

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:

| | | |
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| APPLICATION OF KENTUCKY- |) | |
| AMERICAN WATER COMPANY FOR A |) | CASE NO. 2023-00248 |
| CERTIFICATE OF PUBLIC |) | |
| CONVENIENCE AND NECESSITY |) | |
| AUTHORIZING THE CONSTRUCTION OF |) | |
| A WATER TRANSMISSION MAIN TO THE |) | |
| CITY OF MILLERSBURG |) | |

VERIFIED APPLICATION

Pursuant to KRS 278.020(1) and 807 KAR 5:001, Section 15, Kentucky-American Water Company ("KAW") requests the Commission to issue a Certificate of Public Convenience and Necessity ("CPCN") authorizing KAW to construct a water transmission main to Millersburg, KY ("Project"). In support of this filing, KAW states as follows:

1. KAW is a corporation organized and existing under the laws of the Commonwealth of Kentucky with its principal office and place of business at 2300 Richmond Road, Lexington, Kentucky 40502. KAW can be contacted by e-mail via the e-mail addresses of its counsel set forth below. KAW was incorporated on February 27, 1882 and attests that it is currently in good standing in the Commonwealth of Kentucky.

2. KAW is a wholly-owned subsidiary of American Water Works Company, Inc. ("AWW") and is engaged in the distribution and sale of water in its Central Division, consisting of Bourbon, Clark, Fayette, Harrison, Jessamine, Nicholas, Scott, and Woodford Counties and its Northern Division, consisting of Gallatin, Owen and Grant Counties. It currently owns, operates

and maintains potable water production, treatment, storage, transmission and distribution systems for the purpose of furnishing potable water for residential, commercial, industrial and governmental users in its service territory. KAW is also engaged in the collection and treatment of wastewater in Bourbon, Clark, Owen, and Franklin Counties.

3. Facts Relied Upon to Show that the Project is Required by Public Convenience or Necessity. 807 KAR 5:001, Section 15(2)(a). KAW owns and operates the water distribution system in Millersburg, Kentucky. The Millersburg system is not connected to the rest of KAW's system. Therefore, KAW is unable to supply Millersburg with water treated at one of KAW's water treatment plants. KAW purchases water from Paris Water Works to supply Millersburg. The purchased water is supplied through a single 6" main located south of Millersburg connecting the Paris Water Works system to KAW's system in Millersburg.

4. 807 KAR 5:066, Section 10(4) states that "the quantity of water delivered to the utility's distribution system from all source facilities shall be sufficient to supply adequately, dependably and safely the total reasonable requirements of its customers under maximum consumption." Purchasing water to supply Millersburg creates several challenges for KAW when trying to meet these requirements.

5. As specified in KAW's water purchase agreement with Paris Water Works, provided as Exhibit 1, Paris Water Works is only obligated to sell up to a daily average of 200,000 gallons of water per calendar month to Kentucky American Water. This amount is not sufficient to meet the demand of KAW's retail customers in Millersburg and KAW's two wholesale customers served via the Millersburg system, Harrison County Water Association and Nicholas County Water District. In 2022, KAW's average daily volume purchased from Paris Water Works exceeded 200,000 gallons in six of the twelve months. Events such as fires and main breaks can

result in service interruptions for customers in Millersburg. Thus, the supply of water, at times, is inadequate.

6. In addition to challenges related to the volume of water supplied, purchasing water to supply Millersburg also results in water quality challenges. Water quality monitoring at KAW's master meter with Paris Water Works has measured elevated levels of total trihalomethanes and total haloacetic acids in the supplied water, which indicates the potential for disinfection byproduct ("DBP") formation. To reduce the risk of DBPs forming within KAW's system in Millersburg, KAW filters the purchased water through granular activated carbon filters. Also, at KAW's water treatment plants, KAW treats water with an orthophosphate-based corrosion inhibitor, which is listed in the United States Environmental Protection Agency's "Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems" guidance document as an effective treatment methodology for controlling lead and copper release into potable water. Utilizing this corrosion inhibitor prevents the leaching of lead from piping in private plumbing systems and helps KAW stay in compliance with applicable regulations. The water KAW purchases from Paris Water Works to supply customers in Millersburg does not receive a corrosion inhibitor during treatment. Thus, the quality of water, at times, is inadequate.

7. As described in the direct testimony of John Magner, KAW considered several alternatives for obtaining an adequate water supply to Millersburg. These alternatives included purchasing additional water from other regional utilities and constructing a new transmission main along alternate alignments. After evaluating costs, constructability considerations, and the ability of surrounding utilities to provide water, KAW determined that the proposed Project is the most cost-effective, feasible solution for providing an adequate water supply. The total estimated cost

of the project is \$12,800,000. The construction of the Project as requested herein will be the most reasonable in terms of investment in relation to the efficiency and productivity and will not result in the wasteful duplication of facilities or an unnecessary multiplicity of properties.

8. Copies of Required Permits. 807 KAR 5:001, Section 15(2)(b). The following permits, as listed in John Magner's direct testimony, are anticipated to be required for the Project.

(a) Water Quality (401) Certification, Kentucky Division of Water;

(b) Individual or Nationwide 404 Permit, United States Army Corps of Engineers;

(c) Encroachment Permit, Kentucky Transportation Cabinet;

(d) Utility Crossing Permit, CSX Railroad;

(e) Construction Application for Drinking Water Distribution (DW-1), Kentucky Division of Water;

(f) KYR10 – Kentucky Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities – Kentucky Division of Water; and

(g) Local land disturbance, traffic, and street cut permits, as applicable.

The Project is currently in the preliminary design stage, and, at this time, KAW does not have the above-described permits in hand. To the extent the Commission would like copies of those permits as they are obtained, KAW will provide them. The Project will be implemented in accordance with all issued permits.

9. A Full Description of the Proposed Route, Manner of Construction, and Impacted Utilities. 807 KAR 5:001, Section 15(2)(c). The proposed transmission main will include approximately 33,000 linear feet of 16" main and approximately 31,000 linear feet of 12" main. It will follow the alignment shown in the maps provided in Exhibit 2. The main will begin at a tie-in

to KAW's existing 12-inch main located along US-68 approximately 4.3 miles northeast of the Fayette/Bourbon County border. The main will continue northeast along US-68 into Paris, then route north around Paris along US-68/Martin Luther King Boulevard. Upon reaching the northeast side of Paris, where the main size will transition from 16" to 12", the main will continue northeast along US-68 towards Millersburg. The main will finally route along Old Millersburg Road and tie-into KAW's Millersburg system at a 6-inch main near the existing connection to Paris Water Works.

The main will primarily be constructed via open-cut methodology, with trenchless technologies such as jack-and-bore and horizontal directional drilling utilized as needed at roadway, utility, and stream crossings. KAW anticipates that the main will be mostly located within state right-of-way.

After installation of the transmission main, KAW will no longer purchase water from Paris Water Works for the Millersburg system. KAW does not anticipate that the Project will compete with any other utilities.

10. Three Copies of Maps of Suitable Scale Showing the Location of the Project. 807 KAR 5:001, Section 15(2)(d)(1). Exhibit 2 provides maps showing the alignment of the proposed transmission main. Existing water mains immediately along the proposed main alignment are owned by Paris Water Works.

11. Plans and Specifications and Drawings of the Project. 807 KAR 5:001, Section 15(2)(d)(2). The project is currently in the preliminary design stage and a planned alignment is provided in Exhibit 2 and preliminary pipeline specifications for the construction of the project are provided in Exhibit 3. KAW's design consultant for the project has started developing more

detailed construction plans sheets, and KAW can provide those to the Commission as they are completed.

12. The Manner in Which KAW Plans to Finance the Project. 807 KAR 5:001, Section 15(2)(e). KAW will not finance this project as a standalone item. Instead, it will use an appropriate mix of debt and equity to fund the project as necessary.

13. Estimated Annual Cost of Operation. 807 KAR 5:001, Section 15(2)(f). Operating costs for the proposed transmission main will primarily be related to the treatment and production of water conveyed through the main. In 2022, KAW purchased approximately 76.3 million gallons (MG) from Paris Water Works at a total cost of approximately \$187,000. Based on a variable incremental production cost of approximately \$0.60 per 1,000 gallons for KAW to supply the same volume of water, KAW's cost would be approximately \$46,000.

14. Plans, Specifications, Plats, and Reports Sealed by a Professional Engineer. KRS 322.340. The technical specifications for the proposed transmission main are attached as Exhibit 3 and are stamped and sealed as required.

WHEREFORE, KAW respectfully requests the Commission approve the requested CPCN.

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) SS:
COUNTY OF FAYETTE)

The undersigned, John Magner, being duly sworn, deposes and says that he is the Engineering Project Manager for Kentucky-American Water Company, that he has personal knowledge of the matters set forth in the foregoing Application and that they are true and correct to the best of his information, knowledge and belief.



John P. Magner

Subscribed and sworn to before me, a Notary Public in and before said County and State,
this 25th day of July, 2023.



Notary Public

My Commission Expires:

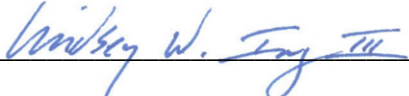
July 31, 2025

Notary ID: KYNP26988

Date: July 26, 2023

Respectfully submitted,

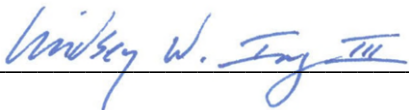
Lindsey W. Ingram III
L.Ingram@skofirm.com
STOLL KEENON OGDEN PLLC
300 West Vine Street, Suite 2100
Lexington, Kentucky 40507-1801
Telephone: (859) 231-3000
Fax: (859) 259-3503

By:  _____
Attorneys for Kentucky-American Water Company

CERTIFICATE

This certifies that Kentucky-American Water Company's electronic filing is a true and accurate copy of the documents in paper medium; that the electronic filing has been transmitted to the Commission on July 26, 2023; and that no party has been excused from participation by electronic means.

STOLL KEENON OGDEN PLLC

By  _____
Attorneys for Kentucky-American Water Company

WATER PURCHASE AGREEMENT

THIS AGREEMENT is made and entered into this the 29th day of July, 2014, by and between KENTUCKY-AMERICAN WATER COMPANY, a Kentucky corporation with offices at 2300 Richmond Road, Lexington, Kentucky 40502 (“KAW”) and the CITY OF PARIS, 525 High Street, Paris, Kentucky 40361 (“Paris”).

WITNESSETH:

WHEREAS, KAW desires to purchase a supply of potable water from Paris in order to adequately fulfill KAW’s obligations to: KAW’s customers in the City of Millersburg; the Harrison County Water Association; and the Nicholas County Water District, and has requested Paris to provide that supply of potable water;

WHEREAS Paris owns and operates a water supply treatment, transmission and distribution system capable of meeting the potable water requirements of its own customers, the estimated number of KAW’s customers in the City of Millersburg, and KAW’s obligations to the Harrison County Water Association and the Nicholas County Water District; and

WHEREAS Paris desires to sell KAW potable water per the terms of this Agreement for use by KAW as described above.

NOW, THEREFORE, the parties hereto do hereby agree as follows:

- From and after the 10th day of August 2014, KAW shall have the right to purchase from Paris, and Paris shall be obligated to sell to KAW, an amount of potable water not to exceed a daily average of 200,000 gallons per calendar month to meet reasonable requirements of the following KAW customers: (a) water customers in the City of Millersburg; (b) Harrison County Water Association; and (c) Nicholas County Water District. Paris hereby agrees

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| KENTUCKY PUBLIC SERVICE COMMISSION |
| JEFF R. DEROUEN EXECUTIVE DIRECTOR |
| TARIFF BRANCH <i>Brent Kirtley</i> |
| EFFECTIVE 9/5/2014 PURSUANT TO 807 KAR 5:011 SECTION 9 (1) |

that it is capable of supplying KAW with an amount of potable water necessary to meet those requirements. Paris shall furnish potable water to KAW at the point of delivery hereinafter specified which shall meet all applicable state, federal and/or other regulatory standards.

2. Delivery of the water purchased by KAW and sold by Paris shall be delivered at a point along Millersburg Road (U.S. 68) approximately 845 feet south of the intersection of Millersburg Road and Old U.S. Highway 68, which is approximately 1.31 miles south of the City of Millersburg at a reasonably constant pressure under normal operating conditions. Paris shall not be responsible for the quality of water purchased by KAW past this point of actual delivery.

3. KAW agrees to install at its own expense at the point of delivery all necessary metering equipment and related required devices for the City to properly measure the quantity of water delivered to KAW. As of the date identified in Paragraph 1 above, ownership in the metering equipment shall be transferred to Paris at no cost to Paris and Paris shall operate and maintain at its own expense the metering equipment. A meter registering not more than two percent above or below the actual flow shall be deemed to be accurate. KAW shall have access to meter for monitoring volumes of water purchased. KAW agrees to construct at its own expense approximately 780 feet of 6-inch diameter line to connect Paris' existing distribution system to the distribution system serving customers in the City of Millersburg.

4. KAW shall pay for the quantity of water purchased by it and sold by Paris at the initial rate of \$2.25 per 1,000 gallons under the first 18 months of this Agreement and thereafter as may change from time to time and as set forth by Paris city ordinance and accepted by the Public Service Commission. Paris shall read the meter on or about the 20th day of each month and provide an invoice to KAW on or about the 1st day of the following month. KAW shall pay

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for the quantity of water purchased no later than the 15th day of the month. Payment may be made by check or by the transfer of electronic funds

5. KAW agrees to continue with the ongoing leak detection services and surveys project for the entire water transmission and distribution system of Paris until that project is complete at no cost to Paris. Paris shall be responsible for costs in repairing municipal facilities associated with line loss.

6. In the event any type of water curtailment practice, procedure, regulation or law is utilized by Paris or is imposed upon Paris, KAW agrees to abide by all recommendations of Paris and to use reasonable efforts to restrict use by customers in the City of Millersburg in a fashion similar to that which is utilized by Paris or imposed on Paris. Paris may only reduce the amount of water available for purchase by KAW in the same ratio or proportion as such is reduced to other Paris customers.

7. Paris shall operate and maintain its water supply system in accordance with all applicable laws, rules and regulations and will take such action as necessary to furnish KAW with the quantity of water set forth in this Agreement. Temporary or partial failures to deliver water shall be remedied with all possible dispatch.

8. In the event all or any part of the waterworks plant and facilities of Paris which are used in meeting its obligations under this Agreement are acquired by a municipal corporation or any other entity, then and in that event Paris shall be relieved of all of its obligations hereunder and, in such event, this Agreement shall be binding upon the municipality or any other entity making such acquisition.

9. This Agreement shall terminate when: (1) the connection between the northeast portion of KAW's distribution system and the southwest portion of Paris' distribution system is

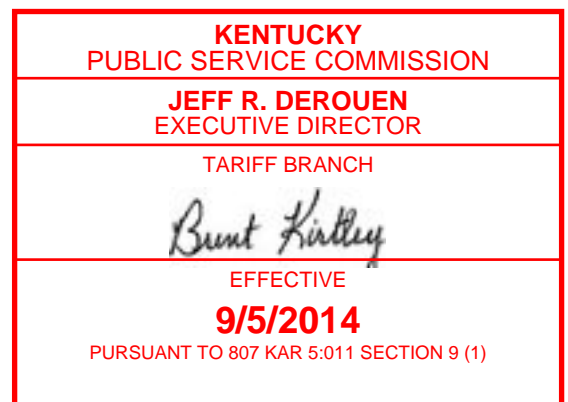
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| KENTUCKY PUBLIC SERVICE COMMISSION |
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| EFFECTIVE 9/5/2014 |
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complete and operating sufficiently such that the requirements of KAW's customers in the City of Millersburg can be met by using that connection in conjunction with the connection described in Paragraph 3 above; and (2) a binding contract between KAW and Paris has been executed and all necessary approvals have been obtained, regulatory or otherwise, the contract having the dual purposes of: (a) providing an emergency interconnection between KAW's distribution system and Paris' distribution system so that KAW can sell water to Paris in the event of a Paris emergency; and (b) KAW's use of Paris' transmission and distribution system so that potable water can be provided to KAW's customers in the City of Millersburg without the need for KAW to purchase water from Paris.

10. The Parties agree to file jointly a copy of this executed contract with the Public Service Commission of Kentucky.

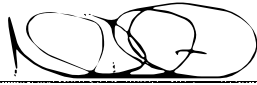
11. This agreement constitutes the entire agreement of the parties and all prior conversations and writings are merged herein.

12. This Agreement shall be construed according to the laws of the Commonwealth of Kentucky.



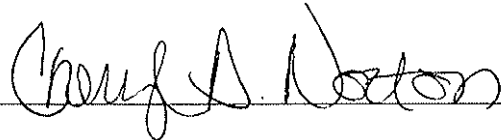
This Agreement has been executed by the parties hereto, by their appropriate authorized representatives, on this the 4th day of August, 2014.

CITY OF PARIS, KENTUCKY

BY: 

Mayor, City of Paris

KENTUCKY-AMERICAN WATER COMPANY

BY: 

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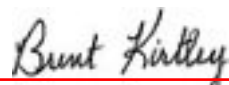
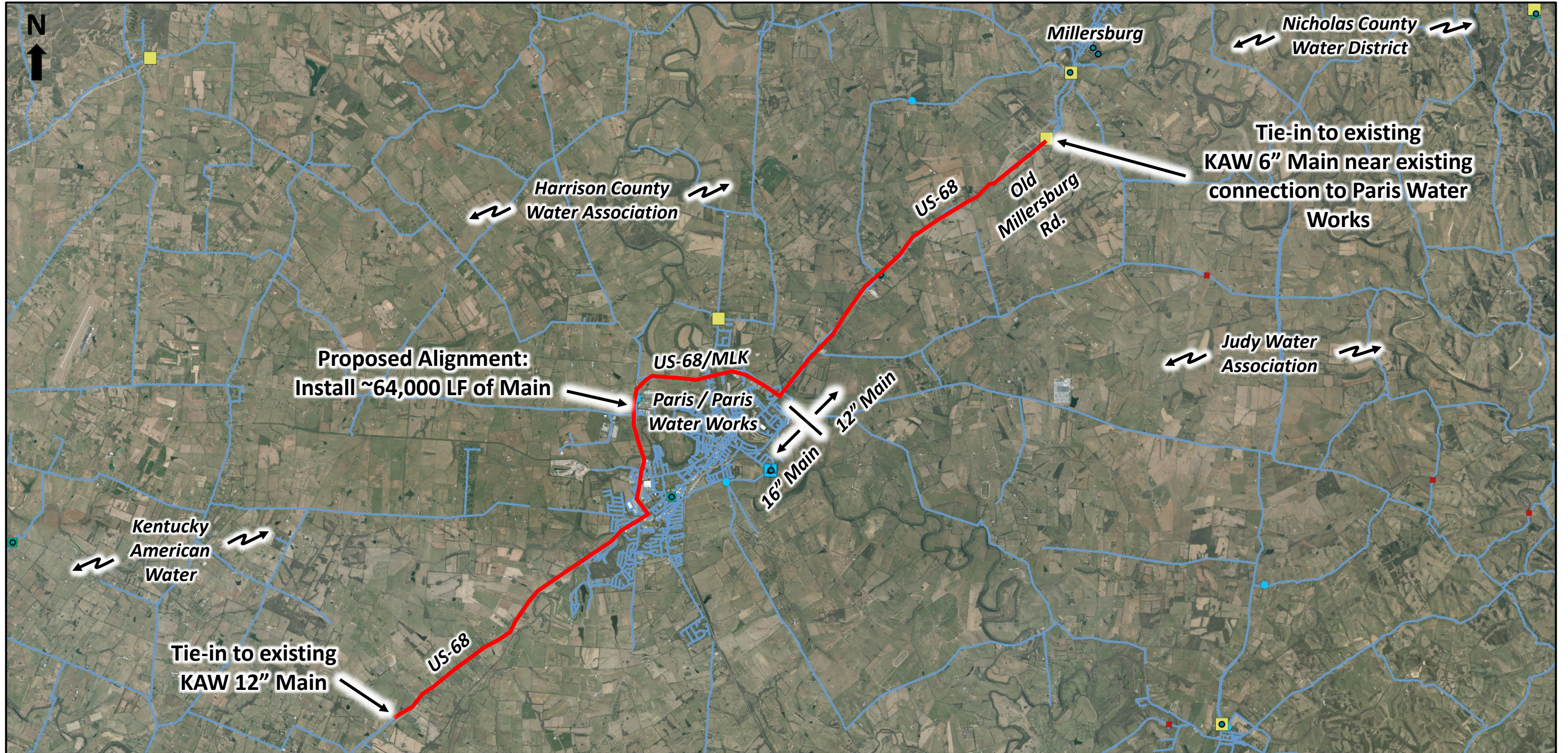
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Figure 1:
Kentucky American Water Millersburg Transmission Main - Alignment Overview



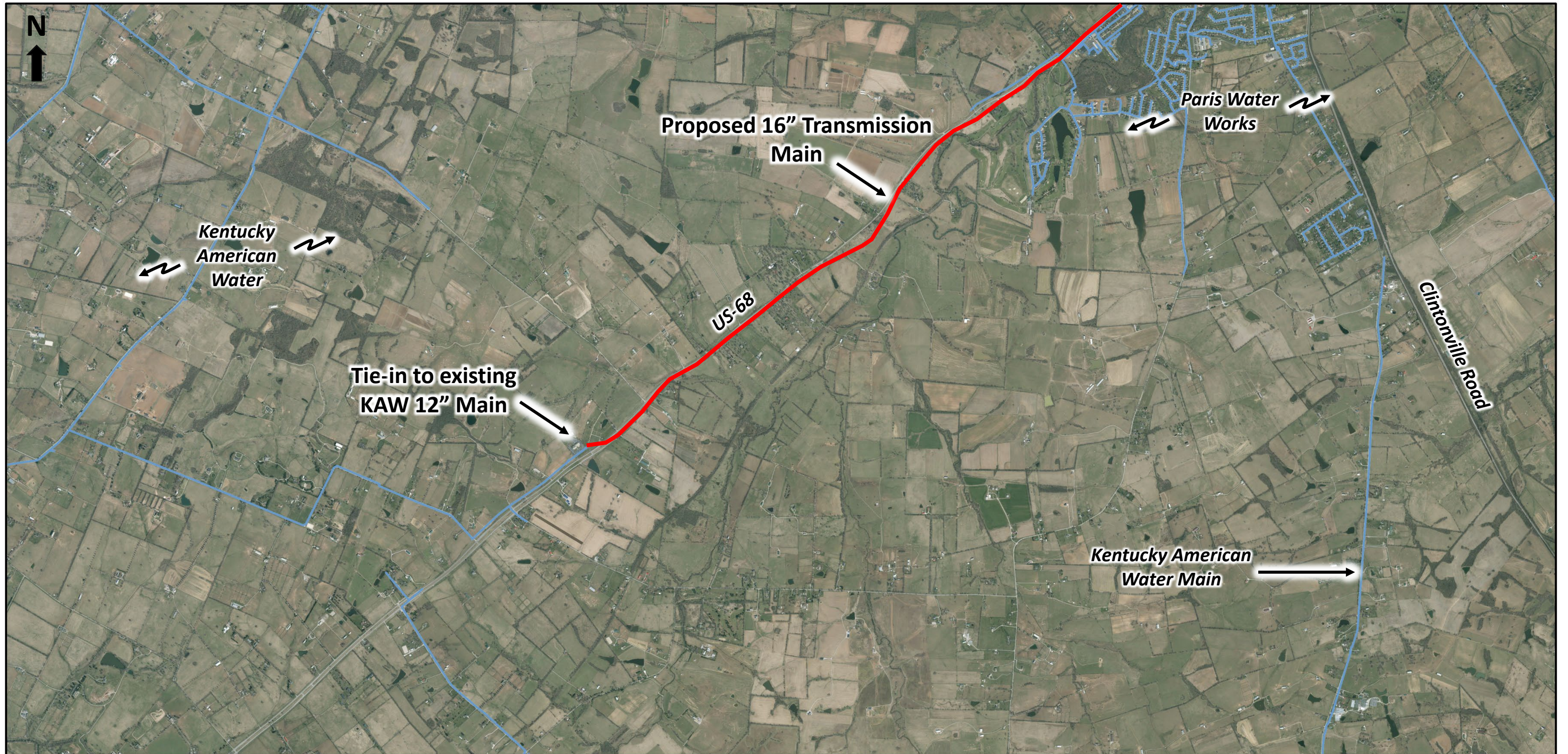
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| Water Lines | Pump Stations | Water Pumps |
| Well Sources | Water Meters | Non-Community Points |
| Water Treatment Plants | Surface and Spring Sources | |
| Water Tanks | Purchase Sources | |











Note:
 Map generated using Kentucky Infrastructure Authority WRIS portal. Additional annotations provided added by Kentucky American Water.

Kentucky Infrastructure Authority (KIA), Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Figure 2:
Kentucky American Water Millersburg Transmission Main – South Detail View



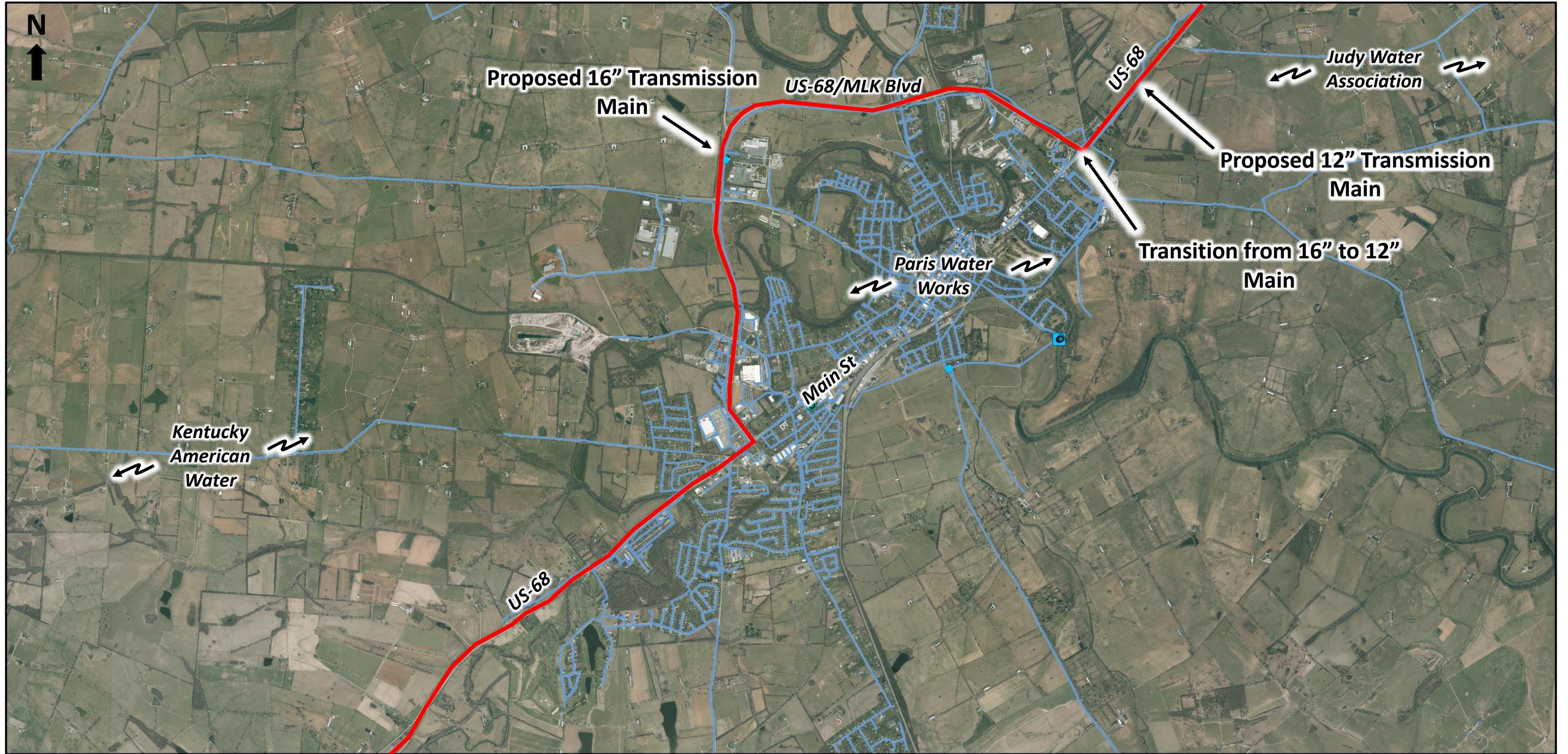
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|  Water Lines |  Pump Stations |  Water Pumps |
|  Well Sources |  Water Meters |  Non-Community Points |
|  Water Treatment Plants |  Surface and Spring Sources | |
|  Water Tanks |  Purchase Sources | |

Note:
 Map generated using Kentucky Infrastructure Authority WRIS portal. Additional annotations provided added by Kentucky American Water.

Kentucky Infrastructure Authority (KIA), Lexington-Fayette Urban Cnty Gov, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

**Figure 3:
Kentucky American Water Millersburg Transmission Main – Central Detail View**



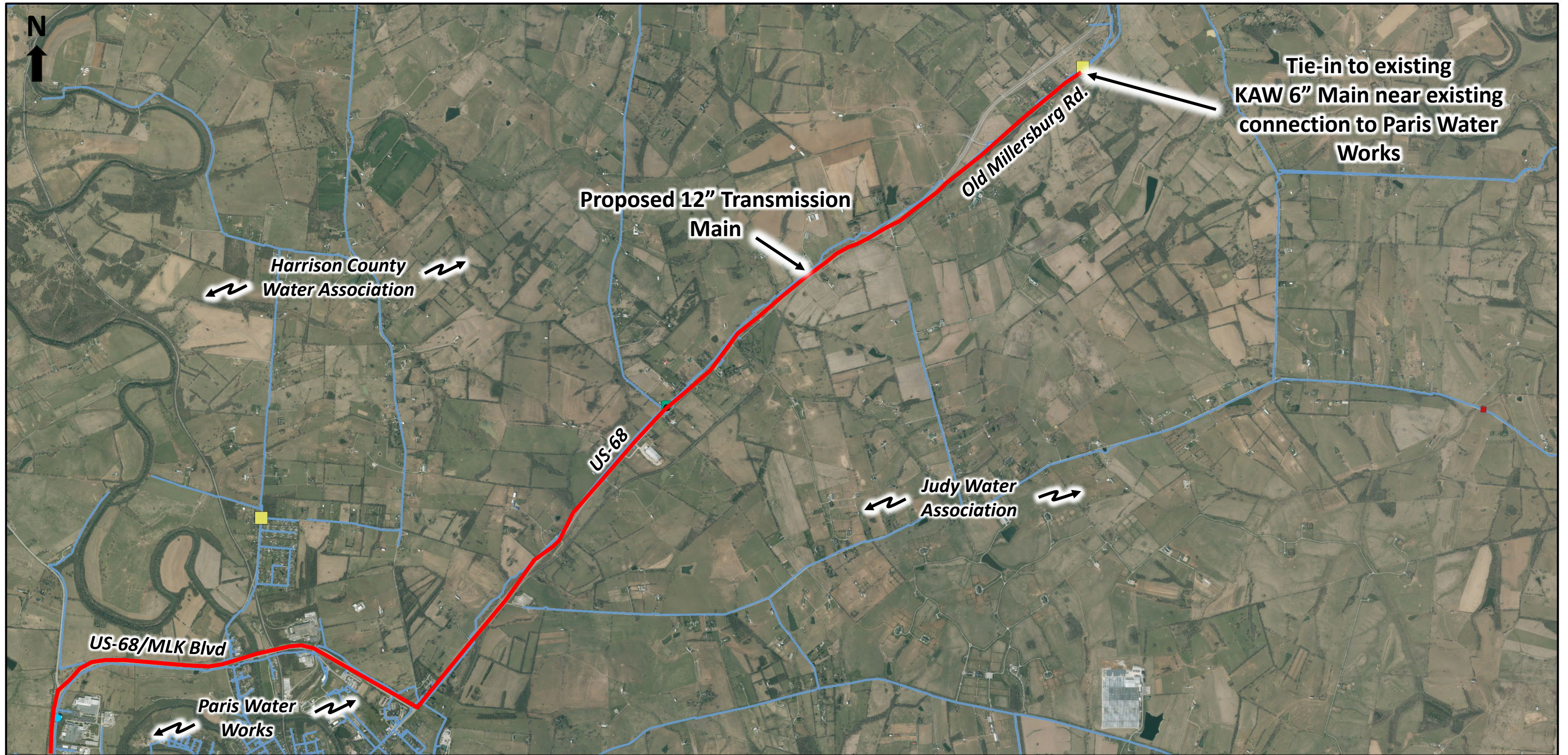
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| Water Lines | Pump Stations | Water Pumps |
| Well Sources | Water Meters | Non-Community Points |
| Water Treatment Plants | Surface and Spring Sources | |
| Water Tanks | Purchase Sources | |

Note:
Map generated using Kentucky Infrastructure Authority WRIS portal. Additional annotations provided added by Kentucky American Water.

Kentucky Infrastructure Authority (KIA), Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

**Figure 4:
Kentucky American Water Millersburg Transmission Main – North Detail View**



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|------------------------|----------------------------|----------------------|
| Water Lines | Pump Stations | Water Pumps |
| Well Sources | Water Meters | Non-Community Points |
| Water Treatment Plants | Surface and Spring Sources | |
| Water Tanks | Purchase Sources | |

Note:
Map generated using Kentucky Infrastructure Authority WRIS portal. Additional annotations provided added by Kentucky American Water.

Kentucky Infrastructure Authority (KIA), Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS



KENTUCKY
AMERICAN WATER

PIPELINE TECHNICAL SPECIFICATIONS

KENTUCKY AMERICAN WATER



Prepared by:

KENTUCKY AMERICAN WATER COMPANY

2300 Richmond Road, Lexington, KY 40502

June 2023

TECHNICAL SPECIFICATIONS

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SECTION 01 11 00
SUMMARY OF WORK

PART 1: GENERAL

1.1 WORK UNDER THIS CONTRACT

- A. Furnish all labor, materials (except as herein noted), equipment and means to construct the pipeline(s) and other Work as described in the Contract Documents and shown on the Drawings. The Work includes, but is not limited to, the following:
1. Contacting Kentucky 811 and identifying locations of existing utilities.
 2. Pavement removal, including saw cutting, as required.
 3. Construction and maintenance of bridges and other structures as required for traffic control.
 4. Furnishing of flagmen, traffic warning and control as required.
 5. Sheeting, bracing and support of trench and adjoining ground where necessary.
 6. Furnish and install thrust blocking and pipe restraints as required.
 7. Handling drainage and water removal.
 8. Guarding the site and materials on site.
 9. Furnishing materials not provided by the owner to the site (see section 1.3)
 10. Unloading, loading, hauling, distributing, laying and testing the pipe, valves, fittings and appurtenances; including the installation of polyethylene encasement, and identification marking tape or location wire, as required by the Owner or Engineer.
 11. Excavation and backfilling of trenches and pits.
 12. Temporary restoration of paved and concrete surfaces.
 13. Permanent restoration of paved and concrete surfaces including curbing, unless the contract documents specify restoration is to be performed by others.
 14. Removal of surplus excavated material and debris.
 15. Installation of required pipe, fittings, vaults, and appurtenances
 16. Performance of pressure and leakage tests.
 17. Disinfecting of pipeline (and dechlorination of discharge).
 18. Site cleaning.
 19. Maintenance of street or other surfaces for the required period of time.
 20. Abandonment/removal of existing facilities.
 21. Ground restoration and planting.
 22. Submit schedules, shop drawings and as-built records.
 23. Erosion and sediment control.

24. Flush & clean

25. Collect GPS data related to the work performed

- B. Contractor will perform the Work as defined in the Contract Documents and Task Orders/Purchase Orders. For each project, Contractor is bound by the specific Task Order/Purchase Order for execution of the project.
- C. Please refer to the Standard General Conditions of the Construction Contract for definitions of the Owner, Contractor, Engineer and other terminology that may be used in this specification.
- D. The above general outline of principal features does not in any way limit the responsibility of the Contractor to perform all Work and furnish the required materials, equipment, labor and means as shown or required by the Contract Documents.
- E. Materials, equipment, labor, etc., obviously a part of the Work and necessary for the proper operation and installation of same, although not specifically indicated in the Contract Documents, shall be provided as if called for in detail without additional cost to the Owner.

1.2 WORK BY OWNER

- A. Owner may perform certain items of Work related to this project which may include the following
 - 1. Mark locations of existing services, valves, mains, etc.
 - 2. Other work, if any, as described below.
 - a. Operate, or direct contractor to operate, valves necessary to shut-off, flush and reactivate its existing pipelines
 - b. Observe flushing
 - c. Collect bacteriological samples
- B. See Special Conditions section for appropriate list of tasks provided by owner.

1.3 MATERIALS FURNISHED BY OWNER

- A. The following materials may be furnished by the Owner and installed by the Contractor. All materials required to complete the Work, but not listed herein, shall be furnished and installed by the Contractor.
 - 1. Pipe and fittings
 - 2. Valves and hydrants
 - 3. Valve and curb boxes, meter pit assemblies
 - 4. Tapping sleeves and tapping valves
 - 5. Tapping saddles, corporations, and curb stops
 - 6. Marking posts, tracer wire
 - 7. Water meters
- B. See Special Conditions section for appropriate list of materials furnished by Owner.

1.4 LOCATIONS

- A. Work is to be performed on Owner's property and/or public rights-of-ways or easements shown on the drawings and described in the Specifications. Work shall be performed by the Contractor within these limits.
- B. It is the obligation and responsibility of the Contractor to determine the exact limitations of the rights-of-way and/or easements and any conditions limiting or affecting the use of the right of way by the Owner and/or the Contractor. All agreements respecting rights-of-way and the easements that are available to the Owner can be made available upon request. The Contractor agrees to indemnify and hold harmless the Owner against any claims made by any property owner, including any claim that the Contractor has failed to keep Contractor work, equipment, materials, or workmen within the limits authorized by the right-of-way and/or easement or any claim that the Contractor has failed to comply with any condition or requirement, or agreement respecting the right-of-way and/or easement.
- C. Some of the locations shown or described in the Contract Documents, such as tie-ins, are approximate. It is the responsibility of the contractor for pinpointing the exact locations.

PART 2: PRODUCTS

2.1 GENERAL

- A. Specifications for the materials and equipment to be provided by the Contractor are detailed in the respective Specification Sections.

PART 3: EXECUTION

3.1 FIELD SURVEY WORK

- A. Lay out the Work in accordance with Paragraph 4.03 of the General Conditions. Owner will provide reference points as noted on the plans.

3.2 COORDINATION

- A. Coordinate work, to phase the construction operations, and provide, install and maintain any temporary connections necessary to prevent interference to operation of Owner's facilities. Any construction work requiring the shutdown of facilities must be scheduled and performed only at such times as shall be authorized by the Owner. Such Work must be completed during the specific periods authorized by the Owner.
- B. It may be necessary that Work will be performed during several shutdown periods and/or during periods of premium time payment to accomplish the desired construction. All costs to perform the Contractor's Work, including premium time payments, shall be borne by the Contractor and are included in the Contract Price.

3.3 REGULATORY REQUIREMENTS

- A. Make necessary arrangements for obtaining and identifying all costs in connection with mandated third party inspections in accordance with Paragraph 15.02 of the General Conditions when the Work is to be done in the third party's transportation or utility right of way and an inspector must be assigned to the Project during the construction of the Work.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1: GENERAL

1.1 SCOPE

- A. Work to be performed under this Contract shall be paid for in accordance with this Specification and the unit prices provided in the Contractor's bid (or Master Service Agreement, if applicable). The cost of labor, equipment, materials or work called for in the Specification, shown on the Drawings, or necessary for a complete and satisfactory installation, but which are not specifically mentioned in this Section, shall be included in the appropriate pay item by the Contractor at no additional expenses to the Owner.

1.2 PAYMENT ITEMS

The prices shown in the Contractor's Bid include all costs to construct the pipeline(s) under this contract. Final payment will be made based on actual quantities. For all Contract Unit Price items, Contractor is responsible for providing any materials, tools, equipment and labor that are not supplied by the Owner.

A. Mobilization and Closeout

1. Payment will be made at the Contract Unit Price per lump sum for the Mobilization Line Charge. The lump sum price bid for Mobilization is limited to a maximum of 5% of the Total Bid Price and will only be paid once per contract. The work shall consist of the assembling and setting up for the project, including but not limited to the Contractor's general facilities, including Contractor's general offices, shops, plants, storage areas, temporary signs, sanitary and any other facilities, as required by the Specifications Section 01 50 00, Temporary Facilities & Controls, Section 01 77 00 Closeout Requirements and special requirements of the Contract, as well as by local or State Law and regulation. The cost of any other initial expense required for the start of work, such as bonds and insurance, will be included in the item.
2. Initial Payment: Forty percent (40%) of the price bid for Mobilization Line Charge and Closeout will be payable to the Contractor whenever the Contractor shall have completed five percent (5%) of the work of the Contract. For the purposes of this item five percent (5%) of the work shall be considered completed based upon the total of payments earned, exclusive of the amount bid for this item, as shown on the monthly billing of the approximate quantities of work done.
3. Final Payment: The final sixty (60%) of the price bid for Mobilization Line Charge and Closeout will be payable to the Contractor whenever the Contractor completes the following:
 - a. Completion of all the work
 - b. Cleaned up and made final restoration
 - c. Delivered all required documents enumerated in the specifications including, but not limited to:

- (1) Required warranties and guarantees
- (2) Special bonds
- (3) Equipment and material certifications from manufacturer(s)
- (4) Record Drawings
- (5) Lien Waivers
- (6) Easements

B. Pre-Construction Pictures / Video

1. Payment will be made at the lump sum Contract Unit Price for the delivery of pre-construction pictures/videos to the Owner prior to the start of construction. These pictures/videos shall be collected and delivered in accordance with Specification 01 33 00 and all applicable Federal, State, and Local requirements.

C. Traffic Control (Not Including Police Service)

1. Payment will be made at the Contract Unit Price lump sum for traffic control where required or directed by the Owner in accordance with the requirements of Specification Section 01 55 26 Traffic Regulations. Contractor is required to provide all materials, equipment, and labor related to traffic control and for ensuring that traffic control measures meet the requirements of the applicable jurisdictional authority. Unless otherwise provided by the Owner, the Contractor shall prepare and submit Maintenance of Traffic plans to the jurisdictional authority and shall obtain all lane closure permits. The Contractor shall coordinate all road closures, traffic diversions, and changes in traffic patterns with the jurisdictional authority prior to implementation.

D. Excavation, Installation, and Backfilling of Pipe

1. Payment will be made at the Contract Unit Price per linear foot for the size and class pipe to be installed via open-cut methodology, complete in place. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the construction of the pipeline(s). The minimum width and depth of the pipe trench shall be in accordance with the requirements of Specification Section 31 23 33, Trenching, Backfilling & Compacting. All costs to complete the pipeline installation are included in the unit price per linear foot of pipeline, regardless of whether the Contractor uses sloped slides or shoring and sheeting when excavating the pipe trench. The unit price for each pipeline is the sum of all costs to complete the work, which includes, but is not limited to:
 - a. Installing new pipe and fittings
 - b. Trench excavation (regardless of trench depth)
 - c. Clearing and grubbing
 - d. Erosion and sediment control
 - e. Removal and disposal or abandonment of existing pipe, valves, fittings, and appurtenances to be replaced, as required
 - f. Hauling and disposal of debris and excavated material
 - g. Dewatering
 - h. Restraining and thrust blocking
 - i. Rock excavation

- j. Tracer wire
 - k. All soil and aggregate backfill/bedding
 - l. Backfilling and compacting
 - m. Polyethylene encasement (Polywrap)
 - n. Flushing/testing/chlorination/de-chlorination
 - o. Turf and lawn restoration
 - p. Temporary paving and maintenance
2. All other work items not listed in the Contract Unit Price items of the Contract will be paid for inclusive in this bid item.
 3. All excavation is unclassified. Additional compensation will not be provided for rock excavation.
- E. Jack and Bore Pipe Installation
1. Payment will be made at the Contract Unit Price per linear foot of casing and main installed by any of the methods described in and according to Specification Section 33 05 07.24. Location to be shown on the Drawings or as directed by the Owner. The Contract Unit Price shall include the cost of the casing pipe, as well as any other materials not provided by the Owner. In addition, the Contract Unit Price shall include all excavation (soil or rock), de-watering, jacking, ramming, drilling or boring (rock or soil), backfilling, installation of end caps, sheeting, bracing, shoring, temporary construction and safety measures, material disposal, etc. as necessary for a complete and satisfactory installation. Installation of the water main in the casing will be included under this Contract Unit Price. The Contract Unit Price will also include all measures required to protect roadways, railroad tracks and embankments from settlement or damage of any type.
- F. Interconnection (Wet Tap)
1. Payment will be made at the Contract Unit Price per each for the size of interconnection (wet tap) to be installed, complete in place. Contract Unit price shall include all excavating and backfilling, temporary paving, and incidental work required to install the interconnection(s) as shown on the drawings. The installation of the valve between the tapping saddle/sleeve and the piping connecting to the wet-tapped pipeline shall be included in this Contract Unit Price item.
- G. Shut Down and Tie-In
1. Payment will be made at the Contract Unit Price per each for the size of shut down and tie-in to be installed, complete in place. The contract unit price shall include excavation and backfilling, line stop preparation, line stop installation (unless installed by Owner), cutting existing piping, installing new piping and fittings, temporary paving, and all incidental work required to install the tie-in complete as shown on the drawings. The Owner will operate all valves necessary to shut off and reactivate its pipelines.
- H. Cap (Plug) Existing Water Main
1. Payment will be made at the Contract Unit Price per each for the size of shut down and cap to be installed, complete in place, as required by the Owner. The contract unit price shall include excavation and backfilling, cutting the existing pipe, installing the cap, and all incidental work required to cap the existing main.

Temporary paving shall be included in this Contract Unit Price. The owner will operate all valves necessary to shut off and reactivate its pipelines.

I. Valve Installation

1. Payment will be made at the Contract Unit Price for each valve (excluding valves explicitly included under other Contract Unit Price items in this specification) installed, complete in place. Contract Unit Price shall include excavation, backfilling and compacting, valve and valve box installation, restraining, thrust blocking, temporary paving, lawn restoration and all incidental work required to install each valve complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation. If an existing valve is being replaced, the Contract Unit Price shall also include removal of the existing valve and all associated incidental work for the valve replacement.

J. Install Air Release Valve

1. Payment will be made at the Contract Unit Price for each air release valve assembly installed, complete in place. Unit price shall include excavation and backfilling; tapping the main; installing the air release valve assembly, vault, lid, curb and corporation stops, tubing/piping, fittings, valves, and concrete blocking; testing of all components; and all incidental work required to construct each structure complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation and in accordance with Specification Section 33 14 19.02.

K. Install Blow Off Assembly

1. Payment will be made at the Contract Unit Price for each blow off assembly, complete in place. Unit price shall include excavation and backfilling; installing the main line tap, blow off assembly, valves and valve boxes, piping and tubing, fittings and appurtenances, and blocking; testing the components; and all incidental work required to construct each blow off assembly complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation.

L. Install Marker Post

1. Payment will be made at the Contract Unit Price for each post installed in place as authorized by the Owner. The unit price will include all work necessary for a complete installation in accordance with Specification Section 33 01 10.50.

M. Hydrants

1. Hydrant Installation: Payment will be made at the Contract Unit Price for each fire hydrant installation. The Contract Unit Price will include installing the hydrant anchor tee, lateral gate valve and valve box, all hydrant lateral piping, and hydrant. The contract unit price will also include excavation, backfill and compaction, disposal of spoils, reaction blocking and restraining, temporary paving, lawn restoration, fabric, and polywrap as required by Specification Section 33 01 10.50 and standard detail or as necessary to make a complete and satisfactory installation. Hydrant testing and painting shall also be included in this Contract Unit Price.
2. Fire Hydrant Removal: Payment will be made at the Contract Unit Price for each hydrant removed. The Contract Unit Price will include removal and disposal of existing hydrant assembly including lateral gate valve and valve box and cut/cap/plug of existing hydrant lateral pipe.

N. Service Install and Reconnection and Meter Relocation

1. All Contract Unit Prices included under this section shall including the following, as required:
 - a. Saw cut and pavement removal
 - b. Excavation and disposal of spoil material
 - c. Placement and compaction of backfill
 - d. Tapping the main, including the installation of tapping saddles
 - e. Turning off corporation stops
 - f. Installation of corporation stops
 - g. Installation of new service piping
 - h. Removal and disposal of existing service line, meter boxes, and other appurtenances
 - i. Cutting clear the exiting service from the corporation
 - j. Installation of new service meter box and setter
 - k. Connection to customer's line outside of meter box
 - l. Turf and lawn restoration
2. Relocate existing water service meter: Payment will be made at the Contract Unit Price for the relocation of each service meter. This Contract Unit Price item shall include all labor and materials not supplied by the Owner to relocate the service meter in accordance with Specifications 33 14 17.01 and 33 14 19.01. This Contract Unit Price item is only applicable when a property has an existing water service meter which must be moved to a new location.
3. New Service Installation: Payment will be made at the Contract Unit Price for each new service installation. The unit price shall include all labor and materials not supplied by the Owner required to completely install a new service from the corporation stop to the customer's meter box and to connect the service. Short side services refer to those services whose length is less than $\frac{1}{2}$ the improved road width. Long side services include those services whose length is equal to or exceeds $\frac{1}{2}$ the improved road width. All service installations shall be in accordance with Specifications 33 14 17.01 and 33 14 19.01.
4. Reconnect Service: Payment will be made at the Contract Unit Price for each existing service reconnected to a new main line. The unit price shall include all labor and materials not provided by the Owner to completely transfer the existing service. This item is not applicable for new service installations. All service reconnections shall be completed in accordance with Specifications 33 14 17.01 and 33 14 19.01.

O. Fire Service

1. Payment will be made at the Contract Unit Price for each fire service installed, complete in place. Contract Unit Price shall include all elements of the fire service from the tee fitting through the post indicator valve including the tee fitting, gate valve, post indicator valve, and associated piping, as well as the bypass meter within the backflow preventer vault. The Contract Unit price shall also include excavation, backfilling and compacting, valve box installation, restraining, thrust blocking, temporary paving, lawn restoration and all incidental work required to

install each fire service complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation.

P. Domestic Service

1. Payment will be made at the Contract Unit Price for each domestic service installed, complete in place. Contract Unit Price shall include all elements of the domestic service from the tee fitting on the main or fire service through the meter box including the tee fitting, gate valve, meter box/vault, meter settings, meters, and associated piping. The Contract Unit price shall also include excavation, backfilling and compacting, valve box installation, restraining, thrust blocking, temporary paving, lawn restoration and all incidental work required to install each domestic service complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation.

Q. Master Meter

1. Payment will be made at the Contract Unit Price for each master meter installed, complete in place. Contract Unit Price shall include the master meter vault and all infrastructure within the vault including valves, meters, piping, and fittings. Hatches and ladders will be supplied by the Owner, unless otherwise specified, but are to be installed by the Contractor. The Contract Unit price shall also include excavation, backfilling and compacting, restraining, thrust blocking, temporary paving, lawn restoration and all incidental work required to install each master meter complete as shown on the drawings, as specified and necessary to make a complete and satisfactory installation. Payment for piping and appurtenances outside of the master meter vault will be made under other applicable Contract Unit Prices listed in this Specification.

R. Flowable Backfill

1. Payment will be made at the Contract Unit Price per cubic yard of flowable backfill for pipe encasement and backfill, where required. No payment will be made for flowable fill needed outside the maximum normal trench width as described in Specification Section 31 23 33. If for any reason the trench width exceeds the maximum trench width defined in the Specification referenced above, the Contractor shall provide the additional flowable fill for backfilling at no cost to the Owner as described in Specification Section 31 23 33. This pay item also includes the removal, hauling and proper disposal of all excavated material.

S. Concrete Work

1. Finished Concrete: Payment will be made at the Contract Unit Price per square foot for finished concrete sidewalk or driveway installed. The unit price shall include stone bedding, concrete and finishing, complete in place conforming to the requirements of Specification Section 03 30 00 and/or any municipal or state requirements that may apply. This bid item includes Sidewalks, Driveways and Handicap Ramps if required by Federal, State or Local Authorities.
2. Street Sub-base (Concrete Cap): Payment will be made at the Contract Unit Price per square yard for installation of a concrete sub-base under a paved road surface. The unit price shall include furnishing, placement, and finishing, complete in place conforming to the requirements of Specification Section 03 30 00 and/or any municipal or state requirements.

T. Curb Replacement

1. Payment will be made at the Contract Unit Price per linear foot for the type of curbing installed. The unit price shall include excavation, stone bedding, concrete, asphalt, finishing, and backfilling, complete in place and conforming to the requirements of Specification Section 03 30 00 and/or any municipal or state requirements that may apply.

U. Pavement Milling and Overlay

1. Overlay Only: Payment will be made at the Contract Unit Price per square foot of overlay. The contract price will include preparing the existing surface (as required) and the furnishing and installation of paving material for overlay in accordance with Specification Section 32 10 00 or as otherwise required by Federal, State or Local Authorities. Unless otherwise specified in the drawings or by the Owner, Engineer, or applicable authority, the square footage allowed shall be defined as the trench width plus two feet times the appropriate length of the trench where overlay is required. Trench width as described in Specification Section 31 23 33.
2. Milling and Overlay: Payment will be made at the Contract Unit Price per square foot of milling overlay. The contract price will include milling the existing surface (if required) and the furnishing and installation of a paving material for overlay in accordance with Specification Section 32 10 00 or as otherwise required by Federal, State or Local Authorities. Unless otherwise specified in the drawings or by the Owner, Engineer, or applicable authority, the square footage allowed shall be defined as the trench width plus two feet times the appropriate length of the trench where milling and overlay are required. Trench width as is described in Specification Section 31 23 33.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1: GENERAL

1.1 SCHEDULES

- A. The Contractor is responsible for completing the Work in accordance with the Contract Times set forth in the Contract.
- B. If requested by the Engineer, the contractor shall submit a construction progress schedule within 7 days.
 - 1. The schedule shall be submitted in a network analysis format (can be in Gantt chart (bar graph) format) and shall include, as a minimum, the following separate activities:
 - a. Physical construction (includes mobilization, demobilization, setup time, lags, etc.).
 - b. Issuance by Contractor of purchase orders for material and equipment and submittal of shop drawings and samples to the Engineer.
 - c. Review by Engineer for each submittal of samples and shop drawings. Unless otherwise approved by the Engineer, allow ten (10) working days for Engineer to review each submittal.
 - d. Delivery of materials and equipment.
 - e. Installation of materials and equipment.
 - f. Testing, start-up and training for individual pieces of equipment or entire systems as appropriate.
 - g. Weather affected activities.
 - h. Outages or interruptions of Owner's facilities required to perform work.
 - i. Demolition or removal work under this Contract.
 - 2. Activity durations shall represent the best estimate of elapsed time considering the scope of the Work involved in the activity and the resources planned for accomplishing the activity expressed in working days.
 - 3. Activity descriptions shall clearly define the scope of work associated with each activity. If activity descriptions contained in the schedule are not sufficient to describe the work, a supplemental narrative description is to be provided.
 - 4. The construction work shall be detailed to an extent that progress can be readily monitored on a weekly basis. In general, the construction work shall be detailed such that no construction activity shall have duration greater than fifteen (15) work days. As a minimum, each activity shall be coded by:

- a. Activity type (i.e., submittal, Engineer's review, material order material delivery, pilot hole drilling, well testing, development, etc.).
 - b. Responsibility (i.e., Contractor, subcontractor A, subcontractor B, Owner, Engineer, etc.).
 - c. Area (i.e., Pilot Wells, pipeline installation, sitework, etc.).
5. The above schedule development requirements are a minimum and the schedule shall be developed as necessary to properly control and manage the project.
 6. The progress schedule shall be submitted in a network analysis format and shall include, as a minimum, a graphic representation of all significant activities and events involved in the construction of the project. The graphic representation and statement must clearly depict and describe the sequence of activities planned by the Contractor, their interdependence and the times estimated to perform each activity.

1.2 REQUIREMENTS FOR CONFORMING TO SCHEDULE

- A. Take such steps as will be necessary to improve progress, if, in the opinion of the Engineer, the Contractor falls behind the project schedule. Engineer may require Contractor to increase the number of shifts and/or overtime operations, days of work, and/or the amount of construction planned, and to submit for approval such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the Owner.

1.3 ADJUSTMENT OF PROGRESS SCHEDULE AND CONTRACT TIMES

- A. If the Contractor desires to make changes in the method of operating which affect the Contract Times established in the Contract, notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer approves these changes, revise and submit for approval, without additional cost to the Owner, all of the affected portions of the schedule.
- B. Shop drawings and samples which are not approved on the first submittal or within the schedule time shall be immediately rescheduled, as well as any work which fails to pass specified tests or has been rejected.
- C. The Contract Times will be adjusted only for causes specified in the General Conditions. In the event the Contractor requests an adjustment of the Contract times, furnish such justification and supporting evidence as the Engineer may deem necessary for a determination as to whether the Contractor is entitled to an adjustment of Contract Times under the provisions of the General Conditions. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing. If the Engineer finds that the Contractor is entitled to any adjustment of the Contract Times, the Engineer's determination as to the total number of days adjustment shall be based upon all data relevant to the adjustment. The Contractor acknowledges and agrees that actual delays in activities which do not affect the Contract completion date will not be the basis for an adjustment of Contract Times.
- D. From time to time it may be necessary for the Contract Times to be adjusted by the Owner to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the Owner, and other unforeseeable conditions

which may indicate schedule and/or Contract Times adjustments. Under such conditions, the Engineer shall direct the Contractor to reschedule the work and/or Contract Time to reflect the changed conditions. No additional compensation shall be made to the Contractor for such changes except as provided in the General Conditions. Unless otherwise directed, take all possible actions to minimize any extension to the Contract Times and any additional cost to the Owner.

1.4 CASH FLOW SCHEDULE

- A. In addition to the Construction Schedule required above, if requested by the Engineer submit a Cash Flow Schedule for approval by the Engineer. The Cash Flow Schedule shall show the amounts of money by months, which will be required to reimburse the Contractor for Work performed during each month of the Contract Time. The sum of all the monthly cash requirements shall equal the total price of the Contract. The monthly cash requirements shall be proportioned with the aid of the Construction Schedule.
- B. The approved Cash Flow Schedule will be used by the Owner to program funds for progress payments to the Contractor. Monthly payments will be made to the Contractor in accordance with the Contract Agreement, but at no time will the aggregate amount of payments exceed the accumulated amount of payments for the same period of the Cash Flow Schedule.

1.5 SHOP DRAWINGS

- A. Promptly supply to the Engineer for approval, shop drawings with details and schedules for all items as noted in the Drawings and/or Specifications and/or required by the Engineer.
- B. All submittals shall be in Portable Document Format (PDF), compliant with the Adobe, latest version. Such submittals shall be PDF formatted text and graphics or PDF searchable images. All drawings available in native format (i.e., AutoCAD) shall be provided as electronic files, in a native format supported by available viewers, in addition to in PDF format. Each submittal shall have the job name on it and the appropriate specification section or contract drawing reference.

1.6 SAMPLES

- A. When required by the Engineer or where noted in other Sections of these Specifications, samples of materials shall be submitted for approval.

1.7 PRE-CONSTRUCTION VIDEO/ELECTRONIC PHOTOS

- A. Prior to mobilization at the site, furnish to the Engineer a recording of all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to, streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures and adjacent building structures. The purpose of the video is to document existing conditions and to provide a fair measure of required restoration. Care should be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard. Notify the Engineer when the video is to be taken to provide the Engineer an option to be on site during the documenting of the project area.
- B. The recording shall be high quality, color and in digital format. Temporary lighting shall be provided as necessary to properly video areas where natural lighting is insufficient

(indoors, shadows, etc.). The video shall include an audio soundtrack to provide the following information:

1. Detailed description of location being viewed referenced to Contract Drawings (i.e., well location, building designation, pipeline route etc.)
 2. Direction (N, S, E, W, looking up, looking down, etc.) of camera view
 3. Date, time, temperature, environmental conditions during recording.
- C. Where required by Engineer, electronic photographs of specific locations shall be provided to supplement the electronic video.
- D. Any areas not readily visible by video/photo methods shall be described in detail. Unless otherwise approved by Engineer, video shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc.
- E. Prepare and provide as many CD/DVD/Flash Drives as are necessary to satisfy the requirements of this section. The original documents shall be submitted to the Engineer accompanied by a detailed log of the contents of each CD/DVD/Flash Drive. The log should include location descriptions with corresponding file name to facilitate the quick location of information contained on the CD/DVD/Flash Drives. The recordings will be maintained by the Engineer during construction and may be viewed at any time by Contractor upon request. Upon final acceptance, the recording will become the permanent property of the Owner.

1.8 PROGRESS PAYMENTS AND SPEND PROJECTIONS

- A. The detailed arrangement for submittal of progress payments shall be discussed at the preconstruction meeting. Unless otherwise specified by the Owner, progress payments shall be submitted monthly in a format acceptable to the Engineer. The progress payment request shall be based on the unit prices and should provide the percentage of completion, total dollar value completed, dollar value completed prior to the current payment, and the amount requested for this progress payment for each line item contained in the schedule of values. Progress payment requests for material and/or equipment suitably stored but not yet incorporated into the work shall be accompanied by a copy of the appropriate manufacturers invoice, shipping order, bill of lading, etc. and the progress payment amount shall be the direct cost to the Contractor, or subcontractor, for such material and/or equipment. Payment will not be made to the Contractor if, upon inspection by the Engineer, it is determined that the material and/or equipment does not conform to the requirements of the Contract Documents including proper storage, receipt of approved shop drawings, receipt of any special guarantees, Bonds, insurance coverage, any evidence of damage or imperfections, etc.
- B. If requested by the Owner, spend projections shall also be submitted monthly to the Owner. The format of the projects shall be determined by the Owner.

1.9 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

- A. If requested by the Engineer, prepare complete written maintenance and operating instructions covering any equipment provided under this Contract. Divide the operating instructions into basic sections according to type of equipment.

- B. Instructions shall describe all equipment and controls, their purpose, and their operation and use. Include maintenance checklists for use by the Owner's personnel and a complete listing of replacement parts with pertinent information relative to ordering such parts.
- C. Submit instructions in duplicate draft form for review by the Engineer at least eight weeks prior to initial operation and in final form within thirty days after return of one copy of the draft with the Engineer's notations.
- D. Prior to release of Final Payments, revise and resubmit copies of the instructions to accord with any changes in procedures or equipment made during start-up or initial operation. Resubmittals are also required for changes made during the guarantee period.

1.10 REQUIREMENTS FOR AMERICAN WATER ASSET VALUES

- A. Provide a breakdown of the contract amount by Property Units in accordance with the list of Property Units that can be provided as requested. This process requires that the contractor assign the full cost of the project to lengths of pipe (by material and size), length of services (by material and size), hydrants, valves (by size), manholes and other fixtures (air relief valves, blowoffs, etc.) in the project. The submission must be approved by the Engineer to verify that the breakdown is realistic and reflects submitted contract unit prices.

1.11 AS BUILTS

- A. Where identified as a product of the work, provide as built drawings adhering to the criteria provided here and that found in the special conditions.
- B. Templates - All measurements and information shall be recorded on templates provided or as directed by the Engineer. No other backgrounds, templates nor formats will be accepted for the As-Built submission.
- C. Recording the Information - Provide the Record As-Built information in both 'Electronic and Hard' copy mediums, with the exception of the Field Sketches. The Field Sketches are not required to be in the electronic format. The electronic medium format shall be in AutoCAD 2000 or later. The base drawing shall be drawn in Model Space at a scale of 1 to 1, in real world coordinates and all plotting, labeling and dimensioning shall be drawn from Paper Space. Templates shall not be modified or resized due to Optical Scanning requirements.
- D. Coordinates – Provide the required survey coordinates in the State Plane Coordinate System unless otherwise noted. The drawing features included shall be as noted below (See 'Pipeline As-Built Drawing Procedure').
- E. Submitting the Information - When the Record information is ready, submit 'Hard' copies of all the information, including sketches to the Engineer for approval. The electronic information shall be burned on a CD (CD-RW), DVD or Flash Drive or transmitted via other electronic means approved by the Owner. CDs/DVDs shall have an all white label with the following information on the upper half of the label in Arial 12 font:

American Water (*State and District*),

Project (*Name*)

Business Unit (*#*),

(*Street*) and (*Town*)

- F. The Information Process - The Engineer will approve the submission or 'red line' any information needing to be corrected or added, and return it for resubmission. When the submittal is approved by the Engineer, provide two Flash Drives/DVDs/CD-RW's each containing all approved Record As-Built information in a clear face hard plastic CD jacket, unless otherwise directed by the Engineer, and one hard copy of all approved Record As-Built information (binder clipped together, not bound)
- G. Initial submission must be provided within (14) calendar days of the 'Construction Completion' date, not including the restoration work. The Engineer will return the submission within (7) calendar days of receipt. The approved final submission must be provided within twenty-eight (28) calendar days from the 'Construction Completion' date, not including the restoration work.
- H. General information required - At a minimum, all As-Built record drawings shall contain the following information:
 - 1. North Arrow with North at the top of the drawing
 - 2. Face of curb lines, easement lines, edge of pavement (EOP) or right-of-way lines
 - 3. Business Unit (BU) Number (data provided by Engineer)
 - 4. Plate Map number (data provided by Engineer)
 - 5. All objects located shall be referenced to other objects with (3) perpendicular measurements. All such measurements shall be from permanent existing structures, such as catch basins, manholes, buildings, etc. (no utility poles)
 - 6. The proposed pipeline 'line' designation shall be shown in bold or heavier line style per template and sample.
- I. Pipeline information required - At a minimum, all As-Built record drawings shall contain the following information:
 - 1. Title Block Information completed (note, any street with work performed in it must have it's name included in the title block)
 - 2. Each drawing shall include only the work along one street block (transmission mains excluded). And include the intersecting street corners with the distance to the center line of each intersection. Include Match Lines if multiple drawings are required.
 - 3. If more than one drawing is required, include an overall site plan of the whole project with a drawing key
 - 4. Pipe diameter and material
 - 5. Bill of Materials with arrow identifying where installed
 - 6. Date the water main was put 'In-service' (data provided by Engineer)
 - 7. Include valve, hydrant and tap/service identifying numbers for each (data provided by Engineer)
 - 8. Reference the Point of Connection where the new main pipeline connects to existing Owner facilities and provide dimensions to nearest existing appurtenance

9. If project continues from an existing stub, a dimension from the center line of the nearest street intersection and existing line valve shall be included. Provide coordinates for the referenced existing valve.
 10. If the project is a continuation of a previous project, reference the previous project reference number
 11. All Valves, tees, horizontal/vertical bends, and the start and end of the new water main shall be located with coordinates in the specified format.
 12. All connections, wet cuts and fittings not required to have coordinates shall be dimensionally located
 13. Indicate abandoned pipe with type of material and length (if applicable)
 14. Indicate and locate buried valves (if applicable) with coordinates in the specified format.
 15. Provide measurement from face of curb or edge of pavement at every 250 foot maximum along the pipeline
 16. At abrupt changes in pipe elevation, provide a referenced drawing showing the profile of the work and list the material used
 17. Provide the depth from finish grade to top of pipe every 100 lf, and at the start and end of the new water main
 18. Name of Contractor and Construction Inspector (full last name) on the project (locate in title block)
- J. Transmission Pipeline Information - Transmission Mains are typically 16" in diameter and larger; however, the Engineer may classify some 12" diameter pipe projects as a transmission main. Transmission main as-built drawings shall include all relevant information noted above and the following:
1. Title Sheet to include at a minimum:
 - a. American Water District & Project name
 - b. Project Business Unit Number (data provided by Engineer)
 - c. Design Consultant Engineering Company name
 - d. Project date
 - e. County and Town
 - f. List of drawings
 - g. Drawing key with corresponding drawing reference
 2. Include both Pipeline plan and profile views if requested by the Owner, and include both on the same sheet. Provide a detail sheet copying all valve cards (data provided by Engineer) listed those included and not included on the plan/profile sheets
 3. Include drawing details of all interconnections
 4. Provide the Manufacturer data for the pipe, fittings and appurtenances on the drawings
 5. Show and identify all restraint locations

6. Include valves, bends, tees, and top of main elevation every 300 foot maximum with coordinates in the specified format.
- K. Connection (Tap and Service) Drawing Information - Service drawings are required where services currently do not exist. This drawing can be incorporated into the Pipeline Drawing noted above. Service drawings shall be on the template provided by the Owner. The drawing shall contain the general information above and the following additional information:
1. Title Block information completed
 2. Every service connection, service valve or curb stop, if installed, shall be located dimensionally with separate measurements for both the corporation and curb/meter box
 3. Valves shall be located with coordinates in the format specified
 4. Identify the main pipeline size, type and location from nearest face of curb or edge of pavement
 5. Tap number and house address shall be clearly shown at each location
 6. Show the size, length and service material
 7. Match lines and/or drawing key if more than one sheet
- L. Field Sketches – Contractors shall provide field sketches to the Owner for work performed. Notes specific to field sketches for some items are noted below. Field sketches shall be provided to the Owner within 1 week of the main being placed into service for Qualified Infrastructure Program (QIP) projects and within 1 week of substantial completion of the project for projects not included in QIP.
1. Main – At a minimum, field sketches shall contain the following:
 - a. Size and material of main
 - b. Fittings, valves, hydrants, and other appurtenances along the main
 - c. Location of connections to other mains
 - d. Length of main installed between each fitting and appurtenance
 - e. Location of casing pipe and concrete encasement, if applicable
 2. Valves (including Valves for Blow-offs) - Valve location measurements and information shall be shown on an 8½” x 11” sketch. Separate sketches are required for each valve, regardless of their proximity to each other. The sketch should be an enlarged and more detailed version of what is depicted on the Pipeline drawing. Any ‘Blow-offs’ installed with the work shall be shown in detail on a Valve sketch with the same level of information as a valve. At a minimum, all Valve sketches shall contain the following:

- a. Manufacturer, type, open direction and number of turns (confirm open direction upon delivery)
 - b. Main Pipeline type and size
 - c. Valves and Blow-off's shall be located with NJSPCS NAD 83 coordinates
 - d. Valve identifying number (data provided by Engineer)
 - e. Identify other valves, hydrants, fittings and blow-offs within the immediate vicinity
 - f. Identify permanent existing structures
 - g. At least (3) tie down measurements to valve from permanent existing structures including catch basins, manholes, buildings, curbs, etc. (no utility poles)
3. Hydrant - Submit hydrant location measurements and information on an 8½" x 11" sketch. Each 'hydrant' shall have a separate sketch. The sketch should be an enlarged and more detailed version of what is depicted on the Pipeline drawing. At a minimum, all Hydrant sketches shall contain the following:
- a. Manufacturer and hydrant number (data provided by Engineer)
 - b. Bill of Material
 - c. Hydrant valves shall be located with NJSPCS NAD 83 coordinates
 - d. Record flow test results on sketch. If no test was required record static pressure (data provided by Engineer)
 - e. Main Pipeline and lateral type and size
 - f. Identify other valves, hydrants, fittings and blow-offs within the vicinity
 - g. Identify permanent existing structures
 - h. If an existing hydrant was relocated, reference the old hydrant number and it's BU (data provided by Engineer)
4. Service Connections - Information shall be shown on the template provided by the Owner (commonly referred to as a "Green Sheet") for each service that is installed, renewed, relocated, or removed. Each service shall have a separate sketch. Sketches shall be provided within 2 weeks of service installation for QIP projects and within 1 week of substantial project completion for projects not included in QIP. All information on the Owner's template shall be filled out and, at a minimum, shall contain the following:

- a. Locate dimensionally the identified Service/Tap
- b. Sketch shall be oriented with the building receiving the service at the top of the sketch.
- c. Locate dimensionally the tapped water main from nearest face of curb or EOP
- d. Locate dimensionally the curb/meter box from nearest curb or EOP
- e. Tap identifying number (data provided by Engineer)
- f. Distance from tap to meter pit/curb stop
- g. House address
- h. Single or dual setting
- i. Notation if the service is new, renewed, relocated, or removed
- j. Quantity, size, and condition of materials installed
- k. Date the work was performed
- l. Task order number
- m. Municipality
- n. Size, material, and depth of tapped main

1.12 GPS DATA COLLECTION

- A. Contractor shall complete GPS data collection training with Owner prior to beginning work.
 - 1. Contractor shall coordinate with Owner to schedule training.
 - 2. Owner will provide GPS equipment to Contractor at the time of training. Contractor will be responsible for maintaining GPS equipment during construction.
 - 3. Unless requested by Owner, previously trained Contractor personnel do not need to repeat training prior to beginning the work.
- B. GPS data points shall be collected for valves, hydrants, vaults, meters, fittings (excluding anchor nipples), and pipe bell ends.
 - 1. Applicable data field in the GPS collection software must be correctly entered for each asset.
 - 2. GPS data points shall be collected in the trench, on top of and in the center of the asset, wherever possible.
 - a. Hydrant points will be taken on the line side of the hydrant.
 - b. Vault points shall be collected on the center of the meter within the vault.
 - 3. 90% of collected points shall have an "RTK Fixed" fix type. Contractor shall contact Owner immediately if "RTK Fixed" fix types cannot be obtained.

PART 2: PRODUCTS

2.1 TESTING DATA CERTIFICATES

- A. Product testing shall comply with all respective AWWA standards. The certificates of compliance shall be electronically scanned and submitted by E-mail to the Engineer or by submitting the hard copy originals to the Engineer.

PART 3: EXECUTION

A. Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES & CONTROLS

PART 1: GENERAL

1.1 WATER SUPPLY

- A. If reasonably available, water for the purpose of this Contract will be supplied to the Contractor by the Owner. All necessary meters, temporary piping and valves in connection with such water supply shall be furnished, installed and maintained by the Contractor.
- B. The Owner reserves the right to meter all water used by the Contractor through an Owner approved meter installed by the Contractor.
- C. The Owner reserves the right to impose limitations upon the Contractor's use of water as the Owner determines may be necessary to assure continued ability to meet the demands of its customers and the volumes and pressures required for fire protection. Any water required by the Contractor in excess of the quantities the Owner provides to the Contractor must be furnished by the Contractor at Contractor's expense.

1.2 TEMPORARY HEAT

- A. Provide and maintain approved type heating apparatus with the necessary fuel in order to protect and/or dry out the work. Do not leave stored fuel unsecured. The stored materials and finished work shall be protected at all times from damage by the weather elements.

1.3 ELECTRICAL SUPPLY

- A. Pay all fees, obtain necessary permits, have meter installed for power and light, and pay all monthly charges as may be required for completing the work.

1.4 TEMPORARY LIGHTING

- A. Provide and maintain lighting for construction operations and lighting to exterior staging and storage areas after dark as necessary for security purposes.

1.5 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas. Barriers shall be sufficient to protect people, existing facilities, and adjacent properties from damage or injury. Provide protection for plant life designated to remain. Replace damaged plant life.

1.6 FENCING

- A. Refer to Part 1.5 Barriers of this Section for temporary barrier requirements.

1.7 PARKING

- A. Arrange for temporary parking to accommodate construction personnel.

- B. Continual parking in grass areas in the right-of-way by the Contractor shall not be allowed.

1.8 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Remove debris and rubbish from closed or remote spaces, prior to enclosing the space. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust. Remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.9 SANITARY FACILITIES

- A. Provide suitable temporary facilities and enclosures for the use of workers and site visitors and shall maintain same in a sanitary condition.
- B. The Contractor is advised that the Owner is in the business of providing potable water and the Contractor's sanitary arrangements shall not endanger the Owner's facilities.

1.10 FIELD OFFICES

- A. Furnishing a field office is not required.

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION

Not Used

END OF SECTION

SECTION 01 55 26

TRAFFIC CONTROL

PART 1: GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install all traffic barricades, markers, signs, controls and provide flagmen, traffic police and other facilities required by the applicable Federal, State, County or local government authorities and the Engineer to protect general public and maintain the existing roads, streets and highways.
- B. Traffic control methods and materials shall conform to the latest editions of applicable State DOT Standard Specifications for Road and Bridge Construction and USDOT Manual on Uniform Traffic Control Devices for Streets and Highways.
- C. Prior to the start of construction, assign one individual at a supervisory level who will be responsible for maintenance and protection of traffic. See General Conditions article 7.
- D. Competent traffic personnel suitably attired for safety shall be employed at every location where the Contractor's equipment is working immediately adjacent to, or is entering, leaving or crossing, active traffic lanes. The traffic personnel shall be employed continuously for the full time such conditions exist.
- E. Special attention shall be given for the protection of pedestrians and, in particular, children going to and coming from school. Ingress and egress shall be maintained for all properties abutting the pipeline.
- F. Notify the State and local police, ambulance services and fire departments of daily traffic diversions.
- G. Be fully responsible to complete all obligations of the Contract regardless of any restrictions which may be imposed by Federal, State, County or local authorities. The Owner or Engineer makes no warranty or representation that the Contractor will be permitted to divert or barricade traffic.

1.2 MAINTAINING TRAFFIC

- A. Traffic Diversion: Whenever it is necessary to divert traffic from its normal channel into another channel, such diversion shall be clearly marked by cones, drums, barricades, temporary guardrail or other appropriate devices. If the markers are left in place at night, suitable lights shall be provided and maintained.
- B. One Way Traffic: Whenever one way traffic is established in a two way traffic area, at least two (2) flagmen shall be provided. Adhere to all requirements of the local police and street regulator having jurisdiction.
- C. Street Closing: When permitted by Federal, State or local authorities having jurisdiction, the Contractor may close streets to through traffic for minimum periods of time. Notify and secure the permission of the local police and fire departments and such other public authorities and, if required by any law, ordinance or regulation, the occupants of all premises bordering the streets. Give all occupants reasonable notice

with respect to the closing of any street, in whole or in part, even when not required by any law, ordinance, or regulation. Schedule work such that the time the street is closed is kept to a minimum and, whenever possible, make suitable preparations for access by local residents, school buses, and mail delivery vehicles. Provide access for police, fire, ambulance and emergency vehicles at all times. Fire hydrants and other public utility valves shall be kept accessible at all times.

1.3 TRAFFIC SIGNALS AND CONTROLS

- A. The installation and operation of all traffic signals and traffic control devices shall conform to the requirements of Federal, State and local government highway departments. The replacement of pavement markings disturbed during construction or the installation of temporary markings is the sole responsibility of the Contractor.
- B. To protect persons from injury and to avoid property damage, adequate barricades including flasher and reflectorized construction signs and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic and pedestrians to use the trenched area.
- C. When permitted to close a street or road to traffic, furnish, erect, maintain and remove barricades, suitable and sufficient red lights, and other lights or reflecting material at the limits of the project, where side streets intersect, and at other points of public access to the project. Furnish, erect and maintain advance warning signs and barricades on side street at the first street intersection beyond the one closed by construction indicating "Street Closed, One Block Ahead". Furnish, erect, maintain and remove detour marking signs on temporary routes.

1.4 TRENCH AND STORED MATERIALS MARKINGS

- A. Before completion of each day's work, in traveled areas, the pipe trench shall be completely backfilled and tamped, and the necessary temporary paving installed. $\frac{3}{4}$ -inch stone will be used in sidewalk and walkway areas and blacktop in driveways, unless local requirements require alternative measures. These areas are not to be left open, impassable or unsafe through the night. In the event that the pipe trench cannot be completely backfilled and tamped, temporary bridges and crossings shall be used to accommodate through traffic and the general public. The job site will be left in a neat and satisfactory condition at the end of each day. The requirements of this Section are in addition to any requirements of Federal, State or local laws, rules, regulations or ordinances or any requirements found elsewhere in the Contract Documents.
- B. Equipment and material stored on the street shall be marked at all times. At night any such material or equipment stored between the side ditches, or between lines 5 feet behind any raised curbs, shall be clearly outlined with light or other dependable warning devices that are approved by the Engineer. In addition, provide any other lights, barricades, etc., that may be needed for the protection of pedestrian traffic.

1.5 OTHER REQUIREMENTS

- A. Trucks and/or trailers used as protective vehicles to protect workers or work equipment from errant vehicles on roadways with posted speed limits of 50 MPH or greater shall be equipped with Truck-Mounted Attenuators conforming to the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features".

