

DEL-CO WATER COMPANY CONSTRUCTION STANDARDS



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HISTORY OF CHANGES

Revision	Description
02 Feb 2005	Reissue Detail D-15 Drainage Tile Repair
17 Nov 2005	Added Details D-22 Flush Hydrant, D-23 Free Bore, & D-24 Tracer Wire
18 July 2007	Revised the coating systems for hydrants and post indicator valves
02 June 2009	Added Kennedy to list of approved gate valve and fire hydrant manufacturers. Added Griffin Pipe to list of approved ductile iron pipe manufacturers. Added Standard Details D-22, D-23, and D-24.
	Revised: General Notes for Water Line Construction, General Notes for Water Line Construction (4-inch Water Line and Smaller CAD Developments), General Notes for Water Line Construction for Water Lines Inside Delaware City Limits, & Del-Co Water Company Standard Easement Statement.
	Revised the Following Details: D-2 Hydrant Setting Type "A" D-3 Hydrant Setting Type "B" D-9 Horizontal Directional Drilling D-10 Master Meter Vault, Page 1, & 2 D-14 Rock Channel Protection
18 May 2015	Added the Following Details: D-19 Cul-de-sac Terminations in Delaware D-20 Silt Fence D-21 Straw Bale Barrier D-22 End of Line 2" Fire Hydrant Detail D-23 Free Bore D-24 Tracer Wire, Page 1, & 2 D-25 Master Pressure Reducing Valve Vault, Pages 1, 2, & 3 D-26 Drainage Ditch Crossing D-27 Check Valve Vault, Page 1, & 2 D-28 Fire Hydrant Lateral Lowering Detail D-29 Long Hydrant Lateral Tracer Wire Detail D-30 Storm Crossing Casing Pipe Detail D-31 Leak Meter Detail

HISTORY OF CHANGES

<u>Revision</u>	<u>Description</u>
17 Jan 2020	Revised: General Notes for Water Line Construction General Notes for Water Line Construction (4-inch Water Line and Smaller CAD Developments) General Notes for Water Line Construction for Water Lines Inside Delaware City Limits, & Del-Co Water Company Standard Easement Statement Added General Notes for the Construction of Off-Site Waterlines Removed the Following Details: D-7 Tap Setting D-8 Casing Spacer & End Seal Revised the Following Details: D-24 Tracer Wire Detail, Page 1 & 2 D-25 Master Pressure Reducing Valve Vault, Page 1, 2, & 3 D-11 Pressure Reducing Station Installation to D-11 Water Line Crossing Detail Added the Following Details: D-8 Casing Pipe – Road Crossing D-32 Casing Detail – Stream Crossing D-33 Tap Setting – Short Water Service D-34 Tap Setting – Long Water Service D-35 Water Line Relocation with Fittings Added GPS Coordinate Specifications Added Tracer Wire Specifications Revised Corporation and Curb Stop Valves to reflect manufacturer's changes to conform to no-lead requirements
16 Feb 2023	Section 2.03A – Added Dresser TPS as an approved manufacturer of tapping sleeves.
04 Apr 2023	Section 02731 / 2.01 / B. / d. – Added Mechanical Joint or Transition Accessory Pack T-bolts shall be corrosion resistant. Section 02731 / 2.01 / C. / b. – Added Mechanical Joint or Transition Accessory Pack T-bolts shall be corrosion resistant. Section 2.01 / B. / 4. / d. – Removed PVC fittings requirement.

<u>Revision</u>	<u>Description</u>
08 May 2024	Section 02731 / 2.02 / B. / f. – Added the EJ FlowMaster Resilient Wedge Gate Valve
	Section 02731 / 2.05 / B. / 7. – Added the EJ WaterMaster Fire Hydrant

<u>Revision</u>	<u>Description – General Notes</u>
03 January 2025	Section 2. / d. - Updated GPS requirements.
03 January 2025	Section 3. / c. - Updated specifications on ductile iron pipe.
03 January 2025	Section 3. / e. - Added corrosion resistant T-bolts to accessory packs.
03 January 2025	Section 3. / g. - Removed mention of butterfly valves. Only gates valves permitted.
03 January 2025	Section 6. – Added new section on flushing hydrants.
03 January 2025	Section 17. - Added new section on requiring EPA approval on all waterlines.

<u>Revision</u>	<u>Description – Specifications</u>
03 January 2025	Section 02731 / 1.02 / C. - Updated GPS requirements.
03 January 2025	Table of Contents - Updated the General Notes section.

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++ END OF SECTION ++

DEL-CO WATER COMPANY
GENERAL NOTES FOR WATER LINE CONSTRUCTION
(Updated January 2025)

1. General Notes as modified by Del-Co Water and shown on the approved Construction Drawings shall supersede the requirements of the *Del-Co Water Company Construction Standards Manual* wherever discrepancies occur.
2. Standard General Notes:
 - a. Waterline design, materials, and installation methods shall conform to applicable sections of Recommended Standards for Water Works (Ten States Standards), American Water Works Association (AWWA) Standards, and the *Del-Co Water Company Construction Standards Manual*. Contractor shall obtain a copy of the standards and have in their possession at all times during construction. Coordinate work with Del-Co Water (740) 548-7746.
 - b. Del-Co Water's signature on this plan signifies only concurrence with the general purpose and location of the proposed waterline improvements. All technical details remain the responsibility of the professional engineer who prepared and certified these plans. Del-Co Water Company takes no responsibility, financial or otherwise, regarding errors in this plan.
 - c. Correction of errors shall be to the applicable Del-Co Water Company standard, and the sole responsibility of the developer. All corrections, or revisions that affect Del-Co's Waterline plans, directly or indirectly shall be submitted to, and approved by Del-Co Water Company prior to revisions being issued.
 - d. The contractor is responsible for the submission of GPS coordinates to the Del-Co Water GIS Department at the completion of the waterline installation. Based on the circumstances of the project, points may be required to be uploaded daily. These coordinates shall include all horizontal and vertical (Northing, Easting, Elevation) survey coordinates. The survey coordinates shall be obtained at the completion of water main installation and shall include all valves, tees, fire hydrants, bends, plugs, reducers, tapped tees, curb boxes, air releases, 2" end of line fire hydrants, ends of casing pipe, and service saddles. GPS points and depths are also required on service line bores at each side of the road in addition to the saddle/water main and meter locations. GPS points should also be collected every 10 feet on services lines that are being deflected. Additional GPS coordinates are required on top of the exposed water main every 60' on straight runs, and at every bell (20') where the waterline is being deflected without fittings and where the trench can be safely entered. All GPS points shall be collected on the center or centerline of the feature. For hydrants, post indicator valves and 2" flush hydrants, the point correct location. To ensure accuracy, the GPS rod and level must be utilized for all points. All GPS points shall also have pertinent attributes collected, especially pipe material and pipe diameter where applicable. If the coordinates are unable to be collected on top of the water main or fitting, it shall be notated in the GPS attributes. If a coordinate is unable to be collected directly on top of the feature, an offset point must be collected by a capable survey grade unit.
 - i. GPS coordinates shall be referenced to the applicable county engineer's monuments and shall be based on the North American Datum of 1983 (NAD 83) with the NSRS2007 adjustment, with further reference made to the Ohio State Plane North Coordinate System, North Zone, with elevations based on NAVD 88 Datum. All coordinates (Northing, Easting, Elevation) shall be

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referenced to the nearest hundredth. All survey coordinates shall be accurate to within 0.6 foot or less horizontal and vertical.

- ii. The GPS coordinates shall be submitted to the Del-Co Water GIS Department in digital form, excluding Portable Document Format (PDF). Preferred file types include comma delimited text files and Microsoft Excel. The above-listed GPS coordinate information shall be submitted to the Del-Co Water GIS or Engineering Department as part of the as-built drawing submittal where applicable.
- iii. Contractors are required to supply (own or rent) and maintain their own GPS devices. Del-Co Water reserves the right to deny inadequate GPS devices that are unable to provide sufficient accuracy required for submission.
- e. As-Built drawings are required following the completion of construction. One set of drawings marked "As-Built" shall be submitted by the developer to Del-Co's Inspection Department for review and approval. Water mains cannot receive a Final Acceptance until as-built drawings have been approved. *Please note: taps may not be purchased nor installed until water lines have received a Final Acceptance*
- f. Water mains shall become the ownership of Del-Co Water upon final acceptance.
- g. Waterline construction plans are approved for a period of one year from the date of the approval letter or signed plans. If construction has not started within one year of the date of approval, plans shall be resubmitted to Del-Co Water Company for approval.

3. Waterline Construction:

- a. Waterlines shall be NSF 61 approved, and compliant with ASTM D2241 & Ohio EPA ENG-08-002 standards.
- b. Use the following type and class of pipe unless otherwise indicated on the drawings:
 - i. 2-inch water line pipe: Class 200 SDR 21 Yelomine PVC (restrained joint).
 - ii. 4-inch water line pipe: Class 200 SDR 21 PVC.
 - iii. 6-inch water line pipe: Class 200 SDR 21 PVC.
 - iv. 8-inch to 12-inch water line pipe: Class 160 SDR 26 PVC.
 - v. 16-inch and larger water line pipe: AWWA C151 Class 52 DIP.
 - vi. 4-inch pipe and larger used for fire service: AWWA C900 DR 18 (150 PSI) PVC.
 - vii. All sizes of Del-Co-owned waterlines used on master meter projects: Class 200 SDR 21 PVC.
- c. All sizes of Ductile Iron pipe shall be installed with V-Bio Enhanced Polyethylene Encasement and in accordance with Del-Co Water Subdivision Construction Standards Section 02731 Ductile Iron.
- d. All fittings shall be mechanical joint conforming to AWWA C153.
- e. Mechanical Joint or Transition Accessory Pack T-bolts shall be corrosion resistant.
- f. Crosses shall not be used without approval of Del-Co Water Company.
- g. All valves shall be mechanical joint conforming to AWWA with AISI 304 stainless steel external hardware and shall be Resilient-Seated Gate valves per AWWA C509. Use of butterfly valves is prohibited.

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- h. Provide heavy-duty valve boxes on all hot-taps and at valves located under gravel or pavement surfaces.
 - i. Top of valve box shall be flush with finished grade in paved areas, and 4 inches above finished grade in non-paved areas.
 - j. Maintain a minimum 10-foot horizontal and 1.5-foot vertical separation between waterlines and sanitary and storm sewers.
 - k. All other buried utilities shall maintain a minimum 5-foot horizontal separation, and 2-foot vertical separation from the centerline of waterlines as finally laid and constructed.
 - l. Provide concrete thrust blocking for all fittings, valves, anchor tees, and hydrants.
 - m. Bury waterlines a minimum depth of 48-inches to the top of pipe.
 - n. All engineered fill to be placed over or under Del-Co Water Lines shall be in place prior to the construction of the water lines.
 - o. Place a 5-foot steel fence post or 4"x4" wood post at valves and the ends of lines. Paint blue.
 - p. Tracer Wire:
 - i. Install Copperhead® or equal 12-gauge high strength 452lb break strength 30 mil HDPE jacket, copper-clad, steel reinforced tracer wire on all water mains and service lines installed by trenching methods.
 - ii. Install Copperhead® or equal 12-gauge extra high strength 1150lb break strength 45 mil HDPE jacket, copper-clad, steel reinforced tracer wire on all water mains and service lines installed by boring methods.
 - iii. Fasten wire to pipe in two places per pipe section. Extend tracer wire to ground surface at all valves and hydrants as shown in the Del-Co standard detail. Splice wires using Burndy Copper Split Bolt KS-15. Thoroughly wrap the connector and bare wires with 3M Temflex 2155 Rubber Splicing Tape, cover entire connection with Scotch Super 88 Heavy Duty Grade Electrical Tape.
 - iv. Connect all service line wires to main line wires using Burndy Copper Split Bolt KS-15. Thoroughly wrap the connector and bare wires with 3M Temflex 2155 Rubber Splicing Tape, cover entire connection with Scotch Super 88 Heavy Duty Grade Electrical Tape.
 - v. Contractor Shall Test the continuity of all wire using a third-party tester.
 - 1. Contractor shall contact Del-Co.'s Inspection Department a minimum of 24 hours prior to test.
 - 2. Tester shall send a signed report to Del-Co Water Inspection Department affirming all wire has continuity.
 - 3. Contractor shall repair all deficiencies.
4. Water Service Construction (between main line and meter pit):
- a. All water services shall be constructed and installed per AWWA C800.
 - b. For meters 1-inch and smaller, use 1-inch Class 200 SDR 7 iron pipe size (IPS) polyethylene pipe.
 - c. Connections to PVC pipe shall be made with approved tapping saddle and corporation stop per Del-Co Subdivision Construction Standards Manual.

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- d. Connections to DIP shall be by direct tap or saddle and approved corporation stop per Del-Co Subdivision Construction Standards Manual.
- e. Provide a curb stop with 1-inch female iron pipe threads on the customer side at the end of service lines. Locate at ROW, but a minimum of five feet from edge of sidewalk unless otherwise approved or directed by Del-Co Water.
- f. All service line valves 1½-inch and larger shall be mechanical joint gate valves, restrained with Duct-Lugs and galvanized all thread rod, or anchor tees where applicable.
- g. Minimum depth of cover shall be 48 inches.
- h. Place a 5-foot steel fence post or 4"x4" wood post at the ends of all service lines, paint blue.
- i. Contractor shall be responsible for providing special backfill material for all lines, including those installed by Del-Co Water Company, where required by the County or City Engineer.

5. Fire Hydrants:

- a. Fire hydrants shall conform to AWWA C502 for dry barrel hydrants.
- b. Main valve: 5.25-inch compression.
- c. Nozzles:
 - i. Threading: Conform to NFPA National Standard fire hose threads.
 - ii. 4.5-inch steamer, except in the following locations provide an integral storz connection; Harrington HIHS50 or equal: Berkshire, Berlin, Concord, Genoa, Kingston, Liberty, Orange, Porter, Trenton, and Scioto Townships; City of Powell; and the Villages of Sunbury and Galena.
 - iii. Two 2.5-inch hose connections.
- d. Inlet Connection: 6-inch mechanical joint.
- e. Operating Nut: 1.5-inch pentagon, turn counterclockwise to open.
- f. Placement of Hydrant: 2 feet from the back of curb or 8 feet from the edge of pavement on non-curbed streets
- g. Extensions and parts: Shall be manufactured by the original equipment manufacturer.
- h. Approved Manufacturers: Mueller Super Centurion 200, American Flow Control B-84-B, Clow Medallion, M&H Model 129M, AVK Nostalgic 2780, or Kennedy Guardian K81D.
- i. Painting: Repaint all hydrants after installation per Del-Co Subdivision Construction Standards Manual Section 02731, Part 2.06.
 - i. Liberty Township, Powell, and Village of Sunbury: Safety Red.
 - ii. Other Townships: Safety Yellow
 - iii. Fire hydrants located on private water lines shall be painted Industrial Green.

6. Flushing Hydrants

- a. All dead ends line shall have either an automatic flushing device or a 2" end of line fire hydrant in accordance with Section 02731 Flushing Hydrants.

7. Disinfect all water lines in accordance with AWWA C651 and Del-Co Water specifications.

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8. All pipe installation and pressure testing shall be in accordance with AWWA C600 for ductile iron pipe and C605 for plastic pipe, and Del-Co Specifications.
 - a. Contractor shall provide all equipment necessary to perform pressure test.
 - b. Schedule test between 8:00 AM and 2:00 PM weekdays. Notify Del-Co Water 24 hours prior to testing.
9. Obtain written approval of material and manufacturers list from Del-Co Water prior to beginning construction.
10. Provide casing pipe for all road crossings unless otherwise approved by Del-Co. Casing pipe shall be steel pipe with 0.375-inch wall thickness, or PVC C900 for waterlines 12-inch Dia. or less. Casings for waterlines larger than 12-inch Dia. may be AWWA C905.
11. Easements shall be provided to Del-Co Water before permission will be given to make new service line connections.
12. Connections to existing water lines will be made by Del-Co Water at the contractor's expense or performed by contractors who are approved for making connections. Notify all property owners, and Del-Co Water, in writing 48 hours before starting construction.
13. Contractor shall excavate to determine the location and depth of existing water lines wherever cover over the water lines is being reduced. If the final depth of the waterline will be below Del-Co Water standards, Contractor shall submit a relocation plan for approval by Del-Co Water, and relocate the water line at their expense.
14. Contractor shall be responsible for locating and protecting the water line prior to final acceptance by Del-Co Water, and repairing all damages from construction activity.
15. Do not fill new water lines until approved by Del-Co Water.
16. Booster pumps are not allowed on individual services.
17. All water mains, including those not designed to provide fire protection, shall be sized following an analysis based on flow demands, and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all designed flow conditions. Normal working pressure in the distribution system shall not be less than 35 psi.
18. Del-Co Water requires all waterlines intended for ownership and maintenance by Del-Co Water, regardless of pipe size, to secure EPA approval prior to the start of construction.

DEL-CO WATER COMPANY
SUPPLEMENT TO THE GENERAL NOTES FOR THE
CONSTRUCTION OF OFF-SITE WATERLINES
(Updated January 2025)

1. The General Notes for the Construction of Off-Site Waterlines listed below shall supplement the Del-Co Water General Notes for Waterline Construction listed above. These General Notes address the design and construction of waterlines to be installed by an owner/developer on property not owned by the owner/developer.
2. The Owner/Developer shall be responsible for the acquisition of all required easement(s) for all proposed offsite waterlines and appurtenances.
 - A. Del-Co will provide a standard easement form to be used by the owner/developer.
 - B. The owner/developer will provide all easement exhibits.
 - C. All original easements shall be returned to Del-Co Water. Del-Co Water will record all easements at the County Courthouse.
3. The Owner/Developer shall provide a video documenting the existing condition of all offsite properties impacted by the waterline construction prior to the start of construction.
 - A. Commentary identifying potential conflicts, surface features, etc. on the impacted property(s) shall be incorporated into the preconstruction video.
 - B. A copy of the preconstruction video shall be provided to Del-Co Water Co., Inc. prior to the start of construction.
4. Property owners shall be notified of the project during the design phase and/or a minimum of ninety (90) days prior to the start of construction.
 - A. Del-Co shall review and approve these construction notices.
 - B. Property owners shall be notified of the installation of all above ground appurtenances on their property including, but not limited to valves, hydrants, & etc.
5. Waterline Construction
 - A. Once waterline construction has begun on a specific property, the contractor shall remain on that property until all of the waterlines have been installed and yard restoration is completed.
 - B. All open excavations shall be properly secured at the end of each workday.
 - C. Contractor shall coordinate the excavation across existing drives with the property owner so as to not limit or prevent access to the property.
 - i. All existing concrete or asphalt driveway crossings shall be completed using directional drilling or other approved trenchless methods unless previously agreed upon in writing by the property owner.

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CONSTRUCTION OF OFF-SITE WATERLINES
(Updated January 2025)

- ii. Excavations that cross existing gravel driveways shall be backfilled per Del-Co Water Detail D-18 Gravel Roadway & Driveway Pavement Replacement
 - iii. All trees, shrubs, fences, landscape features, etc. shall be preserved and protected from damage due to the waterline construction unless agreed upon by the property owner prior to construction. Del-Co Water reserves the right to require the waterline to be installed using directional drilling methods with restrained joint pipe so as to protect these features.
 - D. All waterline backfill shall be compacted. Restoration shall be performed immediately following the completion of construction unless approved by Del-Co Water or the property owner.
6. Post Construction Conditions
- A. Properties not owned by the developer that are affected by the waterline construction shall be returned to “preconstruction” grades and conditions following the waterline installation.
 - B. Yard restoration shall commence immediately following the waterline installation.
 - C. All valve boxes, manual air release pits, etc. shall be set to the appropriate grade to minimize the impact to the properties not owned by the developer.
 - D. All marker posts, blow-offs and etc. shall be removed prior to yard restoration.

Del-Co Water Company Standard Easement Statement

The following statement must be added to all subdivision plats where Del-Co Water is providing water service:

A non-exclusive easement is hereby specifically granted unto Del-Co Water Company Inc., its successors and assigns, for the location of water lines, valves and appurtenances within the rights-of-way hereby dedicated and within areas designated hereon as "Utility Easement" or "Drainage Easement" that are located alongside the rights-of-way hereby dedicated. Also granted is the right of Del-Co Water Company Inc., to install, service, and maintain water meter crocks and appurtenances in said easement areas alongside said rights-of-way. The easement area shall be for the unobstructed use of Del-Co Water Company, Inc. Placement of fences, walls, pillars, trees, gardens, shrubberies, and other surface features is strictly prohibited.

The term *Utility Easement* or *Drainage Easement* must be called out on the plat drawing any place there is a Del-Co owned main line, except at locations where the main crosses Sanitary Easements. If the plat uses easement areas identified as "Del-Co Water Easement" make sure this term is added to the easement statement. Please make sure to use only these terms.

PART I GENERAL

1.01 SCOPE

- A. Work of this Section includes, but is not limited to:
 - 1. Soil Materials
 - 2. Select Fill Materials
 - 3. Site Grading
 - 4. Top Soil Removal
 - 5. Trenching
 - 6. Excavation
 - 7. Backfilling
 - 8. Compaction
 - 9. Protection

1.02 REGULATORY REQUIREMENTS

- A. Conform to all applicable state and local codes for work and disposal of debris.

1.03 JOB CONDITIONS

- A. Verify the location, grade and elevation of all utilities, service connections and other buried and surface features prior to working in the area.
- B. Locations shown on the Drawings shall be followed as closely as possible. Exact positions shall be subject to and adjusted to interferences with other work and utilities. Should major difficulties prevent the installation of any part of this portion of the Project, such conditions shall be brought to the attention of the Del-Co, who will determine final locations.

1.04 SUBMITTALS

- A. PRODUCT DATA
 - 1. Provide technical data for all materials provided demonstrating conformance with the requirements of this section and the approved drawings.
 - 2. Provide gradation curves from an independent laboratory for all select fill and other manufactured soil materials demonstrating compliance with the specifications.
- B. RECORD DRAWINGS
 - 1. Provide record of location of all encountered buried utilities remaining or rerouted. Include horizontal and vertical dimensions and elevations.

1.05 CODES AND STANDARDS

- A. ASTM D698 Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5.5-Pound Rammer and 12-inch Drop.
- B. ASTM D1556 Test Method for Density of Soil in Place by the Sand Cone Method.

- C. ASTM D2167 Test Method for Density of Soil and Unit Weight of Soil in Place by the Rubber Balloon Method.
- D. ASTM D2487 Classification of Soils for Engineering Purposes.
- E. ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
- F. State of Ohio, ODOT Construction and Material Specifications

PART II PRODUCTS

2.01 SOIL MATERIAL DEFINITIONS

- A. TOPSOIL
 - 1. Loose, friable loam material free of clay lumps, stones, weeds and roots.
 - 2. Conformance: ODOT Item No. 653.02
- B. SUITABLE EARTH FILL
 - 1. Naturally occurring on-site sand, clay or gravel free from trash, roots, debris, excessive moisture, objects larger than 4 inches or other deleterious materials.
 - 2. Material shall be approved by Del-Co for use.
- C. SUITABLE PIPE BEDDING
INITIAL BACKFILL MATERIAL
 - 1. Naturally occurring on-site sand or clay free from trash, roots, debris, organic material, excessive moisture, deleterious material, and objects larger than $\frac{3}{4}$ inch.
- D. SUITABLE SUBGRADE
 - 1. Natural, dense, undisturbed soil, free of organic material, excessive moisture, soft areas and roots larger than $\frac{1}{8}$ inch.
 - 2. Subgrade shall be approved by Del-Co prior to placing fill.
- E. SELECT FILL MATERIALS
 - 1. No. 2 Stone
 - a. Gravel, pit run, or crushed stone, washed, free of clay, shale, friable materials and debris.
 - b. Conformance: ODOT Item No. 703.01
 - c. Graded per ASTM C136/ASSHTO M43 Size 2 shown below:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
3-inch	100
2 $\frac{1}{2}$ -inch	90-100
2-inch	35-70
1 $\frac{1}{2}$ - inch	0-15
$\frac{3}{4}$ -inch	0 to 5

2. No. 57 Stone

- a. Gravel, pit run, or crushed stone, washed, free of clay, shale, friable materials and debris.
- b. Conformance: ODOT Item No. 703.01
- c. Graded per ASTM C136/AASHTO M43 Size 57 shown below:

U.S. Sieve Size	Percent Passing
1 ½-inch	100
1-inch	95-100
½-inch	25-60
No. 4	0-10
No. 8	0 to 5

3. No. 8 Stone

- a. Gravel, pit run, or crushed stone, washed, free of clay, shale, friable materials and debris.
- b. Conformance: ODOT Item No. 703.01
- c. Graded per ASTM C136/AASHTO M43 Size 8 shown below:

U.S. Sieve Size	Percent Passing
½ -inch	100
3/8-inch	85-100
No.4	10-30
No. 8	0-10
No. 18	0-5

4. Granular Trench Backfill

Aggregate Base

- a. State of Ohio, ODOT Item No. 304 Aggregate Base, grading shown below:

U.S. Sieve Size	Percent Passing
2-inch	100
1-inch	70-100
¾-inch	50-90
No. 4	30 to 60
No. 30	9-33
No. 200	0-13

5. Asphalt Concrete Base
- a. State of Ohio, ODOT Item 301, Asphalt Concrete Base, grading shown below:

U.S. Sieve Size	Percent Passing
2-inch	100
1-inch	75-100
½-inch	50-85
No. 4	25 to 60
No. 8	15-45
No. 16	10-35
No. 50	3-8
No. 200	1-7

6. Stabilized Crushed Aggregate
- a. State of Ohio, ODOT Item No. 411 Stabilized Crushed Aggregate, grading shown below:

U.S. Sieve Size	Percent Passing
1 ½-inch	100
¾-inch	80-100
3/8-inch	60-90
No. 4	30 to 90
No. 30	3-20

7. Controlled Density Fill (a.k.a Flowable Fill, K-Crete)
- a. State of Ohio, ODOT Item No. 613 Low Strength Mortar Backfill, Type 2, mix shown below:
- Cement ASTM 150: 100 LBS/CY
 Fine Aggregate: 2420 LBS/CY
 Water: 210-300 LBS/CY
 Air Entrainment: 5 %
- b. Other mix designs that meet the general requirements of the mix design may be submitted for approval by Del-Co and the roadway authority.

PART III EXECUTION

3.01 PROTECTION

A. GENERAL

1. Protection of Persons and Property
- a. Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by state or local agencies.
- b. Protect structures, utilities, sidewalks, pavements, and other properties from damages caused by settlement, vibrations, lateral movement, undermining, washout and other hazards created by excavation operations.
- c. Comply with the requirements of all agencies having traffic control authority.

- d. Protect trees and other plants that are to remain from damage.
- e. Restore damaged improvements, including drainage tile, according to the requirements of the Contract Documents.
- 2. Existing Utilities Protection
 - a. Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.
 - b. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Del-Co immediately. Cooperate with Del-Co and public or private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.
 - c. Do not interrupt existing utilities occupied and used by Del-Co or others, except when permitted. Provide temporary utility services as required by the utility.

3.02 EXCAVATION

A. GENERAL

- 1. Remove and properly dispose of all unsatisfactory or surplus materials encountered during construction activities.
- 2. Unauthorized excavation consists of removal of materials beyond the required subgrade elevation or side dimensions without the specific direction by Del-Co.
 - a. Backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by Del-Co.

B. TOPSOIL STRIPPING

- 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with the underlying subsoil or other objectionable material.
 - a. Remove heavy growths of grass from areas before stripping.
 - b. Stop topsoil stripping at a sufficient distance to prevent damage to the main root system where trees are indicated not to be disturbed.
- 2. Stockpile topsoil in storage piles within easements, in areas shown, or where otherwise directed by Del-Co. Construct storage piles to freely drain surface water.

