

STANDARD SPECIFICATIONS
FOR
WASTEWATER SYSTEM CONSTRUCTION



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State of Tennessee
Department of Environment and Conservation
Division of Water Supply
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STANDARD SPECIFICATIONS

FOR

WASTEWATER SYSTEM CONSTRUCTION



CITY OF SEVIERVILLE, TENNESSEE

PREFACE

These Standard Specifications have been prepared to complement the Standard Detail Drawings and to provide the qualitative requirements for products, materials, and workmanship for construction of additions to and replacements of the wastewater collection system which is to be operated by the City of Sevierville Water and Sewer Departments. These Standard Specifications are only to be used for projects with Drawings which have been approved by the Tennessee Department of Environment and Conservation, Division of Water Pollution Control, as prepared by the City of Sevierville Water and Sewer Departments, by its Design Consultant, or by a Developer's Engineer, whose Drawings must first be approved by the City of Sevierville Water and Sewer Departments. All references in these Standard Specifications to "Engineer" and "Owner" shall mean the City of Sevierville Water and Sewer Departments. These Standard Specifications are subject to revision for a specific project, with such revisions identified in the Bidding Requirements and Special Conditions document prepared by the City of Sevierville Water and Sewer Departments or its Design Consultant, or with such revisions noted on the Drawings approved by the City of Sevierville Water and Sewer Departments.

All work requirements described in the Standard Specifications are the responsibility of the Contractor, unless specifically designated otherwise.

SPECIFICATIONS

Section Title

Division 01 – General Requirements

01 33 23 Shop Drawings, Product Data, and Samples
01 57 13 Erosion and Sedimentation Control
01 78 23 Operating and Maintenance Data
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Division 31 – Earthwork

31 11 00 Clearing and Grubbing
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Division 32 – Exterior Improvements

32 10 13 Removing and Replacing Pavement
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Division 33 – Utilities

33 05 23.16 Bore and Jack Casings
33 30 00 Sewers and Accessories

STANDARD DETAIL DRAWINGS

STD-G-01 Silt Fence Detail
STD-G-02 Concrete Encasement Detail
STD-G-03 Concrete Replacement Detail
STD-G-04 Asphalt Replacement Detail
STD-G-05 Creek Crossing Detail
STD-G-06 Typical Road Boring Detail
STD-G-07 Trench Terminology Detail
STD-G-08 Pressure Pipe Bedding and Haunching Details (PS)
STD-G-09 Gravity Pipe Bedding and Haunching Details (GS)
STD-G-10 1,000 Gallon Concrete Grease Trap

STD-WW-01 Precast Concrete Manhole Detail (GS)
STD-WW-02 Precast Shallow Manhole Detail (GS)
STD-WW-03 Manhole Frame and Cover Detail (GS)
STD-WW-04 Service Connection Detail (GS)
STD-WW-05 Concrete/Waterstop Collar Detail (GS)
STD-WW-06 Rubber Boot Detail (GS)

(GS) Gravity Sewer
(PS) Pressure Sewer

STD-WWP-01	Typical Blocking Detail (PS)
STD-WWP-02	Wastewater Air Release Manhole Detail (PS)
STD-WWP-03	Typical End-Line Flushing Station Detail (PS)
STD-WWP-04	Installation of Simplex Grinder Pump Detail (PS)
STD-WWP-05	Electrical Installation for Simplex Grinder Pumps Detail (PS)
STD-WWP-06	Single Service Connection Detail (PS)
STD-WWP-07	Air Valve Detail for Smaller Diameter Pressure Sewer (PS)
STD-WWP-08	Force Main Discharge Manhole Detail (PS)
STD-WWP-09	Force Main Odor Control Injection Tap Detail (PS)

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes submittal to the Engineer of Shop Drawings, Product Data, and Samples required by the various sections of these Specifications.
- B. Submittal Contents: The submittal contents required are specified in each section.
- C. Definitions: Submittals are categorized as follows:
 - 1. Shop Drawings:
 - a. Shop Drawings shall include technical data, drawings, diagrams, procedure and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions, measurements, and similar information as applicable to the specific item for which the Shop Drawing is prepared.
 - b. Provide newly-prepared information, on bond sheets, with graphic information at accurate scale (except as otherwise indicated) or appropriate number of prints hereof, with name of preparer (firm name) indicated. The Contract Drawings shall not be traced or reproduced by any method for use as or in lieu of detail Shop Drawings. Show dimensions and note dimensions that are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements. Do not allow Shop Drawings to be used in connection with the work without appropriate final "Action" markings by the Engineer.
 - c. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, Specification Document, schedule or room numbers shown on the Contract Drawings.
 - d. Minimum assembly drawings sheet size shall be 22 x 34 inches.
 - e. Minimum detail sheet size shall be 8-1/2 x 11 inches.
 - f. Minimum Scale:
 - i. Assembly Drawings Sheet, Scale: 1-inch = 30 feet.
 - ii. Detail Sheet, Scale: 1/4-inch = 1 foot.
 - 2. Product Data:
 - a. Product data includes standard printed information on materials, products and systems, not specially prepared for this project, other than the designation of selections from among available choices printed therein.

- b. Collect required data into one submittal for each unit of work or system and mark each copy to show which choices and options are applicable to the project. Include the Manufacturer’s standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked and special coordination requirements.
- 3. Samples:
 - a. Samples include both fabricated and unfabricated physical examples of materials, products, and units of work, both as complete units and as smaller portions of units of work, either for limited visual inspection or, where indicated, for more detailed testing and analysis.
 - b. Provide units identical with final condition of proposed materials or products for the work. Include “range” samples, not less than 3 units, where unavoidable variations must be expected, and describe or identify variations between units of each set. Provide full set of optional samples where the Engineer’s selection is required. Prepare samples to match the Engineer’s sample where indicated. Include information with each sample to show generic description, source or product name, Manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture, and “kind” by the Engineer. Engineer will note “test” samples, except as otherwise indicated, for other requirements, which are the exclusive responsibility of the Contractor.
- 4. Miscellaneous submittals related directly to the work (non-administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, Record Drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work but not processed as Shop Drawings, product data or samples.

1.2 SPECIFIC CATEGORY REQUIREMENTS

- A. General: Except as otherwise indicated in the individual work sections, comply with general requirements specified herein for each indicated category of submittal. Submittals shall contain:
 - 1. The date of submittal and the dates of any previous submittals.
 - 2. The project title.
 - 3. Numerical submittal numbers, starting with 1.0, 2.0, etc. Revisions to be numbered 1.1, 1.2, etc.
 - 4. The Names of:
 - a. Contractor;

- b. Supplier; and
 - c. Manufacturer.
5. Identification of the product, with the Specification Document number, permanent equipment tag numbers, and applicable Drawing No.
 6. Field dimensions clearly identified as such.
 7. Relation to adjacent or critical features of the work or materials.
 8. Applicable standards, such as ASTM or Federal Specification numbers.
 9. Notification to the Engineer in writing, at time of submissions, of any deviations on the submittals from requirements of the Contract Documents.
 10. Identification of revisions on resubmittals.
 11. An 8 x 3-inch blank space for Contractor and Engineer stamps.
 12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 13. Submittal sheets or Drawings showing more than the particular item under consideration shall have all but the pertinent description of the item for which review is requested crossed out.

1.3 ROUTING OF SUBMITTALS

- A. Submittals and routine correspondence shall be routed as follows:
 1. Supplier to Contractor (through representative, if applicable).
 2. Contractor to Engineer.
 3. Engineer to Contractor and Owner.
 4. Contractor to Supplier.

PART 2 PRODUCTS

2.1 SHOP DRAWINGS

- A. Unless otherwise specifically directed by the Engineer, make all Shop Drawings accurately to a scale sufficiently large enough to show all pertinent features of the item and its method of connection to the work.

- B. Submit all shop assembly drawings, larger than 11 x 17 inches, in PDF format.
- C. Submit all Shop Drawings, 11 x 17 inches and smaller, in PDF format.

2.2 MANUFACTURER'S LITERATURE

- A. Where content of submitted literature from the Manufacturer includes data not pertinent to this submittal, clearly indicate which portion of the contents is being submitted for the Engineer's review.
- B. Submit the number of copies which are required to be returned (not to exceed 3) plus 3 copies which will be retained by the Engineer.

2.3 SAMPLES

- A. Samples shall illustrate materials, equipment or workmanship, and established standards by which completed work is judged.
- B. Unless otherwise specifically directed by the Engineer, all samples shall be of the precise article proposed to be furnished.
- C. Submit all samples in the quantity which is required to be returned plus one sample which will be retained by the Engineer.

2.4 COLORS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the Engineer for review and selection.
- B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

PART 3 EXECUTION

3.1 CONTRACTOR'S COORDINATION OF SUBMITTALS

- A. Prior to submittal for the Engineer's review, the Contractor shall use all means necessary to fully coordinate all material, including the following procedures:
 - 1. Determine and verify all field dimensions and conditions, catalog numbers, and similar data.
 - 2. Coordinate as required with all trades and all public agencies involved.
 - 3. Submit a written statement of review and compliance with the requirements of all applicable technical Specifications as well as the requirements of this section.

4. Clearly indicate in a letter or memorandum on the Manufacturer's or Fabricator's letterhead, all deviations from the Contract Documents.
- B. Each and every copy of the Shop Drawings and data shall bear the Contractor's stamp showing that they have been so checked. Shop Drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement.
 - C. The Owner may backcharge the Contractor for costs associated with having to review a particular Shop Drawing, product data or sample more than two times to receive a "No Exceptions Taken" mark.
 - D. Grouping of Submittals:
 1. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items.
 2. No review will be given to partial submittals of Shop Drawings for items which interconnect and/or are interdependent. It is the Contractor's responsibility to assemble the Shop Drawings for all such interconnecting and/or interdependent items, check them and then make one submittal to the Engineer along with Contractor's comments as to compliance, non-compliance or features requiring special attention.
 - E. Schedule of Submittals: Within 30 days of contract award and prior to any Shop Drawing submittal, the Contractor shall submit a schedule showing the estimated date of submittal and the desired approval date for each Shop Drawing anticipated. A reasonable period shall be scheduled for review and comments. Time lost due to unacceptable submittals shall be the Contractor's responsibility and some time allowance for resubmittal shall be provided. The schedule shall provide for submittal of items which relate to one another to be submitted concurrently.

3.2 TIMING OF SUBMITTALS

- A. Make all submittals far enough in advance of scheduled dates for installation to provide all required time for reviews, for securing necessary approvals, for possible revision and resubmittal, and for placing orders and securing delivery.
- B. In scheduling, allow sufficient time for the Engineer's review following the receipt of the submittal.

3.3 REVIEWED SHOP DRAWINGS

- A. Engineer Review:
 1. Allow a minimum of 30 days for the Engineer's initial processing of each submittal requiring review and response, except allow longer periods where processing must be delayed for coordination with subsequent submittals. The Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination. Allow a minimum of 2 weeks for reprocessing each submittal. Advise the Engineer on each submittal as to whether processing time is critical to the progress of the work, and therefore the work would be expedited, if processing time could be foreshortened.

2. Acceptable submittals will be marked “No Exceptions Taken”.
 3. Submittals requiring minor corrections before the product is acceptable will be marked “Make Corrections Noted”. The Contractor may order, fabricate, and ship the items included in the submittals, provided the indicated corrections are made. Drawings must be resubmitted for review and marked “No Exceptions Taken” prior to installation or use of products.
 4. Submittals marked “Amend and Resubmit” must be revised to reflect required changes and the initial review procedure repeated.
 5. The “Rejected – See Remarks” notation is used to indicate products which are not acceptable. Upon return of a submittal so marked, the Contractor shall repeat the initial review procedure utilizing acceptable products.
- B. No work or products shall be installed without a drawing or submittal bearing the “No Exceptions Taken” notation. The Contractor shall maintain at the jobsite a complete set of Shop Drawings bearing the Engineer’s stamp.
- C. Substitutions: In the event the Contractor obtains the Engineer’s approval for the use of products other than those which are listed first in the Contract Documents, the Contractor shall, at the Contractor’s own expense and using methods approved by the Engineer, make any changes to structures, piping, and electrical work that may be necessary to accommodate these products.
- D. Use of the “No Exceptions Taken” notation on Shop Drawings or other submittals is general and shall not relieve the Contractor of the responsibility of furnishing products of the proper dimension, size, quality, quantity, materials and all performance characteristics, to efficiently perform the requirements and intent of the Contract Documents. The Engineer’s review shall not relieve the Contractor of responsibility for errors of any kind on the Shop Drawings. Review is intended only to assure conformance with the design concept of the project and compliance with the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the jobsite. The Contractor is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades.

3.4 RESUBMISSION REQUIREMENTS

- A. Shop Drawings:
1. Revise initial Drawings as required and resubmit as specified for initial submittal with the resubmittal number shown.
 2. Indicate on Drawings all changes which have been made other than those requested by the Engineer.
- B. Project Data and Samples: Resubmit new data and samples as specified for initial submittal with the resubmittal number shown.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

A. Submittals and Permits:

1. It is the responsibility of the Owner/Developer and Contractor to obtain all permits associated with construction, specifically the Tennessee General Permit (TNR10-0000) for Storm Water.
2. Discharges for Construction Activities: If the disturbed area is greater than 1 acre, the Owner/Developer and Contractor shall provide a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the Tennessee General Permit TNR10-0000. The Owner/Developer and Contractor is responsible for obtaining an individual permit in the event a General Permit is not sufficient. Owner/Developer and Contractor shall prepare and execute a Construction Activity-Storm Water Discharge Notice of Intent (NOI) with the Tennessee Department of Environment and Conservation (TDEC) Field Office.
3. Land disturbance activity shall not commence until the Land Disturbance Permit is issued.
4. Description and working drawings shall indicate controls which will ensure that storm water and drainage from the disturbed jobsite areas, which will be denuded, stripped or modified of its naturally existing or artificially established stabilization or protection against erosion, shall pass through some type of filter system before being discharged. These areas shall be kept sufficiently moist to control dust.
5. Submit a written plan for both temporary and permanent grassing. The plan shall include selection of species, dates, and rates of application for seeding, fertilizer, and mulching.

B. Basic Principles:

1. The Contractor is responsible for inspecting and maintaining all existing erosion and sedimentation control measures.
2. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type, and condition.
3. Minimize the disturbed area and the duration of exposure to erosion elements.
4. Stabilize disturbed areas immediately.
5. Safely convey run-off from the site to an outlet such that erosion will not be increased off-site.
6. Retain sediment on-site that was generated on-site.

7. Minimize encroachment upon watercourses.

C. Implementation:

1. The erosion and sedimentation control measures shown on the Drawings are minimal requirements. The Contractor's methods of operation may dictate additional erosion and sedimentation control measures not shown on the Drawings which shall be the Contractor's responsibility to determine and install said measures. The Contractor's failure to stabilize disturbed areas immediately following intermediate or final grading may dictate additional erosion and sedimentation control measures not shown on the Drawings which shall be the Contractor's responsibility to determine and install said measures.
2. The Contractor shall notify the Engineer of any changes and/or additions to the erosion and sedimentation control plan necessary to accommodate the Contractor's methods of operation. No additional payment shall be made for erosion and sedimentation control measures made necessary by the Contractor's methods of operation.
3. The Contractor shall be solely responsible for control of erosion within the project site and prevention of sedimentation of any adjacent waterways.
4. The Contractor shall install controls which will ensure that storm water and drainage from the disturbed area of the project site shall pass through some type of filter system before being discharged. The filter system must meet the requirements of TDEC.

D. Temporary Erosion and Sedimentation Control: In general, temporary erosion and sedimentation control procedures shall be directed toward:

1. Preventing soil erosion at the source.
2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

E. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the project site.

F. All Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Sevierville Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 QUALITY ASSURANCE

A. General: Perform all work under this section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated herein and these Specifications.

- B. Conflicts: Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.

PART 2 PRODUCTS

2.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL MATERIALS

- A. Silt fence shall meet the requirements of Tennessee Department of Transportation (TDOT) Specification, Section 918.27, Geotextile Material, latest edition. Silt fence fabric must be on the TDOT qualified product list for Geotextile (Type III) used for Erosion Control.
- B. Hay bales shall be clean, seed-free cereal, hay type.
- C. Netting shall be 1/2-inch, galvanized steel, chicken wire mesh.
- D. Filter stone shall be crushed stone conforming to TDOT Specification for mineral aggregate, size 57.
- E. Concrete block shall be hollow, non-load bearing type.
- F. Plywood shall be 3/4-inch thick exterior type.
- G. Erosion Control Matting shall be North American Green S-75.

2.2 RIP RAP

- A. Use only one method throughout the project.
- B. Stone Rip Rap: Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Rip rap shall have less than 66 percent wear when tested in accordance with AASHTO T-96. Unless shown or specified otherwise, stone rip rap shall be Type, 1 rip rap.
 - 1. Type A-1, Machined Rip Rap: The pieces shall vary in size from 2 inches to 1-1/4 feet with no more than 20 percent by weight being less than 4 inches. The thickness of the stone layer shall be 1-1/2 feet with a tolerance of 3 inches. Rip rap size shall conform to TDOT Specification, Section 709.03, Machined Rip Rap, Type A-1.
 - 2. Type A-2, Machined Rip Rap: Shall be identical to Class A-1 except that hand placed rubble stone rip rap placed 1-foot thick in accordance with TDOT Specification, Section 709, Roadway Design, may be substituted for 1-1/2 feet of machined rip rap.
 - 3. Type A-3, Machined Rip Rap: Shall vary in size from 2 inches to 6 inches with no more than 20 percent by weight being less than 4 inches.

C. Sand-Cement Bag Rip Rap:

1. The bags shall be of cotton, burlap or fiber reinforced paper capable of containing the sand-cement mixture without leakage during handling and placing. Bags previously used for sugar or any other material which will adversely affect the sand-cement mixture shall not be used. Capacity shall be not less than 3/4-cubic foot, nor more than 2 cubic feet.
2. Sand and Portland cement shall be mixed at the maximum ratio of 5:1 by weight and shall obtain a minimum compressive strength of 500 psi in 7 days. For sand-cement bag rip rap, the amount of water used shall be just enough to make up the optimum moisture content of the aggregate and cement, as determined by AASHTO T134. When sand-cement rip rap is to be prebagged, the sand-cement shall be mixed dry, and after placing each course, the bags shall be wet until sufficient moisture is present for proper cement hydration.

2.3 FILTER FABRIC

- A. Silt fence shall meet the requirements of TDOT Specification, Section 918.27, Geotextile Material, latest edition. Silt fence fabric must be on the TDOT qualified product list for Geotextile (Type III) used for Erosion Control.

2.4 CONCRETE

- A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 to 5 inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.
- B. Provide a concrete mix design for job mixed concrete for the Engineer's approval.

2.5 SILT CURTAIN

- A. Barriers shall be a bright color (yellow or "international" orange are recommended) that will attract the attention of nearby boaters.
- B. Seams in the fabric shall be either vulcanized, welded or sewn, and shall develop the full strength of the fabric.
- C. Flotation devices shall be flexible, buoyant units, contained in an individual flotation sleeve or collar attached to the curtain. Buoyancy provided by the flotation units shall be sufficient to support the weight of the curtain and maintain a freeboard of at least 3 inches above the water surface.
- D. Load lines shall be fabricated into the bottom of all floating turbidity curtains. The top load line shall consist of woven webbing or vinyl-sheathed steel cable and shall have a break strength in excess of 10,000 pounds. The supplemental (bottom) load line shall consist of a chain incorporated into the bottom hem of the curtain, with sufficient weight to serve as ballast to hold the curtain in a vertical position. Additional anchorage shall be provided as necessary. The load lines shall have suitable connecting devices which develop the full breaking strength for connecting to load lines in adjacent sections.

- E. External anchors may consist of wooden or metal stakes (2-inch x 4-inch or 2-1/2-inch minimum diameter wood or 1.33 pounds/linear foot steel).
- F. Bottom anchors shall be used and shall be sufficient to hold the curtain in the same position relative to the bottom of the watercourse, without interfering with the action of the curtain. The anchor may dig into the bottom (grappling hook, plow or fluke-type) or may be weighted (mushroom type) and shall be attached to a floating anchor buoy via an anchor line. The anchor line would then run from the buoy to the top load line of the curtain. These lines must contain enough slack to allow the buoy and curtain to float freely with water surface changes without pulling the buoy or curtain down and shall be checked regularly to make sure they do not become entangled with debris. Anchor spacing will vary with current velocity and potential wind and wave action; the Manufacturer's recommendations shall be followed.

2.6 POLYMER ADDITIVES

- A. Polyacrylamide (PAM) additives are permissible as a supplement to existing Best Management Practices and are not to be relied on as the only method for erosion control.
- B. If the Contractor intends to use PAM additives, they shall provide adequate documentation and testing to show the polymer type and dosing has been matched to the soil type found in the work area. Testing and documentation shall be prepared by the Manufacturer of the polymer or other licensed soil professional.
- C. PAM products include but are not limited to additives to the soil, hydroseeder, treated mat or treated check dams. Due to the different nature of products, the Manufacturer's directions shall be provided to the Engineer prior to their use. Toxicology reports shall be supplied with all submittal data prior to use.

PART 3 EXECUTION

3.1 GENERAL

- A. Standards: Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with TDEC, local enforcing agency guidelines, and these Specifications.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Temporary erosion and sedimentation control procedures should be initially directed toward preventing silt and sediment from entering the creeks. The preferred method is to provide an undisturbed natural buffer, extending a minimal 25 feet from the top of the bank, to filter the run-off. Should this buffer prove infeasible due to construction activities being too close to the creek, or if the amount of sediment overwhelms the buffer, the Contractor shall place silt fences to filter the run-off and, if necessary, place permanent rip rap to stabilize the creek banks.
- B. Silt dams, silt fences, traps, barriers, check dams, appurtenances, and other temporary measures and devices shall be installed as indicated on the approved plans and permits, shall be maintained until no longer needed, and shall then be removed. Deteriorated hay bales and

dislodged filter stone shall be replaced with new materials. Detention ponds, if constructed, shall be maintained in a condition ensuring that unfiltered water will not leave the pond.

- C. Where permanent grassing is not appropriate, and where the Contractor's temporary erosion and sedimentation control practices are inadequate, the Engineer may direct the Contractor to provide temporary vegetative cover with fast growing seedings. Such temporary vegetative cover shall be provided by the Contractor in compliance with TDEC, specifically in the selection of species, planting dates, and application rates for seedings, fertilizer, and mulching, with the exception that kudzu shall not be permitted.
- D. All erosion and sedimentation control devices, including check dams, shall be inspected by the Contractor at least weekly and after each rainfall occurrence and cleaned out and repaired by the Contractor as necessary.
- E. Temporary erosion and sedimentation control devices shall be installed and maintained from the initial land disturbance activity until the satisfactory completion and establishment of permanent erosion control measures. At that time, temporary devices shall be removed.

3.3 PERMANENT EROSION CONTROL

- A. Permanent erosion control shall include:
 - 1. Restoring the work site to its original contours, unless shown otherwise on the Drawings or directed by the Engineer.
 - 2. Permanent vegetative cover shall be performed in accordance with Article 3.4, below.
 - 3. Permanent stabilization of steep slopes and creeks shall be performed in accordance with Article 3.5, below.
- B. Permanent erosion control measures shall be implemented as soon as practical after the completion of pipe installation or land disturbance for each segment of the project. In no event shall implementation be postponed when no further construction activities will impact that portion or segment of the project. Partial payment requests may be withheld for those portions of the project not complying with this requirement.