- B. The protective truck must be positioned a sufficient distance in front of the workers or equipment being protected to allow for appropriate vehicle roll-ahead, but not so far that errant vehicles will travel around the vehicle and strike the workers/equipment. Attenuators should be in the full down-and-locked position.
- C. For stationary operations, the truck's parking brake should be set and, when possible, the front wheels turned away from the work site. Turning the front wheels should be based on specific conditions at the site such that the after-impact trajectory is into a safe area.
- D. If the regulation of traffic and controls are not being provided in accordance with this Section 01 55 26, and the public is inconvenienced or its safety is being endangered, in the judgment of the Engineer, the Owner may take such steps as it deems advisable to provide such services and all costs in providing such services will be deducted from any payment which may be due or may thereafter become due the Contractor.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1: GENERAL

1.1 PROTECTION OF MATERIAL AND EQUIPMENT

- A. Provide for the safe storage of all material furnished or purchased until it has been incorporated in the completed project and accepted by the Engineer. Bear the risk of loss and/or damage to the materials and Work until the Work is finally accepted by the Engineer.
- B. All electrical and mechanical equipment shall be stored in a warm, dry shelter with proper ventilation. Under no circumstances shall motors, electrical control equipment or any other electrical or mechanical equipment be stored under polyethylene plastic covers or tarpaulins. When space is available inside existing structures, and the Owner approves, the Contractor will be allowed to store equipment inside them. Should such space not be available, construct a shelter with a source of heat and proper ventilation as approved by the Engineer for the storage of equipment.
- C. The interior of all pipe, fittings, and accessories shall be kept free from dirt, foreign matter and standing water at all times.
- D. After valves and hydrants have been inspected, properly store them prior to use. In order to prevent entry of foreign material that could cause damage to the seating surfaces, the valves and hydrants shall be stored in a fully closed position unless recommended otherwise by the manufacturer. Resilient seated valves shall be stored in accordance with the manufacturer's recommendations. This may include storage with protective covers for rubber seats and in marginally open condition. Valves and hydrants shall be stored indoors unless otherwise approved by the Engineer.
- E. If valves must be stored outdoors, protect the operating mechanism, such as gears, motor, actuators and cylinders, from weather elements. Valve ports and flanges must be protected from the weather and foreign materials. If valves are subject to extreme (freezing or excessively hot) temperatures, all water must be removed from the valve interior and the valve closed tightly before storage, unless specifically recommended otherwise by the manufacturer. Valves shall be stored on pallets with the discs in a vertical position to prevent rainwater from accumulating on top of the disc, seeping into the valve body cavity and freezing and cracking the casting.

1.2 SERVICING EQUIPMENT

- A. Check all equipment upon acceptance to determine if oil reservoirs are full and areas to be greased are properly packed with grease. Provide the proper grease or oil for use in lubricating the required areas in the equipment. Any service to equipment while in storage, or installed pending acceptance, is the responsibility of the Contractor and shall be performed per manufacturer's requirements, industry standards or as stated specifically in the technical specifications.

1.3 RESPONSIBILITY FOR MATERIAL AND EQUIPMENT

- A. Under no circumstances shall pipe, valves, fittings, or appurtenances be dropped or dumped from any trucks or equipment. When received from the Carrier and at time of unloading, inspect all pipe and accessories for loss or damage. No shipment of material shall be accepted by the Contractor unless loss or damage has been described on the Bill of Lading by the Carrier's agent. Any discrepancies between the Bill of Lading and the physical material shall be noted on the Bill of Lading. All demurrage charges on carloads or truckloads of pipe or other material shall be paid by the Contractor.
- B. After acceptance of material and/or equipment by Contractor at point of delivery, assume full responsibility for safe and secure storage, handling, servicing and installation of such material and/or equipment in accordance with manufacturer's recommendations, industry standards or specific requirements of the Contract Documents. Once in his possession, assume full responsibility for, and protect all material from theft and damage. Any lost or stolen materials shall be replaced at the Contractor's expense.
- C. Re-inspect all material for defects, correct size, and quantity in the field prior to installation. Immediately report all material found to be defective, improperly sized, or deficient in quantity to the Owner.
- D. The Contractor is responsible for all material furnished by the Contractor and Contractor suppliers. All such material which is defective in manufacture or has been damaged in transit or has been damaged after delivery shall be replaced by the Contractor at his expense.
- E. Certain material and equipment will be furnished by the Owner as noted in the Contract Documents. The Contractor's responsibility for material and/or equipment furnished by the Owner shall begin upon the Contractor's acceptance of such material and/or equipment at the point of delivery. All material and equipment shall be examined and items found to be defective in manufacture and/or otherwise damaged shall be rejected by the Contractor at the time and place of delivery. The Owner will thereupon repair or replace the damaged items. Any material and/or equipment found to be defective prior to acceptance by the Engineer shall be repaired or replaced by Contractor at no additional cost to Owner unless Contractor submits proof that such defect was latent and could not have been detected by Contractor when performing their duties and responsibilities under these Contract Documents.
- F. Contractor's and Owner's responsibilities for providing guarantees or warranty and manufacturer's representatives for service, inspection, certification of installation, installation, field training, start-up, etc. for material and/or equipment furnished by Owner shall be as follows unless otherwise specified: Owner will provide the warranty and Contractor is responsible for providing manufacturer's representatives for all necessary field service, start-up service, installation certifications, installation, field training of Owner's personnel, etc. for Owner furnished material and/or equipment as required for acceptance of such material and/or equipment in the completed project.

PART 2: PRODUCTS

2.1 GENERAL

- A. Unless otherwise specifically provided for in these Specifications, all equipment, materials and articles incorporated in the work shall be new, in current production and the best grade obtainable consistent with general construction usage.

2.2 COORDINATION OF DIMENSIONS

- A. Verify and make necessary corrections to construction dimensions so that all specified and/or alternative equipment, which is approved by the Engineer, can be installed and will function within the intent of the Contract Drawings and Specifications. Promptly notify the Engineer of all necessary corrections required.

2.3 SAFETY AND HEALTH REQUIREMENTS

- A. All materials, equipment, fixtures and devices furnished shall comply with applicable Laws and Regulations.
- B. All material and equipment furnished and installed under this Contract shall be equipped with suitable and approved safety guards and devices required for the safety of the public and operating personnel. Such guards and safety devices shall be in accord with the latest requirements of safety codes approved by the American National Standards Institute as well as the safety requirements of applicable Laws and Regulations. Where said safety codes of the ANSI are incompatible with applicable Laws and Regulations, said Laws and Regulations

PART 3: EXECUTION

3.1 INSTALLATION

- A. Material and equipment shall be installed in accordance with the appropriate Sections of these Specifications.

3.2 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Arrange for a qualified service representative from each company, manufacturing or supplying certain equipment as required by the individual Specification Sections to perform the duties herein described.
- B. After installation of the applicable equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include, but shall not be limited to, the following points as applicable:
 - 1. soundness (without cracked or otherwise damaged parts)
 - 2. completeness in all details, as specified
 - 3. correctness of setting, alignment, and relative arrangement of various parts
 - 4. adequacy and correctness of packing, sealing and lubricants
- C. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.

END OF SECTION

SECTION 01 77 00
CLOSEOUT REQUIREMENTS

PART 1: GENERAL

1.1 TESTING OF FACILITIES

- A. All work shall be tested under operating conditions and pressures and any leaks or malfunctions shall be repaired to the satisfaction of the Engineer at no additional expense to the Owner.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection. Provide submittals to Engineer that are required by governing or other authorities. Submit Application for final payment identifying total adjusted Contract sum, previous payments, and sum remaining due.

1.3 PROGRESS CLEANING AND FINAL CLEANING

- A. Periodically, or as directed during the progress of the Work, remove and properly dispose of the resultant dirt and debris and keep the premises reasonably clear. Upon completion of the Work, remove all temporary construction facilities and unused materials provided for the Work and put the premises in a neat and clean condition and do all cleaning required by the Specifications. Trash and combust-ible materials shall not be allowed to accumulate in construction locations.
- B. Execute final cleaning prior to final inspection. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances. Clean equipment and fixtures to a sanitary condition. Clean debris. Clean site; sweep paved areas, rake clean landscape surfaces. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. contract drawings
 - 2. specifications
 - 3. addenda
 - 4. change orders and other modifications to the Contract
 - 5. reviewed shop drawings, product data, and samples
- B. Store record documents separate from documents used for construction. Record information concurrent with construction progress.
- C. Specifications: Legibly mark each item to record actual construction including:
 - 1. manufacturer's name and product model and number

2. product substitutions or alternates utilized
 3. changes made by addenda and modifications
- D. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths, screen, casing, and pump types and dimensions in relation to finished ground elevation.
 2. Measured site location of well, vault and any other structures.
 3. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 4. Field changes of dimension and detail.
 5. Details not on original Contract Drawings.
- E. Submit documents to Engineer with final Application for Payment.

1.5 SPARE PARTS AND MAINTENANCE MATERIALS

A. Contractor Purchased Material

1. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
2. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

B. Owner Purchased Material

1. Return excess owner material to a location(s) specified by the Engineer within three (3) days of job completion.

1.6 GUARENTEES AND WARRANTEES

- A. The Contractor expressly warrants that all workmanship and materials performed or furnished under this Contract will conform to the Specifications, Drawings, samples and other applicable descriptions furnished or adopted by the Contractor and with all applicable laws, provisions and requirements of the Contract Documents. Remedy any defects due to faulty materials or workmanship which are discovered within a period of one (1) year from the date of acceptance of the work in this project and pay for any damage resulting from faulty materials or workmanship. The Owner shall give notice of observed defects with reasonable promptness. The Contractor warranty hereunder is in addition to, and not in limitation of, any obligations found elsewhere in the Contract Documents, any special guarantees provided by the Contractor or Contractor suppliers, and any obligations imposed by law.
- B. In addition to the above requirements, assign material and equipment guarantees and warranties from all manufacturers and suppliers to the Owner and deliver copies of such guarantees and warranties and the necessary assignments to the Owner in order to assure the Owner of the full benefit of such guarantees and warranties.

1.7 RESTORATION

- A. As required by the Contract Documents, restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces and structures to a condition equal to that before the Work began and to the satisfaction of the

Engineer and furnish all labor and materials incidental thereto. In restoring improved surfaces, new pavement is required.

- B. No permanent bituminous top paving shall be placed within twenty (20) days, or other specified time frame required by law, after the backfilling shall have been completed, except by order of the Engineer. Temporary paving will be installed prior to the placement of permanent surfaces when required by the Engineer or by any federal, state or local governing body having jurisdiction over the site where the work is being performed. In any event, all permanent bituminous top paving shall be placed within forty five (45) days or other specified time required by law, after the backfill has been completed unless otherwise ordered by the Engineer.

1.8 MAINTENANCE OF SURFACES

- A. Following the certification of completion by the Engineer, maintain the surfaces of paved and unpaved trenches and adjacent curbs and gutters, sidewalks, fencing, sod and other disturbed surfaces for a period of one (1) year thereafter or as required by state, county or local authorities unless otherwise stipulated by the Engineer. Supply all material and labor required for the maintenance of the trench surfaces and structures and perform the work in a manner satisfactory to the Engineer.

PART 2: PRODUCTS

- A. Not Used

PART 3: EXECUTION

- A. Not Used

END OF SECTION

SECTION 02 00 00

EXISTING UTILITIES AND STRUCTURES

PART 1: GENERAL

1.1 SCOPE OF WORK

- A. Certain information regarding the reputed presence, size, character, and location of existing Underground Facilities such as pipes, drains, sewers, electrical lines, telephone lines, cable TV lines, gas lines, and water lines has been shown on the Contract Drawings and/or provided in the contract documents. This information with respect to Underground Facilities is provided by the Owner in accordance with conditions described in the General Conditions and for information purposes only. Contractor is responsible to determine actual location of all utilities in proximity to the work for the purposes of the preparation of their bid and during construction.

1.2 NOTIFICATION OF UTILITIES

- A. Notify the applicable State Agency with jurisdiction over underground facilities and/or all utility companies that construction work under this Contract will pass through containing their underground facilities. Notify these parties in advance to support the construction work (minimum 72 hours). All excavation in the vicinity of existing underground utilities shall be performed in accordance with applicable regulations.

PART 2: PRODUCTS

2.1 MATERIALS

- A. Furnish all materials for temporary support, adequate protection, and maintenance of all underground and surface utility structures, supports, drains, sewer and other obstructions encountered in the progress of the work.

PART 3: EXECUTION

3.1 OBSTRUCTIONS BY OTHER UTILITY STRUCTURES

- A. Support, relocate, remove, or reconstruct existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or drains. The obstruction shall be permanently supported, relocated, removed or reconstructed where they obstruct the grade or alignment of the pipe. Contractor must do so in cooperation with the owners of such utility structures. Before proceeding, the Contractor must reach an agreement with the Engineer on the method to work around the obstruction.
- B. No deviation shall be made from the required line or depth without the consent of the Engineer.

3.2 REPAIRS

- A. Repair or replace any damage to existing structures, work, materials, or equipment incurred by Contractor's operations.

- B. Repair all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, trees, shrubs or other public or private property caused by transporting equipment, materials or personnel to or from the work site. Make satisfactory and acceptable arrangements with the persons or agencies having jurisdiction over the damaged property concerning repair or replacement.
- C. Brace and support existing pipes or conduits crossing the trench, or otherwise exposed to prevent trench settlement from disrupting the line or grade of the pipe or conduit. Before proceeding, the Contractor must reach an agreement with the Engineer on the method of bracing and support. Repair or replace all utility services broken or damaged at once to avoid inconvenience to customers. Storm sewers shall not be interrupted overnight. Use temporary arrangements, as approved by the Engineer, until any damaged items can be permanently repaired. Maintain all items damaged or destroyed by construction and subsequently repaired.
- D. American Water Standard Detail SD44 provides requirements for repair or replacement of sanitary or storm drains removed or damaged during installation of the water main.

3.3 RELOCATION

- A. Relocate existing utilities or structures, where necessary, and restore it to a condition equal to that of the original facility. Obtain approval of the owner of the utility or structure prior to relocating and/or restoring the facility.

3.4 SEPARATION OF WATER MAINS AND SANITARY SEWERS

A. General

1. Consider the following factors when determining adequate separation:
 - a. Materials and type of joints and restraints for water and sanitary sewer pipes,
 - b. Soil conditions & backfill materials,
 - c. Service and branch connections into the water main and sanitary sewer line,
 - d. Compensating variations in horizontal and vertical separations,
 - e. Space for repair and alterations of water and sanitary sewer pipes,
 - f. Off-setting of pipes around manholes.

B. Parallel Installation

1. Lay water mains at least 10 feet horizontally from any existing or proposed sanitary sewer. Measure the distance from edge to edge. In cases where it is not practical to maintain a 10-foot separation, the applicable State Agency may allow deviation on a case-by-case basis, if supported by data from the Engineer. Such deviation may allow installation of the water main closer to a sanitary sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sanitary sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sanitary sewer.

C. Crossings

1. Whenever water mains must cross sanitary sewer laterals or sanitary sewers, lay the water main at such an elevation that the bottom of the water main is 18 inches above the top of the sanitary sewer pipe. Maintain this vertical separation for the

portion of the water main located within 10 feet horizontally of any sanitary sewer it crosses. The 10 feet is measured as a perpendicular distance from sanitary sewer line to the water line.

D. Exception

- a. Notify the Engineer when it is impossible to obtain the proper horizontal and vertical separation as stipulated above. If directed by the Engineer, both the water main and sanitary sewer line shall be constructed of, mechanical joint ductile iron or welded joint protected steel pipe. Other types of restrained joints of equal or greater integrity may be used at the discretion of the Engineer after consultation with the applicable State Agency. Thermoplastic sanitary sewer pipe may be used provided mechanical or solvent weld pipe joints are used and accepted by the Engineer. Pressure test these joints before backfilling to assure that they are water tight. Where water mains must cross under a sanitary sewer, additional protection shall be provided by:
 - (1) A vertical separation of at least 18 inches between the bottom of the sanitary sewer and the top of the water line,
 - (2) Adequate structural support for the sanitary sewer to prevent excessive deflection of the joints and the settling on and breaking of the water line,
 - (3) Centering the section of water pipe at the point of the crossing so that the joints shall be equidistant and as far as possible from the sanitary sewer line.
- b. Consult the applicable State Agency, through the Engineer, to discuss the use of double casing or concrete encasement of sanitary sewer and/or water lines as possible alternatives when the above conditions cannot be met.

3.5 SEPARATION OF WATER MAINS AND STORM SEWERS

- A. Where water mains and storm sewers would run parallel, lay water mains at least 10 feet horizontally from the existing or proposed storm sewer (measured from edge to edge). Where storm sewers and water mains would cross, place water mains at least 12 inches from the storm sewer (measured from edge to edge). In cases where it is not practical to maintain the specified separation, the Engineer may allow deviation on a case by case basis or as clearly called out in the plans. If the Engineer deems that such deviation will be allowed, install the water main as directed by the Engineer in such a way that does not compromise more stringent and desired separation from sanitary sewers per subsection 3.4.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE OF WORK

- A. Provide concrete for thrust blocking, manhole bases, pipe encasement, curbs, sidewalks and pavement in accordance with this Specification Section.

PART 2: PRODUCTS

2.1 MATERIALS

- A. Portland Cement shall be Type I or Type III and conform to "Specification for Portland Cement" ASTM C150.
- B. Air-Entraining Agent from approved manufacturer shall be added in accordance with manufacturer's directions to the normal Portland cement to entrain 4½ percent air ± 1 percent with all other ingredients and strength as specified. Air-entraining admixtures shall conform to "Specifications for Air-Entraining Admixtures for Concrete" ASTM C260.
- C. Concrete Aggregates shall conform to "Specifications for Concrete Aggregates" ASTM C33. Coarse aggregates shall be a maximum of 1½ inches in size in footings and plain concrete. Pea gravel shall be used for sections 3 inches or less in thickness.
- D. Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials, or other deleterious substances. In effect, the water used shall be potable water.
- E. Reinforcing Bars shall be billet steel grade (60,000 psi minimum yield) conforming to the requirements of ASTM A615, Grade 60. Reinforcing bars shall be new stock, free from rust, scale, or other coatings that tend to destroy or reduce bonding.
- F. Welded Wire Mesh shall conform to "Specifications for Welded Steel Wire Fabric for Concrete Reinforcements" ASTM A185.
- G. Premolded Expansion Joint Material shall be provided where shown on the Drawings or directed by the Engineer. This non-extruding compressible joint material shall conform to the requirements of "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction", ASTM D1751.

2.2 CONCRETE MIXES

- A. Ready-mixed concrete shall conform to "Specifications for Ready-Mixed Concrete", ASTM C94.

- B. All concrete mixes shall produce a dense durable concrete. The minimum 28 day compressive strength of the concrete shall be:
- C. 3,000 psi - thrust blocking, sidewalks, curbs and pipe encasement. 4,000 psi - manhole bases and road pavement.
- D. Water/cement ratio for the concrete shall not exceed a maximum as shown in Table 4.4 of the ACI Standard 318 latest edition, Building Code Requirements For Reinforced Concrete, when strength data from field experience or trial mixtures are not available. A workable concrete with minimum slump of 3 inches and a maximum slump of 5 inches shall be produced without exceeding the water/cement ratio.

PART 3: EXECUTION

3.1 FORMWORK

- A. Build all forms mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Construct and maintain forms so as to prevent warping and the opening of joints.
- B. The forms shall be substantial and unyielding. Design the forms so that the finished concrete conforms to the proper dimensions and contours. Design the forms to take into account the effect of the vibration of concrete during placement.

3.2 PLACING REINFORCING STEEL

- A. Place all steel reinforcement accurately in the positions shown on the plans. Secure the steel reinforcements firmly in place during the placing and setting of concrete. When placed in the work, it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material. When spacing between crossing tie bars is one foot more, tie all bars at all intersections. When spacing is less than one foot in each direction tie alternate intersections of bars.
- B. Maintain distances from the forms by means of stays, blocks, ties, hangers or other approved supports. Continuous high chairs will not be permitted. Furnish all reinforcement in full lengths as indicated on the plans. Splicing of bars will not be permitted without the approval of the Engineer, except where shown on the plans. Stagger splices as far apart as possible. Unless otherwise shown on the plans, bars shall be lapped 36 diameters to make the splice.
- C. Lap welded wire mesh at least 1½ meshes plus end extension of wires but not less than twelve (12) inches in structural slabs. Lap welded wire mesh at least ½ mesh plus end extension of wires but not less than six (6) inches in slabs on the ground.

3.3 CONVEYING AND PLACING CONCRETE

- A. Convey concrete from the mixer to the forms as rapidly as practical by approved methods which will prevent segregation and loss of ingredients.
- B. Clean formwork of dirt and construction debris, drain water, and remove snow and ice. After the forms have been inspected, deposit the concrete in approximately horizontal layers to avoid flowing along the forms. Place all concrete in the dry free from standing water. Deposit all concrete continuously or in layers of a thickness such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the sections. Place the concrete to create a monolithic structure the component parts of which are

securely bonded together. Compact the concrete during placement by suitable means. Work the concrete around the reinforcement and embedded fixtures and into corners and angles of forms, taking care to avoid overworking which may result in segregation.

- C. Do not drop concrete into forms from a height greater than 5 feet. Use a spout to deposit concrete from a greater height; or, provide openings in the forms to limit the height of drop. Obtain the approval of the Engineer before using any other method of placing concrete from a height greater than 5 feet.
- D. Direct concrete through chutes to prevent it from striking reinforcement or sides of the form above the level of placement. Avoid segregation and coating of the surfaces with paste which may dry before concrete reaches its level.
- E. Submit a concrete mix design to the Engineer for approval prior to placing any concrete by pumping.

3.4 THRUST BLOCKING

- A. See the thrust blocking details. Notify the Engineer whenever field conditions are noted which are more restrictive than the thrust block design data included on detail drawing SD6.
- B. Construct blocking against the vertical face of undisturbed earth or sheeting left in place. Prevent the concrete from enclosing more than half the circumference of the pipe unless it is a straddle block. Keep the concrete away from joints or bolts in the piping.
- C. If thrust blocks are employed, place thrust blocking for hydrants to allow the hydrant to drain.

3.5 PLACING CONCRETE IN COLD WATER

- A. Follow the provisions of ACI 306, ACI 308 and Paragraph 3.8 when the ambient temperature is less than 40°F at time of placement or expected to be less than 40°F during the curing period.
- B. Control concrete setting time with the use of accelerating admixtures as required to facilitate placing and finishing operations. Do not use calcium chloride in excess of 2% by weight in the concrete free of steel reinforcement. Where steel reinforcement is employed and concrete with calcium chloride is permitted, contractor must use galvanized or coated steel satisfactory to the Engineer.
- C. Exposed subgrade, formwork and reinforcing shall be warmer than 33°F prior to placement of concrete.
- D. The temperature of the concrete during placing shall be between 55°F and 75°F. Maintain the temperature of the concrete between 55°F and 75°F for a minimum of 5 days by providing insulating blankets, heated enclosures, or other methods of thermal protection. Provide a means of maintaining atmospheric moisture when dry heat is used. Provide proper curing for a minimum of days or as approved by the Engineer.
- E. In case of low air temperatures (below 40°F), submit a plan to comply with this section. The Engineer may, at their discretion, raise the minimum limiting temperatures for water, aggregates and mixed concrete when temperatures drop below 40°F.

F. Protect all earth supported concrete from damage due to frost heave.

END OF SECTION

SECTION 31 11 00
CLEARING & GRUBBING

PART 1: GENERAL

1.1 PROTECTION

- A. Protect existing trees, shrubs and bushes located outside the clearing limits from damage for the life of this Contract.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with State and local code requirements when disposing of trees, shrubs and all other materials removed under this Specification Section.

1.3 DISPOSAL FEES

- A. Bear all expenses to obtain a suitable disposal area, haul to the disposal area, pay disposal fees, and dump at the disposal area.

PART 2: PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide all materials and equipment required to complete all clearing and grubbing in accordance with this Specification Section.

PART 3: EXECUTION

3.1 CLEARING AND GRUBBING

Clear and grub the minimum area required to provide space for construction operations.

- A. Clear and grub the work site within easement and/or clearing limit lines shown on the Drawings or as shown elsewhere in the Contract Documents. Remove those items that are designated for removal or obstruct construction. This includes, but is not limited to; trees, downed timber, shrubs, bushes, vines, roots, stumps, undergrowth, rubbish, paving materials, debris, and all other objectionable materials. Site objects outside clearing limits shall not be removed. Only those portions of the construction area which are absolutely necessary and essential for construction shall be cleared. Minimize the length of time of ground disturbance as much as practical, especially within environmentally sensitive areas. Ground shall not be cleared and grubbed until immediately prior to construction.
- B. Notify the Engineer of locations where additional trees and shrubs will interfere with installation of facilities. Do not remove additional trees or shrubs without written permission of Engineer. Conduct operations to minimize disturbance of trees and shrubs. Trim trees and roots in accordance with the best horticultural practices, including sealing cuts to preserve the tree.

3.2 CLEARING (IMPROVED AREA)

- A. Remove site improvement objects such as signs, lawn ornaments, etc. which interfere with construction. Removed site improvement objects shall be stored in a manner protecting objects for reinstallation after construction is complete. Relocate the mailbox as necessary. Provide temporary traffic control signs when permanent signs are removed for construction. Temporary signs shall be worded to match permanent signs, except as necessary to be compatible with construction operations.
- B. Remove pavement, curb and sidewalk in accordance with applicable State Standards for Road and Bridge Construction and as specified in these Contract Documents. Saw cuts may be eliminated where paving abuts curb or roadway expansion joints or construction joints, and pavement can be removed without damaging or disturbing curbs or remaining pavement,. Remove sidewalks in full squares only. Saw cut sidewalks if no true joint exists.

3.3 DISPOSAL

- A. Burning of logs, stumps, roots, cuttings and other material on the site will not be permitted.
- B. All materials obtained as a result of the clearing and grubbing operations shall be disposed of in accordance with the requirements of the applicable governing agencies.
- C. Chipping of brush materials will be permitted. However, Contractor shall bear all costs to dispose of the resultant chips at an approved location.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1: GENERAL

1.1 SCOPE OF WORK

- A. Should water be encountered, furnish and operate pumping equipment of sufficient capacity to dewater the trench. Dewater the trench so that the laying and joining of the pipe is made in a dry environment so as to prevent water from entering the pipe during construction.
- B. No additional sum will be allowed for any reasonably anticipated dewatering operation, overtime, equipment rental or any other expense incurred due to the occurrence of ground water, surface water or water from possible leakage of existing buildings, structures and piping in the vicinity of the Contractor's operations. If Contractor believes unreasonable, unanticipated wet conditions exist, immediately contact Engineer to decide appropriate measures and to determine whether Contractor is entitled to additional compensation.
- C. Convey all trench water to a natural drainage channel or storm sewer without causing any property damage. Discharge shall be in strict accordance with state and/or local requirements.
- D. Dispose of silt and debris which accumulates during construction in strict accordance with state and/or local requirements.

1.2 PERMITS

- A. The Contractor shall obtain and pay for any permits required for dewatering and disposal.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

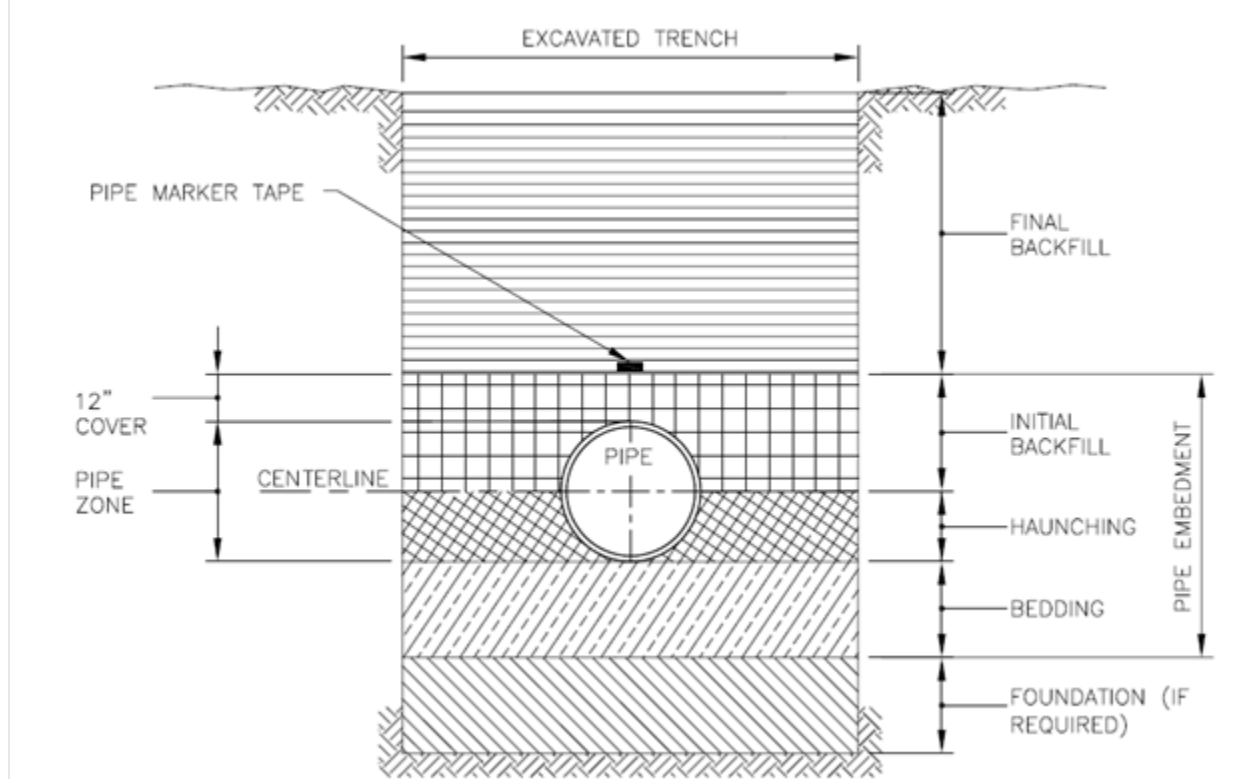
END OF SECTION

SECTION 31 23 33

TRENCHING, BACKFILLING & COMPACTING

PART 1: GENERAL

1.1 DEFINITIONS



TRENCH TERMINOLOGY

FOUNDATION: A FOUNDATION IS NECESSARY ONLY WHEN NATIVE SOILS ARE UNSTABLE. FOR SUCH CONDITIONS, THE TRENCH IS OVER-EXCAVATED AND A LAYER OF SUPPORTIVE MATERIAL IS PLACED AND COMPACTED TO PROVIDE A FIRM FOUNDATION FOR THE SUBSEQUENT PIPE EMBEDMENT MATERIALS.

EMBEDMENT: THIS ZONE IS THE MOST IMPORTANT IN TERMS OF PIPE PERFORMANCE. IT IS DIVIDED INTO THE FOLLOWING SUB ZONES:

- **BEDDING:** TYPICALLY SIX INCHES OF SUPPORTIVE, COMPACTED MATERIAL. THIS ZONE PROVIDES EVEN SUPPORT FOR THE PIPE AND BRINGS IT TO GRADE.
- **HAUNCHING:** EXTENDS FROM THE BOTTOM OF THE PIPE TO THE CENTERLINE OF THE PIPE. IT PROVIDES THE MOST RESISTANCE TO PIPE DEFLECTION. SPECIFYING PROPER MATERIALS AND COMPACTION ARE MOST IMPORTANT FOR THIS ZONE.
- **INITIAL BACKFILL:** EXTENDS FROM THE SPRINGLINE TO A POINT ABOVE THE TOP OF THE PIPE. THIS ZONE PROVIDES SOME PIPE SUPPORT AND HELPS TO PREVENT DAMAGE TO THE PIPE DURING PLACEMENT OF THE FINAL BACKFILL. THE COVER EXTENDS FROM THE TOP OF THE PIPE TO THE TOP OF THE INITIAL BACKFILL. THE DEPTH OF COVER SHOULD BE AS MUCH AS NECESSARY TO PROTECT THE PIPE DURING PLACEMENT OF THE FINAL BACKFILL. TWELVE INCHES IS A COMMON DEPTH OF COVER.

FINAL BACKFILL: THIS ZONE EXTENDS FROM THE TOP OF THE INITIAL BACKFILL TO THE TOP OF THE TRENCH. THIS ZONE HAS LITTLE INFLUENCE ON PIPE PERFORMANCE, BUT CAN BE IMPORTANT TO THE INTEGRITY OF ROADS AND STRUCTURES.

1.2 DESCRIPTION

- A. Provide all labor, tools, material and equipment for trenching, backfilling, and compacting for installation of the pipe and appurtenances, all as specified in contract documents, as directed by the Engineer, or as required by local, state, or federal regulations.

1.3 SUBMITTALS

- A. All backfill materials (to be used for backfill, haunching, and bedding depending on local requirements), including common fill and selected fill [$\frac{3}{4}$ " clean granular fill, $\frac{3}{4}$ " modified stone, $\frac{3}{4}$ " minus granular fill, sand, $\frac{3}{8}$ " crushed wash rock, $\frac{1}{2}$ " wet smooth stone, or $\frac{1}{2}$ " pug mix] shall be approved by the Engineer prior to placing the materials in the pipe trench. Test all backfill materials, whether obtained from the trench excavation or from an off-site source, as directed by the Engineer.
- B. All backfill materials must be approved by the Engineer before they are placed in the pipe trench. Submit samples of the materials to an approved testing agency for analysis as required by the Engineer. Submit the testing agency's test results and report to the Engineer. The report must state that the materials meet the requirements of these Specifications and the Specifications of Federal, State and local authorities (where applicable). Provide flowable fill in areas where it is required by the local street regulator, where the trench is subject to mine drainage and other areas specified in the drawings.

1.4 PROFILES AND TOPOGRAPHY

- A. Contours, topography and profiles of the ground shown on the Drawings are believed to be reasonable approximations and are not guaranteed.
- B. The Contractor accepts the construction site with the conditions that existed at the time of bidding

PART 2: PRODUCTS

2.1 COMMON FILL

- A. Common Fill shall be earth materials entirely free of: vegetation; trash; lumber; and frozen, soft or organic materials. No stones or rocks larger than the sizes listed below will be permitted in the Common Fill:

Common Fill-Type A: No stones or rocks larger than 1-inch

Common Fill-Type B: No stones or rocks larger than 4-inches (measured longest dimension). At the discretion of the Engineer and depending upon the quality of the material, stones and rocks up to a maximum of 6 inches may be allowed on the area one foot above the pipe.

- B. Common fill material may be obtained from the trench excavation provided it has been tested in accordance with the requirements of this specification and approved by the Engineer. Furnish the necessary approved common fill materials from an off-site source whenever approved material obtained from the trench excavation is insufficient to complete the backfill.
- C. The use of common fill is permitted in some circumstances as initial backfill for HDPE pipe; however the size of stone and rock for backfill is limited in accordance with the

pipe diameter. The maximum stone or rock size is limited to 1/2" for pipes up to 4" diameter, 3/4" for pipes 6" to 8" diameter, 1" for pipes 10" to 16" diameter and 1-1/2" for larger pipes.

2.2 HAUNCHING FILL

- A. Materials used for haunching around the pipe shall be coarse to fine, sandy natural soil material with maximum stone size of 1-inch or local approved selected backfill materials as noted on detail drawings and defined below in Specification Section 31 23 33 2.3. The material shall conform to ASTM D 2487 "Standard Method for Classification of Soils for Engineering Purposes" using the "Unified Soil Classification System", except where a higher standard is required elsewhere in the Contract Documents or by rules or regulations of Federal, State or local governmental bodies having jurisdiction over the site of the Work.
- B. The haunching material shall meet the Class II soil type designation. Class II soil types include GW, GP, SW and SP that are described as non-cohesive, well graded and containing some fines. Voids, finer grained soils or movement can allow undesirable migration of haunching material or migration of the trench sidewall material into the haunching material. In such instances place filter fabric, as directed by the Engineer, in the trench bottom and sides before placing the haunching material.
- C. Haunching material may be obtained from the trench excavation provided it has been approved by the Engineer who may, at his discretion, require testing in accordance with this specification. Furnish the necessary approved haunching materials from an off-site source whenever approved material obtained from the trench excavation is insufficient to complete the haunching.

2.3 BEDDING FILL

Bedding fill materials vary from state to state, see special conditions and detail drawings for the appropriate materials for local use.

- A. 3/4 inch clean granular fill material shall meet the sieve analysis requirements of AASHTO as follows 1" sieve passing 100%, 1/2" sieve passing 0-5% and sieve size No 4 passing 0-1%. This material may be wrapped in filter fabric (trench bottom, side, and over top of clean granular fill), as directed by the Engineer, to prevent the migration of finer grained soils into this material or the migration of this material into the trench bottom or sidewall.
- B. 3/4 inch Minus or Modified granular fill material contains additional fine material and may be used as noted in specific pipe specifications. Material shall meet the sieve analysis requirements of AASHTO as follows 1" sieve passing 100%, 3/4" sieve passing 80-90%, No 4 sieve passing 25-50%, No 10 sieve passing 0-20% No 200 passing sieve 0-5%.

2.4 FILTER FABRIC

- A. Filter fabric shall be non-woven, synthetic fiber material with sieve design to prevent the select material in the pipe bedding and haunching from migrating into the surrounding soils. The material shall have a minimum: thickness of 15 mils, tensile strength of 130 lbs., elongation at break of 64%, and trapezoidal tear strength of 70 lbs.

2.5 FLOWABLE FILL

- A. Flowable fill is suitable for use as backfilling for utility trenches. The basic requirements for furnishing, mixing, and transporting flowable fill are as follows. Materials shall conform to the following standards: Cement ASTM C 150, Fly Ash ASTM C 618, Class C or Class F. Fine Aggregate shall be natural or manufactured sand, or a combination thereof, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material. It is intended that the fine aggregate be fine enough to stay in suspension in the mortar to the extent required for proper flow. The fine aggregate shall conform to the following gradation:

| Sieve Size | % Passing |
|-------------------|------------------|
| 3/4 inch | 100 |
| No. 200 | 0-10 |

If a flowable mixture cannot be produced, the sand may be rejected.

- B. The following are given as typical mix designs for trial mixes. Adjustments of the proportions may be made to achieve proper solid suspension and optimum flowability. Admixtures may be used if desired to improve the characteristics of the mix. The suggested quantities of dry material per cubic yard are as follows:
1. Option 1
Cement 50 lbs, Fly Ash 250 lbs. Fine Aggregate 2910 lbs., Water approximately 60 gallons
 2. Option 2
Cement 100 lbs. Fly Ash 250 lbs, Fine Aggregate 2800 lbs., Water approximately 60 gallons
 3. Option 3
Cement 100 lbs., Fly Ash 300 lbs., Fine aggregate 2600 lbs., Water approximately 70 gallons
- C. Consistency may be tested by filling an open-minded three inch diameter cylinder six inches high to the top with flowable fill. The cylinder shall be immediately pulled straight up and the correct consistency of the flowable fill shall produce a minimum eight inch diameter circular-type spread with no segregation.
- D. Materials are to be measured by weight and/or volumetric methods. The flowable fill may be mixed in a central concrete mixer, a ready mix truck, or by other acceptable methods. The flowable fill shall be transported to the point of placement in a revolving drum mixer or in an agitator unit.

2.6 DUCTILE IRON PIPE IN SOIL

- A. Soil shall be coarse to fine, sandy natural soil material with maximum stone size of 1-inch and shall meet ASTM D 2487 "Standard Method for Classification of Soils for Engineering Purposes". Scarify 2" deep before placing pipe.

PART 3: EXECUTION

3.1 CONSTRUCTION EQUIPMENT

- A. All backfilling and materials handling equipment shall have rubber tires when mains are located in or adjacent to pavements. Crawler equipment shall be permitted when there is no danger of damaging pavement. It is the Contractor's responsibility, to repair, at their expense, any damages due to the use of any equipment to complete the work.

3.2 NOISE, DUST AND ODOR CONTROL

- A. Conduct all construction activities so as to eliminate all unnecessary noise, dust and odors.

3.3 PROTECTION OF TREES

- A. Take special care to avoid damage to trees and their root system. Open trenching shall not be used for established trees in areas marked on the plans and designated 'Root Protection Zone'. In these areas, methods to be used include tunneling or boring. In other areas where established trees are to remain with roots in the path of the trench line, the Engineer shall direct acceptable means to install pipe through tree roots. In these areas, methods to be used careful cutting (not ripping or tearing) of larger tree roots. In all cases, operate equipment within the limb spread in a manner which will not injure trees, trunks, branches or their roots. Pay particular attention when employing booms, storing materials, and handling excavated materials.

3.4 TRENCH SUPPORT

- A. Support open cut excavation for mains where trenching may cause danger to life, unnecessary damage to street pavement, trees, structures, poles, utilities, or other private or public property. Support the sides of the excavation by adequate and suitable sheeting, shoring, bracing or other approved means in accordance with all applicable Federal, State, County, Municipal and OSHA rules and regulations during the progress of the work, whenever and wherever it is necessary. Maintain the trench support materials and equipment in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering life or property per Article 6 on safety issues.

3.5 TRENCH EXCAVATION AND BOTTOM PREPARATION

- A. General Excavation
 - 1. General excavation shall consist of the satisfactory removal and disposal of all material taken from within the limits of the Work contracted, meaning the material lying between the original ground line and the finished ground line as shown on the Drawings regardless of whether the original ground line is exposed to air or is covered by water. Excavation below existing ground line to enable any required construction or removals is included. It is distinctly understood that any reference to earth, rock, silt, debris or other materials on the Drawings or in the Specifications is solely for the Owner's information and shall not be taken as an indication of classified excavation or the quantity of earth, rock, silt, debris or other material encountered.

2. Excavation to the lines and grades indicated on the Drawings or established in the field by the Engineer. Backfill over-excavated areas with approved fill material. All labor and materials shall be furnished at the Contractor's expense.
 3. Keep all excavations free from water. Maintain groundwater a minimum of 6 inches below excavations. Remove soil which is disturbed by pressure or flow of groundwater and replace with free draining material.
 4. Remove pavement over excavations made in paved roadways by saw cutting, milling, or removal by a trench machine. Cut the full depth of the pavement with straight lines and squared edges.
 5. Dispose of excess excavated materials and excavated materials unsuitable for backfilling off site. Furnish the Engineer with satisfactory evidence that an appropriate disposal site was used.
- B. Rock Excavation
1. If the Contract includes a unit price for rock excavation, it includes the removal, hauling, stockpiling and/or proper disposal the rock per Specification 01 29 00. Rock is defined as
 - a. boulders or loose rock having a volume of one cubic yard or more;
 - b. material which cannot be loosened or broken down by ripping with a hydraulic ripper or other Engineer approved devices and equipment designed to remove rock; or
 - c. material that requires systematic blasting, backhoe ramming, barring, or wedging for removal.
 2. Notify the Engineer promptly upon encountering rock. The Engineer's determination as to whether the material meets the definition of rock and Engineer's measurement of the volume of rock removal for which the Contractor is entitled to payment will be final and conclusive. No payment will be made for rock removed without Engineer's approval.
 3. Strip rock for measurements as directed by the Engineer. No payment will be made for rock excavated or loosened before measurement. Only rock actually removed will be paid for, and in no case will payment be made for rock removal beyond the payment limits shown for a standard trench or more than 12" beyond the edge of a pipeline or 6" below its bottom for pipes of nominal OD 24 inches and less, unless such rock has been removed at the direction of Engineer.

C. Blasting Rock

1. Blasting is not allowed unless expressly permitted by the Engineer. Notify the Engineer in advance of blasting activity. Provide evidence to the Engineer that the proposed blasting will comply fully with Laws or Regulations.
2. Do not blast where limited or prohibited by any Federal, State or local laws or regulations, or in violation of any limitation or restriction contained in any right-of-way, or wherever specifically prohibited in any Drawing or other Contract Document. Do not blast within forty (40) feet of any pipe or structure without specific permission from the Owner. Properly cover blasts and protect the pipe or structure. Warn all persons in the vicinity. Blasting shall be at the risk of the Contractor who shall be liable for all damages to persons or property. Secure and pay for all necessary permits. Perform whatever pre-blast surveys and investigations that may be required by the circumstances and/or by Federal, State or local laws.
3. Prepare a blasting plan and submit it to the Engineer for approval prior to commencing any blasting work. The plan shall state all procedures and methods which will be used to monitor and mitigate the effect or impact of the proposed blasting work.
4. Employ an experienced blaster holding a blasting license issued by the applicable State to carry out the blasting work. Use, handle, and store explosives as prescribed by the applicable state and federal regulations. Keep all explosives in a safe place at a sufficient distance from the Work so that, in case of accident, no damage will occur to any part of the Work. Contractor shall be held responsible for and shall pay for all damage caused by blasting operations or accidental explosion.

D. Trench Width

Widths of trenches shall be held to a minimum to accommodate the pipe and appurtenances. The trench width shall be measured at the top of the pipe barrel and shall conform to the following limits:

1. Earth

Minimum: Outside diameter of the pipe barrel plus 8 inches, i.e., 4 inches each side.

Maximum: Nominal pipe diameter plus 24 inches.

2. Rock

Minimum: Outside diameter of the pipe barrel plus 24 inches, i.e., 12 inches each side.

Maximum: Normal pipe diameter plus 30 inches. (Contractor will only be compensated for the minimum described above.)

E. Excessive Trench Width

1. Provide additional backfill, haunching, and bedding material, as specified in Specification Sections 31 23 33 2.1, 31 23 33 2.2, and 31 23 33 2.3 as approved by the engineer to fill any trench excavation that exceeds the maximum trench width defined in Specification Section 31 23 33 3.5D. Dispose of excess excavated

materials off site at no cost to the Owner. Furnish the Engineer with satisfactory evidence that an appropriate disposal site was used.

F. Trench Depth

1. General- Provide prescribed minimum cover from the top of the pipe barrel to the top of the finished grade of the roadway, unless otherwise authorized by the Engineer, or as shown on the plans.
2. Earth- Excavate to the depth required, so as to provide a uniform and continuous bearing and support for the pipe barrel on solid and undisturbed ground at every point between joints. It will be permissible to disturb the finished trench bottom over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. Provide bell holes. Prepare the finished trench bottom accurately using hand tools.
3. Rock- Excavate trenches in rock or boulders 6-inches below the pipe barrel for pipe 24-inches or less in diameter. Remove all loose material from the trench bottom. Prepare a pipe bed using bedding material as specified in Specification Section 31 23 33 2.3.
4. Unsuitable Bottom Notify the Engineer whenever unsuitable material is found below subgrade. Remove the material over the area and to the depth determined by the Engineer. Provide compacted bedding material as specified in Specification Sections 31 23 33 2.3 to restore the trench bottom to the required grade in these areas.

G. Open Trench Length

1. The length or size of excavation shall be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, Engineer may require special construction procedures such as limiting the length of the open trench or prohibiting stacking excavated material in the street. Take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public, shall be well lighted.

3.6 TRENCH BACKFILLING - OPEN TERRAIN

All trench backfilling shall be compacted so that no settlement occurs and is stable with surrounding soil that also shall not have settled.

A. Ductile Iron Pipe and HDPE Pipe

1. Bedding

- a. In Suitable Soil - See Section 2.3(c) for definition of soil and means of bedding.
- b. In Rock or Unsuitable Soil- When encountering rock or unsuitable material, prepare pipe bedding immediately before pipe is laid. In this instance, compact clean granular fill as described in Specification Section 33 23 31 2.3 from 6" below the pipe to the bottom of the pipe.

2. Haunching

- a. Place haunching from the bottom of the pipe barrel to the centerline (springline) of the pipe barrel with Haunching Fill (Section 2.2) or clean, granular fill as

described in Specification Sections 31 23 33 2.2 and 31 23 33 2.3. See Drawings for required haunching material. Take care to avoid injuring or moving the pipe. Place the material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints.

3. Initial Trench Backfill

- a. Backfill from the centerline (springline) of the pipe barrel to 12 inches above the pipe with Common Fill-Type A or clean, granular fill as described in Specification Sections 31 23 33 2.1 and 31 23 33 2.3. See Drawings for required initial trench backfill material. Mechanical equipment may be used to place the backfill. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.

4. Final Trench Backfill

- a. Backfill trench from 12 inches above the pipe to final grade with Common Fill-Type B, as described in Specification Section 31 23 33 2.1. Mechanical equipment may be used to place the backfill. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.

5. Surface Conditions

- a. Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.

6. Deficiency of Backfill

- a. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

B. PVC

1. Bedding

- a. Prepare pipe bedding immediately before pipe is laid. Use compacted clean, granular fill as described in Specification Section 31 23 33 2.3 from 6" below the pipe to the bottom of the pipe.

2. Haunching and Initial Backfill

- a. Place haunching and initial backfill from the bottom of the pipe barrel to 12 inches above the top of the pipe barrel with clean, granular fill as described in Specification Section 31 23 33 2.3. When material with high void ratios (e.g. $\frac{3}{4}$ inch clean granular fill) are used for embedment, it is possible for fines in the trench walls to migrate into the voids. This can cause some loss of support. An alternative method is to install filter fabric in the boundary between the

trench and the fill to prevent migration. Place the clean granular material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Another alternative is to use materials containing fines, (e.g. ¾ inch minus or modified).

3. Remaining Trench Backfill
 - a. Backfill from 12 inches above the pipe to finished grade with Common Fill-Type B, as described in Specification Section 31 23 33 2.1. Mechanical equipment may be used to place the backfill. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.
 4. Surface Conditions
 - a. Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.
 5. Deficiency of Backfill
 - a. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.
- 3.7 TRENCH BACKFILLING – UNDER OR WITHIN 18 INCHES OF DRIVEWAYS AND ROADS
- A. Bedding
 1. Install bedding for selected pipe material in accordance with Section 3.6.
 - B. Haunching and Backfill
 1. Haunch around the pipe and fill the remainder of the excavation using clean, granular fill, as described in Specification Section 31 23 33 2.3. Place the material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Take care to avoid injuring or moving the pipe.
 - C. Surface Conditions
 1. Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.
 - D. Deficiency of Backfill
 1. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.
- 3.8 SPECIAL BACKFILLING (UNDER ROADS – OPTION TO THE CONTRACTOR)
- A. Bedding

1. Install bedding for selected pipe material in accordance with Section 3.6.

B. Haunching and Initial Backfill

1. Place haunching and initial backfill from the bottom of the pipe barrel to 12 inches above the top of the pipe barrel with clean, granular fill as described in Specification Section 31 23 33 2.3. When material with high void ratios (e.g. $\frac{3}{4}$ inch clean granular fill) are used for embedment, it is possible for fines in the trench walls to migrate into the voids. This can cause some loss of support. An alternative method is to install filter fabric in the boundary between the trench and the fill to prevent migration. Place the clean granular material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Another alternative is to use materials containing fines, (e.g. $\frac{3}{4}$ inch minus or modified).

C. Remaining Trench Backfill

Backfill from the top of the pipe to subgrade, all cuts, excavations, or other damage done to the public right-of-way with flowable fill as described below. Use flowable fill when required as a condition of the right-of-way excavation permit.

1. Flowable fill shall have the following characteristics:
 - a. Unconfined Compressive Strength (28 day) 50-150 psi.
 - b. Flow Test - diameter of spread < 8 inches.
2. Design: Submit the mix design to the Engineer for approval. A trial batch demonstration may be required. The mix design shall include a list of all ingredients, the source of all materials, the gradation of all aggregates, the names of all admixtures and dosage rates, and the batch rates. Document and justify minor mix design changes, after the trial batch verification, prior to implementation. This does not include adjustments to compensate for routine moisture fluctuations. Resubmit the mix design for approval of changes in the source of materials, the addition or deletion of admixtures, or changes in cementitious materials. The Contractor may be required to provide test data from a laboratory, inspected by the Cement and Concrete Reference Laboratory and approved by the Municipality, which shows the proposed mix design is in accordance with the requirements listed above.
3. Flow Test: Place a three (3) inch diameter by six (6) inch high open-ended cylinder on a smooth, nonporous, level surface and fill it to the top with the flowable fill. Pull the cylinder straight up within 5 seconds of filling. Measure the spread of the fill. The minimum diameter of the spread shall be eight (8) inches.
4. Placement: Discharge the mixture from the mixing equipment into the space to be filled by a reasonable means. The flowable fill shall be brought up uniformly to the fill line. Each filling stage shall be as continuous as practicable. Do not place concrete on the flowable fill until all bleeding water has disappeared and the resistance, as measured by ASTM C403, is at least 60 psi, or as directed by Engineer. Do not place asphalt until at least 24 hours after the fill is completely in place.
5. Limitations: Do not place flowable fill on frozen ground. Protect flowable fill from freezing until the material has stiffened and bleeding water has disappeared. As the temperature nears freezing, additional curing time may be needed.

- D. Surface Conditions: Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.
- E. Deficiency of Backfill: Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

3.9 QUALITY ASSURANCE TESTING

- A. The Owner reserves the right to have the Contractor provide Independent Quality Assurance Testing for the backfill material, at the Contractor's expense.

3.10 TRENCH MAINTENANCE

- A. Assume full responsibility for the condition of the trenches for a period of one (1) year from the date of the final acceptance of the Contractor's work, or as required by state, county or local authorities, and any materials required for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at their expense.

END OF SECTION

SECTION 31 25 00

EROSION & SEDIMENTATION CONTROLS

PART 1: GENERAL

1.1 SCOPE OF WORK

- A. Work to be performed under this Specification Section refers to temporary and permanent vegetation covers, mulching, and baling at the construction site and all areas disturbed during construction, including borrow areas. In addition to the requirements of these Specifications, comply with all local Conservation District laws, rules and regulations and all other Federal, State, County and local requirements for erosion and sedimentation control.

1.2 STANDARDS

- A. Comply with the highest erosion and sedimentation control standards, whether Conservation District, Federal, State, County or local. If in doubt as to the applicable standard, notify the Engineer and comply with the Engineer's directions concerning the prevailing jurisdiction.

PART 2: PRODUCTS

2.1 MATERIALS – GENERAL

- A. All materials such as seeds, mulch, silt fencing and bales shall conform to the Specifications of the local Conservation District and all other applicable Federal, State, County and local requirements.

PART 3: EXECUTION

3.1 GENERAL

- A. Submit plan to comply with regulators and Engineer for approval using established best practices. Construct silt fences, inlet protection, diversion ditches with catch basins and drains as shown on the plans prior to any other construction activity.
- B. Drain the settled water from the catch basins to the natural local drains. Clean the catch basins regularly. After final grading, seed and mulch the area per Specification Sections 1.2 and 2.1.
- C. Permanent vegetation cover, mulching, and baling shall be in accordance with the Conservation District specifications and all other applicable Federal, State, County and local requirements.

END OF SECTION

SECTION 32 10 00
PAVING & SURFACING

PART 1: GENERAL

1.1 DESCRIPTION

- A. Provide all labor, tools, material and equipment to replace pavement, traffic control loops, pavement stripping, curbs, drives and walks that have been damaged or disturbed during the course of the work, all as specified in contract documents, as directed by the Engineer, or as required by local, state, or federal regulations. Placement will be at least equal to the type of pavement, curb, drive, or walk which existed before the work began and to the satisfaction of the Engineer.
- B. Furnish all labor, tools, material, and equipment necessary to spread and roll and/or tamp temporary bituminous pavement, complete, in place, and maintain the same all as specified or as directed by the Engineer
- C. During the entire period of construction of the project, keep all streets, curbs, drives and walks in clean, usable, and safe conditions for public use. Keep the work area free from accumulations of waste material, rubbish and other debris resulting from the Work. Clean all roadways daily. Sweep, scrape, shovel or use whatever other approved means, including mechanical pickup sweeper that may be necessary to clean and maintain the roadways to the satisfaction of Owner and the agency having jurisdictional control over said road
- D. Before final acceptance and after any trench settlement has been corrected to the satisfaction of the Engineer, replace pavement, curbs, drives and walks designated by the Engineer with the type of replacement specified.

PART 2: PRODUCTS

2.1 MATERIALS

- A. Furnish materials of construction for traffic control loops, pavement striping, paving, curbing, and surfacing in accordance with applicable Federal, State and local standards. If there is no applicable standards, use materials which will produce a result that is at least equal to the type which existed before the work began and that is to the satisfaction of the Engineer.

PART 3: EXECUTION

3.1 INSTALLATION

- A. Saw or line cut the existing pavement, where necessary, as required by local, State or Federal regulations. The edges of the face of the old pavement or base shall be left vertical. Trim ragged edges so as to provide a substantially straight line juncture between the old and new surfaces.
- B. Place the pavement replacement so as to conform in grade to the existing streets, drives or sidewalks. The type of pavement replacement shall be as shown on the pavement replacement details in accordance with applicable Federal, State or local

standards. If there are no such applicable standards, replacement will be made to the satisfaction of the Engineer.

- C. Roll and tamp in place a 2-inch thick (minimum) course of bituminous material over trenches where temporary pavement is ordered. Temporary pavement must be rolled with equipment specifically designed for this purpose and not with tracks/tires of equipment. Remove temporary pavement prior to the placing the permanent pavement. The cost shall be included in the contract price. The finished temporary surface shall be flush with the adjacent undisturbed surface. Maintain the temporary bituminous surface until the temporary surface is replaced.
- D. Before the completion of each day's work, in traveled areas, pave the pipe trench with 6 inches of stabilized base, unless another method of pavement restoration is required by the authorized governing body. Place final paving over the stabilized base, overlap each side of the trench a minimum of 6 inches, and feather to meet the existing pavement; unless another method of pavement restoration is required by the authorized governing body. Place final pavement at least 20 days and not more than 45 days after the backfilling has been completed, unless otherwise directed by the Engineer.
- E. Instead of temporary paving, the use of steel roadway plates may be required if an excavation within traveled areas is subject to repeated access prior to backfill/final paving. The use of steel roadway plates shall be in strict accordance all applicable regulations with the Federal, State, County, and/or Local Agency having jurisdiction. Properly secure the steel roadway plates so that they will not be "dragged" from place by a braking truck or "pushed" from place by a snowplow. Submit load bearing calculations, when requested by the Engineer, sealed by a Professional Engineer who is licensed to practice in the applicable State. Calculations must demonstrate that the steel roadway plate is properly designed and installed to accommodate HS-20 vehicular loadings based upon plate dimensions (L x W x T), steel strength, and the size of the excavation (L x W) to be protected.

3.2 MAINTENANCE

- A. Following the certification of completion by the Engineer, maintain the surfaces of curbs and gutters, paved surfaces and sidewalks for a period of one year thereafter, or for such greater period as may be required by Federal, State or local authorities. Supply all material and labor required for such maintenance. The work shall be done in a manner satisfactory to the Owner at no additional cost to the Owner.

END OF SECTION

SECTION 32 16 00

CURBS, SIDEWALKS, AND DRIVEWAYS

PART 1: GENERAL

1.1 SCOPE

- A. The work under this section shall include the installation of all concrete curbs, sidewalks, and drives. Installation will include new installations as required on the drawings, and replacement of all curbs, drives and sidewalks damaged or removed incidental to construction. Adhere to most stringent requirements between local regulations and this specification concerning concrete installations for work performed on property owned by others (the municipality or private owners other than American Water).

PART 2: PRODUCTS

2.1 CONCRETE

- A. All concrete shall conform to the following minimum specifications, unless specified otherwise by the authority having jurisdiction:
 - 1. 28-Day Verification Strength: 4,500 psi
 - 2. Admixtures: Air-entrained
 - 3. ASTM C-150 Type I Portland cement; design mix, with a 4-inch + air-entrained slump ready mixed in accordance with ASTM C-94.
- B. Aggregate shall conform to ASTM C-33, which is clean, hard, durable, screened, crushed stone or gravel. The aggregate shall contain no cheat.

2.2 REINFORCEMENT

- A. As needed to meet or exceed existing conditions or as specified in these contract documents.

2.3 CURING COMPOUND

- A. Curing compound shall conform to the specifications of AASHTO M148, Type II, clear, and shall consist of a practically colorless impervious liquid which will thoroughly seal the surface of the concrete and will not impart a slippery surface thereto. The quality and the quantity to be used shall be approved by the Engineer. The use of any material which would impart a slippery surface to the concrete or alter its natural color will not be permitted. The colorless, impervious compound shall contain not less than twenty-five percent (25%) solids. Admixtures applied to concrete with reinforcing steel require review and approval by the Engineer before use.

2.4 PROTECTION

- A. Immediately upon finishing the concrete, the concrete shall be completely covered with plastic, or alternate approved by the ENGINEER. Canvas or wetted straw will not be allowed as alternate coverings for curing.

PART 3: EXECUTION

3.1 CURBS

- A. All base for the installation shall be thoroughly compacted to support curb installation. Expansion joints should be provided at a minimum of every 12 feet.
- B. All new curb installations shall be as shown on the drawings, and as detailed on the detail sheets, or as otherwise required by the Authority Having Jurisdiction.
- C. All replacement curbs shall be of the same type and thickness as the curb and gutter which it abuts. The grade of the restored curb and gutter shall conform with the grade of the existing adjacent curb and gutter, and installed to insure there is no ponding of water.

3.2 DRIVEWAYS

- A. All base for the installation shall be thoroughly compacted and leveled to support the new and replacement installations without settlement. Expansion joints should be provided at a minimum of every 30 feet.
- B. All new driveways shall be installed as shown on the plans, and as detailed on the detail sheets.
- C. All permanent restoration of driveways shall conform to the construction as originally placed and to the original lines and grades, unless directed otherwise by the ENGINEER.
 - 1. No patching of concrete driveway areas will be allowed between joints or dummy joints.
 - 2. All joints shall be saw cut.
 - 3. In no case shall the thickness of the driveway be less than four inches, with 6x6 W2.9/2.9 welded wire mesh.

3.3 SIDEWALKS

- A. All base for the installation of sidewalks shall be thoroughly compacted and leveled to support the new and replacement installations without settlement. Expansion joints should be provided at a maximum of every 20 feet.
- B. All new sidewalks shall be installed as shown on the plans and as detailed on the detail sheets.
 - 1. Sidewalks shall have a minimum thickness of four inches, with 6x6 W1.4/1.4 welded wire mesh.
 - 2. All sidewalks shall slope 1/4 inch per foot across the width of the walk toward the street.
 - 3. The finish shall be a broom finish at right angles to the walkway.
 - 4. Dummy expansion grooves shall be marked on the sidewalk at five foot intervals. The grooves shall be 1/2 inch deep by 3/8 inch in width.
 - 5. Sawed grooves will not be permitted.
- C. All permanent restoration of sidewalks shall conform to the manner of construction as originally constructed and placed (brick, block or stone).

1. When concrete sidewalks are replaced, the replacements shall match the existing line and grades, and width.
2. All replacement work shall meet the requirements of new sidewalk construction. No patching will be allowed between joints or dummy joints.
3. If a curing compound is employed, it shall be applied per the manufacturer's direction and at a recommended rate of application. If unknown, it shall be applied at 1 gallon (3.79 liters) per 200 square feet (18.58 square meters) for each coat. Surfaces damaged by construction operations during curing shall be resprayed at the same rate.

3.4 PAVED SIDE DITCH

- A. All base for the installation shall be thoroughly compacted and leveled to support the new and replacement installations without settlement.
- B. All new side ditch shall be installed as shown on the plans, and as detailed on the detail sheets.
- C. All permanent restoration of side ditch areas shall conform to the construction as originally placed and to the original lines and grades in accordance with the current appropriate state transportation department guidelines.
 1. No patching of concrete side ditches will be allowed between joints or dummy joints.
 2. All joints shall be saw cut.

3.5 PROTECTION

- A. All concrete work shall be protected by barricades, lights, etc. to protect the concrete until set-up.

END OF SECTION

SECTION 32 92 01

LAWN RESTORATION

PART 1: GENERAL

1.1 DESCRIPTION

- A. Restore and replace shrubbery, fencing, or other disturbed surfaces or structures to conditions equal to that before the work began and to the satisfaction of the Engineer.

PART 2: PRODUCTS

2.1 TOPSOIL

- A. Topsoil shall not contain more than 40 percent clay in that portion passing a No. 10 sieve. Topsoil shall contain between 5 percent and 20 percent organic matter as determined by loss on ignition of samples oven-dried to constant weight at 212 degrees Fahrenheit.

2.2 FERTILIZER

- A. Fertilizer shall be lawn or turf grade 12-12-12.

2.3 SEED AND SOD

A. Lawn Areas

1. Seed areas where lawns are or have been regularly maintained, whether residential, commercial or office areas, with the following mixture or a mixture as required by the Soil Conservation District or other governing authority. (Percentages are by weight.)
 - a. 20 percent Annual Ryegrass (*Lolium multiflorum*)
 - b. Remainder to be specified depending on time of year, regulatory requirements and location.
2. Where sod is required it shall be green, freshly cut, and of good quality with grass free from all noxious weeds. It shall contain all the dense root system of the grass and shall not be less than 1-1/2 inches thick.

B. All Other Areas

1. Seed all other areas with the following mixture:
 - a. 50 percent Perennial Ryegrass (*Lolium perenne*)
 - b. Remainder to be specified depending on time of year, regulatory requirements and location.

2.4 MULCH

- A. Mulch shall be straw reasonably free of weed seed and foreign materials which may affect plant growth. Other materials may be used if approved by the Engineer.

2.5 ASPHALT EMULSION

- A. Emulsion shall be non-toxic to plants and shall conform to AASHTO M140 or AASHTO M208.

PART 3: EXECUTION

3.1 PREPARATION OF SEED BED

A. Topsoil Areas

Removed, store, and use suitable topsoil available from the excavated material to backfill the top 4 inches of the excavation. Remove and dispose of all imported granular fill, grass, weeds, roots, sticks, stones, and other debris 1-inch or greater in diameter. Bring the topsoil to the finished grade by raking.

B. Non-Topsoil Areas

1. When there is insufficient topsoil available from the site excavated materials, furnish 4 inches of topsoil to be used as a seed bed in lawn areas as described in Part 2.03, Paragraph A of this Specification Section or clearly marked as lawn areas on the plans.
2. The trench backfill may be used as a seed bed, where approved by the Engineer or in areas clearly marked on plans that are not considered lawn areas. After the backfill has been given a reasonable time to settle, grade it off to the finished grade and harrow to a depth of 3 inches. Remove and dispose of all grass, weeds, roots, sticks, stones and other debris 1 inch or greater in diameter. Carefully bring the topsoil to the finished grade by raking.

3.2 FERTILIZING

- A. Apply fertilizer uniformly to all areas to be seeded at the rate of 1 pound per 100 square feet in topsoil and 2 pounds per 100 square feet in non-topsoil. Disk, harrow, or rake the fertilizer thoroughly into the soil to a depth of not less than 2 inches. Immediately before sowing the seed, rework the surface until it is a fine, pulverized, smooth seed bed varying not more than 1 inch in 10 feet.

3.3 SEEDING

- A. Seed immediately after preparation and fertilization of the seed bed. Mix the seed thoroughly and sow it evenly over the prepared areas at the rate of 3 pounds per 1,000 square feet. Sow the seed dry or hydraulically. After sowing, rake or drag the area to cover the seed to a depth of approximately 1/4 inch
- B. Sod all areas with slopes greater than 10%.

3.4 SODDING

- A. Sod all areas as noted in the drawings. As a minimum, sod shall be fibrous, well rooted approved grass type. The grass shall be cut to a height of less than three (3) inches. Edges of sod shall be cleanly cut, either by hand or machine, to a uniform thickness of not less than one and one-half (1-1/2) inches, to a uniform width of not less than sixteen (16) inches, and in strips of not less than three (3) feet in length. Sod shall be free from all primary noxious weeds as defined by the applicable State Seed Law.

- B. Lay sod with tight staggered joints. On slopes, start placement at the foot of the incline. Use wood pegs driven flush to hold sod in place on slopes 4:1 or greater. Use two wood pegs per strip of sod. Roll the sod lightly after placement. Fill any open joints with topsoil and/or sod.

3.5 MULCHING

- A. Place mulching material evenly over all seeded areas within 48 hours of seeding. Place mulch at the rate of approximately 2 tons per acre, when seeding is performed in recognized growing season and at the approximate rate of 3 tons per acre when seeding is performed in a recognized non-growing season if applicable.

3.6 EMULSION

- A. Keep mulching materials in place with asphalt emulsion applied at a minimum rate of 60 gallons per ton of mulch or by other methods approved by the Engineer. When mulch is displaced, immediately repair any damage to the topsoil and fertilizer, re-seed, and re-mulch per the requirements of this Specification Section.

3.7 MAINTENANCE

- A. Carefully maintain, tend, and water all seeded and sodded areas necessary to secure a good turf. Fill, grade, and reseed or re-sod all areas that have settled. Maintain the condition of the sodded areas for a period sufficient for the grass to root into the topsoil. Maintain the condition of the seeded areas in accordance with the requirements of this Specification Section for a period of one year from the date of final completion.

END OF SECTION

SECTION 33 01 10.50

PIPING - GENERAL PROVISIONS

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 DRAWINGS

- A. Dimensions shown on Contract Drawings are approximate only. Verify all piping geometry in the field and to ensure proper alignment and fit of all piping consistent with the intent of the Contract Drawings. Submit field layout drawings as required for approval.

1.3 RELATED WORK

- A. See Specification 01 60 00, Section 1.3 - Responsibility for Material and Equipment.

PART 2: PRODUCTS

2.1 CONTRACTOR'S RESPONSIBILITY FOR MATERIAL

- A. Examine all material carefully for defects. Do not install material which is known or thought to be defective.
- B. The Engineer reserves the right to inspect all material and to reject all defective material shipped to the job site or stored on the site. Failure of the Engineer to detect damaged material shall not relieve the Contractor from his total responsibility for the completed work if it leaks or breaks after installation.
- C. Lay all defective material aside for final inspection by the Engineer. The Engineer will determine if corrective repairs may be made, or if the material is rejected. The Engineer shall determine the extent of the repairs.
- D. Classify defective pipe prior to Engineer's inspection as follows:
 - 1. Damage to interior and/or exterior paint seal coatings.
 - 2. Damage to interior cement-mortar or epoxy lining.
 - 3. Insufficient interior cement-mortar lining or epoxy thickness .
 - 4. Excessive pitting of pipe.
 - 5. Poor quality exterior paint seal coat.
 - 6. Pipe out of round.
 - 7. Pipe barrel area damaged to a point where pipe class thickness is reduced (all pipe).
 - 8. Denting or gouges in plain end of pipe (all pipe).

9. Excessive slag on pipe affecting gasket seal (DI).
 10. Any visible cracks, holes.
 11. Embedded foreign materials.
 12. Non-uniform color, density and other physical properties along the length of the pipe.
- E. Take full responsibility for the storage and handling of all material furnished until the material is incorporated in the completed project and accepted by the Engineer. Contractor shall be solely responsible for the safe storage of all material furnished to or by him until incorporated in the completed project and accepted by the Engineer.
 - F. Load and unload pipe, fittings, valves, hydrants and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop these materials. Pipe handled on skidways shall not be skidded or rolled against another pipe. Handle this material in accordance with AWWA C600, C605 or C906 whichever is applicable.
 - G. Drain and store fittings and valves prior to installation in such a manner as to protect them from damage due to freezing of trapped water. Drain, store, and protect fittings and valves in accordance with Specification Section 01 60 00.

2.2 PETROLATUM TAPE COATING

- A. The tape coating shall be a cold applied, saturant tape made from either petrolatum or petroleum wax with a noncellulosic synthetic fiber fabric. The fabric shall be encapsulated and coated on both sides with the petrolatum or petroleum wax. The thickness of the tape shall be no less than 40 mil. The petrolatum or petroleum wax shall be at least 50% of the product by weight.
- B. The tape coating shall be supplied in sheets, pads or rolls. Pads and sheets shall be sized to fit the area that is to be covered, allowing for an overlap per AWWA Standards.

2.3 RUBBERIZED-BITUMEN BASED SPRAY-ON UNDERCOATING

- A. Subject to approval by the ENGINEER, an alternative corrosion protection for exposed buried metal is an aerosol applied rubberized coating. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Underseal Undercoating 08883 or any equivalent rubberized-bitumen based spray-on undercoating may be used. Follow manufacturer's recommendations for storage and application.

PART 3: EXECUTION

3.1 INSTALLATION

- A. Lay and maintain all pipe to the required lines and depths. Install fittings, valves and hydrants in strict accordance with the Specifications at the required locations with joints centered, spigots home, and all valve and hydrant stems plumb. Do not deviate from the required alignment, depth or grade without the written consent of the Engineer.
- B. Buried steel lugs, rods, brackets, and flanged joint nuts and bolts are not permitted unless specifically shown on the drawings or approved in writing by the ENGINEER. Cover any and all buried steel lugs, rods, brackets, and flanged joint nuts and bolts

with approved coating in accordance with AWWA Standard C217 prior to backfilling. Encase the same in polyethylene encased if the specifications require polyethylene encasement of the pipe.

- C. Lay all pipe to the depth specified. Measure the depth from the final surface grade to the top of the pipe barrel. The minimum pipe cover shall be as shown on the Drawings or as specified in the Specifications Special Conditions.
- D. Do not lay pipe in a wet trench, on subgrade containing frost, or when trench conditions are unsuitable for such work. If all efforts fail to obtain a stable dry trench bottom and the Engineer determines that the trench bottom is unsuitable for such work, the Engineer will order the kind of stabilization to be constructed, in writing. In all cases, water levels must be at least 6" below the bottom of the pipe. See section 31 23 19, Dewatering.
- E. Thoroughly clean the pipes and fittings before they are installed. Keep these materials clean until the acceptance of the completed work. Lay pipe with the bell ends facing in the direction of laying, unless otherwise shown on the Drawings, or directed by the Engineer. Exercise care to ensure that each length abuts the next in such a manner that no shoulder or unevenness of any kind occurs in the pipe line.
- F. Do not wedge or block the pipe during laying unless by written order of the Engineer.
- G. Before joints are made, bed each section of pipe the full length of the barrel, at the required grade, and at the invert matching the previously laid pipe. Dig bell holes sufficiently large to permit proper joint making. Do not bring succeeding pipe into position until the preceding length is embedded and secure in place.
- H. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying. Take up, such in-place pipe sections found to be defective and replace them with new pipe. Take up, relaying, and replacement will be at the Contractor's expense.
- I. Place enough backfill over the center sections of the pipe to prevent floating. Take all other necessary precautions to prevent the floating of the pipeline by the accumulation of water in the trench, or the collapse of the pipeline from any cause. Place enough backfill over the center sections of the pipe to prevent floating. Should floating or collapse occur, restoration will be at the Contractor's expense.
- J. Bedding materials and concrete work for the pipe bedding and thrust restraint shall be as specified in the contract documents as well as detail drawings.
- K. Prevent foreign material from entering the pipe while it is being placed. Do not place debris, tools, clothing, or other materials in the pipe during laying operations. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work, or for other reasons such as rest breaks or meal periods.
- L. Only cut pipe with equipment specifically designed for cutting pipe such as an abrasive wheel, a rotary wheel cutter, a guillotine pipe saw, or a milling wheel saw. Do not use chisels or hand saws. Grind cut ends and rough edges smooth. Bevel the cut end slightly for push-on connections as per manufacturer recommendations. Cutting tools shall comply with Owner safety policies.
- M. In distributing material at the site of the Work, unload each piece opposite or near the place where it is to be laid in the trench. If the pipe is to be strung out, do so in a straight line or in a line conforming to the curvature of the street. Block each length of pipe adequately to prevent movement. Block stockpiled pipe adequately to prevent

movement. Do not place pipe, material, or any other object on private property, obstructing walkways or driveways, or in any manner that interferes with the normal flow of traffic.

- N. Exercise special care to avoid damage to the bells, spigots or flanged ends of pipe during handling, temporary storage, and construction. Replace damaged pipe that cannot be repaired to the Engineer's satisfaction, at the Contractor's expense.
- O. Remove all existing pipe, fittings, valves, pipe supports, blocking, and all other items necessary to provide space for making connections to existing pipe and installing all piping required under this Contract.
- P. Maintain the minimum required distance between the water line and other utility lines in strict accordance with all Federal, State, and local requirements and all right-of-way limitations.
- Q. Provide and install polyethylene encasement for ductile iron pipe as required by the Drawing or Specification Special Conditions. See Specification Section 33 05 09.01.
- R. The maximum allowable deflection at the joints for push-on joint pipe shall be the lesser of manufacturer's recommendations or as described in the DIPRA Guideline, Ductile Iron Pipe Joints and Their Uses, see Exhibit 1 below:

Exhibit 1

| Size of Pipe | Deflection Angle | Maximum Deflection (18-ft. Length) | Deflection (20-ft. Length) |
|--------------|------------------|------------------------------------|----------------------------|
| 3"-12" | 5 degrees | 19" | 21" |
| 14"-42" | 3 degrees | 11" | 12" |
| 48"-64" | 3 degrees | N/A | 12" |

- S. Use short lengths of pipe (minimum length 3 feet, no more than three short sections), when approved by the Engineer, to make curves that cannot be made with full length sections of pipe without exceeding the allowable deflection. Making these curves will be at no additional cost to the Owner.
- T. Furnish air relief valve assemblies in accordance with detail drawings provided or as specified in the specification Special Conditions section. Engineer will provide standard detail for additional air release valve assemblies. Any deviation from the standard detail proposed by contractor must be approved in advance.
- U. Exercise particular care so that no high points are established where air can accumulate. Install an air release valve and manhole, as extra Work to the Contract, when the Engineer determines that unforeseen field conditions necessitate a change in the pipe profile that requires the installation of an air release valve and manhole. If the Contractor requests a change in the pipe profile solely for ease of construction, and the requested change requires the installation of an air release valve and manhole as determined by the Engineer, the cost of furnishing and installing the air release valve and manhole will be at the expense of the Contractor.

3.2 CONSTRUCTION METHODS TO AVOID CONTAMINATION

- A. Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is essential that the procedures of this Specification Section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.
- B. Take precautions to protect the interior of pipes, fittings, and valves against contamination. String pipe delivered for construction so as to keep foreign material out of the pipe. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Use rodent-proof plugs approved by Engineer, where it is determined that watertight plugs are not practical and where thorough cleaning will be performed.
- C. Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the lower the likelihood of contamination. Complete the joints of all pipe in the trench before stopping work. If water accumulates in the trench, keep the plugs in place until the trench is dry.
- D. When encountering conditions on pre-existing pipe that requires packing, employ yarning or packing material made of molded or tubular rubber rings, or rope of treated paper or other approved materials. Do not use materials such as jute, asbestos, or hemp. Handle packing material in a manner that avoids contamination.
- E. Do not use contaminated material or any material capable of supporting prolific growth of microorganisms for sealing joints. Handle sealing material or gaskets in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. Deliver the lubricant to the job in closed containers and keep it clean.
- F. If dirt enters the pipe, and in the opinion of the Engineer the dirt will not be removed by the flushing operation, clean the interior of the pipe by mechanical means, then swab with a 1% hypochlorite disinfecting solution. Clean using a pig, swab, or "go-devil" only when the Engineer has specified such and has determined that such operation will not force mud or debris into pipe joint spaces.
- G. If the main is flooded during construction, the flooded section must be isolated from the remainder of the installation as soon as practical. Submit a plan to the Engineer on correcting the condition and do not proceed until authorized by the Engineer. Replace or fully clean and disinfect the affected pipe at no additional cost to the Owner.

3.3 VALVE INSTALLATION

- A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially of seating surfaces, handling damage, and cracks. Correct defective valves or hold for inspection by the Engineer.
- B. Set and join to the pipe in the manner specified in Specification Section 3.1. Provide valves with adequate support, such as crushed stone and concrete pads, so that the pipe will not be required to support the weight of the valve. Set truly vertical. After field installation of the valve all exposed ferrous restraint materials and external bolts except the operating nut shall receive a layer of petrolatum tape coating or, where approved, rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene

encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut exposed and free to be operated.

- C. Provide a valve box for each valve. Set the top of the valve box neatly to existing grade, unless directed otherwise by the Engineer. Do not install in a way that allows the transfer shock or stress to the valve. Center and plumb the box over the wrench nut of the valve. Do not use valves to bring misaligned pipe into alignment during installation. Support pipe in such manner as to prevent stress on the valve. See Standard Detail SD59 for a typical valve box installation detail.
- D. Provide valve marking posts, when authorized by the Owner, at locations designated by the Engineer and in accordance with detail drawings. Payment will be made per post in accordance with the Basis of Payment specification.