C. STABILITY OF EXCAVATIONS

- 1. Slope the sides of excavations to comply with federal, state, and local codes, ordinances and authorities having jurisdiction. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated.
- 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

D. SHORING AND BRACING

- 1. Design and provide shoring and bracing to comply with local codes and authorities having jurisdiction.
- 2. Shoring and Bracing

- a. Provide materials for shoring and bracing, such as sheet piling, soldier beams, stringers, rakes, walers and cross-braces, etc., in good serviceable condition.
- b. Maintain shoring and bracing in excavations regardless of the period excavations will be open. Advance shoring and bracing as the excavation progresses.

E. DEWATERING

1. Prevent surface water and subsurface or groundwater from flowing into the excavations and flooding the Project work area and surrounding area.
2. Do not allow water to accumulate in excavations. Remove water from excavations to prevent softening of foundation bottoms, undercutting of footings, and compromising the stability of subgrades and foundations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey the water away from excavations.
3. Convey rainwater and water removed from excavations to collection or runoff areas. Provide and maintain temporary drainage ditches and other diversions outside the excavation limits for each structure. Do not use trench excavations for waterline pipes as temporary drainage ditches.
4. All excavation, construction and backfilling shall be performed under workable dry conditions. Prior to excavation below groundwater level, the dewatering system shall be installed and placed in operation in order to lower the water levels at least 3' below the bottom and side slopes of the excavation. In the event of layered soils, the hydrostatic head in pervious zones below the subgrade elevation shall be relieved in order to prevent uplift.

F. REMOVAL OF UNSATISFACTORY MATERIALS

1. Excavate unsatisfactory soil materials encountered that extend below the required elevation, to the additional depth as required by Del-Co.

G. COLD WEATHER PROTECTION

1. Protect excavation bottoms against freezing when the atmospheric temperature is less than 35°F.

H. EXISTING IMPROVEMENTS

1. Remove above-grade and below-grade improvements necessary to permit construction and other Work as indicated.
2. Remove abandoned underground piping or conduit interfering with construction.
3. Surface Structures: Remove structures, curbs, gutters, walls, fences, walks, drives, etc., where indicated.
 - a. Saw-cut pavements outside excavation area prior to removing.
 - b. Saw-cut concrete sidewalks and curbs to the nearest construction joint beyond the work area.

I. TOLERANCES

1. Conform to the excavation elevations and dimensions shown on the Drawings, within a tolerance of +0.1 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction required, and for inspection.

J. TRENCHING

1. Follow lines and grades as indicated in the Drawings. Exact locations and elevations shall be adjusted to interferences with other work or existing utilities.
2. Uncover existing utilities ahead of trenching new work.
3. Do not disturb existing utilities, culverts and drainage tiles. Repair any damage to the satisfaction of the property owner.
4. Over excavate where the subgrade is unstable and soft due to ground water, organic soil, or excessive moisture. Replace with Select Fill as directed by Del-Co.

K. STOCKPILING

1. Stockpile materials on the uphill side of trenches.
2. Separate differing soil materials to prevent mixing.
3. Protect stockpile site from erosion or deterioration of materials.

3.03 BACKFILLING AND COMPACTION

A. PIPE BEDDING AND INITIAL BACKFILL

1. Place and compact suitable pipe bedding and initial backfill material as shown in the embedment details.

B. TRENCH BACKFILL AND OTHER FILL

1. Fill designated to be compacted shall be placed in uniform lifts not exceeding 8 inches loose thickness.
2. Acceptable Materials:
 - a. Farmland, pastureland, lawns or landscaped areas: Suitable Earth Fill.
 - b. Gravel Roads and Driveways: Aggregate Base.
 - c. Sidewalks: Aggregate Base.
 - d. Within designated vicinity of public roads as determined by the roadway authority: Aggregate Base.
 - e. Under bituminous or concrete road pavements: Controlled Density Fill, or as required by the roadway authority.

C. DENSITY REQUIREMENTS

1. Conformance: Standard Proctor Moisture-Density procedure per ASTM D698.

Location	Density Requirements
Under tilled farmland, pasture land and unimproved vacant land.	Mound fill over trench and allow for natural settlement.
Under landscaped areas, lawns or other garden areas.	90 % of Maximum Density.
Under footings or other structures	100% of Maximum Density.
Within the designated vicinity of roads.	Per roadway authority regulations. 95% of Maximum Density minimum.

D. GRADING AND RESTORATION

1. Uniformly grade all areas disturbed by construction activities. Smooth finish surfaces with uniform levels or slopes and match existing ground elevation adjacent to work area.
2. Remove surface rocks and other clay lumps.
3. Provide protection from erosion and traffic.

3.04 FINE GRADING

A. GENERAL

1. Fine grade ground surface to reestablish existing or design contours and drainage patterns.
2. Remove stones using a "rock hound" or other mechanical rock-gathering device.
3. At completion of work, site shall be free of debris, soil windrows, rocks, and brush piles.

3.05 BACKFILL AND COMPACTION SCHEDULE

A. GENERAL

1. Provide the method of backfill and compaction for each segment of the waterline according to the Type as shown on the Contract Drawings or defined below. Delineate changes in Types at property lines or with changing surface conditions. Comply with all requirements of the Contract Documents for placement of fill and compaction.

B. TYPE I – COMPACTED SUITABLE EARTH FILL

1. Generally, provide in lawn or landscaped areas, in the public right-of-way, or where called for in the Drawings.
2. Replace suitable earth fill in uniform layers.
3. Mechanically compact each soil layer as it is returned to the trench.
4. Add water to each layer as required to achieve the required level of compaction.
5. Fine-grade work area to match existing ground elevations. Reshape ditches, swales, and other ground features as required to reestablish pre-existing drainage conditions.
6. Remove rocks over disturbed area using a "rock hound" or other mechanical rock-gathering device.
7. At the completion of work, the site shall resemble preexisting conditions as closely as possible, free of debris, soil windrows, rocks, and brush piles.

D. TYPE II – SUITABLE EARTH BACKFILL (NATURAL SETTLEMENT)

1. Generally, provide in tilled farmland, pastures, and vacant land or where called for in the Drawings.
2. Replace Suitable Earth Fill to the trench. Mound excess soil over trench in a neat, single row.
3. Allow for time and sufficient precipitation to provide natural settling of backfill.

4. Upon completion of natural settling, fine grade work area to match existing ground elevations. Reshape ditches, swales and other ground features as required to reestablish pre-existing drainage conditions. Spread excess soil as required to establish finished grade.
5. Remove rocks over the disturbed area using a "rock hound" or other mechanical rock-gathering device.
6. At completion of work, the site shall resemble preexisting conditions as closely as possible, free of debris, soil windrows, rocks, and brush piles.

C. TYPE III – COMPACTED GRANULAR TRENCH BACKFILL

1. Generally, provide under gravel pavements, bituminous or concrete private driveways and parking lots, where called for in the Drawings, and in the public right-of-way where the waterline is within the designated vicinity of the roadway as determined by the roadway authority.
2. Backfill trench with Granular Trench Backfill material in uniform layers.
3. Mechanically compact each soil layer as it is returned to the trench.
4. Add water to each layer as required to achieve the required level of compaction.
5. Replace top six inches of trench with top soil.
6. Fine-grade work area to match existing ground elevations. Reshape ditches, swales, and other ground features as required to reestablish pre-existing or design drainage conditions.
7. Remove rocks over disturbed area using a "rock hound" or other mechanical rock-gathering device.
8. At the completion of work, the site shall resemble preexisting conditions as closely as possible, free of debris, soil windrows, rocks, and brush piles.

D. TYPE IV – CONTROLLED DENSITY FILL (CDF)

1. Generally, provide under all state, county, or township public roads having a bituminous or concrete pavement section, and where indicated on the plans or directed by Del-Co.
2. Backfill trench with CDF to subgrade elevation.
3. Do not apply pavement materials until fill has had sufficient time to set up.
4. Provide steel plates to maintain traffic as required until final pavement section is placed.

++ END OF SECTION ++

PART I GENERAL

1.01 SCOPE

- A. Work of this Section includes, but is not limited to:
 - 1. Furnish and install casing pipe to the limits described on the design drawings by the jacking and boring method to permit the installation of the carrier pipe.
 - 2. Furnish and install carrier pipe.
 - 3. Excavation of jacking and receiving pits, including all shoring, bracing, jacking shields, backstops and other incidentals as needed for the installation.
 - 4. Injecting grout around casing pipe as required.
 - 5. Temporary plugs, bulkheads, and structures.
 - 6. Backfill and compaction of boring and receiving pits.

1.02 REGULATORY REQUIREMENTS

- A. Perform tunneling work in compliance with applicable requirements of governing authorities having jurisdiction and obtain all permits as required.
- B. Conform to all local, state and federal codes for work and disposal of debris.
- C. Maintain traffic control devices in conformance with traffic control plan and authorities having jurisdiction.

1.03 JOB CONDITIONS

- A. General
 - 1. Where work under this item involves jacking and boring under roadways and/or railways, all operations of the Contractor and his agents shall be subordinate to the free and unobstructed use of the roadway and/or railways without delay or danger to life, equipment, or property.
- B. Site Information
 - 1. Locate and protect existing utilities in work area.
 - 2. All excavations shall be shored and braced as required to prevent subsurface subsidence.
 - 3. Access to jacking operations and dewatering of excavations shall be maintained at all times.
 - 4. Closely monitor and detect vertical and horizontal displacement of existing roadways, railways, grades, and utilities.
- C. Protection
 - 1. Guardrails, fences, signs, lights, barricades, barrels, and all other protective items necessary shall be provided in accordance with the requirements of all applicable permits, laws, regulations, and ordinances, and as necessary to prevent damage or injury to private or public property to workers and the general public.
 - 2. Adequately support and protect structures, utilities, pavements and facilities that are encountered in, or maybe affected by, the work from damage caused by settlement, lateral movement, undermining, washout and other hazards created by tunneling or jacking and boring operations.

D. Inspection Costs and Fees

1. Contractor shall be responsible for the payment of all costs that may result due to the roadway or railway authority's requirements, of whatever nature, including the furnishing of watchmen and supervision by its forces.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Provide steel casing pipe and accessories by a single manufacturer specializing in the production of this work and complying with all applicable standards of the American Association of State Highway and Transportation Officials and the American Railway Engineering Association.

B. Installer's Qualifications

1. Contractor performing tunneling work shall have at least five years experience in performing other projects of comparable size and complexity.
2. Welds shall be made by welders who have been previously qualified by tests as prescribed by the Structural Welding Society to perform the type of work required. Installer shall show proof of certifications upon request by the Owner.

C. Design Criteria

1. Contractor shall be wholly responsible for designing, installing, and operating the boring, jacking, or tunneling system that the Contractor selects as necessary to satisfactorily accomplish all operations and the intent of this specification.
2. Casing pipe standards as specified shall be considered a minimum. The steel casing pipe installed by the Contractor shall provide the strength and wall thickness commensurate with the pipe diameter, depth of cover, and jacking thrust; and shall have adequate buckling resistance during installation.

1.05 SUBMITTALS

A. PRODUCT DATA

1. Provide technical data for all materials provided demonstrating conformance with the requirements of this section and the Contract Drawings.
2. Steel Casing Pipe
3. Carrier Pipe
4. Casing Spacers
5. End Seals
6. Grout

B. RECORD DRAWINGS

1. Provide record of location of all encountered buried utilities remaining or rerouted. Include horizontal and vertical dimensions and elevations.
2. Provide record drawing of bore hole as finally constructed including size and horizontal and vertical dimensions and elevations.

C. METHODS

1. Method of installation and Contractor's experience in tunneling.
2. Drawings and details showing the casing pipe proposed. Show location of grout holes and pertinent design criteria.

3. Details of access to jacking pit, sheeting and bracing locations.
4. Description of jacking and boring method; procedure, equipment, manpower, and schedule.
5. Grouting system.

1.06 CODES AND STANDARDS

- A. Reference Standards:
1. AASHTO – American Association of State Highway and Transportation Officials Interim Specification for Steel Tunnel Plates.
 2. AREA - American Railway Engineering Association “Jacking Culvert Pipe through Fills”, and “Specification for Pipelines Conveying Non-Flammable Substances”.
 3. ASTM – American Standards for the Testing of Materials.

PART II PRODUCTS

2.01 MATERIALS

- A. Steel Casing Pipe
1. Comply with ASTM A53, Grade B.
 2. Minimum Yield Strength: 35,000 PSI
 3. Minimum Tensile Strength: 60,000 PSI
 4. Wall Thickness: 0.375 inch minimum.
 5. Manufacturing Process: Seamless or straight seam weld with no more than one longitudinal weld.
 6. Ends: Plain end with mill bevel for field but weld.
 7. Grout holes: Provide 1-1/2 or 2-inch holes drilled 3-feet on center alternating 30 degrees with the vertical plane. Holes shall be tapped and plugged with interior flush-mounted plugs to facilitate boring operation and installation of carrier pipe.
- B. Carrier Pipe
1. Refer to Drawings for type of pipe required and Section 02730, Water Distribution Lines, for material requirements.
- C. Casing Spacers
1. Casing spacers are required on 6-inch diameter and larger pipe.
 1. Casing spacers shall be designed to separate carrier pipe bell from being in contact with casing pipe.
 2. Composite Type:
 - a. Band: Stainless steel with EPDM elastomeric liner. Shall not slide on carrier pipe.
 - b. Runners: Glass reinforced polyester.
 - c. Runner Width: 4 inches minimum.
 - d. Manufacturer:
 - 1) Advance Products Systems, Inc.
 - 2) Pipeline Seal & Insulator, Inc.
 - 3) Or equal.
- D. End Seals
1. Provide end seals on each end of casing.

2. Acceptable types:
 - a. Pull-on or Wrap-around elastomer with stainless steel bands.
 - b. Manufacturer:
 - 1) Pipeline Seal & Insulator, Inc.
 - 2) Advance Products Systems, Inc. Model AC or AW
 - 3) Or equal
- E. Mixes
 1. Grout: Use one part Type I cement to approximately three parts sand to obtain 3,000 PSI minimum compressive strength.

PART III EXECUTION

3.01 GENERAL

- A. Installation of the crossings shall be by jacking and boring and shall conform in all respect to the requirements contained herein and other applicable standards.
- B. Lines and Grades: Contractor is responsible for establishing and maintaining proper line and grade.
 1. Check as required to assure conformance with line and grade shown on the Drawings.
 2. Work required because of Contractor's failure to maintain the proper line and grade shall be performed by the Contractor at no additional cost to the Owner.
 3. Tolerances:
 - a. Vertical: 0.20 feet $\pm$
 - b. Horizontal: 1.00 feet $\pm$

3.02 INSTALLATION

- A. General
 1. Tunneling method shall be by jacking and boring a steel casing pipe by hand or mechanical excavation. Method to be used shall be the option of the Contractor.
 2. Adequate methods of dewatering shall be provided to produce satisfactory and safe working conditions.
 3. Stabilize soils at the excavation face using chemical grout or other approved means where necessary to advance the excavation without loss of ground.
 4. Provide bentonite slurry or other lubricant as necessary to facilitate jacking operation.
 5. Continuously monitor roadway and railroad elevation above bore for vertical displacement. Notify authority immediately if movement is observed.
 6. Excavation pits shall be adequately sheeted, shored and braced to protect the Work, all persons, and adjacent property.
 7. Continuously weld joints around circumference of pipe.
- B. Installing Steel Casing Pipe by Jacking:
 1. Install in accordance with State of Ohio ODOT requirements and the American Railroad Engineering Association specifications and local authority requirements.

2. Design bracing and backstops and use jacks of sufficient rating such that jacking can be accomplished in a continuous manner until the leading edge of the pipe reaches the final positions shown on the Drawings.
- C. Installing Steel Casing Pipe by Boring:
1. The boring method shall consist of pushing the pipe through the earth with a boring auger rotating inside the pipe to remove the soil.
 2. Provide suitable mechanical arrangement at the leading end of the casing pipe to prevent the auger and cutting head from leading the pipe so there will be no unsupported excavation ahead of the pipe.
 3. The equipment and mechanical arrangements or devices used to bore and remove earth shall be removable from within the casing pipe in the event an obstruction is encountered.
 4. Do not use water or other liquids to facilitate casing emplacement or spoil removal.
- D. Grouting:
1. Cement grout shall be pumped around the casing pipe if there is evidence voids have formed, subsidence or settlement is observed, or if the right-of-way authority requires it.
 2. Start at the lowest middle hole of each section to be grouted, grout holes above to remain open, and proceed upward progressively and, if possible, simultaneously on both sides of the casing or tunnel until all voids are completely filled with grout.
 3. Provide additional grouting holes in addition to those specified to ensure filling of all voids.
 4. At any given location, grouting pressures shall not exceed one-half (1/2) PSI for each foot of overburden in earth.
 5. Grouting shall be performed as near to the end of the tunnel as practicable. Provide grout stops near the ends of the tunnel to permit grouting near the ends.
 6. Coordinate all grouting with roadway or railway authority representative.
- E. Installing Carrier Pipe
1. Install and pressure test carrier pipe after completing installation of casing pipe.
 2. Refer to the Drawings for maximum carrier pipe spacer distance.
 3. Care shall be taken to prevent undue stress on pipe joints during installation.
 4. Repair, replace, or take whatever action is required to correct all disturbed joints at no additional cost to the Owner.
- F. Obstructions: If an obstruction is encountered during installation stopping the forward action of the casing pipe, and it becomes evident that it is impossible to advance the pipe, the Contractor shall remove the obstruction at the leading end of the casing pipe. Blasting is not permitted.
- G. Dispose of by-products of operations in accordance with all applicable codes, regulations, ordinances, laws, etc. By-products shall be hauled off-site to final disposal.

++ END OF SECTION ++

PART 1 GENERAL

1.01 SCOPE

- A. Work of this Section includes, but is not limited to:
 - 1. Horizontal directional drilling.
 - 2. Pipe installation in bored hole.
 - 3. Excavation of receiving pit.

1.02 REGULATORY REQUIREMENTS

- A. Perform directional drilling work in compliance with applicable requirements of governing authorities having jurisdiction and obtain all permits as required.
- B. Conform to all local, state and federal codes for work and disposal of debris.
- C. Maintain traffic control devices in conformance with traffic control plan and authorities having jurisdiction.

1.03 JOB CONDITIONS

- A. General
 - 1. Where work under this item involves directional drilling under roadways and/or railways, all operations of the Contractor and his agents shall be subordinate to the free and unobstructed use of the roadway and/or railways without delay or danger to life, equipment, or property.
- B. Site Information
 - 1. Locate and protect existing utilities in work area.
 - 2. All excavations shall be shored and braced as required to prevent subsurface subsidence.
 - 3. Access to drilling operations and dewatering of excavations shall be maintained at all times.
 - 4. Closely monitor and detect vertical and horizontal displacement of existing roadways, railways, grades, and utilities.
 - 5. Closely monitor and detect drilling fluid surface seepage.
- C. Protection
 - 1. Guardrails, fences, signs, lights, barricades, barrels, and all other protective items necessary shall be provided in accordance with the requirements of all applicable permits, laws, regulations, and ordinances, and as necessary to prevent damage or injury to private or public property to workers and the general public.
 - 2. Adequately support and protect structures, utilities, pavements and facilities that are encountered in, or maybe affected by, the work from damage caused by settlement, lateral movement, undermining, seepage, washout and other hazards created by the directional drilling operations.

D. Inspection Costs and Fees

1. Contractor shall be responsible for the payment of all costs that may result due to the roadway or railway authority's requirements, of whatever nature, including the furnishing of watchmen and supervision by its forces.

1.04 SUBMITTALS

A. PRODUCT DATA

1. Provide technical data in accordance with Section 01300, Submittals demonstrating all materials conform to the requirements of this section and the Contract Drawings.
2. Pipe.
3. Special adaptors and connections.

A. RECORD DRAWINGS

1. Provide record of location of all encountered buried utilities remaining or rerouted. Include horizontal and vertical dimensions and elevations.
2. Provide record drawing of bore hole as finally constructed including size and horizontal and vertical dimensions and elevations.

1.05 CODES AND STANDARDS

A. REFERENCE STANDARDS

1. ASTM – American Standards for the Testing of Materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Polyethylene Pipe: Refer to Section 02731, Water Distribution Lines.
- B. Certa-Lok
- C. Yelomine

PART 3 EXECUTION

3.01 PROTECTION

A. GENERAL

1. Protection of Persons and Property
 - a. Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by state or local agencies.
 - b. Protect structures, utilities, sidewalks, pavements, and other properties from damages caused by settlement, vibrations, lateral movement, undermining, washout and other hazards created by excavation operations.
 - c. Comply with the requirements of all agencies having traffic control authority.
 - d. Protect trees and other plants from damage that are to not to be disturbed.

- e. Restore damaged improvements including drainage tile to their original condition, acceptable to parties having jurisdictional ownership.
- 2. Existing Utilities Protection
 - a. Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.
 - b. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Owner immediately. Cooperate with the Owner and public or private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.
 - c. Do not interrupt existing utilities occupied and used by the Owner or others, except when permitted in writing, and then only after acceptable temporary utility services have been provided.

3.02 PROCEDURE

A. GENERAL

- 1. Methods and procedures shall conform to the requirements and recommendations of ASTM F1962, Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstructions, Including River Crossings and referenced standards.

B. EQUIPMENT

- 1. Drilling equipment shall be capable of providing the thrust, pullback and reaming operations. Properly secure equipment to ground for operation.
- 2. Crews shall be trained by the drilling equipment manufacturer and have the proper field experience.
- 3. Provide a breakaway link designed to prevent the pullback force from exceeding the strength of the pipe as recommended by the pipe manufacturer.
- 4. Provide a swivel between the reamer and the pipe designed to prevent torsional loads on the pipe during pullback.

C. BORING PROCEDURES

- 1. Boring shall proceed by creating a pilot drilled hole guided by a drill head capable of being steered in the direction desired.
- 2. A tracking system shall allow the location and depth of the bore head by a manually operated overhead receiver. Document the locations and depth of the drill head at minimum 20-foot intervals and at all obstacles or other changes in soil material that may alter the direction of the drill head.
- 3. Jet fluid, mechanical cutting, or a combination of both shall be utilized in the boring operation.
- 4. Pullback head shall prevent soil, drilling mud or other material from entering the pipe.
- 5. Multiple passes of reaming and pullback may be used to gradually enlarge the size of the borehole to permit the installation of the pipe.
- 6. Drill the borehole to the size required to permit installation of the pipe.
- 7. Do not exceed maximum pipe deflection as recommended by the pipe manufacturer.

D. DRILLING FLUID

1. Drilling fluid shall be utilized to stabilize the borehole, remove cuttings, cool the drill head and provide lubricant for the drill string.
2. Drilling fluid shall consist of bentonite or polymer additives and shall be considered as non-hazardous by all federal, state and local regulations.
3. All excess drilling fluid shall be promptly removed using vacuum truck equipment and properly disposed of off-site.
4. No drilling fluid shall be allowed to discharge into a ditch or waterway.

++ END OF SECTION ++

PART I GENERAL

1.01 SCOPE

- A. Work of this Section includes, but is not limited to:
 - 1. Pipe, fittings and adaptors
 - 2. Buried valves
 - 3. Hydrants
 - 4. Service lines and appurtenances
 - 5. Installation procedures
 - 6. Testing
 - 7. Disinfection

1.02 SUBMITTALS

- A. PRODUCT DATA
 - 1. Provide technical data for all materials supplied demonstrating conformance with the requirements of this section and the General Notes.
 - 2. Provide manufacturer's data showing weights, dimensions and installation recommendations.
 - 3. Indicate specific areas of the project products will be used.
- B. SURVEY CUT SHEETS
 - 1. Provide waterline survey cut sheets showing locations of fittings, valves, reducers and all other waterline appurtenances.
- C. GPS COORDINATES
 - 1. GPS coordinates shall be provided to Del-Co Water at the completion of the waterline installation. These coordinates shall include all materials, equipment and labor necessary to obtain horizontal and vertical (northing, easting and elevation) survey coordinates for the water main improvements. The survey coordinates shall be collected at the completion of the water main installation and shall include all valves, tees, fire hydrants, bends, plugs, reducers, tapped tees, curb stops, air release valves, 2" end of line fire hydrants, ends of casing pipe, service saddles and corporations. Additional GPS coordinates are required on the water main every 200' where no fittings or service saddles are to be installed.
 - a. GPS coordinates shall be referenced to the applicable County Engineer's Monuments and shall be based on the North American Datum of 1983 (NAD 83) with the NSRS2007 adjustment, with further reference made to the Ohio State Plane North Coordinate System, North Zone, with elevations based on NAVD 88 datum. All coordinates (Northing, Easting and Elevation) shall be reported to the nearest hundredth. All survey coordinates shall be accurate to within 0.6 foot or less horizontal and vertical.
 - b. The GPS coordinates shall be submitted to the Del-Co Water Engineering Department in digital spreadsheet form and shall include the applicable item, station, northing, easting and elevation coordinates. The above listed GPS coordinate information shall be submitted to the Del-Co Water Engineering Department as part of the Record Drawing submittal.

D. RECORD DRAWINGS

1. Contractor shall maintain a set of record drawings as construction progresses to mark changes and deviations from the design. Drawings shall be made available to the Del-Co inspector upon request.
2. Submit one full sized set of the Record Drawings to Del-Co.
3. Record Drawings shall be clean, neat and professionally drafted.
4. Record Drawings must be received before final acceptance of waterline will be issued by Del-Co Water.

1.03 HANDLING, DELIVERY AND STORAGE

A. General

1. Handling, delivery, and storage shall be in accordance with the manufacturer's recommendations.
2. In no case shall the pipe or accessories be dumped, dropped, or thrown.
3. Interiors of piping shall be completely free of dirt and foreign matter.

1.04 JOB CONDITIONS

- A. Verify the location, grade and elevation of all utilities, service connections and other buried features prior to working in the area.
- B. Locations shown on the Drawings shall be followed as closely as possible. Exact positions shall be subject to and adjusted to interferences with other work and utilities. Should conditions prevent the construction of the waterline as shown on the approved Construction Drawings, such conditions shall be brought to the attention of Del-Co Water, who will determine final locations.
- C. The General Notes as shown on the Construction Drawings approved by Del-Co Water shall supercede the requirements of this section whenever a conflict may occur.

1.05 JOB MEETINGS

A. PRECONSTRUCTION CONFERENCE

1. The contractor shall arrange for a preconstruction conference prior to beginning waterline work. This meeting may be held in conjunction with other preconstruction meetings for the same project.
2. Notify Del-Co Water at least 24 hours in advance of the meeting.

1.06 CODES AND STANDARDS

A. REFERENCE STANDARDS

1. AWWA – American Water Works Association
2. ASTM – American Society for the Testing of Materials
3. NSF – National Sanitation Foundation
4. NFPA – National Fire Protection Association
5. ANSI – American National Standards Institute

- B. Perform work in compliance with all local codes and agencies having jurisdictional authority.

1.07 WARRANTEES

- A. The contractor shall warrant all materials and workmanship to Del-Co Water for a period of two years after final acceptance by Del-Co Water.

1.08 FINAL ACCEPTANCE

- A. Final acceptance shall not be issued until all punch list items have been addressed to the satisfaction of Del-Co Water and the Record Drawings and GPS Coordinates have been submitted and accepted by Del-Co Water.

PART II PRODUCTS

2.01 WATER MAIN LINE PIPE

A. GENERAL

1. Provide the type and pressure class of pipe as required in the Contract Drawings.
2. Spigot-end pipe shall have a circumferential stripe to indicate proper insertion length.
3. Identification: Provide manufacturer's name, nominal size, pressure rating and NSF stamp continuously along pipe.
4. All materials, including joint lubricant, that come into contact with the water shall be NSF 61 approved.
5. Lubricants shall impart no taste or odors to the water, shall be non-supportive of bacteriological growth, and shall cause no deterioration effect on the pipe or gaskets.

