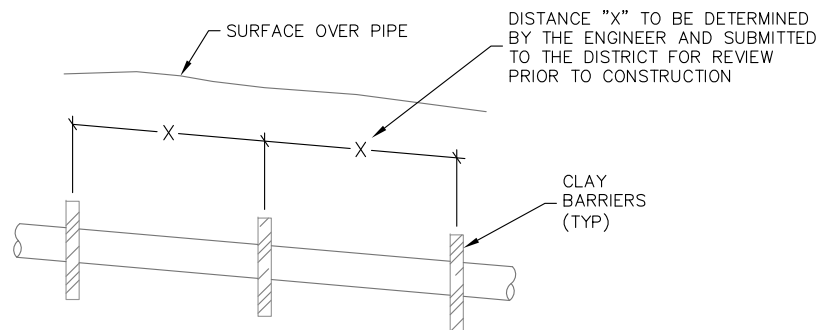
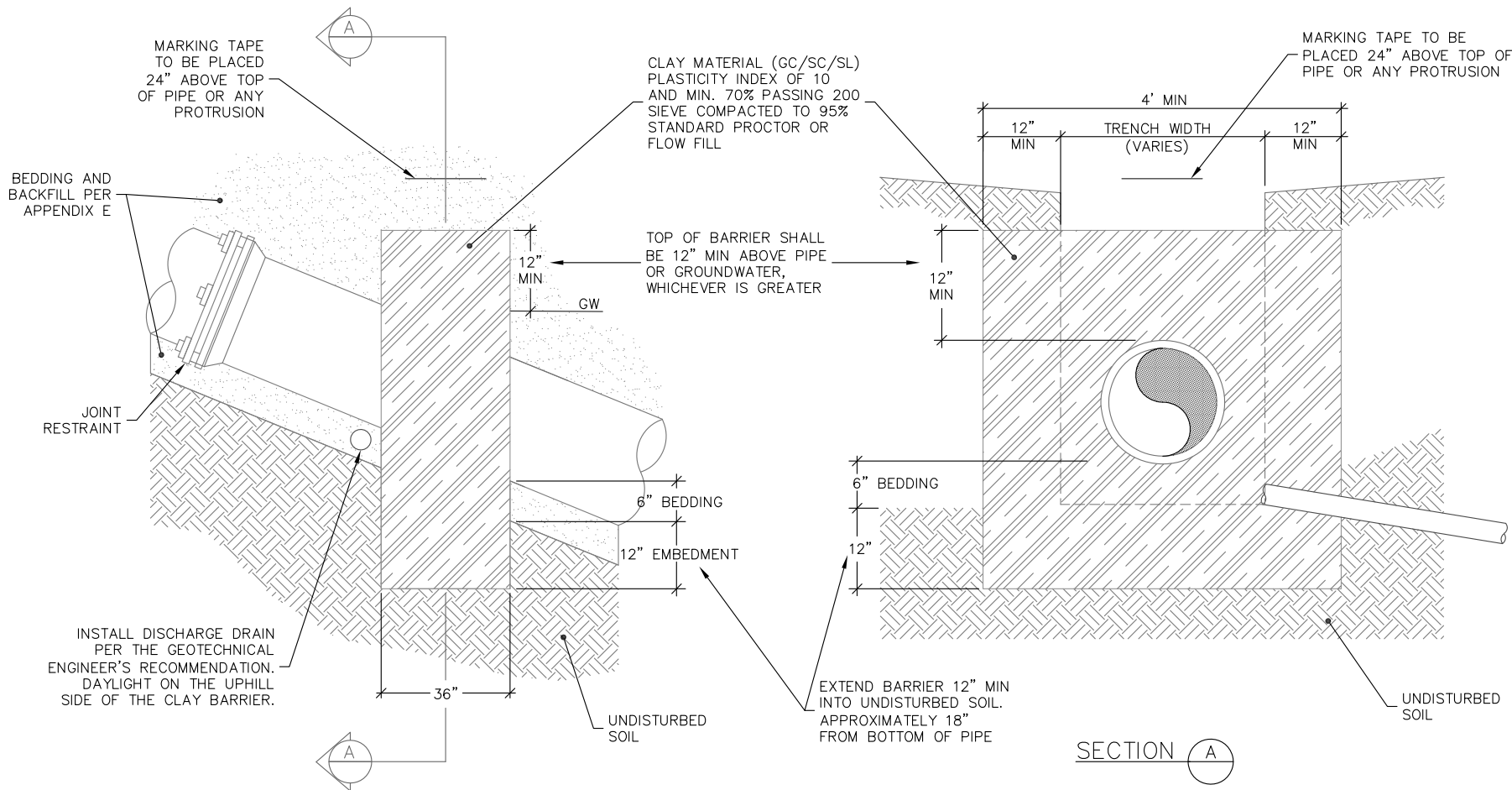


