Department of Health & Human Services
DHHS
NEBRASKA

Division of Public Health

State of Nebraska
Dave Heineman, Governor

February 20, 2013

David Hunter, Jr., General Manager
City of Auburn
PO Box 288
Auburn, NE 68304-0288

Re: PWS – Auburn, NE – Three Year Agreement (2013 -2016) – Standard Plans and Specifications

Dear Mr. Hunter:

The standard plans and specifications submitted by the City of Auburn (System No. NE3112703) have been reviewed and are hereby approved with respect to features of sanitary significance. The Department will not require the City of Auburn to submit plans and specifications for the construction of new distribution mains and replacement of existing distribution water mains pursuant to the Three Year Agreement between the Department and the City of Auburn, provided that the requirements of the Three Year Agreement are met. Please be advised that the Three Year Agreement only applies to water distribution mains. Non-distribution main projects must be submitted for review and written approval prior to construction as per Title 179 NAC 7-003.

Changes of sanitary significance to the approved standard plans and specifications must be submitted to the Department for review and written approval prior to implementation. One set of the submitted standards plans and specifications is being made a part of this Department's records, and the other is being returned for your own records.

Enclosed is a guide developed by the Department to assist design engineers with sewer and water main separation design and installation. In the design and installation of water mains, design engineers must strive to achieve the separation distances required for water mains as per the *Recommended Standards for Water Works*, 2007 Edition. In situations where it is impractical to achieve the separations in the standards, the guidance provided in the enclosed document must be followed for substantial conformance with the regulations.

Sincerely,

CFChew

Chin F. Chew, P.E., Program Manager
Engineering Services Program
Office of Drinking Water and Environmental Health
Department of Health and Human Services
Division of Public Health

CFC:KDT:pz

Enclosures

xc: Evan Wickersham, P.E.
Ken Swanson, City of Auburn
Doug Woodbeck, DHHS-DPH (ec)

Design and Installation Guide
For
Water Main and Sanitary/Storm Sewer Separations

The Department recognizes the challenges and difficulties in designing and installing distribution mains, especially in areas fraught with existing utilities. This guide is developed to assist design engineers with sewers and water main separation design and installation. In the design and installation of water mains, design engineers must strive to achieve the separation distances required for water mains and fire hydrants from sanitary sewer, storm sewer and other potential sources of contamination as per the Recommended Standards for Water Works, 2007 Edition (RSFWW). In cases where it is **impractical** to achieve those separations required in the RSFWW, the protocols provided in this document must be followed to be considered substantial conformance by the Department.

I. Sewer and Water Main Separations

A. Sanitary sewer and water main <u>horizontal separations</u> for parallel installations.

1. Scenario 1
    a. A 10 foot radial separation is considered equivalent to the 10 foot horizontal separation requirement if the water main is above the sanitary sewer and not within 5 feet horizontally.

2. Scenario 2
    a. If the horizontal separation is **greater than 8 feet but less than 10 feet**, the installation would be acceptable if the following is provided:
        i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions; **<u>and</u>**
        ii. Reasons are provided as to why it not practical to provide the 10 feet separation.

3. Scenario 3
    a. If the horizontal separation is **greater than 4 feet but less than 8 feet**, the installation would be acceptable if the following is provided:
        i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
        ii. Reasons are provided as to why at least 8 feet separation cannot be provided; **<u>and</u>**
        iii. The water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer **<u>or</u>**
        iv. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) at locations where the separation cannot be met **<u>or</u>**
        v. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and pressure tested to ensure water tightness **<u>or</u>**
        vi. An alternate method of protection with approval from the Department prior to construction.

4. **Scenario 4**
    a. **If the horizontal separation is less than 4 feet, the installation must not proceed prior to consulting and obtaining written approval from the Department**.

B. Sanitary sewer and water main <u>vertical separations</u> at crossings.

1. Scenario 1
    a. If the water main **<u>is above</u>** the sanitary sewer pipe and the vertical separation is **greater than 12 inches but less than 18 inches**, the installation would be acceptable if the following is provided:
        i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
        ii. Reasons are provided as to why the 18-inch separation cannot be met; **<u>and</u>**

iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible.

2. Scenario 2
   a. If the water main **is above** the sanitary sewer pipe and the vertical separation is **greater than 6 inches but less than 12 inches**, the installation would be acceptable if the following is provided.
      i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
      ii. Reasons are provided as to why at least 12 inches separation cannot be met;
      iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible;
      iv. Proper support is provided to prevent settlement and breaking pipe; **and**
      v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
      vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness **or**
      vii. An alternate method of protection with approval from the Department prior to construction.

3. Scenario 3
   a. If the water main **is below** the sanitary sewer, and the vertical separation is greater than 6 inches but less than 18 inches, the installation would be acceptable if the following is provided:
      i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
      ii. Reasons are provided as to why at least 18 inches separation cannot be met;
      iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible;
      iv. Proper support is provided to prevent settlement and breaking pipe; **and**
      v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
      vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness **or**
      vii. An alternate method of protection with approval from the Department prior to construction.

4. **Scenario 4**
   a. If the vertical separation between the sewer line and the water main will be less than 6 inches, the installation must not proceed prior to consulting and obtaining written approval from the Department.

II. Storm sewer and water main separations

In general, the pollution hazards from a storm sewer are not as significant as a sanitary sewer since the storm sewer does not have flow in it year round. However, during rainstorm events, it may carry surface runoff which contains chemical pollutants but the pathogenic microbial impact is likely to be less than that of a sanitary sewer. For storm sewer and water main separation, the protocols provided in Sections II.A and II.B must be followed.

A. Storm sewer and water main horizontal separations for parallel installations

1. Scenario 1
   a. If the horizontal separation is **greater than 4 feet but less than 10 feet**, the installation would be acceptable if the following is provided:

i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
ii. Reasons are provided as to why the 10 feet separation cannot be met; **and if necessary,**
iii. Additional protection deemed necessary by the design engineer.

2. **Scenario 2**
   a. **If the horizontal separation will be less than 4 feet, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

B. Storm sewer and water main vertical separations at crossings.

1. Scenario 1
   a. If water main **is above** the stormy sewer pipe and the vertical separation is **greater than 6 inches but less than 18 inches**, the installation would be acceptable if the following is provided.
      i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
      ii. Reasons are provided as to why the 18-inch separation cannot be met; **and**
      iii. One full length of water pipe need to be located so that both joints will be as far from the storm sewer crossing as possible - preference shall be given to keep joints further from any sanitary sewer than a storm sewer.

2. Scenario 2
   a. If water main **is below** the storm sewer pipe and the vertical separation is **greater than 6 inches but less than 18 inches**, the installation would be acceptable if the following is provided.

      i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
      ii. Reasons are provided as to why the 18-inch separation cannot be met;
      iii. One full length of water pipe needs to be located so that both joints will be as far from the storm sewer crossing as possible - preference shall be given to keep joints further from any sanitary sewer than a storm sewer;
      iv. Proper support is provided to prevent settlement and breaking pipe; **and**
      v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
      vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness (the storm sewer pipe needs be watertight when pressure tested to at least 10 psi test pressure) **or**
      vii. An alternate method of protection with approval from the Department prior to construction.

3. **Scenario 3**
   a. **If the vertical separation between the storm sewer and the water main will be less than 6 inches, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

III. Force Main Separations

At least **10 feet of horizontal separation** between water mains and sanitary sewer force mains must be provided. There must be at least **18 inches of vertical separation** at crossings between water mains and force mains and one full length of water pipe shall be located so both joints will be as far from the sewer as possible at the crossing. **Where it is impossible to meet these separation requirements for force mains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

IV. Fire Hydrants Separations

A. Fire Hydrants and Sanitary Sewers Separations

1. Hydrant drains must not be connected to, or located within **10 feet of sanitary sewers. Where it is impossible to meet the 10 feet horizontal separation between sanitary sewer and fire hydrant drains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

B. Fire Hydrants and Storm Sewer Separations

1. Where it is impractical to meet the 10 feet horizontal separation requirement for storm sewer and hydrant drains, a less than 10 feet horizontal separation would be acceptable if the following is provided.
    a. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
    b. Reasons are provided as to why the 10 feet horizontal separation cannot be met; **and**
    c. At least 5 feet of horizontal separation is provided.

2. **Where it is impossible to provide at least 5 feet of horizontal separation of storm sewers to hydrant drains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

2013

Standard Plans and Specifications
For Auburn Board of Public Works

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2013 STANDARD PLANS AND SPECIFICATIONS
FOR
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A. Identify required lines, levels, contours and datum locations.

B. Located, identify and protect utilities that remain and protect from damage.

C. Notify utility company to remove and relocate utilities when relocation is required.

D. Implement erosion control plan.

2.02 EXCAVATING

A. Underpin adjacent structures which may be damaged by excavating work.

B. Notify ENGINEER of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

C. Slope bank of excavations deeper than 3 feet to angle of repose or less until shored.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Cut utility trenches wide enough to allow inspection of installed utilities.

F. Hand trim excavations. Remove loose materials.

G. Remove lumped subsoil, boulders and rock.

H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Remove excavated material that is unsuitable for reuse from site.

K. Remove excess excavated material from site.

L. Erosion Control:

1. Maintain erosion control.

2.03 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

SECTION 31 2333
TRENCHING FOR UTILITIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Excavation, backfilling and compacting for utilities.

1.02 RELATED SECTIONS

A. Section 31 2316 – Excavation.

1.03 PROJECT CONDITIONS

A. Verify that survey benchmarks and intended elevations for the work are as indicated. Notify ENGINEER immediately if a discrepancy is identified.
B. Protect plants, lawns, rock outcroppings, trees, amenities and other features to remain.
C. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and amenities from excavating equipment and vehicular traffic.
D. Provide exploratory excavation to determine exact location of existing underground structures or utilities.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Subsoil excavated on-site, imported borrow and local borrow.
    1. Graded.
    2. Free of lumps larger than 3 inches, rocks larger than 1 inches and debris.
    3. Conforming to ASTM D 2487 Group Symbol CL.
B. Granular Fill Gravel: Natural washed stone, free of shale, clay, friable material and debris.
    1. Graded in accordance with Standard Specifications.
C. Sand: Natural river of bank sand, washed, free of silt, clay, loam, friable of soluble materials, and organic matter.
    1. Graded in accordance with Standard Specifications.
D. Flowable Fill:
    1. See Standard Specifications, Geotechnical Report and Section 01 1000 – Special Provisions.
    2. Compressive Strength: 85 to 175 psi.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours and datum locations.

3.02 PREPARATION

A. Removals:
    1. Remove walks, driveways and street pavement as marked by ENGINEER.
    2. Saw cut concrete pavement, walk and driveways a minimum of 1 ½ inches.
    3. Minimum removal width 1 foot wider than trench.
    4. CONTRACTOR is responsible for:

a. Removal beyond the limits marked by ENGINEER.
b. Damage to adjacent surfaces caused by machinery, methods, equipment, and materials.

3.03 TRENCHING

A. Notify ENGINEER of unexpected subsurface conditions and discontinue affected work in areas until notified to resume work.
B. Slope banks of excavation deeper than 3 feet to angle of repose or less until shored.
    1. Install shoring to protect pavement and structures or where backsloping is impractical.
    2. Pile excavated material beyond edge of trench to prevent slides and cave-in.
C. Stockpile topsoil material for placement in areas disturbed by construction.
D. Do not interfere with 45 degree bearing splay of foundations.
E. Cut trenches wide enough to allow inspection of installed utilities.
F. Hand trim excavations. Remove loose material.
G. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.
H. Remove lumped subsoil, boulders and rock.
I. Remove excavated material that is unsuitable for reuse from site.
J. Remove excess excavated material from site.
K. Minimum depth of bury for waterlines is 5.5 feet unless otherwise noted in the drawings.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. Cut off soft areas of subgrade not capable of compaction in place. Backfill with general fill.
B. Compact subgrade to density equal to or greater than requirements for subsequent fill material. See Geotechnical Report.
C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.
D. Provide uniform bearing for each pipe section.
    1. Round bottom of trench to allow at least ¼ of the circumference to rest firmly on undisturbed earth.
    2. Excavate holes for pipe bells.
E. Verify that tracer wire has been installed and is unbroken or damaged.