B. POLYVINYL CHLORIDE (PVC) PIPE

1. Non-AWWA Rated Pipe
 - a. Conformance: ASTM D2241
2. AWWA Rated Pipe
 - a. 4-inch through 12-inch: AWWA C900
 - b. 16-inch: AWWA C905
3. Joints: Push-on bell and spigot.
4. Fittings
 - a. Fittings shall have a pressure rating equal to or greater than the connecting pipe.
 - b. Pipe less than 4-inch diameter: Mechanical joint Class 350 per AWWA C153.
 - c. Pipe 4-inch and greater: Mechanical joint DIP Class 350 per AWWA C153.
 - d. Mechanical Joint or Transition Accessory Pack T-bolts shall be corrosion resistant.
5. Approved Manufacturers for PVC fittings: PVC Fittings or PVC Pipe
 - a. CertainTeed Corp.

- b. JM Eagle
 - c. North American Pipe Corp.
 - d. Bristol Corp.
 - e. Diamond Plastics Corp.
 - f. Jet Stream Corp.
 - g. Freedom Corp.
 - 6. Approved manufacturers for DIP fittings:
 - a. American Pipe
 - b. US Pipe
 - c. Clow
 - 7. Restrained joint PVC: Certa-Lok C900/RJ or Yelomine.
- C. DUCTILE IRON PIPE (DIP)
- 1. Conformance: AWWA C151.
 - 2. Lining: Cement-mortar, AWWA C104 and bituminous coating
 - 3. Joints: Push-on bell and spigot, gasket per AWWA C111.
 - 4. V-Bio Enhanced Polyethylene encasement required on all pipe installed.
 - a. Minimum film thickness of 8 Mil and conform to ANSI/AWWA C105/A21.5.
 - 5. Zinc Coating (*only if specified by Del-Co Water*)
 - 5. Arc-sprayed layer of zinc I accordance with ISO 8179.
 - 6. Cathodic Protection (*only if specified by Del-Co Water*).
 - 7. Fittings: Mechanical joint Compact DIP Class 350 per AWWA C153.
 - a. Reducers shall be concentric.
 - b. Mechanical Joint or Transition Accessory Pack T-bolts shall be corrosion resistant.
 - 8. Thrust Restraint
 - a. Concrete thrust blocking in accordance with Del-Co Standard D-04.
 - b. Wedge-action restraining glands (Series 1100 Megalug by EBBA Iron, Inc.) may be used for temporary joint restraint as necessitated by construction operations/sequencing.
 - c. 7. Anchor Hydrant Tees: Mechanical joint by swivel.
 - 9. Approved Manufacturers:
 - a. American Pipe
 - b. US Pipe
 - c. Clow
- D. POLYETHYLENE PIPE (PE)
- 1. Conformance: AWWA C906
 - 2. Material Code Designation: HDPE 3408
 - 3. Sizing System: Outside diameter for the Ductile Iron Pipe sizing system per Table 7 in AWWA C906-99.
 - 4. Joints: Thermal butt fusion, socket fusion, or electrofusion. Solvents, adhesives and threaded connections shall not be allowed.
 - 5. Stiffeners: Use stainless steel insert stiffeners for all compression connections.
 - 6. Fittings and adaptors shall be electrofusion joint of the same type, size, and class as the connecting PE pipe.
 - a. Use PE mechanical joint adapter at all connections to DIP waterline.
 - 7. Approved Manufacturers:
 - a. Performance Pipe

- b. Owner-approved equal
- E. JOINT RESTRAINTS
 - 1. EBBA Iron, Inc. Series 1100 Megalug.
- 2.02 BURIED MAIN LINE VALVES
 - A. GENERAL
 - 1. Operation: Non-rising stem, 2-inch square operating nut, and open counter-clockwise.
 - 2. Stem Extensions: Provide to bring operating nut to between 30 and 54 inches of finished grade if valve operating nut would otherwise be greater than 54 inches deep.
 - 3. Provide stainless steel bolts and nuts on exterior body of all valves.
 - B. VALVES 12-INCH AND SMALLER
 - 1. Type: Resilient Seat Gate Valve
 - 2. Conformance: AWWA C509
 - 3. Pressure Class: 150 PSI or equal to that of connecting pipe, whichever is greater.
 - 4. Joints: Mechanical
 - 5. Approved Manufacturers:
 - a. Mueller
 - b. American Flow Control
 - c. Clow
 - d. US Pipe
 - e. Kennedy
 - f. EJ FlowMaster Resilient Wedge
 - C. VALVES LARGER THAN 12-INCH
 - 1. Type: Butterfly
 - 2. Conformance: AWWA C504
 - 3. Pressure Class: 150 PSI or equal to that of connecting pipe, whichever is greater.
 - 4. Joints: Mechanical
 - 5. Approved Manufacturers:
 - a. Pratt Groundhog
 - D. Valve Boxes
 - 1. Type: Cast iron, two-piece adjustable extension, and length as required for finish grade.
 - 2. Valve boxes located in the road or shoulder shall be City of Columbus standard heavy-duty three-piece box.
 - 3. Cover: Cast iron with the word "WATER" cast in.
 - E. Post Indicator Valve
 - 1. Type: Adjustable Barrel Assembly equipped to receive owner's padlock
 - 2. Post Indicator Valves installed on Fire Service Lines shall be painted Industrial Safety Red.
 - 3. Post Indicator Valves installed on Master Meter Bypass Lines or Normally Closed Valves shall be painted Industrial Safety Blue.

2.03 MAIN LINE TAPS

A. TAPPING SLEEVES

1. Type: All metal with mechanical joint connection to receive a mechanical joint valve.
2. Design Pressure: 150 PSI
3. Outlet Material: Stainless steel, carbon steel, or ductile iron.
4. Fasteners and hardware: Type 304 stainless steel.

Manufacturer	Model
Romac Industries	SST or SSTIII
Power Seal	3480 or 3490
Ford Meter Box	FAST or FTSS
Smith Blair	662, 663, 664 or 665
JCM	439 or 469
Dresser TPS	Triple Tap Series

B. TAPPING VALVES

1. Type: Resilient Seat Gate Valve
2. Conformance: AWWA C509
3. Pressure Class: 150 PSI or equal to that of connecting pipe, whichever is greater.
4. Joints: Mechanical
5. Tapping valves on 2-inch lines shall be a corporation stop.

2.04 SERVICE LINE CONNECTIONS

A. PVC PIPE SERVICE TAPPING SLEEVES

1. Type: Single strap saddle with minimum 2-inch bearing area on pipe. Bronze screws and confined O-ring seal.
2. Conformance: AWWA C800 threaded outlet
3. Design Working Pressure: 200 PSI
4. Outlet: Sized for 1-inch corporation stop or as shown on drawings.
5. Markings shall indicate size, class, and outside diameter of connecting pipe.
6. Approved Manufacturers:

Manufacturer	PVC Pipe	PVC Pipe (AWWA)
Power Seal	3401	3401
Ford Meter Box	S70	S90
Mueller	H-13000	H-13000
A.Y. McDonald	3801	3805

B. DUCTILE IRON PIPE TAPS

1. Direct tap with 1-inch CC corporation stop

C. CORPORATION STOPS

1. Type: Bronze
2. Conformance: ANSI 61/AWWA C800
3. Approved Manufacturers:

Manufacturer	Model
Ford Meter Box	F-1001-4-NL
Mueller	H-15009N
A.Y. McDonald	74701-33

D. SERVICE LINE PIPE

1. Pipe Size: Required line size shall be based on meter size according to the following table:

Meter Size (Inches)	Service Line Size (Inches)	Class
5/8 to 1	1	PE SDR 7 (IPS)
1½ to 2	2	PVC SDR 21
3	3	PVC SDR 21

2. PVC pipe shall conform to Section 2.01.B.
3. Polyethylene (PE) Pipe
 - a. Conformance: AWWA/ASTM C901/D1248
 - b. Class: SDR 7 Class 200 (IPS)
4. Copper: Type K, soft tempered, per ASTM B88 (Inside City of Delaware).

E. CURB STOPS

1. Conformance: ANSI 61/AWWA C800
2. Thread: Female iron pipe size
3. Curb Boxes: Cast iron two-piece adjustable extension, length as required for finish grade. Cover shall have the word "WATER" cast in.
4. Approved Manufacturers:

Manufacturer	Model
Ford Meter Box	B61-444M-NL or Z61-444SW-NL
Mueller	H-15191N, H-15171N or B-25171N
A.Y. McDonald	76102-33

F. FLUSHING HYDRANTS

1. All dead ends line shall have either an automatic flushing unit or a 2" end of line fire hydrant.
2. Automatic Flushing Units
 - a. Automatic flushing units shall be used in instances where routine flushing on the waterline is expected for an extended period of time.
 - b. Install units as noted on the designer's plans set or at the discretion of Del-Co Water.
 - c. Flushing area must be at or near final grade.
 - d. Discharge shall be directly plumbed into the nearest storm drain. If discharging to a storm drain is not possible, then the discharge

shall be plumbed into the closest curb. Contractor shall supply a 3" sleeve through the curb.

- e. Type: 2-inch Schedule 40 PVC for discharge.
 - f. Freeze proof.
 - g. 2" Isolation valve (gate valve).
 - h. Flushing units shall include the Bluetooth controller.
 - i. Approved Manufacturers: Kupferle Eclipse 9800 Automatic Flushing Station or approved equal.
3. End of Line 2" Fire Hydrant
- a. Type: 2-inch post with breakaway coupling.
 - b. Nozzle: 2.5-inch brass NST with cap and chain.
 - c. Freeze proof.
 - d. Isolation valve: Bronze with 2-inch FIP inlet.
 - e. Approved manufacturers:
 - 1. Mueller Mark II, A-408.
 - 2. Gil Industries Aquarius One-O-One.
 - 3. Kupferle No. 77 Mainguard.

G. FIRE HYDRANTS

- 1. Type: Breakable main rod and barrel flange.
- 2. Conformance: AWWA C502 for dry barrel hydrants.
- 3. Main valve: 5.25-inch compression
- 4. Nozzles:
 - a. Threading: Conform to NFPA National Standard fire hose threads.
 - b. 4.5-inch steamer, except in the following locations provide an integral storz connection; Harrington HIHS50 or equal: Berkshire, Berlin, Concord, Genoa, Kingston, Liberty, Orange, Porter, Trenton, and Scioto Townships; City of Powell; and the Villages of Sunbury and Galena.
 - c. Two 2.5-inch hose
- 5. Inlet Connection: 6-inch mechanical joint
- 6. Operating Nut: 1.5-inch pentagon, turn counterclockwise to open.
- 7. Approved Manufacturers:

Manufacturer	Model
Mueller	Super Centurion 200 No. A-423
American Flow Control	B-84-B
Clow	Medallion
M&H	129M
AVK	Nostalgic 2780
Kennedy	Guardian K81D
EJ WaterMaster	5CD250

2.06 COATING SYSTEMS

A. PRIME COAT

- 1. Generic Type: Polyurethane Primer
- 2. Manufacturers:

- a. Tnemec Omnithane Series 1
- b. Sherwin-Williams Corothane 1 Ironox B

B. FINISH COAT

- 1. Generic Type: Acrylic Polyurethane
- 2. Manufacturers:
 - a. Tnemec Endura-Shield Series 73
 - b. Sherwin-Williams Acrolone 218 HS
 - c. PPG Durethane DTM 95-3300 Series

2.07 TRACER WIRE

- 1 Type: Copper Clad, Steel Reinforced
 - a. Open Trench Excavation: 12-gauge high strength, 452 lb. break strength, 30 mil HDPE jacket
 - b. Directional Drill: 12-gauge high strength, 1150 lb. break strength, 45 mil HDPE jacket
- 2. Approved Manufacturers:
 - a. Copperhead
 - b. Or Equal
- 3. Connectors
 - a. Burndy Copper Split Bolt KS-15
 - b. Or Equal

2.08 MISCELLANEOUS

A. MECHANICAL COUPLINGS

- 1. Type: Solid sleeve with mechanical joint followers.
- 2. Sleeve: Carbon steel, minimum yield strength of 30,000 PSI
- 3. Hardware: Electro-galvanized.
- 4. Finish: Fusion bonded epoxy
- 5. Conformance: AWWA 219
- 6. Manufacturers:
 - a. Smith-Blair Series 400
 - b. Dresser Style 38
 - c. Or equal

B. SOLID SLEEVES, ADAPTORS, PLUGS, CAPS

- 1. Sleeves shall be Long pattern.
- 2. Conform to same material specifications as ductile iron pipe.

PART III EXECUTION

3.01 PIPE, FITTINGS, AND APPURTENANCES

A. PIPE AND FITTINGS

- 1. Install in accordance with manufacturer's recommendations.
- 2. Minimum bending radius in feet for PVC pipe:

Class	Nominal Pipe Diameter (Inches)						
	2	3	4	6	8	10	12
SDR 26	59	59	75	110	144	179	213
SDR 21	59	75	110	144	179	213	275
C900	59	88	100	150	200	250	300

3. Minimum Depth of Bury: 42 inches
4. Place concrete thrust blocks at all fittings and valves.

B. TAPPING WATER LINES

1. Use only tapping machines designed to tap through the valve or corporation stop. The machine must operate with a cutting tool classified as a core-cutting tool or the shell design, which retains the coupon while penetrating the pipe wall. Equipment using a twist drill, hole saw, or auger bit is not allowed.
2. Support tapping sleeves where the tap size is greater than 2-inch on cast-in-place or precast concrete solid block.

C. VALVES

1. Valve boxes shall be straight and free of all dirt, mud or other debris. Top of valve boxes shall be four inches above finished grade.
2. Post indicator valves not dedicated to building fire service lines shall be repainted safety blue.

D. FIRE HYDRANTS

1. Set depth so that break away flange is within 6 inches above finish grade.
2. Set hydrant 2 feet from the back of curb or 8 feet from the edge of pavement on non-curbed streets.
3. Face steamer nozzle toward road.
4. Check for proper operation of weep hole when shut off.
5. Repaint hydrants after installation:
 - a. Del-Co-owned hydrants in Liberty Township, Powell, and Village of Sunbury: Safety Red.
 - b. Del-Co-owned hydrants in Delaware City and other areas: Safety Yellow.
 - c. Privately-owned hydrants: Industrial Green.

E. TRACER WIRE

1. Tracer wire is required to be installed on all water main and water services installed by trench excavation and directional drill method.

F. INSPECTION

1. Coordinate all connections with the Del-Co prior to performing work.
2. Obtain permission from the Del-Co prior to filling lines.

3.02 PRESSURE TESTING

A. GENERAL

1. Test all water lines, hydrants and services in the presence of the Del-Co Water inspector.

2. Provide all equipment necessary for test.
3. Test Gage: Shall range from 0 to 300 PSI with 5-PSI maximum increments.
4. Drums and other equipment used in test shall be clean and free of oil, grease or other contaminants.
5. Time of Test: Test shall commence Monday through Friday between the hours of 8:00 AM and 2:00 PM. Notify the Owner at least 24 hours in advance of the test.
6. Retests will not be allowed until the problem is identified and corrected.

B. PLASTIC PIPE

1. Conformance: AWWA C605.
2. Test Requirements:
 - a. Test Pressure: The greatest of 150% of maximum static pressure or 150 PSI.
 - b. Duration: 2 hours.
 - c. Pressure drop shall not exceed 5 PSI.
 - d. Allowable Leakage: Leakage shall be less than that determined by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where: L = Allowable leakage (Gallons per Hour).

N = Number of joints in the section being tested.

D = Nominal diameter of pipe (inches).

P = Test pressure (Pounds per Square Inch).

Leakage values determined from this formula for selected pipe sizes and test pressures are shown in the table below:

Pipe Size (Inches)	Test Pressure (PSI)		
	150	200	300
	Allowable Leakage per 50 Joints (Gallons per Hour)		
2	0.16	0.19	0.21
3	0.25	0.29	0.32
4	0.33	0.38	0.47
6	0.50	0.57	0.70
8	0.66	0.76	0.94
10	0.83	0.96	1.17
12	0.99	1.15	1.40
16	1.32	1.53	1.87
18	1.49	1.72	2.11
20	1.66	1.91	2.34
24	1.99	2.29	2.81
30	2.48	2.87	3.51
36	2.98	3.44	4.21

C. DUCTILE IRON PIPE

1. Conformance: AWWA C600.

2. Test Requirements:
 - a. Test Pressure: The greatest of 150% of maximum static pressure or 150 PSI.
 - b. Duration: 2 hours.
 - c. Pressure drop shall not exceed 5 PSI.
 - d. Allowable Leakage: Leakage shall be less than that determined by the formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where: L = Allowable leakage (Gallons per Hour).

S = Length of pipe tested (feet).

D = Nominal diameter of pipe (inches).

P = Test pressure (Pounds per Square Inch).

Leakage values determined from this formula for selected pipe sizes and test pressures are shown in the table below:

Pipe Size (Inches)	Test Pressure (PSI)		
	150	200	300
	Allowable Leakage per 1,000 feet (Gallons per Hour)		
3	0.28	0.32	0.39
4	0.37	0.43	0.52
6	0.55	0.64	0.78
8	0.74	0.85	1.04
10	0.92	1.06	1.30
12	1.10	1.28	1.56
16	1.47	1.70	2.08
18	1.66	1.91	2.34
20	1.84	2.12	2.60
24	2.21	2.55	3.12
30	2.76	3.19	3.90
36	3.31	3.82	4.68

3.03 DISINFECTION

A. GENERAL

1. All water lines shall be disinfected.
2. Conformance: AWWA C651
3. Approved Methods:
 - a. Calcium hypochlorite is permitted only in granule form. Place granules at maximum 500-foot spacing. Tablet form is not permitted.
 - b. Continuous feed method
 - c. Slug method

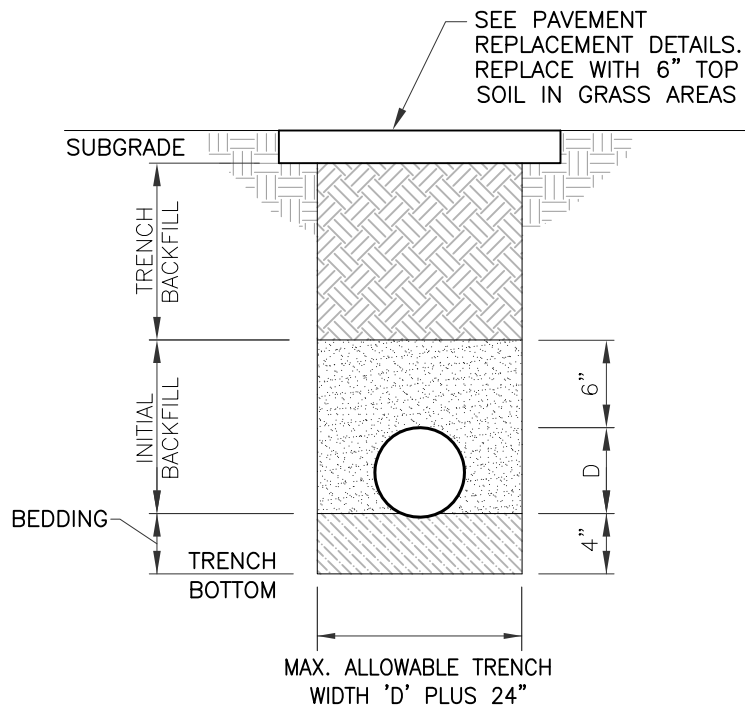
B. FLUSHING AND TESTING

1. Del-Co will flush lines and perform bacteriological testing. Should the bacteriological tests fail, the Contractor shall repeat disinfection of lines as required until a satisfactory bacteriological test is obtained.

3.04 PAINTING

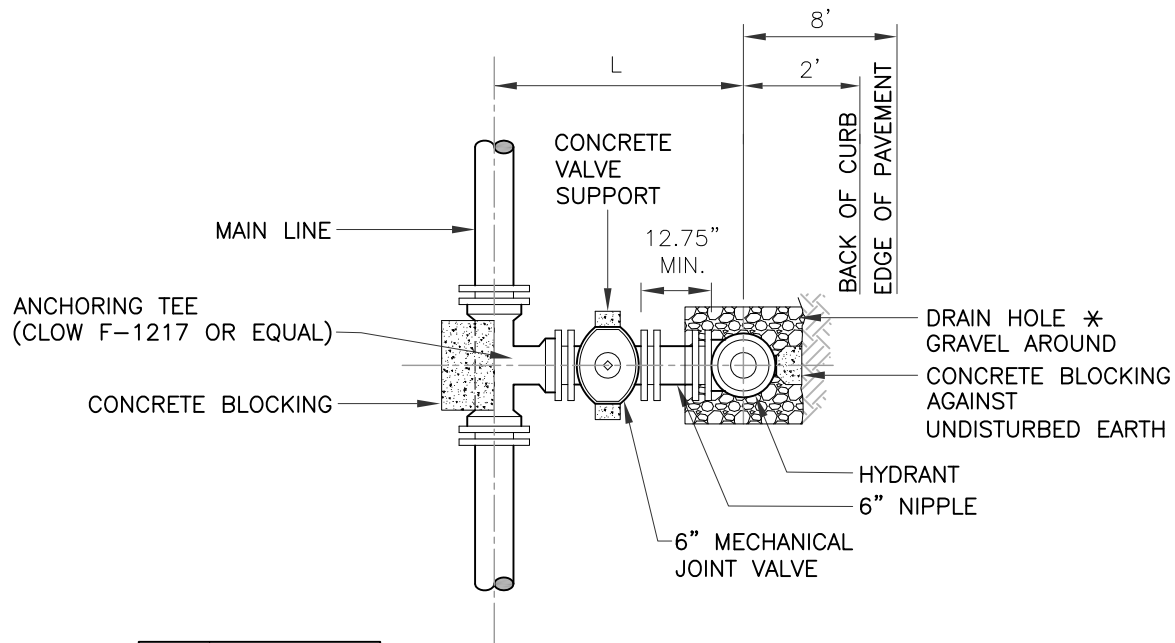
- A. All fire hydrants, flushing hydrants, and post indicator valves shall be repainted per the color-coding system stated above after installation regardless of the color provided by the manufacturer.
 - 1. Prime Coat: Prime coat is required only when the manufacturer's provided coating system has been severely damaged as determined by the Inspector. Provide prime coat at 2.5-4.0 mils DFT.
 - 2. Finished Coat: 2.0-5.0 mils DFT per coat. Provide multiple coats as required to fully cover underlying colors.

++ END OF SECTION ++



NOTES

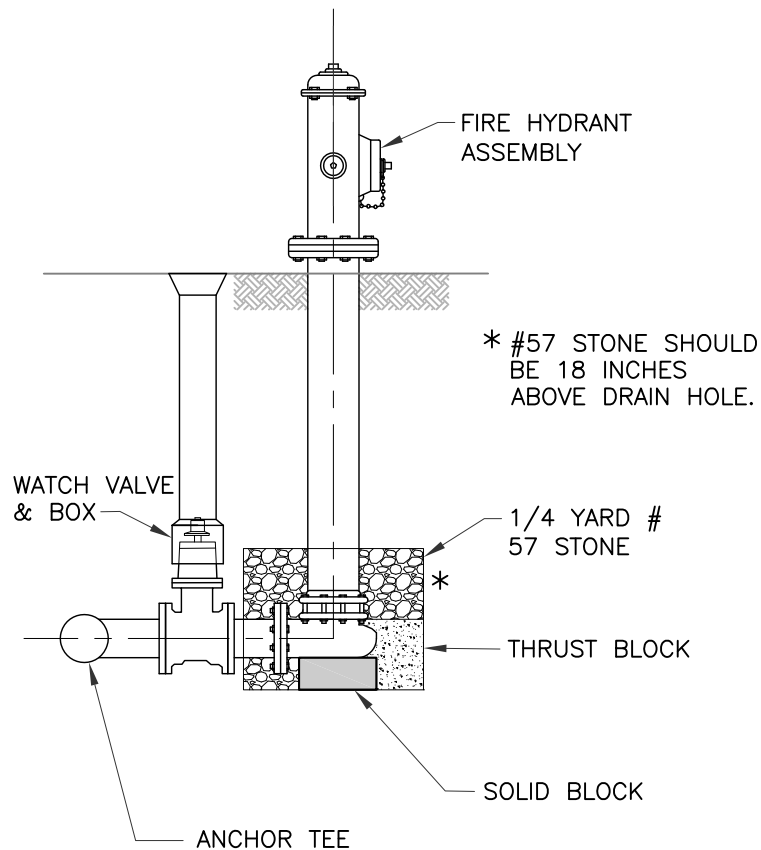
1. SUITABLE BEDDING AND INITIAL BACKFILL MATERIAL SHALL CONSIST OF NATURALLY OCCURRING SAND OR CLAY FREE FROM TRASH, ROOTS, DEBRIS, EXCESSIVE MOISTURE AND OBJECTS LARGER THAN $\frac{3}{4}$ ".
2. PIPE TRENCH WALL SHALL BE VERTICAL TO THE TOP OF THE INITIAL BACKFILL.
3. PROVIDE SELECT FILL No. 8 OR No. 57 STONE FOR BEDDING MATERIAL TO THE DEPTH REQUIRED BY THE WATER UTILITY WHEN UNSTABLE TRENCH BOTTOMS ARE ENCOUNTERED, AS DETERMINED BY THE WATER UTILITY.
4. MANUALLY COMPACT EMBEDMENT MATERIAL FILLING ALL VOIDS AROUND PIPE.
5. TRENCH BACKFILL TYPE SHALL BE PER GENERAL NOTES AND SPECIFICATIONS.

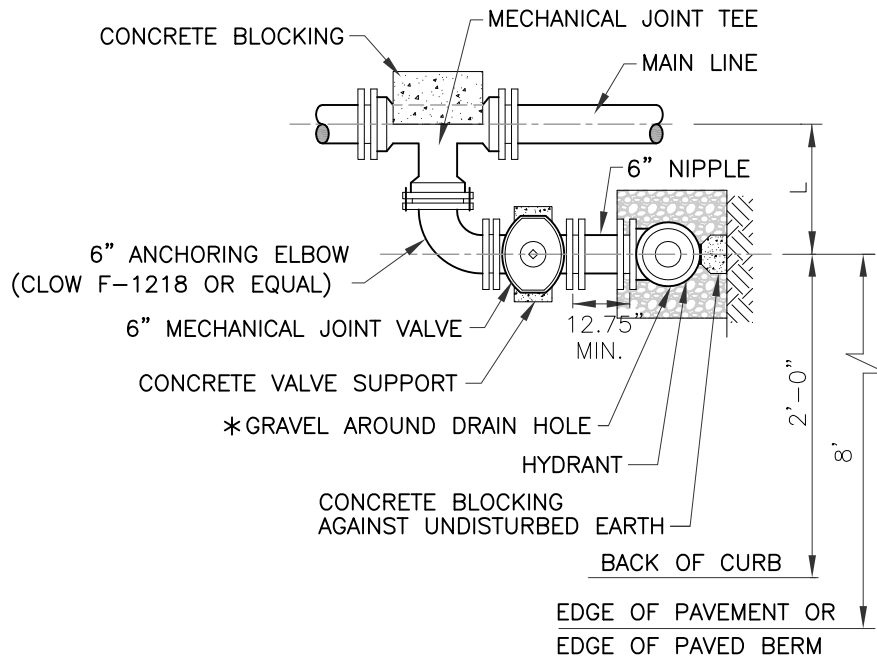


MAIN LINE	DIMENSION L (MINIMUM)
6"	35"
8"	36"
12"	39"
16"	42"

NOTES:

- FIRE HYDRANTS SHALL BE SET A MINIMUM OF 6' FROM ALL DRIVEWAY OPENINGS.
- * CREATE A DRY WELL AROUND HYDRANT DRAIN USING 1/4 YARD OF #57 GRAVEL.





