

STANDARD SANITARY SEWER AND WATER SPECIFICATIONS

For:



Harriman Utility Board

WPN 23.0304

APPROVED FOR CONSTRUCTION

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

07/13/2023

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A
PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE
COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE
DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

**PHYSICAL ADDRESS:
200 N ROANE STREET
HARRIMAN, TN 37748**

**MAILING ADDRESS:
P.O. BOX 434
HARRIMAN, TN 37748**

DW20230585

APPROVED WATER SPECIFICATIONS

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER RESOURCES

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May 22, 2023

Prepared By:



CANNON & CANNON INC
CONSULTING ENGINEERS · FIELD SURVEYORS

TEL 865.670.8555
WWW.CANNON-CANNON.COM

8550 Kingston Pike
Knoxville, TN 37919

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END OF SECTION 00 01 10

SECTION 02 41 00 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition
- B. Related Sections:
 - 1. Section 31 25 00 – Erosion and Sediment Controls

1.3 DEFINITIONS

- A. ACM – Asbestos-containing material.
- B. Demolition – Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof.
- C. Modify – Provide all necessary material and labor to modify an existing item to the condition indicated or specified.
- D. Relocate – Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components require to make the equipment fully functional, to the new location identified on the Drawings.
- E. Renovation – Altering a facility or one or more facility components in any way.
- F. Salvage/Salvageable – Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property is to remain that of the Owner. Unless otherwise specified, title to items identified for demolition shall revert to the Contractor.
- G. Universal Waste Thermostat – A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.4 REGULATORY AND SAFETY REQUIREMENTS

- A. Comply with federal, state, and local hauling and disposal regulations. In addition to any applicable requirements, Contractor's safety requirements shall conform to ANSI A10.6.

1.5 USE OF EXPLOSIVES

- A. Use of explosives for demolition is not permitted.

1.6 ENVIRONMENTAL PROTECTION

- A. Prior to beginning demolition, the Contractor shall establish temporary erosion and sediment control in accordance with Section 31 25 00 – Temporary Erosion and Sediment Control.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

- A. Facilities:
 - 1. Buildings and adjacent designated areas scheduled for complete demolition are as shown on the Drawings.
 - 2. Portions of buildings and other areas scheduled for selective demolition, partial demolition, and renovation are as shown on the Drawings.
- B. Utilities and Related Equipment:
 - 1. Notify Owner or appropriate utilities to turn off affected services at least 48 hours before starting demolition or renovation activities.
 - 2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approve by the Owner.
 - 3. When utility lines are encountered that are not indicated on the Drawings, notify the Owner prior to further work in that area.
 - 4. Remove meters and related equipment and deliver to a location as determined by the Owner.
 - 5. Excavate and remove utility lines serving buildings to be demolished to a distance of 10 feet beyond the outside perimeter of the demolition.
 - 6. Provide a permanent leak-proof closure for water and gas lines.
 - 7. For lines less than 8 inches in diameter, plug sewer lines with concrete to a minimum plug length of 2 feet to prevent groundwater infiltration. For lines 8 inches and larger, or for all pipes abandoned under a roadway, completely fill the abandoned line with flowable fill in accordance with Section 31 23 16.01 – Excavation for Utilities.
- C. Paving and Slabs - Provide neat saw cuts at limits of pavement removal as indicated.

- D. Masonry – Saw cut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new Work. Where new masonry adjoins existing, the new Work shall abut or tie into the existing construction as indicated.
- E. Concrete – Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in wall perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Where new concrete adjoins existing, the new Work shall abut or tie into the existing construction as indicated.
- F. Patching:
 - 1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
 - 2. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
 - 3. Fill holes and depressions left as a result of removals in existing surfaces with an approved patching material, applied in accordance with the manufacturer’s printed instructions.
- G. Electrical:
 - 1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
 - 2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
 - 3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers with panelboards as required to accomplish the finished Work.
 - 4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
 - 5. Raceways and Cabling:
 - a. Scheduled for retirement:
 - 1) Inaccessibly Concealed: Cut off and abandon in place.
 - 2) Exposed or Accessible: Remove.
 - b. Scheduled for future use:
 - 1) Cap/seal and tag
 - c. Schedule for relocation:
 - 1) Extend existing wiring or run new wiring from the source.
 - d. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
 - e. Where concealed raceway is uncovered, remove raceway or extend to new location as appropriate.
 - 6. Provide new typewritten panelboard circuit directory cards.

3.2 PROTECTION

- A. Dust and Debris Control:

1. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
 2. Vacuum and dust interior Work areas daily.
 3. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicular traffic.
- B. Traffic Control Signs – Where pedestrian and driver safety are endangered in the area of removal Work, use traffic barricades with flashing lights.
- C. Existing Work:
1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
 2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of the Owner. Any Contractor-damaged items shall be repaired or replaced as directed by the Owner.
 3. Provide temporary weather protection during intervals between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to the structure or interior areas of existing buildings.
 4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Owner approval.
 5. Do not overload pavements to remain.
- D. Weather Protection – For portions of the building scheduled to remain, protect the building interior, materials, and equipment at all times. Where removal of existing roofing is necessary to accomplish the Work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent loss.
- E. Trees – Protect trees within the Site that might be damaged during demolition and are indicated to be left in place using a 6-foot-high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the Work shall be replaced in kind, as approved by the Owner.
- F. Facilities:
1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
 2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by the Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Owner.
 3. Protect all facility elements not scheduled for demolition.
 4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structures or elements to be demolished and adjacent facilities.
- G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.3 BURNING

- A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.4 RELOCATIONS

- A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of the Owner. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Owner.

3.5 BACKFILL

- A. Demolition debris shall not be used as backfill material.

3.6 TITLE TO MATERIALS

- A. All equipment will be discarded, or may be salvaged, by the Contractor unless specifically identified to remain the property of the Owner in the contract documents.

3.7 DISPOSITION OF MATERIAL

- A. Do not remove equipment and materials without the approval of the Owner.
- B. Remove materials and equipment that are indicated and specified to be removed by Contractor and deliver to a location to be determined by the Owner.
- C. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.
- D. Repair or replace, at the discretion of the Owner, items damaged during removal or storage.
- E. The Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become the Contractor's property after Owner's authorization to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the Site.
- F. Owner will not be responsible for the condition or loss of, or damage to, such property after Owner's authorization to begin demolition.

- G. Store salvaged items as approved by the Owner or Inspector and remove them from Owner's property before completion of the Contract.

3.8 REUSE OF MATERIALS AND EQUIPMENT

- A. Remove and store materials and equipment listed to be reused or relocated to prevent damage, and reinstall as the Work progresses.
- B. Properly store and maintain equipment and materials in the same condition as when removed.
- C. Store equipment and material designated to be reused in a location designated by the Owner.
- D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.
- E. The Owner shall determine condition of equipment and materials prior to removal.

3.9 UNSALVAGEABLE MATERIAL

- A. Concrete, masonry, and other noncombustible materials, except concrete permitted to remain in place, shall be disposed of by the Contractor at a facility permitted to receive the waste by the appropriate state, federal, or local authority.
- B. Combustible material shall be disposed of off of the Site.

3.10 CLEANUP

- A. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION 02 41 00

SECTION 03 30 00.01 - CONCRETE FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in-place concrete.
 - 2. Reinforcing bars.
 - 3. Welded wire fabric.
 - 4. Reinforcement accessories.
 - 5. Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

- A. American Concrete Institute
 - 1. ACI 211 – Guide for Selecting Proportions for Concrete.
 - 2. ACI 301 – Specifications for Structural Concrete.
 - 3. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 4. ACI 305 – Guide to Hot Weather Concreting.
 - 5. ACI 306 – Guide to Cold Weather Concreting.
 - 6. ACI 308 – Guide for External Curing of Concrete.
 - 7. ACI 309 – Guide for Consolidation of Concrete.
 - 8. ACI 318 – Code Requirements for Reinforced Concrete.
 - 9. ACI 347 – Guide to Formwork Concrete.
 - 10. ACI 350 – Code Requirements for Environmental Engineering (Water & Wastewater) Concrete Structures.
- B. ASTM
 - 1.
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 3. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 4. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 5. ASTM C33 - Standard Specification for Concrete Aggregates.

6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 SUBMITTALS

- A. Concrete-Mix designs.
- B. Reinforcing steel.
- C. Concrete placement drawings.
- D. Curing compounds and methods.

1.5 TESTING

- A. Perform and submit materials testing to demonstrate conformance with the specifications.
- B. Samples and tests shall be performed in accordance with ASTM standards.

PART 2 - PRODUCTS

2.1 FORMS

- A. Forms for Exposed Finish Concrete: Unless otherwise specified or shown on the drawings, construct formwork for exposed concrete surfaces with plywood, or other panel type materials in order to provide exposed surfaces that are continuous, straight, and smooth. Furnish panels in the largest practicable sizes. Provide form material that is thick enough to withstand pressure of newly placed concrete without bowing or deflection.
- B. Forms for Unexposed Finish Concrete: For surfaces that will be unexposed in the finished structure, for concrete with plywood, lumber, metal, or other acceptable material. If lumber is used, it shall be dressed on at least two edges and one side for a tight fit.

2.2 FORM COATINGS

- A. Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect the concrete surface and that will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound.

2.3 REINFORCEMENT

- A. Reinforcing bars shall be Grade 60 and in accordance with ASTM A615.
- B. Welded plain and deformed steel wire fabric shall be in accordance with ASTM A1064.

- C. Provide supports for reinforcement, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Unless otherwise indicated on the drawings, use wire type bar supports. Wood and other materials will not be accepted as bar supports.

2.4 CONCRETE MATERIALS

- A. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cast-in-place concrete shall be:
 - 1. Class A 4,000 psi mix design unless otherwise noted.
 - 2. Class B 3,000 psi mix design may be used for non-structural and non-load bearing applications.
- C. Minimum Requirements:
 - 1. Portland Cement: ASTM C150, Type I or II, low-alkali.
 - 2. Aggregate, general:
 - a. ASTM C33, uniformly graded and clean.
 - b. Do not use aggregate known to cause excessive shrinkage.
 - 3. Aggregate, Coarse: Maximum 3/4-inch crushed rock or washed gravel.

2.5 ACCESSORIES AND OTHER MATERIALS

- A. Curing Materials: Contractor selected method and materials shall be in conformance with the requirements of ACI 301.
- B. Provide other materials, not specifically described but required for a complete and proper installation as selected by the Contractor

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, support, brace, and maintain formwork to support any vertical and lateral loads that may be applied until such loads can be supported by the concrete structure. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Construct forms complying with ACI 347 to the sizes, shapes, lines, and dimensions shown on the Construction Drawings so that in the finished structures the work will be level and plumb and have accurate alignment, location, and grade. Provide for openings, offsets, sinkage, keyways, recesses, moldings, rustication, reglets, chambers, blocking, screeds, bulkheads, anchorages, inserts, wall pipes, and other features that the work requires. Use selected materials to obtain the required finishes. But joints solidly, and provide backup at joint to prevent leakage of cement paste.

- C. Fabricate forms so that they can be easily removed without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep for the concrete to be placed with the bottom forms only. To form keyways, reglets, recesses, and the like, kerf wood inserts to prevent swelling and to permit easy removal.
- D. Clean thoroughly forms and adjacent surfaces that are to receive concrete. Remove chips, wood, sawdust, dirt, and any other debris just before the concrete is placed. After concrete placement, retighten the forms as necessary to eliminate mortar leaks.

3.2 EARTH FORMS

- A. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on the Drawings.
- B. Construct wood edge strips at the top of each side of the trench to secure reinforcing and to prevent trench from sloughing.
- C. Tamp earth forms firm and clear them of debris and loose material before depositing concrete.

3.3 REINFORCEMENT

- A. Reinforcement shall be free of loose rust and mill scale, earth, ice, and other materials that reduce or destroy the bond with concrete.
- B. Place reinforcement to obtain at least the minimum coverage for concrete protection as required by ACI 318. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so that ends are directed into the concrete, not toward exposed concrete surfaces.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in.
- B. Mix concrete in accordance with ASTM C94.
- C. Place concrete in accordance with ACI 304.
- D. Deposit concrete either continuously or in layers thick enough to prevent its being placed on concrete that has hardened enough to cause the formation of seams or planes of weakness within the section. Deposit concrete as close to its final location as practicable in order to avoid segregation due to rehandling or flowing.
- E. Deposit concrete in forms in horizontal layers no deeper than 24 inches. Avoid cold joints by placing each layer while the preceding one is still plastic.
- F. Use mechanical vibrating equipment supplemented by hand spading, ridding, or tamping to consolidate placed concrete. The equipment and procedures used to consolidate the concrete shall

comply with the recommended practices of ACI 309 and suit bot the type of concrete and project conditions. Provide standby mechanical vibrating equipment at all concrete placements.

- G. Consolidate concrete during placing operations so that it is thoroughly worked around reinforcement and other embedded items and into corners.
- H. Maintain reinforcement in the proper position during placement operations.

3.5 COLD WEATHER PLACEMENT

- A. Comply with ACI 306 and the requirements herein specified to protect concrete work from physical damage or reduced strength due to frost, freezing, or low temperatures.
- B. When the air temperature has fallen or is expected to fall below 40° F, heat all water and aggregates uniformly before mixing so that the concrete, at point of placement, will have a temperature of not less than 50° F nor more than 80° F.
- C. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade containing frozen subgrade or on subgrade containing frozen materials.
- D. Accelerators and additives shall be approved during the submittal process

3.6 HOT WEATHER PLACEMENT

- A. When the weather is hot enough to impair seriously the concrete's quality and strength, place the concrete as specified herein and in ACI 305.
- B. Cool ingredients before mixing so that when the concrete is placed, its temperature is below 90° F. Mixing water may be chilled, or else a portion of the water may be in the form of chopped ice.
- C. If reinforcing steel becomes hotter than the ambient air temperature, cool it with water-soaked burlap so that its temperature will not exceed the ambient air temperature.

3.7 CONCRETE FINISHING

- A. Unless otherwise indicated, provide the following finishes:
 - 1. Trowel Finish: Apply to monolithic slab surfaces that are to be exposed to view, unless otherwise shown.

END OF SECTION 03 30 00.01

SECTION 31 23 16.01 – EXCAVATION FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preconstruction Site Photos
 - 2. Site Clearing
 - 3. Trenching
 - 4. Rock Removal
 - 5. Dewatering
 - 6. Backfill
 - 7. Warning Tape and Tracer Wire
 - 8. Utility Marker
 - 9. Disposal of Spoils
 - 10. Flowable Fill
- B. Related Sections:
 - 1. Section 31 25 00 – Erosion and Sedimentation Control

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Plant Protection Zone: Area surrounding individual trees and groups of trees to be protected during construction as indicated on the Construction Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.
- F. Rock removal shall consist of the removal of all sound, solid rock which is in its original position in ledges, bedded deposits, or unstratified masses and which is of such hardness and texture that it cannot be loosened or broken down and removed without drilling, wedging, or blasting.

1. Additionally, any boulders, stones, or pieces of masonry encountered with a volume of 1/2 cubic yard or more shall be considered rock removal.
2. Hard pan, small boulders with volume of less than 1/2 cubic yard, chert, clay, soft shale, soft and disintegrated rock, and similar material shall not be considered rock removal.

G. Pipe Zone:

1. Bedding (Lower Pipe Zone): The trench area around a buried pipe that begins 6 inches below the pipe bell and extends upwards to the invert of the pipe for the full width of the trench.
2. Upper Pipe Zone: The trench area around a buried pipe that begins at the invert of the pipe and extends upwards to 12 inches above the pipe crown for the full width of the trench.

H. Paved Area: Shall be the considered any excavation that is under pavement (asphalt, concrete, gravel, etc.) or the edge of the pavement surface is within 3 feet horizontally of the pipe.

I. Backfill: The trench area that begins at the top of the Pipe Zone and extends upwards to the surface or to the bottom of the first paving layer.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain the Owner's property, cleared materials shall become the Contractor's property and shall be removed from the Site.

1.5 SUBMITTALS

A. Preconstruction Site Photos and Videos

1. Take digital photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench. Take video take of the entire project area along each pipe main and service.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features in both right-of-way and private property to the service meter. Record existing settlement or cracking of adjacent structures, pavements, and improvements.
3. Include Project description, date taken, and sequential number in the file name of each photograph.

B. Traffic control plan in accordance with roadway agency, MUTCD, and OSHA regulations.

C. Site Clearing

1. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - a. Use sufficiently detailed photographs or videotape.
 - b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
2. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

D. Rock Removal

1. Shop Drawings: Indicate proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock removal method.
2. Survey Report: Submit survey report on conditions of buildings near locations of rock removal.

PART 2 - PRODUCTS

2.1 BACKFILL SOILS

- A. Native soil backfill will be allowed above the Pipe Zone provided that the material excavated is free of stones greater than 3 inches, dirt clods, debris, frozen materials, organic matter, roots, or refuse.
- B. Borrow materials previously approved by the Engineer may be used for backfill if suitable material is not available from the excavation.

2.2 TRENCH STABILIZATION MATERIAL

- A. Base Rock: TDOT Mineral Aggregate Base Class A, Aggregate Grading D (a.k.a. “crusher run”) as specified in Section 903.05 of the TDOT Standard Specifications for Road and Bridge Construction.

2.3 PIPE ZONE AND CRUSHED STONE BACKFILL MATERIAL

- A. For Pipe Zone and backfill in paved areas, concrete surfaced areas, and gravel surfaced areas, all backfill shall consist of compacted TDOT Mineral Aggregate Base Class A, Aggregate Grading D (a.k.a. “crusher run”) as specified in Section 903.05 of the TDOT Standard Specifications for Road and Bridge Construction.
- B. Excavated Backfill Soils as described in Part 2.1 above.

2.4 COMPACTED BACKFILL

- A. For backfill to be compacted during the installation of flexible pipe outside of paved areas, no rocks or foreign objects greater than 3 inches shall be allowed.
- B. For backfill to be compacted during the installation of rigid pipe outside of paved areas, no rocks or foreign material greater than 3 inches shall be allowed. If soil backfill material is unsuitable, crushed stone may be used for backfill to 18 inches over the pipe being installed.

2.5 FLOWABLE FILL

- A. Select and proportion ingredients to obtain compressive strength between 50 psi and 200 psi at 28 days in accordance with ASTM D4832.
- B. Materials:

1. Cement: ASTM C150, Type I or Type II.
2. Aggregate: ASTM C33, Size 7.
3. Fly Ash (if used): ASTM C618, Class C.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.6 MISCELLANENOUS CRUSHED STONE

- A. Crushed stone, TDOT #57 stone as specified in Section 903.22 of the TDOT Standard Specifications for Road and Bridge Construction.
 1. For use only where specified on the Drawings, Standard Details, or where approved by Owner.

2.7 ROCK REMOVAL

- A. Explosives: Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.
- B. Delay Device: Type recommended by explosives firm.
- C. Blast Mat Materials: Type recommended by explosives firm.

2.8 WARNING TAPE AND TRACER WIRE

- A. Detectable Warning Tape:
 1. All pipelines installed via open trench shall be installed with detectable warning tape. Detectable warning tape shall be:
 - a. 6 inches wide, 4 mils thick.
 - b. Inert, bonded layer plastic.
 - c. Metallized foil core.
 - d. Highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils.
 - e. Utility and Tape Color: Gas = Yellow; Sewer = Green; and Water = Blue.
 - f. Continuously marked with "CAUTION ### LINE BURIED BELOW".
 - 1) "###" shall be the utility being installed "GAS", "SEWER", or "WATER".
- B. Tracer Wire:
 1. All pipe lines, including but not limited to ductile and PVC shall be installed with tracing wire.
 2. Material: Minimum 10-gauge solid copper with high-density polyethylene (HDPE) or high-molecular weight polyethylene (HMWWPE) insulation suitable for direct bury.
 3. Splices: Use wire nut or lug suitable for direct bury as recommended by tracer wire manufacturer. Wire splices shall be taped with waterproof tape.
 4. Manufacturers:
 - a. Copperhead Industries, LLC.
 - b. Performance Wire & Cable Inc.
 - c. Pro-Line Safety Products Company.
 5. Valve Box Access:

- a. Tracer wire shall be looped through valve boxes in order to be accessible for pipe locating.
- b. Wire shall be coiled within valve box so that it may extend 3-foot above grade.
- c. Sleeve wire in 1/2-inch PVC pipe within valve box to avoid conflict accessing nut.
- d. In multiple valve installations, only one wire shall be brought up into each box.

2.9 UTILITY MARKER

- A. Post shall consist of C-shaped thermoplastic extrusion, 3.75-inch wide (minimum), 0.160 typical walls, curved profile with 3-inch radius. Capable of sustaining a minimum of ten direct wheel-over impacts at 60 MPH without damage to post. Constructed of UV-stabilized thermoplastic polycarbonate, without anchor. Shall be made in the U.S.A.
- B. Post shall be 66 inches long (min.) and color shall match utility as noted below, with white decal, and black custom lettering. See Standard Details for custom message.
 - 1. Utility and Post Color: Gas = Yellow; Sewer = Green; and Water = Blue.
- C. Manufacturer and Supply:
 - 1. Post shall be “FG-500 Series” post manufactured by Davidson Traffic Products, or approved equal.
 - 2. Post and decal shall be supplied by G&C Supply Co., Inc. of Atwood, TN, or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Wrap blue vinyl tie tape around each tree at an easily visible height.
- C. Protect existing site improvements to remain from damage during construction.
- D. Contact Tennessee One-Call location services at 811 not less than three working days before performing Work. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Keep utility locates up to date until excavation has received final backfill in that area.
- E. Setup and install traffic control around the work zone in accordance with roadway agency, MUTCD, and OSHA regulations.

3.2 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 3. Use only hand methods for grubbing within protection zones.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

3.3 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations. Grade and shape stockpiles to drain surface water. Cover to prevent windblow dust and erosion by water.

3.4 SITE IMPROVEMENTS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of the off of the Owner's property.

3.5 LAYOUT

- A. Establish line and grade of trench prior to any excavation. This may be done by staking of the alignment with cut/fill depths noted on the stake at regular intervals and at points where the alignment changes direction.

3.6 EXCAVATION FOR TRENCHES

- A. Open cut excavation for pipelines shall be true to the lines and grades shown on the Construction Drawings or as established by the Owner's representative. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline.
- B. Trenches shall be excavated to a depth sufficient to allow a minimum of 36 inches of cover over the installed pipeline.
- C. In areas of rock excavation, the trench shall be excavated such that there is 12 inches of separation between unexcavated stone and the bottom of the pipe and 12 inches of separation between solid stone and either side of the pipe.
- D. The horizontal distance between the vertical planes (or between the inside faces of installed sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance standard details.
- E. Excavate bell holes for bell and spigot pipe so that the barrel of the pipe will rest for its entire length upon the bottom of the trench.

- F. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary access and bypass routes as the Owner deems necessary to maintain vehicular or pedestrian traffic.
- G. In all cases where materials are deposited along open trenches, place them so that in the event of rain or surcharge loading from such deposits no damage will result to the work and/or to adjacent property. Comply with all erosion and siltation control criteria during all excavation activities.
- H. Line construction across all stream corridors shall be in accordance with regulatory criteria, any required permits. Comply with criteria regarding erosion and siltation control measures, side cast of excavated materials, trench excavation during stream low flow conditions, etc. The Contractor shall be responsible for paying any fines or penalties resulting from the Contractor's failure to comply with these regulations.

3.7 EXCAVATION FOR MANHOLES AND STRUCTURES

- A. Excavation for manholes, inlets, vaults, and other incidental structures shall not be greater in horizontal area than that required to allow a two-foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it.
- B. The bottom of the excavation shall be true to the required shape and elevation as shown on the Construction Drawings.
- C. No soil backfilling will be permitted under manholes, inlets, vaults or similar structures. Should the Contractor excavate below the elevations shown or specified, they shall, at their own expense, fill the void with either concrete or compacted granular material approved by the Owner.
- D. Excavation for manholes and other structures may be performed with nonvertical banks except beneath pavements or adjoining existing improvements. The bottom of the excavation shall be true to the required shape and elevation shown on the Construction Drawings.

3.8 SHORING

- A. Trench safety and protection are the sole responsibility of the contractor and shall meet OSHA and local regulations.
- B. Shoring shall be designed to withstand the pressures of earth being held back and the loading from nearby structures, roadways, and railways.
- C. When shoring is within the right-of-way or theoretical embankment zone of a railroad track the shoring system shall be designed and stamped by an engineer licensed in the State of Tennessee.

3.9 DEWATERING

- A. Furnish dewatering and surface water control systems to permit work to be completed on dry and stable subgrade.
- B. Provide standby equipment in the case of dewatering equipment failure.
 - 1. Standby equipment shall be stored at the Site and ready for immediate use.

2. Provide one spare dewatering pump per dewatering system installed. The spare pump shall have a capacity equal to or greater than the largest pump in the dewatering system.
 3. Each pump shall be supplied with its own portable electric generator.
- C. Discharge removed water in accordance with the standard details.

3.10 GENERAL BACKFILLING METHODS

- A. Backfilling operations shall be performed so as not to disturb or injure any pipe or structure against which the backfill is being placed. If any pipe or structure is damaged or displaced during backfilling, Contractor shall open up the backfill and make whatever repairs are necessary. This work shall be done at no cost to Owner.
- B. Backfilling and clean-up operations shall closely follow pipe laying. Do not leave more than 50 feet of trench open at end of working day.
- C. Protect open trench to prevent danger to the public.
- D. Place backfill above the Pipe Zone in no more than 6-inch lifts using a jumping jack compactor between lifts.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Consolidating by flooding will not be permitted under or adjacent to paved or unpaved traffic areas. If tests for in-place density consistently fail to meet the requirements, Owner may require Contractor to change his method of compaction.
- G. Backfill trenches to contours and elevations with suitable fill materials described above.
- H. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- I. Required Compaction Density:
 1. Crushed Stone: 95% of maximum dry density.
 2. Soils: 85% of maximum dry density.
 3. Maximum dry density of standard Proctor as determined by ASTM D698.

3.11 TRENCH STABILIZATION MATERIAL INSTALLATION

- A. Rebuild trench bottom with imported trench stabilization material when trench excavation exceeds elevation of trench zone as directed by Owner.
- B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.
- C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts. Compaction shall be by a jumping jack compactor between lifts.

3.12 PIPE ZONE MATERIAL INSTALLATION

- A. Pipe Zone Bedding shall consist of a minimum of 6 inches of Class, Grade D crushed stone.
- B. Upper Pipe Zone:
 - 1. For flexible pipe materials (PVC, HDPE, etc.) and all pipes under or near paved areas, the Upper Pipe Zone shall consist of Class A, Grade D crushed stone.
 - 2. For rigid pipe materials (DI, Steel, etc.) outside of paved areas, the Upper Pipe Zone shall consist of Backfill Soils.
- C. Hand grade and mechanically compact each lift to provide a firm, unyielding surface.
- D. The bedding material shall be shaped for bell and spigot pipe at proper intervals to provide uniform bearing under the entire length of the pipe.
- E. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a rod to ensure that voids are completely filled before placing each succeeding lift.
- F. After the full depth of the Pipe Zone material has been placed as specified, compact the material by a minimum of three passes with a jumping jack compactor only over the area between the sides of the pipe and the trench walls.
- G. Do not use power-driven impact compactors to compact Pipe Zone material directly over the pipe.
- H. Pipe zone material shall be compacted to the maximum dry density as specified herein.

3.13 FLOWABLE FILL

- A. Where noted on the Construction Drawings or as directed by the Owner’s representative, flowable fill will be used for backfill.

3.14 DISPOSAL OF MATERIALS

- A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the Owner shall be used for these purposes. Any surplus materials not so used shall be managed by Contractor as either consisting solely of earth, rock, concrete or asphalt paving materials (“Clean Spoil”) or, if determined by OWNER to be something other than Clean Spoil, as Waste Materials.
- B. Clean Spoil may be deposited in spoil areas at site locations found by Contractor. For all such areas, the Contractor shall obtain written permission from the property owner and furnish to Owner in advance of depositing any such Clean Spoil on any such site location. Receipt by Owner of the written permission shall not relieve the Contractor of its responsibilities to comply fully with its obligations under the Contract Documents and all Laws and Regulations relating to such Clean Spoil.
- C. Unless otherwise provided in the Contract Documents, Waste Materials shall be properly classified by Contractor and lawfully transported to and disposed of in an appropriate permitted

facility approved by Owner. Proof of each such transport and disposal shall be provided to Owner within 24 hours after such disposal.

- D. Once any part of the Work is completed, the Contractor shall properly manage all surplus Clean Spoil and lawfully dispose of all Waste Materials left within the construction's limits of that Work. The Contractor is responsible for the removal, hauling and final management of Clean Spoil and Waste Materials. The Contractor is responsible for locating spoil sites for depositing of Clean Spoil and appropriate landfills for disposal of Waste Materials and for obtaining all related permissions from spoil site owners and landfill operators, as appropriate, and all required permits from all governmental agencies having jurisdiction over the depositing of such Clean Spoil or disposal of such Waste Materials.
- E. The depositing of Clean Spoil and the disposal of Waste Materials in the manner described above shall be considered an integral part of the excavation work, and one for which NO separate payment shall be allowed.

3.15 CLEAN-UP

- A. After completing section of excavating, remove all debris and all construction materials from the work zone. Then grade and smooth over the surface on both sides of the trench. Leave the entire area clean and in a condition satisfactory to the Owner.

3.16 MAINTENANCE

- A. Contractor shall seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by Owner.
- B. Contractor shall maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by Owner. Continue such maintenance until final acceptance of the work or until Owner issues a written release.

END OF SECTION 31 23 16.01

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Implementation of temporary and permanent erosion and sedimentation controls.
- B. Related Sections:
 - 1. Section 31 23 16.01 – Excavation for Utilities.
 - 2. Section 32 11 00.01 – Surface Restoration for temporary and permanent seeding.

1.3 REFERENCES

- A. Tennessee Department of Environment and Conversation (TDEC)
 - 1. General NPDES Permit for Discharges of Storm Water Associated with Construction Activities, latest version.
 - 2. Tennessee Erosion & Sediment Control Handbook, latest edition.
 - 3. Stormwater Pollution Prevention Plan: when one is provided by the Owner or Engineer.
- B. In the event of conflict between these requirements and pollution control laws, rules or regulations, or other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.4 SYSTEM DESCRIPTION

- A. The work specified in this Section consists of providing, maintaining, and removing temporary erosion and sedimentation control.
- B. The Contractor shall follow the latest edition of the Tennessee Erosion and Sedimentation Control Handbook.
- C. Temporary erosion controls include, but are not limited to, grassing, mulching, watering and reseeding on-site surfaces and spoil and borrow area surfaces, and providing interceptor ditches at ends of berms and at locations which will ensure that erosion during construction will be either eliminated or maintained in accordance with applicable regulations.
- D. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers, filter stone and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained in accordance with applicable regulations.

- E. Temporary Erosion and Sedimentation Control: In general, temporary erosion and sedimentation control procedures shall be directed toward the following:
 - 1. Preventing soil erosion at the source.
 - 2. Preventing silt and sediment from leaving the site if soil erosion cannot be prevented.
 - 3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from leaving the site.
- F. Permanent Erosion Control: Permanent erosion control measure shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the project site.
- G. Basic Principles
 - 1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type, and condition.
 - 2. Minimize the disturbed area and the duration of exposure to erosion elements.
 - 3. Stabilize disturbed areas immediately.
 - 4. Safely convey run-off from the site to an outlet such that erosion will not be increased off site.
 - 5. Retain sediment on site that was generated on site.
 - 6. Minimize encroachment upon watercourses.

PART 2 - PRODUCTS

2.1 GRASS SEED AND MULCH

- A. Temporary seeding shall be in accordance with TDEC Erosion & Sediment Control Handbook.
- B. Permanent seeding shall be in accordance with Section 33 11 00.01 – Surface Restoration.

2.2 TEMPORARY SILT FENCE

- A. Geotextile Fence
 - 1. Equivalent Opening Size per US Standard Sieve: 50-100 (maximum).
 - 2. Grab Tensile Strength per ASTM D4632: 160 lbs. (minimum).
 - 3. UV Stability per ASTM D4355: 70% Strength Resistance (minimum).
 - 4. With 14-gauge steel wire backing with maximum mesh size of 6 inches.
- B. Support Posts:
 - 1. Materials: Hardwoods, steel, or pressure treated softwoods.
 - 2. Wood posts shall be 2"x2" (minimum).
- C. Fasteners: Heavy-duty wire staples as least 1-inch long, tie wires, or hog rings as recommended by geotextile manufacturer.

2.3 WATTLES

- A. A wattle (a.k.a. sediment logs or tubes) shall be a tubular shaped product specifically manufactured for sediment control. They may be used for slope, perimeter, channel, or inlet sediment control and capture.

- B. Wattles shall be manufactured using interwoven biodegradable plant material such as straw, coir, or wood shavings (i.e. excelsior fibers) in a bio or photodegradable netting that is of sufficient strength to resist damage when handling.
- C. The diameter of and spacing between wattles shall be based on the gradient and length of slope in accordance with following table:

SLOPE	WATTLE DIAMETER				
	8"	12"	18"	20"	24"
2% OR LESS	70'	100'	N/A	N/A	N/A
5%	30'	60'	100'	100'	100'
10%	20'	30'	70'	85'	100'
6:1	N/A	20'	40'	50'	55'
4:1	N/A	20'	30'	30'	30'
3:1	N/A	N/A	20'	20'	25'
2:1	N/A	N/A	20'	20'	20'

2.4 INLET PROTECTION

- A. Inlet protection for area drain and curb inlets shall be via inlet filters manufactured by Flexstorm Inlet Filters, or approved equal.

2.5 STONE RIPRAP

- A. Use sound, tough, durable stones resistant to the actions of air and water. Shaley pieces will not be acceptable. Specific gravity of 2.0 or greater.
- B. Riprap shall have less than 66% wear when tested in accordance with AASHTO T-96.
- C. Riprap sizes shall be in accordance with Tennessee Department of Transportation Standard Specifications.

2.6 STRAW BALES

- A. Clean hay or straw of oats, wheat, barley, or rye free from noxious weed seeds; machine baled using standard baling wire or string.
- B. Posts for straw bales shall be 2"x2" wood or metal posts.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF STRUCTURES

- A. Erosion & sediment controls shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook. Different measures than those stated herein and

called for on the Drawings may be required during construction, and may be found in the TDEC Handbook.

- B. Temporary pollution control shall include construction activities outside the project area where such work is necessary as a result of construction. These areas include, but not limited to, borrow pits, equipment and material storage sites, and haul roads.
- C. Sequence:
 - 1. Install erosion and sediment controls prior to construction.
 - 2. Perform and document an initial inspection of the installed measures with the Owner to review that all measures have been properly installed.
 - 3. If at any time the Owner deems it necessary or if the Contractor observes problems during site inspections, the Contractor shall provide additional erosion prevention and sedimentation controls and mark changes on the plan or SWPPP. The site shall be provided with maximum protection from erosion and sediment loss at all times.
 - 4. Perform regular inspection of all installed measures and document in accordance with the SWPPP or regulations.
 - 5. Perform regular maintenance with clean any built up sediment and fix any broken or shifted control elements.
 - 6. Install permanent controls once construction is complete in an area, and remove temporary controls once permanent controls are established. Depose of temporary measures in accordance with regulations.
 - 7. With the Owner, complete and submit notice of completion paperwork to responsible agencies.
 - 8. Maintain permanent controls during the warranty period in accordance with the Contract.
- D. Temporary Silt Fence Installation
 - 1. Not to be installed across areas of concentrated flow such as streams and ditches.
 - 2. Install along the contour, never up or down a slope.
 - 3. Maximum drainage area for silt fence with wire backing is 1 acre per 150 feet.
 - 4. When installed at the base of a slope, install 5 to 7 feet away from the toe of slope.
 - 5. Height of fence shall be no more than 24 to 26 inches above grade.
 - 6. Construct from a continuous roll of fabric. When fabric joints are necessary, overlap a minimum of 4 feet.
 - 7. Excavate a trench approximately 4 inches wide by 6 inches deep.
 - 8. Place 10 inches of fabric in trench and backfill with compacted soil.
 - 9. Install posts on downstream side of fabric, no more than 6 feet apart, and at least 20 inches into the ground.
- E. Wattle Installation
 - 1. Install by laying flat on the ground on contour and perpendicular to flow.
 - 2. Excavate a small trench approximately 2-3 inches in depth, or per manufacturer's instructions.
 - 3. Overlap ends of adjacent tubes a minimum of 6 inches, or per manufacturer's instructions.
 - 4. Install wooden stakes at an angle, at 4 -foot intervals, and at least 12 inches deep, or per manufacturer's instructions.
 - 5. Terminate ends of wattles with a dog leg up slope to prevent channeling of sediment.
- F. Inlet protection filters shall be installed per the manufacturer's instructions.

- G. Check Dams
 - 1. Check dams are barriers composed of riprap, sandbags, wattles, or other non-corrodible material placed across or partially crossing a natural or constructed drainageway.
 - 2. Check dams shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
 - a. If wattles are used, they may have to be stacked to meet required dimensions of check dams.
- H. Temporary Berms
 - 1. Use temporary berms at the top or base of disturbed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.
 - 2. Berms shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
- I. Temporary Slope Drains
 - 1. A temporary slope drain is a facility consisting of stone, concrete, and/or asphalt gutters, fiber mats, plastic sheets, and drain pipe that may be used to carry runoff down a slope or around an area to reduce erosion on the slope or area avoided until permanent controls are installed and stabilized.
 - 2. Slope drains shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
- J. Temporary Construction Entrance/Exit
 - 1. Construction entrance shall be constructed wherever construction traffic leaves a site and enters a public or private roadway.
 - 2. The entrance/exit shall be at least 50 feet long and at least 10 feet wide for one-way traffic, or at least 20 feet wide for two-way traffic. Shall have turning radii of at least 20 feet at the roadway (may be greater depending on speed of traffic). Install drain culvert as necessary for crossing ditches or streams.
 - 3. Shall be constructed by:
 - a. Undercutting at least 3 inches;
 - b. Install geotextile fabric (TDOT Type III); and
 - c. Install clean washed stone with a gradation of 2 to 4 inches, in a layer at least 8 inches thick.
 - 4. Additional gravel may have to be added periodically to maintain proper function.
 - 5. Remove gravel entrance and replace with new base course prior to construction of permanent new roadway.
- K. Sediment Traps
 - 1. Sediment basins, ponds, traps, and bags are prepared or manufactured storage areas to trap and store sediment from eroded areas in order to protect properties and drainage channels below the construction area from excessive siltation.
 - 2. Sediment traps shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
- L. Straw Bales:
 - 1. Embed minimum of 4 inches in flat bottom trench.
 - 2. Place with ends tightly abutting or overlapped. Corner abutment is not acceptable.
 - 3. Install in order that bale bindings are oriented around the sides and not over the top and bottom of each bale.

4. Use two posts for each bale. Drive posts through bale until top of post is flush with top of bale.
5. Wedge loose straw in gaps between bales.

M. Soil Stockpiles

1. Protect from erosion with plastic sheeting and anchor from the wind with stakes or concrete blocks. If not active for more than 14 days, apply temporary seeding and mulch.
2. Surround piles with temporary silt fence or wattles within 10 feet of toe of stockpile.

N. Seeding and Mulching

1. Temporary seeding and soil stabilization shall be in accordance with TDEC Erosion & Sediment Control Handbook.
2. Permanent seeding shall be in accordance with Section 33 11 00.01 – Surface Restoration.

3.2 FIELD QUALITY CONTROL

- A. Conduct regular inspections and document in accordance with the SWPPP and applicable regulations.
- B. Provide inspection documentation, reports, and SWPPP updates with Owner or agency upon request.

3.3 MAINTENANCE AND CLEANING

- A. Clean, repair or replace failed or overloaded silt fences, wattles, check dams, or other temporary controls within two days after inspection.
- B. Keeps roads and other paved surfaces swept clean of soil, stone, and debris at all times, and as directed by the Owner.
- C. Install and provide maintenance for soil stabilization seeding at all times. This includes sprinkling with water to encourage and maintain growth of seedlings.
- D. Temporary erosion and sediment controls once removed shall be become the property of the Contractor and disposed of properly and in accordance with applicable regulations.
- E. Dress sediment deposits remaining after measure has been removed to conform to existing grade. Prepare and seed graded area.

END OF SECTION 31 25 00

SECTION 32 11 00.01 – SURFACE RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specifications sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aggregate Base Courses
 - 2. Asphalt Paving
 - 3. Concrete Paving
 - 4. Sidewalks and Curb Replacement
 - 5. Soil Preparation
 - 6. Seeding

1.3 RELATED SECTIONS

- A. Section 03 10 00.01 - Concrete for Utilities

1.4 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- B. Tennessee Department of Transportation (TDOT):
 - 1. Standard Specifications for Road and Bridge Construction.

1.5 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.6 QUALITY ASSURANCE

- A. Furnish each aggregate material from a single source throughout the Work.
- B. Obtain cementitious materials from a single source throughout the Work.

- C. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing them in clean, dry locations remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.
- D. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- E. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 SUBMITTALS

- A. Product Data:
 - 1. Submit product information for asphalt and aggregate materials.
 - 2. Submit data on concrete materials, joint filler, admixtures, and curing compounds.
 - 3. Submit mix design with laboratory test results supporting design.
 - 4. Submit data for seed mix, fertilizer, mulch, and other accessories.
- B. Design Data:
 - 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - 2. Identify mix ingredients and proportions, including admixtures.
 - 3. Identify chloride content of admixtures and whether chloride was added during manufacture.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.9 AMBIENT CONDITIONS

- A. Do not place asphalt mixture when ambient air or base surface temperature is less than 40° F, or surface is wet or frozen.
- B. Subsequent Conditions: Maintain minimum 50° F for not less than 72 hours after placing, and at a temperature above freezing for remainder of curing period.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

- A. Mineral Aggregate Base shall be Class A, Grading D crushed stone in accordance with TDOT Specifications, Section 303, Subsection 903.05
- B. Bituminous Prime Coats shall be cutback asphalt (Grade RC-250) or emulsified asphalt (Grade AE-P) in accordance with TDOT Specifications, Section 402, Subsections 904.02 and 904.03.
- C. Crushed Stone Chips shall be Size 6 or Size 7 in accordance with TDOT Specifications, Subsection 903.14.
- D. Double Bituminous Surface, for both courses, shall be either cutback asphalt (Grade RC-900 or RC-3000) or emulsified asphalt (Grade RS-2) in accordance with TDOT Specifications, Section 402, Subsections 904.02 and 904.03.
- E. Asphaltic Concrete Binder shall be Grading B or C, as directed by the Owner, in accordance with TDOT Specifications, Section 307.
- F. Bituminous Tack Coat shall be Grade AE-3 in accordance with TDOT Specifications, Section 403, Subsection 904.03.
- G. Asphaltic Concrete Surface shall be Grading E in accordance with TDOT Specifications, Section 411.
- H. Bituminous Seal Coat shall be in accordance with TDOT specifications, Section 405.
- I. Quick Dry Traffic Marking Paint shall be white or yellow and in accordance with TDOT Specifications, Subsection 910.05.

2.2 CONCRETE PAVING

- A. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Concrete paving shall be Class B mix design.
- C. Shall meet the requirements in Division 03.

2.3 SOIL MATERIALS

- A. Topsoil:
 - 1. Excavated from site and free of weeds.
 - 2. Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds, and roots.

2.4 SEED MIXTURE

- A. Grass seed mixture shall be contractor's grade Kentucky 31 Fescue (*Festuca Elatior*) and/or annual rye meeting the requirements of the Tennessee State Department of Agriculture and furnished in new bags; no "below standard" seed will be accepted.

2.5 FERTILIZER

- A. Fertilizer shall be Grade 10-10-10 and be commercially manufactured, furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents.
- B. Fertilizer shall follow all local, state, and federal fertilizer laws.

2.6 AGRICULTURAL LIMESTONE

- A. Agricultural limestone (lime) shall contain a minimum of 85% calcium carbonate and magnesium carbonate combined.

2.7 MULCH

- A. Mulch shall be stalks of rye, oats, wheat, or other approved grain crops that have been properly cured prior to baling, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Asphalt Paving
 - 1. Before any base material is installed, compact the granular subgrade of the area to be paved to 100 % of optimum density as determined by ASTM 2049 with jumping jack compactor.
- B. Concrete Paving
 - 1. Moisten substrate to minimize absorption of water from fresh concrete.
 - 2. Coat surfaces of manholes, vaults, or other structure's frames/covers with oil to prevent bond with concrete paving.

3.2 DEMOLITION

- A. Saw cut and notch existing paving in straight, clean, vertical lines as necessary for the pipeline installation indicated on the Construction Drawings. After the pipeline installation, provide further cutback if damage occurred to the surrounding pavement during pipe line installation.
 - 1. If location of saw cut is within 3 feet of an existing joint or edge of concrete, replace entire concrete section to the joint or edge.

- B. Clean existing paving to remove foreign material, excess joint sealant, and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.3 PAVING INSTALLATION

- A. Asphalt Paving
 - 1. Aggregate Subbase:
 - a. Place aggregate in equal thickness layers to a total compacted thickness of 6 inches or as indicated on the Construction Drawings.
 - b. Compact aggregate to 95% maximum density by rolling, vibrating, or tamping.
 - c. Level and contour surfaces to elevations, profiles, and gradients indicated.
 - d. Maintain optimum moisture content of fill materials to attain specified compaction density.
 - 2. Tack Coat:
 - a. Include tack coat to improve bond between new and existing paving.
 - b. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate of 1/2 gallon per square yard.
 - c. Apply tack coat to contact surfaces of curbs, gutters or any other surrounding concrete or asphalt fixture.
 - d. Coat surfaces of any frames/covers for manholes, vaults, etc. with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
 - 3. Single Course Asphalt Paving:
 - a. Place asphalt within 24 hours of applying primer or tack coat.
 - b. Place asphalt to 6-inch compacted thickness.
 - c. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
 - d. Perform rolling with consecutive passes to achieve an even and smooth finish without roller marks.
 - 4. Tolerances
 - a. Flatness: Pavement shall have a maximum variation of 1/4 inch when measured with a 10-foot straight edge.
 - b. Scheduled Compacted Thickness: Pavement shall be within 1/4 inch of specified thickness.
- B. Concrete Paving, Sidewalks, and Curbs
 - 1. In accordance with Division 03.
 - 2. Forms:
 - a. Place and secure forms and screens to correct location, dimension, profile, and gradient.
 - b. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
 - c. Wood forms: thoroughly wet with water before concrete is placed.
 - 3. Reinforcement:
 - a. Place reinforcing as indicated on Drawings.
 - 4. Placing Concrete:
 - a. Place concrete using the slip form technique.
 - b. Ensure reinforcing, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

- c. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- 5. Joints:
 - a. Place expansion or contraction joints as indicated in the Drawings.
 - b. Place joint filler between paving components and building or other appurtenances.
 - c. Place continuous transverse expansion joints at 5-foot intervals or width of sidewalk, whichever is less.
- 6. Finishing:
 - a. Concrete shall be light broom finished with the lines of the broom finish being perpendicular to the path of travel.
- 7. Curing and Protection
 - a. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - b. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- 8. Backfilling: After curing, backfill, grade, and compact adjacent disturbed area as necessary.

3.4 FIELD QUALITY CONTROL

- A. Asphalt Paving
 - 1. Once per layer or lift, test placed material for compaction in accordance with TDOT Specifications. When tests indicate that the Work does not meet the specified requirements, remove the Work, replace, and retest at the expense of the Contractor.
- B. Concrete
 - 1. Inspect reinforcing placement for size, spacing, location, support.
 - 2. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- C. Records:
 - 1. Maintain records of placed concrete items.
 - 2. Record date, location of pour, quantity, air temperature, precipitation, and any other information pertinent to the pour.

3.5 PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, rain and flowing water, and mechanical injury.
- B. Damaged Concrete:
 - 1. Remove and reconstruct concrete that has been damaged for entire length between scheduled joints.
 - 2. Refinishing damaged portions is not acceptable.
 - 3. Dispose of damaged portions.

3.6 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.7 PLACING TOPSOIL

- A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

3.1 FERTILIZING

- A. Apply fertilizer and agricultural limestone uniformly over the seed bed, and lightly harrow, rake, or otherwise incorporate them into the soil at the following rates:
 - 1. Fertilizer: 15 lbs/1,000 square feet
 - 2. Agricultural Limestone: 40 lbs/1,000 square feet
- B. Do not apply fertilizer at same time or with same machine used to apply seed.
- C. Lightly water soil to aid dissipation of fertilizer. Irrigate the top level of soil uniformly.

3.2 SEEDING

- A. Sow seed uniformly with a rotary seeder, wheelbarrow seeder, or hydraulic equipment or by other satisfactory means.
- B. Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.
- C. The seeding rate shall be 5 lbs/1,000 square feet. Add an additional 3lbs/1,000 square feet of annual rye grass when seeding in March or October.

3.3 MULCHING

- A. When seeding with mulch is specified or deemed to be required by the Owner, spread the mulch material evenly over the seeded areas immediately following the seeding operation.

- B. The mulching rate shall be 100 lbs/1,000 square feet.

3.4 MAINTENANCE

- A. Allow no equipment, material storage, construction traffic, etc. on newly paved or seeded surfaces.
- B. Maintain the surfaces of roadways built and pavements replaced until acceptance of the work. Maintenance shall include replacement, scraping, reshaping, wetting, and rerolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces, and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Owner's representative. Maintenance shall include sprinkling as may be necessary to abate dust from gravel surfaces.
- C. Reseed/fertilize/mulch as necessary to obtain acceptable growth. Acceptable growth is defined as:
 - 1. A minimum of 100 seedlings per square foot.
 - 2. Acceptance of growth by the Owner.

END OF SECTION 32 11 00.01

SECTION 33 01 30 – SEWER INSPECTION, CLEANING, AND FLOW CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. CCTV Inspection
 - 2. Sewer Flow Control
 - 3. Sewer Cleaning
 - 4. Chemical Root Treatment

1.3 COORDINATION

- A. Coordinate Work of this Section with users connected to system.

1.4 SUBMITTALS

- A. CCTV Inspection
 - 1. Catalog and manufacturer's data sheets for television equipment.
 - 2. Traffic Control Plan
 - 3. Inspection Schedule
- B. Sewer Flow Control
 - 1. Sewer Flow Control Plan showing:
 - a. Estimate of peak flow to be controlled
 - b. Schedule
 - c. Schematic Drawing
 - d. List of Equipment with:
 - 1) Pump size, capacity, and quantity
 - 2) Pipeline sizes and materials
 - e. Sewer User Notification Plan
 - f. Emergency Procedures
- C. Sewer Cleaning
 - 1. Catalog and manufacturer's data sheets for cleaning equipment.
 - 2. Traffic Control Plan
 - 3. Liquid Waste Manifest
- D. Chemical Root Treatment
 - 1. Root treatment chemicals product data and MSDS

2. Applicator's Federal DOT number and EPA material registration number.

E. Closeout Submittal:

1. Contractor's markups of all work performed.
2. CCTV reports before and after cleaning. Shall include videos, photos, and reports.

1.5 QUALITY ASSURANCE

A. Minimum of 5 years' experience on similar projects with similar pipe lengths and diameters.

1.6 ADDITIONAL REQUIREMENTS

A. Chemical Root Treatment: Contractor shall hold Pollution Liability Insurance in addition to all other required insurances. Pollution liability coverage shall protect the Contractor, Owner, and any of their officers, agents, and employees from claims for damages to property or the environment, which may arise directly out of the use of chemicals or pollution. The minimum amount of such insurance shall be \$5,000,000 total loss. This insurance shall be provided to the Contractor by an insurance company that holds at least an "A" rating by A.M. Best rating service. The Owner shall be named as an additional insured parties on the Certificate of Insurance, which shall be furnished prior to starting the Work.

1.7 SPECIAL GUARANTEES

A. Chemical Root Treatment: Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for each sewer section (manhole to manhole) that is treated to be guaranteed as follows:

1. At the option of the Owner, the Contractor shall at its own expense, re-treat a sewer section, or refund 100% of the payment received to treat that section in the event that: 1) live roots are found in the section within 6 months after the application; or 2) the section plugs up and floods due to tree root obstructions within a period of 2 years, beginning on the date of treatment and ending 2 years after the date of treatment. Re-treatments, performed at no charge in honor of the guarantee, do not extend the expiration date of the guarantee.
2. The guarantee applies to sewer stoppages caused by live tree roots. It does not apply to stoppages caused by grease or other foreign matter; flat collapsed or deformed pipe; or flooding caused by a surcharged or plugged sewer section downstream from a guaranteed sewer section. This guarantee applies to main line sewers only. Contractor is not responsible for any damages caused by main line sewer stoppages, regardless of cause. The decision of the Owner as to the cause of a stoppage is binding.

1.8 NOTIFICATIONS

A. Notify the Owner a minimum of 5 days before the anticipated beginning of all sewer inspection and cleaning activities. Notify the Owner 24 hours before the actual beginning of any sewer inspection and cleaning activities.

- B. Provide notification via Owner approved door hanger to affected sewer customers a minimum of two full working days before the beginning of any sewer inspection and cleaning activities.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on Site in the manufacturer's original packaging and inspect for damage.
- B. Store materials and protect material from damage in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CCTV INSPECTION

- A. Inspection Vehicle:
 - 1. Equipped with monitoring equipment specifically compatible with the appropriate sewer inspection equipment.
 - 2. Equipped with a safety backup alarm.
 - 3. Clearly marked with the inspection company name and phone number.
- B. Inspection Equipment:
 - 1. Shall include a monitoring studio equipped with independent power source and temperature controlled of a sufficient size to allow seating for a minimum of two people in addition to an operating technician.
 - 2. Secure cables, chains, and other devices used with the camera so as not to obstruct the camera's view or otherwise interfere with proper documentation of sewer conditions.
 - 3. The television monitor shall be located in the monitoring studio and be capable of producing high quality color picture, have a resolution of no less than 350 lines, and provide continuous display during inspection survey.
 - 4. The camera transport platform shall be self-propelled, skid-mounted, or float-mounted and sized for each pipe diameter in accordance with the manufacturer's recommendations. The platform shall be able to be equipped with a tag line suitable for pulling the camera backwards, a winch, power winch, TV cable, powered rewind, or other devices used to move the camera through the pipe.
 - 5. A remote reading footage counter shall be used to determine distance traveled by the camera to an accuracy of two-tenths of a foot. The footage counter display shall be located in the monitoring studio. Measuring of distance by marking of cables will not be allowed. Calibration shall be conducted each day prior to conducting any inspections.
 - 6. CCTV Camera:
 - a. The camera shall be mounted on a transport platform, shall be explosion proof and operative in hazardous and corrosive environment.
 - b. The camera shall have a minimum of 460 lines of horizontal resolution and 400 lines of vertical resolution. The resolution of the camera should meet or exceed the resolution of the monitor.
 - c. The camera shall be capable of 360-degree rotation and 270-degree pan and tilt with adjustable supports specifically designed and constructed for operation in connection with pipe inspection.
 - d. Camera lights shall be mounted to and turn in the direction of the camera head.

