MATERIAL AND CONSTRUCTION STANDARDS

MAY 2019

WATER DISTRICT NO. 7
JOHNSON COUNTY, KANSAS
534 W. MAIN ST • PO BOX 7
GARDNER, KS 66030
O: 913.856.7375 F: 913.856.7173
WWW.WATER7.COM

WATER DISTRICT NO. 7
JOHNSON COUNTY, KANSAS
534 W. Main · P.O. Box 7 · Gardner, KS 66030-0007
O: 913.856.7375 · F: 913.856.7173 · www.water7.com

MATERIAL AND CONSTRUCTION STANDARDS

May 2019

019-216114.2

Set No. ☐

WATER DISTRICT NO. 7
JOHNSON COUNTY, KANSAS

MATERIAL AND CONSTRUCTION STANDARDS

May 2019

TABLE OF CONTENTS

APPENDIX

Separation of Water Mains and Sewers, Division of Environment

Separation of Water Mains and Other Pollution Sources, Division of Environment

Water Main Disinfection Procedures, Division of Environment

STANDARD DETAILS

Title	Sheet Number
END-OF-LINE CLEANOUT DETAILS	CO-1
BRANCH CLEANOUT DETAILS	CO-2
2" CUL-DE-SAC CLEANOUT	CO-3
FIRE HYDRANT DETAIL - ELEVATION	FH-1
FIRE HYDRANT DETAIL- PLANS	FH-2
GATE VALVE DETAILS	GV-1
MARKING POST DETAIL	MP-1
PIPE ENCASEMENT DETAILS	PE-1
ROAD CROSSING DETAILS	RC-1
STRADDLE BLOCK DETAILS	SB-1
SERVICE CONNECTION DETAILS	SC-1
SERVICE RECONNECTION DETAIL	SC-2
THRUST BLOCK DETAILS	TB-1
TRENCH DETAILS	TD-1
GRAVEL ROAD & DRIVE CROSSING TRENCH DETAIL	TD-2
TRACER WIRE DETAIL	TW-1

TYPICAL VAULT DETAILS FOR LARGE METERS AND BACKFLOW PREVENTERS

(General arrangement and requirements subject to review and approval per job specific conditions)

METER VAULT – 3", 4" AND 6"

METER VAULT – 8" AND 10"

DOUBLE CHECK DETECTOR CHECK VALVE VAULT – 3", 4" & 6"

DOUBLE CHECK DETECTOR CHECK VALVE VAULT – 8" & 10"

This page intentionally left blank.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01 00 00 - GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. WORK UNDER THESE CONTRACT DOCUMENTS: The work to be done under these Contract Documents is described as follows:

TO BE COMPLETED PER JOB SPECIFIC REQUIREMENTS

B. CONSTRUCTION SEQUENCE: The work will be completed in the following sequential order unless otherwise approved by the Owner:

TO BE COMPLETED PER JOB SPECIFIC REQUIREMENTS

C. LEGAL ADDRESS OF OWNER: The legal address of the Owner is Water District No. 7, 534 West Main, P.O. Box 7, Gardner, KS 66030-0007, telephone number 913/856-7375.

D. PROJECT AND CONTRACT LIMITS: The limits for this project are generally defined as the work shown on the drawings and described by the specifications, including connections to the existing water distribution system.

E. DRAWINGS: Drawings that form a part of these documents for contract are as listed in the List of Drawings.

F. WORKING HOURS: All work shall be done during the day between the hours of 7:00 a.m. and 8:00 p.m. No work shall be done on Saturdays, Sundays, or Holidays. Any deviation from the schedule above must be approved by the Owner.

G. RIGHTS-OF-WAY AND EASEMENTS: The necessary property and rights-of-way and permanent and temporary easements for the construction will be provided by the Owner on District projects and by the Property Owner/Developer on private projects. The limits of the Owner's property and easements will be marked by the Owner or Property Owner/Developer as appropriate.

The Contractor shall be responsible for all damage to crops and other property outside of such limits and shall make satisfactory settlement for the damage directly with the property owner and tenant involved, as their interests may require.

If it is necessary or desirable that the Contractor use or occupy land outside of the Owner's property, the Contractor shall obtain consent from, and shall execute a written agreement with, the property owner and tenant of the land and shall provide a copy of the agreement to the Owner. Each property owner and tenant of land or other property so occupied shall be notified by the Contractor not less than 5 days prior to such occupation.

H. PERMITS: Permits for construction in and crossing of right-of-ways for highway, county, and city roads and railroad right-of-ways will be obtained from the governing agency by the Owner. The Contractor will be required to comply with the requirements of the permit and provide insurance as required by the governing agency of the right-of-way.

I. WATERLINE AND SANITARY SEWER SEPARATION: The crossing and paralleling of water lines and sewer lines shall be in accordance with the latest revision of the Kansas Department of Health and Environment regulations appended to this document, entitled as follows:

Separation of Water Mains and Sewers
Separation of Water Mains and Other Pollution Sources

J. CLEAN-UP: The Contractor shall replace all surface material and shall restore paving, curbing, shrubbery, fences, sod, and other surfaces disturbed to a condition equal to that before the work began, furnishing all material and labor incidental thereto.

The shape of road shoulders, ditches, backslopes, and fields in road right-of-ways and easements shall be restored as much as possible to their original condition.

All excess excavated material shall be removed and disposed of by the Contractor. Any deficiency in the quantity of material for backfilling or for filling depressions caused by settlement shall be supplied by the Contractor.

Surplus materials, tools, and temporary structures shall be removed by the Contractor; all dirt, rubbish, and excess earth from excavations shall be hauled to a dump provided by the Contractor, and the construction site shall be left clean to the satisfaction of the Owner. Clean-up shall be done on a regular schedule, keeping pace with construction progress.

K. CONSTRUCTION PROCEDURES: Filling, flushing and disinfection operations shall be coordinated with the District's Operation Staff for timing to reduce negative impact to water customers. These operations may be done in sections when approved or directed by the District. Locations for testing equipment and disinfectant insertion are as approved by the District or as shown on the drawings.

It is important that trench backfill and compaction operations must proceed with excavation and pipe laying operations on a day-to-day basis. Backfill must keep pace with excavation, and pipe laying and pipe end excavations must be suitably protected and barricaded overnight. At pipeline connection points, where livestock are not present, backfill may be left incomplete and stockpiles maintained until connection operations are made. Suitable barricades and protection shall be maintained where trench backfill is not at grade

L. CONNECTIONS WITH EXISTING WATERLINES: Where connections are made between new work and existing pipelines, such connections shall be made in a thorough and workmanlike manner, using proper specials and fittings to suit actual conditions encountered in each case. Each connection with an existing water line shall be made at a time and under conditions which will least interfere with water service to customers affected thereby and as authorized by the Owner. Suitable facilities shall be provided for proper dewatering, drainage, and disposal of all water removed from the dewatered lines and excavations, without damage to adjacent property.

At connections to the existing distribution system that require fittings, valves, or piping to be returned immediately to service, the Contractor shall follow disinfection procedures outlined in Section 33 13 02 of these specifications.

M. LABOR, MATERIALS AND EQUIPMENT: As a clarification to the requirements of General Conditions Section 6.03, the following paragraph shall be added:

The Owner will furnish the necessary water for testing and sterilization of the water main at no cost to the Contractor. If water is required for retesting or re-sterilization, the Contractor shall reimburse the Owner for such, in accordance with the existing water rate schedule.

N. DISINFECTION: Disinfection of water mains shall be in accordance with requirements as herein stated in Section 33 13 02, and Kansas Department of Health and Environment regulation entitled "Water Main Disinfection Procedures", appended to this document. In the case of disagreement, the more stringent of the two shall govern.

O. SALVAGE MATERIAL: All usable salvaged items, including fittings, fire hydrants, valves, provided for temporary uses shall be field-cleaned and transported by the Contractor to the Owner's store-yard and shall remain the property of the Owner.

P. FENCES: Fences shall not be cut unless authorized by the Property Owner. The Contractor must make provisions in his operations to observe this condition and prevent any damage to the fences.

Fences authorized to be cut shall be maintained by the Contractor until the completion of the work affected thereby, unless written permission is obtained from the owner thereof to leave an interfering fence dismantled for an agreed period of time. Where fences must be maintained across the right-of-way, adequate gates shall be installed therein. Gates shall be kept closed and locked at all times when not in use.

On completion of the work across any tract of land, the Contractor shall restore all fences to their original or to a better condition and quality, purchasing new material to replace all materials lost, damaged, or destroyed. Temporary gates installed by the Contractor in any fence line may be left in place with the permission of the owner and tenant of the property

1.02 PRICE AND PAYMENT PROCEDURES

A. MEASUREMENT AND PAYMENT:

TO BE COMPLETED PER JOB SPECIFIC REQUIREMENTS

1.03 ADMINISTRATIVE PROCEDURES

A. SCHEDULE OF OPERATIONS: As stated in item 2.05 of the General Conditions, the Contractor shall prepare a detailed schedule of all construction operations that shall not only indicate the sequence of work, but also the expected time of starting and completion of each part.

If conditions beyond the control of the Contractor justify, and the Owner approves a deviation from the above expected time, the Contractor shall service the construction schedule in accordance with the approved change. The Owner may require the Contractor to add to his construction forces as well as increase the working hours if operations fall behind the approved schedule to an extent that the completion of the work within the specified time appears doubtful.

B. SUBMITTAL PROCEDURES: The Contractor shall review the material specifications in the Project Manual and provide the requested submittal information as required in each section. The Contractor shall review the submittal information being provided to assure it complies with the requirements of the drawings and specifications.

Certification: The Contractor shall sign a certification statement on all submittals certifying that review, verification of products required, field dimensions, and coordination of information is in accordance with the requirements of the Contract Documents and meets the intent of the drawings and specifications.

Submittal Annotation: All submittals shall be annotated (marked-up) to clearly show what materials are being provided. Annotations shall include model number and type, materials of construction, sizes, color (where specified), operating direction (where specified), applicable reference specifications, etc. The Contractor shall review the submittals to assure that the applicable requirements included in each specification sections are clearly and completely noted on the submittal. Submittals that have not been properly annotated will be returned.

Submittal Numbering: Sequentially number each separate submittal. Resubmittals to have original number with the revision number (i.e. Original Number 1.0, First Revision 1.1 etc.).

Cover Sheet: Each submittal shall include an attached cover sheet similar to the “Contractor’s Submittal Cover Sheet” included at the end of this section. The cover sheet shall at a minimum include the following information to clearly and uniformly identify the items included in the submittal:

a. Submittal Number, Revision Number (first submittals to have revision number zero)
b. Submission Date
c. Project Information
d. Contractor’s Information
e. Descriptive name of submittal information and applicable specification number and/or drawing number.
f. Contractor’s Certification Statement (signature and date)
g. Location for Engineer’s review stamp.

Submission Requirements: Submit all submittals via email with the Contract Name, “Submittals”, Submittal Number and Name in the subject line. All submittals shall be in portable document format (PDF). Where documents are scanned, all text shall be clearly readable and no information blurred/pixilated. Any non-readable text, blurred/pixilated information on a submittal will cause it to be rejected.

Engineer’s Review: Upon receipt of submittals and shop drawings, the Engineer will review them and mark them as either (1) “No Exceptions Noted”, (2) “Exceptions Noted – No Re-submittal Necessary”, (3) “Exception Noted – Revise and Resubmit”, or (4) “Not Acceptable”. The Engineer will return marked up PDF copies of all submittals via email. Submittals returned with review disposition (3) or (4) shall be revised by the Contractor and resubmitted to the Engineer. The Engineer shall review the initial submittal and the first revision without charge to the Contractor. For all subsequent resubmissions, the Contractor may be charged for the Engineer’s additional time and expenses per the Engineer’s current rate schedule.

Record Copies: The Contractor will provide the Owner with two (2) paper copies of all approved submittals. The paper copies shall be printed in color to match the approved PDF version and

also be bound together to match the PDF version. The paper copies shall be submitted to the Engineer for review and submission to the Owner.

C. PROJECT PHOTOGRAPHS: Photographs of the construction work will be taken before, during and upon completion of construction. Such photographs shall be taken at the direction of the Owner. Contractor shall provide a digital camera, minimum 2.0 mega pixel, and all required compact discs for storage of all images. Owner and Engineer will be provided with electronic files of all photographs. Videos in lieu of photographs are acceptable to the Owner.

D. PROTECTION AND MAINTENANCE OF PROPERTY: The Contractor shall protect and maintain all public and/or private property above or below ground, uncovered or otherwise affected by the construction work performed by him.

E. UTILITIES: The Contractor shall comply with the regulations and policies of the various utilities that he encounters in the prosecution of the work.

F. BASELINES AND BENCHMARKS: The Contractor shall furnish competent personnel to observe the Engineer in the establishment of base lines, bench marks, and other basic reference media needed to control the location and elevation of work under this contract as determined by the Engineer. Thereafter, the Contractor shall carefully preserve such vertical and horizontal control and shall make and be responsible for all measurements from it to the work to be done.

G. PIPELINE AND UTILITY CROSSINGS: It is the Contractor's obligation to contact the owner of any pipeline or utility facilities and schedule the paralleling or crossing construction in cooperation with owner of such facilities. Crossings shall be made to the satisfaction of the pipeline or utility company and the Owner.

1.04 QUALITY REQUIREMENTS

A. CORRECTION PERIOD: If within two years after the date of Substantial Completion any Work is found to be defective or if the repair of any damages to the land ore areas made available for Contractor’s use is found to be defective, Contractor shall promptly, without cost to the Owner and in accordance with Owner’s written instructions:
   1. Repair such defective land or areas; or
   2. Correct such defective Work; or
   3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
   4. satisfactorily correct or repair or remove and replace any damage to the Work, to the Work of others or other land or areas resulting therefrom.

B. RESPONSIBILITY OF CONTRACTOR FOR BACKFILL: The Contractor shall be responsible, financially and otherwise, for (a) all settlement of trench and other backfill which may occur two (2) years from the time of final payment for the entire contract under which the backfilling work was performed, (b) the refilling and repair of all backfill settlement, top surfacings, driveways, surface structures, and utilities, which have been damaged as a result of backfill settlement, or which have been removed or destroyed in connection with backfill replacement operations, and (c) all damage claims or court actions against the Owner for any damage directly or indirectly caused by backfill settlement.

   The Contractor shall make, or cause to be made, all necessary backfill replacements, or repairs or replacements appurtenant thereto, within thirty days, except as stated elsewhere, after due notification by the Engineer or Owner.

1.05 TEMPORARY FACILITIES AND CONTROLS

A. TEMPORARY UTILITIES: The Contractor shall provide their own temporary utilities as required for its operations including: electricity, natural gas, water (other than that used for filling, flushing and testing of completed piping), wastewater and communications.

B. CONSTRUCTION FACILITIES: The Contractor shall provide temporary office and sanitary facilities as follows:

   a. An on-site construction office near the area of the work may be used as a base of operations but is not required.
   b. Provide portable sanitation facilities for use by its workers as required by local governing authorities and agencies.

C. TEMPORARY CONSTRUCTION: The Contractor shall provide all temporary piping, fittings, hoses and other items as required to complete flushing operations of completed water mains.

D. VEHICULAR ACCESS AND PARKING:

Traffic Control: Traffic control regulations of the appropriate City, County or State jurisdiction must be practiced during construction operations in public right-of-way.

Maintenance of Traffic: The Contractor shall conduct his work so as to interfere as little as possible with public travel, whether vehicular or pedestrian, and shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel. Owners of private drives shall be given reasonable notice by the Contractor of the date and extent of construction time involved before initiation of construction which would interfere with normal passage of public or private travel.

In making open cut street and commercial drive crossings, the Contractor shall not block more than one-half of the street or drive at a time. Whenever possible, the Contractor shall widen the shoulder on the opposite side to facilitate traffic flow. Temporary surfacing shall be provided as necessary on shoulders.

Parking: The Contractor shall provide off-street parking for its employees or may utilize on-street parking as permitted provided the vehicles do not restrict access and usage of adjacent properties.

E. TEMPORARY BARRIERS:

Streets and Roads: All streets, roads, entrances or other public thoroughfares which are closed to traffic shall be protected by means of effective barricades on which shall be placed acceptable warning signs. Barricades shall also be located at the nearest intersecting public highway or street on each side of the blocked section.

Trenching: All open trenches and other excavation shall be provided with suitable barriers, signs, and lights to the extent that adequate protection is provided to the public. Obstructions, such as material piles and equipment, shall be provided with similar warning signs and lights. All barricades and obstructions shall be illuminated by means of warning lights at night. All lights used for this purpose shall be kept burning from sunset to sunrise. Materials stored upon or

alongside public streets and highways shall be so placed, and the work at all times shall be so conducted, as to cause the minimum obstruction and inconvenience to the traveling public.

All barricades and light expense will be paid by the Contractor.

F. TEMPORARY CONTROLS: The Contractor shall provide erosion and sediment controls as needed around excavated areas. As directed by the Owner, any sediment eroded from excavation sites shall be cleaned up and removed by the Contractor.

1.06 PRODUCT REQUIREMENTS

A. COMMON PRODUCT REQUIREMENTS: All materials used for construction shall be new and unused. Like materials shall be from the same manufacturer and be the same model or type unless approved otherwise by the Owner.

B. PRODUCT DELIVERY REQUIREMENTS: The Contractor shall be responsible for accepting delivery of all materials to the project. The materials may be stored along the project at locations with adequate room and where they do not impose a risk to adjacent properties or the public. Otherwise materials will be stored at suitable and secure offsite locations until needed.

1.07 EXECUTION AND CLOSEOUT REQUIREMENTS

A. EXAMINATION AND PREPARATION:

Mobilization: The Contractor shall mobilize all machinery, equipment and materials to the project sites as required to complete the work in an efficient and expeditious manner. The Contractor shall provide their own storage sites as needed for this work.

Protection of Adjacent Construction: The Contractor shall protect all adjacent existing construction and facilities during their work on this project. Any damage caused to adjacent construction and facilities by the Contractor's work shall be repaired to prior or better condition by the Contractor.

B. EXECUTION

Installation: Water mains shall be installed in a linear progression from the start of a section to its end. Work on another section shall not be initiated until the previous section is at an acceptable stage of completion. As approved by the Owner, work on subsequent sections may be started provided adequate workmen are assigned to the work to allow work on any started sections to progress in an efficient and expeditious manner.

Cutting and Patching: The Contractor shall cut out and remove sections of street pavement, curb and gutter, sidewalks and other items shown on the drawings as required to complete installation of the new water mains. All such areas where existing improvements have been removed shall be restored per the notes and details shown on the drawings.

C. CLEANING AND WASTE MANAGEMENT

Progress Cleanup: The Contractor shall regularly remove all excess excavation materials, street pavement, sidewalk, etc. from the work areas and dispose at an acceptable location. The work areas shall be kept in a neat and orderly fashion to protect the public and not hinder the use of

adjacent properties. Excavated areas shall be backfilled and graded to provide a reasonably smooth ground surface.

Final Cleanup: When all work on a section of water main has been completed, street pavement, curb and gutter, sidewalks and any other disturbed surfaces shall be restored to their original of better condition. All other non-paved ground that has been disturbed by the construction shall also be restored.

D. STARTUP PROCEDURES: When a section of water main has been completed, the Contractor shall coordinate with the Owner to schedule initiation of flushing of the water main. The Contractor shall complete flushing, pressure testing and disinfection of the completed section of water main. Once a section has passed the disinfection testing, the Contractor can start transferring of services to the new main. The Contractor shall provide a minimum of 24-hours' notice to affected water service users prior to transferring a service.

Once all service connections on a section of existing water main have been transferred, the Contractor shall schedule and coordinate with the Owner work to disconnect the retired section of water main from the distribution system.

E. PROTECTING INSTALLED CONSTRUCTION: The Contractor shall protect all completed new work and be responsible for any damage caused by the Contractor's subsequent work.

F. CLOSEOUT PROCEDURES:

Final Inspection: When all work is completed, the Contractor shall schedule a walk-through inspection with the Owner. The Owner will prepare a list of any deficiencies that need to be addressed and provide it to the Contractor. Once all items on the list have been satisfactorily addressed the Contractor can submit an application for final payment.

G. CLOSEOUT SUBMITTALS

Certifications: Upon completion of all work, the Contractor shall submit to the Owner any required certifications as listed in the contract documents.

Project Record Drawings: Upon completion of all work, the Contractor shall provide the Owner with a complete set of plans on which the Contractor has noted any and all deviations and changes from the original plans.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

Copy Distribution (by Engineer)
- ☐ Engineer
- ☐ Owner
- ☐ RPR
- ☐ Contractor
- ☐ _____

CONTRACTOR'S SUBMITTAL COVER SHEET

Submittal No. _____

Revision No. _____

Submittal Date: _____

Project: _____

Owner: RWD No. 7, Johnson County, Kansas

Project No.: _____

Project Engr: _____ Contractor: _____

_____

_____

Phone: _____

SUBMITTAL DESCRIPTION: _____

_____

References: Specification Section: _____ Drawing Sheet No. _____

Contractor Remarks: _____

_____

CONTRACTOR'S CERTIFICATION:

Check either of the following:

- ☐ We have verified that the material and/or equipment in this submittal meets all requirements specified or shown (no exceptions)
- ☐ We have verified that the material and/or equipment in this submittal meets all requirements specified or shown, except for the following deviations (*list deviations below or attach separate sheet):*

_____

_____

Signed: _____ Date: _____

Contractors Authorized Representative

FOR ENGINEER'S USE ONLY *(To be completed in red or blue ink only)*

Review Disposition:

- ☐ NO EXCEPTIONS NOTED
- ☐ EXCEPTIONS NOTED
  - ○ Revise & Resubmit
  - ○ No Resubmittal Necessary
- ☐ NOT ACCEPTABLE

Corrections or comments made relative to submittals during this review do not relieve the contractor from compliance with the requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractor is responsible for confirming and correlating all qualities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades; and performing his work in a safe and satisfactory manner.

Remarks: _____

_____

Engineer: _____ Date: _____

This page intentionally left blank.

DIVISION 03 - CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1. Work included but not necessarily limited to furnishing and placing of all cast-in-place concrete work for pipeline construction, and miscellaneous uses where applicable.

2. Quality assurance.
   a. Applicable Standards – Latest Revision:
      (1) American Society for Testing and Materials (ASTM):
         (a) ASTM C31/C31M - Practice For Making and Curing Concrete Test Specimens in the Field.
         (b) ASTM C33 - Specification for Concrete Aggregates.
         (c) ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
         (d) ASTM C94 - Specification for Ready-Mixed Concrete.
         (e) ASTM C143/143M - Test Method for Slump of Hydraulic Cement Concrete.
         (f) ASTM C150 - Specification for Portland Cement.
         (g) ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.
      (2) American Concrete Institute:
         (a) ACI 301 - Specification For Structural Concrete For Buildings.
         (b) ACI 318 - Building Code Requirements For Reinforced Concrete.

3. Materials and installation shall meet requirements of ACI 301, "Specifications for Structural Concrete for Buildings". In case of conflicts between this section and ACI 301, this section shall govern.

4. All concrete shall be Class A except as otherwise noted on drawings or specifications.

5. Provide submittal information per Section 01 00 00.

PART 2 – PRODUCTS

1. Portland Cement.
   a. Gray: ASTM C 150, Type I.

2. Aggregate.
   a. Fine: ASTM C33 natural sand.
   b. Coarse: ASTM C33 1" maximum size.
   c. All aggregate clean, well graded.

3. Granular fill: ASTM C33, clean, well graded, crushed limestone or equal (¾-inch maximum size).

4. Water: Fresh, clean, potable.

5. Air entraining admixture: ASTM C260.

a. Euclid Chemical – “EUCON AEA-92”
b. GCP Applied Technologies (Grace) – “Daravair® 1400”
c. Master Builders (BASF) – “MasterAir® AE 90”
d. Approved equal.

6. Vapor barrier.
   a. 6 mil visqueen.

PART 3 – EXECUTION

1. Mix design.
   a. The specified compressive strength (fc') of the concrete shall be designated in Table A below. Average concrete strengths of test cylinders shall exceed fc' in accordance with Chapter 4 of ACI Standard 318.

TABLE A

Design in strict compliance with following proportions and base on maximum slump. Unless otherwise indicated on drawings, all concrete shall be Class A.

Type of Construction:	Max w/c Ratio Gal per sack*	Min. Sacks of cement per yard*	Compression strength at 28 days (fc')
Class A Air-entrained concrete	5.5	6.0	4000 PSI
Class B Non-air-entrained concrete	8.0	4.8	2000 PSI

* These are maximum and minimum values and may not necessarily be used for mix design.

   b. Measurement of materials shall be by weights by apparatus conforming with the National Bureau of Standards "Specifications for Scales."
      (1) Aggregates and cement shall be measured within one (1) percent.
      (2) Water shall be measured within 1-1/2 percent. Measurement of water may be made by volume with a metering device approved by the Engineer.
   c. All concrete shall be normal weight.
   d. Provide air entraining admixture, 4-6% volumetric air content at placement. Use in strict accordance with manufacturer's instructions.
   e. All mixing shall be transit mixed.
   f. Slump 3" plus or minus 1".
   g. Admixtures may not be added to mix unless approved by Engineer.
   h. Ready-mixed concrete shall conform to ASTM C94, except for materials specified herein.

2. Placement
   a. Place no concrete until forms and reinforcing steel have been inspected and approved.
   b. Clean forms before placing concrete.
   c. Use placement procedures to avoid separation.

d. Place as near final position as possible.
e. Place using 4-foot maximum free fall. For greater drops, use tremie or other means approved by Engineer.
f. Place concrete between predetermined construction and/or expansion joints.
g. Place all concrete at a rate that will prevent initial set of in-place concrete before adjacent concrete is placed.
h. Vibrate with mechanical vibrators. Do not vibrate so as to cause segregation of aggregate. Vibrators shall be inserted and removed vertically (not dragged horizontally). In no case shall vibrators be used to transport concrete inside forms. Keep vibrators off sides of forms. One spare vibrator shall be maintained at the site at all times.
i. Do not place if temperature is 40 degrees and dropping, unless conforming to ACI recommendations as directed by the Engineer.
j. Do not place if frost is on forms or reinforcing.
k. Tool exposed joints and edges.
l. Place curbs and gutters shown.
m. Concrete that has attained its initial set or has contained its mixing water for more than 60 minutes shall not be placed in the work.
n. Do not place if temperature exceeds 90^{o} F, unless conforming to ACI recommendations. Placing of concrete will not be permitted when, in the opinion of the Engineer, the sun, heat, wind, or the limitation of the Contractor's facilities prevent proper placing, finishing and curing of the concrete.
o. Before placing new concrete on concrete that has set, the surfaces of set concrete shall be thoroughly roughened and cleaned of laitance, foreign matter, and loose particles.

3. Finishing, protection and curing.
   a. Protect concrete against frost and rapid drying.
   b. In freezing weather, provide means for maintaining concrete temperature above 70 degrees F for 3 days, or 50 degrees F for 5 days.
   c. Cure all slabs with moisture and approved membrane coverings.
   d. Method of form removal and safety involved is the direct responsibility of the Contractor. Form removal time is subject to Engineer's approval.
   e. Finishes.
      Expanded concrete shall be screeded, bull floated, floated, troweled and finished as specified below to provide a hard, durable, impervious surface.
      (1) Medium broom finish - Exterior.

4. Tests.
   a. Performed by an independent testing laboratory approved by Owner.
   b. Test cylinders shall be made and cured in accordance with ASTM C31, and tested in accordance with ASTM C39. A minimum of three cylinders required for following:
      (1) Each day's pour.
      (2) Each type of concrete.
   c. Test of 1 cylinder at 7 days; two at 28 days.
   d. Perform slump test according to ASTM C143 and include in report for each cylinder group.
   e. Provide 3 copies of test results.
   f. An air content test shall be made from one of the first three batches mixed each day and at any other time that verification is requested by Engineer. The Contractor shall provide all equipment and supplies necessary for testing.

END OF SECTION

This page intentionally left blank.

DIVISION 31 - EARTHWORK

SECTION 31 10 00

SITE PREPARATION

PART 1 – GENERAL

1. Work included but not necessarily limited to:
   a. Clearing.
   b. Trees and shrubbery removal.
2. Related Sections:
   a. 31 20 00 Earthwork
   b. 32 92 00 Lawns and grasses

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

1. Clearing.
   a. Satisfactorily dispose of the vegetation, together with brush and rubbish occurring within the area to be cleared.
   b. Conduct clearing operations so as to prevent damage outside the limits of construction and to provide for the safety of the employees and others.
   c. Remove and dispose of all stumps and roots larger than 3 inches in diameter and matted roots and other vegetation within the cleared areas.
   d. Dispose by either burning all branches, stumps, roots, brush and other vegetation within the site, if permitted by governing agencies, or removal from site, with each option subject to the Engineer's (Owner's) review before execution.

2. Trees and Shrubbery Removal.
   a. The drawings may show particular trees and shrubs as being preserved or protected. The Contractor shall exercise whatever means as necessary, including hand excavation and tunneling, to prevent disturbance to these plants and their root systems.
   b. Shrubs and trees within the permanent easement located in yards, fields or pastures for ornamental or crop purposes shall not be disturbed without consent of the property owner and notification of the Engineer or Owner. Where possible, the pipeline shall be located beyond large roots of those trees or shrubs. Isolated trees or shrubs in fields or pastures shall be protected from damage by selective location of pipeline as authorized by Engineer or Owner.
   c. Trees and shrubs outside of permanent easements shall not be removed, except where their removal is authorized by the property owner and the Engineer (Owner's) has been notified of such.
   d. Main tree roots, from trees outside the permanent easement, shall not be cut except where they fall within the area to be occupied by a pipe or structure. Hand excavations, tunneling or boring shall be done where necessary to prevent injury to trees.

e. Provide adequate protection, for trees and shrubs left standing, from permanent damage by construction operations within the construction easement. Trimming of standing trees where required shall be as authorized by the property owner. Replace trees and shrubbery damaged by the Contractor, or removed without authorization, to the satisfaction of the property owner thereof, by and the expense of the Contractor.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 – GENERAL

1. Work included by not necessarily limited to:
   a. Site grading.
   b. Slope protection and erosion control.
   c. Removal of water.
   d. Trenching, backfilling and compacting.

2. Related Sections:
   a. 31 10 00 Site Preparation.
   b. 32 92 00 Lawns and Grasses.
   c. 33 11 00 Pressure Piping.

3. Applicable Standards.
   a. American Society of Testing and Materials (ASTM) – Latest Revision
      (1) D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³).
      (2) D 1556 - Test Method for Density of Soil in Place by The Sand-Cone Method.
      (3) D 6938 - Test Methods for Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
   b. Kansas Department of Transportation (KDOT) – Latest Edition
      (1) Standard Specifications for State Road and Bridge Construction, (Standard Specifications).

4. General requirements.
   a. Perform excavation work in safe and proper manner with suitable precautions against hazards of every kind. Provide adequate working space and clearance for work performed therein.
   b. Except by written permission of the Engineer, allow no backfilling and construction of fills during freezing weather. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill, fill or embankments.
   c. Except for topsoil, no classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition or condition thereof.
   d. In cultivated and crop fields and yards the top 12 inches of topsoil shall be stripped and stockpiled for replacement in the top 12 inches of backfill. Contractor must exercise care to prevent mixing of topsoil with remainder of trench excavation.
   e. Blasting will not be permitted. Excavation of rock will be accomplished with a rock trencher (18-inch minimum trench width) or with an excavator-mounted hoe ram.
   f. Shown on the drawings are details of trenching, clearances, and pipe embedment. The character of such materials is found below.

PART 2 – PRODUCTS

1. Granular Bedding (trench).
   a. Consists of crushed stone or pea gravel with not less than 95% passing 3/4-inch sieve and not less than 95% retained on #8 sieve ("clean rock").
   b. Place in not more than 6-inch layer and compact by slicing with shovel, or place and manipulate with mechanical equipment to achieve uniform compaction results of not less than 95% maximum density at optimum moisture content, as determined by ASTM D2922 (using ASTM D698 as a compaction control test).

2. Compacted Bedding (trench).
   a. Consists of finely-divided, job-excavated material, free from debris, organic material, and stones.
   b. Compact to uniform density which will prevent displacement of the pipe during subsequent operations.

3. Compacted Backfill (trench).
   a. Consists of finely-divided material free of debris and organic material. May contain rubble and detritus from rock excavation at levels as specified in C.2.f.(4)(b).
   b. Place material in lifts with sufficient moisture content and mechanically tamp to 95% maximum density at optimum moisture content, as determined by ASTM D 1556 or ASTM D 2922 (using ASTM D 698 as a compaction control test).
   c. Tracks or wheels, such as provided by tractors, high-loaders or graders, will normally not be an acceptable means of compacting the backfill. Acceptability as determined by Engineer from results of compaction tests.

4. Wheel-Compacted Backfill (trench).
   a. Material to be free of brush, roots more than 2 inches in diameter, debris and junk. May contain rubble and detritus from rock excavation, stones and boulders at levels as specified in C.2.f.(4)(b).
   b. Place material and compact in lifts with wheel loading (not track) of excavation or backfilling equipment and leave 4" to 6" mound over trench when operations are complete. Compaction of lifts may also be achieved by sharp application of the bucket of a track-mounted backhoe.

5. AB-3 Aggregate Base Material.
   a. Consists of crushed limestone or dolomite material conforming with Section 1104 of KDOT Standard Specifications.
   b. Place in lifts that will compact to 6-inch maximum thickness.

PART 3 – EXECUTION

1. General.
   a. Site grading.
      (1) Upon completion of other outside work and backfilling and embankments, grade all areas on site of work to the specified elevations, slopes and contours.
      (2) Trim and dress by hand all slopes and other surfaces so effective drainage is secured.
      (3) Complete grading and surfacing to satisfaction of Engineer.

b. Slope protection and erosion control.
   (1) Provide adequate measures to insure protection from erosion by either wind or water.
      (a) Straw bales.
      (b) Silt fence.
      (c) Erosion control blankets.
      (d) Other acceptable methods.

c. Sheeting and bracing.
   (1) Use as necessary to:
      (a) Protect life and property.
      (b) Conform to Federal, State and local regulations.
      (c) Avoid excessively wide cuts in unstable material.

d. Removal of water.
   (1) Provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavation, trenches or other parts of work. Keep dry each excavation during subgrade preparation and continually thereafter until the pipeline to be installed is completed to the extent that no damage from hydrostatic pressure, flotation or other causes will result.
   (2) Dewater all excavations for trenches which extend down to or below the static groundwater elevations by lowering and maintaining the ground-water level beneath such excavations a distance suitable for successful prosecution of the work.
   (3) Divert or otherwise prevent surface water from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.
   (4) The Contractor will be held responsible for the condition of any pipeline or conduit which he may use for drainage purposes and all such pipes or conduits shall be left clean and free of sediment.

2. Pipeline trenching.
   a. Trench excavation.
      (1) The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. In the event that pipe laying is stopped for any cause, 100 feet shall be the maximum length of open trench permitted on any line under construction.
      (2) Open cut from the surface all trench excavation except where tunneling is required.
      (3) Excavate trenches to a width which will provide adequate working space and pipe clearance for proper pipe installation, jointing and embedment.
      (4) Limiting trench widths for water lines.
         (a) When trench is excavated by trenching machine leaving a uniform bottom surface, base the minimum trench width for PVC waterlines on a sidewall clearance of 2-1/2 inches each side plus pipe barrel outside diameter. It is expected that a uniform deposit of small crumbs will be left in the trench to serve as bedding material.
         (b) When trench is excavated by other machinery that does not leave finely-divided material, or the trench has unyielding material (rock, shale, boulders, etc.) within 6 inches of the pipe, the minimum trench width for PVC pipe shall be based on a sidewall clearance of 6 inches (each side) plus the pipe bell outside diameter.

(c) The minimum trench width at the top elevation of 16-inch and larger sizes of ductile iron pipe shall be that dimension shown on the trench detail in the drawings. A wider trench width may be required to ensure ½ of minimum width on each side of pipe centerline. Ductile iron pipe smaller than 16-inch size shall have the same minimum trench widths as PVC pipe.

(d) The stipulated minimum clearances are not minimum average clearances but are minimum clear distances which will be permitted between any part of the pipe as laid and any part, projection or point of rock, shale, stone or boulder.

(5) Where trench bottom materials do not allow uniform bearing for the entire pipe length or when unyielding material (rock, shale, boulders, etc.) is within 6 inches of trench bottom, carry the excavation to a depth sufficient to allow 6 inches minimum depth of bedding material to be placed under the pipe.

b. Mechanical excavation.