3.05 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.
B. Fill up to subgrade elevations unless otherwise indicated.
C. Employ a placement method that does not disturb or damage other work.
D. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
E. Adjust and maintain optimum moisture content of fill and backfill materials to attain required compaction density.
F. Granular Fill: Place and compact materials in equal, continuous layers.
G. General Fill: Place and compact material in equal, continuous layers.
H. Manually backfill under pipe haunches and around bells.

1. Fill in uniform layer on each side of pipe to prevent displacement.
2. Use handheld pneumatic or mechanical compacting equipment.
3. Use manual methods until backfill is a minimum of 12 inches above top of pipe.
4. Use caution to prevent damage to tracer wire.

I. Leave shoring in place where required to protect structures or pavement.
   1. Cut off top of piling a minimum of 36 inches below subgrade elevation.

J. Install locate wire.
   1. See Section 33 1116 – Water Distribution.

K. Correct areas that are over-excavated.
   1. Thrust Bearing Surfaces: Fill with concrete.
   2. Other Areas: Use general fill, flush to required elevation.

L. Slope grade away from building and structures minimum 2 percent unless noted otherwise. Make gradual grade changes. Bend slope into level areas.

3.06 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 0.100 feet from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.10 feet from required elevations.

3.07 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compaction fill in accordance with ASTM D 1556, ASTM D 2167, ASTM D 2922 or ASTM D 3017.

B. Results shall be evaluated in relation to compaction curve determined by testing un-compacted material in accordance with ASTM D 698 “Standard Proctor”, ASTM D 1557 “Modified Proctor” or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:
   1. 2 tests per 100 linear feet of main line for each utility, 1 at lower portion of excavation and 1 at upper portion of excavation or as determined by ENGINEER.
   2. 1 test of each service line or as determined by ENGINEER.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade, pavers and paving.

3.08 CLEANUP

A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 33 1116
WATER DISTRIBUTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings for water mains, including domestic waterlines and fire waterlines.
B. Valves and fire hydrants.
C. Hydrostatic testing.
D. Disinfection.
E. Thrust Restraints.
F. Water main boring.
G. Casing for water main.
H. Service lines.

1.02 RELATED SECTIONS

A. Section 31 2316 – Excavation.
B. Section 31 2333 – Trenching for Utilities.
C. Section 33 1300 – Disinfection of Water Distribution System.

1.03 REFERENCES

A. ANSI/AWWA C 104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
B. ANSI/AWWA C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
C. ANSI/AWWA C 110 - Ductile-Iron and Gray-Iron Fittings, for Water.
D. ANSI/AWWA C 111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
E. ANSI/AWWA C 115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
F. ANSI/AWWA C 150 - Thickness Design of Ductile-Iron Pipe.
G. ANSI/AWWA C 151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
H. ANSI/AWWA C 153 - Ductile-Iron Compact Fittings, for Water Service.
I. AWWA C 500 - Metal-Seated Gate Valves for Water Supply Service.
J. ANSI/AWWA C 502 - Dry Barrel Fire Hydrants.
K. AWWA C 504 - Rubber-Seated Butterfly Valves.
L. AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 inch through 24 inch NPS.
M. ANSI/AWWA C 509 - Resilient-Seated Gate Valves for Water Supply Service.
N. ANSI/AWWA C 512 - Air Release, Air/Valve and Combination Air Valves for Water Work Service.
O. ANSI/AWWA C 550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
P. ANSI/AWWA C 600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
Q. ANSI/AWWA C 605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
R. ANSI/AWWA C 651 - Disinfecting Water Mains.
S. ANSI/AWWA C 800 - Underground Service Line Valve and Fittings.
T. ANSI/AWWA C 900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for

Water.

U. ANSI/AWWA C 901 - Polyethylene (PE) Pressure Pipe and Tubing 1/2 inch through 3 inch for Water Service.
V. ANSI/AWWA C 905 – Polyvinyl Chloride (PVC) for Pressure Pipe, 14 inch through 48 inch for Water Transmission and Distribution.
W. ANSI/AWWA C 906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch for Water Distribution and Transmission.
X. ANSI/AWWA C 907 – Injection Molded Polyvinyl Chloride (PVC) Pressure Fittings 4 inch (100 mm) through 12 inch (300 mm) for Water Distribution.
Y. ANSI/AWWA C 909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 inch through 24 inch for Water Distribution.
Z. ASTM B 88 – Standard Specification for Seamless Copper Water Tube.
AA. ASTM A 139/A 139M – Standard for Elastomeric Seals (gaskets) for Joining Plastic Pipe.
BB. ASTM F 477 – Specification for Elastomeric Seals (gaskets) for Joining Plastic Pipe.
CC. Recommended Standards for Water Works, latest edition (aka 10 States Standards) by Greater Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers.

1.04 UNIT PRICES

A. Pipe:
    1. Method of Payment and Pay Unit: By linear foot (LF) for each respective size and type of pipe on the bid form.
    2. Includes excavation, hand trimming excavation, bedding, backfilling, compaction, pipe and incidentals thereto.
    3. Measure along centerline of pipe to the nearest foot.
    4. No deduction for length of fittings or valves.
B. Fittings:
    1. Method of Measurement and Pay Unit: By the unit (Each) for each respective size and type of fitting shown on the bid form.
    2. Includes excavation, hand trimming excavation, bedding, thrust restraints, concrete for thrust restraints, backfilling, compaction, fittings and incidentals thereto.
C. Polyethylene Encasement:
    1. Polyethylene encasement of ductile iron pipe, fittings, valves and fire hydrants is considered to be a subsidiary item to the cost of the ductile iron item for which payment is made.
D. Dry Boring and Jacking of Casing Pipe:
    1. Method of Measurement and Pay Unit: By the linear foot (LF) for each respective size and type of casing pipe jacked within the limits shown in the drawings or directed by ENGINEER.
    2. Method of Measurement and Pay Unit: By the linear foot (LF) for each respective size and type of casing pipe jacked within the limits shown in the drawings or directed by ENGINEER.

3. Includes excavation of jacking pits, dry bore hole for casing pipe, removal of bored materials, jacking equipment, casing pipe, casing chocks, backfilling, compaction of jacking pits and incidentals thereto.
4. Carrier Pipe: Installed within casing pipe, measured and paid for separately.
5. Wet boring is not approved for this project.

E. Tracer Wire:
1. Tracer wire, pedestals, mounting stakes, decals and installation are considered to be subsidiary items to the cost of pipe for which payment is made.

F. Disinfection: Subsidiary to pipe.

G. Biological Testing: Subsidiary to pipe.

H. Connection to Existing Water Main (Dry or Cut-in):
1. Method of Measurement and Pay Unit: By the unit (Each).
2. Includes excavation, hand trimming excavation, bedding, thrust restraints, thrust blocking, backfilling, compaction, couplings, bolts, sleeves, adapters and incidental work and materials.
3. All units shall be washed, cleaned and disinfected prior to installation.
4. Fittings shall be paid for as a separate bid item (Each).

I. Connection to Existing Water Main (Pressure or Wet Tap):
1. Method of Measurement and Pay Unit: By the unit (Each).
2. Includes excavation, hand trimming excavation, bedding, thrust restraints, thrust blocking, backfilling, compaction, couplings, ducts, sleeves, adapters and incidental work and materials.
3. All units shall be washed, cleaned and disinfected prior to installation.
4. Tapping tee and attached valve shall be paid for as a separate Bid Item.

1.05 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, hydrants, service line materials and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Project Record Documents:
1. Record actual locations of piping mains, valves, connections, thrust restraints and invert elevations.
2. Identify and describe unexpected variations in subsoil conditions.
3. Identify, describe and record the discovery of uncharted utilities.
4. Testing:
    a. See Disinfection of Water Distribution System Section for testing.

D. Submit the following as appropriate for each valve and hydrant provided.
1. Outline and installation drawings for equipment and fixtures furnished.
2. Equipment performance data and operating characteristics.
3. Manufacturer's catalog data marked to indicate materials being furnished as standard equipment, fixtures, specialties and accessories.

E. Submit the following for restrained joint ductile iron pipe:

1. Restrained joint styles and detailed designs by the pipe manufacturer prior to manufacture. Include detailed laying schedules.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with standards of authorities having jurisdiction for potable water service piping. Includes materials, installation, testing and disinfection.

B. Water testing in accordance with AWWA C 600 or C 605 and ANSI/AWWA C 651 by state approved laboratory.

C. Pipe: Nominal Pipe Size, material code designation, standard dimension ratio, pressure rating, manufacturer's name or trademark, National Sanitation Foundation seal and appropriate ASTM designation numbers marked on pipe.

D. Fittings and Valves: Manufacturer's name and pressure rating marked on body.

E. All products are required to meet applicable AWWA requirements, ANSI/NSF 61 and the requirements of the Safe Drinking Water Act.

1.07 REGULATORY REQUIREMENTS

A. Conform to all applicable state, federal and local codes for materials and installation.

1.08 PROJECT CONDITIONS

A. Verify that survey control points for alignment and elevation are as indicated in the drawings.

B. Research public utility records and verify location of existing utilities. Contact utility locating service for project area.

C. Provide exploratory excavation to determine exact location of existing underground structures or utilities. Notify ENGINEER immediately if a discrepancy is identified.

D. Verify that water service piping can be installed as shown in the drawings and to reference standards.

E. Protect plants, lawns, trees, amenities and other features to remain.

F. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, utility pedestals and amenities from excavating equipment and vehicular traffic.

1.09 DELIVERY, STORAGE AND HANDLING

A. Preparation for Transport:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect threaded ends and flange faces.
3. Set valves in best position for handling.
4. Set valves closed to prevent rattling.
5. Do not telescope small diameter pipe inside larger diameter pipe.

B. During Storage:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
3. Protect PVC pipe from prolonged (more than 1 month) exposure to sunlight.

C. Handling:
    1. Use sling to lift valves where size requires handling by cranes or forklift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.
    2. Protect pipe during shipping, storage and handling to prevent pipe end damage and to prevent entrance of dirt, debris and moisture. Pipe end covers may be required.
    3. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
    4. Protect fittings and specialties from moisture and dirt.
    5. Protect plastic piping during storage from direct sunlight. Support to prevent sagging and bending.
    6. Deliver to trench in sound, undamaged condition.

1.10 SEQUENCE/SCHEDULING

A. Coordinate connection to existing main with utility company:
    1. Give utility and ENGINEER a minimum 24-hour's notice before connection to existing main.
    2. Keep disruption of service less than 4 hours.
B. Give OWNER and governmental agency a minimum 48-hour's notice prior to commencing any boring activity.

1.11 DISTRIBUTION SYSTEM DESIGN

A. New distribution system segments shall be configured and installed in general conformance with the 2007 Recommended Standard for Water Works.
B. New distribution system segments shall have a sufficient number of valves to provide control on water mains installed. Valves shall be used to minimize user inconvenience, prevent system outages due to sanitary hazards or system damage, and to help facilitate routine system maintenance.
C. If areas of groundwater contamination by organic compounds are known or encountered during installation, pipe and joint materials which do not allow permeation of organic compounds shall be used.
D. New distribution system segments that terminate at a dead-end shall be equipped with a means to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.
E. When new distribution system segments are installed to cross beneath water courses, with a normal water surface width greater than 15 feet in width, the following shall be provided:
    1. The pipe shall be of construction having flexible, restrained watertight joints.
    2. Valves shall be installed at both ends of water crossings with no individual service connections between them so that the section can be isolated for testing or repair.
    3. Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve on the higher residual pressure side of the system during normal operation.