VALVE/TRACER WIRE – PLAN


GENERAL NOTES

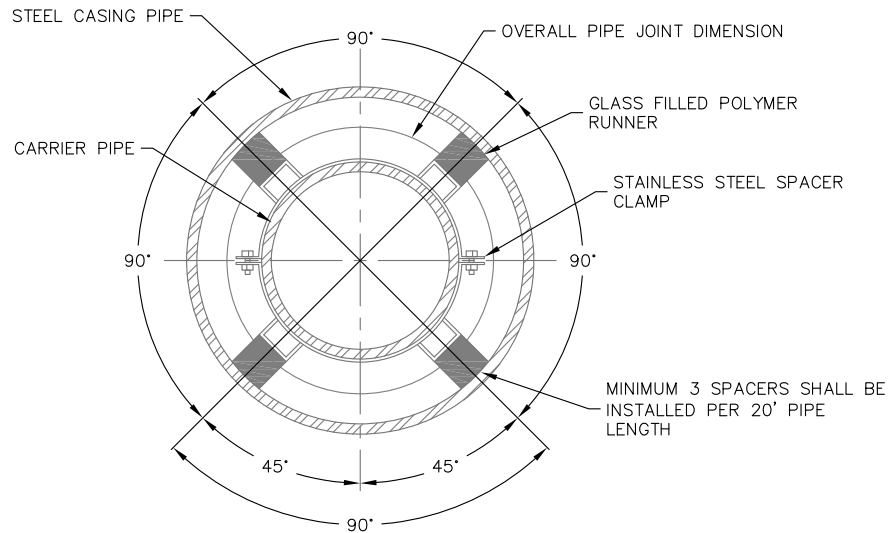
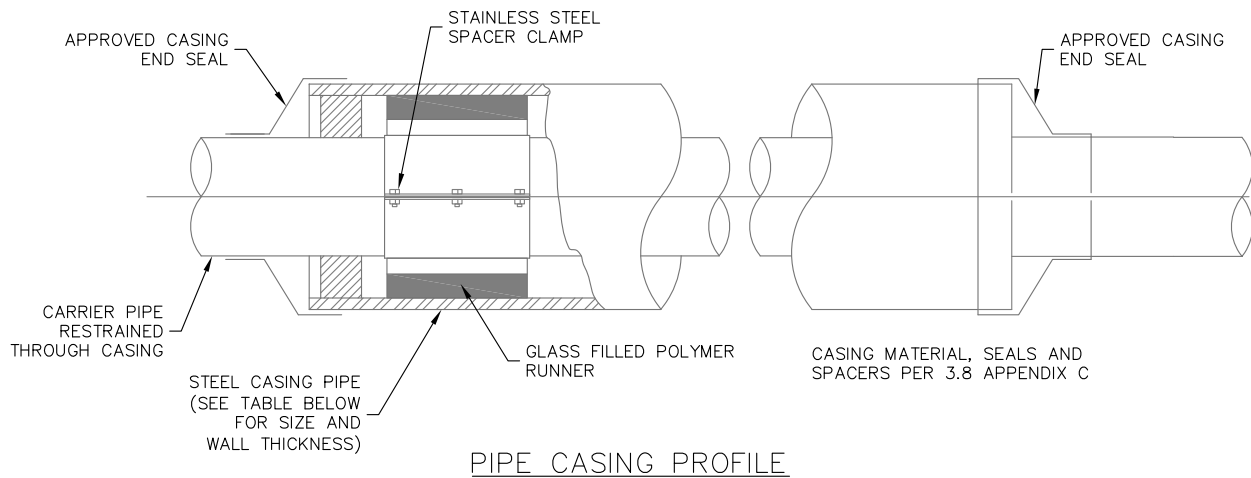
1. VALVE BOX IS TO BE INSTALLED PLUMB, LEVEL, AND CENTERED ON 2" NUT.
2. IF THE DISTANCE FROM THE TOP OF THE OPERATING NUT TO THE TOP OF THE VALVE COVER IS GREATER THAN 9', A CENTERING RING AND EXTENSION STEM IS REQUIRED. THE EXTENSION MUST BE SECURED TO THE VALVE OPERATING NUT.
3. TRACER WIRE MATERIALS AND INSTALLATION PER APPENDIX E