(1) The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, culverts, or other existing property, utilities or structures above or below ground; in such locations, hand excavating tools and methods shall be used.

(2) Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that the trench alignment is such that the pipe, when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the pipe and side walls of the trench. Undercutting of the trench wall to obtain clearance will not be permitted.

(3) All mechanical trench equipment, its operating condition and manner of its operation shall be subject to review of Engineer.

c. Stabilization.

(1) Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated.

(a) Shall be free from mud and muck.

(b) Shall be sufficiently stable to remain firm and intact under the feet of the workmen.

(2) Trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed stone or gravel embedded therein.

(a) Not more than 1/2-inch depth of muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

(b) All stabilization work hereunder shall be performed by and at the expense of the Contractor.

d. Artificial foundations in trenches.

(1) Where the trench bottom subgrade is of unsatisfactory material, excavate to such depth below grade as Engineer may direct, and trench bottom shall be brought to grade with such material as Engineer may order installed.

(2) All timber, concrete foundations, wooden invert pipes, posts, stringers, and/or saddles made necessary by quicksand or other treacherous soil shall be installed as directed by Engineer.

(3) Compensation for the extra excavation, timber, concrete or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for "changes in the work".

e. Pipe embedment.

(1) Provide bell holes for adequate clearance for tools and methods used in installing the pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or the granular fill when the pipe is jointed. Bell holes will not be required for push-on joint rubber gasketed PVC or ductile iron pipe.

(2) Accurately grade trench bottoms to provide uniform bearing and support for the pipe barrel between bell holes. When the trench bottom is of proper character, such as uncemented granular material or other natural bedding material, and uniform shaping can be executed, foreign bedding material will not be required except as stated elsewhere. When trench bottom materials will not allow uniform bearing for the entire length or unyielding material is within 6 inches of trench bottom, Earth or Granular Bedding material as specified herein and detailed on the Standard Details shall be placed under the pipe.

(3) After each joint of pipe has been graded, aligned, placed in final position on the bedding material, and shoved home, sufficient pipe bedding material shall be deposited and compacted under and around each side of pipe and back of the bell, or end thereof, to firmly hold and maintain the pipe in proper position and alignment during subsequent pipe jointing, embedment and backfilling operations. When unyielding material is present, the Granular Bedding shall extend to at least 4 inches above the pipe.

(4) Where wheel compacted trench backfill is used finely-divided backfill material shall be gradually spilled on the pipe and bedding material to a minimum cover depth of 6 inches. Trench backfill can then proceed in a careful manner to prevent displacement or damage of the pipe.

f. Trench backfilling and compacting.

(1) Where trenches are constructed in or across roadway ditches or other water courses, take suitable measures to control erosion. Compacted Backfill or stone, concrete or other suitable ditch checks may be used to stabilize grades and retain shapes and slopes.

(2) Conform backfill above pipe embedment to one of the construction methods (stated in PART 2 – PRODUCTS) which are specifically shown on the drawings.

(3) Provide backfill of compacted Granular Bedding material beneath roads, driveways, curbs, gutters, walks, or other surface construction or structures.

(a) Provide 12 inches of Compacted Backfill topping on the Granular Backfill of areas adjacent to the structures or earth road shoulders.

(4) Proceed with backfill materials in such a manner that no excessive load, shock or impact shall be imposed on installed pipe, thereby resulting in pipe damage or displacement.

(a) Compact masses of stiff mucky clay, or gumbo, or other consolidated material, or stone more than one cubic foot in volume shall not be permitted to fall more than 5 feet into the trench unless cushioned by at least 2 feet of loose backfill above the pipe.

(b) No trench backfill material containing rock or rock excavation detritus shall be placed in the upper 12 inches of the trench.

Hard rock or stone or boulder larger than 8 inches in its greatest dimension shall not be placed within 18 inches of the top of the pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill compaction or settlement will result. Additional backfilling may be necessary, at a later date, before paving or other surfacing is installed or completed.

g. Alignment, grade, and minimum cover.
   (1) Establish alignment and grade (or elevation) of each pipeline by offset stakes, or as otherwise stated for that type of pipe.
   (2) Vertical and horizontal alignment of pipe, and the maximum joint deflection shall be as specified in following sections.
   (3) Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum backfill cover depth of 42 inches over the top of the pipe.
   (4) Greater pipe cover depths may be necessary at fire hydrant or valve locations, on vertical curves, or in providing necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other constructions encountered at normal pipe grades.
   (5) Measurements of pipe cover depth shall be made vertically from the outside top of the pipe to the original ground elevation, or to planned future elevations if they are lower.

3. Pavement removal and replacement.
   a. Replace all pavements or other surfacings of street, walks, drives, or parking areas removed or damaged in the prosecution of the work to their original, or better, state and condition.
   b. Backfill all trenches under surfacings with compacted Granular Bedding material. Maintain the surface at pavement grade until the permanent pavement is replaced. This will be done with a base material surface which is considered a subsidiary obligation of the paving replacement.
   c. Remove pavements constructed of asphalt or concrete, in careful manner, a minimum of 12 inches back from either top edge of the trench, to allow firm footing at all times for the existing pavement.
   d. Asphalt or black-top pavements--Replace with hot or cold mix asphalt material of a thickness not less than that of the existing pavement or 4 inches, whichever is greater.
   e. Chip and seal surfaces--Replace with hot or cold mix asphalt material of a thickness not less than that of the existing pavement or 4 inches, whichever is greater.
   f. Concrete pavements--Replace with a concrete slab of 4,000 psi Class A concrete, reinforced with 0.25% steel, of a thickness not less than that of existing pavement or 6-inch, whichever is greater.

4. Surfacing of gravel roads, drives, and parking areas.
   a. Gravel-surfaced roads – Provide an 18-inch surface layer of compacted AB-3 Aggregate base material.
   b. Gravel-surfaced drives and parking areas – Provide a 12-inch surface layer of compacted AB-3 Aggregate.
   c. Drives and parking areas will have a 4-inch minimum surface layer of same type of material and appearance as existing before excavation. Material and color shall be acceptable to property owner.
   d. Make all backfill with compacted Granular Bedding material.

e. Trench crossings of these types of roads may be open cut, unless otherwise shown.
f. A trench in a graveled road or drive will be considered as having been repaved when the graveled surface has become stable and is at proper grade.

5. Disposal of excess excavated materials.
   a. Except as otherwise permitted, all excess excavated materials shall be disposed of by the Contractor at a nearby site provided by the developer.
   b. The disposal of waste and excess excavated materials, including hauling, handling, leveling, and surfacing, shall be a subsidiary obligation of the Contractor and no separate payment will be made therefore.

END OF SECTION

This page intentionally left blank.

SECTION 32 92 00

LAWNS AND GRASS

PART 1 – GENERAL

1. Work included but not necessarily limited to:
   a. Seed bed preparation, seeding, mulching and fertilizing of areas which have been graded, filled, or otherwise disturbed or damaged by work performed under this contract.

2. Related Sections.
   a. 31 20 00 Earthwork.

3. Quality assurance.
   a. Applicable standards – Latest Revision:
      (1) American Society for Testing and Materials (ASTM):
         (a) ASTM C602 - Specification for Agricultural Liming Materials.
   b. Seed shall conform to the Kansas and Federal Seed Laws. Provide producer's test for purity and germination of seed, dated within nine months of sowing.
   c. Commercial fertilizers shall comply with the Kansas Fertilizer Law and be currently registered with the Kansas State Board of Agriculture.

4. Submittals.
   a. Compliance submittals:
      (1) Includes, but not limited to the following:
         (a) Manufacturer’s data sheets
         (b) Results of seeds' purity and germination test.
         (c) Manufacturer's certification that materials meet specification requirements.

5. Established lawns, pastures, and right-of-way cut by the line of trench or otherwise damaged by construction operations shall require replacement with seed (as determined by property owner) of the same grass type as existing or as requested by property owner. Established lawns will require compacted backfill where trenching or excavation has taken place.

6. Seeding work shall be performed by experienced contractors that perform that type of work, or the Contractor may provide the work with his own forces, subject to prior approval by the Owner. Satisfactory execution of the work will be required irrespective of work forces used.

7. Store seed and fertilizer in weatherproof storage, so it will be kept dry.

PART 2 – PRODUCTS.

1. Seed.
   a. Seed shall conform to all applicable laws of the State of Kansas.
   b. Seed shall be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller and date on which seed was tested.

c. Seed mixture, purity and rate of application shall be as follows:

Kind of Seed	Minimum Pure Live Seed (%)	Rate of Pure Live Seed (Pounds/Acre)
Bromegrass	75%	100 lbs/acre
Kentucky Bluegrass	75%	50 lbs/acre
Turf Fescue	75%	80 lbs/acre
Other as Required	--	--

2. Commercial fertilizer.
   a. Commercial fertilizer for the lawn area shall contain the following percentages by weight:

Content Percentage (or other balance percentage rate)	Application Ratio of Nutrient
12% nitrogen	50 lbs/acre
12% phosphoric acid	50 lbs/acre
12% potash	50 lbs/acre

Using the above 12-12-12 fertilizer the application rate will be 417 lbs/acre.

3. Agriculture lime.
   a. Comply with ASTM C602.

4. Mulch.
   a. Rye, wheat or oat straw.
   b. Smooth bromegrass hay, Sudan grass hay, or prairie hay consisting chiefly of bluestem grasses and other native perennial grasses normally growing in bluestem pastures.
   c. Mulching material shall be free of field bindweed, Johnson grass and other weeds declared noxious by the Kansas State Board of Agriculture.

PART 2 – EXECUTION

1. Prepare for seeding only after preceding work affecting ground surface is completed.
   a. After other outside work has been finished, and backfilling and embankments completed, all areas on the site of the work shall be brought to the original grade. Slopes shall be trimmed and dressed by hand and other surfaces so graded that effective drainage is secured. Grading and surfacing shall be completed to the satisfaction of the Engineer.

2. Fertilizing.
   a. Distribute uniformly over the site a commercial fertilizer of the type specified for lawn areas at the rate of not less than 400 pounds per acre.
   b. Apply the fertilizer with a fertilizer drill before beginning seeding or sodding operation, or if a seed drill with a fertilizer attachment is used, it may be applied with the seeding operation.

3. Seeding.
   a. Seed ditches, shoulders, and grassed areas with first-quality seeds of grass type as listed above or that as requested by property owner and determined acceptable by Owner.

b. Preparation of seed bed.
   (1) Thoroughly till the area to be seeded to a depth of at least 3 inches by discing, harrowing, or other acceptable methods until the soil is well pulverized.
   (2) Adjust pH of subsoil to range of 6.0 to 7.0 by addition of agricultural lime.
   (3) After completion of the tilling operation, clear the surface of all stones stumps, or other objects larger than l½ inches in thickness and of roots, wire, grade stakes, and other objects that might be a hindrance to maintenance operations.
   (4) Paved areas over which hauling operations are conducted shall be kept clean and promptly remove dirt that may be brought upon the surface.
   (5) Remove any objectionable undulations or irregularities in the surface resulting from tillage or other operations before planting operations are initiated.
   (6) Perform seed bed preparation only during periods when satisfactory results are likely to be obtained.
   (7) When results are not satisfactory because of drought, excessive moisture or other causes, stop the work until such conditions are satisfactory to the Engineer.

c. Seed between calendar dates February 15 and April 30 in Spring, and August 15 and October 15 in Fall, or as recommended by the State Agricultural Extension Service.

d. Seed and fertilizer shall be applied uniformly at the rates specified and drilled following the contours of the land surface.

e. Drills shall deliver seeds and fertilizer uniformly in each drill furrow so that seeds are covered, not to exceed that depth recommended by producers.

f. When drilling seed, provisions shall be made by markers or other means to assure that successive planted strips will overlap or be separated by a space not greater than the space between rows planted by the equipment being used.

g. If inspection during planting operations, or after there is a show of green, indicates that strips wider than the space between planted rows have been left or other areas skipped, plant additional seed in all such areas.

h. Apply at the rate of 3.2 pounds pure live seed per 1000 square feet, or at the appropriate rate for grasses requested by property owner.

4. Compacting.
   a. Immediately following the seeding operation, compact the entire area with a cultipacker or other acceptable method.
   b. If a cultipacker is used, it may be pulled behind the drill or as a separate operation. In either case, it shall be operated parallel to the contours.

5. Mulching.
   a. Mulching to be applied immediately after seeding, or not later than 24 hours, but not during windy or rainy weather.
   b. Mulch applied uniformly to seeded areas at a rate of not less than two (2) tons per acre, without matted or clumped areas.
   c. Mulching to be disced or punched into the soil to insure protection from wind or water erosion.

6. Establishment of grass growth.
    a. Reseed spots larger than one square foot not having uniform stand.
    b. The Contractor shall maintain all new seeded areas at his own expense, until final acceptance of the project.
    c. Maintenance shall consist of watering, protecting, and such other work as may be necessary to keep the work in satisfactory condition.
    d. All water required in connection with the seeding work and maintenance shall be furnished by and at the expense of the Contractor.
    e. Establishment period for seeded areas to extend until uniform stand of grass is acceptable to property owner and Owner.

END OF SECTION

SECTION 33 11 00

PRESSURE PIPING

PART 1 – GENERAL

1. Work included but not necessarily limited to:
   a. Piping and fittings to be furnished and installed as required in these specifications and as shown on the drawings.
   b. Handling and installation.

2. Related Sections.
   a. 31 20 00 Earthwork.
   b. 33 11 04 Pipeline Tracer Wire
   c. 33 12 00 Valves and Accessories.
   d. 33 13 01 Testing and Flushing - Pressure Lines.
   e. 33 13 02 Disinfection.

3. Quality assurance.
   a. Applicable standards. (Latest Revision)
      (1) American Water Works Association (AWWA):
         (a) C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
         (b) C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
         (c) C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches, for Water.
         (d) C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
         (e) C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
         (f) C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Service.
         (g) C150 - Thickness Design of Ductile-Iron Pipe.
         (h) C151 - Ductile-Iron Pipe, Centrifugally Cast for Water.
         (i) C153 - Ductile-Iron Compact Fittings, for Water.
         (j) C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In.
         (k) C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.
         (l) C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
         (m) C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in.
         (n) C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in through 24”, for Water, Wastewater and Reclaimed Water Service.

(2) American Society for Testing and Materials (ASTM):
- (a) A307- Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- (b) A536- Specification for Ductile Iron Castings.
- (c) D1248- Specification for Polyethylene Plastics Molding and Extrusion Materials.
- (d) D1784- Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- (e) D1785- Specification for Rigid Poly (Vinyl Chloride) (PVC) Pipe, Schedules 40, 80 and 120.
- (f) D2241- Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- (g) D2466- Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- (h) D2467- Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- (i) D2737 – Specification for Polyethylene (PE) Plastic Tubing
- (j) D3139- Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- (k) F477 – Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- (l) F714 – Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
- (m) F1483 – Specification for Oriented Poly (Vinyl Chloride), PVCO, Pressure Pipe
- (n) F1674 – Specification for Joint Restrained Products for Use with PVC Pipe.

(3) NSF International (NSF):
- (a) NSF/ANSI 61 – Drinking Water System Components – Health Effects.
- (b) NSF/ANSI 372 – Drinking Water System Components – Lead Content

4. Submittals.
   a. Compliance submittals.
      (1) Submit the following for acceptance prior to fabrication:
         (a) Special fitting and coupling details.
   b. Certificates and affidavits.
      (1) Furnish the following prior to shipment.
         (a) Affidavit of compliance with applicable piping material standard.
      (2) Upon request, for PVC piping, a certified report on the production tests of each lot of pipe and fittings shall be furnished to the Engineer and shall include:
         (a) Date of tests.
         (b) Contractor's purchase order number.
         (c) Lot number.
         (d) Measurements of dimensions and tolerances.
         (e) Burst pressure values.
         (f) Extrusion quality results.

5. Product delivery and handling.
    a. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
    b. Handle pipe, fittings, and accessories in a manner that will insure installation of the work in sound, undamaged condition.
    c. Provide proper equipment, tools and methods used in unloading, reloading, hauling, and installing pipe and fittings such that they are not damaged.
    d. Provide broad, well-padded contact surfaces for hooks inserted in ends of pipe.
    e. Replace by and at the expense of the Contractor pipe in which cement lining has been broken or loosened.

6. General material use and location.
    a. Provide all buried piping of sizes shown on the drawings and Class as follows:
        (1) Ductile iron pipe to be Class 350 with push-on or mechanical gasketed joints except as indicated on the drawings.
        (2) PVC pipe to be one of the following types as indicated on the drawings:
            (a) ASTM D2241, Class 200 PVC, SDR 21 with push-on gasketed joints.
            (b) AWWA C909, Class 235 PVCO, with push-on gasketed joints.
            (c) AWWA C900, Class 235 PVC, DR 18 with push-on gasketed joints.
            (d) AWWA C900, Class 235 PVC, DR 18 with restrained joints.

PART 2 – PRODUCTS

1. Pipe requirements.
    a. Furnish pipe of materials and class, joint types and sizes as indicated on drawings or specified herein.
    b. Pipe marking.
        (1) All pipe and fittings shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.
        (2) All PVC pipe shall be marked at intervals to declare NSF 61 product certification.
    c. All rubber gaskets used at pipe connections shall be NSF 61 product certified.

2. Iron Pipe (DIP).
    a. Design and Manufacture of Pipe.
        (1) Ductile iron pipe shall conform to AWWA C115, C150 and C151, except as otherwise specified, with mechanical, restrained push-on, or push-on joints, conforming to AWWA C111.
    b. Joints: Joints shall conform to AWWA C110 and C115, except as otherwise specified, furnish in class as shown on drawings.
        (1) Rubber-Gasket: Mechanical or Push-on joint.
            (a) Conform to AWWA C111.
        (2) Flanged.
            (a) Conform to AWWA C115.
            (b) Flanges for pipe shall conform to the applicable provisions of ANSI B16.1 and shall be drilled Class 125 as required on the drawings.
            (c) Flange bolts and nuts - ASTM A307 Grade B, of such length as to project 1/8 inch to 3/8 inch beyond outer face of nut.
    c. Fittings.
        (1) Fittings shall be cast iron or ductile iron, in traditional or compact dimensions, at Contractor's option unless otherwise shown.

(2) Cast iron fittings shall conform to AWWA Standard C110 with a working pressure rating of 250 psi for sizes 4-inch to 12-inch inclusive and 150 psi for 14-inch and larger. Ductile iron fittings may also be manufactured in accordance with AWWA C110, Class 350 for sizes 4" through 24".

(3) Compact ductile iron fittings shall have a working pressure rating of 350 psi and shall conform to AWWA C153 with ductile iron grade of 70-50-05. Nominal thickness of fittings shall be equal to, or exceed, Class 54 Ductile Iron Pipe thickness.

d. Lining.

(1) All iron pipe and fittings shall be cement-mortar lined in accordance with AWWA C104.

e. Coating.

(1) Furnish exterior bituminous coating in accordance with the aforementioned pipe and fittings standard for use in buried condition.

(2) Furnish exposed interior and exterior piping and fittings with primer coating as specified in appropriate Section.

(3) Flange faces shall be coated with a rust-preventative compound that shall be removed when the pipe is assembled.

f. Reaction anchorage and blocking.

(1) Iron pipe shall be provided with concrete thrust blocking at all fittings in accordance with the thrust block details shown on the drawings.

(2) Restrained joints providing equivalent restraint may be used in lieu of thrust blocks as approved by the Engineer.

g. Restrained joints:

(1) Shall be provided at all locations as indicated on the drawings.

(2) Piping and fittings shall have restrained joints designed to handle the internal operating and test pressures. The length of restrained joint pipe sections shall be as shown on the plans or approved by the Engineer.

(3) For push-on joints provide the following:

(a) Boltless, gasketed, rubber gaskets with integrally molded stainless steel wedges

(i) American Pipe “Fast-Grip”

(iii) U.S. Pipe “Field-Lok”

(ii) Approved equal.

(4) For mechanical joints provide one of the following:

(a) Anchor couplings consisting of shop fabricated DIP sections with welded-on retaining ring and swivel-gland at one or both ends as required.

(b) Mechanical joint gland with gripping ring (4”-12”).

(i) Romac, “Grip Ring”

(ii) Approved equal.

(c) Mechanical joint gland with multiple gripping wedges (3”-24”).

(i) EBAA Iron, “Megalug®” Series 1100

(ii) Ford, “Uni-Flange®” Series 1400

(iii) Romac, “RomaGrip”

(iv) Sigma, “One-Lok™” for DI

(v) Smith-Blair, “Cam-Lock™”

(vi) Tyler Union, “TUFGrip” for DI

(vii) Approved equal.

(d) Rubber gaskets with integrally molded stainless steel wedges and specifically designed gland.

(i) U.S. Pipe, “MJ Field-Lok Gasket”, Series DI

(ii) Approved equal.

(5) For existing bell and spigot joints provide a joint restraint harness with split serrated rings on each side of the joint connected together by through bolts. The joint restraint harness shall be designed to match the pressure class and O.D. of the pipe. The harness rings shall be constructed from ductile iron with a baked on fluoropolymer coating. All bolts and hardware shall be 304 stainless steel.
(a) EBBA Iron Series 1100HD
(b) Ford, Series 1390
(c) Romac, 611 Series
(c) Smith-Blair, “Bell-Lock”
(d) Approved equal.

3. Polyvinyl Chloride (PVC) pipe.
a. Design and manufacturer of AWWA C900 pipe.
(1) AWWA C900 pipe and fittings shall be fabricated from a raw virgin compound of ASTM D1784: PVC 12454-B.
(2) Gasketed joint pipe shall be fabricated in conformance with a minimum 235 psi pressure class and a minimum Dimension Ratio of DR 18.
(3) All pipe shall pass rigid quality control tests from a dimensional standpoint in accordance with the standard dimensions and tolerances for pressure rating.

b. Design and manufacturer of AWWA C909 pipe.
(1) AWWA C909 pipe and fittings shall be fabricated from a raw virgin compound of ASTM D1784: PVC 12454-B.
(2) Gasketed joint pipe shall be fabricated in conformance with a minimum 235 psi pressure class.
(3) All pipe shall pass rigid quality control tests from a dimensional standpoint in accordance with the standard dimensions and tolerances for pressure rating.

c. Design and manufacturer of ASTM D2241 pipe.
(1) ASTM D2241 (SDR-PR) pipe and fittings shall be fabricated from a raw virgin compound of ASTM D1784: PVC 12454-B, 12454-C, or 14333-D.
(2) Gasketed joint pipe shall be fabricated in conformance with a minimum 200 psi pressure rating (PR) and Standard Dimension Ration SDR 21.
(3) All pipe shall pass rigid quality control tests from a dimensional standpoint in accordance with the standard dimensions and tolerances for pressure rating.

d. Boltless gasketed joints.
(1) Joints shall be the boltless, gasketed, slip-on type, meeting ASTM D3139 requirements and NSF-61 approval.
(2) The male end of each section of externally-coupled plastic pipe shall be marked with a line around the circumference which can be used to check the depth of socketing after the pipe is coupled.
(3) Pipe may be furnished with plain ends, for use with gasketed couplings, or with gasketed bell on one end.
(4) Plain ends shall be factory beveled.
(5) All joints shall provide for expansion and contraction.
(6) Jointing of PVC pipe to CIP or others shall be with factory manufactured push-on or mechanical joint fittings.

e. Fittings.
   (1) Fittings for buried PVC pipe 2 inches and larger shall be cast or ductile iron fittings conforming as specified under ductile iron pipe, except that they shall be furnished with ends specifically designed for push-on PVC pipe having a boltless, gasketed joint.
   (2) In cases where push-on fittings for PVC pipe are not readily available and when allowed by the Engineer, the Contractor may substitute mechanical joint cast or ductile iron fittings with transition gaskets.
   (3) Fittings for buried PVC pipe less than 2 inches in diameter shall be gasketed PVC, unless otherwise shown. Provide equal to Harco Plastiline type, or as provided by pipe manufacturer, (200 psi minimum pressure rating), with compatible tolerances to fit the pipe.
   (4) PVC couplings for plain end pipe shall be furnished by the pipe manufacturer and shall be manufactured with compatible tolerances to fit the pipe, shall have a minimum pressure rating of 200 psi or the rating of the PVC pipe, whichever is greater, and shall bear the NSF-61 seal of compliance.

f. Reaction anchorage and blocking.
   (1) PVC pipe shall be provided with concrete thrust blocking at all fittings in accordance with the thrust block details shown on the drawings.
   (2) Restrained joints providing equivalent restraint may be used in lieu of thrust blocks as approved by the Engineer.

g. Restrained joints:
   (1) Shall be provided at all locations as indicated on the drawings.
   (2) Piping and fittings shall have restrained joints designed to handle the internal operating and test pressures. The length of restrained joint pipe sections shall be as shown on the plans or approved by the Engineer.
   (3) For push-on joints provide one of the following:
      (a) Boltless, gasketed, coupling-type with locking spline.
         (i) North American Specialty Products, “Certa-Lok” system RJIB (Restrained Joint Integral Bell)
         (ii) North American Specialty Products, “Certa-Lok” system RJ (Restrained Joint Coupling)
         (iii) Approved equal.
      (b) The joints shall be capable of holding together under the pushing or pulling forces generated by the insertion or removal of the continuous joined length in a casing pipe without causing undue stress on the joint or the pipe itself.
   (4) For mechanical joints provide one of the following:
      (a) Anchor couplings consisting of shop fabricated DIP sections with welded-on retaining ring and swivel-gland at one or both ends as required.
      (b) Mechanical joint gland with gripping ring.
         (i) Romac, “Gripring™”
         (ii) Approved equal.

(c) Mechanical joint gland with multiple gripping wedges.
(i) EBAA Iron, “Megalug®” Series 2000PV
(ii) Ford, “Uni-Flange®” Series 1500
(iii) Sigma, “One-Lok™” for PVC
(iv) Romac, “RomaGrip”
(v) Smith-Blair, “Cam-Lock™”
(vi) Tyler Union, “TUFGrip” for PVC
(vii) Approved equal.
(d) Rubber gaskets with integrally molded stainless steel wedges and specifically designed gland.
(i) U.S. Pipe, “MJ Field-Lok Gasket”, Series PV
(ii) Approved equal.

(5) For existing bell and spigot joints provide a joint restraint harness with split serrated rings on each side of the joint connected together by through bolts. The joint restraint harness shall be designed to match the pressure class and O.D. of the pipe. The harness rings shall be constructed from ductile iron with a baked on fluoropolymer coating. All bolts and hardware shall be 304 stainless steel.
(a) EBBA Iron Series 6500 for IPS O.D. pipe
(b) EBBA Series 1500 for DI O.D. pipe
(c) Ford, Series 1350
(d) Romac, 611 Series
(e) Smith-Blair, “Bell-Lock”
(f) Approved equal.

4. High Density Polyethylene (HDPE) Pipe
a. Distribution Lines
(1) 2” SDR9, IPS, HDPE conforming to ASTM F714
(2) NSF 61 product certified
(3) Blue exterior
(4) Coiled lengths to eliminate joints except at fittings and connections
(5) Fittings shall be similar to those specified for PVC pipe with modifications as required for use with HDPE.
b. Service Lines
(1) 1” and 1 1/2” DR9, CTS, HDPE conforming to ASTM D2737
(2) NSF 61 product certified
(3) Blue exterior
(4) Coiled lengths to eliminate joints except at fittings and connections.
(5) Fittings shall be as specified in Section 33 12 00.

5. Sleeves.
a. Mechanical joint long-pattern solid-sleeve type.
(1) Joint conforming to AWWA C111
(2) Pipe end space shall be as small as possible but shall not exceed 1/2".
(3) Buried service as indicated.
(4) Manufacturer’s standard black coat for buried fittings.
b. Solid-sleeve single-bolt type coupling with restraint.
(1) Acceptable Manufacturers
(a) Krausz, “HYMAX Grip”
(b) Romac, “Alpha Restrained Joint”
(c) Approved equal
(2) Design
(a) Solid sleeve with single-bolt joint restraints
(b) Ductile iron body with stainless steel bolts and hardware.
(c) Fusion bonded epoxy coating in accordance with AWWA C550.

6. Gaskets and bolting materials.
   a. Provide all gaskets, bolts, lubricant, and other accessories required to install pipe, fittings, and specials complete and ready for service. Lubricant shall be certified to meet NSF Standard 61 by an accredited third-party certifier.
   b. Gaskets and bolts for other than flanged joints shall be as otherwise specified for pipe and pipe joints.

7. Finish.
   a. Manufacturer's standard black coat for submerged or buried metal piping and fittings.

8 Polyethylene Encasement
   a. V-Bio® Enhanced Polyethylene Encasement, conforming to AWWA C105.
   b. Material: Three layers of co-extruded Linear low density, polyethylene film (LLDPE) fused into a single thickness.
   c. The inside surface in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion.
   d. Thickness: 8 mil (0.008m)
   e. Type: Tube style sized for pipe diameter and length.
   f. Tape: Provide tape from polyethylene manufacturer, specifically designed for application.
   g. Color: Black

PART 3 – EXECUTION

1. General.
   a. Utilize equipment, methods, and materials insuring installation to lines and grades indicated.
   b. Cleaning.
      (1) Thoroughly clean the interior of all pipe and fittings of all foreign matter before being installed and keep clean until the work has been accepted.
      (2) Keep clean all joint contact surfaces until the jointing is completed.
      (3) Take every precaution to prevent foreign materials in the pipe.
      (4) Place no debris, tools, clothing, or other materials in the pipe.
      (5) Whenever pipe laying is stopped, seal the open ends of the line with a watertight plug.
      (6) Prior to removing the plug, remove all water that may have entered the trench.
      (7) It is essential that no mud, trench water, or other foreign matter be permitted to enter the pipeline at any time.
   c. Inspection.
      (1) Each pipe and fitting shall be inspected for defects just prior to connection.
      (2) All defective, damaged, or unsound pipe and fittings shall be rejected and removed from the site of the work.

2. Laying pipe.
   a. General requirements.
      (1) Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specifications.

(2) Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions.
(3) Pipe shall be laid on grade with the bell ends facing the direction of laying except when making closures.
(4) Pipelines with runs intended to be straight shall be laid straight.
(5) Backfill over waterlines is to be placed in accordance with Section 31 20 00. Minimum cover is to be maintained as specified on the drawings.
(6) Pipe is to be laid in accordance with Appendix 1 regarding separation of waterlines from sanitary sewers and other sources of pollution.
(7) In the event of a stream crossing, waterlines are to maintain a minimum cover of 5-feet below non-navigable streams and 7-feet below navigable streams. Measurement is to be made from the bottom of the stream bed to the top of the pipe.

b. Special provisions for ductile iron pipe.
(1) Deflections from a straight line or grade shall not be more than recommended as a maximum by the pipe manufacturer and/or conform to AWWA C600.
(2) Install shorter pipe sections or special bends where the alignment or grade requires them.

c. Special provisions for plastic pipe.
(1) No deflection shall be allowed at the joints of any size plastic pipe.
(2) Deflection of piping shall be provided by the use of vertical or horizontal curves between joints or proper fittings and shall not be more than recommended as a maximum by the pipe manufacturer and/or conform to AWWA C605.
(3) Pipe is to be aligned and joined in trench with no deflection at joints and as little pipe curvature as necessary to fit trench alignment.

3. Jointing.
a. General requirements.
(1) Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks, and structures.
(2) Perform conforming to manufacturer's recommendations.
(3) Clean and lubricate all joint and gasket surfaces with lubricant recommended. Lubricant shall be NSF-61 certified.
(4) Utilize methods and equipment capable of fully homing or making up joints without damage.
(5) Check joint opening and deflection for specification limits.

b. Special provisions for jointing ductile iron pipe.
(1) Conform to AWWA C600.
(2) Visually examine for damage and other defects while suspended and before lowering into trench.
(a) Damaged and defective materials shall not be used.
(3) Mechanical and push-on joints.
(a) Mechanical and push-on joints shall be carefully assembled in accordance with the manufacturer's recommendations.
(b) If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.
(c) Over-tightening bolts to compensate for poor installation practice will not be permitted.

4. Cutting.
a. Cut in neat manner without damage to pipe.
b. Observe Specifications regarding joint locations.

c. Cut ductile iron and plastic pipe with carborundum saw or other acceptable method.
   (1) Smooth cut by power grinding to remove burrs and sharp edges.
   (2) Repair lining as required and approved.
   (3) Bevel spigot before installation according to manufacturer's recommendations.

5. Closure pieces.
   a. Connect two segments of pipeline with short sections of pipe fabricated for the purpose.
   b. Observe specifications regarding location of joints, type of joints, and pipe materials and strength classifications.
   c. May be accomplished with sleeve or coupling:
      (1) Of length such that gaskets are not less than 3 inches from pipe ends.
      (2) Include spacer ring, identical to pipe material, such that clear space in closure does not exceed l/4 inch.

6. Temporary plugs.
   a. Furnish and install watertight temporary plugs at each end of work.
   b. Plugs must be installed to prevent entry of any dirt, water, foreign materials, or animals to pipe interior.
   c. Plugs must be inserted in pipe when:
      (1) Workmen are not actively laying pipe.
      (2) Pipe end is unattended for more than 10 minutes.
      (3) As each joint of pipe is installed in a water course or other location where contaminated fluids or groundwater may enter pipe.
      (4) As required by Engineer or Owner.
   d. Plugs.
      (1) Test or closure plugs as manufactured by pipe supplier or other equipment manufacturer.
      (2) Watertight against heads up to 20 feet of water.
      (3) Secured in place in a manner to facilitate removal when required to connect pipe or continue pipe laying operations.
   e. Buckets or other similar non-sealing units will not be an acceptable plug.

7. Polyethylene Encasement.
   a. All ductile-iron pipe, valves and fittings shall be fully encased with polyethylene line encasement.
   b. Install in strict conformance with AWWA C105, Method A.
   c. The encasement shall be overlapped one foot in each direction at joints and secured in place around the pipe. Wrap at tap locations shall be taped tightly prior to tapping and inspected for any needed repairs.
   d. All encasement shall be installed by trained personnel.

END OF SECTION

SECTION 33 11 01

PIPELINE CASING

PART 1 – GENERAL

1. Work included, but not necessarily limited to, pipeline casing of road, street and driveway crossings where required as detailed on the drawings.

2. Related Sections.
   a. 33 11 00 Pressure Piping

3. Quality Assurance
   a. Applicable Standards, (Latest Revision):
      (1) American Society for Testing and Materials (ASTM):
         (a) A139 – Specification for Electric-Fusion (Arc)-Welded Steel Pipe
      (2) Kansas Department of Transportation (KDOT):
         (a) Utility Accommodation Policy
         (b) Standard Specifications for State Road and Bridge Construction
            i. Section 1619 – Steel Pipe
      (3) SAE International (SAE):
         (a) SAE Steel Grades
   b. Manufacturers shall be experienced in the design and manufacture of casing spacers for a minimum of 5 years.

4. Submittals.
   a. Compliance submittals.
      (1) Includes, but not limited to the following:
         (a) Certification that the steel casing complies with the listed specifications.
         (b) Catalog data or illustrations showing principal parts and materials for the casing spacers and end seals.
         (c) Assembly/disassembly and repair instructions for the casing spacers and end seals.
5. Permits.
   a. Permits for crossing railroads, highway, county and city road right-of-way will be obtained per the requirements as included in Division 01.

PART 2 – PRODUCTS

1. Steel casing.
   a. Meet the requirements of KDOT Standard Specifications Section 1619.
   b. Comply with ASTM A139, Grade B with a minimum yield strength of 35,000 psi.
   c. Welded steel pipe with a smooth wall and in sound condition.
   d. Minimum wall thickness shall be 0.25-inch or as shown on the drawings.
   e. The pipe ends are to be machined and chamfered for welding according to the requirements of ASTM A139.

2. Split-Steel Casing
   a. Fabricated from welded steel pipe with side and end flanges.
   b. Comply with ASTM A139, Grade B with a minimum yield strength of 35,000 psi.
   c. Minimum wall thickness shall be 0.25-inch or as shown on the drawings.
   d. Provide with 304 stainless steel fastening hardware.

2. Casing end seals.
   a. Acceptable manufacturer and model.
      (1) Advance Products & Systems, Inc., Model AC
      (2) Cascade Waterworks Manufacturing Co., Style CCES
      (3) Approved equal.

   b. Design
      (1) Pull-over type construction.
      (2) Synthetic rubber boot with minimum 0.125-inch thickness
      (3) Provided with Type 304 stainless steel adjustable banding straps for securing the ends of the end seal to the casing pipe and carrier pipe.