- e. The viewing angle shall be a minimum of 65 degrees and have either automatic or remote focus and iris controls. Remote control adjustment for focus and iris shall be located in the monitoring studio.
 - f. The camera shall be operative in 100% humidity conditions.
 - g. The camera shall be able to achieve proper balance of tint and brightness, have a focal distance range from 6 inches to infinity, be capable of 40:1 zoom with 10:1 optical zoom, and have a light sensitivity of greater than 1.5 lux.
 - h. Camera lighting shall minimize reflective glare, have remote variable intensity control, and have lighting quality that provides clear, in-focus picture of the entire inside periphery of the pipe.
- C. Inspection Software:
- 1. The inspection software shall utilize software capable of providing complete survey reports, inspection database, and linked media files.
 - 2. The inspection software shall be the latest version of PACP (Pipeline Assessment and Certification Program) certified by NASSCO.
- D. The contractor shall maintain back-up equipment in the event that primary equipment fails to prevent delays in the completion of work.
- E. Recording and Documentation:
- 1. Upon completion of CCTV inspection, all inspection data shall be transferred to an external hard drive. The codec required for proper playback of the video file must be included on the external hard drive.
 - 2. Provide printed label on the external hard drive or other documentation that indicates the following:
 - a. Name of the Owner
 - b. Project Title
 - c. Dates of Inspection
 - d. Inspection Company
 - e. Deliverable Number
 - f. List of Asset IDs Inspected
- F. Video:
- 1. Provide all inspections with a unique file name per inspection.
 - 2. Video shall be encoded in .WMV, .MPG, or .AVI format.
 - 3. The following information shall be displayed on the opening screen of each inspection:
 - a. Inspection Date and Time
 - b. Surveyor's Name
 - c. Project Name
 - d. Sewer Basin Name
 - e. Street Address and City
 - f. Upstream and Downstream Manhole ID
 - g. Direction of Inspection
 - h. Pipe Material
 - i. Pipe Diameter/Size
 - 4. The following information shall be displayed continuously on-screen during inspection:
 - a. Inspection Date and Time
 - b. Continuous forward and reverse readout of camera distance from center of manhole starting reference.
 - c. Upstream and Downstream Manhole ID

d. Defect or Observation Code as Encountered

G. Audio:

1. Audio shall be embedded in the video file.
2. Verbal description and location of each defect and service connection.

H. Still Photography:

1. Provide digital photographs showing the inspection image at all defects, observations, and service connections.
2. Photos shall have a unique file name describing the image.
3. Photos shall be encoded in .JPEG format with a minimum resolution of 640 x 480.
4. Provide a label on the photograph with the upstream and downstream manhole IDS, footage, and defect code.

I. Database:

1. The database shall contain asset information, inspection information, and defect codes and scores.
2. The database file type shall be MSAccess, .MDB, or .ACCDB.
3. The database format shall be NASSCO PACP Standard Exchange Database.
4. All inspection media shall be linked to the corresponding asset/inspection/defect information within the database.

J. Inspection Reports:

1. Provide .PDF format inspection reports including:
 - a. A summary of the inspections completed
 - b. Pipe graphs of each inspection showing asset information and defects/observations
 - c. Header containing the following information:
 - 1) Date and Time
 - 2) Inspection Company, Address, and Telephone
 - 3) Surveyor's Name
 - 4) Project Name
 - 5) Sewer Basin Name
 - 6) Location code
 - 7) Street Address and City
 - 8) Weather
 - 9) Upstream and Downstream Manhole ID
 - 10) Upstream Manhole Depth
 - 11) Direction of Inspection
 - 12) Pipe Material
 - 13) Pipe Diameter/Size
 - 14) Pre-Cleaning Requirements
 - 15) Date Cleaned
 - 16) Mapping Length
 - 17) Surveyed Length
 - 18) Survey Start and End Time
 - 19) Additional Information as Needed
2. Provide field maps corrected to reflect actual field conditions:
 - a. Neatly strike out incorrect data with a green pen and clearly mark correct data using a red pen. Show notes that clarify changes in blue.

2.2 SEWER FLOW CONTROL SYSTEM

- A. The sewer flow control system shall provide adequate capacity and size to handle existing flows plus additional flows that may occur during periods of rain. Estimate the peak amount of flow to be bypassed and provide bypass flow capacity of at least 125% of the peak flow estimate.
- B. Plugs:
 - 1. Provide with taps for connection of pressure gauges and air hoses, and flow-through capability.
 - 2. Use mechanical plugs with rubber gaskets or pneumatic plugs with rubber boots for pipe diameters 24 inches and smaller.
 - 3. Use inflatable bag stoppers made in two or more pieces for pipe diameters larger than 24 inches.
- C. Piping:
 - 1. Material:
 - a. HDPE pipe shall:
 - 1) Be in accordance with ASTM D3350
 - 2) Have a minimum wall thickness conforming to DR 32.5
 - 3) Have butt-fusion welded joints.
 - b. Ductile Iron Pipe shall:
 - 1) Be in accordance with AWWA C151/A21.51
 - 2) Have rubber gasket push-on joints in accordance with AWWA C111/21.11
 - 3) Have fittings in accordance with AWWA C110/21.20
 - c. Small diameter flexible pipe may be used for low pressure and low flow conditions from 8-inch and smaller gravity sewer lines, as approved by the Owner.
 - d. Pipe material shall have a pressure rating of at least 1.5 times the operating pressure.
 - e. Pipe material may be reused for subsequent flow bypass pumping system placements. The Owner, at their sole discretion, shall have right to reject sections deemed unserviceable.
- D. Bypass Pumps shall:
 - 1. Be fully automatic, self-priming units that do not require the use of foot valves or vacuum pumps in the priming system.
 - 2. Have a solids handling design with the ability to pump minimum 3-inch diameter solids.
 - 3. Be able to run dry for long periods of time to accommodate cyclical nature of flows.
 - 4. Be equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from the source and, if more stringent, comply with all local noise ordinances.
 - 5. Have on standby pump of each size used available onsite.
- E. Electric Power Generators shall:
 - 1. Be able to simultaneously start and run all electric powered pumps required for the flow to be controlled.
 - 2. Be equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from the source and, if more stringent, comply with all local noise ordinances.
 - 3. Include automatic transfer switch if the flow control system is to operate unattended.

2.3 SEWER CLEANING

- A. Sewer cleaning equipment shall be capable of removing dirt, debris, solids, grease, rocks, sand, grit, roots, and obstructions from sanitary sewer mainlines and manholes.
- B. High Velocity Hydro Cleaning Equipment:
 - 1. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation.
 - 2. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned.
 - 3. The Contractor shall use, in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-inches and larger.
 - 4. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and benches and produce at least 2,000 psi of pressure. The gun shall be capable of producing flows from a fine spray to a solid stream.
 - 5. Equipment shall operate above ground and be a combination of high-velocity (hydro-cleaning) jet and vacuum system, truck-mounted for mobility and ease of operation.
 - 6. The hydro-cleaning equipment shall include a minimum 1,000-gallon water storage tank, auxiliary engines and pumps, and include a minimum of 600 feet of 1-1/4-inch high-pressure hose on a power-driven hose reel. Pump nozzle combinations shall be capable of producing water flow rates up to 120 gpm, and a minimum of 60 gpm at a working pressure up to 2,000 psi.
 - 7. A working pressure gauge shall be used on the discharge of all high-pressure water pumps.
 - 8. The vacuum system shall consist of a minimum 6-inch suction line and equipped with a fluidizing nozzle capable of removing material from beneath water surface at depths from ground surface to the sewer invert of at least 35 feet.
- C. Mechanically Powered Cleaning Equipment:
 - 1. Bucket machines shall be furnished with buckets in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drives will not be allowed.
 - 2. Power rodding machines shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.
- D. Root Removal Equipment:
 - 1. Use tools and accessories designed for removing roots, such as hydraulic root cutters, porcupines, or high-velocity hydro cleaners. Use of equipment shall not result in damage to the host pipe.

2.4 CHEMICAL ROOT TREATMENT

- A. Materials, equipment, and accessories specified in this section shall be products of Razorooter II.
- B. All material used shall:
 - 1. Be registered with the EPA and the Tennessee Department of Agriculture.

2. Be labeled for use in sewers to control tree roots.
 3. Contain and active ingredient for controlling tree roots and deterring their re-growth.
 4. Contain a surfactant system to deliver the active ingredient (herbicide) to the target root tissue.
- C. Active ingredients shall:
1. Be a Category “E” compound.
 2. Not be considered a carcinogen, teratogen, mutagen, or oncogene, based on laboratory testing.
 3. Carry a “signal word” assigned by the EPA of either “Warning” or “Caution” on the product label. Pesticides/herbicides carrying the “signal word” “Danger” shall not be accepted.
 4. Be nonvolatile in order to minimize exposure to workers and other individuals by inhalation.
 5. Not be readily absorbed through the skin.
 6. Products containing the active ingredient(s) metam-sodium or copper sulfate are not allowed.
- D. Surfactant system shall:
1. Produce a dense, small bubble, clinging foam which sustains its shape for a minimum of one hour.
 2. Enhance the penetration of herbicide into root masses.
 3. Contain an alkylpolyglucoside (formulations of vegetable oil and carbohydrate from agricultural products).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify location of piping to be cleaned or inspected.

3.2 CCTV INSPECTION

- A. General
 1. CCTV inspection shall be done one sewer line at a time, and the flow in the section being televised shall be suitably controlled. The depth of wastewater flow shall not exceed 25% in any pipe diameter. For new sewer lines, post-construction CCTV inspection shall be performed prior to releasing flow into the pipe.
 2. When depth of flow in a section being worked is above the maximum allowable level for inspection, the flow shall be reduced in accordance with sewer flow control in accordance with this section.
 3. Poor quality inspections including, but not limited to, loss of color, video distortion, outside interference, etc. will not be accepted by the Owner. Reinspection of pipes that do not meet minimum requirements shall be performed at the Contractor’s expense.

B. Inspection

1. Inspection shall be conducted in the direction of flow (upstream to downstream) except while the camera is being used in a reverse setup.
2. Camera Operation:
 - a. The camera shall be moved through the line at a moderate rate, stopping when necessary to permit proper documentation of the sewer line section condition. In no case will the camera be allowed to travel at a speed greater than 30 feet per minute. Stop, for a minimum of 5 seconds, at every lateral, defect, and observation to properly determine each defect condition and lateral status.
 - b. Lens, lighting, and focus shall be readjusted in order to ensure clear, distinct, and properly lighted viewing of defects, laterals, and observations. A reflector in front of the camera may be required to enhance lighting in black pipe.
 - c. The camera lens shall remain above visible water line and may submerge only while passing through clearly identified line sags or vertical misalignments. Otherwise, the inspection shall be conducted at a time of lower flow or flow diversion shall be conducted in accordance with this section.
 - d. The camera height shall be adjusted such that the camera lens is always centered in the pipe being televised.
3. Failure of Initial Inspection:
 - a. If the initial survey attempt fails due to a blockage or obstruction, then the sewer line shall be lightly cleaned and re-attempted before a reverse inspection is performed.
 - b. A reverse setup is only allowed in the event that the initial survey must be abandoned due to obstructions, offset joints, etc.
 - c. If a reverse setup is required, establish a new inspection separate from the initial inspection.

C. Reverse Inspection

1. There may be occasions during CCTV inspection of a sewer line when the camera will not be able to pass an obstruction even though flow is continuing. The Contractor shall televise the pipe section from the downstream manhole in order to obtain a complete video inspection. Whenever such conditions arise, the Owner shall be notified to determine if a point repair is necessary. No additional payment shall be made for reverse set-ups required due to an obstruction.
2. If a complete inspection of the pipe section cannot be completed due to multiple obstructions, the Contractor shall notify and provide the Owner with the incomplete inspection. At the request of the Owner, the Contractor shall re-inspect the pipe after the necessary pipe repairs have been made. The decision to repair or not to repair a pipe shall be made by the Owner. The Owner may accept physical inspection that does not adhere to minimum standards herein if adverse conditions are encountered and re-inspection is not advised.
3. The Owner makes no guarantee that all of the sanitary sewer mains proposed to be inspected are clear for the passage of the camera. The equipment, tools, and methods used for securing the passage of the camera are to be at the discretion of the Contractor, with the approval of the Owner.

D. Measurement

1. All measurements shall be recorded in English units.
2. Obtain pipe diameter by physical measurement using calipers or measuring rod in the manhole.
3. Continuous Distance Meter:

- a. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation of the depth of the manhole, will not be allowed.
- b. Accuracy must be within 2 tenths of a foot tolerance and shall be checked on a daily basis by use of a walking meter, roll-a-tape, or other suitable device. Accuracy shall be satisfactory to the Owner.
- c. Shall be zeroed after each segment inspected.
- d. Defect identifications are to be called out and recorded to the nearest tenth of a foot.
- e. Inspection will be unacceptable if measurement is inaccurate, or identified defects or features leave doubt as to the accuracy of locations or total length.

E. Documentation

- 1. Asset and Inspection Information
 - a. All asset and inspection information (header information) shall be entered in the database in accordance with the NASSCO PACP manual.
 - b. All digital videos will become the property of the Owner.
- 2. Observation and Defect Coding
 - a. All defects and observations shall be coded in the inspection records in the database in accordance with the NASSCO PACP manual.
 - b. All defects and observations codes shall be linked to the corresponding media within the database.

F. Quality Control

- 1. The Contractor shall submit in electronic format digital videos, photos, and evaluation reports to the Owner for review. The Contractor is required to investigate or correct issues noted by the Owner during review and submit corrected deliverables.

3.3 SEWER FLOW CONTROL

A. Performance Requirements

- 1. It is essential to the operation of the existing sewerage system and a requirement that there is no interruption in the flow of sewage throughout the duration of the Project, continuity of sewer service must be maintained at all times.
- 2. Provide, maintain, and operate temporary facilities such as dams, plugs, pumping equipment, pipes, conduit, and necessary power to intercept sewage flow before it reaches the area of Work.
- 3. Properly size all equipment, components, and appurtenances to maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from discharge or damage.
- 4. Any discharge of sewage including discharges into the construction trench shall not be permitted.

B. General

- 1. Notify Owner at least 48 hours prior to implementing any sewer flow control system.
- 2. Operate and maintain sewer flow control systems 24 hours per day, 7 days per week, including holidays, as required, to control flow.
- 3. Take all necessary precautions to ensure no private or public properties are subjected to a sewage backup or spill. The Contractor shall be solely responsible for all cleanup,

damages, and resultant fines in the event of a backup or spill. In the event of a backup or spill, the Contractor shall immediately notify the Owner and begin clean-up procedures.

4. When depth of flow in a pipe section is above the maximum depth specified for inspection, reduce flow by plugging, diverting, or bypass pumping around the work area.
5. Eliminate all flow from sewer manhole-to-manhole segments during point repairs, service connection rehabilitation, manhole construction and sewer pipe replacement or lining within the segment.
6. If flow reaches peak estimated flow that flow control system was designed for, stop all Work that requires flow control, secure the work area, and restore flow in the sewer until flow recedes.
7. After the Work is completed, return flow to the sewer and remove temporary equipment.

C. Plugging or Blocking

1. Flow control may consist of blocking flow with mechanical or pneumatic plugs if only a small amount of flow needs to be controlled and adequate storage is available. Plugging or blocking of flow must be pre-approved by the Owner.
2. Use primary and secondary plugs for each flow control location.
3. When blocking flow is no longer needed for performance and acceptance of the Work, remove plugs in a manner that permits sewage flow to slowly return to normal without surcharging or causing other major disturbances downstream.
4. Remove temporary plugs at end of each working day and restore normal flow. If downstream work is not or cannot be complete during the workday, provide, operate, and maintain a bypass pumping system.
5. Use bypass pumping if the Work cannot be scheduled at a time when flow is low or completed during a low flow period.

D. Bypass Pumping

1. When blocking flow in upstream sewer is not appropriate or allowed by the Owner, use flow bypass pumping for reducing flow below the maximum depth or completely bypassing flow.
2. Design, furnish, install, and maintain all power, primary, and standby pumps, appurtenances, tanks, tucks, and bypass piping required to maintain existing flows and services.
3. The Contractor shall obtain approval and secure all permits for placement of temporary bypass pumping systems and pipelines within public right-of-way.
4. Site Verification
 - a. Locate existing utilities in the area of bypass pipelines.
 - b. Minimize disturbance of existing utilities
 - c. Confine bypass discharge pipeline within public rights-of-way, temporary construction easement, or permanent easement.
 - d. When bypass pipeline crosses local streets and private driveways, place bypass pipeline in a trench and cover with temporary pavement.
 - e. Installation of bypass pipelines is prohibited in riparian/wetland areas unless approved by the Owner.
5. Flow bypass shall be done in such a manner that will not damage private or public property, or create a nuisance or public menace. Pumped sewage shall be in an enclosed pipe that is adequately protected from traffic, and shall be redirected into sanitary sewer system or alternatively into an enclosed tank for hauling to the wastewater treatment plant. Dumping or free flow of sewage on private or public property, gutters, streets, sidewalks, or into storm sewers is prohibited.

6. The Contractor shall equip pump engines with noise suppression devices to keep pump noise to a minimum and comply with applicable noise ordinances.

E. Service Lateral Bypassing

1. When it is necessary to temporarily disconnect a service lateral the Contractor shall do so in accordance with Section 33 31 30 – Sanitary Sewer Services.
2. Disconnected sewer service lateral connections shall be accommodated by bypass pumping or containment from time of disconnection to time of reconnections. This shall be accomplished by a mechanical pump and manifold system or by storage system such as a bladder tank system. The storage system shall be capable of holding adequate sewage from each sewer service connection for a period of 24 hours. Each storage system shall be emptied or pumped during each 24-hour period and properly disposed of in accordance with TDEC requirements.
3. The Contractor shall monitor status of flow and storage and pump disconnected laterals more frequently where flows exceed the storage capacity of the lateral or bladder tank system.

F. Field Quality Control and Maintenance

1. The Contractor shall perform a leakage pressure test of the bypass pumping discharge piping using clean water prior to actual operation. Prior to operation, test each section of discharge piping with maximum pressure equal to 1.5 times the maximum operating pressure of the system. The Owner shall be given 24 hours' notice prior to testing.
2. The Contractor shall inspect bypass pumping system every 2 hours to ensure that the system is working correctly.
3. The Contractor shall ensure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

G. Cleaning

1. Before bypass pumping systems are broken down and moved to the next section or removed at the completion of the Work, discharge sewage remaining in bypass discharge pipeline and pumping equipment to working sewer. Sewage shall not be spilled or discharged to the ground or environment.
2. Upon completion of bypass pumping operations, clean disturbed areas and restore to previous conditions or better, including pavement restoration.

3.4 SEWER CLEANING

A. General

1. When sewer flow depth is greater than 25%, flow depth shall be decreased by sewer flow control in accordance with this section.
2. Designated sanitary sewers and manholes shall be cleaned with the specified cleaning equipment herein. The cleaning process shall remove all dirt, grease, roots, grit, sand, silt, solids, rags, debris, etc. from each sewer segment, including the manhole(s).
3. Precautions shall be taken to protect the sanitary sewer mains and manholes from damage that might be inflicted by the use of the cleaning process or equipment. Any damage to a sewer caused by improper or careless use of cleaning equipment by Contractor shall be repaired by the Contractor at no additional cost to Owner and to the satisfaction of Owner.
4. Cleaning shall also include the initial manhole wall washing by high-pressure water jet.

5. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction shall be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.
6. Contractor shall not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or into structures.
7. If water backups a lateral and enters a building or residence during cleaning, the Contractor shall notify Owner of the occurrence. It is the Contractor's responsibility to clean any backups which occur at no additional cost to Owner. If prior knowledge of backups is available, the Contractor shall take measures to prevent another backup from occurring (i.e., plugging the lateral) before cleaning.
8. Cleaning shall restore pipe to a minimum of 95% of original carrying capacity. No more than 5 percent debris shall remain in existing pipe. Pipe shall be 100% of original carrying capacity (no debris) for post construction inspections.
9. Clean using hydraulically propelled, high velocity hydro, or mechanically powered equipment supplemented with additional equipment as required based on conditions of lines at time Work commences and suitable to obtain a clean sewer line free from dirt, sand, rocks, gravel, grease, sludge, roots, and other debris.
10. Begin cleaning at upstream end of system and proceed in downstream direction. Unless otherwise permitted by the Owner, cleaning pipeline segments upstream of a section of pipe already cleaned will not be allowed. If entire section cannot be cleaned from upstream manhole, it will be assumed a major blockage exists. Contractor shall with the Owner's approval, abandon effort and document what was completed to point of blockage.
11. Notify Owner immediately of any observed pipe failures or instances where the pipe cannot be cleaned.

B. High-Velocity Cleaning

1. Contractor shall operate the equipment so that the pressurized nozzle continues to move at all times.
2. The pressure nozzle shall be turned off or water pressure be reduced anytime the hose is held or delayed in order to prevent damage to the line. In heavy debris the step cleaning method should be used.
3. Contractor shall make a minimum of two passes through pipe segment.

C. Mechanical Cleaning

1. Mechanical cleaning, in addition to normal cleaning when required by Owner, shall be approved equipment and accessories driven by power winching devices.
2. Approved buckets, scrappers, scooters, porcupines, kites, heavy duty brushes, metal pigs and other debris removing equipment/accessories shall be used as appropriate and necessary in the field, in conjunction with the approved power machine(s).

D. Water Usage

1. Any and all Owner water used by Contractor shall be from a metered supply with an approved backflow device to protect the water supply. All metered water supply shall be paid to Owner through the regular billing system.
2. Contractor shall be responsible for obtaining transient water meter(s) from Owner, which shall be installed on the trucks or at fire hydrant(s). All related charges for the set-up shall be considered incidental to the cleaning of the existing sanitary sewer mains.
3. Contractor shall be responsible for preventing contamination of the potable water system. Contractor when drawing water from a public hydrant shall use a backflow preventer or an 18-inch air gap.

4. No fire hydrant shall be obstructed or used when there is a fire in the area.
5. It shall be Contractor's responsibility to obtain approval to use Owner's fire hydrants.
6. Contractor shall remove the water meter(s)/piping etc. from all fire hydrants at the end of each working day.

E. Removal and Disposal of Debris

1. All materials removed from the sewer lines during cleaning operations shall be trapped and removed from the system at the downstream manhole of the section being cleaned. All materials shall be disposed of in compliance with all applicable laws and regulations and in a manner approved by Owner.
2. Passing of debris to a downstream manhole section will not be allowed.
3. Any debris, or liquid waste, sludge, etc. shall not be accumulated on site except in totally enclosed containers that are permitted by Owner and the Tennessee Department of Environment and Conservation (TDEC) for liquid waste hauling.
4. All solids or semi-solids resulting from the cleaning operations shall be removed from the Site at the end of each workday, hauled to and disposed of at an Owner approved dump site.
5. Under no circumstances shall sewage or solids removed in the cleaning process be dumped onto streets or into ditches, catch basins, storm drains, sanitary sewer manholes, cleanouts, or dumps.

3.5 CHEMICAL ROOT TREATMENT

A. General

1. Where Work is located in high-traffic areas, Contractor shall place proper traffic warning devices to protect the Site and to prevent accidents or personal injury to the public.
2. Use a reduced pressure zone backflow prevention device whenever accessing fresh water for mixing chemical.

B. Application

1. Perform the Work according to label instructions and in accordance with the best recommended practice for conditions present in the line under treatment. Application shall be done by foaming or other methods as provided on the product label.
2. Perform in such a way as to contact roots within the primary main line sewer to be treated. Make effort to penetrate secondary lateral sewers in order to contact roots residing in the "wye" connections.
3. Generate foam through the use of air injection equipment and pump the foam into the sewer under pressure as foam. Foam quality shall be sufficient to penetrate "wye" connections, effectively treat large diameter pipe, and to enhance treatment effectiveness overall.
4. Hydraulic sewer cleaning machines will reduce treatment effectiveness by damaging root growths and inhibiting their uptake of chemical. Hydraulic sewer cleaning machines shall not be used prior to or during the treatment process.

C. Protection of Wastewater Treatment Plant

1. Contractor shall take all steps necessary and appropriate to prevent adverse effects on wastewater treatment plant processes during the application process.
2. In the event that a wastewater treatment plant experiences any reduction in operating efficiency during the execution of the Contract, Contractor shall immediately

suspend all applications, at the direction of the Owner. Contractor shall continue operations only after problems at the wastewater treatment plant have been corrected, satisfactory to the wastewater treatment plant operator.

END OF SECTION 33 01 30

SECTION 33 01 30.23 – PIPE BURSTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specifications sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe Bursting
- B. Related Requirements:
 - 1. Section 30 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 2. Section 33 05 05 – Sanitary Sewer Testing
 - 3. Section 33 05 61 – Concrete Manholes
 - 4. Section 33 31 30 – Sanitary Sewer Services

1.3 COORDINATION

- A. Coordinate Work of this Section with users connected to system.

1.4 SUBMITTALS

- A. Action Submittals
 - 1. Catalog cuts and specifications:
 - a. Pipe.
 - b. Electrofusion fittings.
 - c. Joining, including alignment jig, equipment.
 - d. De-beading equipment.
 - 2. Dimensioned layout drawings including installation details.
 - 3. Samples: Trial field fusion welds, when requested by the Owner.
- B. Informational Submittals:
 - 1. Manufacturer's Certificates:
 - a. Certificate of material compliance.
 - 2. Contractor Certifications:
 - a. Installer: Certifications of training by pipe bursting system manufacturer stating that installer have been fully trained in the use of the pipe bursting equipment by an authorized representative of the equipment manufacturer.
 - b. Insertion Equipment Operator: Certification from pipe manufacturer of training in the proper method for handling and installing the new pipe.

- c. Fusion Equipment Operator: Certifications of training by the pipe fusion equipment manufacturers that the operators have been fully trained in the use of the fusion equipment by an authorized representative of the equipment manufacturer.
- 3. Design Calculations:
 - a. Pull/push loads for specified material.
 - b. Thrust loads for specified material.
- 4. Test Results: Certified factory. For trial fusion weld testing follow ASTM D638.
- 5. Installation Plan and Sequencing:
 - a. Detailed Construction Methods & Procedures:
 - b. Layout plans to include sequence of construction.
 - c. Locations, sizes, sequencing for all insertion, receiving, and access pits.
 - d. Arrangement and position of jacks, pipe guides, and backstops complete in assembled position.
 - e. Reconnection and restoration of existing service laterals.
 - f. Detailed descriptions of the methods of modifying and sealing existing manholes.
 - g. Detailed procedures for the installation and bedding of the new pipe in the launching and receiving pits.
 - h. Description of the method to remove and dispose of the host pipe, if required.
- 6. Bypass pumping submittals shall be in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
- 7. Contingency Plan: Provide for the following potential conditions at a minimum:
 - a. Unforeseen obstruction causing burst stoppage, such as unanticipated change in host pipe material, repair section, concrete encasement or cradle(s), buried or abandoned manhole or changes in direction not depicted on Drawings provided by the Owner.
 - b. Substantial surface heave occurs due to the depth of the existing pipe versus the amount of upsizing.
 - c. Damage to existing service connections or to the replacement pipeline’s structural integrity.
 - d. Damage to other existing utilities.
 - e. Soil heaving or settlement.
 - f. Loss of and return to line and grade.
- 8. Pre- and Post-Installation Inspection Data & Reports:
 - a. Pre-installation DVD or external hard drive, original.
 - b. Post-installation DVD or external hard drive, original.
 - c. CCTV Inspection Equipment shall be in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

1.5 QUALITY ASSURANCE

- A. The Contractor shall be certified by pipe bursting system manufacturer as a fully trained user of the pipe bursting system. Operation of the pipe bursting system shall be performed by trained personnel. Such training shall be conducted by a qualified representative of the pipe bursting system manufacturer. The Contractor shall provide certificates of training for any employee directly involved in the supervision or operation of the pipe bursting system. Contractor shall have a minimum of 40,000 linear feet of pipe during preceding 3 years using pipe bursting technology as specified herein.
- B. Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and the recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and

installing the polyethylene pipe. Such training shall be certified and conducted by a qualified representative of the pipe manufacturer. Personnel shall have a minimum of 2 years' experience of fusion welding of HDPE pipe.

- C. Installation of other materials shall be performed by personnel qualified by the specific product manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Materials shall be made safe from theft, vandalism, and damage.
- B. Packing and Shipping:
 - 1. Markings: Pipe materials shall be legibly marked by manufacturer with the following:
 - a. Name and trademark of manufacturer.
 - b. Nominal pipe size.
 - c. SDR.
 - d. Letters PE, followed by polyethylene grade per ASTM D3350, followed by Hydrostatic Design Basis in hundreds of psi.
 - e. Manufacturing standard reference.
 - f. Production code from which date and place of manufacture can be determined.
 - 2. Use pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.
- C. Storage and Protection:
 - 1. HDPE pipe without ultraviolet inhibitor shall not be stored unprotected against outside elements.
 - 2. Store pipe so as not to be deformed axially or circumferentially.
- D. Handling: Use wide band slings for lifting and skids, rollers, or non-abrasive pads for moving pipe. Use of chains and dragging is prohibited.

PART 2 - PRODUCTS

2.1 PIPE:

- A. High-Density Polyethylene (HDPE):
 - 1. Confirm to requirements of AWWA C906.
 - 2. In compliance with NSF 61.
 - 3. Resin:
 - a. Polyethylene resin shall meet or exceed requirements of ASTM D3350 for PE 4710 material with cell classification of 445474C, or better. Pressure rating shall be based on hydrostatic design stress of 1,000 psi at 73.4 degrees F.
 - b. Unless specified on the project drawings the minimum Pressure Rating shall be 200 PSI and nominal DR of 11.

4. Pipes 4” and larger shall have Ductile Iron Pipe Size outside diameter.
5. Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of a compatible resin mix for the fusion process.
6. Fittings:
 - a. PE:
 - 1) Shall be thermal butt-fusion type.
 - 2) Shall have same or higher pressure rating as pipe.
 - b. Ductile Iron:
 - 1) Join to mechanical joint ductile iron fittings w/ restraining gland follower with internal stiffener.
 - 2) Restraining follower glands shall be manufactured by EBAA Iron “Mega-Lug” Model 2000PV or 2100.
7. Electrofusion Couplings:
 - a. May be used for repairs or connecting pipe burst segments in the trench with approval of the Owner.
 - b. Manufacturers:
 - 1) Central Plastics Company; Central Electrofusion System.
 - 2) IPEX, Inc; Friatec.

2.2 SERVICE CONNECTION AT MAINLINE SEWER

- A. Service saddles shall be butt fusion or electrofusion saddle type fitting with DIP outside dimension branch connection:
 1. Specifically designed for connection to type of HDPE being installed.
 2. Manufacturers:
 - a. Central Plastics Company; Central Electrofusion System.
 - b. IPEX Inc.; Friatec.
- B. Option: For HDPE pipe sizes 8 inches or greater an Inserta Tee by Inserta Fittings Company may be used.

2.3 PIPE CONNECTION TO EXISTING MANHOLES

- A. Pipes shall be connected to existing manholes using a sanded manhole adapter
 1. Manufacturers:
 - a. GPK Products Inc.
 - b. Approved equivalent

2.4 SOURCE QUALITY CONTROL

- A. Certify laboratory data confirming that said tests have been performed on sample of pipe to be provided under this Contract, or pipe from that production run, and that satisfactory results were obtained prior to shipping.
- B. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. It shall be uniform in density and other physical properties. Pipe not meeting these criteria shall be rejected.

PART 3 - EXECUTION

3.1 EQUIPMENT:

- A. Pipe Bursting: Provide equipment of sufficient size and power to accomplish the specified pipe replacement under adverse conditions. Utilize hydraulically powered constant tension static pull pipe bursting system or pneumatic hammer.
- B. Joining: Capable of meeting conditions recommended by pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure.
- C. De-beading equipment shall be capable of removing a cold bead in a continuous strip without damaging the joint or bead.

3.2 PREPARATION

- A. General:
 - 1. Work shall be supervised by personnel experienced in installation of similar pipe and shall be onsite at all times from time of commencement to time of completion.
 - 2. Locate insertion or access pits so that the total number is minimized and footage of pipe installed in a single run is maximized. Use excavations at point repair locations for insertion pits where possible.
- B. Pre-CCTV Inspections:
 - 1. The Contractor shall perform a pre-installation CCTV inspection.
 - 2. Existing pipe shall be clean and free of obstructions so as not to prohibit pipe bursting operations.
 - 3. CCTV inspections shall be completed in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
- C. Locating Utilities:
 - 1. The Contractor shall, prior to starting work, verify the location of all adjacent utilities. The minimum clearance from other utilities shall be approximately two feet. The Owner may at its discretion reduce the minimum clearance with justification from the Contractor.
 - 2. The Contractor shall expose all interfering and crossing utilities by spot excavating at the planar intersection of the pipe and removing the soil from around the utility. The cost of exposing these utilities shall be borne by the Contractor as part of the pipe bursting operation.
- D. Sub-Surface Conditions:
 - 1. Owner will furnish the Contractor with available information listed in the Contract Documents, if any are available. The Contractor shall verify this information in the field. All additional subsurface investigations deemed necessary by the Contractor to complete the work shall be included in the Contract at no additional cost to Owner.
 - 2. Copies of all reports and information obtained by additional subsurface investigations by the Contractor shall be provided to the Owner.

- E. Point Repairs:
1. Prior to Pipe Bursting
 - a. Contractor shall perform a point repair if indicated on the Project Drawings.
 - b. If the pre-installation CCTV inspection reveals obstructions in the existing sewer (heavy solids, dropped joints, protruding service taps or collapsed pipe) which will prevent completion of the pipe bursting process, and that cannot be removed by conventional sewer cleaning equipment, then a point repair shall be made by the Contractor, with the approval of the Owner.
 - c. Point repairs on existing pipe shall be completed in accordance with Section 33 31 11 – Gravity Sewer Pipe.
 2. Post Pipe Bursting:
 - a. If the post CCTV inspection reveals a sag in the new sewer after pipe bursting has been completed, the Contractor shall notify the Owner to determine if a point repair is necessary to correct the sag. At the direction of the Owner, the Contractor shall take the necessary measures to eliminate these sags by performing a point repair and bringing the bottom of the newly installed pipe to a uniform grade by excavating the pipe, lifting it, and placing compacted crushed stone bedding under and around the pipe to eliminate the sag.
 3. Backfill per Section 31 23 16.01 – Excavation for Utilities shall be used for the new pipe as support in order to avoid sagging after backfill and compaction.
- F. Locating Service Connections:
1. Sewer service connections shall be identified and located by CCTV prior to start of pipe bursting operation and pipe insertion.
 2. The Contractor shall locate all and expose all sewer service connections prior to pipe insertion to expedite reconnection.
 3. The Contractor shall exercise due diligence in excavating the existing pipe sufficiently to allow for uniform circumferential expansion of the existing pipe through the service connection pit.

3.3 PIPE JOINING

- A. General:
1. When requested by the Owner, prior to pipe installation, two trial fusion welds shall be performed, and reviewed and approved by the Owner. Full penetration welds shall provide homogeneous material across the cross section of weld. Fusion machine employed for trial welds shall be same machine utilized for project installation.
 2. The HDPE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted.
 3. All equipment and procedures used shall be in strict compliance with ASTM F2620 and with the pipe manufacturer's recommendations.
 4. Terminal sections of pipe that are joined within the insertion pit shall be connected with an electrofusion coupling (e.g., Central Plastics couplings).
 5. All connections shall be completed in the absence of flow and in conformance with the manufacturer's installation procedures.
- B. Joint Preparation:
1. Inside and outside of pipe ends shall be cleaned with cotton or non-synthetic cloth to remove dirt, water, grease, and other foreign materials.

2. Pipe ends shall be cut square and carefully aligned prior to heating.

C. Joining:

1. Fusion shall be performed by technicians certified by a manufacturer of pipe fusion equipment.
2. Using an alignment jig, the butt-fused joint shall be true alignment, brought together in firm, rapid motion, applying sufficient pressure to form a uniform rollback bead (1/8 inch to 3/16 inch) on the entire outer and inside circumference of pipe. The joint shall be allowed adequate cooling time before removal of pressure.
3. The fused joint shall be watertight and shall have tensile strength equal to or greater than that of the pipe.
4. All joints shall be subject to acceptance by the Owner prior to insertion.
5. The Contractor shall cut out and replace defective joints at no additional cost to Owner.

D. Weld De-beading:

1. Internal beads shall be removed with an approved de-beading device without inducing any defects to the pipe or bead. The pipe and bead must be completely cooled before the bead is removed.
2. The removed beads shall be in one continuous strip without splitting or defect. The contractor shall remove any joint with defective beads and fuse a new joint.

E. Defects:

1. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10 percent of the wall thickness (ASTM F585), shall not be used and shall be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above.
2. Any section of the pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner shall be discarded and not used.

3.4 BYPASSING OF FLOWS

- A. Use flow bypass pumping for reducing flow below the maximum depth or for completely bypassing flow.
- B. Bypassing of flows shall be provided in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

3.5 PIPE INSTALLATION

A. General:

1. The minimum depth of cover over the installed pipe shall be 4 feet for size-on-size pipe bursting, and shall be 8 feet for increased pipe size pipe bursting. The Contractor may request approval of the Owner reduce the minimum depth of cover.
2. A minimum amount of ground heaving may be allowed, as determined by the Owner, if soil conditions are not favorable and up-sizing of the pipe is required.
3. Unless otherwise noted, settlement or heaving of the ground surface during or after construction will not be allowed. The Contractor is solely responsible for the costs for

repairing any surface heaving at no additional cost to the Owner, unless specified otherwise.

4. Existing pipe shall be clean and free of obstructions so as not to prohibit pipe bursting operations.
5. Pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Owner
6. Lay pipe true to lines and grades within existing sewer as indicated on the Project Drawing
7. Conduct pipe insertion operations to prevent damage to the installed pipe and adjacent facilities.
8. Advancement of bursting head with “chain” is prohibited.
9. Void created by bursting device shall be sufficient in size to accommodate HDPE pipe.

B. Pit Shaft:

1. Excavate for the purpose conducting the trenchless operations and for placing end joints of pipe.
2. Wherever end trenches are cut in the sides of an embankment or beyond, such work shall be sheeted and braced in a manner to prevent earth caving.
3. Backfill in accordance with Section 31 23 16.01 – Excavation for Utilities after pipe has been installed and tested.

C. Existing Manhole:

1. Utilize existing manholes where practicable. Otherwise, excavate predetermined machine and insertion pits.
2. Remove inverts, benches, and channels to permit access for installation.
3. Enlarge input and output pipe openings to accommodate maximum OD size of bursting device.
4. At no time shall bursting device and installation process place undue stress on existing manhole opening surface. In the event the existing manhole sustains visible damage the manhole shall be replaced in accordance with Section 33 05 61 – Concrete Manholes.
5. Make structure and manhole connections 12 hours (or as otherwise recommended by pipe manufacturer), after pipe insertion.
6. Secure pipe to concrete structures or manholes after pipe has been installed.
 - a. Grout in place approved manhole adapter to create a water tight seal between the manhole and adapter.
 - b. Connect the newly installed pipe to the existing manhole by inserting the pipe into the manhole adapter.
7. Reconstruct benches and channels after new pipe is installed to form a smooth transition to eliminate sharp edges.

D. Manhole Drop Connections:

1. Manhole drop connections shall be installed in accordance with Section 33 05 61 – Concrete Manholes.

E. Rescue Shafts:

1. In the event that the pipe-bursting machine encounters an obstruction and is halted, the Contractor will be required to excavate down to the machine to free the obstruction and continue the installation.
2. The Contractor is notified that the construction of such shafts will be considered incidental to the installation by the pipe bursting construction method.
3. Any rescue shafts will be properly braced, shored, or utilize trench boxes to meet applicable Federal, State, and local requirements.

4. Backfill and compaction for such rescue shafts shall be in accordance with Section 31 23 16.01 - Excavation for Utilities.

3.6 LUBRICATION

- A. Lubrication shall be used if in the opinion of Contractor such lubrication is necessary to ensure the successful completion of the job.
- B. The Contractor shall make arrangements for the injection of bentonite into the annular space behind the pipe bursting head, as the lubricant if required.

3.7 Service Lateral Connection:

1. The exact location and number of service connections shall be determined from a pre-CCTV inspection and field located by marking existing service connections. Contractor shall determine and identify all active services. Contractor shall connect all active service connections.
2. Services shall not be reconnected from abandoned or vacant lots, unless directed otherwise by Owner. Restore and correct missed or faulty reconnections as well as damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners.
3. Make service connections 12 hours, minimum, (or as recommended by pipe manufacturer) after pipe insertion to allow for cooling and relaxation.
4. Sewer service connections shall be connected to new pipe and installed in a hole drilled to the full inside diameter of the outlet. Service connections shall be an Inserta-T or an electrofusion saddle per the material requirements herein.
5. Service laterals and associated appurtenances shall be installed in accordance with Section 33 31 30 – Sanitary Sewer Services.

3.8 RESTORATION

- A. The Contractor shall restore all lateral, launching pits and disturbed surface areas to their original condition.

3.9 POST INSTALLATION CCTV INSPECTIONS

- A. The Contractor shall perform post-installation CCTV inspections in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
 1. Post construction video shall be submitted to the Owner on DVDs for review within two weeks after permanent lateral reinstatements have been completed. Should any portion of the inspection video be of inadequate quality or coverage, as determined by the Owner, the Contractor will have that portion re-inspected at no additional expense to the Owner.
- B. From the CCTV inspection, the newly installed pipe shall be visibly free of defects, which may affect the integrity or strength of the pipe. If in the opinion of the Owner such defects exist, the pipe shall be repaired or replaced at the Contractor's expense.

3.10 TESTING OF GRAVITY SEWERS

- A. Testing of gravity sewers shall be in accordance with Section 33 05 05 – Sanitary Sewer Testing.

3.11 FINAL CLEANING

- A. Prior to inspection and acceptance of pipe by Owner, flush and clean system to remove accumulated construction debris, rocks, gravel, sand, silt, and other foreign material in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

END OF SECTION 33 01 30.23

SECTION 33 01 30.72 – CURED-IN-PLACE PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specifications sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cured-in-Place Pipe
- B. Related Requirements:
 - 1. Section 30 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 2. Section 33 05 05 – Sanitary Sewer Testing
 - 3. Section 33 31 30 – Sanitary Sewer Services

1.3 COORDINATION

- A. Coordinate Work of this Section with users connected to system.

1.4 DESIGN CRITERIA

- A. Design liner thickness in accordance with ASTM F1216, F1743, or F2019 (as appropriate for the proposed liner product) using the following criteria:
 - 1. Pipe Diameters: Per Project Drawings
 - 2. Ovality: 3 percent, or as shown on plans.
 - 3. Pipe Condition: Fully deteriorated.
 - 4. External Water: Ground Surface
 - 5. Short-Term Tensile Strength (ASTM D638):
 - a. Unreinforced: 3,000 psi
 - b. Reinforced: 9,000 psi
 - 6. Tensile Strength Reduction Factor: 50 percent
 - 7. Long-Term Tensile Strength:
 - a. Unreinforced: 1,500 psi
 - b. Reinforced: 4,500 psi
 - 8. Flexural Strength (ASTM D790):
 - a. Unreinforced: 4,500 psi
 - b. Reinforced: 6,500 psi
 - 9. Short-Term Flexural Modulus (ASTM D790):
 - a. Unreinforced: 250,000 psi, or as shown on plans

- b. Reinforced: 700,000 psi, or as shown on plans
- 10. Flexural Modulus and Flexural Strength Reduction Factor:
 - a. Unreinforced: 50 percent
 - b. Reinforced: 35 percent, contingent upon approval of Owner after review of submittal with long-term test data, otherwise 50 percent shall be used.
- 11. Long Term Flexural Strength:
 - a. Unreinforced: 2,250 psi
 - b. Reinforced: 3,250 psi
- 12. Long-Term Flexural Modulus:
 - a. Unreinforced: 125,000 psi, or as shown on plans
 - b. Reinforced: 455,000 psi, or as shown on plans
- 13. k Enhancement Factor: 7
- 14. Soil Modulus: 1,000 psi, or as shown on plans.
- 15. Soil Density: 120 pcf, or as shown on plans.
- 16. Highway Live Load: AASHTO HS20-44
- 17. Safety Factor: 2 minimum
- 18. Minimum Thickness: 6 millimeters for steam and water cured liners.
- 19. Poisson's Ratio: 0.3
- 20. Liner shall be watertight.

1.5 SUBMITTALS

A. Action Submittals

- 1. Resin
- 2. Annular Space Sealant
- 3. Service Connection Fittings
- 4. In-Line Curing Temperature Monitoring System

B. Informational Submittals

- 1. Design Calculations
 - a. Liner thickness design calculations signed and sealed by a Professional Engineer licensed in the State of Tennessee
 - b. Manufacturer's certification of material to values utilized in calculations.
 - c. If reinforced liners are proposed, submit long-term ASTM D790 and ASTM D2990 test data supporting reduction factor used in design
- 2. Manufacturer's installation instructions and procedures, including:
 - a. Wet Out
 - b. Insertion
 - c. Curing
 - d. Cool Down
 - e. Finished Pipe
- 3. Wet out and curing schedule.
- 4. Process control sheets for temperature/time during curing
- 5. Installer's and accredited testing laboratory statement of qualifications
- 6. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards
- 7. Warranty and/or Special Guarantee

8. Manufacturer's instructions for material shipping, storage, and handling requirements
9. Certified copies of test reports of factory tests required by the applicable standards and this section.
10. Dye testing results
11. External hard drive of both pre- and post CCTV inspections in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control

1.6 QUALITY ASSURANCE

- A. Installer shall have a minimum of 5 years' experience and have installed a minimum of 500,000 linear feet with the selected liner product and method of curing.
- B. Superintendent shall have a minimum of 3 years of onsite experience with the selected liner product and method of curing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacturer to prevent damage. Materials shall be made safe from theft, vandalism, and damage.
- B. All products and materials specified herein shall be inspected at the request of the Owner or Inspector. All materials that fail to conform to these specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the Contractor at no cost to the Owner.
- C. Ship resin directly to wet out facility from manufacturer.
- D. Maintain resin-impregnated tubes in refrigerated truck trailers at a temperature below 45° F to prevent premature curing. Prior to beginning inversion, no portion of the resin-impregnated liner shall be subjected to sunlight or ultraviolet radiation. Resin-impregnated tubes with signs of premature curing shall not be installed and shall be removed from the Site at no cost to the Owner.

1.8 SPECIAL GUARANTEE

- A. Provide manufacturer's extended guarantee or warranty, with the Owner named as the beneficiary, in writing, as a special guarantee. The special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this section found to be defective, due to material or workmanship failure, during a period of 5 years after the date of Substantial Completion. A warranty inspection can be completed by the Owner up to 5 years after final acceptance.

PART 2 - PRODUCTS

2.1 CURED-IN-PLACE PIPE

A. Resin:

1. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester, epoxy, isophthalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
2. Resistant to municipal wastewater environment and immersion in septic sewage at temperatures up to 75° F.
3. Curing:
 - a. Designed to cure properly within selected curing method.
 - b. Initiation temperature: 180° F, maximum for water cure.
4. Resins shall be chemical resistant and tested and manufactured in accordance with ASTM F1216 and ASTM D543.
5. For lines smaller than 24 inches, PET resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable.
6. For lines 24 inches and larger, any resin additives are contingent upon Owner approval. All enhanced resins shall be submitted as a part of the action submittal process.
7. For reinforced liners, only neat resins are acceptable.
8. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
9. Produce a cured tube resistant to shrinkage that will not corrode or oxidize and is resistant to abrasion from solids, grit, and sand in wastewater.
10. Bond between tube layers shall be strong and uniform. Layers, after cure, shall be saturated with resin.
11. Styrenated resins are prohibited for pipes that will discharge directly to the environment such as treatment plant effluent lines.
12. Manufacturers and Products:
 - a. Reichhold
 - b. Interplastic Corporation
 - c. Ashland Specialty Chemical Company
 - d. AOC

B. Catalysts:

1. Primary catalyst shall not exceed 1% of the resin by volume.
2. Secondary catalyst shall not exceed 0.5% of the resin by volume.
3. Catalysts shall be:
 - a. Primary: Akzo Products, or as required to meet the performance requirements of the liner.
 - b. Secondary: Akzo Products or Puritan Products; or as required to meet the performance requirements of the liner.

C. Tube:

1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality-controlled conditions set by manufacturer and applicable requirements set forth in

ASTM F1216 and ASTM F1743 that, when cured, will be chemically resistant to reagents as defined in ASTM D543.

2. Lining shall be correct diameter; after installation, there shall be no wrinkles or form permanent fins. Tube shall be capable of stretching to fit irregular pipe sections and fabricated and sized for each section to ensure snug and firm fit inside existing sewer; produce required thickness after resin is cured.
3. Wastewater-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt and shall not be a dark or non-reflective nature that inhibits proper CCTV inspection.
4. For lines 24 inches and larger: if reinforcement is utilized it shall consist of impregnated flexible fiberglass. Each lot of fiberglass liner shall be inspected for defects and tested in accordance with ASTM F2019.
5. Manufacturers:
 - a. Applied Felt
 - b. Insituform Technologies
 - c. Liner Products
 - d. National Liner
 - e. Layne Inliner
 - f. Mississippi Textile

D. Accessories:

1. Hydrophilic Rubber Joint Seal:
 - a. Greenstreak, Inc.
 - b. Hydrotite, LMK, Insignia
 - c. Adeka, KM-String
2. PVC Saddle Tees: Solvent welded type for 8-inch CIPP sewer main connections. Tee shall fit the existing pipe and have an integral 6-inch branch connection with gasket. The saddle shall include two stainless steel straps. Saddle tees shall meet the requirements of ASTM D3034 and ASMT F477.
3. Connections to CIPP mains greater than 8 inches in diameter shall be with a minimum 6-inch "Inserta-Tee" manufactured by Inserta Fittings Company and specifically designed for the thickness of the installed CIPP liner.
4. Curing Temperature Monitoring System:
 - a. ZIA Systems
 - b. Pipeline Renewal Technologies, VeriCure

PART 3 - EXECUTION

3.1 WORKER SAFETY

- A. Contractor shall implement all current recommendations, guidelines, and regulations of the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Health and Safety Administration (OSHA) for the safety of workers and the public affected by the CIPP installation.
- B. Records of any complaints or incidents shall be provided to the Owner.

3.2 PREPARATION

- A. Complete the following activities, unless otherwise approved by the Owner.
1. Pre-Insertion Cleaning: Rewash, re-clean and ready existing sewer pipe immediately before the pre-insertion television inspection.
 2. Pre-Insertion CCTV Inspection: Inspect sewer pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining. Provide an external hard drive of the CCTV inspection.
 3. Dye Testing: Where sewer line segments may contain abandoned services, the Contractor shall be responsible for performing dye testing to determine if the services are live and require re-instatement.
 4. Bypassing Wastewater: In accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
 5. Line Obstructions: If pre-insertion video CCTV inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps or collapsed pipe which may prevent completion of the inversion process), that is not identified in the Drawings and cannot be removed by sewer cleaning equipment, then a point repair using a shielded coupling may be made with the approval of the Owner.
 6. Remove active infiltration prior to the installation of the liner.

3.3 INSTALLATION

- A. Wet Out:
1. Verify lengths in the field before cutting liner to length.
 2. Wet out shall be vacuum impregnated with resin under controlled conditions.
 3. Use roller system to uniformly distribute resin throughout the tube.
 4. Resin shall fill all voids in the tube material with no air spaces or pockets.
 5. Handle resin impregnated tube to retard or prevent settling until it is ready for insertion.
 6. Use of alternative methods of resin impregnation shall be approved by the Owner prior to implementation.
- B. Insertion:
1. Install CIPP in accordance with ASTM F1216 (direct inversion) or ASMT F1743 (pull installations) or F2019 (reinforced liners) as appropriate for the liner product being used.
 2. Dewater existing host pipe prior to installation.
 3. Insert wet out tube through an existing manhole or approved access point by means of an inversion method and application of sufficient hydrostatic head to extend the tube to the next designated termination point.
 4. A pull in method using a bladder to expand the tube may be employed if approved by the Owner.
 5. After insertion, maintain sufficient pressure to hold tube tight against the host pipe.
- C. Curing:
1. Complete a curing process control sheet for every lining completed.
 2. Control sheets shall provide required temperatures and time for the different steps of the curing process: Initial cure, post cure, and cooling as outlined in ASTM F1216. Initial cure

may be considered completed when exposed portions of the flexible tube pipe take a hard set and temperature is adequate, as recommended by the manufacturer.

3. After installation, apply hot water, or ultraviolet light as recommended by the liner manufacturer.
 - a. Steam cure method is prohibited.
 - b. Hot Water:
 - 1) Equipment
 - a) Heat source shall be capable of delivering hot water throughout the section and uniformly raising water temperature to above the temperature required to affect cure of the resin.
 - b) For diameters smaller than 24 inches in diameter, install temperature gauges at the incoming water supply, outgoing water supply, and between impregnated tube and pipe invert at lining termination point (lowest elevation point).
 - c) For diameters 24 inches and larger, utilize a curing temperature monitoring system.
 - d) To monitor the temperature inside the tube wall and verify proper curing, temperature sensors shall be placed between the hose pipe and the liner and in the bottom of the host pipe throughout the reach to record the heating and cooling that takes place on the outside of the liner during processing.
 - e) The sensors shall be spaced apart at intervals no greater than 10 feet.
 - f) Sensors shall be strategically placed at points where a significant heat sink is likely to be anticipated, such as areas where the host pipe is exposed, changes materials, or is submerged such as under a stream crossing.
 - g) Prior to installing the liner in the host pipe, the temperature monitoring system's functionality shall be confirmed by measuring the ambient temperature with the temperature sensors.
 - h) No more than two sensors per segment can be found faulty during this test. If three or more sensors are discovered to be faulty, a new sensor array shall be pulled into the host pipe replacing the previously installed array and the new array shall be again tested for proper functionality at the expense of the Contractor.
 - i) Curing of the resin system shall be as per the directions of the CIPP manufacturer. The temperatures achieved and the duration of holding of the liner at those temperatures shall be per the CIPP manufacturer's established procedures.
 - j) If any sensor or sensors along the reach indicates that there is a localized issue with respect to achieving proper curing per the written installation procedure, the Contractor shall address the issue immediately using previously established protocols for such an event.
 - k) The sensor array's database required in the above paragraph shall have an output report that identifies each sensor by its station in the reach and shows the maximum temperature achieved during the processing of the CIPP and the time sustained at or above the manufacturer's required curing temperature at each sensor.
 - 2) Minimum Interface Temperature between Liner and Tube: 120 degrees F.