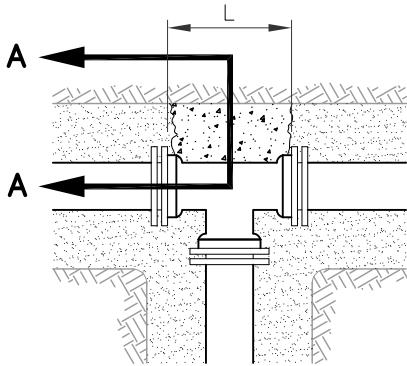
TYPE B: LONG SIDE BEND TO TEE.

TYPE B MODIFIED: SHORT SIDE BEND TO TEE.

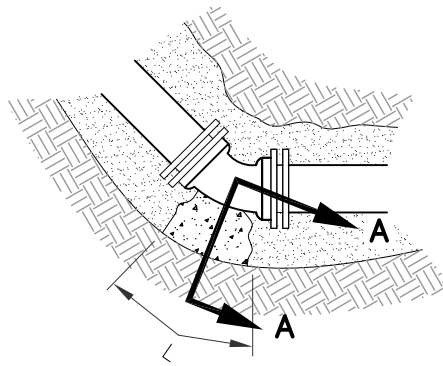
MAIN LINE	DIMENSION L	
	TYPE B	TYPE B MOD.
6"	24"	19"
8"	25"	20"
12"	28"	23"
16"	31"	26"

NOTE:

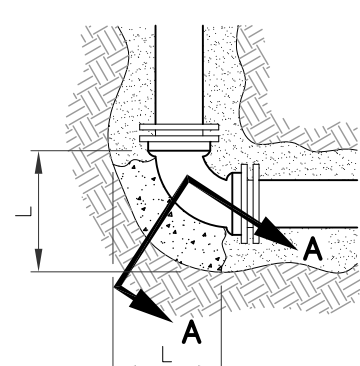
- FIRE HYDRANTS SHALL BE SET A MINIMUM OF 6' FROM ALL DRIVEWAY OPENINGS.
- * CREATE A DRY WELL AROUND HYDRANT DRAIN USING 1/4 YARD OF #57 GRAVEL. GRAVEL TO BE 18" ABOVE DRAIN HOLE.



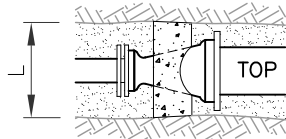
TEE



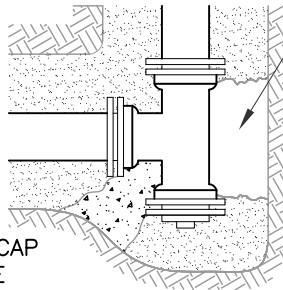
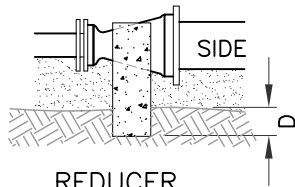
BEND < 90°



HORIZONTAL BEND

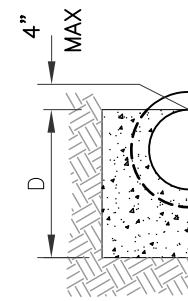


REDUCER

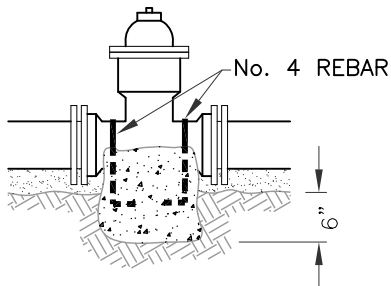


USE END CAP
TABLE SIZE
FOR RUN

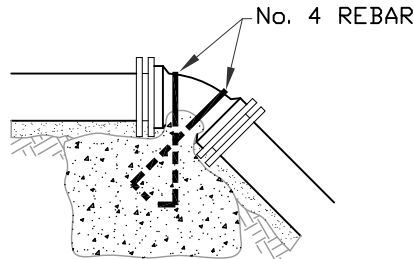
TEE W/ ONE PLUG END



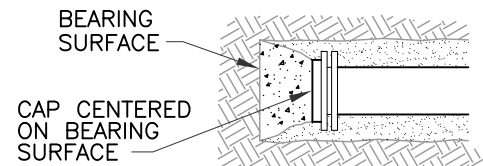
SECTION A-A



VALVE SUPPORT



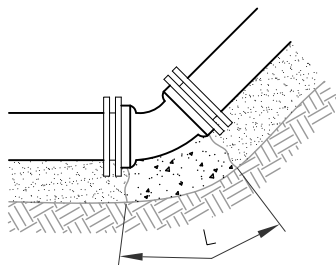
VERTICAL OVER BEND



CAP

NOTES

1. CONCRETE SHALL NOT LAP ONTO BOLTS.
2. EMBED REINFORCING 12" MIN. INTO CONCRETE HOOK ENDS.



VERTICAL UNDER BEND

	UNDISTURBED GROUND
	CONCRETE THRUST BLOCK
	SUITABLE BEDDING MATERIAL

END CAP BLOCKING						
SIZE	2"	4"	6"	8"	12"	16"
BLOCKING AREA	6"x6"	9"x9"	13"x13"	17"x17"	24"x24"	33"x33"

BLOCKING FOR TEES															
R U N	BRANCH														
	4"			6"			8"			12"			16"		
	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.
4"	11	8	0.8												
6"	11	8	0.8	18	12	1.9									
8"	10	9	0.7	18	12	1.9	23	16	3.5						
12"	8	12	0.8	18	12	1.9	23	16	3.5	38	22	8.7			
16"	6	16	0.8	14	16	2.0	20	18	3.5	38	23	8.7	49	30	13.6

SIZE OF CONCRETE BLOCKING FOR VERTICAL OVERBEND		
PIPE SIZE	SIZE OF BLOCK	VOLUME Cu. Yd.
4"	1.5'x1.5'x1.5'	0.13
6"	2.5'x2.5'x2.5'	0.5
8"	3'x3'x3'	1
12"	3.5'x3.5'x3.5'	1.5
16"	4.5'x4.5'x4.5'	3.5

	BLOCKING FOR REDUCERS									
	4"		6"		8"		12"		16"	
	D"	L"	D"	L"	D"	L"	D"	L"	D"	L"
2"	12	6	12	12						
4"			12	12						
6"					12	12				
8"							24	18		
12"									24	24

BLOCKING FOR HORIZONTAL BENDS AND VERTICAL UNDERBENDS												
PIPE SIZE	DEGREE OF BEND											
	11.25°			22.5°			45°			90°		
	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.	L"	D"	Vc.f.
4"	5	4	0.2	9	5	0.4	14	5	0.6	14	5	0.6
6"	8	6	0.5	12	7	0.7	20	8	1.4	18	9	1.7
8"	9	8	0.7	16	9	1.4	24	12	2.7	25	11	4
12"	14	12	1.8	24	14	3.6	36	18	6.8	32	18	10.7
16"	18	16	3.4	32	18	6.7	36	32	13.4	41	26	25.6

VALVE SUPPORTS		
VALVE SIZE	WIDTH	Vc.f.
4"	16"	0.3
6"	17"	0.4
8"	20"	0.4
12"	24"	0.5
16"	30"	0.5



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CONCRETE THRUST BLOCKING

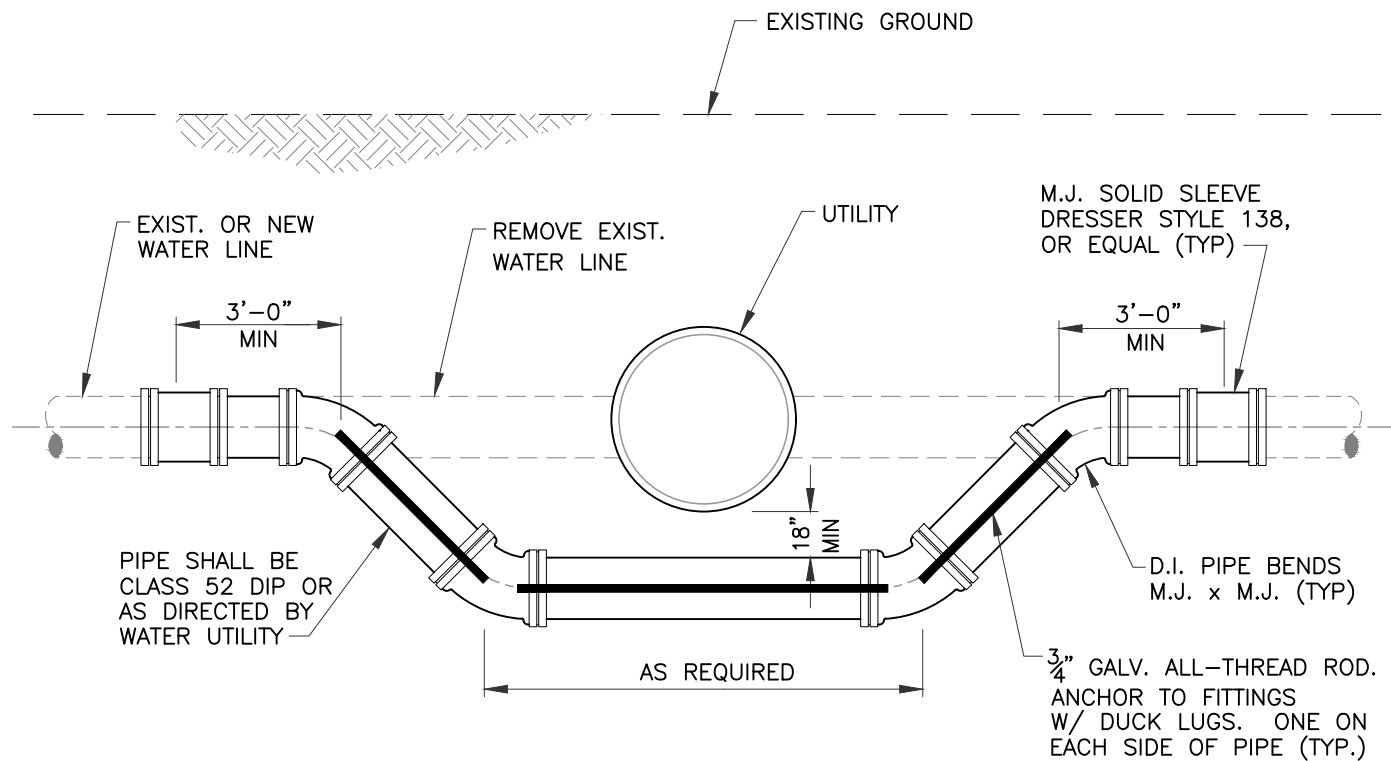
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01 DEC 04

SCALE
NTS

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NOTES

1. COORDINATE WITH DEL-CO WATER FOR SHUT DOWN OF WATER LINE.
2. PROVIDE CONCRETE THRUST BLOCKS AND DUCT-LUGS/ALL THREAD AT ALL FITTINGS,
3. FOR STORM PIPE 15" AND LARGER, CASING REQUIRED, ALSO SEE DETAIL D-30.

* 8" & SMALLER: ONE STICK OF ALL-THREAD ON EACH SIDE OF WATERLINE.
10" & 12": 3 STICKS OF ALL-THREAD REQUIRED.
WATERLINE GREATER THAN 12" USE 4 STICKS OF ALL-THREAD.



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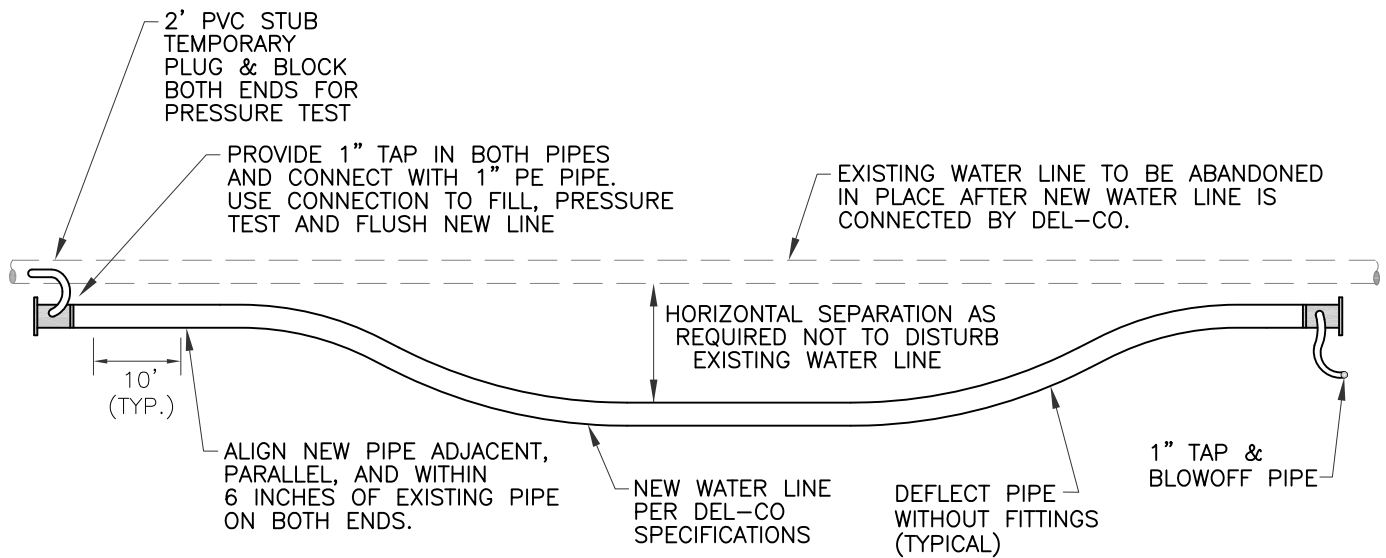
WATER LINE LOWERING

REVISED
20 MARCH 23

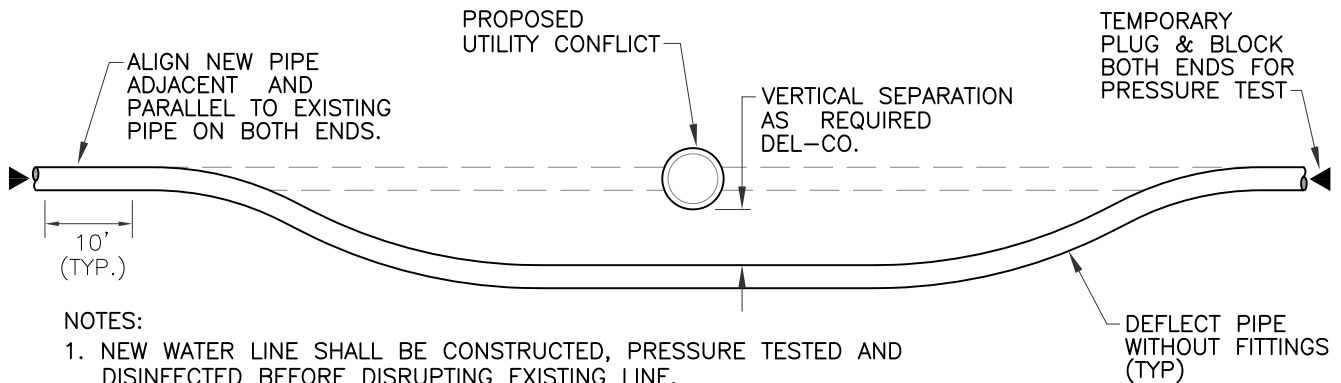
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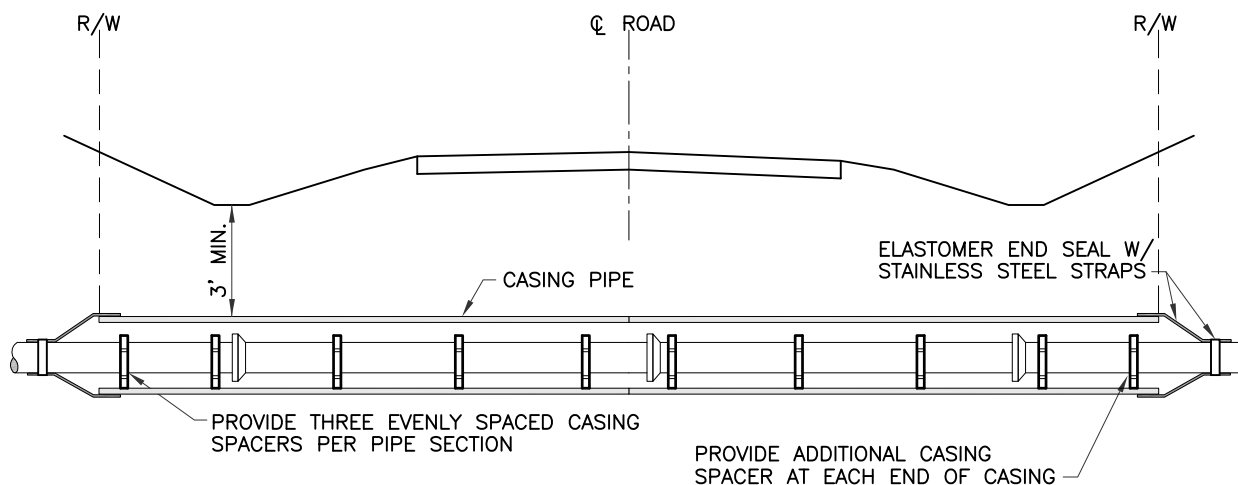
PLAN
NTS



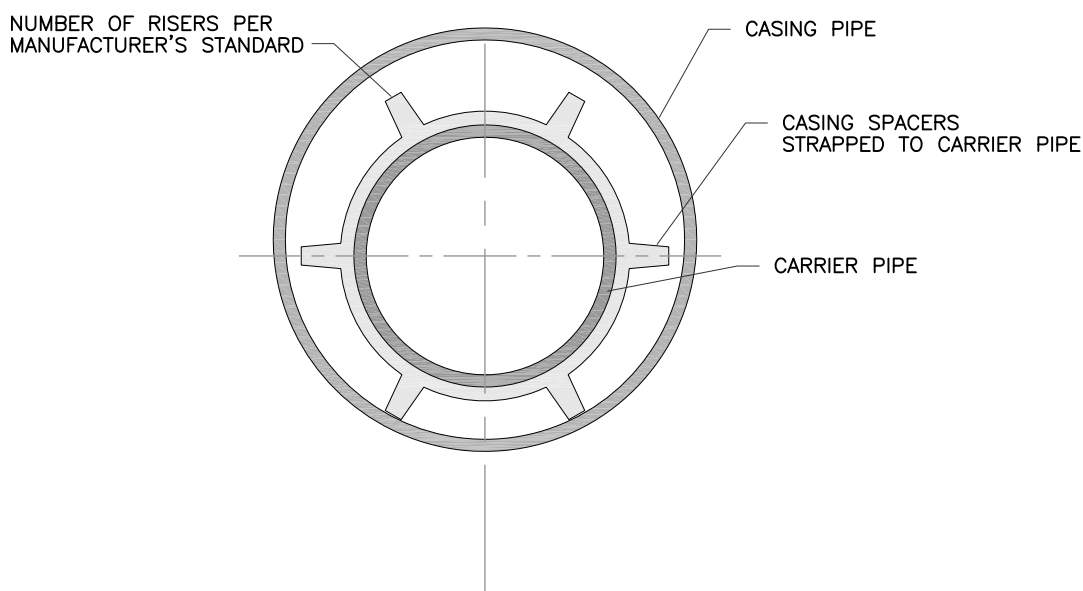
NOTES:

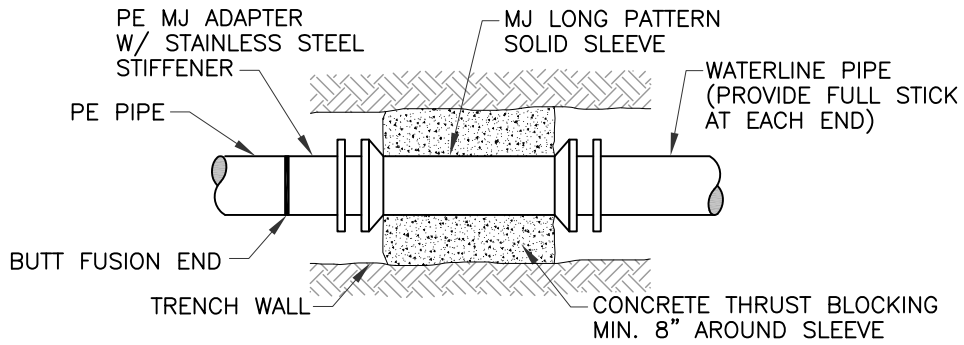
1. NEW WATER LINE SHALL BE CONSTRUCTED, PRESSURE TESTED AND DISINFECTED BEFORE DISRUPTING EXISTING LINE.
2. CONTRACTOR SHALL PERFORM PRESSURE TEST AND DISINFECTION PER DEL-CO SPECIFICATIONS.
3. DEL-CO WILL FLUSH LINE AND PROVIDE BACTERIOLOGICAL TESTING.
4. UPON ACCEPTANCE OF NEW LINE, DEL-CO WILL CONNECT TO EXISTING LINE AT EACH END.

PROFILE
NTS

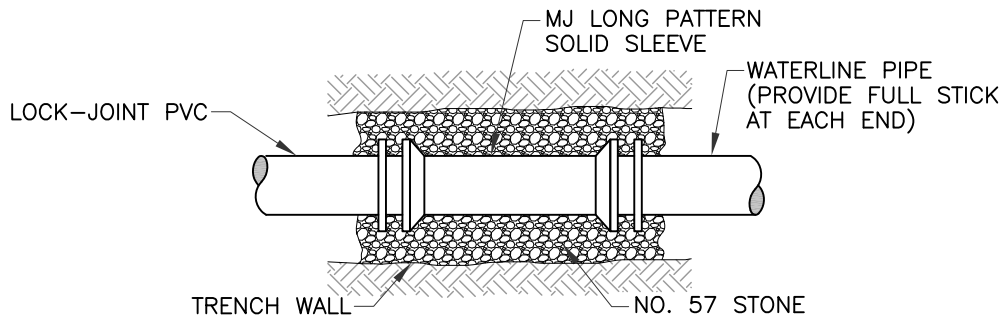


PROVIDE CASING PIPE FOR ALL ROAD CROSSINGS UNLESS OTHERWISE APPROVED BY DEL-CO. CASING PIPE SHALL BE STEEL PIPE WITH 0.375-INCH WALL THICKNESS, OR PVC C900 FOR WATER LINES 12-INCH DIAMETER OR LESS. CASINGS FOR WATER LINES LARGER THAN 12-INCH DIAMETER MAY BE AWWA C905. INSIDE DIAMETER OF THE CASING PIPE SHALL NOT EXCEED 3 INCHES OF THE OUTSIDE DIAMETER OF THE CARRIER PIPE AND CASING SPACERS.

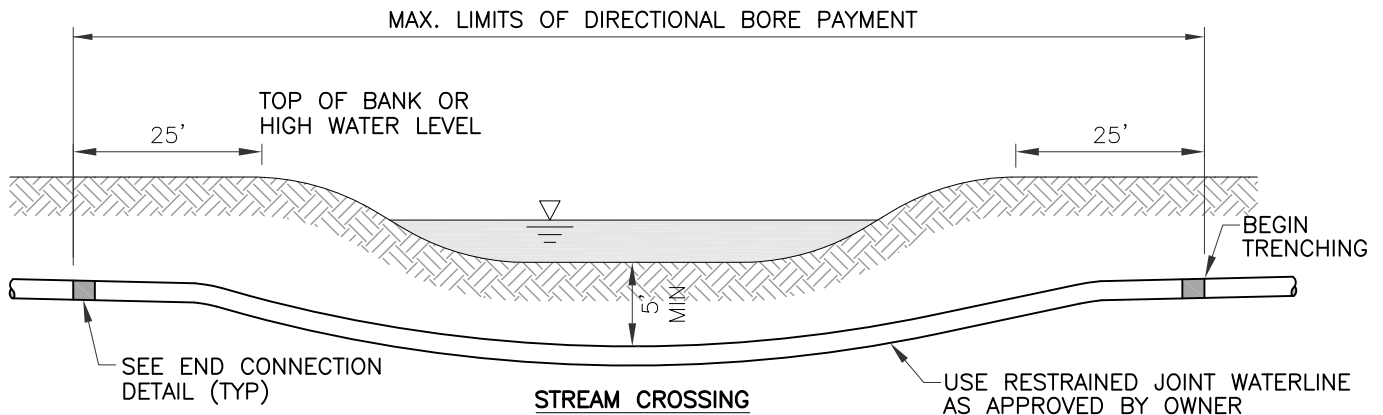


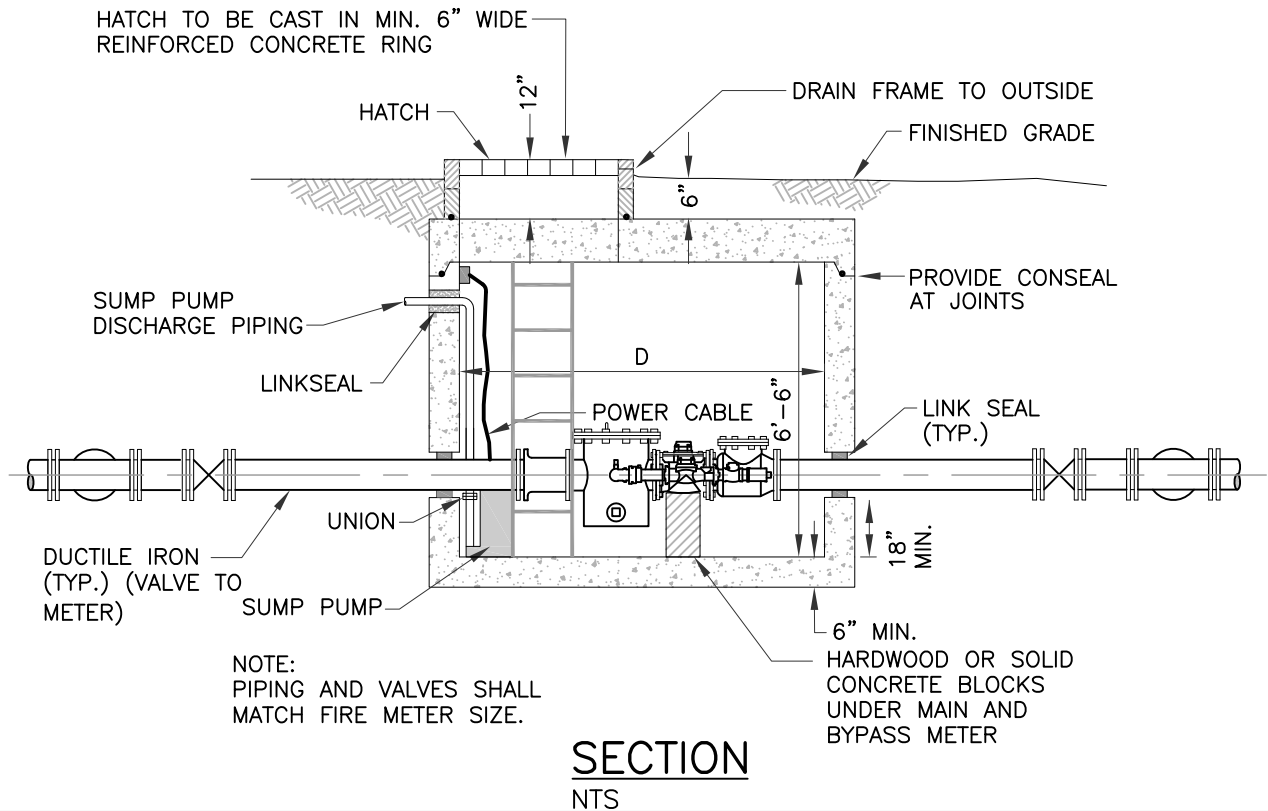
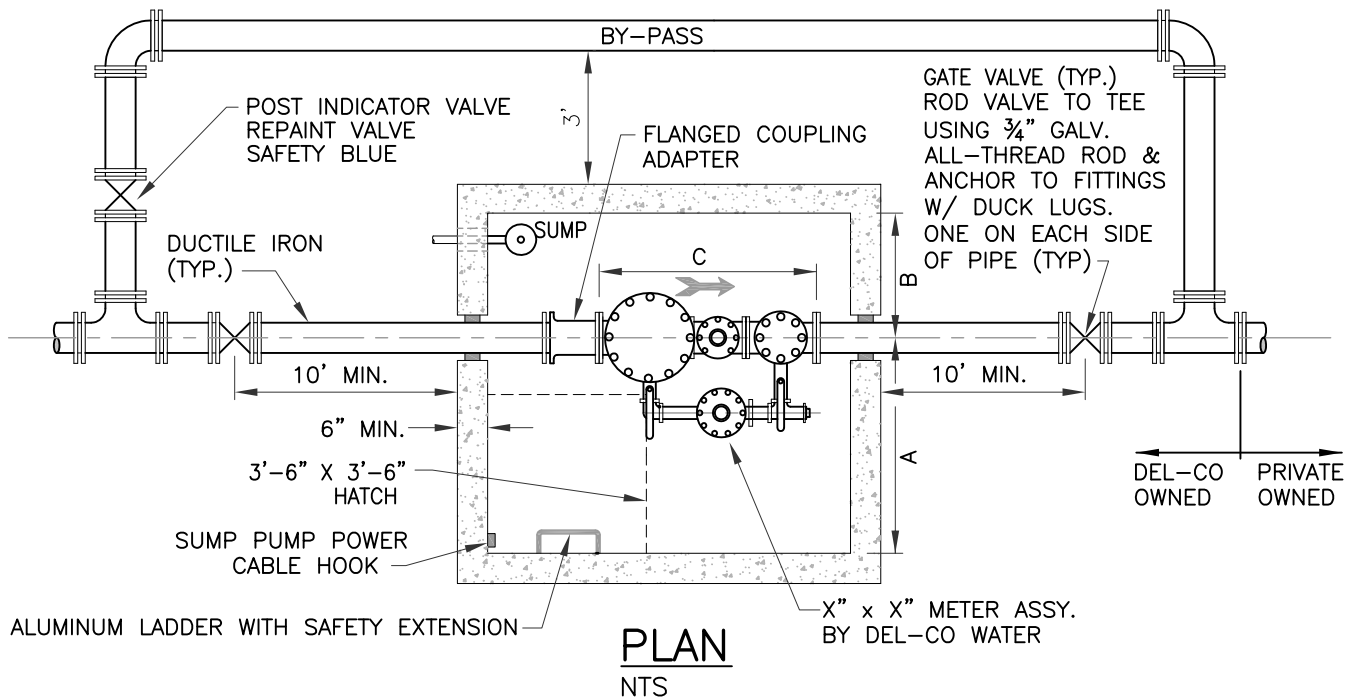