3. Casing spacers.
   a. Acceptable manufacturer and model.
      (1) Advance Products & Systems, Inc., Model SSI8
      (2) Cascade Waterworks Manufacturing Co., Style CCS
      (3) Approved equal.
   b. Design
      (1) Manufacturers standard design to adequately support the carrier pipe and full liquid weight.
      (2) Spacers to be 2-piece, bolt-on style with a shell made of two halves.
      (3) Shell bands and risers shall be fabricated from SAE Type 304 stainless steel. Shell bands shall be minimum 14-gauge thickness and risers shall be minimum 10-gauge thickness. Risers shall be welded to the bands to support UHMW Polymer runners. All welds shall be chemically passivated.
      (4) Bands to be bolted at side flanges and runners to be bolted to the risers that are welded to the bands. All hardware shall be Type 304 stainless steel.
      (5) The band halves shall be lined with a PVC or EPDM liner that overlaps the band sides.
      (6) The combined height of the riser and runner assembly shall extend beyond the pipe bell diameter to center the carrier pipe in the casing.

   c. Spacing
      (1) Support carrier pipe in casing pipe with manufactured casing spacers located at intervals recommended by manufacturer.
      (2) Minimum spacer placement shall be one on each pipe piece at joints and one spacer at mid-span.
      (3) One spacer shall also be placed within 2 feet of each end of casing pipe.

PART 3 – EXECUTION

1. Install as shown on the drawings.

2. General Casing Installation Requirements
   a. Requirements of governing authorities. Where the pipeline crosses railroads and roadways, it must meet the requirements of the interested governing authorities for proper installation of the pipe within their jurisdiction.
   b. Installations in state road right-of-way shall comply with the provisions of the KDOT Utility Accommodation Policy.

3. Steel Casing for Proposed Water Mains
   a. Boring and jacking. Install the casing pipe under the embankment using equipment and material that will provide a continuous steel encasement as the hole is excavated. Extend the casing through the entire embankment in a manner that will not disrupt traffic flow nor damage roadway grade and surface. Water will not be permitted except as necessary to lubricate the cutter and pipe. Removal of the earth shall be accomplished in a manner that leaves no void space between the outside of the casing and the earth-hole surface. Any voids which occur shall be filled by pressure grouting.
   b. Casing pipe sections shall be welded together to form a straight conduit capable of resisting imposed stresses. Welds to be continuous and water-tight and have very minor protrusions into the pipe interior to prevent interference with casing spacer installation.
   c. When casing pipe has been installed and accepted by Owner and governing authority Contractor to install carrier (water main) pipe with securely attached casing spacers.
   d. When carrier pipe is in final position end seals are to be installed at both ends of casing pipe and bands tightened to secure annular space from entry of water or foreign material.

4. Split-Steel Casing Installation on Existing Water Mains.
   a. The main shall remain in service during installation unless otherwise approved by the District.
   b. For mains under pressure, the split-steel casing shall be installed in maximum lengths of 20-feet. A maximum 24-foot length of the existing main shall be excavated and uncovered to allow installation of the split-steel casing. Bedding and backfill to the spring-line of the casing shall be crushed stone vibrated and consolidated around the casing to assure uniform support. Once a section of casing has been installed and backfilled, the next section of the water main can be excavated.
   c. For mains that can be isolated and excavated while not pressurized, the main can be exposed for the full length of the split-steel casing installation.

END OF SECTION

This page intentionally left blank.

SECTION 33 11 04

PIPE TRACER WIRE

PART 1 – GENERAL

1. Work included but not necessarily limited to pipe tracer wire and accessories not specified elsewhere.

2. Related Sections.
   a. 01 00 00 General Requirements
   b. 33 11 00 Pressure Piping
   c. 33 11 05 Water Main Marking Posts
   d. 33 12 00 Valves and Accessories

3. Quality assurance.
   a. Applicable Standards, (Latest Revision):
      (1) American National Standards Institute (ANSI)
         (a) Z535.1 – Safety Color Code
      (2) American Public Works Association (APWA)
         (a) Uniform Color Codes

4. Submittals.
   a. Compliance submittals.
      (1) Includes, but not limited to the following:
         (a) Catalog data or illustrations showing principal parts and materials.
         (b) Installation instructions.
      (2) Provide submittals per requirements of Division 01 00 00.

PART 2 – PRODUCTS

1. Tracer Wire
   a. Acceptable manufacturers:
      (1) Copperhead Industries
      (2) Pro-Line Safety Products
      (3) Approved Equal
   b. General
      (1) All tracer wire shall have HDPE insulation intended for direct bury. Insulation color shall be BLUE per APWA/ANSI standards.
   c. Types
      (1) Open Trench Installation: Tracer wire shall be #12 AWG copper clad high strength steel with minimum 450 lb. break load. Insulation thickness shall be minimum 30 mils.
         i. Copperhead 1230B-HS
         ii. Pro-Line Safety HS-CCS PE30
      (2) Directional Drilling/Boring Installation: Tracer wire shall be #12 AWD copper clad extra-high strength steel with minimum 1,150 lb. break load. Insulation thickness shall be minimum 30 mils.
         i. Copperhead 1245B-EHS
         ii. Pro-Line Safety HDD-CCS PE45

(3) Pipe Bursting/Slip Lining Installation: Tracer wire shall be 7x7 stranded copper clad extreme strength steel with minimum 4,700 lb. break load. Insulation thickness shall be minimum 50 mils.
i. Copperhead PBX-50B
ii. Approved Equal

2. Connectors
a. Acceptable manufacturers
(1) Copperhead,
(2) King Innovation “DryConn Waterproof Connectors”
(3) Pro-Line Safety Products
(4) Approved Equal
b. Design
(1) Dielectric silicon filled to seal out moisture and corrosion, specifically manufactured for use in underground tracer wire installation.
(2) Blue color coding
c. Connection Types
(1) Splices (Direct Bury):

i.	Copperhead	3-way locking connector	LSC1230B
ii.	DryConn	Direct Bury Lug Aqua	90220
iii.	Pro-Line	Pro-Trace TW	

(2) Splices (No Direct Bury):

i.	DryConn	King 6 Blue twist on connector	10600

3. Anodes
a. Acceptable Manufacturers:
(1) Copperhead Industries Part # ANO-12
(2) Approved equal.
b. Design
(1) Magnesium Drive in Anode
(2) 1.5 lb. x 1.315” D x 18.5” L
(3) HDPE cap and 20’ of factory installed 12 AWG copper clad steel tracer wire with RED 30 mil HDPE insulation.

PART 3 – EXECUTION

1. General
a. Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment.
b. Tracer wire shall allow for proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 linear feet.
c. All pipe shall be provided with tracer wire.
2. Installation
a. Tracer wire shall be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
b. Any damage occurring during installation of the tracer wire shall be repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating is not allowed.
c. Tracer wire shall be grounded as shown on the drawings.
d. Tracer wire shall not be connected to existing conductive pipes.
e. Where existing tracer wire is encountered along an existing water main, the new tracer wire shall be connected to the existing using approved splice connectors.
f. Tracer wire shall be continuous and shall pass along the outside of valves and fittings.

3. Location
    a. Tracer wire shall be located along the bottom half of the pipe at approximately the 4 o'clock position.
    b. Tracer wire shall be located along the north and east sides of the pipe.
4. Connections
    a. All mainline tracer wires shall be interconnected at intersections, at mainline tees and main line crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector or alternately using two 3-way connectors with a short jumper wire between them.
    b. All connections shall be completed with approved connectors as listed above.
    c. Connectors are dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
    d. Non-locking friction fit, twist on or tapered connectors are not allowed.
5. Grounding
    a. Install grounding anodes at locations shown on the drawings and as directed by the Owner's representative.
    b. Install grounding anodes as shown on the drawing details.
    c. Anodes shall be driven into undisturbed soil in the bottom of the pipe trench.
    d. When grounding the tracer wire at dead ends/stubs, the grounding anode shall be installed in a direction of 180 degrees opposite of the tracer wire at the maximum distance possible.
    e. When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the ground wire will be terminated at/above grade, install the grounding anode directly beneath and in-line with the tracer wire.
    f. Connect the anode wire lead to the tracer wire as shown on the drawings.
6. Termination Points and Access
    a. Tracer wire shall be extended to the surface at valve boxes as shown on the drawings.
    b. The lead wire from grounding anodes shall also be extended to the surface at locations adjacent to valve boxes.
    c. At access locations, a minimum of 2-feet of excess/slack wire is required after meeting the top elevation of the valve box.
    d. Extend tracer wire into other structures as shown on the drawings.
7. Testing
    a. Verify proper operation of the tracer wire installation by using low frequency (512 Hz or similar) line locating equipment to satisfactorily locate the water main.
    b. Verification testing shall be performed upon completion of rough grading and again prior to final acceptance.
    c. Verification tests shall be witnessed by the Owner's designated representative.
    d. Continuity testing of the tracer wire in lieu of using locating equipment will not be accepted.

END OF SECTION

This page intentionally left blank.

SECTION 33 11 05

WATER MAIN MARKING POSTS

PART 1 – GENERAL

1. Work included but not necessarily limited to water main marking posts not specified elsewhere.

2. Related Sections.
   a. 01 00 00 General Requirements
   b. 33 11 00 Pressure Piping
   c. 33 11 04 Pipe Tracer Wire
   d. 33 12 00 Valves and Accessories

3. Quality assurance.
   a. Applicable Standards, (Latest Revision):
      (1) American National Standards Institute (ANSI)
         (a) Z535.1 – Safety Color Code
      (2) American Public Works Association (APWA)
         (a) Uniform Color Codes

4. Submittals.
   a. Compliance submittals.
      (1) Includes, but not limited to the following:
         (a) Catalog data or illustrations showing principal parts and materials.
         (b) Installation instructions.
      (2) Provide submittals per requirements of Division 01 00 00.

PART 2 – PRODUCTS

1. General
   a. Acceptable manufacturers:
      (1) Rhino Marking and Protection Systems
      (2) Approved Equal
   b. Design
      (1) Triangular cross-section design post with minimum 3” width on each side.
      (2) Minimum wall thickness: 0.080 inches
      (3) Anchor barbs at base for direct bury installation.
      (4) UV stabilized polypropylene ethylene blend body construction.
      (5) Removable top cap
      (6) Color shall be incorporated in the post material throughout the entire cross-section of the post. The color shall not significantly fade or the post material become brittle when exposed to ultra-violet light for at least 10 years.
      (7) Post colors shall conform to APWA/ANSI color code standards.

2. Standard Marking Posts
   a. “TriView®, Model TVF66BB
   b. Length: 66”
   c. Post Color: Blue
   d. Cap Color Yellow

3. Test Station Marking Posts
    a. “TriView® Test Station, Model TVTO66BY2
    b. Two (2) external terminals for connections of tracer wire.
    c. Length: 66”
    d. Post Color: Blue
    e. Cap Color Yellow

PART 3 – EXECUTION

1. Installation.
    a. Install marking posts at locations indicated on the drawings and as directed by the Owner’s Representative.
    b. Direct bury bottom of post per details.
    c. Posts shall be installed plumb.
    d. Connect tracer wires to the terminals on the test station marking posts.
    e. Install marking post decals on each marking post installed as shown on the details. The District will provide, at no cost to the Contractor, three (3) marking post decals, for each marking post installed. Any decals lost or damaged after receipt by the Contractor are to be replaced with additional decals purchased by the Contractor from the District Office.

END OF SECTION

SECTION 33 12 00

VALVES AND ACCESSORIES

PART 1 – GENERAL

1. Work included but not necessarily limited to valves and accessories not specified elsewhere.

2. Related Sections.
   a. 01 00 00 General Requirements
   b. 31 20 00 Earthwork
   c. 33 11 00 Pressure Piping

3. Quality assurance.
   a. Applicable Standards, (Latest Revision):
      (1) American National Standards Institute (ANSI):
         (a) B26 – Fire Hose Couplings Screw Thread.

      (2) American Water Works Association (AWWA):
         (a) C110- Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches, for Water.
         (b) C111 – Rubber Gasket Joints for Ductile- Iron Pressure Pipe and Fittings.
         (c) C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In.
         (d) C223 – Fabricated Steel and Stainless-Steel Tapping Sleeves
         (e) C502 – Dry-Barrel Fire Hydrants
         (f) C504 – Rubber Seated Butterfly Valves
         (g) C509 – Resilient Seated Gate Valves for Water Supply Service.
         (h) C510 – Double Check Valve Backflow Prevention Assembly
         (i) C511 – Reduced-Pressure Principal Backflow Prevention Assembly
         (j) C515 – Reduced-Wall, Resilient-Seated Gate Valves for Waterworks Service
         (k) C518 – Standard for Dual-Disc Swing-Check Valves for Waterworks Service
         (l) C530 – Pilot-Operated Control Valves
         (m) C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
         (n) C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
         (o) C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
         (p) C800 – Underground Service Line Valves and Fittings

      (3) NSF International (NSF):
         (a) NSF/ANSI 61 – Drinking Water System Components – Health Effects.
         (b) NSF/ANSI 372 – Drinking Water System Components – Lead Content

b. Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years.

4. Submittals.
   a. Compliance submittals.
      (1) Includes, but not limited to the following:
         (a) Catalog data or illustrations showing principal parts and materials.
         (b) Spare parts list.
         (c) Assembly and disassembly or repair instructions.
      (2) Provide submittals per requirements of Division 01 00 00.
5. Valve use.
   a. For valve sizes 24 inches, and less, provide gate valves unless otherwise noted.
   b. The resilient seated wedge disc type is considered as the normal gate valve furnishing.

PART 2 – PRODUCTS

1. Resilient seat wedge disk gate valves, 2” through 24”.
   a. Acceptable manufacturers:
      (1) American Valve & Hydrant
      (2) Clow Valve Co.
      (3) Kennedy Valve Co.
      (4) Mueller Company
      (5) Approved Equal
   b. Design.
      (1) Conform to AWWA C-509 or AWWA C-515 and as specified.
      (2) Suitable for type of installation specified, including horizontal service for 16-inch size and larger.
      (3) Mechanical or push-on type rubber gasket joint ends shall conform to AWWA C111. Valves for tapping sleeves shall be flanged by mechanical joint.
      (4) Non-rising, bronze stem with bevel gear operator for 16-inch and larger or outside stem and yoke as indicated.
      (5) Body to be cast iron or ductile iron.
      (6) Non-rising stem seals shall be double 0-ring type.
      (7) Provide epoxy coating conforming to AWWA C550 for valve interior and exterior. No valve will be acceptable without this coating.
      (8) Resilient seat bonded to the gate.
      (9) ALL BOLTS TO BE STAINLESS STEEL EXCEPT FOR MECHANICAL JOINT T-BOLTS.
   c. Operators.
      (1) All valves shall open counter clockwise.
      (2) Furnish operators with 2-inch AWWA operating nuts for all buried installations.
      (3) Furnish operators with handwheels for all interior and exposed valves.

2. Fire Hydrants.
   a. Acceptable manufacturer and model.
      (1) Mueller Company, "Super Centurion 250, Model A-423".
      (2) Kennedy Valve Co., “Guardian K81D”
      (3) **NO SUBSTITUTIONS**
   b. Design.
      (1) Conform to AWWA C502 and as specified.
      (2) Provide compression type main valve designed to open against pressure. Valve facings shall be of nontoxic materials suitable for potable water service.
      (3) Provide three (3) way design.
      (4) Provide main valve opening of minimum 5¼ inches, and 6-inch mechanical joint inlet connection.
      (5) Design to open counterclockwise.
      (6) Provide dry type bonnet with a lubricant reservoir protected by O-ring seals, and a forced lubrication system for the thrust collar.
      (7) Operating nut to have a weather shield to protect the clearance area between the top casting and operating nut.
      (8) Operating nut and nozzle cap nuts shall be 1½-inch pentagon size.
      (9) Furnish for minimum bury depth of 4 feet or greater as necessary for proper installation.
      (10) Provide cast iron or ductile iron flat bottom shoe and mechanical joint inlet. Interior of shoe to be epoxy coated in accordance with AWWA C550.
      (11) Furnish all bronze drain port, oil or grease lubricated operating threads, positive stop for main operating rod, and provide for installation of extension or top replacement without shutting off water.
      (12) Furnish with two 2½-inch hose nozzles and one 4½-inch pumper nozzle with N.S. threads.
      (13) Provide traffic break-off joint located immediately above the ground surface, designed to minimize accident repairs. Breakable unit to be frangible disc or split ring style.
      (14) Hydrant shall be coated above safety flange with fire hydrant enamel and below with manufacturer's standard protective coating. Primer to be applied before finish coatings - all shop coatings.
         (a) Body, Bonnet and Cap Colors
            i. District/Municipal System Red
            ii Private System Chrome Yellow
      (15) ALL BOLTS SHALL BE STAINLESS STEEL.

3. Post Flushing Hydrants.
   a. Acceptable Manufacturers
      (1) Kupferle Foundry Company, Model #77
      (2) Approved equal.
   b. Design
      (1) Self-Draining, Non-Freezing type with 42-inch depth of bury.
      (2) 2-inch FIP threaded horizontal side inlet connection.
      (3) Brass body main valve with operating drive mechanism extended to the surface. 2-inch steel pipe valve box with locking cover.
      (4) 2-inch steel pipe discharge riser with horizontal 2-1/2” NST nozzle with cap and chain. Provided with traffic breakaway coupling.
      (5) Discharge nozzle shall be approximately 24 inches above grade.
      (6) All working parts shall be of brass construction.
      (7) All bolts shall be stainless steel.
      (8) Open left with slotted operating nut.

4. Valve Boxes
   a. General: Provide valve boxes as follows to suit location and as shown on the plans.
      (1) Lids shall have “Water” cast thereon.
   b. Non-Traffic Areas
      (1) General Design: Cast iron cover with 6-inch Class 160 PVC pipe.
      (2) Valve Box Cover
         (a) Acceptable Manufacturer
            i. Clay & Bailey, Model 2194
            ii. Sigma, Model VB284
            iii. Approved Equal
         (b) Design
            i. 2-piece with ring and lid.
            ii. Cast Iron Construction.
            iii. For use with 6-inch Class 160 PVC pipe.
   c. Traffic Areas – Option 1
      (1) General Design: Complete assembled unit composed of the valve box, extension stem, valve centering ring, debris washer and lockable lid. The valve box assembly shall be adjustable to accommodate variable trench depths without field cutting the box.
      (2) Valve Box Assembly
         (a) Acceptable Manufacturer
            i. American Flow Control “Trench Adaptor”.
            ii. Approved Equal
         (b) Design
            i. Adjustable height.
            ii. Ductile iron top section and lid.
            iii. High-Density Polyethylene housing.
            iv. Galvanized steel tubing valve extension stem.
   d. Traffic Areas – Option 2
      (1) General Design: 2-piece adjustable screw type
      (2) Valve Box Assembly
         (a) Acceptable Manufacturer
            i. Clay & Bailey, Model P-1108
            ii. Sigma, Model VB261-8
            iii. Approved Equal
         (b) Design
            i. 2-piece, screw type with 5 ¼-inch shaft
            ii. Cast iron construction
            iii. Belled bottom section to set on valve bonnet.
5. Extension stems.
   a. Extension stems shall be provided for buried valves when the operating nut would be three feet or more below finished grade. Each extension stem for a buried valve shall extend to within three feet (but not closer than 12 inches) of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a 2-inch operating nut.
   b. Extension stems shall be fabricated from solid steel shafting not smaller in diameter than the stem of the valve or from galvanized steel pipe having an ID not smaller than the OD of the valve stem. A gravel shield shall be welded to stem 3 inches below the nut. Gravel shield to be ¼-inch steel plate with a ½-inch smaller diameter than the inside of riser shaft.
   c. Extension stems shall be connected to the valve by a flexible socket type coupling that fits over the valve operating nut. All connections shall be pinned, keyed, or fastened with a set screw before valve is backfilled. Pipe coupling will not be acceptable.

6. Tapping Sleeves
   a. Acceptable Manufacturers
      (1) Cascade Waterworks, Model CST-SL or CST-EX
      (2) Ford Meter Box, Model FAST or FTSS
      (3) Mueller, Model H-304SS
      (4) PowerSeal, Model 3480AS or 3490AS
      (5) Approved Equal
   b. Design
      (1) Comply with AWWA C223
      (2) Minimum 150 psi rated working pressure.
      (3) Fabricated from Type 304 stainless steel
      (4) Type 304 stainless steel bolts and nuts
      (5) Complete circle gasket permanently mounted to sleeve
      (6) Flanged outlet

7. Service saddles.
   a. General: Provide for all service line connections to water mains.
      (1) Sized for O.D. of pipe.
      (2) AWWA type tapered threads (C.C.)
      (3) Comply with AWWA C800.
   b. For 2” to 8” PVC or DIP Pipe
      (1) Acceptable manufacturers.
         (a) A.Y. McDonald, 4855A Series
         (b) Romac, Style 202NS
         (c) Approved equal
      (2) Design
         (a) Ductile iron body with fusion bonded black nylon or epoxy coating.
         (b) Double stainless steel bands with SS nuts and washers.
         (c) EPDM or Nitrile O-ring NSF 61 product certified.
   c. For 12” to 24” PVC or DIP Pipe
      (1) Acceptable manufacturers.
         (a) A.Y. McDonald, Series 835 or 1635
         (b) Romac, Style SS3
         (c) Approved equal
      (2) Design
         (a) SS Repair clamp with tapped outlet
         (b) Stainless steel multiple section shell with sidebars and lugs.
         (c) Welded construction with all welds fully passivated
         (d) Stainless steel bolts, nuts and washers.
         (e) NSF 61 product certified tapered grid pattern gasket, full body of SBR or NBR rubber compounded for water service.
         (f) Minimum Length: 12”

8. Corporation stops – 3/4" to 2”
   a. Acceptable manufacturers.
      (1) A.Y. McDonald,
      (2) Ford Meter Box
      (3) Mueller
      (4) Approved equal.
   b. Design.
      (1) Plug style valve of waterworks brass construction, NSF 372 product certified.
      (2) Inlet – male AWWA tapered threads
      (3) Outlet – compression for copper or plastic

(4) Comply with AWWA C800.

9. Service Line Couplings.
   a. Acceptable Manufacturers.
      (1) A.Y. McDonald.
      (2) Ford Meter Box
      (3) Mueller.
      (4) Approved Equal
   b. Design.
      (1) “Pack-joint” connections
      (2) Waterworks brass construction, NSF 372 product certified
      (3) Copper tube size both ends
      (4) Comply with AWWA C800.

10. Service Meter Setter – 5/8” x 3/4" and 1” meters.
   a. Acceptable manufacturers.
      (1) A.Y. McDonald, 721 Series
      (2) Approved equal by Ford Meter Box or Mueller.
   b. Design.
      (1) Horizontal Style complying with AWWA C800.
      (2) Copper tubing with brass fittings construction, NSF 372 product certified.
      (3) Inlet: angle ball valve with lock wings
      (4) Outlet: dual check valve
      (5) Inlet and Outlet connections: “T” Series CTS compression, 1”
      (6) Meter size: 5/8” x 3/4” or 1”
      (7) Vertical Height: 18”

11. Service Meter Setter – 1 1/2” and 2” meters.
   a. Acceptable manufacturers.
      (1) A.Y. McDonald, 720 Series
      (2) Approved equal by Ford Meter Box or Mueller.

   b. Design.
      (1) Horizontal Style complying with AWWA C800.
      (2) Copper tubing with brass fittings construction, NSF 372 product certified.
      (3) Inlet: Full port angle lock-wing ball valve
      (4) Outlet: Full port angle dual check valve
      (5) FNPT integral inlet and outlet connections
         i. 1 1/2" for 1 1/2" meter
         ii. 2” for 2” meter
      (6) Meter size: 1 1/2" or 2”
      (7) Vertical Height: 18”
      (8) Offset High Riser with ball valve
         i. 1 1/4" for 1 1/2" meter
         ii. 1 1/2” for 2” meter

12. Service Meter Well.
    a. Acceptable manufacturers.
        (1) CONTECH Construction Products, Inc.
        (2) Springfield Plastics, Inc.
        (3) Approved equal.
    b. Design.
        (1) Nominal diameter by meter size as listed and 36” in height.
            i. 18” diameter for 5/8” x 3/4” and 3/4" meters
            ii. 24” diameter for 1” meters
            iii. 36” diameter for 1 1/2" and 2” meters
        (2) Square and smooth cuts at both ends
        (3) Provide cutouts for inlet and outlet piping on opposite sides at base.
        (4) White interior
        (5) Corrugated PVC or polyethylene construction
        (6) CONTECH A-2000, Springfield Plastics “Tuf-Cor+” or equal.

13. Meter Box Cover.
    a. Acceptable Manufacturers.
        (1) Clay & Bailey
        (2) Ford Meter Box
        (3) Approved Equal
    b. Design
        (1) Cast iron frame with nominal 4” height.
        (2) Thermoplastic composite non-locking cover with hole for electronic meter reading equipment.
        (3) Design for 18” meter well.
        (4) Provide with cast iron extension rings when installed on 24” and 36” meter wells.

14. Double-Disc check valves:
    a. Manufacturer:
        (1) Val-Matic,
        (2) Mission
        (3) Approved equal.
    b. Design
        (1) Type: double disc, water-style with torsion spring induced closure complying with AWWA C518.
        (2) Cast iron body.
        (3) Bronze or aluminum bronze seat and disc.
        (4). Type 302 stainless steel torsion spring.
        (5) Buna-N seal provided on seat.
        (6) Suitable for 150 psi operating pressure with a hydrostatic test to 265 psi.
        (7) Paint ferrous surfaces inside and outside with Tnemec Series 20 Pota-Pox, 6 mils dry film thickness conforming to AWWA C550 or approved equal.

15. Flexible connector.
    a. Manufacturer:
        (1) Metraflex Company
        (2) Proco Products Inc.
        (3) Approved equal.
    b. Design
        (1) Type: Metraflex “Cable Sphere” or Proco Style 240 with control rods.

(2) Construction: Molded spherical type; neoprene, EPDM or nitrile body materials with nylon reinforced construction; with internal steel wire reinforced flange bead. NSF 61 product certified.
(3) Flanges: One-piece floating galvanized steel with recessed groove to interlock with rubber connectors raised face flange bead. Flange shall be drilled 125/150 pound ANSI.
(4) Length Control: Provide with integral galvanized steel aircraft cables or galvanized steel control rods and connecting plates.
(5) Pressure rating: 225 PSIG @ 170° F with minimum 4:1 safety factor.

16. Pressure Relief Valve.
    a. Manufacturer.
        (1) Cla-Val, Inc.
        (2) Singer Valve, LLC
        (3) Or approved equal.
    b. The valve shall be pilot controlled, hydraulically operated, diaphragm type automatic control valve. Diaphragm shall be NSF 61 product complaint.
    c. Valve bodies and covers shall be gray/ductile iron with NSF 61 product certified fusion epoxy finish compliant with AWWA C550.
    d. Main valve shall be furnished with a resilient, replaceable seat.
    e. Control pilot shall be a direct-acting, adjustable, spring loaded, normally closed pilot designed to close the main valve whenever the sensed pressure is below the pilot spring setting.
    f. Relief valve shall function to limit the discharge header pressure to the value set into the control pilot.
    g. Valve shall be sized as shown on the plans with globe pattern, threaded ends and have a maximum pressure rating of 250 psi.
    h. NSF 372 or NSF 61 product certified lead-free construction.

17. Flange Coupling Adaptor (3” to 12” diameter).
    a. Acceptable manufacturers.
        (1) Ford, Style FFCA
        (2) Romac, Style FCA501
        (3) Smith-Blair, Model 912
        (4) Approved equal.
    b. Design.
        (1) Body and end rings: ductile iron
        (2) Cross bolts, T-bolts and nuts: stainless steel
        (3) Anchor Studs: stainless steel
        (4) Gaskets and O-rings: Nitrile (Buna N) or SBR, NSF 61 product compliant.
        (5) Finish: fusion bonded epoxy
        (6) Flange: conform to AWWA C110 and ANSI B16.1, Class 150.

18. Flange Coupling Adaptor (14” and larger).
    a. Acceptable manufacturers.
        (1) Romac
        (2) Smith-Blair.
        (3) Or approved equal.
    b. Design.
        (1) Body and end rings: steel
        (2) Cross bolts, T-bolts and nuts: stainless steel
        (3) Anchor Studs: stainless steel

(4) Gaskets and O-rings: Nitrile (Buna N) or SBR, NSF 61 product compliant.
(5) Finish: fusion bonded epoxy
(6) Flange: conform to AWWA C207 and ANSI B16.1, Class 150.
(7) Romac Style FC400, Smith-Blair 913 or equal.

PART 3 – EXECUTION

1. Installation.
   a. Comply with provisions of AWWA C600 and AWWA 605 and as specified.
   b. Thoroughly clean and remove all shipping materials prior to setting. Successfully operate all valves from fully-opened to totally-closed before installing.
   c. Equip with anchorage where indicated.
   d. See details on drawings for typical trench, embedment, valve, and valve anchoring.
   e. Set fire hydrants with nozzles 18 inches above finished grade. Check and fill lubricant chamber. Rotate hydrant barrel as necessary to face street with steamer nozzle.

END OF SECTION

This page intentionally left blank.

SECTION 33 13 01

TESTING AND FLUSHING - PRESSURE LINES

PART 1 – GENERAL

1. Work included but not necessarily limited to:
   a. Filling of potable water mains.
   b. Testing of pressure lines.
   c. Flushing of potable water mains.

2. Related Sections.
   a. 33 11 00 Pressure Piping
   b. 33 13 02 Disinfection

3. Submittals
   a. Compliance submittals.
      (1) Manufacturers data sheets for the poly-pigs.
      (2) Provide submittals per requirements of Division 01 00 00.

4. The Contractor shall provide corporation stops, at locations shown on the drawings, to facilitate planned testing and disinfection sequences and procedures. After use is complete, the corporation stops will be replaced with brass plugs. When timing and direction of filling and flushing are governed by the Owner's water supply and operational limitations or abilities, the basic sequences will be as directed by the Owner. The Contractor must observe these requirements unless changes are granted by prior written approval from the Owner and Engineer.

5. Contractor shall furnish all equipment and material including temporary plugs, valves, fittings, poly-pigs, etc., for flushing and testing.

6. Flushing is no substitute for preventive measures taken before and during pipe installation of potable water mains. Certain contaminants resist flushing at any velocity.

7. Contractor will conduct a 3-cycle flushing operation of new water mains with pipe sized poly-pigs furnished by the Contractor. The Contractor shall insert the poly-pig at the connection point and flush through an outlet at the end of the pipeline. Flushing with a poly-pig shall be done in lieu of velocity flushing of the pipeline. Velocity flushing of pipelines will only be conducted when requested by Owner.

8. The Owner will provide water for initial testing and flushing. The Contractor will be responsible for any additional amount.

PART 2 – PRODUCTS

1. Poly-Pigs
   a. Acceptable Manufacturers
      (1) Girard Industries
      (2) Approved Equal
   b. Design
      (1) Medium Density (5-8 lbs./cu.ft.) open-cell polyurethane foam
      (2) Bullet shaped with a sealed concave base.
      (3) Polyurethane elastomer exterior coating.
      (4) Girard Models RBS, RSS or RCC

PART 3 – EXECUTION

1. Filling of potable water mains.
   a. The water mains shall be constructed, backfilled, thrust blocking completed, and all necessary associated work completed before the water mains are filled.
   b. Resident project representative shall review the details, sequence, and schedule of filling prior to beginning operation.
      (1) The filling shall consider the District's system and water demands and be done in such a manner and time so as to provide as little disruption of normal service as possible.
      (2) Filling shall normally begin at low points in the main and be at such rate as to allow air to escape without entrapment through blowoffs or cleanouts.
      (3) The rate of fill shall not be greater than that tolerable to the Owner's system.
   c. Fill water mains with potable water only.
   d. Where additional air releases are needed, the Contractor shall provide the necessary 3/4-inch corporation stops and saddles on the top of the pipe at high elevations to allow for the removal of air. Such taps shall be plugged with properly threaded brass plugs subsequent to the pressure and leakage test.
   e. Some flushing may be done during the filling operation to ensure that all air is removed.

2. Testing of pressure lines.
   a. It has been observed that allowing the mains to be under some pressure for a few days after filling and bleeding off at high points several times during this period, reduces the amount of entrapped air and aids testing.
   b. It is the intent of this specification that all joints be watertight and free from leaks, and each leak which may be discovered, at any time prior to the expiration of the warranty period after the date of final acceptance by the Owner, shall be repaired by and at the expense of the Contractor.
   c. The Contractor may, at his convenience, make tests upon the system in addition to those listed above.
   d. Allowing a lapse of at least 5 days after the placing of thrust or backing blocks, all newly-laid pipe and its appurtenances or any valved section thereof shall be subjected to pressure and leakage tests.
   e. Tests to be observed by the engineer are intended to be demonstrations of satisfactory performance. The Contractor shall satisfy himself that the section to be demonstrated will pass a test before requesting an observed test.
      (1) Hydrostatic pressure.
         (a) Test pipe at 200 (psi) relative to low point in section being tested.

(b) Test pressure will not be allowed to fall below 125% of the system's normal operating pressure at the highest point of the section of pipe being tested at any time during the pressure and leakage tests.

(2) Pressure test.
   (a) Each section of pipe shall be subjected to a pressure test.
   (b) The pressure, as specified above, in the line section being tested shall be increased by pumping to specified hydrostatic pressure and shall be maintained at that level for at least one hour and for whatever longer period as may be necessary for inspection and to locate any and all defective joints and pipe line materials. If repairs are needed, such repairs shall be made, the line refilled, and the test pressure applied as before; this operation shall be repeated until the line and all parts thereof withstand the test pressure.

(3) Leakage test.
   (a) Immediately after a successful pressure test, each valved section of pipe shall be subjected to a leakage test.
   (b) The pressure shall be maintained at specified hydrostatic pressure for two hours, measured by refilling the container used for pump suction. Line leakage is defined as the total amount of water introduced into the line as measured during the leakage test. In no event shall the line be accepted if the leakage exceeds 10 gallons per 24 hours per mile of pipe per inch nominal diameter. Leaks shall be repaired, air removed, etc., and the test repeated until a successful test in compliance with the above is accomplished.

3. Flushing of potable water mains.
   a. Thoroughly flush mains after successful completion of testing requirements.
   b. When velocity flushing (if permitted) govern maximum rates and duration by the availability of potable water for flushing.
   c. A minimum flushing velocity is 2.5 feet per second.
      (1) Rate of flow to produce this velocity in various diameters is as follows:

Pipe Size	G.P.M.
2-inch	25
4-inch	100
6-inch	220
8-inch	370
12-inch	880
16-inch	1565

   d. Flush through cleanouts and fire hydrants.
   e. Progress from points near the supply connection to the end of the main.
   f. Take precautions so as not to damage property or drainage courses.

END OF SECTION

This page intentionally left blank.

SECTION 33 13 02

DISINFECTION

PART 1 – GENERAL

1. Work included but not necessarily limited to disinfection.

2. Related Sections.
   a. 33 11 00 Pressure Piping
   b. 33 13 01 Testing and Flushing

3. Quality Assurance
   a. Applicable Standards, (Latest Revision)
      (1) American Water Works Association (AWWA)
         (a) B300 – Hypochlorites
         (b) C651 – Disinfecting Water Mains
         (c) C655 – Field Dechlorination
   b. Disinfection of water mains shall be in accordance with requirements as herein stated and in the Kansas Department of Health and Environment regulation entitled “Water Main Disinfection Procedures”, appended to this document. In the case of disagreement, the more stringent of the two shall govern.

4. Submittals
   a. Compliance submittals.
      (1) Manufacturers data sheets and MSD sheets for the disinfection chemical and neutralizing agent.
      (2) Information on proposed feed equipment and proposed arrangement for feeding the disinfection chemical and neutralizing agent.
      (3) Proposed sampling plan with sample locations for chlorine levels and bacteriological samples shall be submitted for review and approval by the Owner.
      (4) Provide submittals per requirements of Division 01 00 00.

5. Disinfection sequences and procedures are governed by Owner's water supply and operational limitations or abilities. The chlorine solution entry tap location shall be located in close proximity of the entry point of the water supply to the new distribution system facilities to be disinfected. The entry tap location shall be as shown on the drawings or as approved by the Owner. The basic sequence of disinfection shall be as described below and as approved by the Owner. The Contractor shall perform disinfection operations in the described manner unless changes are approved by prior written approval from the Engineer and Owner.