F. All new distribution mains shall be a minimum of 8-inches in diameter, or larger if necessary to meet fire flow requirements.

G. Air Release Valves shall be placed at high points in the water distribution system if there are no water service lines, fire hydrants, flushing hydrants or other means of expelling air from the distribution system.

PART 2 – PRODUCTS

2.01 WATER PIPE

A. Polyvinyl Chloride (PVC) Pipe for Water Distribution: Pressure Class 200 meeting all the requirements of AWWA C909.

1. General:
    a. Same outside diameter as ductile iron pipe.
    b. Shall be installed with tracer wire.
2. Joints: AWWA C 900, AWWA C 905 or AWWA C 909.
    a. Elastomeric gasketed push-on joints.
    b. Solvent cement welded joints are not approved.

B. Restrained Joint PVC Pipe: AWWA C 900, DR 18 for 4 inch through 12 inch.

1. General:
    a. Pipe and coupling designed as an integral system using high strength flexible plastic splined inserted into mating, precision machined grooves which align when the pipe is fully inserted providing full 360 degrees restraint with evenly distributed loading.
2. Pipe and Couplings:
    a. Made of same pressure rated material.
    b. Supplied by single manufacturer.
    c. Hydrostatically tested at factory at 4 times rated pressure for minimum of 5 seconds.
    d. UL and FM labels.
    e. Approved by National Sanitation Foundation (NSF) for potable water use.
3. Joints:
    a. Use nonmetallic restrained joint couplings.
    b. Furnish with twin elastomeric sealing gaskets, ASTM F 477.
    c. Furnish coupling with beveled edges.
4. Approved Manufacturer:
    a. CertainTeed Certa-Lok C900/RJ or approved equal.

2.02 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE AND FITTINGS

A. Polyethylene: ANSI/AWWA C 105.

1. Flat sheet or split tube.
2. 8 mil (0.20 mm) thickness.

2.03 FITTINGS

A. Ductile Iron: ANSI/AWWA C 110 or ANSI/AWWA C 153.

B. Mechanical Joint: ANSI/AWWA C 111.
C. Exterior Coating: Asphaltic, 1 mil thickness.
D. Interior Coating: Standard cement lining ANSI/AWWA C 104 with seal coat.
E. All fittings shall be polywrapped.
F. Working Pressure: 350 psi.
G. Bolts and Nuts:
    1. Corten.
    2. Ductile iron.
    3. Stainless Steel.
H. Polyethylene Encasement: ANSI/AWWA C 105 polyethylene jacket.
I. High density polyethylene (HDPE) molded fittings are not approved.

2.04 SPECIAL FITTINGS

A. Ductile Iron Couplings:
    1. Ductile Iron.
    2. Bolts and Nuts: Stainless Steel.
    3. Working Pressure: 150 psi.
B. Mechanical Joint Tapping Sleeves and Crosses:
    1. 2-section construction.
    2. Mechanical joint ends.
    3. Flanged outlet for tapping valve.
C. Stainless Steel Tapping Sleeves:
    1. All stainless steel, 2-section construction.
    2. Flanged outlet for tapping valve.
    3. Bolts and Nuts: Stainless Steel.

2.05 CASING PIPE

A. Steel Pipe:
    1. General: Uncoated smooth wall welded steel pipe; ASTM A 53, Type E or Type S, Grade B black steel; or ASTM A 139, Grade B black steel. Minimum yield strength 35,000 psi.
    2. Minimum Wall Thickness for Highway Crossings:

Pipe Diameter (Inches)	Wall Thickness (Inches)
20 or less	0.250
26 or less	0.281
34 or less	0.312
48 or less	0.344

    3. Minimum Wall Thickness for Railroad Crossings: 0.406 inches.
B. Casing Chocks:
    1. General: Provide casing chocks for carrier pipe 4 inches or greater in diameter and thick enough to provide clearance between casing pipe and carrier pipe couplings.
    2. Approved Casing Chocks: Power Seal.

3. 5’-10” Maximum between Spacers, See Manufacturer’s Recommendations.

C. End Seals:

1. Grout: Sand/Portland cement slurry.

Composition per Cubic Yard	
Cement (Type I or II)	240 pounds
Fine Sand	2,700 pounds
Water (approximate)	420 pounds
Air Content (approximate)	10 percent

2. Rubber end seals with stainless steel zipper and bands.
    a. Approved Manufacturer: Power Seal.

2.06 TRACER WIRE

A. Wire: No. 12 AWG solid copper conductor with type THHN insulation.

B. Splices: Splicing shall be made with 3M DB type direct bury wire splice kits, sized appropriate to the number and size of wires connected.

C. Incidentals: Terminal box, pedestal or duplex box – see detail sheet.

2.07 VALVES

A. All Gate Valves shall be American Flow Control or Mueller.

B. Resilient Seated Gate Valves for Water Supply Service: Meeting requirements of ANSI/AWWA C 509 (also known as resilient wedge gate valve).

1. Resilient-wedge type; non-rising stems.
2. Bolts and Nuts: Stainless Steel.
3. Valve Ends: Mechanical joint of flange.
    a. Push-on end not approved.
4. Operator: 2-inch square nut, counterclockwise to open.
5. Coating: ANSI/AWWA C 550 epoxy coating; inside and outside of body, bonnet and stuffing box.
6. Pressure Rating: 200 psi for 3 through 12 inch, 150 psi for 16 through 30 inch.
7. Polyethylene Encasement: ANSI/AWWA C 105.
8. Shall include a rubber adapter between the valve box and gate valve body to prevent settling and shifting of the valve boxes.

C. Valve Boxes:

1. Cast iron or plastic base, center and top sections; screw type adjustment.
2. Base: Standard or oval as required for valve.
3. Top Section: Drop lid marked “WATER”.
4. Valve box adapter II, manufactured by Adapter Inc., or approved equivalent.

D. Thrust Restraint:

1. Mechanical Restraint:
    a. Threaded Rod: ¾ inch diameter stainless steel or corten.
    b. Nuts: Ductile iron, corten or stainless steel.
    c. Eye Bolts: ¾ inch diameter, corten.
    d. Mega Lugs as approved by OWNER.

E. Rubber-Seated Butterfly Valves: Meeting requirements of ANSI/AWWA C 504.
    1. All valves by same manufacturer.
    2. Bolts and Nuts: Stainless Steel.
    3. Valve Ends: Mechanical joint.
        a. Push-on end not approved.
    4. Operator: 2-inch square nut, counterclockwise to open, manual actuator with encased worm gear for buried service.
    5. Coating: ANSI/AWWA C 550 epoxy coating; inside and outside body.
    6. Pressure Rating: 150 psi.
    7. Polyethylene Encasement: ANSI/AWWA C 105.

F. Air Release Valves:
    1. The Air Release shall be APCO Model 143C combination valve or approved equivalent. The valve shall be a pressure rating of 300 psi.
    2. The valve shall be 1" in size.
    3. Body, Cover and Lever Frame: Cast Iron (ASTM A48, Class 30).
    4. Float: Stainless Steel (ASTM A420).
    5. Needle and Seat: Bruta-N.
    6. Plug: Bronze (ASTM B124).
    7. Leverage Frame: Delrin/Cast Iron (ASTM D2133/ASTM A48, Class 30).
    8. Air Release Manhole Frame & Cover shall be Deeter 1030.
    9. See Detail for Specific Air Release Manhole Requirements.
    10. Air Release Valve piping shall be installed in accordance with the requirements set forth in the Recommended Standards for Water Works.

2.08 HYDRANTS

A. All Fire Hydrants shall be American Flow Control or Mueller.

B. Fire Hydrants: ANSI/AWWA C 502 for dry-barrel fire hydrants.
    1. Type of Shutoff: Compression.
    2. Type of Construction: Break flange or break bolt.
    3. Main Valve Opening: 5 ¼ inches.
    4. Nozzle Arrangement and Size: 3 nozzles – two 2 ½ inch nozzles and on 4 ½ inch pumper nozzle.
    5. Nozzle Thrust: National standard hose threads.
    6. Type of Inlet Connection: Mechanical Joint.
    7. Size of Inlet Connection: 6 inch.
    8. Depth of Bury: Distance from ground line to bottom of connection pipe indicated in the drawings.
    9. Direction of Opening: Counterclockwise.
    10. Packing: Conventional or O-ring.
    11. Size and Shape of Operating Nut: 1 ½ inch, standard pentagon.
    12. Working Pressure: 150 psi.
    13. Color: As selected by OWNER.

14. Polyethylene Encasement: ANSI/AWWA C 105.
15. Epoxy Coated Inner Shoe.

C. Thrust Restraint:
   1. Mechanical Restraint:
      a. Anchor Couplings.
      b. Nuts: Ductile iron, corten or stainless steel.
      c. Eye Bolts: ¾ inch diameter, corten.

2.09 WATER SERVICE LINE MATERIALS

A. Conform to the requirements of ANSI/AWWA C 800 Underground Service Line Valves and Fittings.

B. Polyethylene (PE) plastic pipe (SIDR-PR): ASTM D 2239 and AWWA C 901, SIDR-7.
   1. Minimum Pressure Rating: 200 psi.

C. Service Saddles:
   1. Brass, bronze or ductile iron body for use with water pipe.
   2. Wide band stainless straps.
   3. O-ring seal.
   4. AWWA taper threaded outlet.
   5. Minimum Working Pressure: 150 psi.

D. Corporation Stops:
   1. Brass or bronze body for use with copper or PE service pipe.
   2. AWWA taper threaded inlet.
   3. Minimum Working Pressure: 150 psi.

E. Curb Stops:
   1. Brass or bronze body without drain; ball valve type for use with copper or polyethylene service pipe.
   2. Inlet and outlet connection as noted in the drawings for copper or polyethylene service pipe.
      a. Full port joint.
   3. Minimum Working Pressure: 150 psi.

F. Curb Boxes:
   1. Extendable type with cast iron base and lid:
      a. Steel pipe upper section.
      b. Minimum Inside Diameter: 1 ½ inches.
   2. Base Pattern: Arch.
   3. Lid: Brass pentagon bolt with locking lid.

G. Couplings:
   1. 3/4-inch = Mueller Instatite
   2. 2-inch = Compression type with insert stiffeners.
   3. Minimum Working Pressure: 150 psi.

2.10 CONCRETE

A. Cast-in-Place Concrete for Thrust Restraints:

1. Mix Design: Compressive Strength When Tested in accordance with ASTM C 39 at 28 days: Minimum 3,000 psi.

2.11 APPROVED MANUFACTURERS/PRODUCTS

A. All products furnished shall meet all applicable AWWA requirements and NSF 61 requirements.

PART 3 – EXECUTION

3.01 SECTION INCLUDES

A. Verify that trench cut and excavation base are ready to receive work and excavations, dimensions and elevations are as indicated in the drawings.

B. Verify that building service connection and municipal utility water main size, location and invert are as indicated.

C. Verify depth of sewer lines and other utilities.

3.02 TRENCHING

A. See Section 31 2333 – Trenching for Utilities and drawings for additional requirements.

B. Hand trim excavation for accurate placement of pipe, fittings or valves to elevations indicated.

C. Form and place concrete for pipe thrust restraints at each change in pipe direction. Place concrete to permit full access to pipe and pipe accessories. See drawings for square footage of thrust restraint based on pipe diameter.

D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact; then complete backfilling.