 <p>EAGLE RIVER WATER & SANITATION DISTRICT</p>	<p>846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG</p>
<p>GATE VALVE AND VALVE BOX ASSEMBLY</p>	
<p>DRAWN BY: JEC</p>	<p>DATE: 03/01/2017</p>
<p>SCALE: NONE</p>	<p>REV: 3/31/2023</p>
<p>C-09</p>	



ELEVATION

 <p>EAGLE RIVER WATER & SANITATION DISTRICT</p> <p>846 FOREST ROAD VAIL, CO 81657 (970) 476-7480</p> <p>WWW.ERWSD.ORG</p>	GROUNDWATER BARRIER	
	DRAWN BY: JEC	DATE: 03/01/2017
	SCALE: NONE	REV: N/A
	C-11	



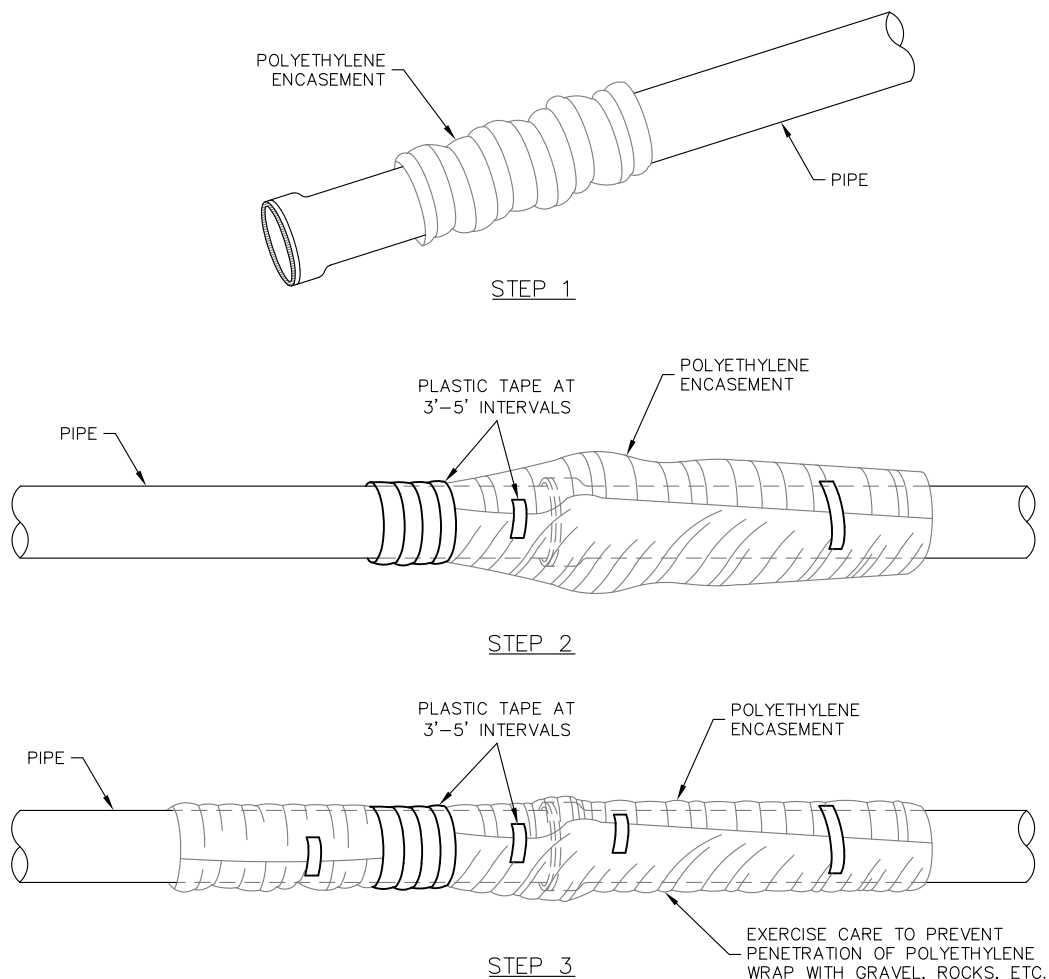
GENERAL NOTES

1. FOLLOW MANUFACTURER'S RECOMMENDATION, IF IN CONFLICT WITH ERWSD STANDARDS, USE MORE RESTRICTIVE SPECIFICATION.
2. CARRIER PIPE SHALL BE CENTERED AND ALL JOINTS RESTRAINED IN & THROUGH THE CASING PIPE.
3. WATER MAINS SHALL BE ENCASED SEPARATELY FROM OTHER UTILITIES.
4. ALL FASTENERS SHALL BE T-304 STAINLESS STEEL.
5. ALL CAD WELDS SHALL BE CONNECTED TO PIPE.
6. MAXIMUM DISTANCE BETWEEN SPACERS SHALL BE 6 FEET ON CENTER.

CARRIER PIPE NOMINAL Ø	CASING PIPE	
	MIN OD	MIN WALL THICKNESS
4"	12"	0.25"
6"	16"	0.3125"
8"	18"	0.3125"
12"	22"	0.375"
16"	28"	0.500"
20"	32"	0.500"

 EAGLE RIVER WATER & SANITATION DISTRICT	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
WATERLINE CASING DETAIL	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: N/A
C-12	

USE OF POLYETHYLENE WRAP FOR CORROSIVE SOILS



FIELD INSTALLATION – POLYETHYLENE WRAP


STEP 1 – PLACE POLYETHYLENE MATERIAL ON PIPE PRIOR TO LOWERING IT INTO PLACE.