END CONNECTION DETAIL P.E. PIPE



END CONNECTION DETAIL LOCK-JOINT PVC

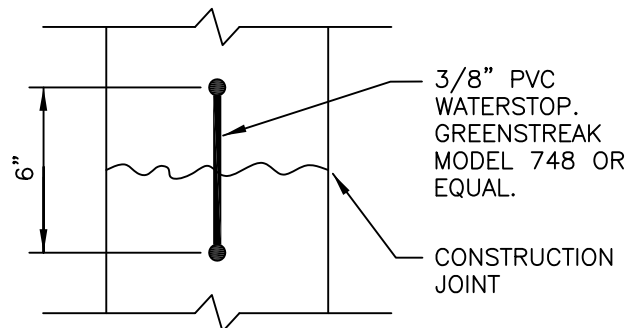




NOTES:

1. VAULT SHALL BE PRECAST REINFORCED CONCRETE, CONSTRUCTED AS A SINGLE WATERTIGHT UNIT WITH THE EXCEPTION OF THE TOP SLAB AND THE ACCESS HATCH RING. PVC WATERSTOP SHALL BE PLACED AT ALL CONSTRUCTION JOINTS AND BE CONTINUOUS FOR THE LENGTH OF JOINT WITH END SEALS WELDED. PROVIDE FOUR INTERIOR LIFTING CABLES AT EACH CORNER. VAULT SHALL BE DESIGNED BY AN OHIO REGISTERED PROFESSIONAL ENGINEER TO WITHSTAND AN AASHTO H₂O LIVE LOAD, WITH EXCEPTION OF THE HATCH. PROVIDE ENGINEERED STAMPED DRAWING SUBMITTAL STATING DESIGN PARAMETERS.
2. PROVIDE ALL EQUIPMENT AND MATERIALS EXCEPT METER. DEL-CO WATER WILL FURNISH METER AT DEL-CO'S OFFICE. CONTRACTOR SHALL TRANSPORT THE METER TO THE SITE AND INSTALL IT.
3. ACCESS HATCH SHALL BE ALUMINUM CHECKERED PLATE WITH EXTRUDED ALUMINUM FRAME. PROVIDE WITH TYPE 316 STAINLESS STEEL HINGES, HOLD OPEN ARM, AND OTHER HARDWARE. DESIGN LIVE LOAD SHALL BE 300 PSF. PROVIDE WITH FLUSH DROP HANDLE AND STAPLE TO RECEIVE OWNER'S PADLOCK. FRAME SHALL BE CAST IN REINFORCED CONCRETE RING. DRAIN FRAME TO OUTSIDE. APPLY BITUMINOUS COATING TO SURFACES IN CONTACT WITH CONCRETE. U.S.F. FABRICATION TPS 300 OR EQUAL.
4. VAULT LADDER SHALL BE ALUMINUM, ANCHORED TO FLOOR AND WALL USING 7 INCH STANDOFFS AND STAINLESS STEEL ANCHORS. LADDER WIDTH SHALL BE 18 INCHES AND RUNGS SPACED AT 12 INCHES. PROVIDE RETRACTABLE ALUMINUM 40-INCH HEIGHT SAFETY EXTENSION.
5. PROVIDE ZOELLER MODEL M95 SUMP PUMP WITH FLOAT SWITCH LEVEL CONTROL. PROVIDE POWER CABLE OF SUFFICIENT LENGTH TO EXTEND 3 FEET PAST HATCH, TERMINATE WITH STAINLESS STEEL 1" J-HOOK.
6. FINAL GRADE SHALL BE SLOPED AWAY FROM THE METER VAULT.
7. THE EASEMENT AREA AROUND THE MASTER METER VAULT SHALL BE FOR THE UNOBSTRUCTED USE OF DEL-CO WATER COMPANY, INC. PLACEMENT OF FENCES, WALLS, PILLARS, TREES, GARDENS, SHRUBBERIES, AND OTHER SURFACE FEATURES IS STRICTLY PROHIBITED.

METER SIZE			
SIZE	6"x1½"	8"x2"	10"x2"
A	51"	57"	66"
B	32"	33"	38"
C	45"	53"	68"
D	89"	96"	112"



WATERSTOP DETAIL



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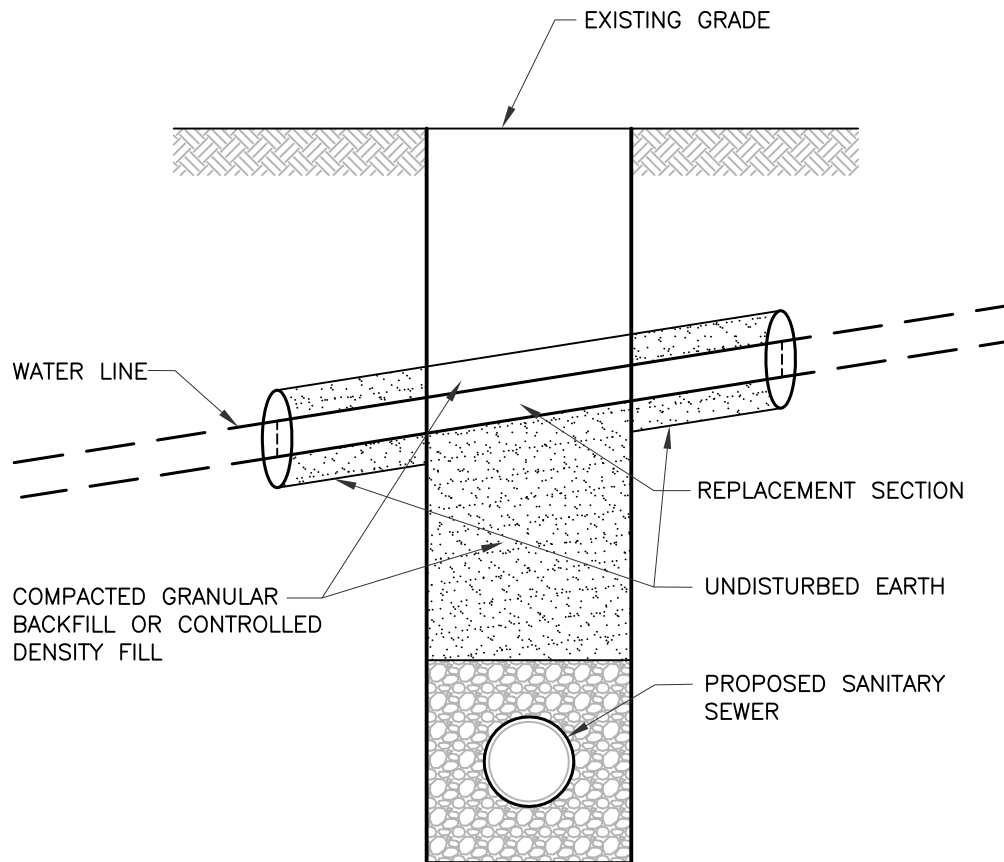
MASTER METER VAULT

REVISED
20-MAY-20

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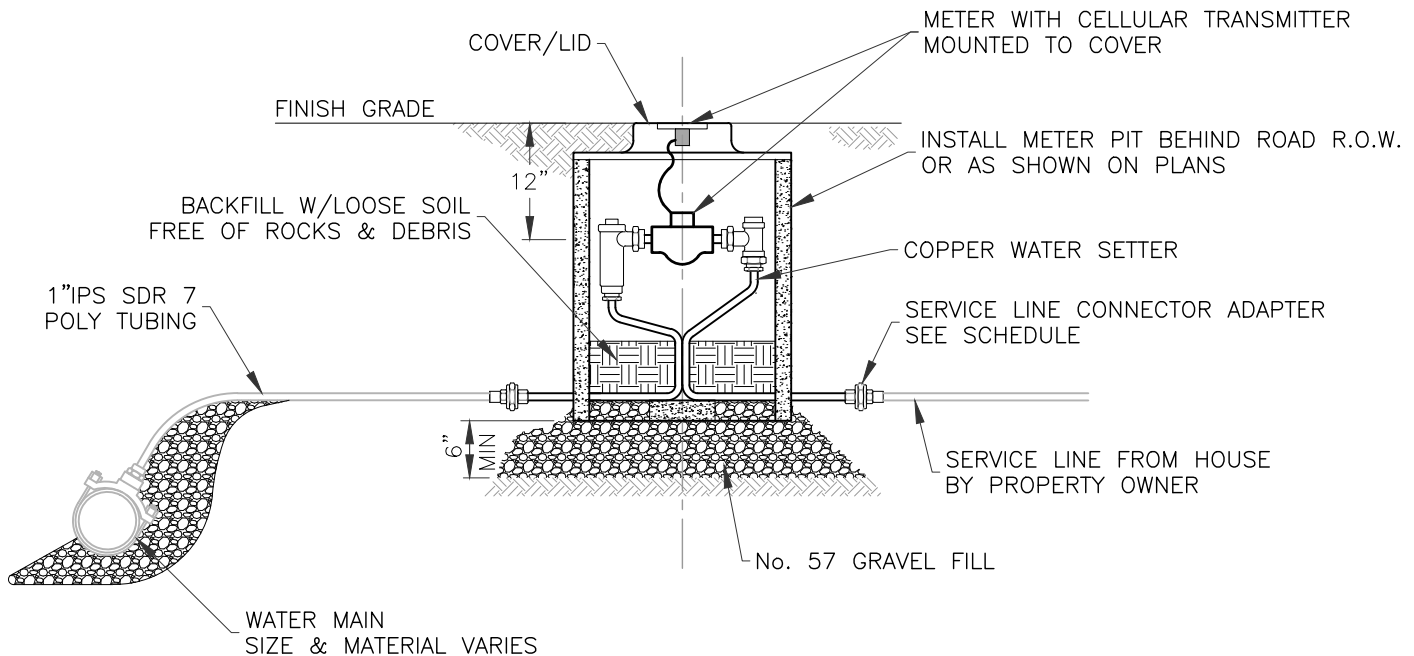
NOTE:

IF THE EXISTING WATER LINE IS DAMAGED OR REMOVED DURING CONSTRUCTION IT SHALL BE REPLACED ACROSS THE SEWER TRENCH SUCH THAT ALL JOINTS ARE ON UNDISTURBED GROUND.

SERVICE LINE CONNECTOR ADAPTER SCHEDULE

SERVICE LINE TYPE	CONNECTOR ADAPTER
COPPER TUBING ($\frac{3}{4}$ " OR 1" K COPPER)	BRASS COMPRESSION
COPPER TUBING SIZE PE ($\frac{3}{4}$ ", 1", 1.5" OR 2" SDR 9)	BRASS COMPRESSION W/ STAINLESS STEEL INSERT
IRON PIPE SIZE TUBING PE (1" SDR 7)	MUELLER INSTA-TITE

NOTE: AS A COURTESY, DEL-CO WILL CONNECT THE PRIVATE SERVICE LINE TO THE METER YOKE WHEN INSTALLING THE METER AS LONG AS THE PRIVATE SERVICE LINE CONFORMS TO THIS ADAPTER SCHEDULE

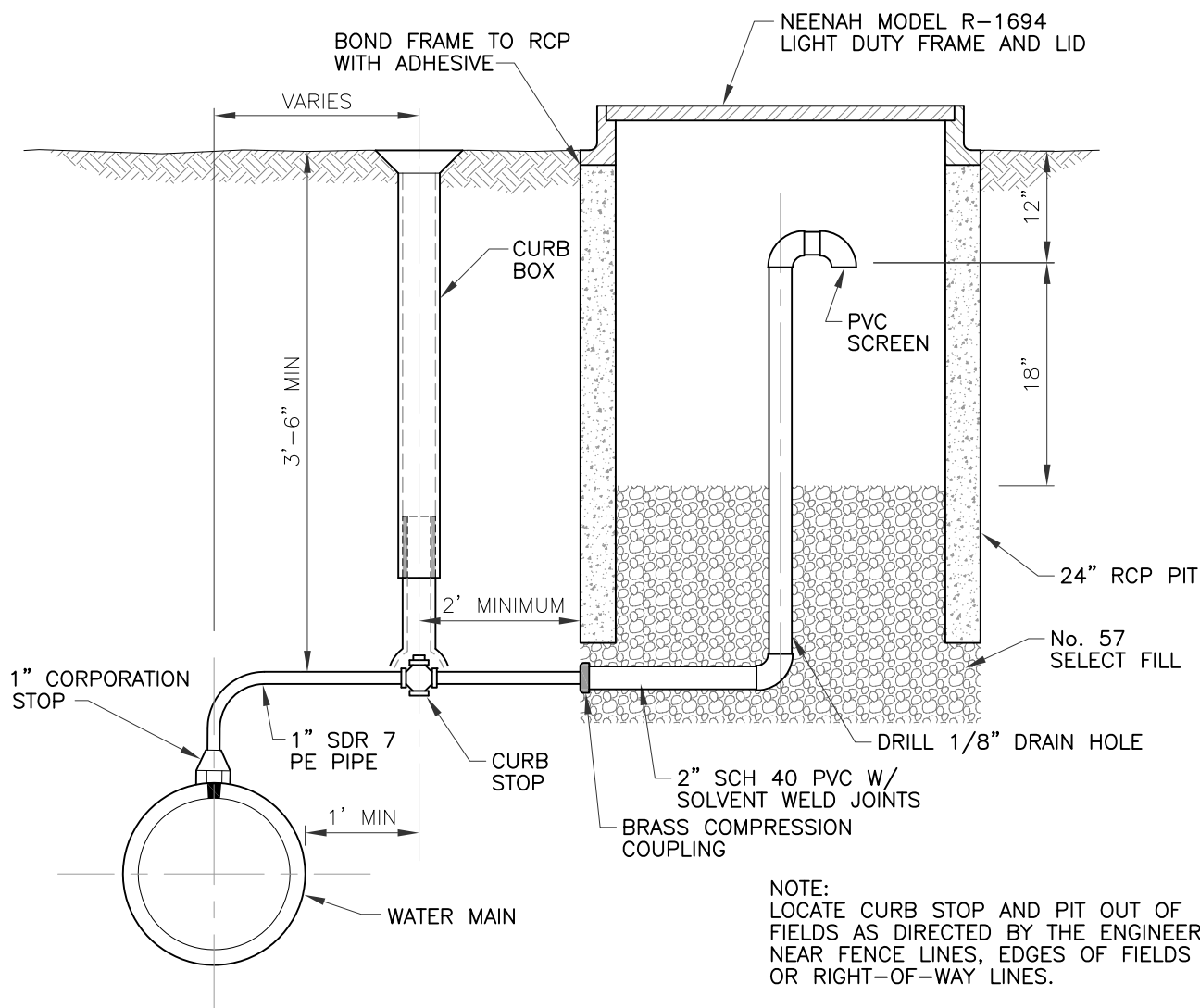


GENERAL NOTES

1. ALL METER INSTALLATIONS (≤ 2 ") ARE PERFORMED BY DEL-CO WATER AS PART OF THE TAP PURCHASE
2. METER INSTALLATIONS TYPICALLY SHALL BE EITHER FIVE (5') FEET OUTSIDE PUBLIC RIGHT-OF-WAY OR FIVE (5') BEHIND EXISTING WATER MAIN.

INSTALLATION NOTES

1. COMPACT SOIL AROUND METER PIT. FINE GRADE AND REMOVE ALL ROCKS AND DEBRIS.
2. CENTERLINE OF THE METER SHALL BE INSTALLED BETWEEN 12 & 18 INCHES BELOW FINISHED GRADE.
3. SEED AND MULCH ALL GRASS AREAS DISTURBED BY CONSTRUCTION.
4. RESTORE GRAVEL/PAVEMENT AREAS TO ORIGINAL CONDITION.
5. REMOVE EXCESS FILL OFFSITE OR ADD SUITABLE FILL AS REQUIRED.
6. COMPLETE AS-BUILT RECORD FOR EACH PROPERTY WHEN METER PIT IS INSTALLED.



MANUAL AIR RELEASE

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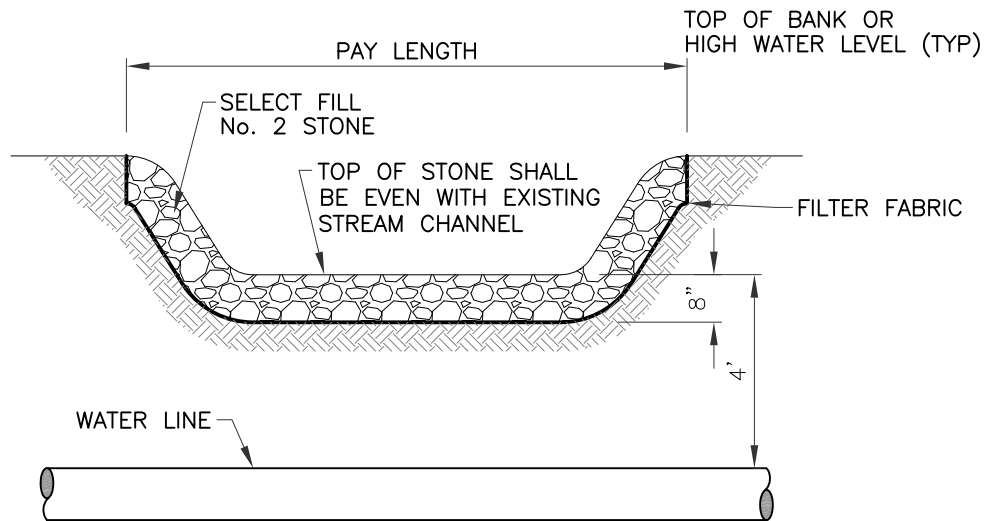
MANUAL AIR RELEASE

REVISED
09 OCT 18

SCALE
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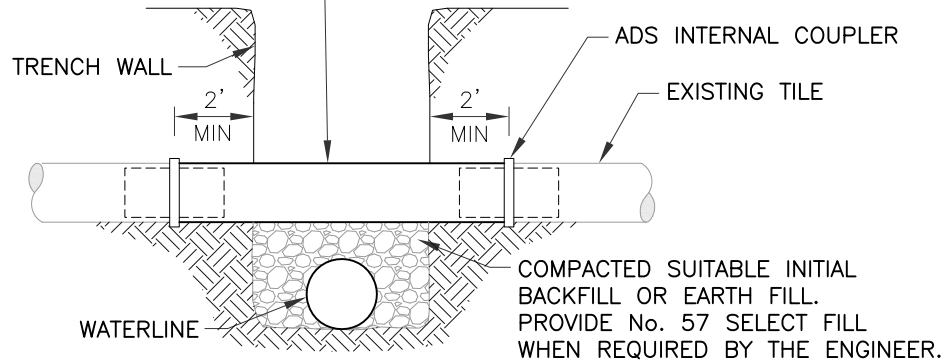
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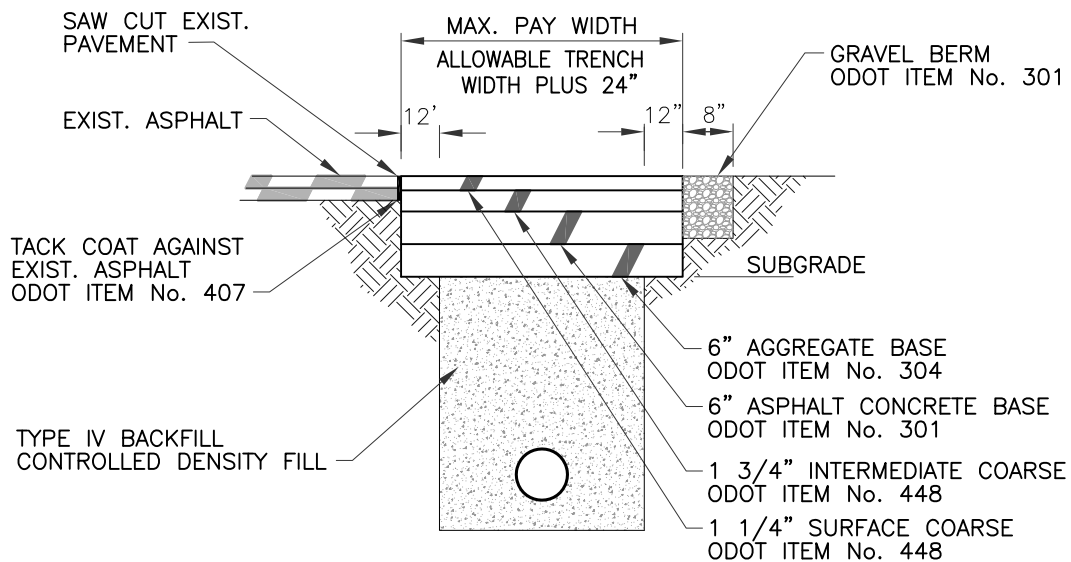
NOTE
 PROVIDE WIDTH OF STONE PLACEMENT EQUAL TO
 TRENCH WIDTH. TWO FEET MIN.

SDR 26 PVC NON-PERFORATED PIPE.
MATCH DIAMETER OF TILE. EXTEND 2'
BEYOND TRENCH WALL ON EACH SIDE
ON UNDISTURBED GROUND.



NOTE

DO NOT BACKFILL UNTIL APPROVED BY ENGINEER.



ASPHALT ROADWAY PAVEMENT REPLACEMENT

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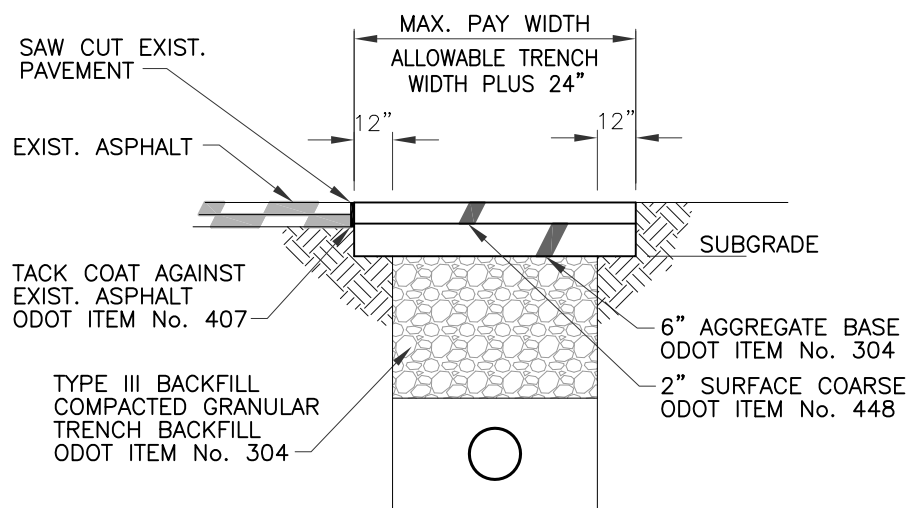
ASPHALT ROADWAY PAVEMENT REPLACEMENT

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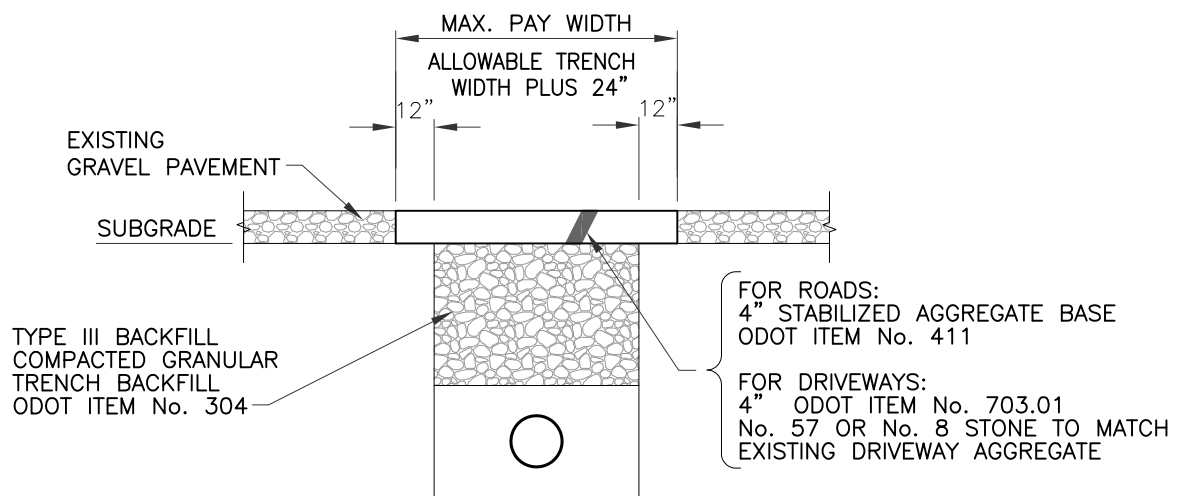
ASPHALT DRIVEWAY PAVEMENT REPLACEMENT