3.4 THRUST RESTRAINT

- A. Provide all plugs, caps, tees, and bends (both horizontal and vertical) with concrete thrust blocking and/or restrained joint pipe as represented on the Drawings or specified in the Specification Special Conditions.
- B. Place concrete thrust blocking between undisturbed solid ground and the fitting to be anchored. Install the concrete thrust blocking in accordance with Specification Section 03 30 00 and standard details provided. Locate the thrust blocking to contain the resultant thrust force while keeping the pipe and fitting joints accessible for repair, unless otherwise shown or directed.
- C. Provide temporary thrust restraint at temporary caps and plugs. Submit details of temporary restraint to the Engineer for approval.
- D. At connections with existing water mains where there is a limit on the time the water main may be removed from service, use metal harnesses of anchor clamps, tie rods and straps; mechanical joints utilizing set-screw retainer glands; or restrained push-on joints as permitted by Engineer. No restraining system can be installed without the approval of the Engineer. Submit details of the proposed installation to the Engineer for approval. For pipe up to 12 inches in size, use a minimum of two 3/4-inch tie rods. If approved for use, install retainer glands in accordance with the manufacturer's instructions. Material for metal harnessing and tie-rods shall be ASTM A36 or A307, as a minimum requirement.
- E. Protection of Metal Harnessing: Protect ties rods, clamps and other metal components against corrosion by hand application of petrolatum tape and by encasement of the entire assembly with 8-mil thick (12 mil thick in corrosive soils) loose polyethylene film in accordance with AWWA C105. Apply tape on all exposed tie rods prior to installing polyethylene.

3.5 TYPICAL INSTALLATION DETAILS

- A. Standard details are attached to the end of the technical specifications.

END OF SECTION

SECTION 33 01 10.54

CLEANING OF WATER UTILITY PIPING

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE OF WORK

- A. Clean the pipelines installed under these Contract Documents using foam pigs, swabs, or "go-devils", as described herein, whenever normal flushing will not sufficiently remove dirt and debris that was introduced during construction.

1.3 GENERAL

- A. Normal pipeline flushing is often inadequate to remove all the entrapped air, loose debris, and other objects that may have been left in the main during installation. In such cases, use polyurethane foam pigs and/or polyurethane hard foam swabs to remove all foreign matter from the pipeline (i.e. "pig" the pipeline). Clean the pipeline per the requirements of this Specification Section prior to testing and disinfecting the main.

1.4 RELATED WORK

- A. See Specification Sections 33 01 10.50 and 33 01 10.58 prior to disinfecting pipelines.

1.5 PROTECTION DURING FLUSHING AND CLEANING

1. Coordinate with Engineer and Owner before flushing to ensure that an adequate volume of flushing water is available, at sufficiently high pressure. Determine if the water can be disposed of safely. Notify the Owner, Engineer, and the following prior to flushing, or cleaning:
 - a. Fire Department
 - b. Other utilities, such as gas, electric and telephone companies, who may have underground facilities in the area.
 - c. Customers who may be inconvenienced by reduced pressure or dirty water.
- B. Coordinate with Owner to isolate the section to be flushed from the operating distribution system. Close valves slowly to prevent water hammer. Open the fire hydrant or blow-off valve slowly until the desired flow rate is obtained. When flushing from a dry barrel fire hydrant, use the gate valve upstream of the hydrant for throttling purposes. Open the hydrant valve fully to prevent water from escaping into the ground through the fire hydrant barrel drain.
- C. Protect the work staff and the public during operation of hydrants and valves. Keep children away from the flow of flushing water. Where practical employ energy

dissipators to help avoid damage to property and the flooding of streets. The safety considerations also apply to main cleaning. See General Conditions Article 7.

PART 2: PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Furnish the foam cleaning plugs (swabs or pigs), labor, and equipment as needed to pig all pipelines. Furnish all materials required for the expulsion of air and other debris from pipelines. Do not use pipe cleaning plugs which utilize bristles, wire brushes, carbide abrasives, steel studs, or any other type abrasive unless specifically approved by the Engineer. Consult a manufacturer of pipe cleaning plugs, such as Knapp Polly Pig (Houston, Texas), to determine the type and size of cleaning plug best suited for the application. Two types of plugs shall be considered and are described as follows:
 1. Swabs:
 - a. Swabs used for cleaning mains shall be made of polyurethane foam. This foam has a density of 1 to 2 pounds per cubic feet. Swabs shall be purchased from commercial manufacturers of swabs for pipes. Both soft and hard grade foam swabs are available. New mains are typically cleaned with hard foam swabs.
 - b. Use swabs cut into cubes and cylinders slightly larger than the size of the pipe to be cleaned. For mains greater than 12-inches in diameter, the swab diameter must be considered individually for each operation. For new mains, swabs 3-inches larger than the pipe diameter have worked well. Swabs for the larger mains are usually 1-1/2 times the diameter in length.
 2. Pigs
 - a. The other type of cleaning plug available is called a pig. Pigs, if used, shall be commercially manufactured for the specific purpose of cleaning pipes. They shall be made of polyurethane foam weighing 2 to 15 lb./cu.ft. Pigs are bullet shaped and come in various grades of flexibility and roughness. Pigs are typically 1/4 -inch to 1/2-inch larger in diameter than the pipe to be cleaned.

PART 3: EXECUTION

3.1 PLUG INSTALLATION AND REMOVAL

- A. Furnish all equipment, material, and labor to satisfactorily expose cleaning wyes, or other entry or exit points. Remove cleaning wye covers, etc., as required by the Engineer to insert the plugs into the mains.
- B. If approved by the Engineer, stripped fire hydrants, air valves and blow-offs may serve as entry and exit points for smaller sized mains. The Engineer will examine these appurtenances and the connecting laterals to ensure that adequate openings exist through which a plug may be launched.
- C. If these appurtenances are used, a special launcher is required to ease the insertion and launching of the plug. If available, a pressurized water source such as a fire hydrant can be used to launch the plug. If water from the system is not available nearby, use a water truck with pump.
- D. If hydrants are used as entry and/or exit points, remove the internal mechanisms and plug the drains under the supervision of the Engineer. Insert the plug and replace the cap with a special flange with a 2-1/2-inch fitting. Connect the 2-1/2-inch fitting, with

- a pressure gauge and valve, to a pressurized water source. After closing the last valve isolating the section to be cleaned, open the hydrant supply valve. Propel the swab or pig into the main by opening the exit valve.
- E. In mains greater than 8-inches, wyes shall be used at the entry and exit points. Fabricate the wye section one size larger than the main to ease the insertion and extraction of the plug. The use of wyes, as with the previously mentioned appurtenances, requires an outside source of pressurized water for launching. Cap the wye with a flange with a 2 to 6-inch fitting for connecting to the pressurized water source.
 - F. Many pigs are harder to insert into a pipe since they are less flexible than swabs. Other methods acceptable to insert pigs include:
 - 1. winching with a double sling,
 - 2. winching with a rope attached to the pig,
 - 3. compression with a banding machine prior to insertion, and
 - 4. the use of a specially designed tapered steel pipe which is removed after use.
 - G. During swab or pig installation, leave as much water as possible in the main to be cleaned. The water suspends the material being removed from the pipe and minimizes the chance of the material forming a solid plug. Water in the pipe also keeps the swab or pig from traveling through the pipe at excessive rates. If swabs or pigs travel too fast, they will remove less material and wear more rapidly.
 - H. At the exit point or blow-off, install a wye long enough to house the swab or pig. Attach temporary piping to the end cap to allow the drainage of the water.
 - I. Take precautions to prevent backflow of purged water into the main when the cleaning plug exits through a dead end main. This can be accomplished by installing mechanical joint bends and pipe joints to provide a riser out of the trench. Additional excavation of the trench may serve the same purpose.

3.2 PRE-CLEANING PROCEDURES

- A. Prepare a written cleaning plan for the Engineer's review,
- B. Suggested pre-cleaning procedures include:
 - 1. Identify mains to be cleaned on a map. Mark the location of the entry, water supply, exit points, any blow-offs to be used, valves to be closed, and the path of the swab or pig.
 - 2. Under the Engineer's supervision and with Owner staff as required, inspect and operate all valves and hydrants to be used in the cleaning operation to ensure their correct operation and a tight shutdown.
 - 3. Check location and type of hydrants, launch and exit location, and blow-offs to be used. Make blow-off tap connections, if necessary.
 - 4. The Owner will notify customers served by the main to be cleaned that their water will be off for a specified period on the day of the cleaning.
 - 5. The Owner will identify customers who may require temporary services during the main cleaning operation. The Contractor shall provide the temporary connections.
 - 6. Determine the number and size of plugs to be used.

3.3 CLEANING PROCEDURE

Clean the pipeline using the following procedures and the Contractor's cleaning plan, as approved by the Engineer.

A. Swab Cleaning Procedures

1. Open the water supply upstream of the swab. Throttle the flow in the main at the discharge (plug exit) point so that the swab passes through the main at a speed of 2 to 4 fps. (At this velocity, swabs will effectively clean pipes for distances of up to 4,000 feet before disintegrating to a size smaller than the main.) Use pitot gauges at the existing hydrant or blow-off to estimate the flow rate in the main.
2. Note the time of entry of the swab into the main and estimate its time of exit. If the swab does not reach the exit point in the estimated time plus ten minutes, then a blockage has probably occurred. Reverse the flow in the main and note the time required for the swab to reach the original entry point. From the return travel time, estimate the location of the blockage. The Engineer may require the use of a swab containing a transmitter to accurately locate the blockage.
3. Swab repeatedly as needed. Stop swabbing when the water behind the swab emerging at the exit clears up within one minute. Account for all swabs inserted into the main.
4. After the last swab has been recovered, flush the main to remove swab particles. This may require up to an hour of flushing.

B. Pig Cleaning Procedures

1. Remove all air valves along the line. Ensure that each isolating valve to the air release valve are completely closed. Operate system to prevent undesired buildup of air while air release valves are out of service.
2. If the pig is inserted directly into the main, set it in motion by opening the upstream gate valve and a downstream fire hydrant or blow-off valve (usually the valve on the capped end at the exit point). If the pig is launched from a wye, fire hydrant, or other appurtenance, use an external pressurized water source to inject the pig into the main as described in Specification Section 3.1.
3. Once the pig is launched, control its speed by throttling the discharge at a downstream fire hydrant or blow-off. Operate pigs at the typical speed of 1 fps. Speeds of up to 2 fps. can be used on straight runs with no restrictions or sharp turns.
4. Make sufficient passes of the pig to obtain thorough cleaning. Two pigs may be used in tandem to save time and water. Sufficient cleaning is established when the water discharging after the pig becomes clear within one minute.

3.4 POST CLEANING PROCEDURE

- A. After successful cleaning; test, flush, and disinfect the main in accordance with applicable sections of these Specifications

END OF SECTION

SECTION 33 01 10.58
DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE OF WORK

- A. Flush and disinfect all pipelines installed under this Contract. This would include furnishing the necessary labor, tools, transportation, and other equipment for the operation of valves, hydrants, and blowoffs during the chlorination. Install, and if directed remove, all chlorination taps required for disinfection. The cost of this work shall be included in the bid item for pipe installation. The disinfection will be performed under the supervision of Owner.

1.3 WORK BY OWNER

- A. The Owner reserves the option to provide/furnish the chlorine and chlorination equipment. The Owner will furnish water for testing, flushing and disinfecting pipelines. The Owner will also perform bacteriological testing and may collect the sample.

1.4 PROTECTION

- A. Chlorine disinfection and dechlorination shall be under the direct supervision of someone familiar with the physiological, chemical, and physical properties of the form of chlorine used. They shall be trained and equipped to handle any emergency that may arise. All personnel involved shall observe appropriate safety practices to protect working personnel and the public.
- B. The forward of AWWA Standard B300 contains information and additional reference material regarding the safe handling of hypochlorite. The Contractor shall familiarize himself with this information prior to performing any disinfection work.

1.5 RELATED WORK

- A. Observe the precautions described in Specification Section 33 01 10.50 to avoid contamination during installation of the pipeline.

1.6 REFERENCES

- A. Refer to current AWWA Standard for Disinfecting Water Mains C651.

PART 2: PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Furnish liquid sodium hypochlorite and injection equipment and/or calcium hypochlorite (HTH) as needed to disinfect all pipelines and appurtenances.
- B. Calcium hypochlorite is available in granular form or in approximately 5-g tablets and contains approximately 65% available chlorine by weight and is employed in calculations used in this specification. The material should be stored in a cool, dry, and dark environment to minimize its deterioration. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material (containing trichloroisocyanuric acid) has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time had been achieved.
- C. Calcium hypochlorite must conform to AWWA B300.

PART 3: EXECUTION

3.1 PREPARATION

- A. All pipelines shall be pressure and leak tested, flushed, and cleaned of debris and dirt prior to application of the disinfectant. Flushing shall continue until the volume in the newly installed main has turned over at least one time unless the Engineer determines that conditions do not permit the required volume to be safely discharged to waste.

3.2 APPLICATION OF DISINFECTANT

- A. Methods to be used for disinfection are those detailed in ANSI/AWWA C651 Disinfecting Water Mains.

3.3 WATER MAINS

- A. The disinfection procedure is described below. Chlorination methods involving the placement of granules or tablets in the main are prohibited by the Owner. Chlorine must be completely dissolved prior to placement in the main.

B. Continuous Feed Method

1. Set Up

- a. The continuous feed method consists of completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and then refilling the main with chlorinated potable water. The potable water shall be chlorinated, so that after a 24-hour holding period in the main, there will be a free chlorine residual of not less than 10 mg/L in collected samples.
- b. Preliminary flushing. Prior to being chlorinated, fill the main to eliminate air pockets and flush to remove particulates. The flushing velocity in the main shall be not less than 2.5 fps unless the Engineer determines that conditions do not permit the required flow to be discharged to waste. Exhibit 1 shows the rates of flow required to produce a velocity of 2.5 fps in pipes of various sizes.

NOTE: Flushing is no substitute for preventive measures during construction. Certain contaminants such as caked deposits resist flushing at any feasible velocity.

**Exhibit 1. Required Flow and Openings to Flush Pipelines
(40 psi Residual Pressure in Water Main)***

| Pipe Diameter (inches) | Flow required to produce 2.5 fps velocity in main (gpm) | Size of Tap (inches) | | | Number of 2-1/2 in. Hydrant Outlets to Use |
|---------------------------|--|-------------------------|-------|---|--|
| | | 1 | 1-1/2 | 2 | |
| | | Number of taps on Pipe† | | | |
| 4 | 100 | 1 | - | - | 1 |
| 6 | 200 | - | 1 | - | 1 |
| 8 | 400 | - | 2 | 1 | 1 |
| 10 | 600 | - | 3 | 2 | 1 |
| 12 | 900 | - | - | 2 | 2 |
| 16 | 1600 | - | - | 4 | 2 |

* With a 40 psi pressure in the main with the hydrant flowing to atmosphere, a 2½-inch hydrant outlet will discharge approximately 1,000 gpm and a 4½-inch hydrant outlet will discharge approximately 2,500 gpm.

† Number of taps on pipe based on discharging through 5 feet of galvanized iron pipe with one 90 degree elbow.

In mains of 24-inches or larger diameter, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweepings prior to chlorinating the main.

2. Chlorinating the Main

- a. Flow water from the existing distribution system or other approved source of supply at a constant, measured rate into the newly laid water main. In the absence of a meter, approximate the rate by placing a pitot gauge in the discharge or measuring the time to fill a container of known volume.
- b. At a point not more than 10 feet downstream from the beginning of the new main, dose the water entering the new main with chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. Measure the chlorine concentration at regular intervals to ensure that this concentration is provided. Measure chlorine in accordance with the procedures described in the current edition of the AWWA Manual M12 or of Standard Methods for the Examination of Water and Wastewater.
- c. Exhibit 2 gives the amount of chlorine required for each 100 feet of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with calcium hypochlorite and the table indicates the appropriate amount of the 65% calcium hypochlorite. If using other concentrations of calcium hypochlorite, a properly adjusted weight must be used. A 1 percent chlorine solution requires 1 pound of calcium hypochlorite in 8 gallons of water.

Exhibit 2. Chlorine and Hypochlorite Required to Produce 25 mg/L Concentration in 100 feet of Pipe by Diameter

| Pipe Diameter (inches) | 65% Hypochlorite (lbs) | 1% Chlorine Solutions (gallons) |
|------------------------|------------------------|---------------------------------|
| 4 | 0.020, | 0.16 |
| 6 | 0.046 | 0.36 |
| 8 | 0.083 | 0.65 |
| 10 | 0.131 | 1.02 |
| 12 | 0.185 | 1.44 |
| 16 | 0.334 | 2.60 |

- d. During the application of chlorine, position valves so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Do not stop the chlorine application until the entire main is filled with heavily chlorinated water. Keep the chlorinated water in the main for at least 24 hours. During this time, operate all valves and hydrants in the section treated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
- e. Hypochlorite solution may be applied to the water main with a gasoline or electrically powered chemical feed pump designed for feeding hypochlorite solutions. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. Check all connections for tightness before the solution is applied to the main.

3.4 DISPOSAL OF HEAVILY CHLORINATED WATER

- A. Do not keep heavily chlorinated water in contact with pipe for more than 48 hours after the applicable retention period. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, flush the heavily chlorinated water from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use. Take all steps necessary to dechlorinate water where required per section 3.4B and 3.4C below. Contact the local sewer department to arrange for disposal of the heavily chlorinated water to the sanitary sewer if applicable.
- B. Neutralize the chlorine residual of the water being disposed of by treating with one of the chemicals listed in Exhibit 4. Select an alternative disposal site if a sanitary sewer system is unavailable for disposal of the chlorinated water.
- C. The proposed alternative disposal site shall be inspected and approved of by the Engineer. Apply a reducing agent to the chlorinated water to be wasted to completely neutralize the chlorine residual remaining in the water. (See Exhibit 4 for neutralizing chemicals. Do not overdose neutralizing chemicals as this may result in adverse

environmental impacts. Only dose the amount required to neutralize the amount of chlorine present). Contact federal, state and local regulatory agencies, where necessary, to determine special provisions for the disposal of heavily chlorinated water.

Exhibit 4. Pounds of chemicals required to neutralize various Residual chlorine concentrations in 100,000 gallons of water

| Residual Chlorine Concentration (mg/L) | Sulfur Dioxide (SO ₂) | Sodium Bisulfite (NaHSO ₃) | Sodium Sulfite (Na ₂ SO ₃) | Sodium Thiosulfate (Na ₂ S ₂ O ₃ · 5H ₂ O) | Ascorbic Acid (C ₆ O ₈ H ₆) |
|---|--------------------------------------|---|--|---|--|
| 1 | 0.8 | 1.2 | 1.4 | 1.2 | 2.1 |
| 2 | 1.7 | 2.5 | 2.9 | 2.4 | 4.2 |
| 10 | 8.3 | 12.5 | 14.6 | 12.0 | 20.9 |
| 50 | 41.7 | 62.6 | 73.0 | 60.0 | 104 |

- D. Test for chlorine residual throughout the disposal process to be sure that the chlorine is neutralized
- E. Submit a plan of disposal of flushed water to the Engineer for approval

3.5 BACTERIOLOGICAL TESTING

- A. After final flushing and before the water main is placed in service, the first of two consecutive sets of acceptable samples can be collected from the new main. The second set of samples must be taken at least 24 hours after the first set of samples. The main should not be flushed between collection of the first and second set of samples except to clear the sample site to collect the second sample. At least one set of samples shall be collected from every 1,200 feet, of the new water main, plus one set from the end of the line and at least one set from each branch when possible or as required by regulatory requirements.
- B. Samples shall be collected by a person knowledgeable in collecting samples for bacteriological sampling or arrange for the Owner to collect the sample. Coordinate with Owner and submit samples to the Owner for testing of bacteriological (chemical and physical) quality. Testing will be in accordance with Standard Methods of the Examination of Water and Wastewater. Samples shall show the absence of coliform organisms; and the presence of a chlorine residual. Samples shall also be tested for turbidity, pH, and standard heterotrophic plate count (HPC). HPC levels must be consistent with levels normally found in the distribution system to which the new main is connected.
- C. Bacteriological tests must show complete absence of coliforms and acceptable HPCs. If tests show the presence of coliform or unacceptable HPCs, perform additional flushing and disinfection of the pipeline until acceptable tests are obtained, all at no cost to the Owner. The Contractor will not be charged for the additional testing performed by the Owner.

3.6 RETESTING AND TESTING SOURCE WATER

- A. At the time of initial flushing the main to remove material and test for air pockets, Contractor may request the Owner to continue flushing until the desired chlorine residual is met at the discharge point. Notification must be provided in advance and the Contractor shall be prepared to test for chlorine at intervals of no more than five minutes as the water clears. This will provide the Contractor with some assurance that the source water is chlorinated.
- B. If the subsequent tests for bacteriological contamination conducted by the Contractor fail, the Contractor may request the Owner to continue flush from the source water into the new pipe system until a chlorine residual is found at the discharge point. Notification must be provided in advance and the Contractor shall be prepared to test for chlorine at intervals of no more than five minutes as the water clears. The operation of all existing system valves shall be by the Owner at the Contractor expense and the discharge point must be opened prior to opening existing valves to avoid contamination. This will provide the Contractor with some assurance that the source water is chlorinated for subsequent tests.

END OF SECTION

SECTION 33 05 05.31
HYDROSTATIC TESTING

PART 1: GENERAL

1.1 SCOPE OF WORK

- A. Test all piping, valves, and appurtenances installed under these Contract Documents. Testing shall be performed concurrent with installation. Do not install more than 1,200 feet of pipe without being tested, unless approved by the Engineer.

1.2 SUBMITTALS

- A. Prepare and submit schedules and procedures to the Engineer for testing of all parts of the water main installed in accordance with these Contract Documents. Submit the schedule at least seven days prior to any testing.

1.3 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

PART 2: PRODUCTS

2.1 EQUIPMENT

- A. Furnish the pump, pipe connections, and all necessary apparatus for the pressure and leakage tests including gauges and metering devices. The Owner reserves the option to furnish the gauges and metering devices for the tests. Excavate, backfill, and furnish all necessary assistance for conducting the tests.

PART 3: EXECUTION

3.1 GENERAL

- A. Perform hydrostatic pressure and leak tests in accordance with AWWA C600, Section 4 - Hydrostatic Testing after the pipe or section of pipe has been laid, thrust blocking cured (min. 5 days), and the trench is completely or partially backfilled. Where practical, testing shall be performed fully isolated from the active distribution system.
- B. The Contractor may, at his option, completely backfill the trench or partially backfill the trench over the center portion of each pipe section to be tested. However, the Engineer may direct the Contractor to completely backfill the trench if local traffic or safety conditions require it.
- C. For system operating pressures of 200 psi or less, perform the hydrostatic test at a pressure of no less than 100 psi above the normal operating pressure without exceeding the rating of the pipe and appurtenances. For system operating pressures in excess of 200 psi, perform the hydrostatic test at a pressure that is 1.5 times the normal operating pressure, but not more than the design rating of the pipe and appurtenances.

- D. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. A test pressure greater than the rated valve working pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests exceeding the rated valve working pressure, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve working pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or the valve can be fully opened if desired.
- E. The test pressure shall not exceed the rated working pressure or differential pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
- F. Attach a tapping sleeve and valve assembly to the main. Pressure test the assembly prior to making the tap. The required test pressure shall be determined in the same manner as for pipe. The test is acceptable if there is no pressure drop in 15 minutes at test pressure.

3.2 FILLING AND TESTING

- A. Slowly fill each segregated section of pipeline with water ensuring that all air is expelled. Extreme care must be taken to ensure that all air is expelled during the filling of pipe. The line shall stand full of water for at least twenty-four hours prior to testing to allow all air to escape. If necessary, tap the main at points of highest elevation to expel air as the pipe is filled. Remove the corporation stops and plug the taps after successfully filling the pipeline and expelling all air as approved by the Engineer.
- B. Apply the specified test pressure, measured at the point of lowest elevation, using a pump connected to the pipe in a manner satisfactory to the Engineer. If the elevation of the high point of the pipeline being tested is such that the pressure during testing will be below 85% of the required test pressure, the Engineer will require a separate test to be performed on this section of pipeline. In lieu of a separate test, the test pressure measured at the lowest elevation may be increased, within the pressure rating of the pipeline material, such that the resulting pressure at the highest point exceeds 85% of the required test pressure. The test will be conducted for at least two hours at the required test pressure \pm 5 psi.
- C. Conduct a leakage test concurrently with the pressure test. Leakage is defined as the volume of the water that must be supplied into the newly laid pipeline to maintain pressure within 5 psi of the test pressure after it is filled and purged of air. Measure the volume of water using a calibrated container or meter.
- D. No pipeline installation will be accepted by the Engineer if the leakage is greater than that shown in Exhibit 1.

Exhibit 1. Allowable Leakage per 1000 ft. of Pipeline* (gph)

| Avg. Test Pressure <i>psi</i> | Nominal Pipe Diameter— <i>in.</i> | | | | | | | | | | | | | |
|----------------------------------|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 36 | 42 | 48 |
| 450 | 0.57 | 0.86 | 1.15 | 1.43 | 1.72 | 2.01 | 2.29 | 2.58 | 2.87 | 3.44 | 4.30 | 5.16 | 6.02 | 6.88 |
| 400 | 0.54 | 0.81 | 1.08 | 1.35 | 1.62 | 1.89 | 2.16 | 2.43 | 2.70 | 3.24 | 4.05 | 4.86 | 5.68 | 6.49 |
| 350 | 0.51 | 0.76 | 1.01 | 1.26 | 1.52 | 1.77 | 2.02 | 2.28 | 2.53 | 3.03 | 3.79 | 4.55 | 5.31 | 6.07 |
| 300 | 0.47 | 0.70 | 0.94 | 1.17 | 1.40 | 1.64 | 1.87 | 2.11 | 2.34 | 2.81 | 3.51 | 4.21 | 4.92 | 5.62 |
| 275 | 0.45 | 0.67 | 0.90 | 1.12 | 1.34 | 1.57 | 1.79 | 2.02 | 2.24 | 2.69 | 3.36 | 4.03 | 4.71 | 5.38 |
| 250 | 0.43 | 0.64 | 0.85 | 1.07 | 1.28 | 1.50 | 1.71 | 1.92 | 2.14 | 2.56 | 3.21 | 3.85 | 4.49 | 5.13 |
| 225 | 0.41 | 0.61 | 0.81 | 1.01 | 1.22 | 1.42 | 1.62 | 1.82 | 2.03 | 2.43 | 3.04 | 3.65 | 4.26 | 4.86 |
| 200 | 0.38 | 0.57 | 0.76 | 0.96 | 1.15 | 1.34 | 1.53 | 1.72 | 1.91 | 2.29 | 2.87 | 3.44 | 4.01 | 4.59 |
| 175 | 0.36 | 0.54 | 0.72 | 0.89 | 1.07 | 1.25 | 1.43 | 1.61 | 1.79 | 2.15 | 2.68 | 3.22 | 3.75 | 4.29 |
| 150 | 0.33 | 0.50 | 0.66 | 0.83 | 0.99 | 1.16 | 1.32 | 1.49 | 1.66 | 1.99 | 2.48 | 2.98 | 3.48 | 3.97 |
| 125 | 0.30 | 0.45 | 0.60 | 0.76 | 0.91 | 1.06 | 1.21 | 1.36 | 1.51 | 1.81 | 2.27 | 2.72 | 3.17 | 3.63 |
| 100 | 0.27 | 0.41 | 0.54 | 0.68 | 0.81 | 0.95 | 1.08 | 1.22 | 1.35 | 1.62 | 2.03 | 2.43 | 2.84 | 3.24 |

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. This table has been generated from the formula:

$$L = \frac{S * D * P^{1/2}}{148,000}$$

where L is the allowable leakage in gallons per hour, S is the length of pipe in feet, D is the nominal pipe diameter in inches, and P is the test pressure in psig.

- E. Should any test disclose damaged or defective materials or leakage greater than that permitted, the Contractor shall, at Contractor's expense, locate and repair and/or replace the damaged or defective materials. Materials used for repair must be approved by the Engineer and meet the specifications. Repeat the tests until the leakage is within the permitted allowance and is satisfactory to the Engineer.

END OF SECTION

SECTION 33 05 06
ABANDONMENT OF MAINS & FIRE HYDRANTS

PART 1: GENERAL

1.1 REFERENCES

- A. AWWA M16 Manual, Work Practices for Asbestos Cement Pipe.
- B. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Transfer all services from main to be abandoned to the new main, make designated connections to existing water lines, and install new hydrants. Upon completion, testing and satisfactory operation of the new mains and connections, cut the existing pipeline to provide a break between the portion of the system remaining in use and the portion to be abandoned, remove all hydrants designated to be abandoned and cap all remaining live ends of the existing mains including hydrant laterals. Completely cover existing hydrants designated to be abandoned to prohibit use until the hydrants are removed. Remove and deliver hydrants to the Owner or disposed of as directed by the Engineer. Remove valve boxes of abandoned valves as directed by the Engineer.
- B. Cutting and Plugging (Capping):
 - 1. Cut the existing pipe at the point shown on the plans or designated by the Engineer. The method of cutting shall be approved by the Engineer. The plugs and/or caps used in connection with the work under this item shall be either mechanical joint or slip joint as compatible with the pipe being capped and shall be manufactured in accordance with AWWA Specification C-110. After the plug or cap is installed, provide the required blocking to adequately brace the plug or cap. Blocking may be used temporarily against the abandoned pipe. However, the permanent blocking shall be installed such that future disturbances of the abandoned pipe shall not affect the permanent blocking. After the water line has been plugged or capped and the permanent blocking has been installed, backfill the excavation as specified under Section 31 23 33.
 - 2. Note: The cost of all work associated with abandonment of existing pipelines and hydrants shall be included in the price of the cut and plug bid item if provided. Otherwise the cost shall be incorporated in the cost of installing the main that is replacing the abandoned pipe.
- C. Treating Remaining Pipe in Place:
 - 1. Water mains will generally remain in place without further action unless otherwise directed by the ENGINEER. There may be water mains that are judged to be of questionable structural condition and may be specified for filling with grout or flowable fill. The contract documents will identify any main or section of main that is to be filled. Pipe located above ground (mounted on bridges, etc.) will be removed.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

- A. Where AC pipe removal is required, pipe cutting and removal shall only be handled by a company specialized in handling AC pipe who will strictly adhere to the AWWA M16 Manual, Work practices for Asbestos Cement Pipe.

END OF SECTION

SECTION 33 05 07.13
SMALL MAIN DIRECTIONAL DRILLING

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools and equipment as necessary to construct a pipeline crossing by the horizontal directional drilling method. Furnish all labor, equipment, materials and supplies and perform all work necessary to provide OWNER with a complete, finished water main crossing. The finished work includes proper installation testing, restoration of underground utilities and environmental protection and restoration.
- B. This specification is applicable for projects less than 250 feet or for pipe size 12 inch or less.

1.3 RELATED SECTIONS

Trenching, Backfilling & Compacting – Section 31 23 33

Piping - General Provisions - Section 33 01 10.50

Disinfection of Water Utility Piping Systems – Section 33 01 10.58

1.4 QUALITY ASSURANCE

- A. The Horizontal Directional Drilling (HDD) equipment operator(s) shall be trained to operate the specific HDD equipment for the Owner's project with at least 3 years' experience in directional drilling obtained within the last five years that includes installation of potable water pipelines of the same or larger diameter and the same or greater lengths. All pipe and appurtenances of similar type and material shall be furnished by a single manufacturer.
- B. Perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The Contractor's supervisor shall have supervised directional drilling of a minimum of 5,000 linear feet of pipe of a similar or greater diameter, of similar material, over similar lengths, and with similar subsurface conditions.
- C. Perform the work in conformance with the "Horizontal Directional Drilling Good Practices Guidelines" (latest edition) as published by the HDD Consortium and pipe manufacturer's guidelines and recommendations.
- D. Adhere to the specifications; any changes must be expressly approved by the Engineer. Approval of any aspect of any Directional Bore operation covered by this Specification shall in no way relieve the Contractor of its ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

1.5 PROFILES AND TOPOGRAPHY

- A. Contours, topography and profiles of the ground as may be shown on the Contract Drawings are believed to be reasonably correct, but are not guaranteed to be absolutely so and are presented only as an approximation. It is the Contractor's responsibility to verify all elevations required to successfully complete the crossing.

1.6 SUBMITTALS

- A. Prior to beginning work, submit to the Engineer copies of a report of schedules, calculations, procedures and any supplemental subsurface soil condition investigations performed along the path of the proposed crossing. The report will summarize the subsurface conditions that are known to the Contractor and that his proposed crossing procedure is based upon factual, best available information. If the subsurface conditions are known to the Contractor by previous work or geotechnical studies done in the immediate area, the information shall be recorded in the report along with any additional geotechnical studies performed by the Contractor. The report shall include the following:

1. Subsurface Information

- a. Record in the report subsurface conditions known to the Contractor by previous work or prior geotechnical studies performed in the immediate project area.
- b. Boring information obtained by the Owner, if any, is listed in the Supplementary Conditions section of these Specifications.
- c. Additional borings performed by the Contractor and analysis of soils along the path of the proposed crossing. The Contractor shall be responsible for obtaining and including in his bid price the cost of any additional borings along the pipe alignment which may be necessary to design the proposed directionally drilled crossing.
- d. At a minimum any supplemental borings performed by the Contractor shall include standard classification of soils, standard penetration tests, split spoon sampling and sieve analysis. Test borings shall be performed to a minimum depth of ten (10) feet below the proposed pipe invert unless rock is encountered in which case test borings shall penetrate at least two feet into rock.

2. Drilling Equipment and Methods

- a. Submit details of equipment and written procedure with working drawings describing the proposed boring method and the entire operation to be used. This shall include, but not be limited to, entry and exit pits; settlement pit; size, capacity and arrangement of drilling and pulling equipment; layout of carrier pipe; details and spacing of pipe rollers; type of current head; method of monitoring and controlling line and grade; method of detection of surface movement; and layout of any proposed construction staging areas.
- b. In addition, submit for approval nameplate data for the drilling equipment, mobile spoils removal unit, and Material Safety Data Sheets (MSDS) information for the drilling slurry compounds. This must be submitted and reviewed by the Engineer before work can proceed.
- c. Submit contingency plans for possible problems, including procedure for handling and correcting inadvertent mud returns or a frac-out.

3. Piping

Submit shop drawings showing the pipe lengths, design details, joint details, etc. for the Engineer's review. Submittals shall include, but are not limited to, the following:

- a. All welding or fusion procedures to be used in fabrication of the different pipe materials and installation methods.
- b. Certified records for hydrostatic testing of all pipe materials to be used.
- c. An affidavit stating that all pipe materials furnished under this section have been manufactured in the United States of America and comply with all applicable provisions of referenced AWWA standards.

4. Proposed Alignment

Submit a graph in plan and profile plotting the pilot drilling hole alignment to the Engineer for review, including entry/exit angles and radius of curvature. After completion of the crossing, submit a final pipe alignment.

5. Schedule

Time schedule for completing the Directional Bore, including any delays due to anticipated soil conditions.

6. Calculations

- a. Submit detailed design calculations for several representative loading conditions for the proposed crossing. If requested by the Engineer, submit calculations to support the design of any particular location of pipe anywhere along the length of the crossing at no additional cost to the Owner.
- b. Design calculations shall be presented in a neat, readable format, with all figures, values and units included to facilitate ease of verification.
- c. Calculations shall be submitted to demonstrate that the pipe thickness design is sufficient to meet all design criteria specified.
- d. Calculations shall address the following loading conditions:
 - (1) Pre-installation:
 - a) Hoop and longitudinal stress during hydrostatic test; spanning stress with pipe full of water and supported on installation rollers, and maximum roller / support spacing.
 - (2) Installation/Post-Installation
 - a) Longitudinal stress from pulling force; longitudinal curvature stress at point of entry and in final position; external pressure from drilling fluid, overburden, and loads from the obstacle being crossed.
 - (3) Post-Installation/In-Service
 - a) Hoop and longitudinal stress during hydrostatic test; internal working and surge pressure; buckling with internal vacuum.
- e. Perform and submit to the Engineer fluids pressure versus overburden strength calculations. These calculations shall be performed to determine minimum acceptable cover requirements and prevent drilling fluids breakout to the ground surface.
- f. All calculations shall bear the seal of a Registered Professional Engineer. Licensure in the State that the work is performed is preferred.

B. Approval

1. No work shall commence without approval by the Engineer. Details and design calculations shall be submitted and approved well in advance of the drilling operation to prevent delays in work. All final layout work, including grades, shall be the Contractor's responsibility.

1.7 JOB CONDITIONS

- A. Any nighttime work is strictly regulated and will be allowed only with prior approval granted by the Owner subject to regulatory agencies having jurisdiction. All crossing operations shall be accomplished during daylight hours, unless approved by the Engineer. Crossing work shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours, unless approved by the Engineer. The Contractor shall provide a Work Plan submittal indicating its proposed hours of operation and length of work week. All work plans shall be subject to compliance with all applicable regulatory requirements for construction activities and any off site impacts.
- B. When hazards of night time work are carefully considered and determined to be insignificant, night time work may be allowed only to complete a properly planned crossing, and only if in the opinion of the Engineer the delay was caused by reasonably unavoidable circumstances, and that such night time work is necessary to avoid placing an undue economic hardship on the Contractor.
- C. In emergency situations, or where delay would increase the likelihood of a failure, nighttime work may be allowed to complete a delayed crossing.
- D. All operations shall continue on a 24-hour per day basis during pipe pull back.

1.8 COORDINATION OF WORK

- A. Coordinate connections to existing pipelines that require shutdown of OWNER facilities. OWNER will designate the time for these connections that could involve work during evenings, nights, Saturdays, Sundays, or holidays. Method of connection and designated times are to cause the least amount of disruption to OWNER'S water service to its customers. The cost for connections is to be included in the contract price. No contract price adjustment will be allowed for overtime, premium time, or other related costs.

1.9 USE OF EXISTING WATER SYSTEMS

- A. All use of existing water systems during construction by the Contractor shall be with the approval and direction of the system Owner and its representatives. The Contractor shall be responsible for all permits, fees, temporary piping, temporary meter rental/provisions, temporary backflow preventer rental/provision and other water utility requirements for supplying water during construction. Use the existing water system only at locations, times and conditions as set forth by the system owner or its representatives.
- B. If water is not readily available at the site or the Owner cannot provide the volume of flow required by the Contractor, provide potable water as needed from an off-site location at no additional cost to the Owner.

PART 2: PRODUCTS

2.1 PIPE

- A. Unless otherwise approved by the Engineer, pipe shall be HDPE pipe with ductile iron pipe outside diameters in accordance with AWWA C906. Verify the appropriate dimension ratio based on the pipe, joint and material pull strength required for the directional drilling.
1. HDPE pipe and related fittings shall be made with prime virgin resins exhibiting a minimum cell classification as defined in ASTM D3350 and meeting the PE 3408 code designation with maximum dimension ratios equal to 11.
 2. HDPE pipe 4-inch and larger nominal diameter shall be joined by means of zero leak-rate butt (thermal heat) fusion welds and/or approved flanged joints. Joints shall provide axial pullout resistance. Pipe shall meet the requirements of ANSI/AWWA C906, and have an outside diameter dimension of ductile iron pipe. Flanged joints shall not be used below finished grade for horizontal directional drilling applications.
 3. HDPE pipe shall have been continuously marked by the manufacturer with permanent printing indicating at a minimum the following.
 - a. Nominal size (inches);
 - b. Dimension ratio (DR);
 - c. Pressure rating (psi);
 - d. Trade name;
 - e. Material classification (PE 3408);
 - f. Plant, extruder and operator codes;
 - g. Resin supplier code;
 - h. Date produced; and
 - i. HDPE pipe used for portable water mains shall bear the NSF Seal of Approval.
 4. HDPE pipe shall be black in color with permanent blue colored stripes extruded into the pipe length or shall be solid blue color.
 5. Installation Curvature: The pipeline curvature shall not have a radius less than as shown in Exhibit 1.

Exhibit 1. HDPE Pipe Deflection Information

| Pipe Diameter (inches) | Minimum Radius of Curvature (feet) | Offset per 20-ft Length (inches) |
|------------------------|------------------------------------|----------------------------------|
| 4 | 23 | 9.3 |
| 6 | 34 | 6.1 |
| 8 | 44 | 4.6 |
| 10 | 56 | 3.5 |
| 12 | 67 | 3.0 |

2.2 EQUIPMENT

- A. General: All equipment for the Directional Bore shall have the capacity, stability, and necessary safety features required to fully comply with the specifications and requirements of this section without showing evidence of undue stress or failure. It shall be the responsibility of the Contractor to assure that the equipment to be used in the Directional Bore is in sound operating condition. Backup equipment shall be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the Directional Bore.
- B. Directional Drilling System: The directional drilling system shall consist of over the road transportable field power unit, mud-mixing and recycling unit, a trailer or carriage-mounted drill unit, and all other support accessory vehicles and equipment. All system components shall be in sound operating condition with no broken welds, excessively worn parts, badly bent, or otherwise misaligned components. All drill pipe, reamers, pull back heads, swivels, drill heads and collars, pipe cradles, pipe rollers, ropes, cables, clamps, and other non-mechanical but essential items shall be in sound condition and replaced immediately when need is apparent. The equipment must be capable of drilling the specified length in a single bore.
1. Mud-Mixing and Recycle Units: The mud-mixing and recycle unit shall be a self-contained system designed to provide a supply of high-pressure bentonite based cutting fluid to the drill unit. It shall contain a fluid storage tank and a complete bentonite and drilling fluid additive(s) mixing system. The cutting fluid is to be mixed on site. The cutting fluid shall be formulated for this specific project and anticipated conditions. It shall permit changes to be made to the bentonite and drilling fluid additive(s) concentrations during drilling in response to changing soil conditions. The field power unit shall contain the power-taken off-driven high pressure cutting fluid pumping system. The recycle units shall be of a capacity to minimize the production of new cutting fluid and maximize the reuse and recirculation of original cutting fluid produced.
 2. Directional Drill System: A carriage-mounted version of the drill system shall include a thrust frame. Both the trailer-mounted and carriage-mounted drill system shall be designed to rotate and push 10-foot (3-meter) minimum hollow drill sections into the tunnel being created by the boring head. The drill sections shall be made of high strength S-grade steel that permits them to bend to a 30-foot (9-meter) radius without yielding. Drill end fittings shall permit rapid makeup of the drill sections while meeting the torque, pressure and lineal load requirements of the system. The boring head itself shall be capable of housing a probe used by the Magnetic Guidance System (MGS) to determine tool depth and location from surface and to orient the head for steering. The MGS shall have a minimum accuracy of plus (+) or minus (-) two (2) percent of the vertical depth.

The drilling equipment must be fitted with a permanent alarm system capable of detecting an electric current. The system will have an audible alarm to warn the operator when the drill head nears electrified cables. The drilling equipment shall be grounded, protected, and operated in accordance with manufacturer's requirements for electric strike safety.

The control console shall contain a calibrated display of inclination, azimuth, tool face location, mud pump rates, and torque pressures. The downhole steering system accuracy shall be plus or minus one percent ($\pm 1.0\%$) of the horizontal bore

length such that the difference between actual depth and machine calculated depth is not more than 1 foot per hundred feet.

3. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the pipe placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular condition of the project. Water sluicing methods, jetting with compressed air, or boring or tunneling devices with vibrating type heads that do not provide positive control of the line and grade shall not be allowed.
- C. Spoils Equipment: The cutting fluid removal system shall include a self-contained vacuum truck which has sufficient vacuum and tank capacity to remove excess cutting fluid mixture and cuttings from the project site as required or directed by the Engineer. Spoils are not to be discharged into sewers or storm drains.

Contain all drilling and pipe lubricating mud by taking special measures to prevent run-off into adjacent properties and/or waterways. All surplus drilling and pipe lubricating mud will be removed from the site and properly disposed of by the Contractor. The Contractor will also be responsible for all required erosion control measures.

- D. Magnetic Guidance System: A Magnetic Guidance System (MGS) probe and location of the drill head during the drilling operation. The tracker shall be capable of tracking at all depths up to one hundred feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The tracker shall be accurate to +/-2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet. Ferrous materials shall not influence or affect the MGS readings or accuracy.

Components: Supply all components and materials to install, operate, and maintain the MGS. This shall include, but not be limited to the following:

1. MGS Probe and Interface
2. Computer, Printer, and Software
3. DC Power Source, Current Control Box, and Coil/Tracking Wire.

The Magnetic Guidance System (MGS) shall be a Tensor TruTracker MGS, or other licensed and industry approved wire guidance system. The Engineer shall be advised of the unit to be used and is subject to his approval. Set up and operate the MGS using personnel experienced with this system. A "Walk-over" tracking systems shall not be used, except as approved by the Engineer. Contractor shall provide Engineer with current calibration certification of MGS in accordance with manufacturer's specifications.

- E. If equipment breakdown or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the boring path shall be filled with a proper bentonite solution immediately, or as directed by the Engineer.
- F. The boring tool shall have steering capability and have an electronic tool detection system. The position of the tool during operation shall be capable of being determined accurately, horizontally within 1% of the horizontal distance of the

borehole and vertically within 2% of the vertical depths of the borehole. The boring tool shall have a nominal steering radius of 9 meters (30 feet).

- G. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.
- H. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations. The rig shall be grounded during drilling and pullback operations. There shall be a system to detect electrical current from the drilling string and an audible alarm that automatically sounds when an electrical current is detected.

2.3 DRILLING FLUIDS

- A. Drilling fluids shall consist of a mixture of potable water and gel-forming colloidal material, such as bentonite or a polymer surfactant mixture producing slurry of custard-like consistency.
- B. Where sandy or granular materials are encountered, a cement slurry or polymer supplement shall be considered for added strength and stability of the bore and over ream hole.
- C. No chemicals or polymer surfactant shall be used in the drilling fluid without written consent of the Engineer, and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe. Clay must be totally inert and contain no risk to the environment.
- D. Provide Owner, Engineer and have on site at all times the Material Safety Data Sheets (MSDS) for all drilling compounds and chemicals.

2.4 TRACER WIRE

- A. Tracer or location wire shall be a direct burial #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil. High molecular weight-high density blue polyethylene jacket complying with ASTM D1248, 30 volt rating. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack model No. 054007-09053. Wire insulation shall be highly resistant to alkalis, acid and other destructive agents found in soil. Location Wire shall be from Copperhead Industries, LLC, part number 1230B-HS or approved equal
- B. Tracer wire shall be installed simultaneously with pullback of the HDPE pipe. Wire shall either be wrapped around the pipe or taped to the pipe at 10 foot minimum intervals before installation.
- C. Tracer wire to be terminated at each end of the crossing within a valve box.

PART 3: EXECUTION

3.1 SITE DISTURBANCE AND SOIL EROSION

- A. Sediment barriers shall be constructed as shown on the Drawings or where directed by the Engineer. All soil erosion and sediment control work shall be done in accordance with the Standards for Soil Erosion and Sediment Control for the location where the work is performed. Contractor shall maintain sediment barriers until the project is deemed complete.
- B. The Contractor shall be responsible for the preservation of all existing trees, plants, and other vegetation that are to remain within or adjacent to the construction site and shall also be responsible for protecting existing concrete curb, fence, utilities, and other structures that are located within or adjacent to the construction site.
- C. The Contractor assumes all liability for environmental damage and cleanup due to inadvertent discharges of slurry or other causes. Slurry materials shall be selected based on the soil conditions encountered to minimize the risk of mud returns.

3.2 PERSONNEL REQUIREMENTS

- A. Provide a competent and experienced supervisor representing the Drilling Contractor who must be present at all times during actual operations. A responsible representative, who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual Directional Pilot Hole, over reaming and pullback operations.
- B. Have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual Directional Bore operation must be on the job site at the beginning of work.
- C. If HDPE is specified for the carrier pipe, HDPE pipe thermal butt fusion welding is to be completed by a welder certified by the manufacturer of the pipe or pipe welding equipment, in accordance with the Plastic Pipe Institute "Handbook of Polyethylene Pipe," Polyethylene Joining Procedures, and 49 CFR 192, Subpart F, latest edition.
- D. If steel pipe is specified for the carrier or casing pipe, welding shall be performed by certified welders. The CONTRACTOR shall be responsible for the qualification of welders with qualification testing conducted by an independent testing agency in accordance with American Welding Society D1.1 requirements. Results of qualification testing shall be submitted to the ENGINEER for approval. Results of previous qualification tests performed within six months from the date of pipe installation will be acceptable. Results from qualification tests performed prior to six months from the date of pipe installation will not be acceptable. All costs associated with qualification testing shall be included in the unit prices bid.
- E. The Engineer and Owner must be notified 48 hours in advance of starting each phase of the work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of Owner to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.
- F. If the Contractor fails to begin the Directional Bore at the agreed time, the Owner will establish the next mutually convenient time to begin. To avoid undue hardship of

either party, reasonable and mutual cooperation should be exercised where starting times are concerned. If one party fails to meet the agreed schedule, the other party is expected to consider a delayed start if the installation cannot be completed during daylight hours.

3.3 WORK PLAN

- A. Prior to beginning WORK, submit a WORK plan to UTILITIES detailing the procedure and schedule to be used to execute the project. The WORK plan should include the following.
 - 1. A description of all equipment to be used;
 - 2. Down-hole tools;
 - 3. A list of personnel and their qualifications and experience;
 - 4. List of SUBCONTRACTORS;
 - 5. A schedule WORK activity;
 - 6. A safety plan, traffic control plan (if applicable);
 - 7. An environmental protection plan and;
 - 8. Contingency PLANS for possible problems.
- B. WORK plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the requirements to complete the project
- C. Equipment:
 - 1. Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to the following:
 - a. Drilling rig;
 - b. Mud system;
 - c. Mud motors (if applicable);
 - d. Down-hole tools;
 - e. Guidance system and;
 - f. Rig safety systems.
 - 2. Submit calibration records for guidance equipment for any drilling fluid additives that will or might be use.

3.4 COORDINATION OF THE WORK

- A. Notify UTILITIES at least three days in advance of starting WORK. In addition, the actual crossing operation shall not begin until UTILITIES is present at the project site and agrees that proper preparations for the crossing have been made. UTILITIES' approval for beginning the crossing shall in no way relieve the CONTRACTOR from the ultimate responsibility for the completion of the WORK.
- B. Coordinate with utilities to select a mutually convenient time for the crossing operation to begin in order to avoid schedule conflicts.

3.5 PROCEDURE

- A. The installation of appropriate safety and warning devices in accordance with the USDOT "Manual of Uniform Traffic Control Devices" (MUTCD) shall be completed prior to beginning WORK and maintained until all construction is completed and the site restored.
- B. The Contractor shall be responsible for providing a Maintenance of Traffic Plan to the Engineer and local traffic law enforcement agency for review. The Maintenance of Traffic Plan shall show the location of all barricades, signs, devices and alternate routes for local traffic and pedestrian safety.
- C. Specifically note in the Maintenance of Traffic Plan street intersections that are to remain open as required during the pipe pull-back operation, or traffic detours implemented. Install a temporary sleeve across the street intersections through which the pipe can be pulled or to construct a temporary bridge for the pipe over the intersections as required. No additional payment will be made for temporary structures required in order to permit access through street intersections or the implementation of traffic detours.
- D. The cost of restoring pavement, curb, sidewalk, driveways, lawns, storm drains, etc., and other landscaped facilities shall be borne by the Contractor unless otherwise noted.

3.6 ALIGNMENT AND GRADE

- A. Determine and physically locate the depth, location, and size of all existing underground facilities in the vicinity of the proposed crossings and provide the ENGINEER with a comprehensive report of these facilities before starting any construction. The Contractor shall be held completely and solely responsible for any damages incurred. The kinds, locations and sizes of the existing underground utilities which may be shown on the Contract Drawings are intended only as a guide to the Contractor and are not guaranteed to be even approximately correct. Notify the owners of all existing utilities along the route and in the vicinity of the crossing prior to the construction to include all test borings and excavations.
- B. If utilities of unknown depth or other obstructions require grade or alignment deviations from the Plans, the grade and/or alignment may be adjusted with Engineer's approval. All adjustments shall permit gradual bends of the pipe to the original alignment beyond the directional bore section. At unusual site conditions, the Contractor may request a review of site conditions by the Engineer for additional adjustment, and such determination shall be final. An adjustment in alignment, position, or elevation approved by Engineer shall not be cause for an adjustment of costs.
- C. Pipe entry and exit points are to be allowed no more than five (5) feet of deviation from the staked centerline. The entry point may be moved up to twenty-five (25) feet further from the original entry point only with Engineer's approval. Exit point lengths greater than twenty-five (25) feet from the original point require Engineer's approval. Entry and exit points normally will not be allowed closer to the banks of a waterway being crossed. Any installation that deviates from the plan may be rejected and any rejected installation shall be reconstructed at the Contractor's expense.
- D. The vertical profile as shown on the drawings is the minimum depth to which the pipeline shall be installed. Contractor may, at his option and with the permission of

Owner, elect to install the pipe at a greater depth than shown on the drawings, at no additional cost to the Owner.

- E. Pilot hole shall be drilled on bore path with no deviations greater than two percent of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than two percent of depth in 100 feet, the Contractor will notify Engineer. The Engineer may require the Contractor to pull-back and redrill from the location along bore path before the deviation.

3.7 INSTALLATION

- A. The following is a general outline of steps for the Directional Bore operation:
 - 1. Clear the right-of-way and temporary work space as shown on the drawings. Contractor to install and maintain all soil erosion and sediment control devices, until project completion with approved permanent site stabilization.
 - 2. Lay out the pipe crossing alignment using a qualified land survey team to confirm accurate horizontal distances, either physically measured or shot by Electric Distance Measurement. Entry and exit points shall be located and marked with survey hubs or markers. Payment for survey mark-out shall be included in the price bid under horizontal directional drilling.
 - 3. Haul, string, and assemble restrained pipe. Joint air test the section prior to installation and hydrostatically test the assembled pipeline section, unless otherwise approved by Engineer. If sufficient linear footage of lay down area for the pipe string is not available, the finished pipeline may be assembled in no more than two sections, with each section joint air tested separately and hydrostatically tested when fully assembled as one piece. The CONTRACTOR will be responsible for ensuring that the drill rig has adequate pullback capacity to overcome the increased frictional resistance resulting from the stoppage of pipe pullback to perform the final weld or fusion of pipe sections. Provide adequate site security and shall be responsible for the integrity of the pipe until after the pullback, final test of the pipeline, and acceptance of the work by the Owner.
 - 4. All assembled pipe sections shall be securely plugged at the end of each work day. The pipe interior is to be protected at all times against dirt, dust, drilling mud, pipe cuttings, debris, animal access, and other sources of contamination.
 - 5. Provide adequate support rollers for the pipeline during pullback of the pipe string into the pre-drilled hole. The rollers and cradles shall be of a type that will prevent damage to the pipe and will be of sufficient number, as recommended by pipe manufacturer, to prevent over stressing due to sag bends during the pullback procedure. The pipe shall be supported at all times, including pullback, to maintain a free stress arc which limits pipe bending and internal hoop stresses to within manufacturer's limits.
 - 6. Pipe which is not properly protected and supported and shows indications of excessive stressing, gouges, cuts, abrasions or other damage which may affect the operational performance intended for the pipe, as recommended by pipe manufacturer, shall be removed from the site and replaced at no additional cost as directed by the Owner or Engineer.

7. Mobilize the drilling equipment, erect the rig, drill a pilot hole, enlarge the hole as necessary to a minimum diameter of 1.5 times the nominal diameter of the pipe, and pullback the prefabricated pipe string under the crossing.
 8. Prior to beginning the Pilot Hole over reaming, furnish to the Engineer with an as-built plan and profile of the actual crossing to confirm the installation is in compliance with the Contract Documents. Pilot hole alignment shall be accepted by Owner in writing prior to reaming and pipe installation.
 9. The Contractor shall be responsible for selecting the reaming process to be utilized, whether forward and/or back reaming will be undertaken, and the number of reaming passes to be made.
 10. Supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction and slurry material displaced by the pipe during installation. Mud pits are to be protected at all times against unauthorized access and be stabilized at all times against surface water runoff and containment berm failure. Pump, haul and dispose of any drill cuttings and excess drill fluids to a receiving site permitted to accept the spoils, all in a manner consistent with the local and state regulations at no additional cost to the Owner.
 11. Pull back the bore pipe in one continuous section and contractor using a swivel to minimize the rotation of the product pipe during pullback. Swivel shall utilize lubricated internal bearings which are fully protected from external contamination and over lubrication. Demonstrate the swivel operation prior to pullback to the Engineer prior to the operation.
 12. Use potable water and disinfect all piping and hoses used for water addition to the carrier pipe to counter the pipe flotation during pullback.
 13. During pullback, maintain records for submission to Owner indicating job, date, time, constant pipe footage progress, mud flow rates, pulling forces required and torque readings. Document the pull head location for each length of drill stem pipe for as built records.
 14. Unless not permitted by the right of way owner, inject low strength cement slurry into the bore hole for approximately 50 feet at each end of the drilled pipeline. Where cement slurry cannot be used, provide restraint at either end of the pipeline outside the bore to hold the pipe in place. The type of restraint shall be submitted to the Engineer in advance of the work and must be approved by the Engineer prior to the start of construction.
 15. Owner and Engineer shall have access at all times to any measuring or gauging devices used for the horizontal drill as well as any drilling logs maintained by the Contractor.
 16. In the event that the Contractor must abandon the drill hole before completion of the crossing, the Contractor will seal the borehole with neat cement grout starting at the low point or end of the drill hole and redrill the crossing at no extra cost to Owner.
- B. Erosion and sedimentation control measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud will be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions. No other chemicals or polymer surfactant shall be used in the drilling fluid without written consent of UTILITIES and after a determination is made

that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe.

C. Pilot Hole:

Pilot hole shall be drilled on bore path with no deviations greater than two percent of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than two percent of depth in 100 feet, the CONTRACTOR will notify ENGINEER. The ENGINEER may require the CONTRACTOR to pull-back and redrill from the location along bore path before the deviation.

D. Reaming:

Upon successful completion of pilot hole, ream borehole to a minimum of 25 percent greater than outside diameter of pipe using the appropriate tools. Do not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

E. Pullback:

After successfully reaming borehole to the required diameter, put the pipe through the borehole. In front of the pipe will be a swivel and barrel reamer to compact bore hole walls. Once pullback operations have commenced, operations must continue without interruption until pipe is completely pulled into borehole. During pullback operations, do not apply more than the maximum safe pipe pull pressure at any time. A break away head rated at the maximum safe pull pressure shall be utilized.

F. As-built variance from the designed bore path shall not exceed plus or minus one foot in the vertical plane and plus or minus two feet in the horizontal plane. Submit any proposed deviations from the design bore path with SHOP DRAWINGS.

G. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the borehole. The pipe shall be guided in the borehole to avoid deformation of, or damage to, the pipe.

H. If unexpected subsurface conditions are encountered during the bore, the procedure shall be stopped. The installation shall not continue until the OWNER and ENGINEER have been consulted.

I. The pipe shall be pulled back through the borehole using the wet insertion construction technique. The pipe shall be installed full of water.

J. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, movement or distortion of surface features.

K. A boring log shall be kept with horizontal and vertical location every 25 feet.

3.8 FIELD TESTING

A. PVC Pipe:

Perform hydrostatic testing for leakage following installation in accordance with the applicable test sections.

B. HDPE Pipe:

After installation the pipe shall be tested in accordance with AWWA “PE Pipe – Design and Installation” Manual of Water Supply Practices M55 and ASTM F2164 with the following modifications:

1. Test Duration: The total test time including initial pressurization, initial expansion and time at test pressure, must not exceed eight hours. If the test is not completed due to leakage, equipment failure, etc., the test section shall be depressurized and allowed to “relax” for a minimum of eight hours before it is brought back up to test pressure. The test procedure consists of initial expansion phase and leakage test phase.
2. Initial Expansion Phase: During the initial expansion phase, the test section is pressured to the test pressure and enough make-up liquid is added each hour for three hours to return to test pressure.
3. Leakage Test Phase: The leakage test phase follows immediately and shall be either two or three hours in duration. At the end of the time test, the test section shall be returned to test pressure by adding a measured amount of liquid. The amount of make-up liquid added shall not exceed the values provided in Exhibit 2 plus allowable leakage.

Exhibit 2. Allowance for Make-up Water Under Test Pressure*

| Test Duration (hours) | Pipe Diameter (inches) | | | | | | | |
|-----------------------|--|------|-----|------|------|------|------|-------|
| | 2 | 4 | 6 | 8 | 12 | 16 | 20 | 24 |
| | Allowance/100 feet of Pipeline (gallons) | | | | | | | |
| 2 | 0.11 | 0.25 | 0.6 | 1.00 | 2.30 | 3.30 | 5.50 | 8.90 |
| 3 | 0.19 | 0.40 | 0.9 | 1.50 | 3.40 | 5.50 | 8.00 | 13.00 |

*Applies to test period and not to initial expansion phase

C. Pressure Testing:

The test pressure for the pipe shall be 1.5 times the Standard Pressure Class of the pipe material being tested, or 150 psi for water and reclaimed water, and 100 psi for wastewater, whichever is less.

D. Mandrel Testing:

Perform mandrel testing through the entire length of the installed pipe. The mandrel size shall be 90 percent of the inside diameter of the pipe

3.9 PRESSURE TESTING AND LEAKAGE

- A. Prior to pullback, perform an allowable leakage test on the full length of pipe after all sections have been welded or fused in accordance with ANSI/AWWA C600, latest revision and as described in Specification Section 33 05 05.31. A hydrostatic pressure test shall also be performed on the installed pipe in accordance with ANSI/AWWA C600, latest revision and as described in Specification Section 33 05 05.31.

3.10 CONNECTION TO ADJOINING PIPE

- A. Install flange connections from the directionally drilled pipe to adjacent pipe installed by open cut with support by backfill material as per Specification Section 31 23 33. Flange bolts shall be carefully tightened in increments, with a final torque value not exceeding the manufacturer's recommendations. Tightening torque increments shall not exceed 15 foot pounds.
- B. Polyethylene and flange gasket will undergo some compression set. Therefore, the flange bolts shall be retightened one hour after the initial assembly, and a second time at least four hours after the second tightening.
- C. HDPE pipe installed by directional drilling may also be connected to ductile iron pipe installed by open-cut by mechanical methods as shown in Figure 2 of AWWA C906. Under this option, a mechanical joint HDPE spigot sized to fit a ductile iron mechanical joint shall be fused to the end of the directionally drilled pipe. The HDPE mechanical joint spigot shall be provided with a polyethylene retaining ring to provide positive joint restraint when used with the gland ring of a ductile iron mechanical joint.

3.11 DISINFECTION

- A. The carrier pipe shall be disinfected as described in Specification Section 33 01 10.58 or as otherwise approved in advance by the Engineer.
- B. The carrier pipe can be filled with potable water, pressure tested and disinfected prior to insertion. Provide Engineer with full work plan to employ this alternative.

3.12 AS-BUILT RECORDS

- A. The MGS pullback data shall be recorded every pilot hole drill stem length during the actual crossing operation. The Contractor shall furnish "as-built" plan and profile drawings, on the same horizontal and vertical control datum shown on the contract documents, based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation.

END OF SECTION

SECTION 33 05 07.14
LARGE MAIN DIRECTIONAL DRILLING

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools and equipment as necessary to construct a pipeline crossing by the horizontal directional drilling method. Furnish all labor, equipment, materials and supplies and perform all work necessary to provide OWNER with a complete, finished water main crossing. The finished work includes proper installation testing, restoration of underground utilities and environmental protection and restoration.
- B. This specification is applicable for projects greater than 250 feet or for pipe size greater than 12 inch.

1.3 RELATED SECTIONS

Trenching, Backfilling & Compacting – Section 31 23 33

Piping - General Provisions - Section 33 01 10.50

Disinfection of Water Utility Piping Systems – Section 33 01 10.58

1.4 QUALITY ASSURANCE

- A. The Horizontal Directional Drilling (HDD) equipment operator(s) shall be trained to operate the specific HDD equipment for the Owner's project with at least 3 years' experience in directional drilling obtained within the last five years that includes installation of potable water pipelines of the same or larger diameter and the same or greater lengths. All pipe and appurtenances of similar type and material shall be furnished by a single manufacturer.
- B. Perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The Contractor's supervisor shall have supervised directional drilling of a minimum of 5,000 linear feet of pipe of a similar or greater diameter, of similar material, over similar lengths, and with similar subsurface conditions.
- C. The requirements set forth in this Specification specify a wide range of procedural precautions necessary to ensure that the basic, essential aspects of a proper Directional Bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this Specification.
- D. Perform the work in general conformance with ASTM Standard F1962, current revision, "Standard Guide for Use of Maxi-Horizontal Directional Drilling for

Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings.”

- E. Adhere to the specifications; any changes must be expressly approved by the Engineer. Approval of any aspect of any Directional Bore operation covered by this Specification shall in no way relieve the Contractor of its ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

1.5 PROFILES AND TOPOGRAPHY

- A. Contours, topography and profiles of the ground as may be shown on the Contract Drawings are believed to be reasonably correct, but are not guaranteed to be absolutely so and are presented only as an approximation. It is the Contractor's responsibility to verify all elevations required to successfully complete the crossing.

1.6 SUBMITTALS

- A. Prior to beginning work, submit to the Engineer copies of a report of schedules, calculations, procedures and any supplemental subsurface soil condition investigations performed along the path of the proposed crossing. The report will summarize the subsurface conditions that are known to the Contractor and that his proposed crossing procedure is based upon factual, best available information. If the subsurface conditions are known to the Contractor by previous work or geotechnical studies done in the immediate area, the information shall be recorded in the report along with any additional geotechnical studies performed by the Contractor. The report shall include the following:

1. Subsurface Information

- a. Record in the report subsurface conditions known to the Contractor by previous work or prior geotechnical studies performed in the immediate project area.
- b. Boring information obtained by the Owner, if any, is listed in the Supplementary Conditions section of these Specifications.
- c. Additional borings performed by the Contractor and analysis of soils along the path of the proposed crossing. The Contractor shall be responsible for obtaining and including in his bid price the cost of any additional borings along the pipe alignment which may be necessary to design the proposed directionally drilled crossing.
- d. At a minimum any supplemental borings performed by the Contractor shall include standard classification of soils, standard penetration tests, split spoon sampling and sieve analysis. Test borings shall be performed to a minimum depth of ten (10) feet below the proposed pipe invert unless rock is encountered in which case test borings shall penetrate at least two feet into rock.

2. Drilling Equipment and Methods

- a. Submit information on equipment and written procedure with working drawings describing in detail the proposed boring method and the entire operation to be used. This shall include, but not be limited to, entry and exit pits; settlement pit; size, capacity and arrangement of drilling and pulling equipment; layout of carrier pipe; details and spacing of pipe rollers; type of current head; method of monitoring and controlling line and grade; method of detection of surface movement; and layout of any proposed construction staging areas.

- b. In addition, submit for approval nameplate data for the drilling equipment, mobile spoils removal unit, and Material Safety Data Sheets (MSDS) information for the drilling slurry compounds. This must be submitted and reviewed by the Engineer before work can proceed.
 - c. Submit contingency plans for possible problems, including procedure for handling and correcting inadvertent mud returns or a frac-out.
3. Piping
- a. Submit shop drawings showing the pipe lengths, design details, joint details, etc. for the Engineer's review. Submittals shall include, but are not limited to, the following:
 - (1) All welding or fusion procedures to be used in fabrication of the different pipe materials and installation methods.
 - (2) Certified records for hydrostatic testing of all pipe materials to be used.
 - (3) An affidavit stating that all pipe materials furnished under this section have been manufactured in the United States of America and comply with all applicable provisions of referenced AWWA standards.
4. Proposed Alignment
- a. Submit a graph in plan and profile plotting the pilot drilling hole alignment to the Engineer for review, including entry/exit angles and radius of curvature. After completion of the crossing, submit a final pipe alignment.
5. Schedule
- a. Time schedule for completing the Directional Bore, including any delays due to anticipated soil conditions.
6. Calculations
- a. Submit detailed design calculations for several representative loading conditions for the proposed crossing. If requested by the Engineer, submit calculations to support the design of any particular location of pipe anywhere along the length of the crossing at no additional cost to the Owner.
 - b. Design calculations shall be presented in a neat, readable format, with all figures, values and units included to facilitate ease of verification.
 - c. Calculations shall be submitted to demonstrate that the pipe thickness design is sufficient to meet all design criteria specified.
 - d. Calculations shall address the following loading conditions:
 - (1) Pre-Installation:
Hoop and longitudinal stress during hydrostatic test; spanning stress with pipe full of water and supported on installation rollers, and maximum roller / support spacing.
 - (2) Installation/Post-Installation:
Longitudinal stress from pulling force; longitudinal curvature stress at point of entry and in final position; external pressure from drilling fluid, overburden, and loads from the obstacle being crossed.

(3) Post-Installation/In-Service:

Hoop and longitudinal stress during hydrostatic test; internal working and surge pressure; buckling with internal vacuum.

- e. Perform and submit to the Engineer fluids pressure versus overburden strength calculations. These calculations shall be performed to determine minimum acceptable cover requirements and prevent drilling fluids breakout to the ground surface.
- f. All calculations shall bear the seal of a Registered Professional Engineer. Licensure in the State that the work is performed is preferred.

B. Approval

- 1. No work shall commence without approval by the Engineer. Details and design calculations shall be submitted and approved well in advance of the drilling operation to prevent delays in work. All final layout work, including grades, shall be the Contractor's responsibility.

1.7 JOB CONDITIONS

- A. Any nighttime work is strictly regulated and will be allowed only with prior approval granted by the Owner subject to regulatory agencies having jurisdiction. All crossing operations shall be accomplished during daylight hours, unless approved by the Engineer. Crossing work shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours, unless approved by the engineer. The Contractor shall provide a Work Plan submittal indicating its proposed hours of operation and length of work week. All work plans shall be subject to compliance with all applicable regulatory requirements for construction activities and any off site impacts.
- B. When hazards of night time work are carefully considered and determined to be insignificant, night time work may be allowed only to complete a properly planned crossing, and only if in the opinion of the Engineer the delay was caused by reasonably unavoidable circumstances, and that such night time work is necessary to avoid placing an undue economic hardship on the Contractor.
- C. In emergency situations, or where delay would increase the likelihood of a failure, nighttime work may be allowed to complete a delayed crossing.
- D. All operations shall continue on a 24-hour per day basis during pipe pull back.

1.8 COORDINATION OF WORK

- A. Coordinate connections to existing pipelines that require shutdown of OWNER facilities. OWNER will designate the time for these connections that could involve work during evenings, nights, Saturdays, Sundays, or holidays. Method of connection and designated times are to cause the least amount of disruption to OWNER'S water service to its customers. The cost for connections is to be included in the contract price. No contract price adjustment will be allowed for overtime, premium time, or other related costs.

1.9 USE OF EXISTING WATER SYSTEMS

- A. All use of existing water systems during construction by the Contractor shall be with the approval and direction of the system Owner and its representatives. The Contractor shall be responsible for all permits, fees, temporary piping, temporary

meter rental/provisions, temporary backflow preventer rental/provision and other water utility requirements for supplying water during construction. The Contractor shall use the existing water system only at locations, times and conditions as set forth by the system owner or its representatives.

- B. If water is not readily available at the site or the Owner cannot provide the volume of flow required by the Contractor, provide potable water as needed from an off-site location at no additional cost to the Owner.

PART 2: PRODUCTS

- A. Unless otherwise specified in the Contract Documents, pipe installed by horizontal directional drilling shall either be high density polyethylene pipe (HDPE) or ductile iron pipe specifically designed for directional drilling. Unless otherwise specified in the Contract Documents, the water main pipe (carrier pipe) shall be installed without a casing pipe.

2.2 PIPE

A. POLYETHYLENE PIPE

1. High Density Polyethylene (HDPE) Pipe, AWWA C-906 compliant, NSF 61 Standard Listed, and furnished in fifty (50) foot lengths.
2. Polyethylene pipe shall be furnished with an outside diameter conforming to ductile iron pipe sizes. Minimum thickness of HDPE pipe shall be determined by the contractor's calculations, but shall not be considering in-service loading shall not be less than DR 11 when measured in accordance with ASTM D-2122.
3. All polyethylene pipe and fittings shall be made of a high-density polyethylene pipe compound with extra high molecular weight that meets the requirements for Type III, Grade P34 Polyethylene material as defined in ASTM D-1248, latest revision.
4. Pipes shall be jointed to one another and to polyethylene fittings by thermal butt-fusion or by socket fusion in accordance with ASTM D-3261.
5. Joining of pipe sections shall be performed in accordance with the procedures recommended by the pipe manufacturer. Joints between pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16-inch.
6. The tensile strength at yield of the butt-fusion joints shall not be less than the pipe. A specimen of pipe cut across the butt-fusion joint shall be tested in accordance with ASTM D-638.
7. Polyethylene pipe shall be joined to ductile iron pipe by the use of flange adapters and back-up rings. Flange adapters shall be butt fused to the polyethylene carrier pipe. The face of the flange adapter shall have a serrated sealing face to assist in holding the flange gasket in place. Flange gaskets shall be full-faced neoprene. Back-up rings shall be Class "D" steel ring flanges in accordance with AWWA C207. Flange bolts must span the entire width of the flange joint, and provide sufficient thread length to fully engage the nut.

B. DUCTILE IRON PIPE

1. Utilize ductile iron pipe equipped with low profile flexible restrained joints such as Flex Ring or TR Flex. Gripping push on joint gaskets, or restrained joint gaskets are not permitted.
2. All ductile iron pipe shall be installed per DIPRA's Horizontal Directional Drilling with Ductile Iron Pipe Handbook to include strict adherence to maximum joint deflection allowances.

C. THICKNESS DESIGN

1. The following design criteria shall be used in calculating pipe thickness for HDPE, steel, or ductile iron pipe:

| | |
|--------------------------|--|
| Working Pressure | As specified by Engineer |
| Test Pressure | As specified by Engineer |
| Surge Pressure | Working pressure + 100 psi |
| Dead Load | Earth cover as shown on Drawings, but not less than 15 feet. |
| Buckling Design | Considering dead load, internal vacuum, H-20 Wheel Loading and a hydrostatic load over top of pipe to grade. |
| Max. Allowable | 3% |
| Horizontal Deflection | |
| Radius of Curvature | 90% of Actual Design Radius |
| Downhole Friction Factor | 1.0 |
| Factor of Safety for | |
| Drilling Fluid Density | 1.5 |

2. The stresses in the pipe shall be calculated for the pre-installation, installation, and post installation loading conditions specified in Part 1 of this Specification Section. Thickness shall be selected so that stresses do not exceed the following under any of the loading conditions.

- All conditions except internal surge pressure 50% of minimum yield point

- Internal surge pressure condition 75% of minimum yield point

3. The contractor shall increase the minimum "in-service" thickness as necessary to support the expected stresses and loadings which are expected to be encountered during the installation of the HDD pipeline. The final selected thickness shall be supported by calculations as required herein. No additional cost shall be considered by the Owner for pipe thickness greater than the specified minimum "in-service" thickness.

D. DEVIATIONS

1. Should the Contractor choose to submit a bid using material that does not meet all the requirements of these specifications, include a description of the deviation with data showing the magnitude of the deviation. Acceptance of such deviations to these specifications shall be subject to the review and approval of the Owner before a contract can be awarded.

E. INSPECTION OF PIPE

1. All pipe and fittings used in the work may be factory inspected by a recognized agency engaged by the Owner. Inform the Owner and the inspection agency of the name and address of the manufacturing plant or other sources of materials to be used in the work and shall coordinate with the manufacturer to assure that the inspection agency has access at the manufacturer's plant and adequate assistance and notice so that each item may be examined. All reports will be made to the Owner and the cost of the services of the inspection agency will be borne by the Owner. Such inspection by the Owner shall not relieve the Contractor of his responsibility to furnish materials in accordance with the applicable standards.

2.3 EQUIPMENT

- A. General: All equipment for the Directional Bore shall have the capacity, stability, and necessary safety features required to fully comply with the specifications and requirements of this section without showing evidence of undue stress or failure. It shall be the responsibility of the Contractor to assure that the equipment to be used in the Directional Bore is in sound operating condition. Backup equipment shall be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the Directional Bore.
- B. Directional Drilling System: The directional drilling system shall consist of over the road transportable field power unit, mud-mixing and recycling unit, a trailer or carriage-mounted drill unit, and all other support accessory vehicles and equipment. All system components shall be in sound operating condition with no broken welds, excessively worn parts, badly bent, or otherwise misaligned components. All drill pipe, reamers, pull back heads, swivels, drill heads and collars, pipe cradles, pipe rollers, ropes, cables, clamps, and other non-mechanical but essential items shall be in sound condition and replaced immediately when need is apparent. The equipment must be capable of drilling the specified length in a single bore.
 1. Mud-Mixing and Recycle Units: The mud-mixing and recycle unit shall be a self-contained system designed to provide a supply of high-pressure Bentonite based cutting fluid to the drill unit. It shall contain a fluid storage tank and a complete Bentonite and drilling fluid additive(s) mixing system. The cutting fluid is to be mixed on site. The cutting fluid shall be formulated for this specific project and anticipated conditions. It shall permit changes to be made to the Bentonite and drilling fluid additive(s) concentrations during drilling in response to changing soil conditions. The field power unit shall contain the power-taken off-driven high pressure cutting fluid pumping system. The recycle units shall be of a capacity to minimize the production of new cutting fluid and maximize the reuse and recirculation of original cutting fluid produced.

2. Directional Drill System: A carriage-mounted version of the drill system shall include a thrust frame. Both the trailer-mounted and carriage-mounted drill system shall be designed to rotate and push 10-foot (3-meter) minimum hollow drill sections into the tunnel being created by the boring head. The drill sections shall be made of a high strength S-grade steel that permits them to bend to a 30-foot (9-meter) radius without yielding. Drill end fittings shall permit rapid makeup of the drill sections while meeting the torque, pressure and lineal load requirements of the system. The boring head itself shall be capable of housing a probe used by the Magnetic Guidance System (MGS) to determine tool depth and location from surface and to orient the head for steering. The MGS shall have a minimum accuracy of plus (+) or minus (-) two (2) percent of the vertical depth.
 3. The drilling equipment must be fitted with a permanent alarm system capable of detecting an electric current. The system will have an audible alarm to warn the operator when the drill head nears electrified cables. The drilling equipment shall be grounded, protected, and operated in accordance with manufacturer's requirements for electric strike safety.
 4. The control console shall contain a calibrated display of inclination, azimuth, tool face location, mud pump rates, and torque pressures. The downhole steering system accuracy shall be plus or minus one percent ($\pm 1.0\%$) of the horizontal bore length such that the difference between actual depth and machine calculated depth is not more than 1 foot per hundred feet.
 5. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the pipe placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular condition of the project. Water sluicing methods, jetting with compressed air, or boring or tunneling devices with vibrating type heads that do not provide positive control of the line and grade shall not be allowed.
- C. Spoils Equipment: The cutting fluid removal system shall include a self-contained vacuum truck which has sufficient vacuum and tank capacity to remove excess cutting fluid mixture and cuttings from the project site as required or directed by the Engineer. Spoils are not to be discharged into sewers or storm drains.
- D. The Contractor will contain all drilling and pipe lubricating mud by taking special measures to prevent run-off into adjacent properties and/or waterways. All surplus drilling and pipe lubricating mud will be removed from the site and properly disposed of by the Contractor. The Contractor will also be responsible for all required erosion control measures.
- E. Magnetic Guidance System: A Magnetic Guidance System (MGS) probe and location of the drill head during the drilling operation. The tracker shall be capable of tracking at all depths up to one hundred feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The tracker shall be accurate to $\pm 2\%$ of the vertical depth of the borehole at sensing position at depths up to one hundred feet. Ferrous materials shall not influence or affect the MGS readings or accuracy.