- 3) Time: 3 hours, minimum unless manufacturer recommends otherwise and approved by the OWNER.
- 4) Cool Down:
 - a) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
 - b) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
 - c) During release of water, prevent vacuum that could damage newly installed CIPP.
- c. UV: If this method of curing is selected, material shall be a polyester needle felt or fiberglass based CIPP liner impregnated with an isophthalic neopentyl glycol resin.
 - 1) Curing parameters, such as curing speed, inner air pressure, and wattage, per the manufacturer.
 - 2) Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
 - 3) Invert liner into pipe with standard pressure drum or pull into pipe using a slip sheet.
 - 4) After completion of inversion process introduce light chain in liner and close ends with couplings.
 - 5) Remove and discard inner film material after curing to provide optimal quality of final product.
 - 6) Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.
 - 7) Flushing of UV cured CIPP liner to reduce styrene residual is not required.

D. The finished CIPP shall:

1. Be continuous over entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
2. For lines 24 inches or larger the CIPP shall have no radially positioned (perpendicular to flow) wrinkles, fins or other discontinuities in the lower third of the pipe which exceed more than 3% of the host pipe inside diameter. Have no radial wrinkles, fins or other discontinuities in the upper 2/3rds of the pipe having a height of 5% or more of the host pipe inside diameter, unless approved.
3. When passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by OWNER.
4. Annular space between existing pipe and the CIPP shall be sealed with a hydrophilic rubber joint seal per manufacturer's instructions.
5. Meet leakage requirements of pressure test as specified in Section 02532, Sanitary Sewers.

3.4 SEALING AND BENCHES IN MANHOLE

- A. CIPP shall make a tight-fitting seal with existing pipe(s) in manhole. For CIPP that is installed continuous through manhole, the top half of the pipe shall be neatly cut off and not broken or sheared off at least 2 inches away from wall. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other pipes or channels, if any.

- B. At each pipe opening into manhole, hydrophilic rubber joint seal shall be bonded with adhesive to the host sewer pipe or to the opening in the manhole barrel to hold it in place during inversion and creating a water-tight seal after curing.
- C. Seal CIPP and existing pipe in manhole as stated above before proceeding on to next manhole section. Manholes shall be individually inspected for liner cut-offs, benches, and sealing of liner annular space.

3.5 MANHOLE DROP CONNECTIONS

- A. Drop connections on existing sewer mains shall be abandoned prior to the installation of CIPP by plugging the manhole to pipe connection with a bulkhead and filling the drop assembly with flowable fill.
- B. Use of internal manhole drop connections shall be indicated on the Drawings or directed and approved by the Owner.

3.6 SERVICE LATERALS

- A. Shutdown
 - 1. Notify Owner at least 1 week prior to the shutdown when it is necessary to shut down a private service line while Work is in progress and before the service lines are reconnected. Notify building occupants with an Owner approved door hanger not less than 36 hours prior to shut down.
 - 2. When a service lateral will be disconnected the flow shall be controlled in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
 - 3. No service is to remain shut down without sewer flow control or a leak free temporary connection. Otherwise, Contractor shall then provide temporary living quarters (i.e., hotel) for the resident at no additional cost to Owner or the resident. Temporary living quarters shall be approved by Owner and coordinated through Owner's Customer Support Representative. Commercial sewer services shall be maintained when businesses are open.
- B. Temporary Service Reinstatements:
 - 1. The exact location and number of service connections shall be determined from a pre-CCTV inspection and field located by marking existing service connections. Contractor shall determine and identify all active services. Contractor shall perform temporary service cut outs at active service connections immediately after liner has cured. Initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90 percent of the original diameter of the connection. Do not damage liner pipe and allow to normalize to ambient temperature before 6-inch diameter hole is drilled out.

2. If the service cannot be replaced through excavation, then internally reinstate the service to 100% of original opening, and provide a smooth opening with no ragged edges. The Owner must approve all permanent lateral cut outs.
3. Services shall not be reconnected from abandoned or vacant lots, unless directed otherwise by the Owner. Restore and correct missed or faulty reconnections as well as damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners.

C. Permanent Service Connection by Excavation:

1. Excavate existing active service connections. Disconnect at joints and existing sewer (now the carrier pipe for the liner) and remove to expose the liner to the extent necessary. Coat cut out hole in liner with approved resin/epoxy that will cure at the ambient temperature.
2. Install PVC saddle tee for the new sewer service lateral over the cut out. Saddle shall be a one-piece saddle attached to the liner with epoxy so that a complete seal is accomplished when the strap-on saddle is tightened with two stainless steel bands; one on each side. The stub-out attached to the saddle shall protrude into liner a distance equal to the wall thickness of liner.
3. All permanent lateral re-instatements shall be completed within 30 days of the initial temporary cut out.
4. Services which are reconnected to rehabilitated liner shall be shown on the record drawings with the distance from the nearest downstream manhole, depth at clean out, and the cleanout distant from mainline.
5. Replace sewer service laterals per Section 33 31 30 – Sanitary Sewer Services.

3.7 TESTING FOR ACCEPTANCE

- A. Sampling and Measuring: Two minimum 12-inch long samples shall be cut from the cured liner installation; sample shall be collected and prepared in accordance with restrained sample method described in ASTM F1216 or ASTM F2019. Samples removed for testing shall be individually labeled and logged to record the following:
 1. Owner's project number and title.
 2. Sample number.
 3. Segment number of line as noted on supplements.
 4. Date and time of sample.
 5. Name of Contractor.
 6. Location and by whom tested.
 7. Street name and address.
 8. Test results
- B. Field Thickness testing shall be in accordance with ASTM D2122. The average thickness, calculated from four measurements on each specimen, shall be equal to or greater than the required design thickness. Plate samples may be used in lieu of restrained samples for pipes greater than 18 inches in diameter and in accordance with ASTM F1216.
- C. Send samples to an independent accredited laboratory and test for modulus of elasticity and flexural strength in accordance with ASTM D790, as directed by Owner. Failure of any test can

be grounds for rejection of the CIPP liner. At the direction of Owner, the second sample shall be tested. Testing results shall be provided to the Owner within 7 days of receipt.

- D. Destructive Testing: In cases where test results of samples from the 12-inch long pipe section are lower than required values, at the direction of Owner, Contractor shall cut samples from liner along length of pipe. The size and shape of the samples shall be determined by Owner. The Contractor shall repair the CIPP liner and host pipe at no additional cost to Owner. Failure of the thickness test shall be grounds for rejection for the CIPP liner.
- E. Resin Sampling: “Wet-out” facility resin mixing equipment shall have a valve downstream of the mixing functions and immediately upstream of the application of the mixed resin to the tube where Owner can draw resin samples.
- F. Contractor’s batch mix facilities, if any, shall provide for sampling of the mixed batch. Submitted “wet-out” schedule cannot be modified without 24-hour notice to Owner. Resin samples shall be drawn at times determined by Owner. The Owner drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.
- G. CCTV shall be as specified in Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control. Televising shall be done after service connections have been made, unless required earlier by Owner. Provide CCTV DVD’s or external hard drive within two weeks after permanent lateral reinstatements have been completed.
- H. For lines 24-inches and less in diameter shall be air tested as specified in Section 33 05 05 – Sanitary Sewer Testing after liner has been installed and service lateral connections have been completed.
- I. For lines greater than 24-inches shall be tested as specified in Section 33 05 05 – Sanitary Sewer Testing.
- J. No visible leak around liner at manhole connections will be allowed.
- K. Correct failed liner or liner deemed unacceptable by OWNER as a result of the post-video inspection or test reports for structural values and thickness.
 - 1. Remedy shall be defined as shown in the following table and shall be based upon lowest test in each test category. Where pipe replacement is required, payment shall be made in full for the cured-in-place pipe. No payment will be made to construct a new sewer segment.

END OF SECTION 33 01 30.72

SECTION 33 01 30.81 – MANHOLE REHABILITATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specifications sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manhole Rehabilitation
- B. Related Requirements:
 - 1. Section 30 01 30 – Sewer Inspection and Cleaning
 - 2. Section 33 05 05 – Sanitary Sewer Testing
 - 3. Section 33 05 61 – Concrete Manholes

1.3 SUBMITTALS

- A. Action Submittals
 - 1. Manufacturer's literature and product data describing the following:
 - a. Rehabilitation System
 - b. Equipment Components
 - c. Material/Chemical Properties
 - d. Mixing and Proportioning Requirements
 - e. Maximum Pot Life
 - f. Coating Thickness
 - g. Curing
 - h. Environmental Requirements for Application
 - i. Epoxy Resins
 - j. Hydraulic Cement
- B. Informational Submittals
 - 1. Manufacturer's Certificate of Compliances
 - 2. Material Safety Data Sheets
 - 3. Manufacturer's instructions on shipping, storage, and handling requirements
 - 4. Manufacturer's application and repair instructions
 - 5. Testing, certification, and warranty sample statements
 - 6. Confined space entry plan
 - 7. Qualifications and experience history of installers.

1.4 QUALITY ASSURANCE

- A. Mortar mix for cementitious lining shall have at least 5 years of successful performance in similar applications, and shall be supplied by an ISO 9002 certified manufacturer. Manufacturer's ISO 9002 certificate shall be submitted to the Owner.
- B. Installers shall have a minimum of 5 years of experience installing the product provided, and shall be certified by the manufacturer. Installers of liners, coatings, and wall repair systems shall submit qualifications and include:
 - 1. Manufacturer's approved equipment list, by name and model number for application of product and Contractor's equipment list showing approved equipment available for use in product application.
 - 2. List of Contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Deliver lining products to site in unopened containers that clearly show, at time of use, product name, date of manufacture, batch number, and name manufacturer. Materials shall be made safe from theft, vandalism, and damage.
- B. Store lining products in protected area with heating or cooling to maintain temperatures within range recommended by lining manufacturer.
- C. All products and materials specified herein shall be inspected at the request of Owner or Inspector. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the Contractor at no cost to the Owner.
- D. The Contractor shall dispose of all wastes in accordance with all applicable laws, codes, and regulations.

1.6 PERFORMANCE REQUIREMENTS

- A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against corrosion
- B. Manufacturer's Product Support:
 - 1. Through the Contractor, manufacturers of wall sealing, coating or lining systems shall submit to the Engineer for review and approval a detailed description of the proposed rehabilitation process. Describe surface preparation, independent laboratory test results, mix design procedures and methods of controlling uniform thickness.
 - 2. A representative employed by the manufacturer and having technical training in admixture and concrete mix design shall be named and available for consultation by telephone during business hours and on site upon 48 hours' notice.

3. Manufacturer's representative on concrete lining systems shall provide technical assistance to concrete batch plant operators to ensure proper usage of dispensing equipment and accurate proportions of admixtures.

1.7 PROJECT CONDITIONS

- A. Manholes Containing Mechanical or Electrical Equipment:
 1. Contract Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, do not remove or disturb and immediately notify the Owner or Inspector.
 2. Reschedule work in such manholes until equipment has been removed by Owner and further instructions are given.
 3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
 4. Damage to installed equipment, due to negligence of Contractor, will be repaired by Owner and cost of repairs charged to Contractor.
- B. Field Location of Manholes, Cleanouts and Inlets:
 1. Contractor is responsible for locating and uncovering all manholes and cleanouts in lines being rehabilitated. If difficulty is encountered in locating a manhole or clean-out covered by ground or pavement, notify the Owner or Inspector and await instructions.
 2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

PART 2 - PRODUCTS

- A. GENERAL
 1. The materials used shall be designed, manufactured and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job sit in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
 2. Each lining system shall be designed for application over wet (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.
- B. Mortar:
 1. Standard premixed in accordance with ASTM C387, or proportion one part Portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.
- C. Hydraulic Cement:
 1. Rapid-setting, high early strength, cementitious product specifically formulated for high volume leak control.
 - a. Manufacturers and Products:
 - 1) Strong Systems Inc.; Strong-Seal Plug
 - 2) Quadex; Quad-Plug
 - 3) Improved Construction Methods; ThoRoc Plug

2. Rapid setting, fiber-reinforced, high early strength, corrosion-resistant material formulated for filling voids and repairing inverts in concrete, brick and other masonry structures.
 - a. Manufacturers and Products:
 - 1) Strong Systems, Inc.; Stong-Seal QSR
 - 2) Quadex; Hyperform
 - 3) Improved Construction Methods; ThoRoc Patch
 - 4) IPA; Octocrete
- D. Chemical Pressure Grouting System:
1. Where pressurized injection of chemical grout behind manhole chimney and joints is required, material supplied shall be urethane gel or polyurethane resin with the following properties:
 - a. During injection, chemical sealant shall be able to react/perform in the presence of infiltrating water.
 - b. Cured sealant capable of withstanding submerged conditions, freeze/thaw cycles, and wet/dry cycles without degradation. Must prevent passage of water and must be flexible, chemically stable, and resistant to sewer environments.
 2. Urethane Gel shall be AV-350 multi-grout or AV-254 urethane gel as manufactured by Avanti International.
 3. Polyurethane resin grout shall have the following properties:
 - a. Viscosity of 120 to 350 centipoise
 - b. Weight of 8.65 pounds to 9.48 pounds per gallon
 - c. Solids content of 88% to 100% by ASTM D2834
 - d. Induction time of 3 to 4 minutes
 - e. Cure time of 5 to 6 minutes
 - f. Tensile strength of 40 to 450 psi by ASTM D3574
 - g. Elongation of 3% to 350% by ASTM D3574
 - h. Shrinkage of less than 2% by ASTM D1042
 - i. Tear resistance of 21 pounds per inch by ASTM D3574
 - j. Density of 28 to 119 pounds per cubic foot by ASTM D3574
 - k. No catalyst required; single component product
- E. Spray Applied Cementitious Manhole Coating
1. Shall consist of a preblended mixture of cements, chemically active aggregates, glass fibers, and other additives. No material, other than potable water, shall be used with or added to the design mix without prior approval or recommendation from the Owner.
 2. One-component, rheoplastic, fiber, or polypropylene-reinforced, shrinkage compensated mortar lining system with the following minimum requirements at 28 days:
 - a. Compressive strength of 8,000 psi by ASTM C109
 - b. Tensile strength of 800 psi by ASTM C496
 - c. Flexural strength of 1,200 psi by ASTM C293
 - d. Shrinkage of 0% with 90% relative humidity by ASTM C596
 - e. Minimum bond strength of 200 psi by ASTM C952
 - f. Slant shear bond strength of 2,400 psi ASTM D882
 - g. No visible damage due to 100 freeze/thaw cycles by ASTM C666
 - h. Applied density of 105 pounds per cubic foot
 3. Product shall be made with calcium aluminate cement except in cases when cementitious lining is used as underlayment for epoxy lining.
- F. Spray Applied Epoxy Coating for Manholes

1. Products shall meet federal, state, and local requirements limiting emissions of volatile organic compounds. Materials, including underlayment and monolithic lining shall be produced by the same manufacturer and meet the following criteria:
 - a. Plural component epoxy composed of 100% solids and capable of spray or roller application
 - b. Capable of application to damp concrete surfaces in high relative humidity environment
 - c. Resistant to attack from hydrogen sulfide and sulfuric acids generated from microbiological sources
 - 1) Bond strength to concrete failure by ASTM C478
 - 2) Tensile strength of 2,500 psi by ASTM C307
 - 3) Flexural strength of 4,800 psi by ASTM C580
 - 4) Moisture absorption of 0.1% by ASTM C413
 - 5) Shrinkage of 0.11% or less by ASTM C631

G. Formed Concrete Lining

1. Concrete used in formed concrete lining shall be Type 1 Portland cement concrete with 3/4-inch and smaller coarse aggregate with fiber reinforcement and plasticizer producing a compressive strength of 4,000 psi at full cure.
2. When corrosive elements are present, a white ribbed plastic liner shall be anchored into the new interior wall during the procedure to create an impermeable barrier.
3. Formed concrete lining shall be by the Permacast process or approved equal.

H. Chimney Liner Seals

1. Chimney liner seals shall be one of the following or Owner approved equal:
 - a. Internal Manhole Chimney Seal by Crete Specialty Products
 - b. FlexRib Chimney Seal by NPC, Inc.
 - c. Flex-Seal by Sealing Systems, Inc.

PART 3 - EXECUTION

3.1 REHABILITATION OF MANHOLE STRUCTURES

A. General Procedures:

1. Safety: The Contractor shall perform all work in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements regarding confined space entry. Provide barricades, warning lights and signs for excavations.
2. Maintaining waste water flows: By-pass pumping shall be conducted in accordance with Section 33 01 30 – Sewer Inspection and Cleaning.
3. Cleaning: All concrete and masonry surfaces to be rehabilitated shall be clean. All grease, oil, laitance, coating, loose bricks, mortar, unsound concrete and other foreign materials shall be completely removed. Water blasting with proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface to meet the manufacturer's requirements. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.

4. Stopping Infiltration: After surface preparation and prior to the application of linings and coatings, infiltration shall be eliminated with the materials specified herein and in accordance with the manufacturer's recommendation. Remove existing roots prior to application by cutting them flush with the manhole wall.
5. Patching: Prepare surfaces with any necessary patching in accordance with manufacturer's instructions. All holes, voids, cracks, and disintegrated material shall be patched or repointed, providing a subbase that meets the manufactures recommendations.
6. Invert & channel repairs: Remove all loose grout and rubble from existing channel. Rebuild channel if required by reshaping, repairing slope of shelves or benches. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve as large a radius as the size of the manhole will permit, but will be shaped to allow easy entrance of maintenance equipment including buckets, T.V. camera, etc.
7. Manhole steps: Existing manhole steps shall be cut and removed and not replaced after rehabilitation.
8. All abandoned pipe and associated connections to the manhole shall be properly sealed with a bulkhead and filled with grout prior to manhole rehabilitation.

3.2 APPLICATION OF CEMENTITIOUS COATING

- A. Clean and prepare substrate surfaces in accordance with these specifications, and recommendations of manufacturer. Materials shall be spray applied to a minimum uniform thickness to ensure that all cracks, crevices, and voids are filled and to a somewhat smooth surface.
- B. Bonding agent: Apply to existing surface per the manufactures recommendations to provide firm adhesion between original and new material.
- C. Apply cementitious lining material per manufactures recommendations to a minimum thickness of 1-inch for depth. For manhole depths greater than 12 feet increase the minimum thickness to 1 ½ inches below the 12-foot depth. Cementitious lining shall be applied to fresh mortar before new bacterial growth or debris can contaminate underlying mortar.
- D. The bench and invert shall be sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/8 inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
- E. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24 hours after application. Do not apply materials if ambient temperature is below 40 degrees F. If ambient temperatures are in excess of 90° F, precautions shall be taken to keep the mix temperature at time of application below 90° F, using ice if necessary. Do not exceed a mix water temperature of 80° F.
- F. The final application shall be allowed to cure for a minimum of four (4) hours before being subjected to active flow. If the manufacture recommends a longer cure time the Contractor shall follow the manufactures recommendation.

3.3 SPRAY APPLIED EPOXY COATING

- A. The material shall be spray applied to a minimum uniform dry film thickness of 50 mils to ensure all cracks, crevices, and voids are filled and a somewhat smooth surface remains. Apply material per the manufactures recommendation to prevent material run or sag. After the epoxy liner has set, repair any visible pinholes or defects per the manufacturer's recommendations.

3.4 CHIMNEY LINER SEALS

- A. Chimney liner & seals shall be installed as specified in the Drawings.
- B. Internal double pleated elastomeric sleeve shall be mechanically attached to and sealed against the manhole frame and chimney with internal expanding bands.
- C. The inside diameter of both the base of the manhole frame and the chimney or cone/corbel section shall be accurately measured as recommended by the manufacturer to obtain the proper size and shape of the seal.
- D. The contact surfaces for the sleeve shall be circular, clean, reasonably smooth, and free of loose material and excessive voids. If the masonry surface is rough or irregular and will not provide an effective seal, it shall be smoothed with mortar. A bed of butyl rubber caulk shall be applied to the sealing surface of the sleeve to fill minor irregularities in the masonry surface. After the sleeve has been placed in proper position, the bands are positioned and individually tightened or expanded as required to provide a watertight seal. Detailed installation instructions shall be in accordance with the manufacturer's instructions.

3.5 MANHOLE REHABILITATION ACCEPTANCE

- A. After the manhole rehabilitation work has been completed, the manhole shall be visually inspected during high groundwater by the Contractor in the presence of the Engineer and the work shall be accepted if found satisfactory to the Engineer. No evidence of visible leaks shall be allowed. In addition, at the Owner's request, the Contractor may be required within one year to visually inspect the manholes that were rehabilitated. Any work that has become defective within the one-year period shall be redone by the Contractor at no additional expense to the Owner.

3.6 MANHOLE VACUUM TESTING

- A. All manholes shall be negative air pressure (vacuum) tested in accordance with ASTM C1244 and Section 33 05 05 – Sanitary Sewer Testing.

END OF SECTION 33 01 30.81

SECTION 33 05 05 – SANITARY SEWER TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specifications sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hydrostatic and Leakage Testing for Pressure Sewer Piping.
 - 2. Infiltration and Exfiltration Testing for Gravity Sewer Piping.
 - 3. Vacuum Testing of Manholes.
 - 4. Exfiltration Testing of Manholes.
 - 5. Low Pressure Air Testing of Gravity Sewer Pipe.
 - 6. Mandrel Testing.
- B. Related Requirements:
 - 1. Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 2. Section 33 05 61 – Concrete Manholes
 - 3. Section 33 31 11 – Gravity Sewer Pipe
 - 4. Section 33 31 26 – Sewer Force Main Pipe
 - 5. Section 33 31 27 – Low Pressure Sewer

1.3 SUBMITTALS

- A. For each test to be performed, submit as applicable:
 - 1. Testing procedures.
 - 2. List of test equipment.
 - 3. Testing sequence schedule.
 - 4. Provisions for disposal of flushing and test water.
 - 5. Certification of test gage calibration.
- B. Qualifications statement for each testing agency engaged by the Contractor.

1.4 QUALITY ASSURANCE

- A. No testing shall be performed without the Owner present.

PART 2 - PRODUCTS

2.1 REQUIRED EQUIPMENT

- A. Hydrostatic Testing
 - 1. Pressure Pump
 - 2. Pressure Hose
 - 3. Water Meter
 - 4. Test Connections
 - 5. Pressure relief Valve
 - 6. Pressure Gage: Calibrated to 0.1 psi

- B. Infiltration and Exfiltration Testing
 - 1. Plugs
 - 2. Pump
 - 3. Measuring Device
 - 4. Weirs

- C. Vacuum Testing
 - 1. Vacuum Pump
 - 2. Vacuum Line
 - 3. Vacuum Tester Base
 - 4. Shutoff Valve
 - 5. Stopwatch
 - 6. Plugs
 - 7. Vacuum Gage: Calibrated to 0.1 in Hg

- D. Low Pressure Air Testing
 - 1. Air Compressor
 - 2. Air Supply Line
 - 3. Shutoff Valves
 - 4. Pressure Regulator
 - 5. Pressure Relief Valve
 - 6. Stopwatch
 - 7. Plugs
 - 8. Pressure Gage: Calibrated to 0.1 psi

- E. Mandrel Testing
 - 1. Mandrel
 - a. The mandrel is to be 95% of the inside diameter of the section of pipe being tested.
 - b. Inside diameter used for selection of mandrel shall be exact and not nominal.
 - 2. Pull Ropes

PART 3 - EXECUTION

3.1 PREPARATION

- A. No testing shall be performed until any component of the sewer system being testing is completely installed and backfilled in accordance with these specifications.
- B. Testing of completed sections of sewer construction prior to the completion of all construction is acceptable provided that all components associated with the test being performed have been completely installed and backfilled in accordance with these specifications.
- C. Prior to testing any section of gravity pipe, that section of pipe shall be lamped.
 - 1. Lamping shall consist of placing a light at one end of a gravity pipe and observing it from the other end.
 - 2. If the lamp is not visible from the other end or the full circle of the gravity pipe on the other end is not visible, then the gravity pipe is not correctly installed to consistent line and grade.
 - 3. Remove and reinstall sections of gravity pipe not installed to consistent line and grade.

3.2 HYDROSTATIC AND LEAKAGE TESTING FOR PRESSURE SEWER PIPING

- A. Hydrostatic and Leakage Testing shall be performed on all pressure sewer pipe.
- B. Prior to Hydrostatic and Leakage Testing:
 - 1. Ensure that all pipe, valves, and branches have been installed and backfilled.
 - 2. Check all valves for the proper open/close position in the test area prior to testing.
 - 3. Install access points and valves prior to testing.
- C. Hydrostatic and Leakage Testing shall be in compliance with AWWA C600 or C605.
- D. Subject the pipe to a minimum pressure of 150% of design operating pressure being measured at the lowest point of the section of pipe to be tested.
- E. The duration of the hydrostatic test shall be no less than two hours. Observe exposed pipes, valve, and other appurtenances for cracks and defects. If defective materials are found, cease hydrostatic testing and replace the defective materials. Correct visible deficiencies and continue testing at same test pressure for an additional two hours to determine leakage rate.
- F. The testing pressure shall not vary by more than ± 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline.
- G. The amount of makeup water added shall be accurately measured in gallons by suitable method and shall not exceed the quantities shown in Table 1 below. Correct visible leaks regardless of quantity of leakage.

Table 1: Allowable Leakage Over Two Hours by Pipe Size			
Pipe Size (Inches)	Leakage per 1,000 LF (Gallons)	Pipe Size (Inches)	Leakage per 1,000 LF (Gallons)
2-1/4	0.2	18	1.7
3	0.3	20	1.9
4	0.4	24	2.2
6	0.6	30	2.8
8	0.8	36	3.3
10	1.0	42	3.9
12	1.1	48	4.4
14	1.3	54	5.0
16	1.5		

3.3 EXFILTRATION TESTING FOR GRAVITY SEWER PIPE

- A. Exfiltration Testing is only permitted for gravity sewer pipes greater than 18-inch, and is not a standard test. Shall only be performed when approved by the Owner.
- B. In the presence of the Owner, watertight bulkhead shall be placed in the inlet to the downstream manhole of the section to be tested.
- C. The upstream manhole shall be fitted with a watertight bulkhead modified for a 9-foot high standpipe which shall be used to test and fill the sewer line with water.
- D. Within 24 hours of filling the test section, the water level in the test standpipe shall be monitored by the Owner for a period of 30 minutes. Water level is to be maintained 8-foot above the crown of the sewer main by adding measured quantities of water if necessary. The total volume of exfiltration shall be determined from the net drop in water level and the volume of water added during the 30 minute test period.
- E. If the measured exfiltration does not exceed 25 gallons/day/inch/mile of pipeline the section shall be approved for leakage.
- F. Any section of pipeline in which the measured exfiltration is in excess of 25 gallons/day/inch/mile shall not be accepted and all leaks shall be located and corrected.

3.4 VACUUM TESTING OF MANHOLES

- A. Vacuum Testing shall be performed on all sewer manholes.
- B. Prior to Vacuum Testing, ensure all manhole components have been installed and backfilled as specified, including all required sealant and manhole frame/cover assembly.

- C. Vacuum testing shall be in compliance with ASTM C1244.
- D. Plug all pipe openings in the manhole to be tested and place the vacuum base over the frame and cover of the manhole. Connect to the vacuum pump to the vacuum base outlet port, draw vacuum to 10 in Hg, and close the vacuum base valve.
- E. The duration that the manhole shall be tested depends on the size of the manhole:
 - 1. Manhole diameter of 4 feet: 60 seconds
 - 2. Manhole diameter of 5 feet: 75 seconds
 - 3. Manhole diameter of 6 feet: 90 seconds
 - 4. For manholes greater than 6 feet diameter or non-circular structures, consult Owner for requirements.
- F. Record the drop in vacuum pressure over the test period.
 - 1. If the vacuum drop is greater than 1 in Hg during the test period, the manhole shall be repaired and retested.
 - 2. If the vacuum drop is less than 1 in Hg during the test period, the manhole is acceptable.
- G. If unsatisfactory testing results are achieved, repair manhole and retest until results meet these specifications.

3.5 EXFILTRATION TESTING OF CONCRETE STRUCTURES

- A. This test method is a substitute for vacuum testing concrete structures only when vacuum testing is not feasible, such as pump station wet well structures (including precast, cast-in-place, or other). This is not a routine test for concrete manholes and vaults, and shall only be performed where specified or where approved by the Owner.
- B. Exfiltration Test shall be performed in accordance with ASTM C969 – “Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines”.
- C. Preparation:
 - 1. Prior to testing, ensure the structure is completely installed and backfilled as specified, including all penetrations installed, influent & effluent pipes connected, anchor bolts and other hardware installed, and coatings have been allowed to dry per manufacturer’s recommendation.
 - 2. Plug all openings in the structure to be tested.
 - 3. Groundwater level shall be monitored and shall be maintained to be at least 3-foot below the water test elevation for the entire test period.
- D. Test Procedure:
 - 1. Fill the structure to the top of the opening with potable water.
 - 2. Allow concrete structures to saturate for a minimum of 4 hours, up to 72 hours. Refill structure with additional water.
 - 3. Replace cover or close hatches to push out any water that may be displaced when the opening is closed. Reopen hatch and mark the water level. Close opening for test.
 - 4. Test period shall be a minimum of 24 hours.
 - 5. Once the test begins the opening shall only be removed in the presence of the Owner.

6. Exfiltration volume will be determined by measuring the amount of water required to raise the water level back to the marked level.
- E. Allowable leakage limit in gallons is (0.1 gallon) (feet of diameter) (feet of head) (hours of test).
 1. Example:
 - a. For a wet well that is 8-foot diameter, 20-foot deep from rim to floor, and groundwater is 5' above the lowest point of the wet well.
 - b. Leakage Limit = 0.1 gallon x 8' dia. x (20'-5') head x 24 hours = 288 gallons
 - F. If unsatisfactory testing results are achieved, repair structure and retest until results meet these specifications.

3.6 LOW PRESSURE AIR TESTING OF GRAVITY SEWER PIPE

- A. Low Pressure Air Testing shall be performed on all gravity sewer pipe less than 18-inch diameter. For pipes greater than 18-inch diameter, consult and obtain approval from Owner.
- B. Prior to Low Pressure Air Testing ensure that all pipe, service taps, and manholes have been installed and backfilled as specified.
- C. Low Pressure Air Testing shall be in compliance with ASTM F1417.
- D. Plug all pipe connections to manholes, service laterals, cleanouts, or any other pipe connection that will allow air to escape the portion of pipe being tested.
- E. Determine the groundwater elevation above the spring line of piping.
- F. Introduce air pressure slowly to approximately 4 psig. For every foot of groundwater above the spring line of the pipe being tested, increase starting air test pressure by 0.43 psi. Do not increase starting air test pressure to above 10 psig. Allow pressure to stabilize for five minutes.
- G. The duration that the section of pipe shall be tested depends on the size and length of the section of pipe and can be found in Table 3 below.

Table 3: Low Pressure Air Minimum Testing Duration	
Pipe Size (Inches)	Duration per 100 ft (Minutes)
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

- H. Record the drop in pressure over the duration of the testing period.
 1. If air pressure drops more than 0.5 psi during the testing period, the piping has failed and the pipe section has failed and shall be repaired and retested.
 2. If air pressure does not drop more than 0.5 psi during the testing period, the piping is acceptable.
- I. If unsatisfactory testing results are achieved, repair pipe section and retest until results meet these specifications.

3.7 MANDREL TESTING

- A. Mandrel Testing shall be performed on all flexible gravity sewer pipe.
- B. Prior to Mandrel Testing, ensure that all pipe, service taps, and manholes have been installed and backfilled as specified. Mandrel Testing shall not be conducted until backfill has been in place for a minimum of 24 hours.
- C. A sized “go/no go” mandrel with a diameter 95% of the inside diameter of the pipe section being tested shall be pulled by hand through the pipe section being tested. Mechanical methods shall not be used to pull the mandrel through the pipe section.
- D. If the mandrel becomes wedged, stuck, or unable to pass any point in the pipe section, then the deflection of that pipe exceeds acceptable deflection and the piping has failed Mandrel Testing.
- E. If the mandrel passes through the pipe section without becoming wedge, stuck, or unable to pass any point in the pipe section, the piping is acceptable.

- F. If unsatisfactory testing results are achieved, repair pipe section and retest until results meet these specifications.

3.8 FIELD QUALITY CONTROL

- A. Testing shall not be performed without the Owner or appointed representative of the Owner present.
- B. Engage a qualified agency or persons to perform tests and inspections.
- C. Test and inspection reports shall be prepared and submitted as a certification of results.

END OF SECTION 33 05 05

SECTION 33 05 07 - TRENCHLESS INSTALLATION OF UTILITY PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Casing pipe.
 - 2. Carrier pipe.
 - 3. Horizontal directional drilling.
- B. Related Sections
 - 1. Section 31 23 16.01 – Excavation for Utilities
 - 2. Section 33 14 13.01 – Water Piping and Valves
 - 3. Section 33 31 11 – Gravity Sewer Pipe
 - 4. Section 33 31 27 – Sewer Force Main Pipe
 - 5. Reference the Standard Details and Section 31 23 16.01 – Excavation for Utilities for pipeline marker requirements.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Casing pipe.
 - 2. Carrier pipe.
 - 3. Casing spacers.
 - 4. End seals.
 - 5. Horizontal directional drilling equipment.
- B. Shop Drawings:
 - 1. Submit technical data for equipment, method of installation, and proposed sequence of construction.
 - 2. Include information pertaining to pits, dewatering, method of spoils removal, and equipment size, capacity, and capabilities, including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade, detection of surface movement, name plate data for drilling equipment, and mobile spoils removal unit.
 - 3. Signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.

- B. Record actual depth of pipe at 25-foot intervals.
- C. Record actual horizontal location of installed pipe.
- D. Show depth and location of abandoned bores.
- E. Record depth and location of drill bits and drill stems not removed from bore.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- A. Handling:
 - 1. Use shipping braces between layers of stacked pipe.
 - 2. Support pipes with nylon slings during handling.
- B. Storage:
 - 1. Store products according to manufacturer instructions.
 - 2. Use wooden shipping braces between layers of stacked pipe.
 - 3. Stack piping lengths no more than three layers high.
 - 4. Store field joint materials in original shipping containers.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide temporary end caps and closures on piping and fittings and maintain in place until installation.
 - 3. Protect piping systems from entry of foreign materials and water by installing temporary covers, completing sections of Work, and isolating parts of completed system.
 - 4. Provide additional protection according to manufacturer instructions.

1.6 QUALITY ASSURANCE

- A. Provide key personnel with at least 5 years' experience in proposed trenchless installation method (bore & jack or HDD) and associated pipe installation, including pipe at least as large as 12 inches in diameter. Key personnel include field supervisor and operators of equipment, including monitoring and steering equipment.

1.7 REFERENCES

- A. American Petroleum Institute (API): 5L, Line Pipe.
- B. AWWA C200 – Steel Water Pipe.
- C. AWWA C210 – Liquid-Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines.
- D. AWWA C906 – High-Density Polyethylene Pipe.

- E. ANSI A139 – Electric-Fusion (Arc)-Welded Steel Pipe.
- F. American Railway Engineering and Maintenance-Of-Way Association (AREMA).
- G. Installation shall meet the requirements of the agency having jurisdiction over the area being traversed (TDOT, railroad, County Highway Department, etc.).

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide all materials, equipment and labor for completing the drill and for adequate protection of the Work.

2.2 EQUIPMENT AND MATERIALS TO BE FURNISHED BY THE CONTRACTOR

- A. The Contractor shall provide all equipment and material required to complete the Work which shall include but not be limited to the following:
 1. Drilling equipment.
 2. Water pumps, hoses, fittings, storage tanks, filters, hay bales, and silt fencing (as required).
 3. Drilling fluids containment, collection, cleaning and disposal equipment, and material.
 4. Fuel and lubricants.
 5. Bentonite and related mixing equipment.
 6. All welding equipment and materials as required.
 7. All hydrostatic and pneumatic testing equipment and materials.
 8. Sidebooms, cranes, backhoes, trucks, and other equipment and materials necessary to load and unload pipe and to support and smoothly transition the pipe while being pulled into the reamed hole.
 9. All equipment and material necessary to restore project areas to pre-existing conditions or better.

2.3 CASING PIPE

- A. The casing pipe shall be of steel meeting the latest American Railway Engineering Association “Specification for Pipelines for Carrying Flammable and Nonflammable Substances.”
- B. The steel casing pipe shall have a minimum yield strength of 35,000 psi and shall have fully welded joints around the complete circumference for the pipe.
- C. For rigid carrier pipes less than 6-inch, the inside diameter of the casing pipe shall be at least 2 inches greater than the largest outside diameter of the carrier pipe’s joints or couplings. For carrier pipe 6-inch and greater, this spacing shall be 4 inches. Approximate casing pipe sizes and minimum wall thicknesses are provided in the table below:

Table of Minimum Wall Thickness for Steel Casing Pipe for E80 Loading w/ Minimum Cover of 5.5-feet		
Carrier Pipe	Casing Pipe	Nominal Thickness
(Inches)	(Inches)	(Inches)
4	10	0.188
6	14	0.25
8	18	0.312
10	20	0.344
12	24	0.375
14	28	0.438
16	30	0.469
18	30	0.469
20	36	0.532
24	36	0.532
30	44	0.657
36	50	0.719

2.4 CARRIER PIPE

- A. The carrier pipe shall be proprietary restrained joint ductile iron pipe as specified in Section 33 14 13.01 – Water Piping and Valves, Section 33 31 11 – Gravity Sewer Pipe, or Section 33 31 26 – Sewer Force Main Piping.

2.5 CASING SPACERS AND END SEALS

- A. Casing spacers shall meet one of the following requirements:
1. Casing spacers shall be flanged, bolt-on style with a two-section stainless steel shell lined with a PVC line, minimum 0.09-inch thick also having a hardness of 85-90 duros. Runners shall be attached to stainless steel risers which shall be properly welded to the shell. The height of the runners and risers shall be manufactured so the pipe does not float within the casing.
 2. Casing spacers shall be flanged, bolt-on style constructed of heat fused PVC coated steel, minimum 14-gauge band and 10-gauge risers, with 2-inch-wide glass reinforced polyester insulating skids, heavy duty PVC inner liner, minimum 0.09-inch having a hardness of 85-90 duros.
- B. Casing spacers shall be manufactured by one of the following companies:
1. Cascade Waterworks Manufacturing Company
 2. Advance Products & System, Inc.
 3. Pipeline Seal and Insulator, Inc.
 4. BWM Company
- C. End Seals:
1. Shall be pull-over type construction and made from Neoprene.

2. T-304 stainless steel bands for securing the ends of the seal to the casing pipe and carrier pipe.
3. Shall be Model CCES as manufactured by Cascade Waterworks Manufacturing Company, BWM Company, or approved equal.

2.6 PIPE FOR INSTALLATION BY HORIZONTAL DIRECTIONAL DRILLING

A. High-Density Polyethylene (HDPE)

1. Confirm to requirements of AWWA C906.
2. In compliance with NSF 61.
3. Resin;
 - a. Polyethylene resin shall meet or exceed requirements of ASTM D3350 for PE 4710 material with cell classification of 445474C, or better. Pressure rating shall be based on hydrostatic design stress of 1,000 psi at 73.4 degrees F.
 - b. Unless specified on the project drawings the minimum Pressure Rating shall be 200 PSI and nominal DR of 11.
4. Pipes 4" and larger shall have Ductile Iron Pipe Size outside diameter.
5. Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of a compatible resin mix for the fusion process.
6. Fittings:
 - a. PE:
 - 1) Shall be thermal butt-fusion type.
 - 2) Shall have same or higher pressure rating as pipe.
 - b. Ductile Iron:
 - 1) Join to mechanical joint ductile iron fittings w/ restraining gland follower with internal stiffener.
 - 2) Restraining follower glands shall be manufactured by EBAA Iron "Mega-Lug" Model 2000PV or 2100.

2.7 MIXES

- A. Flowable Fill: As specified in Section 31 23 16.01 "Excavation for Utilities."
- B. Cementous Grout:
 1. Uniform mixture of 1:6 (cement: sand) cement grout shall be placed under pressure to fill voids which exist between casing pipe and undisturbed earth.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. See Section 31 23 16.01 – Excavation for Utilities for excavation, pit support, dewatering, backfill requirements.

3.2 BORING

- A. The boring shall be accomplished by means of auguring to the size, line, and grade shown in the Construction Drawings.
- B. The front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that no unsupported excavation is ahead of the pipe.
- C. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered.
- D. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than ½ inch. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (plus coating) by more than approximately 1 inch, voids shall be grouted.
- E. Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the casing pipe.
- F. The face of the cutting head shall be arranged to provide a reasonable obstruction to the free flow of soft or poor material.

3.3 INSTALLATION OF CASING PIPE

- A. Jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints.
- B. Do not remove unacceptable casing without prior approval from the Owner. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.
- C. Check line and grade at least once a day to confirm that installation is within tolerance.
- D. Allowable tolerance:
 - 1. Line: 2 inches, maximum.
 - 2. Grade: 2 inches, maximum.

3.4 INSTALLATION OF THE CARRIER PIPE

- A. The carrier pipe shall be furnished by the Contractor. Upon acceptance of the casing, install the carrier pipe in the casing by jacking it through the casing. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1 inch.
- B. Provide a minimum of two casing spacers per piece of carrier pipe installed at intervals recommended by the Manufacturer or as directed by the Owner.
- C. Close the ends of the casing pipe with end seals.

3.5 LAYOUT OF WORK

- A. The Owner will provide the necessary control points required by the Contractor for this construction. The Contractor will provide the detailed layout required to keep the tunnel or bore on grade.

3.6 GUARANTEE OF WORK

- A. Guarantee a usable completed casing between the points specified and to the line and grade specified. The allowable tolerance at the downstream end point of the bore shall be such that the invert of the carrier pipe may be positioned within a vertical area limited on the top by an elevation no higher than the elevation shown on the Construction Drawings and on the bottom by an elevation no lower than the existing inlet pipe invert.
- B. The allowable tolerance at the upstream end point of the bore shall be such that the invert of the carrier pipe may be positioned at the elevation shown on the Construction Drawings.

3.7 INSTALLATION OF PIPE BY HORIZONTAL DIRECTIONAL DRILLING

- A. General: The Contractor shall install the section of the pipeline by the horizontally drilled, directionally controlled method of construction. This method shall consist of the drilling of a pilot hole within the designed tolerances for radius requirements, followed by enlargement of the hole to accommodate the product line.
- B. Instrumentation: The Contractor will at all times provide and maintain instrumentation which will accurately locate the pilot hole position relative to ground surface. Drill fluid flow rate and pressure must also be monitored. Contractor shall maintain and provide to Inspector, upon request, access to the data generated by the downhole survey tools.
- C. Tolerances:
 - 1. Pipe installed by horizontal drilling must be located as shown on the drawings. The Contractor shall employ experienced personnel to operate the directional drilling equipment and the monitoring and steering equipment. At the completion of the pilot hole the Contractor shall provide Owner with the coordinates of the pilot hole as specified.
 - a. Maximum Variation from Horizontal Position: 12 inches
 - b. Maximum Variation from Vertical Elevation: 12 inches
 - c. Minimum Horizontal and Vertical Clearance from Other Utilities: 18 inches
- D. Deviation:
 - 1. If pipe installation deviates beyond specified tolerances, notify Owner, abandon bore, remove installed pipe, rebore, and reinstall pipe in correct alignment.
 - 2. Fill abandoned bores greater than 3 inches in diameter with flowable fill material.
- E. A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the drawings.
- F. The pilot hole (Borehole Entry Point) shall penetrate the ground surface at the approximate location shown on the drawings.

- G. The course of the pilot hole must stay within the given right-of-way at all points along the drilled hole.
- H. The Contractor shall have accurate working gauges, which register tensile force being used to pull the pipeline back through the reamed borehole. It is Contractor's responsibility to prepare the reamed hole such that pull back operations do not exceed the tensile strength of the pipe. The Contractor shall provide estimated calculations for pulling loads and allowable loads before pull back operations begin. If during the pipeline pulling process this force reaches 75% of the allowable load for the pipeline, the Owner must be notified immediately. Logs must be kept intact referencing all forces exerted on the pipeline during the project.
- I. The Contractor shall provide adequate supports along the stringing area to protect the pipe and allow free movement of the pipeline during pullback.
- J. During pullback operations, Contractor shall monitor roller operations and use sidebooms if required to assist movement of the pipe. Situations which could cause damage to the pipe material shall be corrected immediately. Damaged pipe shall be repaired to the satisfaction of the Inspector or replaced before pulling operations resume.
- K. Drilling Mud and Cuttings
 - 1. The Horizontal Directional Drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to water or land areas involved during the construction process. Contractor shall immediately contain and clean up any inadvertent returns.
 - 2. Disposal of drilling fluids shall be the responsibility of the Contractor and shall be conducted in compliance with all relative environmental regulations, easement and workspace agreements and permit requirements. All costs related to disposal shall be the responsibility of the Contractor.
 - 3. Transportation, makeup and Material Safety Data Sheets (MSDS) for drilling fluids shall be provided to Inspector.
 - 4. Water supplied is the Contractor's responsibility, whether purchased locally or hauled in.
 - 5. Drilling fluids must be free of all additives that will adversely affect the environment.
- L. Ream and Pull Back
 - 1. Pre-reaming: Pre-reaming operations shall be conducted at the discretion of the horizontal directional drilling Contractor. All provisions of this specification relating to simultaneous reaming and pulling back operations shall pertain to pre-reaming operations.
 - 2. Pulling Loads: Contractor shall be responsible for determining safe pulling loads required for proper installation. Such loads shall be minimized as required to prevent failure of the pipeline during installation.
 - 3. Torsional Stress: A properly sized and fully operational swivel will be installed between the reaming assembly at the end of the drill pipe and the pipeline to restrict torsional stress from being transmitted to the pipeline.
 - 4. Contractor may opt to fill the pipeline with water (ballasting) as installation proceeds to help prevent buckling and reduce buoyancy. The Contractor shall completely clean and dry the pipeline after installation.
 - 5. Pull Section Support: The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe material is not damaged.

3.8 CLEANUP, REPAIRS AND RESTORATION

- A. The Contractor is responsible for leaving all areas affected by construction activities in a condition equal to or better than the condition before construction.
- B. Install pipeline markers on each end of the installation. See Standard Details for requirements.
- C. The Contractor shall restore area around entry and exit pits as soon as work is completed. Fill to previous existing ground elevation and grade any areas where settlement occurs due to subsidence.

END OF SECTION 33 05 07

SECTION 33 05 61 - CONCRETE MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast Concrete Manholes
 - 2. Butyl Rubber Sealant
 - 3. Frame/Cover Assembly
 - 4. Precast Concrete Grade Rings
 - 5. Manhole Steps
 - 6. Pipe Connections
 - 7. Drop Connections
 - 8. Manhole Coatings
- B. Related Requirements:
 - 1. Section 31 23 16.01 – Excavation
 - 2. Section 33 31 11 – Gravity Sewer Pipe
 - 3. Section 33 01 30.81 – Manhole Rehabilitation

1.3 DEFINITIONS

- A. Bedding: A type of specialized material placed under manhole prior to installation and subsequent backfill operations.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Precast Concrete Manholes
 - 2. Butyl Rubber Sealant
 - 3. Frame/Cover Assembly
 - 4. Precast Concrete Grade Rings
 - 5. Manhole Steps
 - 6. Pipe Connections
 - 7. Drop Connections
 - 8. Manhole Coatings
- B. Shop Drawings:
 - 1. Indicate structure locations and elevations.
 - 2. Indicate sizes, elevations, and orientation of piping and inverts.

3. Signed and sealed by the qualified professional engineer responsible for their preparation, when requested by Owner.

1.5 QUALITY ASSURANCE

- A. Obtain precast concrete products from a single source.
- B. Perform structural design according to ACI 350 for water and wastewater structures.
- C. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- D. Circular manhole sections shall comply with ASTM C478.
- E. Welding:
 1. Structural Steel: Comply with AWS D1.1/D1.1M.
 2. Reinforcing Steel: Comply with AWS D1.4/D1.4M.
- F. Welders Qualifications: AWS qualified within previous 12 months for employed weld types.
- G. Licensed Professionals Qualifications: Professional engineer experienced in design of specified Work and licensed in State of Tennessee.
- H. Clearly mark inside of each precast concrete vault with ASTM Designation, vault size, date of manufacture, name or trademark of manufacturer. Slabs shall be marked on top and bottom surfaces.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Products: Do not deliver products until concrete has attained a minimum of 75% of specified 28-day compressive strength.
- B. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling:
 1. Comply with manufacturer instructions for unloading, storing, and moving manhole sections.
 2. Lift manhole sections from designated lifting points.
- D. Storage:
 1. Store materials according to manufacturer instructions.
 2. Store manhole sections to prevent damage to Owner's property or other public or private property.
 3. Repair property damaged from materials storage.
- E. Protection:
 1. Protect materials in clean location remote from construction operations areas.
 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Manhole sections shall be reinforced precast concrete in accordance with ASTM C478.
- B. The minimum compressive strength of the concrete in precast section shall be 4,000 psi.
- C. The minimum wall thickness shall be 4-inches or one-twelfth of the inside diameter of the base, riser, or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of rubber boots.
- D. Precast manhole top sections shall be eccentric cones with a clear opening of 24 inches.
- E. Each precast section shall have tongue and groove joints and lifting holes to facilitate handling.
- F. Pipe openings shall provide clearance for pipe projecting a minimum of 2 inches inside the manhole. The height of the transition from the pipe opening to the invert trough shall be equal to $\frac{1}{2}$ of the opening inside diameter minus pipe inside diameter.
- G. Floor shall be 1-inch minimum below lowest pipe opening to provide clearance for grouting of flow channel.
- H. When influent pipes are smaller in diameter than effluent pipes, the elevation of the crown of the influent pipe shall be no lower than the crown of the effluent pipe.
- I. The minimum fall through a manhole shall be 1 inch. The minimum radius of the trough centerline is to be 1.5 times the pipe inside diameter.
- J. Structures shall be designed and constructed by the manufacturer to resist flotation with a safety factor greater than one.
- K. The height of the manhole barrel shall be designed such that a minimum of one and a maximum of four precast concrete grade rings will be required to bring the casting to finished grade.
- L. Minimum interior diameter of manhole based on largest connected pipe:
 - 1. Less than 18-inch: 4-foot,
 - 2. 18 – 24-inch: 5-foot,
 - 3. Greater than 24-inch: 6-foot,
 - 4. Or as required based on leg spacing.

2.2 BUTYL RUBBER SEALANT

- A. Butyl Rubber Gasket
 - 1. A butyl rubber gasket shall be installed between each component of the manhole as indicated in the Standard Details, including precast manhole sections, precast concrete grade rings, and the frame and cover attachment to the manhole.
 - 2. Shall be in accordance with ASTM C990.
 - 3. Butyl rubber gasket shall be one of the following or approved equal:
 - a. CS-102 as manufactured by Conseal.

b. Kent-Seal No. 2 as manufactured by Hamilton Kent Manufacturing Company.

B. Butyl Rubber Joint Tape

1. Butyl rubber joint tape shall cover the joint of all precast concrete manhole components as indicated in the Standard Details, including the base, riser sections, cone/cap, and grade rings.
2. Butyl rubber joint tape shall be the following or approved equal:
 - a. CS-212 as manufactured by Conseal.

2.3 FRAMES AND COVERS

- A. Manhole frames and covers shall be cast iron, heavy traffic pattern with solid covers marked with "SANITARY SEWER" and "HARRIMAN UTILITY BOARD" with a 24-inch minimum clear opening.
- B. Metal used in the manufacture of castings shall conform to minimum requirements of ASTM A 48 Class 35B for Gray Iron or ASTM A536 Grade 65-45-12 for Ductile Iron.
- C. All bearing surfaces shall be machined.
- D. Total weight of frame and cover shall be at least 365 pounds.
- E. Shall be H-20 Traffic rated, minimum.
- F. Manhole frames and covers shall be JBS 1154 (4-inch height) or JBS 1155 (6-inch height) as manufactured by John Bouchard and Sons, or Owner approved equal.
- G. Anchor bolts and hardware shall be Type 304 or 316 stainless steel.

2.4 PRECAST CONCRETE GRADE RINGS

- A. Precast concrete grade rings shall be no more than 6 inches in height.
- B. Precast concrete grade rings shall not be used to adjust the height of a manhole by more than 2 feet.
- C. No more than four precast concrete grade rings shall be used to adjust the height of a manhole.

2.5 MANHOLE STEPS

- A. Provide steps in precast manholes on 16-inch centers throughout the structure with a minimum width of 13 inches.
- B. Secure steps to the wall via cast-in-place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place.
- C. Manhole steps shall be copolymer polypropylene coated, textured, and provided with cleats to prevent slippage. Core shall be 1/2-inch, Grade 60 steel reinforced rod.

- D. Manhole steps shall be one of the following or approved equal:
 - 1. No. PS-1 as manufactured by M.A. Industries.
 - 2. No. 81213R as manufactured by Meadow Burke.

2.6 PIPE CONNECTIONS

- A. A flexible pipe to manhole connector shall be used in the connection of the sewer pipe to precast manholes. The flexible pipe connector shall be installed in a round hole cast or cored in the manhole wall.
- B. Shall be in accordance with ASTM C923.
- C. The flexible pipe connector shall be secured to the manhole wall with the stainless-steel retainer that presses the connector to the wall and a separate stainless steel band to seal to the pipe.
- D. The flexible pipe connector shall be one of the following or approved equal:
 - 1. Kor-N-Seal as manufactured by Trelleborg.
 - 2. PSX as manufactured by Press-Seal Gasket Corporation.

2.7 DROP CONNECTIONS

- A. A drop connection assembly shall be provided for any sewer pipe entering a manhole at an elevation of 24 inches or more above the lowest sewer invert.
- B. Inside Drop Connections
 - 1. Inside drops shall be manufactured and made from impact and chemical resistant polymer materials. Inside drops shall be attached to the inside walls with 304 or 316 stainless steel brackets and hardware, as required by the manufacturer.
 - 2. A removable device must be included to allow full diameter access to the influent line where the drop is mounted.
 - 3. Inside drops must not interfere with step ways and use of ladder ways.
 - 4. Inside drops shall be constructed using Reliner drop systems as manufactured by Duran, Inc.
- C. Outside Drop Connections
 - 1. In the event that an inside drop connection is not feasible due to space constraints, an outside drop connection may be used with the approval of the Owner.
 - 2. Outside manhole precast drops shall be integral and monolithically poured with the manhole base and each riser ring used to form the manhole during manufacturing.
 - 3. Outside drop manholes shall be designed and sealed by a structural engineer.
 - 4. When required by depth, the poured slab receiving the manhole base shall be extended to support the drop portion of the manhole in the same manner as a standard manhole.
 - 5. Drop pipe and fittings shall be ductile iron.