3.4 GRASSING

- A. General:
 - 1. All references to grassing, unless noted otherwise, shall relate to establishing permanent vegetative cover as specified herein for seeding, fertilizing, mulching, etc.
 - 2. When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized, and mulched in an effort to restore to a protected condition. Critical areas shall be sodded as directed by the Engineer.
 - 3. Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.

4. Permanent grassing shall be of a perennial species.
 5. The Owner shall inspect seeding and grassing within 60 days after planting to determine if it is acceptable. If an acceptable growth is not obtained on the first planting, reseeding, and remulching will be required.
- B. Replant grass removed or damaged in residential areas using the same variety of grass and at the first appropriate season. Where sod is removed or damaged, replant such areas using sod of the same species of grass at the first appropriate season. Outside of residential or landscaped areas, grass the entire area disturbed by the work on completion of work in any area. In all areas, promptly establish successful stands of grass.
- C. Grassing activities shall comply with TDEC Specifications, specifically for the selection of species, with the exception that kudzu shall not be permitted, planting dates, and application rates for seeding, fertilizer, and mulching. Where permanent vegetative cover (grassing) cannot be immediately established (due to season or other circumstances) the Contractor shall provide temporary vegetative cover. The Contractor must return to the site (at the appropriate season) to install permanent vegetation in areas that have received temporary vegetative cover.

3.5 RIP RAP

- A. Unless shown otherwise on the Drawings, rip rap shall be placed where ordered by the Engineer, at all points where banks of streams or drainage ditches are disturbed by excavation, or at all points where natural vegetation is removed from banks of the streams or drainage ditches. Carefully compact backfill and place rip rap to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing a stream or drainage ditch.
- B. When trenching across a creek, place rip rap a distance of 10 feet upstream and 10 feet downstream from the top of the trench excavation. Place rip rap across creek bottom, across creek banks, and extend rip rap placement 5 feet beyond the top of each creek bank.
- C. Preparation of Foundations: The ground surface upon which the rip rap is to be placed shall be brought in reasonably close conformity to the correct lines and grades before placement is commenced. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers. Unless at creek banks or otherwise shown or specified, rip rap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope. The toe ditch shall be 2 feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the rip rap is placed, the toe ditch shall be backfilled, and the excess dirt spread neatly within the construction easement.
- D. Placement of Filter Fabric: The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions, and debris. The fabric shall be placed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps. The strips shall be placed to provide a minimum width of 1 foot of overlap for each joint. The filter fabric shall be anchored in place with securing pins of the type recommended by the Fabric Manufacturer. Pins shall be placed on or within 3 inches of the centerline of the overlap. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones. The stones shall be dropped no more

than 3 feet during construction. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Any contaminated fabric or any fabric damaged during its installation or during placement of rip rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the Owner.

- E. Placement of Rip Rap: The rip rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric. Rip rap shall be placed with its top elevation conforming with the finished grade or the natural slope of the stream bank and stream bottom.
1. Stone Rip Rap: Stone rip rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings. The thickness tolerance for the course shall be -6 inches and +12 inches. If the Drawings or the Bid do not specify a thickness, the course shall be placed to a thickness of not less than 18 inches.
 2. Sand-Cement Bag Rip Rap: The bags shall be uniformly filled to the maximum capacity which will permit satisfactory tying. The bagged rip rap shall be placed by hand with the tied ends facing the same direction, with close, broken joints. When directed by the Engineer or required by the Drawings, header courses shall be placed. After placing, the bags shall be rammed or packed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than 3 inches above or below the required plane.

END OF SECTION

PART 1 GENERAL**1.1 SCOPE**

- A. The Contractor shall provide a complete and comprehensive reference manual (Operating and Maintenance (O&M) Manual) containing operating and maintenance data to enable operators and plant engineers to correctly operate, service, and maintain all equipment and accessories covered by these Specifications and Drawings. The data contained in the manual shall explain and illustrate clearly and simply all principles and theory of operation, operating instructions, maintenance procedures, calibration procedures, and safety precautions and procedures for the equipment involved.
- B. No separate payment will be made for the O&M Manual and the cost of said manual shall be included in the Contract Price.

1.2 SUBMITTAL SCHEDULE

- A. The Contractor shall submit, for the Engineer's approval, 2 preliminary hard copies of the O&M Manual with all specified material before the work covered by these Contract Documents is 80 percent complete. The Engineer will notify the Contractor, in writing, of any deficiencies in the manual and will return one copy of the manual for completion and/or correction.
- B. Before the operating test period or final acceptance, the Contractor shall submit 2 hard copies and 1 electronic copy of the revised O&M Manual, complete in detail as specified below.
- C. Digital Copies of Manuals: O&M Manuals shall be provided by the Contractor in digital format. Materials available in digital format shall be furnished in accordance with the following:
 - 1. All textual data shall be provided as an electronic file in searchable Adobe Acrobat Portable Document Format (PDF). The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. File(s) shall be identified by utilization of an "eight dot three" convention (XXXXX.YY.pdf) where X is the 5-digit number corresponding to the Specification Section, and YY is an identification number. All documents shall be scanned at 300dpi or greater utilizing optical character recognition (OCR) software. All text in the document must be text selectable with the exception of pages which are in their entirety drawings or diagrams. Word searches of the PDF document must function successfully. PDF files that fail to comply with the indexing and searchable features described above will not be acceptable. All drawing data shall be provided in digital format compatible with AutoCAD Version 14.
 - 2. Materials not available in original digital format (available only in paper format) shall be scanned as noted above into a PDF format and cleaned to remove smudges, fingerprints, artifacts, and other extraneous marks. All notes, version stamps, etc. shall be preserved. Color maps shall be scanned in not less than the number of colors of the document or 16 colors, whichever is greater. Color photographs shall be saved in not less than 256 colors. Black and white or monochrome scans (non-

text) shall not be less than 16 gray scale levels. Color maps, color photographs, and black and white and gray scale photograph files shall be saved as GIF or JPG files, compatible with Adobe Photoshop Version 4.0. Documents shall be scanned in the existing color format of the document, i.e. color documents shall be scanned in color, and black and white or monochrome in gray scale.

3. After the documents are in correct digital format, they shall be furnished to the Engineer as a 120 mm, 680mb, 74-minute CD ROM. All media transmittals shall be accompanied by a detailed paper printout of the files on the media. This printout shall consist of a file name, file size, date of creation, submittal number, and a brief but accurate description of the file. Files shall not be transmitted by modem. One copy of the CD for each O&M Manual shall be provided to the Engineer.

1.3 SUBMITTAL FORMAT

- A. Each copy of the manual shall be assembled in one or more loose leaf binders, each with title page, typed table of contents, typed list of tables, typed list of figures, and heavy section dividers with reinforced holes and numbered plastic index tabs. Binders shall be 3-ring, hardback type, with transparent vinyl pocket front cover suitable for inserting identifying cover and with a transparent vinyl pocket on the spine for label. All data shall be punched for binding. Composition and printing shall be arranged so that punching does not obliterate any data. The cover and binding edge of each manual shall have the project title, Specification Document number and title, and manual title printed thereon, all as approved by the Engineer.
- B. All copies of Shop Drawings, figures, and diagrams shall be reduced to either 8-1/2 x 11 inches or to 11 inches in the vertical dimension and as near as practical to 17 inches in the horizontal dimensions. Such sheets shall be folded to 8-1/2 x 11 inches. The manual and other data shall be printed on first quality paper, 8-1/2 x 11-inch size with standard 3-hole punching. Binders shall be labeled Vol. 1, Vol. 2, etc., where more than one is required. The table of contents for the entire set, identified by volume number, shall appear in each binder. Text, figures, and drawings shall be clearly legible and suitable for dry process reproductions.
- C. Each submittal shall have a cover sheet that includes the following information:
 1. The date of submittal and the dates of any previous submittals.
 2. The project title.
 3. Numerical submittal numbers, starting with 1.90, 2.90, etc. Revisions to be numbered 1.91, 1.92, etc.
 4. The names of the:
 - a. Contractor;
 - b. Supplier; and
 - c. Manufacturer.
 5. Identification of the product, with the Specification Document number, permanent equipment tag numbers, and applicable drawing number.

- D. The Engineer will not recommend final acceptance of the work until the O&M Manual is complete and satisfactory to Engineer.

1.4 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

- A. Each O&M Manual shall include a title page which includes all information specified in Article 1.3, Paragraph C., above. In addition, the title page shall include the Manufacturer's address, phone number, facsimile number, and contact; the Manufacturer's equipment name and model number; and the Supplier's address, phone number, facsimile number, and contact.
- B. Each O&M Manual shall include a table of contents identifying the location of each item listed below, for each component supplied. For items not applicable to a component, the table of contents shall list N/A for the page number.
- C. For all equipment, the Contractor shall furnish a complete, detailed listing of all equipment, components, and accessories showing component name, Manufacturer, model number, and quantity information shall be furnished for each component as outlined below:
 - 1. Equipment function, normal operating characteristics, performance data, and limiting conditions.
 - 2. Detailed disassembly, overhaul and reassembly, installation, alignment, adjustment, and checking instructions.
 - 3. Detailed operating instructions for start-up, calibration, routine and normal operation, regulation and control, safety, shut-down and emergency conditions. Detailed list of settings for relays, pressure switches, temperature switches, level switches, thermostats, alarms, relief valves, rupture discs, etc.
 - 4. Detailed preventative maintenance procedures and schedules, including detailed lubrication instructions and schedules, identification of required lubricants and operating fluids (description, specification, and trade name of at least 2 Manufacturers), and diagrams illustrating lubrication points.
 - 5. Detailed guide to "troubleshooting".
 - 6. Detailed parts lists identified by title, materials of construction, Manufacturer's part number, list of recommended spare parts identified as specified above, predicted life of parts subject to wear, and an exploded or concise cut-away view of each equipment assembly.
 - 7. Electrical and instrumentation schematics, including motor control centers, control panels, instrument panels, and analyzer panels.
 - 8. List of all special tools supplied and description of their use. Special tools include any tool not normally available in an industrial hardware or mill supply house.
 - 9. List of names and addresses of nearest service centers for parts, overhaul, and service.
 - 10. Procedures for storing, handling, and disposing of any chemicals or products used with the equipment or system.

11. The Supplier's operation and maintenance information will address the particular equipment furnished, with specific details on operation and maintenance practices. General data is not acceptable. Information contained in the manual which is not acceptable to the project shall be marked out and noted as "N/A".

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. The Owner's requirements for all Record Drawings and As-Builts shall be as follows:
1. AutoCad format (minimum 2000 version)
 2. NAD83TN State Plane coordinates
 3. Include rim elevations for manholes
 4. Include invert elevations for all pipes entering/exiting manholes
 5. Include size and material for all pipes
 6. Include make/model of hydrants and valves

1.2 "BUY AMERICA" PROVISION

The City of Sevierville Water and Sewer Departments have adopted the Federal Government's BUY AMERICA requirements. All manufacturing processes for steel and iron materials furnished for permanent incorporation into the work shall occur in the United States of America (U.S.A.). The only exception to this requirement is the production of pig iron and the processing, pelletizing, and reduction of iron ore, which may occur in another country. Other than these exceptions, all melting, rolling, extruding, machining, bending, grinding, coating, etc. must occur in the U.S.A.

Products of steel include, but are not limited to, such products as structural steel, piles, reinforcing steel, structural plate, steel culverts, guardrail and steel supports for signs, signals, and luminaires. Products of iron include, but are not limited to, such products as cast iron frames and grates. Coatings include, but are not limited to, the applications of epoxy, galvanizing, and paint. The coating material is not subject to this clause, only the application process.

A Certificate of Compliance shall be furnished for steel and iron materials. Records to be maintained by the Contractor for this certification shall include a signed mill test report and a signed certification by each supplier, distributor, fabricator, and manufacturer that has handled the steel or iron product affirming that every process, including the application of a coating, performed on the steel or iron product has been carried out in the U.S.A., except as allowed by this provision. The lack of these certificates will be justification for rejection of the steel or iron product.

The requirements of said law and regulations do not prevent a minimal use of foreign steel and iron materials if the cost of such materials used does not exceed one-tenth of one percent (0.1%) of the total contract price or \$2,500.00, whichever is greater. Upon completion of the project, the Contractor shall certify in writing as to compliance with this provision and also provide the total project delivered cost of all foreign steel and/or iron permanently incorporated into the project. The form for this certification is entitled "Buy America Certificate of Compliance".

1.3 SEWER MAIN TAPPING

A. No tapping of sewer mains is allowed.

1.4 PRESSURE SEWER MAIN TAPPING

A. No tapping of pressure sewer mains is allowed.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. Clearing and grubbing includes, but is not limited to, removing from the project site, trees, stumps, roots, brush, structures, abandoned utilities, trash, debris, and all other materials found on or near the surface of the ground in the construction area and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated. Precautionary measures that prevent damage to existing features to remain are part of the work.
- B. Clearing and grubbing operations shall be coordinated with temporary and permanent erosion and sedimentation control procedures.
- C. These Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Sevierville Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 QUALITY ASSURANCE

- A. The Contractor shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state or federal authorities having jurisdiction over the project. All required permits of a temporary nature shall be obtained for construction operations by the Contractor.

1.3 JOB CONDITIONS

- A. Location of the Work: The area to be cleared and grubbed is shown schematically on the Drawings or specified below. It includes all areas designated for construction.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. The Contractor shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, tractors, trucks, and loaders.

PART 3 EXECUTION

3.1 SCHEDULING OF CLEARING

- A. The Contractor shall clear at each construction site only that length of the right-of-way, permanent or construction easement which would be the equivalent of one month's pipe laying. This length shall be determined from the Contractor's Progress Schedule.

- B. The Engineer may permit clearing for additional lengths of the pipeline provided that temporary erosion and sedimentation controls are in place and a satisfactory stand of temporary grass is established. Should a satisfactory stand of grass not be possible, no additional clearing shall be permitted beyond that specified above.
- C. A satisfactory stand of grass shall have no bare spots larger than 1 square yard. Bare spots shall be scattered, and the bare area shall not comprise more than 1 percent of any given area.

3.2 CLEARING AND GRUBBING

- A. Clear and grub, as required, on each side of the pipeline before excavating. Remove all trees, growth, debris, stumps, and other objectionable matter. Clear the construction easement or road right-of-way only if necessary.
- B. Materials to be cleared, grubbed, and removed from the project site include, but are not limited to, all trees, stumps, roots, brush, trash, organic matter, paving, miscellaneous structures, houses, debris, and abandoned utilities.
- C. Grubbing shall consist of completely removing roots, stumps, trash, and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.
- D. All stumps, roots, foundations, and planking embedded in the ground shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of 2 feet below the limits of excavation for structures, trenches, and roadways or 2 feet below finish grade, whichever is lower.
- E. Landscaping features shall include, but are not necessarily limited to, fences, mailboxes, cultivated trees, cultivated shrubbery, property corners, man-made improvements, subdivision and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly reestablishing these features.
- F. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as riprap.
- G. Where the tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.
- H. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.
- I. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored, and replaced. Any fencing that, in the Engineer's opinion, is significantly damaged shall be replaced with new fence material.
- J. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any damage the Contractor's operations have inflicted on such property.

- K. The Contractor shall be responsible for all damages to existing improvements resulting from Contractor's operations.

3.3 DISPOSAL OF DEBRIS

- A. The debris resulting from the clearing and grubbing operation shall be hauled to a disposal site secured by the Contractor and shall be disposed of in accordance with all requirements of federal, state, county, and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley. No debris shall be deposited upon any private property except with written consent of the property owner. In no case shall any material or debris be left on the project, shoved onto abutting private properties or buried on the project.

END OF SECTION

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PART 1 GENERAL

1.1 SCOPE

- A. The work under this section consists of furnishing all labor, equipment, and materials and performing all operations in connection with the trench excavation and backfill required to install the pipelines shown on the Drawings and as specified.
- B. Excavation shall include the removal of any trees, stumps, brush, debris or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install the pipe and appurtenances in conformance with the lines and grades shown on the Drawings and as specified.
- C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface or road grade at crossing.
- D. The trench is divided into five specific areas:
 - 1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization.
 - 2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
 - 3. Haunching: The area above the bottom of the barrel of the pipe up to a specified height above the bottom of the barrel of the pipe.
 - 4. Initial Backfill: The area above the haunching material and below a plane 12 inches above the top of the barrel of the pipe.
 - 5. Final Backfill: The area above a plane 12 inches above the top of the barrel of the pipe.
- E. The choice of method, means, techniques, and equipment rests with the Contractor. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected, available easement or right-of-way, and prevailing practice in the area.
- F. All Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Sevierville Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 QUALITY ASSURANCE

- A. Density: All references to “maximum dry density” shall mean the maximum dry density defined by ASTM D698, “Maximum Density-Optimum Moisture Test”. Determination of the density of foundation, bedding, haunching or backfill materials in place shall meet with the requirements of ASTM D1556, “Density of Soil In Place by the Sand Cone Method”; ASTM D2937, “Density of Soil In Place by the Drive-Cylinder Method” or ASTM D2922, “Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)”.
- B. Sources and Evaluation Testing: Testing of materials to certify conformance with the Specifications shall be performed by an independent testing laboratory at no cost to the Owner. The Contractor’s testing laboratory shall perform tests, at no cost to the Owner, upon change of source and at sufficient intervals during the work to certify conformance of all select material furnished for use on this project.

1.3 SAFETY

- A. Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act (OSHA) of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P, “Excavation, Trenching & Shoring” as described in OSHA Publication 2226. All trench safety is the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 TRENCH FOUNDATION MATERIALS

- A. Crushed stone or surge stone shall be utilized for trench foundation (trench stabilization).
- B. Crushed stone shall be crushed limestone and shall meet the requirements of the Tennessee Department of Transportation (TDOT), Specification 903.11. Stone size shall be between No. 57 and No. 4, inclusive, as determined by TDOT Specification 903.22.
- C. Surge stone shall be crushed limestone and shall meet the requirements of TDOT Specification 903.11. Stone size shall be No. 1, inclusive, as determined by TDOT Specification 903.22.

2.2 BEDDING AND HAUNCHING MATERIALS

- A. Unless specified otherwise, bedding and haunching materials shall be crushed stone or earth materials as specified below.
- B. Crushed stone utilized for bedding and haunching shall meet the requirements of TDOT Specification 903.11. Stone size shall be No. 57, as determined by TDOT Specification 903.22.
- C. Earth materials utilized for bedding and haunching shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes, and other unsuitable materials. Should the material excavated from the

trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, earth bedding and haunching materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as bedding or haunching material, provide select material conforming to the requirements of this section at no additional cost to the Owner.

2.3 INITIAL BACKFILL

- A. Unless shown on Drawings or specified otherwise, initial backfill material shall be crushed stone or earth materials as specified for bedding and haunching materials.
- B. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes, and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this section.

2.4 FINAL BACKFILL

- A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 3 inches at its greatest diameter, cinders, stumps, limbs, man-made wastes, and other unsuitable materials. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this section.

2.5 SELECT BACKFILL

- A. Select backfill shall be materials which meet the requirements as specified for bedding, haunching, initial backfill or final backfill materials, including compaction requirements.

2.6 CONCRETE

- A. Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 to 5 inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.7 FLOWABLE FILL

- A. Flowable fill for final backfill shall not have a compressive strength exceeding 150 psi, with not less than 100 pounds of cement per cubic yard, and a minimum of 250 pounds of Class C or F, Fly Ash, per cubic yard. Flowable fill shall be mixed and transported in accordance with ASTM C94.

PART 3 EXECUTION

3.1 TRENCH EXCAVATION

- A. Topsoil and grass shall be stripped a minimum of 6 inches over the trench excavation site and stockpiled separately for replacement over the finished grading areas.
- B. Trenches shall be excavated to the lines and grades shown on the Drawings with the centerlines of the trenches on the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipe and other structures and accessories.
- C. Trench Width for Pipelines:
 - 1. The sides of all trenches shall be vertical to a minimum of 1 foot above the top of the pipe. Unless otherwise indicated on the Drawings, the minimum trench width shall be equal to the sum of the outside diameter of the pipe plus 2 feet.
 - 2. Excavate the top portion of the trench to any width within the construction easement or right-of-way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.
 - 3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 12 inches clearance between the rock and the side of the pipe barrel or manhole.
 - 4. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher Class or Type of bedding and haunching as shown on the Drawings for the full trench width as actually cut. The excessive trench width may be due to unstable trench walls, inadequate or improperly placed bracing and sheeting which caused sloughing, accidental over-excavation, intentional over-excavation necessitated by the size of the Contractor's tamping and compaction equipment, intentional over-excavation due to the size of the Contractor's excavation equipment, or other reasons beyond the control of the Engineer or Owner.
- D. Depth:
 - 1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the dimensions shown on the Drawings.
 - 2. Force Mains and Low Pressure Mains:
 - a. Depth of Trenches: Excavate trenches to provide depths as shown on the Drawings. The depth of cover shall not exceed that as shown on the Drawings by more than 1 foot, without approval of the Engineer.
 - b. Excavate trenches to provide a minimum cover not less than 3 feet. Within the right-of-way of highways, streets or roadways, excavate to place the top of the pipe a minimum of 40 inches below the nearest pavement edge or drainage ditch.

- c. Increase the depth of cover where specifically shown on the Drawings and where necessary to avoid interference with underground utilities and obstructions.
 - d. Depth of cover shall not exceed 5 feet unless indicated on the Drawings.
 - 3. Where rock is encountered in trenches for pipelines, provide a minimum of 6 inches clearance between the bottom of the trench and the bottom of the pipe or accessory for pipe 21 inches in diameter and smaller and 12 inches for larger pipe, valves, and manholes.
- E. Excavated Materials:
 - 1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Topsoil shall be carefully separated and lastly placed in its original location.
 - 2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements.

3.2 SHEETING, BRACING, AND SHORING

- A. Sheeting, bracing, and shoring shall be performed in the following instances:
 - 1. Where sloping of the trench wall does not adequately protect persons within the trench from slides or cave-ins.
 - 2. In caving ground.
 - 3. In wet, saturated, flowing or otherwise unstable materials. The sides of all trenches and excavations shall be adequately sheeted, braced, and shored.
 - 4. Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees or private properties which are required to remain.
 - 5. Where necessary to maintain the top of the trench within the available construction easement or right-of-way.
- B. In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.
- C. Timber: Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots and in good, serviceable condition. Size and spacing shall be in accordance with OSHA regulations.
- D. Steel Sheeting and Sheet Piling: Steel sheet piling shall be the continuous interlock type. The weight, depth, and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth

that the ground under existing structures shall be protected against lateral movement at all times. The Contractor shall provide closure and sealing between sheet piling and existing facilities.

- E. Trench Shield: A trench shield or box may be used to support the trench walls. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting. When trench shields are used, care shall be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved. When the bottom of the trench shield extends below the top of the pipe, the trench shield shall be raised in 6-inch increments with specified backfilling occurring simultaneously. At no time shall the trench shield be “dragged” with the bottom of the shield extending below the top of the pipe or utility.
- F. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property. Leave sheeting in place when in the opinion of the Engineer it cannot be safely removed or is within 3 feet of an existing structure, utility or pipeline. Cut off any sheeting left in place at least 2 feet below the surface.

3.3 ROCK EXCAVATION

- A. Definition of Rock: Any material which cannot be excavated with conventional excavating equipment, and is removed by drilling and blasting, and occupies an original volume of at least one-half cubic yard.
- B. Blasting: Provide licensed, experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast. Repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.
- C. Removal of Rock: Dispose of rock off-site that is surplus or not suitable for use as rip rap or backfill.
- D. The Contractor shall notify the Engineer prior to any blasting. Additionally, the Contractor shall notify the Engineer before any charge is set.
- E. Following review by the Engineer regarding the proximity of permanent buildings and structures to the blasting site, the Engineer may direct the Contractor to employ an independent, qualified specialty subcontractor, approved by the Engineer, to monitor the blasting by use of seismograph, identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

3.4 DEWATERING EXCAVATIONS

- A. The Contractor, at his own expense, shall provide adequate facilities for promptly removing water from all excavations. Dewater the excavation continuously to maintain a water level 2 feet below the bottom of the trench.