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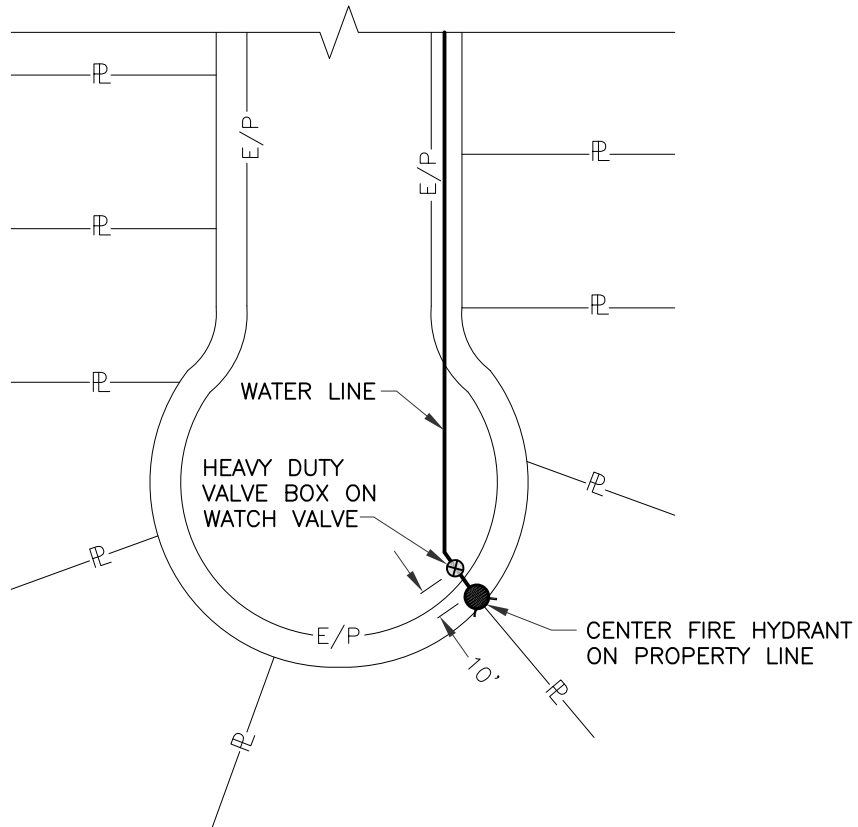
GRAVEL ROADWAY AND DRIVEWAY PAVEMENT REPLACEMENT

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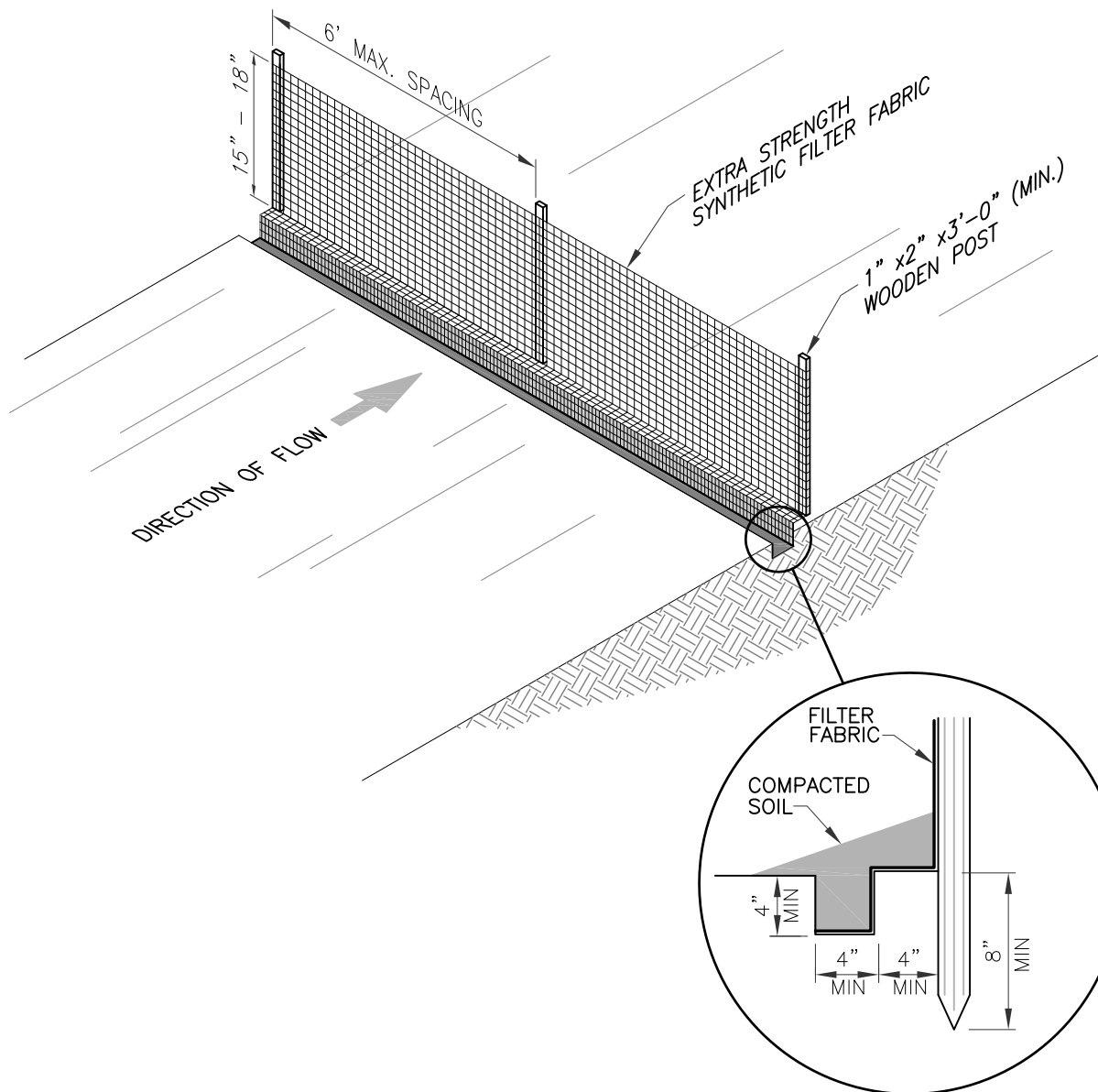
CUL-DE-SAC TERMINATION IN DELAWARE CITY

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NOTES

FILTER FABRIC SHALL BE FASTENED TO WOODEN POSTS USING 1/2" HEAVY DUTY STAPLES. FILTER FABRIC SHALL BE PLACED IN A CONTINUOUS ROLL TO MINIMIZE THE OCCURRENCE OF JOINTS. WHERE JOINTS CANNOT BE AVOIDED, FABRIC SHALL BE SPLICED TOGETHER AT SUPPORT POSTS, WITH A MINIMUM OF 6 INCH OVERLAP, AND SECURELY SEALED.

ALTERNATELY, A 14 GAUGE WIRE FENCE REINFORCEMENT HAVING A MINIMUM HEIGHT OF 18 INCHES AND A MAXIMUM MESH SPACING OF 6 INCHES MAY BE USED AS A FENCE SUPPORT. IF THE WIRE REINFORCEMENT IS USED, STANDARD STRENGTH SYNTHETIC FILTER FABRIC MAY BE USED AND WOODEN POSTS MAY BE SPACED AT 10 FOOT INTERVALS. THE WIRE REINFORCING SHALL BE BURIED A MINIMUM OF 4 INCHES AND SHALL BE FASTENED TO THE WOODEN POSTS USING 1" HEAVY DUTY STAPLES.

SILT FENCE

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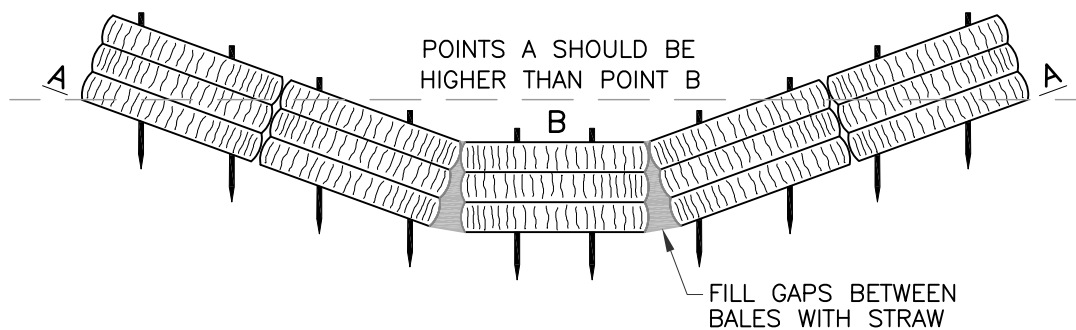
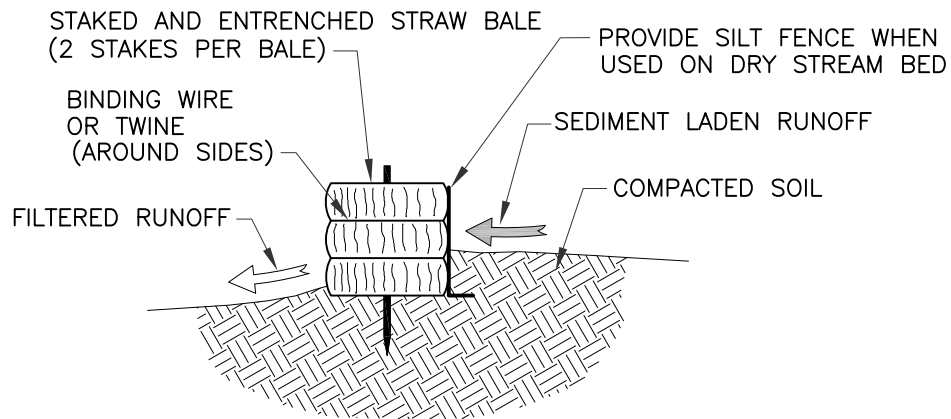
SILT FENCE

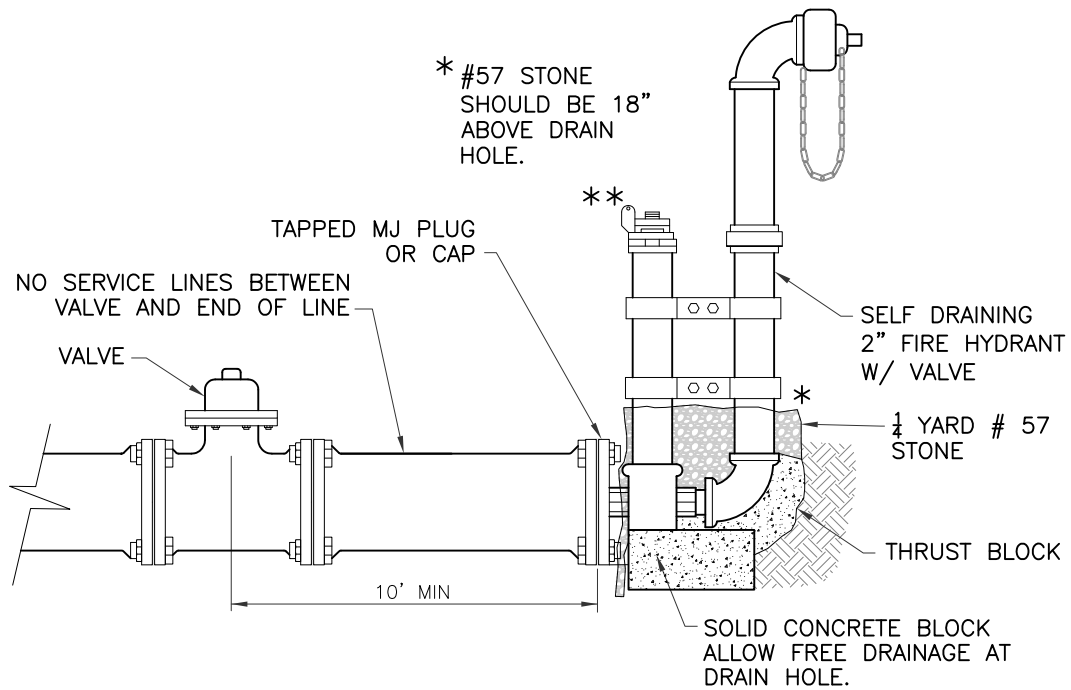
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09 OCT 18

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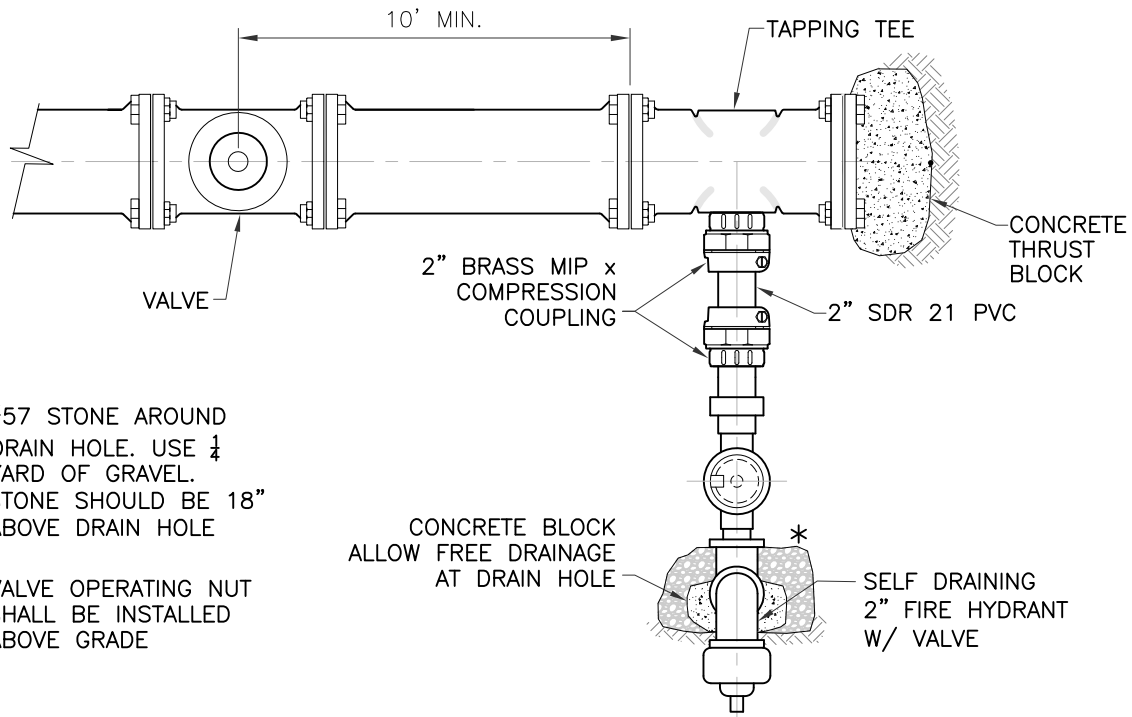
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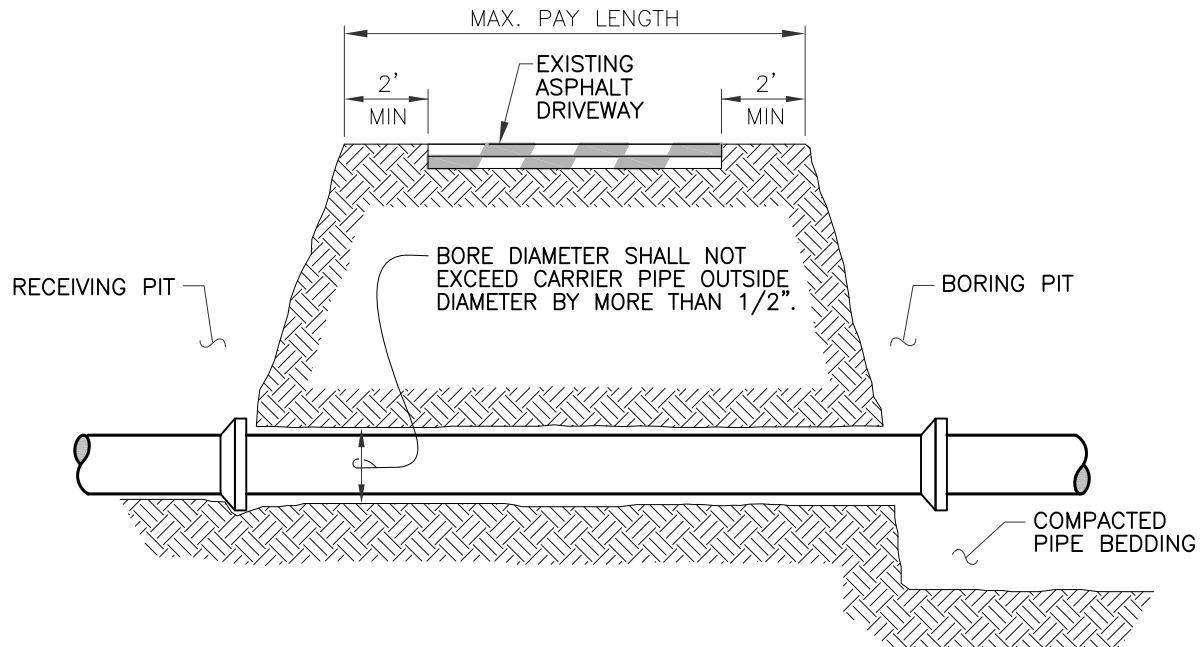




FOR MAINLINE ≤ 4"
NTS

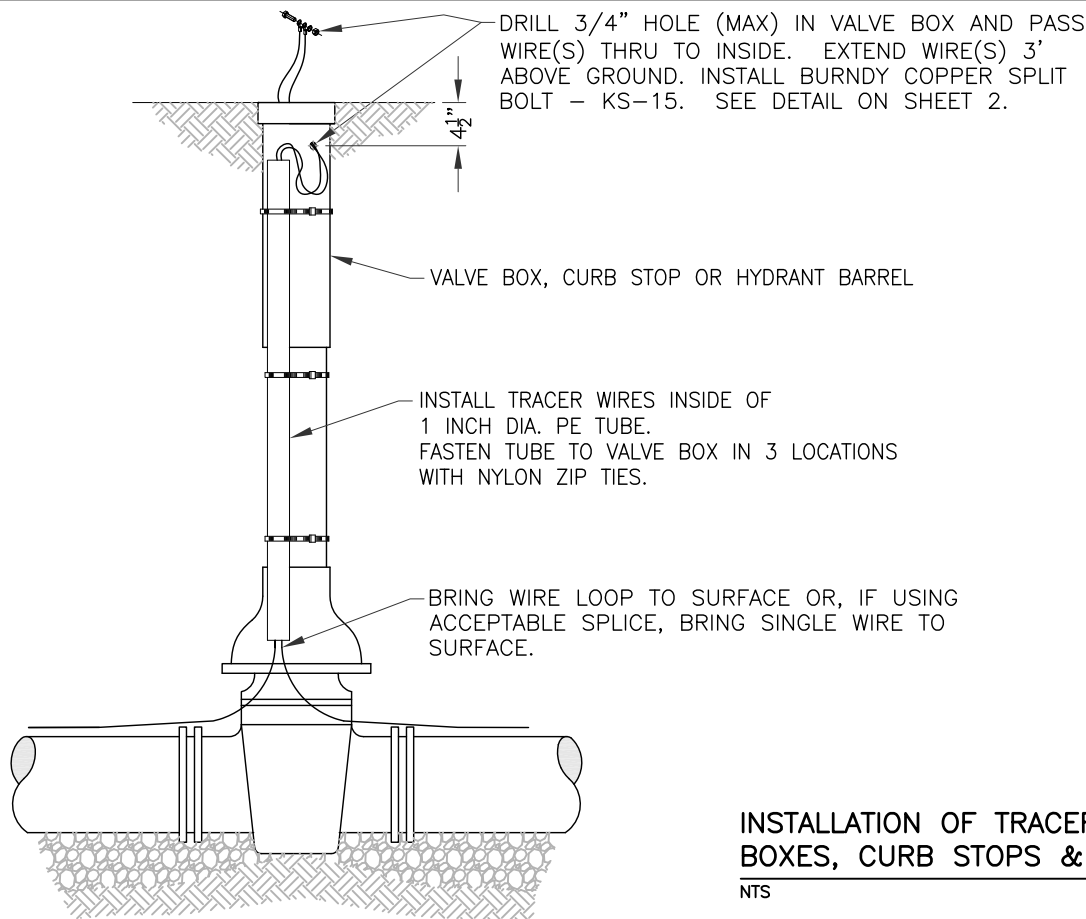


FOR MAINLINE > 4"
NTS



NOTES:

1. COMPLETE FREE BORE. REMOVE AUGER, AND INSERT CARRIER PIPE W/ SPIGOT END.
2. PROVIDE SINGLE PIECE OF CARRIER PIPE FOR ENTIRE SPAN OF FREE BORE WITH NO JOINTS.



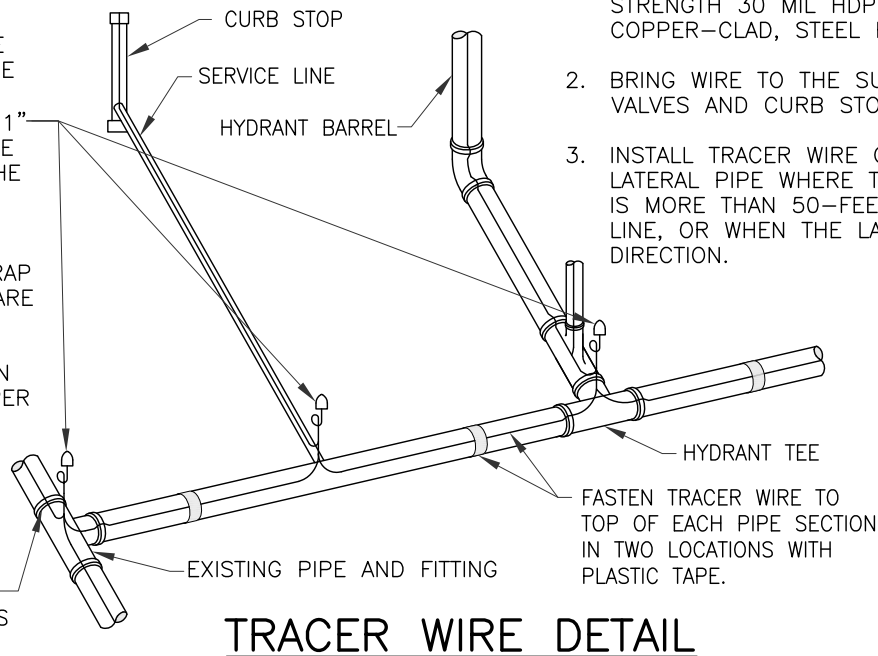
INSTALLATION OF TRACER WIRE AT VALVE BOXES, CURB STOPS & FIRE HYDRANTS

NTS

NOTES:

1. TRACER WIRE SHALL BE 12-GAUGE HIGH STRENGTH 30 MIL HDPE JACKET, COPPER-CLAD, STEEL REINFORCED.
2. BRING WIRE TO THE SURFACE AT ALL VALVES AND CURB STOPS.
3. INSTALL TRACER WIRE ON FIRE HYDRANT LATERAL PIPE WHERE THE FIRE HYDRANT IS MORE THAN 50-FEET FROM THE MAIN LINE, OR WHEN THE LATERAL CHANGES DIRECTION.

SPLICES & SERVICE LINE CONNECTIONS: LOOP WIRE AND TIE INTO KNOT. CONNECT BY STRIPPING 1" OF INSULATION FROM THE MAIN WIRE AND FROM THE END OF THE LATERAL WIRE. INSTALL BURNDY COPPER SPLIT BOLT KS-15. THOROUGHLY WRAP THE CONNECTOR AND BARE WIRES WITH 3M TEMFLEX2155 RUBBER SPLICING TAPE AND THEN WRAP WITH SCOTCH SUPER 88 HEAVY DUTY GRADE ELECTRICAL TAPE.



TRACER WIRE DETAIL

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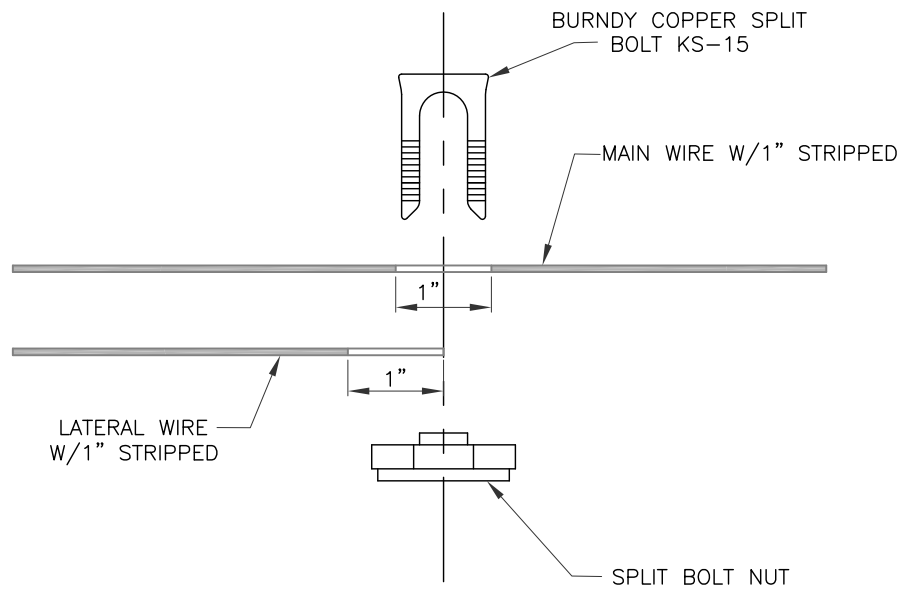
TRACER WIRE DETAIL

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4-26-16

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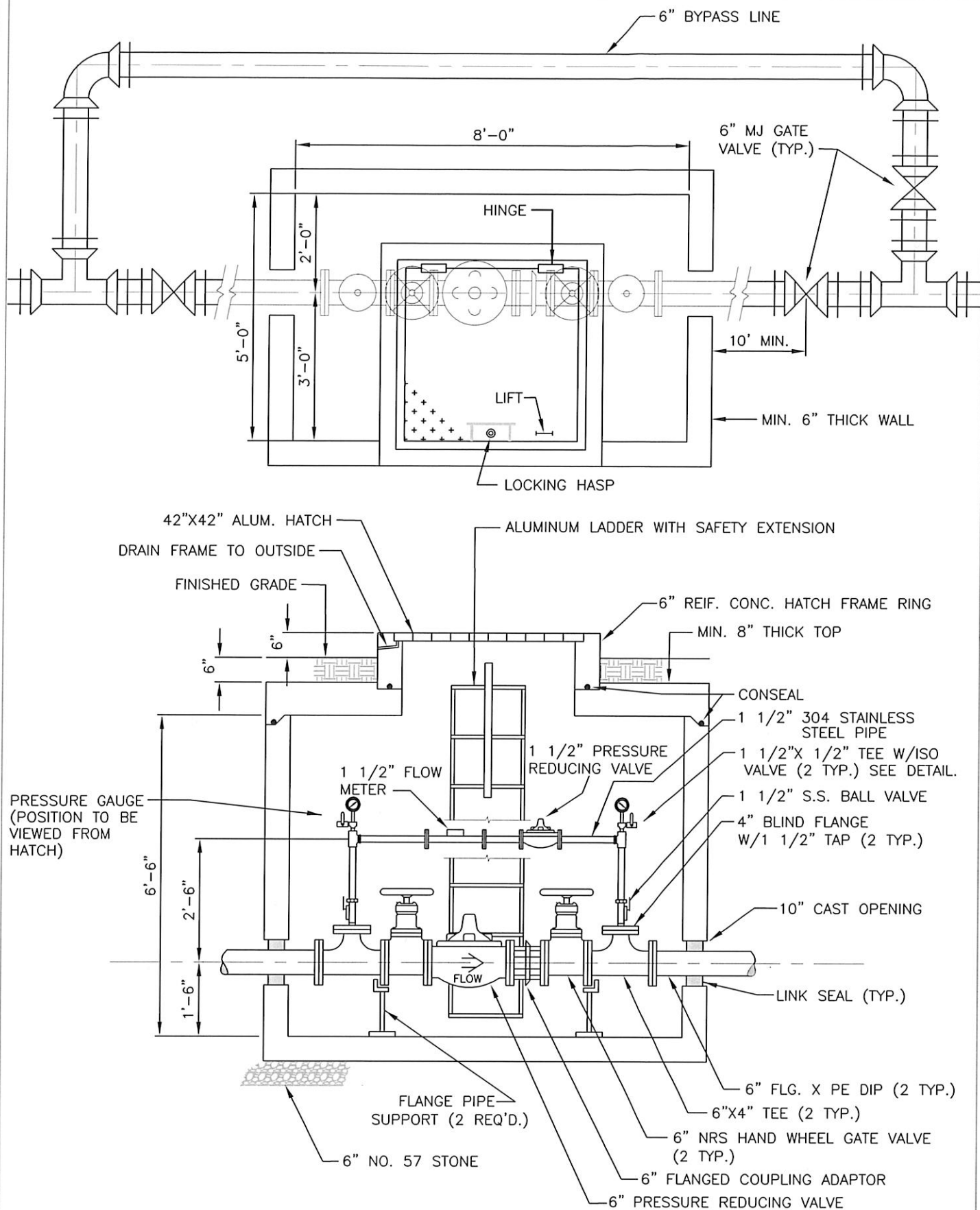
TRACER WIRE DETAIL