6. Contractor will use a poly-pig for fill and discharge of the chlorinated water.

7. Contractor to provide bacteriological lab tests of water samples from new pipeline to verify successful disinfection.

8. Owner will provide water for initial disinfection operations. The Contractor will be responsible for any additional amount.

PART 2 – PRODUCTS

1. Disinfection chemical.
   a. 65% calcium hypochlorite complying with AWWA B300

2. Neutralizing Agent.
   a. Calcium Thiosulfate Solution (CTS) manufactured in accordance with ANSI NSF Standard 60.

PART 3 – EXECUTION

1. Potable water piping.
   a. After flushing, all new piping and appurtenances shall be disinfected by the Contractor following the guidelines of AWWA C651 and as outlined below.
   b. Apply solution made with 65% calcium hypochlorite to the water by means of a chemical feed pump and equipment designed to feed chlorine solutions.
   c. The application shall be by the continuous feed method.
   d. Make potable water flow at a constant measured rate through the main to be disinfected.
   e. The water shall receive a dose of chlorine, also fed at a constant measured rate.
   f. Proportion the two rates so that the chlorine concentration in the water in the main is maintained at a minimum of 50mg/l available chlorine.
   g. To assure this concentration, check chlorine residuals at regular intervals by using standard testing methods.
   h. Chlorine required to produce 50mg/l concentration in 100 feet of pipe by diameter is as follows:

Pipe Size Inches	100% Cl. Pounds	65% Cl. Pounds	1% Cl. Solution Gallons
2	0.008	0.012	0.08
4	0.033	0.051	0.33
6	0.066	0.102	0.73
8	0.109	0.168	1.30
12	0.240	0.369	2.88
16	0.426	0.656	5.12

   i. A 1% solution of calcium hypochlorite requires approximately 1 pound of calcium hypochlorite in 7.8 gallons of water.
   j. During the chlorine application.
      (1) Manipulate valves to prevent treatment dosage from flowing back into supply lines.
      (2) Chlorine application shall not cease until entire main is filled with chlorine solution.
      (3) All valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances.
      (4) Retain solution in the main for at least 24 hours.

k. At the end of the 24-hour period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.

l. After successful completion of the above, flush and dechlorinate the heavily-chlorinated water from main until chlorine concentration in water main is no higher than that generally prevailing in the system or less than 1 mg/l.

m. The Contractor shall discharge the highly chlorinated water from the system by inserting a disinfected poly-pig at the entry point of the new pipeline after partially opening the outlet valve and flowing some water past the entry point. The poly-pig will then be flushed through the new pipeline to the outlet at the end of the pipeline.

n. All highly chlorinated water shall be dechlorinated while being discharged from the distribution system by a controlled feed of CTS to the discharge water stream. The CTS feed shall be proportioned to adequately dechlorinate the water based on its chlorine level and rate of discharge. Use of a venturi type proportioning feeding device is recommended. Dechlorination procedures shall comply with the guidelines of AWWA C655.

o. Operate all valves, hydrants, and cleanouts during flushing.

p. Determine chlorine residual to ascertain that the heavily-chlorinated water has been removed from the pipelines.

q. Contractor to properly conduct water sampling (for bacteriological testing) at locations per the approved sampling plan for submittal to an acceptable laboratory for verification of effective pipeline disinfection procedures.

s. Bacteriological testing should be conducted in accordance with Method A of AWWA C651 and satisfactory bacteriological results should be obtained prior to placing the main in service.

r. Make final connections and put main into service when disinfection has been successful and accepted by Owner.

2. Pipeline connections to existing system.

a. Disinfect connections to the existing distribution system (fittings, valves, and short-connecting piping) that require rapid return to service or where pipe interiors have been exposed as follows:

(1) Clean the piping of all dirt and foreign material; wash with water, if necessary.

(2) Swab all surfaces that will come in contact with the potable water (including all joints - inside and outside) with a chlorine (HTH) solution containing a minimum of 1% chlorine, a minimum of 30 minutes prior to installation. Swab brought through length of pipe must contact entire inside surface of pipe in each pass.

(3) Repeat swabbing with chlorine solution at time of installation.

(4) Flush main and return to service after completing connection.

END OF SECTION

This page intentionally left blank.

APPENDIX

B. PROTECTION CONSIDERATIONS

1. SEPARATION OF WATER MAINS AND SEWERS

a. GRAVITY SANITARY SEWERS

1) Para1lel Placements - When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall not be less than 10 ft. (3.0 m). The distance of separation shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. Where it is not practical to maintain a 10 ft. (3.0 m) separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as fused HDPE or cured-in-place pipe liner.

2) Crossing Placements - When a water pipe and a sanitary sewer cross and the sewer is 2 ft. (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to the most recent revision of KDHE's *Minimum Standards of Design of Water Pollution Control Facilities:*

a) Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/ A21.10 or ANSI/AWWA C111/A21.11.

b) PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.

c) Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2 ft. (0.6 m) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum thickness of 6 inches (15.2 cm) for a 10ft. (3.0 m) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. The above requirements shall also apply where a water main must cross under an existing sanitary sewer. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

When a water main and a sanitary sewer must cross, it is preferred that the water main cross over the sanitary sewer, regardless of whether the sanitary sewer is new or existing.

Special provisions may be required to ensure adequate structural support for, and to maintain minimum pipe-to-pipe clearances between, a water main and a sanitary sewer at a water main and sanitary sewer crossing.

b. SEWER CONNECTIONS - There are to be no physical connections between any parts of a potable water system and building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach a well, storage reservoir, or distribution system.

c. PRESSURE SEWER LINES - When pressure sewer lines (force mains) run parallel to water lines, the separation distance shall be as far as practical, maintaining a minimum horizontal separation distance of at least 10ft. (3.0 m). There shall be at least a 2 ft. (0.6 m) vertical separation at crossings with the water main always crossing above the sewer force main. Where it is not practical to maintain the required horizontal or vertical separation distance between a water line and a sanitary sewer force main, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer.

d. SEWER MANHOLES - No water pipe shall pass through or come in contact with any part of a sewer manhole. Required horizontal separation distances between water mains and manholes are equivalent to those for water mains and gravity sanitary sewers.

e. STORM SEWERS - The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations. Required separation distances between water

mains and combined storm/sanitary sewers are equivalent to those for water mains and gravity sanitary sewers.

f. DRAINS - Underground drains from fire hydrants, pits, or underground structures in general (valve pits, meter pits, underground pump stations, etc.) shall not be directly connected to sanitary or storm drains.

2. SEPARATION OF WATER MAINS AND OTHER POLLUTION SOURCES - It is of the utmost importance that potable water lines be protected from any source of pollution. The following shall pertain to instances where septic tanks, absorption fields, waste stabilization ponds, feedlots, or other sources of pollution are encountered.

a. A minimum distance of 25 ft. (7.6 m) shall be maintained between all potable water lines and all pollution sources, e.g., septic tanks, septic tank absorption fields, waste stabilization ponds, sewage contamination, wastewater, landfill leachate, and all CAFO facilities.

b. Under no circumstances shall a water line be extended through an area that is a real or potential source of contamination to the water line or water supply.

c. Under no conditions shall the encasement of a water line be considered as adequate protection of a water line or a water supply for the purpose of extending the water line through a real or potential source of contamination.

3. CROSS CONNECTIONS - There shall be no physical connection between the PWSS and any pipes, pumps, hydrants, tanks, or non-potable waters supplies whereby unsafe water or other contaminating materials may be discharged or drawn into the system. KDHE approval shall be obtained for interconnections between potable water supplies. KDHE does not approve of the interconnection of any public water supply water line with any individual or independent water supply source such as a home well. Neither steam condensate nor cooling water from engine jacket or other heat exchange devices shall be returned to the potable water supply.

KSA 65-171 g prohibits the contamination of water (and air) by sewage through direct connection or back siphonage and KAR 28-15-18 (f) requires each PWSS to have a formal cross-connection prevention program. KDHE must approve the program used to accomplish the contro1. Publications regarding cross-connection control are available from AWWA (2004a), USEP A (2003c), and University of Southern California (1993).

The water purveyor should be aware of any situation requiring an inspection and/or a reinspection necessary to detect hazardous conditions resulting from cross connections. If, in the opinion of the water purveyor. effective measures consistent

with the degrees of the hazards created by the cross-connections have not been taken, then the water purveyor should immediately take such measures as are deemed necessary to ensure that the PWSS is protected from any contamination arising from any of the cross-connections. Appropriate measures may include requiring the installation of a backflow protection device consistent with the degree of hazard or discontinuance of service.

APPENDIX D

PROCEDURES FOR THE DISINFECTION OF WATER MAINS

All new or repaired potable water lines in a public water supply system must be disinfected with free chlorine before they are put into service (KAR 28-15-18(d)). These disinfection procedures are based on the AWWA Standard for Disinfecting Water Mains, AWWA C651. The most recent revision of the standard shall apply. A copy of the complete standard is available for review at the KDHE office, Curtis State Office Building, 1000 Jackson St., Suite 420, Topeka, KS. A copy of the standard may be obtained from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado, 80235.

NON-EMERGENCY PROCEDURES FOR THE DISINFECTION OF WATER MAINS

There are five basic steps for the non-emergency disinfection of water mains. The first step is to protect the water main's sanitary condition. It is always best to prevent the introduction of contaminated material into water main pipe, especially during its installation. However, whenever this is not possible, any contamination that does occur must be either flushed from the water main or removed by other more direct methods prior to disinfection. When the water main has been adequately cleared, it may then be disinfected by either the tablet, continuous or slug method of disinfection. These methods disinfect by maintaining a minimum period of contact between the water main and the disinfecting solution prepared and delivered as prescribed below for each method. In addition, each method requires flushing of the heavily chlorinated disinfecting solution followed by its proper disposal in a manner that does not adversely impact the environment. The final step consists of collecting samples from the water main for bacteriological testing as a means to confirm the effectiveness of the disinfection procedure. While this method of confirmation is not required, KDHE strongly recommends that this final step be completed.

Step 1: Preventative Measures During Construction

During construction, the interior as well as all sealing surfaces of pipes, fittings, and accessories should be kept clean as possible. Inspect the interior of all pipes prior to installation. If dirt enters the pipe, it should be removed and the affected interior of the pipe swabbed with a 1 percent free available chlorine solution. All openings in pipelines should be closed with watertight plugs whenever the trench is unattended. Sealing, lubricating, or gasket materials used in pipe installation should be stored and handled in a manner that avoids contamination and keeps them suitable for use with potable water.

Step 2: Preliminary Flushing of Mains

Before being chlorinated, the main should be completely filled with water to eliminate air pockets and then flushed to purge the line of dirt and debris. This is typically done after the completion of the leakage and pressure tests. Incomplete removal of dirt and debris from lines prior to disinfection often leads to failed bacteriological tests, requiring repeated disinfection. Preliminary

flushing should be accomplished at a rate of at least 2.5 ft/sec. Fittings and valves should be thoroughly cleaned before applying chlorine to a main. Special attention should be given to mechanical joints, fittings, and valves that may contain spaces that are difficult to chlorinate once they become filled with water.

Table 1 shows the required flow rate to obtain a velocity of 2.5 ft/sec in commonly used sizes of pipe. Flushing can be enhanced by the use of soft pigs to remove dirt, debris, and air from the main prior to disinfection. The use of pigs can also conserve water and is particularly useful when there is insufficient water supply to attain a 2.5 ft/sec minimum flushing velocity.

TABLE 1 - FLOWS REQUIRED FOR VARIOUS FLUSHING VELOCITIES

Pipe Size (in)	Pipe Area (sq ft)	Flow Required (gpm) for Given Velocity		
		1 ft/sec	2.5 ft/sec	5 ft/sec
2	0.02	10	25	50
4	0.09	40	100	200
6	0.20	90	220	440
8	0.35	155	390	780
10	0.55	245	610	1,220
12	0.79	350	880	1,760
14	1.07	480	1,200	1,400
16	1.40	625	1,570	3,140

Preliminary flushing, however, should not be conducted if tablets or granules of calcium hypochlorite have been placed in the pipe during installation. In this case, special care must be exercised in ensuring that the main does not become contaminated with dirt or other materials during construction.

Step 3: Chlorination of Mains

Disinfection of mains should be done only by crews who have had experience with chlorinating agents, who are aware of the potential health hazards associated with these chemicals, and who are trained to carefully observe proper construction and disinfection practices.

Chemical Forms of Chlorine

Chlorine is generally available in three chemical forms: gaseous (elemental) chlorine (shipped as a liquefied gas); in solution (sodium hypochlorite); and as a solid (calcium hypochlorite tablets or

granules). The gaseous form may only be applied with feed systems that operate under vacuum, the solution form is generally diluted, and the solid form must be dissolved.

A. Gaseous Chlorine

Gaseous chlorine is generated from the controlled vaporization of liquid chlorine supplied in 100 or 150-lb steel cylinders through a vacuum-operated chlorinator with a booster pump. The vacuum-operated chlorinator injects chlorine gas into water to form a solution; the booster pump introduces the solution into the main to be disinfected. Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, are not approved for use due to the danger of chlorine release. Gaseous chlorine application should only be conducted under the direct supervision of a trained operator and in accordance with the safety standards and practices described in Chapter IX of KDHE's "Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas."

B. Sodium Hypochlorite

Sodium hypochlorite is available as a liquid in 1 quart to 5 gallon containers and contains approximately 5 to 15 percent available chlorine. ANSI/NSF 60 certified household bleaches typically contain approximately 5.25 percent available chlorine. The availability of household bleaches having NSF International's ANSI/NSF 60 certification varies from market to market. Special precautions must be taken to minimize deterioration of sodium hypochlorite solutions in storage.

C. Calcium Hypochlorite (HTH)

Calcium hypochlorite (HTH) is available in granular and tablet forms typically containing approximately 65 percent available chlorine. The granules dissolve readily in water; however, the tablets can be more difficult to dissolve. In contrast to sodium hypochlorite, calcium hypochlorite can be stored for extended periods of time without significant deterioration. Contact with organic material or high temperatures must be avoided due to the danger of fire or explosion.

Methods of Chlorination

AWWA Standard C651 provides for three methods of chlorination for water mains: tablet, continuous, and slug. The chlorine dose and minimum contact time for each AWWA method are summarized in Table 2. Recommendations for disinfection of small sections of mains under emergency repair are also included in Table 2. Methods for measurement of free chlorine residual are summarized in Attachment A. Before any disinfection method is utilized, valves must be positioned so that the highly chlorinated water in the main being treated does not flow into water mains that are in active service.

TABLE 2 - CHLORINATION METHODS FOR DISINFECTING WATER MAINS

Chlorination Method Used	Initial Chlorine Dose (mg/L)	Minimum Contact Time (hours)	Minimum Chlorine Resid. (mg/L)
Nonemergency Procedures			
Tablet	25	24	10
Continuous	25	24	10
Slug	100	3	50
Emergency Procedures			
Premixed Solution or Hypochlorite Injection	300	0.25	100
Swabbing	10,000 (1% sol)	---	Swab throughly the interior of pipes and fittings used in repairs.

Factors to consider when choosing a method of chlorination include length and diameter of the main, types of joints present, equipment and materials necessary for disinfection, skills and training of personnel, safety concerns, and if the main must be quickly put into service. The continuous and slug methods require the use of appropriate chlorine feed equipment and the determination of the necessary chlorine feed rate for the chlorine solution. In long, large-diameter mains, the slug method has the potential for reducing the volume of water and amount of chemicals needed as compared to the continuous method.

The tablet method is convenient to use for mains with diameters less than 24 inches and does not require special chlorine feed equipment. There are, however, important limitations with this method. The tablet method precludes preliminary flushing which is often necessary to remove dirt and debris and assist in the removal of air from the lines. Calcium hypochlorite granules or tablets may be dislodged from the lines during filling and accumulate at points of restriction leaving portions of the line without disinfectant. The tablet method should not be used in large diameter mains, where a worker might enter the main for inspection, due to the potential for tablets to release toxic fumes.

A. Tablet Method

The tablet method consists of pre-placing calcium hypochlorite granules or tablets in the main during pipe installation in sufficient amounts so as to obtain a 25 mg/L available chlorine dose. For calcium hypochlorite granules, they should be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft.

intervals. Additionally, one tablet should be placed in each hydrant, hydrant branch, and other appurtenances. For 65 percent available chlorine, the quantities of granules necessary for a 25 mg/L chlorine dose are listed in Table 3 as a function of pipe diameter.

TABLE 3 - AMOUNTS OF CALCIUM HYPOCHLORITE GRANULES TO BE PLACED AT 500-ft INTERVALS FOR 25 mg/L FREE CHLORINE DOSE

Pipe Diameter (in)	Calcium Hypochlorite Granules (65% available) (ounces)	(grams)
2	0.4	12
4	1.7	47
6	3.8	107
8	6.7	190
10	10.5	297
12	15.1	427
16	26.8	760

Adapted from AWWA Standard C651-05

Calcium hypochlorite granules should not be placed in the pipe so as to come in contact with exposed joint compounds, such as those used on solvent-welded plastic pipe, because of the danger of fire or explosion from the reaction of the joint compound with the calcium hypochlorite.

Instead of granules, calcium hypochlorite 5-g tablets can be attached with a food-grade adhesive to the top inside surface of each section of the main's pipe. Table 4 shows the number of 5-g tablets required for commonly used pipe sizes.

After installation is complete, the main should be filled with potable water at a velocity no greater than 1 ft/sec (See Table 1 for flow rates corresponding to 1 ft/sec velocity for standard pipe sizes.). The chlorinated water must be maintained in the main for at least 24 hours. If the water temperature is less than 41°F (5°C), the water should remain in the pipe for at least 48 hours. At the end of the minimum contact period, the treated water in all portions of the main must have a residual of not less than 10 mg/L free chlorine as confirmed by measurement of the chlorine residual. Methods utilized to measure free chlorine residual are discussed in Attachment A.

TABLE 4 - NUMBER OF 5-g CALCIUM HYPOCHLORITE TABLETS REQUIRED FOR DOSE OF 25 mg/L*

Pipe Diameter (in)	Length of Pipe Section, ft				
	13 or less	18	20	30	40
	Number of 5-g Calcium Hypochlorite Tablets				
2	1	1	1	1	1
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

*Based on 3.25-g available chlorine per tablet; any portion of tablet rounded to the next highest interger. (Adapted from AWWA Standard C651-05)

B. Continuous Method

Though this method is referred to as "continuous," it does not require continuous feeding of chlorine into the main over a 24 hour period. The key feature is that the main is "continuously" in contact with at least 10 mg/L free chlorine concentration over 24 hours with an initial dose of 25 mg/L. Two procedures will be outlined below.

Procedure 1: Addition of Pre-mixed Chlorinated Water

In this procedure, hypochlorite is added to potable water in a tanker truck or other large container in sufficient volume to completely fill the main with a chlorine residual of 25 mg/L. The chlorinated water from the tanker truck or large container is then pumped into the main until full as indicated by a discharge through a terminal outlet such as a hydrant. The addition of premixed chlorinated water to the main does not require the feeding of a concentrated chlorine solution or the measurement and control of the filling rate and the chlorine solution injection rate.

The minimum amount of calcium hypochlorite (HTH) required for a 25 mg/L chlorine dose can be calculated from the known volume of the main that is to be disinfected:

$$\frac{Vol_{main,}gal * \frac{1\,MG}{1\times 10^6 gal} * 8.34\,\frac{lb}{gal} * 25\,\frac{mg}{L}}{\frac{(\%\ available\ Cl_2)}{100}} = \text{minimum lbs of HTH available} \quad \text{(Eq. 1)}$$

where,

Vol_{main} = volume of main, gal
= length(ft) * π[dia(ft)]^2/4 * 7.48 gal/ft^3

Please note that the units in the above equation (Eq. 1) will correctly cancel provided one recognizes that there are one million mg in one liter (10^6 mg/liter) and that % available Cl_2/100 is equal to lbs of chlorine per lb of HTH (lb Cl_2/lb HTH).

The following equation determines the necessary amount of sodium hypochlorite to achieve a 25 mg/L chlorine dose in a given main:

$$\frac{Vol_{main} * 25\,\frac{mg}{L}}{Conc_{soln}\,\frac{mg}{L}} = Vol_{soln} \quad \text{(Eq. 2)}$$

where,

Vol_{main} = volume of main, gal
$Conc_{soln}$ = concentration of chlorine in sodium hypochlorite solution, mg/L as Cl_2
Vol_{soln} = volume of sodium hypochlorite solution, gal

The quantities of 15 percent available chlorine sodium hypochlorite or 65 percent available chlorine calcium hypochlorite (HTH) required to produce a 25 mg/L concentration in water filling a section of main with a length of 100 ft. in common diameters are shown in Table 5.

Procedure 2: Injection of Concentrated Chlorine Solution

An alternate approach is to inject a concentrated chlorine solution into the main while it is being filled. The contractor or operator maintains a desired water flow rate while filling the main through an inlet valve on a temporary connection to the existing distribution system or other approved source. At a point no more than 10 ft. downstream from the inlet to the main, the concentrated chlorine solution is pumped into the main at a uniform feed rate until the desired chlorine residual (at least 25 mg/L) is measured in the flushed water at the terminal outlet (Figure 1). The main is then shut down and the chlorinated water allowed to stand in the pipe for a 24 hour period. At the end of this time period, the treated water in the main should have a chlorine residual of not less than 10 mg/L free chorine in all portions of

the main as confirmed by the measurement of the chlorine residual in samples collected from the main. Methods utilized to measure free chlorine residual are discussed in Attachment A.

TABLE 5 - HYPOCHLORITE REQUIRED TO PRODUCE 25-mg/L DOSE IN 100 ft OF PIPE

		Hypochlorite Solution				Granules
		Percent Available Chlorine				
Pipe Size (in)	Total Pipe Volume (gal)	1-percent (gal)	5-percent (gal)	10-percent (gal)	15-percent (gal)	65-percent (ounces)
2	16.3	0.041	0.0082	0.0041	0.0027	0.084
4	65.3	0.16	0.033	0.016	0.011	0.34
6	147	0.37	0.073	0.037	0.024	0.75
8	261	0.65	0.13	0.065	0.044	1.3
10	408	1.02	0.20	0.10	0.068	2.1
12	587	1.47	0.29	0.15	0.098	3.0
16	1044	2.61	0.52	0.26	0.17	5.4

Note: 1-percent chlorine solution = 10,000 ppm or mg/L free chlorine.

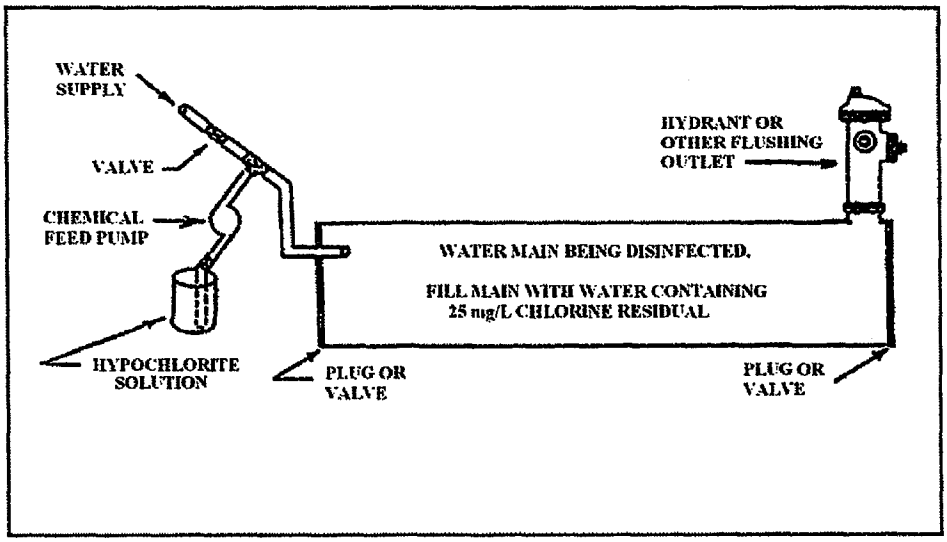


Figure 1 - TYPICAL HYPOCHLORITE INJECTION SYSTEM

The concentrated chlorine solution may be prepared from calcium or sodium hypochlorite and injected into the main with a chemical feed pump designed for chlorine solutions. While this is readily accomplished with sodium hypochlorite because it is purchased as a liquid, calcium hypochlorite in the form of HTH granules or tablets must first be dissolved in water. It is important to remember that the HTH granules or tablets should be added to the correct volume of water in order to adequately disperse the heat generated during dissolution, rather than adding water to the HTH granules or tablets. Feed lines and connections should be of such material and strength as to safely withstand the corrosive effect of the concentrated chlorine solution and the pressure of the pump. The flows of both the water filling the main and the concentrated chlorine solution being injected must be proportioned so that the resulting chlorine concentration in the main is uniform and at least 25 mg/L (Figure 2).

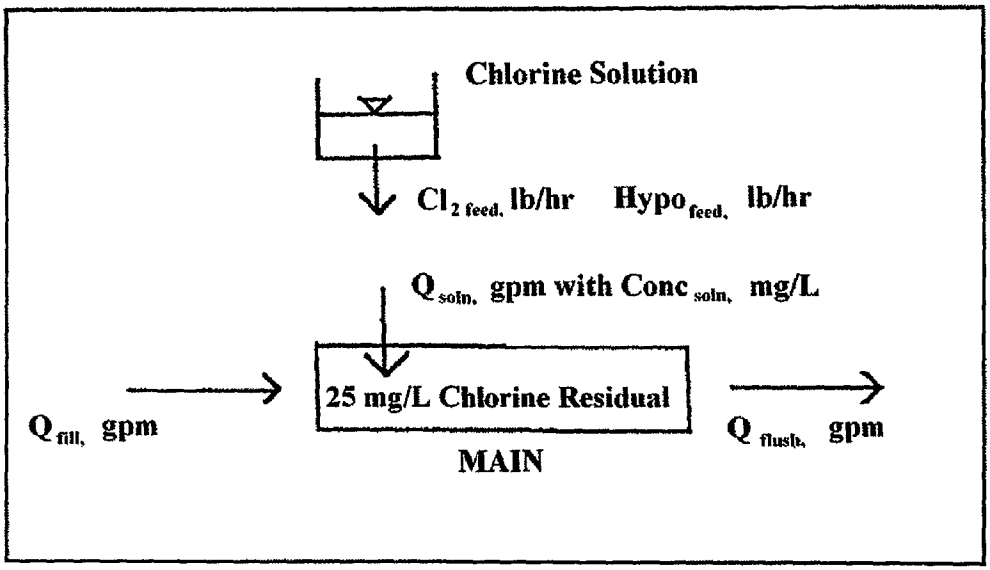


Figure 2 - MASS BALANCE DIAGRAM FOR Cl_2 SOLUTION INJECTION

In most cases, the chlorine solution injection rate, Q_{soln}, will be significantly less than the rate of filling the main, Q_{fill}. When this is true, Q_{fill} may be considered essentially equivalent to the rate of water exiting the main, Q_{flush}. After startup of the chlorine solution injection, the chlorine residual should be checked at the first available outlet, and the hypochlorite injection rate adjusted to obtain a residual of at least 25 mg/L.

This approach, the injection of a concentrated chlorine solution into a flowing main, is consistent with the typical chlorination procedure used by operators in disinfecting a continuous flow of water from a well using a hypochlorite feed system. It does, however, require maintaining a specific main filling rate (or flushing rate from the outlet of the pipe)

as well as a uniform chlorine solution injection rate. Flow rates may be difficult to measure accurately under field conditions that typically involve temporary connections. In addition to the use of flow meters, methods for estimating flow rates include measuring the time to fill a container of known volume or measuring the trajectory of the discharge from a hydrant and using the formula in Figure 3 to determine the flow rate.

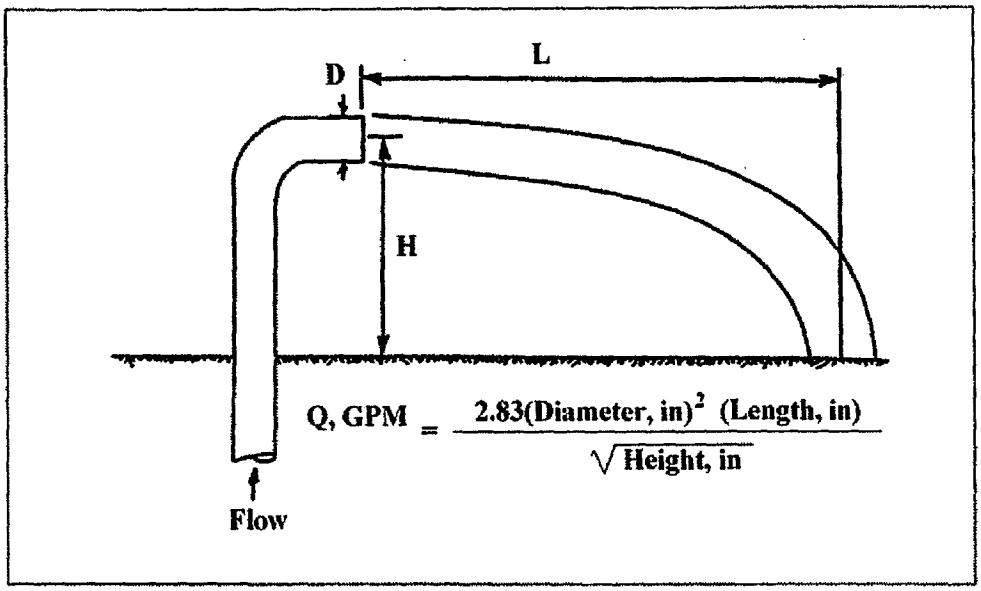


Figure 3 - FORMULA FOR ESTIMATING RATE OF DISCHARGE
Reproduced from *Water Distribution System Operation and Maintenance: A Field Study Training Program*, 5th ed. (2005), with permission. Copyright by the California State University, Sacramento Foundation.

The chlorine feed rate into the main, $Cl_{2\ feed}$, for a 25 mg/L dose (assuming 100 percent available chlorine such as supplied by chlorine gas) may be calculated with the following equation:

$$Q_{fill}, \frac{gal}{min} * 1440 \frac{min}{day} * \frac{1\ day}{24\ hr} * \frac{1\ MG}{1 \times 10^6 gal} * 8.34 \frac{lb}{gal} * 25 \frac{mg}{L} = Cl_{2\ feed}, \frac{lb}{hr} \quad \text{(Eq. 3)}$$

where,

Q_{fill} = flow rate of water filling main, gpm
$Cl_{2\ feed}$ = chlorine feed rate into main, lbs of Cl_2 as 100% available chlorine /hr

In chlorine feed rate problems, the chlorine solution injection rate, Q_{soln}, and the filling rate of the main, Q_{fill}, are typically assumed and fixed. Where the chlorine solution is applied uniformly to the main while it is filling, the time of filling of the main, T_{fill}, is essentially equivalent to the time of chlorine solution injection, $T_{injection}$:

$$\frac{Vol_{main}, gal}{Q_{fill}, \frac{gal}{min}} = T_{fill}, min = T_{injection}, min \quad \text{(Eq. 4)}$$

where,

Vol_{main} = volume of main, gal
Q_{fill} = main filling rate, gpm
T_{fill} = time to fill main, min
$T_{injection}$ = time of chlorine solution injection, min

The minimum volume of chlorine solution, prepared from either sodium or calcium hypochlorite, may be determined by multiplying the chlorine solution injection rate by the time of chlorine solution injection:

$$Q_{soln}, \frac{gal}{min} * T_{injection}, min = Vol_{soln}, gal \quad \text{(Eq. 5)}$$

where,

Q_{soln} = rate of chlorine solution injection, gpm
$T_{injection}$ = time of chlorine solution injection, min
Vol_{soln} = volume of chlorine solution, gal

Utilization of Calcium Hypochlorite (HTH)

When calcium hypochlorite is utilized to prepare a concentrated chlorine solution for this second procedure, the chlorine solution feed rate, $Cl_{2\ feed}$ (lb/hr) (Eq. 3), can be converted to a calcium hypochlorite feed rate (HTH), HTH_{feed} (lb/hr) by use of the following equation:

$$\frac{Cl_{2\ feed}, \frac{lb}{hr}}{\frac{(\%\ available\ Cl_2)}{100}} = HTH_{feed}, \frac{lb}{hr} \quad \text{(Eq. 6)}$$

The total lbs of calcium hypochlorite required for disinfecting a given main are determined by multiplying HTH_{feed}, (lb/hr) by the injection time, $T_{injection}$, expressed in units of hours or by solving Eq. 1 above:

$$HTH_{feed}, \frac{lb}{hr} * T_{injection}, hr = \text{minimum required HTH, lbs} \quad \text{(Eq.7)}$$

where,

HTH_{feed} = calcium hypochlorite feed rate, lb/hr
$T_{injection}$ = time of chlorine solution injection, hr

The concentration of the chlorine solution, prepared by the addition of the required lbs of HTH to the necessary volume of water, Vol_{soln} (Eq. 5), may be calculated by use of the following equation:

$$\frac{\text{lbs of HTH}}{Vol_{soln}, gal} * \frac{(\%\ \text{available } Cl_2)}{100} * \frac{1 \times 10^6}{1\ MG} * \frac{1\frac{mg}{L}}{8.34\frac{lb}{MG}} = Conc_{soln}, \frac{mg}{L} \quad \text{(Eq. 8)}$$

where,

Vol_{soln} = volume of chlorine solution, gal
$Conc_{soln}$ = chlorine concentration in injected solution, mg/L as Cl_2

Utilization of Sodium Hypochlorite Solution

A concentrated sodium hypochlorite solution may also be utilized for this second procedure. Sodium hypochlorite is available in liquid form as a concentrated chlorine solution expressed typically in percent available chlorine where 1 percent available chlorine is approximately equivalent to 10,000 mg/L chlorine. Strong solutions of sodium hypochlorite, such as 15 percent, may be injected directly into a flowing main with a chemical feed pump without the necessity of dilution. In such cases, the concentration of chlorine in the injected solution is known. For an assumed sodium hypochlorite solution injection rate, Q_{soln}, the filling rate of the main, Q_{fill}, can be determined from the following equation:

$$\frac{Q_{soln} * Conc_{soln}, \frac{mg}{L}}{25\frac{mg}{L}} - Q_{soln} = Q_{fill} \quad \text{(Eq. 9)}$$

where,

Q_{soln} = rate of sodium hypochlorite solution injection, gpm
$Conc_{soln}$ = chlorine concentration in injected solution, mg/L as Cl_2
Q_{fill} = main filling rate, gpm

Table 5 includes the minimum volumes of various sodium hypochlorite solutions (1%, 5%, 10%, and 15%) for direct injection into a 100 ft. main to prepare a 25 mg/L chlorine dose. Eq. 2 above may also be used to calculate the required volume of chlorine solution as sodium hypochlorite for a given Vol_{main}, Q_{fill}, and Q_{soln}. For a given Q_{fill}, Eq. 3 above may be utilized to calculate the necessary chlorine feed rate into the main, which is converted to a sodium hypochlorite feed rate by the following equation:

$$\frac{Cl_{2\,feed}, \frac{lb}{hr}}{\frac{(\%\ available\ Cl_2)}{100}} = Na-hypo_{feed}, \frac{lb}{hr} \quad \text{(Eq. 10)}$$

where,

$Cl_{2\,feed}$ = chlorine feed rate into main, lbs of Cl_2 as 100% available chlorine /hr
$Na\text{-}hypo_{feed}$ = rate of sodium hypochlorite solution injection, lb/hr

If a flow rate in gal/hr is more convenient, then the sodium hypochlorite feed rate can be determined by the following equation:

$$\frac{Cl_{2\,feed}, \frac{lb}{hr}}{\frac{(\%\ available\ Cl_2)}{100} * 8.34\frac{lb}{gal}} = Na-hypo_{feed}, \frac{gal}{hr} \quad \text{(Eq. 11)}$$

where,

$Cl_{2\,feed}$ = chlorine feed rate into main, lbs of Cl_2 as 100% available chlorine /hr
$Na\text{-}hypo_{feed}$ = rate of sodium hypochlorite solution injection, gal/hr

If a sodium hypochlorite solution must be diluted with water to prepare for injection into a main a given volume of a solution having a lower chlorine concentration (e.g., diluting a 15 percent available chlorine solution to form a 5 percent available chlorine solution), then the following equation may be used to determine the volume of concentrated sodium hypochlorite required:

$$\frac{(gal\ dilute\ soln) * (\%\ available\ Cl_2\ dilute\ soln)}{(\%\ available\ Cl_2\ concentrated\ soln)} = gal\ concentrated\ soln \quad \text{(Eq.12)}$$

C. Slug Method

The slug method consists of the formation of a slug of chlorinated water in the main with a free chlorine concentration of at least 100 mg/L. The slug of highly chlorinated water must flow through the main at a slow enough rate so that all parts of the main and its

appurtenances will be exposed to the highly chlorinated water for a period of at least 3 hours. As the slug moves through the main, all valves must be fully operated to ensure complete disinfection. This method would be appropriate for long, large diameter mains where the continuous feed method would be impractical. It could also be used for smaller mains of limited length where the continuous method's requirement of 24 hours of contact time cannot be satisfied. By application of a solution having a higher initial chlorine dose, 100 mg/L, the required minimum contact time may be reduced from 24 hours to 3 hours.