- B. Control drainage in the vicinity of excavation so the ground surface is properly sloped to prevent water running into the excavation.
- C. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations. Where the utility crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.
- D. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.
- E. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least 2 feet below the bottom of the trench. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump 2 feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.
- F. Dewater by use of a well point system when pumping from sumps does not lower the water level 2 feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing, 6 to 10 inches in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand, and withdrawing the casing.

3.5 TRENCH FOUNDATION AND STABILIZATION

- A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. The trench bottom shall be graded to support the pipe and bedding uniformly throughout its length and width.
- B. Should the undisturbed material encountered at the trench bottom constitute, in the opinion of the Engineer, an unstable foundation for the pipe, the Contractor shall be required to remove such unstable material and fill the trench to the proper subgrade with crushed stone or 3,000 psi concrete as directed by the Engineer.
- C. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 90 percent of the maximum dry density, unless shown or specified otherwise.

3.6 BEDDING AND HAUNCHING

- A. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.
- B. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying

pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.

- C. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
- D. After the pipe section is properly placed, add the haunching material to the specified depth. The haunching material shall be shovel sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders or dirt clods.
- E. Gravity Sewers and Accessories: Lay PVC pipe with minimum Class “B”, Bedding. Lay all other pipe with Class “C”, Bedding, unless shown or specified otherwise.
 - 1. Class “A” (Bedding Factor - 2.8): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Lay pipe to line and grade on concrete block. Place concrete to the full width of the trench and to a height of one-fourth of the outside diameter of the pipe above the invert.
 - 2. Class “B” (Bedding Factor - 1.9): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to the centerline of the pipe.
 - 3. Class “C” (Bedding Factor - 1.5): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to a height of one-fourth the outside diameter of the pipe above the bottom of the pipe barrel.
 - 4. Type 5: Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade before installing pipe. After the pipe has been brought to the proper grade, haunching material shall be carefully placed by hand and compacted to the top of the pipe.
- F. Manholes: Excavate to a minimum of 12 inches below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.
- G. Force Mains and Low Pressure Mains:
 - 1. Ductile Iron Pipe:
 - a. Unless otherwise shown on the Drawings or specified, bedding and haunching shall utilize earth materials and meet the requirements for Type 2, Pipe Bedding, where rock is not encountered.

- b. In areas where rock is encountered, bedding and haunching material shall be crushed stone. Crushed stone bedding shall extend a minimum of 6 inches below the pipe.
- c. Where the depth of cover over the piping exceeds 15 feet, the pipe bedding shall meet the requirements of Type 4, Pipe Bedding. Where the depth of cover over the piping exceeds 18 feet, the pipe bedding shall meet the requirements of Type 5, Pipe Bedding.
- d. Type 4 or Type 5, Pipe Bedding, called for on the Drawings, specified or ordered by the Engineer, shall meet requirements for Type 4 or Type 5, Pipe Bedding, utilizing crushed stone bedding and haunching material.

2. Polyvinyl Chloride (PVC) Pipe:

- a. Unless otherwise shown on the Drawings or specified, bedding and haunching shall utilize earth materials and meet the requirements for Type 2, Pipe Bedding, where rock is not encountered.
- b. In areas where rock is encountered, bedding and haunching material shall be crushed stone. Crushed stone bedding shall extend a minimum of 6 inches below the pipe.

H. Excessive Width and Depth:

- 1. Gravity Sewers: If the trench is excavated to excess width, provide the bedding class with the next higher bedding factor. Crushed stone haunching and initial backfill may be used in lieu of Class "A", Bedding, where Class "A", Bedding, is necessitated by excessive trench width.
- 2. Force Mains: If the trench is excavated to excess width, provide the next higher type or class of pipe bedding, but a minimum of Type 4, as detailed on the Drawings.
- 3. If the trench is excavated to excessive depth, provide crushed stone to place the bedding at the proper elevation or grade.
- 4. Depth of cover will not exceed 5 feet unless indicated on the plans.

- I. Compaction: Bedding and haunching materials under pipe, manholes, and accessories shall be compacted to a minimum of 90 percent of the maximum dry density, unless shown or specified otherwise.

3.7 INITIAL BACKFILL

- A. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill, and ensure the uniform distribution of the loads over the top of the pipe.
- B. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 12 inches above the pipe barrel. Layer depths shall be a maximum of 6 inches for pipe 18 inches in diameter and smaller and a maximum of 12 inches for pipe larger than 18 inches in diameter.

- C. Backfill on both sides of the pipe simultaneously to prevent side pressures.
- D. Compact each layer thoroughly with suitable hand tools or tamping equipment.
- E. Initial backfill shall be compacted to a minimum 90 percent of the maximum dry density, unless shown or specified otherwise.
- F. In areas where the trench is cut into rock or where suitable backfill is unavailable, crushed stone shall be used for initial backfill up to 12 inches above the pipe barrel.
- G. Crushed stone shall be used for initial backfill up to 12 inches above the pipe barrel for all pipe material for gravity sewers.

3.8 CONCRETE ENCASEMENT FOR PIPELINES

- A. Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 6 inches clearance from the bell of the pipe. Lay the pipe to line and grade on sandbags. In lieu of bedding, haunching, and initial backfill, place concrete to the full width of the trench and to a height of not less than 6 inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.9 FINAL BACKFILL

- A. Backfill carefully to restore the ground surface to its original condition.
- B. The top 6 inches shall be topsoil obtained as specified in Article 3.1, Trench Excavation, above.
- C. Excavated material, which is unsuitable for backfilling and excess material, shall be disposed of, at no additional cost to the Owner, in a manner approved by the Engineer. Surplus soil may be distributed and spread over the site if approved by the Engineer. If such spreading is allowed, the site shall be left in a clean and sightly condition and shall not affect pre-construction drainage patterns. Surplus rock from the trenching operations shall be removed from the site.
- D. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this section.
- E. After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
 - 1. In 6-inch layers, if using light power tamping equipment, such as a “jumping jack”.
 - 2. In 12-inch layers, if using heavy tamping equipment, such as hammer with tamping feet.
 - 3. In 24-inch layers, if using a hydra-hammer.
- F. Settlement: If trench settles, refill and grade the surface to conform to the adjacent surfaces.

- G. Final backfill shall be compacted to a minimum 90 percent of the maximum dry density, unless specified otherwise.

3.10 BACKFILL UNDER ROADS

- A. Crushed stone shall be used as bedding, haunching, and initial backfill for all pipe materials. Flowable Fill shall be used as final backfill up to the top of the asphalt or concrete pavement. Steel plate shall cover the patch until the fill has cured. Once the Flowable Fill has cured, the required thickness can be removed, and appropriate materials can be used to repair the road.
- B. When required by the Owner, one-half of the road crossing shall be excavated, then temporary bridges consisting of steel plate shall be placed over the excavation for use by the traveling public; then the remainder of the excavation can be carried out.

3.11 BACKFILL WITHIN TDOT RIGHT-OF-WAY

- A. Backfill within the TDOT right-of-way shall meet all requirements, standards, and specifications stipulated by TDOT.

3.12 BACKFILL ALONG RESTRAINED JOINT PIPE

- A. Backfill along restrained joint pipe shall be compacted to a minimum 90 percent of the maximum dry density.

3.13 DETECTION WIRE

- A. Provide detection wire as specified in Section 33 30 00, Sewers and Accessories, Article 2.3, Paragraph C., for all pressure and gravity sewer mains and servicelines (regardless of pipe material).

3.14 TESTING AND INSPECTION

- A. The soils testing laboratory is responsible for the following:
 - 1. Compaction tests in accordance with Article 1.2, above.
 - 2. Field density tests for each 2 feet of lift, one test for each 2,000 feet of pipe installed or more frequently if ordered by the Engineer.
 - 3. Inspecting and testing stripped site, subgrades, and proposed fill materials.
- B. The Contractor's duties relative to testing include:
 - 1. Notifying laboratory of conditions requiring testing.
 - 2. Coordinating with laboratory for field testing.
 - 3. Paying costs for additional testing performed beyond the scope of that required and for retesting where initial tests reveal non-conformance with specified requirements.
 - 4. Providing excavation as necessary for laboratory personnel to conduct tests.

- C. Inspection:
1. Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill is subject to inspection by the Engineer.
 2. Foundations and shallow spread footing foundations are required to be inspected by a geotechnical engineer, who shall verify suitable bearing and construction.
- D. Comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state or federal authorities having jurisdiction.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. The work to be performed under this section shall consist of removing and replacing existing pavement, sidewalks, and curbs in paved areas where such have been removed for construction of water mains, fire hydrants, sewers, manholes, and all other water and sewer appurtenances and structures.
- B. All Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Sevierville Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 SUBMITTALS

- A. Certificates: Provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.

1.3 CONDITIONS

- A. Weather Limitations:
 - 1. Do not conduct paving operations when surface is wet or contains excess of moisture which would prevent uniform distribution and required penetration.
 - 2. Construct prime and tack coats, and asphaltic courses only when atmospheric temperature in the shade is above 50° F, when the underlying base is dry and when weather is not rainy.
 - 3. Place base course when air temperature is above 35° F and rising.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.
- C. Sevier County and City of Sevierville Streets: All work within Sevier County or the City of Sevierville road rights-of-way shall be performed in accordance with the requirements and specifications of the applicable agency.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Mineral Aggregate Base Course: Mineral aggregate base course shall conform to the requirements of the Tennessee Department of Transportation (TDOT) Bureau of Highways (BH), Standard Specification Section 303, Road and Bridge Construction, Type A base.

- B. Bituminous Plant Mix Base (Hot Mix): The base of all paved roadways shall conform to the requirements of TDOT BH, Standard Specification Section 307, Road and Bridge Construction.
- C. Bituminous Sand-Gravel Binder Course: The binder course of all paved roadways shall conform to the requirements of TDOT BH, Standard Specification Section 409, Road and Bridge Construction.
- D. Asphaltic Concrete Surface (Hot Mix): The surface course for all pavement shall conform to the requirements of TDOT BH, Standard Specification Section 411, Road and Bridge Construction, Grading "E".
- E. Double Bituminous Surface Treatment: The surface for all pavements shall conform to the requirements of TDOT BH, Standard Specification Section 404, Road and Bridge Construction.
- F. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of TDOT BH, Standard Specification Section 501, Road and Bridge Construction.
- G. Special Surfaces: Where driveways or roadways are disturbed or damaged which are constructed of specialty type surfaces, e.g. brick or stone, these driveways and roadways shall be restored utilizing similar, if not original, materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed. Where a construction joint is within 12 inches of the broken surface, the surface shall be removed and replaced to the point along the construction joint.

2.2 TYPES OF PAVEMENTS

- A. General: All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existing prior to construction, unless otherwise directed by the Engineer. Materials, equipment, and construction methods used for paving work shall conform to TDOT Specifications applicable to the particular type required for replacement, repair or new pavements.
- B. Aggregate Base: Aggregate base shall be constructed in accordance with the requirements of TDOT BH, Standard Specification Section 303, Road and Bridge Construction, Type A base. Material shall be mixed and placed by the stationary plant method. If the finished compacted base course depth is 6 inches or more, the course shall be constructed in 2 or more layers of approximately equal thickness.
- C. Concrete Pavement: Concrete pavement or base courses shall be replaced with concrete. The surface finish of the replaced concrete pavement shall conform to that of the existing pavement. The surface of the replaced concrete base course shall be left rough. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6 inches thick. Transverse and longitudinal joints removed from concrete pavement shall be replaced at the same locations and to the same types and dimensions as those removed. Concrete pavements or concrete base courses shall be reinforced and shall conform to TDOT BH, Standard Specification Section 501.

- D. Asphalt Concrete Base, Binder, and Surface Course: Asphalt concrete base, binder, and surface course construction shall conform to the following TDOT BH, Standard Specifications: Section 307, bituminous plant mix base course; Section 409, bituminous sand-gravel binder course; and Section 411, Grading “E”, asphalt concrete surface course. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared, is intact, compacted as specified herein, properly cured, dry, and the prime and/or tack coat has been applied. Apply and compact the asphalt concrete in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Engineer. After compaction, the asphalt concrete shall be smooth and true to established profiles and sections. Immediately correct any high, low or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.
- E. Double Bituminous Surface Treatment: Double bituminous surface treatment shall be replaced with a minimum thickness of 1-inch conforming to the requirements of TDOT BH, Standard Specification Section 404. No bituminous surface shall be installed between October 15 and April 15, and only when the air and pavement temperatures in the shade are above 60° F.
- F. Gravel Surfaces: Existing gravel road, drive, and parking area replacement shall meet the requirements of aggregate base course. This surfacing may be authorized by the Engineer as a temporary surface for paved streets until replacement of hard surfaced pavement is authorized.
- G. Temporary Measures: During the time period between pavement removal and complete replacement of permanent pavement, maintain highways, streets, and roadways by the use of steel running plates anchored to prevent movement. The backfill above the pipe shall be compacted, as specified elsewhere, up to the existing pavement surface to provide support for the steel running plates. All pavement shall be replaced within 7 calendar days of its removal.

PART 3 EXECUTION

3.1 REMOVING PAVEMENT

- A. General: Remove existing pavement as necessary for installing the pipeline and appurtenances.
- B. Marking: Before removing any pavement, mark the pavement neatly paralleling pipelines and existing streetlines. Space the marks the width of the trench.
- C. Breaking: Break asphalt pavement along the marks using pavement shearing equipment, jack hammers or other suitable tools. Break concrete pavement along the marks by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.
- D. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.
- E. Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

- F. Damage to Traffic Signal Loops: Any pavement removal which will include removal of traffic signal loops embedded in the pavement shall be coordinated with the City of Sevierville, Traffic Engineering Department, having jurisdiction over the traffic signal 5 days prior to pavement removal.
- G. Sidewalk: Remove and replace any sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
- H. Curbs: Tunnel under or remove and replace any curb disturbed by construction to the nearest undisturbed joint.

3.2 REPLACING PAVEMENT

- A. Preparation of Subgrade: During backfilling and compaction of the backfill, arrange to have the compaction tested by an independent testing laboratory. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks, and curbs removed.
 - 1. The existing street pavement or surface shall be removed along the lines of the work for the allowable width specified for the trench or structure. After the installation of the sewerage or water works facilities and after the backfill has been compacted suitably, the additional width of pavement to be removed, as shown on the Drawings, shall be done immediately prior to replacing the pavement.
 - 2. Trench backfill shall utilize flowable fill for the full depth of the trench as specified in Section 31 23 33, Trench Excavation and Backfill, of these Specifications.
 - 3. Temporary trench backfill along streets and driveways shall include 6 inches of crushed stone or cherty clay as a temporary surfacing of the trenches. This temporary surface shall be maintained carefully at grade and dust-free by the Contractor until the backfill of the trench has thoroughly compacted in the opinion of the Engineer and permission is granted to replace the street pavement.
 - 4. When temporary crushed stone or chert surface is considered by the Engineer to be sufficient surface for gravel pavement, the surface shall be graded smooth and to an elevation that will make the final permanent surfacing level with the adjacent surfacing that was undisturbed.
- B. Pavement Replacement:
 - 1. Prior to replacing pavement, make a final cut in concrete pavement 12 inches back from the edge of the damaged pavement with a concrete saw. Remove asphalt pavement 12 inches back from the edge of the damaged pavement using pavement shearing equipment, jack hammers or other suitable tools.
 - 2. Replace all street and roadway pavement as shown on the Drawings. Replace driveways, sidewalks, and curbs with the same material, to nearest existing undisturbed construction joint and to the same dimensions as those existing.
 - 3. If the temporary crushed stone or chert surface is to be replaced, the top 6 inches shall be removed and the crushed stone surfacing for unpaved streets or the base for the bituminous surface shall be placed.

4. Following this preparation, the chert or crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.
5. Where the paved surface is to be replaced with asphaltic concrete pavement, concrete pavement or with a concrete base and a surface course, the temporary chert or crushed stone surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings. All edges of the existing pavement shall be cut to a straight, vertical edge. Care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.
6. Where driveways or roadways, constructed of specialty type surfaces, e.g. brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed. Where a construction joint is within 12 inches of the broken surface, the surface shall be removed and replaced to the nearest undisturbed construction joint.

C. Pavement Resurfacing:

1. Certain areas to be resurfaced are specified or noted on the Drawings. Where pavement to be resurfaced has been damaged with potholes, the Contractor shall remove all existing loose pavement material and fill the hole with Bituminous Plant Mix Base, as specified, to the level of the existing pavement. After all pipeline installations are complete and existing pavement has been removed and replaced along the trench route, apply tack coat and surface course as specified.
2. Resurfacing limits shall be perpendicular to the road centerline. The limits of resurfacing shall be 10 feet beyond the edge of the pavement replacement on the main road being resurfaced, and to the point of tangency of the pavement on the side streets.

D. Pavement Striping: Pavement striping removed or paved over shall be replaced with the same type, dimension, and material as original unless directed otherwise by the Engineer.

E. Traffic Signal Loops: The replacement or repair of all traffic signal loops removed or damaged during the removal and replacement of pavement shall be coordinated by the Contractor with the City of Sevierville, Traffic Engineering Department, having jurisdiction over each traffic signal. The Contractor shall be responsible for payment of all fees associated with replacement or repair of traffic signal loops.

3.3 SIDEWALK AND CURB REPLACEMENT

A. Construction:

1. Whenever sidewalks are removed or disturbed in connection with construction work, they shall be replaced to the original lines and grades in fully as good or better condition than which existed prior to the Contractor's operations. All concrete

sidewalks and curbs shall be replaced with class “A” concrete. Other types of sidewalks, such as brick, stone, etc., shall be replaced with material removed during the progress of the work, in equally as good or better condition as the original.

2. Pre-formed joints shall be 1/2-inch thick, conforming to the latest edition of AASHTO M59 for sidewalks and AASHTO M123 for curbs.
 3. Forms for sidewalks shall be of wood or metal, shall be straight and free from warp, and shall be of sufficient strength, when in place, to hold the concrete true to line and grade without springing or distorting.
 4. Forms for curbs shall be metal and of an approved section. They shall be straight and free from distortions, showing no vertical variation greater than 1/8-inch in 10 feet and no lateral variation greater than 1/4-inch in 10 feet from the true plain surface on the vertical face of the form. Forms shall be of the full depth of the structure and constructed such to permit the inside forms to be securely fastened to the outside forms.
 5. Securely hold forms in place true to the lines and grades indicated on the Drawings.
 6. Wood forms may be used on sharp turns and for special sections, as approved by the Engineer. Where wooden forms are used, they shall be free from warp and shall be the nominal depth of the structure.
 7. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.
- B. When a section is removed, the existing sidewalk or curb shall be cut to a neat line, perpendicular to both the centerline and the surface of the concrete slab. Existing concrete shall be cut along the nearest existing construction joints; if such joints do not exist, the cut shall be made at minimum distances shown on the Drawings.
- C. Existing concrete sidewalks and curbs that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed. Sidewalks shall have a minimum uniform thickness of 4 inches. The new work shall be neatly jointed to the existing concrete so that the surface of the new work shall form an even, unbroken plane with the existing surfaces.
- D. The subgrade shall be formed by excavating to a depth equal to the thickness of the concrete, plus 2 inches. Subgrade shall be of such width as to permit the proper installation and bracing of the forms. Subgrades shall be compacted by hand tamping or rolling. Soft, yielding or unstable material shall be removed and backfilled with satisfactory material. Place 2 inches of porous crushed stone under all sidewalks and curbs and compact thoroughly, then finish to a smooth, unyielding surface at proper line, grade, and cross section. Immediately prior to pouring concrete, the stone shall be thoroughly wetted, or the concrete shall be poured on a layer of heavy building paper.

E. Joint for Curbs:

1. Joints shall be constructed as indicated on the Drawings and as specified. Construct joints true to line with their faces perpendicular to the surface of the structure and within 1/4-inch of their designated position.
2. Thoroughly spade and compact the concrete at the faces of all joints filling all voids.
3. Install expansion joint materials at the point of curve at all street returns. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
4. Place contraction joints every 10 feet along the length of the curbs and gutters. Form contraction joints using steel templates or division plates which conform to the cross section of the structure. Leave the templates in place until the concrete has set sufficiently to hold its shape but remove them while the forms are still in place. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or they shall be notched to permit the reinforcement to be continuous through the joint. Contraction joints shall be a minimum of 1-1/2 inches deep.

F. Expansion joints shall be required to replace any removed expansion joints or in new construction wherever shown on the Drawings. Expansion joints shall be true and even, shall present a satisfactory appearance, and shall extend to within 1/2-inch of the top of finished concrete surface.

G. Finishing:

1. Strike off the surface with a template and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made, and the surface finished with a wood float or steel trowel.
2. Finish the face of the curbs at the top and bottom with an approved finishing tool of the radius indicated on the Drawings.
3. Finish edges with an approved finishing tool having a 1/4-inch radius.
4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.
5. The finished surface shall not vary more than 1/8-inch in 10 feet from the established grade.

H. Driveway and Sidewalk Ramp Openings:

1. Provide driveway openings of the widths and at the locations indicated on the Drawings and as directed by the Engineer.
2. Provide sidewalk ramp openings as indicated on the Drawings, in conformance with the applicable regulations and as directed by the Engineer.

- I. Concrete shall be suitably protected from freezing and excessive heat. It shall be kept covered with burlap or other suitable material and kept wet until cured. Provide necessary barricades to protect the work. All damage caused by people, vehicles, animals, rain, the Contractor's operations, and the like shall be repaired by the Contractor, at no additional expense to the Owner.

3.4 MAINTENANCE

- A. The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the project. 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 Engineer. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.5 SUPERVISION AND APPROVAL

- A. Pavement restoration shall meet the requirements of the City of Sevierville, Sevier County Highway Department or another agency as required. All permits shall be obtained prior to cutting or working around any pavement. Obtain agency approval of pavement restorations before requesting final approval.
- B. Obtain the Engineer's approval of restoration of pavement, such as private roads and drives that are not the responsibility of a regulatory agency.
- C. Complete pavement restoration as soon as possible after backfilling.
- D. Failure of Pavement: Should any pavement restoration or repairs fail or settle during the life of the Contract, including the warranty period, promptly restore or repair defects.

3.6 CLEANING

- A. The Contractor shall remove all surplus excavation materials and debris from the street surfaces and rights-of-way and shall restore street, roadway or sidewalk surfacing to its original condition.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment, and miscellaneous items as necessary for the installation of a complete chain link fence system. Fencing shall be installed in the location as shown on the Drawings in complete conformity with the Manufacturer's written recommendations and as specified herein.
- B. Security fencing for the Contractor is at Contractor's option and is not included as part of the work specified.

1.2 SUBMITTALS

- A. Product data shall be submitted in complete conformance with the requirements of Section 01 33 23, Shop Drawings, Product Data, and Samples, of these Specifications.

1.3 DELIVERY AND HANDLING

- A. Deliver materials with the Manufacturer's tags and labels intact.
- B. Handle and store materials in such a manner that will avoid damage.

1.4 STORAGE AND PROTECTION

- A. All materials shall be stored and protected in accordance with the Manufacturer's recommendations and as approved by the Engineer.

1.5 QUALITY ASSURANCE

- A. Standards of Manufacturer shall comply with the standards of the Chain Link Manufacturers Institute and these Specifications.
- B. Provide fencing as a complete unit produced by a single Manufacturer including the required erection accessories, fittings, and fasteners.