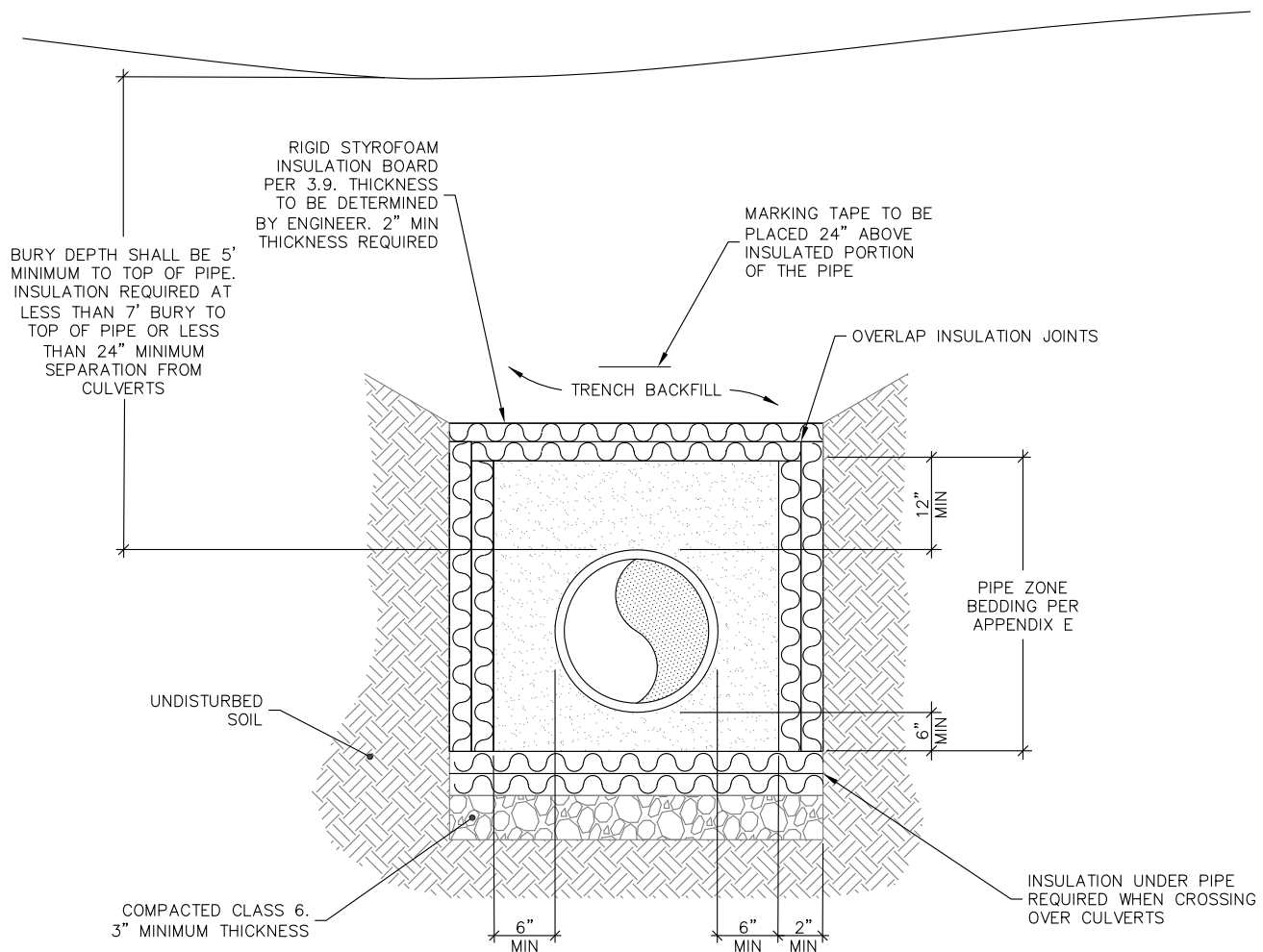
STEP 2 – PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH TAPE TO HOLD THE POLYETHYLENE ENCASEMENT IN PLACE.

STEP 3 – OVERLAP FIRST TUBE WITH ADJACENT TUBE AND SECURE WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE SHALL BE LOOSE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF PIPE AND TAPED IN PLACE.

GENERAL NOTES:

1. ALL DUCTILE IRON PIPE REQUIRES THE USE OF POLYETHYLENE WRAP UNLESS APPLICANT SUBMITS A SOILS TEST INDICATING THAT NO CORROSIVE SOILS ARE PRESENT.
2. POLYETHYLENE ENCASEMENT PER APPENDIX C 3.2.10.


 <p>EAGLE RIVER WATER & SANITATION DISTRICT</p>	<p>846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG</p>
<h2 style="margin: 0;">POLYETHYLENE WRAP</h2>	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: N/A
<h1 style="margin: 0;">C-13</h1>	