The slug of chlorinated water is typically formed through the application of gaseous chlorine, although hypochlorite solutions, purchased as premixed or mixed on site, could also be employed. For relatively small mains, hypochlorite could be added to potable water in a tanker truck or a large container such that the chlorinated water would have an initial concentration of at least 100 mg/L free chlorine. The chlorinated water from the tanker truck or large container could then be pumped into a section of the main until full as indicated by a discharge from the outlet at the other end of the section of main being repaired.

The free chlorine residual must be regularly measured in the slug during the required minimum 3 hours of contact time. If at any time, the free chlorine residual in the slug drops below 50 mg/L, additional chlorine must be applied to the head of the slug in order to reestablish the level of free chlorine in the slug to be at least 100 mg/L.

Step 4: Final Flushing of Mains

After the appropriate minimum retention period, highly chlorinated water should be flushed from the main until chlorine residual measurements show that the chlorine concentration of the water leaving the repaired section of main is no higher than that generally prevailing in the distribution system. Care must be exercised when disposing of water with excessive chlorine residuals. Chlorine is toxic to fish and other aquatic life. Disposal of chlorinated water into storm sewers without prior neutralization of the chlorine residual should be avoided if residual chlorine will still be present when the water directly or indirectly reaches a stream, river, or lake.

Neutralization of the chlorine residual remaining in the water can be accomplished by application of a de-chlorination chemical to the highly chlorinated water in a temporary retention pond, container, or tanker truck. Typical de-chlorination chemicals employed are sulfur dioxide (SO_2), sodium bisulfite ($NaHSO_3$), sodium sulfite (Na_2SO_3), and sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$). The amounts of these chemicals required to neutralize various residual chlorine concentrations in 100,000 gallons of water are listed in Table 6. While the application of de-chlorination chemicals to highly chlorinated waters quickly reduces the level of free available chlorine, significant reductions can also be achieved by exposure of these waters to sunlight in open ponds or in containers. Note that over-feeding a de-chlorination chemical can deoxygenate the receiving water, so the de-chlorination process must be carefully controlled.

TABLE 6 - AMOUNTS OF CHEMICALS REQUIRED TO NEUTRALIZE VARIOUS RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER

Residual Chlorine Concentration (mg/L)	Chemical Required			
	Sulfur Dioxide (lb)	Sodium Bisulfite (lb)	Sodium Sulfite (lb)	Sodium Thiosulfate (lb)
1	0.8	1.2	1.4	1.2
10	8.3	12.5	14.6	12.0
25	20.9	31.3	36.5	30.0
50	41.7	62.6	73.0	60.0

Adapted from AWWA Standard C651-05.

Step 5: Bacteriological Testing (Optional)

AWWA Standard C651 requires that after the final flushing two consecutive sets of bacteriological samples within a 24 hour period be collected from the new main. At least one set of samples shall be collected from every 1200 ft. of the new main, one set from the end of the line and at least one set from each branch. The samples are tested for the presence of coliform organisms in accordance with *Standard Methods for the Examination of Water and Wastewater* (APHA *et al.*, 2005). KDHE does not require bacteriological testing of new mains but recommends such tests to confirm the effectiveness of the disinfection procedure. It is not uncommon for a public water supply system to require bacteriological testing of mains as part of their standard specifications for the installation of water mains. Unless the provisions of AWWA Standard C651 are incorporated by reference in the system's specifications, the specifications for bacteriological testing should provide: the type, number, and frequency of samples for bacteriological tests; the method of initial sample collection to include repeat sample collection; the party or parties responsible for testing; and the laboratory selection requirements.

Attachment B to this appendix provides a brief summary of bacteriological sampling procedures and analytical methods; however, the most current procedures and methods as outlined in the drinking water regulations should always be employed.

EMERGENCY WATER MAIN DISINFECTION PROCEDURES

When repairs require that mains be opened and depressurized under emergency conditions such as a break or other physical failure of the pipeline, the necessity of restoring water service as soon as possible prevents complete compliance with the routine main disinfection procedures of AWWA Standard C651. Alternate disinfection procedures under such conditions are described in more

detail in an article published by Scoot R. Yoo in OPFLOW (Yoo, 1986). The following recommended disinfection procedure is based in part on the article.

The entry of contaminants into the repaired main should be minimized. When feasible, employ clamps, sleeves or other devices to avoid having to take the main out of service and to depressurize it to make the necessary repairs. If the main must be taken out of service and depressurized while repairs are being made it is important that excavated areas be dewatered to the extent practical to prevent dirty water from contacting or entering the pipe. When a pipe is cut and a section removed, the inside of the remaining pipe ends must be examined and pieces of pipe, scale, or other debris removed. Temporary plugs for all open ends of pipes must be provided.

If the main must be depressurized and opened, then the pipe should be disinfected by swabbing it with a concentrated chlorine solution and then thoroughly flushed upon completion of repairs. Alternatively, a high chlorine residual should be maintained in the repaired section of the main for an appropriate period of time. The swabbing method is quick and is generally effective under repair conditions that do not pose a threat of significant contamination. The swabbing method, however, should not be utilized where there is a potential for significant contamination of the main, e.g., when sewage is detected in the trench during repairs.

Swabbing Method

All new pieces of pipe, couplings, clamps, sleeves, and other materials used in the repair must be thoroughly swabbed with a concentrated (1 percent available chlorine or greater) chlorine solution to disinfect all surfaces which will come in contact with potable water. The concentrated chlorine solution may be prepared by adding 2 oz of calcium hypochlorite (65 percent available chlorine) or 26 fl oz of household bleach (5 percent available chlorine) to 1 gallon of water. Clean rags or a sprayer are typically employed to apply the concentrated chlorine solution. Longer pieces of pipe may be disinfected using a clean mop. Proper personal protection such as rubber gloves and goggles should be worn. Respiratory protection equipment should also be worn when ventilation is inadequate.

Hypochlorite Injection or Addition of Pre-mixed Solution

In both of these methods of disinfection, the repaired section of main is briefly contacted with chlorinated water that will have high chlorine residual.

Preliminary Steps

Both methods require the repaired section of main to be isolated from the distribution system. This will require that all service connections along the section of main to be disinfected be shut off. Temporary connections for filling the main with water as well as a method of flushing the main through a hydrant or other temporary outlet must be provided. The isolated section of main must be initially flushed to remove dirty water, debris, and air.

Hypochlorite Injection

In the hypochlorite injection method, liquid sodium hypochlorite is injected into the flowing main by means of a chemical feed pump to establish a high chlorine residual in the repaired section of the main (Figure 1). The initial required chlorine dose is 300 mg/L, verified by measuring the chlorine residual in the water flushed out through an outlet in the other end of the repaired section. The minimum amount of hypochlorite solution required to treat one pipe volume with an initial chlorine dose of 300 mg/L can be calculated using the following equation:

$$\frac{300\frac{mg}{L}}{Conc_{soln}} * Vol_{main} = Vol_{soln} \quad \text{(Eq. 13)}$$

where,

$Conc_{soln}$ = concentration of chlorine in a sodium hypochlorite solution, in mg/L as Cl_2, where 1 percent available chlorine solution is approximately equal to 10,000 mg/L.
Vol_{main} = volume of main, gal
Vol_{soln} = volume of sodium hypochlorite as chlorine solution, gal

Table 7 includes the minimum volumes of sodium hypochlorite solution (5 and 12.5 percent available chlorine) necessary to achieve an initial chlorine dosage of 300 mg/L in 100 ft. of main. Volumes in excess of the table values will be necessary because pumping must continue until the minimum chlorine dose is verified at the flushing outlet.

TABLE 7 - HYPOCHLORITE REQUIRED PER 100 FT OF MAIN

		Hypochlorite Solution				Hypochlorite Granules	
	Total	gal of 5-percent		gal of 12.5-percent		ounces of 65-percent	
Pipe Size (in)	Pipe Volume (gal)	Dose 100 mg/L	Dose 300 mg/L	Dose 100 mg/L	Dose 300 mg/L	Dose 100 mg/L	Dose 300 mg/L
2	16.3	0.03	0.10	0.013	0.039	0.33	1.0
4	65.3	0.13	0.39	0.052	0.16	1.3	4.0
6	147	0.29	0.88	0.12	0.35	3.0	9.0
8	261	0.52	1.6	0.21	0.63	5.4	16.1
10	408	0.82	2.4	0.33	0.98	8.4	25.1
12	587	1.2	3.5	0.47	1.4	12.1	36.2
16	1044	2.1	6.3	0.84	2.5	21.4	64.3

Note: 5-percent chlorine solution = 50,000 ppm or mg/L free chlorine.

Addition of Premixed Solution

An alternate method is the preparation of a premixed chlorine solution in sufficient volume to completely fill the repaired section of main. A hypochlorite compound is added to potable water in a tanker truck or other large container in the proportions indicated in Table 7 to form a thoroughly mixed solution having a chlorine concentration of at least 300 mg/L. The chlorine solution from the tanker truck or large container is then pumped into the repaired section of the water main until the water main is full as indicated by a discharge through a hydrant or other outlet device at the other end of the section of water main being tested.

Minimum Contact Period

The minimum contact period for an initial chlorine dose of 300 mg/L is 15 minutes. After the minimum 15 minute contact period, a chlorine residual of at least 100 mg/L should be verified. Lower initial chlorine doses may be used for longer contact periods (e.g., 100 mg/L initial chlorine dose with a 3 hour contact time).

Final Steps

The heavily chlorinated water is flushed from the main until the chlorine residual is reduced to the level normally present in water supplied to the area. Consideration should be given to the collection of bacteriological samples after the disinfection procedure has been completed to provide a record of the effectiveness of the disinfection procedures where repairs were made under conditions that posed a threat of contamination.

Bibliography

APHA, AWWA, and WEF, 2005. *Standard Methods for the Examination of Water and Wastewater, 21st ed.* American Public Health Association, Washington, D.C.

AWWA, 1990. *AWWA's Pocket Guide to Water Sampling, Vol 1. Microbiological Contamination.* Denver, CO.

AWWA, 2003. *Basic Science Concepts and Applications, Principles and Practices of Water Supply Operations, 3rd ed.* Denver, CO.

AWWA, 2005. *Disinfecting Water Mains.* AWWA Standard C651. Denver, CO.

California Department of Health Services, Sanitary Engineering Branch, and USEPA, Office of Drinking Water, 2004. *Water Treatment Plant Operation, A Field Study Training Program, Volume 1, 5th ed.* Hornet Foundation, Inc. California State University, Sacramento, CA.

California Department of Health Services, Sanitary Engineering Branch, and USEPA, Office of Drinking Water, 2005. *Water Distribution System Operation and Maintenance, A Field Study Training Program, 5th ed.* Hornet Foundation, Inc. California State University, Sacramento, CA.

KDHE, Bureau of Water, 2004. *Public Water Supply Survival Guide for the Total Coliform Rule.* KDHE, Bureau of Water, Topeka, KS

Lisle, J., 1993. *An Operator's Guide to Bacteriological Testing.* American Water Works Association, Denver, CO.

Stevens, R. L., and J. C. Dice, 1981. Chlorination – A Proven Means of Disinfecting Mains, *Opflow, 7* (10) (October).

Stevens, R. L. and J. C. Dice, 1987. Chlorination – Pills for Pipe and Techniques for Tanks, *Opflow, 7* (11) (November).

White, G. C., 1999. *Handbook of Chlorination and Alternative Disinfectants, 4th ed.* John Wiley & Sons, Inc., New York, NY.

Yoo, S. R., 1986. Procedures for Emergency Disinfection of Mains, *Opflow, 12* (1) (January).

This page was intentionally left blank.

ATTACHMENT A

METHODS FOR MEASURING FREE CHLORINE RESIDUAL

Standard Methods for the Examination of Water and Wastewater (APHA *et al.*, 2005) describes eight methods for measuring residual chlorine concentration. Of the eight, the amperometric titration, DPD colorimetric, DPD ferrous titrimetric, and iodometric titration methods are the most commonly practiced. The amperometric titration method is the most common method of measurement practiced in the laboratory and the DPD colorimetric method is the most common and simplest method of measurement practiced in the field.

DPD colorimetric methods used in the field typically involve collecting a water sample in the sample tube of a DPD test kit; adding the DPD color reagent (N,N-diethyl-p-phenylenediamine) provided in the kit to the water sample; and then matching the resulting color of the sample with a color on the comparator wheel to estimate the free chlorine residual in mg/L. The magenta or red coloring of the sample can be observed as the DPD is oxidized by the free chlorine in the sample. The intensity of the color is directly proportional to the free chlorine concentration in the sample. DPD colorimetric field test kits for a variety of ranges of free chlorine are widely available.

Each DPD colorimetric chlorine test kit is designed to measure a specified range of free chlorine concentration. Low range test kits typically measure free chlorine concentrations as high as 3.5 to 5 mg/L. Some manufacturers have produced high range test kits that are capable of measuring free chlorine concentrations at the level of doses required for disinfection of water mains, e.g. 25 mg/L. A low range test kit can, however, be used to measure a free chlorine concentration higher than the kit's range by diluting the sample to reduce the free concentration to be within range of the test kit. Samples can be diluted using the graduated cylinder dilution method or the DPD drop dilution method.

It is important to note that if the concentration of chlorine in the sample exceeds the highest concentration for which a DPD test kit is valid, or if the reagents are not added in the proper order, the results are likely to be erroneous.

Graduated Cylinder Dilution Method

Collect a 2 mL sample of highly chlorinated water and pour the sample into an empty 50 mL or larger graduated cylinder. Add distilled water for a total of 50 mL and gently mix. Distilled water can be purchased in most grocery and convenience stores in gallon containers.

Transfer from the graduated cylinder the volume of diluted chlorinated water specified by the test kit to the test kit's sample tube. Add DPD reagent, mix, and then estimate the free chlorine concentration based on a comparison of the color of the diluted sample with the kit's standards according to the kit's instructions.

Multiply the estimated free chlorine concentration by the dilution factor, which is calculated as follows:

$$\frac{\text{(Volume of distilled water + Volume of chlorinated sample)}}{\text{(Volume of chlorinated sample)}} = \text{Dilution Factor} \quad \text{(Eq. A1)}$$

When 2 mL of sample are combined with 48 mL of distilled water in a graduated cylinder, the dilution factor is 25 as determined below:

$$\frac{\textbf{(48 mL of distilled water + 2mL of sample)}}{\textbf{(2mL of chlorinated sample)}} = \textbf{Dil. Factor of 25}$$

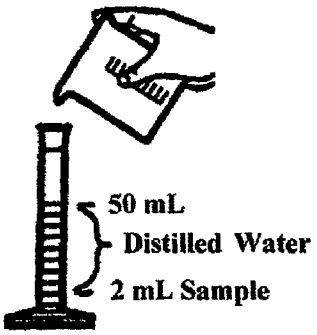


Figure A-1 Dilution of Sample in Graduated Cylinder.

For example, if it is determined that the diluted sample from the graduated cylinder has a chlorine residual of 1 mg/L, the undiluted sample from the disinfected main would have a residual of 25 x 1 mg/L or 25 mg/L. If it is not possible to accurately determine the chlorine residual of the undiluted sample, it may be necessary to apply a different dilution to the sample. For example, if the anticipated level of chlorine residual is around 100 mg/L, as it might be in for the slug method, a more appropriate dilution factor would be 50. This level of dilution could be obtained by diluting 1 mL of sample with 49 mL of distilled water.

DPD Drop Dilution Method

Add 10 mL of distilled water and one premeasured packet or powder pillow of DPD reagent (or 0.5 mL of DPD solution) to the DPD test kit's sample tube.

Using an eye dropper, add a sample of the highly chlorinated water on a drop-by-drop basis to the kit's sample tube until a color is produced.

Record the number of drops added to the sample tube. Assume one drop equals 0.05 mL.

Determine the free chlorine concentration in the kit's sample tube that contains the drops of sample, 10 mL of distilled water, and the DPD reagent by means of a colorimetric comparison with the standard according to the test kit's instructions.

Estimate the chlorine residual in the chlorinated sample from the disinfected main with the following equation:

$$\frac{(Cl_2\ \text{Residual}_{\text{sample-tube}}, \frac{mg}{L}) * (\text{Vol}_{\text{distilled-water}}, mL)}{(\text{Vol}_{\text{sample}}, \text{drops}) * (0.05 \frac{mL}{\text{drop}})} = Cl_{2\ \text{residual-sample}}, \frac{mg}{L} \quad \text{(Eq. A2)}$$

For example, assume three drops of chlorinated water from the disinfected main determined a free chlorine concentration of 0.6 mg/L in 10 mL of distilled water in the kit's sample tube. Determine the free chlorine concentration in the sample of chlorinated water from the disinfected main with Eq. A2:

$$\frac{(0.6\ mg/L) * (10\ mL)}{(3\ \text{drops}) * (0.05\ mL/\text{drop})} = 40\ mg/L$$

This page was intentionally left blank.

ATTACHMENT B

BACTERIOLOGICAL SAMPLING AND ANALYSIS

AWWA C651-05 requires that two consecutive sets of samples, taken at least 24 hours apart, be collected from the main and examined for bacteriological contamination after the final flushing and prior to connecting the new main to the distribution system. If the results of the examination of the initial bacteriological samples are unsatisfactory, the new main should be flushed and additional samples collected and examined. According to AWWA C651-05, if the results of the examination of any of the additional samples are also unsatisfactory, the main must be re-chlorinated, flushed, and resampled until satisfactory results are obtained. KDHE recommends bacteriological testing of newly installed or repaired mains.

Analytical Methods

AWWA Standard C651-05 requires that the samples be examined for bacteriological quality in accordance with AWWA's *Standard Methods for the Examination of Water and Wastewater* (APHA *et al.*, 2005). Coliforms are the indicator organisms used in monitoring the bacteriological quality of drinking water. The maximum contaminant level for total coliforms under the Safe Drinking Water Act is based on the presence or absence of the indicator bacteria, not on density or direct count. Four commonly utilized laboratory methods of examination for coliforms are described in *Standard Methods for the Examination of Water and Wastewater*: MMO-MUG, multiple tube fermentation (MTF), presence-absence (PA), and membrane filtration (MF).

Several private laboratories located within the state of Kansas are certified for microbiological examination of drinking water samples. A current list can be obtained from the Public Water Supply Section of KDHE at (785) 296-5514, KDHE's Laboratory Improvement Program Office at (785) 296-3811 or http://www.kdheks.gov/lipo/index.html, or the KDHE district offices. The laboratory that is chosen to perform the analysis will typically provide the sampler with instructions and appropriate containers for sample collection. The KDHE microbiology laboratory is also available for examination of bacteriological samples. Scheduling for sample bottles and their examination by the KDHE microbiology laboratory may be requested from the Public Water Supply Section of KDHE at (785) 296-5514. Public Water Supply Systems that currently receive monthly sample bottles for monitoring distribution system samples for compliance with the Total Coliform Rule must not utilize their regular monthly bottle allotment for assessing the effectiveness of disinfection procedures on mains. Additional sample bottles requested for this sampling effort must be requested as a special project.

Number of Samples

AWWA Standard C651-05 provides that at least one set of samples for bacteriological examination be collected from every 1,200 ft of the new water main, plus one set from the end of the

line, and at least one set from each branch. If trench water or excessive quantities of dirt entered the new main during construction, samples should be taken at intervals of approximately 200 ft and identified by location.

Sample Collection Procedures

Use only sterile bottles furnished by the laboratory. Keep the bottles sealed until used. Each sample bottle should contain a de-chlorinating agent (typically, sodium thiosulfate) in sufficient amount to neutralize any residual chlorine in the water sample. Do not rinse the bottle prior to taking the sample as such rinsing will remove the de-chlorinating agent and render the subsequent sample invalid. Samples are not to be taken from a sampling fixture that has an aerator attached or from a sampling fixture attached to pipe or pipe/hydrant combination having a weep hole.

C651-05 prohibits collection of samples from hoses or fire hydrants. Experience has shown that the examination of samples collected from these types of sampling locations may result in a false presence of coliforms due to contamination of the sample. AWWA Standard C651-05 recommends the use of a specially installed sampling tap consisting of a smooth, unthreaded, 0.5-inch hose bib. Alternatively, a corporation stop installed in the main equipped with a copper-tube gooseneck assembly may be utilized as a sampling tap. After the samples have been collected, the gooseneck assembly may be removed and retained for future use.

Be sure that the heavily chlorinated water has been thoroughly flushed from the main before sampling. Run water through the sampling tap at a steady rate 3 to 5 minutes before beginning sampling procedure.

Wash hands thoroughly. Remove the bottle lid just before filling, holding the lid in your free hand. Do not contaminate the inner surface of the cap of the bottle with your hands. Fill the bottle to the shoulder or fill line. Do not overflow the bottle or splash water into or out of the bottle or onto the outside rim of the bottle. Replace the lid and tighten securely.

Complete the appropriate sample documentation provided by the laboratory. This will typically include a sample label and chain of custody form. If the KDHE laboratory is being utilized, a KDHE Sampling Data Card must be completed instead of a chain of custody form. The KDHE Sampling Data Card requires completion of the following information: collection date, collector's last name and first initial, time of collection, collection location, and chlorine residual.

Sample Delivery to Laboratory

Deliver the samples to the laboratory promptly after collection. There are strict time limits on the amount of time that may elapse between sample collection and analysis before the sample is considered too old to analyze. Check with your laboratory on sample holding time requirements. The EPA requires that samples reach the laboratory within 30 hours of collection. Unless special arrangements are made, schedule the collection of samples so that they do not arrive at the laboratory on weekends or holidays. Samples should be held at a temperature of 40 °F (4°C). If practicable, place samples in an iced cooler for storage during transport if transport time will exceed

one hour. At no time, however, should the sample container be allowed to become immersed or submerged in the ice or melted ice water. Check with the laboratory for specific packaging and transport recommendations.

This page was intentionally left blank.

ATTACHMENT C

EXAMPLE CALCULATIONS FOR THE DISINFECTION OF WATER MAINS WITH CHLORINE

1. FLUSHING RATE – Calculate the flushing rate for a given velocity (Table 1).

Example:

Calculate the flushing rate for a 6-inch diameter pipe which would provide a velocity of 2.5 ft/sec within the main.

Formulas:

$Area_{main}$, $ft^2 = \pi[(dia, ft)^2/4]$ = cross-sectional area of main

Flushing rate, gpm
= $(Area_{main}, ft^2)*(Velocity, ft/sec)*(7.48\ gal/ft^3)*(60\ sec/min)$

Solution:

$Area_{main}$, $ft^2 = \pi[(6\ in)*(1\ ft/12\ in)]^2/4 = 0.196\ ft^2$

Flushing rate, gpm
= $(0.196\ ft^2)*(2.5\ ft/sec)*(7.48\ gal/ft^3)*(60\ sec/min)$
= 220 gpm

2. PREPLACEMENT OF HTH GRANULES IN MAIN – Calculation of the amount of calcium hypochlorite (HTH) granules required for disinfection of a water main with a chlorine dose of 25 mg/L (Table 3).

Example:

Calculate the quantity of calcium hypochlorite granules required to disinfect 1,000 feet of a 4-inch diameter PVC pipe. Assume granules contain 65 percent available chlorine by weight.

Formulas:

Vol_{main}, $MG = \pi(dia, ft)^2/4*(length, ft)*(7.48\ gal/ft^3)*(1\ MG/1x10^6\ gal)$

Cl_2 needed, lb = $(Vol, MG)*(Cl_2\ dose, mg/L)*(8.34\ lb/gal)$

Calcium hypochlorite needed, lb = (Cl_2 needed, lb)/(percent available Cl_2/100)

Solution:

Vol_{main}, MG = π[(4 in)*(1 ft/12 in)]^2/4*(1,000 ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)
= 0.000653 MG

Calcium hypochlorite needed for disinfection of 1,000 ft of 4-in pipe, oz
= (0.000653 MG)*(25 mg/L Cl_2)*(8.34 lb/gal)*(16 oz/lb)/(0.65)
= 3.4 oz

This answer could also be obtained from Table 3 which is expressed in terms of the ounces of calcium hypochlorite granules required each 500-foot interval. In this example, since the pipe is 1,000 feet long, the amount of granules required must be doubled so the amount needed is 2 * 1.7 oz = 3.4 oz.

3. **PREPLACEMENT OF HTH TABLETS IN MAIN – Calculation of the number of 5-g calcium hypochlorite tablets (65 percent available chlorine) for disinfection of a water main with an initial chlorine dose of 25 mg/L (Table 4).**

Example:

Calculate the number of 5-g calcium hypochlorite tablets (65 percent available chlorine) necessary to apply an initial chlorine dose of 25 mg/L to 846 feet of 8-inch diameter PVC pipe.

Formulas:

Vol_{main}, MG = π[(dia, ft)^2/4]*(length, ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)

Calcium hypochlorite needed, lb
= (Vol, MG)*(Cl_2 dose, mg/L)*(8.34 lb/gal)/(percent available Cl_2/100)

Solution:

Vol_{main}, MG = π[(8 in)*(1 ft/12 in)]^2/4*(846 ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)
= 0.00221 MG

Calcium hypochlorite needed for disinfection of 846 ft of 8-in pipe, lb
= (0.00221 MG)*(25 mg/L Cl_2)*(8.34 lb/gal)/(65%/100)
= 0.71 lb

Weight per 5-g tablet of calcium hypochlorite, lb/tablet
= (5 g/tablet)*(0.035274 oz/g)*(1 lb/16 oz)
= 0.011 lb/tablet

Number of tablets providing 0.71 lb of calcium hypochlorite, tablets
= (0.71 lb calcium hypochlorite)*(1 tablet/0.011 lb)
= 64.5 tablets

Since there are approximately 47 sections of 18-foot sections in an 846-foot length of main, the number of tablets required per 18-foot section is 64.5 tablets/47 sections = 1.37 tablets per section. Assuming partial tablets are not possible, 2 tablets should be used per section of pipe for a total of 94 tablets for the 846 ft length of pipe. As Table 4 indicates, this solution could also be obtained from 2 tablets for each 18-foot section of 8-inch pipe.

4. CONTINUOUS METHOD

Procedure 1: Addition of Premixed Chlorinated Water (Table 5)

Example:

Calculate the amount of hypochlorite (sodium or calcium) necessary for disinfection of 500 ft of 6-inch main by the addition of premixed chlorinated water. For this problem, assume calcium hypochlorite is 65 percent available chlorine and sodium hypochlorite is a 15 percent available chlorine solution.

Formulas:

Vol_{main}, MG = π[(dia, ft)^2/4]*(Length, ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)

Utilizing calcium hypochlorite,
lbs of HTH = (Vol_{main}, MG)*(8.34 lb/gal)*(25 mg/L Cl_2)/(percent available Cl_2/100)

Utilizing sodium hypochlorite,
minimum volume, gal = (Vol_{main})*(25 mg/L Cl_2)/($Conc_{soln}$, mg/L as Cl_2), where a 1 percent available chlorine solution as sodium hypochlorite is approximately equivalent to 10,000 mg/L as Cl_2.

Solution:

Vol_{main}, MG = π[(6/12)^2/4]*(500 ft)]*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)
= 7.34 x 10^{-4} MG or 734 gal

Utilizing 65 percent available chlorine calcium hypochlorite, the required amount of HTH in lbs to be added to 734 gal:

= (7.34 x 10^{-4} MG)*(8.34 lb/gal)*(25 mg/L Cl_2)/(0.65)
= 0.24 lb or 3.8 oz

The volume of 15 percent available chlorine sodium hypochlorite to be added to 734 gallons:

= (734 gal)*(25 mg/L Cl_2)/(150,000 mg/L)
= 0.12 gal

This answer can also be obtained from Table 5 which indicates that for a 100-foot section of 6-inch diameter water main, 0.024 gal of 15 percent available chlorine sodium hypochlorite or 0.75 ounces of 65 percent available chlorine HTH are required for a 25 mg/L chlorine dose. Since the problem statement specifies a 500-foot main, the table entries should be multiplied by 5 yielding the minimum quantities of 0.12 gal of 15 percent available chlorine sodium hypochlorite or 3.8 oz of 65 percent available chlorine HTH.

Procedure 2: Injection of Concentrated Chlorine Solution (Table 5)

Example:

Calculate the amount of hypochlorite (sodium or calcium) necessary for disinfection of 5,250 ft of 8-inch diameter main by the continuous method. For this problem, assume calcium hypochlorite is 65 percent available chlorine and sodium hypochlorite is a 15 percent available chlorine solution.

Formulas:

Vol_{main}, MG = π[(dia, ft)^2/4]*(length, ft)]*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)

Chlorine feed rate ($Cl_{2\ feed}$), lb/hr
= (Q_{fill}, gpm)*(1440 min/day)*(1 day/24 hr)*(1 MG/1x10^6 gal)*(25 mg/L)

Calcium Hypochlorite

Calcium hypochlorite, lb/hr = ($Cl_{2\ feed}$, lb/hr)/(percent available Cl_2/100)

HTH, in lb = (Vol_{main}, MG)*(8.34 lb/gal)*(25 mg/L Cl_2)/(percent available Cl_2/100)

Chlorine concentration in prepared chlorine solution, mg/L
= (HTH, lb)/(Vol_{soln})* (1x10^6 gal/1 MG)
(1 mg/L/8.34 lb/MG)(percent available Cl_2/100)

Sodium Hypochlorite

Flow rate of water into main (Q_{fill}), gpm
= [($Conc_{soln}$) * (Q_{soln}, gpm)/25 mg/L)] – (Q_{soln}, gpm)

Solution:

Vol_{main}, MG = π[(8 in)*(1 ft/12 in)]^2/4]*(5,250 ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)
= 0.0137 MG

Calcium Hypochlorite

Assume a chlorine solution injection rate of 2.5 gal/hr (0.0417 gpm) and a filling rate of 150 gpm.

Cl_2 feed rate, lb/hr
= (150 gpm)*(1440 min/24 hr)*(1 MG/1x10^6 gal)*(8.34 lb/gal)*(25 mg/L)
= 1.88 lb/hr

Calcium hypochlorite feed rate, lb/hr
= (1.88 lb/hr)/(65%/100)
= 2.89 lb/hr

Calcium hypochlorite necessary for disinfection of 5,250 ft of main, lb
= (0.0137 MG)*(25 mg/L Cl_2)*(8.34 lb/gal)/(65%/100)
= 4.4 lb

The time it takes to fill the main, T_{fill}, which may be assumed equivalent to the period of chlorine solution injection, $T_{injection}$, is determined by dividing the volume of the main by the rate of filling: 13,700 gal/150 gpm = 91 min. For a chlorine solution injection rate, Q_{soln}, of 0.0417 gpm, the required volume of chlorine solution, Vol_{soln}, is 3.8 gal. The combination of 4.4 lb of HTH in 3.8 gal of water results in a chlorine solution with a concentration estimated by the following:

Chlorine concentration in solution, mg/L as Cl_2
= (4.4 lb/3.8 gal)*(65%/100)*(1x10^6 gal/1 MG)*(1 mg/L/8.34 lb/MG)
= 90,200 mg/L or an approximately 9% solution.

Sodium Hypochlorite

In this case, assume the 15 percent available chlorine sodium hypochlorite solution will be pumped into the main without dilution at an injection rate of 2.5 gal/hr (0.0417 gpm). The required main filling rate, Q_{fill}, can be calculated as follows:

Q_{fill}, gpm = [(0.0417 gpm)*(150,000 mg/L)]/(25 mg/L) – 0.0417 = 250 gpm
The required volume of sodium hypochlorite solution is calculated from $T_{injection}$ and the assumed injection rate:

T_{fill}, min = $T_{injection}$, min = 13,700 gal/250 gpm = 55 min

Vol_{soln}, gal = (55 min)*(0.0417 gpm) = 2.3 gal

An alternative approach is to calculate the required feed rate of sodium hypochlorite. For an assumed main filling rate of 150 gpm (Q_{fill}), a 15 percent available chlorine solution, and an injection rate of 2.5 gal/hr (0.0417 gpm), the sodium hypochlorite feed rate ($Na\text{-}hypo_{feed}$) to form a 25 mg/L chlorine dose is calculated from the following equation:

Sodium hypochlorite feed rate (15 percent available chlorine), lb/hr
= [(150 gpm)*(1440 min/day)*(1 day/24 hr)*(1 MG/1x10^6 gal)
(8.34 lb/gal)(25 mg/L Cl_2)]/(15%/100)
= 12.5 lb/hr

Sodium hypochlorite feed rate (15 percent available chlorine), gal/hr
= [(150 gpm)*(1440 min/day)*(1 day/24 hr)*(1 MG/1x10^6 gal)
*(25 mg/L Cl_2)]/(15%/100)
= 1.5 gal/hr

T_{fill}, min = $T_{injection}$, min = 13,700 gal/150 gpm = 91 min

$Vol_{Na\text{-}hypo}$, gal = (91 min)*(0.0417 gpm) = 3.8 gal of sodium hypochlorite

Sodium hypochlorite, lb
= (12.5 lb/hr)*(91 min)*(1 hr/60 min)
= 18.9 lb

Sodium hypochlorite, gal
= (1.5 gal/hr)*(91 min)*(1 hr/60 min)
= 2.3 gal

5. SLUG METHOD – Calculation of the amount of chlorine necessary to form a slug of chlorinated water in a main with an initial chlorine dose of 100 mg/L.

Example:

Calculate the amount of chlorine gas required to create a slug of chlorinated water in 5,000 ft of a 6-inch diameter ductile iron main with an initial chlorine dose of 100 mg/L.

Formulas:

Vol, MG
= π[(dia, ft)^2/4]*(length of "slug", ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)

Chlorine (100 percent available chlorine) needed, lb
= (Vol, MG)*(Cl_2 dose, mg/L)*(8.34 lb/gal)

Solution:

Vol_{main}, MG
= (π[(16 in)*(1 ft/12 in)]^2/4)*(5,000 ft)*(7.48 gal/ft^3)*(1 MG/1x10^6 gal)
= 0.0522 MG

Chlorine (100 percent available chlorine) needed, lb
= (0.0522 MG)*(100 mg/L)*(8.34 lb/gal)
= 43.5 lb

6. **EMERGENCY MAIN DISINFECTION – Calculation of the sodium hypochlorite pumping rate and minimum volume of hypochlorite necessary to establish initial chlorine doses of 100 mg/L and 300 mg/L in a water main (Table 7).**

Example:

Calculate the sodium hypochlorite pumping rate (assuming a 5 percent available chlorine solution) and the amount of sodium hypochlorite solution necessary to establish a 300 mg/L chlorine dose in a 300-foot section of a 6-inch diameter main. Assume Q_{fill} into the main is 50 gpm.