PART 2 PRODUCTS

2.1 GENERAL

- A. Overall height for new fencing shall be 9 feet including 3 strands of barbed wire on malleable iron post tops. Posts shall be set at no more than 10 foot centers, a full 3 feet deep in concrete footings, poured the full size of the holes as excavated. Corner posts shall have the necessary strut and tie bracing. Gates shall be provided of the size and at the locations indicated on the Drawings.

- B. Where fencing crosses ditches, steep grades, and other unusual conditions, make special provisions to ensure that the security, appearance, maintainability, and permanence of the standard fencing are equaled or exceeded.

2.2 MATERIALS AND CONSTRUCTION

- A. Fence Mesh: 9 gauge wire, woven to 2-inch squares, galvanized after weaving, 8 foot wide roll. Continuous tension wire shall be provided at the lower edge of the mesh.
- B. Line Post: 2-1/2-inch O.D. Galvanized Pipe (3.65 #/ft.)
- C. Corner Post: 3-inch O.D. Galvanized Pipe (5.79 #/ft.)
- D. Gate Post: 4-inch O.D. Galvanized Pipe (9.11 #/ft.)
- E. Top Rail: 1-5/8-inch O.D. Galvanized Pipe (2.27 #/ft.) with extra long pressed steel sleeves.
- F. Gates shall be supplied with heavy-duty latches, keepers, and heavy duty hardened bronze padlocks with duplicate keys.
- G. Gate Frames: 2-inch O.D. Galvanized Pipe Frame (2.72 #/ft.)
- H. Fencescreen: 100 percent High Density Polypropylene (HDPE); Melt Index: 0.6; Density: 0.957; Tensile Strength: 3,700 psi; match to fence height; equal to 4000 Series Tube Slats with Bottom Lock by fencescreen.com. Color to be selected by Owner.
- I. Barbed wire shall consist of 3 strands of 12 gauge wire, with 4-point pattern barbs, galvanized after weaving.
- J. Concrete shall be furnished in accordance with the requirements of Section 33 30 00, Sewers and Accessories, of these Specifications.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fence installation shall not be started before the final grading is completed, with finish grade elevations established, unless otherwise permitted.
- B. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. If not shown on the Drawings, excavate holes to the minimum diameters as recommended by Fence Manufacturer.

2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than the post bottom, with bottom of posts set not less than 36 inches below the surface when in firm, undisturbed soil.
 3. If solid rock is encountered near the surface, drill into rock at least 12 inches for line posts and at least 18 inches for end, pull corner, and gate posts. Drill hole at least 1-inch greater diameter than the largest dimension for the post to be placed. If solid rock is below soil overburden, drill to full depth required. Penetration into rock need not exceed the minimum depths specified above.
- C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes and moisten soil prior to placing concrete.
1. Center and align posts in holes 3 inches above bottom of excavation.
 2. Place concrete around posts in a continuous pour and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
 3. Trowel finish tops of footings and slope of dome to direct water away from posts. Extend footings for gate posts to the underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.
 4. Keep exposed concrete surfaces moist for at least 7 days after placement or cure with membrane curing materials or other acceptable curing methods.
 5. Grout-in posts set into sleeved holes, concrete constructions or rock excavations with non-shrink Portland cement grout or other acceptable grouting material.
- D. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28 day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire or fabric is installed. Do not stretch and tension fabric and wires and do not hang gates until the concrete has attained its full design strength.
- E. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by Fence Manufacturer.
- F. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- G. Tension Wire: Install tension wires by weaving through the fabric and tying to each post with not less than 6 gauge galvanized wire or by securing the wire to the fabric.
- H. Fabric: Pull fabric taut and tie to posts, rails and tension wires. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.

- I. Repair damaged coatings in the shop or during field erection by recoating with Manufacturer's recommended repair compound, applied per Manufacturer's directions.
- J. Stretcher Bars: Thread through or clamp to fabric 4 inches on center and secure to posts with metal bands spaced 15 inches on center.
- K. Barbed Wire: Install 3 parallel wires on each extension arm; on security side of fence, unless otherwise indicated. Pull wire taut and fasten securely to each extension arm.
- L. Tie Wires: Use U-shaped wire appropriate for the diameter of pipe. Attach pipe and fabric firmly with tie wire ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
- M. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.2 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all debris and equipment. Repair all damage resulting from chain link fence system installation.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to bore and jack casings and to properly complete pipeline construction as described herein and/or shown on the Drawings.
- B. Supply all materials and perform all work in accordance with applicable American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI) or other recognized standards. Latest revisions of all standards are applicable. If requested by the Engineer, submit evidence that the Manufacturer has consistently produced products of satisfactory quality and performance over a period of at least 2 years.
- C. All Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Sevierville Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 SUBMITTALS

- A. Submit Shop Drawings, product data, and experience in accordance with the requirements set forth by the Owner.
- B. Material Submittals: The Contractor shall provide Shop Drawings and other pertinent specifications and product data as follows:
 - 1. Shop Drawings for casing pipe showing sizes and connection details.
 - 2. Design mixes for concrete and grout.
 - 3. Casing Spacers.
- C. Experience Submittals: Boring and jacking casings is deemed to be specialty contractor work. A minimum of 5 continuous years of experience in steel casing construction is required of the casing installer. Evidence of this experience must be provided with the Shop Drawings for review by the Engineer.

1.3 STORAGE AND PROTECTION

- A. All materials shall be stored and protected in accordance with the Manufacturer's recommendations and as approved by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Casing:

1. The casing shall be new and unused pipe. The casing shall be made from steel plate having a minimum yield strength of 35,000 psi. The steel plate shall also meet the chemical requirements of one of the following: ASTM A36; ASTM A139, Grade B, C, D or E; ASTM A53, Type S or Type E, Grade A or B.
2. The thicknesses of casing shown in Paragraph B., below, are minimum thicknesses. Actual thicknesses shall be determined by the casing installer, based on an evaluation of the required forces to be exerted on the casing when jacking. Any buckling of the casing due to jacking forces shall be repaired at no additional cost to the Owner.
3. The diameters of casing shown in Paragraph B., below, and shown on the Drawings are minimum. Larger casings, with the Engineer's approval, may be provided at no additional cost to the Owner, for whatever reasons the Contractor may decide, whether casing size availability, line and grade tolerances, soil conditions, etc.

B. Casing Sizes:

UNDER RAILROADS		
Pipe Diameter, inches	Casing Diameter, inches	Wall Thickness, Inches - Coated
6	14	0.250
8	18	0.250
10	20	0.281
12	24	0.344
14	24	0.344
16	32	0.438
18	36	0.469
20	42	0.500
24	48	0.625

UNDER HIGHWAYS		
Pipe Diameter, inches	Casing Diameter, inches	Wall Thickness, inches
6	12	0.250
8	16	0.250
10	20	0.250
12	24	0.250
14	30	0.312
16	32	0.312
18	36	0.375
20	42	0.375
24	48	0.500

C. Casing Spacers: 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 liner, minimum 0.09-inch thick also having a hardness of 85-90 durometer. 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 such that the pipe does not float within the casing.
2. Casing spacers shall be a two-section, 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 thick having a hardness of 85-90 durometer, and all stainless steel or cadmium plated hardware.

3. Casing spacers shall be equal to Cascade Waterworks Manufacturing Company, Pipeline Seal and Insulator, Inc. or Advance Products and Systems, Inc.
 4. Three casing spacers shall be installed per joint of pipe installed in the casing or per the Manufacturer's recommendation, whichever is greater.
- D. Carrier Pipe: Carrier pipes shall meet requirements as specified in Section 33 30 00, Sewers and Accessories, of these Specifications, for restrained joint pipe.
- E. End seals will be used to seal the carrier and casing pipe ends. Seal material shall be 1/8-inch thick synthetic rubber secured with T-304 stainless steel banding straps. Seals shall be by Advance Products & Systems, Inc., Model AC.
- F. Surface Settlement Markers: Surface settlement markers within pavement areas shall be P.K. nails. Surface settlement markers within non-paved areas shall be wooden hubs.

2.2 EQUIPMENT

- A. A cutting head shall be attached to a continuous auger mounted inside the casing pipe.
- B. On casing pipe for gravity sewer over 60 feet in length, the installation equipment shall include a steering head and a grade indicator.
- C. The steering head shall be controlled manually from the bore pit. The grade indicator shall consist of a water level attached to the casing which would indicate the elevation of the front end of the casing or some other means for grade indication approved by the Engineer.

PART 3 EXECUTION

3.1 GENERAL

- A. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriate authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.
- B. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages, and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to the Owner.

- C. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.
- D. Casing Design: Design of the bore pit and required bearing to resist jacking forces are the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to the Owner. Due to restrictive right-of-way and construction easements, boring and jacking casing lengths less than the nominal 20-foot length may be necessary.
- E. Highway Crossings:
 - 1. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the highway right-of-way.
 - 2. Work along or across the highway department rights-of-way shall be subject to inspection by such highway department.
 - 3. All installations shall be performed to leave free flows in drainage ditches, pipes, culverts or other surface drainage facilities of the highway, street or its connections.
 - 4. No excavated material or equipment shall be placed on the pavement or shoulders of the roadway without the express approval of the highway department.
 - 5. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight. Construction materials to be installed, which are placed on the right-of-way in advance of construction, shall be placed in such a manner as not to interfere with the safe operation of the roadway.
 - 6. The Contractor shall be responsible for providing the Owner sufficient information to obtain a blasting permit in a timely manner.
- F. Railroad Crossings:
 - 1. The Contractor shall secure permission from the Railroad to schedule work so as not to interfere with the operation of the Railroad.
 - 2. Additional insurance is required for each railroad crossing. The Contractor shall furnish the Railroad with such additional insurance as may be needed, cost of the same shall be borne by the Contractor.
 - 3. All work on the Railroad right-of-way, including necessary support of tracks, safety of operations, and other standard and incidental operation procedures may be under the supervision of the appropriate authorized representative of the Railroad affected and any decisions of this representative pertaining to construction and/or operations shall be final and construction must be governed by such decisions.
 - 4. If, in the opinion of the Railroad, it becomes necessary to provide flagging protection, watchmen or the performance of any other work in order to keep the tracks safe for traffic, the Contractor shall coordinate such work and shall reimburse

the Railroad, in cash, for such services, in accordance with accounting procedures agreed on by the Contractor and affected Railroad before construction is started.

5. No blasting shall be permitted within the Railroad right-of-way.

3.2 GROUND WATER CONTROL

- A. The Contractor shall control the ground water throughout the construction of the casing.
- B. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.
- C. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24-hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum. Dewater into a sediment trap and comply with requirements specified in Section 01 57 13, Erosion and Sedimentation Control, of these Specifications.

3.3 SAFETY

- A. Provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic, persons, and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.
- B. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.
- C. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL-596), as amended, applicable regulations of the Federal Government, OSHA 29 CFR 1926 and applicable criteria of ANSI A10.16-81, "Safety Requirements for Construction of Tunnel Shafts and Caissons".

3.4 SURFACE SETTLEMENT MONITORING

- A. Provide surface settlement markers, placed as specified and as directed by the Engineer. The Contractor shall place settlement markers outside of pavement area, along the centerline of the casing at 20-foot intervals and offset 10 feet each way from the centerline of the tunnel. Markers shall also be placed at each shoulder of the roadway, at each edge of pavement, at the centerline of the pavement, and at 10 and 25 feet in each direction from the centerline of the casing. Tie settlement markers to benchmarks and indices sufficiently removed as not to be affected by the casing operations.
- B. Make observations of surface settlement markers, placed as required herein, at regular time intervals acceptable to the Engineer. In the event settlement or heave on any marker exceeds 1-inch, the Contractor shall immediately cease work and using a method approved by the Engineer and the authority having jurisdiction over the project site, take immediate action to restore surface elevations to that existing prior to start of casing operations.

- C. Take readings and permanently record surface elevations prior to start of dewatering operations and/or shaft excavation. The following schedule shall be used for obtaining and recording elevation readings: all settlement markers, once a week; all settlement markers within 50 feet of the casing heading, at the beginning of each day; more frequently at the Engineer's direction if settlement is identified. Make all elevation measurements to the nearest 0.01 foot.
- D. The Contractor shall cooperate fully with jurisdictional personnel. Any settlement shall be corrected by, and at the expense of, the Contractor.
- E. Promptly report any settlement and horizontal movement immediately to the Engineer and take immediate remedial action.

3.5 BORING AND JACKING

A. Shaft:

1. Conduct boring and jacking operations from a shaft excavated at one end of the section to be bored. Where conditions and accessibility are suitable, place the shaft on the downstream end of the bore.
2. The shaft shall be rectangular and excavated to a width and length required for ample working space. If necessary, sheet and shore shaft properly on all sides. Shaft sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to site and soil conditions. Keep preparations dry during all operations. Perform pumping operations as necessary.
3. The bottom of the shaft shall be firm and unyielding to form an adequate foundation upon which to work. In the event the shaft bottom is not stable, excavate to such additional depth as required and place a gravel subbase or a concrete subbase, if directed by the Engineer due to soil conditions.

B. Jacking Rails and Frame:

1. Set jacking rails to proper line and grade within the shaft. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.
2. Place backing between the heels of jacking rails and the rear of the shaft. The backing shall be adequate to withstand all jacking forces and loads.
3. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.

- C. Boring and jacking of casing pipes shall be accomplished by the dry auger boring method without jetting, sluicing or wet-boring.
- D. Auger the hole and jack the casing through the soil simultaneously.

- E. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
- F. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe. Make all investigations and determine if the soil conditions are such as to require the use of a shield.
- G. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation. For casing pipe installations over 100 feet in length, the auger shall be removed, and the alignment and grade checked at minimum intervals of 60 feet.
- H. Any casing pipe damaged in jacking operations shall be repaired, if approved by the Engineer, or removed and replaced at Contractor's own expense.
- I. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise. Joints between casing pipe sections shall be butt joints with complete joint penetration, single groove welds, for the entire joint circumference, in accordance with AWS recommended procedures. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.
- J. The Contractor shall prepare a contingency plan which will allow the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.
- K. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.
- L. Care shall be taken to ensure that casing pipe installed by boring and jacking method will be at the proper alignment and grade.
- M. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.
- N. Adequate sheeting, shoring, and bracing for embankments, operating pits, and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring, and bracing shall be left in place, cut off or removed, as designated by the Engineer.
- O. Trench excavation, all classes and type of excavation, the removal of rock, muck, debris, the excavation of all working pits, and backfill requirements of Section 31 23 33, Trench Excavation and Backfill, of these Specifications.
- P. All surplus material shall be removed from the right-of-way and the excavation finished flush with the surrounding ground.
- Q. Grout backfill shall be used for unused holes or abandoned pipes.

- R. Any replacement of carrier pipe in an existing casing shall be considered a new installation, subject to the applicable requirements of these Specifications.

3.6 VENTILATION AND AIR QUALITY

- A. Provide, operate, and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.

3.7 INSTALLATION OF PIPE

- A. After construction of the casing is complete, and has been accepted by the Engineer, install the pipeline in accordance with the Drawings and Specifications.
- B. Check the alignment and grade of the casing and prepare a plan to set the pipe at proper alignment, grade, and elevation, without any sags or high spots.
- C. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1-inch. Provide a minimum of 3 casing spacers per nominal length of pipe.
- D. Close the ends of the casing with end seals.

3.8 SHEETING REMOVAL

- A. Remove sheeting used for shoring from the shaft and off the jobsite. The removal of sheeting, shoring, and bracing shall be done in such a manner as not to endanger or damage either new or existing structures, private or public properties, and also to avoid cave-ins or sliding in the banks.

3.9 INTERSTATE RESTORATION

- A. When boring and jacking operations encroach upon the rights-of-way of the federal interstate system, the Contractor shall restore all screening trees with seedlings of like species.

END OF SECTION

PART 1 GENERAL**1.1 SCOPE**

- A. This section describes products to be incorporated into sewers and accessories and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- B. General: Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI) or other recognized standards. Latest revisions of all standards are applicable.
- C. All Specifications are only the minimum requirements; actual requirements may be greater depending upon the situation. These Specifications may be adjusted by the sole discretion of the City of Water and Sewer Department to fit a particular situation not routinely encountered, or as public safety issues become apparent.

1.2 QUALIFICATIONS

- A. If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least 2 years.

1.3 SUBMITTALS

- A. Complete Shop Drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01 33 23, Shop Drawings, Product Data, and Samples, of these Specifications.
- B. Operating and maintenance data for all equipment shall be furnished in accordance with Section 01 78 23, Operating and Maintenance Data, of these Specifications.

1.4 TRANSPORTATION AND HANDLING

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing, and storing pipe, fittings, valves, and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.
- B. Handling: Handle pipe, fittings, valves, and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift or front loader. Do not use material damaged in handling.

1.5 STORAGE AND PROTECTION

- A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.

- B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least 2 rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.
- D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

1.6 QUALITY ASSURANCE

- A. Product manufacturers shall provide the Engineer with written certification that all products furnished comply with all applicable provisions of these Specifications. All materials which fail to conform to these Specifications shall be rejected.
- B. After delivery to the site, any materials which have been damaged in transit or are unsuitable for use in the work shall be rejected and removed from the site.
- C. All products shall be of new manufacture and free of defects and damage. No products will be allowed which were manufactured more than 1 year prior to date of installation.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe (DIP) shall be manufactured in accordance with AWWA C151. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
4 – 18	350
20	300
24	250

- 1. Pipe and fittings shall have ceramic epoxy lining (Protecto 401). Pipe and fittings shall be furnished with a bituminous outside coating.
- B. Fittings and Accessories:
 - 1. Fittings shall be ductile iron mechanical joint and shall conform to AWWA C110 or C153 with a minimum rated working pressure of 350 psi.

2. Thrust Collars: Thrust collars shall be welded-on ductile iron body type capable of withstanding a thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. Weld-on collars shall be continuously welded to the pipe by the pipe manufacturer. Retainer glands may be used for thrust collars where shown on the Drawings and as specified in this section.
 3. Solid Sleeves: Solid sleeves shall permit the connection of plain end DIP and plain end Polyvinyl Chloride (PVC) pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110 for long pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have a mechanical or restrained joint as specified in this section and as shown on the Drawings. Solid sleeves shall be provided with gaskets suitable for the type of pipe to be connected. Solid sleeves shall be used only in locations shown on the Drawings or at the direction of the Engineer. Solid sleeves shall be manufactured by ACIPCO, U.S. Pipe or McWane.
 4. All fittings shall have ceramic epoxy lining (Protecto 401).
- C. Joints for DIP and Fittings:
1. General:
 - a. Joints for DIP and fittings shall be mechanical joint, flanged joint, restrained joint, push-on joint as shown on the Drawings or specified herein.
 - b. Unless otherwise shown on the Drawings, specified or directed, all DIP laid underground shall be joined using mechanical joints or push-on type joints.
 - c. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported nor by the environment in which the pipe is installed.
 - d. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A, external fit, and Class 2B, internal fit. All bolts and nuts shall be made in the U.S.A.
 2. Mechanical Joints:
 - a. Joints shall conform to AWWA C111/ANSI A21.11.
 - b. Bolts and nuts shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A242 to the dimensions shown in AWWA C111/ANSI A21.11.
 - c. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of Neoprene.
 - d. Mechanical joint glands shall be ductile or cast iron.

3. Push-On Joints: Push-on joints and gaskets shall conform to AWWA C111/ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite", McWane "Tyton/Fastite" or U.S. Pipe or Griffin "Tyton" joints.
4. Restrained Joints:
 - a. Restrained joints shall be ACIPCO "FLEX-RING", McWane TR-FLEX, McWane "SUPER-LOCK" or U.S. Pipe "TR-FLEX".
 - b. Restraining gaskets may be used for restrained joints and shall be ACIPCO "Fast-Grip", McWane "Sure Stop 350" or U.S. Pipe "Field-Lok Gasket".
 - c. Bolts and nuts shall be in accordance with the manufacturer's recommendations.
 - d. Gaskets shall be in accordance with the manufacturer's recommendations.
 - e. Joints for restrained joint pipe on supports shall be equal to McWane "LONG SPAN".
 - f. Mechanical joints with retainer glands are not acceptable substitutes for restrained joints.

D. Ceramic Epoxy Lining:

1. Lining Material: All pipe shall be epoxy lined. The lining material shall be Protecto 401 Ceramic Epoxy, an amine cured novalac epoxy containing at least 20 percent by volume of ceramic quartz pigment. The material shall meet the following minimum requirements:
 - a. A permeability rating of 0.00 when tested according to Method A of ASTM E96-66, Procedure A, with a test duration of 30 days.
 - b. The following test shall be run on coupons from factory lined DIP:
 - i. ASTM B117, Salt Spray (scribed panel) – Results to equal 0.0 undercutting after 2 years.
 - ii. ASTM G95, Cathodic Disbondment, 1.5 volts @ 77° F. Results to equal no more than 0.5 mm undercutting after 30 days.
 - iii. Immersion Testing rated using ASTM D714-87.
 - 1) 20 percent, Sulfuric Acid – No effect after 2 years.
 - 2) 140° F, 25 percent, Sodium Hydroxide – No effect after 2 years.
 - 3) 160° F Distilled Water – No effect after 2 years.

- 4) 120° F Tap Water (scribed panel) – 0.0 undercutting after 2 years with no effect.
- c. An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8, Abrasion Resistance.
2. Surface Preparation: Surface preparation shall consist of the ductile iron surface to a near-gray blast finish. This degree of cleanliness is comparable to a SSPC-SP10 for steel with the exception that ductile iron attains a gray color when blast cleaned. The blast cleaning operation shall remove 95 percent of all surface contaminants, including tightly adhered annealing scale. The anchor tooth pattern, resulting from the blasting operation, shall have a minimum height of 3.0 mils.
 3. Applicators: The lining shall be applied using a centrifugal lance applicator by applicators certified by the lining manufacturer. The workers shall be experienced and competent in the surface preparation, application, and inspection of the lining to be applied.
 4. Lining: After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. Minimum thickness shall be 30 mils. No lining shall take place when the substrate or ambient temperature is below 40° F. The surface shall be dry and dust free. If flange pipe or fittings are lined, the lining shall not be used on the face of the flange.
 5. Bell Sockets and Spigot Ends: The gasket area and spigot end up to 6 inches back from the end of the spigot end shall be coated with 6 mils nominal, 10 mils maximum, using Protecto Joint Compound. The joint compound shall be applied by brush to ensure coverage. Care should be taken that the joint compound is smooth without excess build-up in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be performed after the application of the lining.
 6. Number of Coats: The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.
 7. Touch-Up and Repair: Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.
 8. Lining Holiday Test: At the manufacturer's facility, the lining shall be tested over 100 percent of the pipe barrel surface with a high-voltage spark tester as recommended by ASTM Designation G62, Method B. If holidays are found in the lining by the above test at the manufacturing plant, the holiday shall be repaired per the lining manufacturer's recommendation. The holiday detector shall be a commercially available detector available from holiday detection equipment manufacturers such as SPY, TINKER AND RASOR, and ZORELCO.

9. All pipe linings shall be checked for thickness using a magnetic film thickness gauge. Thickness testing shall be performed in accordance with SSPC-PA-2.
 10. Each pipe joint and fitting shall be marked with the date of application of the lining system and with the numerical sequence of application of that date.
 11. Certification: The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification, and that the material used was as specified.
 12. Handling: Protecto 401 lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning or laying
- E. Acceptance: Acceptance will be on the basis of the Engineer’s inspection and the manufacturer’s written certification that the pipe was manufactured and tested in accordance with the applicable standards.
- F. All DIP, fittings, and accessories shall be manufactured by ACIPCO, U.S. Pipe, Griffin Pipe, American or McWane.
- G. All DIP, fittings, and accessories shall be supplied by a single manufacturer and are subject to “BUY AMERICA” provisions in accordance with the General Requirements.