2.8 MANHOLE COATINGS AND LINERS

- A. Liners for New Manholes:

1. Lined manholes shall be installed on new manholes that will be connected to a sewer force main or low pressure sewer pipe, where called for on the Drawings, or as required by Owner.
 2. HDPE Liner:
 - a. Sheets shall be studded and have a minimum design thickness of 2 mm (0.079 inch).
 - b. Provide minimum of 39 anchoring studs per square foot of liner.
 - 1) Minimum Stud Height: Minimum 9 mm (0.39 inch) with a minimum length of 14 mm (0.55 inch).
 - 2) Capable of resisting continuous hydraulic backpressure, to a minimum of 40 feet of hydraulic head, exerted between interior wall of concrete structure and anchoring stud side of protective liner.
 - c. As manufactured by AGRU, or approved equal.
 3. PVC Liner, Channel Joints, H-joints and Corner Joints:
 - a. Manufactured from polyvinyl chloride resin.
 - b. White in color to assist in providing a light reflective environment.
 - c. All sheet compounds shall result in a semi-rigid material for thermoforming to the contour of the structure and shall maintain a minimum wall thickness of 1.7mm (0.065 inch).
 - d. Shall be Duraplate 100 Liner System by ALOK, or approved equal.
 4. Lined manholes shall have a flat top that is lined with same type of protective liner as manhole.
 5. Provide a rubber gasket between structures for a watertight seal. Gasket shall be DURA-Plate-Lok-Sealant MT-320 measuring 0.5 inch by 1.5 inches to be placed on the return. When the two sections are coupled, the butyl-lok will displace over the return on the bell and tongue ends of the liner.
 6. Linings shall be installed by certified lining manhole precaster, while constructing the manhole, in strict conformance with the manufacturer's requirements.
- B. Coatings for Existing Manholes:
1. All existing manholes that are connected to a new sewer force main or low pressure sewer pipe shall have interior epoxy coating.
 2. See Section 33 01 30.81 – Manhole Rehabilitation for epoxy coating requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Dewater excavations sufficiently to maintain the ground water level at or below the bottom of the structure foundation prior to and during placement of the base.
- B. Obtain an adequate foundation for all structures by removing and replacing unsuitable material with well-graded granular material per Section 31 23 16.01 – Excavation for Utilities.
- C. When the foundation subgrade has been prepared and is approved by the Inspector, carefully install the structure to the line and grade required by the Construction Drawings.

3.2 INSTALLATION OF PRECAST CONCRETE MANHOLES

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Excavation:
 - 1. As specified in Section 31 23 16.01 – Excavation for Utilities and below.
 - 2. Excavate for manholes to the dimensions, shapes, and elevations as indicated and as required by mechanical and/or hand methods. Excavations for manhole bases shall be plumb, level, firm, clean, and free of loose earth, loose rock, vegetation, mud, water, frozen earth, topsoil, and other unsatisfactory materials immediately before concrete placement. The outside dimensions of manhole excavations shall be at least 12 inches greater than the manhole outside dimensions to facilitate manhole construction and backfilling around the structure.
 - 3. If excavation is carried below indicated or authorized elevations or is the subgrade should be spoiled in any way, fill the over-excavated or spoiled areas with 3,000-psi concrete unless otherwise specified or authorized.
 - 4. Unsuitable Subgrade: Where the existing subgrade will not provide a sufficiently firm foundation to support the manhole and superimposed loads, remove the unsuitable material down to the depth required and replace with the specified granular material.
 - 5. Maintaining Drainage: Provide and maintain in proper working order all dewatering equipment required to remove water from the excavations and to keep the excavation bottoms stable until the work has been installed properly and will be unaffected by submersion. Where the excavation bottom is mucky or otherwise unstable because of ground water, lower the ground water level and stabilize the trench bottom by the use of bailing, pumps, or other suitable method. Where quicksand or other water bearing strata are encountered, install and connect the necessary number of well points with pumping equipment of sufficient capacity to prevent rise of water in the excavation.
 - 6. Bracing: Adequately brace excavation as required to protect personnel, adjacent structures, and adjacent property.
- C. Placing Manhole Sections
 - 1. Excavate the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6 inches beyond the manhole base.
 - 2. Set base plumb and level, aligning manhole invert with pipe invert.
 - 3. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the butyl rubber gasket directly against base of spigot. Leave protective wrapper attached until sealant is unrolled against spigot. Do not stretch. Overlap from side to side, not top to bottom.
 - 4. Set risers and cones so that steps align above the effluent pipe connection, taking particular care to clean, prepare and seal joints.
 - 5. After joining manhole sections, apply the butyl rubber joint tape around the outside perimeter of the joint.
 - 6. Lift holes leaving less than 2 inches of wall thickness shall be plugged from the outside using a sand cement mortar. Lift holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8 inch thick extending 2 inches beyond the penetration.
 - 7. Set the manhole frames to the required elevation using no more than 12 inches of precast concrete grade rings, sealing all joints between cone, grade rings, and manhole frame with the butyl sealant rope and sheet.

8. Perform the final finishing to the manhole interior by filling all chips or fractures greater than ½-inch in length, width or depth and depressions more than ½-inch deep in inverts with a high strength grout or SikaSet Plug. Do not fill the joints between the precast concrete sections. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

D. Manholes Installed on Existing Lines

1. For all lines 12 inches in diameter or less, a section of pipe shall be removed and a complete precast manhole installed. The existing pipes shall be joined by a flexible coupling to pipe extensions from the manhole. By-pass pumping shall be conducted in accordance with the requirements of the Owner or the regulatory agency having jurisdiction. The most stringent shall apply.
2. For all lines greater than 12 inches in diameter, the material beneath the pipe shall be removed in such a manner that a 6-inch reinforced concrete base (with Grade 60 #4 bars at 12-inch centers) may be constructed. After a 24-hour waiting period, the precast concrete riser section with “doghouse door” cutouts shall be placed on this base so that a watertight seal is achieved between the riser, pipe, and base. Portland cement grout shall be used to join the riser to the base. A waterstop is required for PVC pipe, and cement grouting is not acceptable. The existing pipe within the manhole shall be saw-cut to provide a smooth edge with care to prevent pieces of pipe from entering the line. By-pass pumping shall be conducted in accordance with the requirements of the Owner or the regulatory agency having jurisdiction. The most stringent shall apply.

3.3 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency or persons to perform tests and inspections.
- B. Tests and Inspections:
 1. All new, adjusted, or modified manholes are subject to Vacuum Testing in accordance with Section 33 05 05 – Sanitary Sewer Testing.
 2. Failure of any specified test will result in rejection of the Work.
- C. Prepare test and inspection reports.

END OF SECTION 33 05 61

SECTION 33 05 63 – CONCRETE VAULTS AND CHAMBERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast concrete vaults and chambers for potable and non-potable water systems.
 - 2. Frames and covers.
 - 3. Access hatches.
- B. Related Section:
 - 1. Section 33 05 61 – Concrete Manholes for sanitary sewer manholes.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Precast concrete vaults, chambers, and manholes.
 - 2. Precast concrete riser sections and grade rings.
 - 3. Gaskets, steps, joint sealant, and coatings.
 - 4. Frames and covers.
 - 5. Access hatches.

1.4 QUALITY ASSURANCE

- A. Obtain precast concrete products from a single source.
- B. Perform structural design for water and wastewater structures according to ACI 350.
- C. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- D. Material and Fabrication:
 - 1. Circular Manhole Sections: Comply with ASTM C478.
 - 2. Single-Cell Box Culvert Sections: Comply with ASTM C1433.
 - 3. Underground Precast Concrete Utility Structures: Comply with ASTM C858.
 - 4. Other Structures: Comply with ASTM C913.
- E. Welding:
 - 1. Structural Steel: Comply with AWS D1.1/D1.1M.
 - 2. Reinforcing Steel: Comply with AWS D1.4/D1.4M.

- F. Welders Qualifications: AWS qualified within previous 12 months for employed weld types.
- G. Licensed Professionals Qualifications: Professional engineer experienced in design of specified Work and licensed in State of Tennessee.
- H. Clearly mark inside of each precast concrete vault with ASTM Designation, vault size, date of manufacture, name or trademark of manufacturer. Slabs shall be marked on top and bottom surfaces.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Products: Do not deliver products until concrete has attained a minimum of 75% of specified 28-day compressive strength.
- B. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling:
 - 1. Comply with manufacturer instructions for unloading, storing, and moving vaults or chambers.
 - 2. Lift vaults or chambers from designated lifting points.
- D. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store vaults and chambers to prevent damage to Owner's property or other public or private property.
 - 3. Repair property damaged from materials storage.
- E. Protection:
 - 1. Protect materials in clean location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Precast construct structures shall be manufactured with 4,000 psi concrete (minimum).
- B. Structures shall be designed and constructed by the manufacturer to resist flotation with a safety factor greater than one.

2.2 PRECAST CONCRETE MANHOLES:

- A. Precast manholes and components shall conform to ASTM C478.
- B. The height of the manhole barrel shall be designed such that a minimum of one and a maximum of four precast concrete grade rings will be required to bring the casting to finished grade.

2.3 PRECAST CONCRETE VAULTS

- A. Precast concrete vaults and components shall conform to ASTM C858.

2.4 FRAME AND COVER:

- A. Frame and cover shall be grey cast iron conforming to the requirements of ASTM A48 (Class 35B), be made accurately to the required dimensions, and be sound, smooth, clean, and free from blisters and other defects. The casting shall not be plugged or otherwise treated to remedy defects.
- B. Bearing surfaces shall be machined to provide a secure fit without rocking.
- C. The frame and cover shall be thoroughly cleaned and coated with a bituminous coating before rusting begins.
- D. The actual weight of the casting (in pounds) shall be stenciled or printed by the manufacturer on each casting with white paint.
- E. The clear opening in the frame casting shall not be less than 24 inches.
- F. The cover shall weight not more that 180 pounds, and shall have the words “WATER” cast on the face of the cover.
- G. Manhole frames and covers shall be JBS 1154 (4” height) or JBS 1155 (6” height) as manufactured by John Bouchard and Sons, or Owner approved equal.
- H. Anchor bolts and hardware shall be 304 or 316 stainless steel.

2.5 ACCESS HATCHES:

- 1. Size as indicated on the Drawings.
- 2. Cover shall be of aluminum construction with antislip coating.
- 3. Lid shall be flush to frame. Frame shall be continuous extruded channel.
- 4. Spring assist opening.
- 5. Weatherproof with continuous EPDM seal of frame.
- 6. All fasteners and hardware are to be Type 316 stainless steel.
- 7. Stainless steel lift handles.
- 8. Design Loading:
 - a. In pavement condition: H20 Traffic Load, low density traffic.
 - b. Off pavement condition: Pedestrian lad rated (300 psf).
- 9. Manufacturers:
 - a. BILCO Company,
 - b. U.S.F. Fabrication,
 - c. Halliday Products,
 - d. Or approved equal.

2.6 PRECAST CONCRETE GRADE RINGS

- A. Precast concrete grade rings shall conform to ASTM C478.

- B. The thickness of precast concrete grade rings shall not be less than 4 inches and shall not be greater than 6 inches.
- C. No more than four precast concrete grade rings shall be used on any structure.

2.7 ACCESSORIES

- A. Manhole/Vault Steps
 1. Install steps in precast concrete structures on 16-inch centers throughout the structure with a minimum width of 13 inches.
 2. Secure steps to the wall via cast-in-place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place.
 3. Steps shall be copolymer, polypropylene coated, textured, and provided with cleats to prevent slippage. Core shall be 1/2-inch, Grade 60 steel reinforced rod.
 4. Steps shall be one of the following models and manufacturer's or approved equal:
 - a. No. PS-1 by M.A. Industries; or
 - b. No. 81213R by Meadow Burke.
- B. Joint Sealants and Gaskets
 1. Precast concrete riser sections for manholes and vaults shall be constructed with tongue and groove joints and sealed using two pieces of butyl rubber sealant.
 2. Butyl rubber sealant shall also be utilized at connection points for grade rings and castings.
 3. Butyl rubber sealant shall meet ASTM C990.
 4. The outside of the manhole shall have a 4-inch-wide non-curing butyl rubber tape on all joints.
 5. The butyl rubber sealant and tape shall meet or exceed the requirements:
 - a. Conseal "CS-102" and "CS-212", respectively; or
 - b. Kent-Seal No. 2 by Hamilton Kent Manufacturing Company.
- C. Pipe Entry Connections:
 1. For pipes passing through structure that require sealing, seal to circular void with a modular mechanical seal.
 2. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
 3. Fabrication:
 - a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
 - b. Pressure plates shall be reinforced nylon polymer.
 4. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening, and to withstand a hydrostatic head of 40 feet of water.
 5. Manufacturer: Thunderline Corp. Link-Seal Division.
- D. Bituminous Coating:
 1. The inside and outside of manholes and vaults shall be sealed with a water-resistant bituminous seal coat.
 2. The bituminous sealant shall be Daubert No. 68 or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Dewater excavations sufficiently to maintain the ground water level at or below the bottom of the structure foundation prior to and during placement of the base.
- B. Obtain an adequate foundation for all structures by removing and replacing unsuitable material with well-graded granular material per Section 31 23 16.01 – Excavation for Utilities.
- C. When the foundation subgrade has been prepared and is approved by the Owner, carefully install the structure to the line and grade required by the Construction Drawings.

3.2 INSTALLATION

- A. Place structure base, riser sections, and cone/cap with:
 - 1. Two pieces of butyl rubber sealant between each structure section as seen in the Standard Details.
 - 2. Exterior joints wrapped with butyl rubber sealant tape.
- B. After structure stack out is complete, completely fill all lift holes and joints between precast elements with mortar.
- C. Paint the inside and outside of the structure with bituminous coating to ensure watertightness.
- D. Set the cast iron frame for the cover at the required elevation and connect it to the grade ring with stainless steel anchor bolts. Wherever manholes are constructed in paved areas, tilt the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the existing adjacent pavement.

3.3 BACKFILL

- A. Place backfill by hand around the manhole and to a distance of at least one pipe length into each trench to an elevation of 12 inches above the crown of all entering pipes.
- B. Continue backfilling in accordance with the requirements of Section 31 23 16.01 – Excavation for Utilities.

END OF SECTION 33 05 63

SECTION 33 14 00 – BACKFLOW PREVENTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Backflow prevention devices and accessories.

1.3 GENERAL REQUIREMENTS

- A. In accordance with the Tennessee Code Annotated, and Harriman Utility Board (HUB) rules and regulations, no person shall cause a cross-connection or inter-connection to be made, or allow one to exist for any purpose whatsoever unless the construction and operation of the same has been approved by the Owner.
- B. Protective devices are required to:
 - 1. Protect the Owner's water system from contamination.
 - 2. Eliminate or control existing or potential cross connections between potable and non-potable water systems.
 - 3. Protect the occupants or users of the water supply within the customers' premises in certain situations from in-house contamination.
- C. Protective devices will be required when the nature of use of the water supplied to a premises by the Owner is such that it is deemed:
 - 1. Impractical to provide and effective air gap separation.
 - 2. That the property owner and/or occupant cannot or will not demonstrate to the Owner that the water use and protective features of the plumbing are such that they pose no threat to the safety of potability of the water supply.
 - 3. That the nature and mode of operations within a facility are such that frequent plumbing changes are made.
 - 4. There is a likelihood that protective measures may be subverted, altered, or disconnected (portable or temporary meters).
 - 5. A type of facility requiring protection as listed by the Tennessee Department of Environment and Conservation (TDEC) and/or the Environmental Protection Agency (EPA).
 - 6. To come into contact with chemicals or remain stagnant within the water line.
 - 7. Use of secondary meters to supply fire suppression systems, irrigation systems, pools, fountains, and hot tubs.
- D. Area Plumbing Inspectors' Offices may require a plumbing permit and inspection for the installation of backflow prevention devices (BFD). The Owner should be contacted to

determine their requirements prior to installing a BFD. The property owner or occupant must call the Owner at 865-882-3242, ext.253 to schedule an inspection after the device is installed.

- E. All costs associated with the subject program are to be born by the customer or appropriate party. This includes the initial purchase of the BFD and its proper installation, testing, and maintenance.

1.4 REFERENCES

- A. Owner's Cross-Connection Policy.
- B. TDEC Division of Water Supply Cross Connection Control Manual, latest version.
- C. Foundation for Cross Connection Control and Hydraulic Research, latest version.
- D. University of Southern California Standards, latest version.

1.5 DEFINITIONS

- A. Cross-Connection – Any physical connection whereby the public water supply is connected with any other water supply system, whether public or private, either inside or outside of any public building or buildings, in such a manner that a flow of water into the public water supply is possible either through the manipulation of valves, ineffective check or back pressure valves, or because of any other arrangement.
- B. Inter-Connection – Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer, drain, conduit, pool, storage reservoir or other device which does or may contain sewage or other waste, or liquid which would be capable of imparting contamination to the public water supply.

1.6 ACRONYMS

- A. BFD – Backflow Device
- B. DCDA – Double Check Detector Assembly
- C. RPZ – Reduced Pressure Zone Valve

1.7 SUBMITTALS

- A. Action Submittals
 1. BFP Product Data
 2. Piping and Joint Restraint Devices
 3. Chemicals and Appropriate MSDS for Fire Suppression Systems
 4. Layout drawings showing how the private system will be connected to the public water system.
 5. Backflow preventer test results.

PART 2 - PRODUCTS

2.1 REDUCED PRESSURE BACKFLOW PREVENTER (RPZ)

- A. A RPZ BFD is required for protection of the water distribution system.
- B. Only RPZ's listed in the "Approved Backflow Prevention Assemblies" listing available through TDEC Division of Water Supply shall be installed on the Owner's water system.
 - 1. As an exception, non-chemical fire suppression systems may use a DCDA.
 - 2. RPZs installed on domestic water mains are recommended to be installed as two devices in parallel to prevent service disruption during annual testing.
 - 3. RPZ devices in contact with potable water shall be lead-free brass meeting State and Federal material requirements.
 - 4. The BFD should be of sufficient size to deliver the same capacity as the water meter supplying the premises when it is installed in the main line.
 - 5. The PRZ device must contain two spring-loaded, resilient seat check valves and be equipped with a relief valve mechanism between the two check valves that ensures the pressure in the zone is always at least 2 psi lower than the inlet pressure.
 - 6. Devices 3/4 inches through 2 inches shall have bronze bodies and 2-1/2 inches through 10 inches shall have fusion epoxy coated bodies rated at a minimum 180 psi working pressure and water temperature 32° F to 140° F. Contact Owner for questions regarding operating pressure before installation.
 - 7. The RPZ device must be installed with either a bronze or inside and out coated fusion epoxy strainer, complete with a blow down.
 - 8. The device must be installed between two tight-closing resilient seated, inside and outside coated fusion epoxy gate valves, or full port ball valves.
 - 9. Test cocks must be of bronze, stainless steel, or polymer construction. They must also be resilient seated, have full port characteristics, and be located as follows:
 - a. On the upstream side of the #1 shut-off valve
 - b. Between the #1 shut-off valve and the #1 check valve
 - c. Between the #1 and #2 check valve
 - d. Between the #2 check valve and the #2 shut-off valve

2.2 DOUBLE CHECK DETECTOR ASSEMBLY BACKFLOW PREVENTER (DCDA)

- A. DCDA BFDs are required for the protection of the water distribution system on non-chemical fire lines only. A DCDA does not provide the same degree of protection as a RPZ.
- B. Only DCDA's listed in the "Approved Backflow Prevention Assemblies" listing maintained by TDEC Division of Water Supply shall be installed on the Owner's system.
- C. The DCDA device must have two internally loaded, independently acting, resilient seat valves in series. The unit includes tightly closing shutoff valves located on each end of the assembly and suitable connections for testing the water-tightness of each check valve.
- D. The DCDA will function under pressure for extended periods and, when functioning properly, will protect against backpressure and back-siphonage conditions. Unlike the RPZ, protection against backflow is not provided when both check valves leak.

- E. Devices 3/4 inches through 2 inches shall have bronze bodies and devices 2-1/2 inches through 10 inches shall have 304 stainless steel or fusion epoxy coated bodies rated at a minimum 180-psi working pressure and water temperature d water temperature 32° F to 140° F. Contact the Owner for questions regarding operating pressure before installation.
- F. Test cocks must be of bronze, stainless steel, or polymer construction. They must also be resilient seated and have full port characteristics. The test cocks located on the BFD shall be mounted at the top of the valve to reduce clearance problems and to assist in the evacuation of air from the BFD assembly.

2.3 PIPING AND FITTINGS

- A. Pipe and fittings for BFD shall be ductile iron and be in accordance with Section 33 14 13.01 – Water Piping and Valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General
 1. Install piping, valves, and fittings in accordance with manufacturer's recommendations and with Owner's specifications.
 2. Provide and use proper implements, tools, and facilities for safe and proper execution of Work.
 3. Provide work in accordance with applicable State and Local Fire Marshall's Office requirements.
- B. Cross-Connection Protection Requirement
 1. The TDEC Department of Water Supply determines the types of facilities requiring cross connection prevention. A current list of these facilities may be obtained by contacting the Owner or by referring to the Foundation for Cross Connection Control and Hydraulic Research, USC Standards, latest version. Based upon the identified degree of risk, the Owner will specify the type of BFD required.
- C. RPZ Valves
 1. Install in such a location that:
 - a. The master valve (if installed) is located after the backflow.
 - b. The device is located before the first possible use of water.
 - c. The device is installed above ground.
 - d. The device is not installed in a way that allows it to be bypassed.
 - e. The device can be easily accessed for testing on an annual basis and repaired as needed.
 - f. The device is installed with at least 12 inches between the ground/floor and the bottom of the BFD.
 - g. The device is installed at least 6 inches away from wall for BFDs size 2 inches and smaller and at least 12 inches away from walls for BFDs over 2 inches.
 - h. The device is not installed below ground or inside a pit.
 - i. The device is not exposed to grit, sticky, corrosive, or abrasive substances.

- j. The device is protected from mechanical abuse, freezing, and flooding.
 - k. The device is adequately supported to prevent the unit from sagging. Special supports are needed for units in the 4-inch to 10-inch size range.
2. Flush line and provide testing in accordance with testing requirements.
 3. RPZ installations on domestic water mains shall require two devices operating in parallel.

D. DCDA

1. Install in such a location that:
 - a. The device is located before the first possible use of water.
 - b. The device is installed above ground.
 - c. The device is not installed in a way that allows it to be bypassed.
 - d. The device can be easily accessed for testing on an annual basis and repaired as needed.
 - e. The device is installed with at least 12 inches between the ground/floor and the bottom of the BFD.
 - f. The device is installed at least 6 inches away from wall for BFDs size 2 inches and smaller and at least 12 inches away from walls for BFDs over 2 inches.
 - g. The device is not installed below ground or inside a pit.
 - h. The device is not exposed to grit, sticky, corrosive, or abrasive substances.
 - i. The device is protected from mechanical abuse, freezing, and flooding.
 - j. The device is adequately supported to prevent the unit from sagging. Special supports are needed for units in the 4-inch to 10-inch size range.
2. Flush line and provide testing in accordance with testing requirements.

3.2 TESTING

- A. Provide cleaning, disinfection, bacteriological testing, and hydrostatic testing in accordance with Section 33 14 13.01 – Water Piping and Valves.
- B. Performance Test:
 1. All assemblies used to protect the public water system shall be tested prior to being placed into service, every 12 months, and after every repair.
 2. Shall be performed by tester with valid Certificate of Competency in Testing and Evaluation Backflow Prevention Assemblies issued by the State of Tennessee.
 3. Evaluation shall be performed with an annually certified test kit, according to the latest TDEC Division of Water Resource’s approved procedures, and on State approved test report. Completed test report shall be submitted to Owner for approval and Owner’s records.
 4. All assemblies failing test procedures should be repaired or replaced, and re-tested promptly. Water service will be discontinued until a passing assembly is in place.

3.3 ACCEPTANCE BY OWNER

- A. The Owner will accept connection of the private line contingent upon satisfactory inspection and testing of the pipe, valves, and appurtenances and approval of the State and or Local Fire Marshall’s Office requirements.

END OF SECTION 33 14 00

SECTION 33 14 13.01 - WATER PIPING AND VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Public water utility distribution piping.
 - 2. Valves and fire hydrants.
 - 3. Hydrostatic testing.
 - 4. Disinfection.
 - 5. Bacteriological testing.
- B. Related Requirements:
 - 1. Section 03 30 00.01 – Concrete for Utilities
 - 2. Section 31 23 16.01 – Excavation for Utilities
 - 3. Section 33 14 17 – Water Utility Services

1.3 QUALITY ASSURANCE

- A. Hydrostatic testing shall not be performed without the Inspector present.
- B. Contractor shall engage a qualified testing agency to perform tests.

1.4 SUBMITTALS

- A. Disinfection Procedure: Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.
- B. Disinfection Report (information only):
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and completion.
 - 3. Test locations.
 - 4. Name of person collecting samples.
 - 5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
 - 6. Date and time of flushing start and completion.
 - 7. Disinfectant residual after flushing for each outlet tested.
- C. Product Data:
 - 1. Water piping.

2. Joint restraint systems.
3. Valves and fire hydrants.
4. Tapping sleeves and valves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Provide additional protection, such as UV protection, according to manufacturer instructions.

1.6 STANDARDS

- A. All products under this Section in contact with potable water shall be NSF 61 approved.

PART 2 - PRODUCTS

2.1 WATER MAIN PIPE AND JOINTS

- A. Ductile Iron Pipe (DIP)
 1. Water lines 10 inches and larger shall be constructed of ductile iron pipe unless otherwise indicated in the Construction Drawings.
 2. Ductile cast iron pipe shall be made of good quality ductile iron. The design pressure class shall be that specified by ANSI A21.50/AWWA C150 with a minimum pressure class of 350 psi, unless otherwise noted on the Drawings.
 3. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A536 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.
 4. The length of each individual piece of ductile iron pipe shipped must be plainly marked on that piece of pipe.
 5. Pipe Joints:
 - a. Push-on joints: Shall comply with AWWA C111. Unless otherwise noted on the plans or planning documents, ductile iron pipe joints shall be push-on, single gasket joints and shall be Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U.S. Pipe and Foundry Company), Tyton (McWane Ductile). Gasketed ductile joints shall be UL approved and able to withstand 350 psi of operating pressure.
 - b. Restrained Joint (RJ):

- 1) Push-On Restrained Joint pipe shall include restraining type gaskets and shall be Fast-Grip (as manufactured by American Cast Iron Pipe Company), Field LOK 350 (US Pipe), or Sure Stop 350 (McWane Ductile).
 - 2) Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe. Manufacturers and products:
 - a) American Ductile Iron Pipe: Flex-Ring, Field Flex Ring, and Lok-Ring.
 - b) U.S. Pipe and McWane Ductile: TR Flex Restrained Joint Pipe.
 - c. Flange (Exposed service only): Shall comply with AWWA C110 or C115.
 - 1) All flange bolts and hardware shall be stainless steel.
 - d. All gaskets shall be provided by the same manufacturer as pipe.
 - e. Use of set screws for restraint shall not be allowed.
6. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe, factory or field cut, shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.
 7. The gasket shall be of high-quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe and the design, hardness, and other properties of the gasket itself shall be such that the joint is liquid tight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.
 8. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This lubricant shall be nontoxic, impart no taste or smell to the water, and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe.
 9. Standard and special fitting shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings or ANSI A21.53/AWWA C153 for compact fittings.
 10. Pipe and fittings shall be lined with cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. A petroleum asphaltic coating approximately 1 mil thick shall be applied to the outside of the pipe.
 11. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company or McWane.
 12. Fitting Joints:
 - a. Mechanical Joint (MJ): Unless otherwise noted on the plans or planning documents, Mechanical joint fitting shall include gasket, gland, and bolts.
 13. The pipe manufacturer is to furnish the Owner a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and withstood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces of pipe in the shipment, the length of each piece of pipe, and the serial number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the serial number of each pipe length and attached to the certificate of inspection.

B. PVC Pipe:

1. Water lines 8 inches and smaller shall be constructed of PVC pipe unless otherwise indicated in the Construction Drawings.
2. All plastic pipe shall be SDR 17, Class 250 polyvinyl chloride plastic as defined by ASTM D2241.
 - a. If working pressure is greater than 200-PSIG, then DR14, Class 305 PVC pipe as defined by AWWA C900 shall be used.
3. All pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following test shall be run for each machine on each size and type of pipe being produced, as specified below:
 - a. Flattening Test: Once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.
 - b. Acetone Test (Extrusion Quality Test): Once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the tests.
 - c. Quick Burst Test: Once per 24 hours in accordance with ASTM D1599.
 - d. Impact Test: For pipe 6 inches and larger, once per shift in accordance with ASTM D2444; for pipe 4 inches and smaller, once each 2 hours in accordance with ASTM D2444.
 - e. Wall Thickness and Outside Dimensions Tests: Once per hour in accordance with ASTM D2122.
 - f. Bell Dimensions Test: Once per hour in accordance with ASTM D3139.
4. If any specimen fails to meet any of the above-mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests rerun.
5. Furnish a certificate from the pipe manufacturer stating that they are fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that they have manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.
6. All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.
7. All 4-inch and 6-inch pipe may be furnished in the manufacturer's standard laying lengths of 20 feet, 38 feet or 40 feet. Pipe 8 inches and larger shall be furnished in lengths of 20 feet. The Contractor's methods of storing and handling the pipe shall be approved by the Owner. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed water line routes will not be allowed without Owner approval.
8. Each piece of pipe shall be labelled with the following:
 - a. Nominal Size
 - b. Type of Material
 - c. SDR or Class
 - d. Manufacturer
 - e. NSF Seal of Approval
9. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.
10. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or

synthetic rubber; no reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, thus forming a positive seal.

11. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75° F.
12. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be nontoxic, impart no taste or smell to the water, have no harmful effect on the gasket or pipe material, and not support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name.
13. Joints shall be manufactured in accordance with ASTM D3139 except that the thickness of the bell shall be, as a minimum, equal to that of the barrel. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, H&W, or Vulcan Plastic Corporation; twin gasket couplings as manufactured by the Certain-Teed Products Corporation, or Owner approved equal. However, the pipe and bell must be made by the same manufacturer.
14. Standard and special fittings shall be ductile iron, full body fittings as specified in Part 2.1. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings. The gaskets shall be duck tipped transition gaskets for use with I.P.S. outside diameter PVC pipe.

C. Joint Restraint Systems

1. Provide pressure pipeline with restrained joints at each bend, tee, and change in direction and as indicated in the Construction Drawings and Standard Details.
2. Joint Restraint for Ductile Iron Pipe
 - a. For mechanical joint ductile iron pipe and fittings, joint restraints shall consist of follower glands by EBAA Iron MEGALUG® Series 1100, Ford Uni-Flange® Series 1400, SIGMA One-Lok Series "SLDE", or approved equal.
 - b. For restrained joint ductile iron pipe, joints shall be as specified in Part 2.1.
3. Joint Restraint for PVC Pipe
 - a. Restraint for ASTM D2241 pipe bells shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. A split serrated ring shall be utilized behind the pipe bell. A split serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring to the gripping ring. The restraint devices shall be coated per restraint manufacturer's recommendations. The restraint shall be the Series 6500, manufactured by EBAA Iron, or approved equal.
 - b. Restraint of molded PVC fittings on IPS O.D. PVC pipe (ASTM D2241) shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. The restraint devices shall be coated per restraint manufacturer's recommendations. A split, non-serrated ring shall be utilized on the fitting bell. A split, serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used.

- c. Restraint of ductile iron mechanical joint fittings to IPS O.D. PVC pipe (ASTM D2241) shall have duck tipped transition gaskets, and follower glands by:
 - 1) EBAA Iron Model 2200PV,
 - 2) Ford Uni-Flange Series 1500,
 - 3) Or approved equal.

2.2 WARNING TAPE, TRACING, AND UTILITY MARKER

- A. Detectable Warning Tape, Tracer Wire, and Utility Marker for water piping shall be as specified in Section 31 23 16.01 – Excavation for Utilities.

2.3 RESILIENT SEATED GATE VALVES

- A. Gate valves on water lines 8 inches and smaller shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 of latest revision.
- B. Valves shall have an unobstructed waterway not less than the full nominal diameter of the valve.
- C. The valves shall be non-rising stem with the stem made of cast, forged, or rolled bronze. Two stem seals of the O-ring type shall be provided to prevent leakage around the stem.
- D. The stem nut, also made of bronze, may be independent of the gate or cast integrally with the gate. If the stem nut is cast integrally, the threads shall be straight and true with the axis of the stem to avoid binding during the opening or closing cycle.
- E. The sealing mechanism shall consist of a cast iron gate having a vulcanized syntactic rubber coating or a rubber seat mechanically retained on the gate. The resilient sealing mechanism shall provide zero leakage at 200 psi working pressure when installed with the line flow in either direction.
- F. The valve body, bonnet and bonnet cover shall be cast iron, ASTM A126, Class B or ductile iron per ASTM A536. All exposed bolts and hardware shall be 304 stainless steel.
- G. All valves shall be tested in strict accordance with AWWA C509.
- H. Buried valves shall have integrally cast mechanical joint ends in accordance with AWWA C111 and have 2-inch square wrench nut operators. Mechanical joint accessories shall be supplied by the valve manufacturer. Exposed valves in structures shall have flanged ends and removable handwheel operators. The direction of opening for either type of valve shall be counterclockwise as viewed from the top. Opening direction shall be clearly indicated on the body of the valve.
- I. All ferrous surfaces of the valve body, both inside and outside, shall be protected by a fusion-bonded epoxy coating.
- J. Markings shall be cast on the bonnet or body of each valve to identify the size working water pressure, year of manufacture and manufacturer of the valve.
- K. Gate valves shall be as manufactured by M&H: Model 4067, or approved equal.

2.4 BUTTERFLY VALVES

- A. Valves 10 inches and larger shall be butterfly valves, designed for direct burial service, which meet or exceed the requirements of AWWA C504 of latest revision.
- B. The valve body shall be constructed of ASTM A126, Class B cast iron or ASTM A536, Grade 65-45-12 ductile iron with integrally cast mechanical joint ends in accordance with AWWA C1.11. Mechanical joint accessories shall be supplied by the valve manufacturer. All bolts and hardware shall be stainless steel.
- C. Valve discs shall be constructed of alloy cast iron or ductile iron.
- D. Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel. Shaft diameters must meet the minimum requirements established by AWWA C504 for Class 250.
- E. The resilient seating shall be obtained by either of the following two designs:
 - 1. Resilient Seat in the Valve Body: Valve seats shall be of a synthetic rubber compound vulcanized or bonded to the valve body. The seat bond must withstand 75 pounds per inch of pull under test procedure ASTM D429, Method B.
 - 2. Resilient Seat Attached to the Valve Disc: The valve disc shall be fitted with a resilient seat of synthetic rubber fixed in place with a retaining ring and cap screws passing through the rubber seat. The seat retaining ring and cap screws shall be of 18-8 stainless steel. The rubber seat shall be replaceable in the field.
- F. Valves shall be fitted with sleeve type bearings contained in the hubs of the valve body. Bearings shall be corrosion resistant and self-lubricating. Bearing loads shall not exceed 1/5 of the compressive strength of the bearing or shaft material.
 - 1. Packing shall be of the O-ring or self-adjusting chevron type.
 - 2. Valve operators shall conform to AWWA C504.
 - 3. Valve operators shall be of the travelling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering.
 - 4. Valve operators shall be equipped with mechanical stop limiting devices to prevent overtravel of the disc in the open and closed positions.
 - 5. Valve operators shall be designed to withstand a minimum input torque at the fully open or fully closed position of 300 foot-pounds without damage to the valve or operator.
 - 6. Valve operators shall be fully enclosed and designed to withstand a continuous submergence in water to a head pressure of 25 feet.
 - 7. The direction of opening shall be counterclockwise as viewed from the top. Opening direction shall be clearly indicated on the body of the valve.
- G. Markings shall be cast on the body of each valve to identify the size, working water pressure, year of manufacture, and manufacturer of the valve.
- H. Butterfly valves shall be as manufactured by M&H, or approved equal.

2.5 BLOW-OFF VALVES

- A. Blow-off valves shall be constructed according to the detail in the Standard Drawings.

- B. Provide 2" gate valve, valve box, and 2-inch discharge pipework with fittings as shown in the Standard Drawings.
- C. Valves shall be heavy duty with square operating nut. Handwheel operation will not be allowed.

2.6 VALVE BOXES

- A. All valves not inside structures shall be provided with cast iron valve boxes and covers unless noted otherwise on the Drawings.
- B. Valve boxes shall be two-piece adjustable screw type with round or oval bases and 5-1/4-inch shafts with upper telescoping sections as manufactured by SIGMA, Tyler/Union, or approved equal.
- C. Valve boxes shall be equipped with a mud plug made of closed cell foam and equipped with a rope pull handle. The mud plug shall be DMPlug as manufactured by SIGMA or approved equal.
- D. Valve box covers shall be marked "Water" unless noted otherwise.

2.7 AIR RELEASE VALVE ASSEMBLIES

- A. Air release assemblies shall be furnished and constructed according to the detail in the Standard Drawings. Install meter box or manhole cone as indicated.
- B. Combination Air Valve:
 - 1. The combination air valve shall conform to AWWA C512 and perform the functions of an air release valve and an air & vacuum valve, in a single body dual chamber type, and suitable for use with municipal potable water.
 - 2. Valves 3-inch and smaller shall have an NPT inlet and outlet. Sizes 4-inch and larger shall have flanged inlet and a protective cowl on the outlet. Additional plugged NPT ports shall be provided near the top and bottom of the body for testing and draining.
 - 3. Materials:
 - a. The valve body and cover shall be made from cast iron conforming to ASTM A126 Class B.
 - b. The float balls shall be spherical and made from Type 316 stainless steel. Internal linkage mechanism shall be Type 316 stainless steel. Non-metallic linkage mechanism and/or float balls are not acceptable.
 - c. The air & vacuum and air release seats shall be replaceable and made from Buna-N rubber.
 - d. The exterior of the valve shall be shop coated with enamel primer.
 - 4. Manufacturer: Golden Anderson Industries, Figure 945; or approved equal.
- C. Brass ball valve shall quarter-turn, lever handle type with zero leakage at a working pressure of 200psi. Shall comply with NSF 61.

2.8 FIRE HYDRANTS

- A. Fire hydrants shall comply in all respects with AWWA C502 of latest revision and shall be of the compression type, with the main valve opening against the pressure and closing with the pressure.
- B. The main valve opening shall not be less than 5-1/2 inches in diameter. The main valve facing of the hydrant shall be made of balata or similar material especially suited and prove for the service intended.
- C. The bottom stem threads of the main valve rod shall be fitted with an acorn nut or suitable means for sealing the threads away from the water.
- D. Hydrants shall be connected to the main by a 6-inch mechanical joint shoe and restrained follower glands.
- E. Two 2-1/2-inch hose nozzles and one 4-1/2-inch steamer nozzle shall be inserted into the hydrant barrel and then pinned to prevent turning.
- F. Operating nut shall be provided with convenient means to afford lubrication to ensure ease of operation and the prevention of wear and corrosion.
- G. Hydrants shall be the dry barrel type, and the hydrant shoe shall have two positive acting noncorrodible drain valves that drain the hydrant completely by opening as soon as the main valve is closed and by closing tightly when the main valve is open. Drain valves operated by springs or gravity will not be acceptable.
- H. The packing gland located in the bonnet shall be solid bronze and gland bolts shall be steel with bronze nuts. A double O-ring seal may be used in lieu of conventional stuffing box.
- I. The hydrant shall open by being turned counterclockwise. Opening direction shall be clearly indicated on the bonnet.
- J. Thread on hose and steamer nozzles, operating unit, and cap nuts shall conform to municipality's fire department and Owner's requirements.
- K. Bury depth shall be 36 inches minimum, with the depth being measured from grade line to bottom of trench or connecting pipe.
- L. Body shall be epoxy coated and "red" in color.
- M. Hydrant bonnets shall be painted to match NFPA 291 for flow capacity. Consult with Owner for bonnet color.
- N. Exposed bolts and hardware shall be Type 304 or 316 stainless steel.
- O. Hydrants shall be:
 - 1. M&H Style 129 "Traffic", or Owner approved equal.

2.9 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves for Cast Iron and Ductile Iron Pipe:

1. Tapping sleeves shall be a full sleeve, mechanical joint type meeting AWWA C223. Sleeves shall be manufactured from gray cast iron, meeting or exceeding ASTM A126, Grade B for outlet sizes 12 inches and smaller and ductile iron meeting ASTM A536, Grade 65-45-12 for outlet sizes 14 inches and larger. Sleeves shall be coated with a fusion bonded epoxy meeting AWWA C213.
2. Sleeves 12 inches and smaller shall be rated for 200 psi working pressure. Sleeves 14 inches and larger shall be rated for 150 psi working pressure.
3. Side flange seals shall be of the O-ring type of either round or rectangular cross-sectional shape and shall but against the split end gaskets to produce a totally watertight seal.
4. The flanged throat section of mechanical joint sleeves 12 inches and smaller shall be counterbored in accordance with MSS-SP60 for true alignment of the tapping valve and tapping machine. For sleeves with throat sections larger than 12 inches, the sleeves and tapping valves shall be provided by the same manufacturer.
5. The sleeve manufacturer shall furnish all the accessories necessary to assemble the sleeve to the pipe.
6. The inside and outside of all tapping sleeves shall be coated in accordance with AWWA standards and Federal Specifications TT-V-51, or approved equal.
7. Sleeves 8 inches and larger shall be provided with a test plug on the outlet throat.
8. Tapping sleeves shall be as manufactured by Romac or Smith-Blair.

B. Tapping Sleeves for PVC Pipe:

1. Tapping sleeves shall be the high strength type having a wide body, made of ASTM A285 Grade C steel, which conforms to and reinforces the pipe. The sleeves shall have a recessed, roll resistant type, Buna-N gasket around the outlet.
2. Sleeves 12 inches and smaller shall be capable of withstanding hydrostatic test pressure of 300 psi.
3. The flanged throat section of sleeves 12 inches and smaller shall be counterbored in accordance with MSS-SP60 for true alignment of the tapping valve and tapping machine.
4. Bolts shall be corrosion resistant, high strength, low alloy bolts per AWWA C1.11, ANSI A2 1.11 and shall be provide by the manufacturer.
5. The sleeves shall be provided with a fusion bonded epoxy coating meeting AWWA C213.
6. Sleeves 8 inches and larger shall be provided with a test plug on the outlet throat.
7. Tapping sleeves shall be as manufactured by Romac or Smith-Blair.

C. Testing Tapping Sleeves

1. Tapping sleeves and valves 8 inches and larger shall be subjected to a pressure test while in place on the existing water line, prior to the existing line being tapped. The tapping sleeve and valve shall be subjected to a hydrostatic pressure of 200 psi for a period of 15 minutes. The connection being tested shall maintain 100 percent of the test pressure throughout the test period. The Contractor shall supply all necessary equipment for testing sleeves. Other details of the test shall be as directed by the Inspector.

D. Tapping Valves – Resilient Seated

1. Tapping valves 12 inches and smaller shall conform to AWWA C509 and this specification covering gate valves except as modified for passage and clearance of tapping machine cutters. Valves shall be furnished with tapping sleeve side to ANSI B16.1 standards for flanges with male pilots for centering and the outlet side mechanical

joint, conforming to AWWA C111. Flange and mechanical accessories shall be supplied by the valve manufacturer.

2.10 DISINFECTION CHEMICALS

- A. Chemicals:
 - 1. Hypochlorite: Comply with AWWA B300.
 - 2. Sodium Chlorite: Comply with AWWA B303.

2.11 HYDROSTATIC TESTING

- A. Equipment:
 - 1. Pressure pump.
 - 2. Pressure hose.
 - 3. Water meter.
 - 4. Test connections.
 - 5. Pressure relief valve.
 - 6. Pressure Gage: Calibrated to 0.1 psi.

PART 3 - EXECUTION

3.1 PERFORMANCE REQUIREMENTS

- A. Perform Work according to:
 - 1. AWWA C600 – Installation of Ductile Iron Mains & Their Appurtenances
 - 2. AWWA C605 – Installation of PVC Mains & Their Appurtenances
 - 3. AWWA C651 – Disinfecting Water Mains

3.2 PREPARATION

- A. Distribution Piping
 - 1. Preconstruction Site Photos: See Section 31 23 16.01 – Excavation for Utilities.
 - 2. Pipe Cutting:
 - a. Cut pipe in accordance with manufacturer's recommendations.
 - b. Cut pipe ends square, ream pipe and tube end to full pipe diameter, and remove burrs.
 - c. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
 - d. Grind edges smooth with beveled end for push-on connections.
 - 3. Remove scale and dirt on inside and outside before assembly.
 - 4. Prepare pipe connections to equipment with flanges or unions.
- B. Thrust Restraints
 - 1. Clean surfaces of pipe and fittings that are to receive tied joint restraint systems.
- C. Hydrostatic Testing
 - 1. Ensure that all pipe, valves, and services have been installed and backfilled.

2. Check all valves for the proper open/close position in the test area prior to testing.
3. Install access points, valves, and sampling points prior to testing and disinfection.

D. Disinfection

1. Take precautions to protect pipe interiors, fittings, and valves against contamination during construction. Place watertight plugs in the ends of all pipes when construction is not in progress. If water accumulates in the trench, do not remove the watertight plugs until the trench has been dewatered.
2. If the pipe has become contaminated with dirt or other foreign material that will not, in the opinion of the Inspector, be removed by flushing, clean the interior of the pipe and swab with a disinfecting solution of 5% hypochlorite.
3. Verify that piping system has been cleaned, inspected, and pressure tested prior to beginning disinfection.

3.3 INSTALLATION OF PUBLIC WATER UTILITY DISTRIBUTION PIPING

A. Excavation, Bedding, Backfill, Clean-Up, and Maintenance:

1. As specified in Section 31 23 16.13 – Excavation for Utilities.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.

B. Installation of Water Lines:

1. Lay water lines to the lines and grades required by the Construction Drawings.
2. Unless otherwise noted on the Construction Drawings, all water pipes shall have a minimum of 36 inches of cover.
3. Take every precaution to keep foreign material from getting into the pipe while it is being staged or placed in the line. Remove all debris, mud, leaves, etc., that may have accumulated within the pipe. Before any pipe is laid, brush and wipe clean the outside of its spigot end and inside the bell, and leave dry and oil-free.
4. Place no debris, tools, clothing, or other materials in the pipe during laying operations.
5. Pipe shall be placed in the center of the trench, equidistant from the walls of the trench.
6. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Pipe shall be “homed” per manufacturer’s instructions.
7. Whenever pipe laying is not in progress, close the open ends of the pipe with a watertight plug. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in the trench, leave the seal in place until the trench has been completely dewatered.
8. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer’s recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe’s axis.
9. Lay pipe with the bell ends facing in the direction laying unless otherwise directed by the Engineer.
10. Wherever pipe must be deflected from a straight line (vertically or horizontally), the amount of deflection and/or the radius of curvature shall not exceed that recommended by the manufacturer.
11. Thrust restraint shall be installed wherever the water main changes in direction, at dead ends, casing pipes, stream crossings, or at any other point recommended by the manufacturer or as indicated in the Construction Drawings.
 - a. Joint restraint shall be installed:

- 1) For all pipe joints within a stream crossing,
 - 2) For all joints within a casing pipe,
 - 3) The last joint of pipe prior to a dead-end or tie-in location,
 - 4) As otherwise noted on the Construction Drawings or Standard Details.
12. Lay no pipe in water or when it is the Inspector's opinion that trench conditions are unsuitable.
 13. Where a water line crosses over a storm or sanitary sewer, provide a minimum of 18 inches of vertical separation between the lines.
 14. Where a water line is to be parallel to a sanitary or storm sewer, provide a minimum of 10 feet of horizontal separation between the lines.
 15. Lay copper tracer wire the full length of all water lines. The wire shall be looped through valve boxes to be accessible for pipe locating. Wire splices shall be taped with waterproof tape. The wire shall be installed with 3-6 inches of separation between the pipe and the wire.
 16. Bury detectable tape in the trench directly above the water line. A vertical distance of approximately 12 inches from the finished grade. The tape shall be placed in the trench with the printed side up, and shall be essentially parallel to the finished surface.
 17. The Contractor shall take necessary precautions to ensure that the tracer wire and marking tape are not pulled, distorted, or otherwise misplaced in completing the trench backfill.

C. Installation of Valves

1. Install valves as shown on the Construction Drawings and in accordance with the valve manufacturer's recommendations.
2. Valves 12-inch and larger shall be provided with special supports such as crushed stone or concrete pads so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.
3. Valve boxes shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed where depth of bury place the operating nut in excess of 60 inches beneath the grade so as to set the top of the operating nut 30 inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as indicated in the Construction Drawings.
4. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.
5. A valve marker shall be provided for each underground valve. Unless otherwise detailed on the Construction Drawings or directed by the Engineer, valve markers shall be installed 6 inches inside the right-of-way or easement.
6. Air release valves shall be installed at all high points or as directed by the Owner and as shown on the Standard Drawings.

D. Installation of Fire Hydrants

1. Set each hydrant on a 4-inch-thick 16-inch-square minimum size precast concrete slab in true plumb position, with lowest nozzle at least 18 inches above finished grade per NFPA. Securely block or anchor hydrant to prevent it from blowing off of the lead.
2. Hydrants shall be set to the established grade, with the centerline of the lowest nozzle at least 18 inches above the ground.

3. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch gate valve. When a hydrant is set in soil, drainage shall be provided at the base of the hydrant by placing No. 57 crushed stone from the bottom of the trench to at least 6 inches above the drain port opening in the hydrant to a distance of 12 inches around the elbow.
4. Hydrants shall be located as shown on the Construction Drawings or as directed by the Owner.
5. Install fire hydrants as shown on the Construction Drawings and in accordance with the hydrant manufacturer's recommendations.

E. Installation of Thrust Restraint for Utility Piping

1. Thrust restraint system shall be joint restraint (preferred) and/or Thrust Blocking, as specified on the Drawings.
2. Joint restraint shall be in accordance with AWWA C600.
 - a. Install joint restraint system such that joints are mechanically locked together to prevent joint separation.
 - b. Restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
 - c. The Contractor shall inspect each pipe joint within 500 feet on either side of main line valves to ensure 100 percent seating of the pipe spigot, except as noted otherwise.
 - d. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
3. Thrust blocking shall be Class A concrete and as shown in the Standard Drawings.

3.4 HYDROSTATIC AND LEAKAGE TESTING

- A. Subject the pipe to a minimum pressure of 200 PSIG or 50 PSIG in excess of maximum static pressure, whichever is greatest, with static pressure being measured at the lowest point of the section of pipe to be tested.
- B. The duration of the hydrostatic test shall be no less than two hours. Observe exposed pipes, hydrants, valve, and other appurtenances for cracks and defects. If defective materials are found, cease hydrostatic testing and replace the defective materials. Correct visible deficiencies and continue testing at same test pressure for an additional two hours to determine leakage rate.
- C. The testing pressure shall not vary by more than ± 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline.
- D. The amount of makeup water added shall be accurately measured in gallons by suitable method and shall not exceed the quantities shown in Table 1 below. Correct visible leaks regardless of quantity of leakage.

Table 1: Allowable Leakage Over Two Hours by Pipe Size			
Pipe Size (Inches)	Leakage per 1,000 LF (Gallons)	Pipe Size (Inches)	Leakage per 1,000 LF (Gallons)
2-1/4	0.2	18	1.7
3	0.3	20	1.9
4	0.4	24	2.2
6	0.6	30	2.8
8	0.8	36	3.3
10	1.0	42	3.9
12	1.1	48	4.4
14	1.3	54	5.0
16	1.5		

3.5 DISINFECTION

- A. Shall be performed in accordance with AWWA C651.
- B. Feed water into the pipe from the existing distribution system or other source approved by the Owner. Water and chlorine shall be fed at constant, measured rates proportioned such that the chlorine concentration in the water pipe is kept at a minimum of 50 mg/L available chlorine. See Table 1 below for chlorine required to produce 50 mg/L available chlorine. Measure the chlorine residual at regular intervals to ensure that this concentration is maintained.

Table 1: Chlorine Required to Produce a 50 mg/L Concentration in 100 Feet of Pipe, By Diameter		
Pipe Size (Inches)	100% Chlorine (Pounds)	1% Chlorine Solution (Gallons)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.328	3.96
16	0.428	5.12
18	0.540	6.48
20	0.680	8.00
24	0.980	11.52

- C. While the chlorine is being applied, manipulate valves so that the treatment dosage will not flow back into the line that is supplying the water. Continue the application of chlorine until the entire line being treated is filled with chlorine solution.

- D. The chlorine solution shall remain in the line for a minimum of 24 hours. During this time, all valves and hydrants in the line being treated shall be operated such that appurtenances can also be disinfected. The treated water shall have a minimum residual chlorine concentration of at least 25 mg/L throughout the line.
- E. Disposal of Heavily Chlorinated Water:
 - 1. Do not allow flow into waterway without neutralizing disinfectant residual.
 - 2. See the appendix of AWWA C651 for acceptable neutralization methods.

3.6 DISINFECTION PROCEDURE AFTER BUTTING INTO OR REPAIRING EXISTING LINES

- A. The procedures outlined above apply primarily to cases in which the lines are wholly or partially dewatered.
- B. However, leaks or breaks that are repaired with clamping devices while the lines remain full of water under pressure present little danger of contamination and require no disinfection.
- C. When an existing line is opened, whether by accident or design, the excavated area could be wet and contaminated because of the presence of sewers nearby. The danger of contamination from such pollution can be lessened if liberal quantities of hypochlorite are applied to the open trenches. It is better to use tablets for disinfection in such cases because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation site.
- D. Where practical, treat the lines by the slug method in accordance with AWWA C651.
- E. The following disinfection procedure is considered the minimum that may be used when existing lines are repaired:
 - 1. Swab the interior of all pipes and fittings (particularly couplings and tapping sleeves) that are to be used in repairing an existing line with a solution of 5 % hypochlorite before installing them.
 - 2. The most practical means of removing contamination introduced into a line during repairs is to give the line a thorough flushing. If the locations of valves and hydrants make it possible, flushing in both directions is recommended. Start flushing as soon as repairs are completed and continue until all discolored water is eliminated.