3.03 PIPE AND FITTIGN INSTALLATION

A. Install pipe and appurtenances in accordance with manufacturer's recommendations and AWWA C 600 (Ductile Iron) on AWWA C 605 (PVC).

B. Handling Pipe and Appurtenances:
   1. Deliver to trench in sound, undamaged condition.
   2. Use web slings. End hooks not allowed.

C. Inspect for Defects.

D. Protection of Pipe Interior:
   1. Clean pipe interior of foreign material before lowering into trench.
   2. Keep clean at all times.
   3. Securely close open pipe ends and fittings with watertight plugs during non-working periods including:
      a. When pipe laying is not in progress.
      b. Lunch breaks.
      c. Nights.
      d. Weekends.

E. Cutting Pipe:
   1. Use methods recommended by manufacturer.

2. Cut pipe in neat, workmanlike manner without damage to interior lining or exterior coating.
3. Use approved mechanical cutter.
4. Grind smooth and bevel cut ends.

F. Joining Pipe:
1. Use methods recommended by manufacturer.
2. Use minimum amount of gasket lubricant.
3. Apply lubricant to gasket only.
4. Do not apply lubricant to inside of bell.

G. Pipe Deflections:
1. Do not exceed manufacturer's recommendations for type and size of pipe and joint being used.
2. Utilize bend fittings or shorter lengths of where necessary to achieve desired alignment.

H. Pipe Gradient:
1. Lay pipe to slope gradient noted in drawings.
2. Install air release or combination air release and air/vacuum valves and manholes as shown in drawings.

I. Separation Between Water Mains and Sewer Lines:
1. Maintain minimum of 10 feet horizontal separation of water mains from sewer lines.
2. Maintain minimum of 18 inches vertical separation where sewer and waterlines cross.
    a. Center 1 full length (approximately 20 feet) of water main pipe at sewer line crossing.
    b. Correct any misalignment and/or loosened joints of sewer line prior to backfilling.
    c. Carefully compact backfill beneath sewer line to prevent misalignment.
    d. Repair any damage to sewer line at no cost to OWNER. Use ENGINEER approved method of repair.

J. Polyethylene Encasement:
1. Wrap ductile iron and steel pipe, fittings, valves and operators, and hydrants with polyethylene encasement per ANSI/AWWA C 105.
2. Repair damaged areas of polyethylene encasements.

K. Tracer Wire and Pedestals:
1. Place tracer wire in trench on top of water main.
2. Terminate tracer wire in terminal boxes/pedestals as shown in drawings.
3. Minimum Bury of Tracer Wire from Water Main to Terminal Box/Pedestal: 36 inches.
4. Boring with Casing Pipe, Dry Boring and Directional Boring:
    a. Attach tracer wire to carrier pipe as required.

b. Install a terminal box/pedestal at each end of the boring or casing pipe.
c. Test tracer wire to insure continuity.

L. Depth of Cover:
1. Minimum Depth of Cover: 5.5 feet unless noted otherwise in the drawings. (Depth of Cover is measured from top of pipe to finish grade elevation.)

3.04 VALVE AND HYDRANT INSTALLATION

A. Set valves and hydrants on solid bearing.
B. Center and plumb valve box over valve using valve box adapter II.
1. Set box cover flush with finished grade.
2. Set valve box cover in 24 inch by 24 inch by 6 inch thick concrete collar with reinforcing bars as shown in the drawings.
C. Fire Hydrants:
1. Set hydrant at location and grade shown in the drawings.
2. Set plumb.
3. Locate pumper nozzle perpendicular to and facing roadway unless directed otherwise.
4. Set hydrant “bury line” at finish grade.
5. Set hydrant on 18 inch square by 4 inch thick concrete foundation.
6. Provide a drainage pit 36 inches square by 24 inches deep filled with washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
7. Tie auxiliary gate valve a minimum of 18 inches from hydrant.
8. Place a temporary cover over the hydrant until placed in service.

3.05 RESTRAINT

A. Restrained Joint Ductile Iron Pipe:
1. Provide restrained joint ductile iron pipe indicated in the drawings. Include detailed laying schedule.
2. Field cutting of restrained joint pipe not allowed.
a. Exceptions: Locations that utilize a “field cut” restrained joint end kit as provided and recommended by pipe manufacturer and noted in the drawings.
B. Protect restraining mechanisms, tie rods, clamps or other components of dissimilar metal against corrosion by hand application of a suitable coating or by encasement of entire assembly with polyethylene film in accordance with ANSI/AWWA C 105/A 21.5.
C. Concrete Thrust Blocks:
1. Place concrete thrust blocks at bends, tees and dead ends against undisturbed soil.

3.06 BORING WITH CASING PIPE

A. General:
1. Location: As indicated in the drawings and indicated in any special permit.
2. Refer to permit provided by governmental agency.
3. Boring under federal and state highways in accordance with:

a. State Policy for Accommodating Utilities on State Highway Right-of-Way.
b. Standard Specifications for Highway Construction, latest edition, including all current supplemental specifications.

4. Boring under railroad tracks in accordance with railroad permit.
5. Encase water mains and service lines that cross rural roads from toe of fill slope to toe of fill slope and urban streets 6 feet back of curb.
6. Pits for boring, tunneling or jacking not permitted closer to roadway than toe of fill slope or toe of foreslope in rural or 2 feet back of curb in urban sections.
7. Installation of casing and pipe accomplished by boring, tunneling or jacking methods.
    a. Use of water under pressure (jetting) or puddling not permitted.
    b. Water used to lubricate cutter and pipe, with ENGINEER approval, considered as dry boring.
8. Where unstable soil conditions exist, conduct boring or tunneling operation in a manner which is not detrimental to roadside being crossed.
9. Take prompt remedial action when excessive voids or oversized bored hole is produced or when abandoning a bored or tunneled hole. Obtain approval of ENGINEER prior to taking action.
10. Pressure grout all voids or abandoned holes caused by boring or jacking.
11. Hole diameter for casing not to exceed 1 ½ inches for pipe having inside diameter of 12 inches or less.
12. Hole diameter for casing not to exceed 2 inches for pipe having inside diameter of greater than 12 inches.
13. Install water main 4 inches or greater in diameter through casing pipe using casing chocks.
    a. Follow manufacturer's recommendations.
    b. Spacing of Chocks: Maximum 10-foot centers for ductile iron pipe; maximum 6-foot centers for PVC pipe.
14. Leave space between carrier pipe and casing open.
15. Seal annular space at end of casing with grout or rubber end seal with stainless steel zipper and bands.
16. Backfill bore pit.
    a. See Section 31 2333 – Trenching for Utilities.
    b. Backfill and compact over excavated areas with clean sand or rock.
    c. Compaction Density for Bore Pit Backfill: 98 percent of maximum dry density or as required in the geotechnical report.

3.07 DRY BORING

A. Use of water under pressure (jetting) or puddling not permitted.
B. Water used to lubricate cutter and pipe, with ENGINEER approval, considered as dry boring.
C. Hole diameter for water main not to exceed outside diameter of bell or coupling plus 2 inches for pipe having inside diameter of 4 inches or less.

D. Hole diameter for water main not to exceed outside diameter of bell or coupling plus 4 inches for pipe having inside diameter of more than 4 inches.
E. Where unstable soil conditions exist, conduct boring operation in a manner which is not detrimental to adjacent features or structures.
F. Take prompt remedial action when excessive voids or oversize bored hole is produced or when abandoning a bored hole. Obtain approval of ENGINEER prior to taking action.
G. Pressure grout all voids or abandoned holes caused by boring or jacking.
H. Backfill pit.
    1. See Section 31 2333 – Trenching for Utilities
    2. Backfill over excavated areas with compacted clean sand or rock.

3.08 DIRECTIONAL BORING

A. Examination of Site:
    a. Verify horizontal and vertical alignment.
    b. Review geotechnical report.
    c. Verify depth and location of sewer lines and other utilities.
    d. Notify ENGINEER immediately of any observations affecting the work.
B. Materials: Restrained joint PVC pipe of high density polyethylene (HDPE) pipe.
C. Diameter of bore hole only large enough to properly install waterline without causing excessive stress on pipe.
D. Do not exceed maximum bending radius of pipe as given by manufacturer.

3.09 CONNECTION TO EXISTING WATER MAIN

A. General:
    1. Coordinate connection location with OWNER.
    2. Coordinate time and date for connection with OWNER.
    3. Obtain permission from OWNER prior to operating controls and/or valves.
    4. All salvaged valve and fittings to be salvaged and delivered to OWNER.
    5. Minimize shutoff time of existing water distribution system.
    6. Disinfect new fittings and piping prior to installation.

3.10 CLEANING AND FLUSHING OF PIPING AND APPURTENANCES

A. Cleaning:
    1. Prior assembly and installation, thoroughly clean interior of each piece of pipe, valve and fitting.
    2. Keep interior clean at all times.
B. Flushing:
    1. Obtain approval of OWNER and ENGINEER prior to discharging flush water into storm sewer or natural waterway.
    2. Use flushing methods which prevent damage to private and public property.
    3. Hydrants may be used for flushing.
    4. Minimum Flushing Velocity: 2.5 feet per second (fps).
    5. Flush 5 times the volume of the line.
C. Disinfection:

1. See Section 33 1300 – Disinfection of Water Distribution System.

3.11 HYDROSTATIC TEST

A. General:
   1. Pressure test piping and appurtenances in accordance with AWWA C 600 or C 605.
   2. Test against closed hydrant, auxiliary valve open.
   3. Test individual sections between valves.
   4. Test performed simultaneously with initial disinfection and flushing.

B. Preparation:
   1. Expel air from system.
      a. Install corporation stops at high points. Close prior to testing.
      b. OWNER's Option: Remove corporation stop and install plug or leave in place.

C. Test:
   1. Test Pressure: 150 psi or as directed by ENGINEER.
      a. Not less than 1.25 times working pressure at highest point of test section.
      b. Minimum Test Period: 2 hours.
   2. Determination of Leakage:
      a. Add water to system by pump to maintain pressure within 5 psi of test pressure.
   3. Allowable Leakage:
      a. PVC Pipe: Allowable leakage formula.

         Q = LD x √P divided by 148,000, Where:

         Q = Quantity of makeup water, in gallons per hour

         L = Length of pipe section being tested, in feet

         D = Nominal diameter of pipe in inches

         P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

      b. Ductile Iron Pipe: Allowable leakage formula.

         L = SD x √P divided by 148,000, Where:

         L = Testing allowance (makeup water), in gallons per hour

         S = Length of pipe being test in feet

         D = Nominal diameter of pipe in inches

         P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

D. Defective Materials and/or Workmanship:
   1. Acceptance based on leakage test.
   2. Locate and repair visible leaks.
   3. Replace damaged or defective pipe, fittings, valves, hydrants or joints.
   4. Repeat test.

3.12 DISINFECTION AND BACTERIOLOGICAL TESTING

A. Perform disinfection and bacteriological testing.

1. See Section 33 1300 – Disinfection of Water Distribution System.

3.13 SERVICE LINES

A. General:
   1. Extend new service line from corporation stop on water main to new or existing curb stop or as shown in the drawings or details.

B. Service Taps:
   1. Made in conformance with AWWA C 600 at location shown in the drawings.
   2. Use service saddle or if service is greater than 4 inches, direct tap.
   3. Locate 45 degrees to top of pipe.
   4. Follow manufacturer's recommendations.
   5. Inspected by OWNER's representative prior to backfilling.

C. Service Line:
   1. Depth of Cover: Minimum 5.5 feet.
   2. Minimum 2-foot separation between structures open to weather (i.e. storm sewer pipe).
   3. Deviations in Depth of Cover and/or Minimum Separation: Notify ENGINEER immediately of any deviation in depth of alignment. Make changes as directed by ENGINEER.