- F. Components: The Contractor shall supply all components and materials to install, operate, and maintain the MGS. This shall include, but not be limited to the following:
 - 1. MGS Probe and Interface
 - 2. Computer, Printer, and Software
 - 3. DC Power Source, Current Control Box, and Coil/Tracking Wire.
- G. The Magnetic Guidance System (MGS) shall be a Tensor TruTracker MGS, or other licensed and industry approved wire guidance system. The Engineer shall be advised of the unit to be used and is subject to his approval. Set up and operate the MGS using personnel experienced with this system. A "Walk-over" tracking systems shall not be used, except as approved by the Engineer. Contractor shall provide Engineer with current calibration certification of MGS in accordance with manufacturer's specifications.
- H. If equipment breakdown or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the boring path shall be filled with a proper Bentonite solution immediately, or as directed by the Engineer.
- I. The boring tool shall have steering capability and have an electronic tool detection system. The position of the tool during operation shall be capable of being determined accurately, horizontally within 1% of the horizontal distance of the borehole and vertically within 2% of the vertical depths of the borehole. The boring tool shall have a nominal steering radius of 9 meters (30 feet).
- J. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.
- K. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations. The rig shall be grounded during drilling and pullback operations. There shall be a system to detect electrical current from the drilling string and an audible alarm that automatically sounds when an electrical current is detected.

L.

2.4 DRILLING FLUIDS

- A. A mixture of Bentonite drilling clay, project specific cutting fluid additives, and potable water is to be used as the cutting fluid (MUD) and over ream hole filler for the Directional Bore. The drilling fluid mixture used shall have the following minimum viscosities as measured by a March Funnel:

| | |
|------------|---------|
| Rock Clay | 60 sec. |
| Hard Clay | 40 sec. |
| Soft Clay | 45 sec. |
| Sandy Clay | 90 sec. |

| | |
|-------------|----------|
| Stable Sand | 120 sec. |
| Loose Sand | 150 sec. |
| Wet Sand | 150 sec. |

- B. These viscosities may be varied to best fit the soil conditions encountered as recommended by the drilling mud and fluid additive manufacturer, and as approved by the Engineer.
- C. Where sandy or granular materials are encountered, a cement slurry or polymer supplement shall be considered for added strength and stability of the bore and over ream hole.
- D. No chemicals or polymer surfactant shall be used in the drilling fluid without written consent of the Engineer, and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe. Clay must be totally inert and contain no risk to the environment.
- E. Provide Owner, Engineer and have on site at all times the Material Safety Data Sheets (MSDS) for all drilling compounds and chemicals.

2.5 TRACER WIRE

- A. When HDPE pipe is used, tracer or location wire shall be a direct burial #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil. High molecular weight-high density blue polyethylene jacket complying with ASTM D1248, 30 volt rating. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack model No. 054007-09053. Wire insulation shall be highly resistant to alkalis, acid and other destructive agents found in soil. Location Wire shall be from Copperhead Industries, LLC, part number 1230B-HS or approved equal
- B. Tracer wire shall be installed simultaneously with pullback of the HDPE pipe. Wire shall either be wrapped around the pipe or taped to the pipe at 10 foot minimum intervals before installation.
- C. Tracer wire to be terminated at each end of the crossing within a valve box.

PART 3: EXECUTION

3.1 SITE DISTURBANCE AND SOIL EROSION

- A. Sediment barriers shall be constructed as shown on the Drawings or where directed by the Engineer. All soil erosion and sediment control work shall be done in accordance with the Standards for Soil Erosion and Sediment Control for the location where the work is performed. Contractor shall maintain sediment barriers until the project is deemed complete.
- B. The Contractor shall be responsible for the preservation of all existing trees, plants, and other vegetation that are to remain within or adjacent to the construction site and shall also be responsible for protecting existing concrete curb, fence, utilities, and other structures that are located within or adjacent to the construction site.

- C. The Contractor assumes all liability for environmental damage and cleanup due to inadvertent discharges of slurry or other causes. Slurry materials shall be selected based on the soil conditions encountered to minimize the risk of mud returns.

3.2 PERSONNEL REQUIREMENTS

- A. Provide a competent and experienced supervisor representing the Drilling Contractor who must be present at all times during actual operations. A responsible representative, who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual Directional Pilot Hole, over reaming and pullback operations.
- B. Have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual Directional Bore operation must be on the job site at the beginning of work.
- C. If HDPE is specified for the carrier pipe, HDPE pipe thermal butt fusion welding is to be completed by a welder certified by the manufacturer of the pipe or pipe welding equipment, in accordance with the Plastic Pipe Institute "Handbook of Polyethylene Pipe," Polyethylene Joining Procedures, and 49 CFR 192, Subpart F, latest edition.
- D. If steel pipe is specified for the carrier or casing pipe, welding shall be performed by certified welders. The CONTRACTOR shall be responsible for the qualification of welders with qualification testing conducted by an independent testing agency in accordance with American Welding Society D1.1 requirements. Results of qualification testing shall be submitted to the ENGINEER for approval. Results of previous qualification tests performed within six months from the date of pipe installation will be acceptable. Results from qualification tests performed prior to six months from the date of pipe installation will not be acceptable. All costs associated with qualification testing shall be included in the unit prices bid.
- E. The Engineer and Owner must be notified 48 hours in advance of starting each phase of the work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of Owner to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.
- F. If the Contractor fails to begin the Directional Bore at the agreed time, the Owner will establish the next mutually convenient time to begin. To avoid undue hardship of either party, reasonable and mutual cooperation should be exercised where starting times are concerned. If one party fails to meet the agreed schedule, the other party is expected to consider a delayed start if the installation cannot be completed during daylight hours.

3.3 WORK PLAN

- A. Prior to beginning WORK, submit a WORK plan to UTILITIES detailing the procedure and schedule to be used to execute the project. The WORK plan should include the following.

1. A description of all equipment to be used;
 2. Down-hole tools;
 3. A list of personnel and their qualifications and experience;
 4. List of SUBCONTRACTORS;
 5. A schedule WORK activity;
 6. A safety plan, traffic control plan (if applicable);
 7. An environmental protection plan and;
 8. Contingency PLANS for possible problems.
- B. WORK plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the requirements to complete the project
- C. Equipment:
1. Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to the following:
 - a. Drilling rig;
 - b. Mud system;
 - c. Mud motors (if applicable);
 - d. Down-hole tools;
 - e. Guidance system and;
 - f. Rig safety systems.
 2. Submit calibration records for guidance equipment for any drilling fluid additives that will or might be use.

3.4 COORDINATION OF THE WORK

- A. Notify UTILITIES at least three days in advance of starting WORK. In addition, the actual crossing operation shall not begin until UTILITIES is present at the project site and agrees that proper preparations for the crossing have been made. UTILITIES' approval for beginning the crossing shall in no way relieve the CONTRACTOR from the ultimate responsibility for the completion of the WORK.
- B. Coordinate with utilities to select a mutually convenient time for the crossing operation to begin in order to avoid schedule conflicts.

3.5 PROCEDURE

- A. The installation of appropriate safety and warning devices in accordance with the USDOT "Manual of Uniform Traffic Control Devices" (MUTCD) shall be completed prior to beginning WORK and maintained until all construction is completed and the site restored.
- B. The Contractor shall be responsible for providing a Maintenance of Traffic Plan to the Engineer and local traffic law enforcement agency for review. The Maintenance of Traffic Plan shall show the location of all barricades, signs, devices and alternate routes for local traffic and pedestrian safety.

- C. Specifically note in the Maintenance of Traffic Plan street intersections that are to remain open as required during the pipe pull-back operation, or traffic detours implemented. Install a temporary sleeve across the street intersections through which the pipe can be pulled or to construct a temporary bridge for the pipe over the intersections as required. No additional payment will be made for temporary structures required in order to permit access through street intersections or the implementation of traffic detours.
- D. The cost of restoring pavement, curb, sidewalk, driveways, lawns, storm drains, etc., and other landscaped facilities shall be borne by the Contractor unless otherwise noted.

3.6 ALIGNMENT AND GRADE

- A. Determine and physically locate the depth, location, and size of all existing underground facilities in the vicinity of the proposed crossings and provide the ENGINEER with a comprehensive report of these facilities before starting any construction. The Contractor shall be held completely and solely responsible for any damages incurred. The kinds, locations and sizes of the existing underground utilities which may be shown on the Contract Drawings are intended only as a guide to the Contractor and are not guaranteed to be even approximately correct. Notify the owners of all existing utilities along the route and in the vicinity of the crossing prior to the construction to include all test borings and excavations.
- B. If utilities of unknown depth or other obstructions require grade or alignment deviations from the Plans, the grade and/or alignment may be adjusted with Engineer's approval. All adjustments shall permit gradual bends of the pipe to the original alignment beyond the directional bore section. At unusual site conditions, the Contractor may request a review of site conditions by the Engineer for additional adjustment, and such determination shall be final. An adjustment in alignment, position, or elevation approved by Engineer shall not be cause for an adjustment of costs.
- C. Pipe entry and exit points are to be allowed no more than five (5) feet of deviation from the staked centerline. The entry point may be moved up to twenty-five (25) feet further from the original entry point only with Engineer's approval. Exit point lengths greater than twenty-five (25) feet from the original point require Engineer's approval. Entry and exit points normally will not be allowed closer to the banks of a waterway being crossed. Any installation that deviates from the plan may be rejected and any rejected installation shall be reconstructed at the Contractor's expense.
- D. The vertical profile as shown on the drawings is the minimum depth to which the pipeline shall be installed. Contractor may, at his option and with the permission of Owner, elect to install the pipe at a greater depth than shown on the drawings, at no additional cost to the Owner.

3.7 INSTALLATION:

- A. The following is a general outline of steps for the Directional Bore operation:
 - 1. Clear the right-of-way and temporary work space as shown on the drawings. Contractor to install and maintain all soil erosion and sediment control devices, until project completion with approved permanent site stabilization.

2. Lay out the pipe crossing alignment using a qualified land survey team to confirm accurate horizontal distances, either physically measured or shot by Electric Distance Measurement. Entry and exit points shall be located and marked with survey hubs or markers. Payment for survey mark-out shall be included in the price bid under horizontal directional drilling.
3. Haul, string, and assemble restrained pipe. Joint air test the section prior to installation and hydrostatically test the assembled pipeline section, unless otherwise approved by Engineer. If sufficient linear footage of lay down area for the pipe string is not available, the finished pipeline may be assembled in no more than two sections, with each section joint air tested separately and hydrostatically tested when fully assembled as one piece. The CONTRACTOR will be responsible for ensuring that the drill rig has adequate pullback capacity to overcome the increased frictional resistance resulting from the stoppage of pipe pullback to perform the final weld or fusion of pipe sections. Provide adequate site security and shall be responsible for the integrity of the pipe until after the pullback, final test of the pipeline, and acceptance of the work by the Owner.
4. All assembled pipe sections shall be securely plugged at the end of each work day. The pipe interior is to be protected at all times against dirt, dust, drilling mud, pipe cuttings, debris, animal access, and other sources of contamination.
5. Provide adequate support rollers for the pipeline during pullback of the pipe string into the pre-drilled hole. The rollers and cradles shall be of a type that will prevent damage to the pipe and will be of sufficient number, as recommended by pipe manufacturer, to prevent over stressing due to sag bends during the pullback procedure. The pipe shall be supported at all times, including pullback, to maintain a free stress arc which limits pipe bending and internal hoop stresses to within manufacturer's limits.
6. Pipe which is not properly protected and supported and shows indications of excessive stressing, gouges, cuts, abrasions or other damage which may affect the operational performance intended for the pipe, as recommended by pipe manufacturer, shall be removed from the site and replaced at no additional cost as directed by the Owner or Engineer.
7. Mobilize the drilling equipment, erect the rig, drill a pilot hole, enlarge the hole as necessary to a minimum diameter of 1.5 times the nominal diameter of the pipe, and pullback the prefabricated pipe string under the crossing.
8. Prior to beginning the Pilot Hole over reaming, furnish to the Engineer with an as-built plan and profile of the actual crossing to confirm the installation is in compliance with the Contract Documents. Pilot hole alignment shall be accepted by Owner in writing prior to reaming and pipe installation.
9. The Contractor shall be responsible for selecting the reaming process to be utilized, whether forward and/or back reaming will be undertaken, and the number of reaming passes to be made.
10. Supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction and slurry material displaced by the pipe during installation. Mud pits are to be protected at all times against unauthorized access and be stabilized at all times against surface water runoff and containment berm failure. Pump, haul and dispose of any drill cuttings and excess drill fluids to a

receiving site permitted to accept the spoils, all in a manner consistent with the local and state regulations at no additional cost to the Owner.

11. Pull back the bore pipe in one continuous section and contractor using a swivel to minimize the rotation of the product pipe during pullback. Swivel shall utilize lubricated internal bearings which are fully protected from external contamination and over lubrication. Demonstrate the swivel operation prior to pullback to the Engineer prior to the operation.
 12. Use potable water and disinfect all piping and hoses used for water addition to the carrier pipe to counter the pipe flotation during pullback.
 13. During pullback, maintain records for submission to Owner indicating job, date, time, constant pipe footage progress, mud flow rates, pulling forces required and torque readings. Document the pull head location for each length of drill stem pipe for as build records.
 14. Unless not permitted by the right of way owner, inject a low strength cement slurry into the bore hole for approximately 50 feet at each end of the drilled pipeline. Where cement slurry cannot be used, provide restraint at either end of the pipeline outside the bore to hold the pipe in place. The type of restraint shall be submitted to the Engineer in advance of the work and must be approved by the Engineer prior to the start of construction.
 15. Owner and Engineer shall have access at all times to any measuring or gauging devices used for the horizontal drill as well as any drilling logs maintained by the Contractor.
 16. In the event that the Contractor must abandon the drill hole before completion of the crossing, the Contractor will seal the borehole with neat cement grout starting at the low point or end of the drill hole and redrill the crossing at no extra cost to Owner.
- B. Erosion and sedimentation control measures and on-site containers shall be installed to prevent drilling mud from spilling out of entry and/or exit pits. Drilling mud will be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions. No other chemicals or polymer surfactant shall be used in the drilling fluid without written consent of UTILITIES and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe.

- C. Pilot Hole:
- D. Pilot hole shall be drilled on bore path with no deviations greater than two percent of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than two percent of depth in 100 feet, the CONTRACTOR will notify ENGINEER. The ENGINEER may require the CONTRACTOR to pull-back and redrill from the location along bore path before the deviation.
- E. Reaming:
- F. Upon successful completion of pilot hole, ream borehole to a minimum of 25 percent greater than outside diameter of pipe using the appropriate tools. Do not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- G. Pullback:
- H. After successfully reaming borehole to the required diameter, put the pipe through the borehole. In front of the pipe will be a swivel and barrel reamer to compact bore hole walls. Once pullback operations have commenced, operations must continue without interruption until pipe is completely pulled into borehole. During pullback operations, do not apply more than the maximum safe pipe pull pressure at any time. A break away head rated at the maximum safe pull pressure shall be utilized.
- I. As-built variance from the designed bore path shall not exceed plus or minus one foot in the vertical plane and plus or minus two feet in the horizontal plane. Submit any proposed deviations from the design bore path with SHOP DRAWINGS.
- J. The pipe entry area shall be graded to provide support for the pipe to allow free movement into the borehole. The pipe shall be guided in the borehole to avoid deformation of, or damage to, the pipe.
- K. If unexpected subsurface conditions are encountered during the bore, the procedure shall be stopped. The installation shall not continue until the OWNER and ENGINEER have been consulted.
- L. The pipe shall be pulled back through the borehole using the wet insertion construction technique. The pipe shall be installed full of water.
- M. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, movement or distortion of surface features.
- N. A boring log shall be kept with horizontal and vertical location every 25 feet.

3.8 PRESSURE TESTING AND LEAKAGE

- A. Prior to pullback, perform an allowable leakage test on the full length of pipe after all sections have been welded or fused in accordance with ANSI/AWWA C600, latest revision and as described in Specification Section 33 05 05.31. A hydrostatic pressure test shall also be performed on the installed pipe in accordance with ANSI/AWWA C600, latest revision and as described in Specification Section 33 05 05.31.

3.9 CONNECTION TO ADJOINING PIPE

- A. Install flange connections from the directionally drilled pipe to adjacent pipe installed by open cut with support by backfill material as per Specification Section 31 23 33. Flange bolts shall be carefully tightened in increments, with a final torque value not

exceeding the manufacturer's recommendations. Tightening torque increments shall not exceed 15 foot pounds.

- B. Polyethylene and flange gasket will undergo some compression set. Therefore, the flange bolts shall be retightened one hour after the initial assembly, and a second time at least four hours after the second tightening.

3.10 DISINFECTION

- A. The carrier pipe shall be disinfected as described in Specification Section 33 01 10.58 or as otherwise approved in advance by the Engineer.
- B. The carrier pipe can be filled with potable water, pressure tested and disinfected prior to insertion. Provide Engineer with full work plan to employ this alternative.

3.11 AS-BUILT RECORDS

- A. The MGS pullback data shall be recorded every pilot hole drill stem length during the actual crossing operation. The Contractor shall furnish "as-built" plan and profile drawings, on the same horizontal and vertical control datum shown on the contract documents, based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation.

END OF SECTION

SECTION 33 05 07.24

CASING PIPING FOR UTILITY JACKING

PART 1: GENERAL

1.1 SCOPE

- A. Casing Pipe design requirements, acceptable manufacturers, field preparation and installation procedures.

1.2 GENERAL REQUIREMENTS

- A. The design, sourcing, and installation of casing pipe shall conform to these Specifications and any Federal, State or local Highway requirements or applicable Railroad requirements whichever may be more restrictive.

1.3 SUBMITTALS

Submit the following to Engineer for approval:

- A. Shop drawings for casing pipe and appurtenances.
- B. Details of proposed jacking or boring pits, showing locations, dimensions, and details of sheeting and shoring required, if requested.

1.4 RELATED WORK

- A. Section 31 23 33 - Trenching, Backfilling and Compacting.
- B. Section 33 05 07.13 - Small Main Directional Drilling.
- C. Section 33 05 07.14 - Large Main Directional Drilling.

1.5 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

PART 2: PRODUCTS

2.1 CASING PIPE

- A. Casing pipe shall be bare wall steel pipe with a minimum yield strength of 35,000 psi and a minimum wall thickness as listed below:

| Casing Outside Diameter <u>Inches</u> | Highway Crossings Casing Wall Thickness <u>Inches</u> | Railroad Crossings Casing Wall Thickness <u>Inches</u> |
|--|---|--|
| 8.625 | 0.250 | 0.250 |
| 10.75 | 0.250 | 0.250 |
| 12.75 | 0.250 | 0.250 |
| 14 | 0.250 | 0.281 |
| 16 | 0.250 | 0.281 |

| | | |
|----|-------|-------|
| 18 | 0.250 | 0.312 |
| 20 | 0.312 | 0.344 |
| 24 | 0.312 | 0.406 |
| 30 | 0.375 | 0.469 |
| 36 | 0.500 | 0.532 |
| 42 | 0.500 | 0.563 |
| 48 | 0.625 | 0.625 |
| 54 | 0.625 | 0.688 |
| 60 | 0.625 | 0.750 |
| 66 | 0.625 | 0.813 |
| 72 | 0.750 | 0.875 |

- B. Smooth wall steel plates with a nominal diameter of over 54 inches shall not be permitted.
- C. The inside diameter of the casing pipe shall be: at least four (4) inches greater than the outside diameter of the carrier pipe joints or couplings for carrier pipe less than six (6) inches in diameter; and at least six (6) inches greater than the outside diameter of the carrier pipe joints or couplings for carrier pipe six (6) inches and greater in diameter.

2.2 CASING INSULATORS

- A. The carrier pipe and casing shall be separated by an insulator. The insulator spacing shall be installed to support the weight of the pipe and contents. As a minimum, an insulator shall be placed a maximum of 3 foot from each side of a joint and evenly spaced along the carrier pipe with 3 insulators per each length of carrier pipe. Timber skids are not allowed. Casing insulators shall be sized according to the manufacturer's specifications for pipe sizes from the following list of approved manufacturers and casing types.
 1. Cascade Water Works Manufacturing Company (Stainless Steel only).
 2. Pipeline Seal and Insulator, Inc. (Carbon Steel with polyvinyl chloride or the Ranger II model).
 3. Advanced Products and Systems, Inc. (Model SI).
 4. Power Seal Pipeline Products Corp. (Model 4810).
 5. RACI (polyethylene model F-60 for 12-inch carrier pipe and smaller). RACI shall not be used for carrier pipe larger than 12-inch.
- B. At the sole discretion of the Engineer, alternate manufacturers in lieu of those described above and new or improved products by the same manufacturers may be permitted. To seek approval, adequately describe any proposed alternate product and submit the same with shop drawings and specifications to the Engineer. The Contractor cannot proceed to employ said alternate products prior to receiving written approval from the Engineer.

PART 3: EXECUTION

3.1 ALIGNMENT AND GRADE

- A. Locate pipelines to cross roadways or tracks at approximately right angles where practicable, but preferably at not less than 45 degrees. Do not place pipelines in culverts or under bridges where there is a likelihood of their restricting the area required for the purposes for which the bridges or culverts were built, or of endangering the foundations. Install the casing pipe on an even grade for its entire length and sloped to one end or as noted in a profile plan if provided. Satisfy a maximum tolerance of 1.5% (18" in one hundred feet) with the desired location of the casing or as otherwise required by regulation or specified on the plans, whichever is more restrictive.

3.2 WELDING

- A. Connect steel casing sections by welding. Welding shall conform to AWWA Standard C206.

3.3 PROTECTION AT ENDS OF CASING

- A. Block up both ends of casings in such a way as to prevent the entrance of foreign material, but to allow leakage to pass in the event of a carrier break.

3.4 DEPTH OF INSTALLATION

- A. Unless the depth of casing pipe is specifically specified on the drawings, the casing pipe depth shall be in accordance with highway or railroad requirements.

3.5 CASING INSULATORS

- A. The carrier pipe and casing shall be separated by an insulator. The insulator spacing shall be installed to support the weight of the pipe and contents. As a minimum, an insulator shall be placed a maximum of 3 foot from each side of a joint and evenly spaced along the carrier pipe with 3 insulators per each length of carrier pipe. Timber skids are not allowed.

3.6 INSTALLATION

- A. Refer to Standard Detail SD45 at the end of this Specification Section for a typical casing installation detail.
- B. Install casing pipes by one of the following methods:
 - 1. Jacking
 - a. This method shall be in accordance with the current American Railway Engineering Association Specifications, Chapter 1, Part 4, "Jacking Culvert Pipe Through Fills", except that steel pipe shall be used with welded joints. Conduct this operation without hand mining ahead of the pipe and without the use of any type of boring, auguring or drilling equipment.
 - b. Design the bracing, backstops, and jacks so that the jacking can progress without stoppage (except for adding lengths of pipe).
 - 2. Drilling
 - a. This method employs the use of an oil field type rock roller bit, or a plate bit made up of individual roller cutter units, welded to the pipe casing being

installed. Turn the pipe for its entire length from the drilling machine to the head to give the bit the necessary cutting action against the ground being drilled. Inject high density slurry (oil field drilling mud) through a supply line to the head to act as a cutter lubricant. Inject this slurry at the rear of the cutter units to prevent any jetting action ahead of the pipe. Advance the drilling machine on a set of steel rails (thus advancing the pipe) by a set of hydraulic jacks. The method can be used to drill earth or rock.

3. Boring

- a. This method consists of pushing the pipe into the fill with a boring auger rotating within the pipe to remove the soil. When augers or similar devices are used for pipe placement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.
- b. If an obstruction is encountered during installation that stops the forward action of the pipe, and if it becomes evident that it is impossible to advance the pipe, operations will cease, and the pipe shall be abandoned in place and filled completely with grout.
- c. Bored or jacked installations shall have a bore hole essentially the same as the outside diameter of the pipe. Grout any voids that develop. Also grout around the casing pipe when the bore hole diameter is greater than the outside diameter of the pipe by more than 1 inch.

4. Directional Drilling – see Specifications 33 05 07.13 and 33 05 07.14:

- a. This process employs a drilling bit that is guided through soil to create a round cavity, which will stay intact with suitable soils and conditions for at least several days. Consequently, soil testing may be required by the Engineer. Test hole and ream as required. The drill head is propelled and remains linked to the rig by adding segments of rod as the head proceeds forward. After the hole has been completed the drill bit is removed and a pulling adaptor is attached to the drilling stem and pipe is secured to the adaptor.
- b. As the adaptor is pulled back to the rig, segments of drill rod are removed. Pipe is either a continuous fused material or segments of restrained pipe are added as the adaptor is pulled back to the rig. The selection of pipe material and restraints, if required must be approved by the Engineer. The process continues until the adaptor returns to the rig and all of the water main is in place.
- c. This process may be employed only if approved by Engineer and governing transportation and or regulating authority). The drilled opening and pipe inserted cannot be less than 3 inches in tolerance. Circulate grout in annular space completely. Alignment and grade must be maintained and the drilled hole must be controllable using steering technology. Use radio equipment to track. Provide report of depth and location at 20 foot intervals during installation and submit as a report.

END OF SECTION

SECTION 33 05 09.01
PIPING SPECIALS FOR UTILITIES (OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. See Specification Section 33 01 10.50 - Piping - General Provisions. See Detail Drawings included in the Contract Documents for installation details for piping specialties.

PART 2: PRODUCTS

Materials to be furnished by the Owner are included in the Special Conditions.

2.1 MATERIALS FURNISHED BY THE OWNER

- A. Owner will furnish and Contractor shall install the piping specialties included in the Specifications Special Conditions. Piping specialties in general may include:
 - 1. Polyethylene encasement
 - 2. Valve boxes
 - 3. Gate valves and butterfly valves (see also specifications 40 05 61.01 and 40 05 64.16.01 respectively)
 - 4. Tapping valves and tapping sleeves (see also specification 33 05 09.43.01)
 - 5. Air release valves (see also specification 33 14 19.01)
 - 6. Air blow off (see also specification 33 14 19.01)
 - 7. Corporation and curb stops
 - 8. Test/tracer wire boxes
 - 9. Water line, valve, blowoff marker posts

PART 3: EXECUTION

3.1 INSTALLATION

Install "piping specialties" in accordance with the general provisions provided in Specification Section 33 01 10.50 and the following:

- A. Polyethylene Encasement
 - 1. Encase piping in polyethylene as required to prevent contact with surrounding backfill and bedding material in all areas shown on the plans or designated by the Engineer. Polyethylene shall be 12 mils.

2. Install the polyethylene wrap material in accordance with AWWA Standard C105. Polyethylene shall fit snugly and not tightly stretched. All holes or tears shall be repaired with tape approved for this purpose. Large holes or tears shall be repaired by taping another piece of polyethylene over the hole. Tape or plastic tie straps at joint overlaps and at every 3 foot interval.
3. Dig bell holes and slide polywrap over the adjacent pipe and provide a minimum of 1 foot of overlap. Tightly secure bottom of polywrap using two to three passes of polyethylene tape on the pipe to polywrap connection and the overlap polywrap to polywrap connection.
4. Where polyethylene wrapped pipe being installed connects to a pipe that is not wrapped (including existing pipe), extend the wrap a minimum of 3 feet onto the previously uncovered pipe. This includes service lines which may be wrapped in polyethylene or dielectric tape.
5. Exposure of wrapped pipe to sunlight should be kept to a minimum. Pipe can be stored with the polywrap on the pipe for a maximum of 14 days.
6. At no time shall the polywrapped pipe be subjected to a point load during handling, temporary storage, or installation. The polywrap must be moved away from the timbers or hoisting device while on the pipe to prevent point loads and resulting pin holes.
7. Direct service taps for polyethylene encased pipe shall follow the procedure described in AWWA Standard C600. Access to the main for tapping through polyethylene is accomplished by making two to three passes of polyethylene tape around the pipe and over the polywrap. The tap is to be made directly through the tape and polywrap.
8. Tape shall be polyethylene compatible adhesive and a minimum of 1.5" wide. Acceptable manufacturers are: Scotchwrap #50, Fulton #355, or Polyken #900.

B. Valve Boxes

Valve boxes shall be supported so that no load can be transmitted from the valve box to the valve. See Detail Drawing SD59. Install a self-centering alignment ring at the operating nut American Flow Control, or equal or otherwise make sure that the bottom of the box is centered over the operating and runs perpendicular to the horizontal.

1. Butterfly Valves and Gate Valves

Install the valves in strict accordance with the requirements of Specification Section 33 01 10.50. Set valves at the required locations with joints centered, spigots home and valve stems plumb unless otherwise directed by the Engineer.

2. Tapping Sleeves and Valves

Install the valves in strict accordance with the requirements of Specification Section 33 01 10.50. After installation of the tapping sleeve and valve assembly but prior to making the tap the assembly shall be pressure tested hydrostatically in accordance with Specification Section 33 05 05.31. The test shall be made with the valve open using a tapped mechanical joint cap. No leakage is acceptable. The test pressure shall be maintained for 15 minutes minimum.

C. Air Release Valve Assemblies

See Detail Drawings for a typical air release valve assembly.

D. Air Blow-off

See Detail Drawings for air blow-off details.

E. Corporations and Curb Stops

Service line piping shall be compatible with corporation and curbs stops provided with appropriate protection between dissimilar materials and a minimum of interconnecting fittings

F. Test/Tracer Wire Boxes

Boxes shall be placed at areas designated on the plans and shall be flush with existing grade unless otherwise noted.

G. Marker Posts

Install Marker Posts using equipment designed for its installation per manufacturer guidelines and place at locations noted on the drawings.

END OF SECTION

SECTION 33 05 09.43.01
TAPPING SLEEVES, SADDLES & VALVES FOR UTILITY PIPING
(OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Install all tapping sleeves, tapping valves, and tapping saddles as shown on the Drawings.

1.3 RELATED WORK

- A. Specification Section 33 01 10.50 - Piping - General Provisions

PART 2: PRODUCTS

Tapping sleeves, saddles and tapping valve material shall be furnished by the Owner for installation by the Contractor.

2.1 GENERAL

- A. All tapping sleeves, saddles and valves shall be designed for a working pressure of at least 250 psig for 12-inch and smaller. The valves shall be designed for a minimum differential pressure of 250 psi and a minimum internal test pressure of 500 psi unless otherwise noted on the plans.

2.2 DUCTILE IRON TAPPING SLEEVES

- A. Verify the type of existing pipe and the outside diameter of the pipe on which the tapping sleeve is to be installed. Tapping sleeves provided shall be ductile iron dual compression type unless otherwise specified on the Drawings. The Drawings may require the use of corrosion resistant tapping sleeves in addition to polywrap in areas with corrosive soils. The sleeves shall be made in two halves which can be assembled and bolted around the main. Sleeves shall meet the requirements of NSF 61. Outlet flanges shall conform to the flange requirements of AWWA C110.

2.3 TAPPING VALVES

- A. The horizontal tapping valve shall conform to the applicable requirements of AWWA Standard C509. All tapping valves, 3 inches through 12 inches NPS, shall be ductile iron body, resilient-seated, nut-operated, non-rising stem gate valves suitable for buried service. The tapping valves shall have flanged inlets with mechanical joint outlets, enclosed bevel gears, bypass valve, rollers, tracks and scrapers. All valves provided shall open (left or right) in accordance with the Owner's standard.

2.4 STAINLESS STEEL TAPPING SLEEVES

The stainless-steel band flange shall be manufactured in compliance with AWWA C207, Class D ANSI B.16.1 drilling, recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94 and be NSF 61 approved.

A. Tapping Sleeves from 4" to 12"

Tapping sleeves to be attached to 4" through 12" nominal pipe diameter shall meet the following minimum requirements.

1. The gasket shall provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under the combinations of joint and gasket tolerances. The materials used shall be vulcanized natural or vulcanized synthetic rubber with antioxidant and antiozonant ingredients to resist set after installation. No reclaimed rubber shall be used. A heavy-gauge-type 304-stainless armor plate shall be vulcanized into the gasket to span the lug area.
2. The lugs shall be heliarc welded (GMAW) to the shell. The lug shall have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts shall NOT BE integrally welded to the sleeve.
3. Bolts and nuts shall be type 304 (18-8) stainless steel and Teflon coated or as specified in the bolt section below at the discretion of the Engineer. Bent or damaged units will be rejected.
4. Quality control procedures shall be employed to ensure that the shell, Lug, (4" and Larger Nominal Pipe Diameter) armor plate, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, shall have a working-pressure rating up to 250 psi.
5. The sleeve construction shall provide a positive means of preventing gasket cold flow and/or extrusion.

B. Tapping Sleeves from 16" and Larger

Tapping sleeves attached to 16" and larger nominal pipe diameter shall meet the following minimum requirements:

1. The body shall be in compliance with ASTM A285, Grade C or ASTM A36. The test plug shall be 3/4" NPT conforming to ANSI B2.1.
2. The gasket shall provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gaskets shall be formed from vulcanized natural or vulcanized synthetic rubber with antioxidant ingredients to resist set after installation. No reclaimed rubber shall be used.
3. Bolts and nuts shall be high strength, corrosion resistant, low alloy, pre AWWA C111, ANSI A21.11 and as specified in the subsection on bolts in this specification.
4. Unless otherwise noted, unit shall be protected by electrostatically applied baked epoxy or polyurethane.
5. Units for concrete, steel cylinder pipe provided shall be equipped with load bearing setscrews on the gland flange to transfer loads on the outlet away from the steel

cylinder and onto the sleeve. Epoxy –coated tapping sleeves do not require grout seal cavity (AWWA M-9 Manual).

6. Each sleeve shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The marking shall be permanent type, water resistant, that will not smear or become illegible.

2.5 FABRICATED STEEL TAPPING SLEEVES

- A. Sleeves shall be fabricated of minimum three-eighths (3/8) inch carbon steel meeting ASTM A285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 lb. drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall be vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion bonded epoxy coating, minimum 12 mil thickness., Class D ANSI B.16.1 drilling, recessed for tapping valve MSS-SP60. Mechanical Joint tapping sleeve outlet shall be suitable for use with standard mechanical joint by mechanical joint resilient wedge gate valves per ANSI/AWWA C509-94.

2.6 TAPPING SADDLES

- A. Unless otherwise specified by the Drawings, tapping saddles conform to the requirements of AWWA Standard C800 for the High Pressure class tapping saddles. Tapping saddles shall consist of ductile iron outlet castings, attached to the pipeline with high strength stainless steel straps. Castings shall be sealed to pipeline with O-ring seals. Saddles shall have ANSI A21.10 flanged outlets counterbored for use with tapping valves and tapping equipment.

2.7 BOLTS

- A. All bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Bolts shall be Xylan or FluoroKote #1 suitable for direct bury in corrosive soils.

PART 3: EXECUTION

3.1 INSTALLATION

- A. Install the tapping sleeves, saddles, and valves in strict accordance with the requirements of Specification Section 33 01 10.50. Install the tapping sleeves, tapping saddles, and tapping valves in accordance with the manufacturer's instructions. The tapping procedure is to be in accordance with the tapping machine manufacturer's instructions.

3.2 PROTECTION

- A. After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfilling. If polyethylene is applied to the pipe, the entire sleeve and valve assembly shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut of the tapping valve exposed and free to be operated.

3.3 PRELIMINARY TESTING

- A. Perform a hydrostatic test of the tapping sleeve and valve assembly in accordance with Specification Section 33 05 05.31 after installation of the tapping sleeve and valve, but prior to making the tap. The test shall be made with the valve open using a tapped mechanical joint cap. No leakage is acceptable. The test pressure shall be maintained for a minimum of 15 minutes.
- B. Perform hydrostatic test of tapping saddles in accordance with AWWA Standard C800.

END OF SECTION

SECTION 33 05 19.01

DUCTILE IRON UTILITY PIPE (OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 COORDINATION OF WORK

- A. Connection to existing pipelines may require shutdown of Owner facilities. Closely coordinate construction work and connections with the Owner through the Engineer. The Engineer, in consultation with the Owner, may select the time for connection to existing pipelines, including Saturdays, Sundays, or holidays, which, in the opinion of the Engineer, will cause the least inconvenience to the Owner and/or its customers. Make such connections at such times as may be directed by the Owner, at the Contract prices, with no claim for premium time or additional costs.

1.3 RELATED WORK

Piping - General Provisions - Specification Section 33 01 10.50

1.4 REFERENCES

Refer to current AWWA Standards:

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C115 - American National Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. AWWA C116 - American National Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
7. AWWA C150 - American National Standard for the Thickness Design of Ductile-Iron Pipe
8. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

9. AWWA C153 - American National Standard for Ductile-Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch, for Water Service
10. AWWA C600 -- AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances

PART 2: PRODUCTS

Refer to Specification Section SSC-1000.1.03 for material to be furnished by the Owner.

2.1 PIPE MATERIAL

- A. Install all ductile iron pipe and fittings furnished by the Owner. The Owner will furnish the list of materials provided.
- B. Research has documented that certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied under this Specification Section assume that petroleum products or organic solvents will not be encountered. If during the course of pipeline installation the Contractor identifies or suspects the presence of petroleum products or any unknown chemical substance, notify the Engineer immediately. Stop installing piping in the area of suspected contamination until direction is provided by the Engineer.

PART 3: EXECUTION

3.1 INSTALLATION

Follow the provisions of Specification Section 33 01 10.50 and 31 23 33 in addition to the following requirements:

- A. Push-On Joints
 1. Clean the surfaces that the gasket will contact thoroughly, just prior to assembly using a bacteria free solution (bleach, potable water or NSF approved material). Insert the gasket into the groove in the bell. Apply a liberal coating of special lubricant to the gasket and the spigot end of the pipe before assembling the joint. Center the spigot end in the bell and push home the spigot end.
- B. Mechanical Joints
 1. Clean and lubricate all components with soapy water prior to assembly. Slip the follower gland and gasket over the pipe plain end making sure that the small side of the gasket and lip of the gland face the bell socket. Insert the plain end into socket. Push gasket into position with fingers. Seat gasket evenly. Slide gland into position, insert bolts, and tighten nuts by hand. Tighten bolts alternately (across from one another) to the recommended manufacturing rating or if not provided, to the following normal torques:

| <u>Bolt Size</u> | <u>Range of Torque In Foot-Pounds</u> |
|------------------|---|
| 5/8" | 40 - 60 |
| 3/4" | 60 - 90 |
| 1" | 70 - 100 |
| 1-1/4" | 90 - 120 |

After field installation, all bolts shall receive petrolatum tape or petroleum wax protection or other approved coating material.

C. Restrained Joints

1. Ball and Socket

Assemble and install the ball and socket joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

2. Push-On

Assemble and install the push-on joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when "pushing home" any pipe by using wood or other suitable (non-metallic) material.

3. Mechanical Joint

Assemble and install the mechanical joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Use approved restrained joint device on fittings and valves where required and approved for use by Engineer.

D. Pipe Protection

1. Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when "pushing home" any pipe. Wood or other suitable material (non-metallic) shall be used to push home the pipe.

E. Gaskets

1. Gaskets shall be as provided or recommended by the manufacturer and satisfy AWWA standard C111 in all respects. As noted in the products section of this specification, some gasket materials are prone to permeation of certain hydrocarbons which may exist in the soil (see part 2). Under these conditions and at the Engineer's discretion require contractor to provide FKM (Viton, Flourel) gasket material in areas of concern.

END OF SECTION

SECTION 33 05 31.16.01

POLYVINYL CHLORIDE PRESSURE PIPE FOR WATER TRANSMISSION & DISTRIBUTION (AWWA C900 & C905) (OWNER FURNISHED)

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. PVC pressure pipe in nominal sizes 4 inches through 12 inches with cast iron pipe equivalent outside diameters. Under special conditions 2" PVC may be provided by Owner.

1.2 REFERENCES

- A. ASTM – American Society for Testing and Materials
 - 1. A536: Standard Specification for Ductile Iron Castings.
 - 2. D2241: Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 3. D2855: Standard Practice for Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- B. AWWA – American Water Works Association
 - 1. Standard C605: Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
 - 2. Standard C900: Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution.
 - 3. Standard C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.
 - 4. M23: PVC Pipe - Design and Installation.
- C. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

PART 2: PRODUCTS

PVC pipe material shall be furnished by the Owner for installation by the Contractor. Research has documented that certain pipe materials (such as polyvinyl chloride) and certain elastomers (such as those used in gasket material) may be subject to permeation by lower molecular weight organic solvents or petroleum products. Products supplied under this Specification Section assume that petroleum products or organic solvents will not be encountered. If during the course of pipeline installation the Contractor identifies, or suspects the presence of petroleum products or any unknown chemical substance, notify the Engineer immediately. Stop installing piping in the area of suspected contamination until direction is provided by the Engineer.

2.1 PIPE MATERIALS

- A. Install PVC pipe and joint materials furnished by the Owner. Materials to be furnished by the Owner are included in Section SSC-1000.1.03 of the Specifications Special Conditions. All PVC pipe shall be PVC 1120 pressure pipe made from class 12454 material as defined by ASTM D-1784 with outside diameter dimensions of steel or cast iron pipe. The PVC compounds shall be treated or certified suitable for potable water products by the National Sanitation Foundation (NSF) Testing Laboratory (NSF Standard No. 61).
- B. PVC Pipe 2 inch (where permitted):
Pipe fittings less than 4-inches may be schedule 40 PVC (ASTM D-2466) or schedule 80 PVC (ASTM D-2467) systems having working pressures of 100 psi and 150 psi respectively.
- C. PVC Pipe 4 inch through 12 inch:
AWWA Standard C900, DR14 and where permitted DR18. DR25 pipe will not be allowed. PVC pipe has recently been upgraded by pressure class, however American Water does not allow pipe in its system to be fully subject to the revised pressures in AWWA C900. DR14 shall not be subjected to pressures exceeding 250 psi. When 2" PVC is provided it shall meet NSF 61 and be DR14 pipe. DR18 shall not be subjected to pressures exceeding 200 psi.

2.2 RECEIVING, HANDLING AND STORAGE

- A. Inspect pipe and appurtenances for defects prior to installation in the trench. Set aside and clearly mark defective, damaged or unsound material and hold material for inspection by the Owner or Engineer.
- B. Load and unload all materials in accordance with the manufacturer's recommendations and in such a manner as to prevent damage. Do not drop pipe and accessories or handle them in a rough manner.
- C. Provide safe storage for all materials. Cover stored pipe that will be exposed to sunlight for periods longer than 6 months. Cover with canvas or other opaque material with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

PART 3: EXECUTION

3.1 INSTALLATION

Follow the provisions of Specification Sections 33 01 10.50, and 31 23 33 in addition to the following requirements:

- A. Remove all dirt and foreign matter from pipe before lowering it into the trench. Do not place debris, hand tools, clothing or other materials in the pipe. Keep pipe clean during and after laying.
- B. Lay pipe with the bell end pointing in the direction of work progress. Do not roll, drop or dump pipe or appurtenances into the trench.

- C. Assemble push-on joints in accordance with the pipe manufacturer's recommendations. Assemble mechanical joints in accordance with the fitting manufacturer's recommendations.
- D. Cut pipe in accordance with manufacturer's recommendations and American Water safety practices. Provide a smooth end at a right angle to the longitudinal axis of the pipe. Deburr, bevel, and re-mark insertion line on spigot ends. Match factory bevel length and angle for field bevels. When connecting to certain shallow depth bells, such as those on some cast iron fittings and valves, cut off the factory bevel and prepare a deburred, square cut end with a slight outer bevel.
- E. Clean the sealing surface of the spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets immediately before assembly. Do not remove factory installed gaskets for cleaning. Keep the joint free of dirt, sand, grit, grease or any foreign material. Apply NSF approved lubricant when assembling gasketed joints in accordance with the pipe manufacturer's requirements. The use of improper lubricants can damage gaskets. Excessive lubricant use can make disinfection more difficult and cause taste and odor problems when the line is placed in service.
- F. Good pipe alignment is essential for proper joint assembly. Neither deflection nor bending of PVC pipe or pipe joints is permitted. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. Avoid metal to plastic contact when pushing the pipe "home" by using wood or other suitable material to cushion moving the pipe.
- G. Assemble pipe using the following types of joints:
 - 1. Gasketed bell joint – Integral with the pipe or fitting
 - 2. Gasketed coupling – A double gasketed coupling
 - 3. Mechanical joint – Any of the several joint designs that have gaskets and bolts manufactured in accordance with AWWA standards.
- H. Tracer Wire
 - 1. Place tracer wire in accordance with Specification 33 05 97.
 - 2. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack Model No. 054007-09053.
- I. Pressure testing of DR 14 PVC pipe should not exceed 275 psi. Pressure testing of DR 18 PVC pipe if permitted should not exceed 200 psi if approved for use.
- J. PVC pipe fittings shall employ ductile iron pipe fittings per specifications 33 05 19.01 and 33 05 19.02. See detail drawings for transitions between different pipe materials.
- K. Gaskets shall be as provided by the manufacturer and satisfy AWWA standard C111 in all respects. Where ductile iron pipe and PVC pipe are directly connected, the appropriate gasket material for this purpose shall be employed. As noted in the products section of this specification, some gasket materials are prone to permeation of certain hydrocarbons which may exist in the soil (see part 2). Under these conditions and at the Engineer's discretion FKM (Viton, Flourel) gasket material may be provided by the Owner.

3.2 SERVICE CONNECTIONS

Install service connections in accordance with AWWA Standard C605 and the manufacturer's recommendations using the following methods:

- A. Tapping is only permitted through the use of service clamps or saddles.
- B. Using injection molded couplings with threaded outlets.
- C. Tapping with large service connections through appropriately sized tapping sleeves and valves.
- D. Direct tapping of 1 inch and smaller service connections is not permitted. Use service saddles only for AWWA Standard C900 pipe, for nominal pipe sizes 6 inch through 12 inch. Corporation stops shall be threaded and conform to AWWA Standard C800.
- E. The distance between the PVC pipe joint and a service tap (2" and smaller) shall be a minimum of 3 feet. The distance between the PVC pipe joint and a service tap (4" and larger) shall be a minimum of 4 feet. Where necessary, excavate along the pipe to confirm the acceptable distance before starting the tap.

END OF SECTION

SECTION 33 05 33.23.01
POLYETHYLENE PRESSURE PIPE & TUBING
(AWWA C901 & C906) (OWNER FURNISHED)

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Installing 4 inch through 65 inch high density polyethylene (HDPE) pipe and fittings for water distribution and transmission. Pipe furnished by owner.

1.2 REFERENCES

- A. Design, manufacture, and execution of materials or equipment specified herein shall be in accordance with, but not limited to, published standards of the following, as applicable:
 1. AWWA Standard C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) though 65 In. (1,575 mm), for Water Distribution and Transmission.
 2. ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 3. ASTM D2683: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
 4. ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 5. ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
 6. ASTM D2774: Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.3 SUBMITTALS

- A. Submit classification and gradation test results for material(s) to be used for pipe embedment and backfill.

PART 2: PRODUCTS

HDPE pipe material shall be furnished by the Owner for installation by the Contractor.

2.1 MATERIALS

- A. Research has documented that polyethylene and certain elastomers, such as used in jointing gaskets and packing glands, may be subject to permeation by lower molecular weight organic solvents or petroleum products. Products supplied under this

Specification Section assume that petroleum products or organic solvents will not be encountered. If during the course of pipeline installation the Contractor identifies, or suspects the presence of petroleum products or any unknown chemical substance, notify the Engineer immediately. Stop installing piping in the area of suspected contamination until direction is provided by the Engineer.

2.2 PIPE

- A. HDPE may be deflected subject to approval by the Engineer. The following Exhibit 1 shows maximum deflection based upon the allowable strain of the pipe wall. Potential flow restrictions, surge and other non-trench stability and pipe strain issues may reduce the values shown here per the Engineer's recommendations. The bend radius multiplier determines the minimum radius of the pipe curvature and is calculated by multiplying the outside diameter of the pipe by the multiplier from the appropriate DR used. Bending radius allowed by the manufacturer can vary. Verify the multiplier with the manufacturer. In no case shall the radius be less than 125% of the manufacturer's permitted multiplier.

Exhibit 1

| PE pipe Dimension Ratio (DR) | Allowable Deflection (%) | Bend Radius Multiplier |
|------------------------------|--------------------------|------------------------|
| 32.5 | 8.1 | 50 |
| 26.0 | 6.5 | 45 |
| 21.0 | 5.2 | 40 |
| 19.0 | 4.7 | 37.5 |
| 17.0 | 4.2 | 32.5 |
| 15.5 | 3.9 | 30 |
| 13.5 | 3.4 | 27.5 |
| 11.0 | 2.7 | 25 |

2.3 FITTINGS

- A. Plain end butt fused fittings and electrofusion couplings shall be used when joining polyethylene materials. Mechanical (compression) fittings shall be used only when joining polyethylene materials to different piping materials and approved by the Engineer.
- B. Butt fusion fittings shall comply with ASTM D3261.
- C. Electrofusion fittings shall comply with ASTM F1055.
- D. Mechanical (compression) fittings used with polyethylene pipe shall be specifically designed for, or tested and found to be acceptable for, use with polyethylene pipe.

PART 3: EXECUTION

3.1 PACKAGING, HANDLING, AND STORAGE

- A. Per requirements imposed on the supplier the interior of all pipe shipped clean with plastic cleanliness plugs in all pipes. The manufacturer/supplier is instructed to package the pipe in a manner designed to ensure that it arrives at the project neat, clean, intact, and without physical damage. The pipe should arrive on-site, properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged.
- B. Inspect pipe and appurtenances for defects prior to installation in the trench. Set aside defective, damaged or unsound material and hold material for inspection by the Engineer.
- C. Store pipe on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.
- D. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined by butt fusing or the use of electrofusion fittings.

3.2 PIPE INSTALLATION

- A. Refer to Specifications 33 01 10.50 and referenced drawings that are part of these Contract Documents. Trenching shall be performed in accordance with ASTM D2774 and embedment materials shall be in accordance with ASTM D2321.
- B. Remove all dirt and foreign matter from pipe before lowering into the trench. Do not place debris, hand tools, clothing or other materials in the pipe. Keep pipe clean during and after laying.
- C. Maximum pipe bending radius shall be in conformance with the manufacturer's recommendation for the specific diameter and dimension ratio (DR) of the pipe. Whenever possible, changes in direction shall be accomplished by bending the pipe in lieu of installing a fitting, except as approved by the Engineer.
- D. Place location wire immediately above the initial backfill material, directly over the pipe. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack model No. 054007-09053. Wire insulation shall be highly resistant to alkalis, acid and other destructive agents found in soil.
- E. Prevent flotation of sealed pipe during work stoppages.
- F. HDPE pipe will not be employed with directional drilling through rock and other abrasive conditions unless it is encased.

3.3 PIPE AND FITTING JOINING

- A. Butt fusion and electrofusion procedures shall be in accordance with the manufacturer's recommendations. Surfaces must be clean and dry before joining. The fusion equipment operator shall be fully trained in the use of the respective equipment.

- The wall thicknesses of the adjoining pipes shall have the same DR at the point of fusion.
- B. Butt fusion equipment shall be equipped with a Datalogger. Records of each weld (including, as a minimum, heater temperature, fusion pressure, and a graph of the fusion cycle) shall be appropriately identified and provided to the Engineer.
 - C. Electrofusion reports of each weld shall be appropriately identified and provided to the Engineer. The reports shall include, as a minimum, the fusion date, time, ambient temperature, fitting type and size, user ID, and the manufacturer of the part.
 - D. Mechanical (compression) joining of pipe and fittings is only permissible when joining polyethylene pipe to unlike materials. HDPE stiffeners shall be utilized with all mechanical (compression) fittings. Blocking must be provided at changes in direction for any mechanical fittings. Use of positive restrained joints fittings (non-friction type) is permissible when approved by the Engineer.

3.4 SERVICE CONNECTIONS

- A. Sidewall fused polyethylene hot-tapping tees shall be used for 3/4 inch and 1 inch service lines off mains 3 inches to 12 inches in diameter. For larger sized mains, polyethylene service saddles may be used, sidewall fused, and then tapped with a tapping tool or machine.
- B. For large mains (>12 inch), mechanical clamps or tapping saddles may be used provided they are designed for HDPE pipe and acceptable to the manufacturer of the pipe.

3.5 TESTING AND DISINFECTION

- A. Pressure testing shall be conducted in accordance with the Manufacturer's recommended procedure or as recommended by the Engineer. Pressure testing shall use water as the test media. Pneumatic (air) testing is prohibited. Air must be completely removed before pressure testing. Under no circumstances shall HDPE pipe be pressure tested when the temperature of the pipe is above 80 degrees F.
- B. Disinfection of the piping system shall be conducted in accordance with the Manufacturer's recommendations, and as specified in AWWA C651 "Disinfecting Water Mains" and Specification Section 33 01 10.58.

END OF SECTION

SECTION 33 05 61
CONCRETE MANHOLES

PART 1: GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, tools and equipment necessary to do all work required to install manholes as indicated on the Drawings and as specified in this Specification Section.

1.2 SUBMITALLS

- A. Submit shop drawings or manufacturer's literature to the Engineer for approval.

1.3 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

PART 2: PRODUCTS

2.1 MANHOLE SECTIONS

- A. Manhole riser sections shall be designed, manufactured, tested, finished and marked in accordance with the Drawings and ASTM C478, "Precast Reinforced Concrete Manhole Sections".

2.2 BRICK

- A. Brick used to bring manhole to grade shall comply with ASTM C62, Grade SW.

2.3 LADDER

- A. For heavy duty traffic manholes specified in section 2.4, ladder rungs shall be provided in accordance with OSHA regulations. Rungs shall have a minimum diameter of 1-inch and 10-inch clear tread width and be of the drop front design. Rungs shall be polypropylene coated ½ inch grade 60 deformed rebar by Lane International Corporation, M.A. Industries, or approved equal.

2.4 FRAME AND COVER

- A. For areas of heavy duty traffic or as noted on plans (flush mount), manhole frame with vented lid shall be Neenah Foundry Company's R-1752 Series Heavy Duty (36" round). For non-traffic areas with limited traffic (flush mount) Bilco's J-4H2O Series Floor, Vault and Sidewalk Door shall be used (36" square). For areas of non-traffic (mounted 8-12" above the surrounding surface). Bilco's J-4H2O Series Floor, Vault and Sidewalk Door shall be used (36" square).

PART 3: EXECUTION

3.1 HANDLING

- A. Lift and move all precast manhole components using suitable lifting slings and plugs that will not damage the precast manhole lip.
- B. Thoroughly repair all damage to precast sections in the presence of the Engineer. Repair and patch minor breaks by chipping and scarifying the defective area before applying grout. All sufficient curing time before the precast sections are put together. Form and key concrete cast-in-place bases specially to accommodate the bottom precast section.

3.2 INSTALLATION

- A. Unless otherwise noted in the drawings, rest and support manhole bases uniformly on a 6-inch mat of compacted crushed stone or gravel placed over a base of sound, level, undisturbed earth.
- B. Before placing concrete base, set the downstream and upstream pipes to proper grade so the pipe ends will be flush with the inside of the manhole.
- C. Set the pipes securely in the opening of the precast sections of manholes and grout at the correct line and grade. There shall be at least a one-half inch clearance between the outside of the pipe and the manhole opening to insure proper grouting. Clean the pipe and base thoroughly before the grout is applied.
- D. Bring the top of all precast manholes to proper grade for receiving manhole frames. If proposed grade is to be flush to existing grade, the top of the manhole ring and cover shall be within 1" of surrounding grade. If proposed grade is to be above existing grade, the top of the manhole ring and cover shall be between 8-12 inches of surrounding grade unless otherwise noted on the plans.

END OF SECTION

SECTION 33 05 97

IDENTIFICATION & SIGNAGE FOR UTILITIES

PART 1: GENERAL

1.1 REFERENCES

Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Furnish and install identification tape and location wire over the centerline of buried potable water mains, hydrant branches, and trenched services as indicated in this specification or noted in the drawings.

PART 2: PRODUCTS

2.1 IDENTIFICATION TAPE FOR PIPE

A. Identification Tape for Pipe

Identification tape shall be manufactured of polyethylene with a minimum thickness of 4-mils and shall have a 1-mil thick metallic foil core. The tape shall be highly resistant to alkalis, acid and other destructive agents found in soil. Tape width shall be a minimum of 3 inches and a maximum of 6 inches and shall have the background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of the tape.

B. Tape Background Colors and Imprints Shall be as Follows:

| <u>Imprint</u> | <u>Background Color</u> |
|---|-------------------------|
| "CAUTION CAUTION - WATER LINE BURIED BELOW" | Blue |

- C. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX, or approved equal.

2.2 LOCATION WIRE

- A. Location (Tracer) Wire for Polyvinyl Chloride and HDPE Pipe (and other pipe where noted in the drawings or identified in special conditions):

Location wire shall be a direct burial #12 AWG Solid (.0808" diameter), 21% conductivity annealed copper-clad high carbon steel strength tracer wire, 380# average tensile break load, 30 mil. High molecular weight-high density blue polyethylene jacket complying with ASTM D1248, 30 volt rating. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack model No. 054007-09053. Wire insulation shall be highly resistant to alkalis, acid and other destructive agents found in soil.

- B. Location Wire shall be manufactured by Copperhead Industries, LLC, part number 1230B-HS or approved equal.

- C. If directional drilling is used for this project please refer to specification 33 05 07.13.02 for the product description of location wire to be used with the directional drilling

2.3 RESTRAINED JOINT MARKING TAPE

- A. Joint restraint tape is specifically to warn Water Company workers/contractors that the water main is joint restrained. It is not to be used in place of regular marking tape.
- B. Restrained Joint Marking Tape (for with mains that are restrained joint as directed by the Engineer) shall be polyethylene 4-mil thick and 2 ½-inches wide with blue lettering on white background color and imprinted with the words "RESTRAINED JOINT" every 2 foot. The tape shall have an adhesive backer. The tape shall be highly resistant to alkalis, acid and other destructive agents found in soil.
- C. Restrained Joint Gasket indicator tape shall be part number 515401-010 manufactured by St. Louis Paper & Box Company located at 3843 Garfield, St. Louis, MO 63113 or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION OF IDENTIFICATION TAPE

- A. If directed by the Owner, install the identification tape with all buried potable water lines in accordance with the manufacturer's installation instructions and as specified.
- B. Install identification tape one foot above the top of the pipe.

3.2 INSTALLATION OF LOCATION (TRACER) WIRE

- A. Install location wire with buried water lines in accordance with the manufacturer's installation instructions and as specified in Contract Documents.
- B. Install the location wire directly on top of the buried pipe.
- C. In all pipe installations, loop the location wire up into the valve boxes for connection to a locating device. The wire shall be one continuous piece from valve box to valve box up to 1250 feet maximum.

3.3 INSTALLATION OF RESTRAINED JOINT MARKING TAPE

- A. Install the joint marking tape by adhering directly to the pipe as it is installed. The marking tape shall be installed along the entire length of pipe, including around the circumference of the bells of all fittings and valves. The pipe must be free of any foreign matter along the surface of the pipe for the marking tape installation. If clear polywrap is used, the restrained joint tape can be applied on the top of the pipe so long as it is visible. Otherwise the joint marking tape shall be applied on top of the polywrap and secured so the tape is not shifted by backfilling.
- B. The tape does not adhere in wet or cold conditions. The tape should be stored in temperatures above 50 degrees F until the time of application. The pipe must be free of frost and moisture along the surface of the pipe receiving the tape.

END OF SECTION

SECTION 33 14 17.01
SERVICE LINES & VALVES (OWNER FURNISHED)

PART 1: GENERAL

1.1 SCOPE

- A. Install Owner supplied service lines originating at the water main and terminating at a curb stop connection as shown on the Drawings and/or Specification Special Conditions. This Specification Section does not include service lines or meter installations beyond the curb stop. Refer to Standard Details.

1.2 RELATED WORK

- A. Specification Section 33 01 10.50 - Piping - General Provisions.

1.3 REFERENCES

- A. Refer to current AWWA Standards: AWWA Standard for Underground Service Valves and Fittings C800.
- B. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

PART 2: PRODUCTS

Service line material shall be furnished by the Owner for installation by the Contractor.

PART 3: EXECUTION

3.1 INSTALLATION OF CORPORATION STOPS

- A. Use experienced craftsmen familiar with installation of water service lines when tapping water mains. Make all taps with a suitable tapping machine (Mueller, Ford, Hays or Dresser type) using the proper combined drill and tap. Hand held drilling equipment is not acceptable.
- B. Before making the tap, inspect corporation stops for cleanliness, damaged threads, and proper operation of the ball valve prior to installation. Do not install corporation stops that fail this inspection.
- C. The main may be tapped on the top half of the pipe as shown on Standard Detail SD47. Use a tapping saddle when the water main wall thickness or material (plastic, concrete or A-C pipeline material) make it unsuitable for direct tapping. Verify saddle use with Engineer.
- D. In the case of multiple services of small diameter (less than 2" diameter), corporation stops shall be at least 12 inches apart and at least 22-1/2 degrees above or below the location of any adjacent tap(s) and curb stops and boxes shall be at least one foot apart. In the case of large diameter multiple services, tap at least 24 inches apart and at least 22-1/2 degrees above or below the location of any adjacent tap(s).

- E. Install all corporation stops so that between 2 and 3 threads extend beyond the inside wall of the main. Use the procedures outlined in AWWA Standard C600 for installing taps on grey iron or ductile iron mains encased in polyethylene. If necessary, make a test tap with the boring bar marked to the proper depth. The corporation stop, when properly installed, will not be shouldered with the main. Do not use lubricants of any type when installing the corporation stop. Dielectric unions shall be installed to prevent transfer of any electrical stray currents from metallic service lines to metallic water main.

3.2 INSTALLATION OF SERVICE LINE AND FITTINGS

- A. Excavate the service line trench in accordance with Division 31 Specifications. Where augering or moling is permitted, follow guidelines provided by the equipment manufacturer including making a proper size hole to launch and receive the unit. If moling or augering, take appropriate precautions to avoid damaging other utilities and disturbing the unexcavated surface.
- B. Install service line between the tap connection and the curb stop location making only gradual changes in grade or alignment as required. Sharp bends (greater than 15 degrees) in any direction are not allowed unless approved by the Engineer. 1-1/2" and 2" service lines may be installed using three (3) 1-inch corporation stops and a 3-branch connection. This is in lieu of installing a 1-1/2" or 2" corporation stop. Installation shall be in accordance with Specification Section 33 01 10.50 and Standard Detail 0201-0601-SD47.
- C. Install all services straight and at right angles to the main. If this cannot be accomplished, provide the Owner with accurate as-built dimensions to the tee or corporation stop. The Contractor may be required to attach Owner supplied magnets to curb box and valve box.
- D. All trench services shall be installed with marking tape. This tape shall provide an early warning at shallow depth excavation. The non-detectable tape shall be 6" wide, and buried approximately 12" above the service pipe, but a minimum of 12" below finished grade. It shall consist of multiple layers of polyethylene with an overall thickness of 3 to 5 mils. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards. It shall be installed continuous from the corporation stop to the curb stop. All plastic service line connections shall use insert stiffeners of the appropriate length and size.
- E. When replacing service lines and/or meter setters, a minimum of 30 inches of new copper service line shall be installed on the customer side of the setter. The connection of the new copper line to the existing customer service line shall be outside of the meter box. If the existing customer service line is copper, the contractor may reconnect the customers service line to the setter if approved by Owner.

3.3 INSTALLATION OF CURB STOPS

- A. Install curb stops with the operating nut in the vertical position and the curb box centered over the nut. Install curb boxes plum and adjusted to be flush with finished grade. Install and lock curb boxes immediately after installation.
- B. After completion of service line installation, but prior to backfilling, open the corporation stop slowly to fill the line. When the line is full and all air has been removed, completely open the corporation and close the curb stop. Visually inspect that all piping, fittings,

and taps for leaks. Backfill and restore the surface the service line trench in accordance with Division 31 Specifications.

3.4 POLYETHYLENE ENCASEMENT

- A. Install polyethylene encasement, or other protective wrap approved by the Engineer, on all metal service lines and fittings (pile, valves, stops, etc.) when they are made of different materials than the water main. When the polyethylene is applied on the main, it shall extend for a minimum clear distance of three (3) feet away from the main when services are not being renewed or extend from the main connection to and including the curb stop or curb meter setter for all new copper service lines. Encasement material and installation shall be per Specification Section 33 05 09.01 and AWWA Standard C105.

END OF SECTION

SECTION 33 14 19.01
VALVES AND HYDRANTS FOR WATER UTILITY SERVICE
(OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.
- B. Refer to current AWWA Standards: AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for waterworks Service C512.

1.2 SCOPE

- A. Install air release and blow-off outlets at the locations shown on the Drawings or as directed by the Engineer.

PART 2: PRODUCTS

2.1 MATERIALS

- A. Air release and blowoff outlet material shall be furnished by the Owner for installation by the Contractor.

2.2 COMBINATION AIR/VACUUM RELEASE VALVES

- A. Owner shall provide 1" APCO Model No. 143C as manufactured by Valve and Primer Corporation (Schaumburg, IL) or 1" Val-Matic Valve & Mfg. Corp (Elmhurst, IL) Model 201 for mains 12" and smaller unless noted otherwise on the plans.
- B. Owner shall provide 2" APCO Model No. 145C as manufactured by Valve and Primer Corporation or Val-Matic Model 202C for mains 16" and larger unless noted otherwise on the plans.
- C. Combination valves are double acting to prevent accumulation of air in the pressurized main and to permit air to enter the pipe when pressure seriously drops. Valve bodies are cast iron with stainless steel floats.

2.3 BLOWOFF FLUSHING HYDRANT

- A. Owner shall provide blow off assemblies designed to fit within a standard valve box. In cold weather areas, the units shall be self-draining and non-freezing. All working parts shall be serviceable from above with no digging required and are operated such that the device goes from full open to full close in a ¼ turn clockwise turn.
- B. Approved types of flushing hydrants are Truflo Model TF 500 by the Kupferle Foundry Co. or equal.

2.4 COPPER PIPE

- A. Copper pipe shall be Type L or Type K, as specified in plans, meeting the requirements of ASTM Standard B88.

2.5 CORPORATION STOPS

- A. Corporation stops provided shall be of the brass ball valve type manufactured in accordance with AWWA Standard C800. The inlet connection shall have standard AWWA tapered threads. The outlet connection has a compressed fitting end. The sizes range from 1/2" to 2" and shall match the size of specified copper pipe material.

2.6 CURB STOPS

- A. Curb stops provided are bronze body construction, ball valves, with Double O-ring stem seals. Curb stops shall conform to AWWA Standard C800. End connections shall be suitable for flared copper connection. If required by the Engineer, valves shall be furnished with square gate valve operating nuts. Sizes shall be from 3/4" to 2" and shall match the service line size.
- B. Acceptable manufacturers and model numbers:
 - 1. Ford Meter Box Company – B22 Series
 - 2. Mueller - B-25204
 - 3. A.Y. McDonald - 6100 Series

2.7 CURB BOXES

- A. Curb boxes, if provided, are standard cast iron, sliding or screw type, 1" or 2-1/2" as required, complete with lid and head bolt. Boxes shall be adjustable from 18-inches to 66-inches.
- B. The box size will be determined by the Engineer or as shown on the plans.

PART 3: EXECUTION

3.1 INSTALLATION

- A. See Specification Section 33 01 10.50 for pipe installation. See Detail Drawings SD1, SD2, SD3, SD4, SD5, SD65, and SD66 showing installation details for air/vacuum release valve assemblies and blow-off assemblies. See sections 33 14 17.02 and 33 14 19.02 for information about selected components (copper pipe, corporation stops, curb stops, curb boxes) common to service lines.

3.2 INSTALLATION OF CORPORATION STOPS

- A. Use experienced craftsmen familiar with installation of water service lines when tapping water mains. Make all taps with a suitable tapping machine (Mueller, Ford, Hays or Dresser type) using the proper combined drill and tap. Hand held drilling equipment is not acceptable.
- B. Inspect corporation stops for cleanliness, damaged threads, and proper operation of the ball valve prior to installation. Do not install corporation stops that fail this inspection

- C. The main may be tapped at the horizontal centerline on the top of the pipe as shown on Detail Drawings. Use a tapping saddle when the water main wall thickness or material (plastic, concrete or asbestos cement pipeline material) make it unsuitable for direct tapping.
- D. Install all corporation stops so that between 2 and 3 threads extend beyond the inside wall of the main. If necessary, make a test tap with the boring bar marked to the proper depth. The corporation stop, when properly installed, will not be shouldered with the main. Do not use lubricants of any type when installing the corporation stop.
- E. Use the procedure outlined in AWWA Standard C600 for installing taps on grey iron or ductile iron mains encased in polyethylene.

3.3 INSTALLATION OF BLOWOFF/DISCHARGE LINE AND FITTINGS

- A. Excavate, backfill, and restore the surface in accordance with Divisions 31 and 32 of these Specifications.
- B. Install copper pipe between the corporation stop and the curb stop or air release valve location making only gradual changes in grade or alignment, as required. Do not make bends greater than 15 degrees in any direction. Install curb stops with the operating nut in the vertical position
- C. Open the corporation stop slowly to fill the service line. When the line is full and all air has been removed, completely open the corporation. Perform a visual leak inspection of all piping, fittings, and taps prior to backfilling. Zero leakage is allowed in 10 minutes.
- D. Provide polyethylene encasement, or other protective wrap approved by the Engineer, on all Service Lines (pile, valves, stops, etc.) unless they are made of different materials than the grey-iron or ductile iron main or not subject to aggressive soils. Polyethylene encasement shall extend along the service line for its entire length.
- E. Install the curb box centered over the nut. Install and adjust the curb boxes to be flush with finished grade. Install and lock the lids on the curb boxes. Discharge piping to the surface, if provided, shall be schedule 40 galvanized steel or schedule 40 PVC and properly supported.

3.4 HYDRANT TESTING AND PAINTING

- A. Contractor shall pressure test all installed hydrants per Owner requirements. Testing shall include measurements for static and pitot pressures. Contractor shall use a 2.5-inch diffuser that provides dechlorination of diffused water during testing. The diffuser shall be approved by Owner. Pressure test data shall be provided to Owner.
- B. Contractor shall paint all installed hydrants per Owner requirements.

END OF SECTION

SECTION 35 53 33

UNDERWATER PIPELINE CROSSING

PART 1: GENERAL

1.1 REFERENCES

Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Furnish all labor, materials, and equipment necessary to install the stream crossings as shown on the plans and described in the construction documents.
- B. Install the stream crossings in such a manner as to protect the mains from erosion and to restore, as much as practicable, the stream banks and bottom to their original condition and in compliance with requirements of the regulating agency.
- C. Protect the main from erosion by concrete encasement around the pipe or by a sufficient depth of compacted backfill as shown.

1.3 PROFILES AND TOPOGRAPHY

- A. Contours, topography and profiles of the ground shown on the Drawings are believed to be reasonable approximations and are not guaranteed.
- B. The Contractor accepts the construction site with the conditions that existed at the time of bidding.

1.4 RELATED WORK

- A. Excavation, backfilling and compaction procedures shall conform to Specification Section 31 23 33.
- B. Concrete placement shall conform to Specification Section 03 30 00.

PART 2: PRODUCTS

2.1 MATERIALS

- A. Excavation, fill and concrete materials shall be as specified in Specification Sections, 31 23 33 and 03 30 00.

PART 3: EXECUTION

3.1 CONSTRUCTION PROCEDURE

- A. Comply with construction procedures if provided as a condition of the regulators stream opening permit. If methodology is not provided through permitting process, provide and submit the same to the Engineer and all Federal, State and local authorities having jurisdiction over the stream crossing for their review and approval.

3.2 STREAM BANK RESTORATION

- A. Restore the stream banks by backfilling the main trench with mechanically compacted backfill of earth or rip rap, approved by the Engineer and in compliance with regulatory requirements, to the original ground surface (unless new contours are shown on drawings). The limits of compaction shall extend from the top of bank to top of bank on each side of the crossing as determined by the Engineer or as shown on the detail drawings provided.
- B. Immediately following the completion of a stream crossing, place straw bales or silt-fence along the trench excavation on each stream bank from within two (2) feet of the edge of water to beyond the limits of the excavated trench width per detail on straw bale and fabric fence. Straw bales or silt-fence shall remain in place until after the stream banks have been fine graded, fertilized and seeded, and the seeding has grown sufficiently to protect the stream banks from erosion.

3.3 STREAM BOTTOM RESTORATION

- A. If the plans call for open cut across the stream bottom, backfill the trench within the stream bottom (high water to high water) mechanically compacted earth or riprap that has been approved by the Engineer and meeting regulatory requirements. Rip rap placement must be flush with stream bottoms from upstream to downstream.

END OF SECTION

SECTION 40 05 61.01
GATE VALVES (OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Install all gate valves shown on the Drawings, provided by the Owner.

1.3 SUBMITTALS

- A. Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 01 33 00.

1.4 RELATED WORK

- A. Specification Section 33 01 10.50 - Piping - General Provisions.

PART 2: PRODUCTS

Gate valves shall be furnished by the Owner for installation by the Contractor.

2.1 SMALL GATE VALVES

- A. All gate valves, 3 inches through 12 inches NPS, shall be iron body, resilient-seated, nut-operated, non-rising stem gate valves suitable for buried service. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550 (average dry film thickness shall be a minimum of 6 mil). The valves shall be designed for a minimum differential pressure of 250 psi and a minimum internal test pressure of 500 psi unless otherwise noted on the plans. Valves shall be designed to operate in the vertical position.
- B. Valves shall comply fully with AWWA Standard C509. Valve ends shall be push on joint or mechanical joint (when restrained), or as shown on the plans or approved in writing in accordance with AWWA Standard C111. Stems shall be made of a low zinc alloy in accordance with AWWA C509. Stem seals shall be double O-ring stem seals. Square operating nuts conforming to AWWA Standard C509 shall be provided. Valves shall open (left or right) in accordance with the Owner's standard.
- C. All valve materials shall meet the requirements of NSF 61.

2.2 LARGE GATE VALVES

- A. Gate valves larger than 12-inches NPS shall be iron body, double disc (metal to metal seat), parallel seats, bronze mounted, rubber O-ring packing seals, epoxy coated interior and exterior meeting the requirements of AWWA Standard C550, and conforming to AWWA Standard C500. Stems shall be made of a low zinc alloy in accordance with AWWA C500. All valves shall have openings through the body of the

same circular area as that of the pipe to which they are attached. All valves furnished shall open (left or right) in accordance with the Owner's standard.

- B. Valves shall have mechanical joint ends unless otherwise designated on the plans or approved by the Engineer.
- C. The valves shall be designed for a minimum differential pressure of 150 psi and a minimum internal test pressure of 300 psi, unless otherwise noted on the plans. Make all valves tight under their working pressures after they have been placed and before the main is placed in operation. Any defective parts shall be replaced at the Contractor's expense.
- D. All valve materials shall meet the requirements of NSF 61.

PART 3: EXECUTION

3.1 INSTALLATION

- A. Install the valves in strict accordance with the requirements contained in Specification Section 33 01 10.50 and detail drawings. All large gate valves shall be restrained.

3.2 PROTECTION

- A. After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut exposed and free to be operated. Valve box shall be installed per Piping Specialties Specification 33 05 09.01.

END OF SECTION

SECTION 40 05 64.16.01

AWWA RESILIENT SEATED BUTTERFLY VALVES (OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Install all butterfly valves shown on the Drawings, provided by the Owner.

1.3 RELATED WORK

- A. Specification Section 33 01 10.50 - Piping - General Provisions.

1.4 SUBMITTALS

- A. Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 01 33 00.

PART 2: PRODUCTS

Butterfly valves shall be furnished by the Owner for installation by the Contractor.

2.1 VALVES

- A. Butterfly valves conform to Class 150B of the AWWA Standard C504 and this specification unless working pressure is greater than 150 psi in which case, the butterfly valve shall conform to Class 250B of the AWWA Standard C504. All valves furnished shall open (left or right) in accordance with the Owner's standard.
- B. Valve bodies shall be ductile iron with mechanical joint ends. Mechanical joint ends shall conform to AWWA Standard C111.
- C. All valve materials shall meet the requirements of NSF 61.
- D. Valve shafts shall consist of one-piece units extending through the discs of 18-8 stainless steel Type 303 or 304. Shaft diameter shall be in accordance with Table 3 of AWWA Standard C504.
 - 1. Valve discs shall be Ni-Resist, Type 1, or cast iron with stainless steel edges.
 - 2. Valve seats shall be nitrile rubber (also known as Buna-N or NBR) mounted in the valve body.
 - 3. Valve bearings shall be nylon or Teflon.
- E. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550 (average dry film thickness shall be a minimum of 6 mil).

- F. All elastomers used in the butterfly valves must be suitable for service in the following water conditions:
 - 1. Chlorine concentration up to 12 mg/L.
 - 2. Chloramine concentrations up to 6 mg/L.
 - 3. Ozone concentrations up to 2.0 mg/L.
 - 4. pH range of 4-11.
- G. Manual buried operators, if provided, shall be either worm gear or traveling nut type and shall be furnished with 2-inch AWWA nuts and extension shafts. Input required at nuts to produce specified output torque shall be less than 150 ft.-lbs. Operators shall be designed to withstand an input at the nut of 300 ft.-lb. without damage to any operator components.

PART 3: EXECUTION

3.1 SETTING VALVES

- A. Install the valves in strict accordance with the requirements of Specification Section 33 01 10.50. All butterfly valves shall be restrained.

3.2 PROTECTION

- A. After field installation of the valve all external bolts except the operating nut shall receive a layer of tape coating or approved rubberized-bitumen based spray-on undercoating applied before backfill. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut exposed and free to be operated.

END OF SECTION

SECTION 40 05 80.13.01

FIRE HYDRANTS (OWNER FURNISHED)

PART 1: GENERAL

1.1 REFERENCES

- A. Where reference is made to a published standard, the revision in effect at the time of bid opening shall apply. Any reference to a specific section of the standard shall be taken to refer to the applicable sections in the latest revision, regardless of location.

1.2 SCOPE

- A. Furnish all labor, material, tools, and equipment required to install owner provided fire hydrants at the location shown on the plans, or where designated by the Engineer.

PART 2: PRODUCTS

Fire hydrants material shall be furnished by the Owner for installation by the Contractor.

2.1 MATERIAL

- A. All fire hydrants shall be ductile iron and conform to the requirements of AWWA C502, traffic-model break-away type fire hydrants.
- B. All fire hydrants shall open left or right as required and be clearly marked on the top of the hydrant with a 1-1/2" pentagon top nut and have not less than two (2) O- ring stem seals. The number and sizes of hose nozzle outlets is dependent on the local regulation. (Most typical is two (2) bronze male threaded 2-1/2" hose outlet nozzles and one (1) bronze male threaded 4-1/2" pumper outlet nozzle with American National Fire Hose Connection Screw Threads (NH).)
- C. The hydrant shall be break-away traffic flange, 5-1/4" valve opening, 6" mechanical joint pipe connection. The hydrant interior and exterior shall be epoxy coated at the factory by the hydrant manufacturer in accordance with AWWA Standard C550 (average dry film thickness shall be a minimum of 6 mil).

PART 3: EXECUTION

3.1 INSPECTION PRIOR TO INSTALLATION

- A. Contractor shall inspect all fire hydrants upon delivery. Cycle each hydrant to full open and full closed positions to ensure that no internal damage or breakage has occurred during shipment and handling. Check all external bolts for proper tightness.
- B. After inspection, close the hydrant valves and replace the outlet nozzle caps to prevent the entry of foreign matter. Protect stored hydrants from the weather/elements with the inlets facing downward.