Formulas:

Sodium hypochlorite solution pumping rate, gpm
= [(Cl_2 dose, mg/L)/($Conc_{soln}$, mg/L)]*(Q_{fill}, gpm)

Vol_{main}, gal
= (π(dia, ft)^2/4)*(Length, ft)*(7.48 gal/ft^3)

Volume of sodium hypochlorite solution, gal
= [(Cl_2 dose, mg/L)/($Conc_{soln}$, mg/L)]*(Vol_{main}, gal)

Solution:

Sodium hypochlorite solution pumping rate, gpm
= [(300 mg/L Cl_2)/(50,000 mg/L Cl_2)]*(50 gpm)
= 0.3 gpm

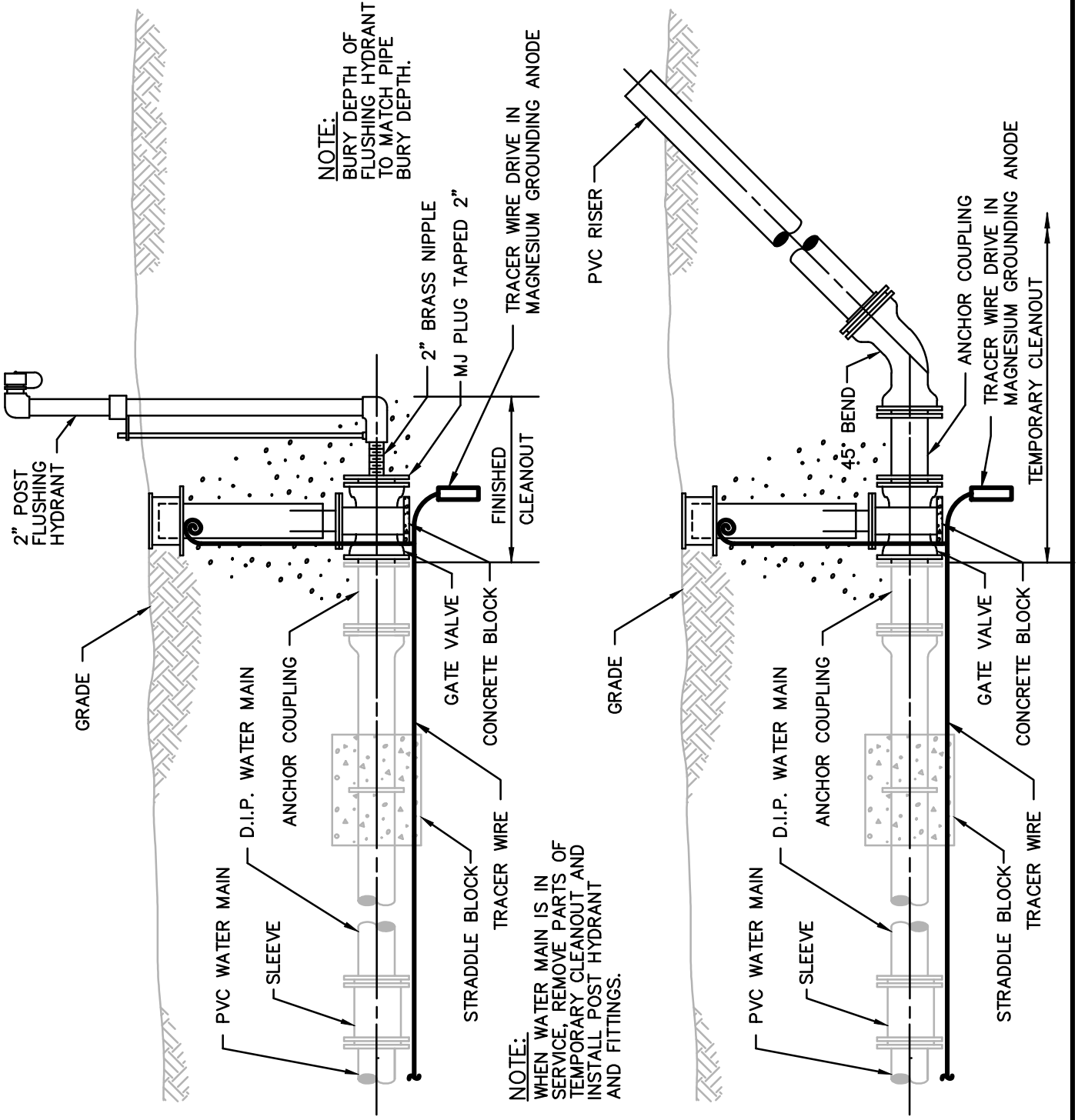
Vol_{main}, gal
= (π[(6 in)*(1 ft/12 in)]^2/4)*(300 ft)*(7.48 gal/ft^3)
= 441 gal

Volume of sodium hypochlorite solution, gal
= [(300 mg/L Cl_2)/(50,000 mg/L)]*441 gal
= 2.65 gal

$T_{injection}$, min = 2.65 gal/0.3 gpm = 441 gal/50 gpm = 8.8 min

The volume of sodium hypochlorite solution calculated in this problem can also be determined from Table 7. Table 7 indicates for a 6-inch pipe, 0.88 gal of 5-percent sodium hypochlorite solution is required to establish a 300 mg/L dose of Cl_2 in a 100-ft section of main. For a 300-ft section of main, the necessary volume of sodium hypochlorite from Table 7 for a 100-ft section should be multiplied by 3 to give 2.6 gal.

STANDARD DETAILS

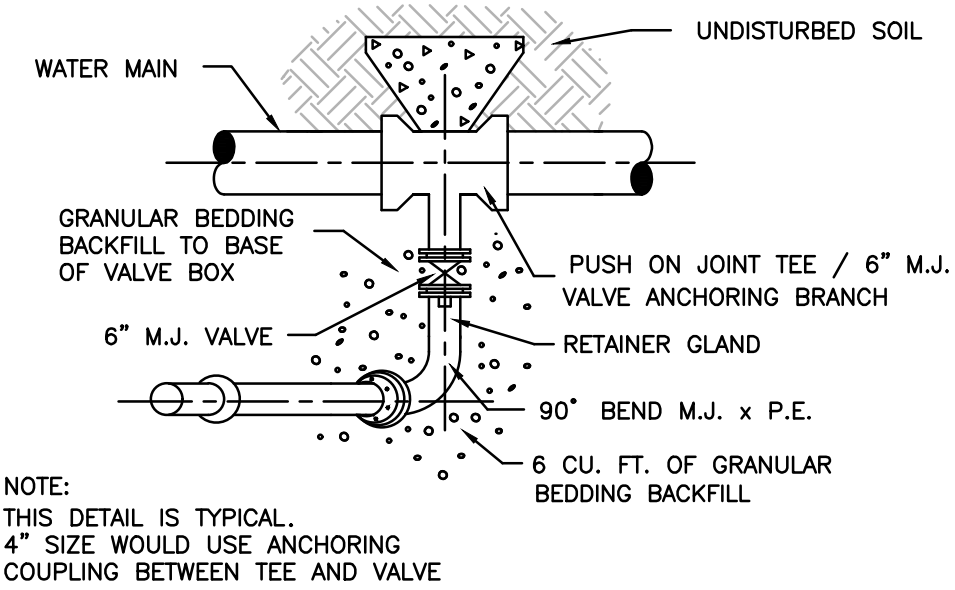


NOTE:
SEE DETAIL GV-1 FOR TRACER WIRE INSTALLATION DETAILS AT GATE VALVE

END-OF-LINE CLEANOUT DETAIL

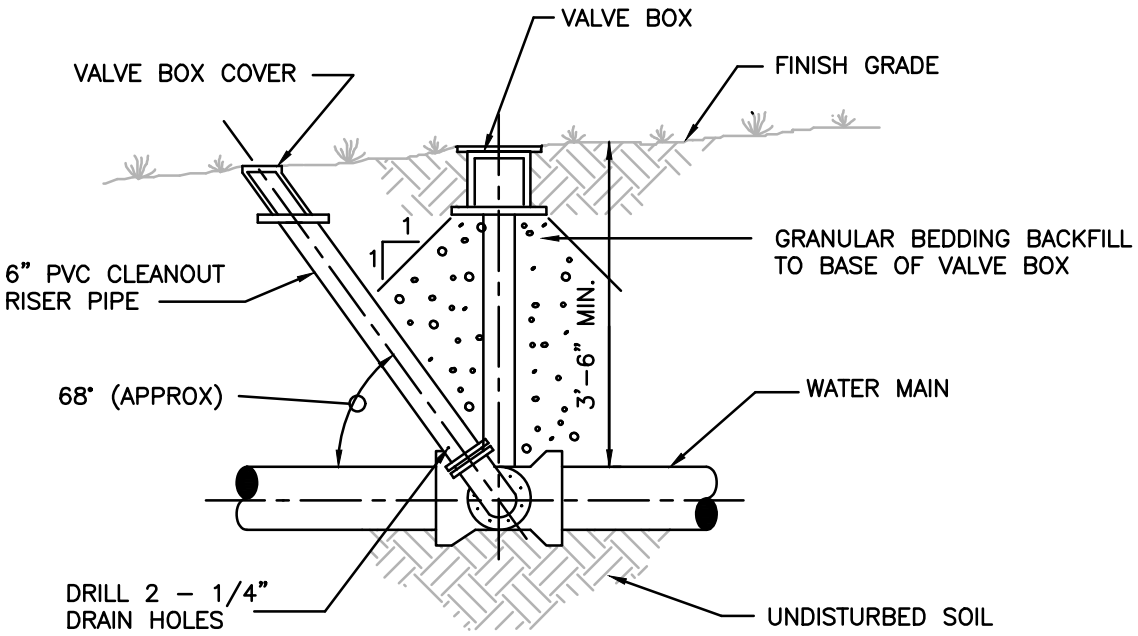
WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	END-OF-LINE CLEANOUT DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: CO-1

TEMP_C01-S



NOTE:
THIS DETAIL IS TYPICAL.
4" SIZE WOULD USE ANCHORING COUPLING BETWEEN TEE AND VALVE

PLAN



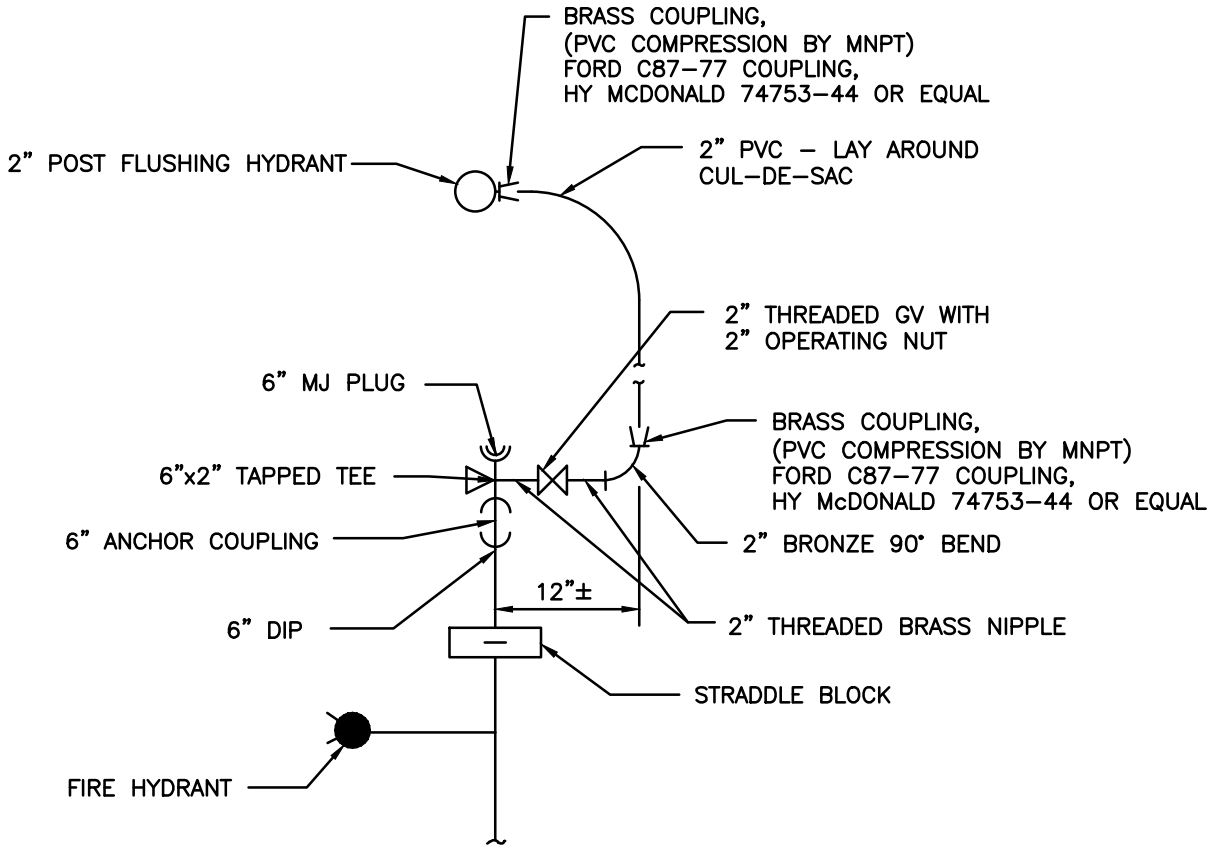
ELEVATION

NOTE:
SEE DETAIL GV-1 FOR TRACER WIRE INSTALLATION DETAILS AT GATE VALVE

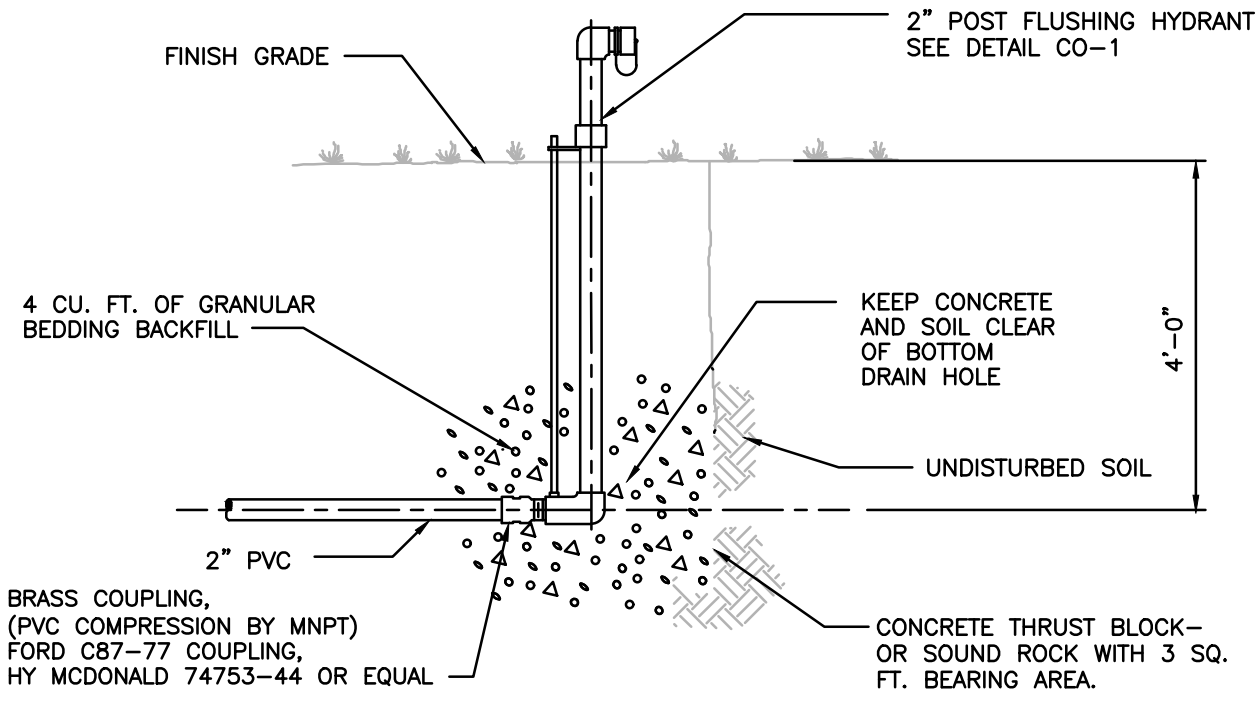
BRANCH CLEANOUT DETAIL

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	BRANCH CLEANOUT DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: CO-2

CLEAN1-S



PLAN

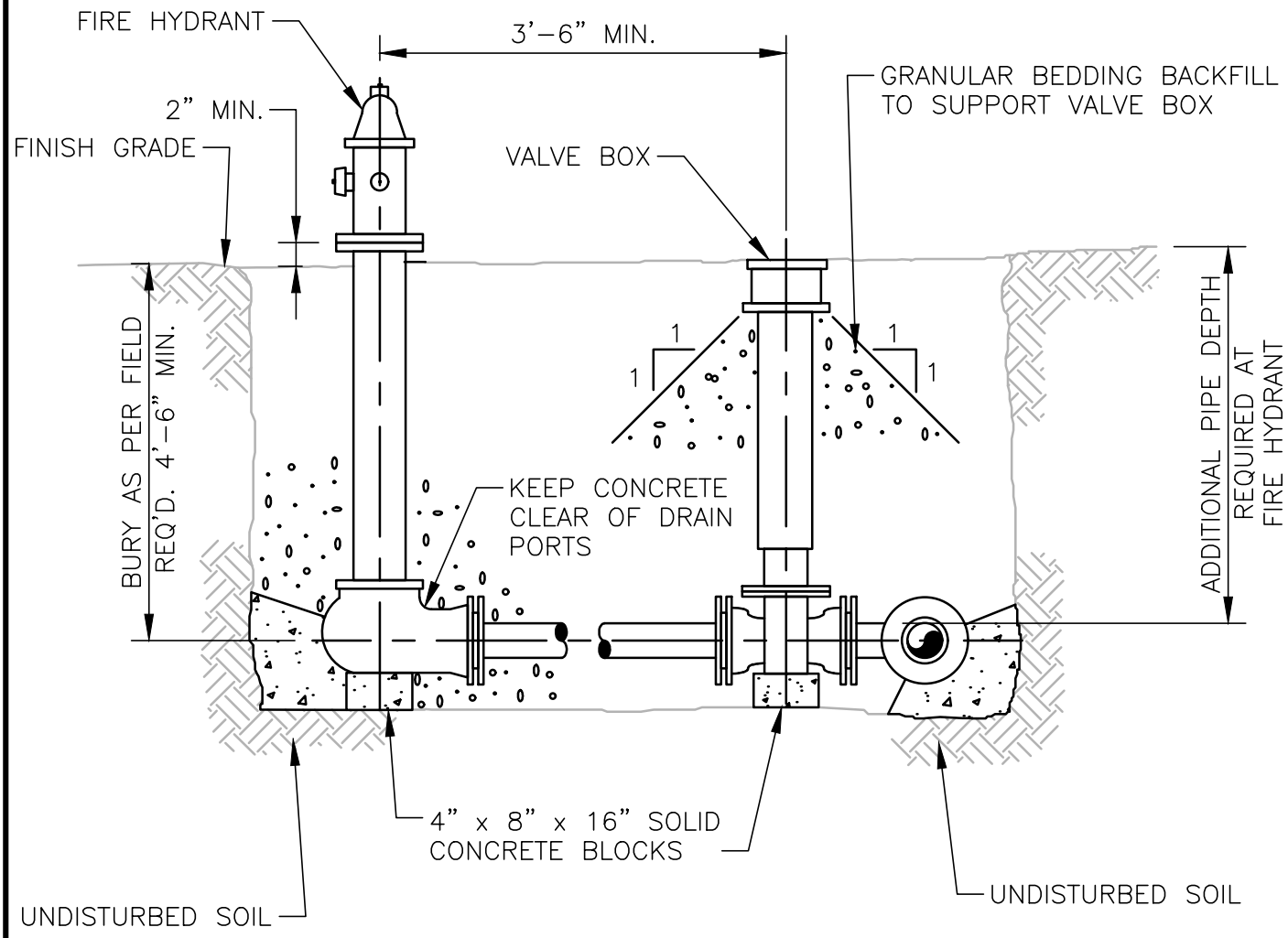


ELEVATION

2" CUL-DE-SAC CLEANOUT

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	2" CUL-DE-SAC CLEANOUT		
	DATE: SEPT, 2018	REVISED:	SHEET: CO-3

CULD



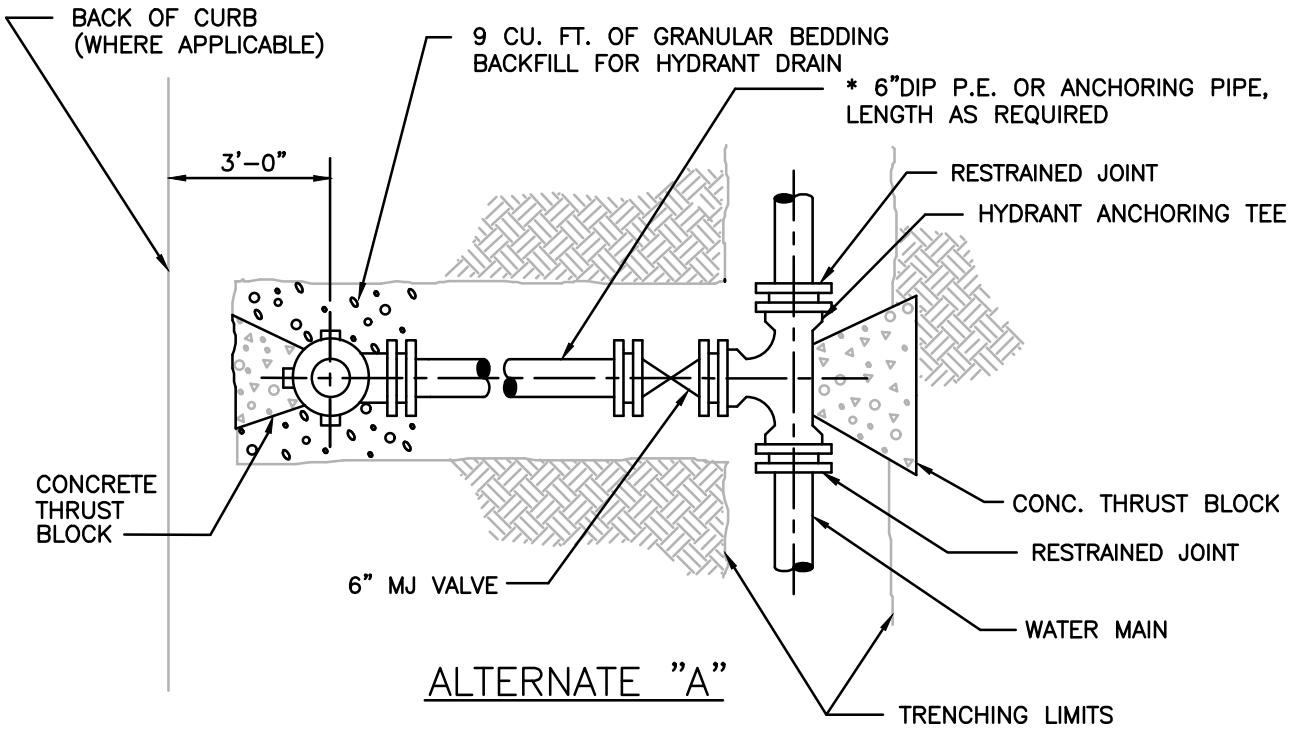
ELEVATION

NOTE:
SEE DETAIL GV-1 FOR TRACER WIRE
INSTALLATION DETAILS AT GATE VALVE

FIRE HYDRANT DETAIL

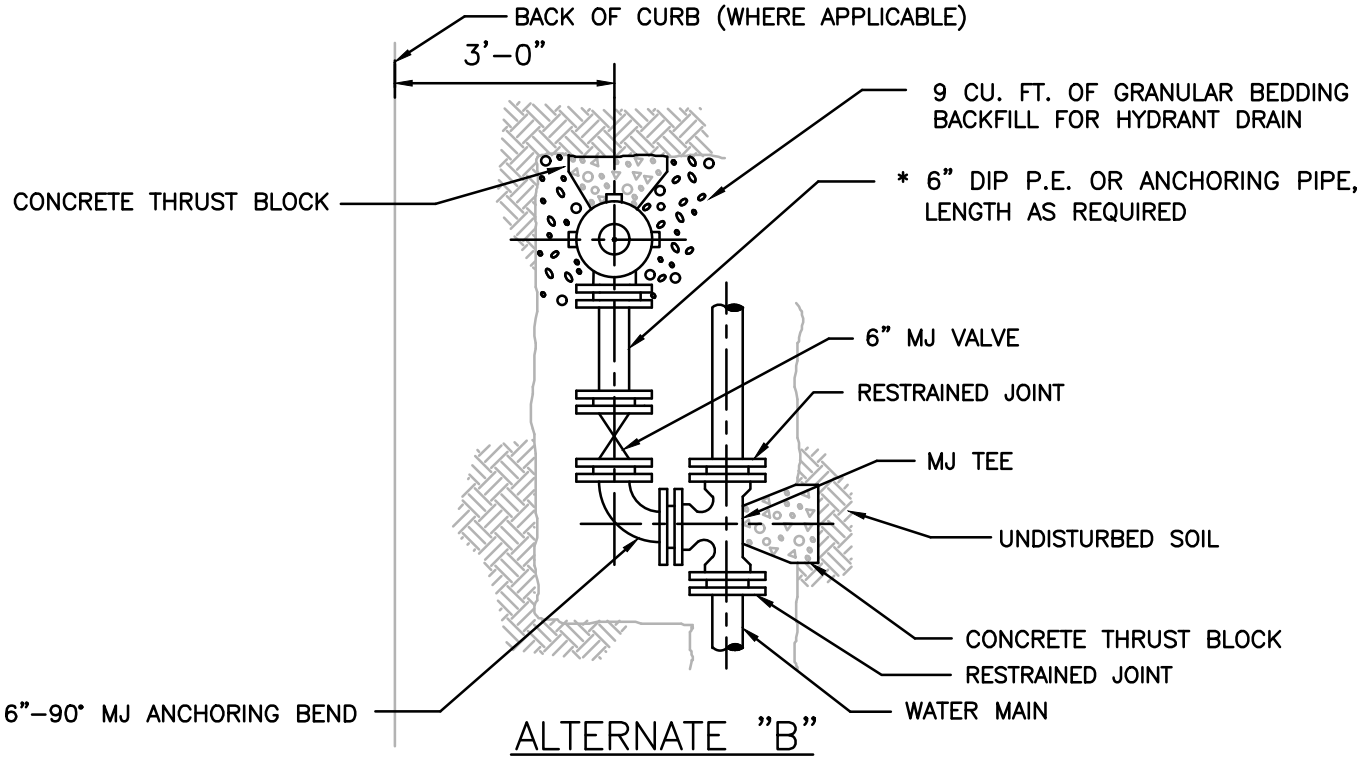
WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	FIRE HYDRANT DETAIL – ELEVATION		
	DATE: SEPT, 2018	REVISED:	SHEET: FH-1

FHELEV1-S



ALTERNATE "A"

* LENGTH DETERMINED BY FIELD CONDITIONS. WHEN USING ANCHORING PIPE, CONCRETE THRUST BLOCKS FOR FIRE HYDRANT AND ANCHORING TEE MAY BE REPLACED WITH SOLID CONCRETE BLOCKS (TIGHTLY WEDGED AGAINST TRENCH WALL)



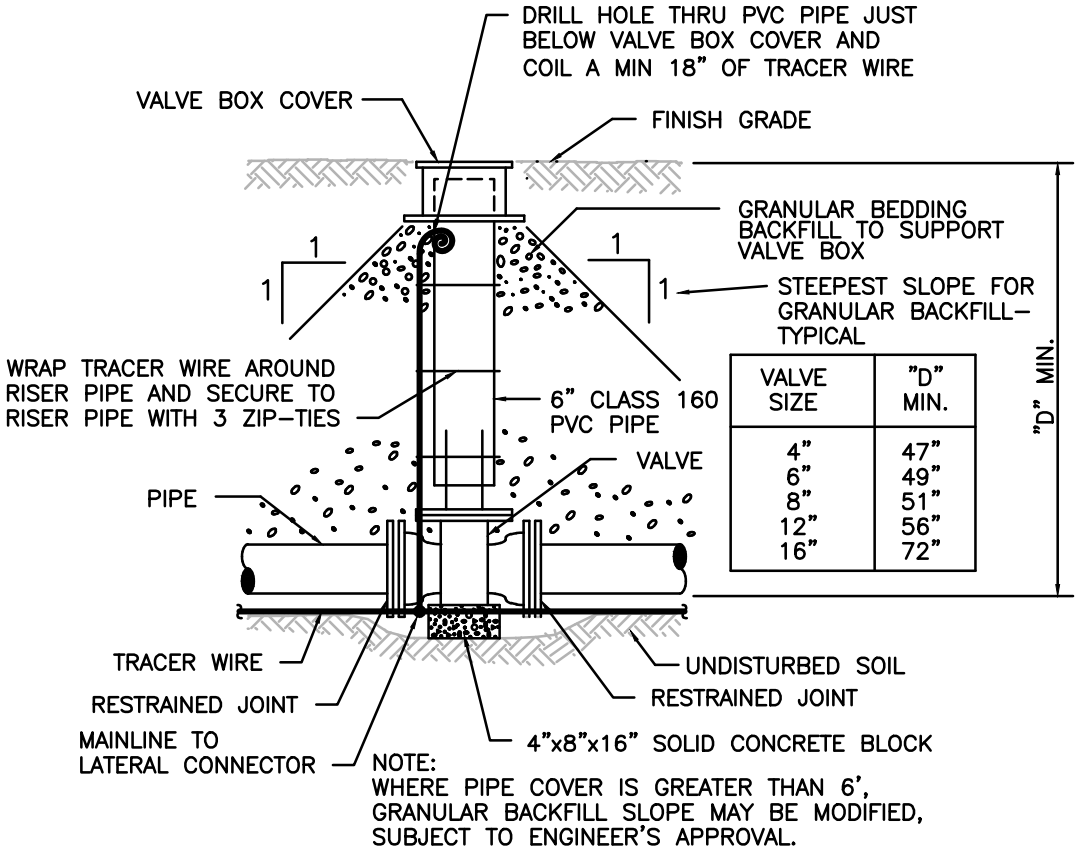
ALTERNATE "B"

NOTE:
SEE DETAIL GV-1 FOR TRACER WIRE INSTALLATION DETAILS AT GATE VALVE

FIRE HYDRANT DETAIL

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	FIRE HYDRANT DETAIL – PLANS		
	DATE: SEPT, 2018	REVISED:	SHEET: FH-2

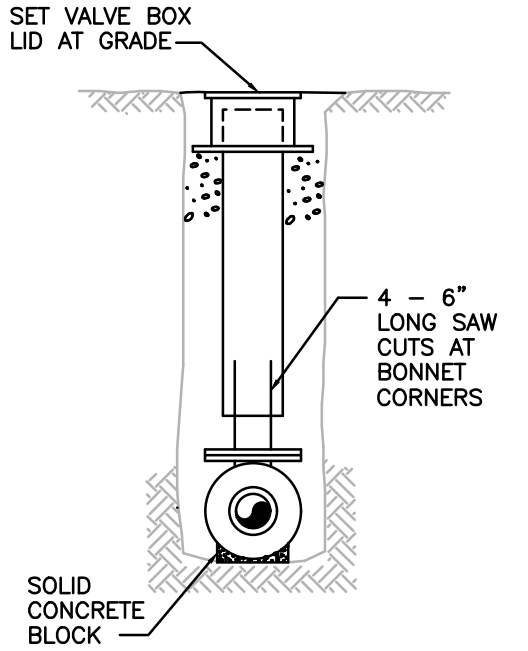
FIREH-S



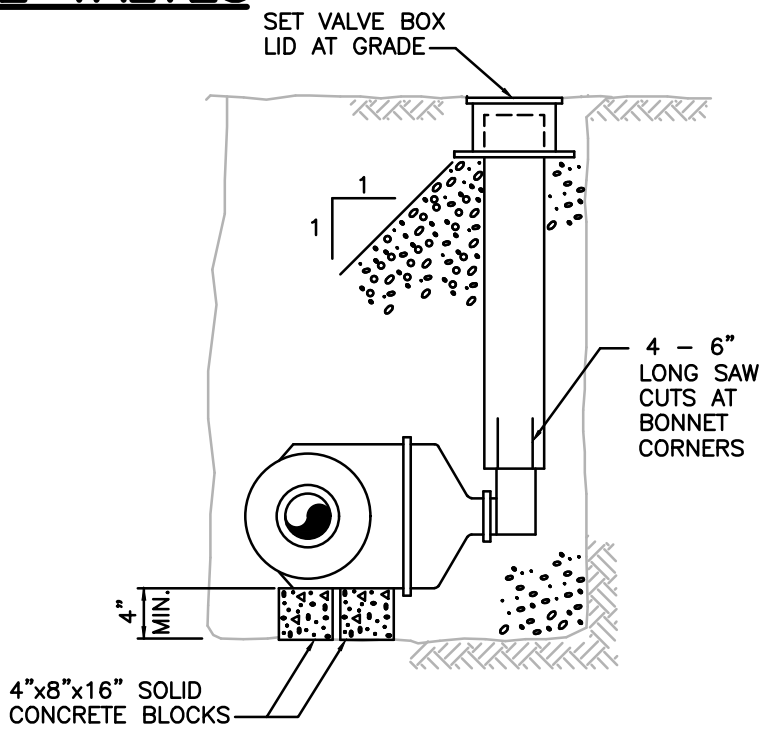
VALVE SIZE	"D" MIN.
4"	47"
6"	49"
8"	51"
12"	56"
16"	72"

NOTE:
WHERE PIPE COVER IS GREATER THAN 6', GRANULAR BACKFILL SLOPE MAY BE MODIFIED, SUBJECT TO ENGINEER'S APPROVAL.