D. Curb Stops and Boxes:
   1. Follow manufacturer's recommendations.

E. Leakage:
   1. Locate and repair all visible leaks.
   2. Replace damaged and defective pipe, fittings, valves or joints.

F. Maintenance of Service to Customers:
   1. Do not abandon, disconnect or discontinue an existing water service until customer is connected temporary or permanent service line.
   2. Provide OWNER and ENGINEER with service connection schedule.
   3. Notify service customer 24 hours in advance of making connection to curb stop.
   4. Keep disruption of service at maximum of 1 hour.
   5. Provide temporary connection if necessary.

G. Connection of New Water Service Inside of House or Building:
   1. CONTRACTOR to coordinate this connection with the OWNER and property owner.
   2. Connection of new service line to existing plumbing inside of the house or building will be done by a Licensed Plumber.

3.14 FIELD QUALITY CONTROL

A. Compaction density testing shall be performed on compaction fill in accordance with ASTM D 1556, ASTM D 2167, ASTM D 2922 or ASTM D 3017. As directed by the OWNER.

B. Results shall be evaluated in relation to compaction curve determined by testing un-compacted material in accordance with ASTM D 698 "Standard Proctor", ASTM D 1557 "Modified Proctor" or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests:
    1. Under Pacing, Slabs-on-Grade and Similar Construction:
        a. 1 test per 150 linear feet of main line or as determined by OWNER. Test at random depths.
        b. 1 test of each service line or determined by ENGINEER.
    2. Non-Paved Areas:
        a. 1 test per 300 linear feet of main line or as determined by OWNER. Test at random depths.
        b. 1 test of each service line or as determined by OWNER.

E. Perform hydrostatic test at CONTRACTOR's expense.
    1. If test indicated work does not meet specified requirements, remove work, replace and retest at no cost to OWNER.

F. Perform disinfection and biological test at CONTRACTOR's expense.
    1. See Section 33 1300 – Disinfection of Water Distribution System.
    2. If test indicates work does not meet specified requirements, take remedial action and retest at no cost to OWNER.

G. Tracer Wire Test:
    1. CONTRACTOR shall perform a conductivity test on all tracer wire prior to the acceptance of the water system. This test may be performed by either hiring an acceptable underground utility locating firm to physically locate the tracer wire in the presence of a representative of OWNER or via a low voltage circuit completed with the use of a suitable voltage source and meter to ensure continuity of the tracer wire.
    2. In the event that a closed clamp circuit cannot be completed or difficulties with the locating or test arise, the cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and shall meet the requirements.

END OF SECTION

SECTION 33 1300
DISINFECTION OF WATER DISTRIBUTION SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Disinfection of waterline.
B. Testing and Reporting.

1.02 RELATED SECTIONS

A. Section 33 1116 – Water Distribution

1.03 REFERENCES

A. AWWA B 300 – Hypochlorites (ANSI/AWWA B 300).
B. AWWA B 301 – Liquid Chlorine (ANSI/AWWA B 301).
C. AWWA B 302 – Ammonium Sulfate.
D. AWWA B 303 – Sodium Chlorite.
E. AWWA C 651 – Disinfecting Water Mains (ANSI/AWWA C 651).

1.04 QUALITY ASSURANCE

A. Perform work in accordance with AWWA C 651.
B. Disinfection: Company with minimum of 3 years documented experience in disinfecting potable water systems.
C. Testing Firm: State Regulatory Agency laboratory or company specializing in testing potable water systems, certified and approved by the State Regulatory Agency for microbiological testing.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable State and Regulatory Agency code or regulation for performing the work of this section.
B. Provide certificate of compliance from authority having jurisdiction, indicating approval of water system.

PART 2 – PRODUCTS

2.01 DISINFECTION CHEMICAL

A. ANSI/AWWA B 300, Hypochlorites:
    1. Sodium hypochlorite solution.
    2. Calcium hypochlorite granules.
    3. Calcium hypochlorite tablets.
B. ANSI/AWWA B 301, Liquid Chlorine.
C. ANSI/AWWA B 302, Ammonium Sulfate.
D. ANSI/AWWA B 304, Sodium Chlorite.

2.02 FOOD GRADE ADHESIVES

A. Permatex Form-A-Gasket No. 2.
B. Permatex clear RTV silicone adhesive sealant.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that piping systems or water well has been cleared, inspected and pressure tested.

B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, and demonstration procedures, including related systems.

3.02 EXECUTION

A. General:

1. Disinfection in accordance with ANSI/AWWA C 651.
2. Water supplied from existing distribution system or other approved source.

B. Tablet/Granular Method:

1. General:
   a. Need written permission of OWNER.
   b. Do not use on solvent-welded plastic or screwed-joint steel pipe.
   c. Use only if pipe and appurtenances have been kept clean and dry during construction.
   d. Use with calcium hypochlorite granules or tablets to give average chlorine dose of 25 mg/L.
2. Placing Calcium Hypochlorite Granules (HTH):
   a. Place at upstream end of first section of pipe and each branch main.
   b. Place at 500-foot intervals. See table.

Pipe Diameter (Inches)	HTH Granules (65% Available Chlorine)	
	(Ounces)	(Grams)
4	1.7	57
6	3.8	113
8	6.7	200
10	10.5	300
12	15.1	430
14 and Larger	D^2 x 15.1	D^2 x 427.9

(D is the inside pipe diameter in feet)

3. Placing Calcium Hypochlorite Tablets (HTH):
   a. Place 5-gram tablet(s) in each section of pipe. See table.

Number of 5 Gram HTH Tablets
(65% Available Chlorine)

	Pipe Size									
Length of Pipe	4”	6”	8”	10”	12”	16”	20”	24”	30”	36”
13’	1	1	1	2	3	4	7	9	15	21
18’	1	1	2	3	4	6	9	13	20	28
20’	1	1	2	3	4	7	10	14	22	32
40’	1	2	4	5	7	13	20	28	44	63

(Number of 5g tablets per pipe section = 0.0012D2 L rounded up,
where D = inside diameter of pipe in inches and L = length in feet.)

b. Place 1 tablet in each hydrant, hydrant branch and other appurtenances.
c. Attach tablets to inside, top of pipe of each length of pipe with food-grade adhesive.

4. Filling Pipe:
   a. Slowly fill pipe. Keep velocity less than 1 foot per second. See table.

Pipe Size (Inches)	Flow (GPM) @ 1 Ft/Sec Velocity
4	40
6	85
8	155
10	245
12	350
14	480
16	625

   b. Ensure that air pockets are eliminated.
5. Retention Time:
   a. Allow treated water to stand 24 hours.
   b. If water temperature is less than 41 degrees F, allow treated water to stand 48 hours.
   c. Maintain minimum 10 mg/L free residual chlorine concentration during entire retention time.

C. Continuous-Feed Method:
1. Preparation:
   a. Flush line following procedures outlined in Part 3 of Section 33 1116 – Water Distribution.
   b. Provide corporation stop within 10 feet downstream from beginning of pipe.
   c. Prepare 1 percent chlorine solution.
2. Application of Chlorine Solution:
   a. Fill line with water and chlorine solution at constant and measured rate.

b. Apply solution using one of the following methods:
    1) Liquid chlorine solution-feed, vacuum-operated chlorinator and booster pump.
    2) Liquid sodium hypochlorite-metered, chemical feed pump.
    3) Calcium hypochlorite solution-metered, chemical feed pump.
c. Direct-feed chlorinators which operate solely from gas pressure in chlorine cylinder are not allowed.
d. Proportion water and chlorine solution flows so water entering the new line will not have less than 25 mg/L available chlorine. See table.

Minimum Rate Feed for 1% Chlorine Solution to Obtain 25 mg/L Available Chlorine

Water Feed Rate (gpm)	1% Chlorine Solution Feed Rate (gpm)
100	0.25
200	0.50
300	0.75
400	1.00
500	1.25

3. Retention Time:
    a. Allow treated water to stand 24 hours.
    b. If water temperature is less than 41 degrees F, allow treated water to stand 48 hours.
    c. Maintain minimum of 10 mg/L free residual chlorine concentration during entire retention time.

D. Flushing:
1. Obtain approval of OWNER prior to discharging chlorinated water into storm sewer or natural waterway.
2. Use flushing methods which prevent damage to private and public property.
3. Hydrants may be used for flushing.
4. Minimum Flushing Velocity: 2.5 feet per second (fps).
5. Flush 5 times the volume of the line.
6. Ascertain that heavily chlorinated water has been removed from waterline.
7. Chlorine concentration should be no higher than that generally maintained in the system or less than 1 mg/L.

E. Water Samples:
1. Procedure:
    a. After final flushing and before new waterline is placed in service, fill line with potable water.
    b. Install corporation stop on waterline with copper tube gooseneck assembly.
    c. Collect 2 consecutive sets of samples at least 24 hours apart.

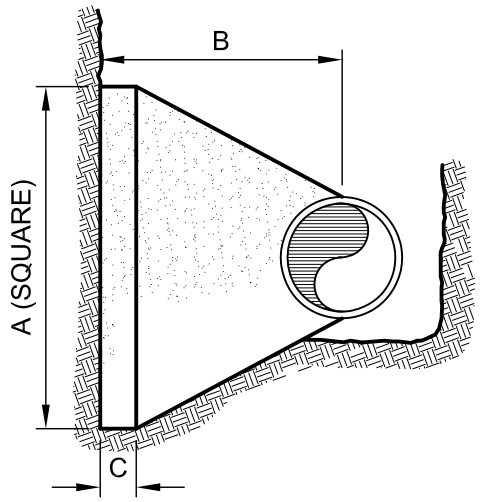
d. Location of Samples:
    1) 1 set at end of each test section.
    2) 1 set for every 1m200 feet.
    3) 1 set from each branch.
    4) Others as shown in the drawings.
e. Collect samples in sterile bottles treated with sodium thiosulfate.
f. Do not take samples from hose or fire hydrant.

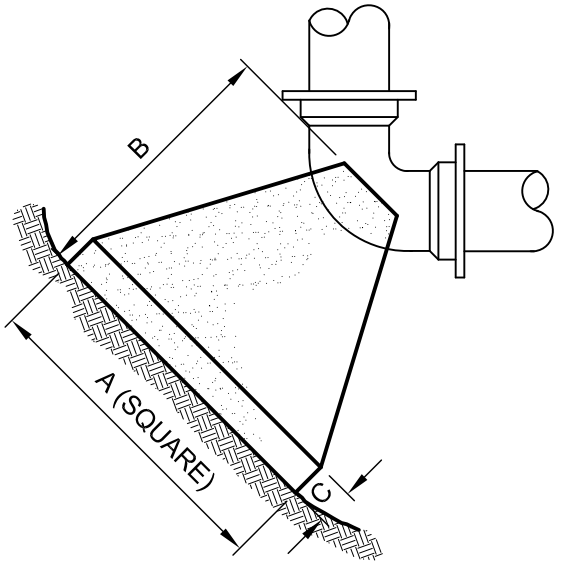
2. Submit water samples to state regulatory agency laboratory or certified testing laboratory for bacteriological analysis.
3. Bacteriological Test Failure:
    a. Repeat flushing and disinfection procedures.
    b. Use continuous-feed method for disinfection.
    c. Repeat bacteriological sampling and testing.