3.7 FLUSHING

- A. After the disinfection retention period, flush the heavily chlorinated water from the line until the chlorine concentration in the flushed water is no higher than that generally prevailing in the system, or less than 1 mg/L.
- B. The velocity of the water used to flush shall be at least 2.5 ft/s. See Table 2 below for flow rates required to produce this velocity in various pipe sizes.

Table 2: Required Openings to Flush Pipelines (40 psi Residual Pressure)				
Pipe Size	Required Flow	Orifice Size	Number	Hydrant Outlet
(Inches)	(gpm for 2.5 ft/s)	(Inches)	--	(Inches)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1,200	3-1/4	2	2-1/2
16	1,565	3-5/8	2	2-1/2
18	1,980	4-3/16	2	2-1/2
20	2,440	--	2	2-1/2
24	3,470	--	2	2-1/2

- C. Replace permanent system devices that were removed for disinfection or flushing.

3.8 BACTERIOLOGICAL TESTING

- A. Perform in accordance with AWWA C651, Section 5.
- B. Twenty-four hours (16 hours minimum per C651) after a water line has undergone final flushing but before it is placed into service, the Owner shall collect a sample for bacteriological testing from the end of that line, every 1,200 feet of line, one from each branch that is greater than one pipe segment, and additional samples as directed by the Owner.
- C. Samples are to be collected in sterile bottles treated with sodium thiosulphate. Do not use a hose or fire hydrant to collect samples. Samples are suggested to be collected by installing a standard corporation stop in the line with a copper tube gooseneck assembly.
- D. Samples are to be taken to an Owner approved laboratory to be tested for bacteriological quality in order to determine if they contain any coliform organisms. If the initial disinfection fails to produce satisfactory samples, repeat disinfection and flushing until satisfactory samples are obtained.
- E. When tested samples are found to be satisfactory, the water line may be placed into service.

END OF SECTION 33 14 13.01

SECTION 33 14 17 - WATER UTILITY SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to the Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Water service piping and fittings.
 - 2. Corporation stop assemblies.
 - 3. Curb stop assemblies.
 - 4. Water meters.
 - 5. Meter setting equipment.
- B. Related Requirements:
 - 1. Section 312316.13 – Excavation for Utilities
 - 2. Section 330563 - Concrete Vaults and Chambers
 - 3. Section 331413.01 – Water Piping and Valves

1.3 SUBMITTALS

- A. Product Data:
 - 1. Water piping and fittings.
 - 2. Corporation stop assemblies.
 - 3. Curb stop assemblies.
 - 4. Valves.
 - 5. Meter setting equipment.
- B. Installation Records for each service line:
 - 1. Coupon of water piping installed.
 - 2. Hydraulic leak testing record.
 - 3. Flow test record.
 - 4. Chlorine residual test record.
 - 5. Bacteriological testing sample.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.

- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.5 REFERENCES

- A. AWWA C800 – Underground Service Line Valves and Fittings.
- B. ASTM B88 – Specification for Seamless Copper Water Tube.
- C. ASTM D3350 – Specification for Polyethylene Plastic Pipe and Fitting Materials.
- D. NSF/ANSI 61 – Drinking Water System Components – Health Effects.
- E. NSF/ANSI 372 – Drinking Water System Components – Lead Content.

PART 2 - PRODUCTS

2.1 SERVICE ASSEMBLY

- A. The service assembly shall include a corporation stop, service pipe, meter yoke, meter box, and tapping saddle as required. The service meter shall be provided and installed by Owner.
- B. Corporation Stop:
 - 1. The corporation stop shall be of solid bronze suitable for a compression flange on the service pipe and for tapping into the water main at an angle, as shown in the Standard Details.
 - 2. The threads on the corporation stop shall be AWWA/CC Taper Thread.
 - 3. The corporation stop shall be manufactured by the Ford Meter Box Company Inc., Mueller, or approved equal:
 - a. Ford Series F-600 for copper service line; or
 - b. Ford Series F-1000-3 or Mueller H-15008N for PEX service lines.
- C. Service Pipe:
 - 1. Service pipe shall be:
 - a. Municipex PEXa as manufactured by Rehau, or approved equal.
 - b. Type 'K' Copper Tubing meeting ASTM B88, only on 2-inch service lines or with Owner approval.
- D. Meter Yoke:
 - 1. Meter yokes shall be equipped with an angle ball valve on inlet and angle check valve on the outlet side.
 - 2. Meter yokes 5/8-inch by 3/4-inch with quick joint inlet and double purpose connection outlet shall be Ford Linesetter LSVBH41-233W-Q-NL, or approved equal.
 - 3. Meter yoke for 2-inch meter shall be Ford Model VBHH77-12B-11-77-NL with 2-inch FIP inlet and outlet.
- E. Meter Boxes:

1. Meter boxes are to be a minimum of 18 inches deep, or as shown on the Construction Drawings.
 2. Lids shall be marked "WATER METER", unless otherwise noted.
 3. Meter boxes located within vehicular traffic areas shall be AASHTO "H-20" traffic rated. Boxes and lid shall be of cast iron meeting ASTM A48, Class 30B and shall measure approximately 20"x10"x18" deep, w/ two mouse holes. Locating meter boxes in traffic areas will only be allowed where approved by Owner.
 4. Meter boxes located outside of vehicle traffic areas shall be rectangular and manufactured by Ametek AMT1015-18B-W with 1419 black AMR solid plastic meter box lid with molded touch read hole.
 5. Meter boxes for 2-inch services shall be Carson Heavywall BCF Meter Box Model 1730, 18-inch deep.
- F. Tapping Saddles:
1. Tapping saddles shall be used for tapping all 4-inch to 12-inch PVC pipe. Ductile iron pipe may be tapped without a saddle, only with Owner's approval.
 2. Tapping saddles shall be Ford S70 Series or approved equal, and shall be threaded according to AWWA/CC Taper Thread to accept the corporation stop specified above.
 3. No taps larger than one inch shall be made in any size pipe without the approval of the Owner.
- G. Service Fittings:
1. Service fittings shall be compression type and be manufactured by the Ford Meter Box Company Inc. or approved equal.
- H. Ball Straight Service Valve:
1. Shall be 3-piece, reduced port, Lead Free forged brass body, fluorocarbon-coated brass ball, EPDM seats, stem packing, and stem O-ring. Shall be lockable when closed.
 2. Rated for 300-PSIG working pressure.
 3. Valve shall be Ford Meter Box Company B41-233 W-NL, Mueller B-25170R, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make no taps on dry lines without the prior approval of the Owner. Make taps at locations and times specified by the Owner.
- B. Corporation Stop Assemblies:
1. Make connections for each different kind of water main, using suitable materials, equipment, and methods as approved by Owner.
 2. Provide tapping saddles for mains constructed of materials other than ductile iron.
- C. Location:
1. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock positions along the main's circumference.
 2. Located and stagger corporation stops at least 12 inches apart longitudinally.

- D. Plastic Pipe Mains:
 - 1. Provide full support for the tapping saddle for full circumference of pipe, with minimum 2-inch width bearing area.
 - 2. Exercise care against crushing or causing other damage to mains at time of tapping.
 - 3. Use seals or other devices such that no leaks are present in mains at points of tapping.
- E. The service line shall have a minimum of 18 inches of cover. The service line shall not be taut from the corporation stop to the curb stop. The service line shall be installed as a single continuous piece without couplings from the corporation stop to the curb stop.
- F. Install the meter box as near the property line as possible in the right-of-way. Where authorized by the Owner, meter boxes may be installed on private property adjacent to the right-of-way. The meter box shall be installed plumb with the lid approximately 1 inch above finish grade to prevent water from entering the box.
- G. Install the meter yoke plumb and level.
- H. Do not backfill and cover service connections until installation has been approved by Owner.
- I. Excavation, bedding and backfill see Section 31 23 16.01 – Excavation for Utilities.
- J. Prepare and submit to the Owner Installation Record submittals for each water service installed.
- K. Testing and disinfection of water services shall have the same requirements as water mains and shall be accordance with Section 33 14 13.01 – Water Piping and Valves.

END OF SECTION 33 14 17

SECTION 33 31 11 – GRAVITY SEWER PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ductile Iron Pipe and Fittings
 - 2. PVC Pipe and Fittings
- B. Related Requirements:
 - 1. Section 31 23 16.01 – Excavation for Utilities
 - 2. Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 3. Section 33 05 05 – Sanitary Sewer Testing
 - 4. Section 33 31 30 – Sanitary Sewer Service Connections

1.3 SUBMITTALS

- A. Product Data:
 - 1. Ductile Iron Pipe
 - a. Pipe and fittings
 - b. Coating and Lining
 - c. Joints
 - 2. PVC Pipe
 - a. Pipe and fittings
 - b. Joints
- B. Sewer flow control plan. See Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
- C. Post-Construction CCTV.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer's instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection, such as UV protection, according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE (DIP)

- A. Ductile iron shall only be used in areas of fill grading, finished depths greater than 17 feet, or as required by the Owner.
- B. Ductile cast iron pipe shall be made of good quality ductile iron. The design pressure class shall be that specified by ANSI A21.50/AWWA C150. Minimum class by pipe size:
 1. 4 – 12-inch: Class 350, and
 2. 14 – 36-inch: Class 250.
- C. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A536 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.
- D. The length of each individual piece of ductile iron pipe shipped must be plainly marked on that piece of pipe.
- E. Pipe Joints:
 1. Push-on joints: Shall comply with AWWA C111. Unless otherwise noted on the plans or planning documents, ductile iron pipe joints shall be push-on, single gasket joints and shall be Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U.S. Pipe and Foundry Company), Tyton (McWane Ductile). Gasketed ductile joints shall be UL approved and able to withstand 350 psi of operating pressure.
 2. Restrained Joint (RJ):
 - a. Push-On Restrained Joint pipe shall include restraining type gaskets and shall be Fast-Grip (as manufactured by American Cast Iron Pipe Company), Field LOK 350 (US Pipe), or Sure Stop 350 (McWane Ductile).
 - b. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe. Manufacturers and products:
 - 1) American Ductile Iron Pipe: Flex-Ring, Field Flex Ring, and Lok-Ring.
 - 2) U.S. Pipe and McWane Ductile: TR Flex Restrained Joint Pipe.
 3. Flange (Exposed service only): Shall comply with AWWA C110 or C115.
 - a. All flange bolts and hardware shall be stainless steel.
 4. All gaskets shall be provided by the same manufacturer as pipe.
 5. Use of set screws for restraint shall not be allowed.
- F. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe, factory or field cut, shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.
- G. The gasket shall be of high-quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe and the design, hardness, and

other properties of the gasket itself shall be such that the joint is liquid tight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.

- H. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This lubricant shall be nontoxic, impart no taste or smell to the water, and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe.
- I. Standard and special fitting shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings or ANSI A21.53/AWWA C153 for compact fittings.
- J. Pipe and fittings shall be lined with ceramic epoxy lining that is 40-mil dry film thickness, consisting of amine cured novolac epoxy containing at least 20% by volume quartz pigment manufactured under the name "Protecto 401", or approved equal. A petroleum asphaltic coating approximately 1 mil thick shall be applied to the outside of the pipe.
- K. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, or McWane.
- L. Fitting Joints:
 - 1. Mechanical Joint (MJ): Unless otherwise noted on the plans or planning documents, Mechanical joint fitting shall include gasket, gland, and bolts.
 - 2. Ductile iron restrained fittings shall be as specified in Section 33 31 26 – Sewer Force Main.
- M. The pipe manufacturer is to furnish the Owner a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and withstood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces of pipe in the shipment, the length of each piece of pipe, and the serial number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the serial number of each pipe length and attached to the certificate of inspection.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- A. PVC pipe shall be manufactured in accordance with ASTM D3034 or ASTM F679 as applicable.
- B. PVC material shall be 12454-B, 12454-C, or 13343-C as defined by ASTM D1784.
- C. PVC pipe in sizes less than 15-inch shall be SDR 26.
- D. PVC pipe in sizes 18 thru 48-inch shall be pipe stiffness 46-psi.
- E. Joints
 - 1. Joints for PVC pipe used in gravity sewer shall be push-on or restrained joint, as specified or shown in the Drawings.

2. Gaskets for push-on and restrained joints shall conform to ASTM F477.
 3. Gaskets shall be factory installed and positively retained by means of a stainless steel, polypropylene, or PVC ring.
 4. Push-on joints and restrained joints shall conform to ASTM D3212.
- F. Restrained joint PVC shall be as specified in Section 33 31 26 – Sewer Force Main.

2.3 COUPLINGS FOR GRAVITY SEWER PIPE

A. Steel Shielding Coupling:

1. Designed to join sewer pipes of the same or different material or size and designed for resistance to heavy backfill loads and shear forces, and provide improved pipe alignment. Shielding couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in non-pressure applications.
2. Manufactured from elastomeric polyvinyl chloride (PVC) which is unaffected by soil conditions and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 minimum to 65 maximum Shore A durometer hardness. Couplings shall conform to ASTM D5926 and ASTM C1173 and the applicable parts of ASTMs C443, C425, C564, and D1869,
3. The coupling shall be cased with a corrosion resistant Series 300 stainless steel band and end clamps which when tightened to 60 inch-pounds torque, seal the joint.
4. Manufactures
 - a. Fernco 5000 Series or OWNER approved equal
 - b. Approved and listed by all of the following code agencies: SBCCI (Southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).

B. Flexible Couplings:

1. Designed to join sewer pipes of the same or different material or sizes. Flexible couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in non-pressure applications. Flexible couplings shall flex with normal earth movement to maintain integrity of seal. Use of flexible couplings shall be approved by the OWNER.
2. Manufactured from elastomeric polyvinyl chloride (PVC) which is unaffected by soil conditions and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 minimum to 65 maximum Shore A durometer hardness. Couplings shall conform to the applicable parts of ASTM C443, ASTM C425, ASTM C564, and ASTM D1869.
3. Flexible coupling shall be supplied with two corrosion resistant Series 300 stainless steel clamps, which when tightened to 60 inch-pounds torque, seal the joint.
4. Approved and listed by all of the following code agencies: SBCCI (Southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).

C. Ductile Iron Coupling:

1. Designed to join sewer pipes of the same or different material or size and designed for resistance to heavy backfill loads and shear forces, and provide improved pipe alignment.
2. Manufactured by Romac Series 501 fitting, or approved equal.

2.4 WARNING TAPE AND UTILITY MARKER

- A. See Section 31 23 16.01 – Excavation for Utilities.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to any excavation/trenching, contact Tennessee One-Call at 811 to have existing underground utilities located and marked.
- B. Site clearing, excavation/trenching, rock removal, dewatering, backfill, disposal of spoils, and flowable fill shall be in accordance with Section 31 23 16.01 – Excavation for Utilities.

3.2 DIP AND PVC PIPE INSTALLATION

- A. All pipe shall be installed in accordance with the Drawings, manufacturer's recommendations, and in the presence of the Inspector. Do not begin the backfilling of trenches until the pipe in place has been visually inspected by the Inspector. Pipe installation shall begin at the lowest elevation, unless otherwise approved by the Owner.
- B. Lower pipe, fittings, and appurtenances into trench by means of crane, slings, or other suitable tools and equipment in such a manner as to prevent damage to pipe materials, protective coatings, and linings. Do not drop or dump pipe into trenches.
- C. Lasers shall be used to install sewers to the line and grade indicated on the Drawings. Reference points for both line and grade shall be set at each manhole. Check for pipe alignment and grade after each joint has been made. Measure for grade at pipe the invert, not at the top of pipe.
- D. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trench than the available dewatering and pumping facilities are able to dewater.
- E. Trench bottoms that are found to be unsuitable shall be stabilized as specified in section 31 23 16.01 – Excavation for Utilities.
- F. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed up grade, starting at the lower end of the grade and with the bells up grade. Ensure that the bottom of the pipe is in contact with bottom of trench for the full length of each section. Place sufficient pipe bedding material to secure pipe from movement before the next joint is installed. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

- G. Excavation for bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Excavate bell holes no more than two joints ahead of the pipe laying.
- H. Bedding, pipe zone material, backfill, compaction, and detectable warning tape shall be in accordance with Section 31 23 16.01- Excavation for Utilities and with the Standard Details.

3.3 CONNECTIONS TO MANHOLES

- A. Connections to new precast manhole shall be in accordance with Section 33 05 61 – Concrete Manholes.
- B. Unless otherwise noted on the Drawings, connections to existing manholes shall be made using a Kor-N-Seal flexible connector in accordance with the manufacturer’s recommendations.

3.4 SERVICE LATERALS

- A. Installation and reconnection of service laterals shall be in accordance with Section 33 31 30 – Sanitary Sewer Services.

3.5 SPECIAL INSTALLATIONS

- A. Gravity sewer pipe installed in a casing pipe or crossing a stream shall be restrained joint.
- B. Where sewer crosses less than 18 inches below waterline, use restrained joint ductile iron or PVC pressure pipe or encase in concrete for a minimum distance of 9 feet each side of the waterline.

3.6 POINT REPAIRS

- A. When a section of gravity sewer pipe is to be replaced between manholes, joints shall be watertight and secured with a steel shielded type coupling.

3.7 TESTING

- A. Testing and inspection of installed gravity sewer shall be in accordance with Section 33 05 05 – Sanitary Sewer Testing.

3.8 POST-CONSTRUCTION CCTV

- A. CCTV newly constructed sewer mains after backfill and prior to placing into service.
- B. May be used by Owner to determine acceptability of work performed.
- C. Shall be performed in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

END OF SECTION 33 31 11

SECTION 33 31 26 – SEWER FORCE MAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sanitary sewer force main pipelines.
- 2. Air release valves.
- 3. Valves.

- B. Related Requirements:

- 1. Section 31 23 16.01 – Excavation for Utilities
- 2. Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control
- 3. Section 33 05 05 – Sanitary Sewer Testing

1.3 SUBMITTALS

- A. Action Submittals:

- 1. Complete shop drawings and laying diagrams showing location of each pipe section as requested by the Owner. Drawings shall include:
 - a. Pipe dimensions, pipe class, pipe joints, fitting fabrication details, and gasket properties,
- 2. For ductile iron pipe indicate coating and lining data including its chemical resistance data.
- 3. Sewer flow control plan. See Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

1.4 QUALITY ASSURANCE

- A. Materials will be visually inspected by Owner or Inspector at the Site for conformance to the Specifications. At Owner's discretion, Contractor may be required to supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications. Any material that fails to conform to these Specifications shall be rejected and removed from the project by the Contractor at no cost to the Owner.
- B. Installation of materials shall be performed by qualified personnel.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer's instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection, such as UV protection, according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 DUCTILE IRON (DI) PIPE AND FITTINGS

- A. Sanitary sewer force mains greater than 12-inch diameter or exposed service shall be constructed of ductile iron pipe, unless shown otherwise on the Drawings.
- B. Ductile cast iron pipe shall be made of good quality ductile iron. The design pressure class shall be that specified by ANSI A21.50/AWWA C150 with a minimum pressure class of 250 psi, unless otherwise noted on the Drawings.
- C. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A536 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.
- D. The length of each individual piece of ductile iron pipe shipped must be plainly marked on that piece of pipe.
- E. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe, factory or field cut, shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.
- F. The gasket shall be of high-quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe and the design, hardness, and other properties of the gasket itself shall be such that the joint is liquid tight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.
- G. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This lubricant shall be nontoxic and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe.
- H. Pipe Joints:
 - 1. Push-on joints: Shall comply with AWWA C111. Unless otherwise noted on the plans or planning documents, ductile iron pipe joints shall be push-on, single gasket joints and

- shall be Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U.S. Pipe and Foundry Company), Tyton (McWane Ductile). Gasketed ductile joints shall be UL approved and able to withstand 350 psi of operating pressure.
2. Restrained Joint (RJ):
 - a. Push-On Restrained Joint pipe shall include restraining type gaskets and shall be Fast-Grip (as manufactured by American Cast Iron Pipe Company), Field LOK 350 (US Pipe), or Sure Stop 350 (McWane Ductile).
 - b. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe. Manufacturers and products:
 - c. American Ductile Iron Pipe: Flex-Ring, Field Flex Ring, and Lok-Ring.
 - d. U.S. Pipe and McWane Ductile: TR Flex Restrained Joint Pipe.
 3. Flange (Process piping only): Shall comply with AWWA C110 or C115.
 - a. All bolts and hardware shall be Type 304 or 316 stainless steel.
 4. All gaskets shall be provided by the same manufacturer as pipe.
 5. Use of set screws for restraint shall not be allowed.
- I. Standard and special fitting shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings or ANSI A21.53/AWWA C153 for compact fittings.
- J. Lining: Pipe and fittings shall be lined with ceramic epoxy lining that is 40-mil dry film thickness, consisting of amine cured novolac epoxy containing at least 20% by volume quartz pigment manufactured under the name "Protecto 401", or approved equal.
- K. Coating for Pipe and Fittings:
1. Prepare surface in accordance with manufacturer's recommendations.
 2. Buried Service: A petroleum asphaltic coating approximately 1 mil thick shall be applied to the outside of the pipe.
 3. Exposed Service:
 - a. Coating shall be as specified below and manufactured by TNEMEC Co., Inc., or approved equal.
 - b. Non-Immersion (i.e. valve and meter vaults):
 - 1) First coat N69- Color Hi-Build Epoxoline II at 4.0 - 6.0 MDFT,
 - 2) Second coat N69-Color Hi-Build Epoxoline II at 4.0 - 6.0 MDFT.
 - c. Immersion or Hydrogen Sulfide Exposure (i.e. wet well):
 - 1) First coat 446 Perma-Shield at 7.0 - 10.0 MDFT,
 - 2) Second coat 446 Perma-Shield at 7.0 - 10.0 MDFT.
 - d. For interior spaces, such as interior of treatment plants, consult with Owner.
 - e. Color: Black, unless otherwise directed by Owner.
- L. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company or McWane.
- M. Fitting Joints:
1. Mechanical Joint (MJ): Unless otherwise noted on the plans or planning documents, Mechanical joint fitting shall include gasket, gland, and bolts.
- N. The pipe manufacturer is to furnish the Owner a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and withstood a hydrostatic pressure of 500 psi. Each statement is to give the number of

pieces of pipe in the shipment, the length of each piece of pipe, and the serial number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the serial number of each pipe length and attached to the certificate of inspection.

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Sanitary sewer force mains 12-inch and less shall be constructed of SDR 17 PVC pipe.
- B. All pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following test shall be run for each machine on each size and type of pipe being produced, as specified below:
 - 1. Flattening Test: Once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.
 - 2. Acetone Test (Extrusion Quality Test): Once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the tests.
 - 3. Quick Burst Test: Once per 24 hours in accordance with ASTM D1599.
 - 4. Impact Test: For pipe 6 inches and larger, once per shift in accordance with ASTM D2444; for pipe 4 inches and smaller, once each 2 hours in accordance with ASTM D2444.
 - 5. Wall Thickness and Outside Dimensions Tests: Once per hour in accordance with ASTM D2122.
 - 6. Bell Dimensions Test: Once per hour in accordance with ASTM D3139.
 - 7. If any specimen fails to meet any of the above-mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests rerun.
- C. Furnish a certificate from the pipe manufacturer stating that they are fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that they have manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.
- D. All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.
- E. All 4-inch and 6-inch pipe may be furnished in the manufacturer's standard laying lengths of 20 feet, 38 feet or 40 feet. Pipe 8 inches and larger shall be furnished in lengths of 20 feet. The Contractor's methods of storing and handling the pipe shall be approved by the Owner. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed sewer line routes will not be allowed without Owner approval.
- F. Each piece of pipe shall be labelled with the following:
 - 1. Nominal Size
 - 2. Type of Material

3. SDR or Class
 4. Manufacturer
 5. NSF Seal of Approval
- G. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.
- H. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or synthetic rubber; no reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, thus forming a positive seal.
- I. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75° F.
- J. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be nontoxic and have no harmful effect on the gasket or pipe material, and not support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name.
- K. Joints shall be manufactured in accordance with ASTM D3139 except that the thickness of the bell shall be, as a minimum, equal to that of the barrel. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, H&W, or Vulcan Plastic Corporation; twin gasket couplings as manufactured by the Certain-Teed Products Corporation, or Owner approved equal. However, the pipe and bell must be made by the same manufacturer.
- L. Standard and special fittings shall be ductile iron, full body fittings as specified in Part 2.1. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110 for full body fittings. The gaskets shall be duck tipped transition gaskets for use with I.P.S. outside diameter PVC pipe.

2.3 JOINT RESTRAINT SYSTEMS

- A. Provide pressure pipeline with restrained joints at each bend, tee, and change in direction and as indicated in the Construction Drawings and Standard Details.
- B. Joint Restraint for Ductile Iron Pipe
1. For mechanical joint ductile iron pipe and fittings, joint restraints shall consist of follower glands by EBAA Iron MEGALUG® Series 1100, Ford Uni-Flange® Series 1400, SIGMA One-Lok Series "SLDE", or approved equal.
 2. For restrained joint ductile iron pipe, joints shall be as specified in Part 2.1.
- C. Joint Restraint for PVC Pipe

1. Restraint for ASTM D2241 pipe bells shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. A split serrated ring shall be utilized behind the pipe bell. A split serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring to the gripping ring. The restraint devices shall be coated per restraint manufacturer's recommendations. The restraint shall be the Series 6500, manufactured by EBAA Iron, or approved equal.
2. Restraint of molded PVC fittings on IPS O.D. PVC pipe (ASTM D2241) shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. The restraint devices shall be coated per restraint manufacturer's recommendations. A split, non-serrated ring shall be utilized on the fitting bell. A split, serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used.
3. Restraint of ductile iron mechanical joint fittings to IPS O.D. PVC pipe (ASTM D2241) shall have duck tipped transition gaskets, and follower glands by:
 - a. EBAA Iron Model 2200PV,
 - b. Ford Uni-Flange Series 1500,
 - c. Or approved equal.

D. All exposed bolts and hardware shall be Type 304 or 316 stainless steel.

2.4 WARNING TAPE, TRACER WIRE, AND UTILITY MARKER:

- A. For product information on detectable warning tape, tracer wire, and utility markers reference Section 31 23 16.01 – Excavation for Utilities.

2.5 AIR RELEASE VALVE ASSEMBLIES

- A. Air release assemblies shall be furnished and constructed according to the detail in the Standard Drawings. Install meter box or manhole cone as indicated.
- B. Air valves shall be located at all high points on the pipeline in accordance with the drawings, or as directed by the Owner.
- C. Combination Air Valve:
 1. The combination air valve shall conform to AWWA C512 and perform the functions of an air release valve and an air & vacuum valve, in a single body type, and suitable for use with municipal wastewater.
 2. Minimum valve size is 2-inch. Valves 3-inch and smaller shall have an NPT inlet and outlet. Sizes 4-inch and larger shall have flanged inlet and a protective cowl on the outlet. Additional plugged NPT ports shall be provided near the top and bottom of the body for testing and draining.
 3. Materials:
 - a. The valve body and cover shall be made from cast iron conforming to ASTM A126 Class B.
 - b. The float balls shall be spherical and made from Type 316 stainless steel. Internal linkage mechanism, plug, seat, and orifice shall be Type 316 stainless steel. Non-metallic linkage mechanism and/or float balls are not acceptable.
 - c. The air release seats shall be adjustable, replaceable and made from Buna-N rubber. The air & vacuum seat shall be replaceable and made from Buna-N rubber.
 - d. The exterior of the valve shall be shop coated with enamel primer.

- e. Exterior bolts and hardware shall be Type 304 or 316 stainless steel.
 - 4. Valve shall be rated for 200-psi with working pressures up to 150-psi.
 - 5. Manufacturer: A.R.I., Model D-020 Combination Air Valve for Wastewater.
- D. Brass ball valve shall quarter-turn, lever handle type with zero leakage at a working pressure of 200psi. Shall comply with NSF 61.

2.6 CHECK VALVE

- A. The swing check valve shall be designed, manufactured, tested, and certified to conform with AWWA C508.
- B. Design and Materials:
1. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The 4 in. (100mm) valve shall be capable of passing a 3 in. (75mm) solid. The seating surface shall be on a 45 degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line.
 2. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.
 3. The disc shall be of one-piece construction, precision molded Buna-N rubber with an integral O-ring type sealing surface and reinforced with alloy steel. The flex portion of the disc contains nylon reinforcement and shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short 35 degree disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig.
 4. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
 5. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
 6. A mechanical indicator shall be provided to provide disc position indication on valves 3-inch and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.
 7. All exterior bolts and hardware shall be Type 304 or 316 stainless steel.
 8. Flange ends conforming with ANSI B16.1, Class 125.
 9. Shall be rated for 250-psi cold water working pressure.
- C. Valve shall be “Swing-Flex” Series #500 manufactured by Val-Matic Valve & Mtg.

2.7 PLUG VALVE

- A. Eccentric plug valves shall be design, manufactured, and tested in accordance with AWWA C517.
- B. Design and Materials:
1. Valves shall have port areas of not less than 100% of pipe area.

2. Valve seat shall be a welded overlay of 95% pure nickel applied directly to the body on a pre-machined, cast seating surface and machined to a smooth finish.
3. Shaft seals shall have V-type packing in a fixed gland with an adjustable follower and removable shims under the follower flange to provide for adjustment and prevent over compression.
4. Permanently lubricated, radial shaft bearings shall be supplied in the upper and lower bearing journals to eliminate the need for grease fittings. Thrust bearings shall be provided in the upper and lower journal areas, except for threaded type which only have upper thrust bearings. Bearings shall be self-lubricating Type 316 stainless steel. The thrust bearings shall be PTFE.
5. Both the packing and bearings in the upper and lower journals shall be protected by Buna-N shaft seals located on the valve shaft to minimize the entrance of grit into the bearing journal and shaft seal areas.
6. Plug shall be of one-piece construction and made of ASTM A536 Grade 65-45-12 ductile iron and fully encapsulated with resilient facing per ASTM D2000-BG and ANSI/AWWA C517 requirements.
7. Valve bodies and covers shall be constructed of ASTM A126 Class B for working pressures up to 175 psig (1200 kPa). The words "SEAT END" shall be cast on the exterior of the body seat end.
 - a. For valves requiring higher pressure rating, consult Owner.
8. Exposed worm gear shaft shall be stainless steel. Gear actuator shall be designed to withstand, without damage, 1.5 times maximum operating shutoff pressure, or 200-lbs pull on handwheel and an input torque of 300-lbs for nuts, whichever is greater.
9. For exposed service:
 - a. Equipped with totally enclosed and sealed worm gear with position indicator, and externally adjustable open and closed stops.
 - b. Operators for valves less than 6-inch: Wrench lever manual.
 - c. Operators for valves 6-inch and greater: Handwheel, manual (unless otherwise noted on the Drawings).
 - d. Flange ends conforming with ANSI B16.1, Class 125.
10. For buried service:
 - a. Actuator shall be equipped with 2-inch nut, packed with grease, and sealed for temporary submergence to 20-foot.
 - b. Restrained mechanical joint ends.
11. Interior and exterior of valve shall be coated with fusion bonded epoxy.
12. All exposed bolts and hardware shall be Type 304 or 316 stainless steel.

C. Valve shall be

1. Series 5600 or 5700 100% Port Eccentric Plug Valve by Val-Matic Valve & Mtg.,
2. Model PEF 100% Eccentric Plug Valve by DeZurik.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRESSURE SEWER PIPE

A. Excavation, Bedding, Backfill, Clean-Up, and Maintenance:

1. As specified in Section 31 23 16.01 – Excavation for Utilities.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.

B. Installation of pipe:

1. Lay pressure sewer pipe to the lines and grades required by the Drawings.
2. Unless otherwise noted on the Drawings, all pressure sewer pipes shall have a minimum of 36 inches of cover.
3. Take every precaution to keep foreign material from getting into the pipe while it is being staged or placed in the line. Remove all debris, mud, leaves, etc., that may have accumulated within the pipe. Before any pipe is laid, brush and wipe clean the outside of its spigot end and inside the bell, and leave dry and oil-free.
4. Place no debris, tools, clothing, or other materials in the pipe during laying operations.
5. Pipe shall be placed in the center of the trench, equidistant from the walls of the trench.
6. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Pipe shall be "homed" per manufacturer's instructions.
7. Whenever pipe laying is not in progress, close the open ends of the pipe with a watertight plug. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in the trench, leave the seal in place until the trench has been completely dewatered.
8. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.
9. Lay pipe with the bell ends facing in the direction laying unless otherwise directed by the Owner.
10. Wherever pipe must be deflected from a straight line (vertically or horizontally), the amount of deflection and/or the radius of curvature shall not exceed that recommended by the manufacturer.
11. Thrust restraint shall be installed wherever the force main changes in direction, casing pipes, stream crossings, or at any other point recommended by the manufacturer or as indicated in the Construction Drawings.
 - a. Joint restraint shall be installed:
 - 1) For all pipe joints within a stream crossing,
 - 2) For all joints within a casing pipe,
 - 3) The last joint of pipe prior to a tie-in location,
 - 4) As otherwise noted on the Construction Drawings or Standard Details.
12. Lay no pipe in water or when it is the Inspector's opinion that trench conditions are unsuitable.
13. Where a sewer line crosses a drinking water or storm sewer line, the sewer line shall be installed below the line being crossed and shall provide a minimum of 18 inches of vertical separation between the lines.
14. Where a pressure sewer line is to be installed parallel to a drinking water or storm sewer line, provide a minimum of 10 feet of horizontal separation between the lines.
15. Install tracer wire and detectable warning tape the full length of all pressure sewer lines.
15. The Contractor shall take necessary precautions to ensure that the tracer wire and marking tape are not pulled, distorted, or otherwise misplaced in completing the trench backfill.
16. Backfill trench according to Section 31 23 16.01 – Excavation for Utilities and the Standard Drawings.

3.2 INSTALLATION OF VALVES

- A. Install valves as shown on the Construction Drawings and in accordance with the valve manufacturer's recommendations.
- B. Valves 12-inch and larger shall be provided with special supports such as crushed stone or concrete pads so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.
- C. Valve boxes shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed where depth of bury place the operating nut in excess of 60 inches beneath the grade so as to set the top of the operating nut 30 inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as indicated in the Construction Drawings.
- D. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.
- E. A valve marker shall be provided for each underground valve. Unless otherwise detailed on the Construction Drawings or directed by the Engineer, valve markers shall be installed 6 inches inside the right-of-way or easement.
- F. Air release valves shall be installed at all high points or as directed by the Owner and as shown on the Standard Drawings.

3.3 INSTALLATION OF THRUST RESTRAINT FOR UTILITY PIPING

- A. Thrust restraint system shall be joint restraint (preferred) and/or Thrust Blocking, as specified on the Drawings.
- B. Joint restraint shall be in accordance with AWWA C600.
 - 1. Install joint restraint system such that joints are mechanically locked together to prevent joint separation.
 - 2. Restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
 - 3. The Contractor shall inspect each pipe joint within 500 feet on either side of main line valves to ensure 100 percent seating of the pipe spigot, except as noted otherwise.
 - 4. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
- C. Thrust blocking shall be Class A concrete and as shown in the Standard Drawings.

3.4 TESTING

- A. Testing and inspection of installed sewer force main piping shall be in accordance with Section 33 05 05 – Sanitary Sewer Testing.

END OF SECTION 33 31 26

SECTION 33 31 27 – LOW PRESSURE SEWER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sanitary sewer low-pressure pipelines.

- B. Related Requirements:

- 1. Section 31 23 16.01 – Excavation for Utilities
- 2. Section 33 05 05 – Sanitary Sewer Testing
- 3. Section 33 31 26 – Sewer Force Main Piping
- 4. Section 33 31 30 – Sanitary Sewer Services
- 5. Section 33 32 16 – Packaged Wastewater Grinder Pump Assemblies

1.3 SUBMITTALS

- A. Action Submittals:

- 1. Shop Drawings
 - a. Catalog information confirming pipe, fittings, and other materials conform to the requirements of this section.
 - b. Drawings of specific connection details.
 - c. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.

1.4 QUALITY ASSURANCE

- A. Materials will be visually inspected by Owner or Inspector at the Site for conformance to the Specifications. At Owner's discretion, Contractor may be required to supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications. Any material that fails to conform to these Specifications shall be rejected and removed from the project by the Contractor at no cost to the Owner.
- B. Installation of materials shall be performed by qualified personnel.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on Site in manufacturer's original packaging and inspect for damage.

- B. Store materials according to manufacturer's instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection, such as UV protection, according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 LOW-PRESSURE SEWER PIPING

- A. Pipe and fittings used for Low-Pressure Sewer (LPS) Mains shall be:
 - 1. Less than 4-inch: HDPE as specified herein.
 - 2. 4-inch and greater: As specified in Section 33 31 23 – Sewer Force Main Piping, with the exception piping shall be SDR 21, Class 200.
- B. HDPE pipe shall conform to the requirements of AWWA C906 or ASTM F714.
- C. Polyethylene resin shall meet or exceed requirements of ASTM 3350 for PE 4710 material. Pressure rating shall be based on hydrostatic design stress of 800 psi at 73.4° F.
- D. Minimum DR 11 with 200 PSI pressure rating, unless otherwise noted on the Drawings.
- E. Outer diameter basis shall be iron pipe size (IPS).
- F. Pipe length, fittings, flanged connections to be joined by thermal butt-fusion shall be of compatible resin mix for the fusion process.
- G. HDPE pipe shall have a co-extruded green cover or extruded green stripes designating used for sanitary sewer. Color print lines are not an acceptable method for designation of sewer mains. Pipe with extruded green stripe shall have a minimum of three equally spaced stripes. Pipe shall have a heat indented print line containing the information required in ASTM D3035.
- H. Pipe shall be manufactured by the following manufacturers or Owner approved equal:
 - 1. Performance Pipe
 - 2. Rinker Polypipe
 - 3. Uponor North America
 - 4. ARNCO, Elyria, OH
- I. HDPE Fittings:
 - 1. Molded and fabricated from polyethylene.
 - 2. Polyethylene fittings shall have same or higher pressure rating as pipe.
 - 3. Butt fusion fittings shall comply with ASTM D3261 requirements.
 - 4. Backup Rings:
 - a. Convolute for flanged connections:
 - 1) ASTM A536, ductile iron
 - 2) Complete with one-piece, molded polyethylene flange adapters.
 - 3) Flanged connections shall have the same or higher pressure rating as pipe.

- b. Ductile iron: Shop primed with red oxide and shop coated with two-part epoxy material in accordance with AWWA C550. Dry film thickness shall be 10 mils minimum.
- 5. Electrofusion joint fittings shall have ISO 9001 and NSF 61 certification and shall be manufactured by the following or Owner approved equal:
 - a. Central Plastics Company; Central Electrofusion System
 - b. IPEX, Inc.; Friatec
- 6. Joints:
 - a. Thermal butt-fusion or electrofusion, except where connecting to unions, valves, and equipment with flanged or threaded connections that may require future disassembly or as indicated on the Drawings.
 - b. Mechanical joints shall not be utilized with HDPE pipe less than 4-inch diameter.

2.2 WARNING TAPE, TRACER WIRE, AND UTILITY MARKER:

- A. For product information on detectable warning tape, tracer wire, and utility markers reference Section 31 23 16.01 – Excavation for Utilities.

2.3 AIR RELEASE VALVE ASSEMBLIES

- A. See Section 33 31 26 – Sewer Force Main Piping and the Standard Drawings.

2.4 VALVES AND ACCESSORIES

- A. For valves 4-inch and greater see Section 33 31 26 – Sewer Force Main Piping.
- B. Ball Valve (Less than 4-inch): SDR 11, full-port body with butt-fusion flanges. Components shall include a polyethylene PE 4710 body, polyethylene ball, EPDM seat, neoprene seal, and polypropylene adaptor.
- C. Flushing Assembly:
 - 1. Install flushing assembly at the upstream end-of-line, changes in diameter, every 500 linear feet, or as directed by Owner.
 - 2. Install in accordance with the Standard Drawings.

2.5 JOINT RESTRAINT

- A. Thrust restraint and blocking is an integral part of the LPS main and shall be installed at locations shown on the Drawings, in accordance with the manufacturer's instructions, or as required by the Owner. LPS mains shall be properly restrained in accordance with manufacturer's instructions to resist longitudinal forces in the pipe due to thermal expansion. Install any restraint devices necessary to properly secure the pipe.
- B. Provide thrust restraint blocking in accordance with the Standard Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF LOW-PRESSURE SEWER MAINS

- A. Sewers shall be designed with a 10-foot horizontal separation from any existing or proposed water main. If this is not practical, the sewer may be placed closer than 10 feet to a water main, provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main, or as directed by Owner.
- B. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation, or the water main shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the sewer with a full pipe section of the water main centered over the sewer, or as directed by Owner.
- C. Pipe Joining:
 - 1. General:
 - a. When requested by the Owner, prior to pipe installation, two trial fusion welds shall be performed, and reviewed and approved by the Owner. Full penetration welds shall provide homogeneous material across the cross section of weld. Fusion machine employed for trial welds shall be same machine utilized for project installation.
 - b. The HDPE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted.
 - c. All equipment and procedures used shall be in strict compliance with ASTM F2620 and with the pipe manufacturer's recommendations.
 - d. Terminal sections of pipe that are joined within the insertion pit shall be connected with an electrofusion coupling (e.g., Central Plastics couplings).
 - e. All connections shall be completed in the absence of flow and in conformance with the manufacturer's installation procedures.
 - 2. Joint Preparation:
 - a. Inside and outside of pipe ends shall be cleaned with cotton or non- synthetic cloth to remove dirt, water, grease, and other foreign materials.
 - b. Pipe ends shall be cut square and carefully aligned prior to heating.
 - 3. Joining:
 - a. Fusion shall be performed by technicians certified by a manufacturer of pipe fusion equipment.
 - b. Using an alignment jig, the butt-fused joint shall be true alignment, brought together in firm, rapid motion, applying sufficient pressure to form a uniform rollback bead (1/8 inch to 3/16 inch) on the entire outer and inside circumference of pipe. The joint shall be allowed adequate cooling time before removal of pressure.
 - c. The fused joint shall be watertight and shall have tensile strength equal to or greater than that of the pipe.
 - d. All joints shall be subject to acceptance by the Owner prior to insertion.
 - e. Cut out and replace defective joints at no additional cost to Owner.
 - 4. Weld De-beading:

- a. Internal beads shall be removed with an approved de-beading device without inducing any defects to the pipe or bead. The pipe and bead must be completely cooled before the bead is removed.
- b. The removed beads shall be in one continuous strip without splitting or defect. The contractor shall remove any joint with defective beads and fuse a new joint.

3.2 FIELD QUALITY CONTROL

- A. For pipes 4-inch and greater see Section 33 31 26 – Sewer Force Main Piping.
- B. Joint Fusion: Measure and log each joint fusion by an electronic monitoring device (data logger) affixed to fusion machine, and shall be capable of being retrieved electronically. Also log on report the ambient temperature, humidity, and if bead was removed.
- C. Joint Weld Testing:
 1. ASTM D638 test procedure.
 2. Specimen shall be cut pipe 12 inches on each side of the field made joint. Rejoin ends and proceed with Work.
 3. Test Frequency:
 - a. First two joints selected at random by Owner.
 - b. Each additional joint selected at random by Owner.
 - c. Each Test Failure: Two additional joints selected at random by Owner.
- D. Hydrostatic and Leakage Test: In accordance with Section 33 05 05 – Sanitary Sewer Testing.

END OF SECTION 33 31 27

SECTION 33 31 30 - SANITARY SEWER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification section, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gravity Sewer Service Connections
 - 2. Low Pressure Sewer Service Connections
- B. Related Requirements:
 - 1. Section 31 23 16.01 – Excavation for Utilities
 - 2. Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
 - 3. Section 33 05 05 – Sanitary Sewer Testing
 - 4. Section 33 31 11 – Gravity Sewer Piping
 - 5. Section 33 31 26 – Sewer Force Main Piping
 - 6. Section 33 32 16 – Packaged Wastewater Grinder Pump Assemblies

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store valves in shipping containers with labeling in place.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection, such as UV protection, according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 GRAVITY SEWER SERVICE CONNECTIONS

- A. Connection during new construction:

1. Connection to PVC gravity sewer lines during new construction shall be achieved using a factory-made sanitary wye constructed of the same material and grade as the pipe being used in construction of the line.
 2. Connection to DIP gravity sewer lines during new construction shall be achieved using a tapping saddle. The tapping saddle shall be Romac 218-4634U for 4-inch or Romac 218-6664U for 6-inch service connections.
- B. Connection to existing lines:
1. Connection to existing gravity sewer lines shall be achieved using a tapping saddle. The tapping saddle shall be Romac 218-4634U for 4-inch or Romac 218-6664U for 6-inch service connections.
- C. Connection to manholes:
1. Gravity sewer service connections to manholes shall not be allowed without the explicit approval of the Owner.
 2. Connection to manholes shall be achieved by coring of the manhole wall and the use of a flexible boot for connection of the service pipe. The flexible boot shall be Kor-N-Seal.
 3. Service connections to manholes more than two feet above the invert of the manhole shall be provided with an interior drop assembly. Interior drop assemblies shall be Reliner as manufactured by Duran, Inc.

2.2 GRAVITY SEWER SERVICE LATERALS

- A. Gravity sewer service laterals shall be a minimum of 6 inches in diameter.
- B. Sewer service laterals shall be constructed of either SDR 26 PVC or Class 350 ductile iron pipe. If the lateral is constructed of ductile iron, it shall be lined with epoxy or Protecto 401.
- C. Sewer service laterals with less than 3 feet of cover shall be constructed of ductile iron pipe.
- D. When joining pipes of different materials, a flexible, watertight, rubber transition coupling shall be used. Rubber transition couplings shall be manufactured by Fernco or approved equal.
- E. Riser connections shall be required when the main sewer line is ten or more feet below finished grade. Riser connections shall be constructed of SDR 26 PVC.

2.3 LOW PRESSURE SEWER SERVICE CONNECTIONS

- A. Standard low-pressure sewer service size is 1.25-inch for a single family residence. If a different size is required, coordinate with Owner.
- B. Connection to Existing Low-Pressure Sewer Main:
 1. Tapping saddle with dual stainless steel straps shall be installed to facilitate connection of service line. Connection shall utilize a stainless steel nipple and stainless steel ball valve. Service saddle shall conform to AWWA C800.
 2. Shall be manufactured by Romac Model 202NH with IP threaded Outlet, or approved equal.
- C. Connection to New Low-Pressure Sewer Main:

1. Install fusible, molded, HDPE tee with branch matching customer service size.
- D. Connection to gravity sewer:
1. Connection of low-pressure sewer to gravity sewer shall be achieved by connection to a manhole.
 2. Connection to manholes shall be achieved by coring of the manhole wall and use of a flexible boot for connection of the service pipe. The flexible boot shall be Kor-N-Seal.
 3. Service connections to manholes more than two feet above the invert of the manhole shall be provided with an interior drop assembly. Interior drop assemblies shall be Reliner as manufactured by Duran, Inc.
 4. Manholes receiving low-pressure sewers or force mains shall be lined or coated per Section 33 05 61 – Concrete Manholes.

2.4 LOW PRESSURE SEWER SERVICE LATERAL

- A. Between the connection to the main and meter box the pipe shall meet requirements of Section 33 31 27 – Low Pressure Sewer.
- B. Meter Box:
1. Inside meter box install a ball valve and check valve. Each valve shall be full port, 200-psi rated, true union, with compression connections compactable with HDPE pipe.
 2. Shall be placed at property line with ball valve, check valve, and looped tracer wire.
 3. Shall be polyethylene body with snap-lock green lid with minimum dimension of 13-inch x 18-inch with 18-inch depth.
 - a. Shall be manufactured by Amtek, or approved equal.
- C. On customer side of meter box, service pipe shall be HDPE in accordance with Section 33 31 27 – Low Pressure Sewer. Include warning tape and tracer wire.
- D. Service lines under roadways, sidewalk, or driveways shall be encased in Schedule 40 PVC pipe.
- E. Grinder Pump System: See Section 33 32 16 – Packaged Wastewater Grinder Pump Assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Gravity Sewer Services
1. Laying of piping for gravity sewer service shall be in accordance with Section 33 31 11 – Gravity Sewer Piping.
 2. The sewer service line shall be installed from the sanitary wye or tapping saddle connection to the edge of the public or utility right-of-way.
 3. At the edge of public or utility right-of-way, a cleanout shall be installed. A watertight plug backed by a 2” x 4” stake shall be installed at the end of the line until the facility being served is connected to the lateral.

B. Low Pressure Sewer Services

1. Laying of piping for low-pressure sewer services shall be in accordance with Section 33 31 27 – Low Pressure Sewer.
2. The sewer service line shall be installed from the branch saddle, tapping saddle, or manhole connection to the edge of the public or utility right-of-way.
3. Pipes shall slope continuously between high and low points to eliminate the formation of air pockets inside the pipes whenever possible. If laying of the line creates high points or as shown on the Drawings, an air release valve assembly shall be provided in accordance with Section 33 31 26 – Sewer Force Main Piping.
4. Low-pressure sewer piping shall have 7-foot of cover at high points to facilitate the installation of the air/vacuum release valve assembly.
5. At the edge of public or utility right-of-way, an appropriately sized isolation valve and valve box shall be installed.
6. A 2-foot-long stub of service pipe shall extend into the property to be served to allow connection from the facility side. A watertight cap backed by a 2” x 4” stake shall be installed at the end of the line until the facility being served is connected to the lateral.
7. The customer is required to install lateral pipe, meter box, ball valve, and check valve upon connection of facility piping to the service lateral.

END OF SECTION 33 31 30

SECTION 33 32 11 – WASTEWATER PUMPING STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements and guidance for design, construction, and initial operation of public wastewater pumping stations.
 - 2. Approvals, meeting, documentation, quality assurance, and other submittal requirements for coordination, review, and approval with Owner for the proposed Work.
- B. Related Requirements:
 - 1. Section 03 30 00.01 – Concrete for Utilities
 - 2. Section 31 23 16.01 – Excavation for Utilities
 - 3. Section 3 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 4. Section 33 05 61 – Concrete Manholes
 - 5. Section 33 31 26 – Sewer Force Main Pipe
 - 6. Section 33 32 16 – Packaged Wastewater Grinder Pump Assemblies for low pressure sewer pumps and systems.

1.3 STANDARDS

- A. Reference Standards:
 - 1. Hydraulic Institute Standards
 - 2. ANSI – American National Standards Institute.
 - 3. NEMA – National Electrical Manufacturers Association.
 - 4. UL – Underwriters Laboratory
 - 5. ETL – Electrical Testing Laboratories
 - 6. NEC – National Electric Code
 - 7. ASTM – American Society for Testing and Materials.
 - 8. NSF – National Sanitation Foundation
- B. Codes and Agency Requirements:
 - 1. Tennessee Department of Environment and Conservation (TDEC):
 - a. Design Criteria for Review of Sewage Works Construction Plans and Documents.
 - b. NPDES General Permit for Discharges of Stormwater Associated with Construction Activities (CGP).
 - 2. Fabrication and construction shall be in accordance with all local, state, and federal codes and laws.

1.4 MEETINGS

- A. Predesign Meeting: Developers and their engineer shall meet with Owner early in the design process to determine if additional requirements will be necessary.
- B. Preconstruction Meeting: Convene minimum one week prior to commencing Work of this Section.
- C. Startup & Performance Testing: See Execution part herein.

1.5 SUBMITTALS

- A. Prior to Construction:
 - 1. Proposed station and influent sewers shall be approved by Owner.
 - a. Provide complete construction plans, specifications, and calculations prepared and stamped by an engineer registered in the State of Tennessee, to Owner for approval.
 - b. Once approved by Owner, Owner will provide a letter noting approval and acceptance of the system.
 - 2. Proposed facilities shall then be approved by TDEC's Division of Water Resources. All fees to be paid by Developer.
- B. Product Data:
 - 1. Manufacturer catalog data for wet well, hatches, slide rail assembly, discharge piping, valves, junction box, level controls, control panel, instrumentation, valve enclosure or vault, and accessories.
 - 2. Manufacturer pump information, performance curve, breakaway fittings data, and access frame data.
 - 3. Control panel data, control logic (if applicable), and panel wiring schematic.
- C. Shop Drawings:
 - 1. Layout of pumping station.
 - 2. Show size, materials, and components of system.
 - 3. Indicate wet well size and dimensions, inlet and discharge location & elevation, cover dimensions, vent location, lifting locations, valve vault or enclosure, valve locations, pump locations, discharge piping location, junction box locations, guide rail assembly location, level control locations, instrumentation location, and ballast support flange dimensions.
 - 4. Site layout including driveways, fencing, parking, water service & hydrants, turn radii,
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions.
- F. Test and Evaluation Reports: Submit written report showing that factory pump inspections and that tests have been successfully performed.
- G. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- J. Manufacturer Reports:
 - 1. Submit report of each visit of manufacturer's representative to provide technical assistance during installation.
 - 2. Submit startup report before final acceptance of pumps and control system to document that pumping station operation meets performance requirements and operates properly in "Auto".
- K. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of packaged pumping stations, including wet wells, vaults, site layout, and control panel.
- B. Operations and Maintenance manuals for all equipment.

1.7 SPARE PARTS

- A. Furnish one spare bearing set, one mechanical seal set, and grease tube for every three pumps.
- B. Furnish one additional float switch for each pump station.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and properly licensed for such Work in accordance with State law.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of Tennessee.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Handling: Support wet well with nylon slings to structural lift points.
- C. Store materials according to manufacturer instructions.

- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide temporary end caps and closures on piping and fittings, and maintain in place until installation.
 - 3. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

- A. Standard one-year warranty on all Work and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Pumping Station:
 - 1. Configuration: Duplex (minimum). Firm capacity shall be provided with largest pump out of service.
 - 2. Wet well: Circular, precast, reinforced concrete.
 - 3. Pump Type: Submersible, solids handling, non-clog pumps suitable for use with municipal wastewater.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Pumping System:
 - 1. Pump selection shall be to maximize hydraulic efficiency close proximity to the pump's best efficiency point (BEP).
 - a. Design duty point shall be within the pump's preferred operating range (POR) as defined by HI Standards.
 - b. All design normal operating conditions shall be within the pump's acceptable operating range as defined by HI standards.
 - 2. Capable of handling municipal, unscreened, wastewater.
 - 3. Discharge Connection Elbow: Permanently installed in chamber with discharge piping.
 - 4. Connection: Automatic to discharge connection elbows when lowered into place, and pump is easily removed for inspection or service.
- B. Sound, Vibration, and Thermal Control:
 - 1. Dampen or suppress noise.
 - 2. Absorb vibration.
 - 3. Accommodate thermal expansion and stresses.
 - 4. Adjust or correct for misalignment in piping systems.