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4-26-16

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DELCO
WATER COMPANY

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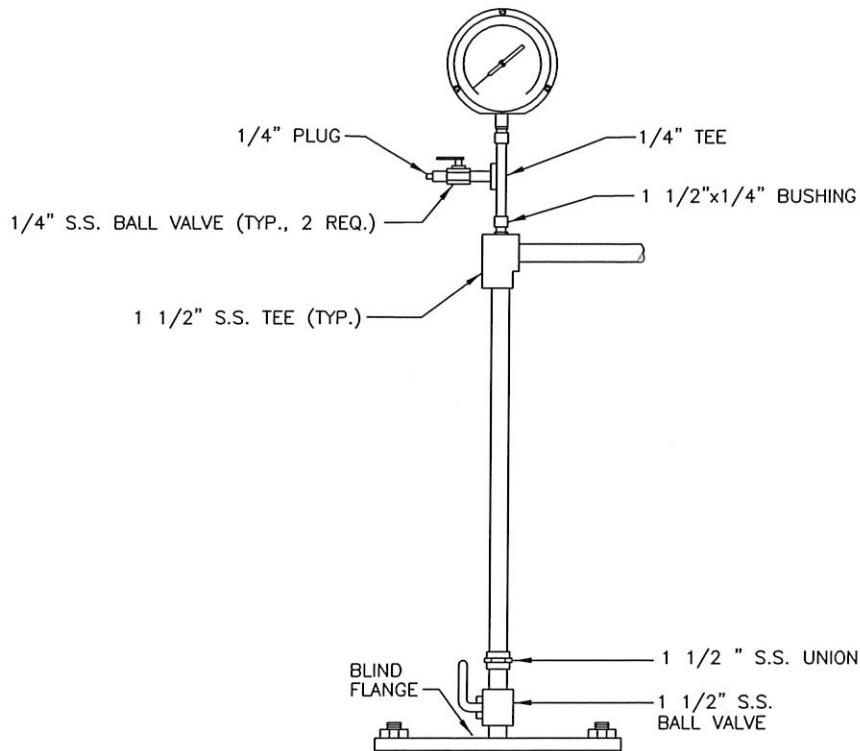
MASTER PRESSURE REDUCING VALVE VAULT

REVISED
12-14-17

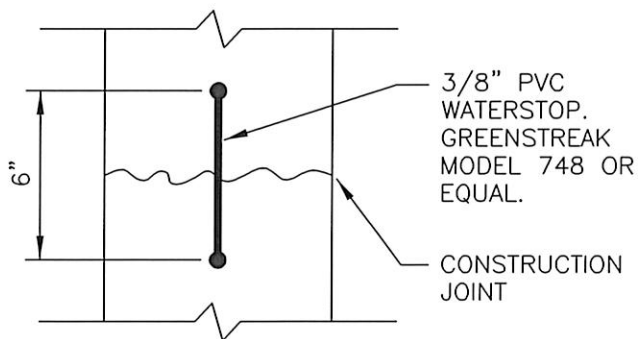
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PRESSURE GAUGE DETAIL
(2 REQUIRED)



WATERSTOP DETAIL



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MASTER PRESSURE REDUCING VALVE VAULT

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12-14-17

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NOTES:

1. VAULT SHALL BE PRECAST REINFORCED CONCRETE, CONSTRUCTED AS A SINGLE WATERTIGHT UNIT WITH THE EXCEPTION OF THE TOP SLAB AND THE ACCESS HATCH RING. PVC WATERSTOP SHALL BE PLACED AT ALL CONSTRUCTION JOINTS AND BE CONTINUOUS FOR THE LENGTH OF JOINT WITH ENDS SEAL WELDED. PROVIDE FOUR INTERIOR LIFTING CABLES AT EACH CORNER. VAULT SHALL BE DESIGNED BY AN OHIO REGISTERED PROFESSIONAL ENGINEER TO WITHSTAND AN AASHTO H20 LIVE LOAD, WITH EXCEPTION OF HATCH. PROVIDE ENGINEERED STAMPED DRAWING SUBMITTAL STATING DESIGN PARAMETERS.
2. ACCESS HATCH SHALL BE ALUMINUM CHECKERED PLATE WITH EXTRUDED ALUMINUM FRAME. PROVIDE WITH TYPE 316 STAINLESS STEEL HINGES, HOLD OPEN ARM, AND OTHER HARDWARE. DESIGN LIVE LOAD SHALL BE 300 PSF. PROVIDE WITH FLUSH DROP HANDLE AND STAPLE TO RECEIVE OWNER'S PADLOCK. FRAME SHALL BE CAST IN REINFORCED CONCRETE RING. DRAIN FRAME TO OUTSIDE. APPLY BITUMINOUS COATING TO SURFACES IN CONTACT WITH CONCRETE. U.S.F. FABRICATION TPS 300 OR EQUAL.
3. PRESSURE REDUCING VALVES SHALL BE CLA-VAL MODEL 90-01 WITH EPOXY-LINED DUCTILE IRON BODY, 150 LB. FLANGED ENDS, STAINLESS STEEL SEAT, DISC GUIDE AND ALL OTHER INTERIOR TRIM. CONTROL PIPING SHALL BE BLACK NYLON (250 PSI) AND INCLUDE ISOLATION VALVES AT MAIN BODY, CV SPEED CONTROL VALVES FOR OPENING AND CLOSING, X43 "Y" STRAINER, AND X101 MAIN VALVE POSITION INDICATOR, PILOT VALVE SHALL BE BRONZE WITH STAINLESS STEEL TRIM. OPERATING RANGE 20 TO 105 PSI.
4. VAULT LADDER SHALL BE ALUMINUM, ANCHORED TO FLOOR AND WALL USING 7 INCH STANDOFFS AND STAINLESS STEEL ANCHORS. LADDER WIDTH SHALL BE 18 INCHES AND RUNGS SPACED AT 12 INCHES. PROVIDE RETRACTABLE ALUMINUM 40-INCH MINIMUM HEIGHT SAFETY EXTENSION.
5. GATE VALVES SHALL BE AWWA C509 RESILIENT WEDGE NON-RISING STEM WITH HAND WHEEL OPERATOR AND 150 LB. FLANGED ENDS.
6. FLOW METER SHALL BE BATTERY POWERED BADGER E SERIES ULTRASONIC FLOW METER WITH STAINLESS STEEL BODY AND FLANGED ENDS.
7. PIPING INSIDE VAULT FOUR INCH AND LARGER SHALL BE FLANGED CLASS 52 DIP. PROVIDE SHOP PRIMER COMPATIBLE WITH FINISH COATING SYSTEM. PIPE SMALLER THAN FOUR INCH SHALL BE TYPE 304 SCHEDULE 40 STAINLESS STEEL PIPE. SMALLER PIPE FITTINGS AND BALL VALVES SHALL BE STAINLESS STEEL.
8. PIPE FLANGE SUPPORTS SHALL BE HOT DIP GALVANIZED BOLTED TO FLANGE TO PREVENT PIPE ROTATION. ANCHOR TO FLOOR WITH STAINLESS STEEL ANCHORS. COOPER B-LINE MODEL B3094 AND B3088 OR EQUAL.
9. PRESSURE GAUGES SHALL BE BOURDON STYLE MINIMUM 4.5-INCH DIAL DRY CASE SCALED 0-160 PSI, ACCURACY $\pm 1.0\%$ OF SPAN. CASE AND INTERIOR MOVEMENT COMPONENTS SHALL BE STAINLESS STEEL WIKA SERIES 232.50 OR EQUAL.
10. PAINT PIPING AND EQUIPMENT INSIDE VAULT AFTER ASSEMBLY WITH TWO COATS OF TNE MEC N140 POTAPOX AT 4.0-6.0 MILS DFT, SAFETY BLUE. DO NOT PAINT STAINLESS STEEL PIPE, CONTROL VALVES OR BRASS FITTINGS.



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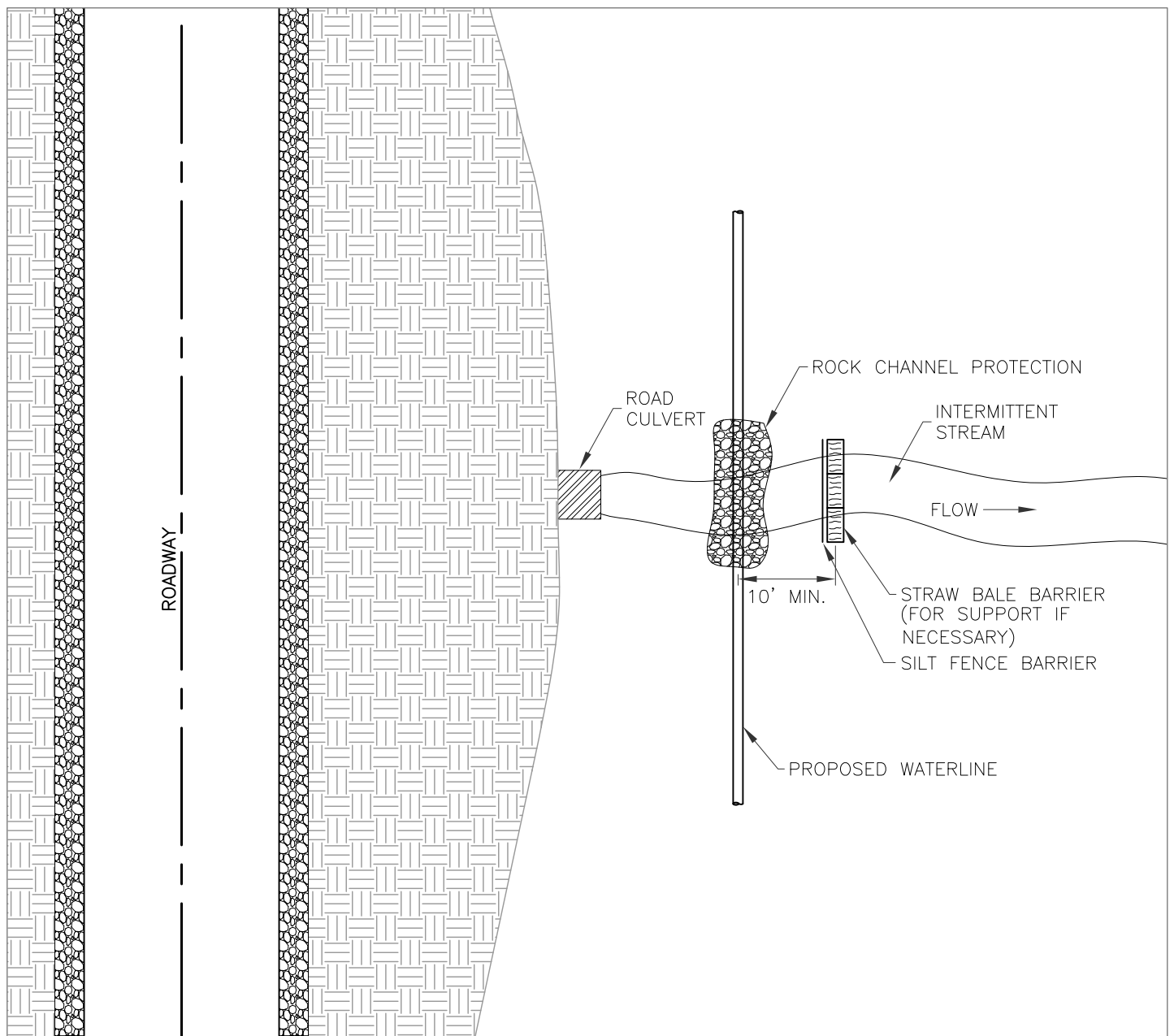
MASTER PRESSURE REDUCING VALVE VAULT

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NOTES:

1. CONTRACTOR MAY OPEN CUT INTERMITTENT STREAM IF WATER IS NOT FLOWING AT THE TIME OF CROSSING.
2. OPEN CUT STREAM CROSSING SHALL BE COMPLETED WITHIN 24 HOURS OF START INCLUDING FINAL GRADING AND SEEDING.
3. WORK AREA ACROSS INTERMITTENT STREAM SHALL BE RESTORED WITH ROCK CHANNEL PROTECTION ACCORDING TO DETAIL.

INTERMITTENT STREAM CROSSING DETAIL

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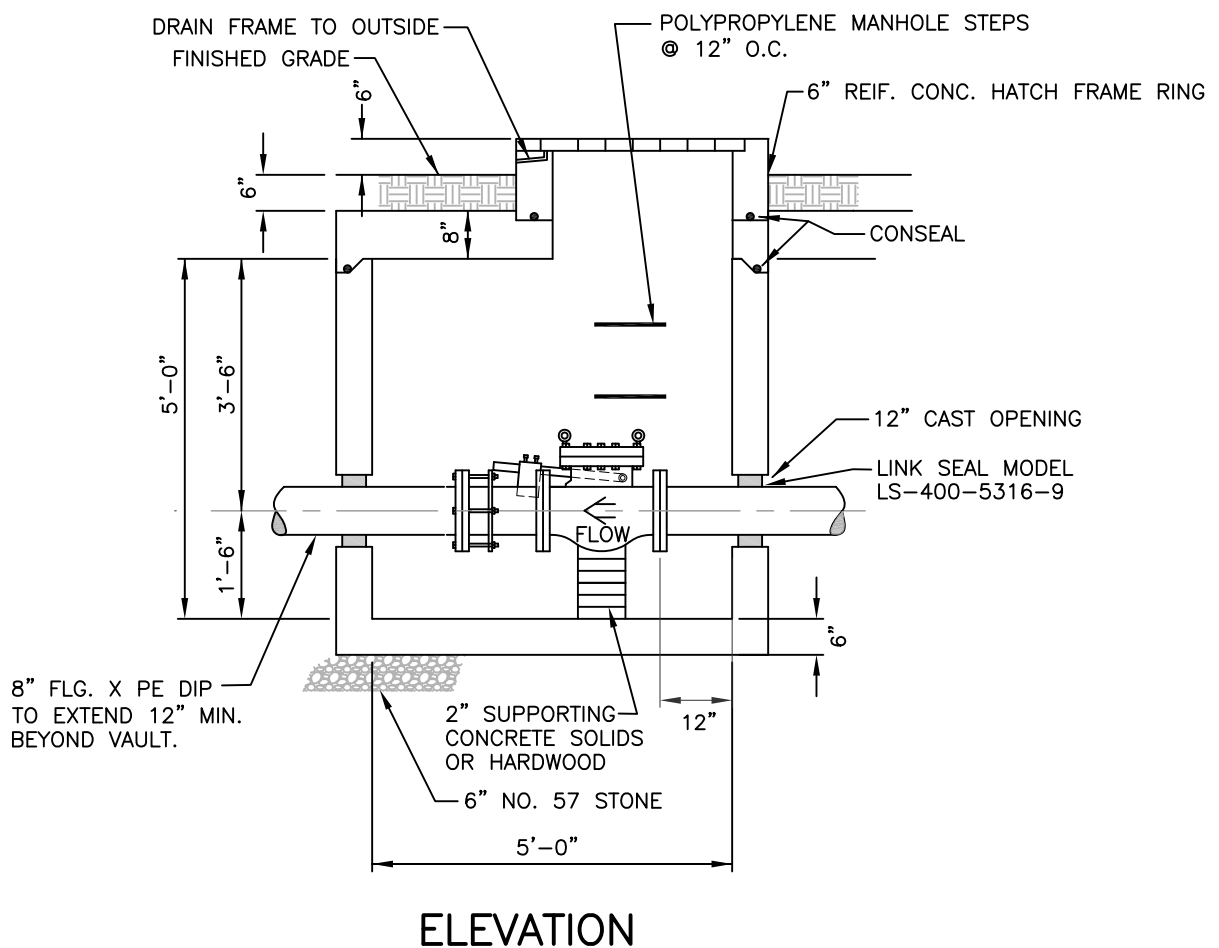
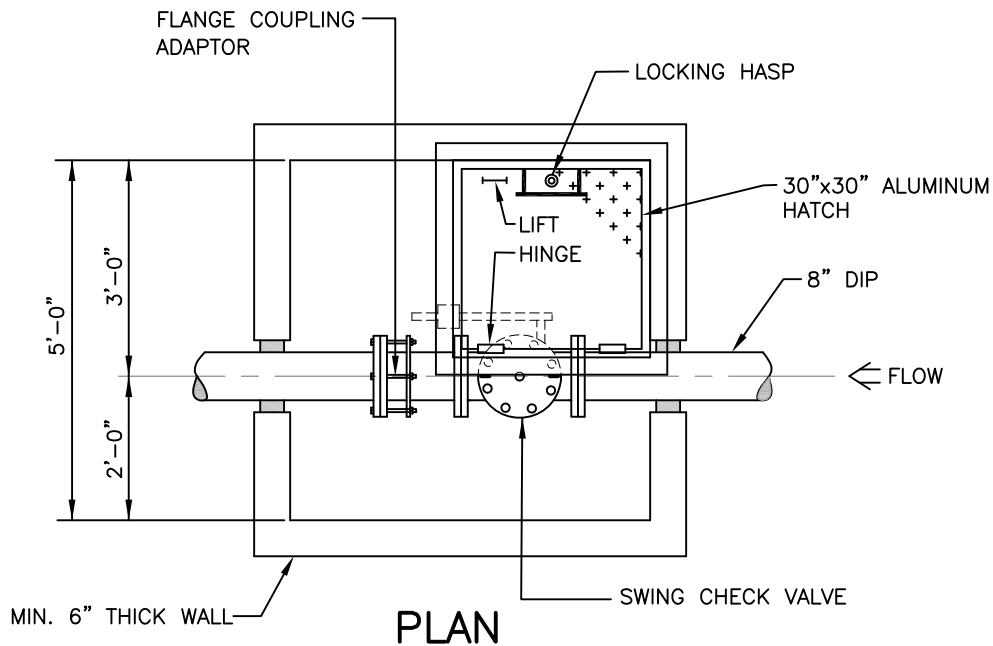
DRAINAGE DITCH CROSSING WITHOUT PRECIPITATION

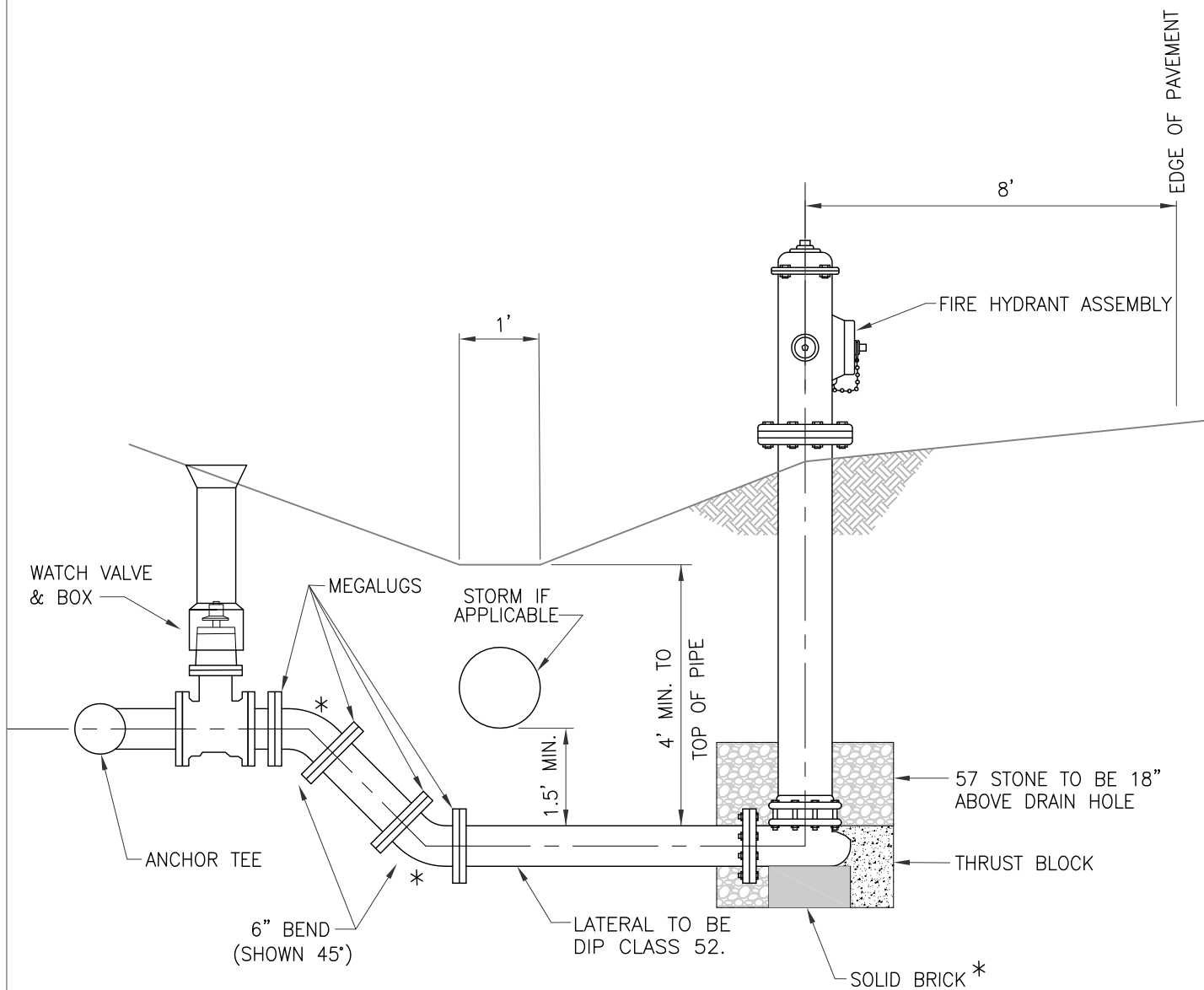
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* SEE DEL-CO WATER COMPANY
STANDARD DRAWING D-04 FOR
THRUST BLOCKING DETAILS.



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FIRE HYDRANT LATERAL LOWERING DETAIL

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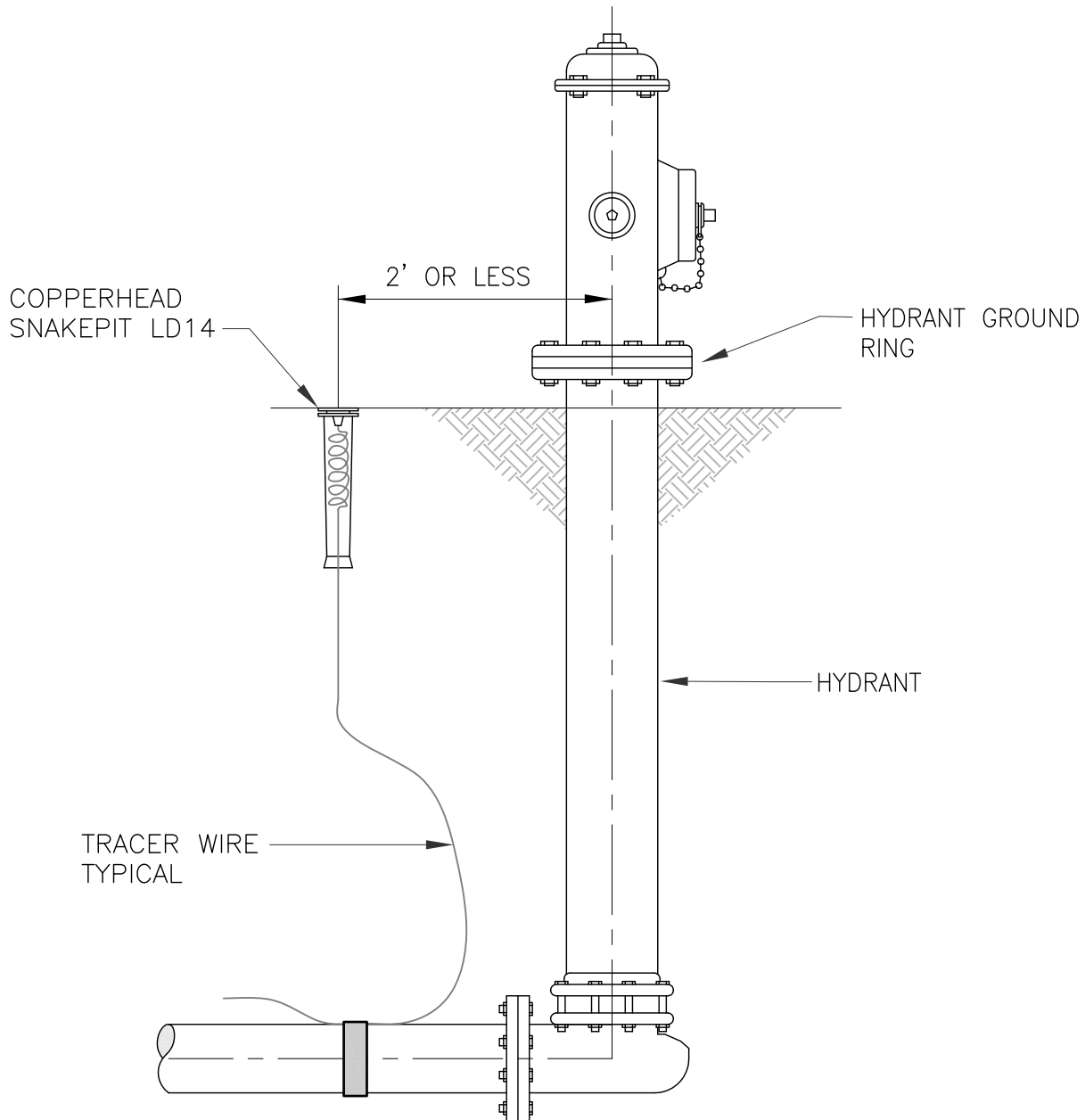
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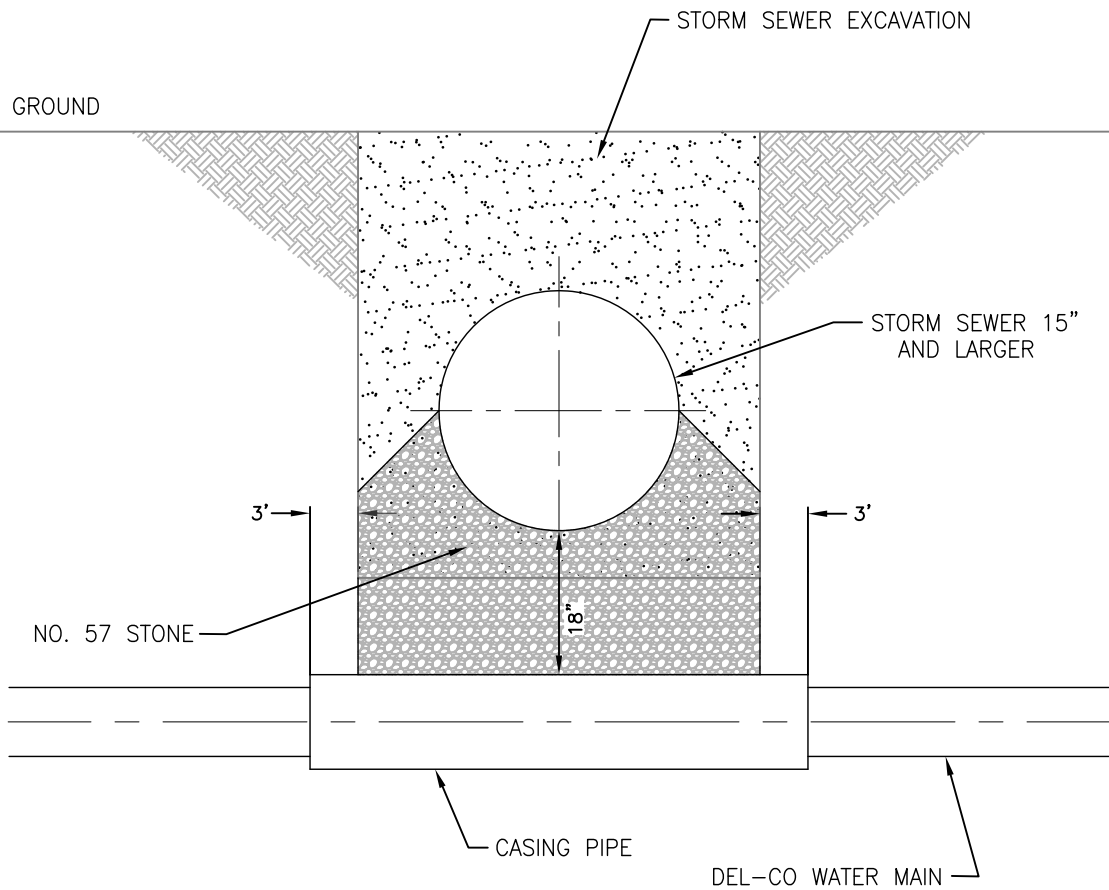
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COPPERHEAD SNAKEPIT MAGNETIZED TRACER BOX # LD14*TP.