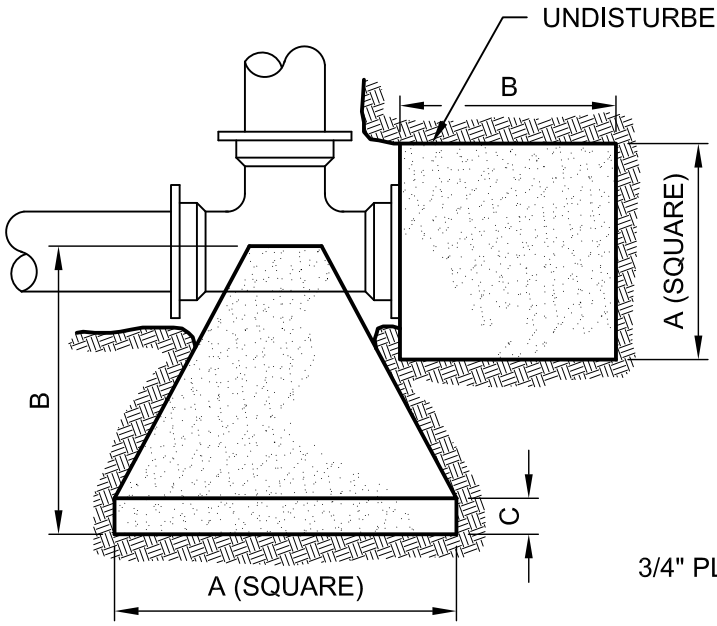
END OF SECTION

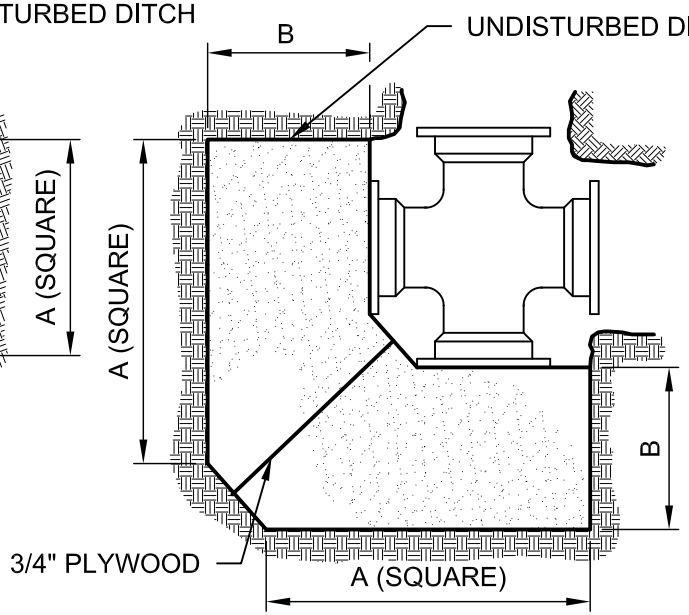
SIZE OF FITTING	THRUST BLOCK DIMENSIONS		
	A	B	C
4"	1'-0"	1'-0"	3"
6"	1'-6"	1'-0"	6"
8"	2'-0"	1'-0"	6"
10"	2'-6"	2'-0"	9"
12"	3'-0"	2'-6"	9"
16"	4'-0"	2'-6"	12"

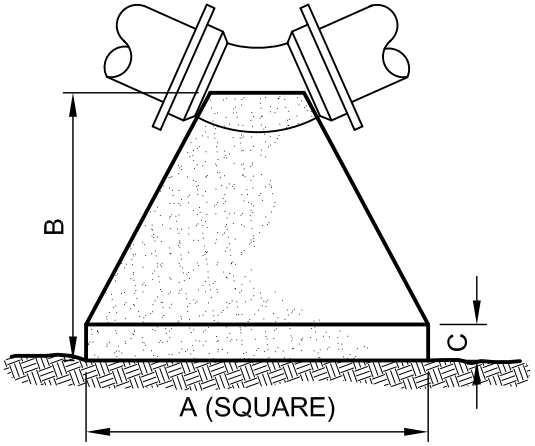
NOTE: POLYWRAP ALL FITTINGS











CONCRETE THRUST BLOCK

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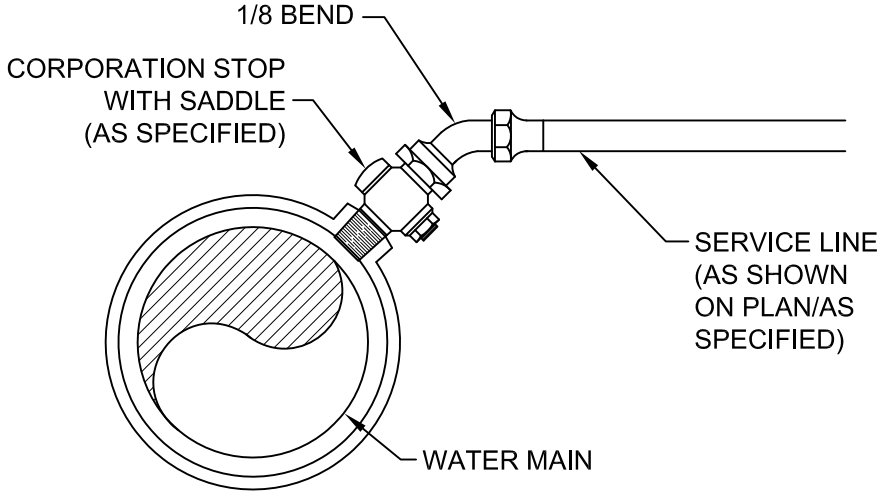

CORPORATION STOP AND SADDLE

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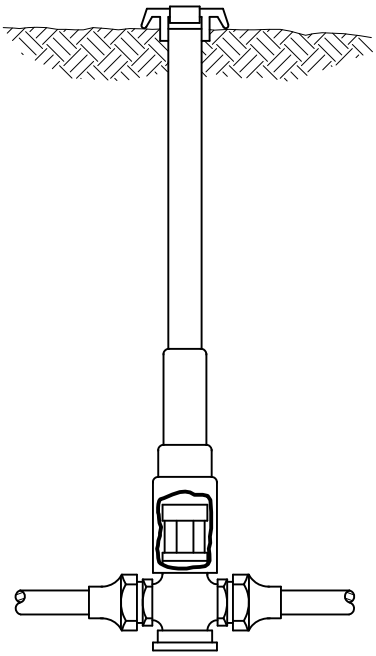


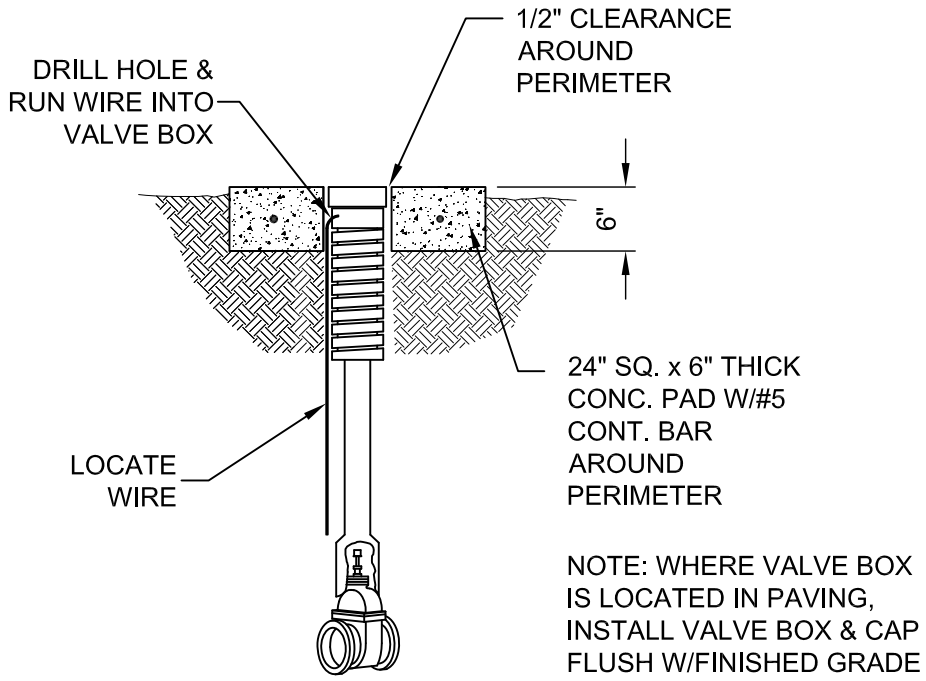
(AS SPECIFIED)

CURB STOP AND BOX

SCALE: N.T.S.

WATER LINE CURB STOP AND BOX 032B

MODIFIED: 9/29/2009

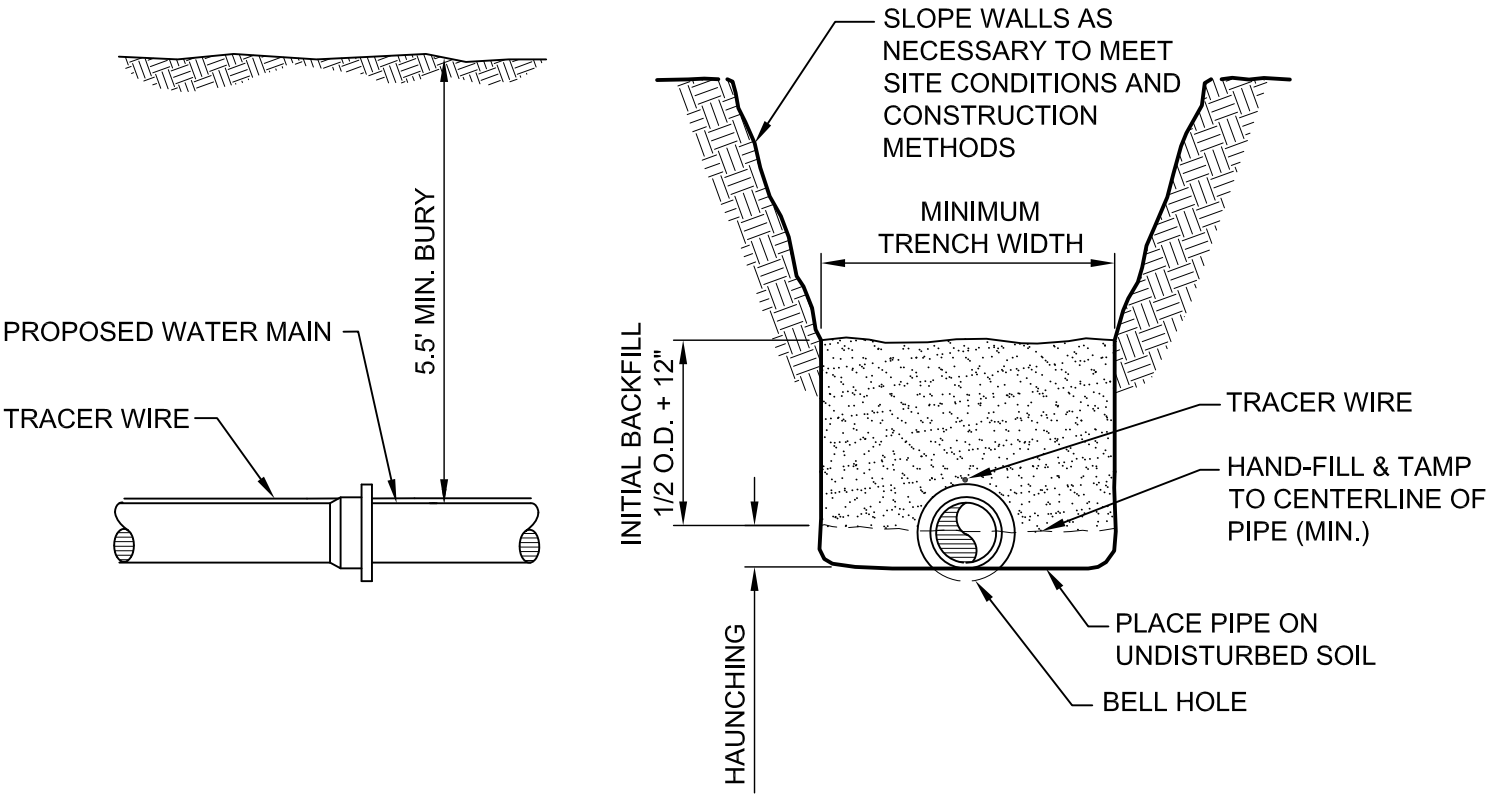


GATE VALVE & BOX

SCALE: N.T.S.