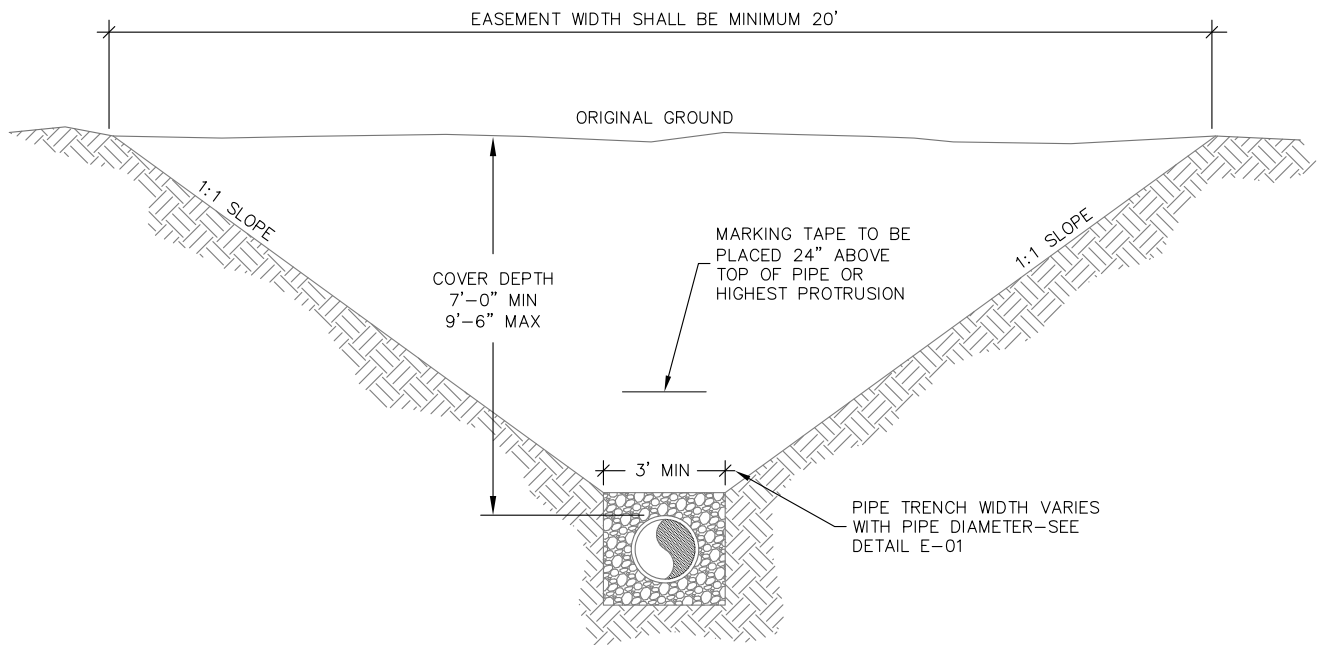
ELEVATION

GENERAL NOTES

1. CONDITION OF LESS THAN MINIMUM BURY DEPTH ALLOWED ONLY WITH WRITTEN APPROVAL FROM THE DISTRICT PRIOR TO CONSTRUCTION. INSULATION SHALL BE INSTALLED ON ALL PIPE THAT DOES NOT MEET MINIMUM BURY REQUIREMENTS.
2. SEE SEWER AND WATER PIPE BEDDING DETAIL AND APPENDIX E FOR BACKFILL MATERIAL AND COMPACTION SPECIFICATIONS.
3. INSULATION SHALL BE INSTALLED ON ALL PIPES THAT DO NOT HAVE A MINIMUM OF 7' OF EFFECTIVE COVER. EFFECTIVE COVER SHALL BE DEFINED AS SEPARATION FROM COLD AIR SOURCES, INCLUDING STORM SEWERS. 1" OF INSULATION BOARD MAY BE SUBSTITUTED FOR EACH 1' OF SOIL COVER (MIN. 2" INSULATION) REQUIRED TO MEET THE MINIMUM COVER REQUIREMENT.