2.3 PIPING, FITTINGS, AND VALVES

- A. Pressure Piping & Fittings – At Station:

1. Exposed: Ductile iron pipe, flange. In accordance with Section 33 31 26 – Sewer Force Main Pipe.
 2. Buried: Ductile iron pipe, restrained joint. In accordance with Section 33 31 26 – Sewer Force Main Pipe.
- B. Pressure Piping and Fittings – Force Main: In accordance with Section 33 31 26 – Sewer Force Main Pipe.
- C. Gravity Piping: In accordance with Section 33 31 11 – Gravity Sewer Pipe.
- D. Isolation, Check, and Air Valves: In accordance with Section 33 31 26 – Sewer Force Main Pipe.
1. Air Valve and Pressure Gauge Assemblies:
 - a. NPT threaded, stainless steel pipe, fittings, and ball valves.
 - b. Tapping saddles in accordance with Section 33 31 26 – Sewer Force Main Pipe.
- E. All exposed bolts, nuts, washers, and hardware shall be stainless steel, unless otherwise specified.

2.4 WET WELL SYSTEM

- A. Concrete Wet Well:
1. Description: Precast reinforced concrete basin and inlet pipe connections, as specified in Division 33 - Concrete Manholes.
 - a. Cast-in-place, reinforced concrete wet wells are acceptable for stations that required wet wells larger than 10-foot diameter, or when approved by Owner.
 - b. Equipped with anti-floatation ring designed by manufacturer.
 2. Inside Diameter: 60 inches minimum.
 - a. Larger diameter wet wells are acceptable, and shall be one nominal size larger than the minimum diameter required for required clearances and hydraulics.
 3. Interior:
 - a. Shall meet Hydraulic Institute Standard 9.8 for solids-bearing pump intake designs.
 - 1) Shall include grout fillets to direct solids to pump intake.
 - 2) Wet wells using a trench-type, self-cleaning design are prohibited.
 - b. Shall be coated with spray on epoxy. See Section 33 01 30.81 – Manhole Rehabilitation for additional requirements.
 4. Vent Pipe: 4-inch (minimum) gooseneck shape with stainless steel bug screen.
- B. Access Hatch:
1. Material: Aluminum.
 2. Pattern: Diamond.
 3. Hinges and hardware: Stainless steel.
 4. Furnish anchor flange, drainage coupling, and automatic hold-open arm to 90 degrees.
 5. Equipped with protective fall-thru grating.
 6. Handle and Lock: Recessed handle and lock box suitable for Owner provided padlock.
 7. Rated for pedestrian (300 lbs/sqft) loading (minimum).
- C. Rail System:

1. Slide rail assembly consisting of stainless-steel, upper and lower rail brackets and additional pump guide brackets as recommended by manufacturer.
 2. Guide Bars:
 - a. Two guide bars per pump.
 - b. Pressed tight to pump's discharge elbow.
 - c. Designed not to warp or break when lifting and lower pump.
- D. Cable Hanging Rack:
1. Stainless steel cable mounting rack with hooks to hold drop cable support grips for all power and signal cables in the wet well and additional hooks for holding pump lifting chain.
 2. Shall be located just inside the access hatch opening and out of the way of lifting pumps from wet well.
- E. Concrete Valve Vault:
1. Description:
 - a. Precast reinforced concrete vault, as specified in Division 33 - Concrete Manholes.
 - 1) Cast-in-place, reinforced concrete wet wells are acceptable for larger stations, or when approved by Owner.
 - b. To house the air valves, check valves, dismantling joints, and pump isolation valves.
 - c. Valves shall be properly supported per industry standards.
 2. Inside Dimensions:
 - a. Minimum width is 18-inch clear space between pipelines, and minimum 3-foot clear space on at least one side of each pipeline.
 - b. Minimum length shall house all valves and fittings listed above, plus 8 inches of clearance between the wall and outer flanges.
 3. Interior of valve vault shall be sloped to one end. Low end shall have a side outlet, 4-inch drain hole with drain pipe back to the wet well. Drain pipe end shall be equipped with duckbill type check valve manufactured by Tideflex model TF-1 (or approved equal) fastened with stainless steel compression bands.
 4. Vault shall be equipped with manhole steps.

2.5 PUMPS

- A. Manufacturers:
1. ABS by Sulzer Management Limited.
 2. Ebara Pumps Americas Corporation.
 3. Flygt.
 4. Goulds Water Technology.
 5. Grundfos Pumps Corporation U.S.A.
 6. KSB, Inc.
 7. Zoeller Company.
- B. Description:
1. Submersible vertical shaft, nonclog, solids handling, centrifugal pumps with motor, power/signal cable, control/monitoring system, discharge base elbow, lifting chain, and slide rail guide shoe.
 2. Pumps shall be provided by a single manufacturer and supplier for complete system, unless otherwise approved by Owner.

3. Main Features:
 - a. Impeller, volute, and discharge shall be capable of passing a 3-inch diameter sphere (minimum) and solids and stringy material common in municipal raw wastewater.
 - b. Mating surfaces shall be watertight with nitrile O-rings.
 - c. Casing shall be easily removable from the motor for full inspection of the impeller.
 - d. Pump Speed Control:
 - 1) Less than 100 HP: Constant speed, with soft-starter.
 - 2) 100 HP and greater: Operate on VFDs.

- C. Volute, Pump Casing, Motor Housing, Seal Plate, Wear Rings Case, Impeller, and Base Elbow:
 1. Material: Cast iron.
 2. Comply with ASTM A48/A48M, Class 30.
 3. Impeller:
 - a. Semi-open design for pumps 30HP and less.
 - b. Enclosed design for pumps greater than 30HP.
 - c. Dynamically balanced.
 4. Exterior surfaces in contact with municipal wastewater shall be coated in manufacturer's standard epoxy coating system.

- D. Shaft, Fasteners:
 1. Material: Stainless steel (unless otherwise noted).
 2. Shaft shall be keyed for connection to impeller and fastened with stainless steel hardware.

- E. Seal:
 1. Design: Tandem mechanical, oil-filled reservoir with drain and inspection plugs with antileak seals. Plug shall be accessible from the exterior of the pump.
 2. Materials:
 - a. Upper Seal: Carbon/Ceramic.
 - b. Lower Seal: Silicon carbide/Silicon Carbide.
 - c. Silicon carbide and Tungsten carbide are also acceptable materials in lieu of ceramic and silicon carbide, respectively.
 - d. Stainless steel parts.

- F. Power and Control Cable:
 1. Suitable for submersible applications, meeting NFPA 70.
 2. Manufacturer's Cable Length:
 - a. Sufficient length so that the cable is not pulled tight when lowered.
 - b. Cable shall terminate:
 - 1) In the control panel, or
 - 2) In the case where the control panel is a separate building, into a terminal junction box mounted at least 3 feet above the wet well opening.
 - 3) No splicing allowed between pump and termination point.
 3. At pump connection, provide pressure grommet with clamp set for sealing and strain relief. Shall be easily removed and reused during routine maintenance.

- G. Pump Speed Control:
 1. Less than 100 HP: Constant speed with soft-starter.
 2. 100 HP and greater: Operate on VFDs.
 3. Or as required by Owner on a case-by-case basis.

- H. Bearings:
 1. Comply with ABMA 9.
 2. Minimum L-10 Life: 40,000 hours.
 3. Upper and lower bearings shall be single or double row to withstand radial and thrust forces, and be a pre-lubricated with grease for the life of the bearing.

- I. Motors:
 1. Meet requirements of NFPA 70.
 2. Type: Squirrel cage, induction.
 3. Design: Shell type.
 4. Housing: Air-filled, watertight chambers. Suitable for continued submerged service to a depth of 50 feet.
 5. Insulation: Class B.
 6. Non-overloading throughout entire pump performance range based on 1.15 service factor.
 7. Duty: Continuous, capable of sustaining minimum of 10 starts per hour.
 8. Indefinite operation without overheating when submerged. The motor shall not require a cooling jacket or other means of colling during normal partially submerged operation.
 9. Stators:
 - a. Copper windings with copper connectors applied to high-grade steel laminations.
 - b. Dipped and baked three times in Class F varnish.
 - c. Heat-shrink-fitted into stator housings.
 - d. Furnish thermal sensors to monitor stator temperatures.
 - e. Include thermostatic switches embedded in end coils of stator winding, one switch in each stator phase. Switches shall have automatic reset.
 - f. Stator Windings and Leads: Insulated with moisture-resistant Class F insulation capable of resisting temperature of 311 degrees F (155 degrees C).
 10. Moisture Detection: Shall detect the presence of moisture in the motor housing.
 11. Thermal and moisture protection systems shall be connected to the pump control system and automatically shut down pump and issue an alarm in the event of either being tripped.

- J. Lifting Chain:
 1. Stainless steel chain of sufficient strength to support the complete weight of the pump.
 2. Attached permanently to pump lifting handle.
 3. Sufficient length to reach from the pump to the hatch opening, plus 3 feet (minimum).
 4. Supply one coated, chain grip (a.k.a. "grip-eye"), with each station, of sufficient strength to support weight of pump and chain.

2.6 SUPPLY POWER DISCONNECT

- A. Fused Disconnect in a NEMA 4X stainless steel, lockable enclosure, installed between meter and control panel. Equipped with external disconnect lever.
- B. Shall be rated for the ampere, phase, and voltage of the incoming power supply.

2.7 CONTROL PANEL

- A. SCADA:

1. Control panel shall be designed to be compactable with Owner's SCADA system. Provide control inputs and outputs from control panel to the SCADA RTU using a "dry contact" design.
2. Owner's SCADA RTU is manufactured by High Tide Technologies, LLC. and shall be in a separate panel enclosure.
3. The RTU shall be provided by the pump station supplier to form a complete system.
4. Developer and supplier shall coordinate with Owner about adding station's cellular service to Owner's existing cellular contract.
5. Mount antenna to a location with suitable reception according to manufacturer's recommendation. This may be on top of equipment rack or pole mounted.

B. Control Sequence:

1. Pumps shall operate in a LEAD, LAG 1 format.
 - a. If more than two pumps are installed then additional pumps shall be LAG 2, etc.
 - b. Controller shall be capable of automatic and manual alternation of LEAD/LAG pump. Initial setpoint for alternating LEAD/LAG pump is 24 hours.
2. There shall be at least 6 inches of operating depth between setpoints.
3. Pump control shall be based on analog level input.
4. Alarm Float Switches:
 - a. HIGH LEVEL alarm switch:
 - 1) Energizes alarm signal when liquid level reaches HIGH-LEVEL setting and rising.
 - 2) Calls LEAD pump to run at maximum speed if pump is not already running.
 - 3) Shall be set a minimum of 1-foot below the lowest invert into the wet well.
 - b. LOW LEVEL alarm switch:
 - 1) Energizes alarm signal when liquid level reaches LOW-LEVEL setting.
 - 2) Is hardwired to shutdown all pumps.
 - 3) LOW LEVEL shall be set a minimum of 6-inches below the ALL PUMPS OFF setpoint, and a minimum of 6 inches above the minimum liquid level set by the pump manufacturer.

C. Enclosure:

1. Stainless steel with NEMA 4X rating with UL listing.
2. Size shall be sufficient for all required equipment.
3. Door:
 - a. Padlock hasp with captive stainless-steel screws for door closure.
 - b. Continuous stainless-steel piano hinge with stainless-steel removable pin.
 - c. If exterior mounted, panel shall have a dead-front.
4. Panel: Aluminum, drilled and tapped, with machine-screw-mounted components.
5. Include additional conduit and penetrations for connection to SCADA RTU in a separate panel.

D. Components:

1. Circuit breaker.
2. Starter: Soft-starter or VFD, based on motor horsepower.
3. Overload Relay: Solid state block type with visual trip indication with trip-free operation.
4. Heater Element:
 - a. Class 10, quick trip.
 - b. One heater for each motor phase.
5. Switch:
 - a. HAND-OFF-AUTO.

- b. NEMA 250 Type 1.
- 6. Light:
 - a. Pump motor RUN.
 - b. NEMA 250 Type 1.
- 7. Subplate: Switch and light mounting.
- 8. Transformers: Appropriately sized for station equipment per electric code.
- 9. Control Transformer Primary Circuit Breaker: Thermal magnetic type, complies with requirements of NFPA 70.
- 10. Control Circuit Breaker: Thermal magnetic type, complies with requirements of NFPA 70.
- 11. Transient voltage surge suppressor.
- 12. Circuit breaker for each motor.
- 13. Terminal Strip: Box lugs for wiring.
- 14. Alternator: Automatic - PUMP 1 - PUMP 2 , etc..
- 15. Disconnect switch.
- 16. Terminal Strip: Box lugs for wiring.
- 17. Wiring:
 - a. In accordance with NFPA 70 and NEC requirements.
 - b. Size:
 - 1) Power Circuits: 14 AWG minimum.
 - 2) Control Circuits: 16 AWG minimum.
 - c. Color-Coding:
 - 1) Power: Black.
 - 2) AC control less than line voltage: Red.
 - 3) DC control circuit: Blue.
 - 4) Interlock control circuit, from external source: Yellow.
 - 5) Equipment grounding conductor: Green.
 - 6) Neutral grounded conductors: White.
 - 7) Hot with circuit breaker open: Orange.
- 18. Receptacles:
 - a. One duplex, GFI rated.
 - b. 120 A ac.
 - c. Mounted to exterior of panel.
- 19. Control Relays:
 - a. 10 A, 24 V ac. Minimum.
 - b. Dust Covers: Clear.
 - c. Coils: Encapsulated.
- 20. LED Indicators: Indicator lights parallel to relays to indicate coil is energized for each pump running, and one for each alarm condition.
- 21. Digital Level Display.
- 22. Time Counter: Six digit elapsed time indicator for total time in hours and tenth-hours.
- 23. Logic Chassis: Liquid-level wiring harness, marked at both ends with thermally engraved heat-shrink tubing.
- 24. Alarm Light:
 - a. Description:
 - 1) NEMA 250 Type 4X.
 - 2) Material: Red translucent plastic with vandal-resistant globe.
 - 3) Lamp: 40 W.
 - b. Mounting:
 - 1) On top of enclosure.
 - 2) Stainless-steel screws and closed-cell neoprene gasket.

- c. Attach to logic chassis to provide flashing light for failure alarm.
- 25. Logic Chassis Permanent Markings: Identify components and functions with permanent corrosion resistant name plates.
 - a. Provide nameplate with:
 - 1) Manufacturer name and location,
 - 2) Serial number,
 - 3) Supply power voltage, phases, and current rating
 - 4) Motor horsepower and FLA,
 - 5) Motor overload heater element, and
 - 6) Motor circuit breaker rating.
- 26. Power Failure: Pump lockout and alarm circuitry for power failure, phase loss, low voltage, pump motor moisture, and pump over temperature.

E. Lightning Arrestors.

F. Space Heater: Maintain internal temperature 1 to 3 degrees F to mitigate humidity and condensation.

G. Auxiliary Power Supply:

- 1. Less than 100HP pumps:
 - a. Capable of receiving and operating on power from a portable generator.
 - b. Double throw switch for selecting power source.
 - c. Check with Owner for make and model of generator connection receptacle.
- 2. 100HP or greater pumps, or as required by Owner:
 - a. Diesel stand-by generator with fuel for 24-hours of continuous operations (minimum). System will issue an alarm when fuel level is low.
 - b. Automatic transfer switch.
 - c. Generator system shall be manufactured by:
 - 1) Caterpillar,
 - 2) Kubota,
 - 3) Cummins, or
 - 4) Owner approved equal.

H. Grounding:

- 1. Equipped with common grounding bar mounted on back plate.
- 2. Make field connections to main ground lug and pump motor in accordance with NEC.

I. Variable Frequency Drives: (if so equipped)

- 1. Shall be manufactured by Allen-Bradley or Danfoss.
- 2. Contact Owner for additional requirements.

2.8 INSTRUMENTATION

A. Level:

- 1. Submersible Level Transmitter:
 - a. For primary pump control with 4-20 mA output.
 - b. Keller America, Inc. "LevelRat" model, or Owner approved equal.
 - c. Installed in a stilling well, with spacer.
 - d. Digital level readout and interface installed in control panel.
 - e. Level reading shall be outputted to Owner's SCADA system.

2. Floats:
 - a. For liquid level discrete alarms and backup operation.
 - b. Suitable for use in municipal wastewater applications.
- B. Flow:
1. Flow Meter:
 - a. Electro-magnetic flow meter suitable for measuring pressure pipe flow in municipal wastewater applications.
 - b. Shall be installed on the effluent force main and in a separate vault per manufacturer's recommendations.
 - c. Digital flow readout and interface installed in control panel.
 - d. Flow reading shall be outputted to Owner's SCADA system.
 - e. Install with one dismantling joint fitting and isolating plug valves on each side of the meter.
 - f. Provide a spool piece of ductile iron pipe the same diameter and length of flow meter.
- C. Pressure:
1. Pressure gauge installed on each discharge pipe in the valve vault that is suitable for use with grit found in municipal wastewater applications. Shall be located between check valve and pump.
 2. Install with NPT threaded connections, isolating valve on receiving end, and pressure blow-off valve on branch.
 3. The main body of the sensor shall be completely protected from the pumped fluid by a flexible elastomer sensing sleeve. The elastomer sensing sleeve shall be one piece construction with integral flanges locked in by bolted end covers. The flexible sensing ring shall have a cavity behind the ring filled with fluid to transfer pressure to the gauge.
 4. Four-inch dial (minimum) shall have maximum pressure reading the covers the normal operating range of the station, 100-PSIG minimum.
 5. Series 42 pressure sensor manufactured by Red Valve Co., or Owner approved equal.

2.9 ACCESSORIES

- A. Pipe Penetration Sealant in Concrete Structures: Non-shrink grout.
- B. Site Layout:
1. Driveway and Parking:
 - a. Width, turn radii, and parking within the fenced area shall be enough to accommodate one flatbed truck with attached crane.
 - b. Total area shall be sufficient to accommodate at least two large pick-up trucks parked out of the road's travel way.
 - c. Layout shall allow for circle driveway or means for maintenance vehicles to turn around to prevent backing into traffic.
 - d. Shall meet TDOT standards for driveway connections.
 - e. Pavement shall be of a heavy-duty, asphalt design.
 2. Exterior Lighting: Site lighting with at least one pole mounted LED fixture.
 3. Fencing and Security Gate:
 - a. Shall meet applicable ASTM standards for industrial and commercial fencing and gates.
 - b. 8-foot tall, galvanized steel, chain-link fence with three strands of barbed wire.

- c. One 16-foot wide opening via a swing or slide gate. Shall be equipped with hold open bar and padlock acceptable.
 - d. Fencing shall be located a minimum of 5 feet from any structure within the fence.
- C. Potable Water Supply: One 1-inch frost-proof hydrant with backflow preventer.
- D. Equipment Mounting Rack:
 - 1. Control panel and other panel equipment shall be supported on a metal framing support channels system.
 - 2. Support and Mounting Hardware Material: 316 stainless steel.
 - 3. Attach panels to supports per manufacturer's recommendations.
 - 4. Metal support framing shall be elevated off the ground:
 - a. Ground Mounted: Pressure-treated (ground contact rated) 6x6 (inch; min.) wood posts. Posts shall be encased in 6 inches of Class A concrete.
 - b. Slab Mounted: Aluminum posts with mounting plates and anchors. Posts, plates, and anchors shall be sized and installed per manufacturer's recommendations.
 - 5. The ground surface within 3 feet of panel mounted equipment shall be concrete slab or gravel.
 - 6. If the rack is in proximity to a driveway or road, protect equipment with concrete filled, steel pipe bollards. Bollards shall be epoxy painted "safety yellow".
- E. Bypass Pump Assembly:
 - 1. Between the effluent valve vault and the flow meter vault install an above-grade bypass connection assembly.
 - 2. Assembly shall have isolating valves after the bypass connection and on the pipe returning upstream towards the valve vault.
 - 3. Bypass Connection shall be stainless steel camlock coupling with cap. Check with Owner on required size, 4-inch minimum.

2.10 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assemblies.
- B. Inspection:
 - 1. Verify that motor voltage and frequency are as shown on nameplate.
 - 2. Verify that motor and cable insulation test for moisture content or insulation defects comply with UL 83.
- C. Pump and Motor Testing:
 - 1. Factory Performance Test:
 - a. Grade 2B for motor less than 100HP, Grade 1B for motors 100HP and greater in accordance with HI 11.6.
 - b. Provide test data sheets, curve test results, and performance logs in submittal.
 - 2. Conduct on each pump.
 - 3. Perform under actual or simulated operating conditions.
 - 4. Hydrostatic test of pump casing.

PART 3 - EXECUTION

3.1 PREPARATION AND EXAMINATION

- A. Verify that inlet and discharge piping connections are size, location, and elevation as indicated on Drawings.
- B. Protect piping systems from entry of foreign materials and water by using temporary covers, completing sections of Work, and isolating parts of completed system.

3.2 INSTALLATION

- A. Excavation and Backfill: See Division 31 “Excavation for Utilities”.
- B. Wet Well: Install as specified in Division 33 “Concrete Manholes”.
- C. Pumps, Piping, Fittings, and Valves, Instrumentation:
 - 1. Install per manufacturer’s instructions.
 - 2. Connect piping to minimize strain on piping connections.
 - 3. Keep equipment in its original packaging and properly stored until ready to be installed.
 - 4. Handle equipment during installation per manufacturer’s instructions.
 - 5. Field paint in accordance with manufacturer’s instructions.
- D. Power Supply and Control Panel:
 - 1. Mount and wire enclosures and control panel for pumping station operation, including motor controls, circuit breaker, starter, control transformer, fuse box, terminal block, alternator, alarm, running lights, and auxiliary power system.
 - 2. Wiring:
 - a. Comply with requirements of NFPA 70 and NEC.
 - b. Number each conductor.
 - 3. Locate and connect cable from control panel to wet well junction box.

3.3 FIELD QUALITY CONTROL

- A. Preoperational Inspection:
 - 1. Check pump and motor alignment.
 - 2. Check for proper motor rotation.
 - 3. Check pump and drive units for proper lubrication.
- B. Leak Testing:
 - 1. Pressure and gravity piping shall be tested in accordance with Section 33 05 05 “Sanitary Sewer Testing”.
 - 2. Wet well and other water retaining structures shall be leaked tested using either vacuum or exfiltration testing methods as specified in Section 33 05 05 “Sanitary Sewer Testing”.
- C. Startup and Performance Testing:
 - 1. Notify Owner 3 days prior to flow rate testing.

2. Startup and Initial Testing: Coordinate and operate pumps in conjunction with construction of other facilities.
 3. Hydraulically test station to performance requirements by receiving, pumping, and discharging water to and from wet well. Contractor shall provide water for test. Water level shall remain within the operating range of the wet well for the entire test.
 4. Confirm general sequencing of pump and float operations at wet well and control panel are according to performance requirements.
 5. Document and certify startup results in startup report.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- E. Equipment Acceptance:
1. Adjust, repair, modify, or replace system components failing to perform as specified and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
 3. Document adjustments, repairs, and replacements in manufacturer's field services certification.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.
- G. Document and certify startup and testing results in written report.

3.4 ADJUSTING

- A. Adjust wet well, pump, and control panel systems such that station operates to performance requirements and according to Specifications.

3.5 DEMONSTRATION

- A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 33 32 11

SECTION 33 32 16 - PACKAGED WASTEWATER GRINDER PUMP ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. On-lot sewage grinder pumping units.
 - 2. Wet well basin.
 - 3. Discharge piping and valves.
 - 4. Pump control systems.
- B. Related Requirements:
 - 1. Section 31 23 16.01 – Excavation for Utilities.
 - 2. Section 33 05 05 – Sanitary Sewer Testing
 - 3. Section 33 31 27 – Low-Pressure Sewer
 - 4. Section 33 31 30 – Sanitary Sewer Services

1.3 STANDARDS

- A. Reference Standards:
 - 1. ANSI – American National Standards Institute.
 - 2. NEMA – National Electrical Manufacturers Association.
 - 3. UL – Underwriters Laboratory
 - 4. NEC – National Electric Code
 - 5. ASTM – American Society for Testing and Materials.
- B. Codes and Agency Requirements:
 - 1. Tennessee Department of Environment and Conservation (TDEC):
 - a. Design Criteria for Review of Sewage Works Construction Plans and Documents.
 - 2. Fabrication and construction shall be in accordance with all local, state, and federal codes and laws.

1.4 MEETINGS

- A. Predesign Meeting: Developers and their engineer shall meet with Owner early in the design process to determine if additional requirements will be necessary.
- B. Preconstruction Meeting: Convene minimum one week prior to commencing Work of this Section.

- C. Startup & Performance Testing: See Execution part herein.

1.5 SUBMITTALS

- A. Prior to Construction:
 - 1. Proposed stations and force main shall be approved by Owner.
 - a. Provide complete construction plans, specifications, and calculations prepared and stamped by an engineer registered in the State of Tennessee, to Owner for approval.
 - b. Once approved by Owner, Owner will provide a letter noting approval and acceptance of the system.
 - 2. Proposed facilities shall then be approved by TDEC's Division of Water Resources. All fees to be paid by Developer.
- B. Product Data:
 - 1. Manufacturer catalog data for wet well basins, controls.
 - 2. Manufacturer pump core unit information, and performance curve.
 - 3. Control panel data, control logic (if applicable), and panel wiring schematic.
- C. Shop Drawings:
 - 1. Layout of low pressure sewer system.
 - 2. Show size, materials, and components of complete system.
 - 3. Indicate number of pumps, wet well basin size and dimensions, inlet and discharge location & elevation, valve locations, pump locations, discharge piping location, junction box locations, level control locations, instrumentation location, and ballast support flange dimensions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- A. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions.
- B. Test and Evaluation Reports: Submit written report showing that factory pump and basin inspections and that tests have been successfully performed.
- C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Manufacturer Reports:
 - 1. Submit report of each visit of manufacturer's representative to provide technical assistance during installation.
 - 2. Submit startup report before final acceptance of pumps and control system to document that pumping station operation meets performance requirements and operates properly in "Auto".
- G. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and final orientation of equipment and accessories.
- B. Operations and Maintenance manuals for all equipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and properly licensed for such Work in accordance with State law.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of Tennessee.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Handling:
 1. Handle materials to prevent damage to interior or exterior surfaces.
 2. Prepare pumps and accessories for shipment in such a manner as to prevent entry of foreign matter into product body.
- C. Storage:
 1. Store materials according to manufacturer instructions.
 2. Store products in areas protected from weather, moisture, or possible damage.
 3. Do not store products directly on ground.
- D. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. The grinder pump assembly manufacturer shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, the panel for a period of 24 months after notice of Owner's acceptance, but no greater than 27 months after receipt of shipment. Any manufacturing defects found during the warranty period will be reported to the Manufacturer by the Owner and will be corrected by the Manufacturer at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PROGRESSIVE-CAVITY GRINDER PUMPS

- A. Manufacturers:
1. Environment One (E-One) Corporation (basis of design),
 2. Keen Pump Company, Model KPCG-(C),
 3. Zoeller Pump Company, Model 810,
 4. Or approved equal.
- B. Operating Conditions:
1. Suitable for use in domestic wastewater service.
 2. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG).
 3. The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s).
 4. Under no conditions shall in-line piping or valving be allowed to create a false apparent head.
- C. Pump:
1. Integral, vertical rotor, motor driven, solids handling, grinding pump of the progressing cavity type with a mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier.
 2. Castings & Coating: Cast iron, manufacturer's standard epoxy coating.
 3. Rotor: Through-hardened, highly polished, precipitation hardened stainless steel.
 4. Stator: Ethylene propylene synthetic elastomer or nitrile rubber suitable for domestic wastewater service.
- D. Grinder:
1. Below the pumping elements and shall be direct-driven by a single, one-piece motor shaft.
 2. Impeller (Cutter Wheel) Assembly:
 - a. Fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable.
 - b. One-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth.
 - c. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance.
 3. Shredder Ring:
 - a. Stationary type and made of white cast iron.
 - b. Teeth shall be ground into the material to achieve effective grinding. Staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.
 4. Dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

- a. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.
 - b. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
5. Capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter discharge piping.

E. Motor:

- 1. Motor Size: 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase.
- 2. Starter:
 - a. Capacitor start, not exceed 30 amperes, starting torque of 8.4-pounds minimum.
 - b. Shall be secured in a dry compartment of the pump core unit.
 - c. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability.
- 3. Other Features:
 - a. Ball bearing shall have L-10 bearing life of 100,000 hours.
 - b. Type:
 - 1) Air-cooled induction type with Class F insulation, or
 - 2) Oil-filled motors with Class B insulation.
 - c. Press-fit into the casting for better heat transfer and longer winding life.
 - d. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor.
 - e. Underwriters Laboratories Inc. listed.
 - f. The wet portion of the motor armature must be 300 Series stainless steel.
 - g. Pump operation during instances of potentially damaging high current or low voltage conditions shall be inhibited by an in-pump electrical monitoring system that UL listed. Motor start shall be controlled by a DC driven electromechanical relay integrated within the control compartment of the pump. Electrical monitoring shall ensure the relay operates reliably. AC Mechanical contactors for motor start are susceptible to damage from short cycling and will not be accepted.

F. Mechanical Seal:

- 1. Mechanical shaft seal to prevent leakage between the motor and pump.
- 2. Stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.2 WET WELL BASIN

A. General:

- 1. Open well type with an easily removable core assembly containing pump, motor, grinder, all internal motor controls, valves, disconnects, and wiring.
- 2. Penetrations:
 - a. All penetrations shall be factory installed, sealed, and tested.
 - b. Equipped with factory installed PVC inlet or EPDM grommet for receiving the at the pipe material, size, elevation, and rotation shown on the Drawings.

- c. Electrical penetration shall be watertight with strain relief connector. No electrical junction box shall not be permitted in the basin.
 - 3. Basin wall and bottom shall be designed to withstand the pressure exerted by saturated soil and hydrostatic pressure loadings to the maximum depth.
 - 4. Shall meet applicable ASTM standards.
 - 5. Equipped with an anti-floatation flange and designed by the manufacturer to resist floatation with a safety factor greater than one.
 - 6. Shall be of sufficient diameter to accommodate the total number of pumps and for the design gallons per day from the customer.
 - 7. Top of basin shall extend a minimum of 3 inches above finished grade.
- B. HDPE Construction:
 - 1. Basin shall of high density polyethylene (HDPE) of a grade selected for environmental stress cracking resistance.
 - 2. Dual wall, corrugated construction with smooth interior surface.
 - 3. Seams shall be factory, thermally welded.
 - 4. Cover:
 - a. The tank shall include a lockable cover assembly providing low profile mounting and watertight capability.
 - b. HDPE construction, green in color, with a load rating of 150-psf.
 - c. Equipped with 2-inch gasketed vent to prevent sewage gases from accumulating in the tank.
 - d. Height shall be field adjustable up or down 3 inches without sealants or adhesives.
- C. Fiberglass Construction:
 - 1. Single wall, laminated fiberglass construction. The resin shall be of a commercial grade suitable for the environment. The reinforcing material shall be a commercial grade of glass fiber capable of bonding with the selected resin.
 - 2. The inner surface shall have a smooth finish and be free of cracks and crazing. The exterior tank surface shall be relatively smooth with no exposed fiber or sharp projections present.
 - 3. The tank bottom shall be reinforced with a fiberglass plate extending beyond the tank walls to support concrete anchoring, as required, to prevent flotation.
 - 4. Fiberglass tank shall have a stainless steel discharge bulkhead which terminates outside the tank wall with a female pipe thread. The discharge bulkhead shall be factory installed and warranted by the manufacturer to be watertight.
 - 5. Equipped with mushroom vent to prevent sewage gases from accumulating in the tank.

2.3 DISCHARGE ASSEMBLY

- A. One discharge assembly per pump within a basin.
- B. Discharge Pipe: For each pump, and is located within the wet well.
 - 1. Diameter: 1.25-inch minimum.
 - 2. Material: Polypropylene flexible hose or Schedule 80 PVC, with EPDM gasketed or threaded connections.
 - a. For low pressure sewer force main pipe materials see Section 33 31 27 – Low Pressure Sewer.
 - 3. Pressure rating of 200 PSI minimum.

- C. Shut-Off Valve:
 1. Ball-valve type with lever.
 2. Pressure rated of 200 PSI minimum.

- D. Check Valve:
 1. Factory installed, gravity operated, flapper-type integral check valve built into the discharge piping.
 2. 100% port, moving parts of 300 series stainless steel with fabric reinforced synthetic elastomer, thermoplastic body, rated for 200 PSI minimum.

- E. Anti-Siphon Valve:
 1. Factory installed, gravity operated, flapper-type integral anti-siphon valve built into the discharge piping.
 2. 60% port, moving parts of 300 series stainless steel with fabric reinforced synthetic elastomer, thermoplastic or brass body, rated for 200 PSI minimum.

2.4 CONTROLS

- A. Level sensing shall be by manufacturer's standard:
 1. Pressure switch equipped with the pump core unit.
 2. Float switch system.
 - a. Separate floats for pump control and high water alarm.

- B. Cable:
 1. UL listed, pre-wired, watertight meeting NEC.
 2. Shall be quickly disconnected when removing core unit.
 3. Supply length sufficient for installed conditions.

- C. Alarm Panel:
 1. Junction boxes or alarm panels located within the wet well basin are not permitted.
 2. Basis of Design: E-One's "Sentry Simplex Protect".
 3. Enclosure:
 - a. NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting.
 - b. Thermoplastic polyester or stainless steel enclosure with hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel.
 4. Features:
 - a. One 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit.
 - b. Push-to-run feature, an internal run indicator, and a complete alarm circuit.
 - c. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
 - d. External audible and visual alarm.
 - e. Push-to-run switch.
 - f. Push-to-silence button: Encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.
 - g. Redundant pump start.
 - h. High level alarm capability. Alarm sequence:

- 1) When liquid level in the sewage wet-well rises above the alarm level, the contacts on the alarm pressure switch activate, audible and visual alarms are activated, and the redundant pump starting system is energized.
 - 2) The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3) Visual alarm remains illuminated until the sewage level in the wet-well drops below the “off” setting of the alarm pressure switch.
5. Alarm Light:
- a. Red, oblong lens at least 3.75" L x 2.38" W x 1.5" H.
 - b. Mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating.
6. Horn:
- a. Externally mounted on the bottom of the enclosure.
 - b. Capable of 93 dB @ 2 feet.
 - c. Capable of being deactivated by depressing push-to-silence button.
7. Run-time/Hour Meter: A run-time or hour meter to display the total run-time or operation time for the pump core shall be provided.
8. Event/Cycle Counter: An event or cycle counter to display the number of operations of the pump core shall be provided.
9. Protections:
- a. Low Voltage (Brownout) Protection: A lockout cycle will prevent the motor from operating and will illuminate an LED if:
 - 1) The incoming AC Mains voltage drops below a predetermined minimum, typically 12% of nameplate (211 volts for a 240 volt system) for 2 to 3 seconds, regardless of whether the motor is running.
 - 2) The lockout cycle will end if the incoming AC Mains voltage returns to a predetermined value, typically 10% of nameplate (216 volts for a 240 volt system).
 - 3) The system continues to retest the voltage every second indefinitely. If the lockout cycle has been initiated and the voltage comes back above the predetermined starting voltage, the system will function normally. The LED remains illuminated during a Brownout condition and remains latched until the pump breaker is turned off and then on again (reset). The audible and visual alarm will not be activated unless there is a high wastewater level in the tank.
 - b. Run Dry Protection:
 - 1) A 20-minute lockout cycle will prevent the motor from operating and will illuminate an LED when the wastewater level in the tank is below the pump inlet level. The condition is rechecked every 20 minutes.
 - 2) If the lockout cycle has been initiated and the condition is satisfied, the pump is not allowed to cycle normally but the LED remains latched. The LED will remain latched until the pump breaker is turned off and then on again (reset).
 - 3) If the condition is not satisfied after 3 consecutive attempts, the visual alarm will be activated until the pump breaker is turned off and on (reset) or until there is one cycle of normal operation.
 - 4) If a high level condition is presented at any time, a pump run cycle will be activated.
 - c. High System Pressure Protection:
 - 1) A 20-minute lockout cycle will prevent the motor from operating and will illuminate an LED when the pressure in the discharge line is atypically high

- (closed valve or abnormal line plug). The condition is rechecked every 20 minutes.
- 2) If the condition is satisfied, the pump is allowed to cycle normally but the LED remains latched. If the condition is not satisfied after 3 consecutive attempts, the pump is locked out indefinitely until the condition is removed and power is reset.
 - 3) The LED will remain latched until the pump breaker is turned off and then on again (reset). The audible and visual alarm will be activated.
 - d. In all of the above cases, if more than one error condition is presented, the LED depicting the most recent error condition will be displayed.
10. Other Features:
- a. Alarm Activated Dry Contacts: Normally open relay contact closes upon alarm activation.
 - b. Alarm Activated Contacts for Remote Indoor Alarm Module: Will work with or without power to the alarm panel and is designed to work with a remote alarm indicator.
 - c. Inner Door Dead Front.
 - d. Separate LED's for each condition.

2.5 SERVICEABILITY

- A. The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation.
- B. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.6 SAFETY

- A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

2.7 SOURCE QUALITY CONTROL

- A. The OWNER reserves the right to inspect such testing procedures with representatives of the ENGINEER, at the manufacturer's facility.
- B. Grinder Pump:
 - 1. Each grinder pump shall be submerged and operated for 1.5 minutes (minimum).
 - 2. Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls.
 - 3. All factory tests shall incorporate each of the above listed items.
 - 4. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable.
 - 5. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve.
 - 6. Additional validation tests include: integral level control performance, continuity to ground and acoustic tests of the rotating components.
- C. Wet Well Basins:
 - 1. All basins shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).
 - 2. Test shall meet the minimum requirements for exfiltration testing of manholes as stated in Section 33 05 05 – Sanitary Sewer Testing.

PART 3 - EXECUTION

3.1 PREPARATION AND EXAMINATION

- A. Verify that inlet and discharge piping connections are size, location, and elevation as indicated on Drawings.
- B. Protect piping systems from entry of foreign materials and water by using temporary covers, completing sections of Work, and isolating parts of completed system.

3.2 DELIVERY

- A. All grinder pump core units, including level controls, and basins will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Grinder pump cores must be boxed for ease of handling.
- B. Grinder pump cores will be shipped separately from basins. Installing the cores and discharge piping/hose into the basins is the only assembly step required and allowed due to the workmanship issues associated with other on-site assembly.

3.3 INSTALLATION

- A. Coordinate location of basin and alarm panel with Owner and property owner.
- B. Excavation and backfill: As specified in Section 31 23 16.01 – Excavation for Utilities.
- C. A concrete anti-flotation collar, sized according to the manufacturer’s instructions, shall be required and shall be pre-cast to the grinder pump or poured in place.
- D. Install basins pump units and accessories where indicated on Drawings and according to manufacturer's instructions.
- E. Provide and connect piping, accessories, and power and control conduit and wiring to make a complete system operational and ready for startup.
- F. Flush piping with clean water.

3.4 FIELD QUALITY CONTROL

- A. Inspection: Check and adjust liquid-level control and alarm settings.
- B. Leak Testing:
 - 1. Pressure and gravity piping shall be tested in accordance with Section 33 05 05 “Sanitary Sewer Testing”.
 - 2. Wet well and other water retaining structures shall be leaked tested using either vacuum or exfiltration testing methods as specified in Section 33 05 05 “Sanitary Sewer Testing”.
- C. Startup and Performance Testing:
 - 1. Make certain the discharge shut-off valve in the station is fully open.
 - 2. Turn ON the alarm power circuit and verify the alarm is functioning properly.
 - 3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic “on/off” controls are operative. The pump should immediately turn ON.
 - 4. Consult the Manufacturer’s Service Manual for detailed start-up procedures.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products to be placed under this Section for not less than 1 day plus expenses per project for every 20 pump stations supplied for installation, inspection, field testing, startup, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

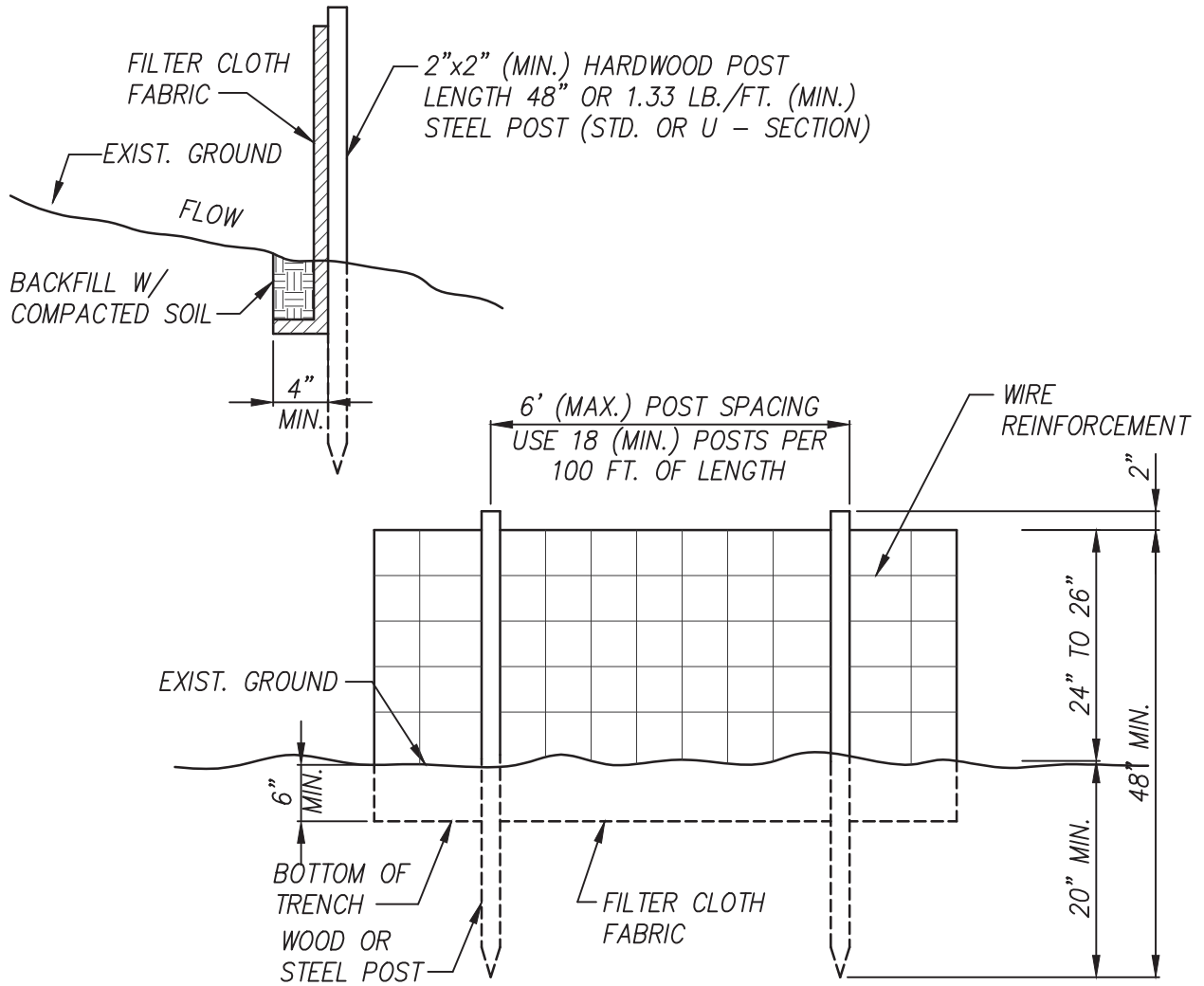
3.5 OPERATION AND MAINTENANCE

- A. Spare Core: Supply one spare grinder pump core for every 50 grinder pump stations installed or portion thereof, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.
- B. Manual: Supply one hard copy and one PDF copy of Operation and Maintenance Manuals to the Owner, and one PDF copy of the same to the Engineer.

END OF SECTION 33 32 16

APPENDIX A

STANDARD DETAIL DRAWINGS



NOTES:

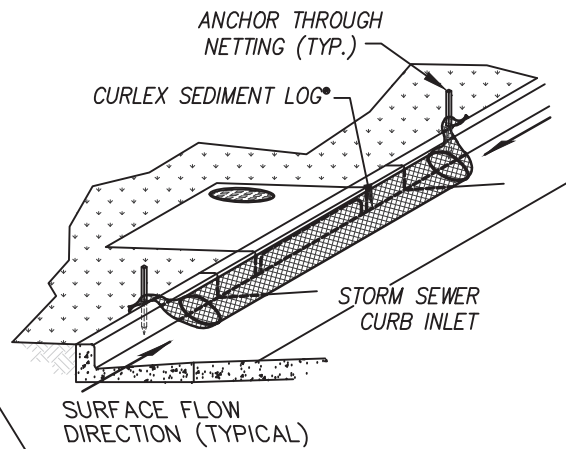
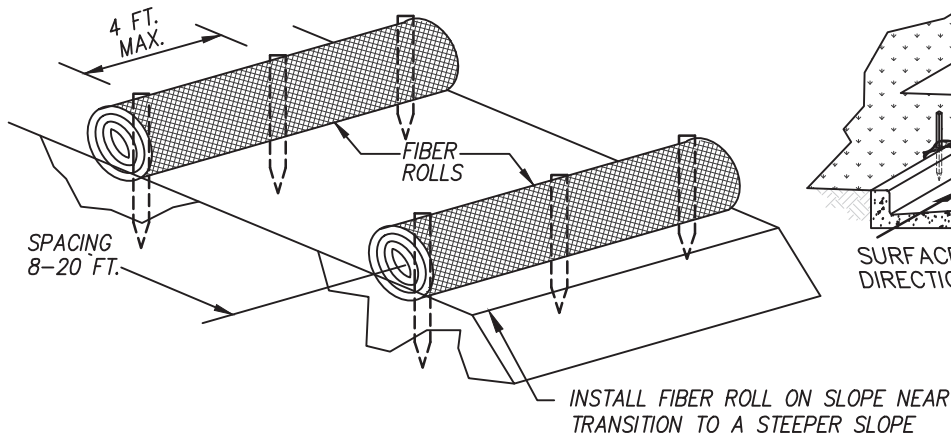
1. SILT FENCE SHALL BE PRE-ASSEMBLED AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS.
2. SILT FENCE SHALL HAVE AN APPROVED BACKING OR A BUILT-IN REINFORCED STRUCTURE AS RECOMMENDED BY THE MANUFACTURER TO SUPPORT THE GEOTEXTILE FABRIC.
3. FOR ADDITIONAL REQUIREMENTS, SEE EROSION AND SEDIMENTATION SPECIFICATION SECTION.



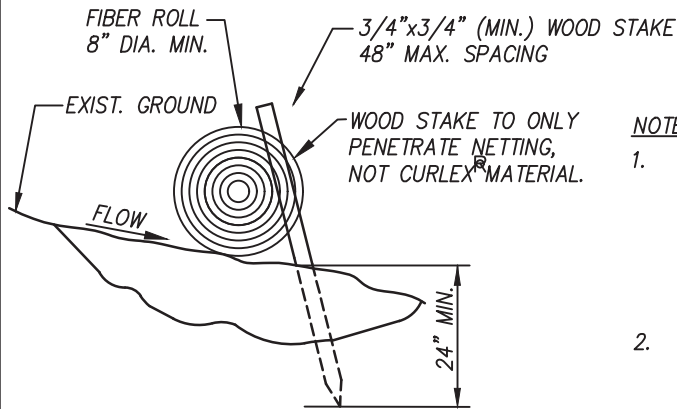
HARRIMAN UTILITY BOARD
 200 NORTH ROANE STREET
 HARRIMAN, TN 37748
 (865) 882-3242

DWG. NAME:	E-01	DATE	MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

**TEMPORARY
 TYPE 'C' SILT FENCE**

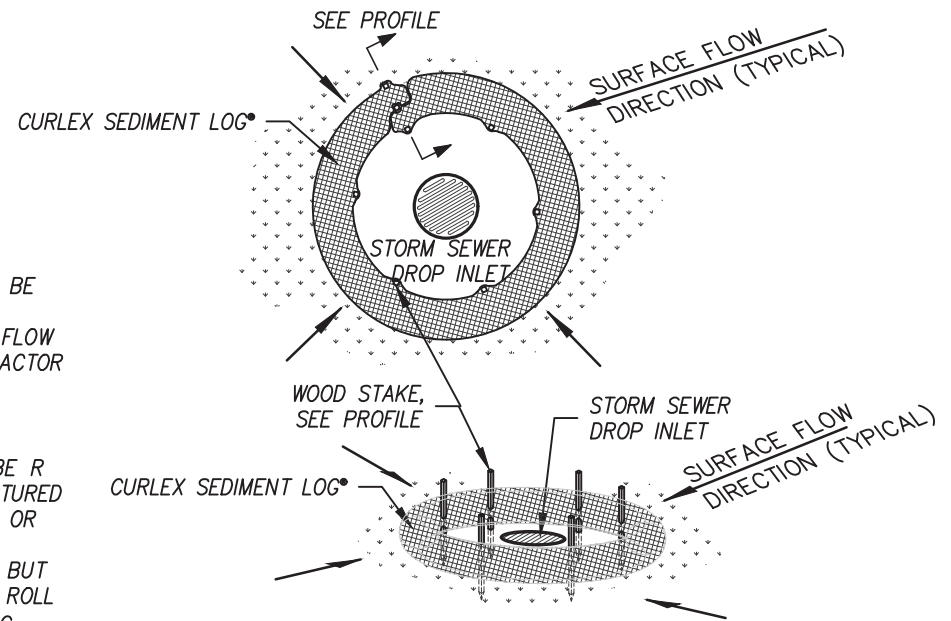


	TYPE I	TYPE II	TYPE III	TYPE IV
NORMAL DIAMETER	50 CM (20 IN)	30 CM (12 IN)	23 CM (9 IN)	15 CM (6 IN)
LENGTH	3.05 M (10 FT.)	3.05 M (10 FT.)	7.62 M (25 FT.)	7.62 M (25 FT.)
WEIGHT (±10%)	13.62 KG (30 LB)	9.08 KG (20 LB)	11.35 KG (25 LB)	5.45 KG (12 LB)
NET OPENING (HEXAGONAL-SHAPED)	2.5 CM (1 IN)	2.5 CM (1 IN)	1.9 CM (.75 IN)	1.3 CM (.5 IN)



NOTES:

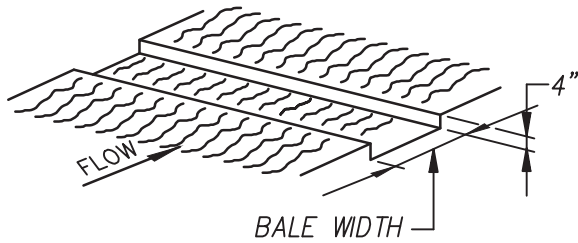
1. TYPE III SEDIMENT CONTROL LOGS TO BE THE MINIMUM USED FOR ENERGY DISSIPATION IN MILD CONCENTRATED FLOW AREAS, SLOPE INTERRUPTION. CONTRACTOR TO DETERMINE IF TYPE I OR II IS APPROPRIATE PER MANUFACTURER'S RECOMMENDATION.
2. SEDIMENT CONTROL DEVICES SHALL BE R CURLEX SEDIMENT LOG, AS MANUFACTURED BY AMERICAN EXCELSIOR COMPANY, OR EQUAL.
3. WHERE EROSION CONTROL IS NEEDED BUT STAKING IS NOT PRACTICAL, SECURE ROLL USING SANDBAGS AT 2' C-C SPACING.