2.2 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

- A. Acceptability of PVC pipe for gravity sewers is indicated in the following table:

Standard Minimum Thickness Type PVC¹	Wall Type	≤ 6	8 to 12
ASTM D3034 SDR 2612454B	Solid Wall	Yes	Yes

¹ As specified in ASTM D1784

- B. All pipe shall have a minimum pipe stiffness of 115 psi at 5 percent deflection as determined by ASTM D2412.
- C. PVC gravity sewer pipe shall be supplied in lengths not longer than 13 feet.
- D. Fittings:
1. Fittings 15 inches in diameter and less shall be manufactured in accordance with ASTM D3034. PVC compound shall be 12454B or 12454C as specified in ASTM D1784. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.

2. Fittings 18 inches in diameter and larger shall be fabricated from pipe conforming to ASTM F679 using solvent welding. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
- E. Joints: Joints for pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage, when tested in accordance with ASTM D3212. Gaskets shall meet the requirements of ASTM F477. The joint system shall be subject to the approval of the Engineer and shall be identical for pipe and fittings.
- F. Manhole Connections: The sewer shall be connected to manholes utilizing a standard pipe section.
- G. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe and fittings were manufactured and tested in accordance with the applicable standards.

2.3 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. PVC Pipe (AWWA C900):

1. All PVC pipe shall have belled ends for push-on type jointing and shall conform to ANSI/AWWA C900, DIP equivalent outside diameters. The pipe shall have a Dimension Ratio (DR) of 14 and shall be capable of withstanding a working pressure of 200 psi. Pipe shall be supplied in minimum lengths of 20 feet.
2. All fittings shall be of ductile iron meeting the requirements of AWWA C110 or AWWA C153 with a minimum rated working pressure of 350 psi. Fittings shall be cement lined in accordance with AWWA C104/ANSI A21.4.
3. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

B. PVC Pressure Pipe (SDR Pipe):

1. Pipe: PVC pipe shall conform to ASTM D2241. The pipe shall have a Standard Dimensional Rating (SDR) of 21 and shall be capable of withstanding a working pressure of 200 psi. All force main sewer in roadway shall be DR 14 C900.
2. Fittings:
 - a. PVC Fittings: Fittings for pipe 2 inches in diameter and below shall be one-piece gasket, push-on type PVC meeting the requirements of ASTM D3139. Lubricant shall be as recommended by the pipe or fitting manufacturer.
 - b. Ductile Iron Fittings: All fittings shall be of ductile iron meeting the requirements of AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 with a minimum rated working pressure of 350 psi. Fittings shall be cement lined in accordance with AWWA C104/ANSI A21.4. Special

adapters shall be provided, as recommended by the manufacturer, to adapt the PVC pipe to mechanical jointing with cast or DIP, fittings or valves. All fittings shall be lined with ceramic epoxy as specified below.

- c. Special linings shall cover all exposed surfaces of fittings subject to contact with sewer liquid or gas. The lining in fittings shall cover the interior surfaces including the socket areas as defined above. All linings shall be hermetically sealed at the ends.
- 3. PVC pressure pipe shall be supplied in 20-foot nominal lengths.
 - 4. Joints: Pipe and fittings shall have integral bell and spigot type joints with elastomeric gaskets having the capability of absorbing expansion and contraction without leakage. Joints shall meet the requirements of ASTM D3139; gaskets shall meet the requirements of ASTM F477. Joint system shall be subject to the approval of the Engineer.
 - 5. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.
- C. Detection Wire: Magnetically detectable wire shall be installed to locate all pressure and gravity mains (regardless of pipe material). Detectable wire shall be 10-gauge single solid strand copper in a green Thermo High Heat Nylon insulated jacket (10 ga THHN). Wire shall be manufactured for and be labeled "For Direct Bury".

2.4 STAINLESS STEEL PIPE

- A. Stainless steel pipe in sizes 10 inches and smaller shall be seamless stainless steel pipe conforming to the requirements of ASTM A312, Type 304.
- B. Unless otherwise specified or shown, stainless steel pipe 1-1/2 inches and smaller shall be Schedule 40S with threaded joints. Stainless steel pipe in sizes 2 to 10 inches shall be Schedule 10S or 40S, as directed by the Engineer, with welded joints, unless otherwise shown on the Drawings.
- C. Threaded fittings and unions 1-1/2 inches and smaller shall be 3,000-pound forged stainless steel conforming to ASTM A182, Grade F304, and ANSI B16.11.
- D. Welded fittings shall be of the butt-welded type of wrought stainless steel conforming to ASTM A403, Grade WP304, and ANSI/ASME B16.9. Reducing branch connections shall be made using threadolets or weldolets.
- E. Flanges shall be forged stainless steel conforming to ASTM A182, Grade 304, and ANSI/ASME B16.5, Class 150. Bolts shall be heavy hex conforming to ASTM A193, Grade B8. Nuts shall be heavy hex conforming to ASTM A194, Grade 8. Gaskets shall be red rubber, 1/16-inch thick, conforming to ANSI/ASME B16.5.

2.5 MANHOLES AND PRECAST CONCRETE PRODUCTS

A. Precast Concrete Sections:

1. Precast concrete sections shall meet the requirements of ASTM C478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.
2. The minimum wall thickness shall be 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 the rubber boots.
3. Transition slabs which convert bases larger than 4 feet in diameter to 4-foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.
4. Seal joints between precast sections by means of flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS202.
5. Xypex Admix C-1000R shall be added to the concrete during batching operations to provide chemical resistance and water proofing. The XYPEX admix shall be added at 3.5 percent (including dye) of the weight of the Portland cement. The amount of cement shall remain the same and not be reduced.
6. All precast concrete sections shall be manufactured by VanHooseCo, LLC, or approved equal.

B. Iron Castings:

1. Cast iron manhole frames, covers, and steps shall meet the requirements of ASTM A48, Class 30, gray iron, and all applicable local standards. All castings shall be tough, close grained, smooth, and free from blow holes, blisters, shrinkage, strains, cracks, cold shots, and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop Drawings must indicate the design weight and provide sufficient dimensions to permit checking.
2. Manhole frames and covers shall say "CITY OF SEVIERVILLE SANITARY SEWER" have a 24-inch diameter opening and be East Jordan Ironworks 1040 or approved equal.
3. All frames and covers shall have machined horizontal bearing surfaces.
4. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings.
5. Watertight covers shall be of inner lid design with the inner lid being held in place with a bolt and lock bar. Covers shall be rotatable and interchangeable.

C. Plastic Steps: Manhole steps of polypropylene molded around a steel rod equal to products of M.A. Industries may be used.

- D. Rubber Boots: Provide pre-formed rubber boots and fasteners equal to those manufactured by Kor-N-Seal or Press Seal Gasket Corporation.
- E. Anchor Bolts: Concrete anchor bolts shall be used to anchor the frame to the manhole riser. Bolts shall be 5/8-inch diameter by 4-1/2-inch long.

2.6 MISCELLANEOUS ACCESSORIES

- A. Tapping Saddles for air release valves and low pressure service connections shall be a strap type saddles. Saddle strap, fasteners, and threaded outlet shall be 304 Stainless Steel material. Gasket shall be made of NSF 61 Certified Nitrile Butadiene Rubber (NBR) for water and sewer service. Tapping saddle shall meet all parts of AWWA C800 and be NSF 61 Certified. Tapping Saddles shall be Romac Service Saddle Style 306.
- B. Flexible Adapter Couplings:
 - 1. Couplings for pipe sizes 15 inches in diameter and less shall be elastomeric plastic sleeves designed to connect pipes of dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leak proof and root-proof up to 4.3 psi. The adapter manufacturer shall provide all stainless steel clamps and required accessories.
 - 2. Couplings shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.
- C. Flexible Adapter Donuts:
 - 1. Adapter donuts shall be elastomeric PVC, compressible seals designed for sealing joints between sewer pipes of different sizes and/or dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leak proof and root-proof up to 4.3 psi.
 - 2. Donuts shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.
- D. Anchor Couplings: Lengths and sizes shall be as shown on the Drawings. Anchor couplings shall be equal to Tyler Pipe 5-198.
- E. Flange Adapter: Flange adapters shall permit the connection of unthreaded, ungrooved, open-ended, DIP to ANSI/ASME B16.1, Class 125, flanges. Flange adapters shall meet the test requirements of ANSI/ASME B16.1 for Class 125, flanges. The adapter shall be a ductile iron casting incorporating a flange with extended throat, set screws, and gasket. The gasket shall provide a compression seal between the adapter, the pipe, and the adjacent flange. Flange adapters are to be used only in locations specifically shown on the Drawings or at the direction of the Engineer, and in accordance with the manufacturer's recommendations. Flange adapters shall be equal to EBAA Iron "Mega Flange".

2.7 CONCRETE

- A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 to 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.8 VALVES

- A. Ball and Check Valves for use as low pressure sewer service connections: assemblies will be factory assembled with Schedule 80 adapter fittings and tested for 150-psi service pressure. Service assemblies will be assembled by Environment One® (E-One®) Corporation and supplied by licensed E-One® dealer.

2.9 PLUG VALVES

- A. Valves shall be 90-degree turn, non-lubricated, eccentric type with resilient faced plugs. Design of the valve shall provide that contact between the seat and the plug shall only occur in the final degrees of plug movement.
- B. Operating Requirements: Valves shall provide drip-tight shut-off up to the full pressure rating with pressure in either direction. Pressure ratings shall be established by hydrostatic tests conducted in accordance with ANSI B16.1. Valves shall be rated at a minimum of 175 psi for valves 12 inches and larger.
- C. Valve Body: Bodies shall be cast iron conforming to ASTM A126, Class B, with weld-in overlay of at least 95 percent nickel alloy content on all surfaces contacting the face of the plug. Valves shall have flanged or mechanical joint ends as shown on the Drawings. Flanged valves shall have ANSI 125-pound standard flanges. Mechanical joint valves shall have bell ends conforming to applicable requirements of ANSI 21.11. Flanged valves with flange-to-Mechanical Joint adapters shall not be acceptable in lieu of mechanical joint valves.
- D. Shaft Bearings: Valves shall be furnished with permanently lubricated stainless steel sleeve-type bearings conforming to AWWA C517.
- E. Shaft Seal: Valve shaft seals shall be of the "U" cup type, in accordance with AWWA C517. Seals shall be self-adjusting and repackable without removing the bonnet from the valve.
- F. Manual Operation: Valves shall have worm and gear actuators suitable for buried service.
- G. Manufacturer: All plug valves shall be products of a single manufacturer who must submit evidence of 5 years satisfactory service in sewage applications of the same design and of the sizes required. Valve design basis is Pratt or M&H.

2.10 BALL VALVES

- A. Ball Valves for Air Release Valves or Flushing Stations: Valves shall be stainless steel as manufactured by Milwaukee Valve or approved equal.

2.11 AIR VALVES FOR SEWERAGE SERVICE

- A. Air Release Valves: Valves shall be automatic air release valves designed to allow escape of air under pressure and close water-tight when liquid enters the valve. Valve openings shall be as specified on the plans. The valve body shall be steel designed to facilitate disassembly for cleaning and maintenance. Valves shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without dismantling the valve.
- B. Air/Vacuum Valves: Valves shall be automatic air and vacuum valves designed to allow escape of air, close water-tight when liquid enters the valve, and allow air to enter in the event of a vacuum. The valve body shall be steel designed to facilitate disassembly for cleaning and maintenance. Valves shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without dismantling the valve.
- C. Combination Air Valve: Valves shall be designed to allow escape of air, close watertight when liquid enters the valve, and allow air to enter in the event of a vacuum and to allow escape of air under pressure and close watertight when liquid enters the valve.
- D. Valves shall be recommended by the manufacturer for wastewater service and shall be A.R.I. Flow Control. (Air Release Valves D-025, D-025 ST or D-025 ST ST.)

2.12 VALVE BOXES AND EXTENSION STEMS

- A. Valve Boxes:
 - 1. All valves shall be equipped with valve boxes. The valve boxes shall be cast iron two-piece screw type with drop covers. Valve boxes shall have a 5-1/4-inch inside diameter. Valve box covers shall weigh a minimum of 13 pounds. The valve boxes shall be adjustable to 6 inches up or down from the nominal required cover over the pipe. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut. Ductile or cast iron extensions shall be provided as necessary. Covers shall have "SEWER" cast into them. Valve boxes shall be by a U.S.A. manufacturer.
 - 2. Valve boxes shall be manufactured by Tyler or Opelika.
- B. Extension Stems: All valves shall be furnished with extension stems, as necessary, to bring the operating nut to within 30 inches of the top of the valve box. Connection to the valve shall be with a wrench nut coupling and a set screw to secure the coupling to the valve's operating nut. The coupling and square wrench nut shall be welded to the extension stem. Extension stems shall be equal to Mueller or M&H.

2.13 RESTRAINT GLANDS AND RINGS

- A. Restraint glands for DIP shall be Megalug Series 1100, as manufactured by EBAA Iron.
- B. Restraint Rings for PVC pipe shall be GripRing as manufactured by Romac.

2.14 VALVE MARKERS

- A. The Contractor shall provide a concrete valve marker as detailed on the Drawings for each valve installed. Valve markers shall be stamped "SEWER".

2.15 GRINDER PUMP STATION

- A. The pump shall be E-One[®] Incorporated, Series 2000 Grinder Pump Stations where shown on the Drawings.
- B. The pump station shall include a fiberglass-reinforced polyester tank which shall house a displacement grinder pump, level controls, piping, anti-siphon valve, check valve, wiring, and other miscellaneous appurtenances. The alarm/disconnect panel and 6 conductor, 12-gauge, type SJOW power and alarm cable shall also be supplied as part of the pump station.
- C. Pump and Motor:
 - 1. The pump shall be a semi-displacement, direct-drive grinder pump, capable of delivering 15 gpm at 0 feet TDH and 9 gpm at 138 feet TDH.
 - 2. The motor shall be 1 HP, 1,725 RPM, 240 volt, 60 Hz, single-phase with capacitor start and squirrel cage induction type.
- D. Alarm/Disconnect Panel:
 - 1. The alarm/disconnect panel shall be NEMA 3R, UL listed, thermoplastic enclosure with a hinged, padlockable cover and secured dead front, and component knockouts. A visual alarm lamp enclosed within a red fluted lens at least 2-5/8 inches in diameter and 1-11/16 inches in height shall be mounted on top of the panel in such a manner as to maintain a NEMA 3R rating. An audible alarm, capable of being deactivated by depressing a push-type switch, encapsulated in a weatherproof silicone boot, shall be mounted on the bottom of the enclosure.
 - 2. The panel shall contain one 15 amp, double-pole circuit breaker for the power circuit and one 15 amp single-pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, and a complete alarm feature.
 - 3. Additional features shall include an audible and visual alarm, push-to-run switch, and high level (redundant) pump starting control.
 - 4. Alarm Sequence:
 - a. Wastewater in wet well rising above alarm level triggers a visual and audio alarm. The contacts on the alarm switch will close. The redundant pump starting system will be energized.
 - b. The audible alarm may be silenced by means of the externally-mounted push-to-silence button.
 - c. Visual alarm remains illuminated until the wastewater level in the wet well drops below the "off" setting of the alarm pressure switch.

2.16 SEWAGE LIFT STATIONS

- A. The preferred Design Basis is a Suction Lift self-priming pump station. Self-priming is defined as during unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
- B. Suction Lift Station Enclosure: Each station enclosure shall contain, protect, and secure all pumps, interior piping, valves, and associated controls. Preferred design basis is minimum sized Gorman Rupp 6x6 T fiberglass enclosure. Enclosures shall incorporate the following design and service features:
1. Access panels must be supplied on all sides. Location and size shall permit access for routine maintenance functions such as pump and motor inspection, drive belt adjustment, and pump clean-out.
 2. A continuous hinge and latch shall be installed on the 4 access panels. The hinged panels shall allow easy access to the electrical controls for frequent adjustments and inspections. Latch handle locks shall be match keyed, requiring only one key to open all access panels.
 3. The enclosure shall allow proper free air flow for ventilation.
 4. Each station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30 percent fiberglass, and a maximum of 70 percent resin. Resin fillers or extenders shall not be used.
 5. Station base shall be constructed of pre-cast, reinforced concrete, encapsulated in a fiberglass mold. The design shall resist deformation of the structure during shipping, lifting or handling. The base shall incorporate anchor bolt recesses for securing the complete station to a concrete pad (supplied by the Contractor) in accordance with the project plans.
 6. A blower mounted in the station roof shall be sized to exchange station air volume at least once every 2 minutes.
 7. Each pump station shall be provided with a 1300/1500 watt, 115-volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.
 8. Insulation Package: Each pump station enclosure shall be furnished with 1-inch thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.
- C. The wet well shall be of watertight construction made of precast reinforced concrete as specified in Article 2.5, above. Non-corrosive steps accessible from the top must be mounted to the inside walls going to the bottom of the wet well. All piping entering and leaving the wet well must be sealed so it is watertight. A spray applied, two-component polyurea liner shall be applied at all wet wells and the first upstream manhole. The liner system shall be OBIC 1000 as installed by OBIC, LLC or their approved applicator.

- D. The cover of the wet well shall be formed of concrete with a lockable, hinged aluminum access hatch with safety grate factory installed. The door shall be large enough to allow personnel access with equipment. The top of the wet well shall be at least 2 feet below the lowest structure within the development or subdivision.
- E. Interior Accessories:
1. All bolts, nuts, washers, anchor bolts, and other hardware used anywhere inside the wet well shall be stainless steel. No plastic or PVC will be accepted.
 2. Suction and discharge piping shall be stainless steel as specified in Article 2.4, Paragraph A., above.
 3. There shall be brackets, easily accessible at the top of the station, to hold and separate each of the cables and float switches. The brackets shall be positioned so the float switches cannot get hung or tangled in other hardware in the wet well.
- F. Electrical Control Panel:
1. All panels shall have NEMA 4XSS lockable enclosures and be UL Listed. Enclosures shall be metal with lock hasp and door fasteners and internally mounted backplate with mounted components. Enclosures shall be mounted minimum 4 foot clear from the top of the wet well.
 2. A power service disconnect switch shall be installed ahead of the control panel to cut all power to station, if necessary. The preferred voltage for the stations is 480V, three-phase. A definite purpose contactor and a block type manual reset overload relays with spare auxiliary contacts shall be provided for each pump. For stations above 10 horsepower the use of variable frequency drives shall be utilized to control the pumps. Variable frequency drives shall be Allen Bradley Power Flex 753 series. An alternating relay, conventional electrical switch type, shall be provided to alternate the lead pump. An interlock relay shall be provided to automatically reconnect the control circuit in case of circuit breaker trip on one pump. If electrical supply is single-phase, the station shall be provided with variable frequency drives in order to utilize three-phase pumps. A lightning surge suppressor shall be provided for the control panel. Minimum 80KA per mode.
 3. A hand-off-automatic switch and run light shall be provided for each pump. All switches and lights shall be mounted to the panel or an interior mounted door.
 - a. The minimum control sequence shall be: lead pump on, lag pump on, high water alarm, and off. Lead and Lag shall alternate between pumps.
 - b. A circuit breaker shall be provided for each pump, and a main circuit breaker shall be provided for the control circuitry.
 4. A labeled terminal strip for pumps, level switches, seal sensors, and heat sensors shall be provided. All wires going to components shall be numbered or color coded. All contactor, overload, and alternator control components shall be approved by the Owner.

5. Indicators and Alarms:
 - a. A seal failure system with solid state module controlled current circuitry and external light indicator shall be provided for each pump.
 - b. A heat sensor circuitry interconnected with the contactor overload shall be provided for each pump motor.
 - c. An external mounted high water flashing alarm light and audible alarm shall be provided on the panel.
6. Provide Level Control System for the Pump System, installed in the wet well to start and stop pump motors in response to changes in wet well level. The level control system shall utilize alternation to select first one pump, then the second pump; alternation shall occur at the end of a pumping cycle. Provide selectable alternator switch for the option of designating lead and lag pump. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level to read wet well level at any time. The level control system shall be an air bubbler primary level control with a 4 float back-up.
 - a. The suction lift pump station primary level control shall be an air bubbler level control system. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals. The secondary level control shall be a mercury-free float switch type system. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals. Both the primary bubbler system and secondary float system shall initiate signals at each of the indicated levels.
7. The control panel shall be approved by the Owner. Elapsed time meters shall be installed for each pump and be mounted with face of the meter visible on the outside of the inner door.

G. Exterior Accessories:

1. Pressure gauge: Pumps stations shall include a pressure gauge tapped directly into the discharge piping.
2. A bypass connection shall be installed as part of the package station or on the discharge pipe inside the fence and prior to the isolation valve. The bypass connection shall be easily accessible for maintenance personnel.
3. A yard hydrant shall be provided inside the fence area of the pump station. the hydrant shall include a 1-inch water meter and be isolated from the water distribution system.

H. Internal and External Piping: Piping shall be stainless steel pipe. Each pump discharge shall have a flanged full flow type check valve capable of passing a 3-inch spherical solid. Valve shall have an external lever and torsional spring, rated 175 psi working pressure. Depending on station discharge manifold piping, provide a flanged 2-way or 3-way plug valve of non-lubricated tapered type, drip-tight shut-off with stainless steel bearings, resilient facing

bonding to the sealing surface, single lever actuator operator with a locking device to hold plug in desired location. Provide an automatic air release valve for each pump, operating solely on discharge pressure, designed to permit the escape of air to the atmosphere during initial priming and unattended repriming cycles. Materials exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials; use stainless steel fittings to connect valve to station piping.

- I. Flow Meter-Magnetic: All lift stations shall have a flow meter installed on the discharge piping in an appropriately sized concrete vault with a traffic bearing hatch.
 1. Type: Pulsed DC coil, flanged type.
 2. Body:
 - a. Flanged Type: Short form design, 304 stainless steel flow tube, carbon steel ANSI 150 flanges.
 - b. Flow tube must meet submersible rating IP68 or NEMA 6P.
 3. Linear Material: As required
 4. Electrode Material: As required
 5. Grounding Rings Material: As required
 6. Transmitter:
 - a. Power: 120 VAC.
 - b. Enclosure: NEMA 4X, coated cast aluminum or fiberglass.
 - c. Mounting: Remote, pipe- or rack-mounted.
 - d. Local Indicator: Integral.
 - e. Cabling: FE/FIT-120 – Sufficient to connect flow tube and transmitter (30 feet minimum), verify prior to ordering equipment.
 - f. Output: Isolated 4 to 20 mADC.
 - g. Accuracy: ± 1.0 percent of flow rate.
 7. Acceptable Manufacturer: Rosemount, Krohne, Flexim (preferred) or approved equal.
- J. Site Layout:
 1. An LED area light (equal to one 400W high-pressure sodium light) shall be provided at the site. Provide photocell and switch in weatherproof enclosure.

2. All sewer lift station property shall be a minimum 50-foot wide, 25 feet each way of the centerline of the lift station structures.
3. Sewer lift stations shall be equipped with direct access to wet well structure via a minimum 20 feet wide access gate.
4. Sewer lift stations shall be accessible by a minimum of one (1) 4 feet wide manual swing gate.
5. Acceptable Pump Manufacturers: Suction Lift Station Pump manufacturers shall include Gorman Rupp and others as approved by the Owner.