4. INSULATION SPECIFICATIONS PER APPENDIX C 3.9.

 EAGLE RIVER WATER & SANITATION DISTRICT	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG
MINIMUM COVER AND CULVERT CROSSING INSULATION DETAIL	
DRAWN BY: JEC	DATE: 03/01/2017
SCALE: NONE	REV: N/A
C-14	

WATER MAIN COVER DEPTH	MINIMUM EASEMENT WIDTH REQUIRED
7'-0" TO 8'-6"	20'
8'-7" TO 9'-6"	25'



MINIMUM EASEMENT WIDTH

GENERAL NOTES

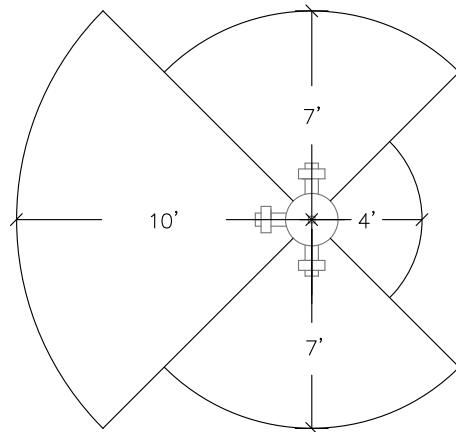
1. PIPE SHALL BE CENTERED IN EASEMENT.
2. CALCULATE EASEMENT WIDTH AS FOLLOWS:
 $W = \text{DEPTH TO TOP OF PIPE} \times 2 + 3 \text{ FEET}$
 (ROUND UP IN 5 FOOT INCREMENTS)