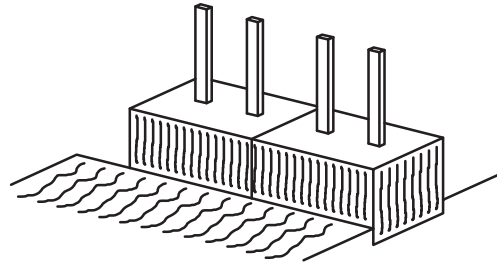
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DWG. NAME:	E-02
DATE	MAY 22, 2023
SCALE	N.T.S.
DRAWN	WBW
CHECKED	WWL

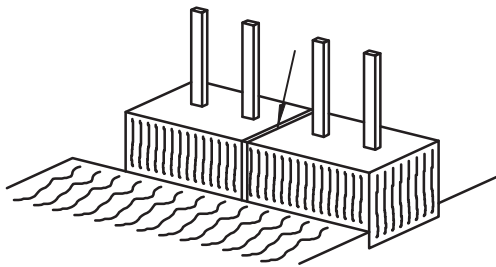
TEMPORARY SEDIMENT LOGS



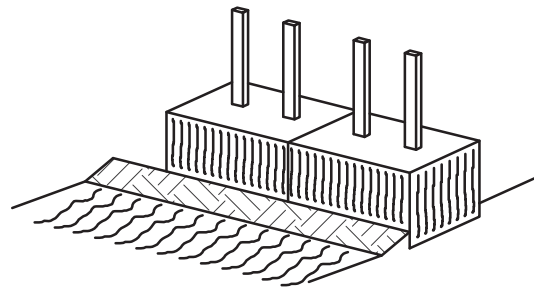
1. EXCAVATE THE TRENCH



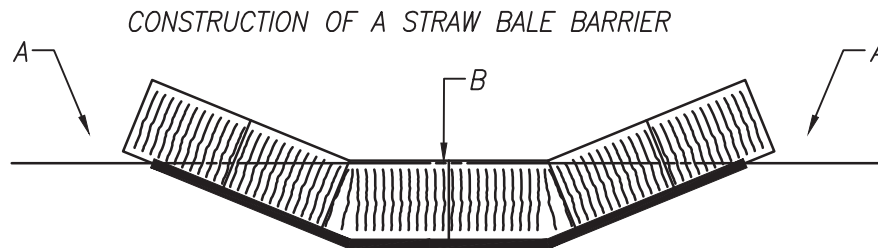
2. PLACE AND STAKE STRAW BALES



3. WEDGE LOOSE STRAW BETWEEN BALES.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



CONSTRUCTION OF A STRAW BALE BARRIER

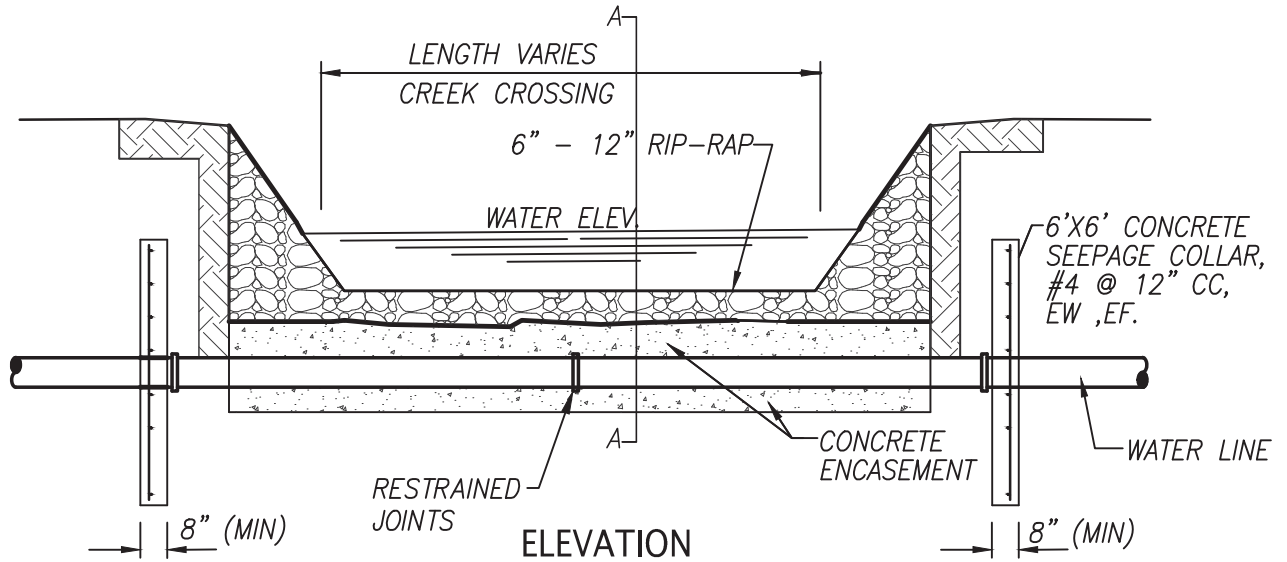
POINTS 'A' SHOULD BE HIGHER THAN POINT 'B'
 PROPER PLACEMENT OF STRAW BALE
 BARRIER IN DRAINAGE WAY



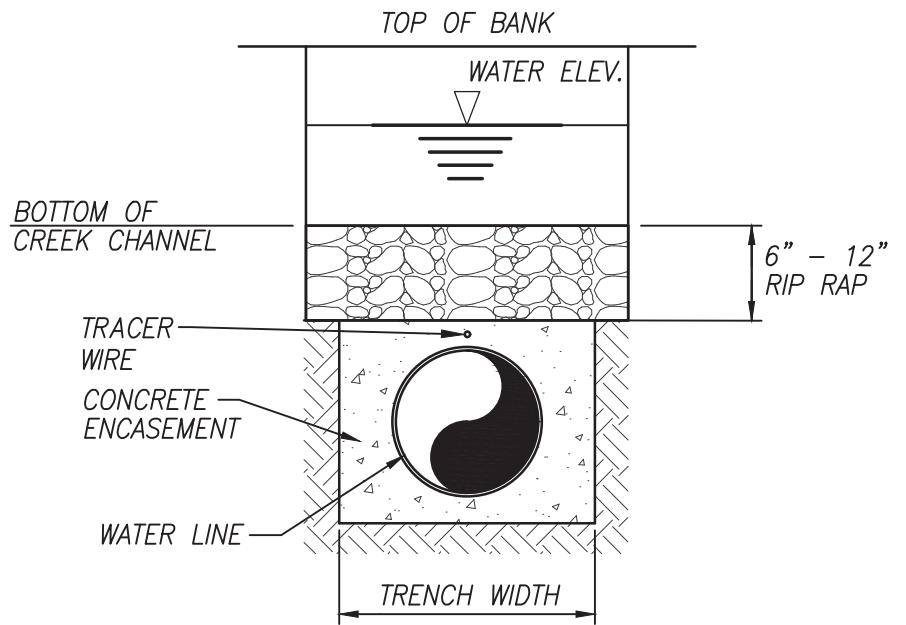
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DWG. NAME:	E-03	DATE	MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

**TEMPORARY
 STRAW BALE INSTALLATION**



ELEVATION



SECTION A-A

NOTES:

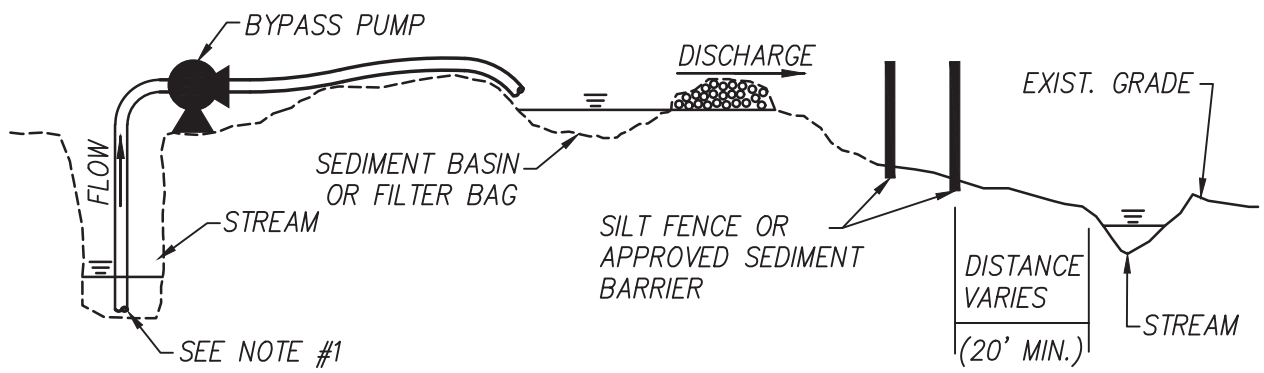
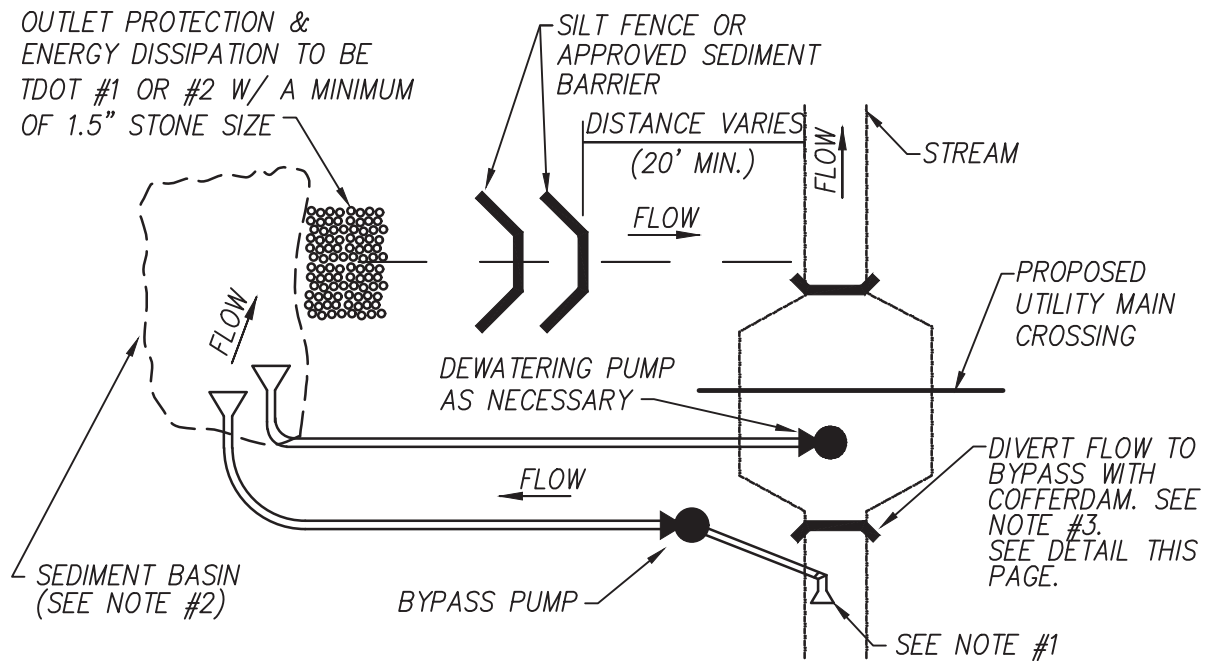
1. SEEPAGE COLLARS SHALL BE INSTALLED ON BOTH SIDES OF CREEK CROSSING.
2. THE SEEPAGE COLLAR SHALL NOT ENCASE A PIPE JOINT.
3. REFERENCE DETAIL G-06: CONCRETE ENCASEMENT FOR DIMENSIONS AND OTHER REQUIREMENTS.



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DWG. NAME: E-04		DATE: MAY 22, 2023	
SCALE: N.T.S.	DRAWN: WBW	CHECKED: WWL	

**STREAM CROSSING
 TRENCH DETAILS**



NOTES:

1. INSTALL FABRIC FILTER ON PUMP INTAKE.

2. THE DESIGN OF SEDIMENT BASINS SHALL BE COMPLETED BY A PROFESSIONAL TRAINED IN THE DESIGN OF IMPOUNDMENT STRUCTURES, AND IN ACCORDANCE WITH GOOD ENGINEERING PRACTICES. APPROVED FILTER BAGS MAY BE USED AS A SUBSTITUTE.

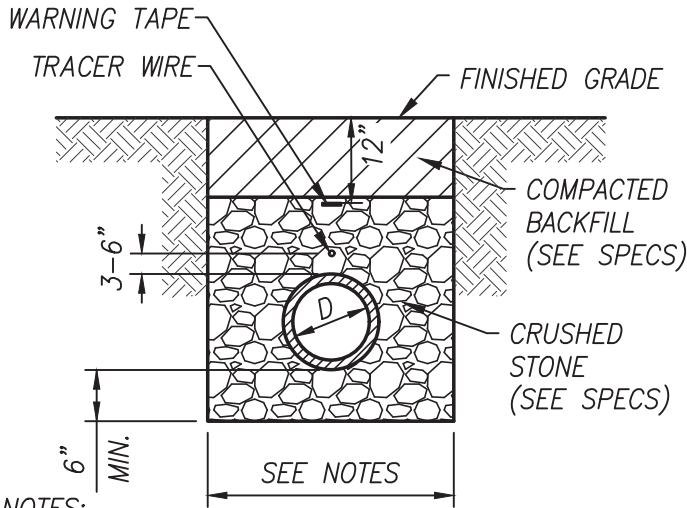
3. EXCAVATION AND FILL ACTIVITIES SHALL BE SEPARATED FROM FLOWING WATERS. ALL SURFACE WATER FLOWING TOWARD THE EXCAVATION OR FILL WORK SHALL BE DIVERTED THROUGH UTILIZATION OF COFFERDAMS OR BERMS. COFFERDAMS OR BERMS MUST BE PROTECTED BY NON-ERODIBLE MATERIAL AND LINED TO THE EXPECTED HIGH WATER LEVEL. COFFERDAMS MUST BE CONSTRUCTED OF SANDBAGS, CLEAN ROCK, STEEL SHEETING OR OTHER NON-ERODIBLE MATERIAL. CLEAN ROCK IS ROCK OF VARIOUS TYPE AND SIZE, DEPENDING UPON APPLICATION, THAT CONTAINS NO FINES, SOILS, OR OTHER WASTES OR CONTAMINANTS.



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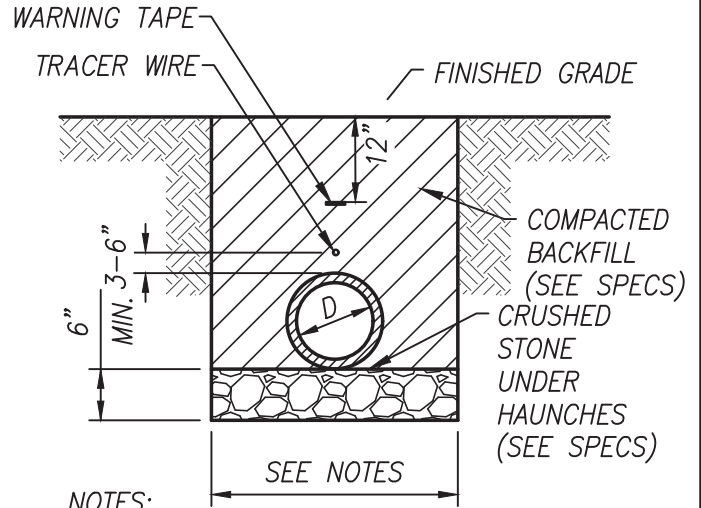
BYPASS PUMPING DETAIL



NOTES:

1. TYPICAL BACKFILL & PIPE BEDDING FOR FLEXIBLE PIPE OUTSIDE (3' OR GREATER) OF PAVED AREAS.

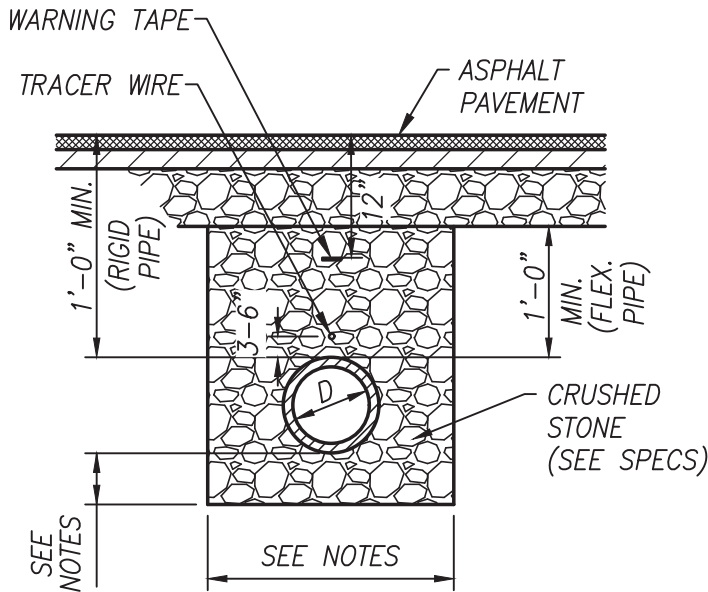
TYPE 1



NOTES:

1. TYPICAL BACKFILL & PIPE BEDDING FOR RIGID PIPE OUTSIDE (3' OR GREATER) OF PAVED AREAS.

TYPE 2



TYPE 3 (PAVED AREAS)

NOTES:

1. INSTALLATION OF BEDDING & BACKFILL SHALL BE IN STRICT COMPLIANCE WITH THE PIPE MANUFACTURER'S SPECIFICATIONS AND EXCAVATION SPECIFICATIONS.
2. TRENCH DESIGN AND SAFETY FOR PIPELINE CONSTRUCTION IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL CONFORM WITH ALL APPLICABLE LOCAL, STATE, AND OSHA REGULATIONS.
3. REFERENCE PIPE SPECIFICATIONS FOR WARNING TAPE AND TRACER WIRE REQUIREMENTS.
4. MINIMUM TRENCH WIDTH:
 - A. PLACEMENT IN SOIL: $D + 16''$ (MIN.)
 - B. PLACEMENT IN ROCK: $D + 24''$ (MIN.)
 - C. MAXIMUM REPLACEMENT WIDTH FOR CONTRACTOR PAYMENT IS 1-FT OF TOTAL ADDITIONAL TOTAL WIDTH BEYOND THE MINIMUM TRENCH WIDTH, UNLESS APPROVED BY OWNER.
5. BEDDING DEPTH:
 - A. PLACEMENT IN SOIL: 6'' (MIN.)
 - B. PLACEMENT IN ROCK: 12'' (MIN.)

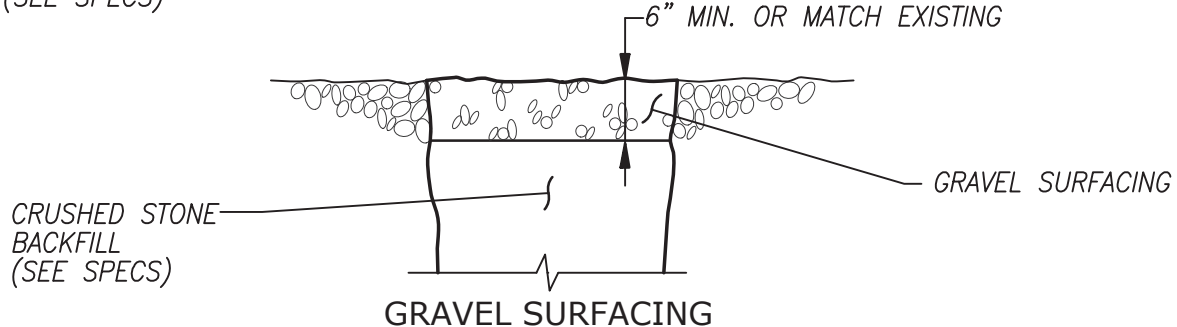
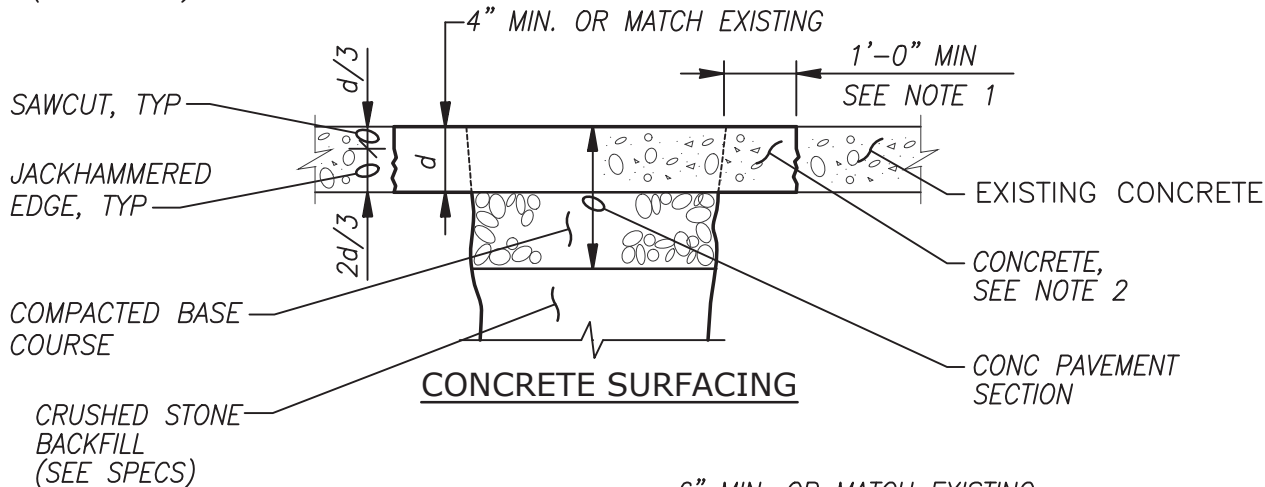
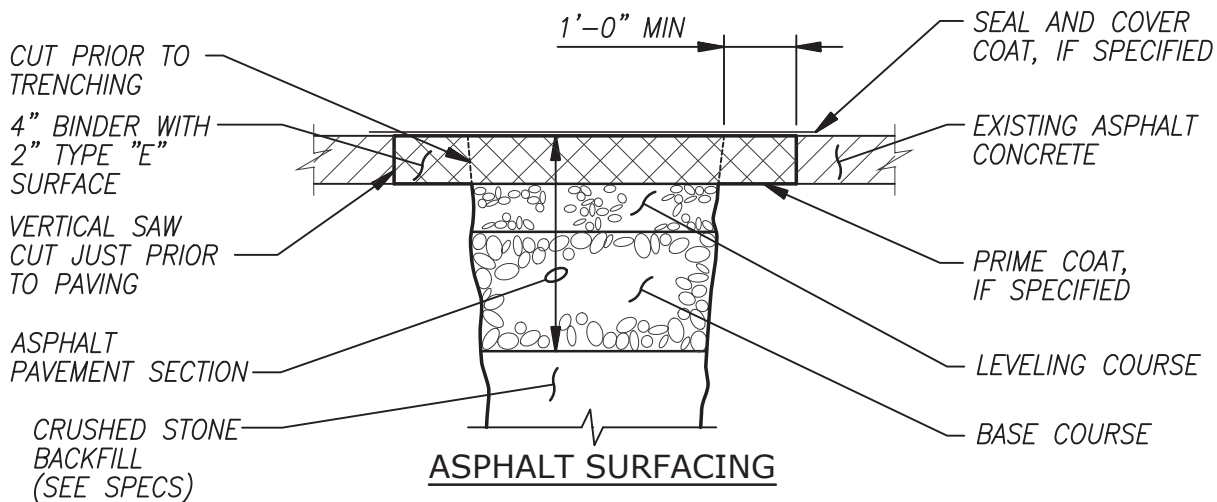


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PIPE BEDDING & BACKFILL



NOTES:

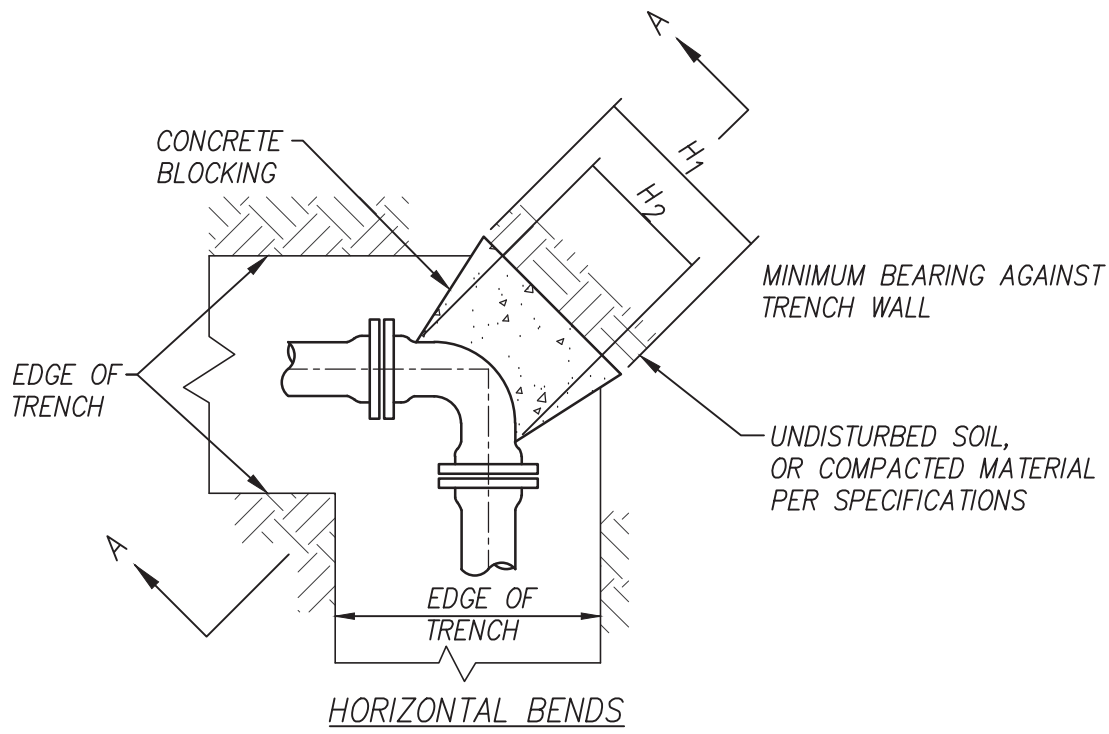
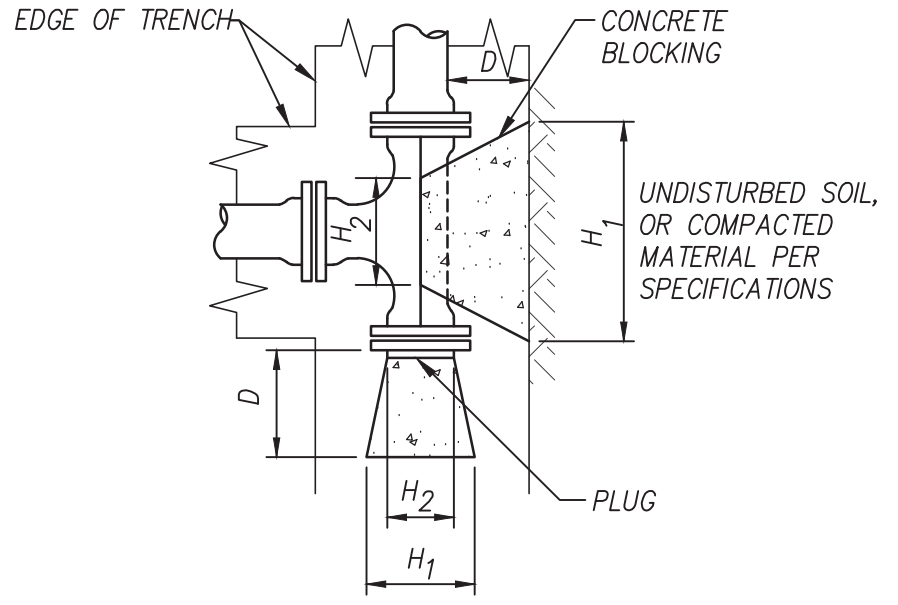
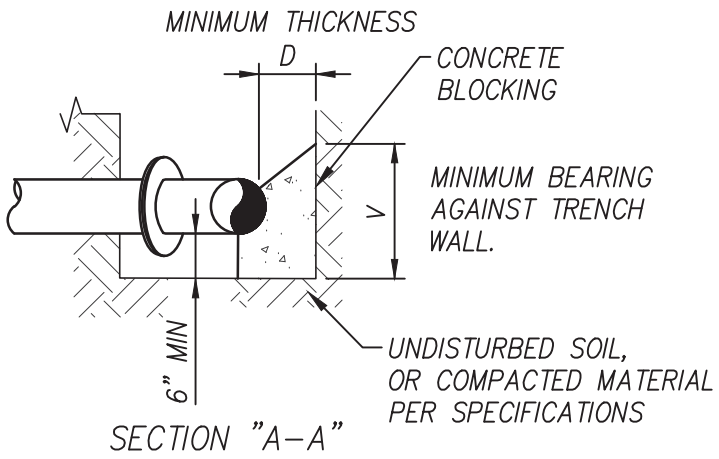
1. IF LOCATION OF TRENCH SAW CUT IS WITHIN 3 FEET OF AN EXISTING JOINT OR EDGE OF CONCRETE, REPLACE ENTIRE CONCRETE TO THE JOINT OR EDGE.
2. CONSTRUCT JOINTS ACROSS NEW CONCRETE TO MATCH EXISTING JOINT TYPES AND LOCATIONS.
3. DIMENSIONS AND DETAILS ABOVE ARE MINIMUM REQUIREMENTS. PAVEMENT REMOVAL AND REPLACEMENT SHALL BE PERFORMED IN ACCORDANCE WITH DETAILS AND SPECIFICATIONS OF THE AUTHORITY HAVING JURISDICTION, SEE SURFACE RESTORATION SPECIFICATIONS.
4. MAXIMUM REPLACEMENT WIDTH FOR CONTRACTOR PAYMENT IS 1-FT OF TOTAL ADDITIONAL TOTAL WIDTH BEYOND THE MINIMUM TRENCH WIDTH PER DETAIL G-01, UNLESS APPROVED BY OWNER.



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PAVEMENT REPAIR



NOTES:

1. THRUST BLOCKING BASED UPON AN INTERNAL HYDROSTATIC PRESSURE OF 200 PSI AND AN ALLOWABLE SOIL BEARING CAPACITY OF 4000 LBS/SF. CONTRACTOR SHALL INCREASE THRUST BLOCK SIZE AS REQUIRED AND PROVIDE CALCULATIONS TO SUPPORT SAID MODIFICATION SHOULD PRESSURE BE GREATER AND/OR SOIL BEARING CAPACITY SHOULD BE LESS THAN THAT NOTED ABOVE.
2. OWNER SHALL APPROVE ALL THRUST BLOCKS.
3. WRAP ALL FITTINGS & PIPE IN PLASTIC PRIOR TO PLACING CONCRETE.



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THRUST BLOCK DETAIL 'A'

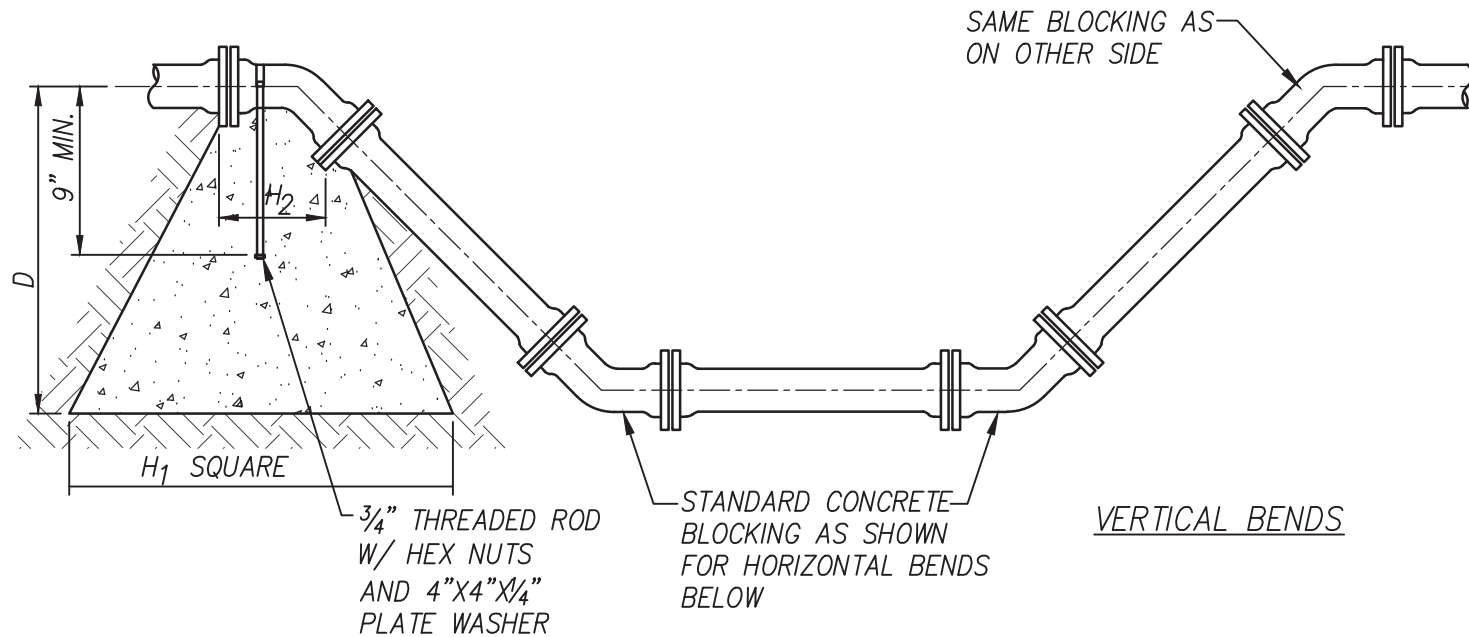


TABLE OF DIMENSIONS FOR CONCRETE BLOCKING																											
SIZE	TEES, PLUGS CROSSES					90° BENDS				45° BENDS				22 1/2° BENDS				11 1/4° BENDS				SIZE					
PIPE (INCHES)	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	H ₁	H ₂	V	D	CU FT.	PIPE	
2&2-1/4	18	10	12	18	1.9	18	10	12	18	1.9	18	6	12	18	1.5	18	6	12	18	1.5	18	6	12	18	1.5	18	2&2-1/4
3 & 4	24	12	12	18	2.3	24	12	12	18	2.3	18	8	12	18	1.6	18	8	12	18	1.6	18	8	12	18	1.6	18	3 & 4
6	24	16	18	18	3.5	30	16	18	18	4.1	24	10	16	18	3.2	24	10	16	18	3.2	24	10	16	18	3.2	24	6
8	36	18	18	18	5.1	39	18	24	18	7.3	30	11	18	18	4.0	24	11	18	18	3.5	24	11	16	18	3.4	18	8
10	48	24	18	24	7.2	54	32	24	18	10.3	24	18	21	18	4.6	24	18	21	18	4.6	24	18	21	18	4.6	24	10
12	54	30	24	24	13.4	54	32	36	24	18.2	42	18	24	24	9.6	24	18	24	24	6.6	24	18	21	24	6.1	24	12
18	60	45	30	30	27.3	60	45	36	30	32.8	47	24	30	30	18.5	34	18	34	34	17.0	34	18	34	34	17.0	34	18
20	62	48	30	30	28.1	62	48	36	31	34.8	56	24	31	30	21.5	36	24	36	36	22.5	36	24	36	36	22.5	36	20
24	64	48	32	32	33.2	64	48	36	32	36.1	64	30	32	32	27.9	40	24	40	40	29.0	40	24	40	40	29.0	40	24



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THRUST BLOCK DETAIL 'B'

DUCTILE IRON PIPE DIAMETER (INCHES)										
FITTING/VALVE TYPE	2	4	6	8	10	12	16	18	20	24
MINIMUM RESTRAINED LENGTH (FEET)										
PLUG/CAP	40	40	60	80	80	80	100	120	140	140
INLINE VALVE	40	40	60	80	80	80	100	120	140	140
TEE	40	40	40	60	80	80	100	120	140	140
90° BEND	20	40	40	40	60	60	80	80	100	100
45° BEND	20	20	20	20	20	40	40	40	60	60
22.5° BEND	20	20	20	20	20	20	20	20	20	20
11.25° BEND	20	20	20	20	20	20	20	20	20	20
REDUCER	SEE NOTE 3		SEE NOTE 3		SEE NOTE 3		SEE NOTE 3		SEE NOTE 3	

NOTES:

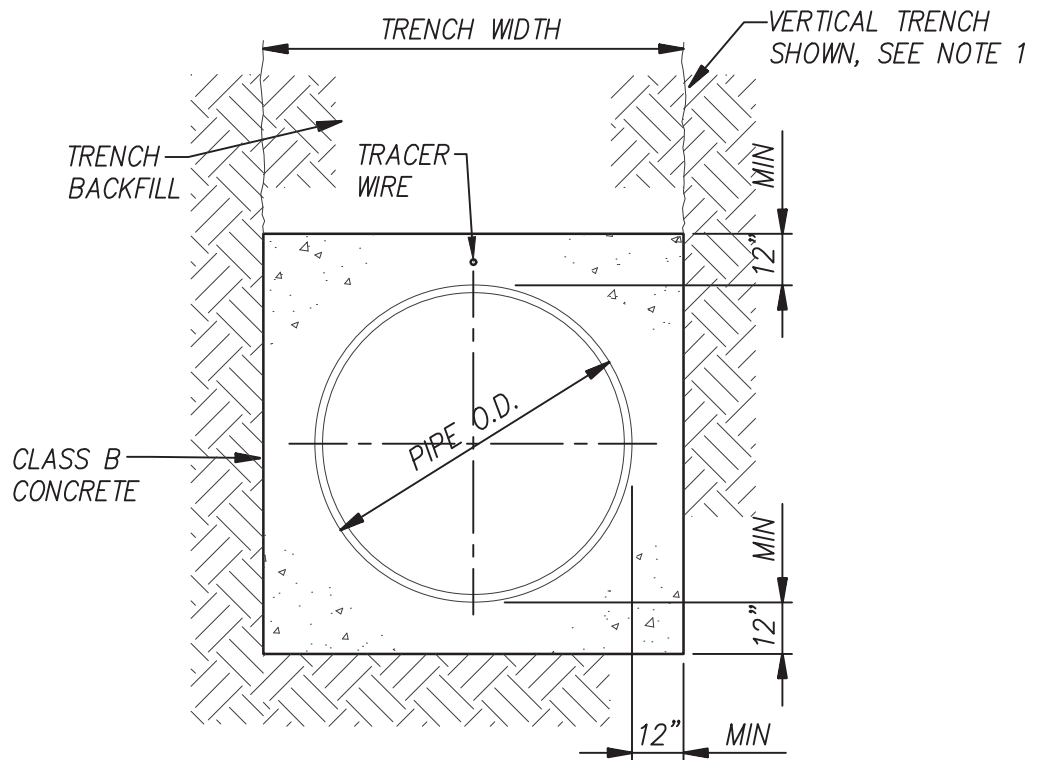
1. CONTRACTOR SHALL USE MECHANICAL JOINT RESTRAINED JOINT FITTINGS FOR EVERY FITTING INSTALLED ON THE PROJECT.
2. RESTRAINT SYSTEM SHOWN IS DESIGNED FOR DUCTILE IRON PIPE BEDDED IN 4 INCHES MINIMUM LOOSE SOIL WITH BACKFILL LIGHTLY CONSOLIDATED TO TOP OF THE PIPE (TRENCH TYPE 3), BACKFILLED WITH NATIVE CLAY SOIL (CL), TEST PRESSURE 250 PSI, 3 FT OF COVER. WHERE THIS SYSTEM IS INAPPROPRIATE BECAUSE OF DIFFERENT CONDITIONS, SUBMIT DETAILS OF ALTERNATE SYSTEM TO OWNER FOR APPROVAL.
3. SUBMIT DETAILS OF RESTRAINT SYSTEM FOR REDUCERS TO OWNER FOR APPROVAL.
4. WHERE RESTRAINED JOINT FITTINGS ARE REQUIRED BY THE PLANS OR SPECIFICATIONS, RESTRAINED JOINT FITTINGS MUST BE INSTALLED AS REQUIRED BY THE TABLES AND NOTES FOUND WITHIN THE PLANS AND SPECIFICATIONS.
5. CONTRACTOR SHALL INSTALL DUCTILE IRON PIPE WITH RESTRAINING GASKETS FOR PUSH-ON JOINT PIPE A MINIMUM DISTANCE FROM EACH VALVE OR FITTING AS REQUIRED IN THE ABOVE TABLE.



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THRUST RESTRAINT TABLE



NOTES:

1. VERTICAL TRENCH WALLS SHOWN. CONTRACTOR SHALL SLOPE TRENCH WALLS OR SHORE EXCAVATIONS FOR CONSTRUCTION AND SAFETY IN ACCORDANCE WITH CURRENT OSHA REQUIREMENTS.
2. PEA GRAVEL BAGS, SANDBAGS, OR PRECAST SHAPED CONCRETE BLOCKS (12" MIN WIDTH) DESIGNED TO HANDLE THE INTENDED LOADS, MAY BE USED TO SUPPORT PIPE WHEN PLACING CONCRETE.
3. SEE DETAIL G-01 FOR MINIMUM AND MAXIMUM TRENCH WIDTH DIMENSIONS.

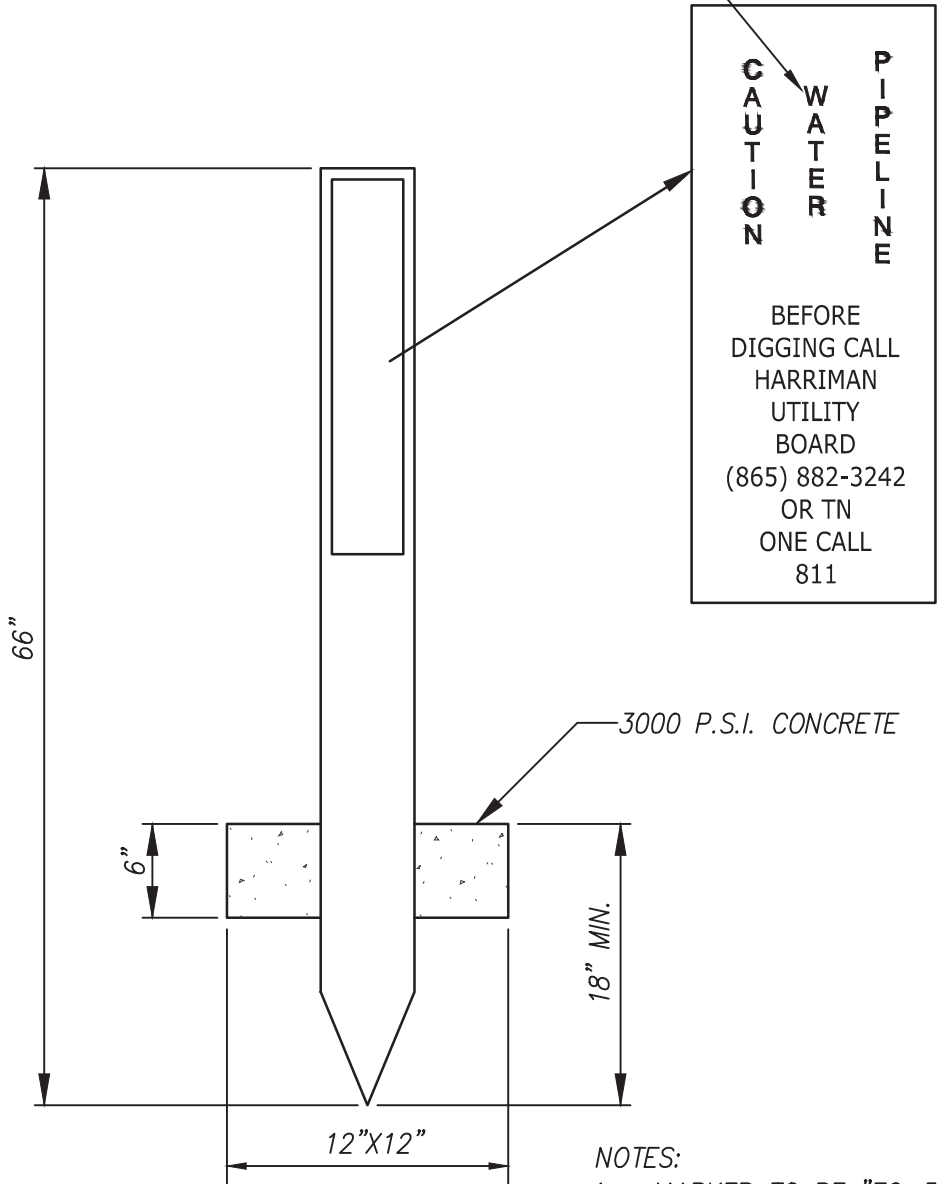


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CONCRETE ENCASUREMENT

MATCH THE UTILITY MARKED
(SEE NOTES)



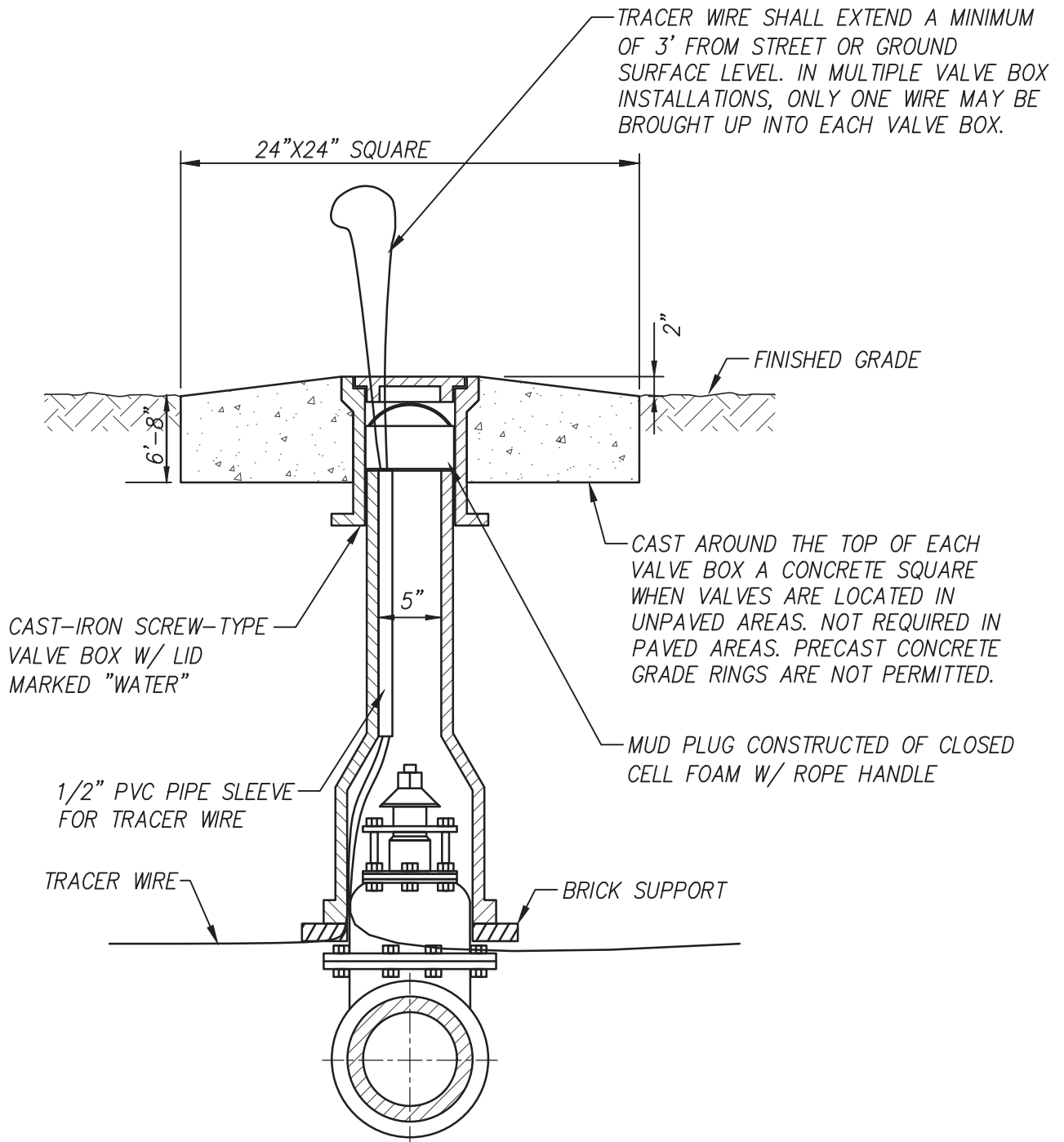
- NOTES:
1. MARKER TO BE "FG-500 SERIES" POST MADE BY DAVIDSON TRAFFIC PRODUCTS, OR APPROVED EQUAL.
 2. TEXT AND POST COLOR TO MATCH UTILITY: WATER - BLUE, SEWER - GREEN, GAS - YELLOW.
 3. DECAL COLOR WHITE WITH BLACK LETTERING.
 4. REFERENCE EXCAVATION SPECIFICATION FOR ADDITIONAL INFORMATION.



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UTILITY MARKER



NOTES:

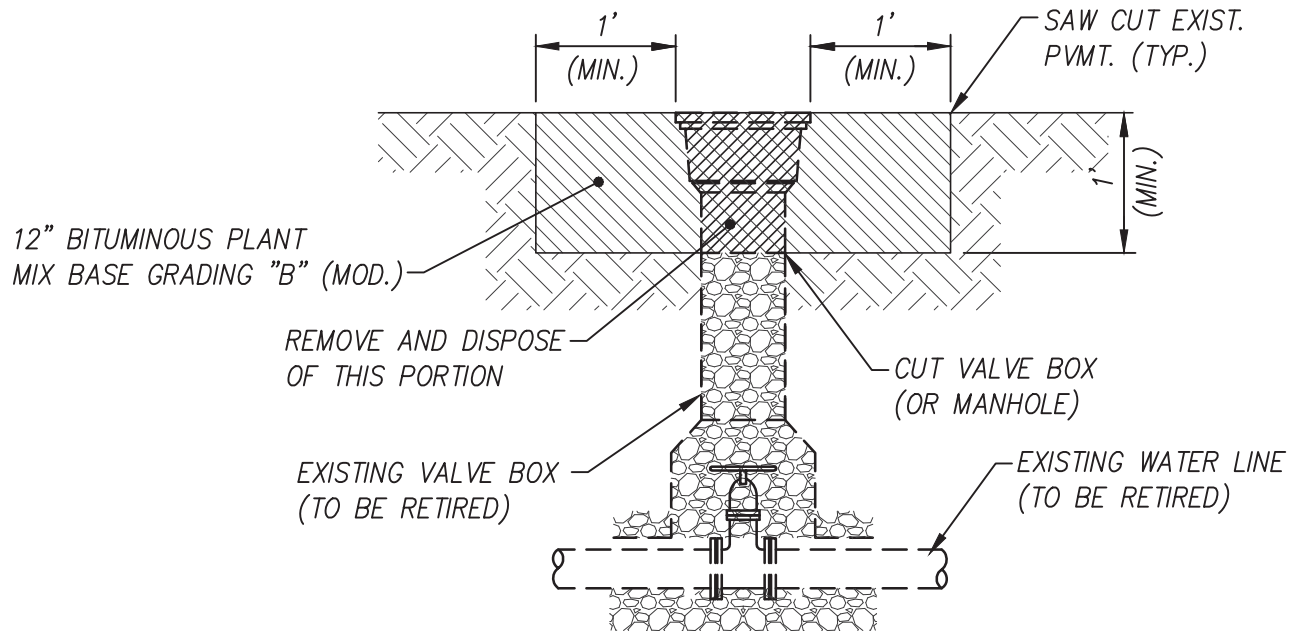
1. VALVE BOX SHALL NOT SUPPORTED BY VALVE OR PIPE.
2. INSTALL EXTENSION STEMS SO NUT IS 30 TO 60-INCHES FROM FINISHED GRADE.
3. INSTALL WITH UTILITY MARKER POST WHEN OUTSIDE PAVED AREAS. SEE DETAIL G-07.



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VALVE BOX



NOTES:

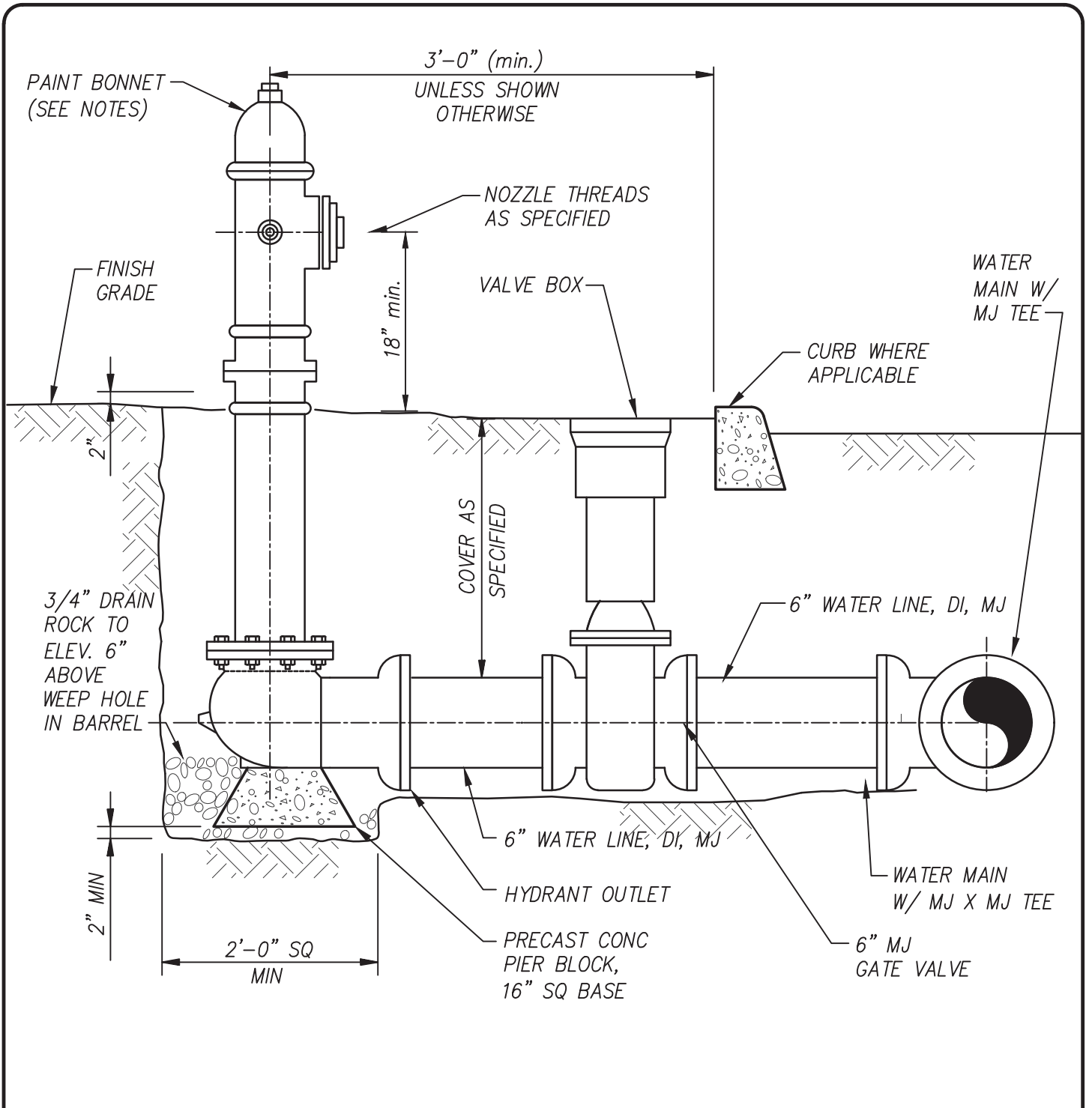
1. AFTER EXISTING WATER LINE(S) HAVE BEEN RETIRED, SAW CUT EXISTING PAVEMENT A MINIMUM OF 1 FOOT BEYOND THE OUTSIDE EDGE OF VALVE (OR STRUCTURE) TO A MINIMUM DEPTH OF 1 FOOT.
2. CUT VALVE BOX (OR MANHOLE) AT 1 FOOT BELOW GRADE, REMOVE TOP PORTION, AND DISPOSE OF REMOVED MATERIAL PROPERLY. CONTRACTOR MAY REMOVE ENTIRE TOP SECTION OF VALVE BOX (OR MANHOLE) WITHOUT CUTTING IF APPROPRIATE, AT NO ADDITIONAL COST TO OWNER.
3. FILL REMAINING PORTION OF VALVE BOX WITH #57 STONE.
4. PROVIDE #57 CRUSHED STONE FOR LEVELING COURSE TO 1 FOOT BELOW GRADE.
5. WHEN A TEMPORARY ASPHALT PATCH IS USED, IT SHALL BE PLACED IMMEDIATELY AFTER CRUSHED STONE BACKFILL. ALL TEMPORARY REPAIRS MUST BE REPLACED PERMANENTLY WITHIN 90 DAYS.