PART 3 EXECUTION

3.1 EXISTING UTILITIES AND OBSTRUCITONS

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call the Tennessee One Call System, Inc. (800-351-1111) as required by the Tennessee Law “Underground Utility Damage Prevention Act” (Code Section 65-31-106), and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (3 business days) prior to construction, to verify the location of the existing utilities.
- B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.
 1. Provide the required notice to the utility owners to allow them to locate their facilities according to Tennessee law. Field utility locations are valid for only 10 days after original notice. The Contractor shall ensure, at the time of any excavation that a valid utility location exists at the point of excavation.
 2. Expose the facility to verify its true location and grade for a distance of at least 200 feet in advance of pipeline construction to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
 3. Avoid utility damage and interruption by protecting it with means or methods recommended by the utility owner.
 4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently, if required.
- C. Conflict with Existing Utilities:
 1. Horizontal Conflict: Horizontal distance shall be defined as the actual horizontal separation between the edge of a utility, main or service and closest edge of the proposed sewer main. The horizontal distance shall be at least 3 feet between the

water main and other utilities (except water, which is 10 feet). The Contractor must change the proposed alignment of the sewer main to avoid horizontal conflicts.

2. Vertical Conflict: Vertical distance shall be defined as the actual vertical separation between the edge of a utility, main or service and the closest edge of the proposed sewer main. The vertical distance shall be at least 18 inches between the sewer main and other utilities. The contractor must change the proposed alignment of the sewer main to avoid vertical conflicts.
- D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipelines or other obstructions.
- E. Water and Sewer Separation:
1. Sewers should maintain a minimum 10 foot edge-to-edge separation from water mains. Where the sewer crosses a water main, an 18-inch vertical separation, with water on top, shall be maintained where possible. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Engineer.
 2. No water main shall be permitted to pass through or come in contact with any part of a manhole.

3.2 CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

- A. Install pipelines and appurtenances along highways, streets, and roadways in accordance with the applicable regulations of, and permits issued by, the State Department of Transportation, County, and the City with reference to construction operations, safety, traffic control, road maintenance, and repair.
- B. Traffic Control:
1. The Contractor shall: provide, erect, and maintain all necessary barricades; suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct traffic; take all necessary precautions for the protection of the work and the safety of the public.
 2. Construction traffic control devices and their installation shall be in accordance with the current Manual on Uniform Traffic Control Devices for Streets and Highways.
 3. Placement and removal of construction traffic control devices shall be coordinated with the State Department of Transportation, County, and the City a minimum of 48 hours in advance of the activity.
 4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right-of-way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as “Flagmen Ahead”, shall be removed and replaced when needed.

5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary locations shall provide the same visibility to affected traffic as the original location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.
 6. Construction traffic control devices shall be maintained in good repair and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.
 7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the State Department of Transportation, County, and the City. Sign panels shall be of durable materials capable of maintaining their color, reflective character, and legibility during the period of construction.
 8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the current Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to ensure that they are maintained in the proper position throughout their period of use.
- C. Construction Operations:
1. Perform all work along highways, streets, and roadways to minimize interference with traffic.
 2. Stripping: Where the pipeline is laid along road right-of-way, strip and stockpile all sod, topsoil, and other material suitable for right-of-way restoration.
 3. Trenching, Laying, and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.
 4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod, and any other materials removed from shoulders.
- D. Excavated Materials: Do not place excavated material along highways, streets, and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off the pavement in a timely manner.
- E. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of run-off.

- F. Landscaping features shall include but are not necessarily limited to fences, property corners, cultivated trees and shrubbery, manmade improvements, subdivision and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly reestablishing these features.
- G. Maintaining Highways, Streets, Roadways, and Driveways:
 - 1. Maintain streets, highways, roadways, and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.
 - 2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets, and roadways by the use of steel running plates. The edges of running plates shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted, as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.
 - 3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. Make the grader or front-end loader available at all times.
 - 4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.3 PIPE DISTRIBUTION

- A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.
- B. No pipe shall be strung further along the route than 500 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets, and roadways upon which pipe is distributed.
- D. No distributed pipe shall be placed inside drainage ditches.
- E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than 5 feet from the roadway pavement, as measured edge-to-edge.

3.4 LOCATION AND GRADE

- A. The Drawings show the alignment and grade of the sewer and the position of manholes and other appurtenances. The slope shown on the profile and/or called for in the Specifications is the slope of the invert of the pipe.
- B. From the information on the Drawings and the survey points found on the project site, the Contractor shall perform all surveys necessary for the establishment of the horizontal and vertical alignment of the sewer.

C. Reference Points:

1. The Contractor shall take all precautions necessary, which includes, but is not necessarily limited to, installing reference points, in order to protect and preserve the centerline or baseline established by the Engineer.
2. Reference points shall be placed, at or no more than 3 feet, from the outside of the construction easement or right-of-way. The location of the reference points shall be recorded in a log with a copy provided to the Engineer for use prior to his verifying reference point locations. Distances between reference points and the manhole centerlines shall be accurately measured to the nearest 0.01 foot.
3. The Contractor shall give the Engineer reasonable notice that reference points are set. The reference point locations must be verified by the Engineer prior to commencing clearing and grubbing operations.

D. After location of the manhole centerlines or baselines of the sewer, the Contractor shall perform clearing and grubbing.

E. Construction shall begin at the low end of the sewer and proceed upstream without interruption. Multiple construction sites shall not be permitted without written authorization from the Engineer for each site. As a minimum, cut sheets between construction sites shall be submitted and approved before multiple construction sites will be permitted.

F. The Contractor shall be responsible for any damage done to reference points, baselines, centerlines, and temporary benchmarks, and shall be responsible for the cost of reestablishment of reference points, baselines, centerlines, and temporary benchmarks as a result of the operations.

3.5 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.

B. Pipe Installation:

1. Proper implements, tools, and facilities shall be provided for the safe performance of the work. All pipe, fittings, and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be dropped or dumped into the trench.
2. All pipe, fittings, valves, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
3. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.

4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
5. As each length of pipe is placed in the trench, the joint shall be assembled, and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
6. It is common practice to lay pipe with the bells facing the direction in which work is progressing; however, it is not mandatory.
7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.
8. Provide detection wire as specified in Article 2.3, Paragraph C., above, for all pressure and gravity sewer mains and servicelines (regardless of pipe material). The wire shall be laid with the pipe. Tracer wire shall be connected together with a brass curney, then taped each direction an additional 3 inches. Surface access to wire shall be accomplished at valve and air release valve locations or at manholes not to exceed 1,000 LF between surface access locations. Provide 2-inch Schedule 40 PVC pipe at manholes to provide surface access for the wire. At service laterals wire is to be installed with the pipe with surface access at a valve box at the clean-out and installed along the service piping to the main and connected to detection wire on the main. All wire must be tested for location prior to acceptance.

C. Alignment and Gradient:

1. Lay pipe straight in alignment and gradient or follow true curves, where shown on the Drawings, as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.
2. Maintain a transit, level, and accessories on the project site to lay out angles and ensure that deflection allowances are not exceeded.
3. The Contractor shall check the invert elevation at each manhole and the pipe invert elevation at least 3 times daily: start, mid-day, and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the pipe is being constructed at minimum slope.
4. Do not install force main such as to generate a high point, except where shown on the Drawings. Prior to backfilling the trench, the Contractor shall survey the elevation of the force main top of pipe barrel at minimum 100-foot intervals, at all bends, at all air valves, and where specific elevations are shown on the Drawings. The location description and elevation of each point surveyed shall be recorded. Vertical deflections required to avoid existing underground obstructions shall not result in a high point in the force main unless approved by the Engineer.
5. Any section of force main which is determined to have been installed such that a high point is generated at a location other than that shown on the Drawings shall be removed and reinstalled to the correct elevation, unless the variation in elevation is approved in writing by the Engineer.

6. The Contractor shall check the horizontal alignment of the sewer at the same schedule as for invert elevations.
- D. Lining Repair: Repair epoxy linings and recoat spigot ends of cut pipe with an epoxy coating as specified in PART 2 of this Specification and as specified below:
1. Remove all burrs and areas of loose lining materials by sanding or scraping to bare metal.
 2. Remove oil and lubricants used during field cutting.
 3. Lining shall be stripped back a minimum of 1-inch from the spigot end into well adhered lined areas.
 4. Roughen 1 to 2 inches of good lining with a rough grade (40 grit) emery paper, rasp or small chisel, to allow an overlap between new and existing lining.
 5. Apply lining repair material in the number of coats required to match the thickness requirements as specified in PART 2 of this Specification and in accordance with the manufacturer's recommendations.
- E. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary, to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Engineer. All open ends of unfinished pipelines shall be securely plugged or closed at end of each workday or when line is left open for an extended time. Clean-up shall be maintained no more than 500 feet behind pipe installation and shall be brought up to the construction area at the end of each day.
- F. Joint Assembly:
1. Push-on, mechanical, flange, and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
 2. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
 3. The Contractor shall internally inspect each pipe joint to ensure proper assembly for pipe 24 inches in diameter and larger after the pipe has been brought to final alignment.
- G. Cutting Pipe:
1. Cut DIP using an abrasive wheel saw.
 2. Cut PVC pipe using a suitable saw.
 3. Remove all burrs and smooth the end before jointing.

4. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories, and closure pieces in the correct location. Only push-on or mechanical joint pipe shall be cut.

H. Valve and Fitting Installation:

1. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage, and cracks. Defective valves shall be corrected or held for inspection by the Engineer. Valves shall be closed before being installed.
2. Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified in this Specification for cleaning, laying, and joining pipe, except that 12-inch and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve.
3. A valve box shall be provided on each underground valve. They 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 places the operating nut in excess of 30 inches beneath finished 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 directed by the Engineer.
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 Drawings or directed by the Engineer, valve markers shall be installed 6 inches inside the right-of-way or easement.

I. Air Valve Manholes:

1. Construct the manhole as detailed on the Drawings.
2. The frame shall be attached to the manhole cone by means of four 5/8-inch by 4-1/2-inch anchor bolts and shall be set in a bed of mastic so as to constitute a watertight seal between the cone and the frame.
3. Where vent pipes are not shown on the Drawings, the frame and cover or floor door shall be provided with 1-inch holes to provide equivalent opening as in air valve, but not less than 2. The quantity for each valve size is as follows: 2-inch, 4; 3-inch, 9; 4-inch, 16; 6-inch, 36; 8-inch, 64.

- J. House Connections: Install wyes or tees in locations designated by the Engineer for future connection of servicelines. Plug the branch of the wye or tee. Record the location of fittings installed on a copy of the Drawings to be submitted as Record Drawings.
- K. Waterstop Collars:
 - 1. Waterstop collars shall be installed at all stream crossings and shall be within 10 feet upstream of each manhole on both sides of stream crossings.
 - 2. Waterstop collars shall be constructed as shown on the Drawings. Concrete shall be poured against undisturbed earth on the sides and bottom of the trench.
 - 3. The sides and bottom of the trench shall be over-excavated a minimum of 2 feet for the placement of the waterstop collar. If rock is encountered in the trench, over-excavation is not required. Before pouring, all rock surfaces shall be clean of dirt, debris, and loose rock from blasting. Pouring concrete on pulverized rock or loose gravel will not be permitted.

3.6 MANHOLE AND PRECAST CONCRETE PRODUCT CONSTRUCTION

- A. Construct manholes as shown on the Drawings.
- B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.
- C. Brick: Bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, 3/4-inch thick, on the inside and outside of manhole.
- D. Pipe Connections: All pipes shall be connected to precast concrete manholes by a rubber boot provided in a cored or precast hole of the proper diameter.
- E. Inverts: Form channels as shown on the Drawings, rounded, and troweled smooth. Maintain consistent grade through the invert.
- F. Top Elevations: Build manholes outside of paved areas to finished grade unless otherwise shown on the Drawings or directed by the Engineer. Build manholes in paved areas to existing grades.
- G. Drop Connections: Manholes requiring drop connections are shown on the Drawings. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings.
- H. Frames and Covers: The frame shall be attached to the manhole barrel by means of four 5/8-inch by 4-1/2-inch anchor bolts and shall be set on a bed of mastic so as to constitute a watertight seal between the barrel and the frame.
- I. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.

- J. Invert Elevations: The invert elevations shown on the Drawings shall be for the invert at the centerline of the precast concrete manhole. Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole. Should the elevation differ from that shown on the Drawings, the Contractor shall take the following corrective action:
1. If the sewer is laid at negative grade, the Contractor shall remove and reinstall the sewer at the correct grade.
 2. If the sewer is laid at a grade less than that shown on the Drawings, thus reducing the sewer's capacity, the Owner may require the sewer to be removed and relaid at the correct grade. As a minimum, the grade to the next upstream manhole shall be adjusted such that the next upstream manhole shall be set at the correct elevation.
 3. If the sewer is laid at a grade greater than that shown on the Drawings, and if the Contractor can show that there are no conflicts with upstream existing utilities or obstructions, the Contractor shall adjust the grade of the next upstream sewer segment such that the next upstream manhole shall be set at the correct elevation. If such an adjustment, in the Engineer's opinion, is substantial, the grade adjustment shall be spread over multiple sections of the sewer. If such an adjustment, in the Owner's opinion, significantly reduces the sewer's capacity, the Owner may require the Contractor to remove and relay that portion of the sewer laid at the improper grade.
- K. Manholes shall be constructed such that their walls are plumb.
- L. Rehab: Rehab manholes shall be a spray applied, two-part polyurea liner. The liner system shall be OBIC 1000 as installed by OBIC, LLC or their approved applicator.

3.7 THRUST RESTRAINT

- A. Provide restraint at all points where hydraulic thrust may develop.
- B. Force Mains: All force mains 12-inch diameter and greater, installed in fill or in areas where the soil is disturbed shall be restrained joint pipe (see Article 2.1, Paragraph D., above).
- C. Restraint Glands: Provide restraint glands where shown on the Drawings and all associated fittings, valves, and related piping. The device shall be capable of full mechanical joint deflection during assembly and the flexibility shall be maintained after burial. For DIP the restraining mechanism shall consist of individually actuated wedges which increase their resistance to pull-out as pressure or external forces increase. Design basis is Megalug. For PVC pipe the restraining mechanism is a circumferential grip ring and T-bolt to tighten the ring and compress the gasket. Design basis is Romac Grip Ring. Restraint glands shall be installed in accordance with the manufacturer's recommendations.
- D. Harnessing: Provide harness rods only where specifically shown on the Drawings or directed by the Engineer. Harness rods shall be manufactured in accordance with ASTM A36 and shall have an allowable tensile stress of no less than 22,000 psi. Harness rods shall be hot-dip galvanized or field coated with bitumastic before backfilling. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90-degree bend eye bolts. Eye bolts shall be of the same diameter as specified in AWWA

C111 for that pipe size. The eye shall be welded closed. Where eye bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.

E. Concrete Blocking:

1. Provide concrete blocking for all other bends, tees, valves, and other points where thrust may develop, except where other means of thrust restraint are specifically shown on the Drawings.
2. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

F. Thrust Collars: Collars shall be constructed as shown on the Drawings. Concrete and reinforcing steel shall meet the requirements specified in Article 2.3, above. The welded-on collar shall be attached to the pipe by the pipe manufacturer.

3.8 CONCRETE COLLARS

A. Construct collars as shown on the Drawings.

3.9 INSPECTION AND TESTING

A. Clean and test lines before requesting final acceptance. The term “cleaning” shall mean removing all sediment and obstructions from the sewer pipeline and manholes. This is to be accomplished using high velocity jet (hydrocleaning) equipment or mechanically powered equipment. The equipment and method shall be satisfactory to the Owner. Cleaning work is to be performed only in the presence of the Owner’s designated representative. The Contractor shall be responsible for obtaining the water necessary for cleaning and any other work items requiring water. After cleaning has been performed to the satisfaction of the Owner, the Contractor shall perform an internal inspection of the lines using closed circuit television (CCTV). The video work is to be performed in the presence of the Owner’s representative. This work is to be performed by qualified personnel with a minimum of 5 years of experience in the CCTV inspection business and is to be certified per National Association of Sewer Service Companies (NASSCO). The video data collected is to be provided in a format acceptable to the Owner. Any defects discovered during the video inspection are to be repaired or replaced as soon as possible to the satisfaction of the Owner.

B. Gravity Sewers: Pipelines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.

1. All gravity sewers shall be reviewed by CCTV inspection prior to testing and approval by the Owner.
2. Pipe joints for sewers 30 inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and shall pressurize the joint area to 4 psi. The pressure shall not drop more than 2 psi in 10 seconds. The joint tester assembly shall be equal to Cherne Industries, Inc.

3. Infiltration Tests: Perform only when groundwater is 2 feet above the top of the pipe.
 - a. Install suitable weirs in manholes selected by the Engineer to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be 5,000 feet. Measure leakage only when all visible leaks have been repaired and the ground water is 2 feet above the top of the pipe. If leakage in any section of the sewer line exceeds 25 gpd/inch diameter/mile, locate and repair leaks. Repair methods must be approved by the Engineer. After repairs are completed, retest for leakage.
 - b. Furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests. Where continuous monitoring of flow level is required, the Owner will provide and operate monitoring equipment.
4. Exfiltration Tests: Choose one of the following when groundwater is not 2 feet above the top of the pipe.
 - a. Hydrostatic Test:
 - i. Test pipe between manholes with a minimum of 10 feet hydrostatic pressure, measured at the center of the pipe at the upstream manhole.
 - ii. The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into the top of each bulkhead shall be a 2-inch pipe nipple with an elbow. At the upper end of the test section, a 12-inch riser pipe shall be connected to the 2-inch nipple. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a valve, until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe 24 hours prior to the test period to allow complete saturation. House servicelines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.
 - iii. During the test period, which shall extend over a period of 2 hours, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the test period shall not exceed that specified for infiltration.
 - b. Low-Pressure Air Test: Only sewer diameters less than or equal to 24 inches:
 - i. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using

inflatable balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately 2 to 5 minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line. Minimum test time for various pipe sizes and types is as follows:

Nominal Pipe Size, inches	T (Time Min/100) Feet
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6

Source: ASTM F1417

- ii. Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of ± 2 percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.
- iii. The Contractor shall keep records of all tests made. Copy of such records will be given to the Engineer or the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Engineer.

The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured, and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

5. Deflection Test:

- a. Test PVC gravity sewer for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed the following:

Nominal Pipe Diameter	Maximum Allowable Deflection
≤ 12-inches	5%
15 to 30-inches	4%
> 30-inches	3%

- b. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than 9. The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum or other material approved by the Engineer and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe. The mandrel dimensions shall be checked by the Engineer before use by the Contractor.
- c. Excavate and install properly any section of pipe not passing this test. Retest until results are satisfactory.
- d. This test shall be performed within the first 30 days of installation and during final inspection, at the completion of this contract.

C. Force Main Pressure and Leakage Test:

- 1. All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of line will be considered ready for testing after completion of all thrust restraint and backfilling. Each segment of pipeline between line valves shall be tested individually.
- 2. Test Preparation:
 - a. Flush pipeline section thoroughly at flow velocities adequate to remove debris from pipe and valve seats. Partially operate valves and hydrants to clean-out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.
 - b. Provide temporary blocking, bulkheads, flanges, and plugs as necessary, to assure all new pipe, valves, and appurtenances will be pressure tested.
 - c. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary corporation stops at highpoints to expel air as line is filled with water.
 - d. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible but shall not exceed manufacturer's pressure rating.

3. Test Pressure: Test the pipeline at 100 psi measured at the lowest point for at least 2 hours. The test pressure shall not vary by more than 5 psi for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gauge with graduation not less than 5 psi.
4. Leakage:
 - a. Leakage shall be defined as the quantity of water that must be pumped into the test section equal to the sum of the water, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
 - b. The Owner assumes no responsibility for leakage occurring through existing valves.
5. Test Results: No test section shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.
6. Completion: After a pipeline section has been accepted, relieve test pressure. Record type, size, and location of all outlets on Record Drawings.

D. Manholes:

1. Prior to testing manholes for watertightness, all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.
2. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the top of the casting and the compression head inflated to 40 psi to affect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut-off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.

- E. Inspection: Inspection of construction shall be performed by the Resident Inspector or the Owner's Inspector. All mains will be inspected prior to backfilling of any mains. If any joints, pipes or other workmanship materials are found to be defective, they shall be removed and replaced by the Contractor. Contractor shall schedule work around the Inspector's 40-hour workweek. Specific procedures for Contractors working more than 40 hours per week are covered in Section 1 of Sevierville Water and Sewer Department's Policies & Procedures for Developers and Contractors.

3.10 PROTECTION AND RESTORATION OF WORK AREA

- A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.
 - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
 - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of run-off.
 - 3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
 - 4. The Tennessee Department of Transportation's (TDOT) officials shall be authorized to stop all work by the Contractor when restoration and clean-up are unsatisfactory and to require appropriate remedial measures.
- B. Man-Made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mailboxes, pipelines, drain culverts, power and telephone lines and cables, property pins, and other improvements that may be encountered in the work.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Engineer. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles or trash piles will be permitted on the work site.
- E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate county, state, and federal regulatory agencies.

3.11 GRINDER PUMP STATION

- A. Sequence of Construction: The installation of the individual pump system shall begin after the pressure sewer mains and service connections have been constructed, approved by the

Engineer, and accepted by the Owner. Installation of the individual pump system shall include the following steps:

1. Examine the property with the Engineer and Owner to determine the location for the grinder pump station and the alarm/disconnect panel.
2. Install the grinder pump station and alarm/disconnect panel at the designated location according to specifications.
3. Install 1-1/4-inch pressure serviceline from the grinder pump station to the service connection.
4. In the cases installing Grinder Pump Station at existing homes, reroute the gravity serviceline from the house to the grinder pump station and complete the wiring. Cap or plug the existing gravity serviceline to the septic tank.
5. Open the valve at the service connection and test the system.
6. Clean-up and restore the property to its original condition.

B. The Property Owner or Developer shall be responsible for the following:

1. Locate and uncover at the house foundation the gravity serviceline.
2. Assist with establishing the location of the grinder pump station.
3. Furnish the grinder pump station, including the alarm/disconnect panel and the alarm/power cable to the Contractor for installation. The Contractor shall receive the pump station at the Sevierville Water Department's supply yard at 2295 McCroskey Island Road, Sevierville, Tennessee 37876, and transport them to the site.
4. Provide the following specified electrical circuits to the location designated for the alarm/disconnect panel:
 - a. Pump: 240 volt, two-pole, 15 amp
 - b. Alarm: 120 volt, single-pole, 15 amp

C. Installation of Grinder Pump Station:

1. The Contractor shall provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding. The grinder pump station shall not be set into the excavation until the installation procedures and excavation have been approved by the Engineer.
2. Remove packing material. The Users Instructions must be given to the property owner. Hardware supplied with the unit, if required, shall be used at installation. The basin shall be supplied with a standard 4-inch inlet grommet (4-1/2-inch o.d.) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin shall not be dropped, rolled or laid on its side for any reason.