EXAMPLE:
 9 FOOT DEEP PIPE = $9 \times 2 + 3 = 21 \text{ FEET}$
 $W = 25 \text{ FOOT WIDE EASEMENT (ROUNDED UP)}$

	846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG	
	EASEMENT WIDTH DETAIL	
DRAWN BY: JEC	DATE: 03/01/2017	
SCALE: NONE	REV: N/A	
C-15		

HYDRANT CLEARANCE DIAGRAM

NO ABOVE GROUND OBSTRUCTIONS ALLOWED IN THESE AREAS



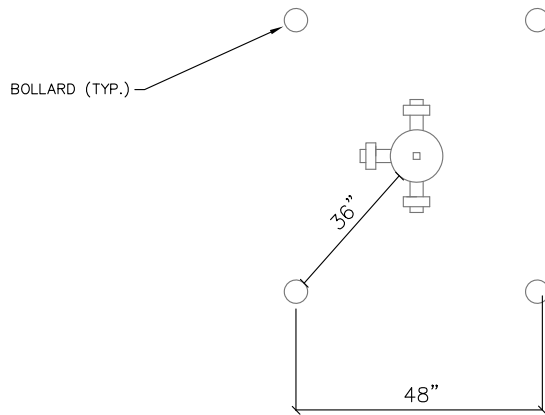
FRONT---10 FEET OF CLEARANCE

SIDES---7 FEET OF CLEARANCE

REAR---4 FEET OF CLEARANCE

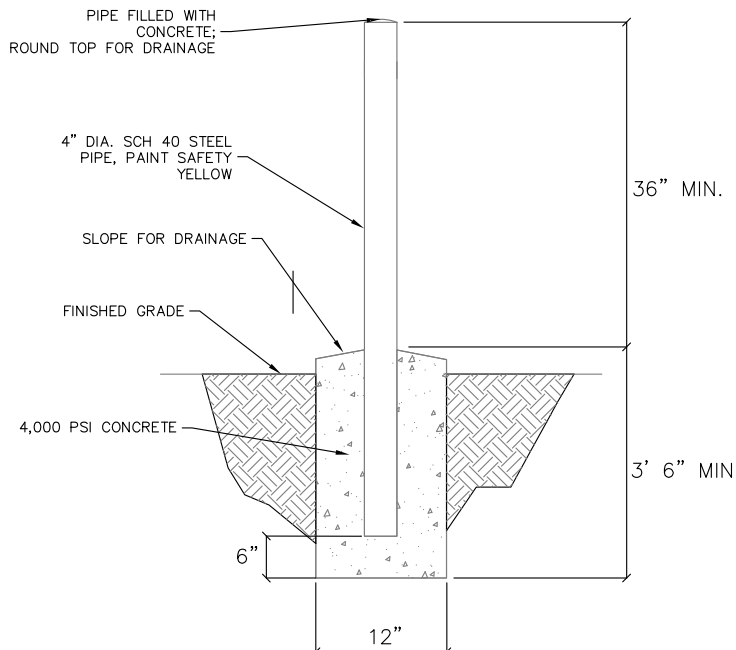
ABOVE---20 FEET OF CLEARANCE


HYDRANT BOLLARD DIAGRAM



BOLLARDS REQUIRED
WHEN LESS THAN 3'
OF HORIZONTAL
CLEARANCE EXISTS
BETWEEN HYDRANT
AND BACK OF
CURB/EDGE OF ROAD

BOLLARD DETAIL



		846 FOREST ROAD VAIL, CO 81657 (970) 476-7480 WWW.ERWSD.ORG	
		FIRE HYDRANT CLEARANCES AND BOLLARDS	
DRAWN BY:	JRS	DATE:	1/20/2020
SCALE:	NONE	REV:	N/A
C-16			