3.2 INSTALLATION

- A. Locate hydrants on the plans or as directed by the Engineer and in compliance with local regulations. The location shall provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than eighteen to twenty- four inches, depending on local requirements, from the gutter face of the curb. All hydrants shall stand plumb with the pumper nozzle facing the curb. Set hydrants with nozzles at least eighteen inches above the finished grade as shown on the plans. Set the break flange at least two but no more than six inches above finished grade, or as directed by the Engineer. Connect each hydrant to the main with a six inch branch connection controlled by an independent six inch gate valve, unless otherwise shown on the plans. All hydrants assemblies must be restrained from the hydrant back to the main.
- B. The Engineer may authorize hydrant protection using steel pipe bollards when hydrant installations have a greater than normal exposure to vehicular damage (e.g. parking lot installations, unusual driving situation, etc.). Install all such protection designated by the Engineer. Locate bollards as necessary adjacent to the hydrant and in such a manner as to not interfere with the ability to connect hoses or operate the hydrant as per detail drawing. Additionally, locate the bottom of the bollard and encasement above the hydrant supply piping and valve to prevent the possibility of damage to the piping should the bollard be displaced when hit. Payment for bollards shall be per the supplemental unit price schedule.
- C. Unless otherwise directed by the Engineer, excavate a drainage pit two feet in diameter and two feet deep below but not beyond each hydrant. Fill the pit with compacted $\frac{3}{4}$ inch clean granular under and around the base of the hydrant to a level 6 inches above the hydrant drain opening. No hydrant drainage pit shall be connected to a sewer.
- D. Line and cover the drainage pit with geotextile fabric. The fabric shall completely isolate the gravel or stone so that no fill material or adjacent earth comes in contact with pit material.
- E. Notify the Engineer of situations where the ground water table is above the drain opening of dry barrel hydrants. If directed by Engineer, plug the drain opening using a method acceptable to the hydrant manufacturer. No drainage pit is required when the hydrant drain is plugged. Mark the hydrant, in a manner acceptable to the Owner, to indicate that the drain opening has been plugged. Operation of a hydrant with plugged drain leaves the hydrant barrel full of water. Pump the hydrant barrel dry after each use.
- F. Reaction or thrust blocking at the base of each hydrant must not obstruct the drainage outlet of the hydrant. The size and shape of concrete thrust backing and the number and size of tie rods, when required, shall be approved by the Engineer. Use the thrust blocking material specified in Specification Section 03 30 00. See Specification Section 33 01 10.50 for tie rod requirements.

3.3 TESTING

After installation and before backfilling (and after pressure testing the water main) test the hydrant as follows:

- A. Pressure Test

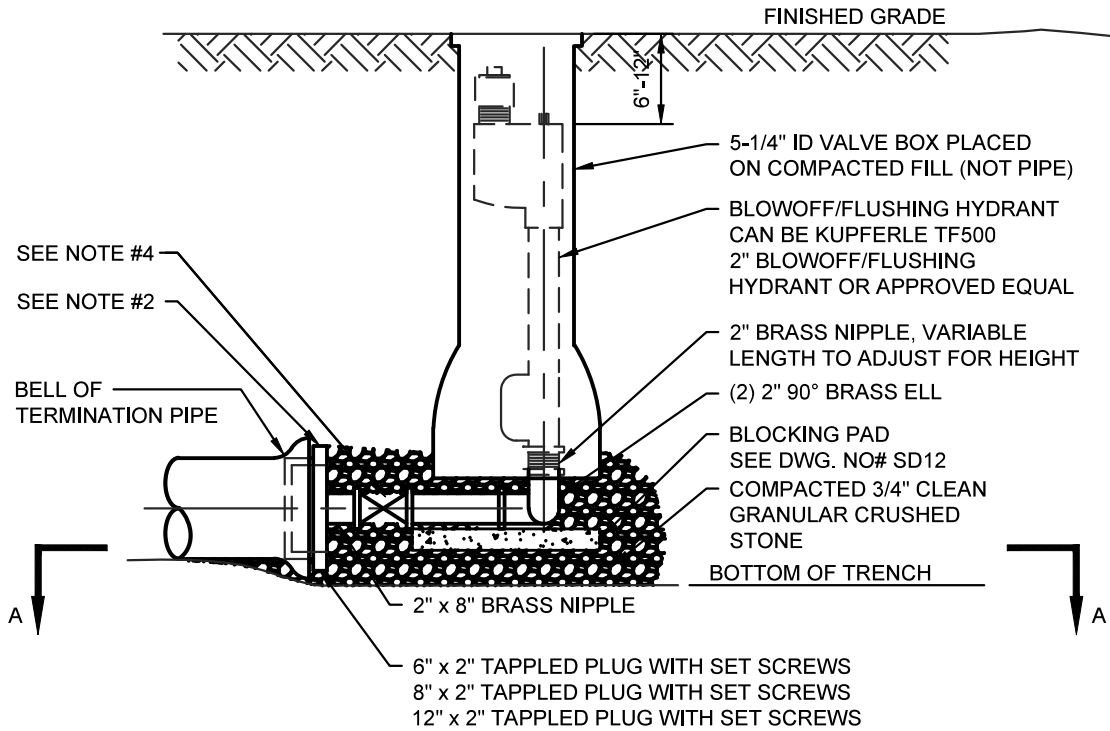
1. Open the hydrant fully and fill with water; close all outlets.
 2. To prevent caps from being blow off dry-barrel hydrants and to prevent other possible damage, vent air from the hydrant by leaving one of the caps slightly loose as the hydrant is being filled. After all air has escaped, tighten the cap before proceeding.
 3. Apply line pressure.
 4. Check for leakage at flanges, nozzles and operating stem.
 5. If leakage is noted, repair or replace components or complete hydrant until no leaks are evident.
- B. Drainage Test for Dry-Barrel Hydrants
1. Following the pressure test, close hydrant.
 2. Remove one nozzle cap and place pylon or hand over nozzle opening.
 3. Drainage rate should be sufficiently rapid to create a noticeable suction.
 4. After backfilling, operate the hydrant to flush out any foreign material.
 5. Tighten nozzle caps, then back them off slightly so that they will not be excessively tight; leave tight enough to prevent removal by hand.
- C. Paint all hydrant above the bury line in accordance with the local operations standards. Touch up paint (as specified by the OWNER under Special Conditions) shall be applied upon completion of installation as needed. Take extreme care to avoid getting any paint on the "O" ring under the top operating nut or on the hydrant nozzles. Should paint be found on the "O" ring, the Contractor shall remove the paint and replace the "O" ring at his expense. Any paint on the hydrant nozzles shall be removed at the Contractor's expense.

END OF SECTION

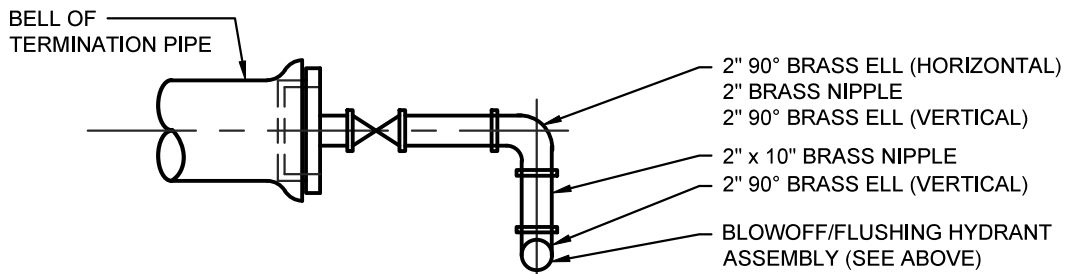
**AMERICAN WATER
STANDARD DETAILS**

NOTES:

1. POLYETHYLENE ENCASING ON ALL D.I. PIPE WHERE REQUIRED.
2. ENCASE OR COAT BRASS AS NEEDED.
3. SEE DWG. NO. SD13 FOR RESTRAINT OF PLUG. PIPE RESTRAINT NOT SHOWN.
4. OPTIONAL CURB BOX FOR VALVE NOT SHOWN.



ELEVATION



SECTION A-A

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
BLOWOFF/FLUSHING HYDRANT ASSEMBLY DETAIL**

DATE: 09-OCT-2019

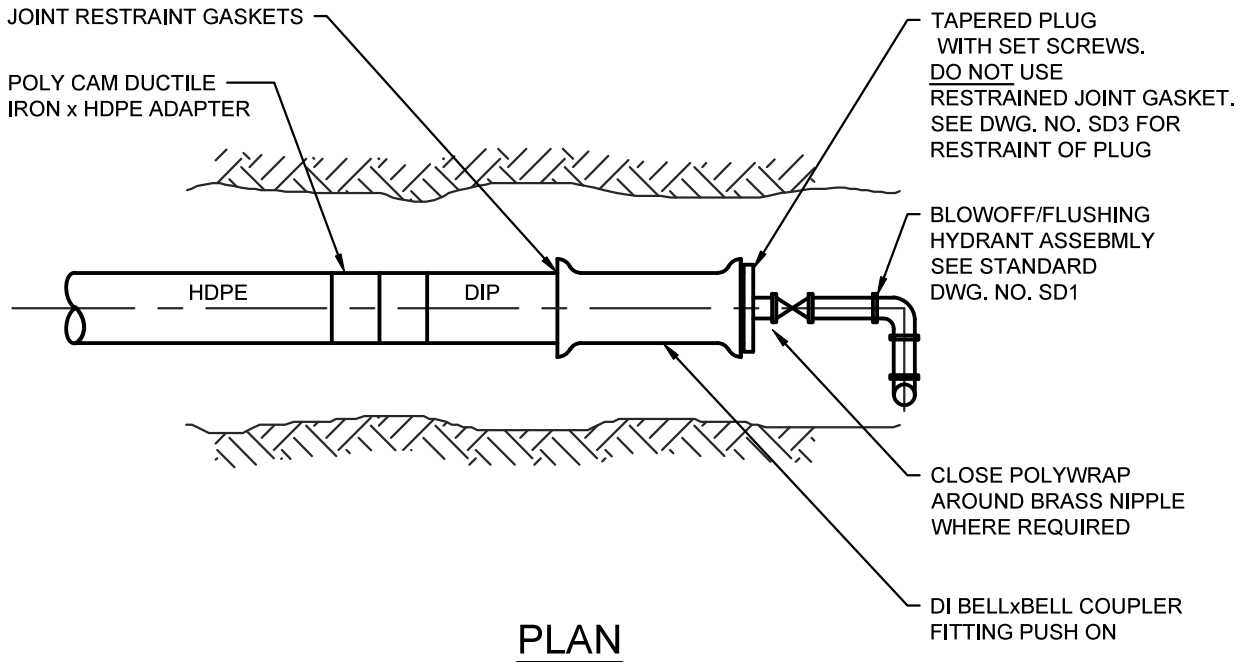
AMERICAN WATER ENGINEERING

SCALE: NTS

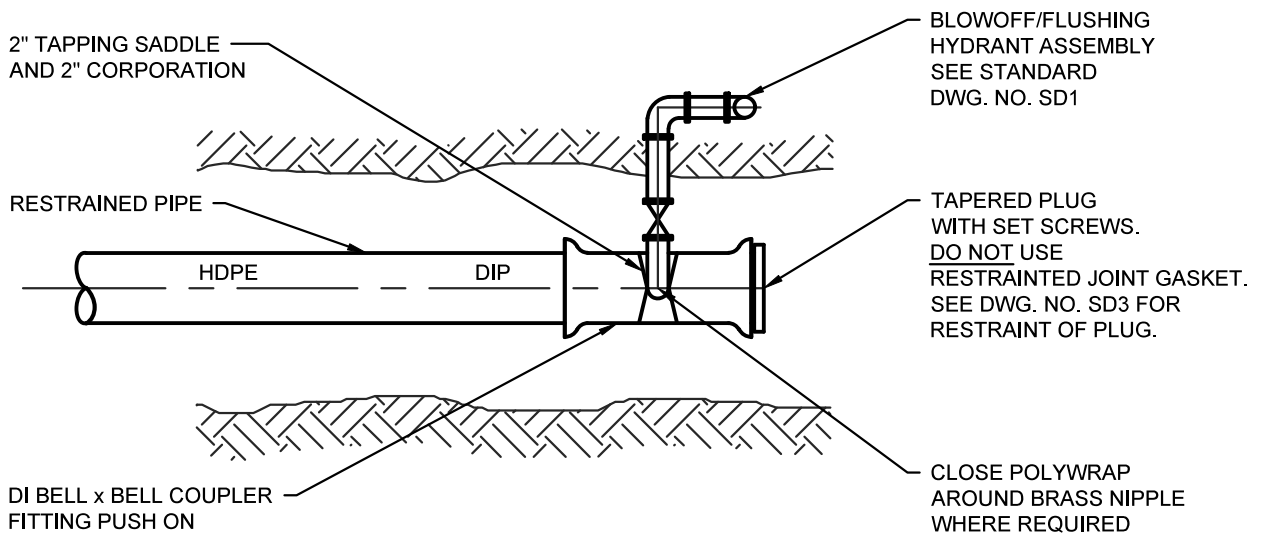
STANDARD DETAILS

APPROVED

SD- 1



PLAN



ALTERNATIVE PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
HDPE FLUSH VALVE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

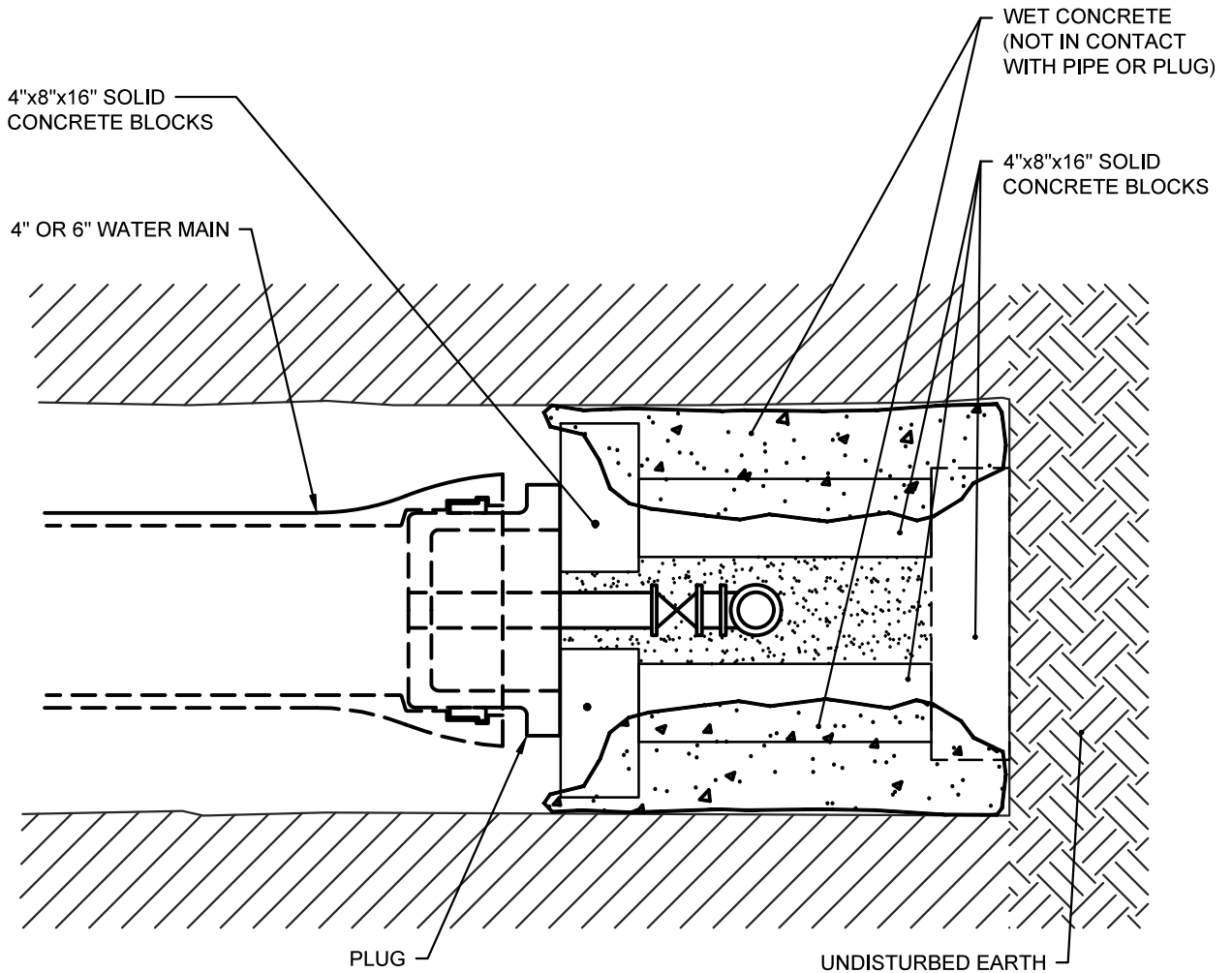
STANDARD DETAILS

APPROVED

SD- 2

NOTES:

1. RESTRAINT OF WATER MAIN PIPE LENGTHS NOT SHOWN.
2. SEE DRAWING SD13 FOR LARGER MAIN SIZES.
3. ALTERNATIVE PLAN USING 2" CORPORATION WITH TAPPING SADDLE PERMITTED WHERE APPROVED BY ENGINEER.



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
BLOCKING AT END OF MAIN WITH BLOW-OFF DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

STANDARD DETAILS

APPROVED

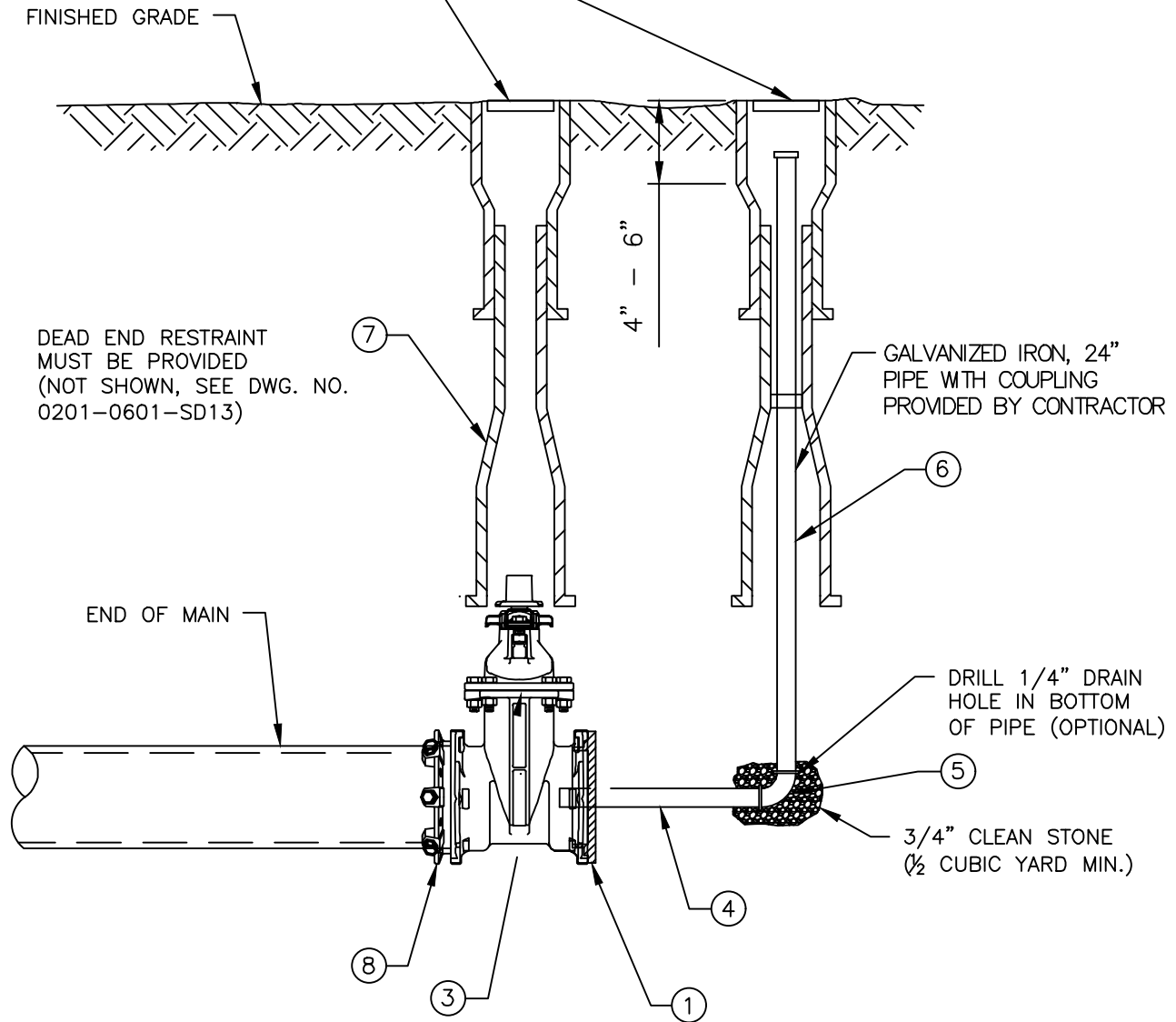
SD- 3

NOTES

- IF LOCATED OUTSIDE OF PAVEMENT, BOTH VALVE BOXES MAY BE REPLACED WITH SINGLE METER BOX (SEE NO. 0201-0601-SD47)

SEE DWG. NO. 0201-0601-SD61 FOR TYPICAL VALVE BOX INSTALLATION DETAIL

| NUMBER | PART ID | DESCRIPTION |
|--------|---------|---------------------------------------|
| 1 | 1407833 | 6" MJ PLUG W/ 2' TAP |
| 2 | 1600040 | NIPPLE, IMPORT, NL, 2X6 |
| 3 | 1407975 | 6" MJ GATE VALVE |
| 4 | 1600043 | NIPPLE, IMPORT, NL, 2X12 |
| 5 | 1601043 | BEND, 90, IMPORT, NL, FIP, 2 |
| 6 | | GI RISER PIPE |
| 7 | 1405593 | 5 1/4" X 15" ADJUSTABLE VALVE BOX TOP |
| | 1405529 | 5 1/4" VALVE BOX BONNET |
| | 1405531 | 5 1/4" ADJUSTABLE VALVE BOX MIDDLE |
| | 1409358 | 5 1/4" VALVE BOX LID |
| 8 | | MEGALUG FOR PLUG-PIPE RESTRAINT |



REVISIONS

AMERICAN WATER STANDARD
CIVIL
2" BLOW-OFF AT END OF MAIN
DETAIL

AMERICAN WATER
VOORHEES, NJ 08043

AMERICAN WATER ENG. CENTER
213 CARRIAGE LANE
DELRAN, NJ 08075



DRAWN BY RJB
PROJECT ENGR
APPROVED

DATE 10-02-07
PROJECT IP

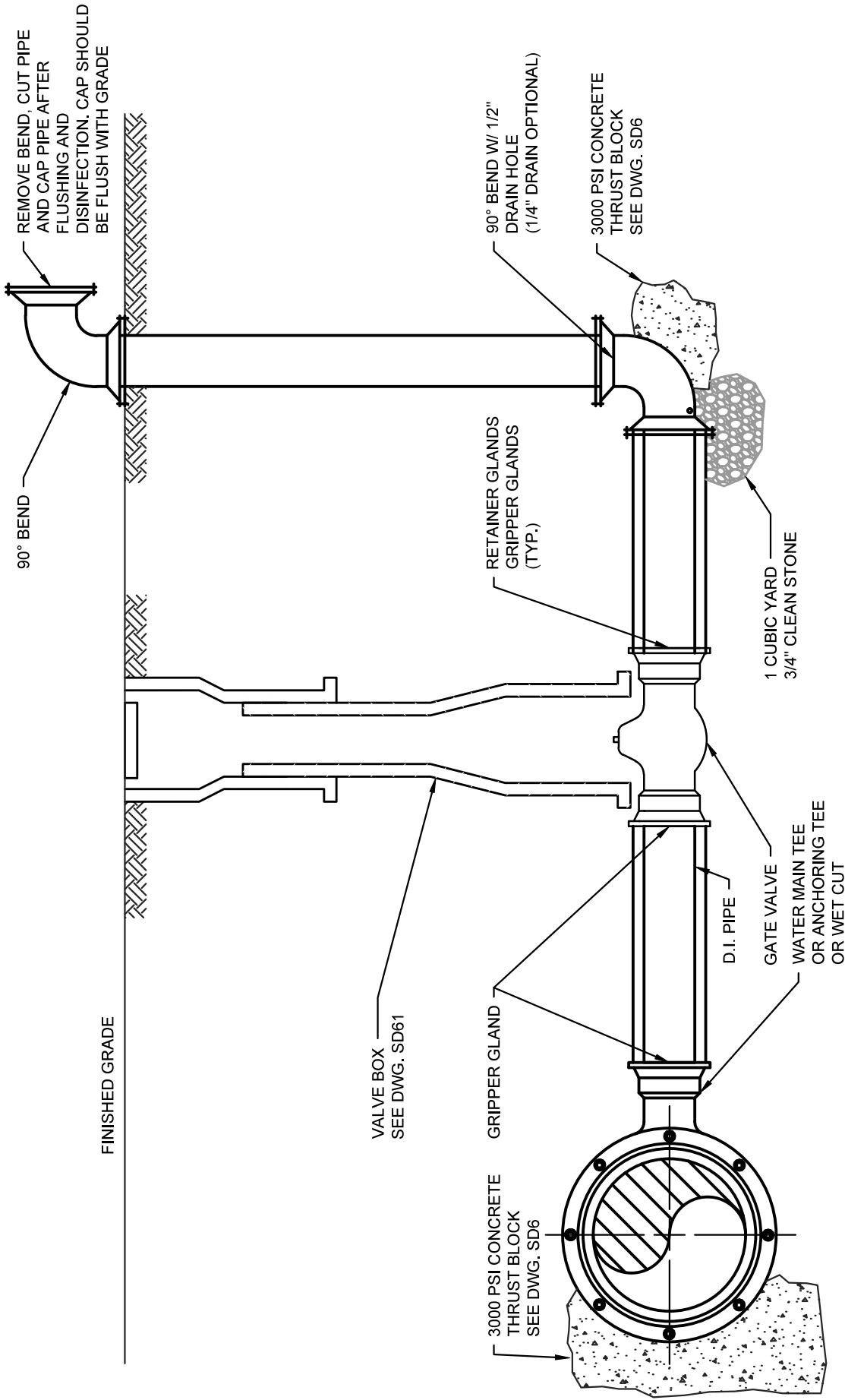
USE DIMENSIONS ONLY
SCALE N.T.S.

USE APPROVED DRAWINGS ONLY
FOR CONSTRUCTION PURPOSES

0201-0601-SD4

FOR COMMENTS

0201-0601-SD4



AMERICAN WATER ENGINEERING
 1 WATER STREET
 CAMDEN, NJ 08102



AMERICAN WATER

**AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 4" OR 6" BLOW-OFF ASSEMBLY DETAIL**

NOTES:

WHERE PERMITTED BY ENGINEER,
 GATE VALVE MAY BE FLANGEXMJ
 WITH FLANGE END BOLTED DIRECTLY
 TO FLANGE FACE TEE.

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

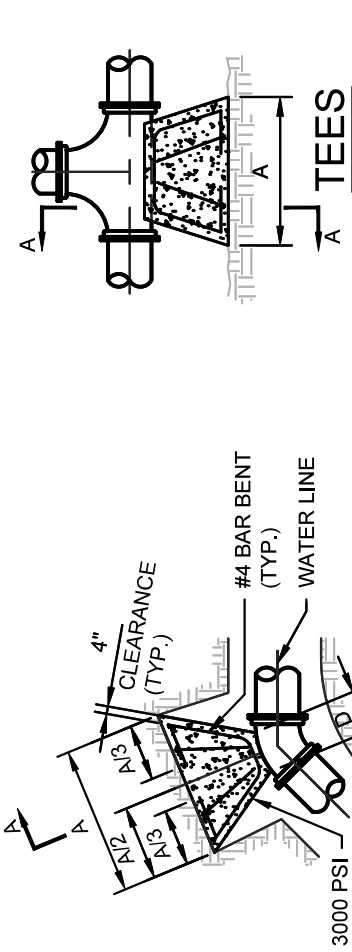
STANDARD DETAILS

APPROVED

SD-5

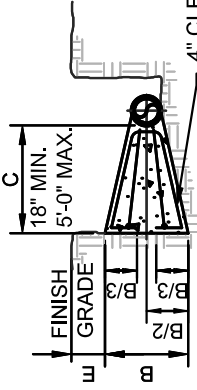
NOTES:

- COVER TOP OF PIPE SHALL BE BELOW FROST LINE OR 30" MINIMUM, 72" MAXIMUM ACCORDING TO REGULATORY REQUIREMENTS. IF GRADING PLANS RECEIVED BY THE ENGINEER/OWNER WITH THE REQUEST FOR WATER MAIN LAYOUT, INDICATE ADJUSTMENTS TO EXISTING GRADE, THEN PIPE SHALL BE INSTALLED TO MEET MINIMUM AND MAXIMUM COVER FROM PROPOSED GRADES SHOWN ON SAID PLANS.
- THRUST BLOCKS SHALL BE BUILT AGAINST UNDISTURBED SOIL WITH ADEQUATE BACKING TO PREVENT MOVEMENT OF FITTING. WHERE IT IS NOT POSSIBLE, THE FILL BETWEEN THE BEARING SURFACE AND UNDISTURBED SOIL MUST BE COMPACTED TO AT LEAST 90% STANDARD PROCTOR DENSITY. E
- NO THRUST BLOCKS TO BE PLACED IN SEWER LATERAL DITCHES.
- THRUST BLOCKING MUST FIT IN EASEMENT, IN SOME CASES ADDITIONAL RESTRAINT MAY BE REQUIRED.
- BASED ON 200 PSI (150 PSI STATIC PRESSURE PLUS 50 PSI WATER HAMMER) AND 2000 PSF SOIL BEARING. CONSULT ENGINEER FOR ADJUSTMENTS.
- POLYETHYLENE ENCASEMENT ON ALL D.I. PIPE AND FITTINGS.
- PIPE JOINTS AND BOLTS MUST BE ACCESSIBLE.
- ALLOW SUFFICIENT CLEARANCE BETWEEN CONCRETE AND BOLTS FOR FUTURE MAINTENANCE.
- ALL ANCHOR BOLTS SHALL BE COR-BLUE, MINIMUM 1/2" DIAMETER. COAT EXPOSED ROD WITH ASPHALT CEMENT AFTER CONCRETE HAS SET.
- ALL M.J. AND FLG. FITTINGS TO RECEIVE THRUST BLOCKS SHALL HAVE THE FASTENER AREAS FELT WRAPPED AND TAPED PRIOR TO THE CONCRETE POUR TO ALLOW FUTURE ACCESS TO THE FASTENERS AT THE JOINTS.
- THRUST BLOCKING DETAILS ARE SHOWN HERE FOR TYPICAL INSTALLATIONS. IN SOME CASES, ADDITIONAL RESTRAINT MAY BE REQUIRED.
- PORTLAND CEMENT CONCRETE USED FOR THRUST BLOCKS SHALL BE MIN 3000 PSI CONCRETE.
- FOR UNSTABLE SOIL CONDITIONS, CHECK WITH ENGINEER FOR THRUST BLOCK DIMENSIONS.
- FOR MAIN SIZES GREATER THAN 36", SEE ENGINEER FOR THRUST BLOCK DIMENSIONS.



- A. = WIDTH OF THRUST BLOCK
 B. = HEIGHT OF THRUST BLOCK
 C. = B OR 18", WHICHEVER IS GREATER. SPECIAL DESIGN REQUIRED IF GREATER THAN 5'-0".
 D. = DIAMETER OF PIPE
 E. = B OR 24", WHICHEVER IS GREATER.

BENDS



SECTION A-A

REQUIRED BEARING AREA ON UNDISTURBED SOIL AND TYPICAL THRUST BLOCK DIMENSIONS

| NOMINAL PIPE SIZE | 90 DEGREE BENDS | | | 45 DEGREE BENDS | | | 22.5 DEGREE BENDS | | | 11.25 DEGREE BENDS | | | TEES/PLUGS | | |
|-------------------|-----------------|----------------|-----------------|-----------------|----------------|-----------------|-------------------|----------------|-----------------|--------------------|----------------|-----------------|--------------|----------------|-----------------|
| | AREA (sq ft) | WIDTH (A) (in) | HEIGHT (B) (in) | AREA (sq ft) | WIDTH (A) (in) | HEIGHT (B) (in) | AREA (sq ft) | WIDTH (A) (in) | HEIGHT (B) (in) | AREA (sq ft) | WIDTH (A) (in) | HEIGHT (B) (in) | AREA (sq ft) | WIDTH (A) (in) | HEIGHT (B) (in) |
| 6 | 7.0 | 46 | 23 | 3.8 | 34 | 17 | 2.0 | 24 | 12 | 1.0 | 18 | 9 | 5.0 | 38 | 19 |
| 8 | 12.5 | 60 | 30 | 6.8 | 46 | 23 | 3.4 | 34 | 32 | 1.6 | 1.7 | 24 | 8.8 | 52 | 26 |
| 10 | 19.1 | 76 | 38 | 10.3 | 56 | 28 | 5.3 | 40 | 20 | 2.7 | 2.8 | 14 | 13.5 | 64 | 32 |
| 12 | 27.1 | 90 | 45 | 14.7 | 66 | 33 | 7.5 | 48 | 24 | 3.8 | 3.4 | 17 | 19.2 | 76 | 38 |
| 14 | 36.6 | 104 | 52 | 19.8 | 76 | 38 | 10.1 | 54 | 27 | 5.1 | 4.0 | 20 | 25.5 | 88 | 44 |
| 16 | 47.4 | 118 | 59 | 25.6 | 86 | 43 | 13.1 | 62 | 31 | 6.6 | 4.4 | 22 | 33.5 | 100 | 50 |
| 18 | 59.7 | 132 | 66 | 32.3 | 98 | 49 | 16.5 | 70 | 35 | 8.3 | 5.0 | 25 | 42.2 | 112 | 56 |
| 20 | 73.3 | 146 | 73 | 39.7 | 108 | 54 | 20.2 | 78 | 39 | 10.2 | 5.6 | 28 | 51.5 | 124 | 62 |
| 24 | 104.8 | 174 | 87 | 56.7 | 138 | 64 | 28.9 | 92 | 46 | 14.5 | 6.6 | 33 | 74.1 | 148 | 74 |
| 30 | 160.3 | 215 | 108 | 86.8 | 180 | 82 | 44.2 | 114 | 57 | 22.2 | 8.2 | 41 | 113.4 | 182 | 91 |
| 36 | 230.3 | 258 | 129 | 124.7 | 190 | 95 | 63.6 | 136 | 68 | 31.9 | 9.6 | 48 | 162.9 | 218 | 109 |

- NOTES:**
- AREA IN SQUARE FEET, WIDTH (A) AND HEIGHT (B) IN INCHES
 - AREA IS BASED ON 200 PSI MAXIMUM WATER PRESSURE AND SOIL BEARING CAPACITY OF 2000 LB/SQUARE FOOT
 - FOR HIGHER WATER PRESSURES OF LOWER BEARING CAPACITIES, CONSULT ENGINEER FOR ADJUSTMENT
 - TABLE INCLUDES SAFETY FACTOR = 1.5
 - ADDITIONAL SAFETY FACTOR AND/OR BEARING AREA MAY BE REQUIRED AS DIRECTED BY THE ENGINEER


AMERICAN WATER ENGINEERING
 1 WATER STREET
 CAMDEN, NJ 08102

AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 THRUST BLOCK DETAIL

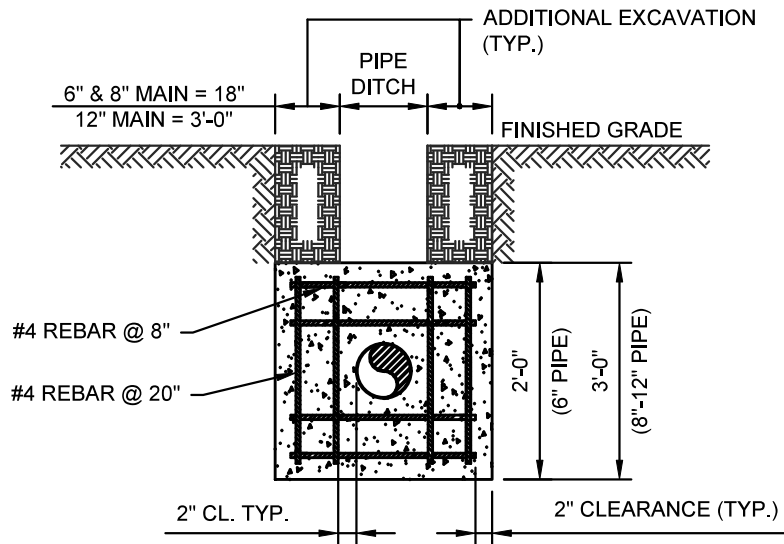
DATE: 09-OCT-2019
 STANDARD DETAILS
 AMERICAN WATER ENGINEERING
 APPROVED

SCALE: AS SHOWN
 SD-6

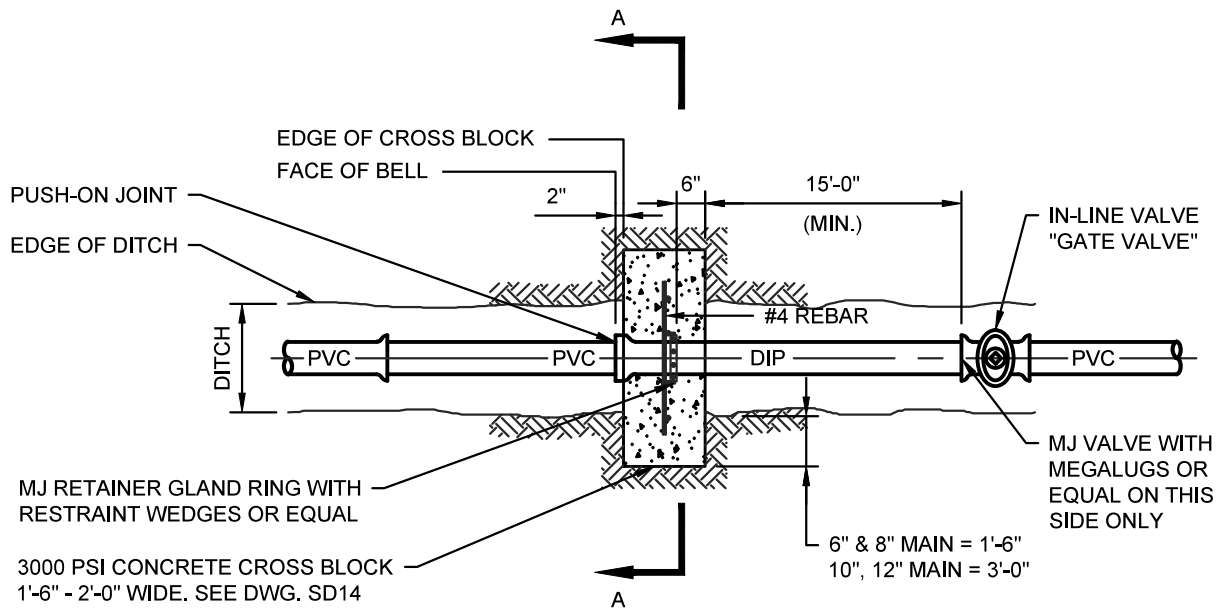
NOTES:

 UNDISTURBED SOIL

1. ONE RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS
3. CENTER BLOCK ON PIPE.



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
IN-LINE VALVE BLOCKING FOR PVC WATER MAIN DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

STANDARD DETAILS

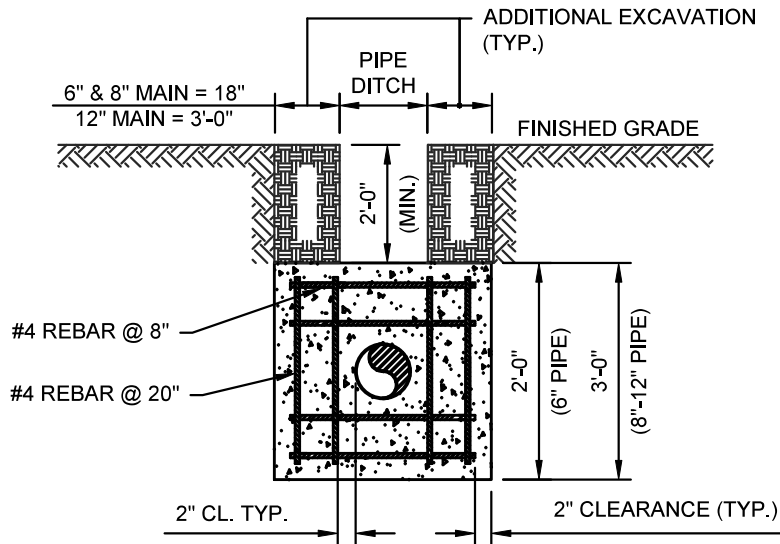
APPROVED

SD-7

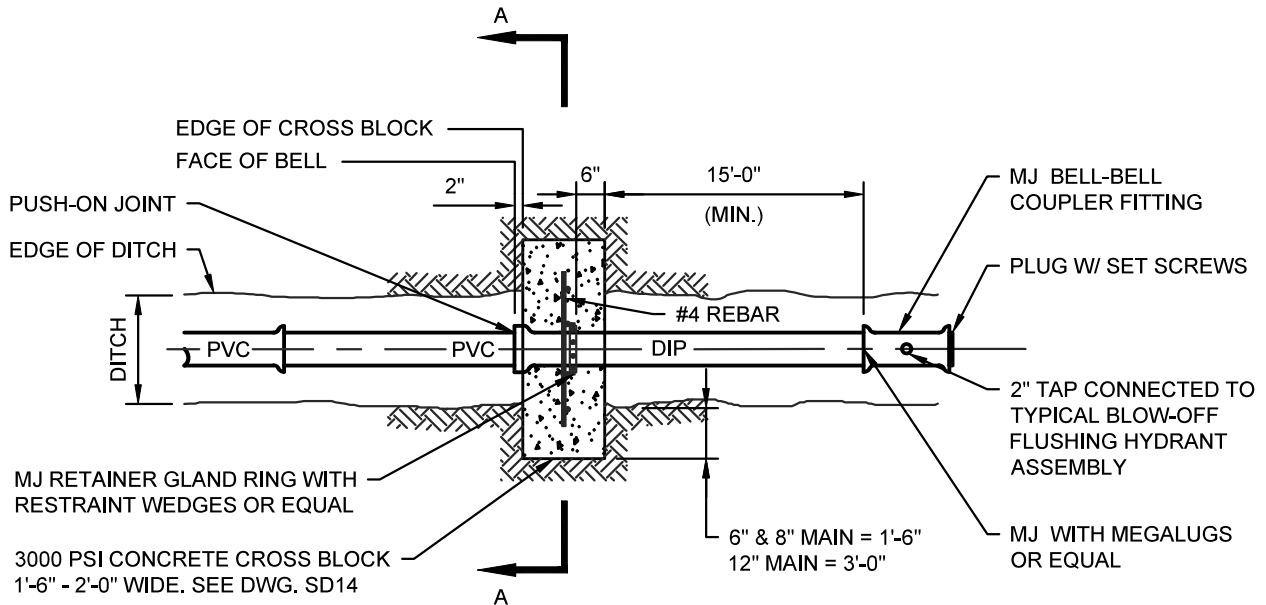
NOTES:

 UNDISTURBED SOIL

1. RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS.
3. CENTER BLOCK ON PIPE



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DEAD-END PVC x DIP BLOCKING METHOD DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

STANDARD DETAILS

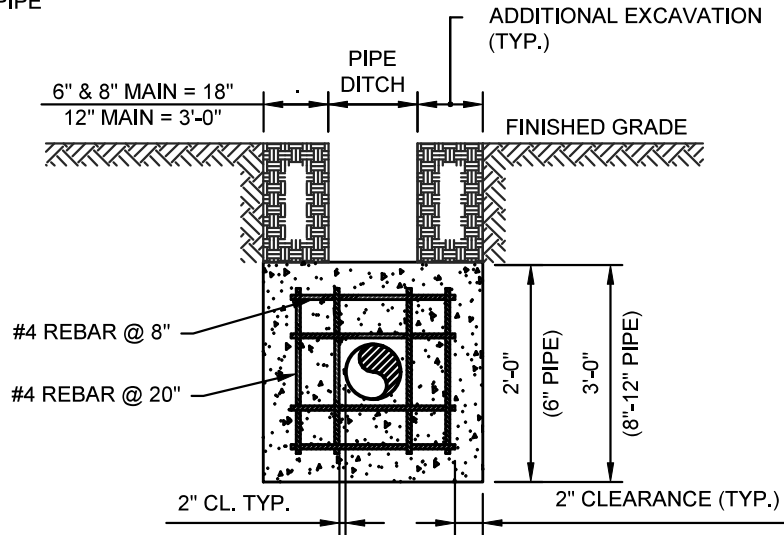
APPROVED

SD- 8

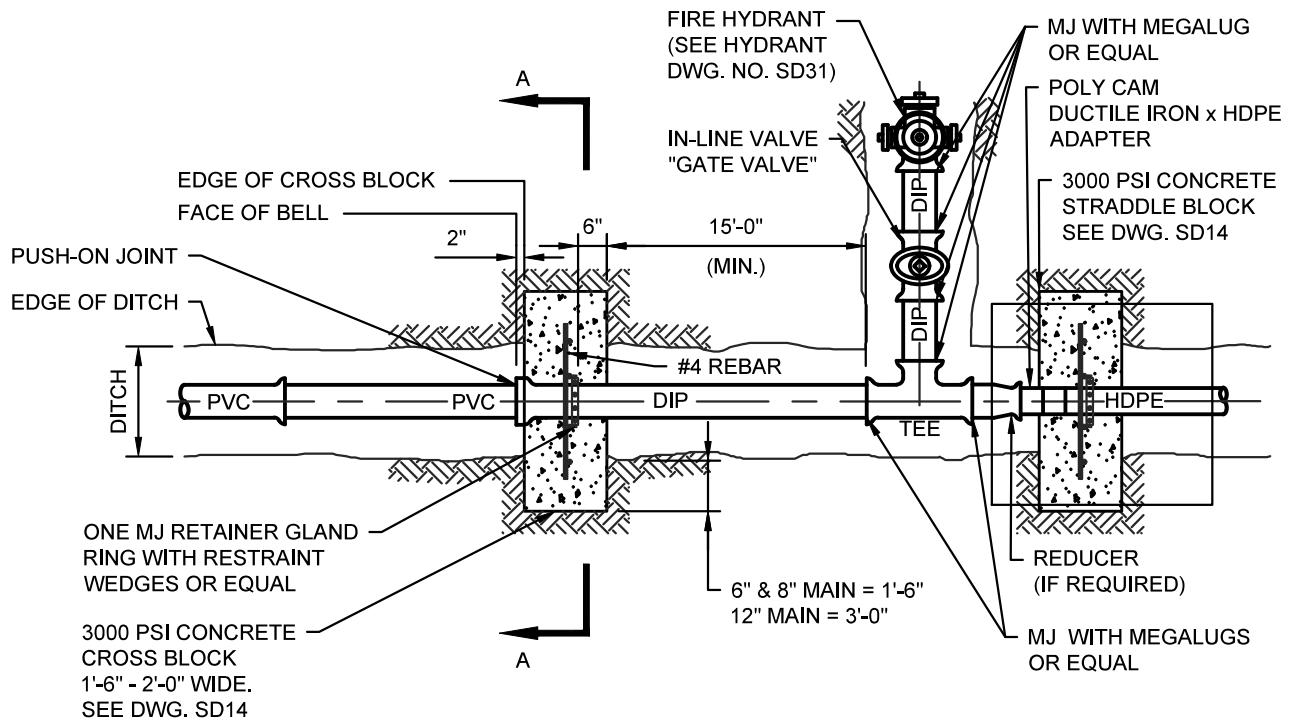
NOTES:

 UNDISTURBED SOIL

1. RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS.
3. CENTER BLOCK ON PIPE



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PVC x HDPE TRANSITION DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

STANDARD DETAILS

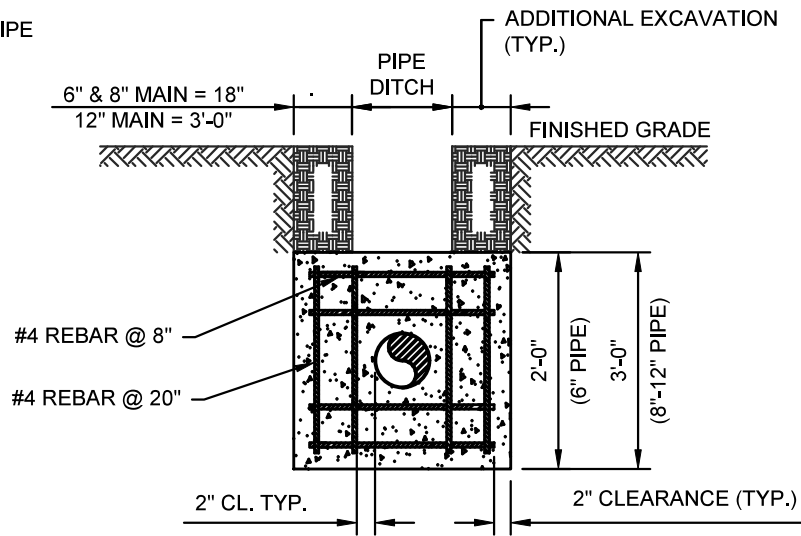
APPROVED

SD- 9

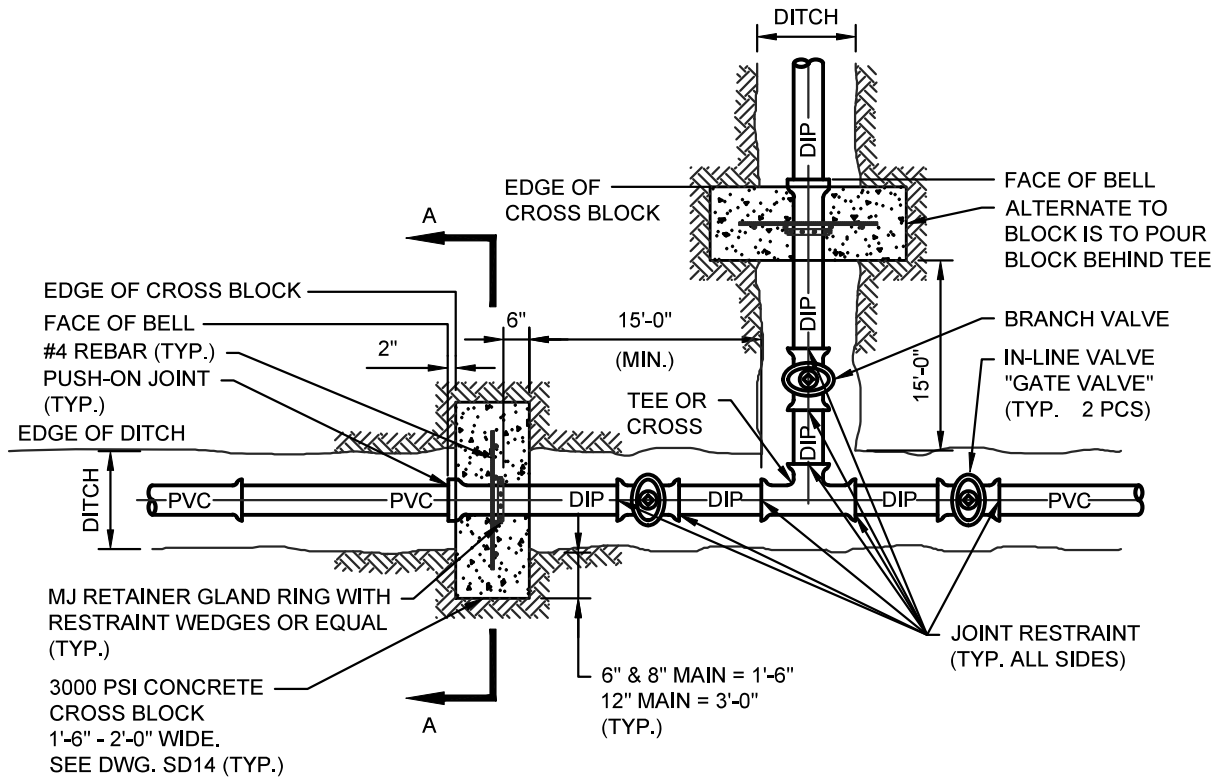
NOTES:

 **UNDISTURBED SOIL**

1. RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS.
3. CENTER BLOCK ON PIPE



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DOUBLE IN-LINE x BRANCH VALVE BLOCKING DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

STANDARD DETAILS

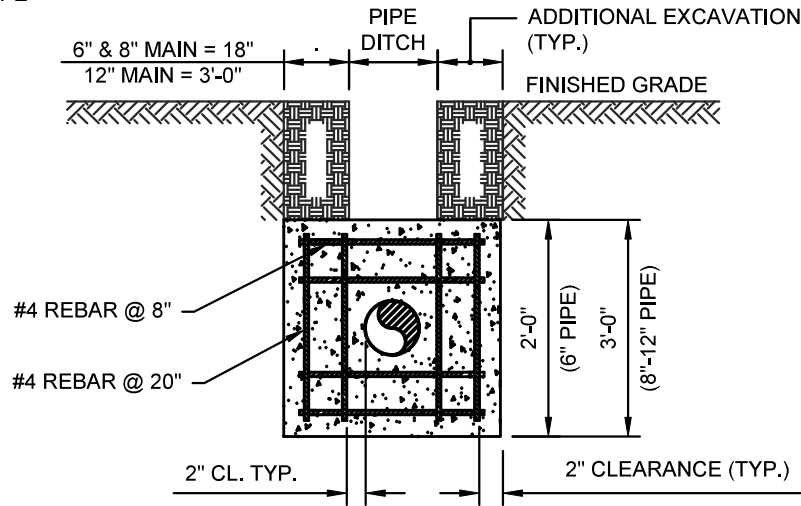
APPROVED

SD- 10

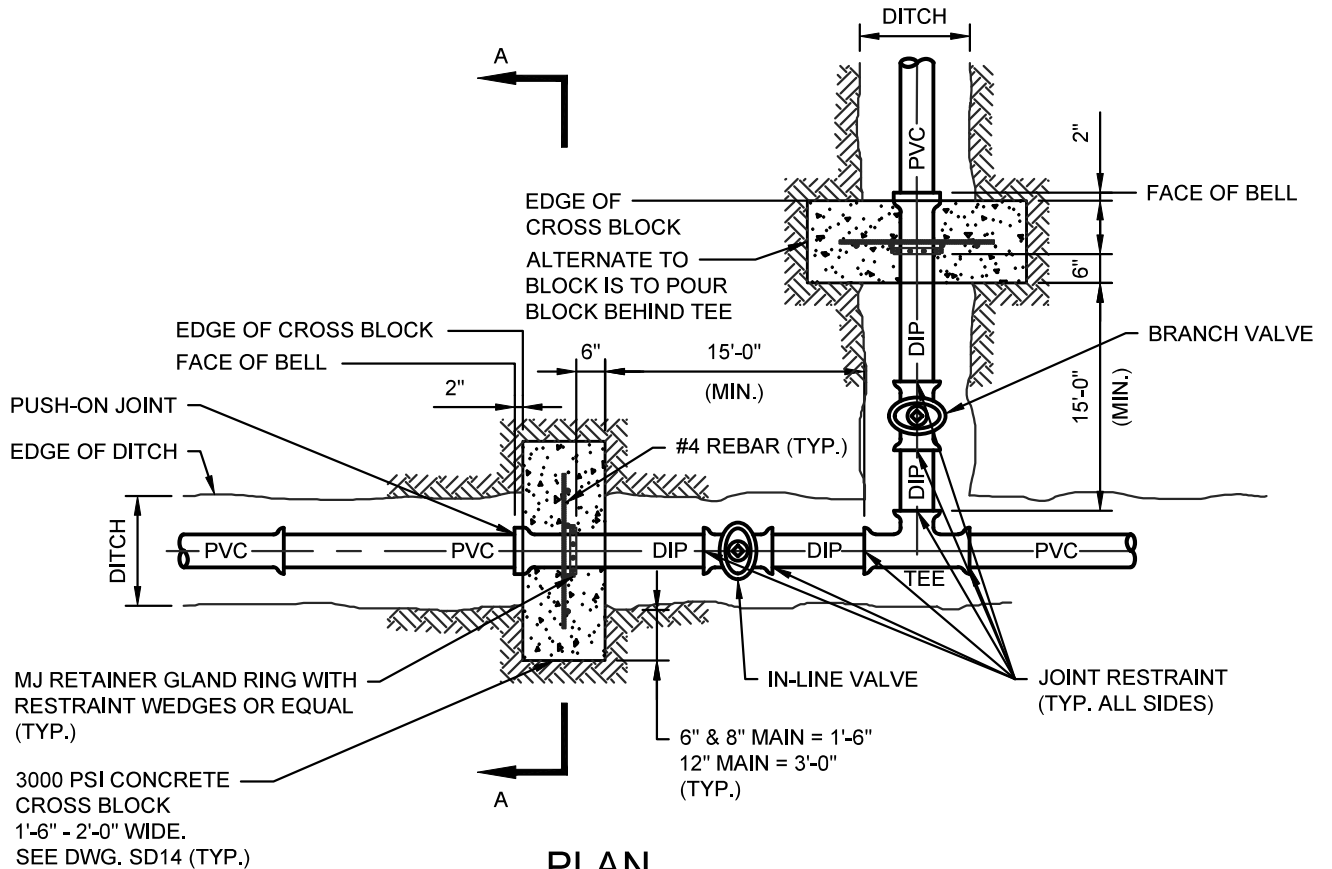
NOTES:

 **UNDISTURBED SOIL**

1. RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. ALL VALVES MUST BE RESTRAINED BACK TO CROSS BLOCKS.
3. CENTER BLOCK ON PIPE



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
IN-LINE x BRANCH VALVE BLOCKING DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

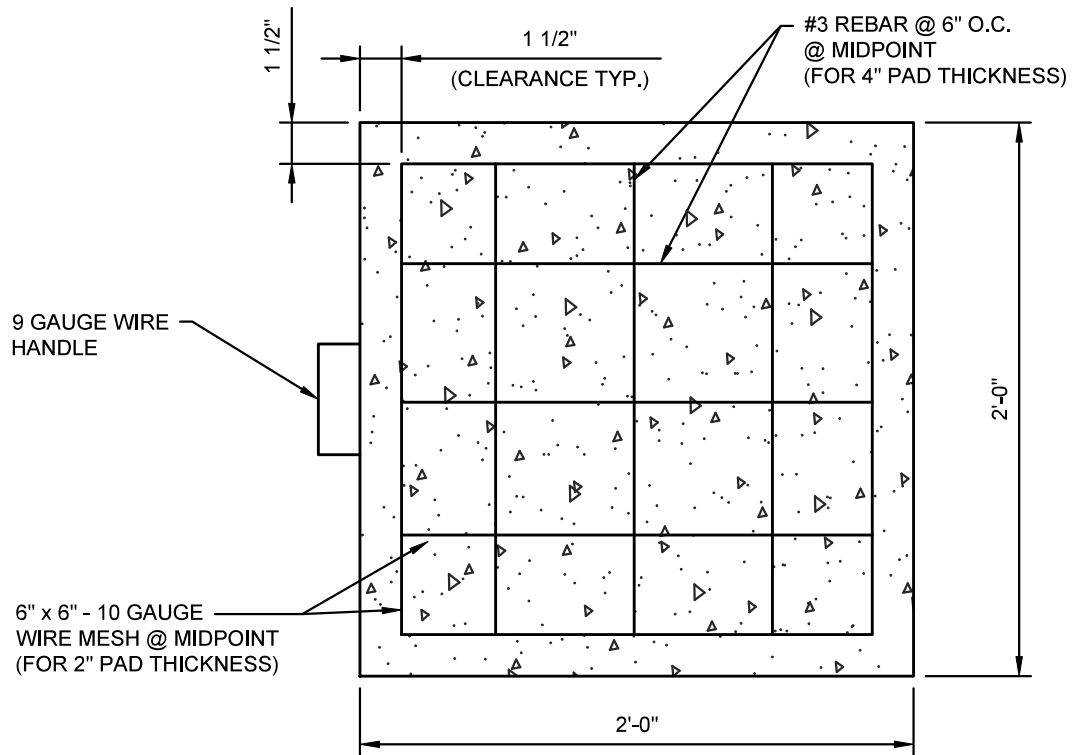
STANDARD DETAILS

APPROVED

SD- 11

NOTES:

1. PAD THICKNESS = 2" OR 4"
2. PROVIDE CERTIFICATION OF REINFORCING WIRE AS REQUIRED.
3. PORTLAND CEMENT CONCRETE USED FOR PAD SHALL BE MIN. 3000 PSI CONCRETE.



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PREFAB. STEEL REINFORCED CONCRETE BLOCKING PAD DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING


SCALE: NTS

STANDARD DETAILS

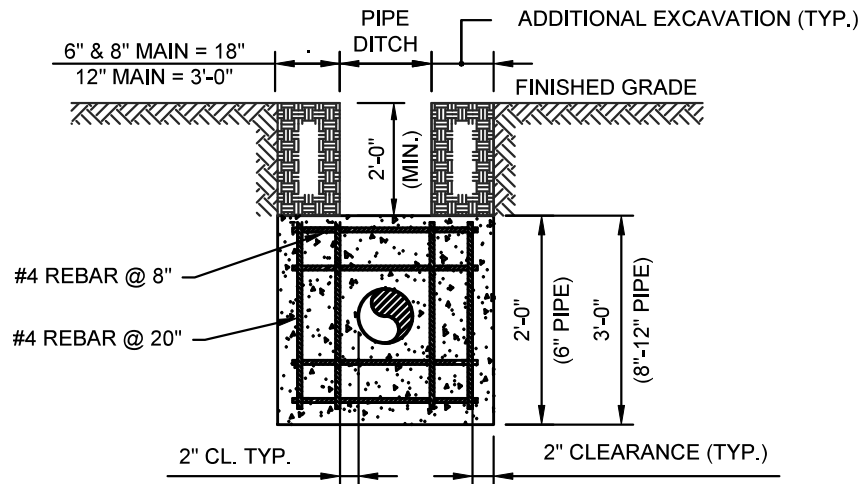
APPROVED

SD- 12

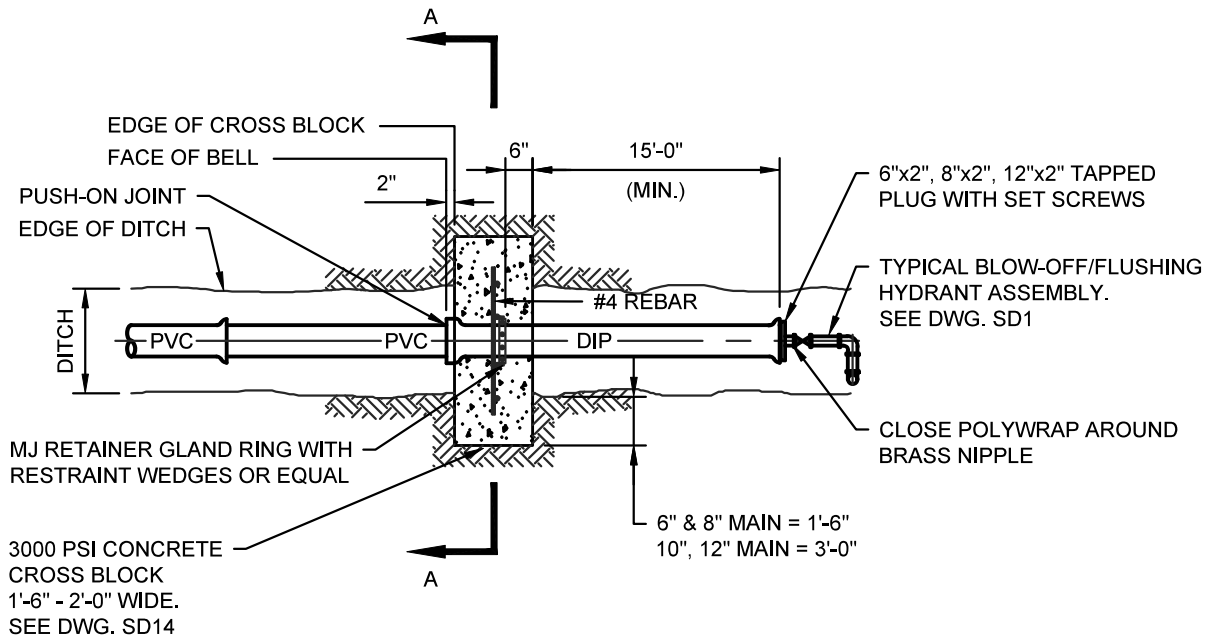
NOTES:

 UNDISTURBED SOIL

1. ONE RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS.
3. CENTER BLOCK ON PIPE



SECTION A-A



PLAN

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DEAD-END AND CROSS BLOCKING DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

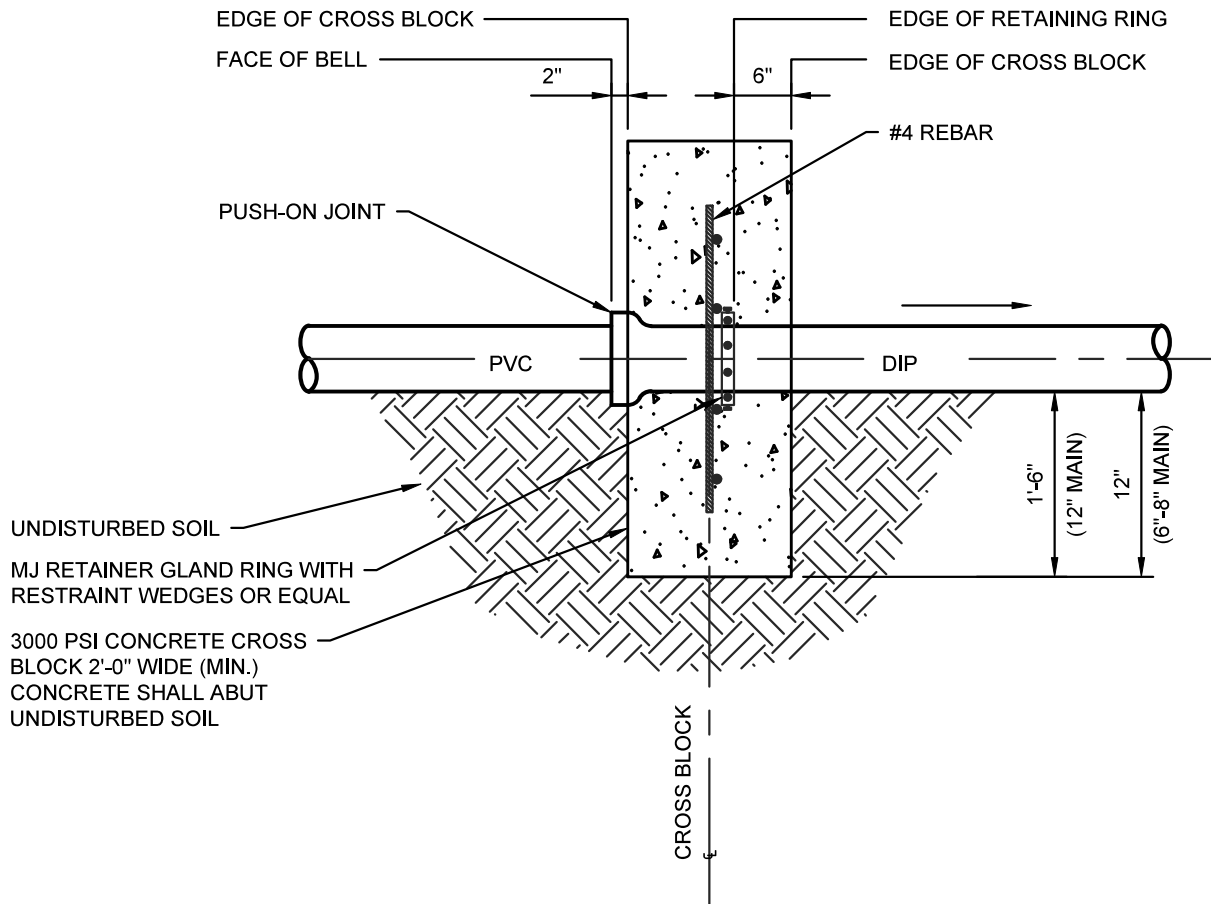
STANDARD DETAILS

APPROVED

SD- 13

NOTES:

1. ONE RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. PVC PIPE RESTRAINT REQUIRED IN DIRECTION AWAY FROM CROSS BLOCK NOT SHOWN.
3. PORTLAND CEMENT CONCRETE USED FOR CROSS BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.



CROSS BLOCK SIDE VIEW
CROSS BLOCK KEYED INTO BOTTOM OF DITCH

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CROSS BLOCK SIDE VIEW DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

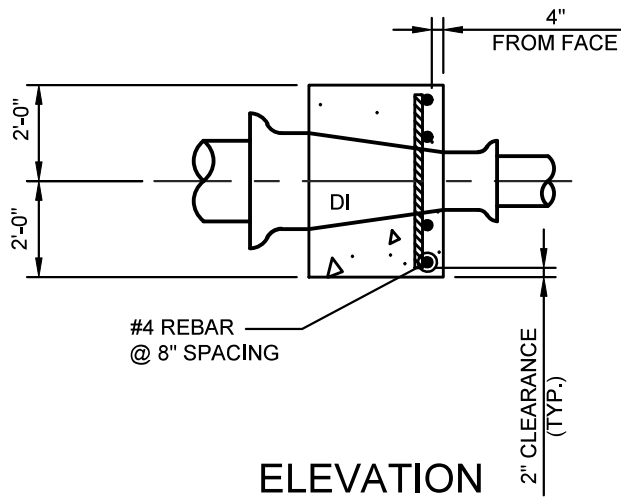
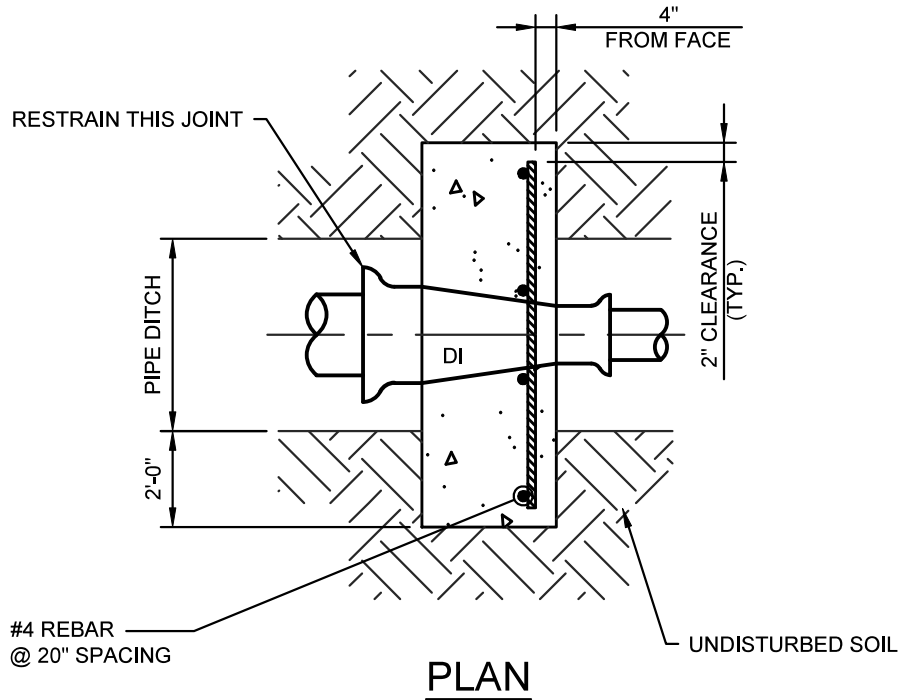
STANDARD DETAILS

APPROVED

SD- 14

NOTES:

1. ONLY BELL TO BELL REDUCERS ARE ACCEPTABLE.
2. THE JOINT BETWEEN THE LARGE END OF THE REDUCER AND FOLLOWING PIPE SHOULD BE RESTRAINED AS WELL.
3. AVOID USE OF MEGALUGS ON DIP FITTINGS IN CONCRETE.
4. PORTLAND CEMENT CONCRETE USED FOR THRUST BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.



AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
REDUCER THRUST BLOCK DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: NTS

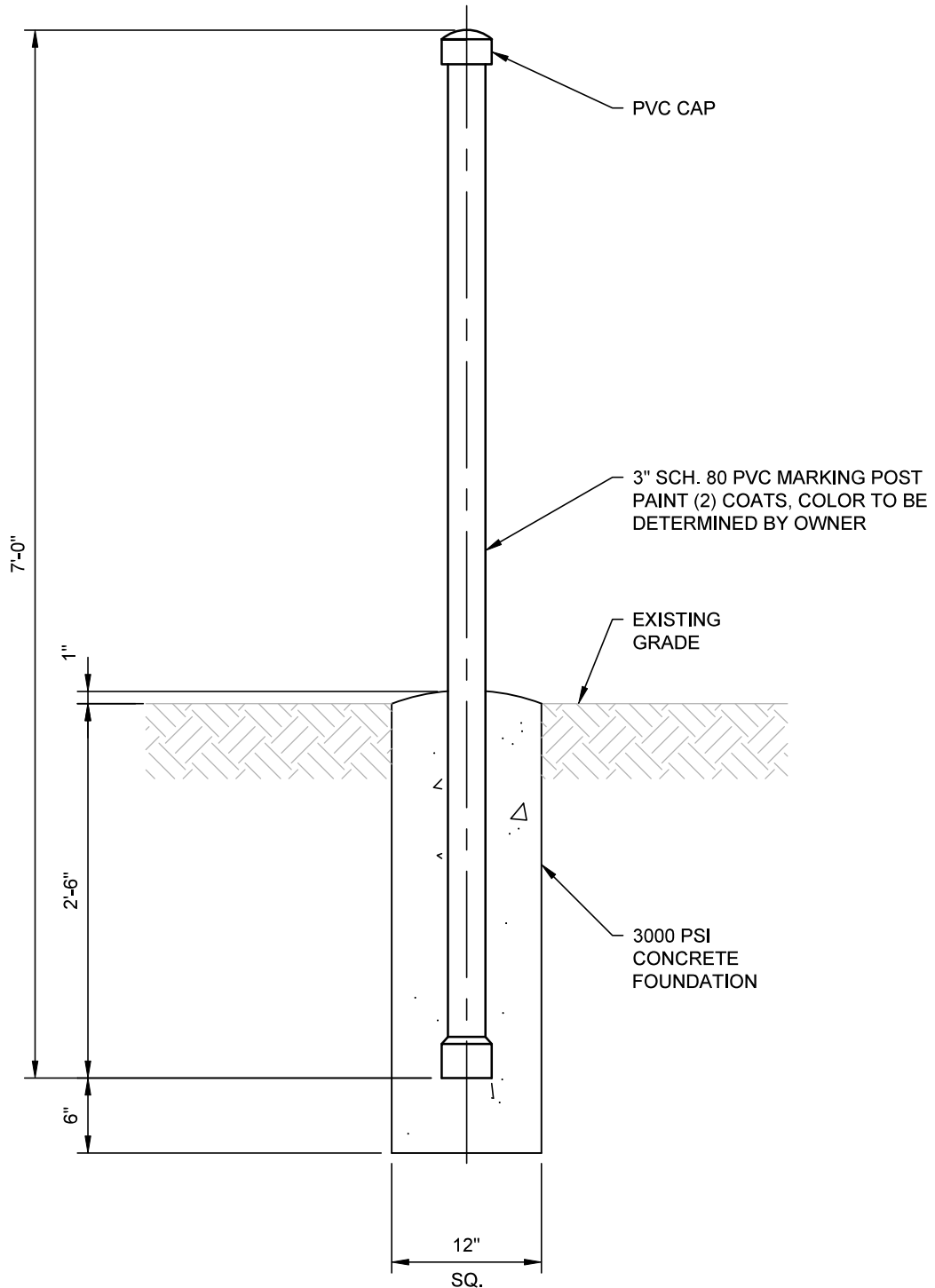
STANDARD DETAILS

APPROVED

SD- 15

NOTE:

DO NOT LOCATE POST DIRECTLY ABOVE MAIN



AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
VALVE MARKING POST DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

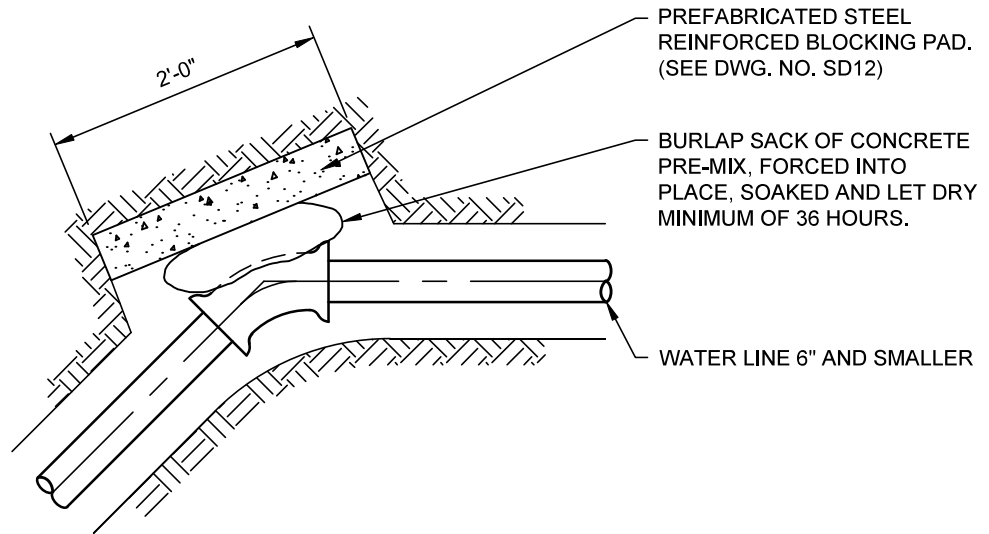
STANDARD DETAILS

APPROVED

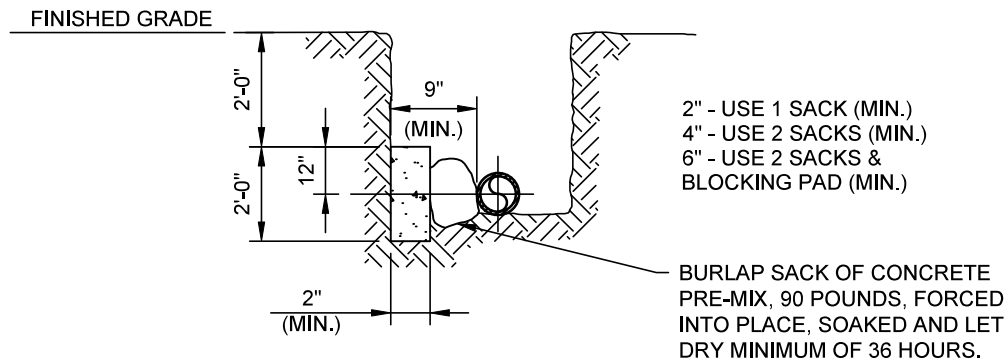
SD- 16

NOTES:

1. FOR BLOCKING OF PIPE SIZES 8" AND LARGER, SEE
DETAIL DRAWING SD6
2. FOR BLOCKING OF PIPE SIZES 6" AND SMALLER,
SUBJECT TO APPROVAL BY ENGINEER.
3. PORTLAND CEMENT CONCRETE USED FOR CROSS
BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.