GATE VALVES



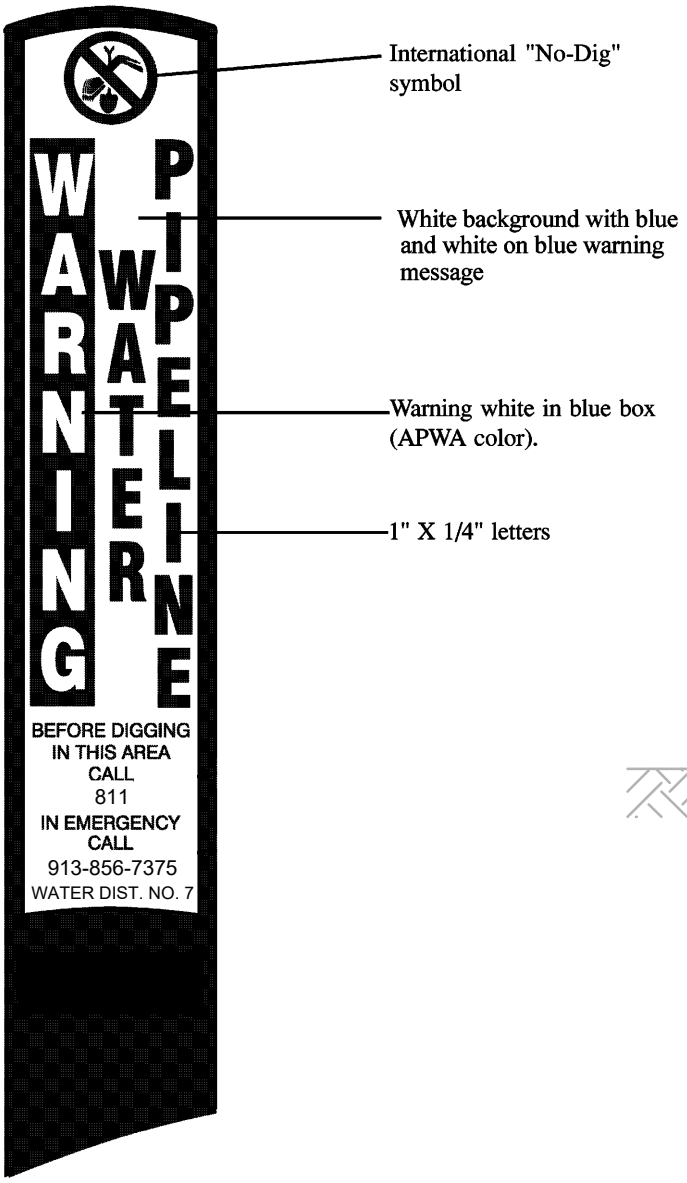
12" AND SMALLER SIZE GATE VALVES



16" AND LARGER SIZE GATE VALVES

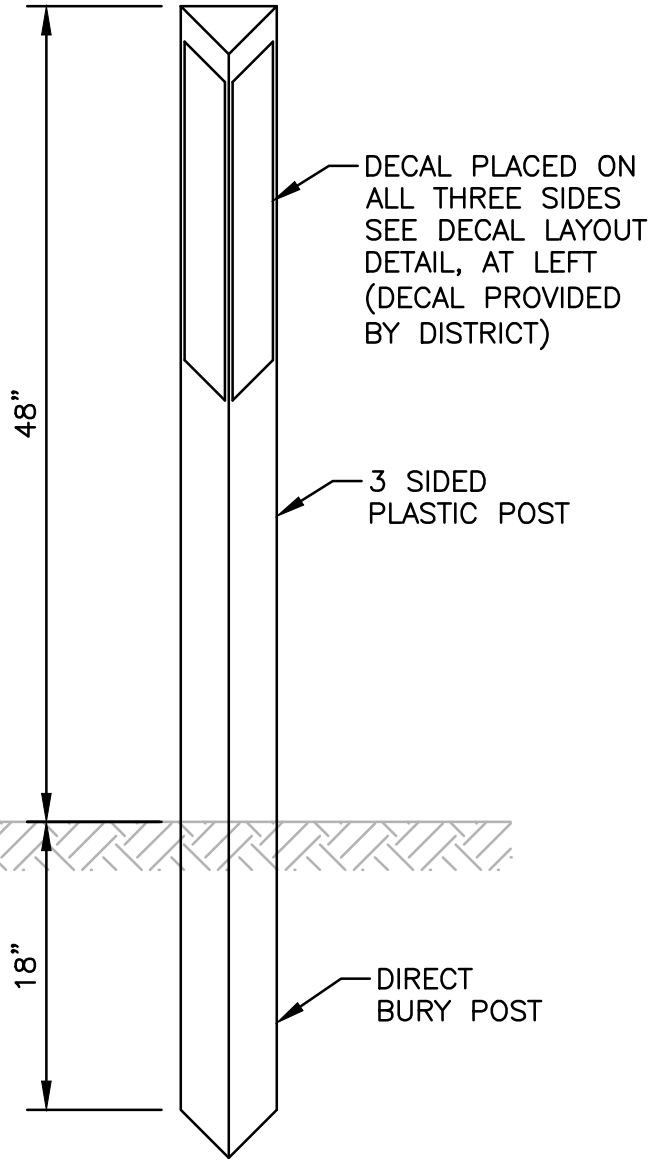
WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	GATE VALVE DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: GV–1

VALVE1–S



UTILITY MARKER DECAL LAYOUT

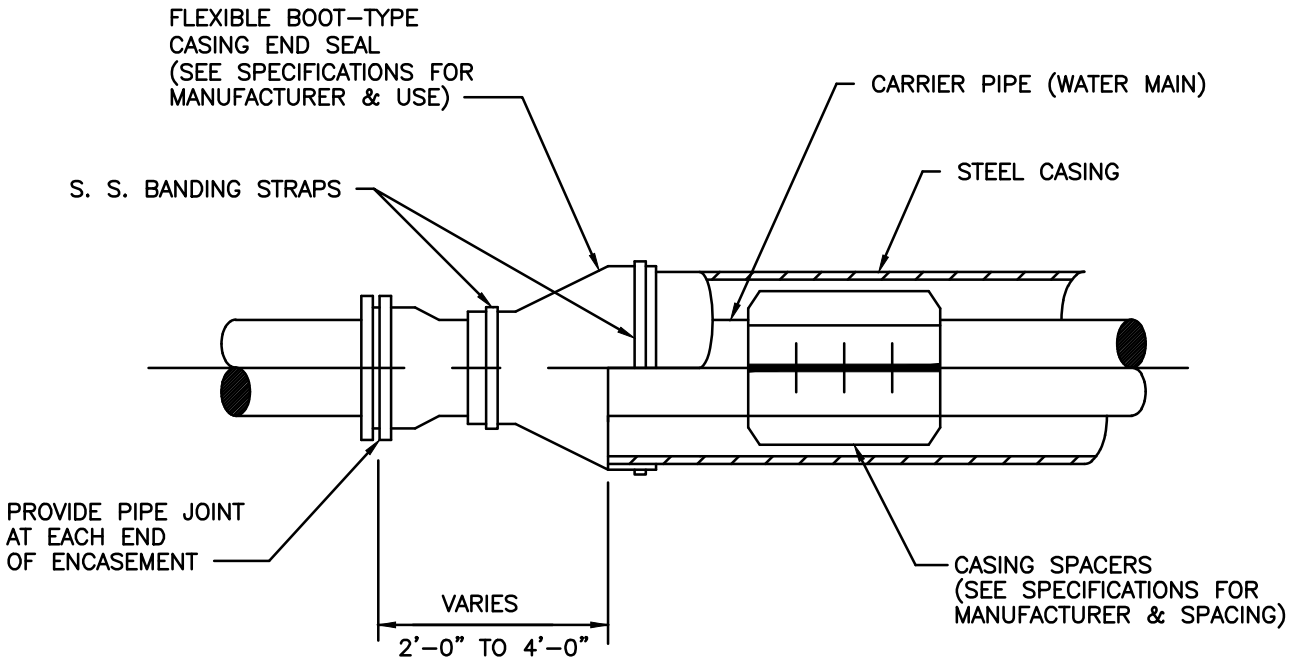
(DECAL PROVIDED BY DISTRICT)



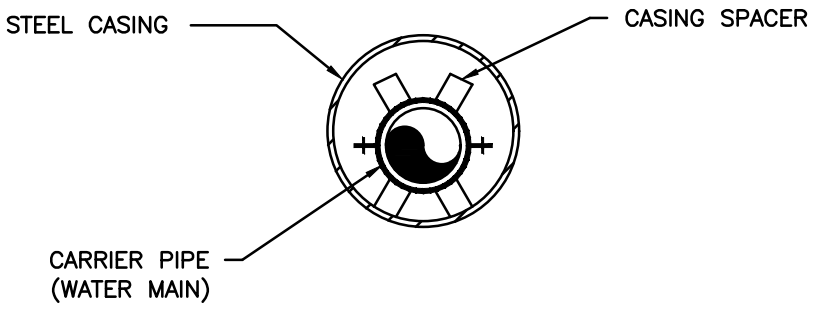
PIPELINE MARKER

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	MARKING POST DETAIL		
	DATE: SEPT, 2018	REVISED:	SHEET: MP–1

PIPELINE MARKER



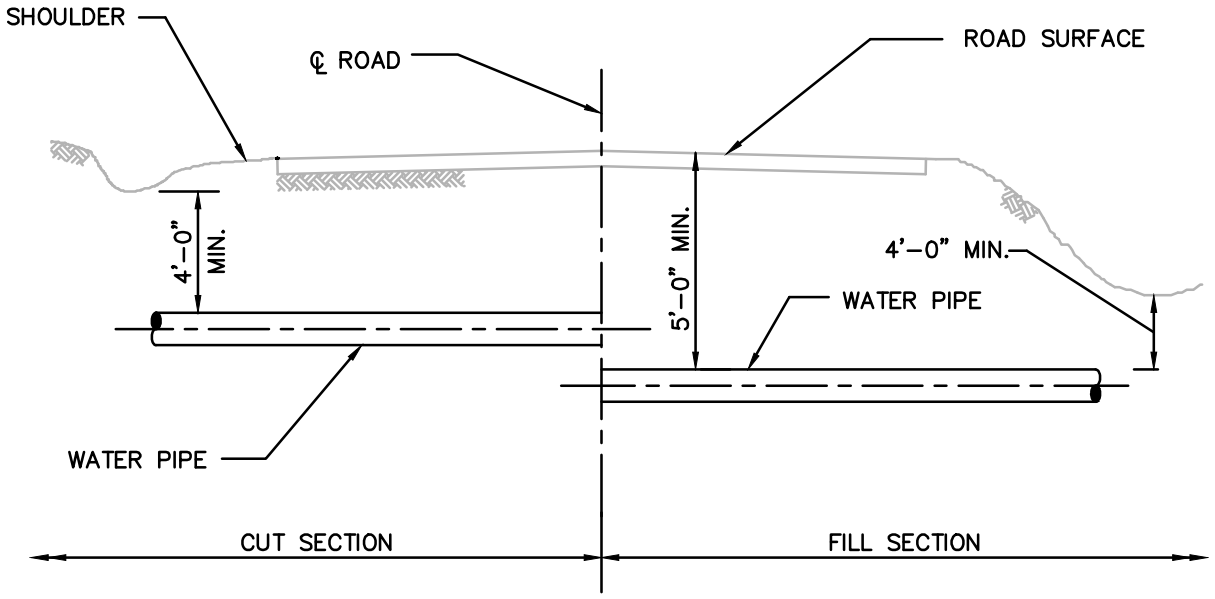
ELEVATION/SECTION



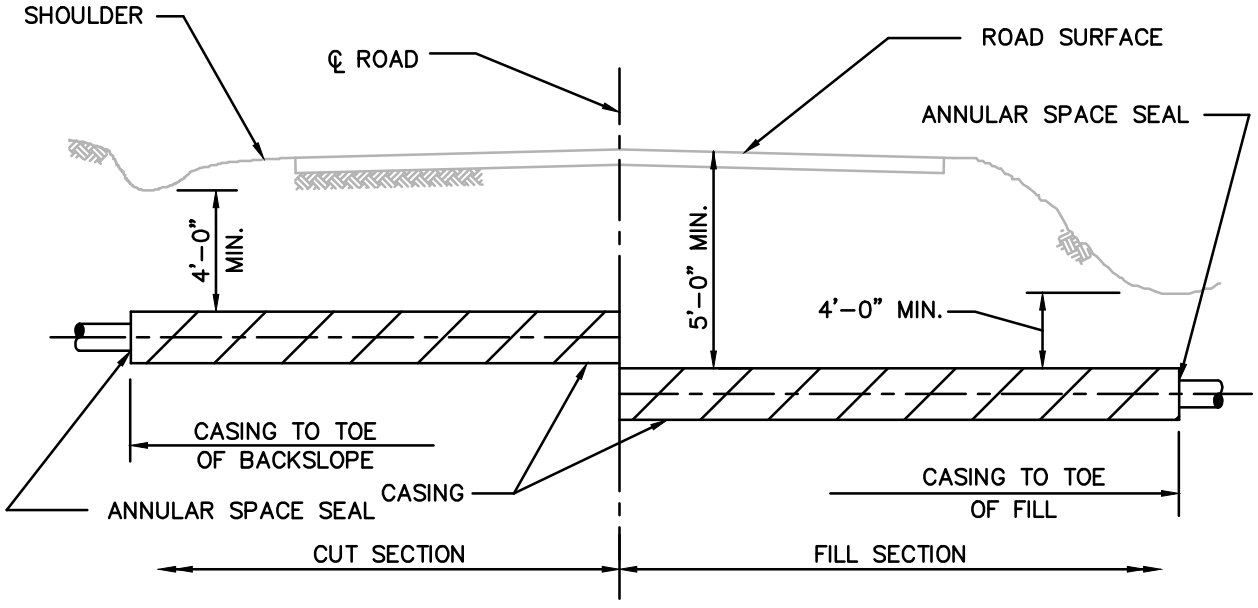
SECTION

ENCASE2-1-S

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	PIPE ENCASEMENT DETAILS		
	DATE: DEC, 2018	REVISED:	SHEET: PE-1



UNENCASED CROSSING



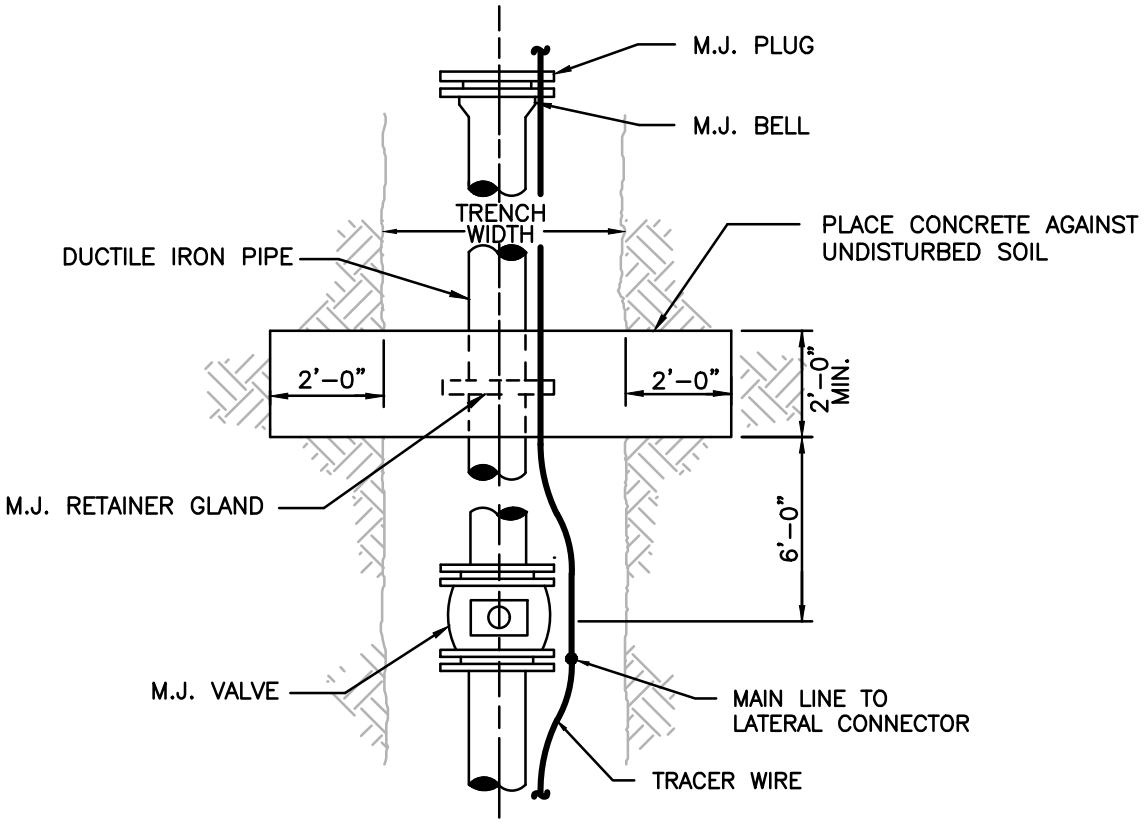
ENCASED CROSSING

NOTES:

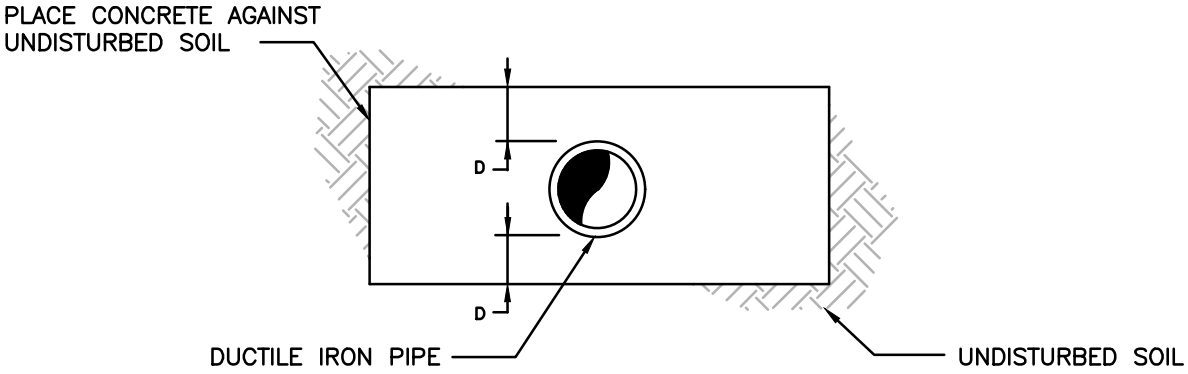
1. OWNER WILL OBTAIN ALL NECESSARY PERMITS.
2. SPECIFIC REQUIREMENTS OF THE PERMIT AGENCY MUST BE FOLLOWED IF MORE STRINGENT THAN THE REQUIREMENTS IN THESE RWD NO. 7 CONSTRUCTION STANDARDS.

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	ROAD CROSSING DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: RC–1

ROADX1–S



PLAN



D=NOMINAL PIPE DIAMETER

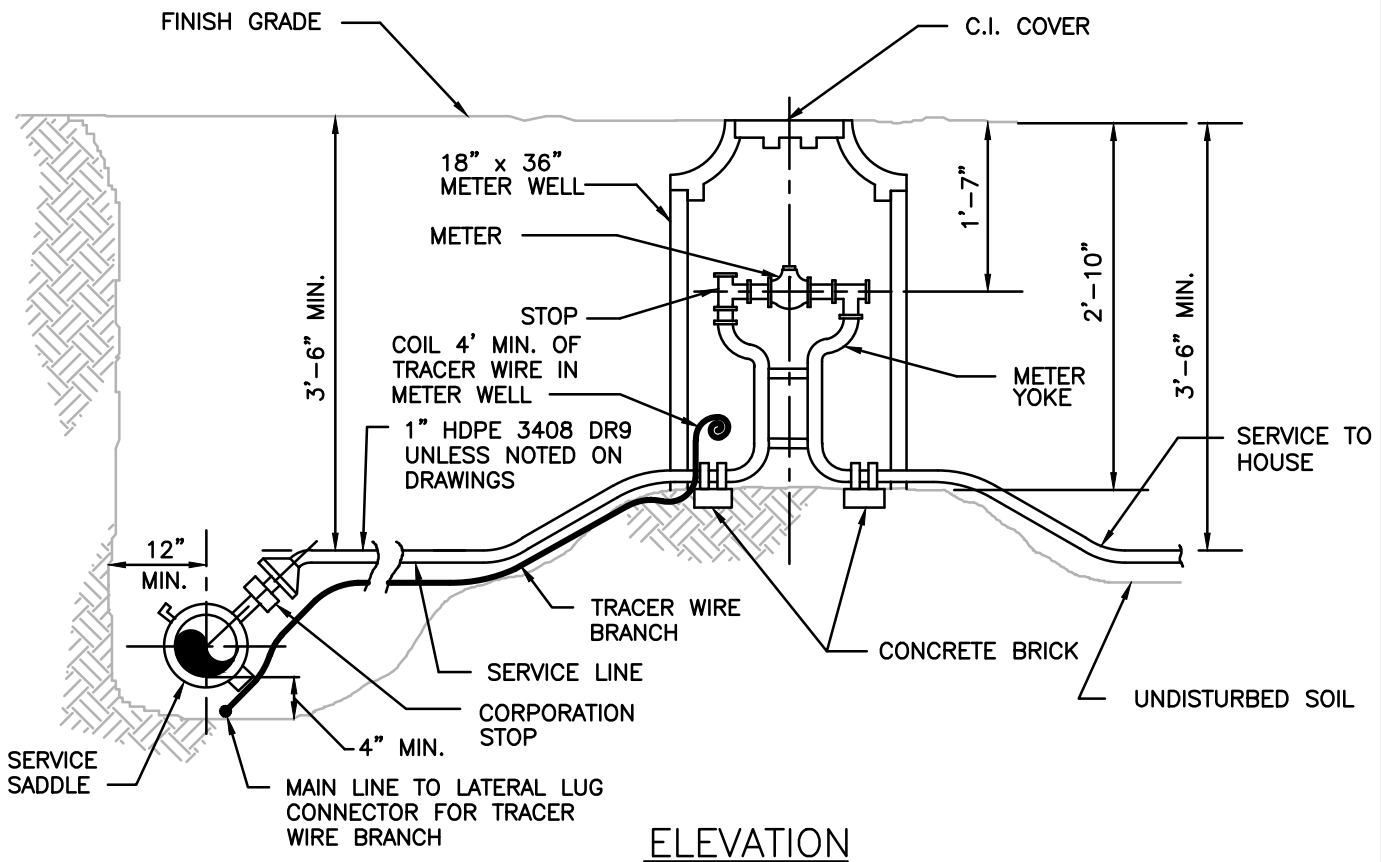
SECTION

NOTE:
SEE DETAIL GV-1 FOR TRACER WIRE INSTALLATION DETAILS AT GATE VALVE

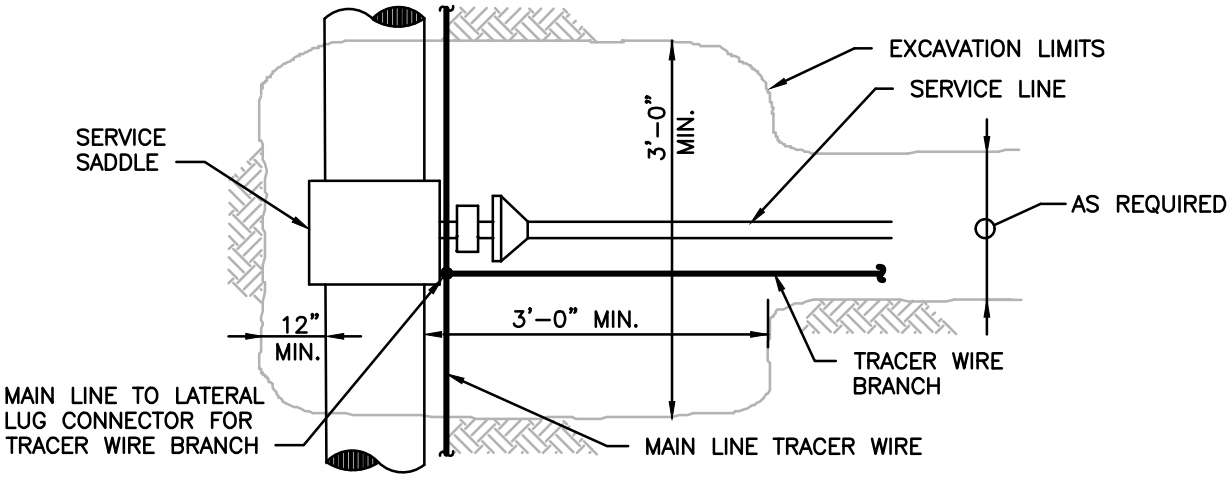
STRADDLE BLOCK DETAIL

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	STRADDLE BLOCK DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: SB-1

STRAD1-S



ELEVATION

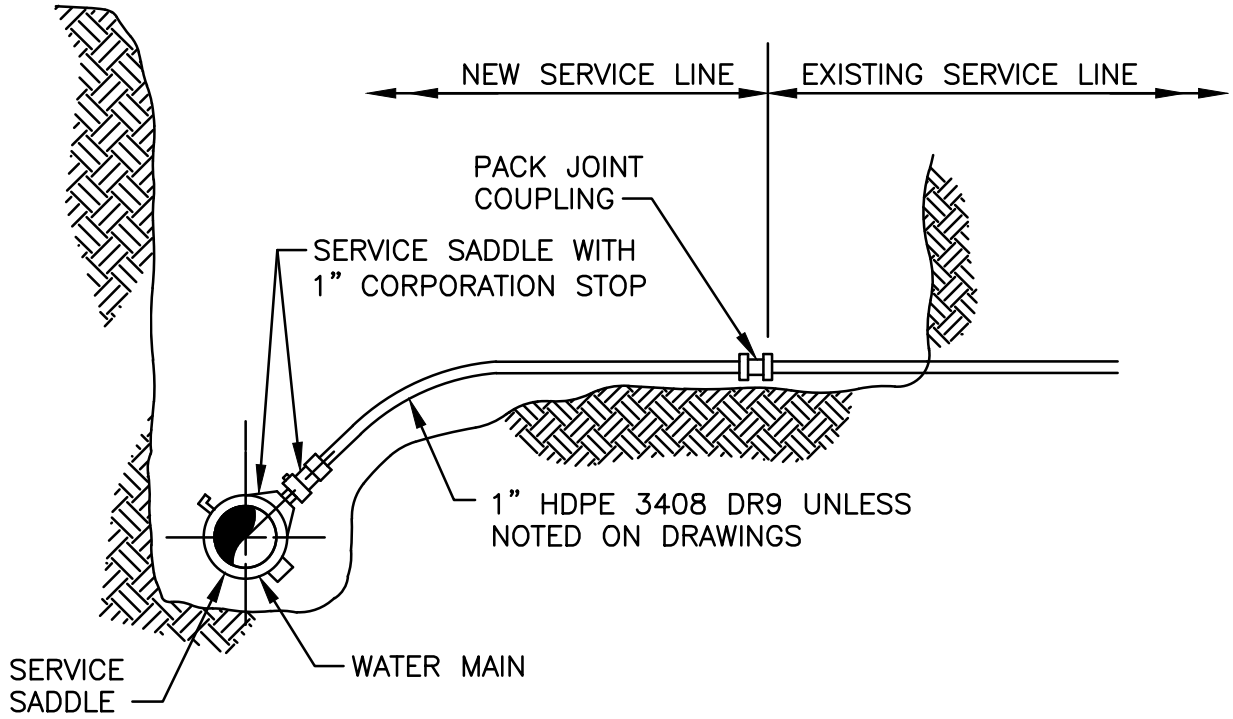


PLAN

5/8" x 3/4" METER INSTALLATION
METER RELOCATION DETAIL

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	SERVICE CONNECTION DETAIL		
	DATE: SEPT, 2018	REVISED:	SHEET: SC-1

SERV1-S



SERVICE RECONNECTION DETAIL

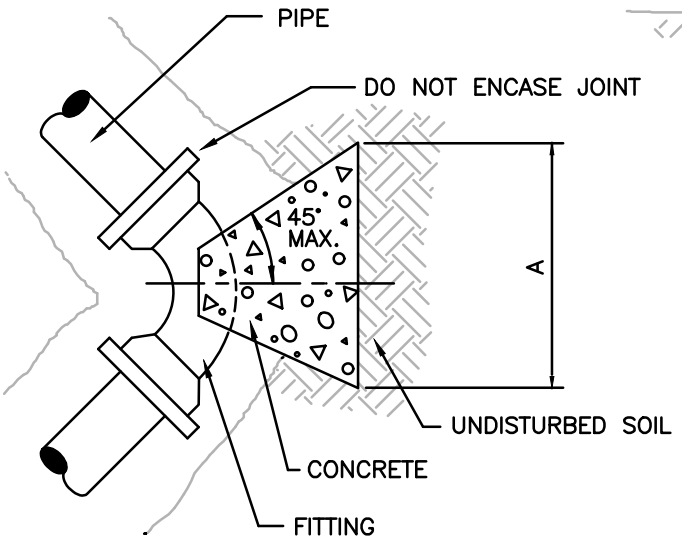
WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	SERVICE RECONNECTION DETAIL		
	DATE: SEPT, 2018	REVISED:	SHEET: SC–2

SERV2–S

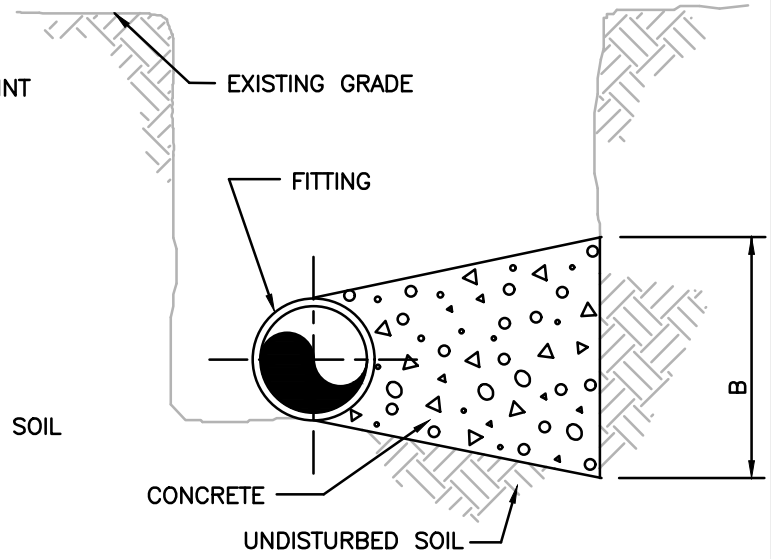
THRUST BLOCK SCHEDULE

PIPE SIZE	FITTING	A	B	CU. FT.
4" OR SMALLER	TEE	2'–0"	1'–6"	2.5
	90°	2'–9"	1'–6"	4.7
	45°	2'–0"	1'–0"	1.7
6"	TEE	3'–0"	2'–0"	7.5
	90°	3'–6"	2'–6"	13.3
	45°	2'–0"	2'–0"	3.4
8"	TEE	3'–6"	2'–6"	12.7
	90°	4'–0"	3'–0"	20.0
	45°	3'–0"	2'–0"	7.5
12"	TEE	4'–0"	4'–0"	26.7
	90°	5'–6"	4'–0"	50.4
	45°	4'–0"	3'–0"	20.0
16"	TEE	6'–0"	4'–0"	60.0
	90°	7'–0"	5'–0"	90.0
	45°	5'–0"	4'–0"	50.0

NOTES:
1. CLASS B CONCRETE – 2,000PSI, 28 DAYS.
2. SCHEDULE BASED ON THRUST RESISTANCE OF SOIL OF 1000 LBS. PER SQ. FT. AND 100 PSI LINE PRESSURE.
3. FOR LINE PRESSURE GREATER THAN 100 PSI AND/OR SOIL RESISTANCE LESS THAN 1,000 LBS. PER SQ.FT., THE SCHEDULE SHALL BE ADJUSTED IN THE FIELD.
4. DEAD END BLOCKING IS THE SAME AS FOR TEE.
5. FOR 8" AND SMALLER SIZE PIPE–THRUST BLOCK "A" AND "B" DIMENSIONS FOR 22 1/2° AND 11 1/4° BENDS SHALL BE THE SAME AS 45° BENDS.
6. FOR 12" AND LARGER SIZE PIPE–THRUST BLOCK "A" AND "B" DIMENSIONS FOR 22 1/2° AND 11 1/4° BENDS SHALL YIELD 50% AND 25%, RESPECTIVELY, OF THE BEARING AREA FOR 45° BENDS.



PLAN



SECTION

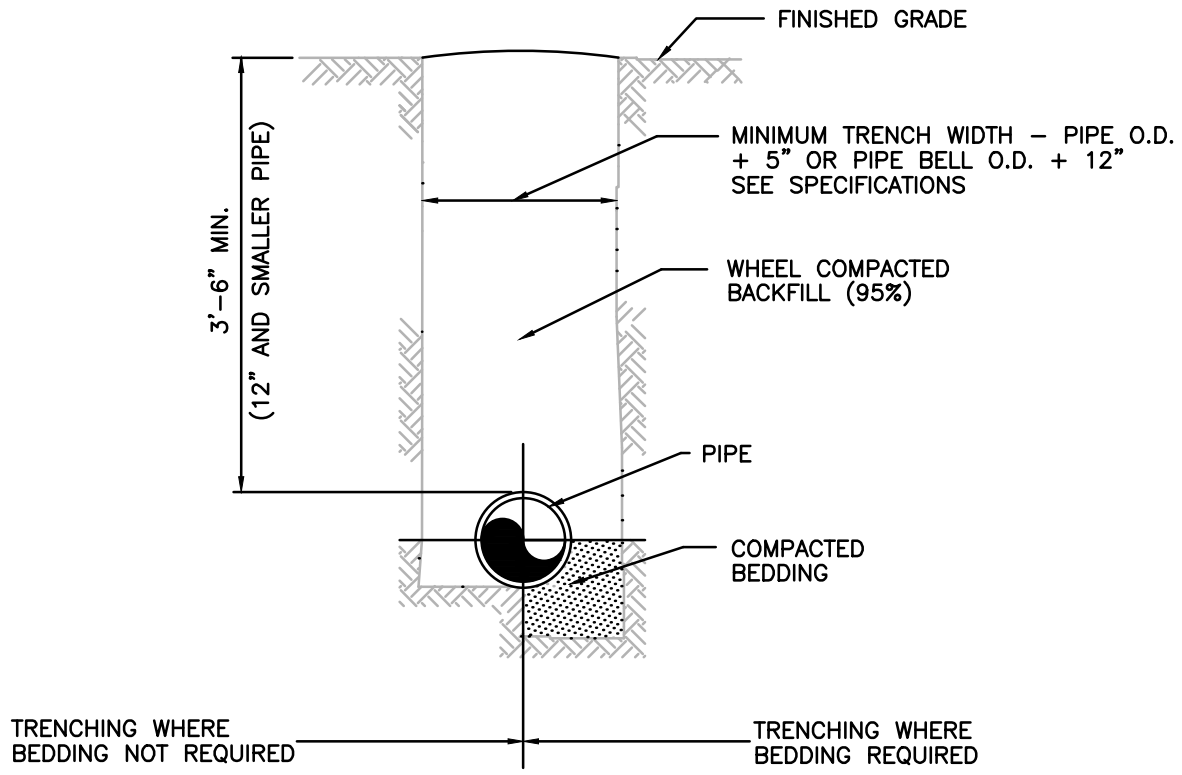
CONCRETE THRUST BLOCK DETAIL

WATER DISTRICT NO. 7
JOHNSON COUNTY, KANSAS

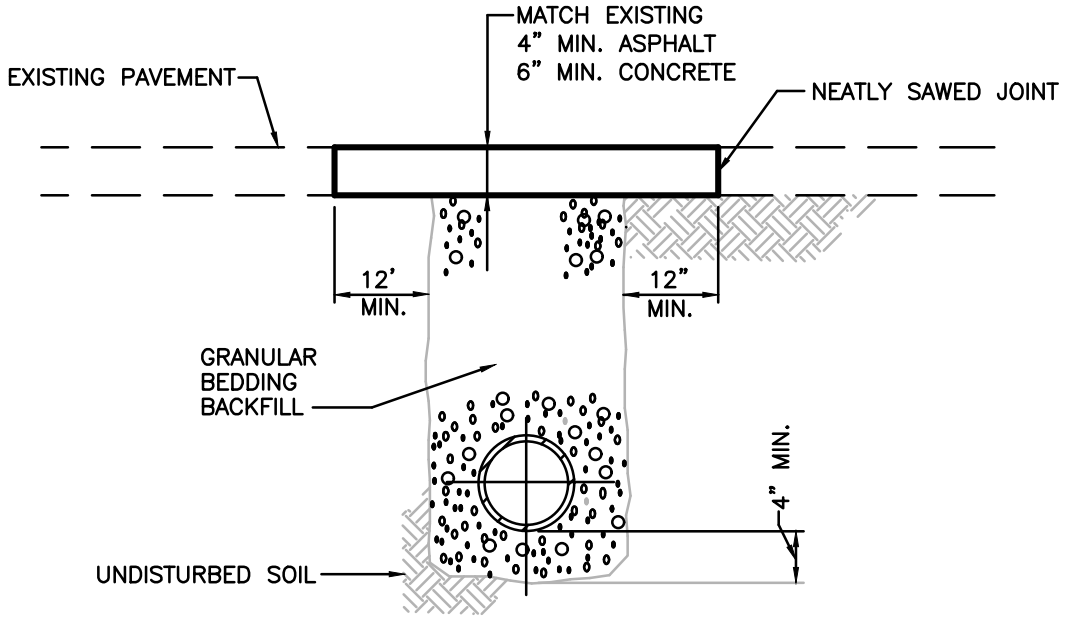
THRUST BLOCK DETAILS

DATE:	REVISED:	SHEET:
SEPT, 2018		TB–1

THRUST–S



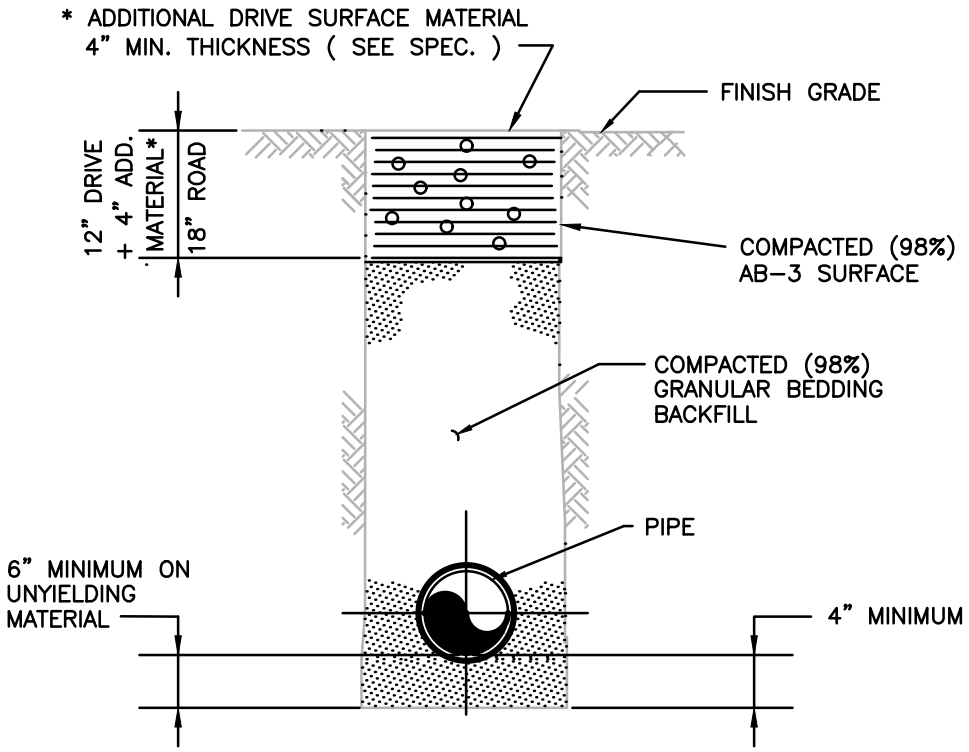
TYPICAL TRENCH DETAIL



PAVEMENT CUT REPAIR

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	TRENCH DETAILS		
	DATE: SEPT, 2018	REVISED:	SHEET: TD–1

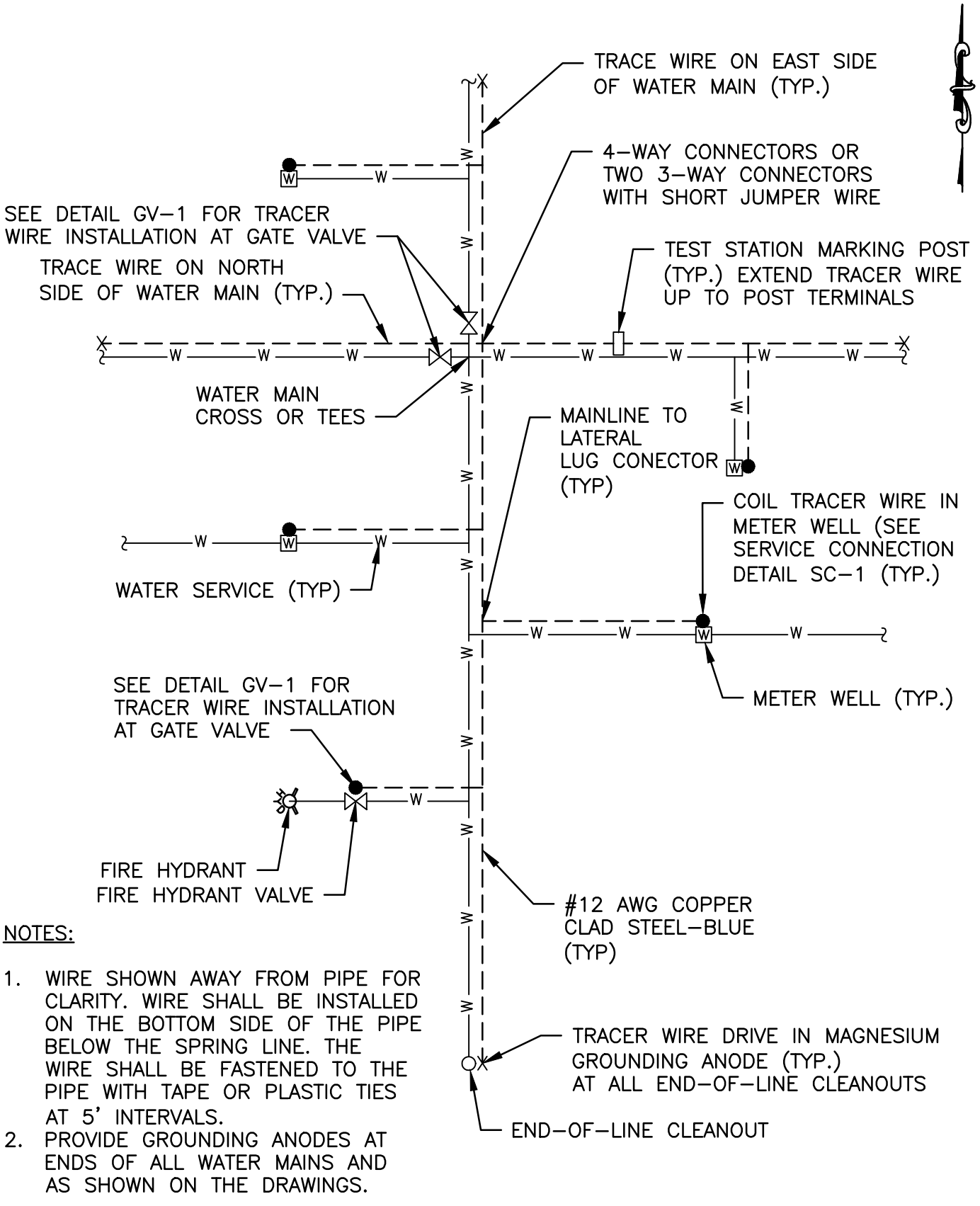
TRENCH1–S



GRAVEL ROAD AND DRIVE CROSSING TRENCH DETAIL

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	GRAVEL ROAD & DRIVE CROSSING TRENCH DETAIL		
	DATE: SEPT, 2018	REVISED:	SHEET: TD-2

RD_DR-TRENCH1-S



NOTES:

1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE BOTTOM SIDE OF THE PIPE BELOW THE SPRING LINE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.
2. PROVIDE GROUNDING ANODES AT ENDS OF ALL WATER MAINS AND AS SHOWN ON THE DRAWINGS.