3. Installation shall be accomplished so that 1 to 4 inches of accessway below the bottom of the lid extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the hole must be large enough to allow for the concrete anchor.
 4. A minimum 6-inch layer of aggregate, clean and free flowing, with particle size of not less than 1/8-inch nor more than 3/4-inch shall be used as bedding material under each unit. A concrete anti-flotation collar sized according to the manufacturer's instructions, shall be required and shall be precast to the grinder pump or poured-in-place. Each grinder pump station with its precast anti-flotation collar shall have a minimum of 3 lifting eyes for loading and unloading purposes. The unit shall be leveled and filled with water to the bottom of the inlet to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8-inch sleeve is required over the inlet prior to the concrete being poured.
 5. Backfill of clean, native earth, free of rocks, roots, and foreign objects shall be thoroughly compacted in lifts not exceeding 12 inches to a final density of 85 percent. Improper backfilling may result in damaged accessways. The grinder pump station shall be installed at a minimum depth of 30 inches from grade to the top of the 1-1/4-inch discharge line. The finish grade line shall be 1 to 4 inches below the bottom of the lid, and final grade shall slope away from the grinder pump station.
 6. All restoration shall be the Contractor's responsibility. Properties shall be restored to their original condition in all respects, including but not limited to, sidewalk replacement, landscaping, loaming and seeding, and restoration of traveled ways, as directed by the Engineer.
 7. The electrical enclosure shall be furnished, installed, and wired to the grinder pump station by the Contractor.
 8. An alarm device is required on every installation. The Contractor shall mount the alarm device in a conspicuous location. The alarm/disconnect panel shall be connected to the grinder pump station by a length of 6 conductor, 12-gauge TC type cable as shown on the Drawings. The power and alarm circuits must be on separate power circuits.
- D. Plumbing Requirements: The following requirements are specific to the plumbing of the Grinder Pump Station. Comply with all local plumbing codes.
1. There shall be no permanent obstruction within 6 feet of the pump or discharge lines.
 2. The top of the Grinder Pump Station shall be at least 2 feet below the finished floor of the structure being served.
 3. A clean-out is to be place immediately upstream from the pump basin; the exact location will be determined by the Owner's personnel. All clean-outs will be installed with a P-107 Box as shown on Detail STD-WW-04.

4. Mark the inlet pipe 3-1/2 inches from the end to be inserted. Glue a 4-inch straight coupling on the inlet pipe at the 3-1/2-inch mark, allow the glue to dry. The inlet pipe shall be chamfered and lubricated with a soap solution. Lubricate the inlet grommet with soap solution as well. Inlet the pipe into the grommet to the 3-1/2-inch mark. Inspect to ensure the grommet has remained intact and in place.
 5. Service assemblies consisting of a pre-assembled check and ball valve will be installed within a meter box as shown on the drawings. The service assembly will be installed in a way to facilitate future removal.
 6. The unit must be properly vented to assure correct operation of the pump. The outdoor unit shall be supplied with a vent pipe from the wet well to the top of the access way.
- E. Electrical Requirements: The following requirements are specific to the wiring of the Grinder Pump Station. Comply with all local electrical codes. In the event there is a conflict, the stricter shall apply. Always verify printed manufacturer instructions, as those may be modified without notice.
1. The 30 amp disconnect (NEMA 3R or better enclosure) must be located outside and within 20 feet of the pump station location. The disconnect may be mounted on an outside wall or on a 4-inch x 4-inch post. The disconnect and the E-One® alarm panel shall be mounted no lower than 4 feet nor higher than 5 feet from finished grade.
 2. The E-One® supply cable shall be used to connect the station to the alarm panel. Locate the cable and the feed-thru connector on the wall of the shroud inside the station. Loosen the nut on the connector and pull the supply cable out through the connector until it hits the crimped stop feature on the cable, approximately 24 inches from the electrical quick disconnect, then retighten nut.
- F. Service Lateral Installation: Service lateral shall be installed in accordance with these Specifications for PVC pipe, including installation of tracer wire between the pump station and the lateral assembly. Lateral Crossings under pavement shall utilize a 2-1/2-inch casing of Schedule 40 or HDPE pipe extending 3 feet beyond edge of pavement.
- G. Rock Excavation: Any rock encountered during the installation of the individual pump system, including the trenching of the pressure service and the gravity servicelines shall be removed by means other than blasting.

3.12 SEWER LIFT STATION LAYOUT

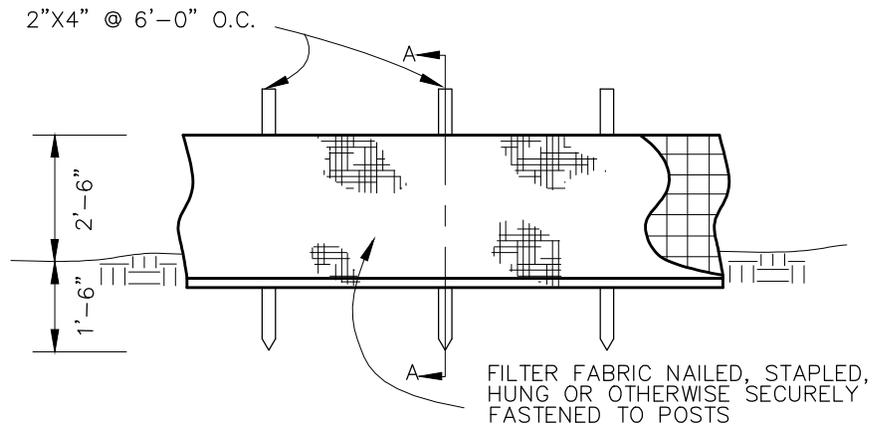
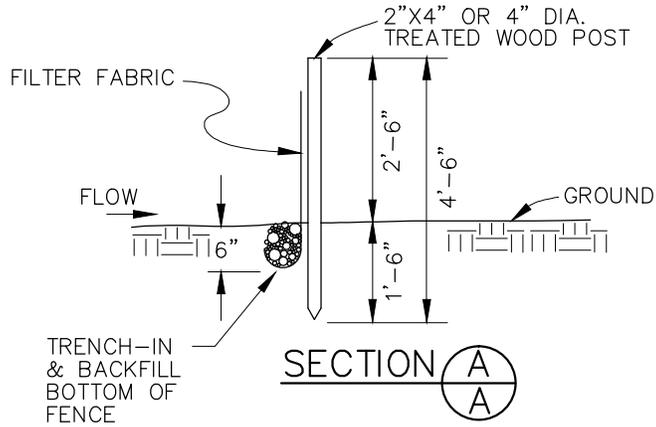
- A. Service and Maintenance Access: Space for services and maintenance vehicles shall be provided in order to have direct access to major components.
- B. A minimum of 4-foot horizontal clearance shall be provided around all component access panels, doors or hatches.
- C. Property boundaries shall be laid out such to provide a minimum of 25 feet each.

END OF SECTION

Standard Detail Drawings

(GS) Gravity Sewer
(PS) Pressure Sewer

STD-G-01	Silt Fence Detail
STD-G-02	Concrete Encasement Detail
STD-G-03	Concrete Replacement Detail
STD-G-04	Asphalt Replacement Detail
STD-G-05	Creek Crossing Detail
STD-G-06	Typical Road Boring Detail
STD-G-07	Trench Terminology Detail
STD-G-08	Pressure Pipe Bedding and Haunching Details (PS)
STD-G-09	Gravity Pipe Bedding and Haunching Details (GS)
STD-G-10	1,000 Gallon Concrete Grease Trap
STD-WW-01	Precast Concrete Manhole Detail (GS)
STD-WW-02	Precast Shallow Manhole Detail (GS)
STD-WW-03	Manhole Frame and Cover Detail (GS)
STD-WW-04	Service Connection Detail (GS)
STD-WW-05	Concrete/Waterstop Collar Detail (GS)
STD-WW-06	Rubber Boot Detail (GS)
STD-WWP-01	Typical Blocking Detail (PS)
STD-WWP-02	Wastewater Air Release Manhole Detail (PS)
STD-WWP-03	Typical End-Line Flushing Station Detail (PS)
STD-WWP-04	Installation of Simplex Grinder Pump Detail (PS)
STD-WWP-05	Electrical Installation for Simplex Grinder Pumps Detail (PS)
STD-WWP-06	Single Service Connection Detail (PS)
STD-WWP-07	Air Valve Detail for Smaller Diameter Pressure Sewer (PS)
STD-WWP-08	Force Main Discharge Manhole Detail (PS)
STD-WWP-09	Force Main Odor Control Injection Tap Detail (PS)



SILT FENCE DETAIL
NTS



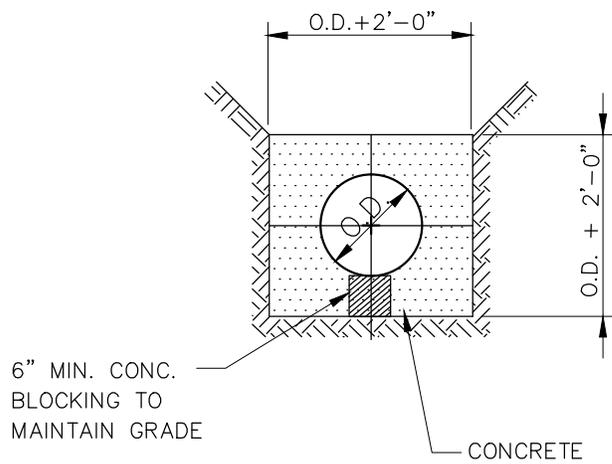
SEVIERVILLE WATER & SEWER DEPT.

DATE : DEC 2016

STANDARD DETAILS
TYPICAL CONSTRUCTION

SCALE : N.T.S

STD-G-01



CONCRETE ENCASEMENT DETAIL
N.T.S.



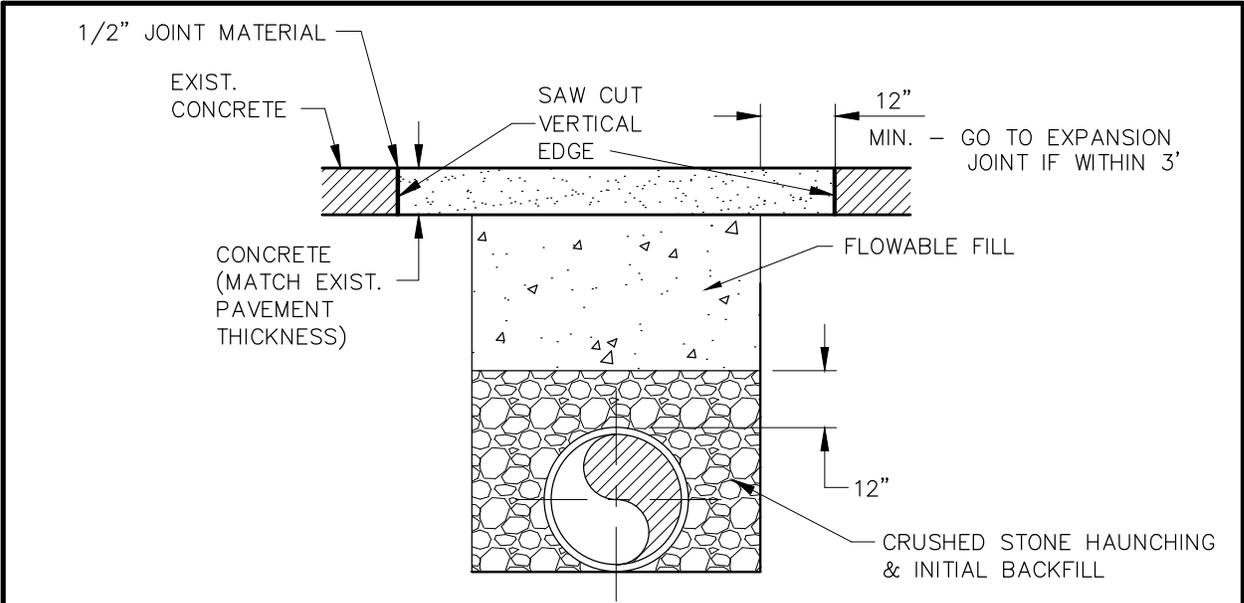
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STANDARD DETAILS
TYPICAL CONSTRUCTION

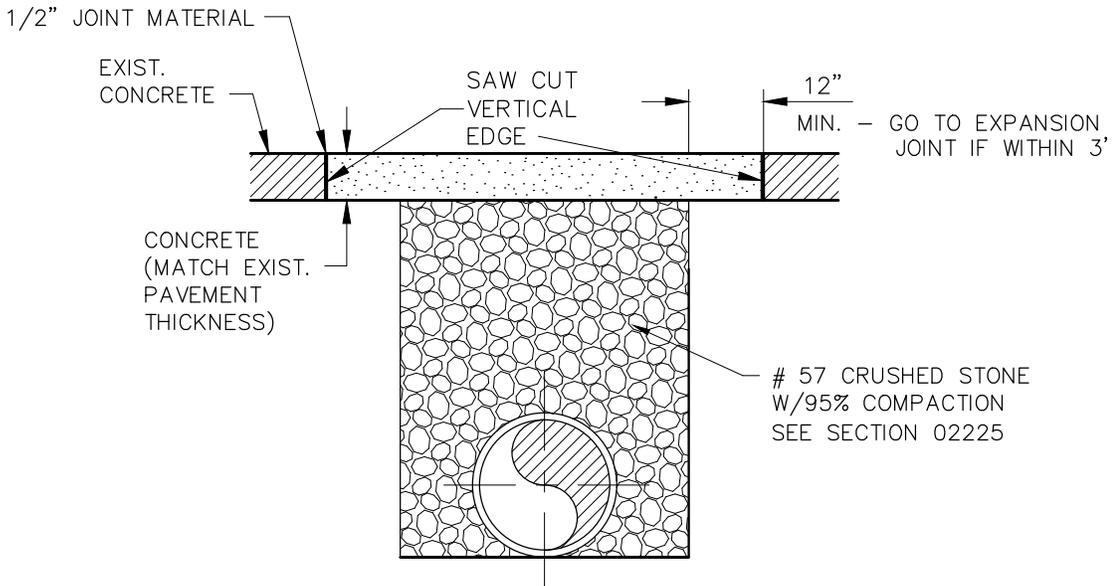
DATE : DEC. 2016

SCALE : N.T.S

STD-G-02



CITY & COUNTY STREETS



ALL OTHERS

CONCRETE REPLACEMENT DETAIL

NTS



SEVIERVILLE WATER & SEWER DEPT.

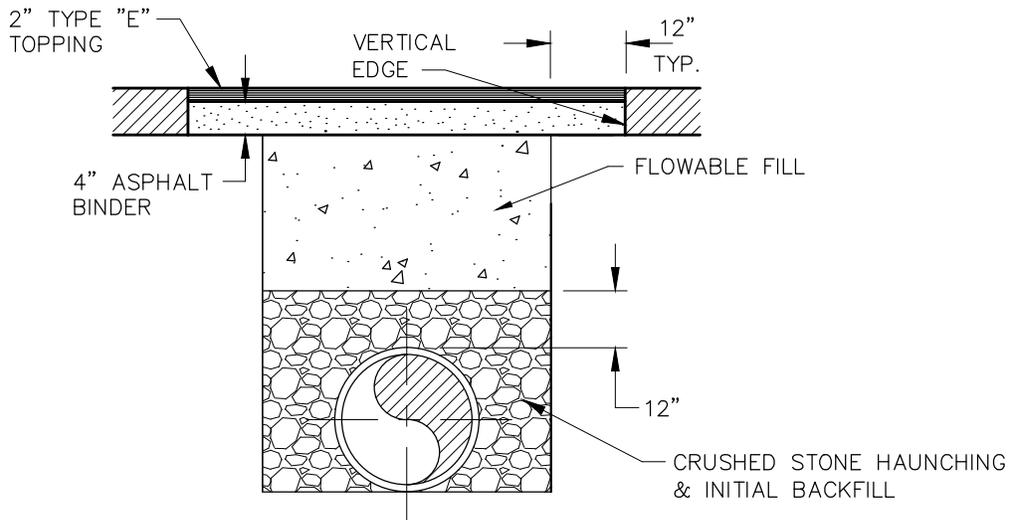
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STANDARD DETAILS

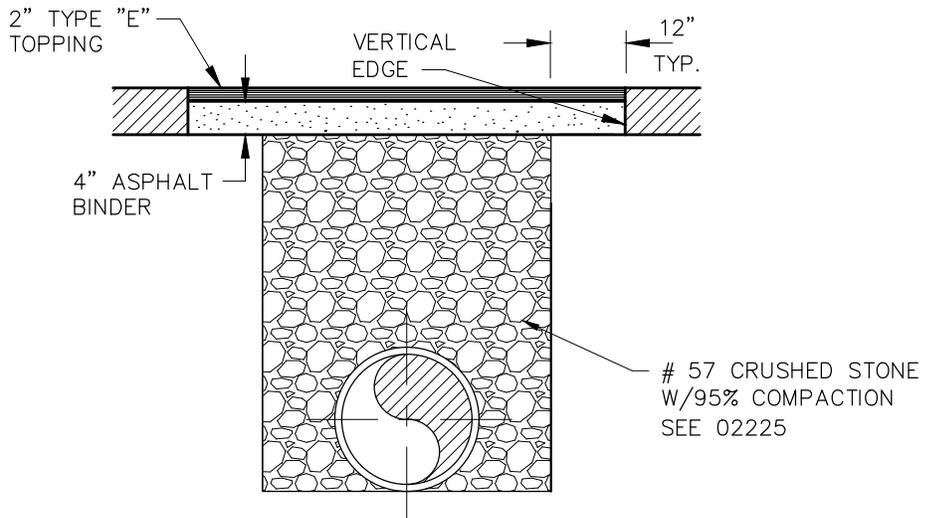
SCALE : N.T.S

TYPICAL CONSTRUCTION

STD-G-03



CITY & COUNTY STREETS



ALL OTHERS

ASPHALT REPLACEMENT DETAIL

NTS



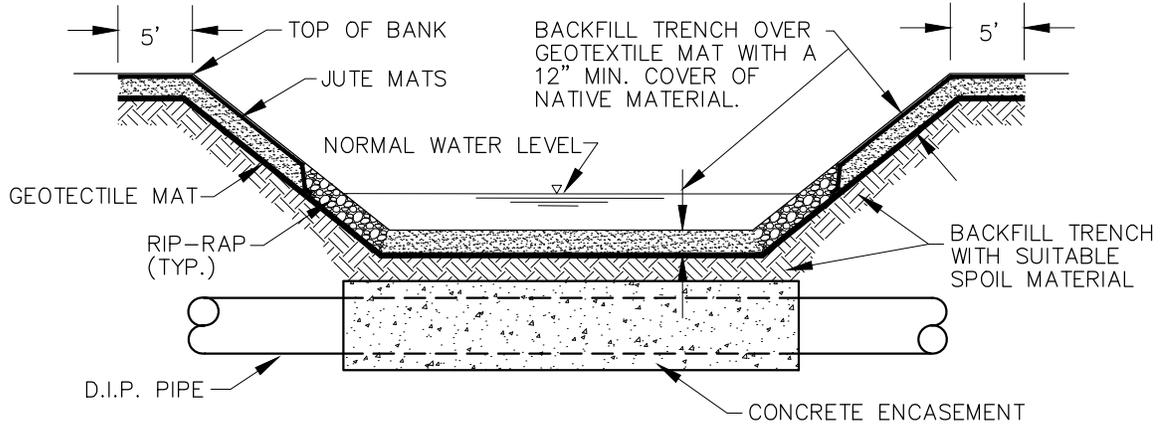
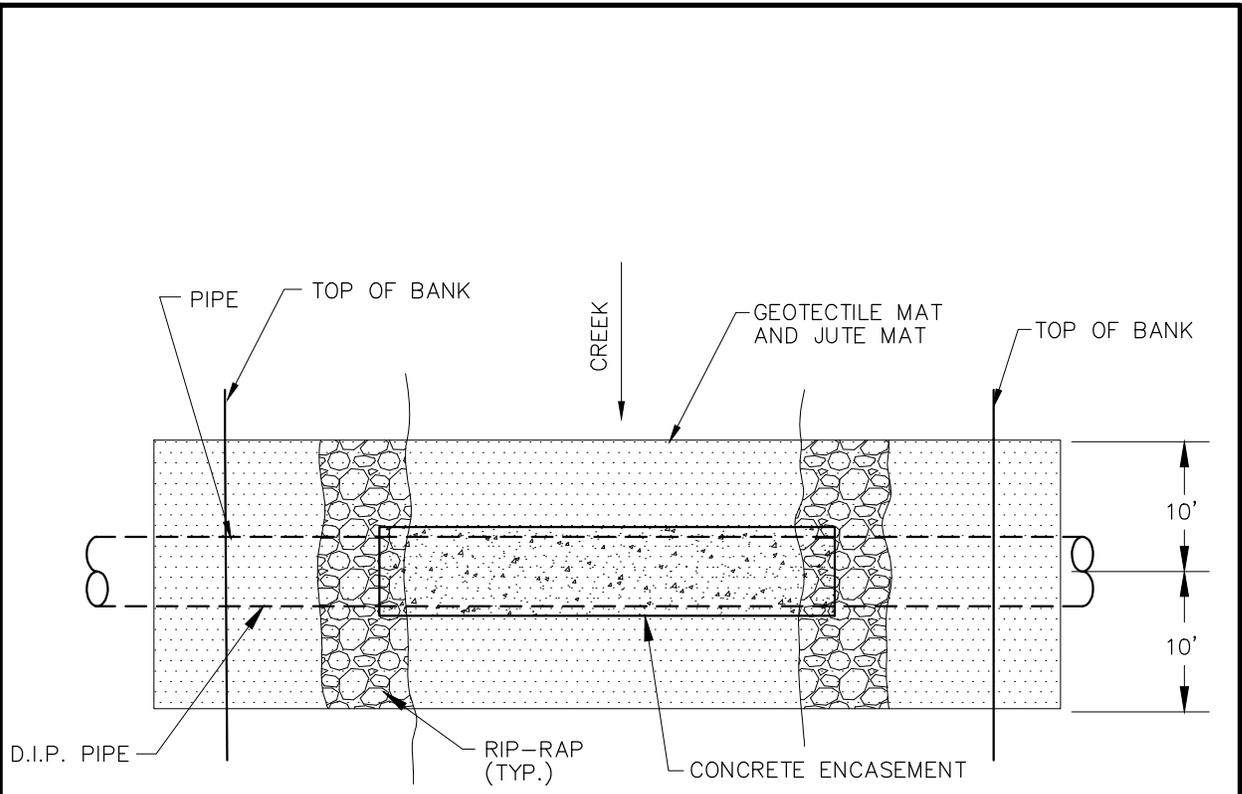
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DATE : DEC. 2016