PLAN



ELEVATION

(FOR 2", 4", AND 6" DIA. PIPE ONLY)

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
THRUST BLOCK AT HORIZONTAL BENDS DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

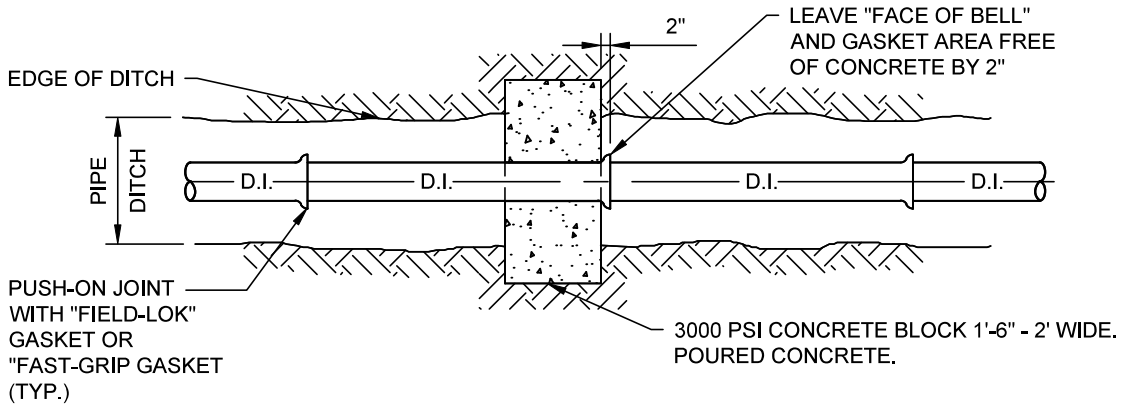
STANDARD DETAILS

APPROVED

SD- 17

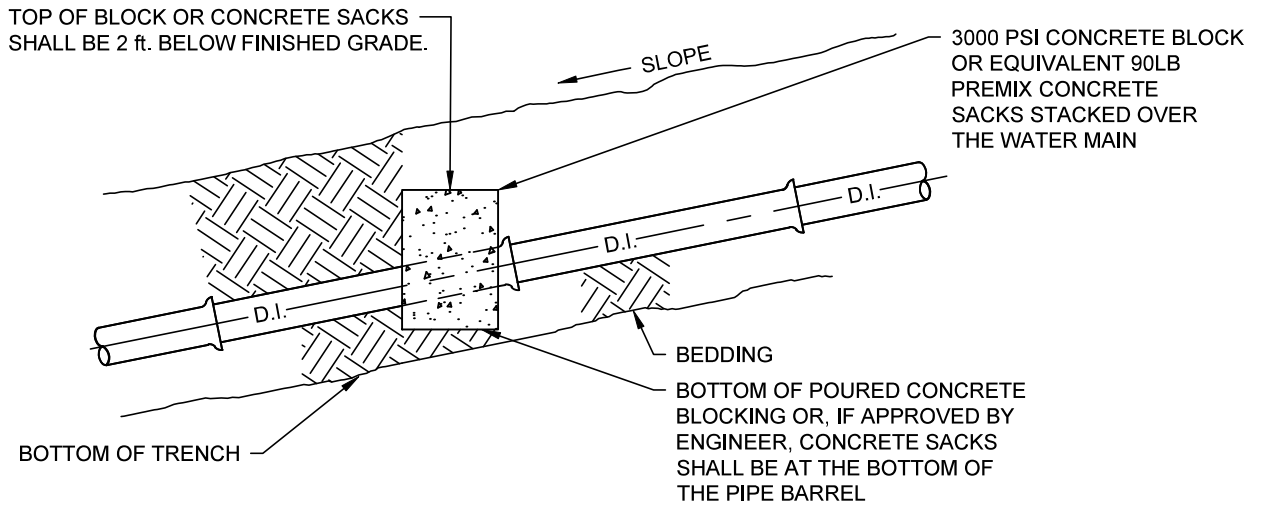
NOTE:

FIELD-LOK GASKET IS THE PREFERRED OPTION OF RESTRAINED JOINT.



DITCH CHECK FOR SLOPES
GREATER THAN 3.5:1

PLAN



ELEVATION

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DITCH CHECK FOR SLOPES GREATER THAN 3.5:1 DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

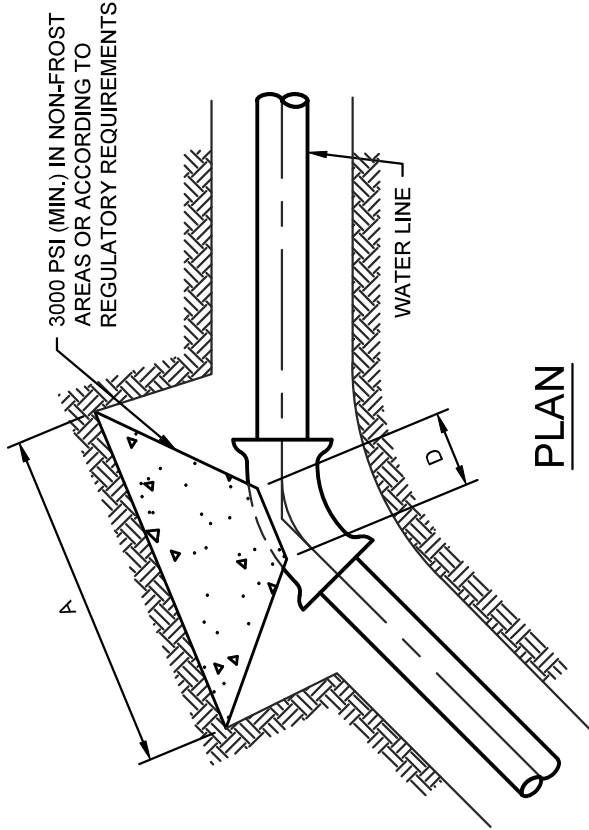
APPROVED

SD- 18

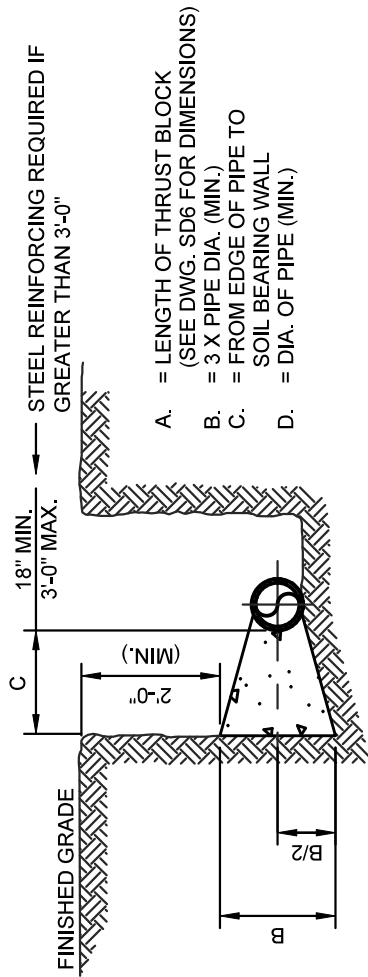
GENERAL NOTES:

1. COVER OVER TOP OF PIPE SHALL BE BELOW FROST LINE OR MINIMUM 30" IN NON-FROST AREAS OR ACCORDING TO REGULATORY REQUIREMENTS. IF GRADING PLANS RECEIVED BY THE ENGINEER/OWNER WITH THE REQUEST FOR WATER MAIN LAYOUT, INDICATE ADJUSTMENTS TO EXISTING GRADE, THEN PIPE SHALL BE INSTALLED TO MEET MINIMUM AND MAXIMUM COVER FROM PROPOSED GRADES SHOWN ON SAID PLANS.
2. THRUST BLOCKS SHALL BE BUILT AGAINST UNDISTURBED SOIL WITH ADEQUATE BACKING TO PREVENT MOVEMENT OF FITTING.
3. NO THRUST BLOCKS TO BE PLACED IN SEWER LATERAL DITCHES.
4. THRUST BLOCKING MUST FIT IN EASEMENT, IN SOME CASES ADDITIONAL RESTRAINT MAY BE REQUIRED.
5. DIMENSION "C" BASED ON MINIMUM BEARING AREA. 18" MINIMUM.
6. POLYETHYLENE ENCASEMENT ON ALL D.I. PIPE AND FITTINGS.
7. PIPE JOINTS AND BOLTS MUST BE ACCESSIBLE.
8. ALL ANCHOR BOLTS SHALL BE COR-BLUE. MINIMUM 1/2" DIAMETER. COAT EXPOSED ROD WITH APPROVED MATERIAL AFTER CONCRETE HAS SET.
9. ALLOW SUFFICIENT CLEARANCE BETWEEN CONCRETE AND BOLTS FOR FUTURE MAINTENANCE.
10. ALL M.J. AND FLG. FITTINGS TO RECEIVE THRUST BLOCKS SHALL HAVE THE FASTENER AREAS KEPT FREE OF CONCRETE TO ALLOW FUTURE ACCESS TO THE FASTENERS AT THE JOINTS.
11. THRUST BLOCKING DETAILS ARE SHOWN HERE FOR TYPICAL INSTALLATIONS. IN SOME CASES, ADDITIONAL RESTRAINT MAY BE REQUIRED.
12. PORTLAND CEMENT CONCRETE USED FOR THRUST BLOCKS SHALL BE 3000 PSI CONCRETE (MIN.).

* BEARING AREAS ARE BASED ON SOIL HAVING AN ALLOWABLE SAFE LATERAL BEARING OF 2000 LBS/SQ.FT. & 200 PSI TEST PRESSURE. AREA MUST BE REVISED FOR SOILS WITH A LOWER BEARING CAPACITY OR HIGHER TEST PRESSURE.



PLAN



ELEVATION

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



AMERICAN WATER STANDARD
CIVIL

WATER DISTRIBUTION SYSTEM

THRUST BLOCK AT HORIZONTAL BENDS LESS THAN 3' DETAIL

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD-19

GENERAL NOTES:

1. COVER OVER TOP OF PIPE SHALL BE BELOW FROST LINE OR 30" MINIMUM IN NON-FROST AREAS OR ACCORDING TO REGULATORY REQUIREMENTS. IF GRADING PLANS RECEIVED BY THE ENGINEER/OWNER WITH THE REQUEST FOR WATER MAIN LAYOUT, INDICATE ADJUSTMENTS TO EXISTING GRADE, THEN PIPE SHALL BE INSTALLED TO MEET MINIMUM AND MAXIMUM COVER FROM PROPOSED GRADES SHOWN ON SAID PLANS.
2. THRUST BLOCKS SHALL BE BUILT AGAINST UNDISTURBED SOIL WITH ADEQUATE BACKING TO PREVENT MOVEMENT OF FITTING.
3. NO THRUST BLOCKS TO BE PLACED IN SEWER LATERAL DITCHES.
4. THRUST BLOCKING MUST FIT IN EASEMENT, IN SOME CASES ADDITIONAL RESTRAINT MAY BE REQUIRED.
5. DIMENSION "C" BASED ON MINIMUM BEARING AREA.
6. POLYETHYLENE ENCASUREMENT ON ALL D.I. PIPE AND FITTINGS.
7. PIPE JOINTS AND BOLTS MUST BE ACCESSIBLE.
8. ALL ANCHOR BOLTS SHALL BE COR-BLUE, MINIMUM 1/2" DIAMETER. COAT EXPOSED ROD WITH APPROVED MATERIAL AFTER CONCRETE HAS SET.
9. ALLOW SUFFICIENT CLEARANCE BETWEEN CONCRETE AND BOLTS FOR FUTURE MAINTENANCE.
10. ALL M.J. AND FLG. FITTINGS TO RECEIVE THRUST BLOCKS SHALL HAVE THE FASTENER AREAS FELT WRAPPED AND TAPED PRIOR TO THE CONCRETE POUR TO ALLOW FUTURE ACCESS TO THE FASTENERS AT THE JOINTS.
11. THRUST BLOCKING DETAILS ARE SHOWN HERE FOR TYPICAL INSTALLATIONS. IN SOME CASES, ADDITIONAL RESTRAINT MAY BE REQUIRED.
12. PORTLAND CEMENT CONCRETE USED FOR THRUST BLOCKS SHALL BE 3000 PSI CONCRETE MINIMUM.

* SPECIAL DESIGN REQUIRED IF GREATER THAN 5'-0"
 * BEARING AREAS ARE BASED ON SOIL HAVING AN ALLOWABLE SAFE LATERAL BEARING OF 2000 POUNDS PER SQUARE FOOT AND 200 PSI TEST PRESSURE. AREA MUST BE REVISED FOR SOILS WITH A LOWER BEARING CAPACITY OR HIGHER TEST PRESSURE.



AMERICAN WATER ENGINEERING
 1 WATER STREET
 CAMDEN, NJ 08102

AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 THRUST BLOCK AT HORIZONTAL BENDS GREATER THAN 3' DETAIL

DATE: 09-OCT-2019

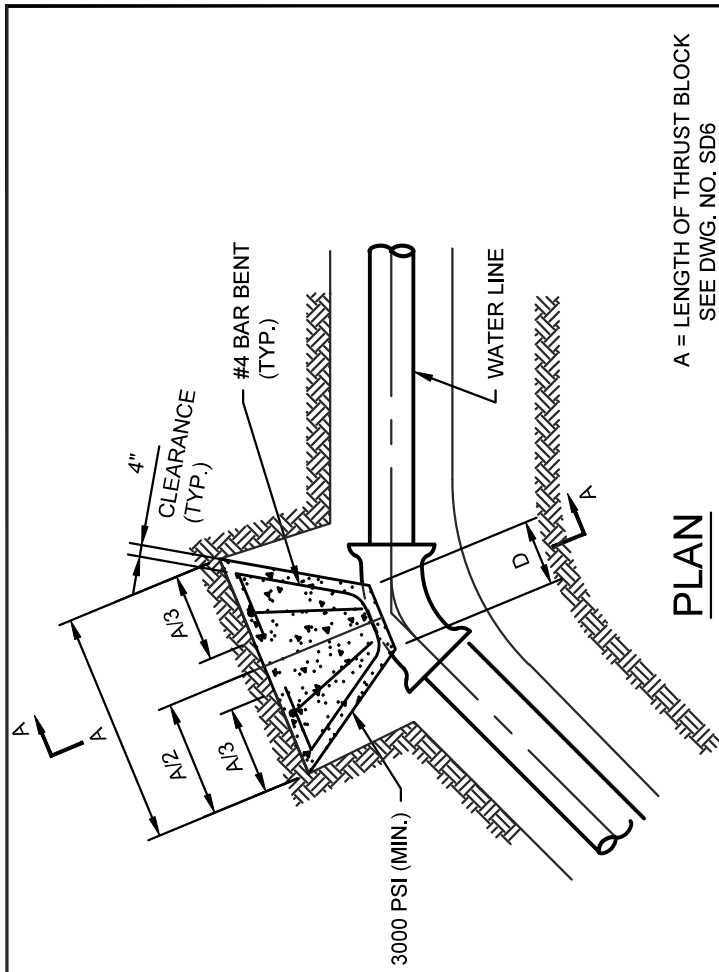
STANDARD DETAILS

AMERICAN WATER ENGINEERING

APPROVED

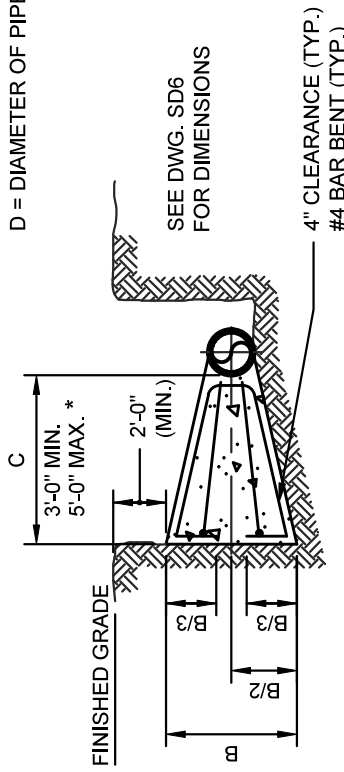
SCALE: AS SHOWN

SD-20



PLAN

A = LENGTH OF THRUST BLOCK
 SEE DWG. NO. SD6
 B = 3xD
 C = SEE NOTE 5
 D = DIAMETER OF PIPE



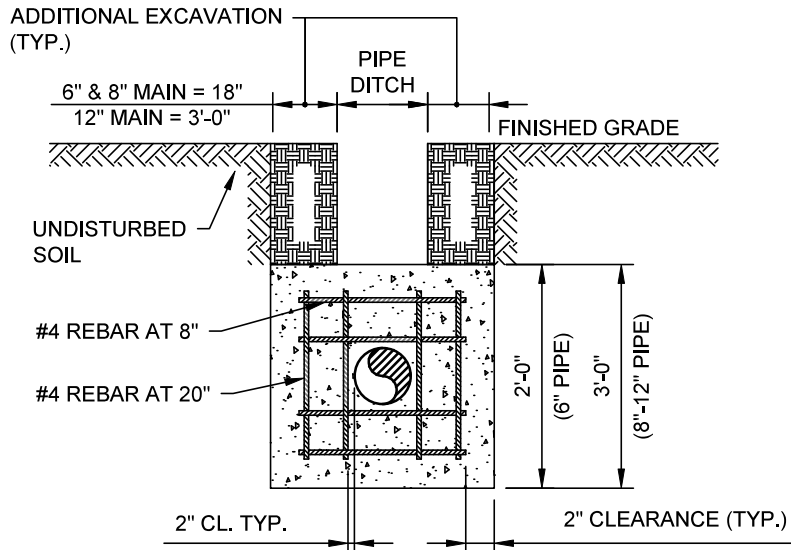
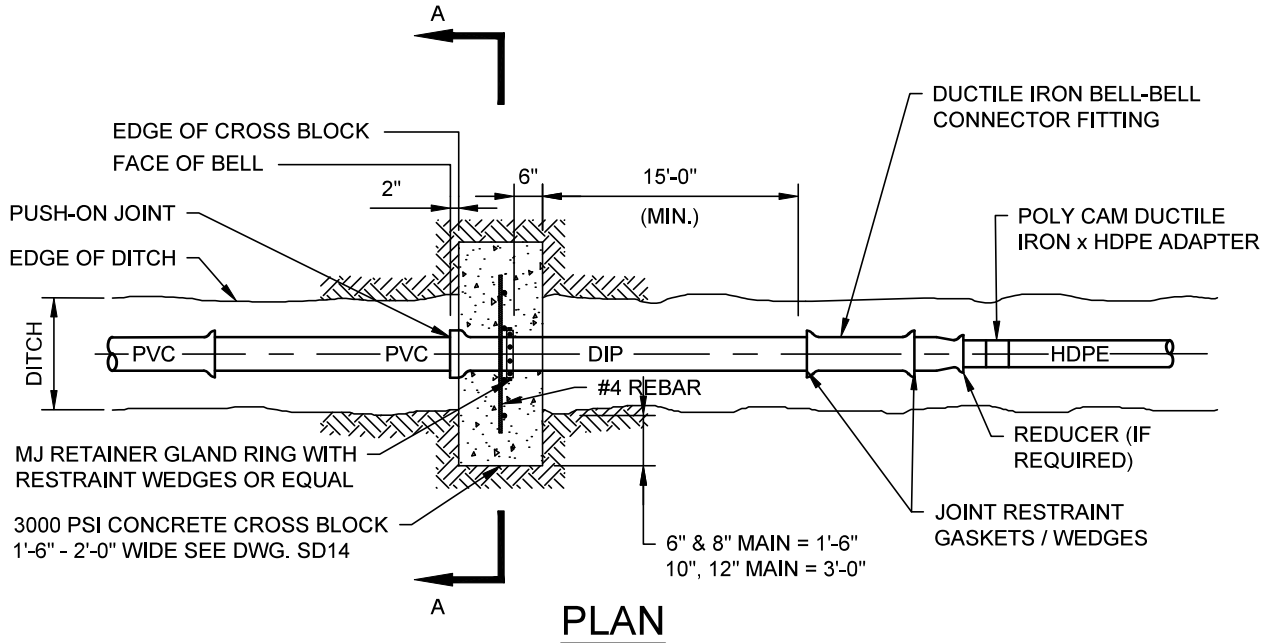
SECTION A-A

SEE DWG. SD6
 FOR DIMENSIONS

4" CLEARANCE (TYP.)
 #4 BAR BENT (TYP.)

NOTES:

1. ONE RETAINER GLAND RING WITH RESTRAINT WEDGES SHALL BE INSTALLED TOWARDS BELL.
2. DO NOT USE RESTAINED JOINT GASKETS.
3. CENTER BLOCK ON PIPE



AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PVC x HDPE TRANSITION WITHOUT HYDRANT OR BRANCH DETAIL**

DATE: 09-OCT-2019

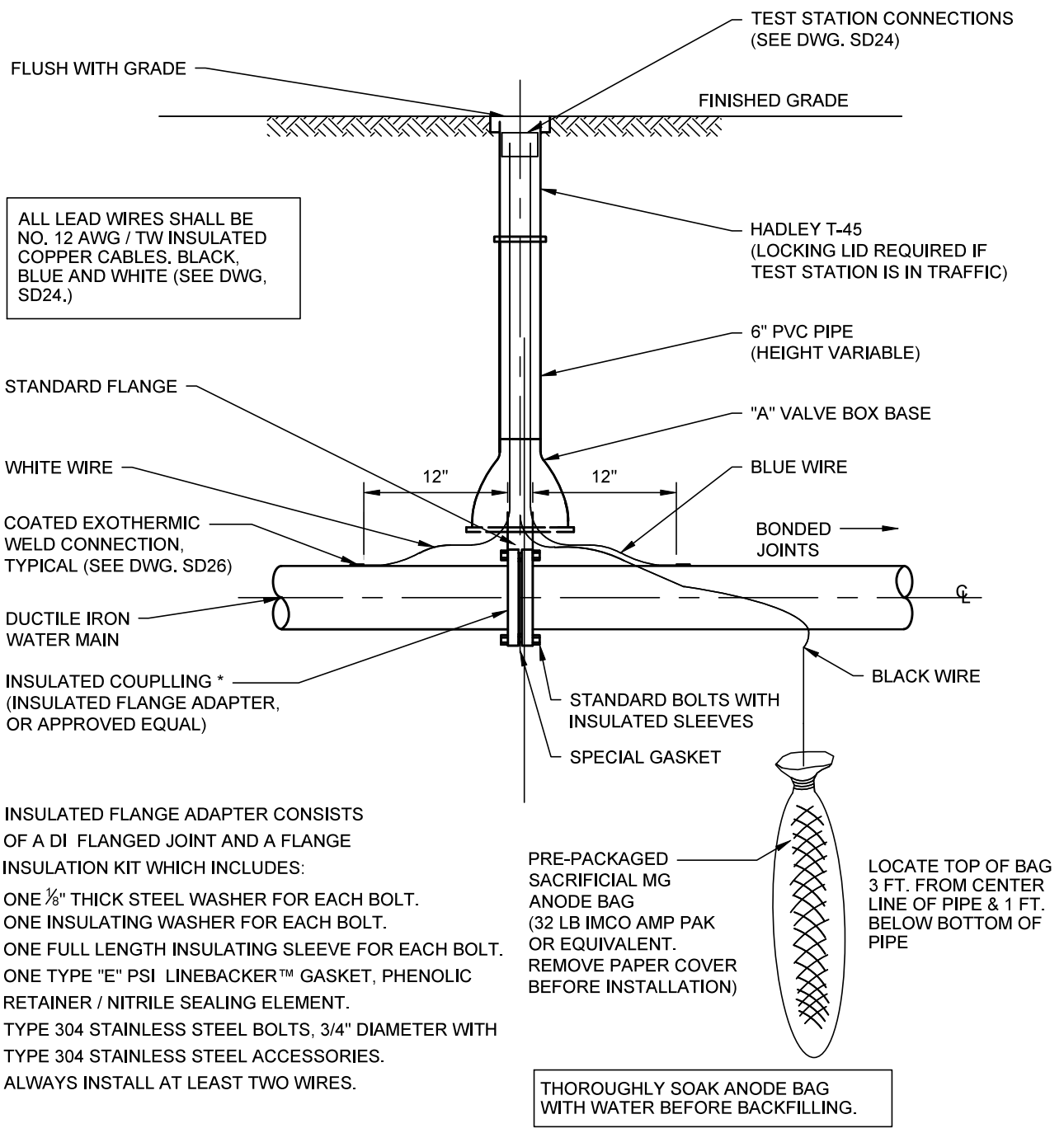
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 21




ALL LEAD WIRES SHALL BE NO. 12 AWG / TW INSULATED COPPER CABLES, BLACK, BLUE AND WHITE (SEE DWG, SD24.)

- * INSULATED FLANGE ADAPTER CONSISTS OF A DI FLANGED JOINT AND A FLANGE INSULATION KIT WHICH INCLUDES:
- ONE 1/8" THICK STEEL WASHER FOR EACH BOLT.
 - ONE INSULATING WASHER FOR EACH BOLT.
 - ONE FULL LENGTH INSULATING SLEEVE FOR EACH BOLT.
 - ONE TYPE "E" PSI LINEBACKER™ GASKET, PHENOLIC RETAINER / NITRILE SEALING ELEMENT.
 - TYPE 304 STAINLESS STEEL BOLTS, 3/4" DIAMETER WITH TYPE 304 STAINLESS STEEL ACCESSORIES.
 - ALWAYS INSTALL AT LEAST TWO WIRES.

THOROUGHLY SOAK ANODE BAG WITH WATER BEFORE BACKFILLING.

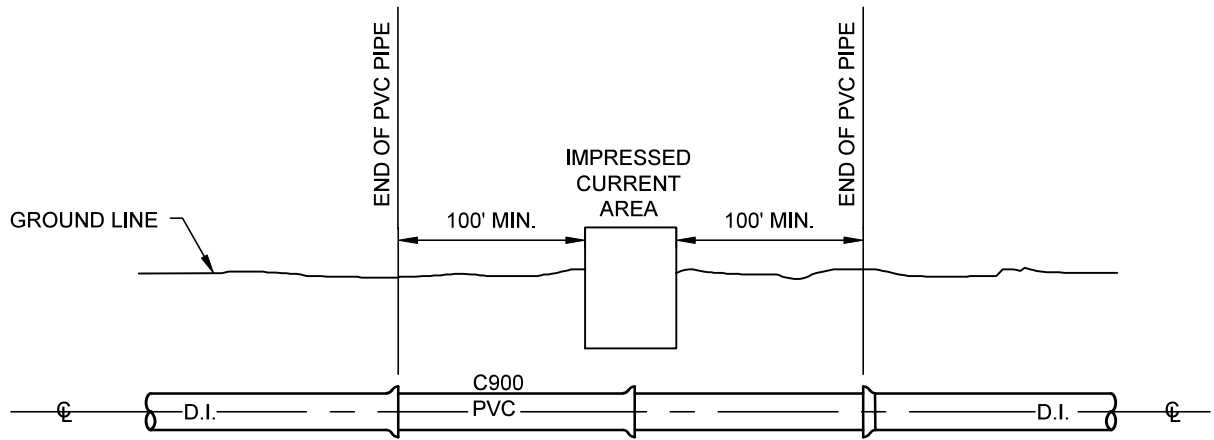
NOTES:

1. PREFERRED METHOD TO CROSS ANY IMPRESSED CURRENT AREA IS TO INSTALL APPROPRIATE CLASS OF PVC PIPE.
2. INSTALLATION OF CATHODIC PROTECTION SYSTEM SHALL BE DONE IN CONSULTATION WITH AGENCY OPERATING IMPRESSED CURRENT AREA.
3. DOUBLE POLYWRAP PIPE WITH BONDED JOINTS PLUS ONE PIPE LENGTH ON UNBONDED SIDE.
4. CONTRACTOR SHALL CONDUCT TESTS OF SOIL RESISTIVITY AND RESISTANCE BETWEEN WIRES WITH COMPLETION OF WIRING NOTING DATE AND TIME OF TEST, REPORTING ALL RESULTS TO ENGINEER.

| | | |
|---|---|-----------------------------------|
| <p>AMERICAN WATER ENGINEERING 1 WATER STREET CAMDEN, NJ 08102</p>  | <p>AMERICAN WATER STANDARD CIVIL WATER DISTRIBUTION SYSTEM PLACEMENT OF ANODE BAG TEST STATION & LEAD WIRES DETAIL</p> | |
| | <p>DATE: 09-OCT-2019</p> | <p>AMERICAN WATER ENGINEERING</p> |
| <p>STANDARD DETAILS</p> | <p>APPROVED</p> | <p>SD- 22</p> |

NOTES:

1. IF PIPE IS BEING CONNECTED TO (OR IS PART OF) A SYSTEM WITH FERROUS PIPE, PVC SHALL BE CLASS 200.
2. SEE SD22 FOR ALL PIPE 16" AND LARGER.



TEST STATIONS
AS REQUIRED

PLAN VIEW

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CATHODIC PROTECTION WITH PVC PIPE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 23

TEST STATION

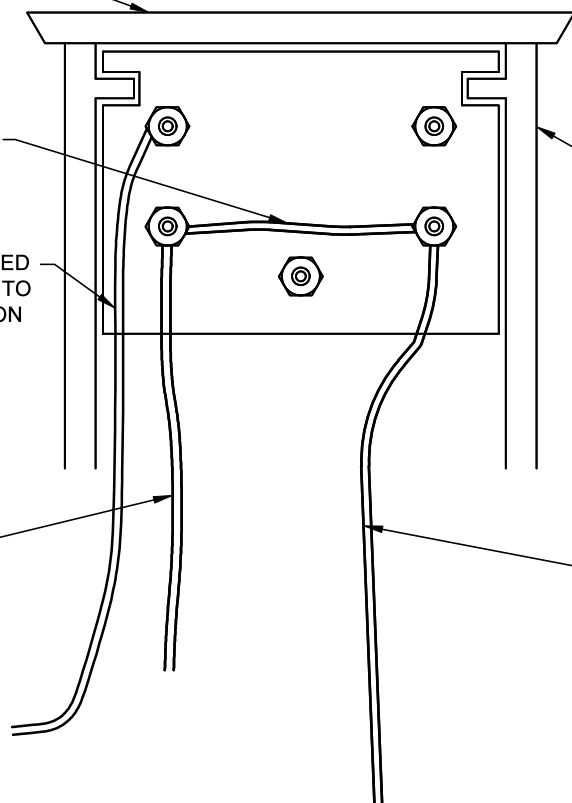
0.01 OHM SHUNT OR NO. 12 AWG/TW INSULATED COPPER CABLE

NO. 12 AWG/TW INSULATED COPPER CABLE (WHITE) TO MAIN (UNBONDED SIDE ON INSULATED COUPLING)

NO. 12 AWG/TW INSULATED COPPER CABLE (BLUE) TO MAIN (BONDED SIDE OF INSULATED COUPLING)

HANDLEY INDUSTRIES, INC. 4" CATHODIC TEST STATIONS (T-45) WITH (5) SCREW TERMINALS WITH LOCKING LID.

ANODE BAG LEAD WIRE (BLACK) TO MG ANODE BAG



AMERICAN WATER ENGINEERING
1 WATER STREET
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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TEST STATION CONNECTION DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

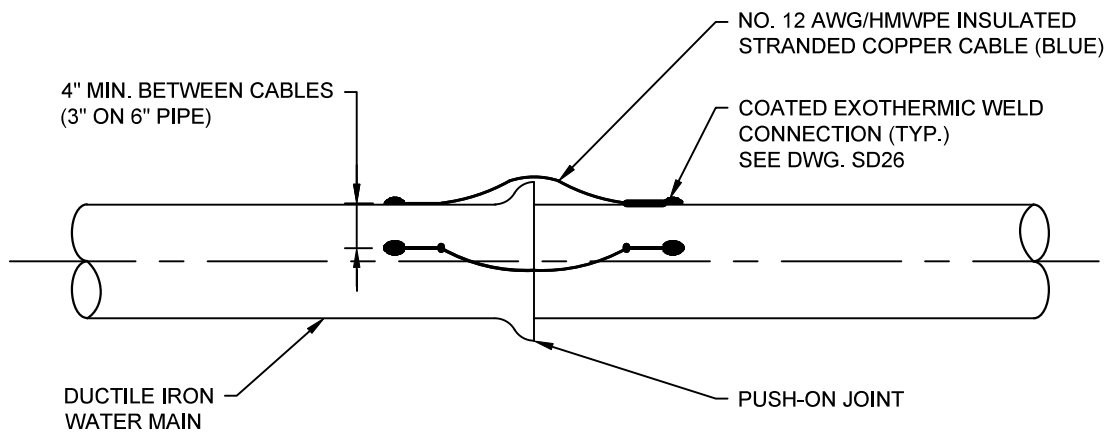
STANDARD DETAILS

APPROVED

SD- 24

NOTES:

1. MINIMUM 2 CONNECTIONS BETWEEN PIPES AS SHOWN.
2. COAT ALL EXOTHERMIC WELDS WITH APPROVED MATERIAL.



AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CONTINUITY BONDS FOR PUSH-ON DUCTILE IRON PIPE DETAIL**

DATE: 09-OCT-2019

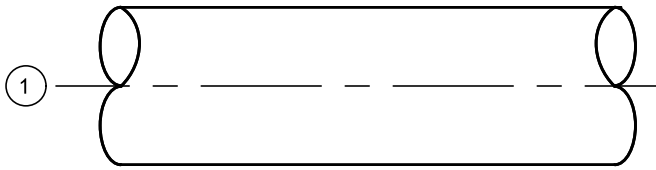
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

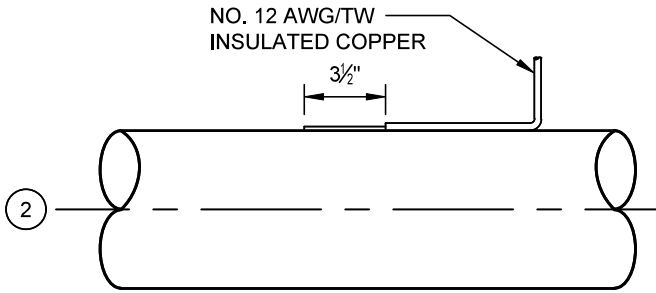
STANDARD DETAILS

APPROVED

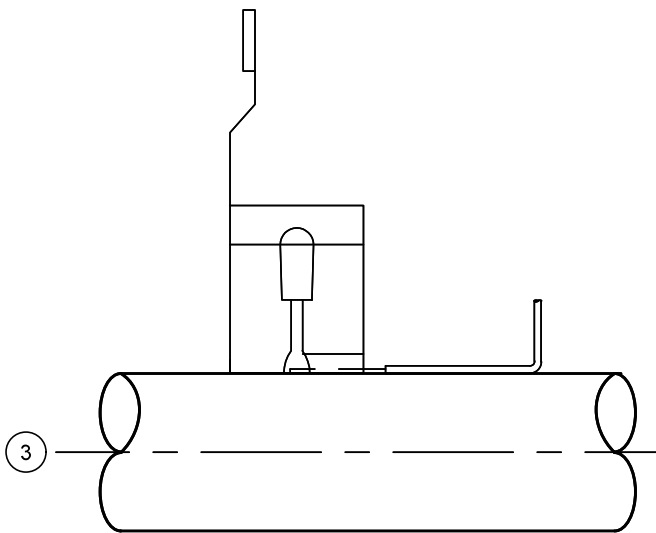
SD- 25



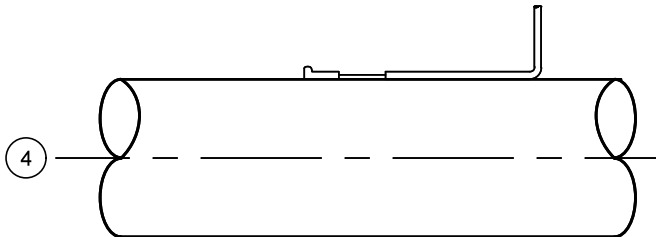
1. REMOVE COATING, FILE SURFACE TO BRIGHT METAL AND DRY.



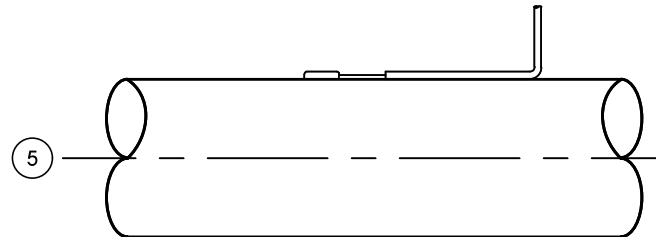
2. STRIP INSULATION FROM WIRE, CRIMP ON COPPER SLEEVE (AS REQ'D), PLACE WIRE AGAINST METAL SURFACE.



3. PLACE PREPARED WELDER OVER WIRE AND HOLD FIRM WHILE MAKING CONNECTION. APPLY SPARK TO SIDE OF WELDER.



4. AFTER WELD COOLS, REMOVE SLAG WITH HAMMER.



5. COAT CONNECTION WITH 3M RUBBERIZED AEROSOL UNDERCOATING PART #051135/08883 OR EQUIVALENT

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
EXOTHERMIC WELD CONNECTION DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

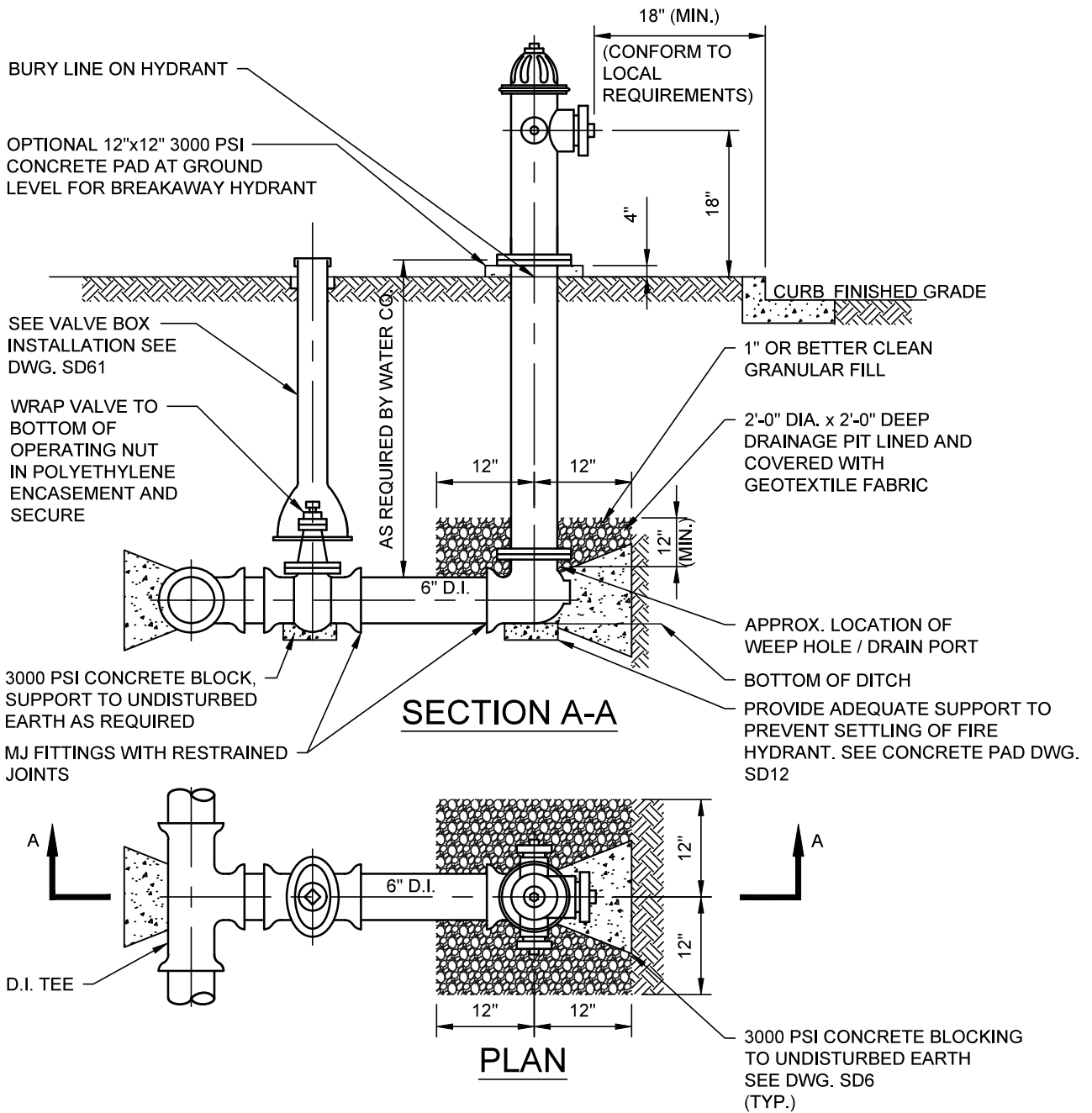
APPROVED

SD- 26

RESERVED FOR FUTURE USE

RESERVED FOR FUTURE USE

RESERVED FOR FUTURE USE



FIRE HYDRANT DETAIL-STANDARD

NOTES:

1. CONTRACTOR TO SUBMIT RESTRAINED DESIGN. ADDITIONAL RESTRAINT (BESIDES BLOCKING) ONLY AS REQUIRED BY ENGINEER.
2. PAINT HYDRANT TO BURY LINE (AND CAN BE DONE PRIOR TO INSTALLATION).
3. APPLY TOUCH UP PAINT AS REQUIRED AFTER INSTALLATION.
4. ALL HYDRANTS SHALL STAND PLUMB AND SHALL HAVE THE PUMPER NOZZLE FACING THE CURB.
5. PORTLAND CEMENT CONCRETE USED FOR THE THRUST BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DRY BARREL FIRE HYDRANT WITH BLOCKING DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

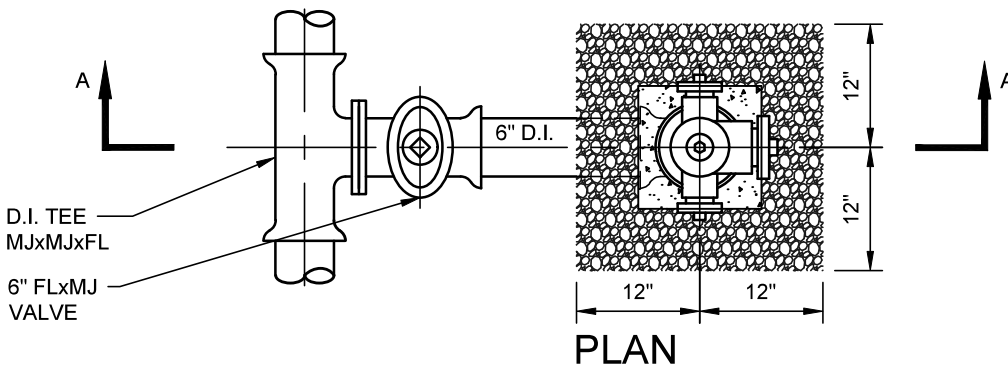
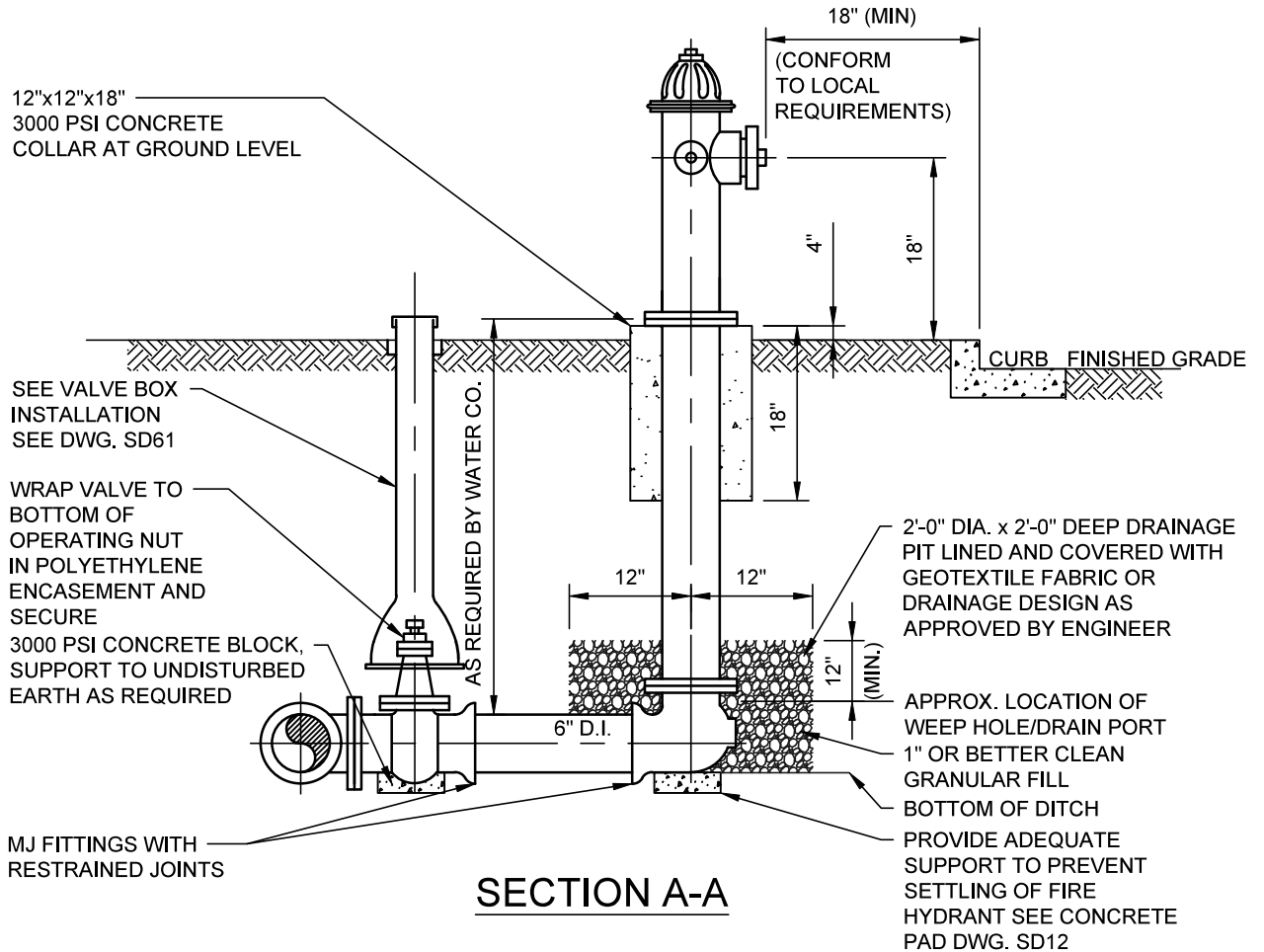
STANDARD DETAILS

APPROVED

SD- 30

NOTES:

1. CONTRACTOR TO SUBMIT RESTRAINED DESIGN.
2. PAINT HYDRANT TO BURY LINE (CAN BE DONE PRIOR TO INSTALLATION).
3. APPLY TOUCH UP PAINT AS REQUIRED AFTER INSTALLATION.
4. ALL HYDRANTS SHALL STAND PLUMB AND SHALL HAVE THE PUMPER NOZZLE FACING THE CURB.
5. PORTLAND CEMENT CONCRETE USED FOR THE THRUST BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.



FIRE HYDRANT DETAIL-STANDARD

AMERICAN WATER ENGINEERING
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CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
WET BARREL FIRE HYDRANT WITH FLANGE TEE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

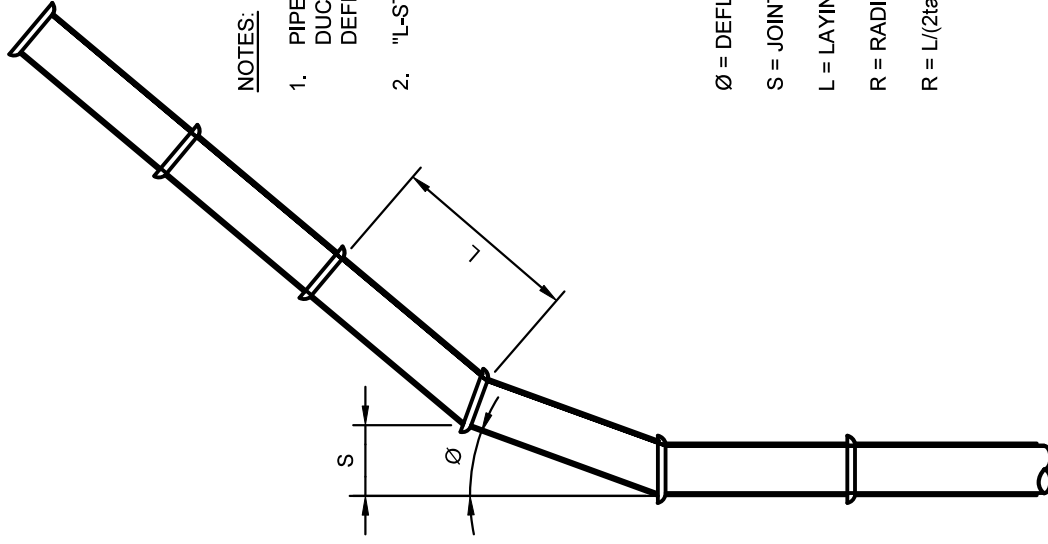
APPROVED

SD- 31

MAXIMUM JOINT DEFLECTION

| MAXIMUM JOINT DEFLECTION DUCTILE IRON PUSH ON PIPE | | | | | | |
|--|--------------------------|---------------------|---------|--|---------|-------------------------------------|
| NOMINAL PIPE SIZE INCHES | DEFLECTION ANGLE DEGREES | MAX OFFSET-S INCHES | | APPROX RADIUS OF CURVE · R PRODUCED BY SUCCESSION OF JOINTS INCHES | | CURRENT AW DEFLECTION ANGLE DEGREES |
| | | L=18 FT | L=20 FT | L=18 FT | L=20 FT | |
| 3 | 4 | 15 | 17 | 256 | 285 | |
| 4 | 4 | 15 | 17 | 256 | 285 | |
| 6 | 4 | 15 | 17 | 256 | 285 | 4 |
| 8 | 4 | 15 | 17 | 256 | 285 | 4 |
| 10 | 4 | 15 | 17 | 256 | 285 | 4 |
| 12 | 4 | 15 | 17 | 256 | 285 | 4 |
| 14 | 4 | 9 | 10 | 256 | 285 | 4 |
| 16 | 2.5 | 9 | 10 | 429 | 476 | 2.5 |
| 18 | 2.5 | 9 | 10 | 429 | 476 | 2 |
| 20 | 2.5 | 9 | 10 | 429 | 476 | 2 |
| 24 | 2.5 | 9 | 10 | 429 | 476 | 1.5 |

| MAXIMUM JOINT DEFLECTION DUCTILE IRON MJ PIPE | | | | | | |
|---|--------------------------|---------------------|---------|--|---------|-------------------------------------|
| NOMINAL PIPE SIZE INCHES | DEFLECTION ANGLE DEGREES | MAX OFFSET-S INCHES | | APPROX RADIUS OF CURVE · R PRODUCED BY SUCCESSION OF JOINTS INCHES | | CURRENT AW DEFLECTION ANGLE DEGREES |
| | | L=18 FT | L=20 FT | L=18 FT | L=20 FT | |
| 3 | 6.5 | 25 | 28 | 158 | 176 | table deleted |
| 4 | 6.5 | 25 | 28 | 158 | 176 | |
| 6 | 5.5 | 22 | 24 | 182 | 202 | |
| 8 | 4 | 16 | 18 | 256 | 285 | |
| 10 | 4 | 16 | 18 | 256 | 285 | |
| 12 | 4 | 16 | 18 | 256 | 285 | |
| 14 | 3 | 11 | 12 | 367 | 408 | |
| 16 | 3 | 11 | 12 | 367 | 408 | |
| 18 | 2.5 | 11 | 10 | 429 | 476 | |
| 20 | 2.5 | 9 | 10 | 429 | 476 | |
| 24 | 1.5 | 9 | 8 | 644 | 715 | |



NOTES:

1. PIPE JOINT DEFLECTION ALLOWED ON DUCTILE IRON PIPE ONLY. PIPE JOINT DEFLECTION NOT ALLOWED ON PVC PIPE.
2. "L"-STANDARD LENGTH OF PIPE SECTION.

Ø = DEFLECTION ANGLE
 S = JOINT DEFLECTION OFFSET
 L = LAYING LENGTH
 R = RADIUS OF CURVE
 $R = L / (2 \tan(\Ø/2))$



AMERICAN WATER ENGINEERING
 1 WATER STREET
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AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 PIPE CURVE GEOMETRY DETAIL

DATE: 09-OCT-2019

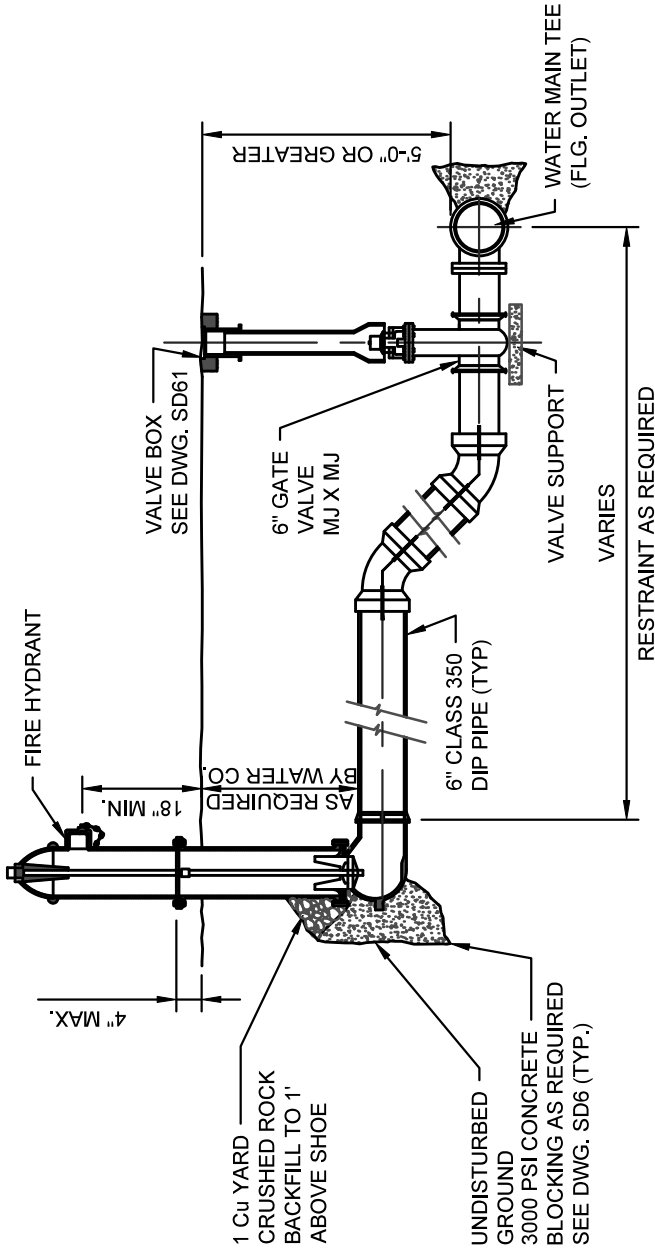
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

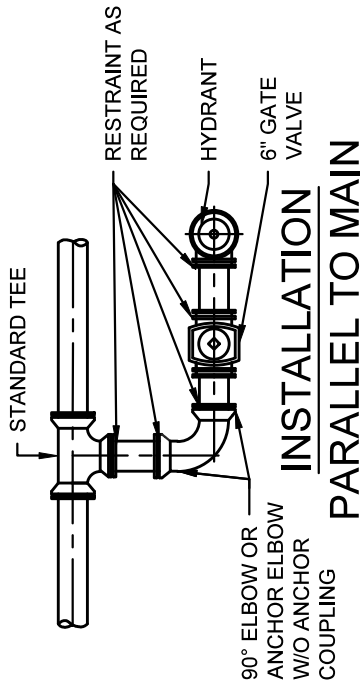
APPROVED

SD-32

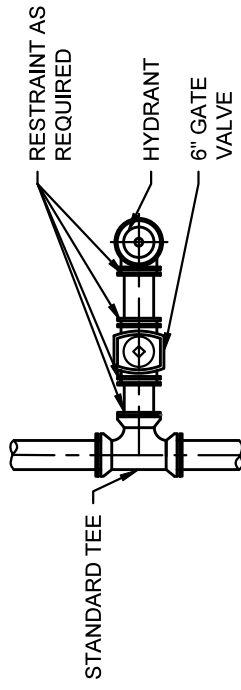


DEEP MAIN INSTALLATION

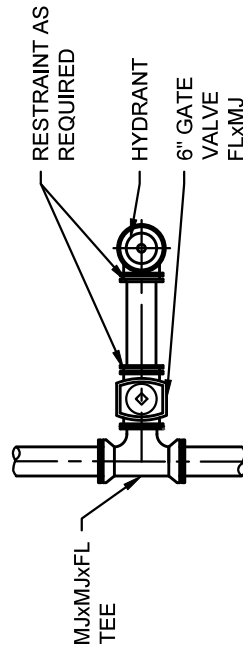
(ALTERNATIVE IS HYDRANT BARREL WITH DEEPER BURY OR BARREL EXTENSIONS PER ENGINEER'S RECOMMENDATIONS.)



INSTALLATION PARALLEL TO MAIN



INSTALLATION PERPENDICULAR TO MAIN



INSTALLATION PERPENDICULAR TO MAIN WITH MJxFLANGE TEE

NOTES:

- THESE SCHEMATICS DISPLAY ALTERNATIVE LAYOUTS AND DETAIL OF RESTRAINT HAS NOT BEEN PROVIDED HERE.
- ALL FITTINGS SHALL BE MJ FOR HYDRANT ALTERNATIVES SHOWN.

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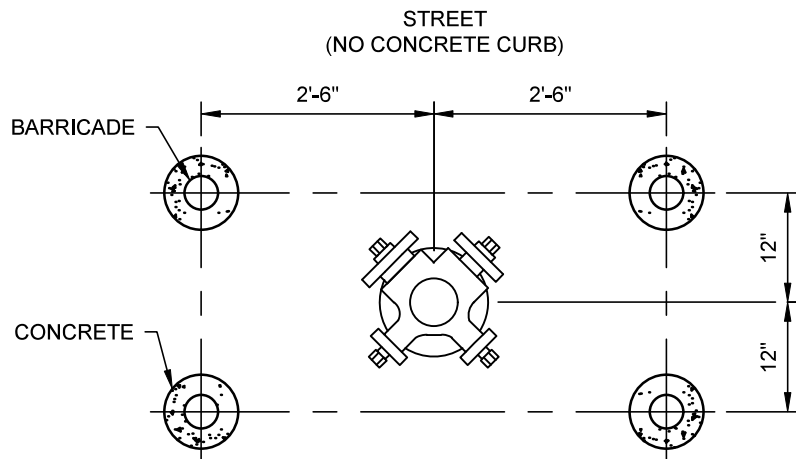


AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
FIRE HYDRANT ALTERNATIVES DETAIL

DATE: 09-OCT-2019
STANDARD DETAILS

AMERICAN WATER ENGINEERING
APPROVED

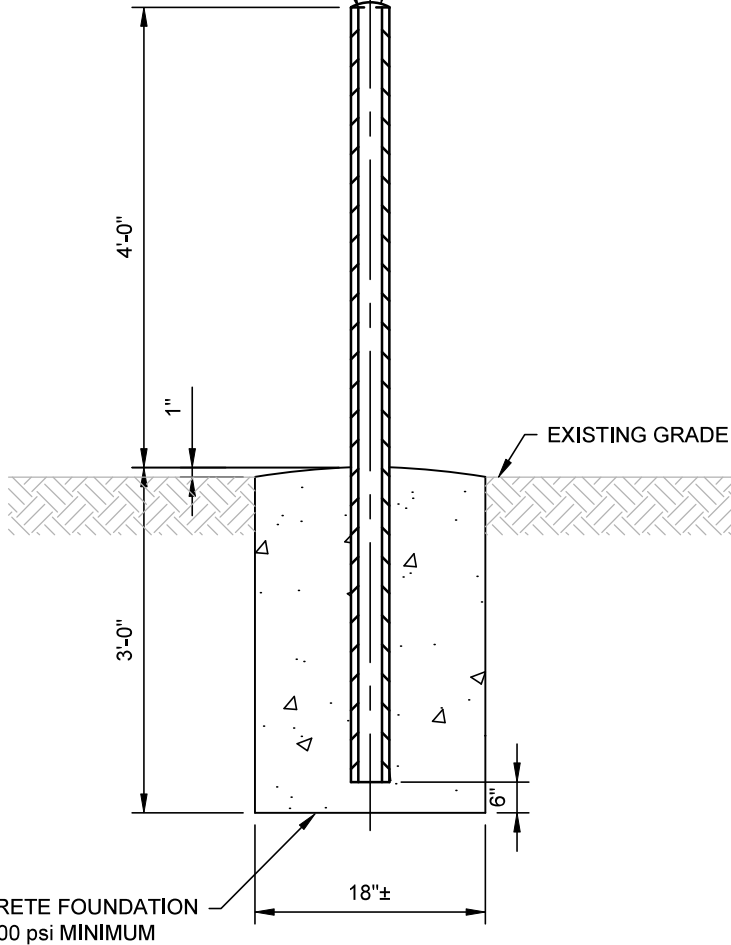
SCALE: AS SHOWN
SD-33



PLAN

4" OR 6" SCH. 80 STEEL OR DI PIPE
 PAINT SAFETY YELLOW (2 COATS)
 FILL WITH CONCRETE

CONCRETE CAP
 WASH SMOOTH



SECTION

NOTES:

1. SEE PLANS FOR No. OF BARRICADES TO BE USED.
2. THE EXACT LOCATION OF BARRICADES MAY BE CHANGED BY THE ENGR.
3. THE STEEL PIPE ABOVE GROUND SHALL BE PAINTED WITH PRIMER COAT.
4. TWO FINISH COATS OF TNE MEC "SCHOOL BUS YELLOW" SHALL BE USED FOR BARRICADES.
5. BARRICADES FOR FLUSHOUTS, AIR RELEASE VALVES, & VAULT VENTS SHALL BE GIVEN TWO FINISH COATS OF YELLOW PAINT.
6. DO NOT LOCATE BOLLARD DIRECTLY ABOVE MAIN OR HYDRANT LATERAL.
7. BOLLARDS SHALL BE ORIENTED SO AS TO AVOID DISRUPTING HYDRANT OPERATION.

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**AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 FIRE HYDRANT PROTECTION PIPE BOLLARD DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

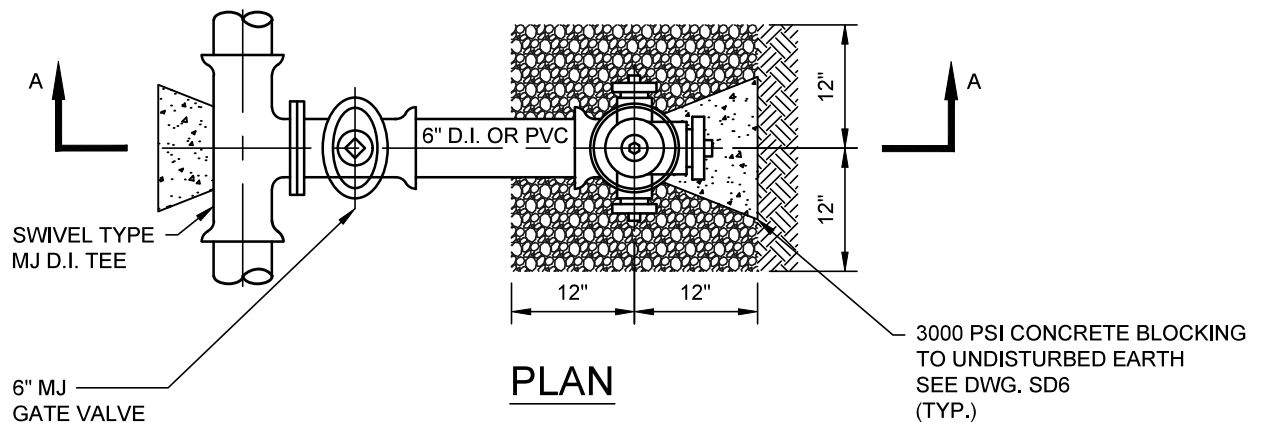
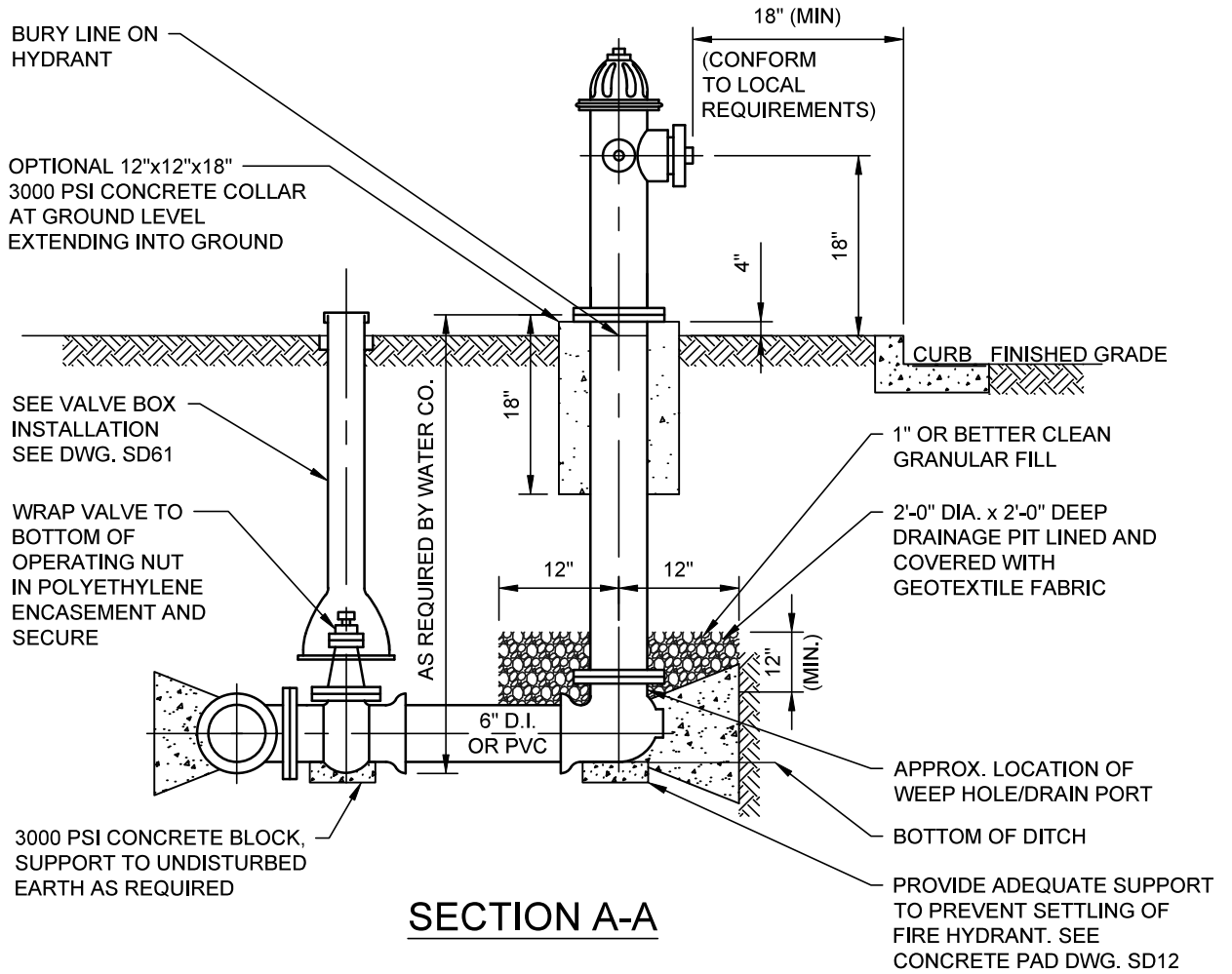
STANDARD DETAILS

APPROVED

SD- 34

NOTES:

1. CONTRACTOR TO SUBMIT RESTRAINED DESIGN.
2. PAINT HYDRANT TO BURY LINE. (CAN BE DONE PRIOR TO INSTALLATION).
3. APPLY TOUCH UP PAINT AS REQUIRED AFTER INSTALLATION.
4. ALL HYDRANTS SHALL STAND PLUMB AND SHALL HAVE THE PUMPER NOZZLE FACING THE CURB.
5. PORTLAND CEMENT CONCRETE USED FOR THRUST BLOCKS SHALL BE MIN. 3000 PSI CONCRETE.



FIRE HYDRANT DETAIL-STANDARD

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CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
WET BARREL FIRE HYDRANT WITH BLOCKING/FLANGE TEE DETAIL**

DATE: 09-OCT-2019

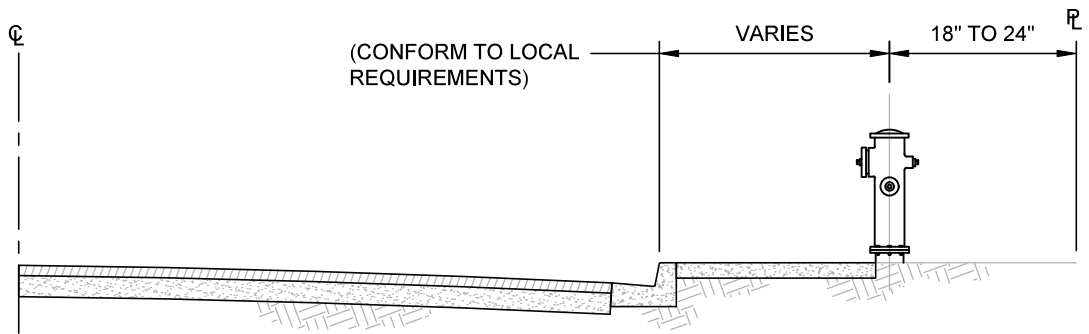
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

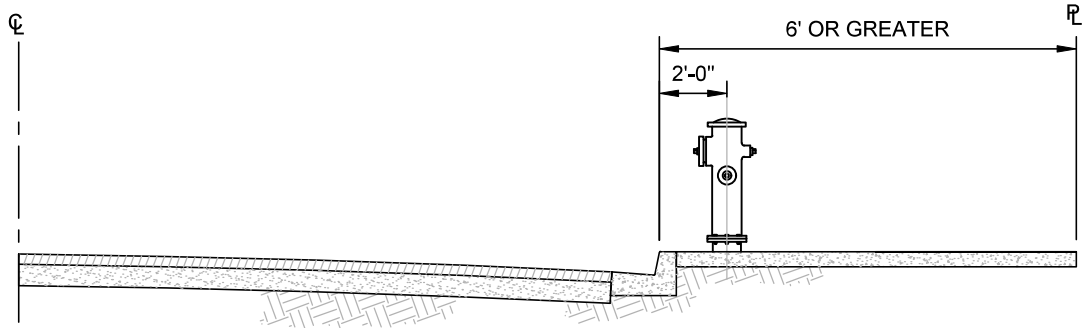
APPROVED

SD- 35



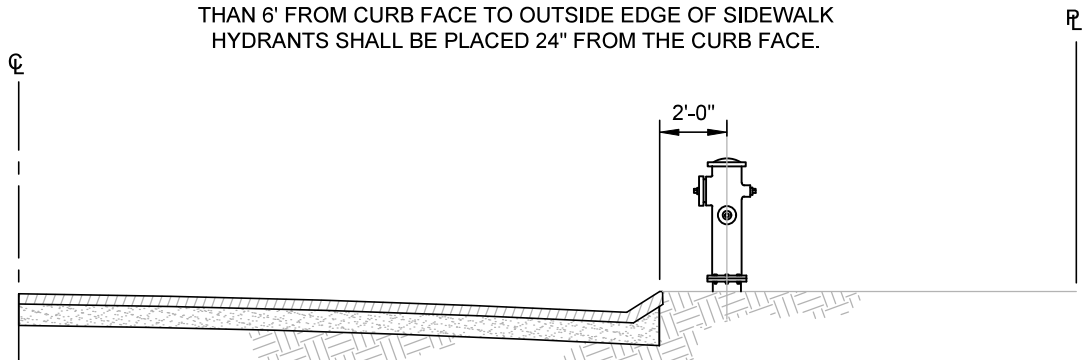
CASE 1

WHEN SIDEWALKS ARE ADJACENT TO CURB, HYDRANTS SHALL BE CENTERED AT BACK OF SIDEWALK.



CASE 2

WHEN SIDEWALKS ARE CONSTRUCTED WITH WIDTHS GREATER THAN 6' FROM CURB FACE TO OUTSIDE EDGE OF SIDEWALK HYDRANTS SHALL BE PLACED 24" FROM THE CURB FACE.



CASE 3

WHEN INVERTED SHOULDER SECTION IS PERMITTED AND CURB, GUTTER AND SIDEWALKS ARE WAIVED, THE HYDRANT SHALL BE CENTERED 24" BEHIND THE EDGE OF PAVEMENT.

NOTES:

1. REQUIREMENT OF LOCAL AUTHORITY HAVING JURISDICTION SHALL PREVAIL. IN THEIR ABSENCE, THE INSTALLATIONS SHOWN MAY BE USED.
2. EXACT HYDRANT LOCATION TO BE FIELD DETERMINED BY LOCAL AUTHORITY HAVING JURISDICTION.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
FIRE HYDRANT LOCATION DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

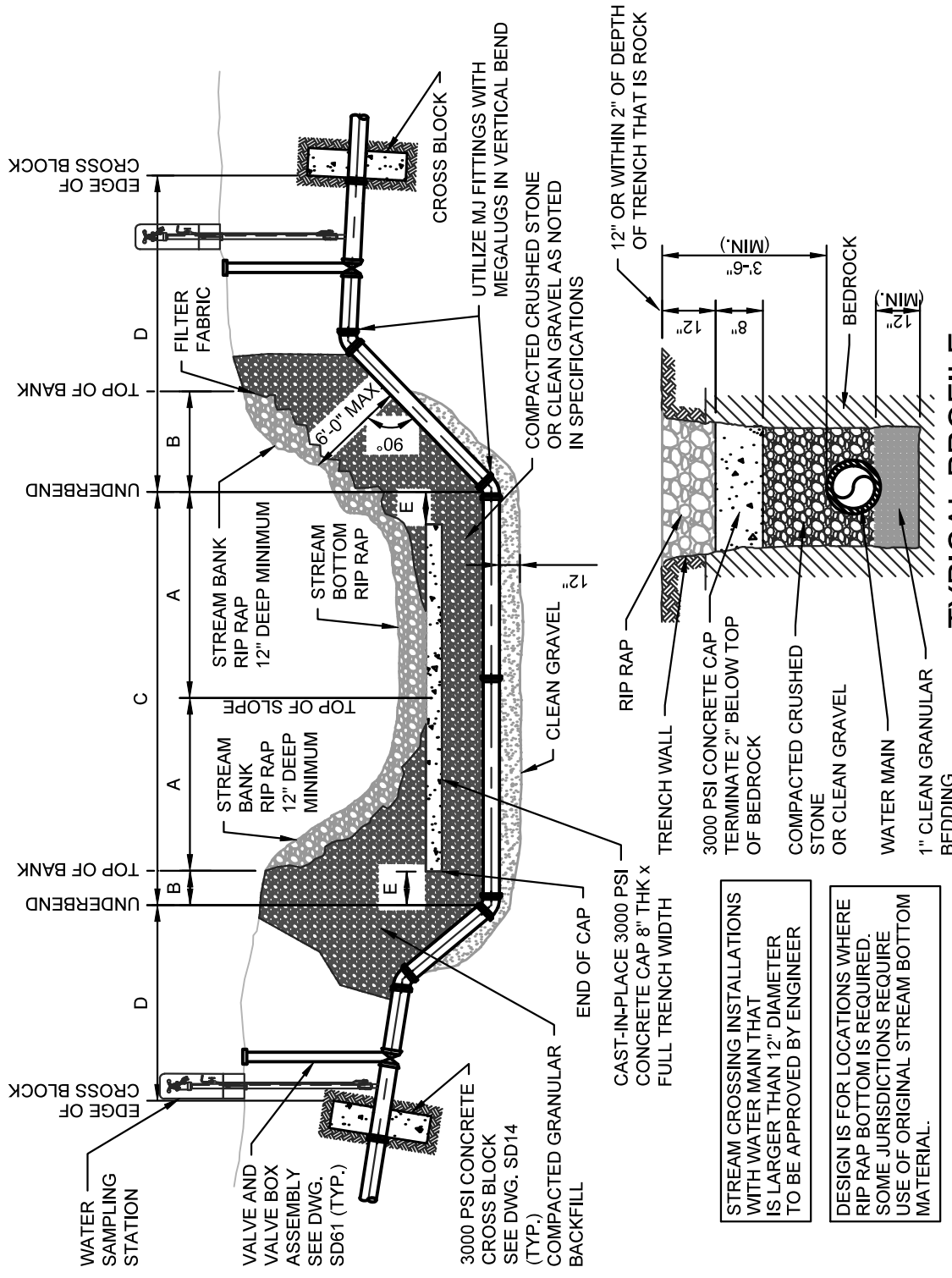
STANDARD DETAILS

APPROVED

SD- 36

NOTES:

1. ALL PIPE AND FITTINGS SHALL BE MECHANICAL JOINT WITH MEGALUG RESTRAINT.
2. RIP RAP SIZE AND QUANTITY DETERMINED BY ENGINEER.
3. DIMENSIONS A, B, C, D & E DETERMINED BY FIELD REPRESENTATIVE.
4. FOR D.I. OVER/UNDER BENDS SEE WATER MAIN INSTALLATION DETAILS.
5. FOR CONCRETE THRUST RESTRAINT SEE DRAWING SD6.
6. VALVE BOXES SHALL BE ACCESSIBLE AND NOT SUBJECT TO FREQUENT FLOODING. VALVE LOCATION TO BE DETERMINED BY ENGINEER.
7. TR FLEX RESTRAINT JOINT OR EQUAL IS REQUIRED FOR 20 INCH DIAMETER AND LARGER. NON-VERTICAL FIELD CUT JOINTS SHALL BE COMPLETED WITH A GRIPPER RING ON THE SPIGOT END FOR THE JOINT PER MFG. RECOMMENDATIONS. MEGA-LUG TO BE USED ON VERTICAL INSTALLATIONS. VERIFY DESIGN WITH ENGINEER.
8. PIPE SHALL BE KEPT CLEAN AND DRY AT ALL TIMES DURING INSTALLATION.
9. INSTALL WATER SAMPLING STATION APPROXIMATELY 15 FEET FROM STREAM BANK OR AS DETERMINED BY ENGINEER. STATION TO BE PROVIDED BY WATER CO.



STREAM CROSSING INSTALLATIONS WITH WATER MAIN THAT IS LARGER THAN 12" DIAMETER TO BE APPROVED BY ENGINEER

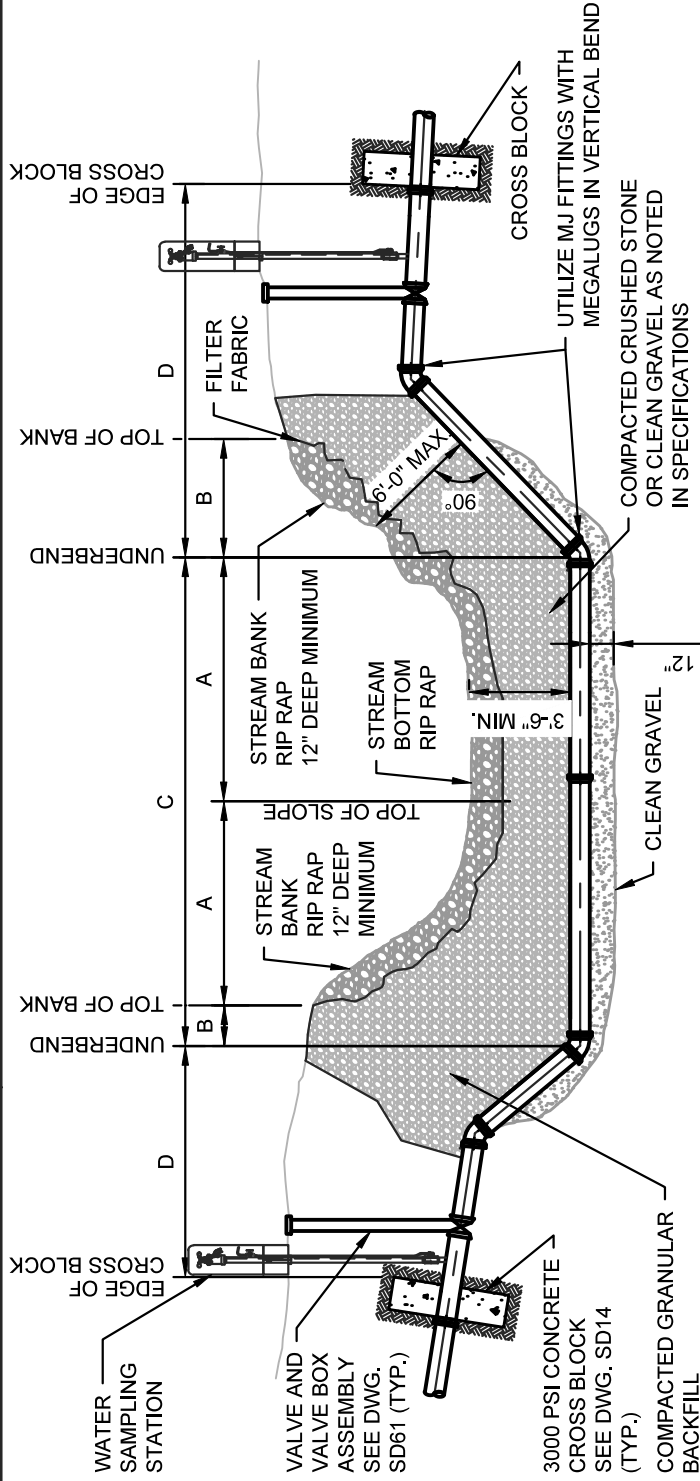
DESIGN IS FOR LOCATIONS WHERE RIP RAP BOTTOM IS REQUIRED. SOME JURISDICTIONS REQUIRE USE OF ORIGINAL STREAM BOTTOM MATERIAL.