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VALVE BOX RETIREMENT



NOTES:

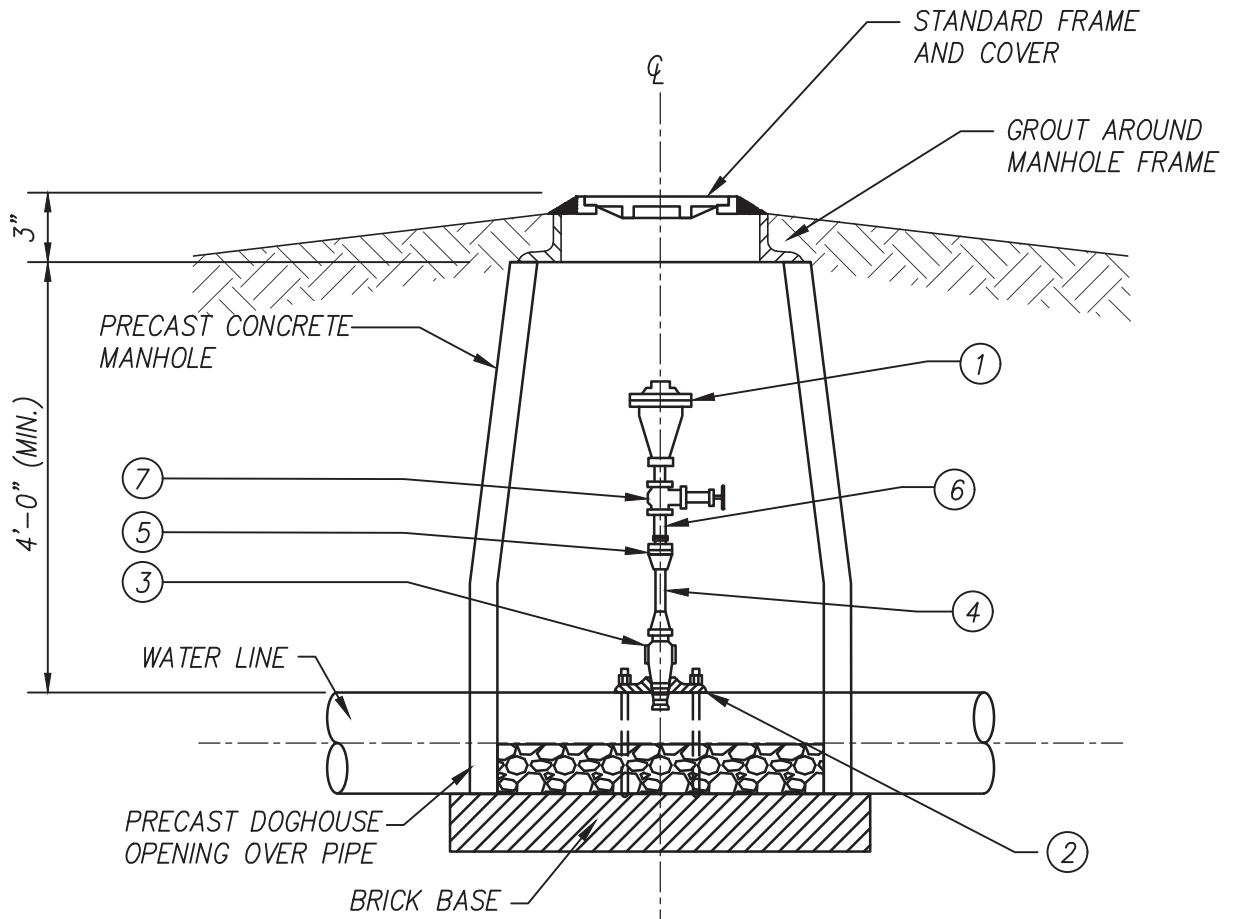
1. HYDRANT, TEE, AND GATE VALVE TO BE RESTRAINED WITH MECHANICAL JOINT FITTINGS WITH RESTRAINED FOLLOWER GLANDS.
2. HYDRANT SHALL BE EPOXY COATED AND RED IN COLOR.
3. PROVIDE CONCRETE THRUST BLOCKING AT HYDRANT ELBOW (NOT SHOWN FOR CLARITY) IN ACCORDANCE WITH DETAIL G-03. DO NOT OBSTRUCT WEEP HOLE(S) WITH CONCRETE.
4. CONFER WITH OWNER ON NFPA PAINT COLOR FOR BONNET.



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FIRE HYDRANT ASSEMBLY



- ① COMBINATION AIR VALVE, MALE THREAD
- ② TAPPING SADDLE (DIP MAY BE DIRECT TAPPED)
- ③ CORP STOP
- ④ COPPER
- ⑤ MALE ADAPTOR (BRASS)
- ⑥ SHORT NIPPLE (BRASS)
- ⑦ 1/4 TURN BRASS BALL VALVE

NOTES:

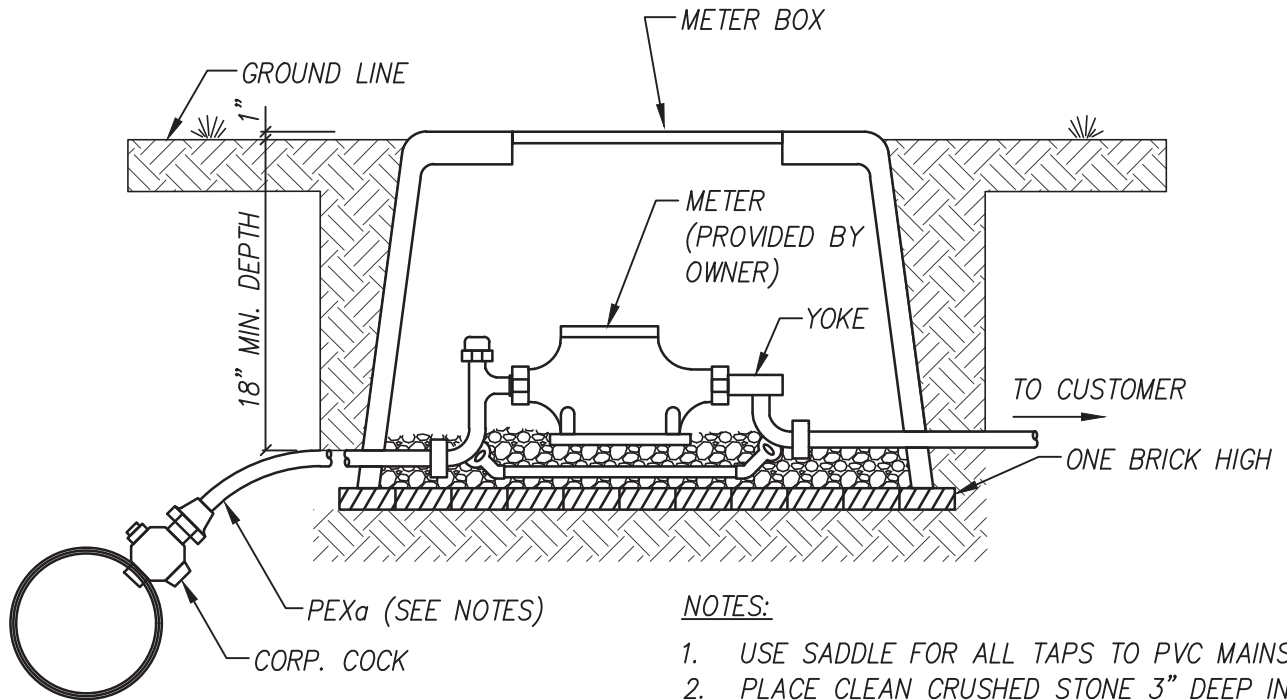
1. AIR VALVE AND PLUMBING SIZE:
 10" AND LESS WATER MAIN: 1"
 12" AND LARGER WATER MAIN: 2"



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**AIR RELEASE VALVE
 ASSEMBLY - WATER**



NOTES:

1. USE SADDLE FOR ALL TAPS TO PVC MAINS.
2. PLACE CLEAN CRUSHED STONE 3" DEEP IN BOTTOM OF METER BOX.
3. SERVICE LINE FROM MAIN TO METER SHALL BE ONE CONTINUOUS PIECE, NO COUPLINGS.

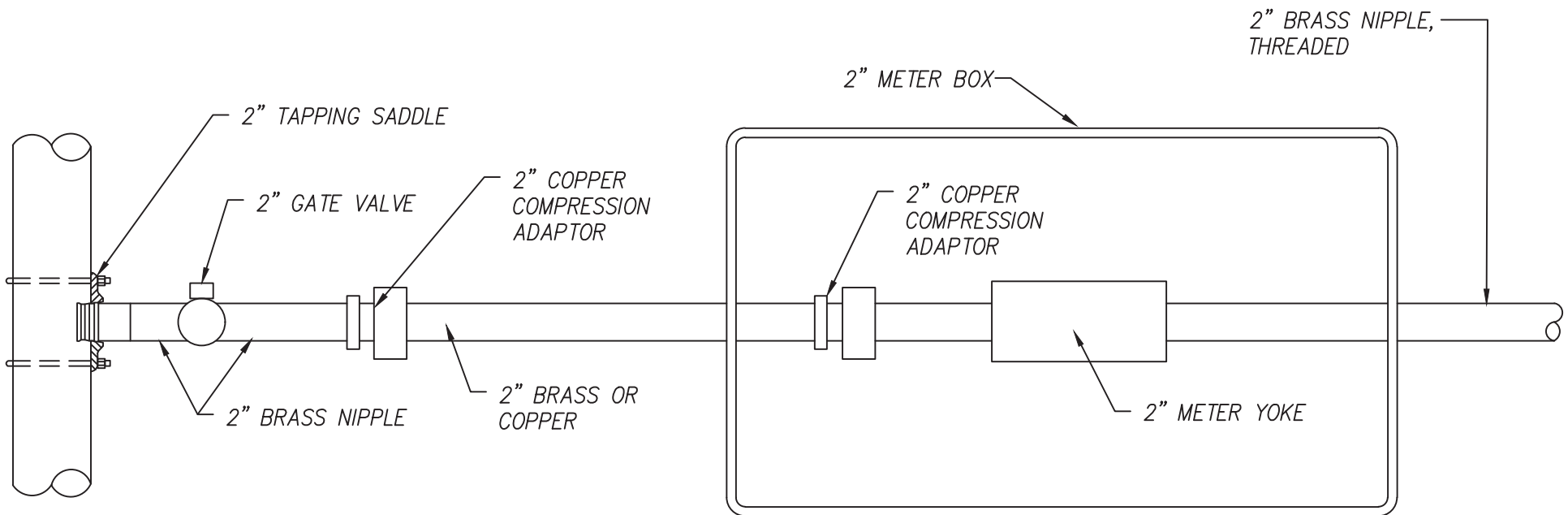
SERVICE METER ASSEMBLY
(OWNER)



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**3/4" OR 1" WATER
SERVICE ASSEMBLY**



NOTES:

1. NO COPPER COMPRESSION ADAPTER REQUIRED IF THREADED BRASS IS USED.

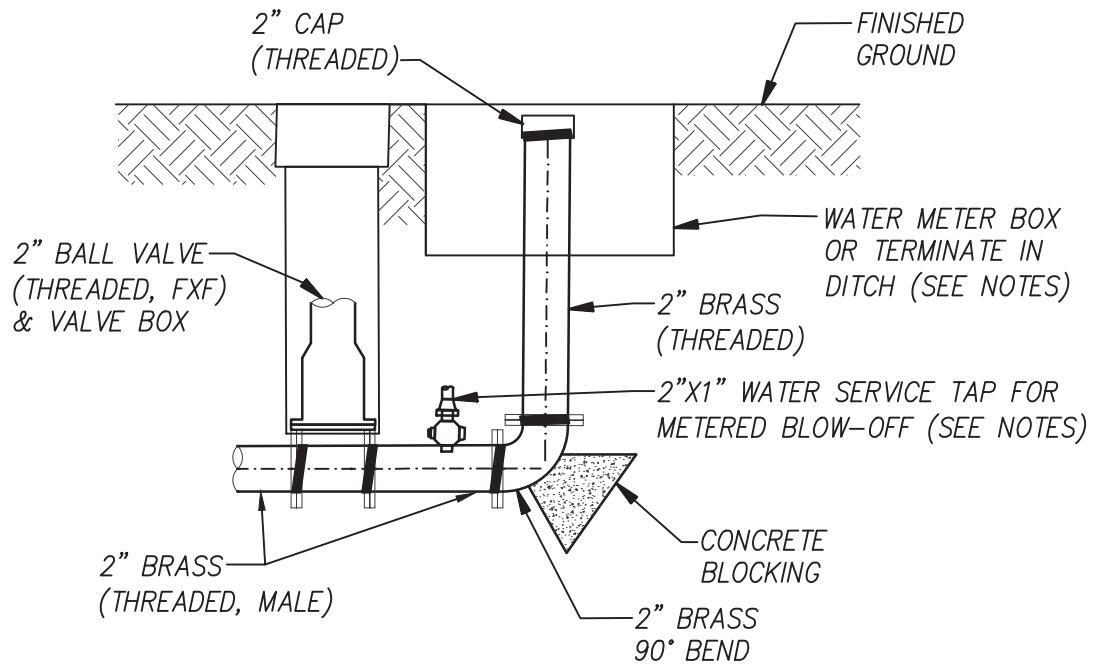


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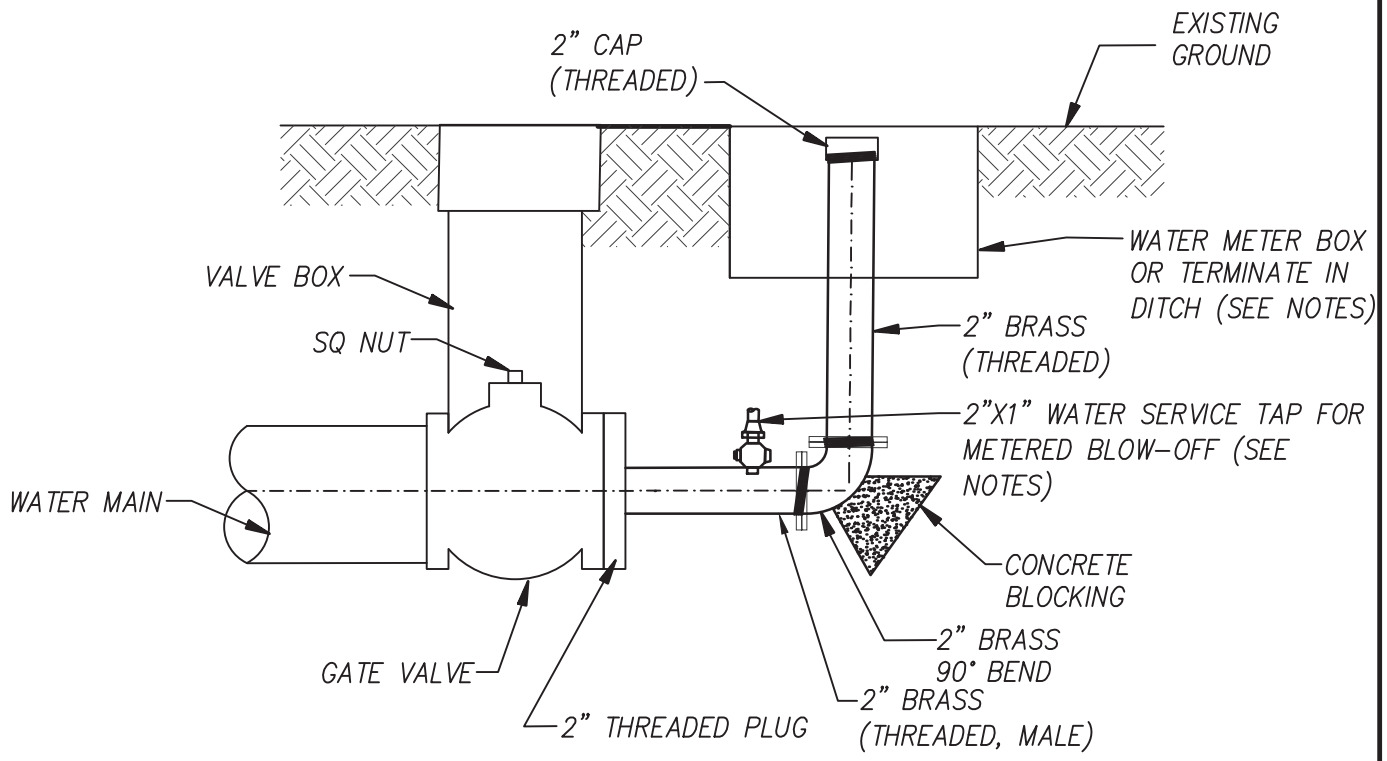
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2" WATER SERVICE ASSEMBLY



2" WATER MAIN



>2" WATER MAIN

NOTES:

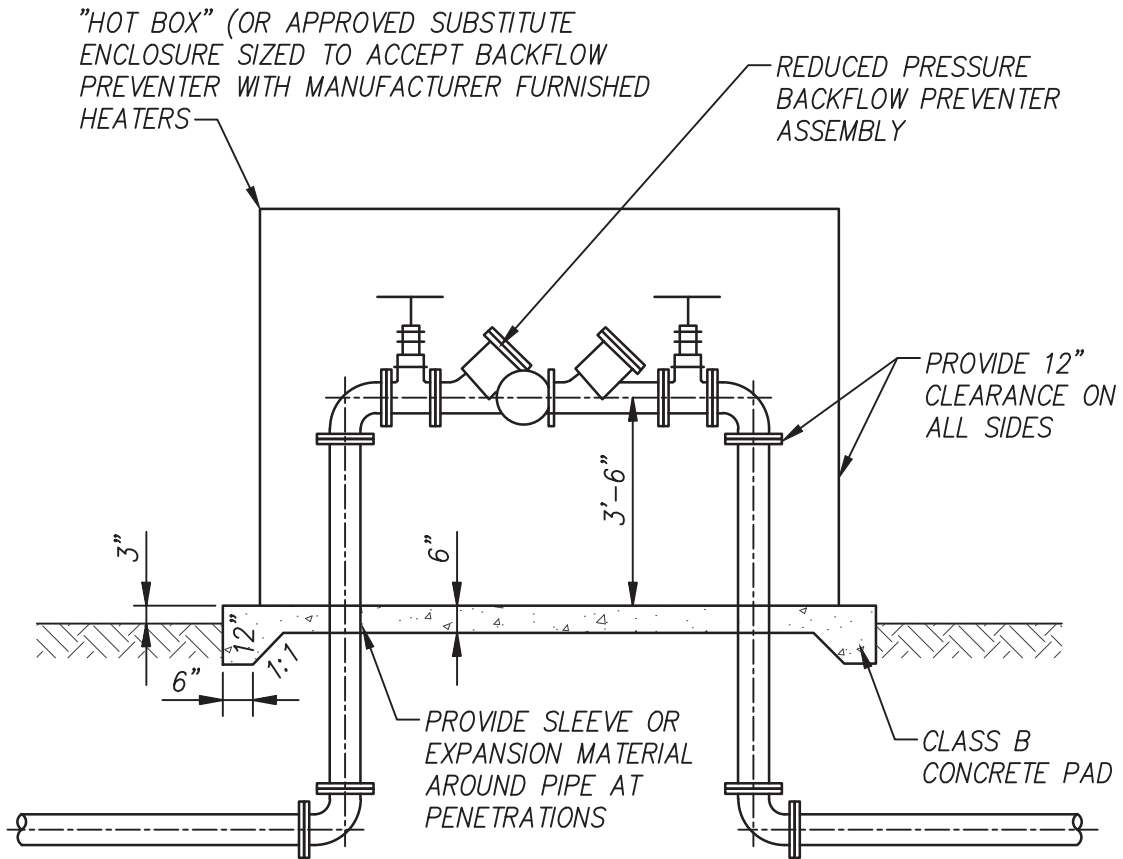
1. INSTALL RESTRAINED JOINT PIPE AND FITTINGS UPSTREAM OF BLOW-OFF VALVE PER SPECIFICATIONS.
2. DAYLIGHT TO DITCH WHEN POSSIBLE.
3. METERED BLOW-OFF:
 - A. INSTALL METERED BLOW-OFFS WHERE CALLED FOR ON THE DRAWINGS.
 - B. SEE DETAIL W-05 FOR CONTINUATION OF WATER SERVICE ASSEMBLY.



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2" BLOW-OFF ASSEMBLY



NOTE:

1. DETAILS/SHOP DRAWINGS AND DESIGN CALCULATIONS MUST BE SUBMITTED TO OWNER AND APPROVED PRIOR TO INSTALLATION OF EQUIPMENT.
2. ALL PIPE, FITTINGS, VALVES, AND JOINTS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
3. INSTALL CONCRETE THRUST BLOCKS AT ALL BURIED FITTINGS.
4. ALL CONCRETE SHALL BE CLASS B.
5. HEATING EQUIPMENT SHALL BE FURNISHED AND DESIGNED BY THE MANUFACTURER OF THE ENCLOSURE TO MAINTAIN AN INTERIOR TEMPERATURE OF +40° F, WITH AN OUTSIDE TEMPERATURE OF -30° F, AND A WIND VELOCITY OF 15 MILES PER HOUR, ELECTRICAL SERVICE SHALL BE 120V.
6. BACKFLOW PREVENTION ASSEMBLY ENCLOSURE SHALL HAVE ACCESS PANELS. PANELS SHALL BE COMPLETELY REMOVABLE. ENCLOSURE SHALL BE ASSEMBLED AND MOUNTED TO CONCRETE PAD ACCORDING TO MANUFACTURER'S INSTRUCTIONS.



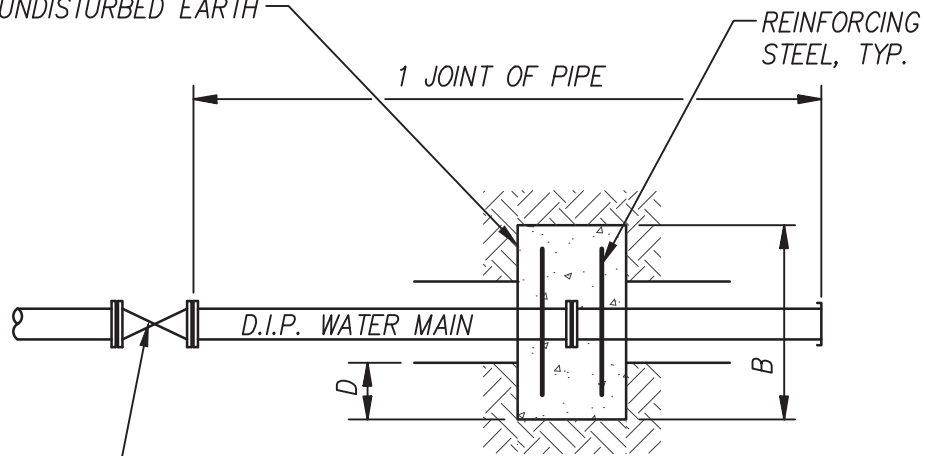
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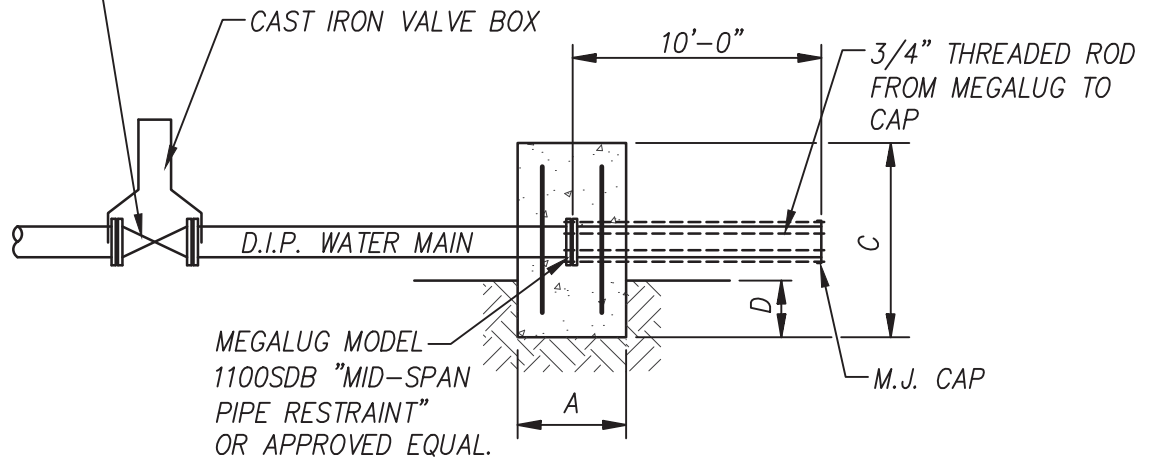
**BACKFLOW/CHECK VALVE
 PREVENTER**

POUR CONCRETE THRUST BLOCKING
AGAINST UNDISTURBED EARTH



PLAN

GATE VALVE OR
BUTTERFLY VALVE AS
SHOWN ON DRAWINGS



SECTION

MAIN DIA.	CONCRETE COLLAR DIM.				STEEL REINFORCING
	A	B	C	D	
12"	1'-2"	5'-3"	5'-3"	1'-0"	#7 @ 12" O.C. E.W.E.F.
4", 6" OR 8"	1'-0"	4'-0"	4'-0"	0'-8"	#6 @ 12" O.C. E.W.E.F.

NOTE:

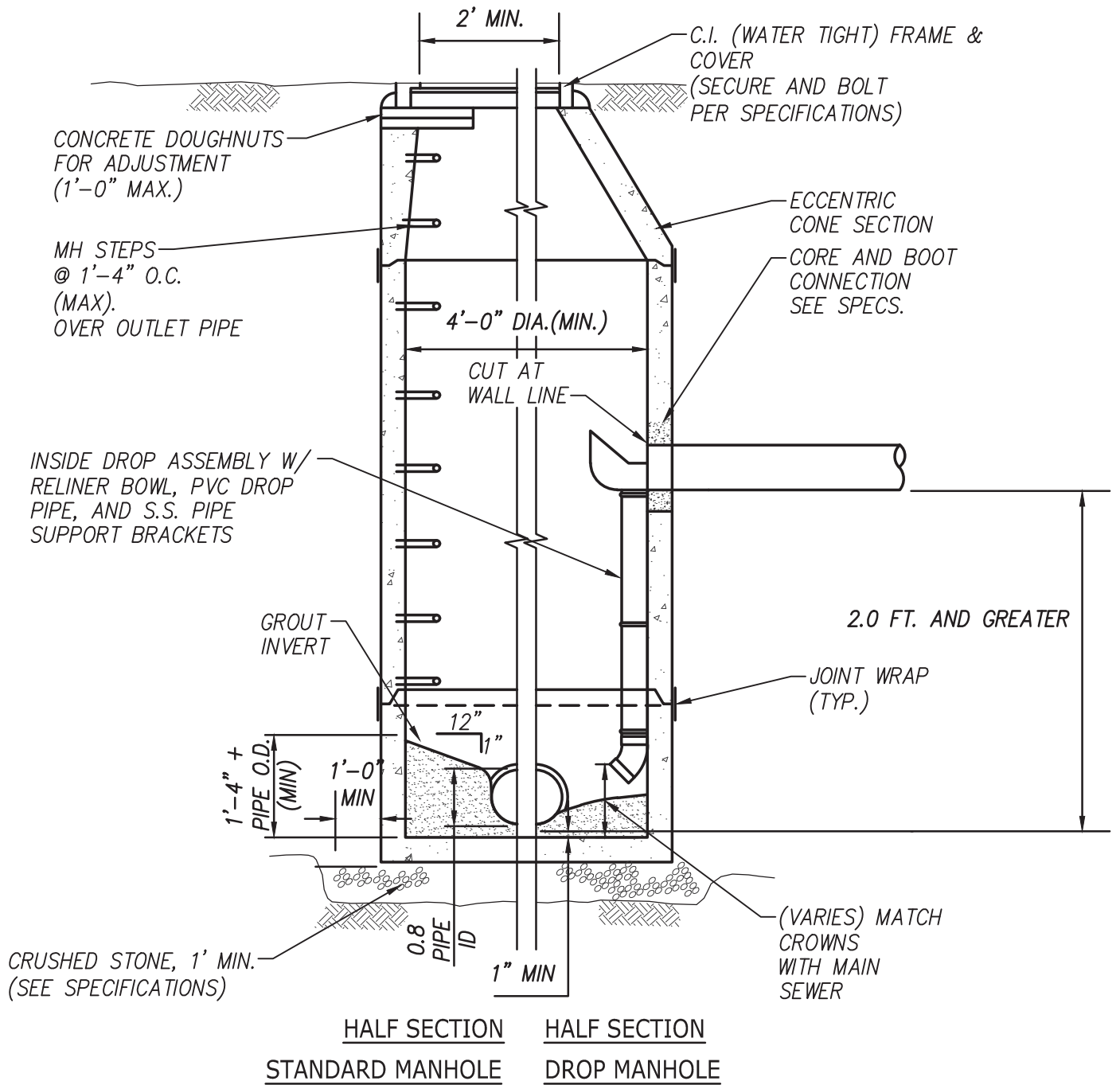
1. TEST PRESSURE: 250 PSI
2. SOIL BEARING PRESSURE: 3,000 PSF
3. KEY CONCRETE COLLAR INTO UNDISTURBED SOIL
4. D = MINIMUM DISTANCE INTO UNDISTURBED EARTH, BOTTOM AND SIDES
5. PROVIDE 1" MINIMUM CLASS B CONCRETE COVER OVER REBAR
6. INSTALL RESTRAINED JOINT PIPE AND FITTINGS UPSTREAM OF VALVE PER SPECIFICATIONS



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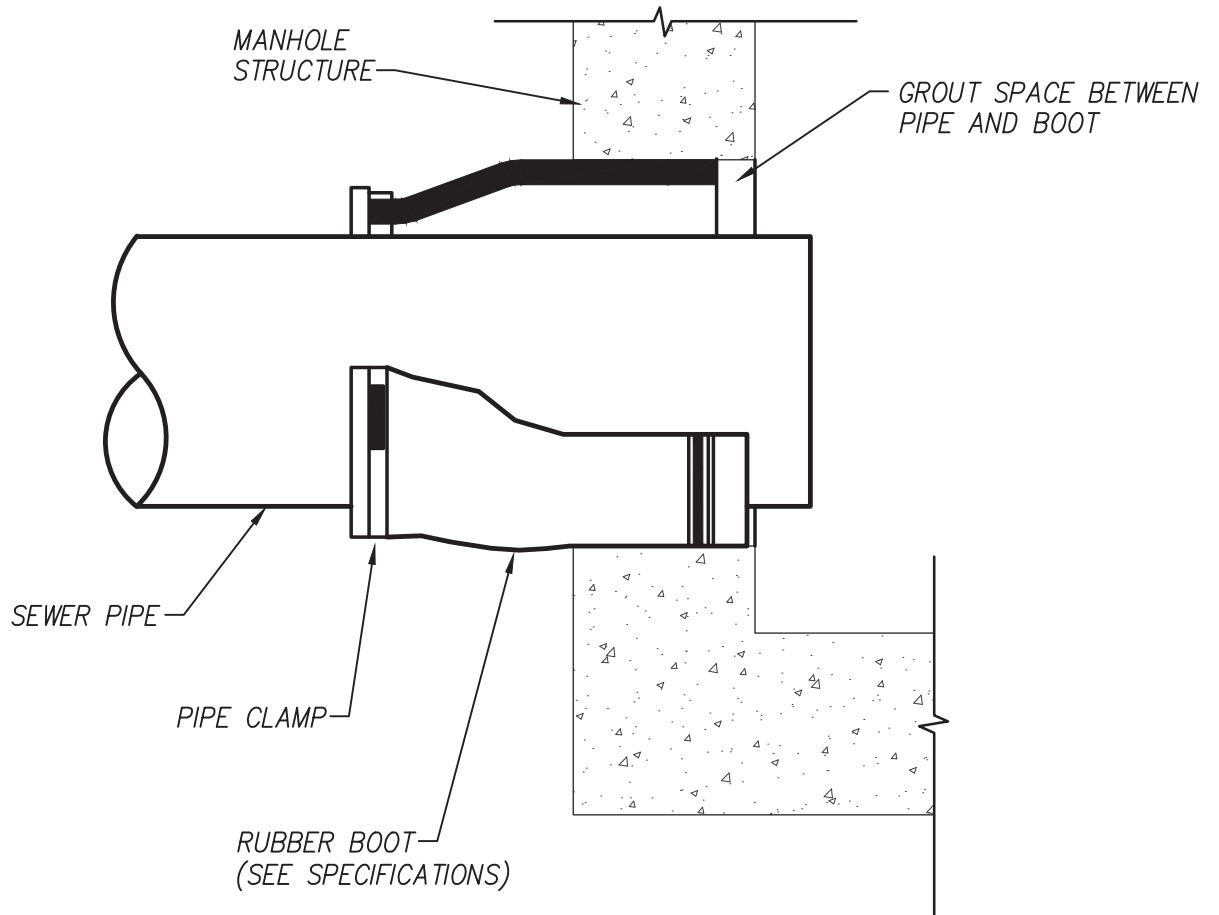
WATER LINE TERMINATION



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SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

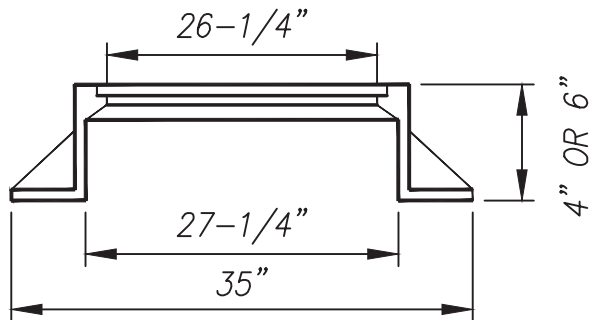
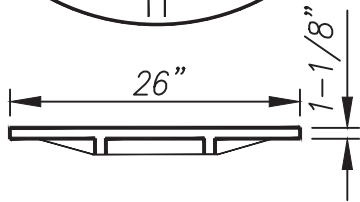
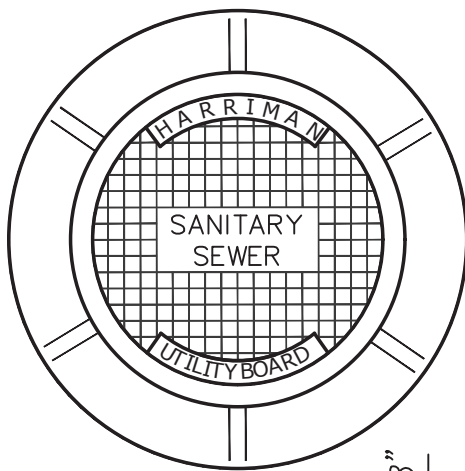
PRECAST CONCRETE MANHOLE



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DWG. NAME:		WW-02	DATE		MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW	CHECKED	WWL

RUBBER BOOT



JOHN BOUCHARD & SONS #1154 (4"),
 #1155 (6"), OR APPROVED EQUIVALENT
 (MIN. COMBINED WEIGHT OF 325 LBS.)

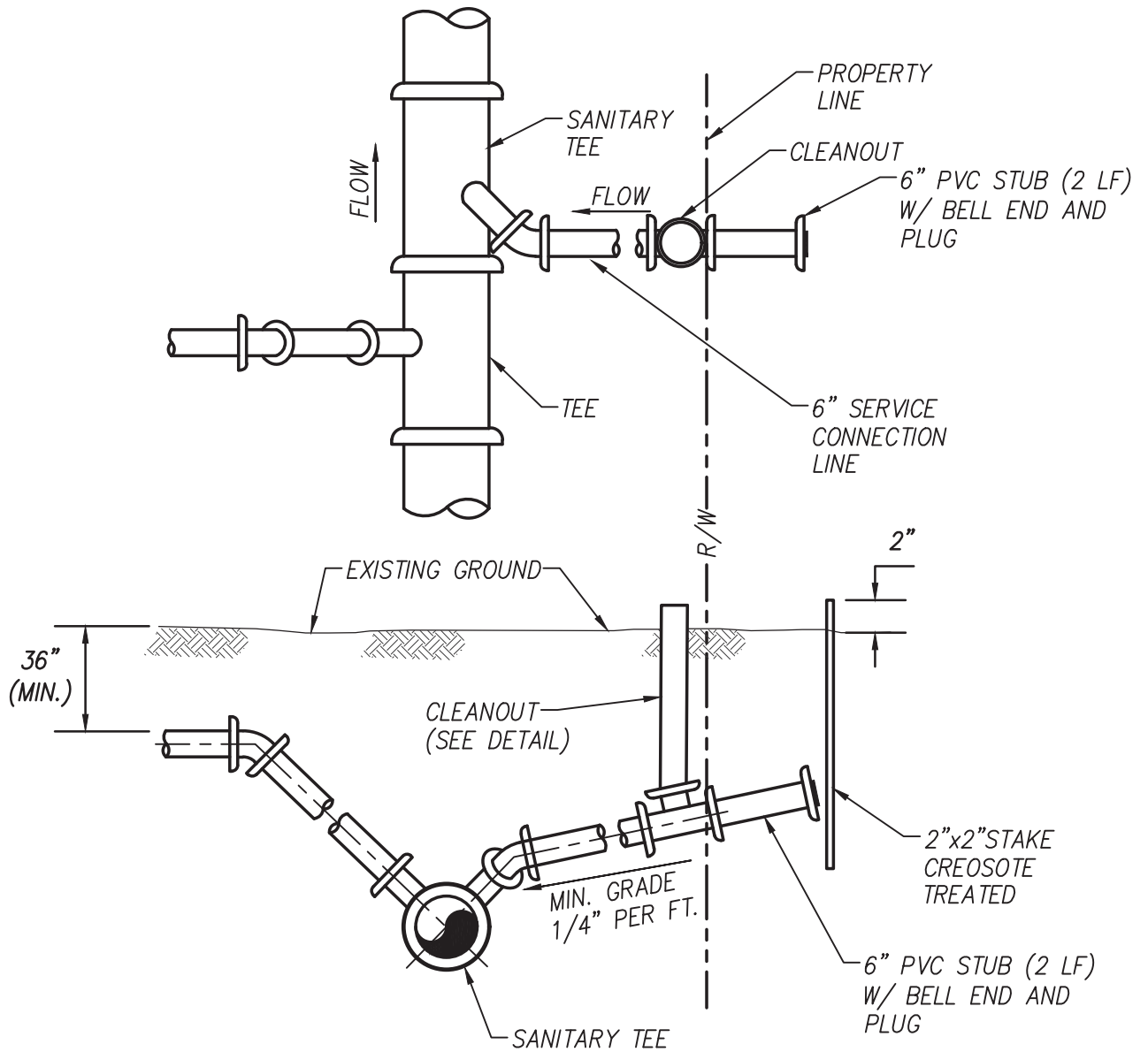


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DWG. NAME:	WW-03	DATE	MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

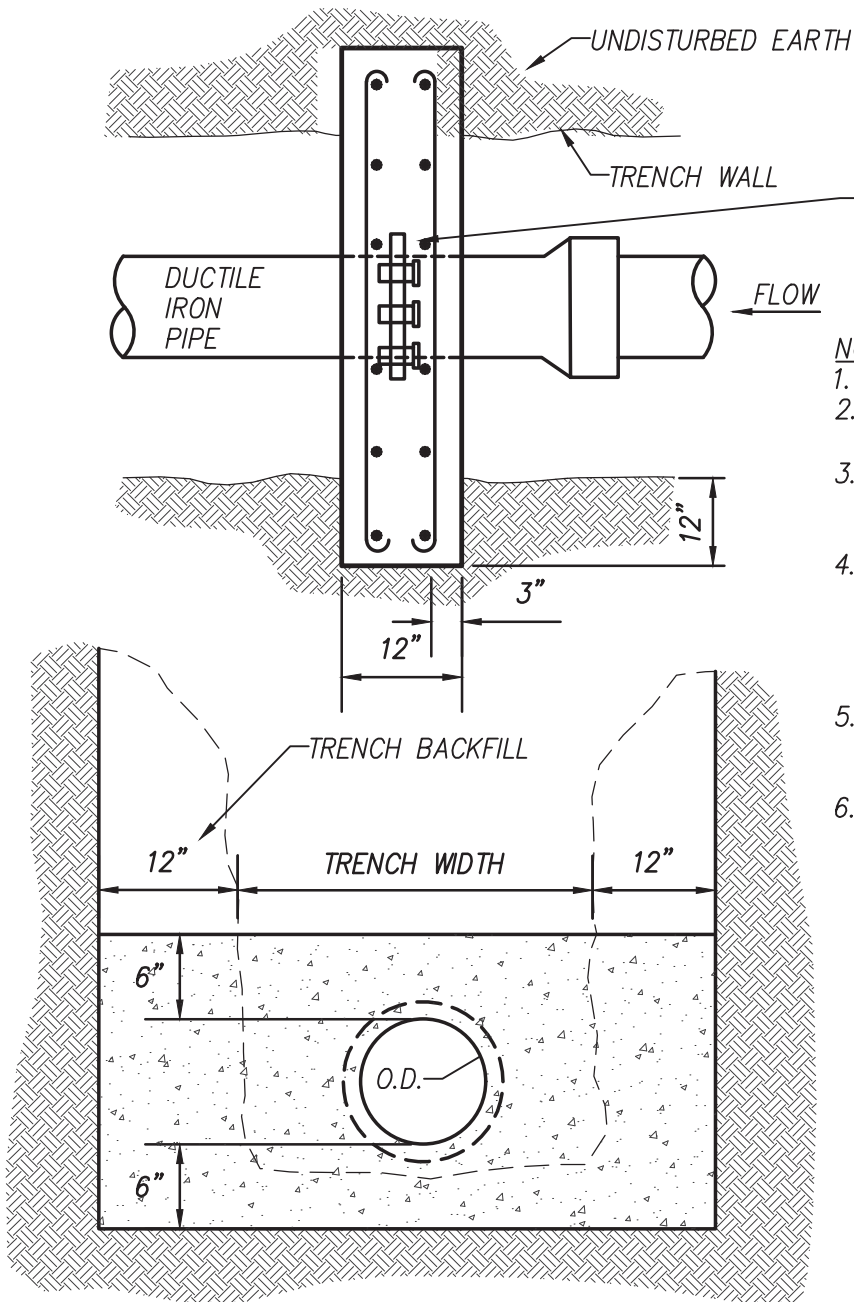
TYPICAL MANHOLE COVER



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DWG. NAME: WW-04		DATE: MAY 22, 2023	
SCALE: N.T.S.	DRAWN: WBW	CHECKED: WWL	

SERVICE CONNECTION



SECURE MEGA-LUG FITTING TO PIPE AND CAST INTO CONCRETE ANCHOR

NOTES:

1. CONCRETE SHALL BE 3000-PSI.
2. REINFORCING BARS SHALL BE No.4 BARS AT 12" E.W.
3. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
4. ANCHOR SPACING SHALL BE:

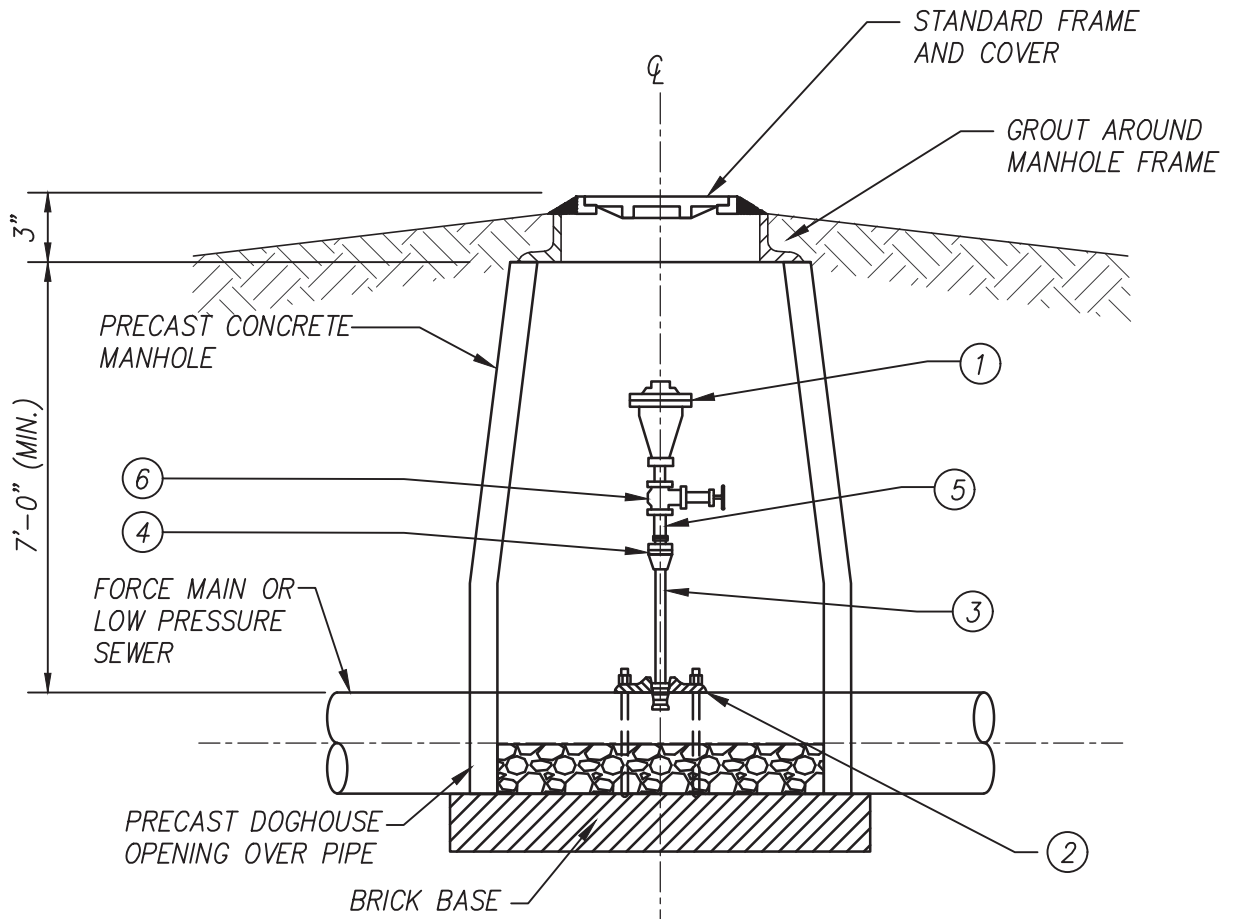
SLOPE	SPACING
18-35%	36-FT
35-50%	24-FT
>50%	16-FT
5. DUCTILE IRON PIPE MUST BE USED WHEN SLOPES ARE 18% OR GREATER.
6. KEYING PIPES IS REQUIRED FOR ALL PIPES ON A 18% SLOPE OR GREATER.



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DWG. NAME:	WW-05	DATE	MAY 22, 2023
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		CHECKED	WWL

CONCRETE ANCHORS FOR GRAVITY SEWER



- ① COMBINATION AIR VALVE, MALE THREAD
- ② TAPPING SADDLE (DIP MAY BE DIRECT TAPPED)
- ③ STAINLESS STEEL NIPPLE
- ④ MALE ADAPTOR (STAINLESS STEEL)
- ⑤ SHORT NIPPLE (STAINLESS STEEL)
- ⑥ 1/4 TURN STAINLESS STEEL BALL VALVE

NOTES:

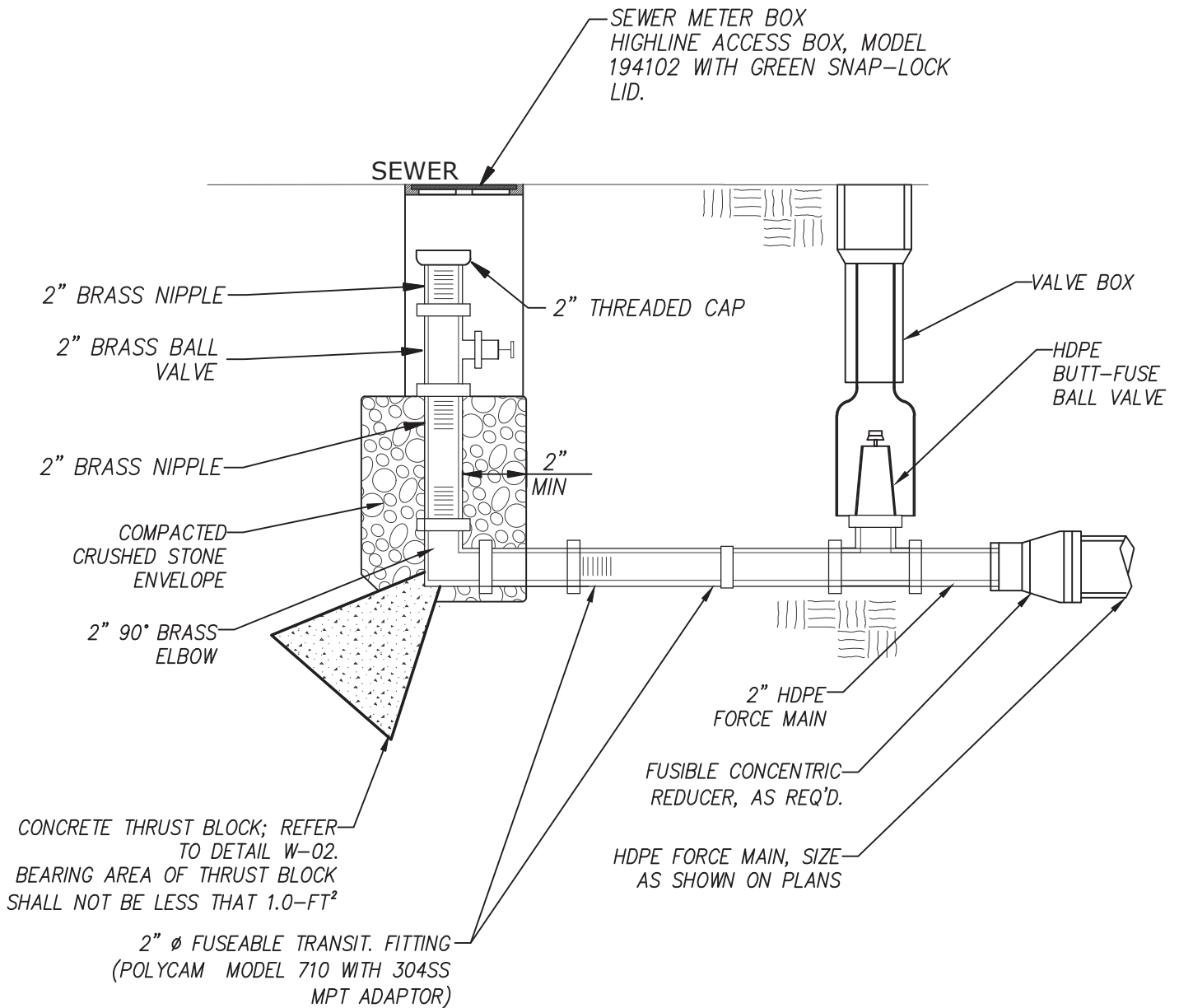
1. MINIMUM VALVE AND PLUMBING SIZE IS 2-INCH FOR SEWER FORCE MAINS AND LOW-PRESSURE SEWER MAINS.
2. FOR MAINS REQUIRING LARGER THAN 2-INCH AIR VALVE, CONSULT OWNER.



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DWG. NAME: WW-06		DATE: MAY 22, 2023	
SCALE: N.T.S.	DRAWN: WBW	CHECKED: WWL	

**AIR RELEASE VALVE
 ASSEMBLY - SEWER**

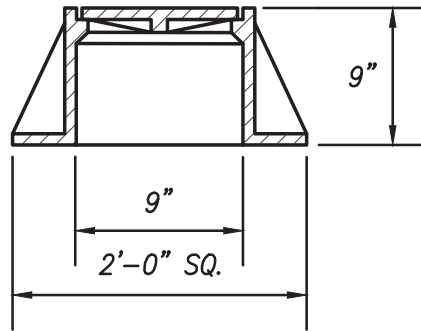


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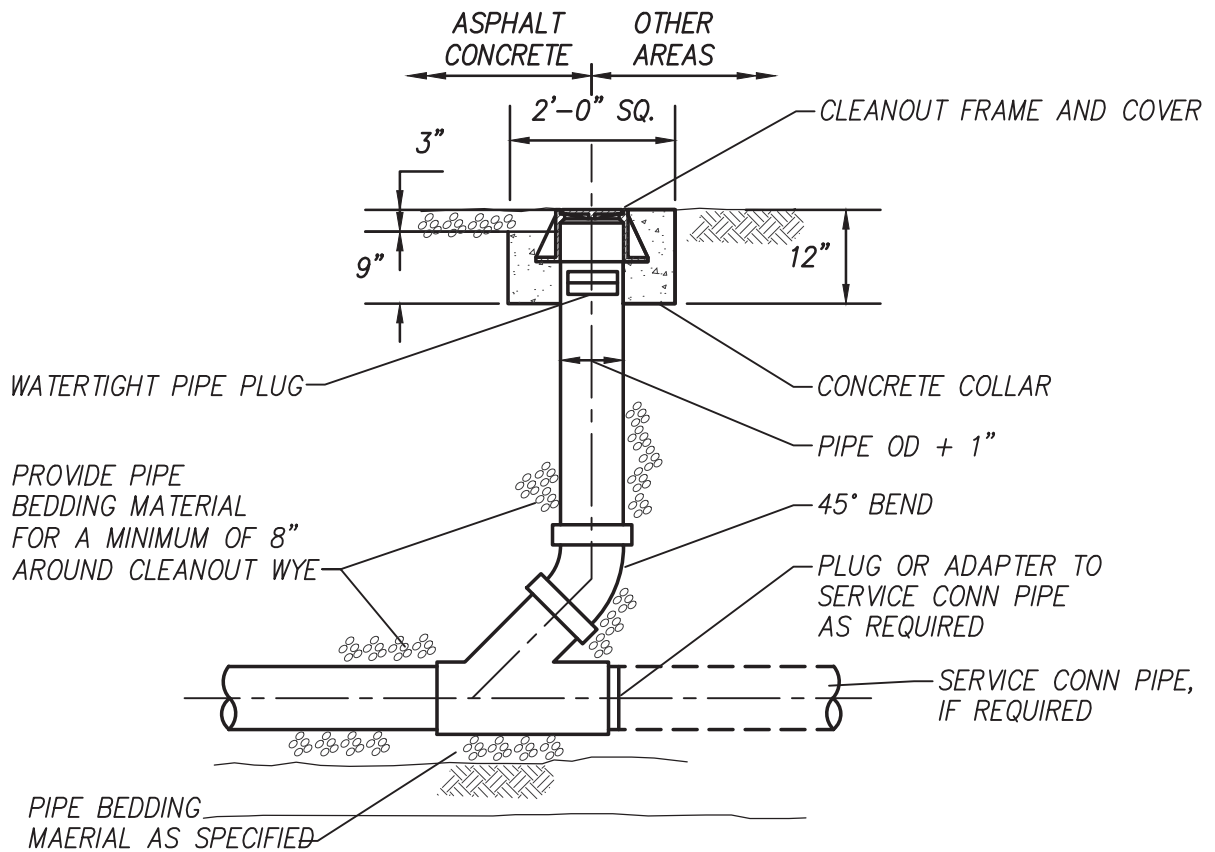
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DWG. NAME:	WW-07	DATE	MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

END-LINE FLUSHING STATION



CLEANOUT FRAME AND COVER



CLEANOUT



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DWG. NAME:	WW-08	DATE	MAY 22, 2023
SCALE	N.T.S.	DRAWN	WBW
		CHECKED	WWL

CLEANOUT