1. CURL 18"–24" EXTRA TRACER WIRE IN BOX.
2. CONNECT COPPERHEAD TRACER WIRE TO BRASS NUT ON BOTTOM OF CAST BOX LID.
3. WRAP TRACER WIRE CONNECTION WITH COPPERHEAD WAX TAPE INCLUDED WITH BOX.
4. SECURE LID WITH PENTAGON TOOL.





NOTES:

CASING PIPE SHALL BE SDR 26 OR GREATER
AND SHALL BE SIZED SO THAT PIPE CAN BE
EASILY REMOVED IF NECESSARY.

DO NOT INSTALL CASING SPACERS OR END
SEALS.



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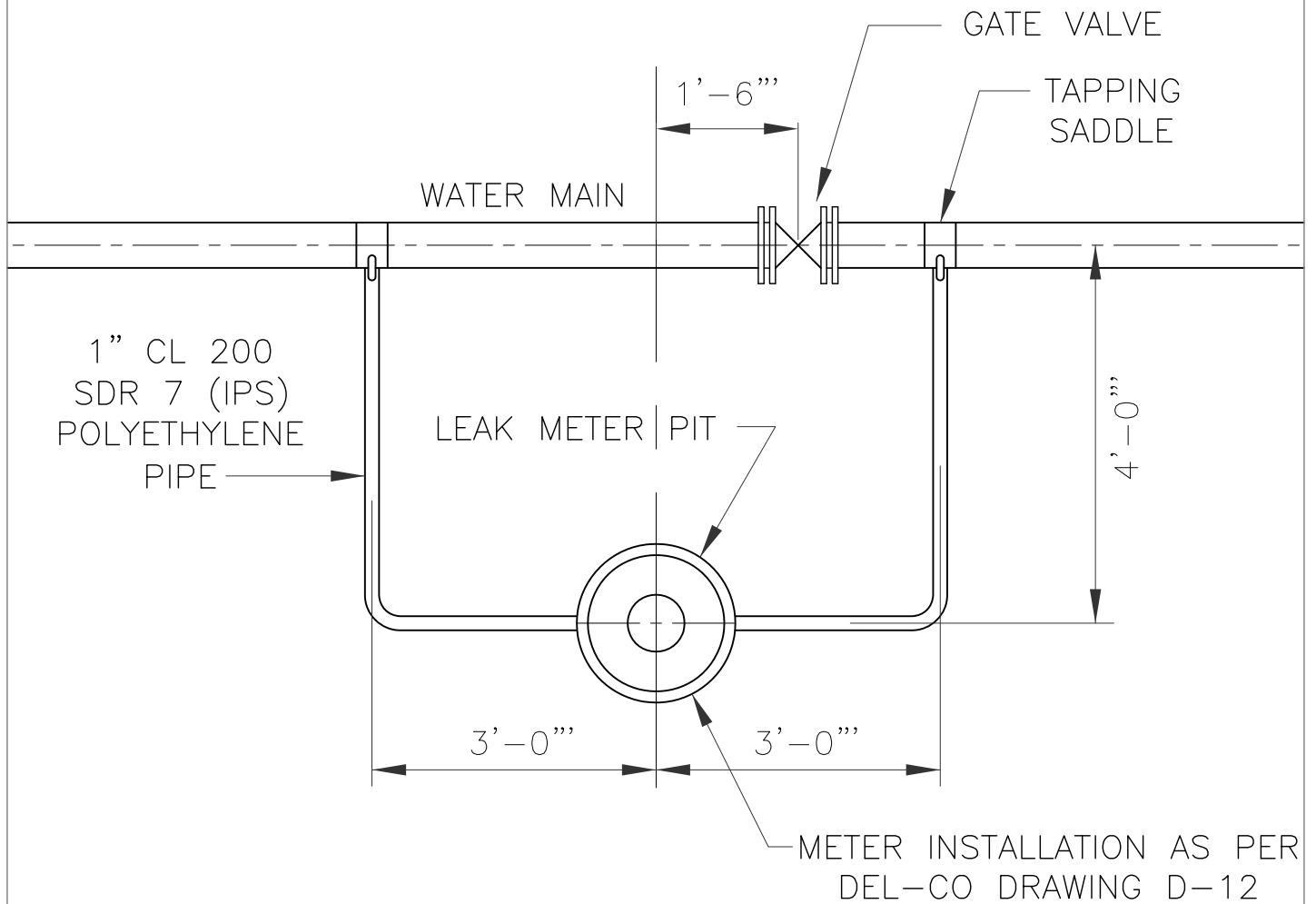
STORM CROSSING CASING PIPE DETAIL

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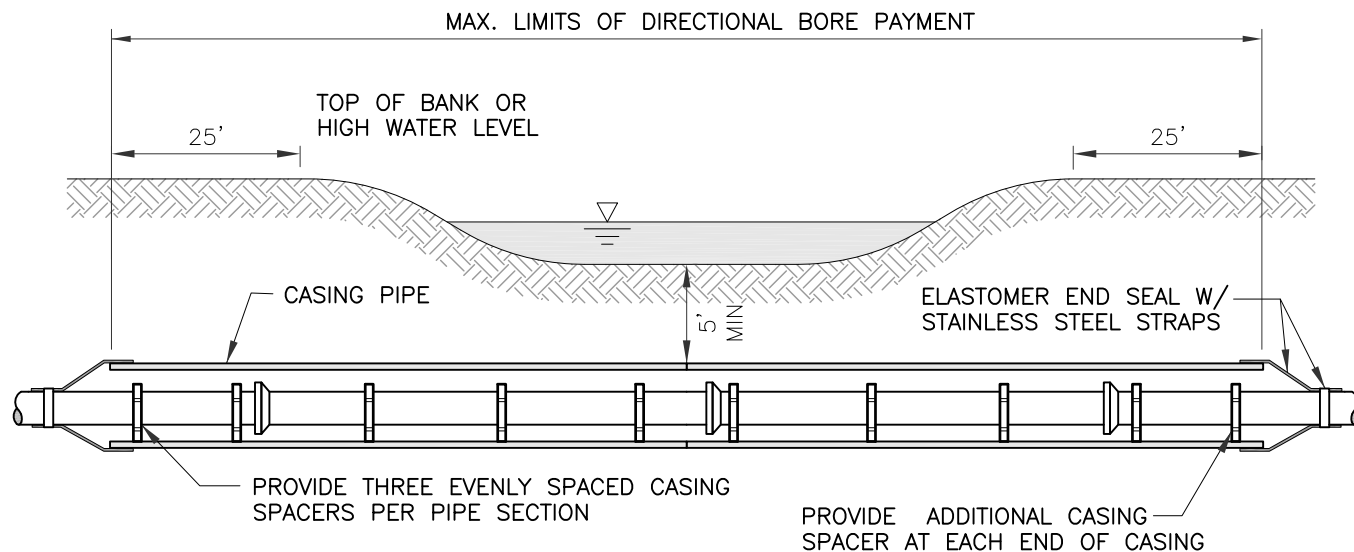
LEAK METER DETAIL

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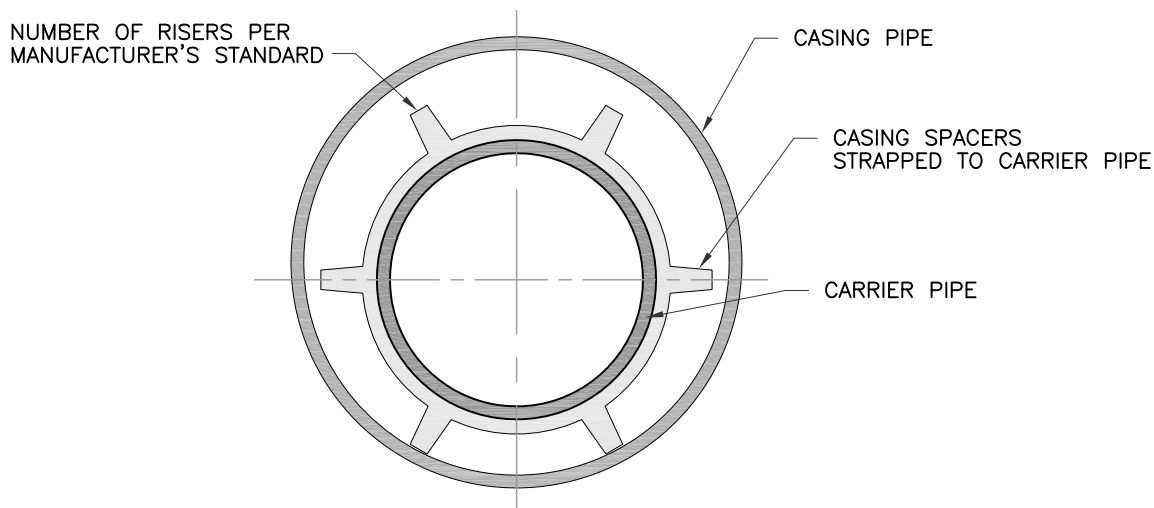
PAGE 1 OF 1

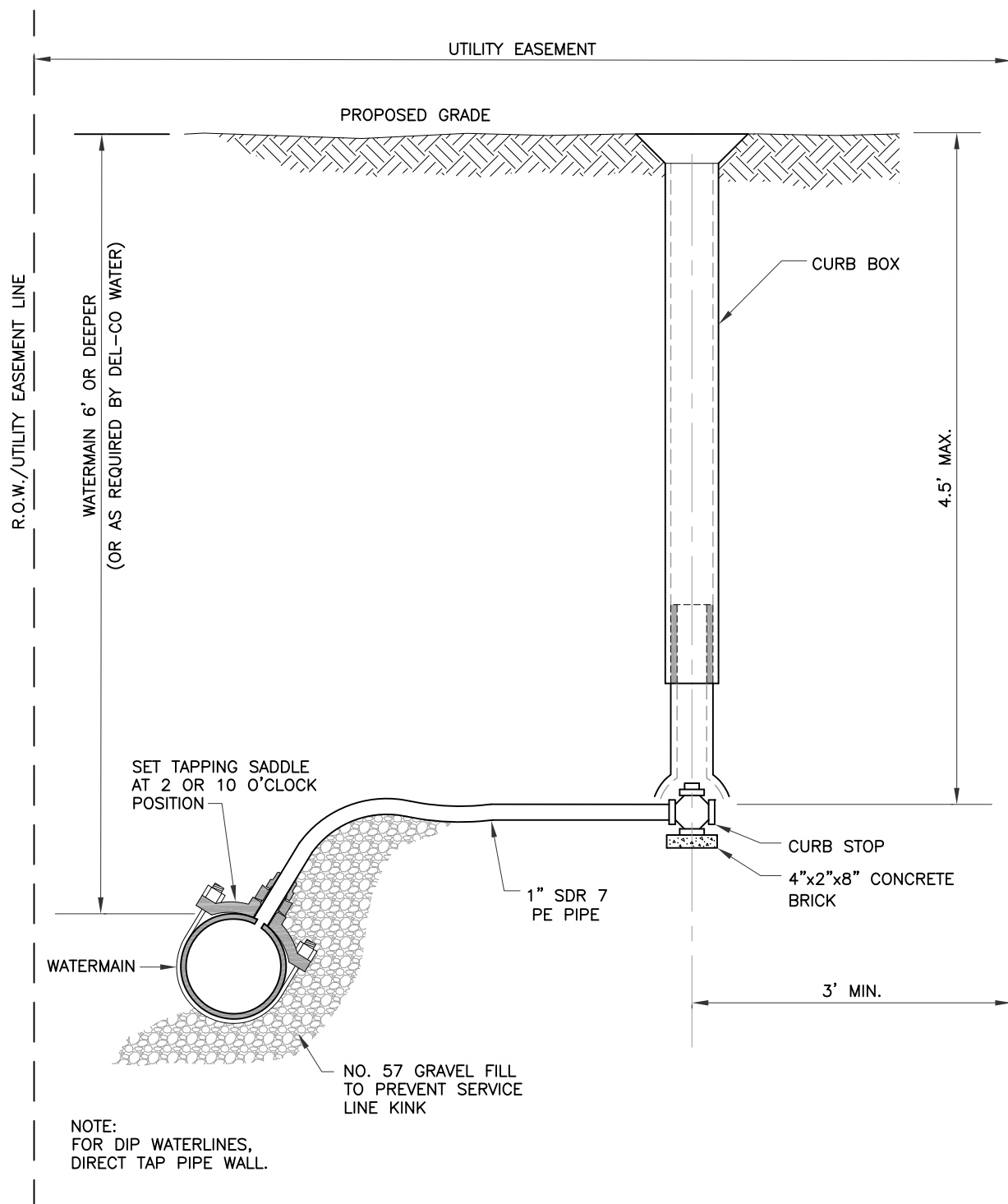
D-31

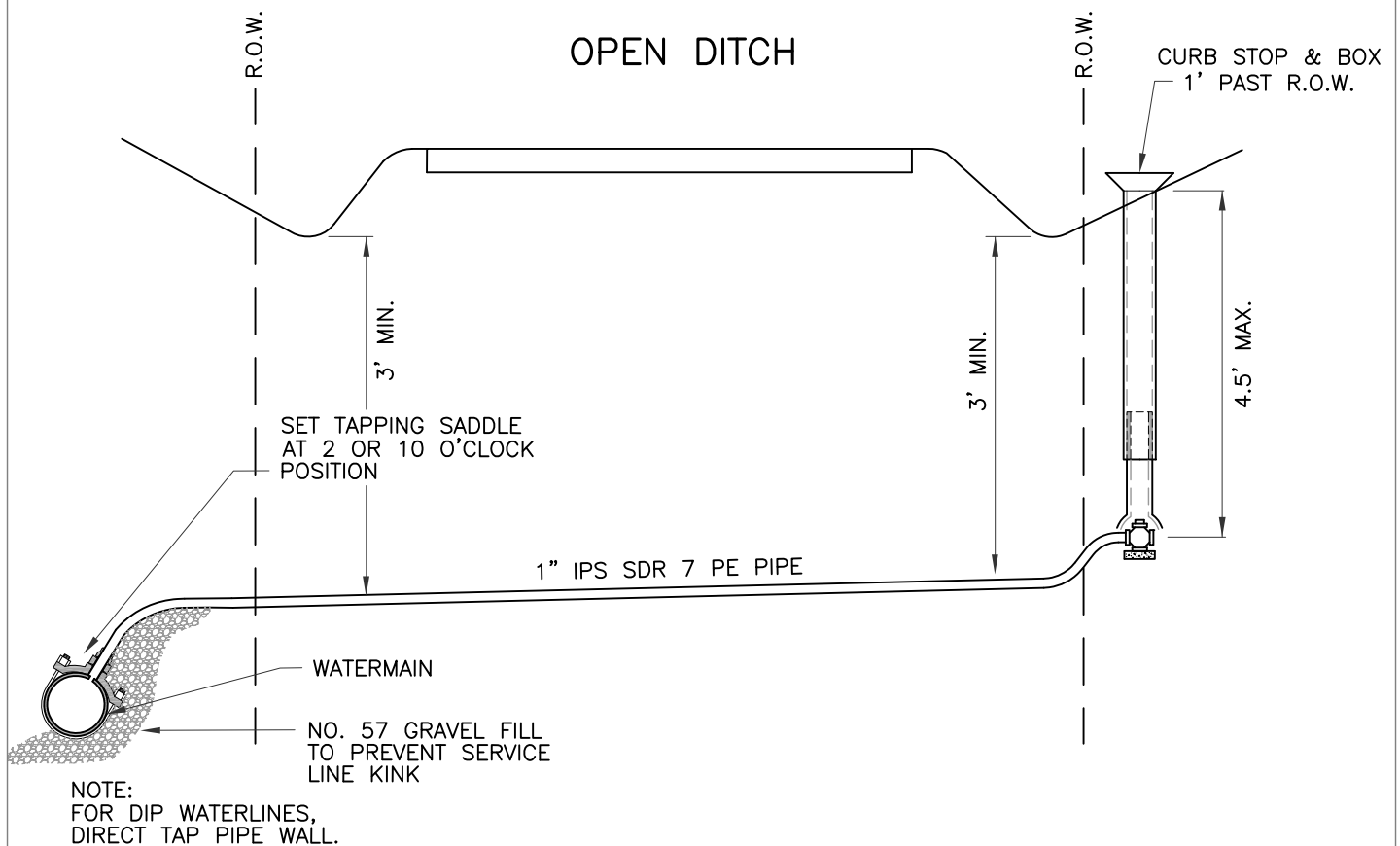
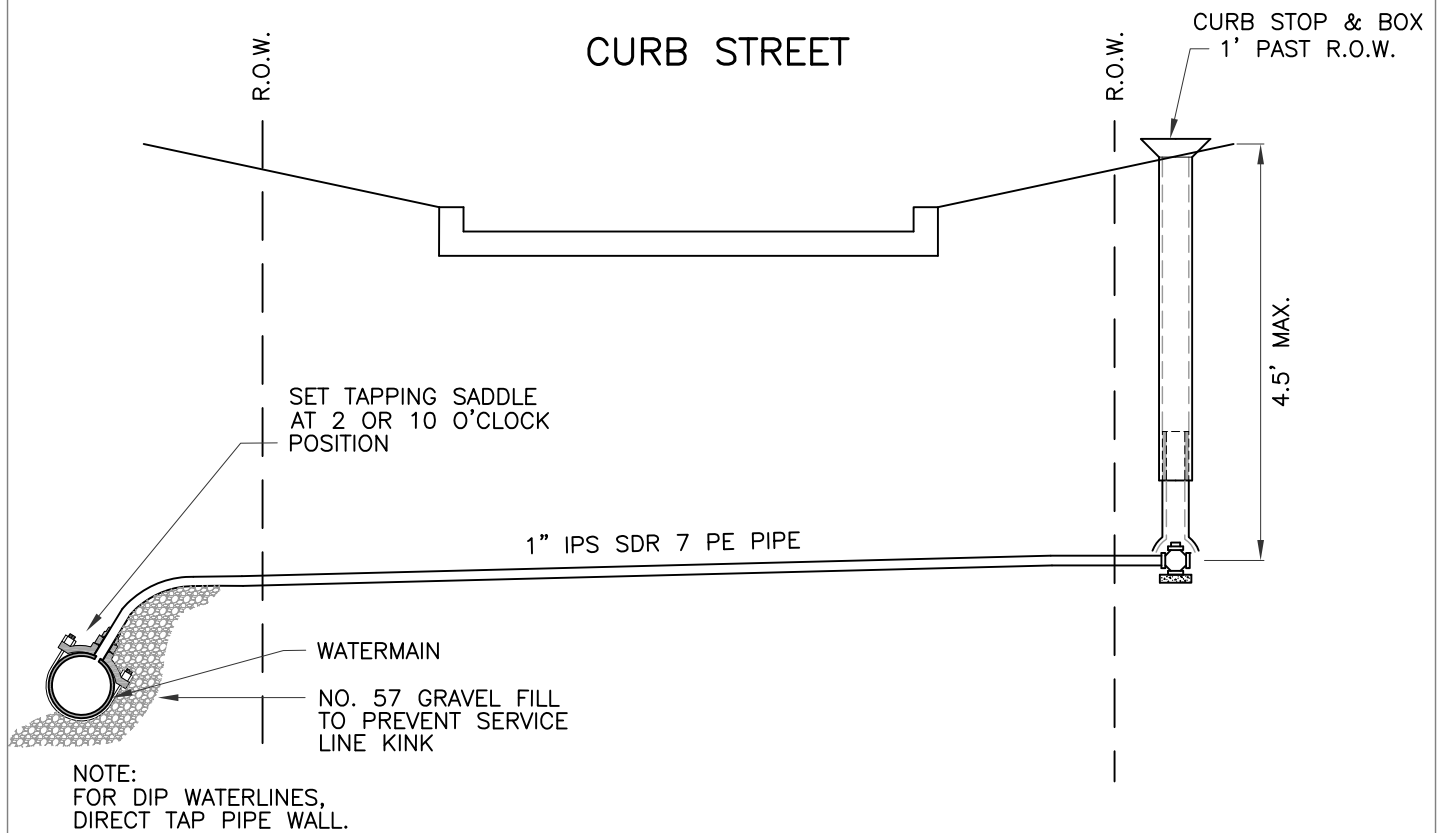


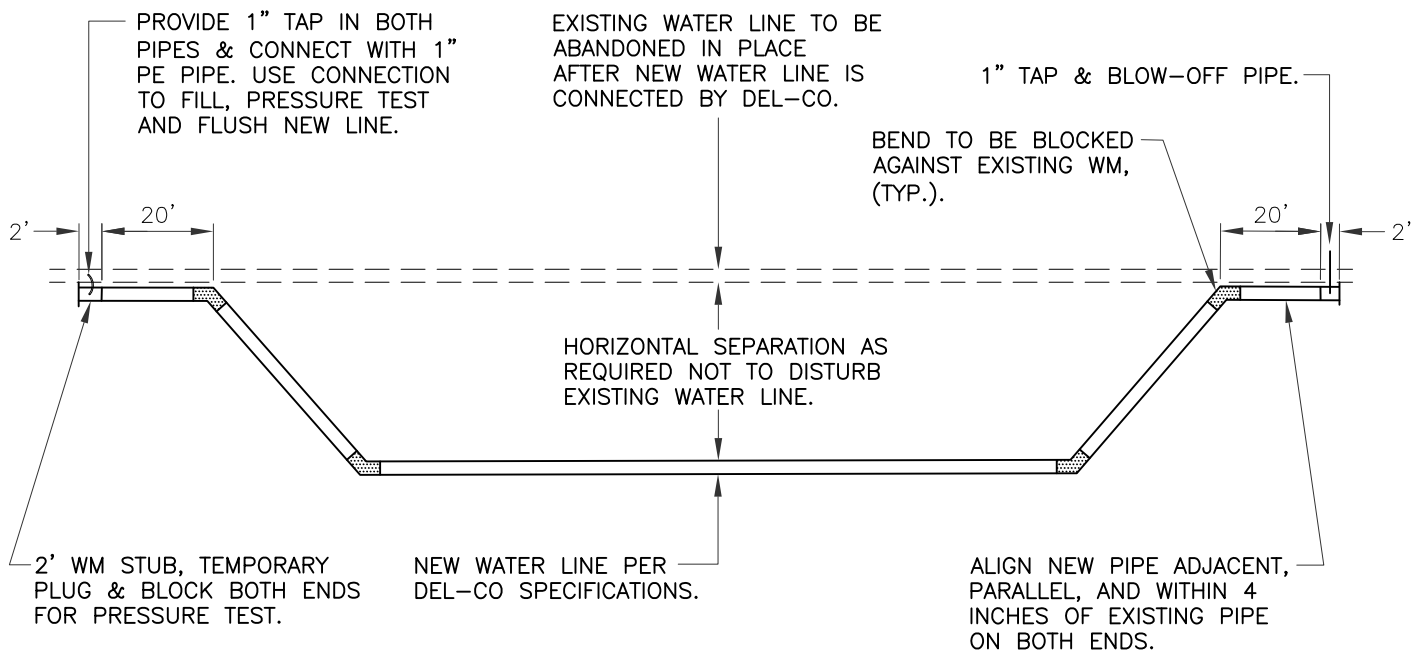
STREAM CROSSING

PROVIDE CASING PIPE FOR ALL STREAM CROSSINGS UNLESS OTHERWISE APPROVED BY DEL-CO. CASING PIPE SHALL BE STEEL PIPE WITH 0.375-INCH WALL THICKNESS. INSIDE DIAMETER OF THE CASING PIPE SHALL NOT EXCEED 3 INCHES OF THE OUTSIDE DIAMETER OF THE CARRIER PIPE AND CASING SPACERS.

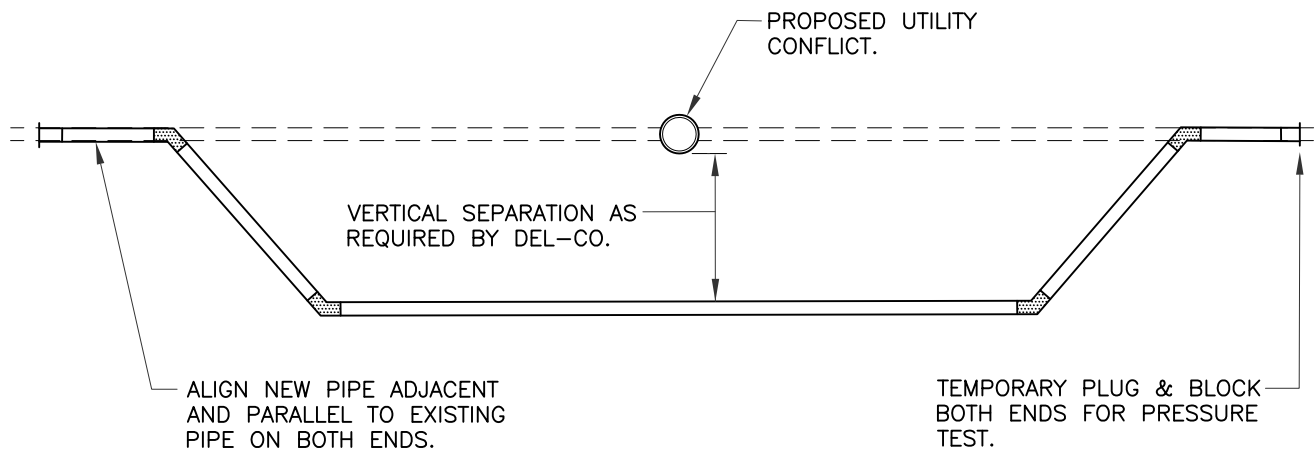








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***INSTALL THRUST BLOCKS
ON ALL FITTINGS PER
DEL-CO DETAIL D-4.**



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WATER LINE RELOCATION WITH FITTINGS

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- DELCO**
WATER COMPANY

STANDARD MASTER METER INSTALLATION IN ABOVE GROUND STRUCTURE

D-36

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