TYPICAL PROFILE

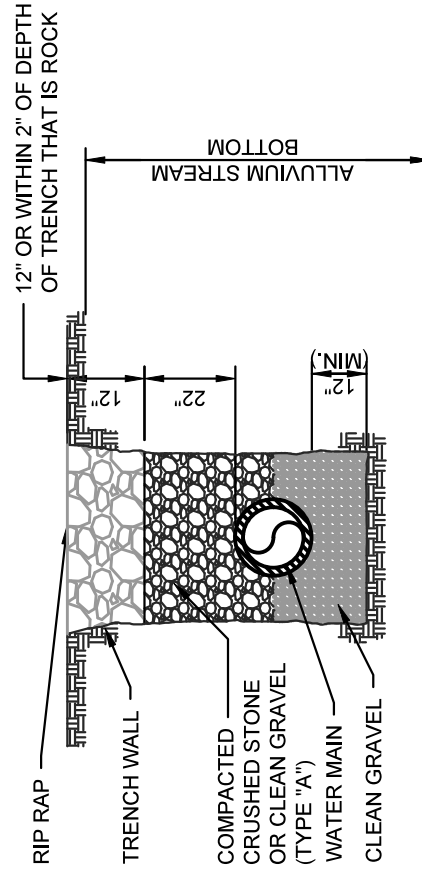
| | | |
|--|---|---|
| <p>AMERICAN WATER STANDARD CIVIL</p> <p>AMERICAN WATER ENGINEERING</p> | <p>AMERICAN WATER STANDARD CIVIL</p> <p>WATER DISTRIBUTION SYSTEM</p> <p>SOLID ROCK STREAM BOTTOM FOR OPEN CUT INSTALLATIONS DETAIL</p> | |
| | <p>DATE: 09-OCT-2019</p> <p>STANDARD DETAILS</p> | <p>APPROVED</p> <p>SCALE: AS SHOWN</p> <p>SD-37</p> |

NOTES:

1. ALL PIPE AND FITTINGS SHALL BE MECHANICAL JOINT WITH MEGALUG RESTRAINT.
2. RIP RAP SIZE AND QUANTITY DETERMINED BY ENGINEER.
3. DIMENSIONS A, B, C, D & E DETERMINED BY FIELD REPRESENTATIVE.
4. FOR D.I. OVER/UNDER BENDS SEE WATER MAIN INSTALLATION DETAILS.
5. FOR CONCRETE THRUST RESTRAINT SEE DRAWING SD6.
6. VALVE BOXES SHALL BE ACCESSIBLE AND NOT SUBJECT TO FREQUENT FLOODING. VALVE LOCATION TO BE DETERMINED BY ENGINEER.
7. TR FLEX RESTRAINT JOINT OR EQUAL IS REQUIRED FOR 20 INCH DIAMETER AND LARGER. NON-VERTICAL FIELD CUT JOINTS SHALL BE COMPLETED WITH A GRIPPER RING ON THE SPIGOT END FOR THE JOINT PER MFG. RECOMMENDATIONS. MEGALUG TO BE USED ON VERTICAL INSTALLATIONS. VERIFY DESIGN WITH ENGINEER.
8. PIPE SHALL BE KEPT CLEAN AND DRY AT ALL TIMES DURING INSTALLATION.
9. INSTALL WATER SAMPLING STATION APPROXIMATELY 15 FEET FROM STREAM BANK OR AS DETERMINED BY ENGINEER. STATION TO BE PROVIDED BY WATER CO.



TYPICAL PROFILE



STREAM CROSSING INSTALLATIONS WITH WATER MAIN THAT IS LARGER THAN 12" DIAMETER TO BE APPROVED BY ENGINEER

DESIGN IS FOR LOCATIONS WHERE RIP RAP BOTTOM IS REQUIRED. SOME JURISDICTIONS REQUIRE USE OF ORIGINAL STREAM BOTTOM MATERIAL.

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1 WATER STREET
CAMDEN, NJ 08102

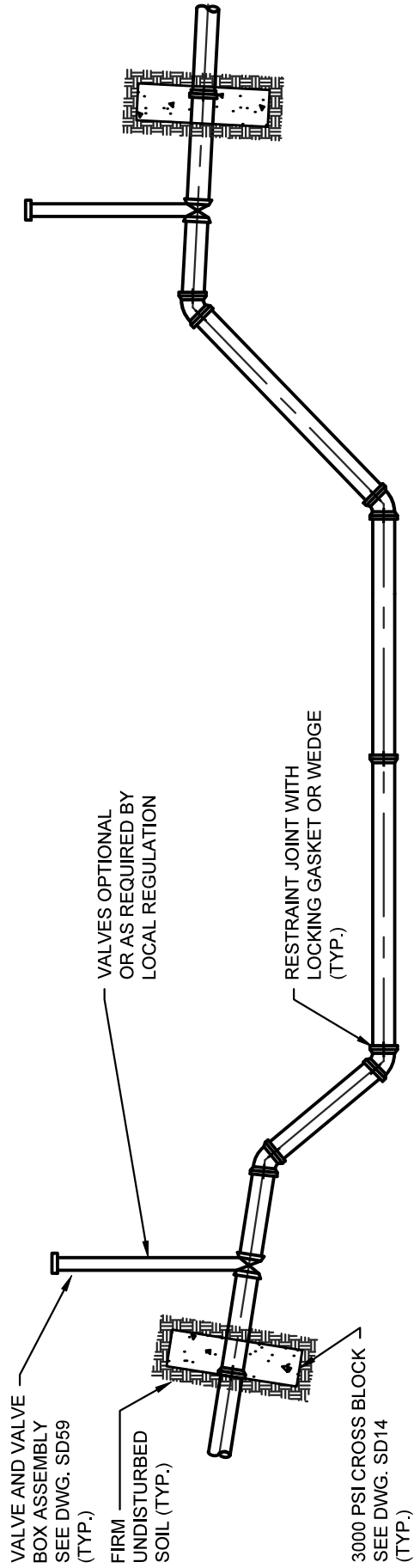


AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
ALLUVIUM STREAM BOTTOM CROSSING DETAIL

| | | |
|-------------------|----------------------------|-----------------|
| DATE: 09-OCT-2019 | AMERICAN WATER ENGINEERING | SCALE: AS SHOWN |
| STANDARD DETAILS | APPROVED | SD-38 |

NOTES:

1. TR FLEX RESTRAINT JOINT IS REQUIRED FOR 20 INCH DIAMETER AND LARGER. VERTICAL FIELD CUT JOINTS SHALL BE COMPLETED WITH A GRIPPER RING ON THE SPIGOT END FOR THE JOINT PER MFG. MEGA-LUG TO BE USED ON VERTICAL INSTALLATIONS. VERIFY DESIGN WITH ENGINEER.
2. ALTERNATIVE TO CROSS BLOCKING PER ENGINEER REVIEW IS RESTRAINING JOINTS 75 FEET MINIMUM BEYOND VALVES.



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
UTILITY CROSS WAYS PIPE CROSSING DETAIL**

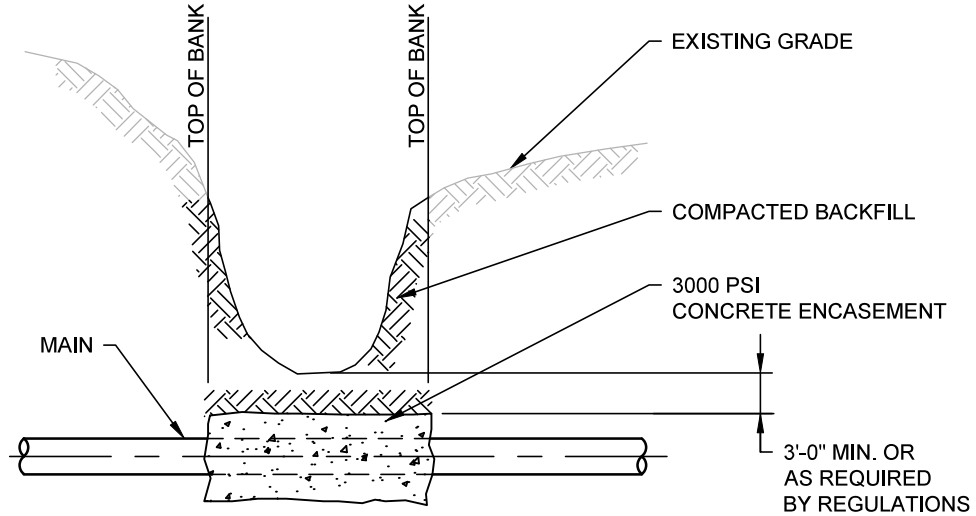
AMERICAN WATER ENGINEERING
APPROVED

DATE: 09-OCT-2019
STANDARD DETAILS

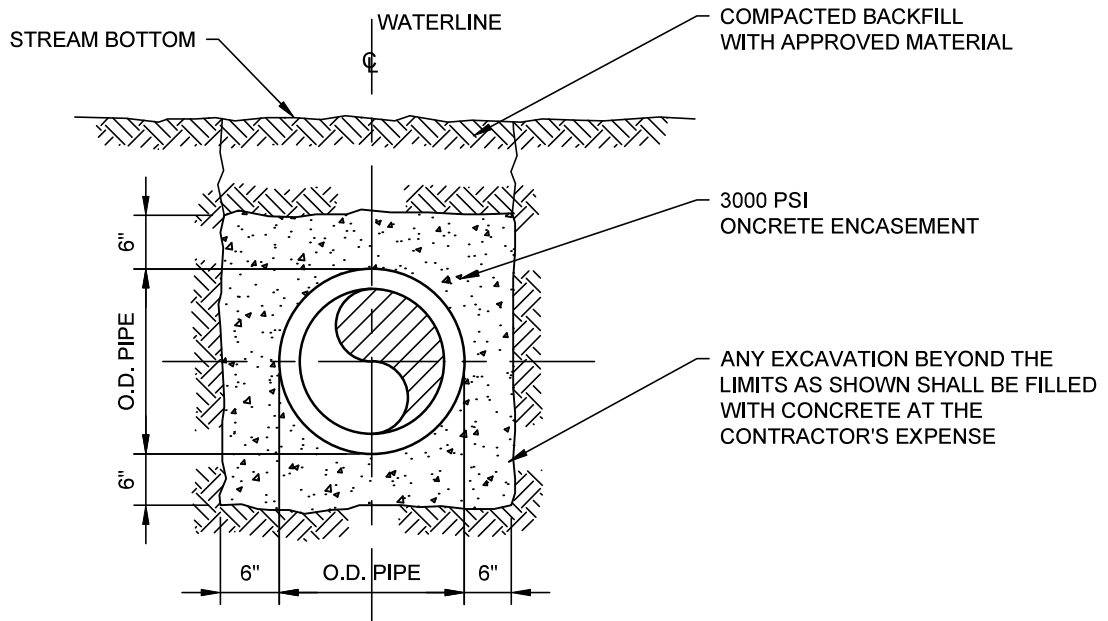
SCALE: AS SHOWN
SD-39

NOTES:

1. MINIMUM ENCASUREMENT LIMITS ARE SHOWN ON THE DRAWINGS. THE ACTUAL LIMITS SHALL BE DETERMINED BY THE ENGINEER AT THE TIME OF CONSTRUCTION SUCH THAT THE ENCASUREMENT TERMINATES AT A PIPE JOINT. THE JOINT SHALL BE FREE OF CONCRETE SO AS TO PROVIDE A FLEXIBLE JOINT.
2. REQUIRED COVER UNDER SMALL CREEKS, WASHES AND DRY STEADY BEDS SHALL BE PER LOCAL REQUIREMENTS.



TYPICAL PROFILE



TYPICAL SECTION

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
MINOR STREAM CROSSING WITH CONCRETE ENCASUREMENT DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

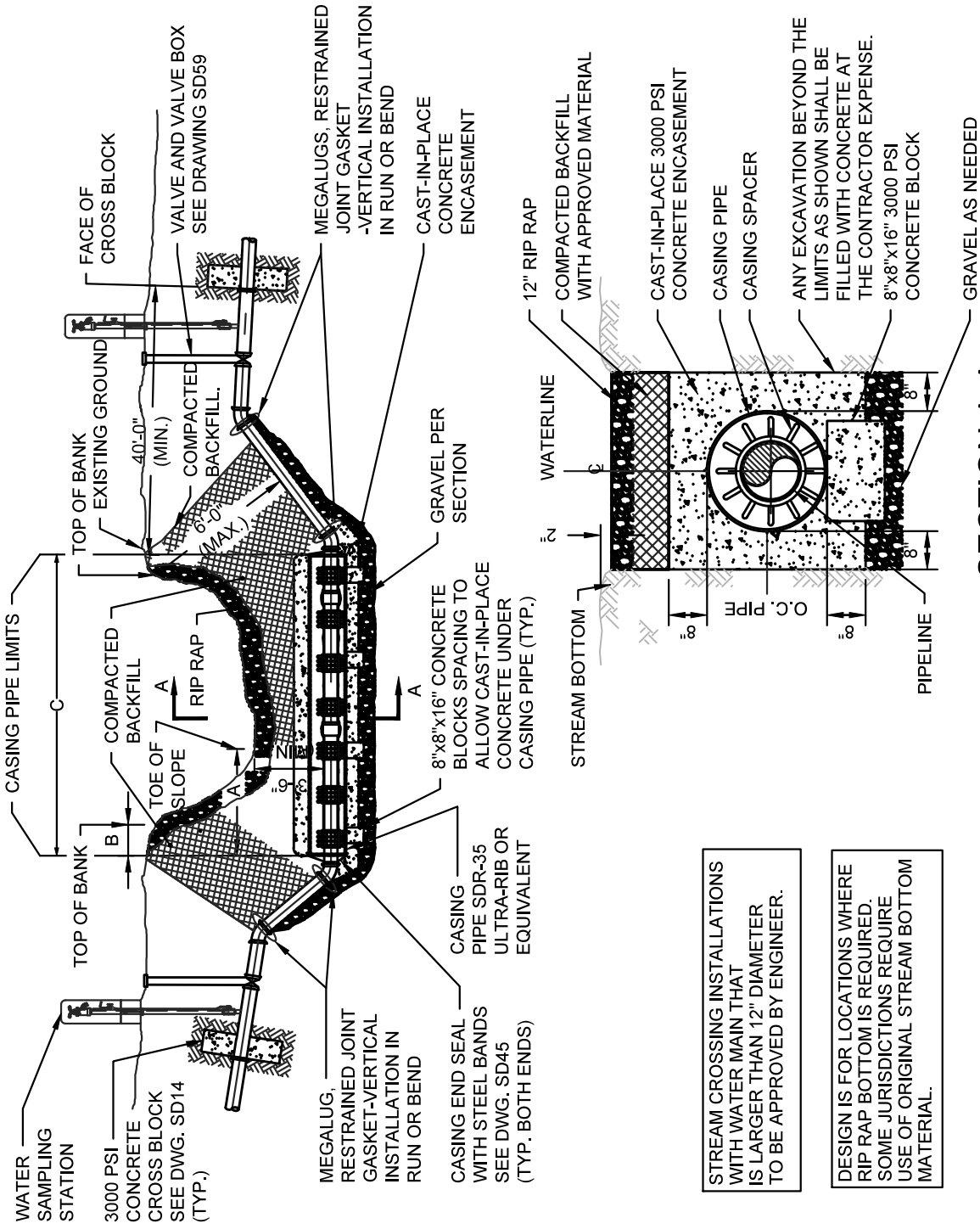
STANDARD DETAILS

APPROVED

SD- 40

NOTES:

- FOR ENCASUREMENT SPACER DETAILS AND TYPICAL THRUST RESTRAINT FOR D.I. OVER BENDS AND PIPING SEE WATER MAIN DETAILS, DRAWING SD45.
- DIMENSIONS A, B & C TO BE DETERMINED BY FIELD REPRESENTATIVE.
- MINIMUM ENCASUREMENT LIMITS ARE SHOWN ON THE DRAWINGS. THE ACTUAL LIMITS SHALL BE DETERMINED AT THE TIME OF CONSTRUCTION SUCH THAT THE ENCASUREMENT TERMINATES AT A PIPE JOINT. THE JOINTS SHALL BE FREE OF CAST-IN-PLACE CONCRETE.
- RIP RAP SHALL BE INSTALLED TO MATCH CONTOUR OF STREAM BOTTOM AND STREAM BANK SIDES. DEPTH OF RIP RAP IS 18 INCHES.
- ALL PIPE AND FITTINGS SHALL BE PUSH-ON DUCTILE IRON WITH JOINT RESTRAINT GASKETS FOR 16 INCH DIAMETER AND SMALLER.
- TR FLEX RESTRAINT JOINT IS REQUIRED FOR 20 INCH DIAMETER AND LARGER. NON-VERTICAL FIELD AND CUT JOINTS SHALL BE COMPLETED WITH A GRIPPER RING ON THE SPIGOT END FOR THE JOINT PER MFG. RECOMMENDATIONS. MEGA-LUG TO BE USED ON VERTICAL INSTALLATIONS.
- VALVES SHALL BE INSTALLED AT BOTH ENDS OF THE CROSSING. VALVE BOXES SHALL BE ACCESSIBLE AND NOT SUBJECT TO FREQUENT FLOODING. VALVE LOCATION TO BE DETERMINED BY ENGINEER.
- PROVIDE ANCHORING AS NEEDED TO PREVENT CASING FROM FLOATING.
- INSTALL WATER SAMPLING STATION APPROXIMATELY 15 FEET FROM STREAM BANK OR AS DETERMINED BY ENGINEER. STATION TO BE PROVIDED BY WATER CO.

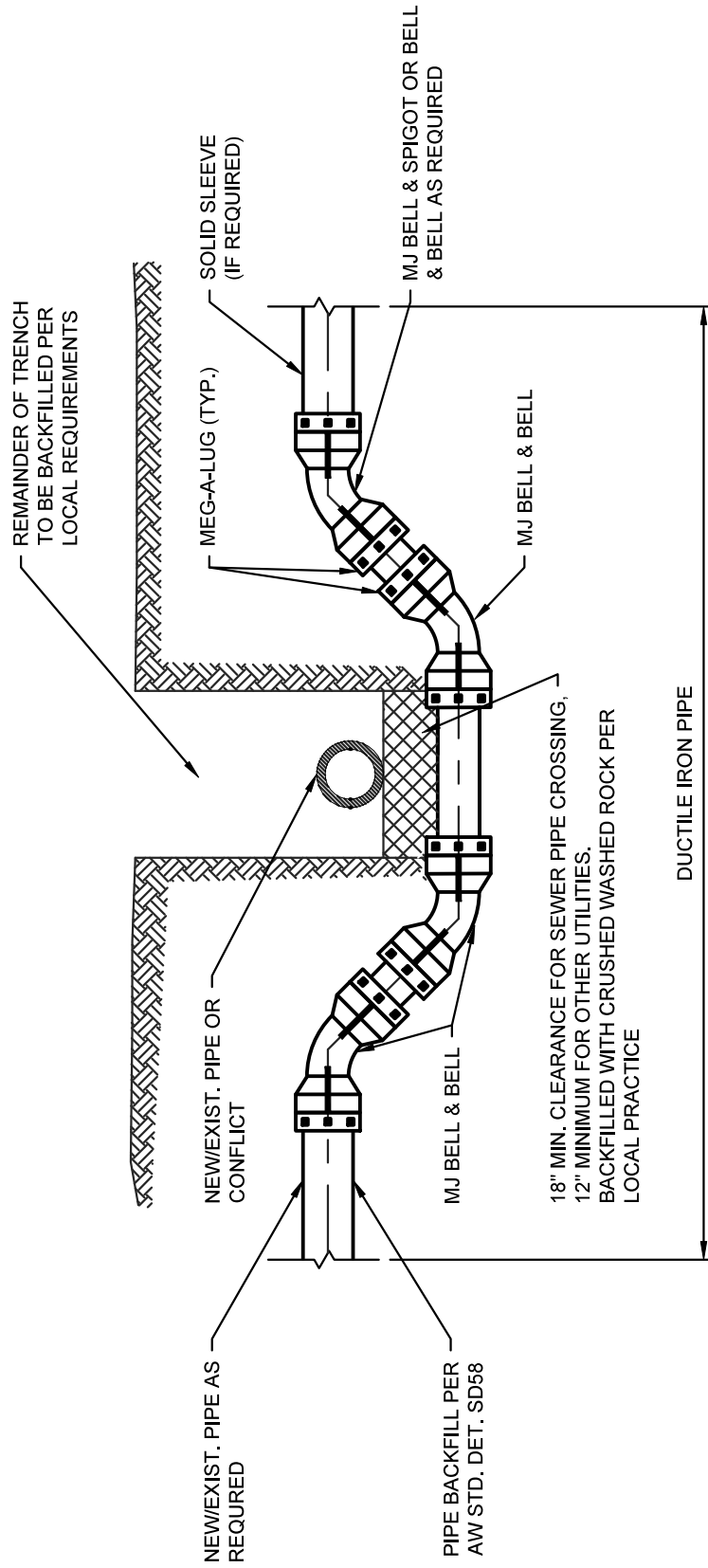


STREAM CROSSING INSTALLATIONS WITH WATER MAIN THAT IS LARGER THAN 12" DIAMETER TO BE APPROVED BY ENGINEER.

DESIGN IS FOR LOCATIONS WHERE RIP RAP BOTTOM IS REQUIRED. SOME JURISDICTIONS REQUIRE USE OF ORIGINAL STREAM BOTTOM MATERIAL.

SECTION A-A

| | | | |
|---|---|--|----------------------------------|
| <p>AMERICAN WATER STANDARD CIVIL WATER DISTRIBUTION SYSTEM STREAM CROSSING ENCASED IN CONCRETE DETAIL</p> | <p>AMERICAN WATER STANDARD CIVIL WATER DISTRIBUTION SYSTEM STREAM CROSSING ENCASED IN CONCRETE DETAIL</p> | <p>AMERICAN WATER ENGINEERING APPROVED</p> | <p>SCALE: AS SHOWN SD-41</p> |
| | <p>AMERICAN WATER ENGINEERING 1 WATER STREET CAMDEN, NJ 08102</p> | <p>AMERICAN WATER ENGINEERING</p> | <p>DATE: 17-SEPT-2020</p> |



NOTES:

1. ALL PIPE TO BE JOINT RESTRAINED.
2. PIPE IS TO BE DUCTILE IRON, CLASS 52 (MINIMUM), OR AS OTHERWISE SPECIFIED BY WATER CO..
3. ALL DUCTILE IRON PIPE SHALL BE POLYETHYLENE WRAPPED FOR THE ENTIRE LENGTH.
4. BEGIN/END RESTRAINED JOINT STATIONING TO BE SHOWN ON THE APPROVED CONSTRUCTION DRAWINGS. ALL BENDS & FITTINGS SHALL HAVE STATIONING AND ELEVATION SHOWN ON THE APPROVED CONSTRUCTION DRAWINGS. THE BOTTOM ELEVATION OF THE CONFLICT AND THE TOP ELEVATION OF THE DUCTILE IRON PIPE AT THE CENTERLINE OF THE CONFLICT SHALL BE SHOWN ON THE APPROVED CONSTRUCTION DRAWINGS..

AMERICAN WATER ENGINEERING
 1 WATER STREET
 CAMDEN, NJ 08102

AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 VERTICAL REALIGNMENT OF WATER MAINS DETAIL

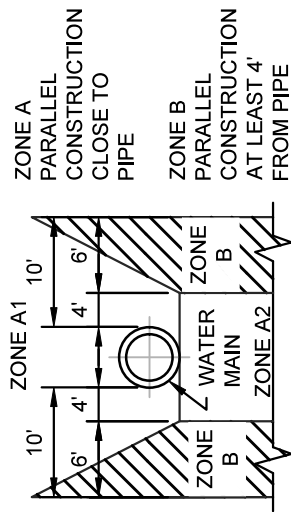
AMERICAN WATER ENGINEERING
 APPROVED

SCALE: AS SHOWN
 SD-42

SPECIAL CONSTRUCTION REQUIREMENTS

WHERE REQUIRED WATER MAIN SEPARATION FROM SEWER CANNOT BE MAINTAINED

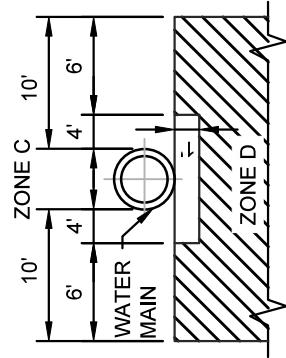
PARALLEL CONSTRUCTION



ZONE A
PARALLEL CONSTRUCTION CLOSE TO PIPE

ZONE B
PARALLEL CONSTRUCTION AT LEAST 4' FROM PIPE

PERPENDICULAR CONSTRUCTION



ZONE C
PERPENDICULAR ABOVE OR EVEN HORIZONTAL

ZONE D
PERPENDICULAR BELOW HORIZONTAL IF AN EXISTING SEWER IS LOCATED WITHIN THESE LIMITS, THE CONDITIONS REQUIREMENTS MAY APPLY (CONFIRM WITH REGULATOR)

IF AN EXISTING SEWER IS LOCATED WITHIN ZONES A1, A2, B, C, OR D OF A PROPOSED WATER MAIN, THE FOLLOWING SPECIAL REQUIREMENTS APPLY:

ZONE

- A. NO WATER MAINS SHALL BE CONSTRUCTED WITHOUT SPECIAL PERMISSION FROM THE APPROPRIATE HEALTH OR ENVIRONMENTAL REGULATOR.
- B. IF THE SEWER DOES NOT MEET ZONE B REQUIREMENTS, THE WATER MAIN SHALL BE OF PRESSURE CLASS 200 PIPE FOR PVC AND CLASS 350 FOR D.I. PIPE. SEWER SHALL BE CONSTRUCTED EQUAL TO WATER PIPE AND TESTED FOR WATER TIGHTNESS.
- C. NO WATER MAINS SHALL BE CONSTRUCTED WITHOUT SPECIAL PERMISSION FROM THE HEALTH REGULATOR. IF PERMISSION IS GRANTED, THE SEWER PIPE SHALL BE ENCASED WITH REINFORCED CONCRETE AND THE WATER MAIN SHALL BE OF CLASS 200 PIPE OR EQUIVALENT.
- D. THE SEWER SHALL BE ENCASED WITH REINFORCED CONCRETE.

REQUIRED SEPARATION BETWEEN WATER MAINS AND SANITARY SEWERS

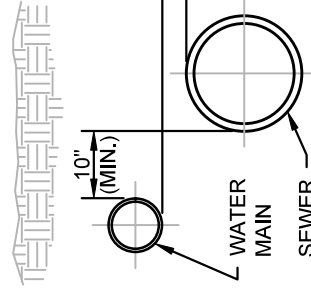
BASIC SEPARATION REQUIREMENTS

WATER MAINS AND SEWERS SHOULD BE SEPARATED AS FAR AS IS REASONABLE IN BOTH THE HORIZONTAL AND VERTICAL DIRECTIONS WITH SEWERS LOWER THAN WATER MAINS.

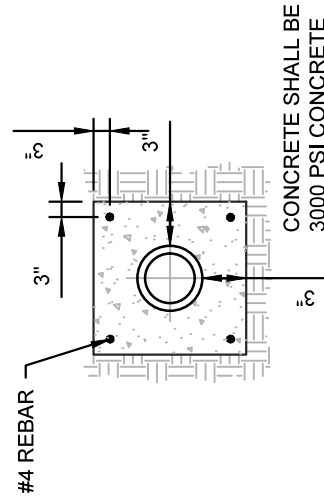
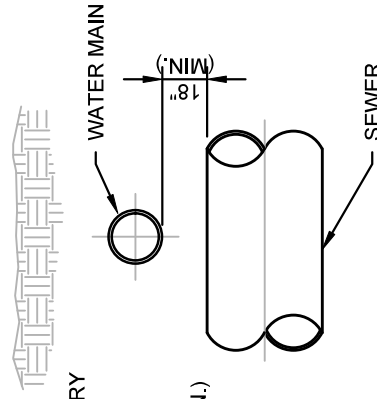
PARALLEL CONSTRUCTION: THE HORIZONTAL DISTANCE BETWEEN PRESSURE WATER MAINS AND SEWERS SHALL BE AT LEAST 10 FEET.

PERPENDICULAR CONSTRUCTION (CROSSING): PRESSURE WATER MAINS SHALL BE AT LEAST 18" ABOVE SANITARY SEWERS WHERE THESE LINES MUST CROSS.

PARALLEL CONSTRUCTION



PERPENDICULAR CONSTRUCTION



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM**

SPECIAL CONSTRUCTION REQUIREMENTS FOR WATER MAIN DETAIL

DATE: 17-SEPT-2020

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

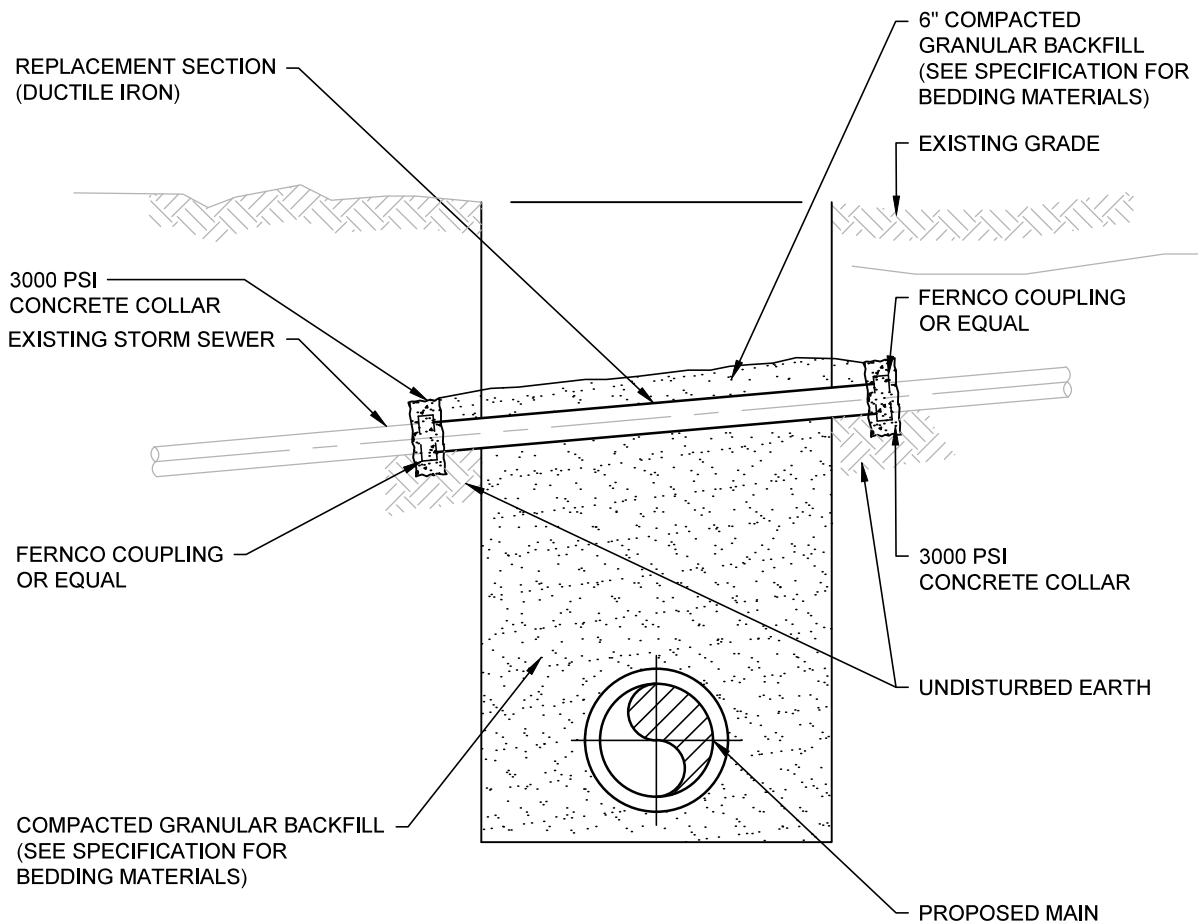
STANDARD DETAILS

APPROVED

SD-43

NOTES:

1. IF THE EXISTING STORM SEWER IS DAMAGED OR REMOVED DURING CONSTRUCTION IT SHALL BE REPLACED ACROSS THE TRENCH SUCH THAT THE CONCRETE COLLARS ARE SUPPORTED ON UNDISTURBED EARTH.
2. THE CONCRETE COLLAR SHALL BE FORMED AT A JOINT WITH THE EXISTING HOUSE LATERAL USING FERNCO COUPLINGS.
3. THE REPLACEMENT SECTION SHALL BE CLASS 350 DUCTILE IRON PIPE WITH AN INSIDE DIAMETER EQUAL TO THE EXISTING PIPE. ANSI/AWWA C151/A21.51 DUCTILE IRON PIPE SHALL BE USED AS A MINIMUM STANDARD.
4. WHEN THE STORM SEWER OWNER HAS REQUIREMENTS WHICH ARE MORE STRINGENT, THE CONTRACTOR SHALL CONFORM TO THE MORE STRINGENT REQUIREMENTS AND MAKE NO CLAIM FOR ADDITIONAL COMPENSATION OR AN EXTENSION OF TIME BECAUSE OF SUCH REQUIREMENTS.



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
STORM SEWER REPLACEMENT DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

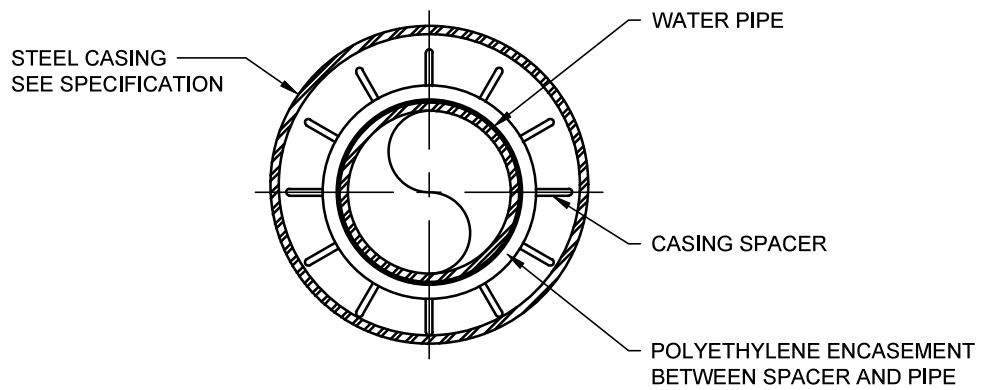
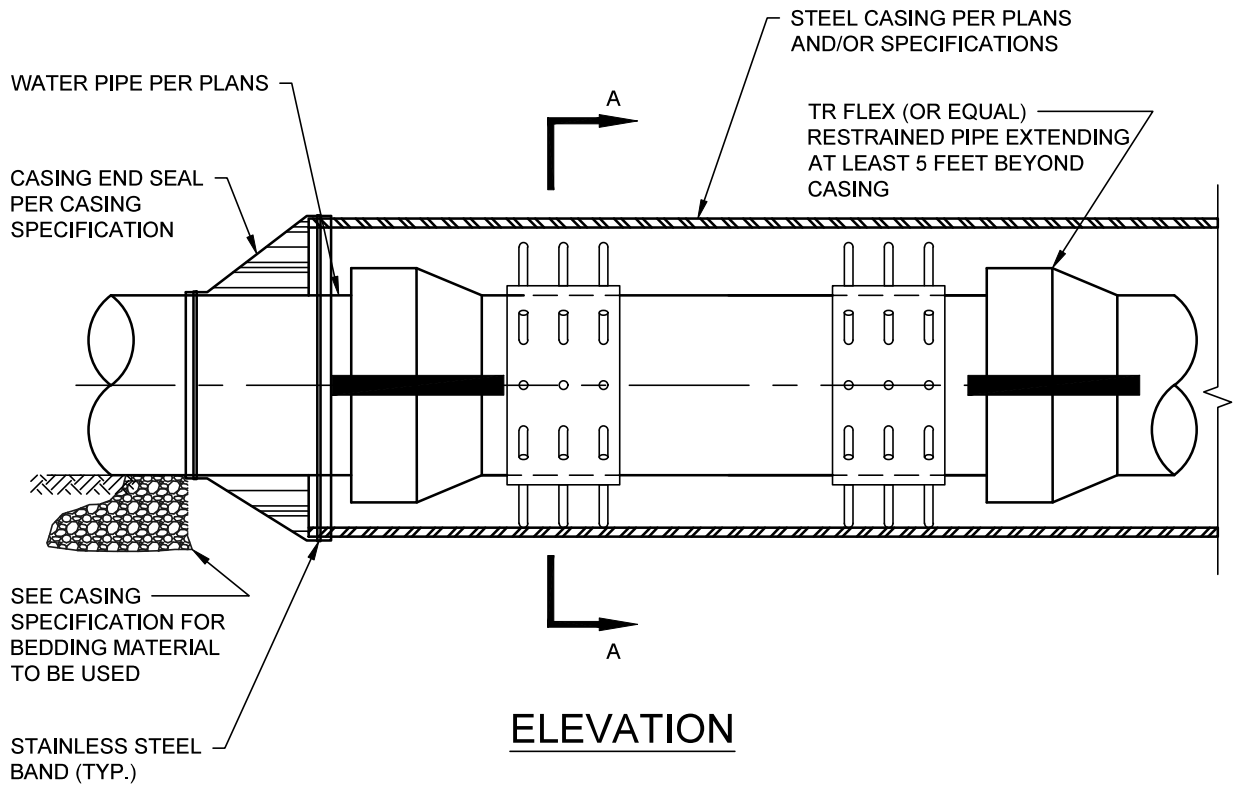
STANDARD DETAILS

APPROVED

SD- 44

NOTES:

1. RESTRAINT OR EQUALS DEFINED AS REQUIRING NO SPECIAL TOOLS OR SHIMS TO REMOVE PIPE FROM CASING IN THE FUTURE
2. THIS STANDARD APPLICABLE TO 4" DIA. AND LARGER PIPE.



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CASING INSTALLATION DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

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NOTES:

CUL-DE-SACS THAT ARE DESIGNED WITH THE SANITARY SEWER INSTALLED OR PROPOSED AROUND THE PERIMETER OF A CUL-DE-SAC IN AN EASEMENT MUST MEET THE DNR CODE OF STATE REGULATIONS (CSR) AS OUTLINED BELOW, DUE TO THE WIDTH OF SEWER TRENCHES AND THE RESULTING DISTURBED SOIL OCCUPYING THE ENTIRE EASEMENT.

REGULATIONS NORMALLY REQUIRE 10 FEET SEPARATION BETWEEN THE WATER MAIN AND THE BUILDING LINE WHERE A WATER MAIN IS INSTALLED OR PROPOSED AROUND THE PERIMETER OF A CUL-DE-SAC.

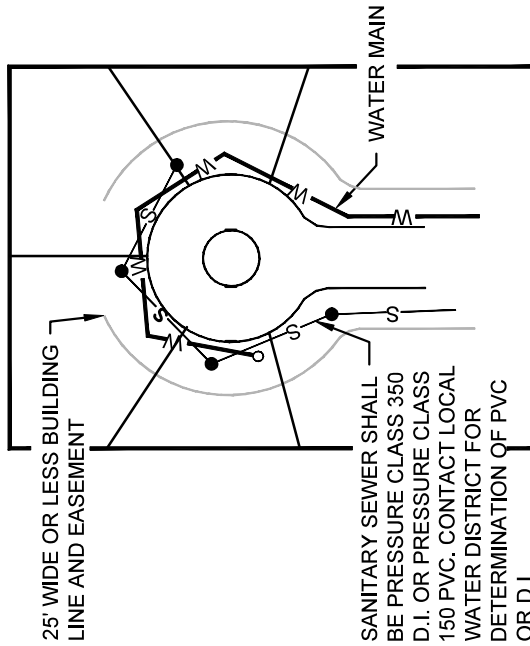
CUL-DE-SACS WITH 30 FOOT WIDE EASEMENT AND BUILDING LINE SHOULD NOT BE AN ISSUE AS LONG AS THE SEWER IS INSTALLED LESS THAN 10 FEET FROM THE EDGE OF RIGHT OF WAY.

HORIZONTAL SEPARATION - SEWER MAINS SHALL BE AT LEAST 10 FEET HORIZONTALLY FROM ANY EXISTING OR PROPOSED WATER MAIN. THE DISTANCES SHALL BE MEASURED EDGE-TO-EDGE. IN CASES WHERE IT IS NOT PRACTICAL TO MAINTAIN TEN FOOT (10') SEPARATION, DEVIATION ON A CASE BY CASE BASIS, IF SUPPORTED BY DATA FROM THE DESIGN ENGINEER. THIS DEVIATION MAY ALLOW INSTALLATION OF THE SEWER CLOSER TO THE WATER MAIN, PROVIDED THAT THE WATER MAIN IS IN A SEPARATE TRENCH OR AN UNDISTURBED EARTH SHELF LOCATED ON ONE (1) SIDE OF THE SEWER AT AN ELEVATION THAT THE BOTTOM OF THE WATER MAIN IS AT LEAST EIGHTEEN INCHES (18") ABOVE THE TOP OF THE SEWER. CONSTRUCTOR SHALL NOT PROCEED WITH DEVIATION WITHOUT AW APPROVAL.

CROSSING - SEWERS CROSSING WATER MAINS SHALL BE LAID TO PROVIDE A MINIMUM VERTICAL DISTANCE OF EIGHTEEN INCHES (18") BETWEEN THE OUTSIDE OF THE WATER MAIN AND THE OUTSIDE OF THE SEWER. THIS SHALL BE THE CASE WHERE THE WATER MAIN IS EITHER ABOVE OR BELOW THE SEWER. THE CROSSING SHALL BE ARRANGED SO THE SEWER JOINT WILL BE EQUIVALENT AND AS FAR AS POSSIBLE FROM THE WATER MAIN JOINTS. WHEN A WATER MAIN CROSSES UNDER A SEWER, ADEQUATE STRUCTURAL SUPPORT SHALL BE PROVIDED FOR THE SEWER TO PREVENT DAMAGE TO THE WATER MAIN.

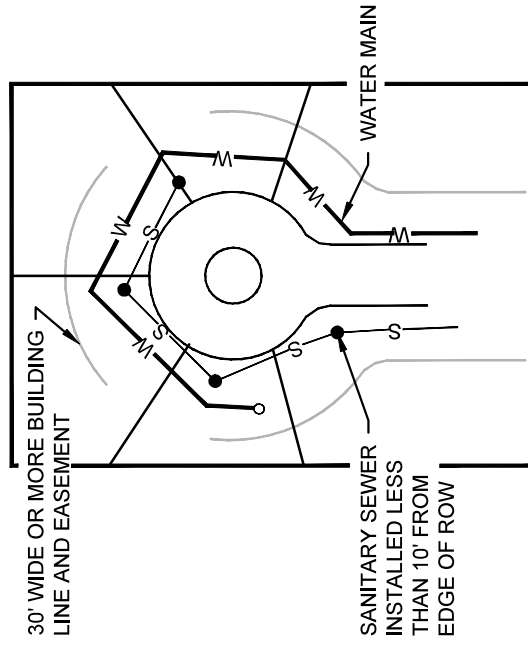
SPECIAL CONDITIONS. WHEN IT IS IMPOSSIBLE TO OBTAIN PROPER HORIZONTAL AND VERTICAL SEPARATION AS STIPULATED PREVIOUSLY. THE SEWER SHALL BE DESIGNED AND CONSTRUCTED EQUAL TO THE WATER PIPE AND SHALL BE PRESSURE TESTED TO ENSURE WATER-TIGHTNESS PRIOR TO BACKFILLING.

AN AWC DESIGNATED INSPECTOR SHALL VERIFY AND DOCUMENT THE TYPE AND PRESSURE OF SEWER MATERIAL INSTALLED. SHALL VERIFY PRESSURE TESTING FOR WATER-TIGHTNESS, AND SHALL PROVIDE AS-BUILT DRAWINGS OF THE SEWER MAIN SHOWING THE LOCATION OF THE SEWER JOINTS AND MANHOLES. SEWER DOCUMENTATION AND AS-BUILT DRAWINGS FOR LAYOUT "A" SHALL BE SENT TO AWC NEW BUSINESS DEPARTMENT PRIOR TO WATER MAIN CONSTRUCTION.



LAYOUT "A"

BUILDING SETBACK 25' OR LESS CSR 20-8 (SPECIAL CONDITIONS)



LAYOUT "B"

BUILDING SETBACK 30' OR MORE CSR 20-8 (TEN FOOT SEPARATION)



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PROTECTION OF WATER SUPPLIES DETAIL**

DATE: 17-SEPT-2020

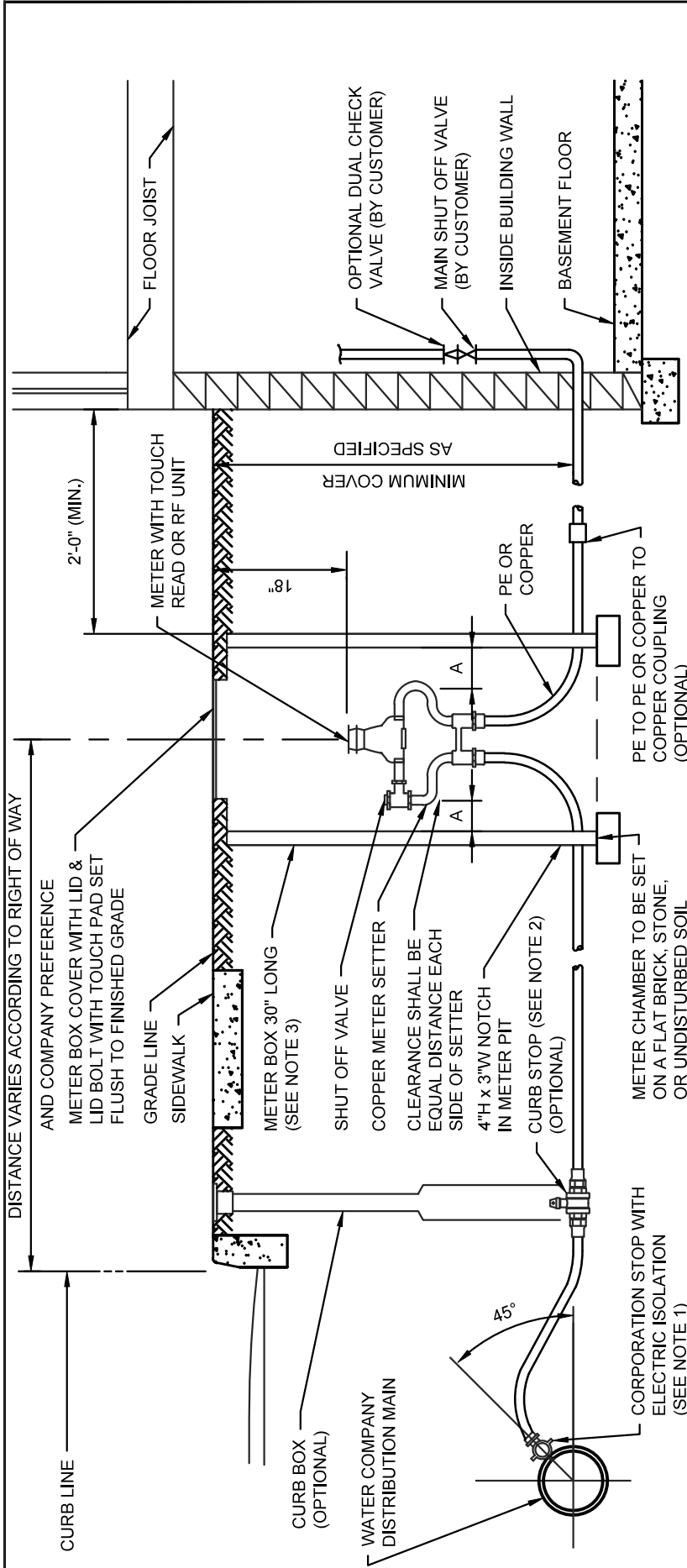
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS


APPROVED

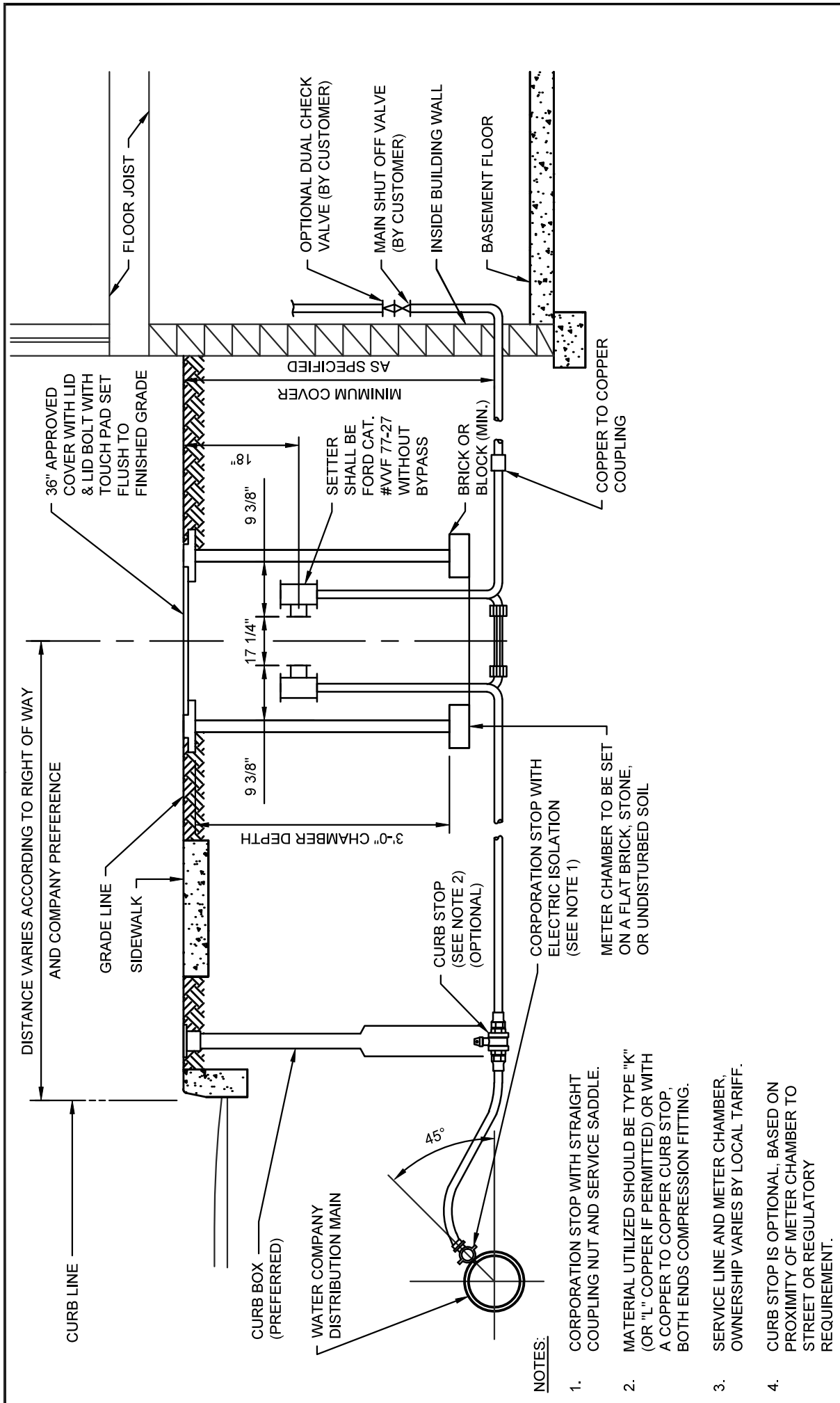
SD-46



NOTES:

1. CORPORATION STOP WITH STRAIGHT COUPLING NUT. SERVICE SADDLES WILL BE USED FOR ALL TAPS IN A/C, PVC OR CONCRETE MAINS.
2. MATERIAL UTILIZED SHOULD BE TYPE "K" (OR "L" COPPER IF PERMITTED) WITH A COPPER TO COPPER CURB STOP, BOTH ENDS COMPRESSION FITTING, POLYETHYLENE ENCASE AS REQUIRED.
3. 18" I.D. CHAMBER FOR USE WITH 5/8" METER. 20" I.D. CHAMBER FOR USE WITH 1" METER. SQUARE METER PITS MAY BE USED IF LOCAL PREFERENCE EXISTS.
4. METER BOX LOCATION TO BE DETERMINED BY LOCAL AUTHORITY AND AWW.
5. SERVICE LINE AND METER BOX OWNERSHIP VARIES BY LOCAL TARIFF.
6. POLYWRAP SERVICE FROM MAIN TO METER PIT IF SOIL IS CORROSIVE.
7. IN HEAVY FROST AREAS, A PLASTIC INNER LID AND BLANKET CAN BE USED.
8. CONNECTIONS BETWEEN PIPE LENGTHS SHALL BE COMPRESSION OR FLARE AND MAY DEPEND ON LOCAL PLUMBING REQUIREMENT.

| | | | |
|--|---|--|-----------------|
| AMERICAN WATER ENGINEERING 1 WATER STREET CAMDEN, NJ 08102 |  AMERICAN WATER | AMERICAN WATER STANDARD CIVIL WATER DISTRIBUTION SYSTEM EXT. 3/4" WATER METER/COPPER SERVICE DETAIL | |
| | | DATE: 09-OCT-2019 | SCALE: AS SHOWN |
| STANDARD DETAILS | | AMERICAN WATER ENGINEERING | APPROVED |
| | | AMERICAN WATER ENGINEERING | SD- 47 |



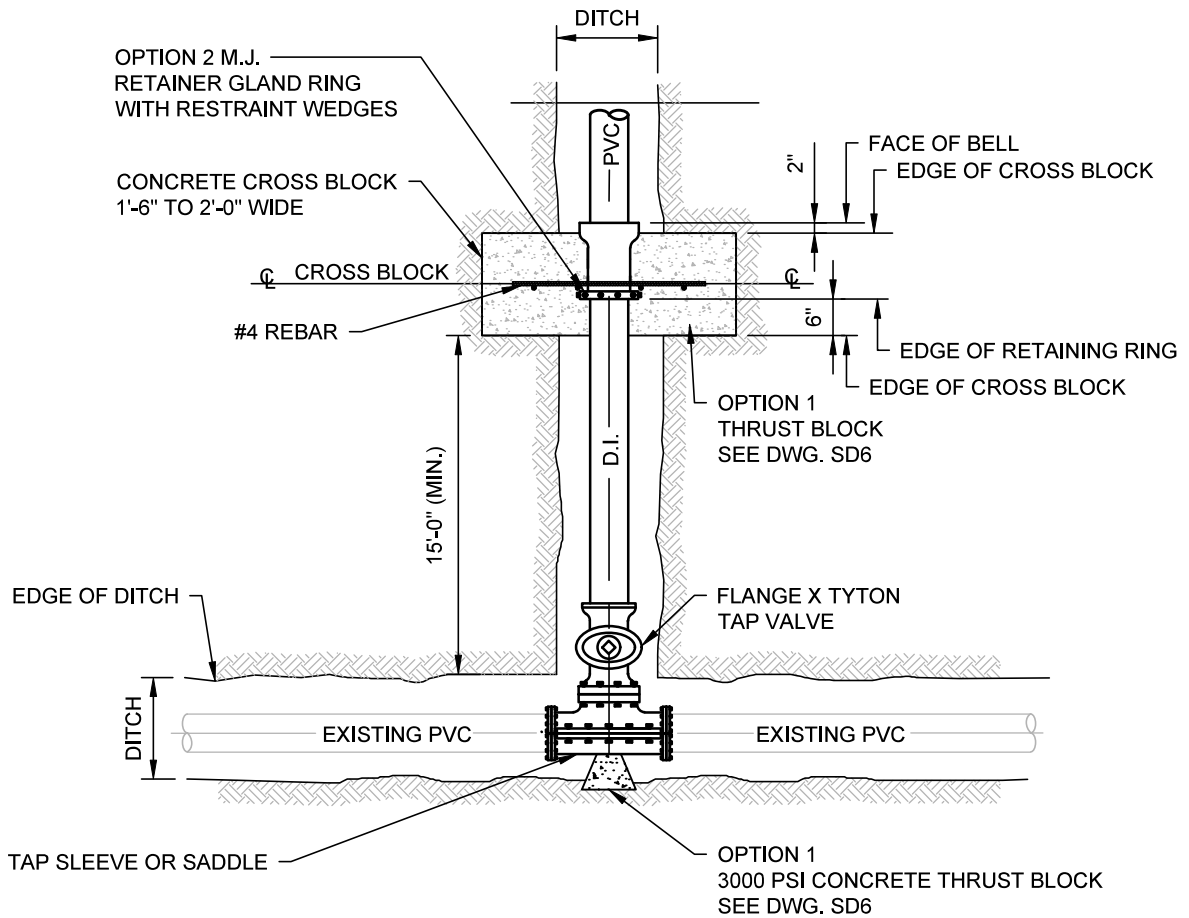
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|---|--|------------------------|
| <p>AMERICAN WATER ENGINEERING 1 WATER STREET CAMDEN, NJ 08102</p>  <p>AMERICAN WATER</p> | <p>AMERICAN WATER STANDARD CIVIL WATER DISTRIBUTION SYSTEM EXT. 2" WATER METER/COPPER SERVICE DETAIL</p> | |
| | <p>DATE: 17-SEPT-2020</p> | <p>SCALE: AS SHOWN</p> |
| <p>STANDARD DETAILS</p> | <p>APPROVED</p> | <p>SD-48</p> |

NOTES:

- CORPORATION STOP WITH STRAIGHT COUPLING NUT AND SERVICE SADDLE.
- MATERIAL UTILIZED SHOULD BE TYPE "K" (OR "L" COPPER IF PERMITTED) OR WITH A COPPER TO COPPER CURB STOP. BOTH ENDS COMPRESSION FITTING.
- SERVICE LINE AND METER CHAMBER, OWNERSHIP VARIES BY LOCAL TARIFF.
- CURB STOP IS OPTIONAL, BASED ON PROXIMITY OF METER CHAMBER TO STREET OR REGULATORY REQUIREMENT.
- POLYWRAP COPPER SERVICE FROM MAIN TO CURB STOP IF SOIL IS CORROSIVE.
- CONNECTIONS BETWEEN PIPE LENGTHS SHALL BE COMPRESSION OR FLARED AND MAY DEPEND ON LOCAL PLUMBING REQUIREMENT.

NOTES:

1. ONE RETAINER GLAND RINGS WITH RESTRAINT WEDGES SHALL BE INSTALLED FACING THE TAPPING SLEEVE.
2. RETAINER GLAND RINGS PER SPECIFICATION.
3. ALL PUSH-ON JOINT PIPE.



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
RESTRAINED PVC TAP DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

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1-1/2" OR 2" CURB STOP

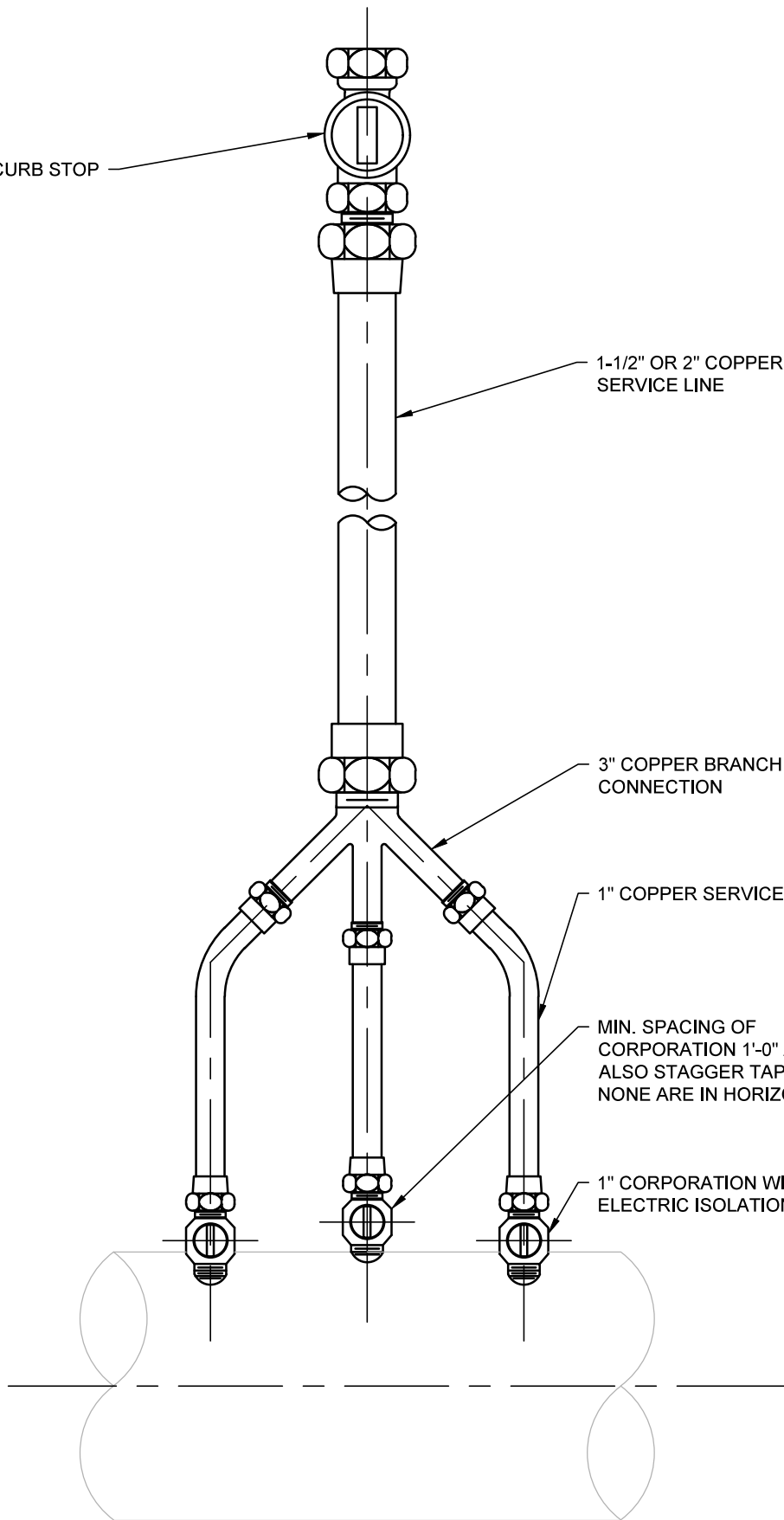
1-1/2" OR 2" COPPER SERVICE LINE

3" COPPER BRANCH CONNECTION

1" COPPER SERVICE LINE

MIN. SPACING OF CORPORATION 1'-0" APART. ALSO STAGGER TAPS SO THAT NONE ARE IN HORIZONTAL LINE.

1" CORPORATION WITH ELECTRIC ISOLATION



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
1-1/2" & 2" SERVICE LINES DETAIL**

DATE: 09-OCT-2019

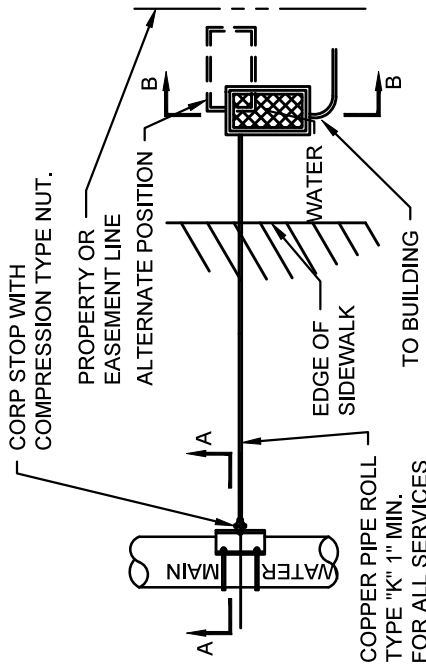
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

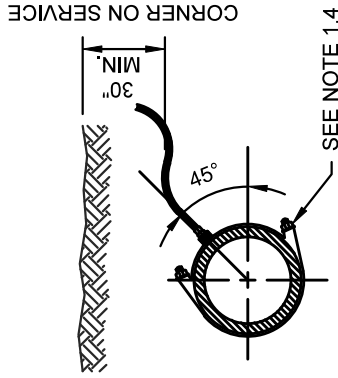
STANDARD DETAILS

APPROVED

SD- 50



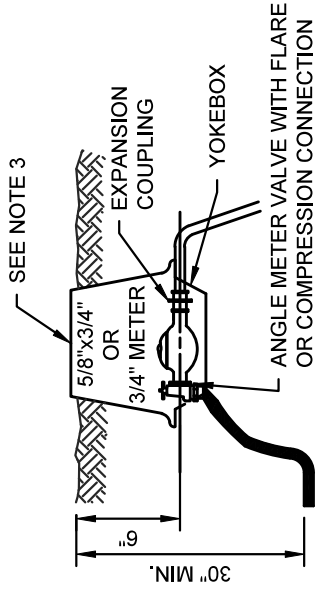
PLAN VIEW



SECTION A-A

ALL SERVICES

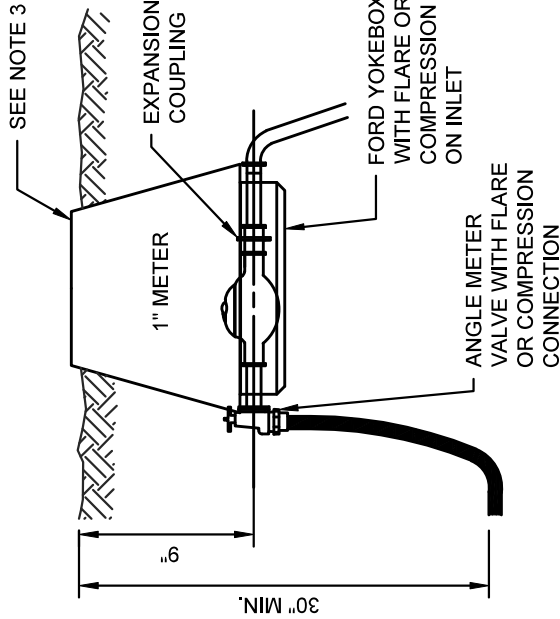
SEE NOTE 1,4



SECTION B-B

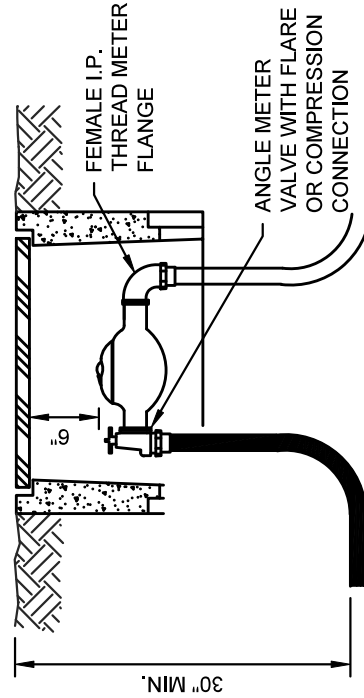
1" SERVICE w/ 5/8"x3/4" METER or 3/4" METER

FORD YL241-243 OR MUELLER P1453-J W/ 1" ANGLE INLET CUSTOMER SERVICE PER PLUMBING CODE



SECTION B-B

1" SERVICE w/ 1" METER



SECTION B-B

1-1/2" & 2" SERVICE w/ CORRESPONDING METER

NOTES:

1. SEE WATER COMPANY MATERIAL SPECIFICATIONS FOR APPROVED SADDLES.
2. METER TO BE SET BY AW UPON PAYMENT OF FEES.
3. LIDS FOR 3/4" & 1" FORD YOKE BOXES TO BE NON-LOCKING LIDS.
4. CHECK FOR SADDLE REQUIREMENTS, IF ANY, FOR DUCTILE IRON TAPS.

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AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
POTABLE WATER SERVICE CONNECTION NON-FROST AREAS DETAIL

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

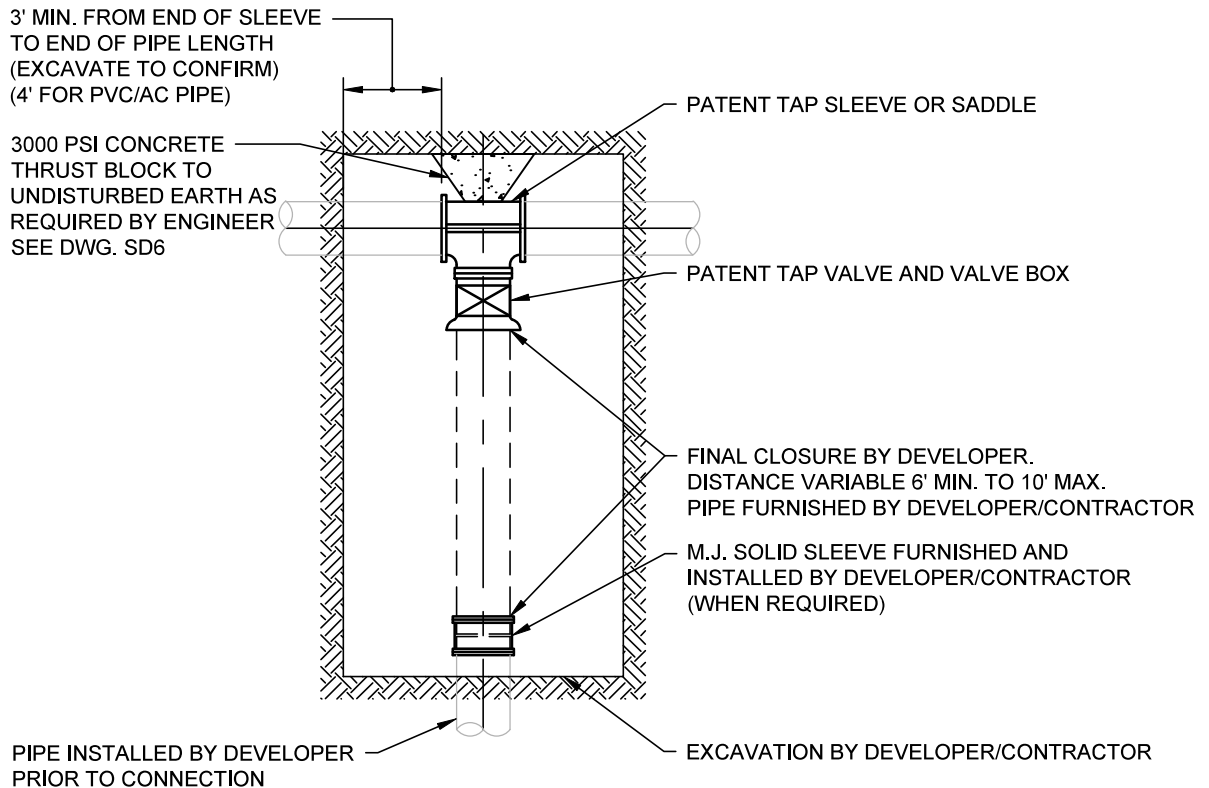
STANDARD DETAILS

APPROVED

SD-51

NOTES:

1. TAP CONNECTIONS TO AC (TRANSITE PIPE) 4" AND LARGER REQUIRE AN EXCAVATION 5 FT. IN WIDTH. (MAIN SIZE IS VARIABLE).
2. ALL EXCAVATIONS SHALL COMPLY WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS FOR PROTECTION OF WORKERS.
3. IF PIPE BELL IS EXPOSED IN TAP HOLE OR OTHER OBSTACLES ENCOUNTERED, CONTACT LOCAL WATER COMPANY DISTRICT PERSONNEL FOR FIELD REVIEW BEFORE COMPLETING EXCAVATION.
4. TAP HOLE SHALL BE FREE OF WATER AND MUD TO ALLOW SAFE HANDLING OF HEAVY SLEEVES AND TAPPING MACHINE.
5. CONCRETE BLOCKING BEHIND TAP TO BE PER REQUIREMENTS ON DRAWING SD6.
6. BOTTOM OF EXCAVATION TO BE 12" BELOW BOTTOM OF PIPE AND REASONABLY LEVEL.



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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PATENT TAP CONNECTION DETAIL**

DATE: 09-OCT-2019

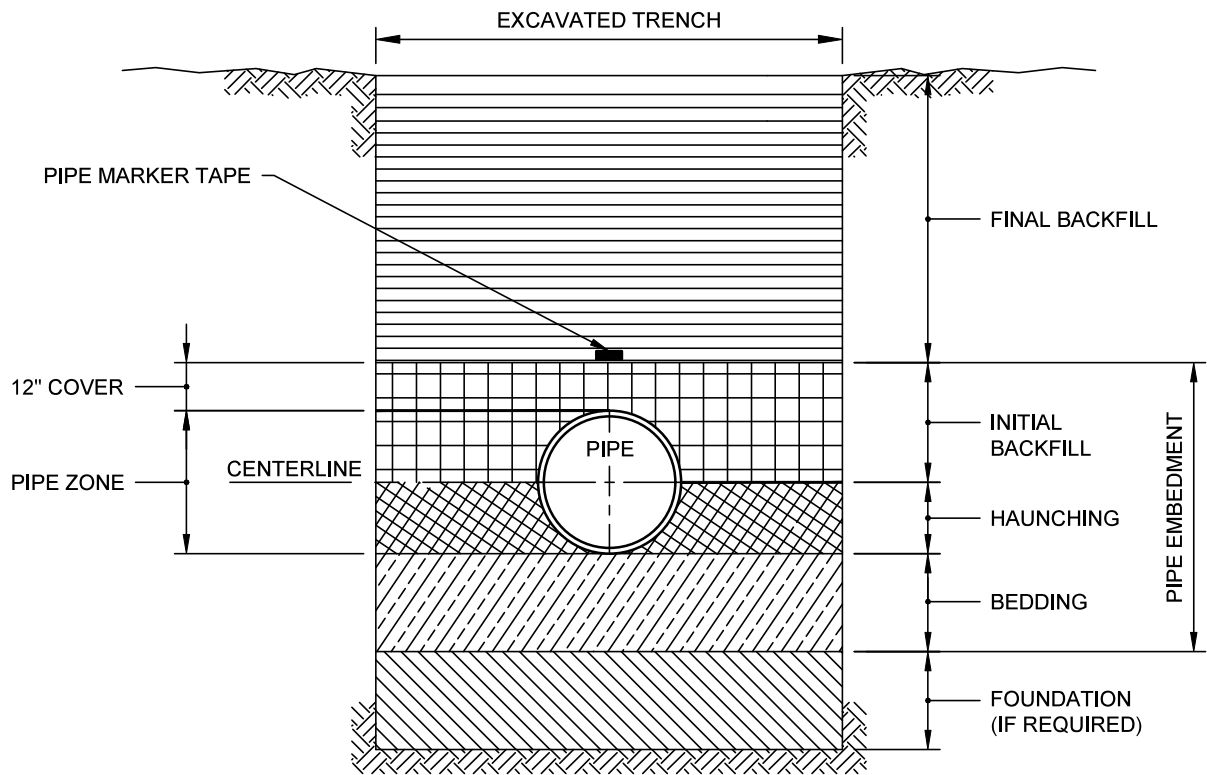
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 52



TRENCH TERMINOLOGY:

FOUNDATION: A FOUNDATION IS NECESSARY ONLY WHEN NATIVE SOILS ARE UNSTABLE. FOR SUCH CONDITIONS, THE TRENCH IS OVER-EXCAVATED AND A LAYER OF SUPPORTIVE MATERIAL IS PLACED AND COMPACTED TO PROVIDE A FIRM FOUNDATION FOR THE SUBSEQUENT PIPE EMBEDMENT MATERIALS.

EMBEDMENT: THIS ZONE IS THE MOST IMPORTANT IN TERMS OF PIPE PERFORMANCE. IT IS DIVIDED INTO THE FOLLOWING SUB ZONES:

- **BEDDING:** TYPICALLY SIX INCHES OF SUPPORTIVE, COMPACTED MATERIAL. THIS ZONE PROVIDES EVEN SUPPORT FOR THE PIPE AND BRINGS IT TO GRADE.
- **HAUNCHING:** EXTENDS FROM THE BOTTOM OF THE PIPE TO THE CENTERLINE OF THE PIPE. IT PROVIDES THE MOST RESISTANCE TO PIPE DEFLECTION. SPECIFYING PROPER MATERIALS AND COMPACTION ARE MOST IMPORTANT FOR THIS ZONE.
- **INITIAL BACKFILL:** EXTENDS FROM THE SPRINGLINE TO A POINT ABOVE THE TOP OF THE PIPE. THIS ZONE PROVIDES SOME PIPE SUPPORT AND HELPS TO PREVENT DAMAGE TO THE PIPE DURING PLACEMENT OF THE FINAL BACKFILL. THE COVER EXTENDS FROM THE TOP OF THE PIPE TO THE TOP OF THE INITIAL BACKFILL. THE DEPTH OF COVER SHOULD BE AS MUCH AS NECESSARY TO PROTECT THE PIPE DURING PLACEMENT OF THE FINAL BACKFILL. TWELVE INCHES IS A COMMON DEPTH OF COVER.

FINAL BACKFILL: THIS ZONE EXTENDS FROM THE TOP OF THE INITIAL BACKFILL TO THE TOP OF THE TRENCH. THIS ZONE HAS LITTLE INFLUENCE ON PIPE PERFORMANCE, BUT CAN BE IMPORTANT TO THE INTEGRITY OF ROADS AND STRUCTURES.