WATER LINE GATE VALVE AND BOX 032C

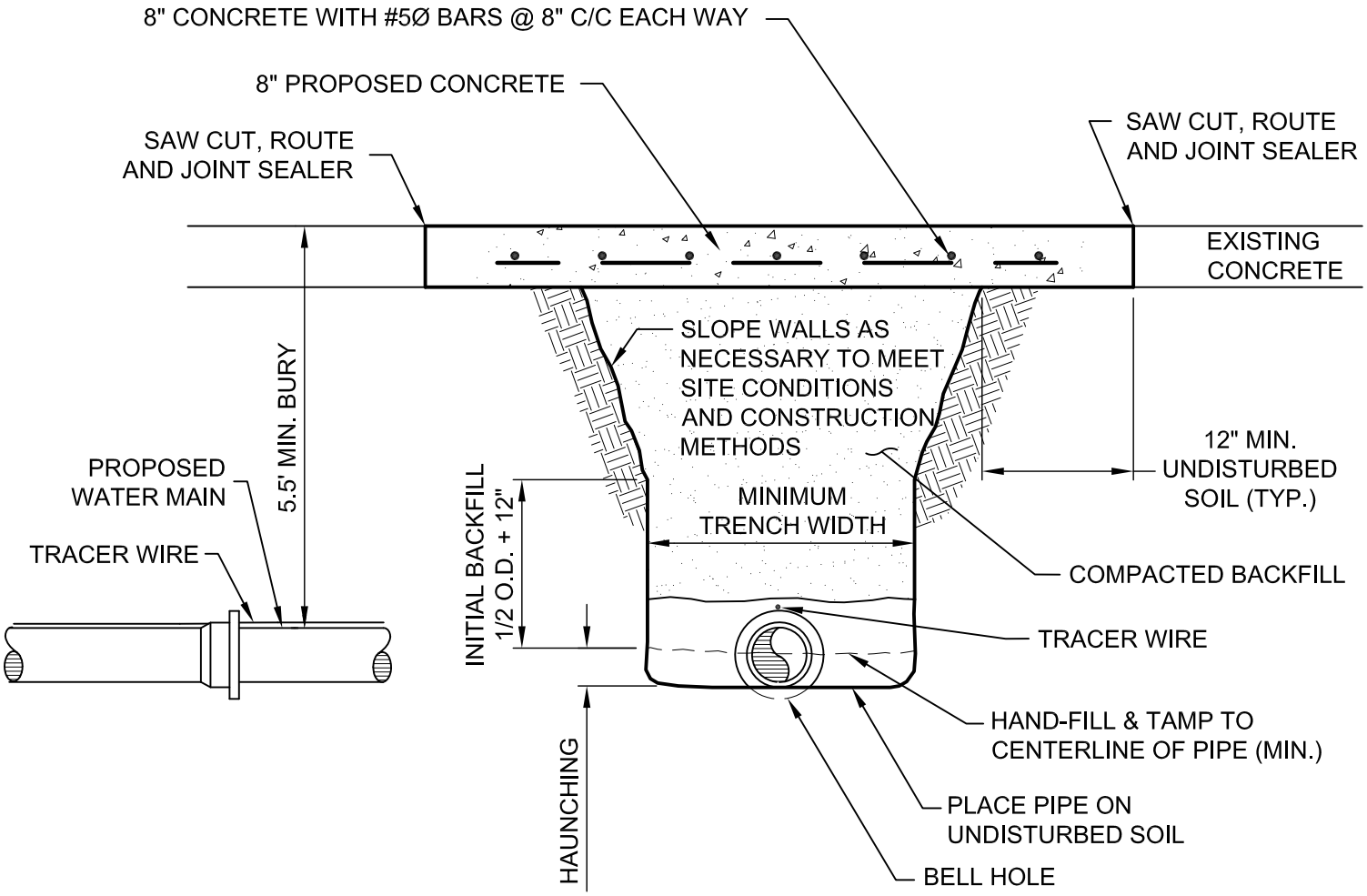
MODIFIED: 10/14/2010



PIPE SIZE	MIN. TRENCH WIDTH
4"	18"
6"	18"
8"	24"
10"	26"
12"	30"
15"	30"
18"	32"

WATER MAIN TRENCH

SCALE: N.T.S.



PIPE SIZE	MIN. TRENCH WIDTH
4"	18"
6"	18"
8"	24"
10"	26"
12"	30"
15"	30"
18"	32"

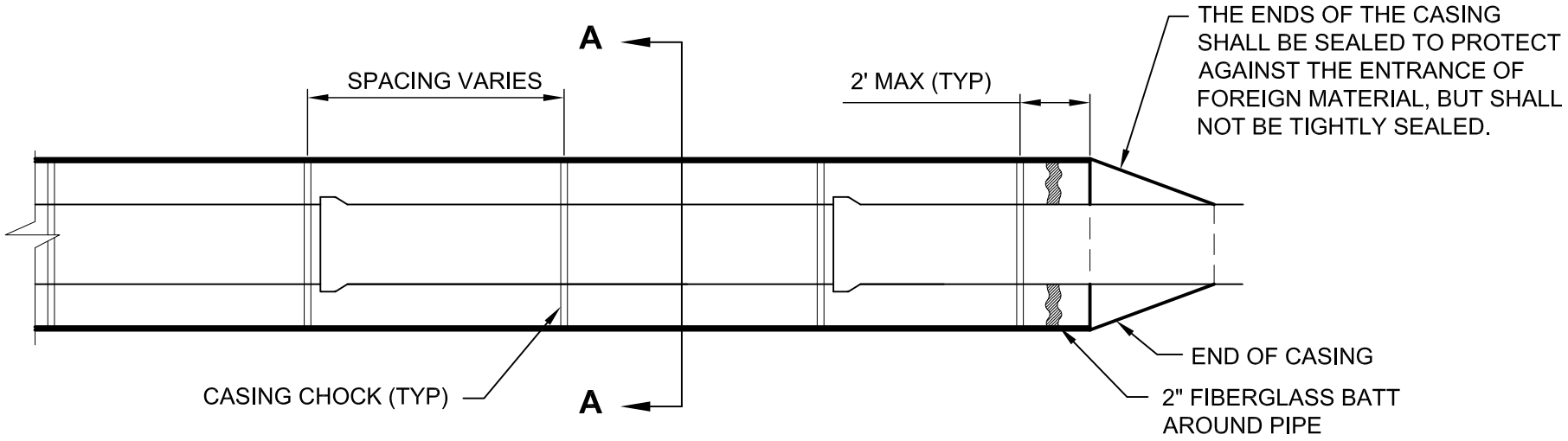
WATER MAIN TRENCH - CONCRETE PAVEMENT

Sheet

SCALE: N.T.S.

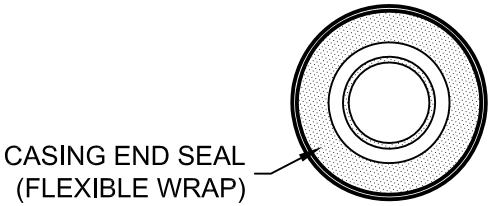
WATER MAIN TRENCH - CONCRETE PAVEMENT 034C

MODIFIED: 9/29/2009

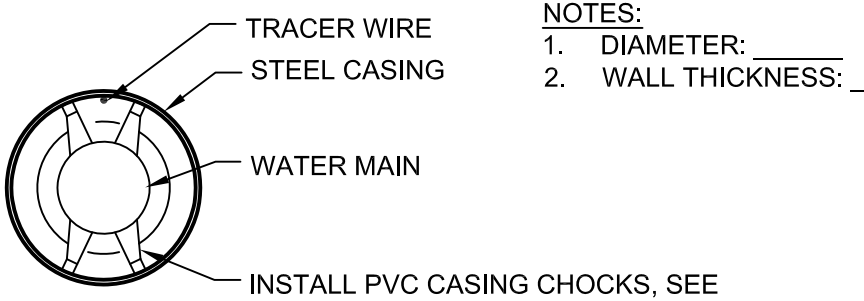


DETAIL 'A' (TYPICAL)

NOTES:
1. DIAMETER: _____
2. WALL THICKNESS: _____



END VIEW

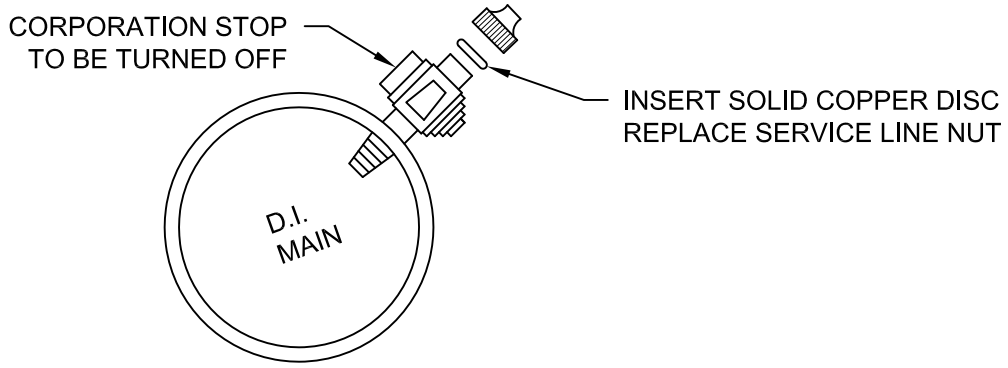


SECTION A-A (TYPICAL)