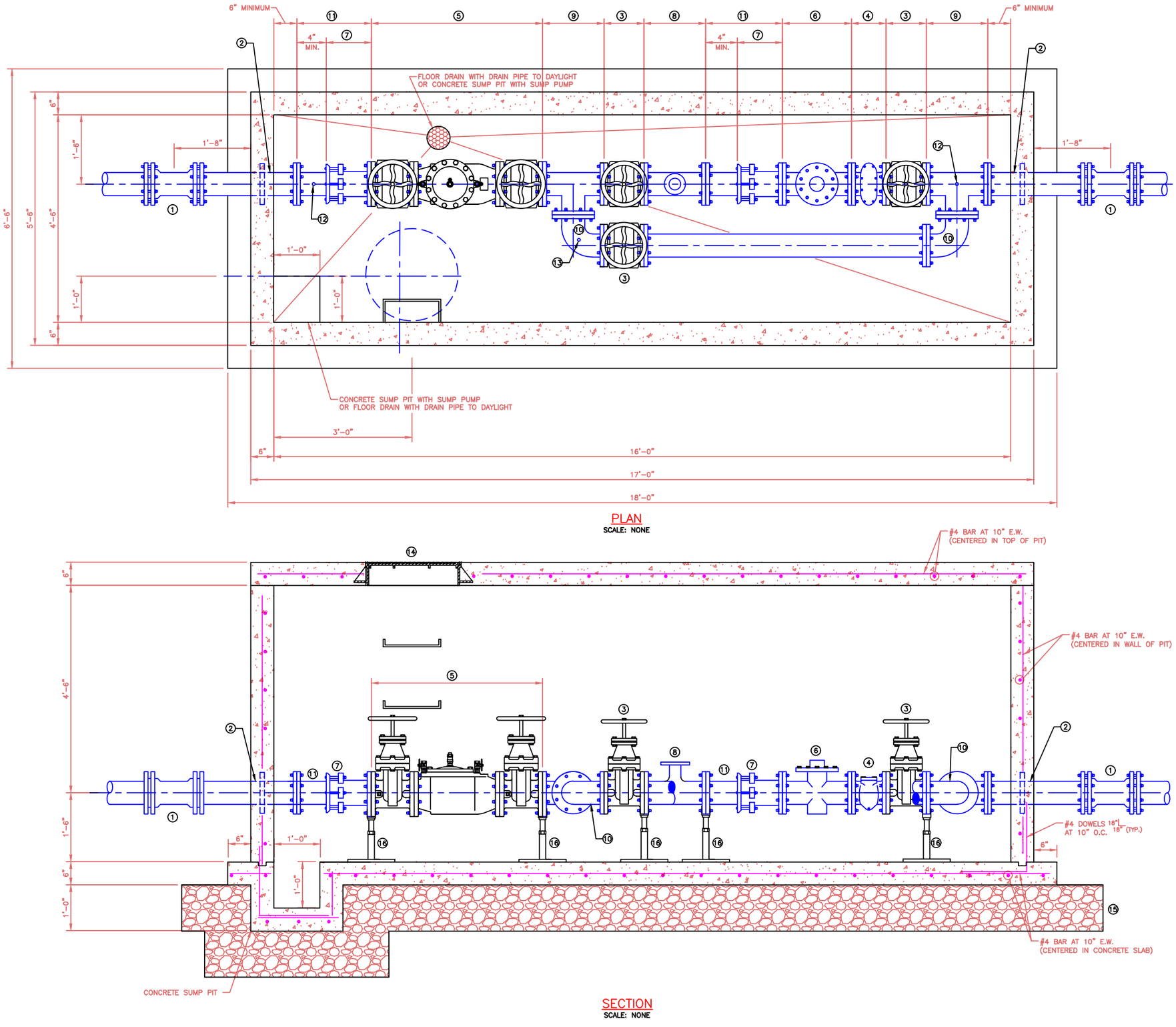
TRACER WIRE PLAN (WATER)

WATER DISTRICT NO. 7 JOHNSON COUNTY, KANSAS	TRACER WIRE		
	DATE: SEPT, 2018	REVISED:	SHEET: TW–1

TW–1

TYPICAL VAULT DETAILS FOR LARGE METERS AND BACKFLOW PREVENTERS

(General arrangement and requirements subject to review and approval per job specific conditions)



PLAN
SCALE: NONE

SECTION
SCALE: NONE

LEGEND

1. DUCTILE IRON CLASS 350 MECHANICAL JOINT LONG PATTERN SOLID SLEEVE
2. WALL PIPE (FLANGED x PLAIN END DIP)
3. RESILIENT SEATED GATE VALVE
4. AWWA TYPE WATER METER STRAINER
5. DOUBLE CHECK BACKFLOW PREVENTER
6. METER TO CONFORM TO OWNER'S CURRENT STANDARD METERS.
7. ROCKWELL 913 FLANGED COUPLING ADAPTER
8. TEST TEE WITH BLIND FLANGE
9. TEE
10. 90° BEND
11. FL. x PLAIN END DUCTILE IRON PIPE (MAX. LENGTH TO ALLOW ½" GAP TO COMPANION FLANGE, MIN. LENGTH TO ALLOW 3" GAP TO COMPANION FLANGE)
12. ½" TAP FOR PRESSURE GAUGE (ASHCROFT MODEL 1279ASL)
13. ¾" TAP FOR ¾" HOSE BIB
14. CLAY AND BAILEY LID AND COVER # 2213
15. 12" OF ½" TO ¾" CRUSHED ROCK
16. PIPE SUPPORT

TABLE

PART NO.	PIPE SIZE	OVERALL LENGTH	
①	3"	12"	
	4"	12"	
	6"	12"	
②	3"	—	
	4"	—	
	6"	—	
③	3"	8"	
	4"	9"	
	6"	10½"	
④	3"	7"	
	4"	9"	
	6"	9"	
⑤	3"	32¾"	
	4"	39"	
	6"	44⅝"	
⑥		TURBO	COMPOUND
	3"	12"	17"
	4"	14"	20"
	6"	18"	24"
⑦	3"	9"	
	4"	9"	
	6"	12"	
⑧	3"x3"	11"	
	4"x3"	13"	
	6"x3"	16"	
⑨	3"x3"	11"	
	4"x4"	13"	
	6"x6"	16"	
⑩	3"	5½" (℄ TO FLANGE)	
	4"	6½" (℄ TO FLANGE)	
	6"	8" (℄ TO FLANGE)	

WATER DISTRICT NO. 7 - JOHNSON COUNTY, KANSAS
METER VAULT
3",4" AND 6"
PLAN AND SECTION

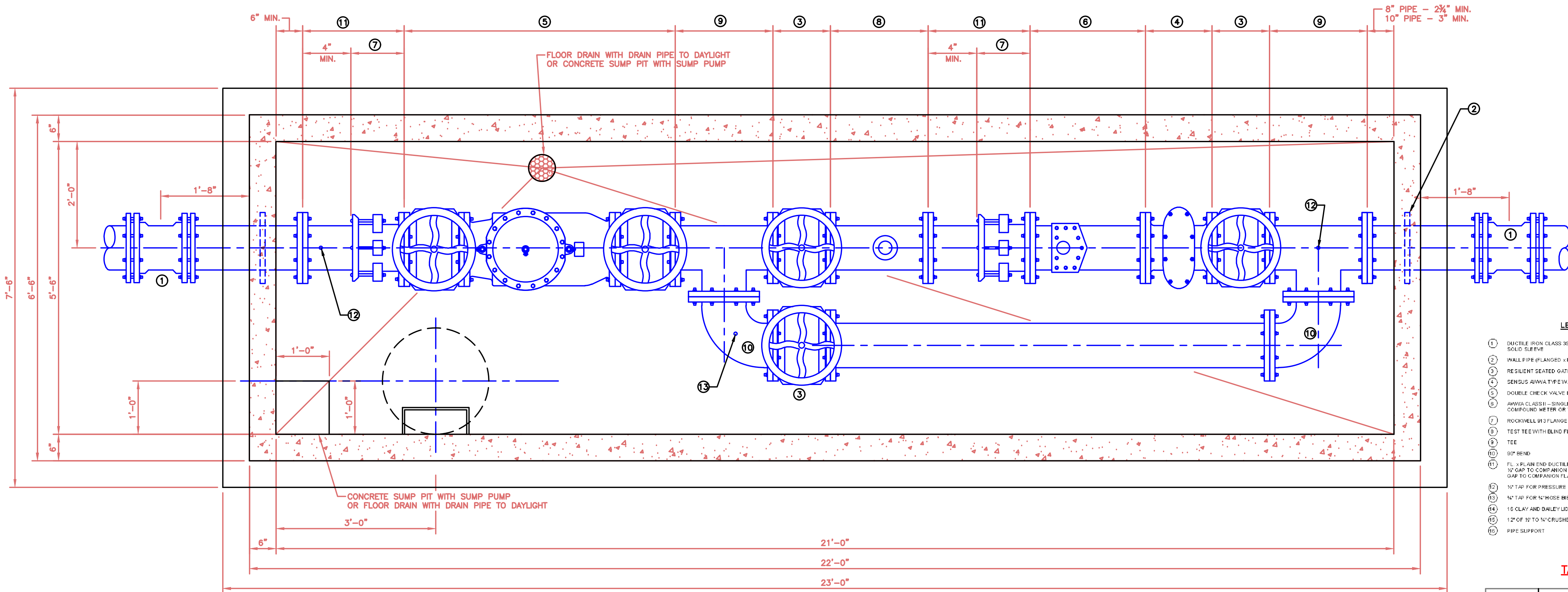
PONZER-YOUNGQUIST, P.A.
Consulting Engineers & Land Surveyors
227 E. Dennis Avenue
Olathe, Kansas 66061
Phone: (913)-782-0541
Fax: (913)-782-0109
Email: py@pyengineers.com

Designed By: JWC
Drawn By: JAH
Checked By: JWB
Date: SEP 2018
Dwg File: CHECK VALVE/PIT

No.	Date	Revision	By

PROJECT NUMBER

SHEET NUMBER
1 OF 1



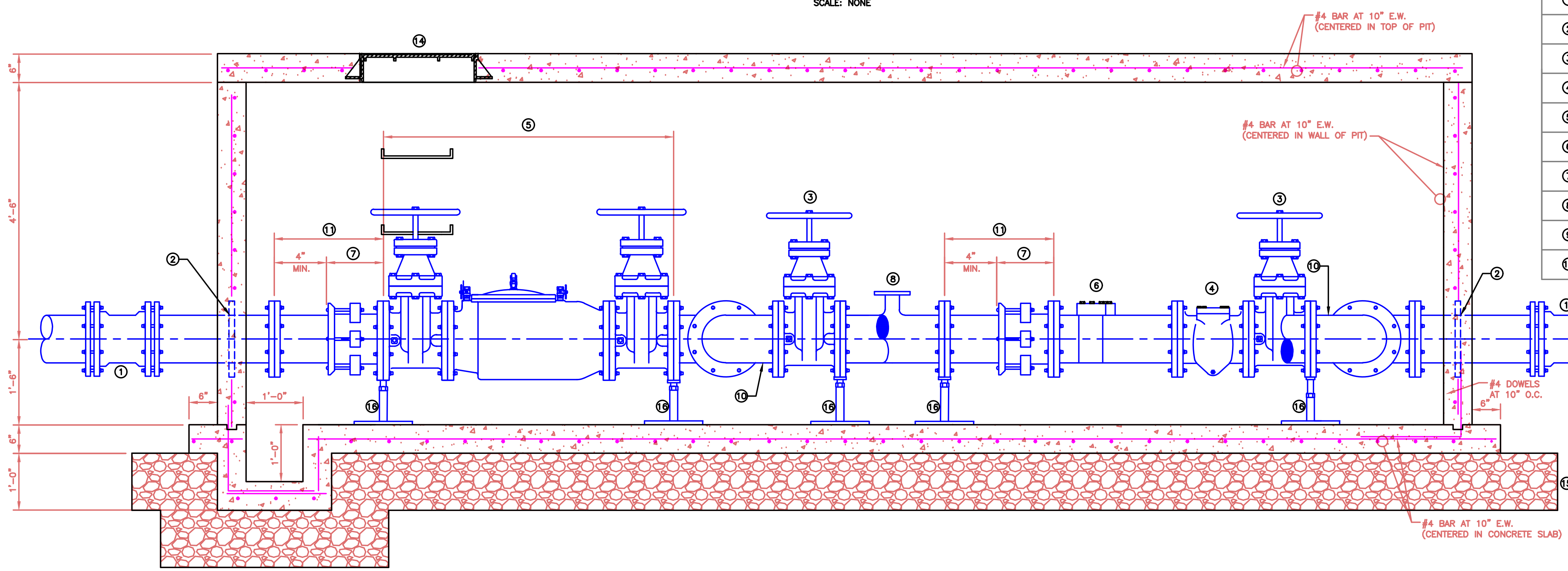
PLAN
SCALE: NONE

LEGEND

①	DUCTILE IRON CLASS 350 MECHANICAL JOINT LONG PATTERN SOLID SLEEVE
②	WALL PIPE (FLANGED x PLAIN END DIP)
③	RESILIENT SEATED GATE VALVE
④	SENSUS AWWA TYPE WATER METER STRAINER
⑤	DOUBLE CHECK VALVE BACKFLOW PREVENTER
⑥	AWWA CLASS II – SINGLE REGISTER HIGH-PERFORMANCE COMPOUND METER OR TURBO METER AT OWNER'S OPTION.
⑦	ROCKWELL 913 FLANGED COUPLING ADAPTER
⑧	TEST TEE WITH BLIND FLANGE
⑨	TEE
⑩	90° BEND
⑪	FL. x PLAIN END DUCTILE IRON PIPE (MAX. LENGTH TO ALLOW ½" GAP TO COMPANION FLANGE, MIN. LENGTH TO ALLOW 3" GAP TO COMPANION FLANGE)
⑫	½" TAP FOR PRESSURE GAUGE (ASHCROFT MODEL 1279ASL)
⑬	¾" TAP FOR ¾" HOSE BIB
⑭	16 CLAY AND BAILEY LID AND COVER # 2213
⑮	12" OF ½" TO ¾" CRUSHED ROCK
⑯	PIPE SUPPORT

TABLE

PART NO.	PIPE SIZE	OVERALL LENGTH
①	8"	12"
	10"	12"
②	8"	—
	10"	—
③	8"	11½"
	10"	13"
④	8"	10"
	10"	15"
⑤	8"	52½"
	10"	61⅛"
⑥	8"	20"
	10"	26"
⑦	8"	12"
	10"	12"
⑧	8"x3"	18"
	10"x4"	22"
⑨	8"x8"	18"
	10"x10"	22"
⑩	8"	9" (℄ TO FLANGE)
	10"	11" (℄ TO FLANGE)



SECTION
SCALE: NONE

WATER DISTRICT NO. 7 - JOHNSON COUNTY, KANSAS
METER VAULT
8" AND 10"
PLAN AND SECTION

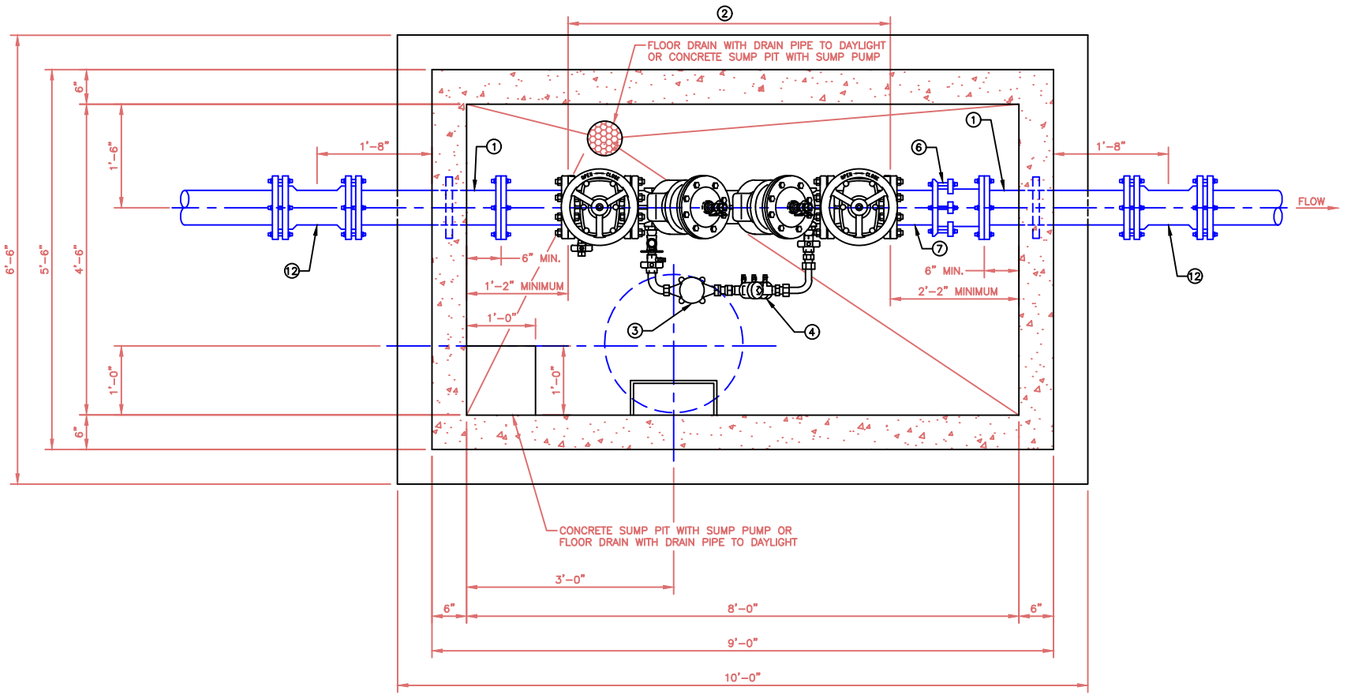
PONZER-YOUNGQUIST, P.A.
Consulting Engineers & Land Surveyors
227 E. Dennis Avenue
Olathe, Kansas 66061
Phone: (913)-782-0541
Fax: (913)-782-0109
Email: py@pyengineers.com

Designed By: JWC
Drawn By: JAH
Checked By: JWB
Date: SEP./2018
Dwg File: METER PIT(8-10")

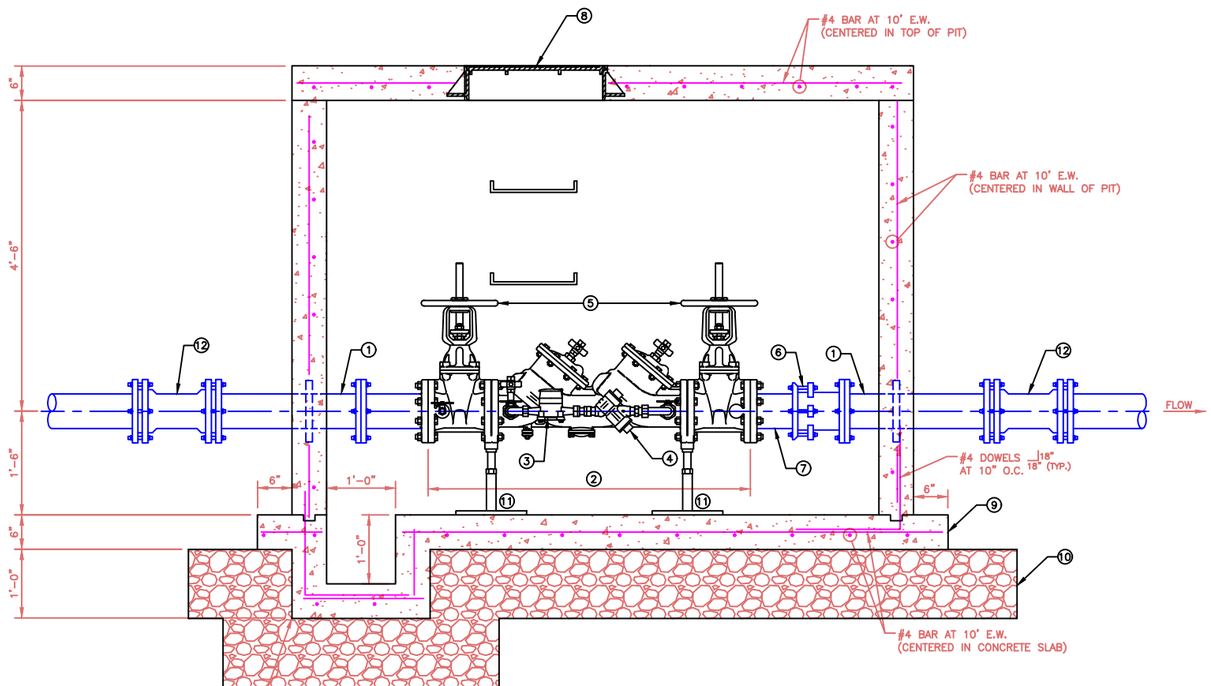
No.	Date	Revision	By

PROJECT NUMBER

SHEET NUMBER
1 OF 1



PLAN
SCALE: NONE



SECTION
SCALE: NONE

LEGEND

1. WALL PIPE (FLANGED x PLAIN END DIP)
2. APPROVED DOUBLE CHECK DETECTOR VALVE ASSEMBLY WITH FOUR TEST COCKS (SHALL BE FITTED WITH BRASS PLUGS)
3. WATER METER
4. APPROVED DOUBLE CHECK VALVE ASSEMBLY WITH FOUR TEST COCKS (FITTED WITH BRASS PLUGS)
5. O.S. & Y. RESILIENT SEATED WHEEL GATE VALVE
6. ROCKWELL 913 STEEL FLANGED COUPLING ADAPTER
7. FLANGED x PLAIN END DIP (ALLOW 1" GAP BETWEEN PLAIN END AND WALL PIPE FLANGE TO ALLOW REMOVAL OF ASSEMBLY)
8. 24" CLAY-BAILEY LID AND COVER #2213
9. REINFORCED CONCRETE SLAB
10. 12" OF ½" TO ¾" CRUSHED ROCK
11. PIPE SUPPORT
12. DUCTILE IRON CLASS 350 MECHANICAL JOINT LONG PATTERN SOLID SLEEVE

NOTES:

1. ALL BACKFLOW ASSEMBLIES SHALL BE INSTALLED HORIZONTALLY.
2. ALL FERROUS-BODIED BACKFLOW ASSEMBLIES SHALL BE FITTED WITH REPLACEABLE VALVE SEATS.
3. AB-3, CA-5 OR GRAVEL WILL NOT BE ALLOWED AS BACK FILL MATERIAL AROUND WATER SERVICE.

TABLE

PIPE SIZE	OVERALL LENGTH ②
3"	41⅞"
4"	46¾"
6"	56"

WATER DISTRICT NO. 7 - JOHNSON COUNTY, KANSAS

DOUBLE CHECK DETECTOR CHECK VALVE VAULT
3" 4" AND 6"
PLAN AND SECTION

PONZER-YOUNGQUIST, P.A.
Consulting Engineers & Land Surveyors
227 E. Dennis Avenue
Olathe, Kansas 66061
Phone: (913)-782-0541
Fax: (913)-782-0109
Email: py@pyengineers.com

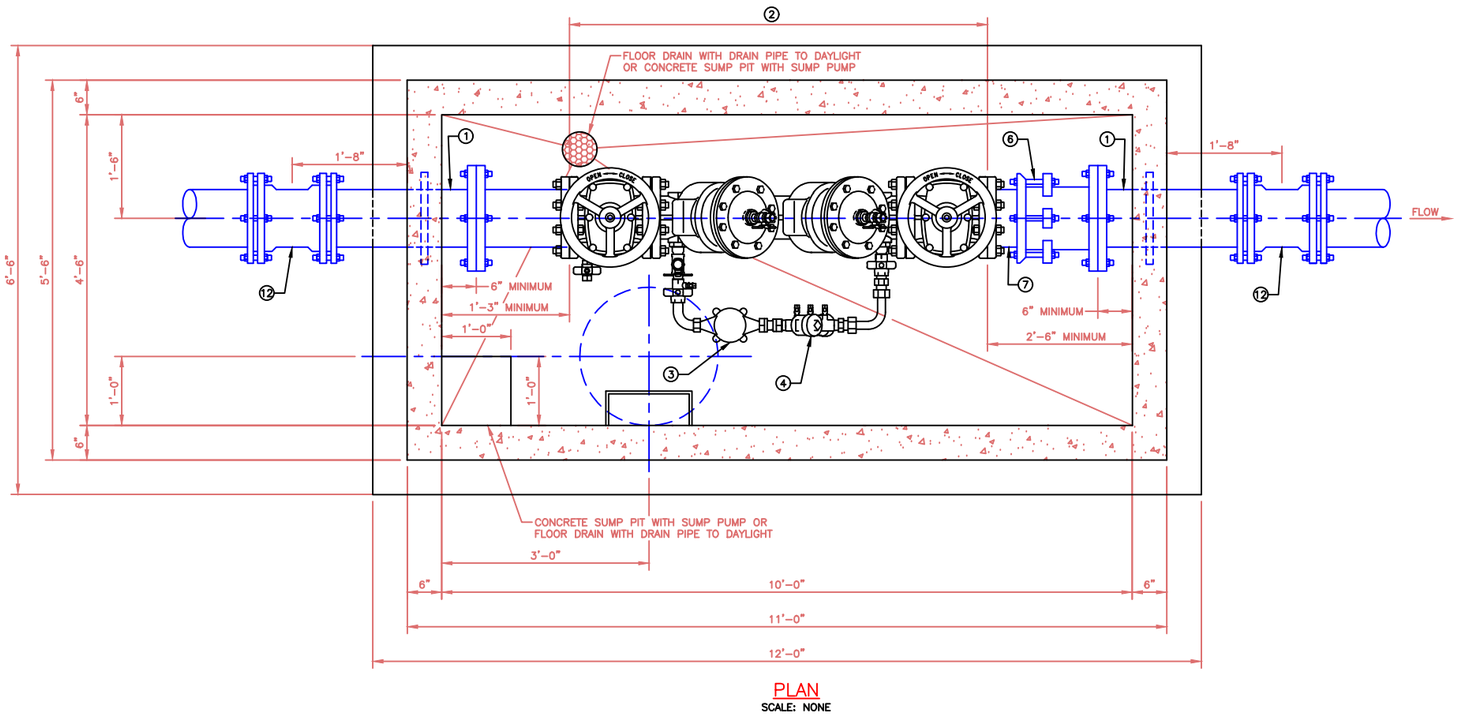
py

Designed By: JWC
Drawn By: JAH
Checked By: JWB
Date: SEP/2018
Dwg File: CHECK VALVE/PIT

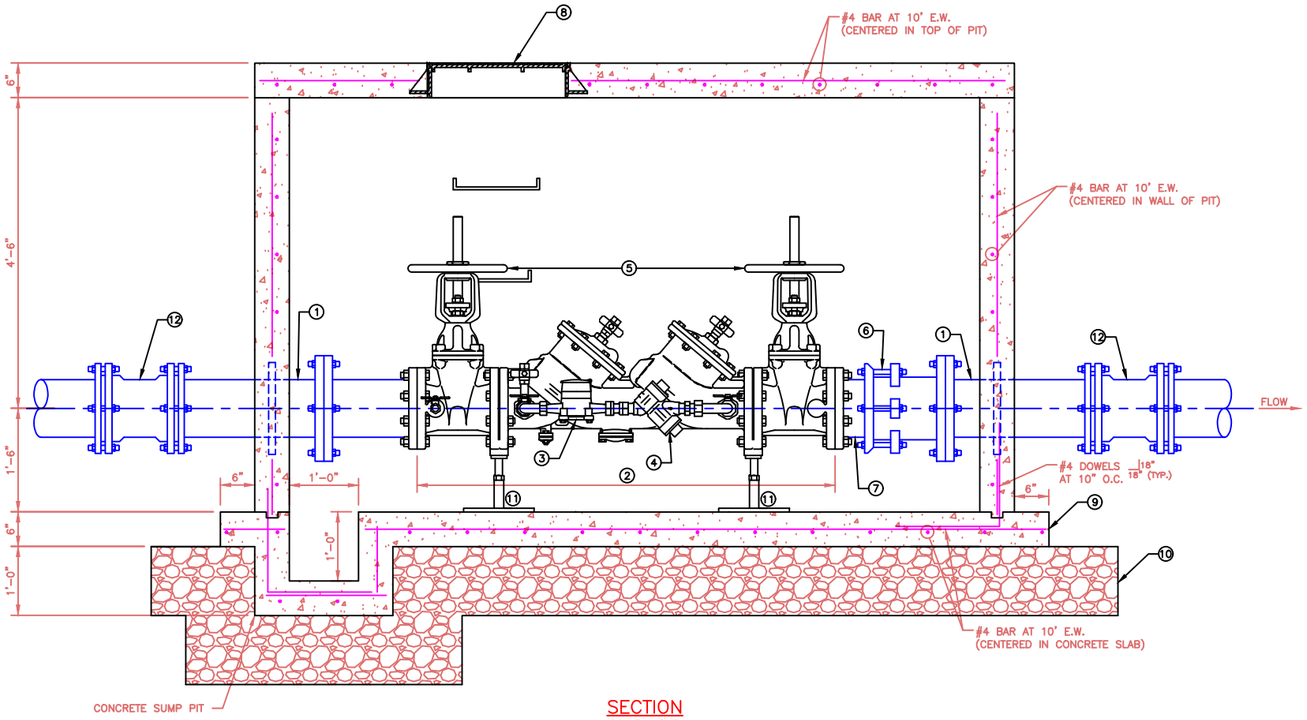
No.	Date	Revision	By

PROJECT NUMBER

SHEET NUMBER
1 OF 1



PLAN
SCALE: NONE



SECTION
SCALE: NONE

LEGEND

1. WALL PIPE (FLANGED x PLAIN END DIP)
2. APPROVED DOUBLE CHECK DETECTOR VALVE ASSEMBLY WITH FOUR TEST COCKS (SHALL BE FITTED WITH BRASS PLUGS)
3. WATER METER
4. APPROVED DOUBLE CHECK VALVE ASSEMBLY WITH FOUR TEST COCKS (FITTED WITH BRASS PLUGS)
5. O.S. & Y. RESILIENT SEATED WHEEL GATE VALVE
6. ROCKWELL 913 STEEL FLANGED COUPLING ADAPTER
7. FLANGED x PLAIN END DIP (ALLOW 1" GAP BETWEEN PLAIN END AND WALL PIPE FLANGE TO ALLOW REMOVAL OF ASSEMBLY)
8. 24" CLAY-BAILEY LID AND COVER #2213
9. REINFORCED CONCRETE SLAB
10. 12" OF ½" TO ¾" CRUSHED ROCK
11. PIPE SUPPORT
12. DUCTILE IRON CLASS 350 MECHANICAL JOINT LONG PATTERN SOLID SLEEVE

NOTES:

1. ALL BACKFLOW ASSEMBLIES SHALL BE INSTALLED HORIZONTALLY.
2. ALL FERROUS-BODIED BACKFLOW ASSEMBLIES SHALL BE FITTED WITH REPLACEABLE VALVE SEATS.
3. AB-3, CA-5 OR GRAVEL WILL NOT BE ALLOWED AS BACK FILL MATERIAL AROUND WATER SERVICE.

TABLE

PIPE SIZE	OVERALL LENGTH ②
8"	65"
10"	72⅝"

WATER DISTRICT NO. 7 - JOHNSON COUNTY, KANSAS

DOUBLE CHECK DETECTOR CHECK VALVE VAULT
8" AND 10"
PLAN AND SECTION

PONZER-YOUNGQUIST, P.A.
Consulting Engineers & Land Surveyors
227 E. Dennis Avenue
Olathe, Kansas 66061
Phone: (913)-782-0541
Fax: (913)-782-0109
Email: py@pyengineers.com

Designed By: JWC
Drawn By: JAH
Checked By: JWB
Date: SEP /2018
Dwg File: CHECK VALVE/PIT

No.	Date	Revision	By

PROJECT NUMBER

SHEET NUMBER
1 OF 1