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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
PIPE TRENCH TERMINOLOGY DETAIL**

DATE: 09-OCT-2019

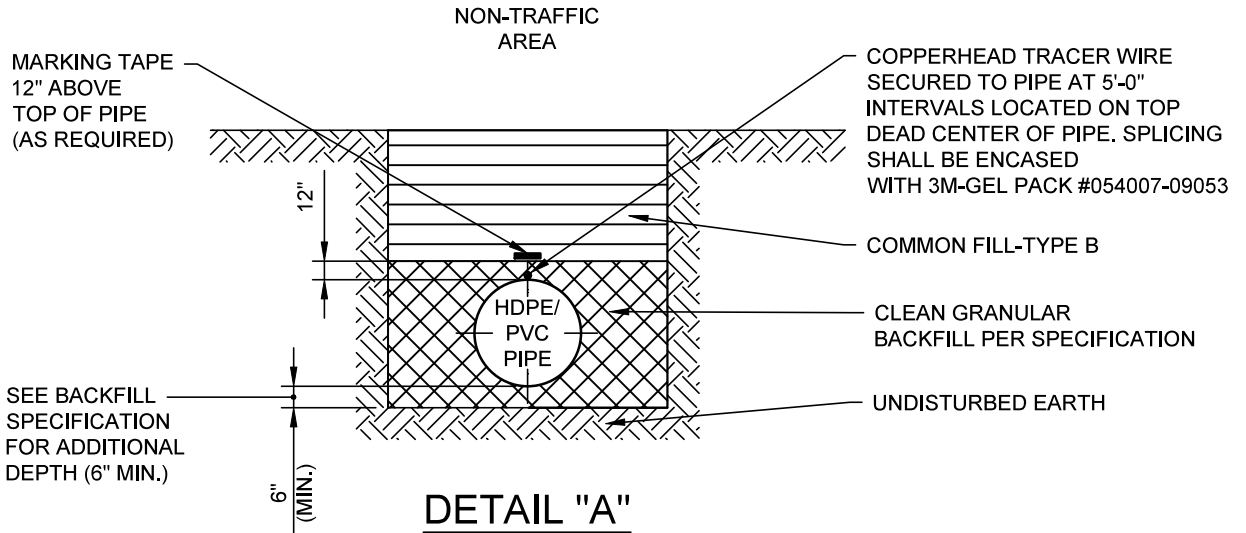
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

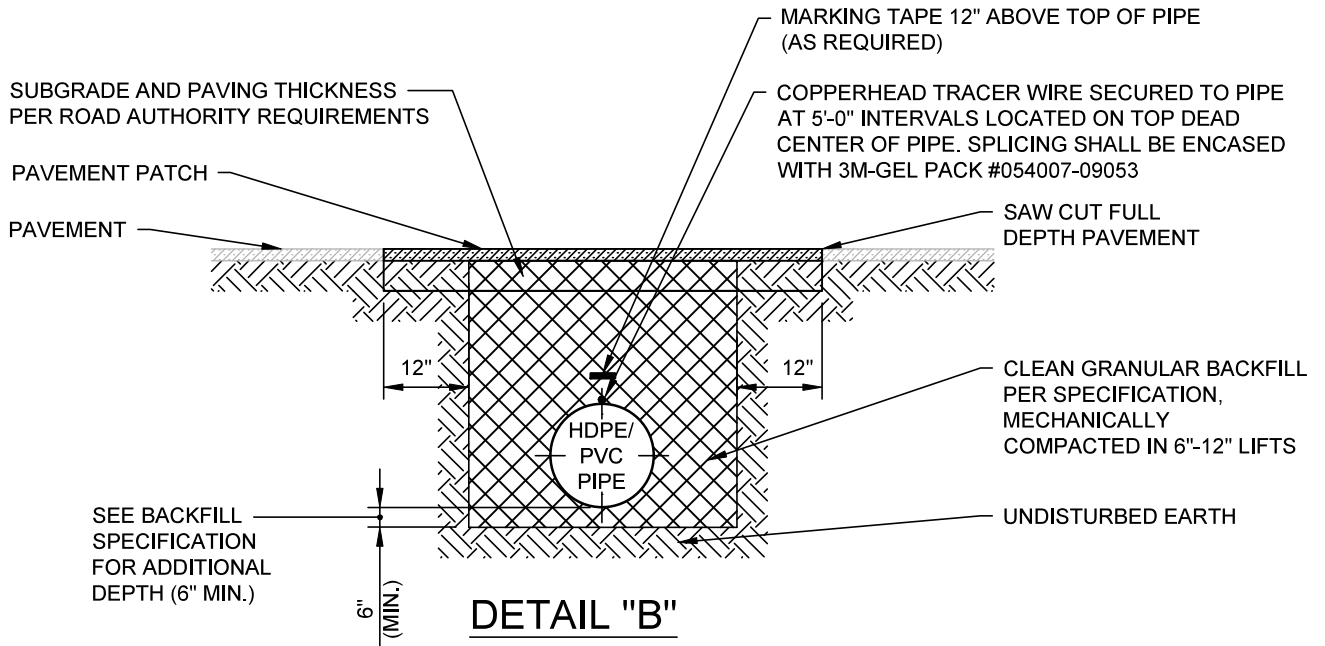
STANDARD DETAILS

APPROVED

SD- 53



HDPE/PVC - ROCK/SOIL
(FOR AREAS NOT TO BE PAVED)



HDPE/PVC - ROCK/SOIL
(FOR PAVED AREAS OR AREAS TO BE PAVED OR WITHIN 18" OF PAVING)

NOTES:

1. CAUTION MUST BE EXERCISED TO ENSURE PROPER PLACEMENT OF EMBEDMENT MATERIAL UNDER THE HAUNCHES OF THE PIPE.
2. CAUTION MUST BE EXERCISED TO PREVENT UNNECESSARY SCRATCHING AND CUTTING OF PLASTIC PIPE DURING BACKFILL.
3. COMMON FILL TYPE "A" MAY BE PERMITTED FOR HAUNCHING AND INITIAL COVER FOR HDPE PIPE. SEE SPECIFICATION 312333. IN ALL CASES 3/4" CLEAN GRANULAR FILL IS REQUIRED AS BEDDING MATERIAL.
4. SEE SPECIFICATION SECTION 312333 FOR DESCRIPTION OF BACKFILL AND BEDDING MATERIAL.

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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TRENCH - HDPE & PVC PIPE IN ROCK/SOIL DETAIL**

DATE: 09-OCT-2019

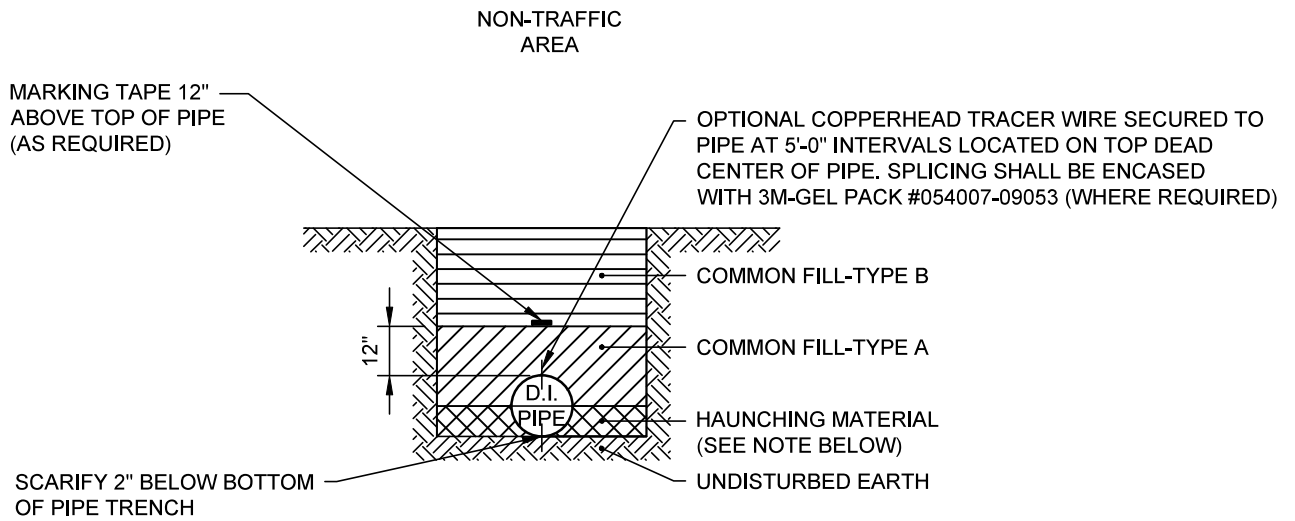
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

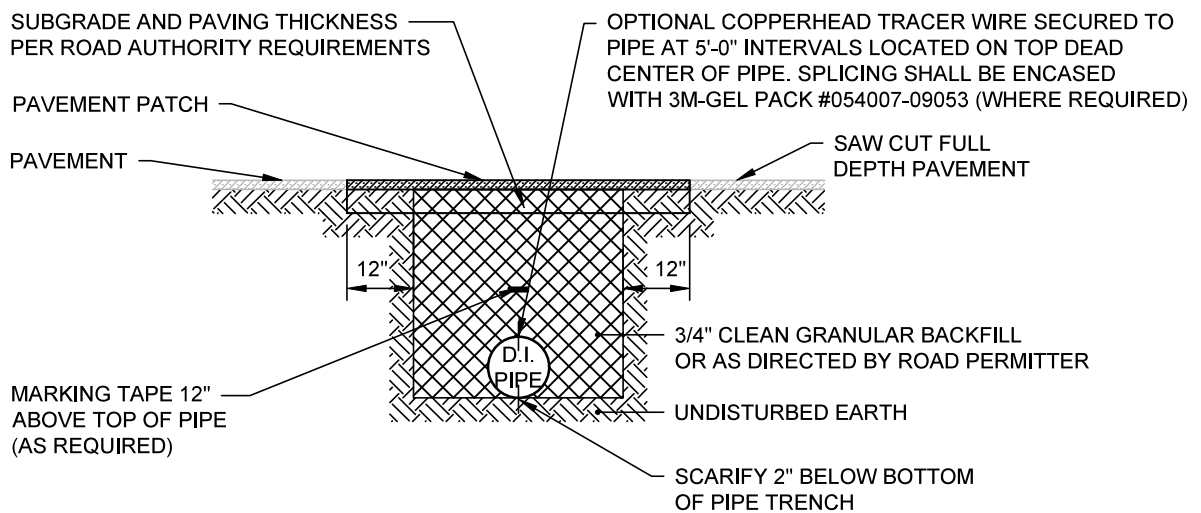
APPROVED

SD- 54



DETAIL "A"

D.I. - SOIL
(FOR AREAS NOT TO BE PAVED)



DETAIL "B"

D.I. - SOIL
(FOR PAVED AREAS OR AREAS TO BE PAVED OR WITHIN 18" OF PAVING)

NOTES:

1. CAUTION MUST BE EXERCISED TO ENSURE PROPER PLACEMENT OF EMBEDMENT MATERIAL UNDER THE HAUNCHES OF THE PIPE.
2. POLYETHYLENE ENCASING ON ALL D.I. PIPE, FITTINGS, VALVES & APPURTENANCES.
3. SEE SPECIFICATION SECTION 312333 FOR DESCRIPTION OF BACKFILL AND BEDDING MATERIAL.

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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TRENCH - D.I. PIPE IN SOIL DETAIL**

DATE: 23-OCT-2020

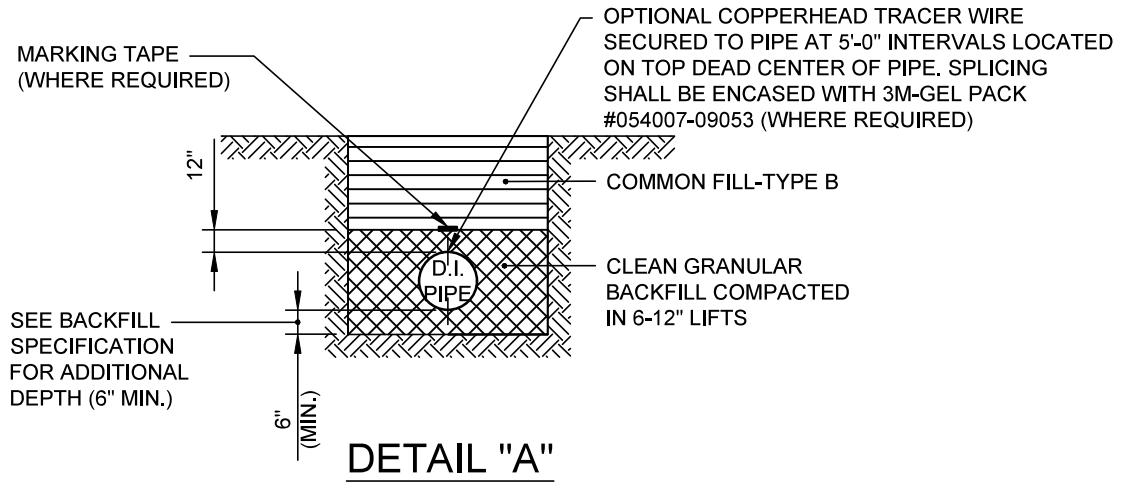
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

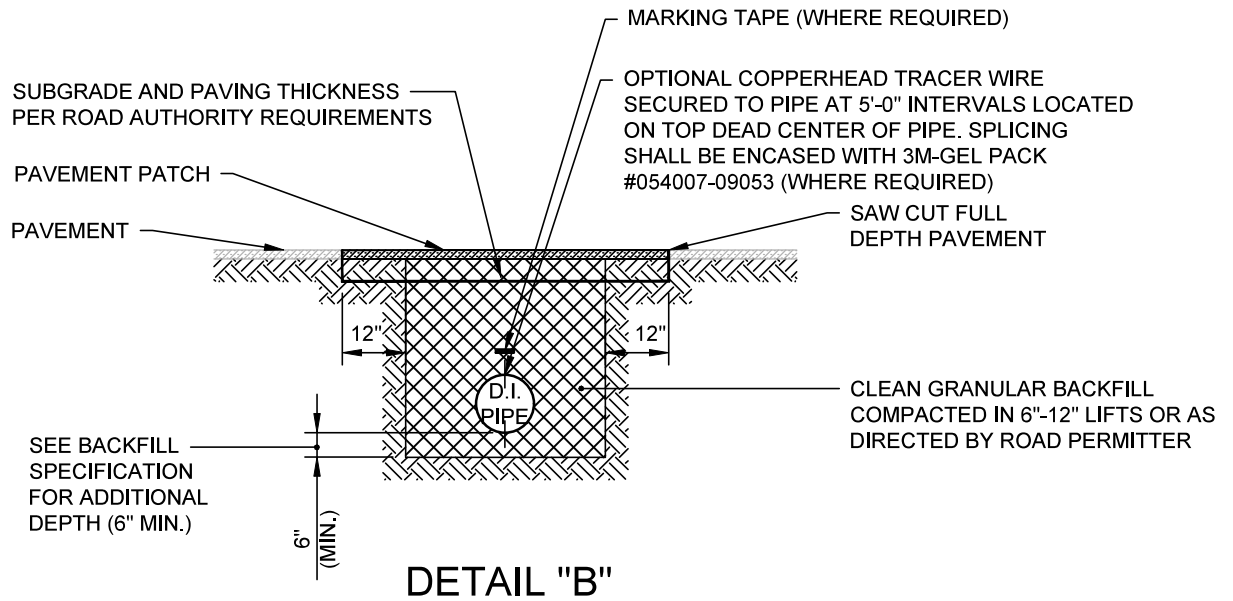
STANDARD DETAILS

APPROVED

SD- 55



D.I. - ROCK/UNSUITABLE SOIL
(FOR AREAS NOT TO BE PAVED)



D.I. - ROCK
(FOR PAVED AREAS OR AREAS TO BE PAVED OR WITHIN 18" OF PAVING)

NOTES:

1. CAUTION MUST BE EXERCISED TO ENSURE PROPER PLACEMENT OF EMBEDMENT MATERIAL UNDER THE HAUNCHES OF THE PIPE.
2. POLYETHYLENE ENCASING ON ALL D.I. PIPE, FITTINGS, VALVES & APPURTENANCES.
3. CLEAN GRANULAR BACKFILL SHALL BE AS SPECIFIED IN CONTRACT DOCUMENTS.
4. SEE SPECIFICATION SECTION 312333 FOR DESCRIPTION OF BACKFILL AND BEDDING MATERIAL.

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**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TRENCH - D.I. PIPE IN ROCK DETAIL**

DATE: 23-OCT-2020

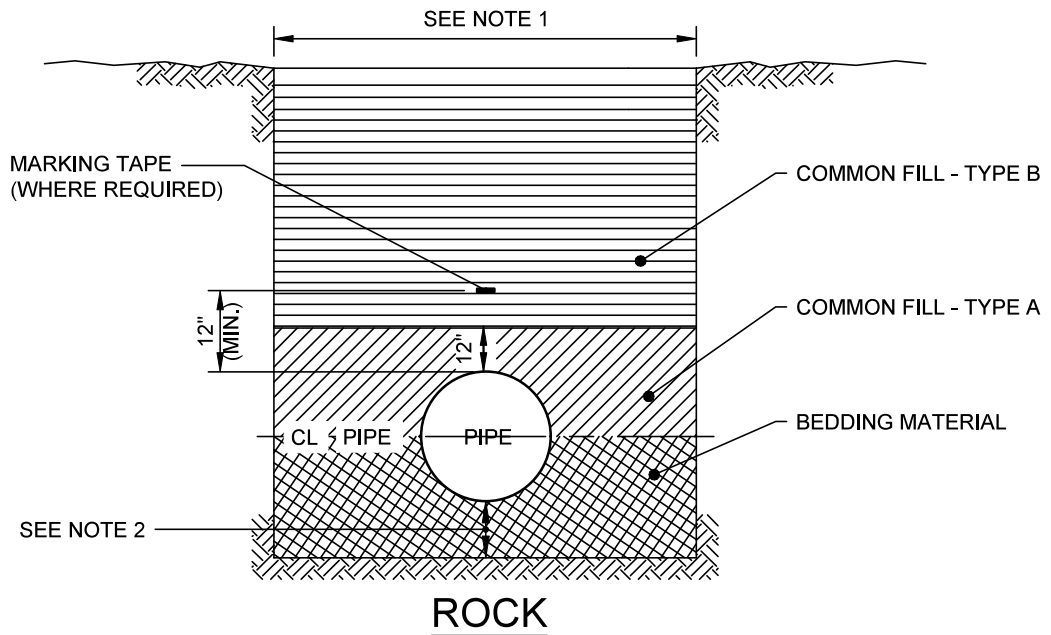
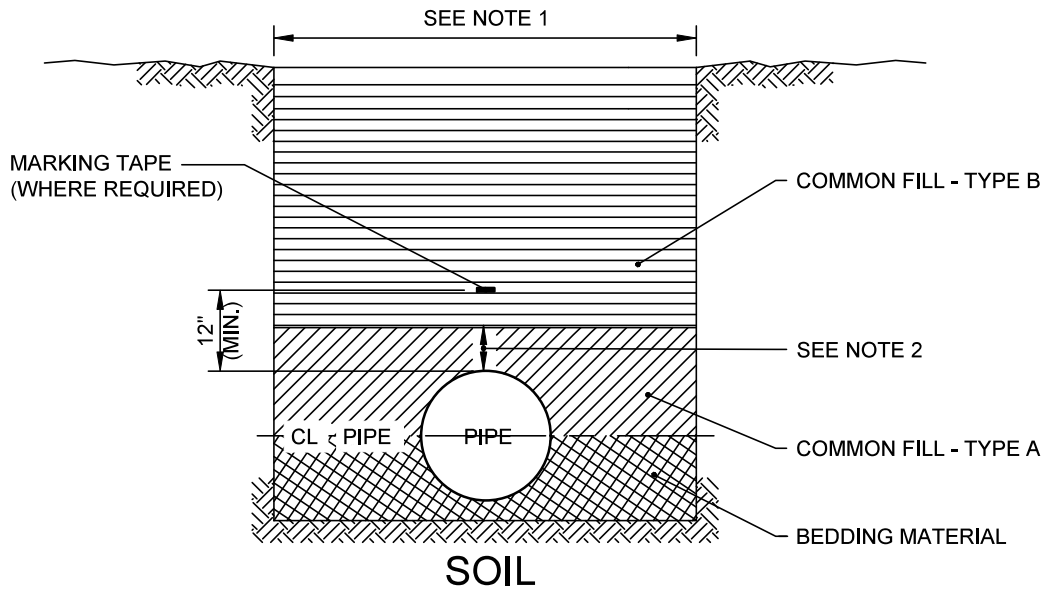
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 56



NOTES:

1. IN UPLAND AREAS USE 4" TOPSOIL, SEED, MULCH & FERTILIZE PER SPECIFICATIONS.
 IN WETLAND AREAS, TOP 18" TO BE BACKFILLED WITH NATIVE EXCAVATED SOIL AND REPLANTED WITH NATIVE VEGETATION.
 IN STREAM CHANNELS AND ADJACENT STREAM BANKS, TOP 12" RIP-RAP, VOIDS FILLED WITH NATIVE SOIL.
2. SEE SPECIFICATION SECTION 31 23 33 TRENCHING AND BACKFILLING.

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**AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 TRENCH BACKFILL MATERIALS UNPAVED AREAS DETAIL**

DATE: 23-OCT-2020

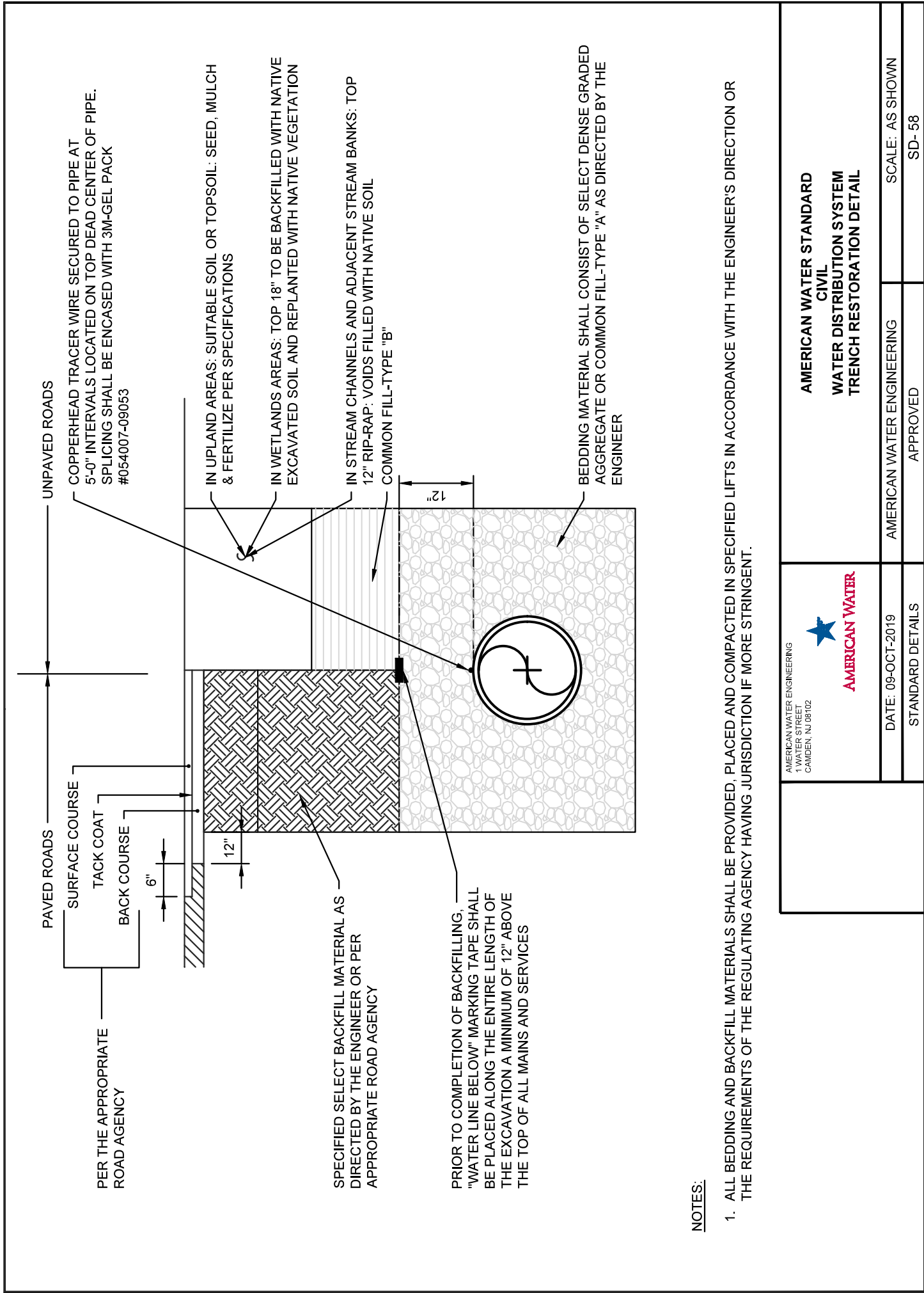
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

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PAVED ROADS

UNPAVED ROADS

PER THE APPROPRIATE ROAD AGENCY

COPPERHEAD TRACER WIRE SECURED TO PIPE AT 5'-0" INTERVALS LOCATED ON TOP DEAD CENTER OF PIPE. SPlicing SHALL BE ENCASED WITH 3M-GEL PACK #054007-09053

IN UPLAND AREAS: SUITABLE SOIL OR TOPSOIL: SEED, MULCH & FERTILIZE PER SPECIFICATIONS

IN WETLANDS AREAS: TOP 18" TO BE BACKFILLED WITH NATIVE EXCAVATED SOIL AND REPLANTED WITH NATIVE VEGETATION

IN STREAM CHANNELS AND ADJACENT STREAM BANKS: TOP 12" RIP-RAP: VOIDS FILLED WITH NATIVE SOIL COMMON FILL-TYPE "B"

12"

12"

BEDDING MATERIAL SHALL CONSIST OF SELECT DENSE GRADED AGGREGATE OR COMMON FILL-TYPE "A" AS DIRECTED BY THE ENGINEER

SPECIFIED SELECT BACKFILL MATERIAL AS DIRECTED BY THE ENGINEER OR PER APPROPRIATE ROAD AGENCY

PRIOR TO COMPLETION OF BACKFILLING, "WATER LINE BELOW" MARKING TAPE SHALL BE PLACED ALONG THE ENTIRE LENGTH OF THE EXCAVATION A MINIMUM OF 12" ABOVE THE TOP OF ALL MAINS AND SERVICES

NOTES:

1. ALL BEDDING AND BACKFILL MATERIALS SHALL BE PROVIDED, PLACED AND COMPACTED IN SPECIFIED LIFTS IN ACCORDANCE WITH THE ENGINEER'S DIRECTION OR THE REQUIREMENTS OF THE REGULATING AGENCY HAVING JURISDICTION IF MORE STRINGENT.

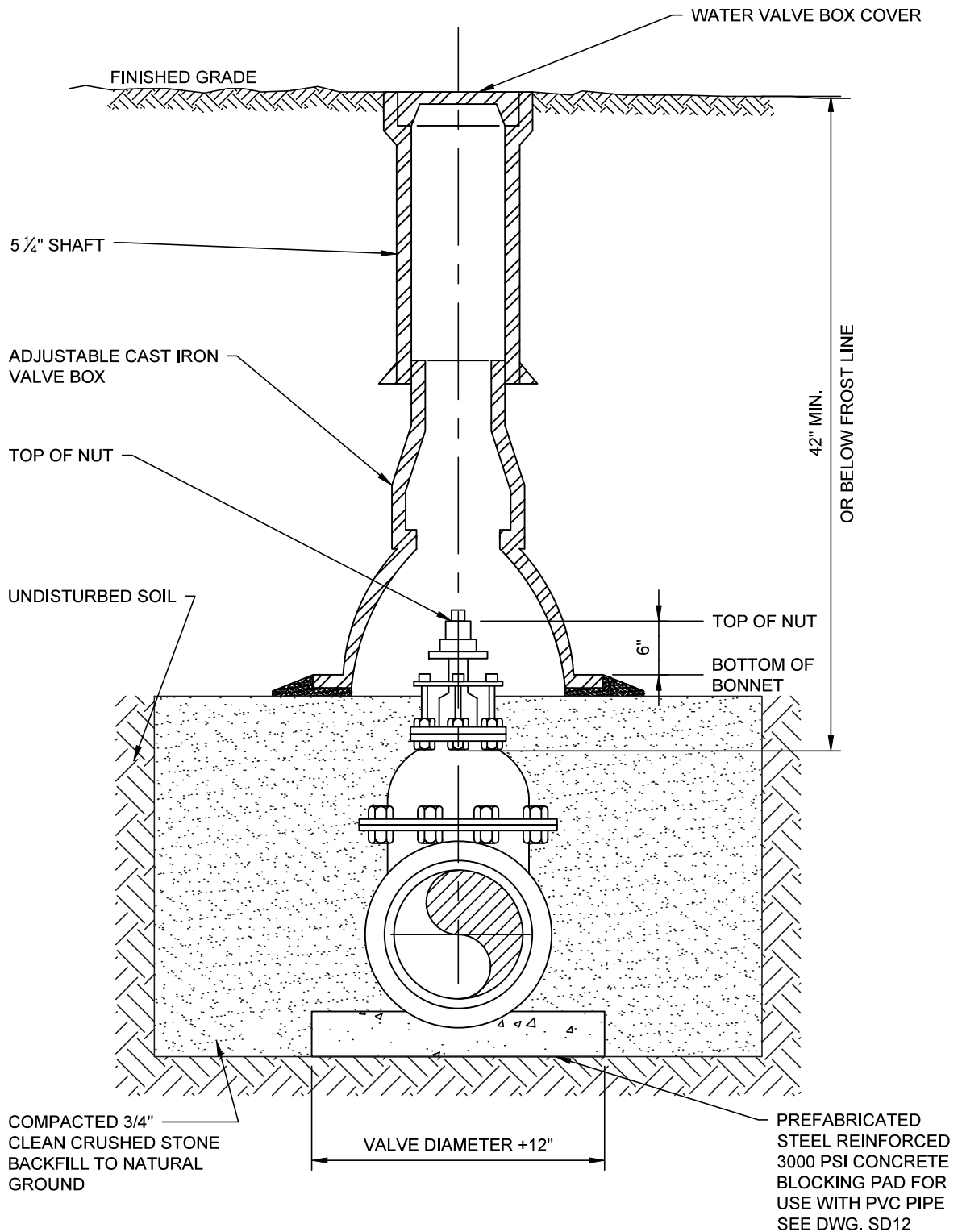


AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TRENCH RESTORATION DETAIL

| | |
|----------------------------|-----------------|
| AMERICAN WATER ENGINEERING | SCALE: AS SHOWN |
| DATE: 09-OCT-2019 | SD-58 |
| STANDARD DETAILS | APPROVED |

NOTE:

1. 6"x6" WOOD BLOCK MAY BE USED AS VALVE PAD WHERE APPROVED BY ENGINEER.



AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
VALVE BOX INSTALLATION FROST AREAS DETAIL**

DATE: 23-OCT-2020

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

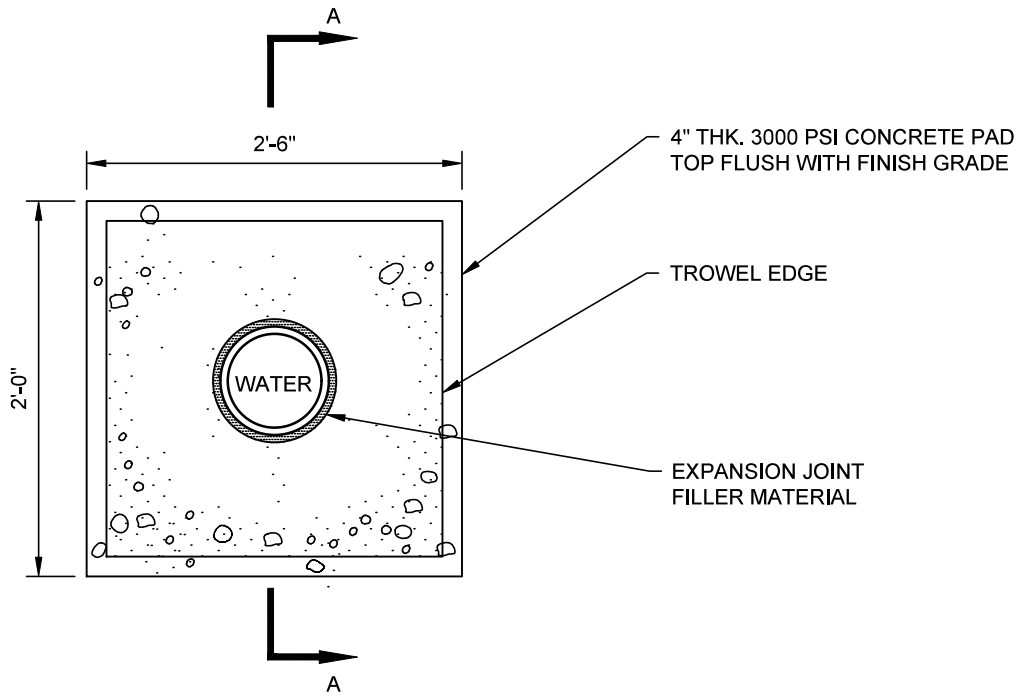
STANDARD DETAILS

APPROVED

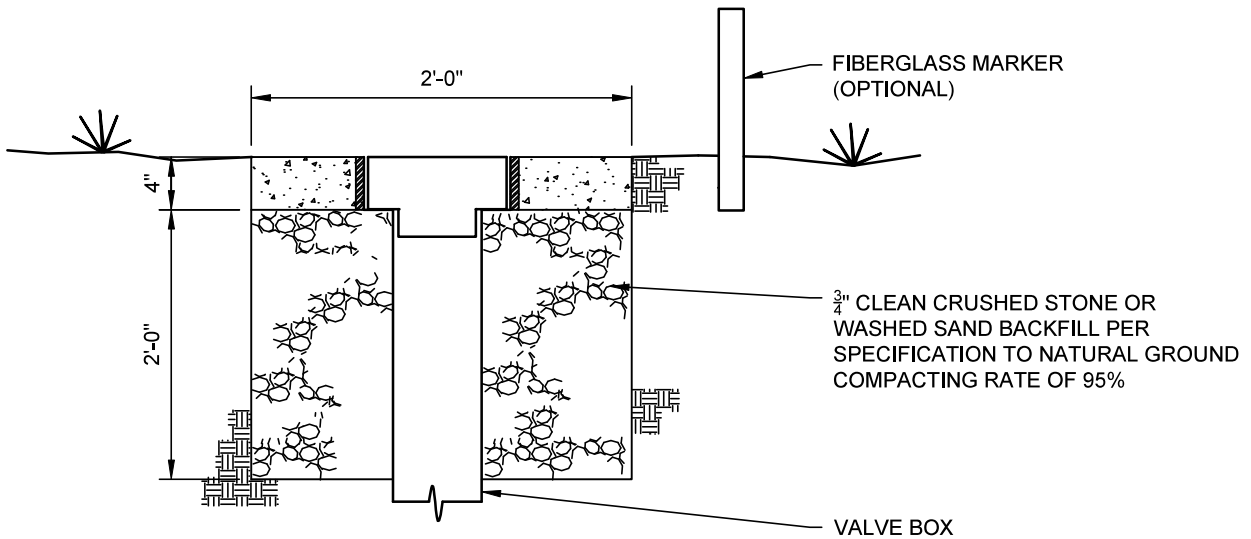
SD- 59

NOTE:

1. IF PAD IS NOT TO BE POURED IMMEDIATELY AFTER VALVE BOX INSTALLATION, HOLE SHOULD BE BACKFILLED TO GRADE WITH $\frac{3}{4}$ " CLEAN STONE BACKFILL.



PLAN



SECTION A-A

VALVE BOX DETAIL IN UNPAVED AREAS

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CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CONCRETE VALVE BOX PAD DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 60

EXISTING OR PROPOSED
FINISHED GRADE

WATER VALVE BOX COVER

5 1/4" SHAFT

ADJUSTABLE CAST IRON
OR PLASTIC VALVE BOX

CENTERING RING

SUPPORT BOX WITH
TAMPED STONE
BACKFILL OR MINIMUM
12" HIGH BRICK OR
BLOCK

COMPACTED
CLEAN STONE
BACKFILL
TO NATURAL
GROUND

2'-6" MIN.
OR BELOW FROST LINE

3000 PSI CONCRETE BEARING
PAD TO BE USED WITH PVC PIPE
SEE DWG. SD12

VALVE DIAMETER +12"

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1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
OPTIONAL VALVE BOX INSTALLATION FROST AREAS DETAIL**

DATE: 09-OCT-2019

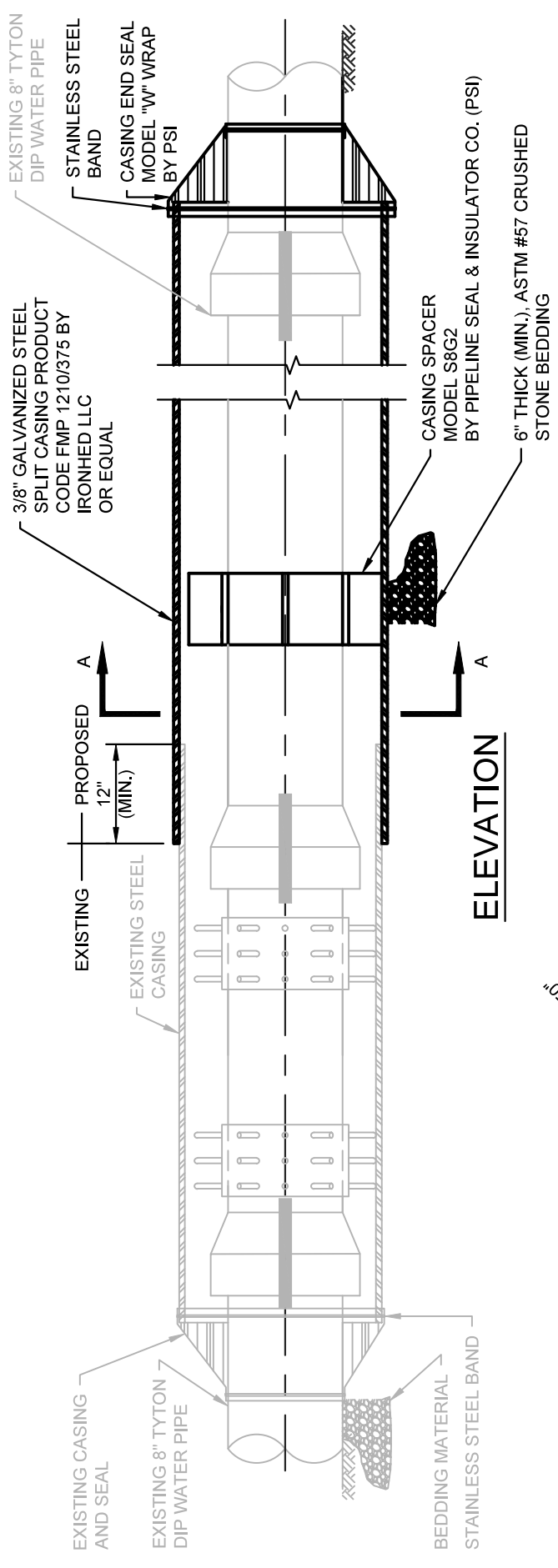
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

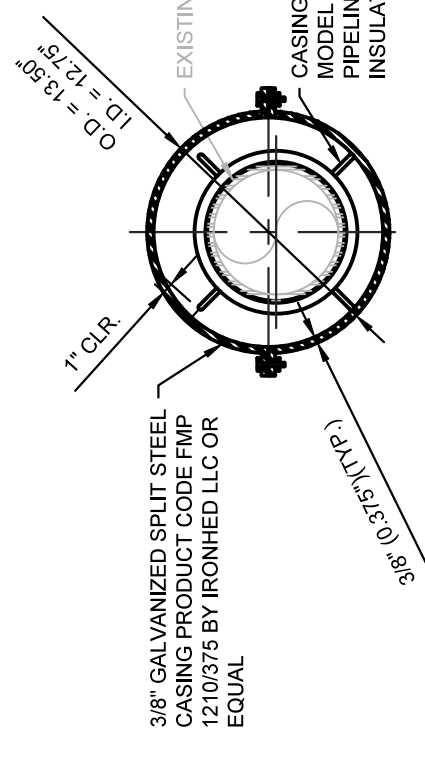
STANDARD DETAILS

APPROVED

SD- 61



ELEVATION



SECTION A-A

NOTES:

1. CONTRACTOR TO CONFIRM EXISTING WATER MAIN PIPE OD AT BELL & BARREL PRIOR TO INSTALLATION OF SPLIT CASING EXTENSION.
2. CASING SPACERS TO BE PROVIDED AND INSTALLED PER MANUFACTURER'S REQUIREMENTS.
3. CONTRACTOR TO REMOVE PORTION OF SPLIT CASING FLANGE AS NECESSARY TO INSTALL CASING END SEAL.



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CAMDEN, NJ 08102

**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
CASING EXTENSION INSTALLATION DETAIL**

DATE: 17-SEPT-2020

AMERICAN WATER ENGINEERING

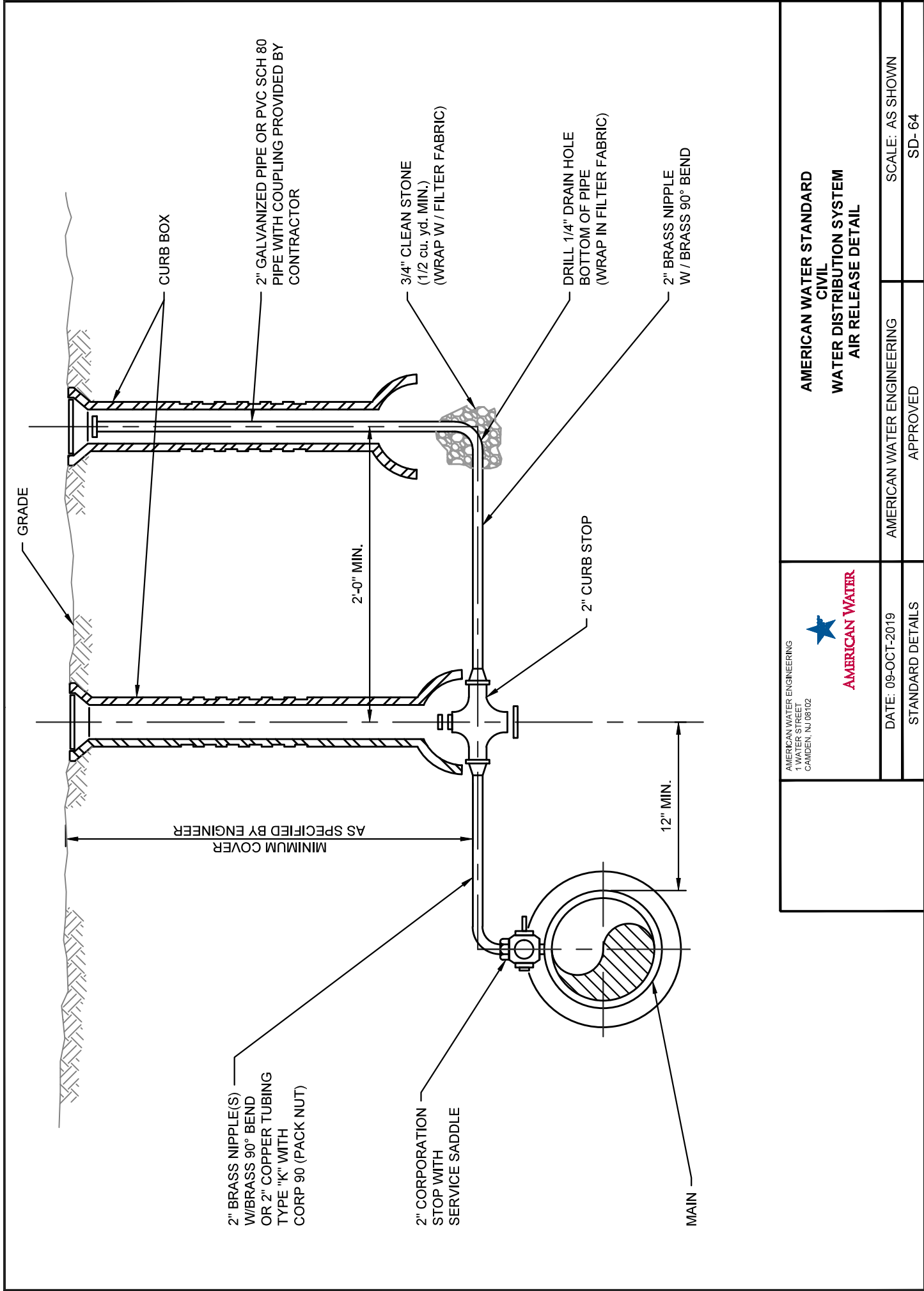
SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD-62

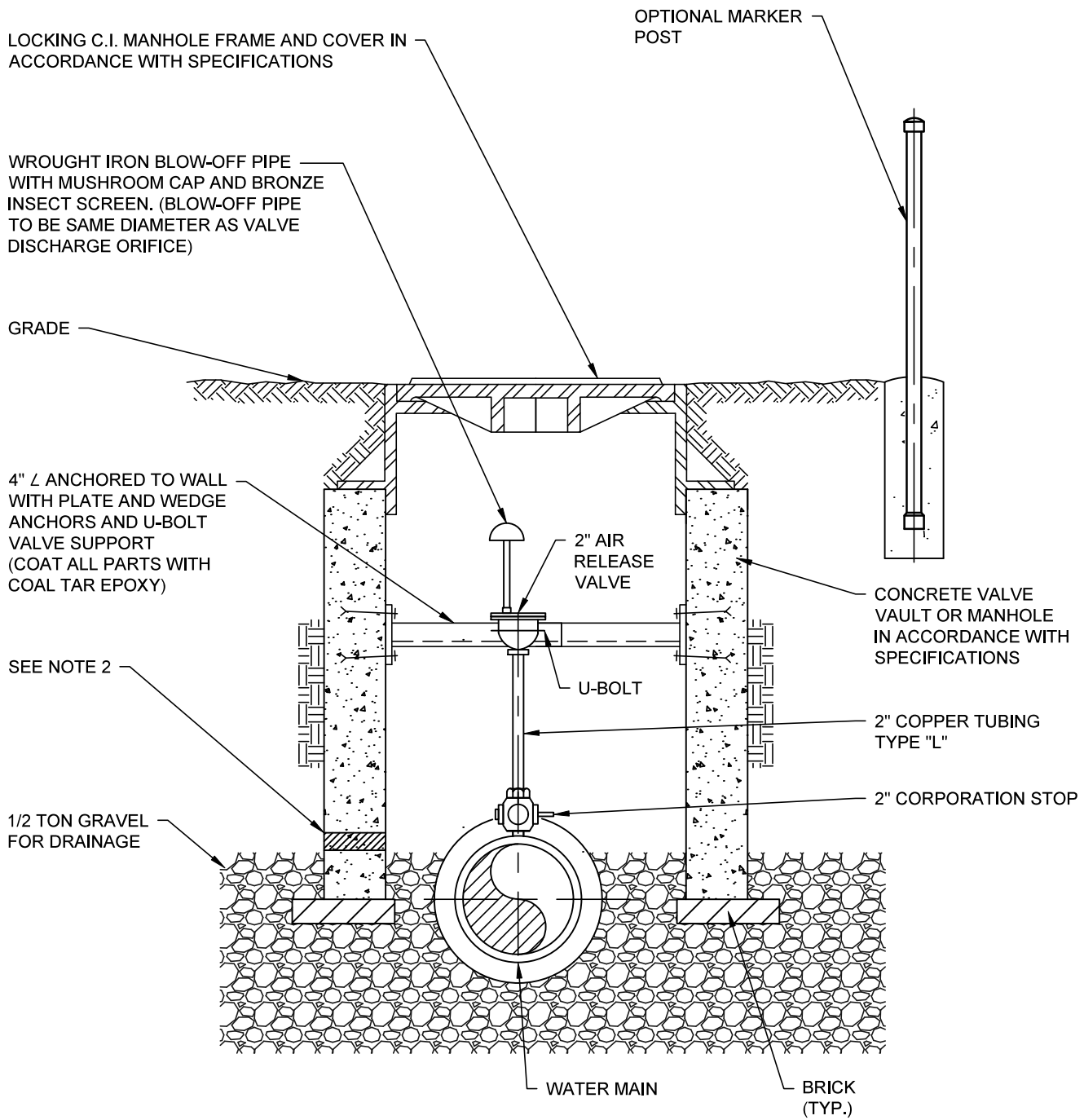
RESERVED FOR FUTURE USE



AMERICAN WATER STANDARD
 CIVIL
 WATER DISTRIBUTION SYSTEM
 AIR RELEASE DETAIL



| | | |
|--|----------------------------|-----------------|
| AMERICAN WATER ENGINEERING 1 WATER STREET CAMDEN, NJ 08102 | AMERICAN WATER ENGINEERING | SCALE: AS SHOWN |
| DATE: 09-OCT-2019 | APPROVED | SD-64 |
| STANDARD DETAILS | | |



NOTES:

1. THIS DESIGN IS PROVIDED WHERE RISK OF WATER FILLING THE CHAMBER IS MINIMAL AND AIR RELEASE DOES NOT FUNCTION AS VACUUM RELEASE.
2. PROVIDE DAYLIGHT DRAIN WHERE FEASIBLE OR SUMP HOLE WHEN DAYLIGHT DRAIN IS NOT FEASIBLE.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102

**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
SHALLOW BURY AIR RELEASE VALVE ASSEMBLY DETAIL**

| | | |
|-------------------|----------------------------|-----------------|
| DATE: 09-OCT-2019 | AMERICAN WATER ENGINEERING | SCALE: AS SHOWN |
| STANDARD DETAILS | APPROVED | SD- 65 |

WROUGHT IRON BLOW-OFF PIPE WITH MUSHROOM CAP AND BRONZE INSECT SCREEN. (BLOW-OFF PIPE TO BE SAME DIAMETER AS VALVE DISCHARGE ORIFICE)

OPTIONAL MARKER POST

GRADE

LOCKING C.I. MANHOLE FRAME AND COVER IN ACCORDANCE WITH SPECIFICATIONS

4" L ANCHORED TO WALL WITH PLATE AND WEDGE ANCHORS AND U-BOLT VALVE SUPPORT (COAT ALL PARTS WITH COAL TAR EPOXY)

AIR RELEASE VALVE

SEE NOTE 2

U-BOLT

CONCRETE VALVE VAULT OR MANHOLE IN ACCORDANCE WITH SPECIFICATIONS

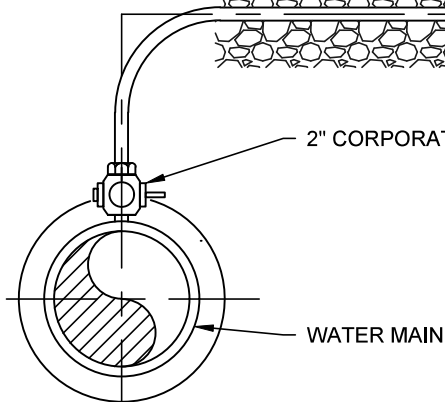
1/2 TON GRAVEL FOR DRAINAGE

2" CURB STOP

2" COPPER TUBING TYPE "L"

BRICK (TYP.)

2" CORPORATION STOP



NOTES:

1. THIS DESIGN IS PROVIDED WHERE RISK OF WATER FILLING THE CHAMBER IS MINIMAL AND AIR RELEASE DOES NOT FUNCTION AS VACUUM RELEASE.
2. PROVIDE DAYLIGHT DRAIN WHERE FEASIBLE OR SUMP HOLE WHEN DAYLIGHT DRAIN IS NOT FEASIBLE.

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1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
DEEP BURY AIR RELEASE VALVE ASSEMBLY DETAIL**

DATE: 09-OCT-2019

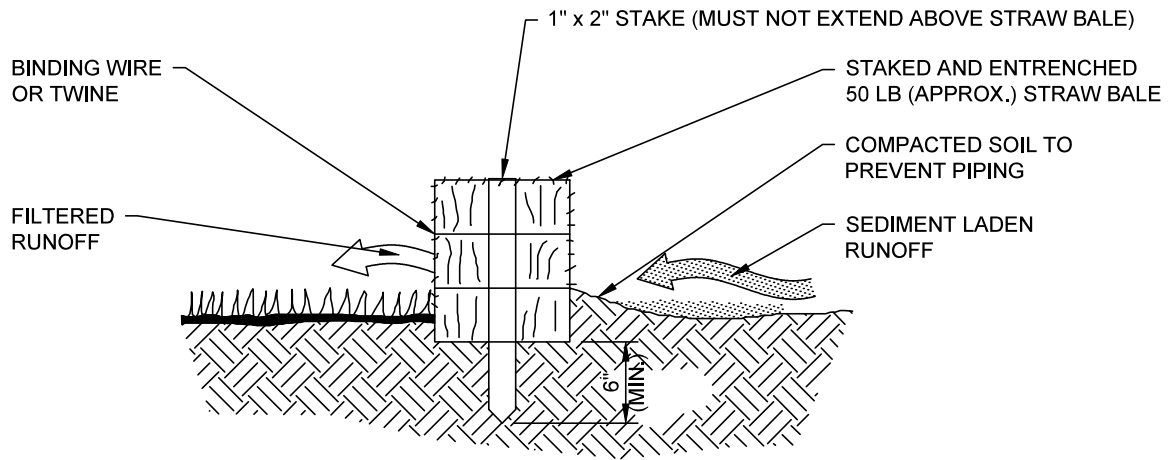
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

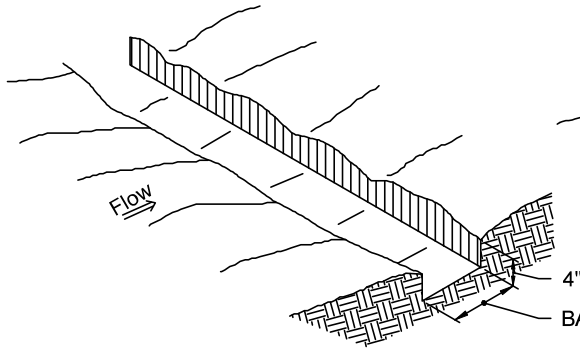
APPROVED

SD- 66

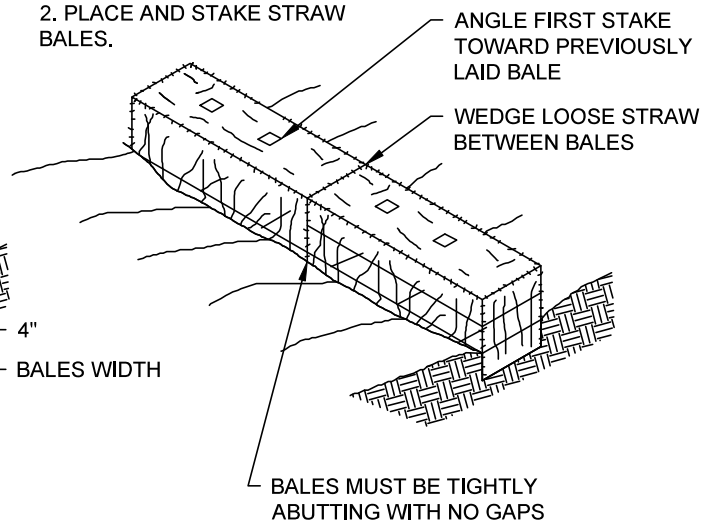


PROPERLY INSTALLED STRAW BALE
(CROSS-SECTION)

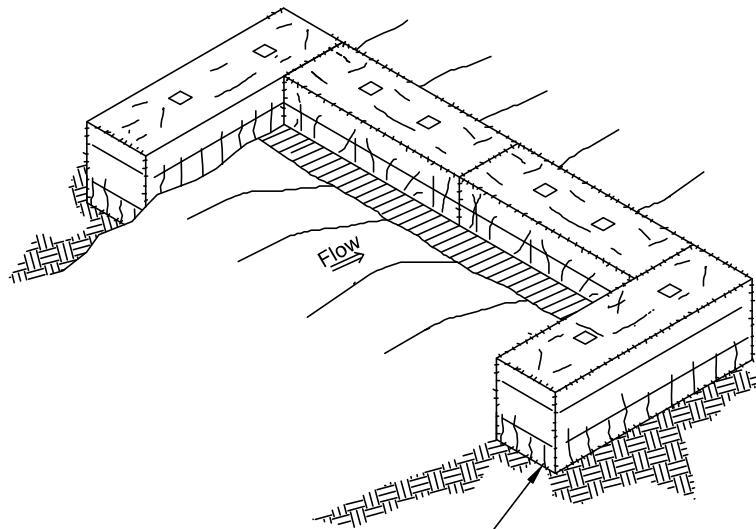
1. EXCAVATE THE TRENCH MIN. 4" DEEP.



2. PLACE AND STAKE STRAW BALES.



3. BACKFILL AND COMPACT THE EXCAVATED SOIL.



NOTES:

1. SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH 4" ABOVE GROUND HEIGHT.
2. ANY SECTION, WHICH HAS BEEN UNDERMINED OR TOPPED, MUST BE IMMEDIATELY REPLACED.
3. ENDS OF STRAW BALES MUST BE INSTALLED TO PROHIBIT RUNOFF FROM BEING ALLOWED TO FLOW AROUND ENDS.

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1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
TEMPORARY STRAW BALE SEDIMENT BARRIER DETAIL**

DATE: 09-OCT-2019

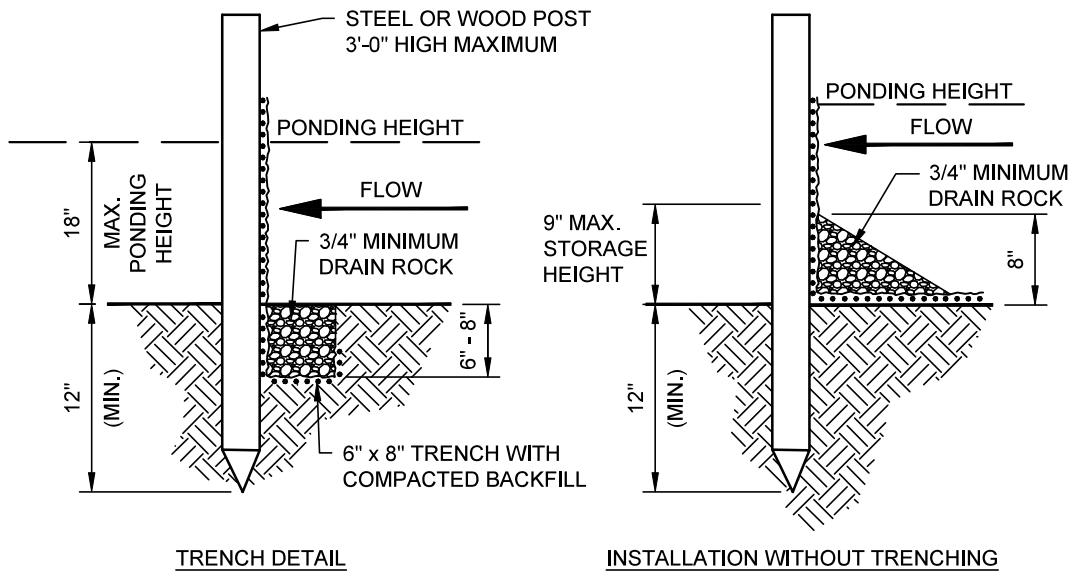
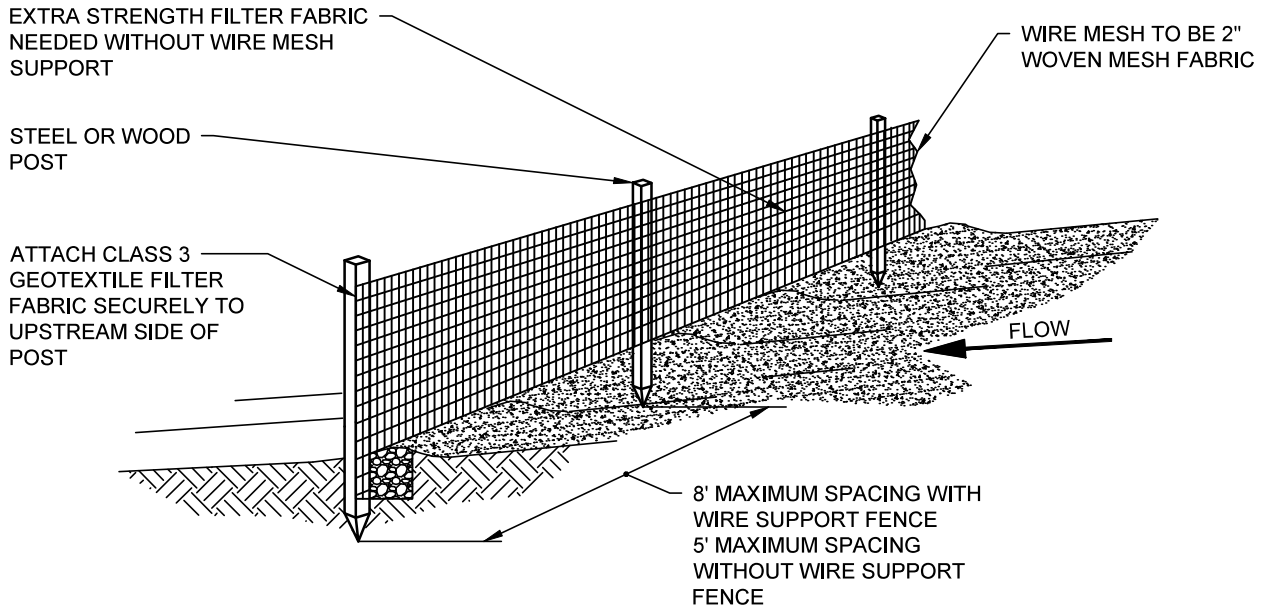
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD-67



NOTES:

1. FILTER FABRIC FENCE MUST BE INSTALLED AT LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST EXTEND AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.
2. SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH A MAXIMUM OF 9" ABOVE GROUND HEIGHT OF THE FENCE.
3. ANY FENCE SECTION, WHICH HAS BEEN UNDERMINED OR TOPPED, MUST BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET. (SEE ROCK FILTER OUTLET DETAIL).
4. WHERE ENDS OF FILTER FABRIC COME TOGETHER, THEY MUST BE OVERLAPPED, FOLDED AND STAPLED TO PREVENT SEDIMENT BYPASS. THE TOE ANCHOR MUST BE BACKFILLED AND COMPACTED TO A DENSITY EQUAL TO THE SURROUNDING SOILS.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
SILT FENCE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

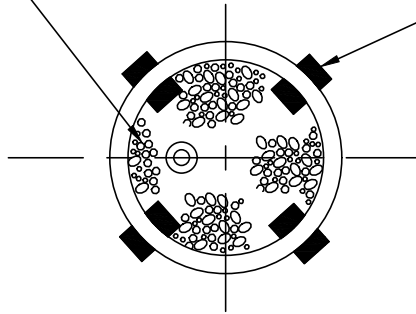
STANDARD DETAILS

APPROVED

SD- 68

8" OF 3/4" CLEAN CRUSHED STONE

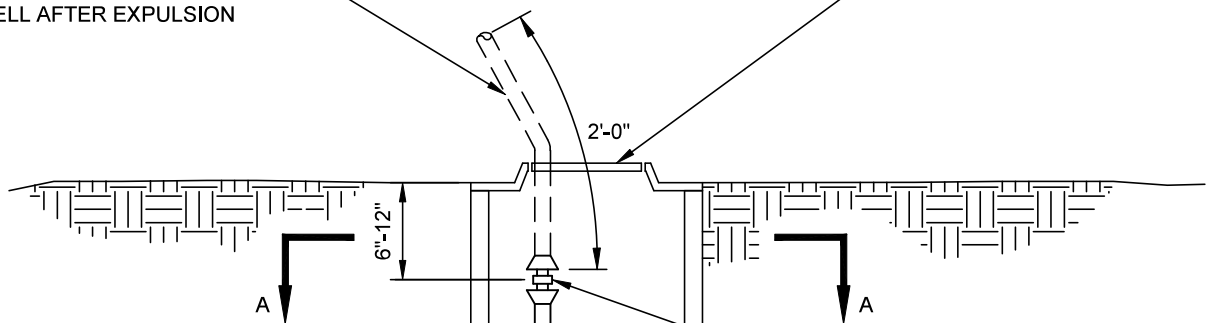
CONCRETE BLOCKS



SECTION A-A

LEAVE TAIL PIECE IN METER WELL AFTER EXPULSION

METER WELL COVER



30" DIA. SONOCE PLASTIC METER WELL

COMPRESSION COUPLING

DRAIN ACCESS (SEE NOTE)

CURB STOP

CONCRETE BLOCKS

8" OF 3/4" CLEAN CRUSHED STONE

1" TYPE "K" COPPER

CORPORATION STOP

WATER MAIN

NOTE:

1. PROVIDE DAYLIGHT DRAIN PIPE IF FEASIBLE OR SUMP AT BOTTOM OF PIT IF NOT FEASIBLE.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
MANUAL AIR RELEASE VALVE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

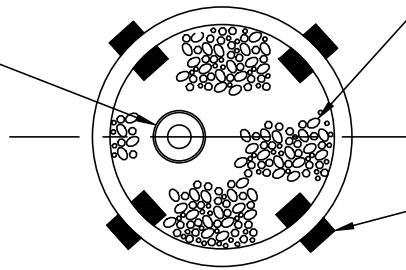
SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 69

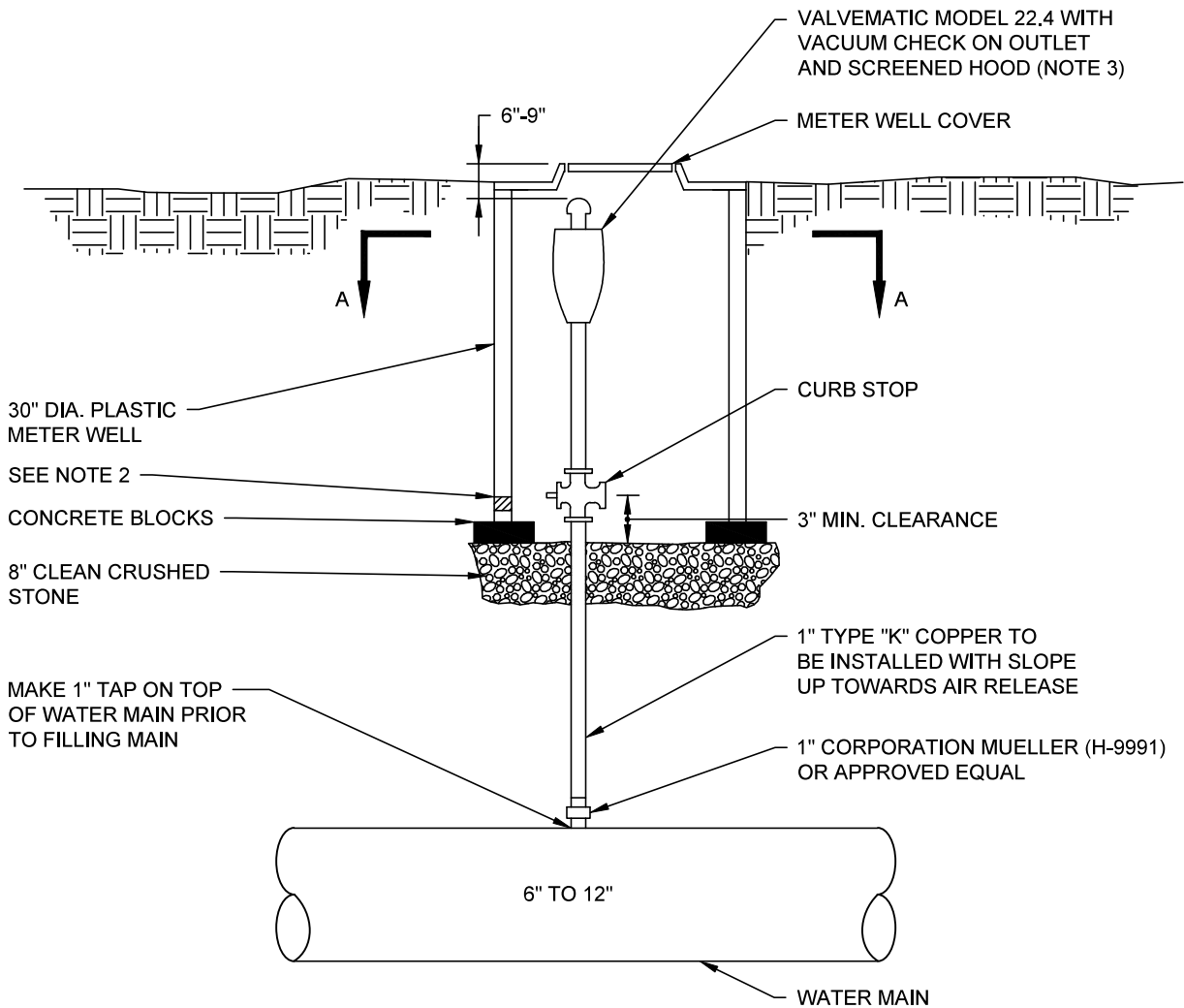
VALVEMATIC MODEL 22.4
AIR RELEASE VALVE
(NOTE 3)



8" CLEAN CRUSHED
STONE

CONCRETE BLOCKS

SECTION A-A



VALVEMATIC MODEL 22.4 WITH
VACUUM CHECK ON OUTLET
AND SCREENED HOOD (NOTE 3)

METER WELL COVER

6"-9"

A ↓

A ↓

30" DIA. PLASTIC
METER WELL

CURB STOP

SEE NOTE 2

CONCRETE BLOCKS

3" MIN. CLEARANCE

8" CLEAN CRUSHED
STONE

1" TYPE "K" COPPER TO
BE INSTALLED WITH SLOPE
UP TOWARDS AIR RELEASE

MAKE 1" TAP ON TOP
OF WATER MAIN PRIOR
TO FILLING MAIN

1" CORPORATION MUELLER (H-9991)
OR APPROVED EQUAL

6" TO 12"

WATER MAIN

NOTES:

1. DESIGN TO BE USED ONLY IF SECURITY WITH METER WELL COVER IS ADEQUATE.
2. PROVIDE DAYLIGHT DRAIN IF FEASIBLE AND IF NOT, PROVIDE SUMP AT BOTTOM OF CHAMBER.
3. MAXIMUM PRESSURE AIR RELEASE ASSEMBLY CAN WITHSTAND IS 175 PSI. USE VALVEMATIC MODEL 25.6 UP TO 300 PSI.

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
AUTOMATIC AIR RELEASE VALVE DETAIL**

DATE: 09-OCT-2019

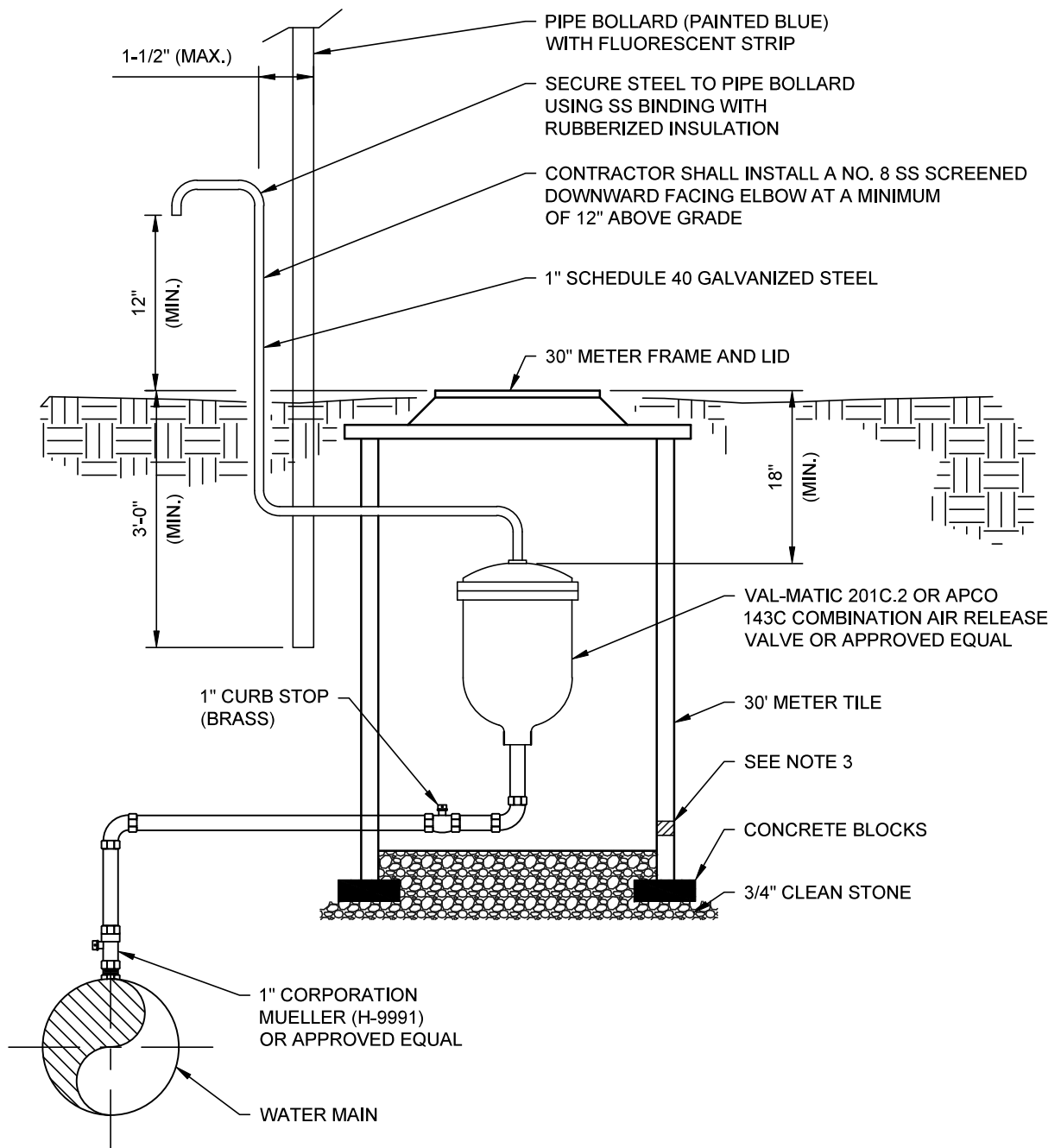
AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

APPROVED

SD- 70



NOTES:

1. THE APPLICATION AND LOCATION MUST BE APPROVED PRIOR TO INSTALLATION. IT IS DESIGNED FOR AREAS WHERE THE RISK OF FILLING THE CHAMBER WITH DISCHARGE EXISTS.
2. THE COMBINATION AIR VACUUM OPTION MUST BE APPROVED BY AN AMERICAN WATER REPRESENTATIVE PRIOR TO INSTALLATION.
3. PROVIDE DAYLIGHT DRAIN WHERE FEASIBLE, OTHERWISE PROVIDE SUMP.

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1 WATER STREET
CAMDEN, NJ 08102



**AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
AUTOMATIC COMBINATION AIR RELEASE/VACUUM VALVE DETAIL**

DATE: 09-OCT-2019

AMERICAN WATER ENGINEERING

SCALE: AS SHOWN

STANDARD DETAILS

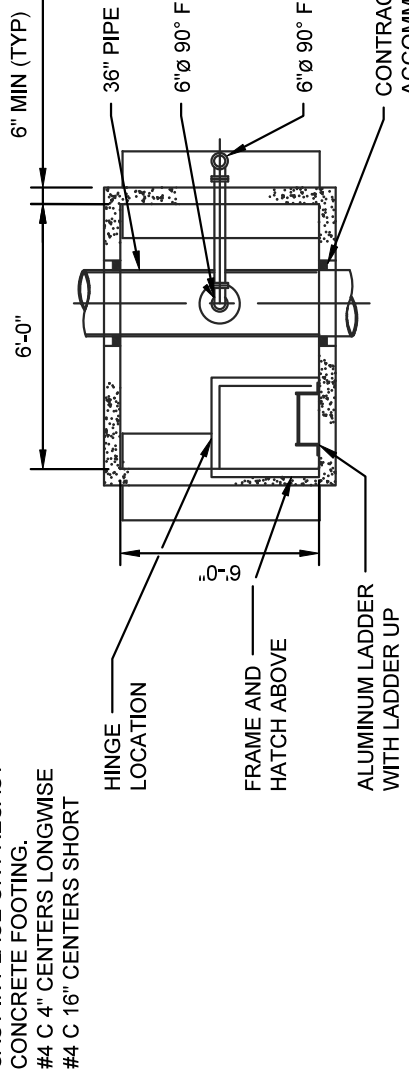
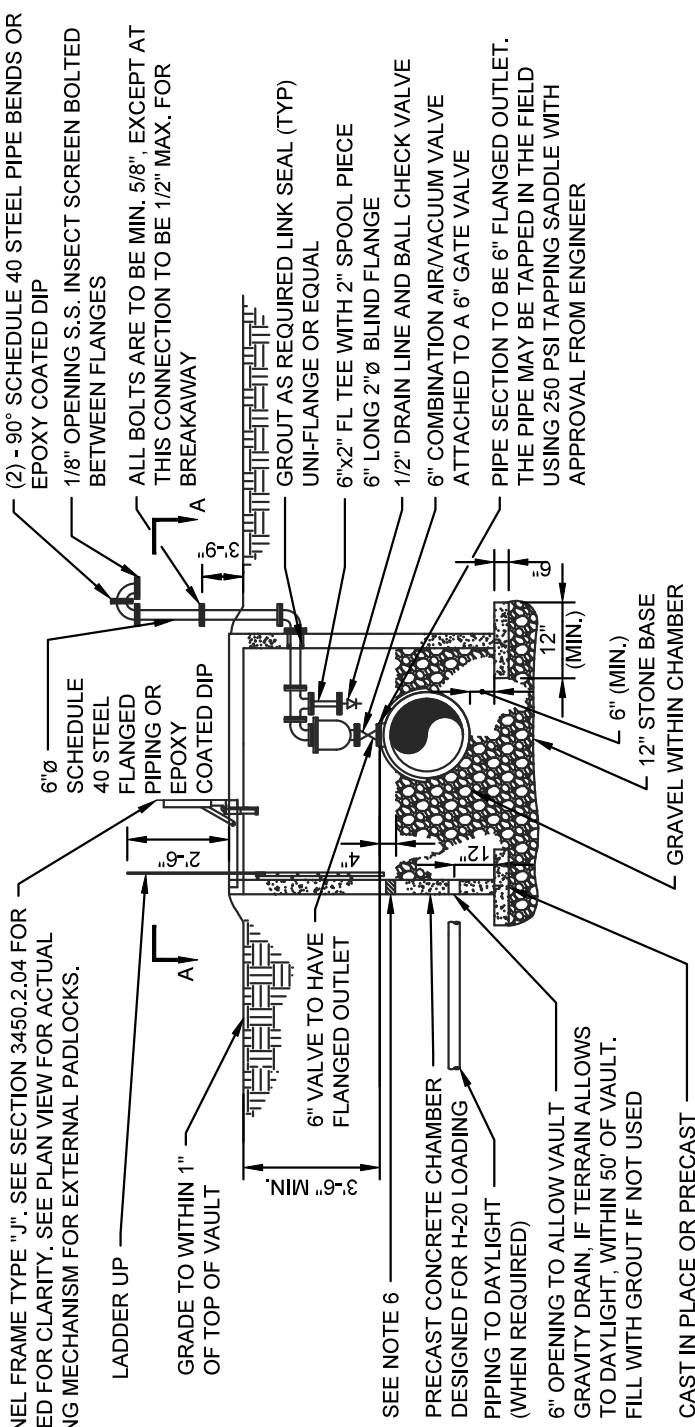
APPROVED

SD- 71

36"x36" BILCO SINGLE LEAF CHANNEL FRAME TYPE "J". SEE SECTION 3450.2.04 FOR FRAME AND OVER COVER. ROTATED FOR CLARITY. SEE PLAN VIEW FOR ACTUAL ORIENTATION. MUST HAVE LOCKING MECHANISM FOR EXTERNAL PADLOCKS.

NOTES:


- THIS DESIGN IS PROVIDED FOR LOCATIONS WHERE THERE IS A RISK OF THE MANHOLE FILLING WITH DISCHARGE WATER.
- ALL STEEL DISCHARGE PIPING TO BE PAINTED WITH TNE MEC SERIES 66. 2 COATS 8 MIL, DFT COLOR TO BE BLUE.
- VAULT TO BE DESIGNED AND MANUFACTURED FOR INTERMITTENT WATER LOADING. PREFABRICATED VAULT MUST HAVE SUBMITTAL INDICATING SUCH. CAST IN PLACE VAULTS MUST HAVE PE SEAL ON CONCRETE, STEEL, AND VAULT DESIGN SUBMITTAL. (DESIGN NOT FOR HIGH TRAFFIC AREAS)
- PIPE FITTING AND AIR RELEASE SIZES CAN BE CHANGED 4" THRU 6" TO ACCOMMODATE PIPE SIZES 16" THRU 36" WITH APPROVAL FROM THE ENGINEER.
- ACCESS TO PRECAST CONCRETE CHAMBER MAY BE A 36" CAST IRON MANHOLE LID ASSEMBLY SUBJECT TO APPROVAL BY ENGINEER.
- PROVIDE DAYLIGHT DRAIN WHERE FEASIBLE, IF NOT FEASIBLE PROVIDE SUMP.



SECTION A-A

CONTRACTOR SHALL SIZE OPENING TO ACCOMMODATE PIPE OPENINGS TO BE SEALED WITH GROUT (TYP) AND LINK SEAL IF CIRCULAR OPENING

AMERICAN WATER ENGINEERING
1 WATER STREET
CAMDEN, NJ 08102



AMERICAN WATER

AMERICAN WATER STANDARD
CIVIL
WATER DISTRIBUTION SYSTEM
COMBINATION AIR RELEASE VACUUM 16" TO 36" DETAIL

| | | | |
|----------------------------|------------------|----------------------------|-----------------|
| AMERICAN WATER ENGINEERING | APPROVED | AMERICAN WATER ENGINEERING | SCALE: AS SHOWN |
| DATE: 09-OCT-2019 | STANDARD DETAILS | | SD-72 |