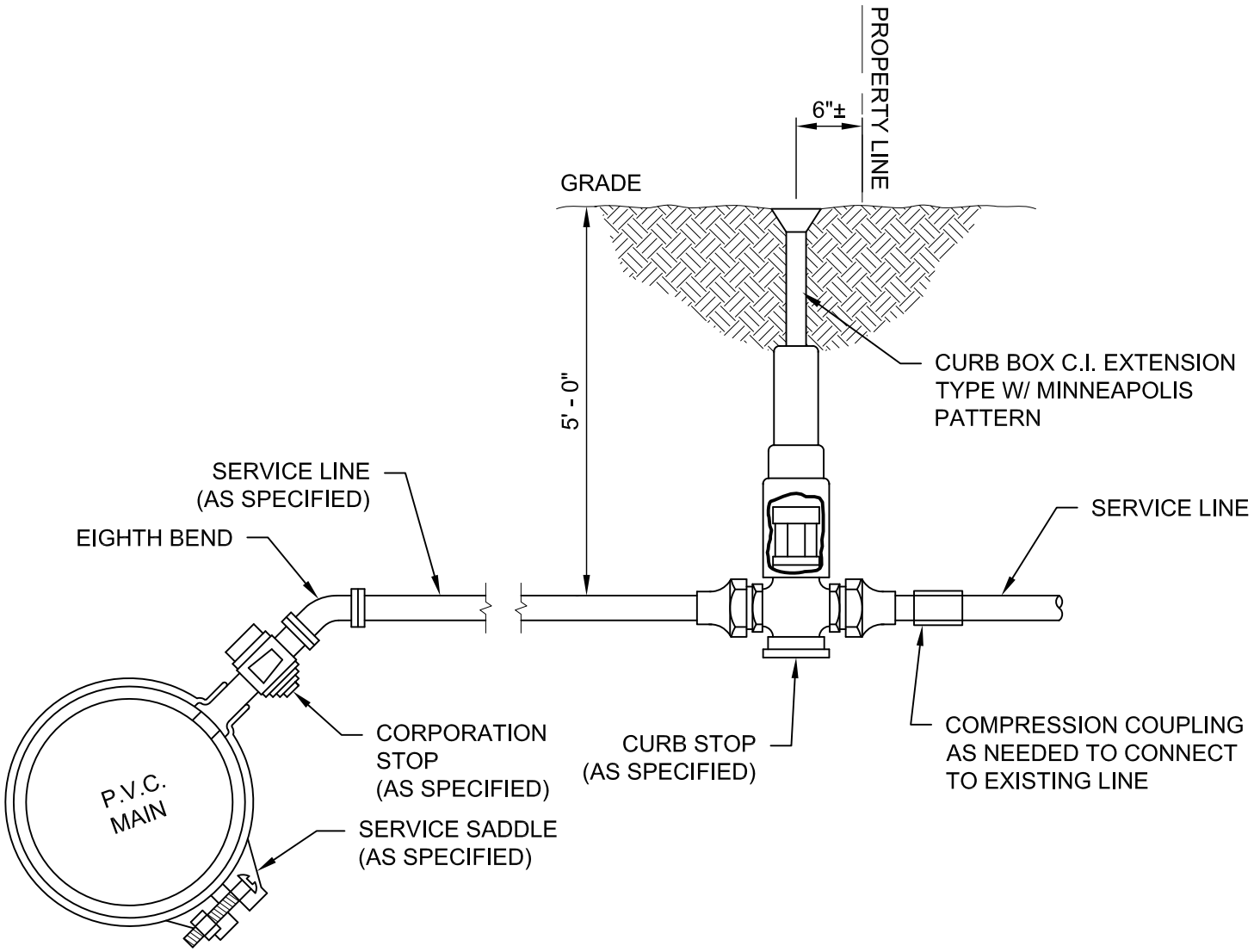
STEEL CASING

037

MODIFIED: 8/26/2009



TYPICAL ABANDONMENT OF EXISTING
CORPORATION STOP



WATER SERVICE INSTALLATION

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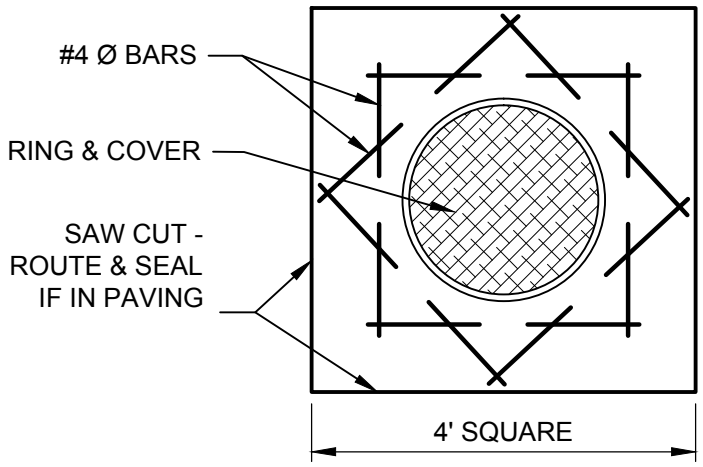
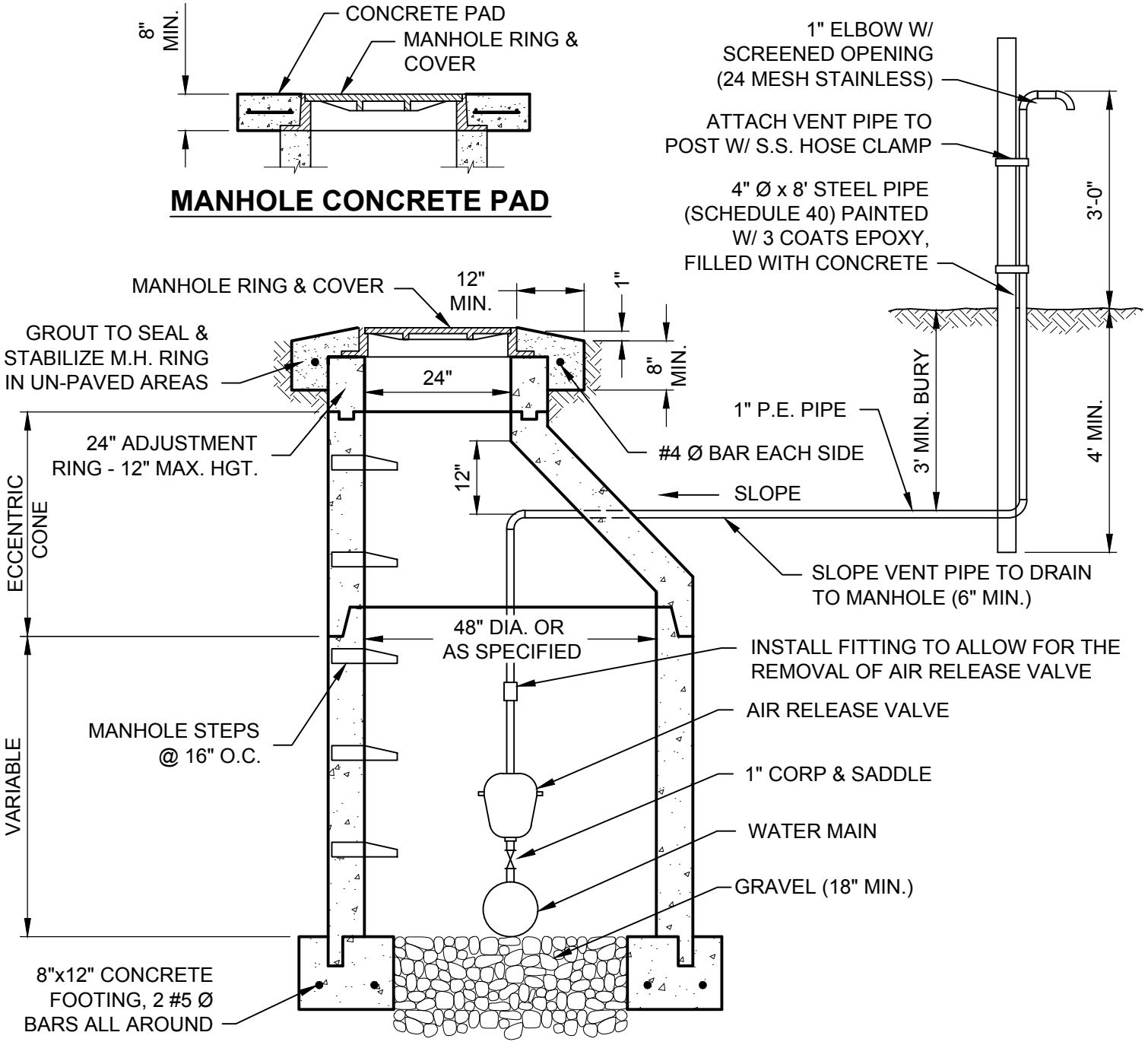


NOTES:

1. MANHOLE (PRECAST) REINFORCEMENT SHALL MEET A.S.T.M. C-478 REQUIREMENTS
2. MANHOLE JOINTS & LIFT HOLES SHALL BE SEALED WITH PORTLAND CEMENT MORTAR OR APPROVED EQUAL
3. MANHOLE STEPS SHALL BE ALUMINUM OR COATED STEEL STEPS MEETING O.S.H.A. REQUIREMENTS.
4. MANHOLE RING & COVER SHALL BE HEAVY DUTY, 450 LB MIN. MACHINED WITH LIFT HOLE.

MANHOLE CONCRETE PAD



WATER AIR RELEASE MANHOLE 044

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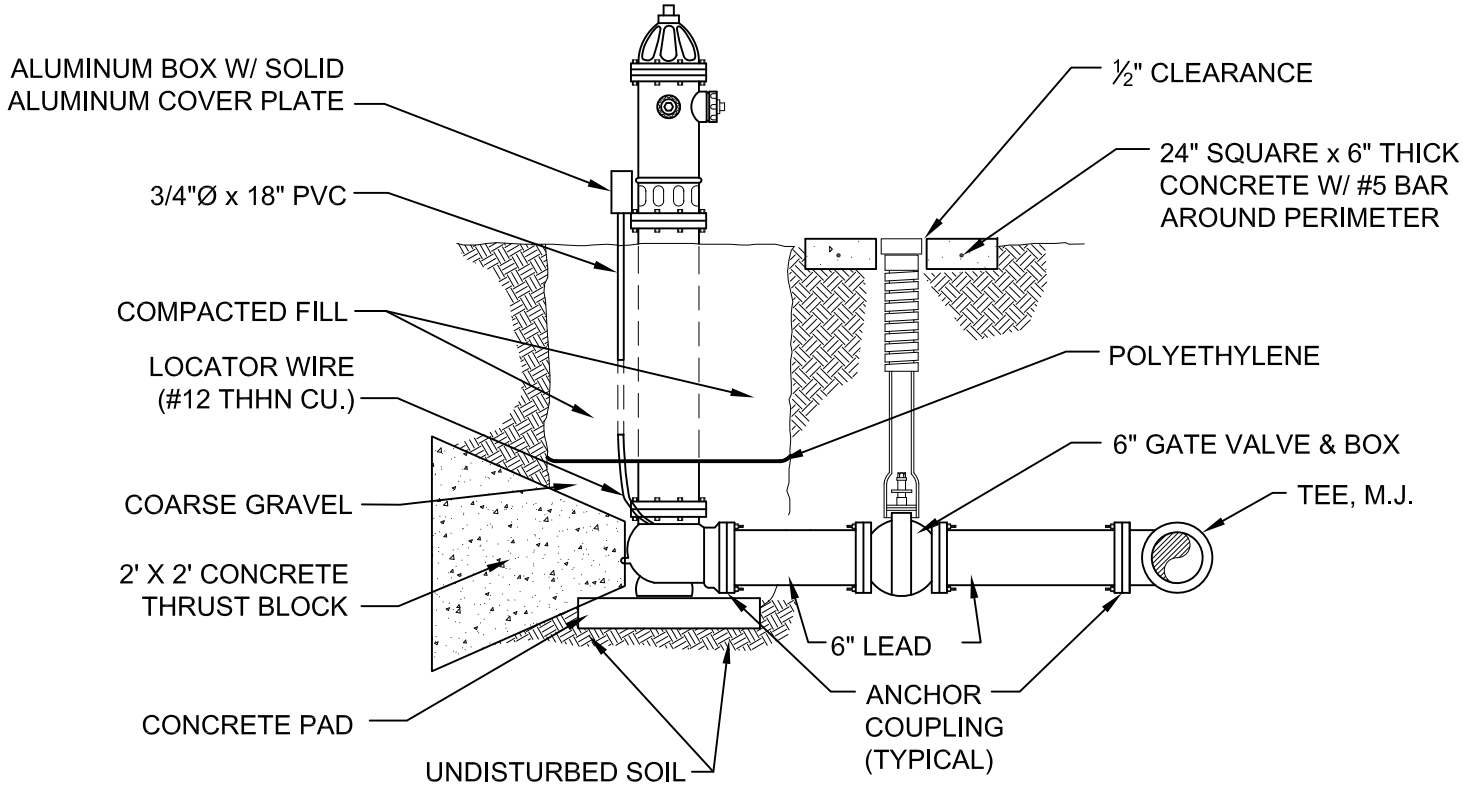

NOTES:

1. HYDRANT ASSEMBLY TO INCLUDE RETAINER GLANDS, PIPING AND GATE VALVE.
2. ALL FITTINGS TO BE MECHANICAL JOINT, WITH RETAINER GLANDS
3. THRUST RODS AND APPURTENANCES SHALL BE STAINLESS STEEL OR CORTEN STEEL

/ Sheet

FIRE HYDRANT ASSEMBLY

SCALE: N.T.S.