SCALE : N.T.S

STANDARD DETAILS
TYPICAL CONSTRUCTION

STD-G-04

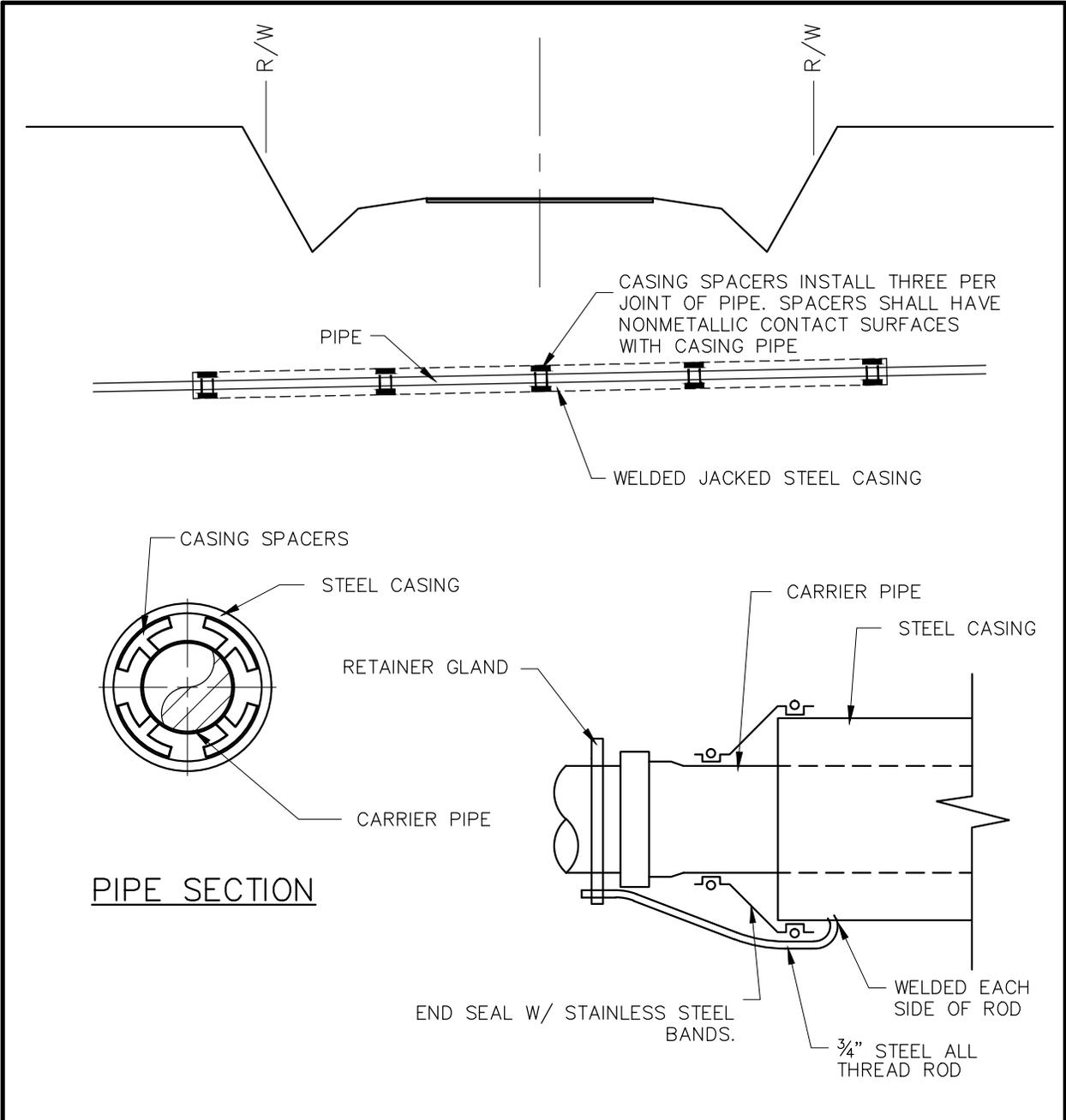


CREEK CROSSING DETAIL
 NTS



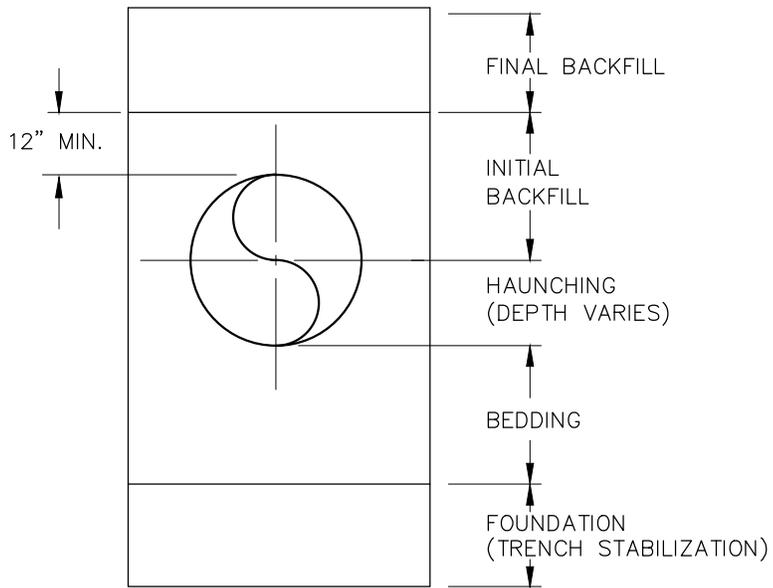
SEVIERVILLE WATER & SEWER DEPT.
 STANDARD DETAILS
 TYPICAL CONSTRUCTION

DATE : DEC. 2016
 SCALE : N.T.S.
 STD-G-05



TYPICAL ROAD BORING DETAIL
 N.T.S.

	SEVIERVILLE WATER & SEWER DEPT.	DATE : DEC. 2016
	STANDARD DETAILS TYPICAL CONSTRUCTION	SCALE : N.T.S
	STD-G-06	



NOTE: SEE SPECIFICATIONS AND PIPE
BEDDING AND HAUNCHING DETAILS
FOR DIMENSIONS AND MATERIALS

TRENCH TERMINOLOGY DETAIL

N.T.S.



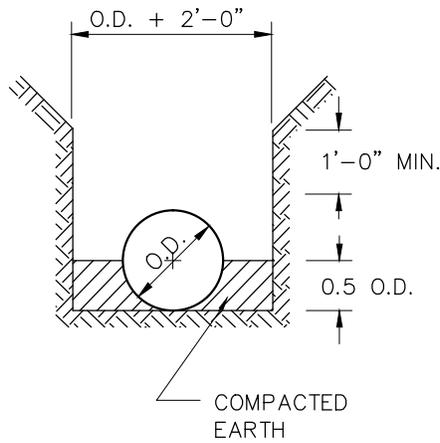
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STANDARD DETAILS
TYPICAL CONSTRUCTION

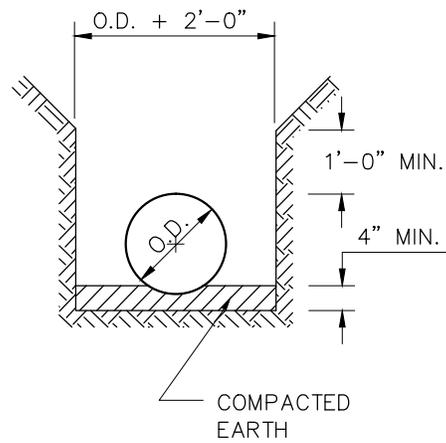
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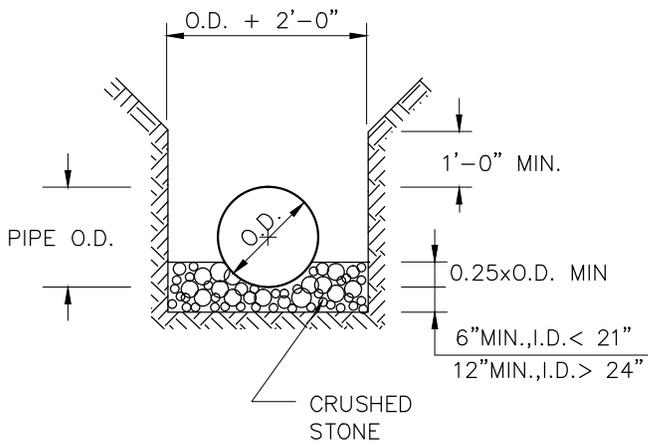
STD-G-07



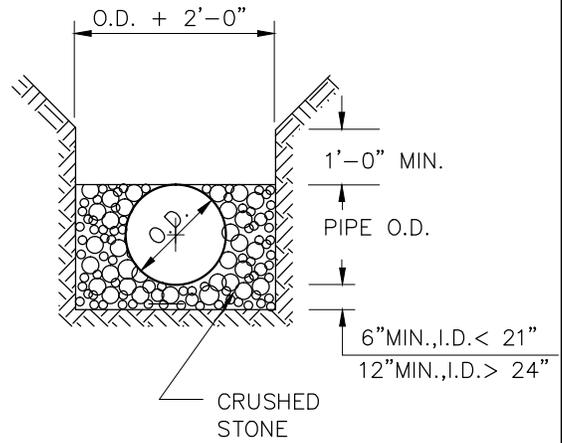
TYPE 2



TYPE 3



TYPE 4



TYPE 5

PRESSURE PIPE BEDDING AND
HAUNCHING DETAILS
N.T.S.



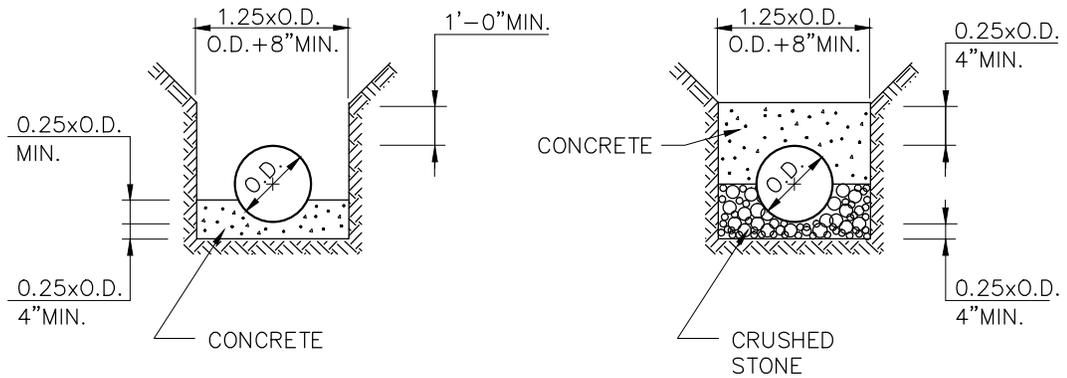
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STANDARD DETAILS
TYPICAL CONSTRUCTION

DATE : DEC. 2016

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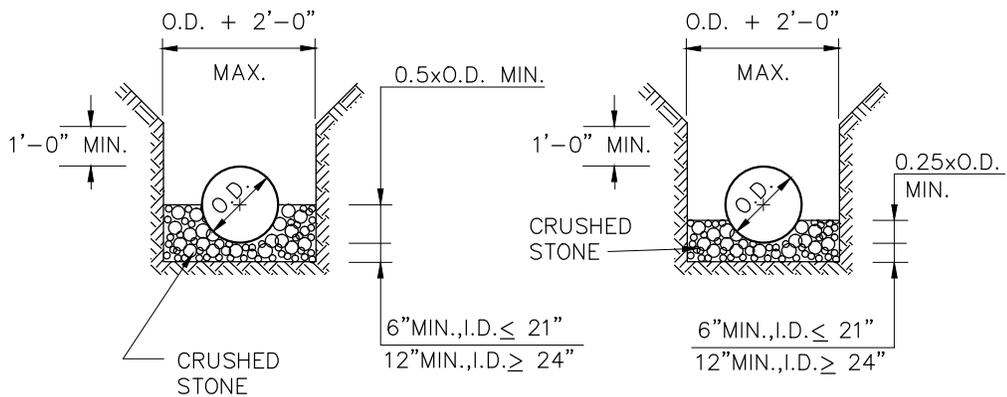
STD-G-08



CONCRETE CRADLE

CONCRETE ARCH.

CLASS "A"



CLASS "B"

CLASS "C"

GRAVITY PIPE BEDDING AND
HAUNCHING DETAILS

N.T.S.



SEVIERVILLE WATER & SEWER DEPT.

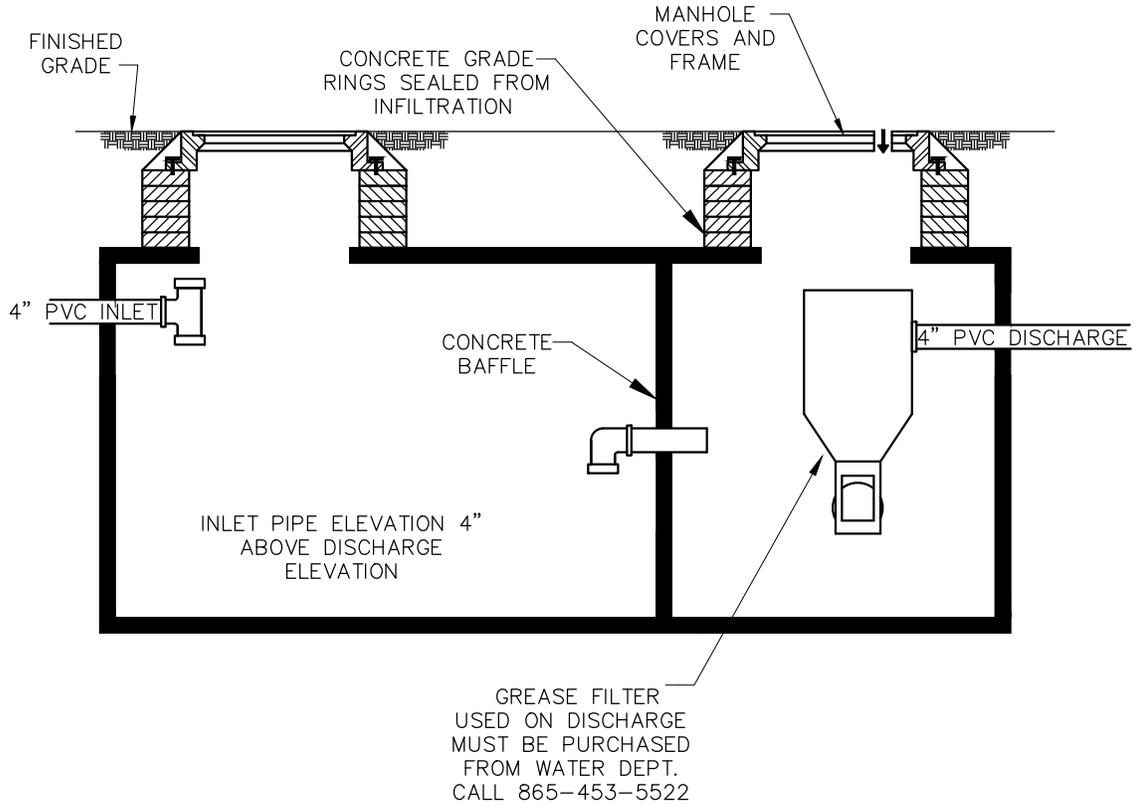
DATE : DEC. 2016

STANDARD DETAILS
TYPICAL CONSTRUCTION

SCALE : N.T.S

STD-G-09

UNDERGROUND GREASE TRAP DESIGN



NOTE:

AT A MINIMUM, GREASE TRAP DESIGN SHALL BE EQUAL TO BARGER PRECAST 1000 GALLON TANK DESIGN

1000 GALLON CONCRETE GREASE TRAP

NTS



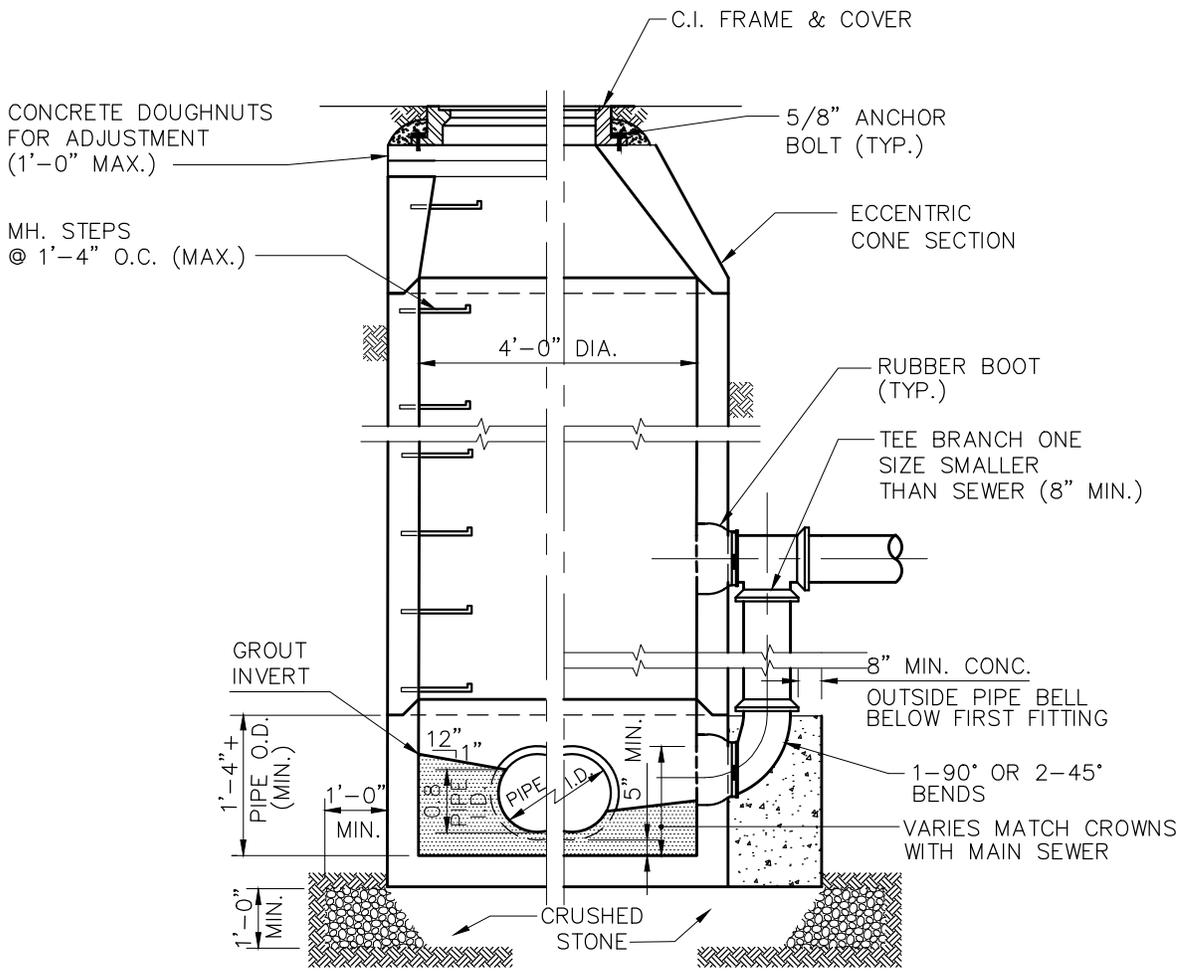
SEVIERVILLE WATER & SEWER DEPT.

STANDARD DETAILS
PRESSURE SEWER

DATE : DEC. 2016

SCALE : N.T.S

STD-G-10



HALF SECTION HALF SECTION
STANDARD MANHOLE DROP MANHOLE

PRECAST CONCRETE MANHOLE DETAIL
 NTS



SEVIERVILLE WATER & SEWER DEPT.

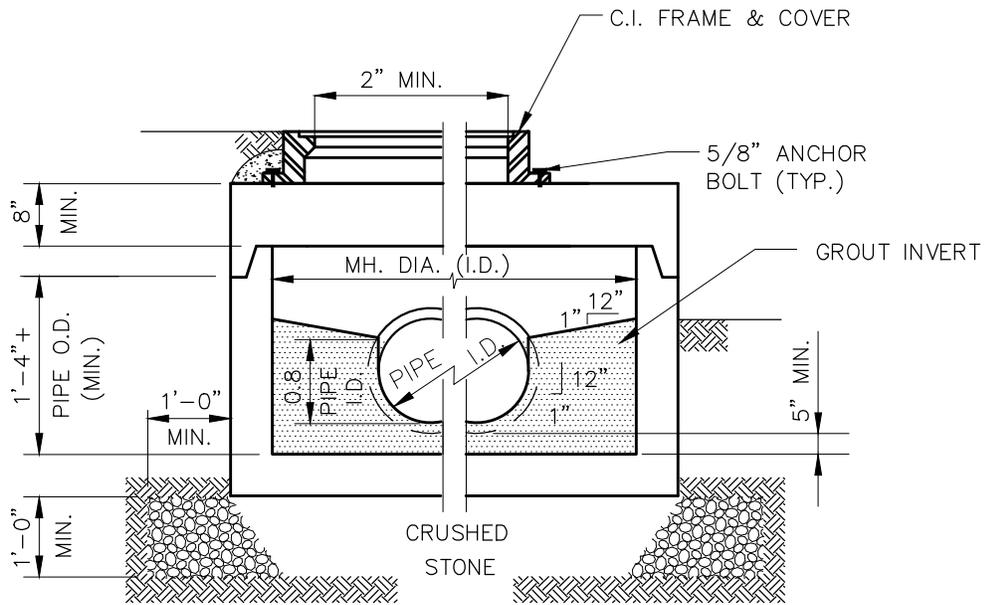
DATE : DEC. 2016

SCALE : N.T.S

STANDARD DETAILS

GRAVITY SEWER

STD-WW-01



TOP AT GRADE

TOP ABOVE GRADE

PRECAST CONCRETE
SHALLOW MANHOLE DETAIL

N.T.S.



SEVIERVILLE WATER & SEWER DEPT.

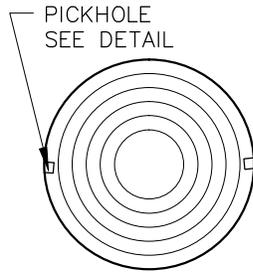
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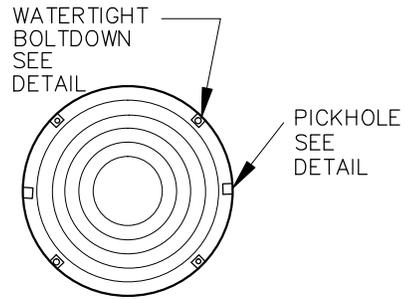
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GRAVITY SEWER

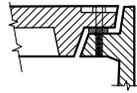
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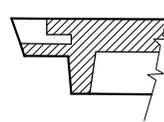
STANDARD



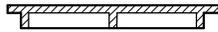
WATERTIGHT



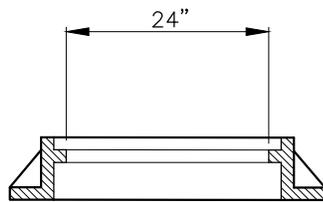
WATERTIGHT DETAIL



PICKHOLE DETAIL

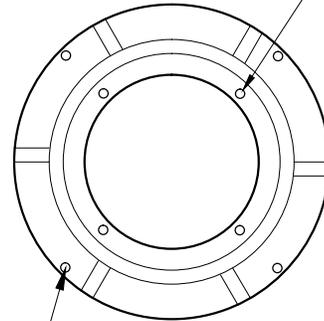


COVERS



STANDARD AND
WATERTIGHT FRAME

ONLY FOR WATERTIGHT COVER



ALL FRAMES

MANHOLE FRAME & COVER

NTS



SEVIERVILLE WATER & SEWER DEPT.

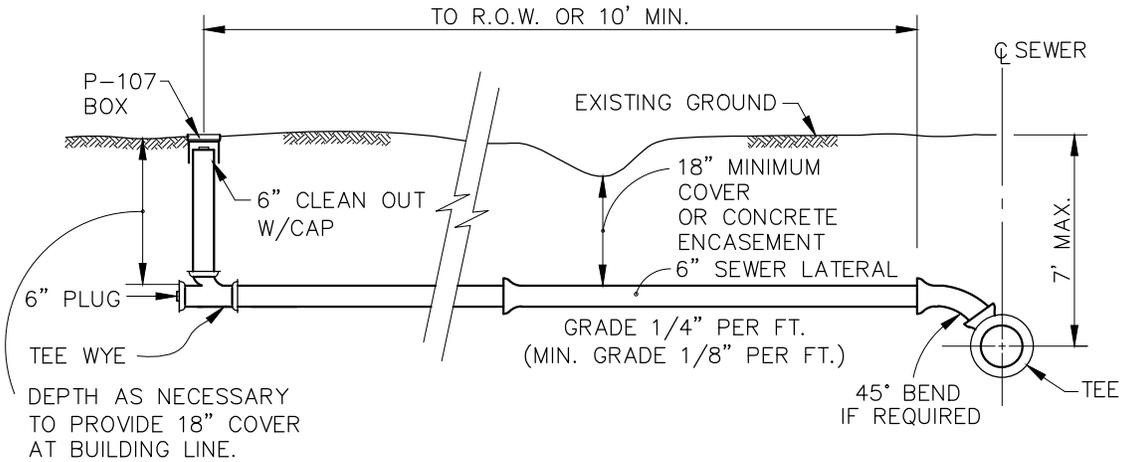
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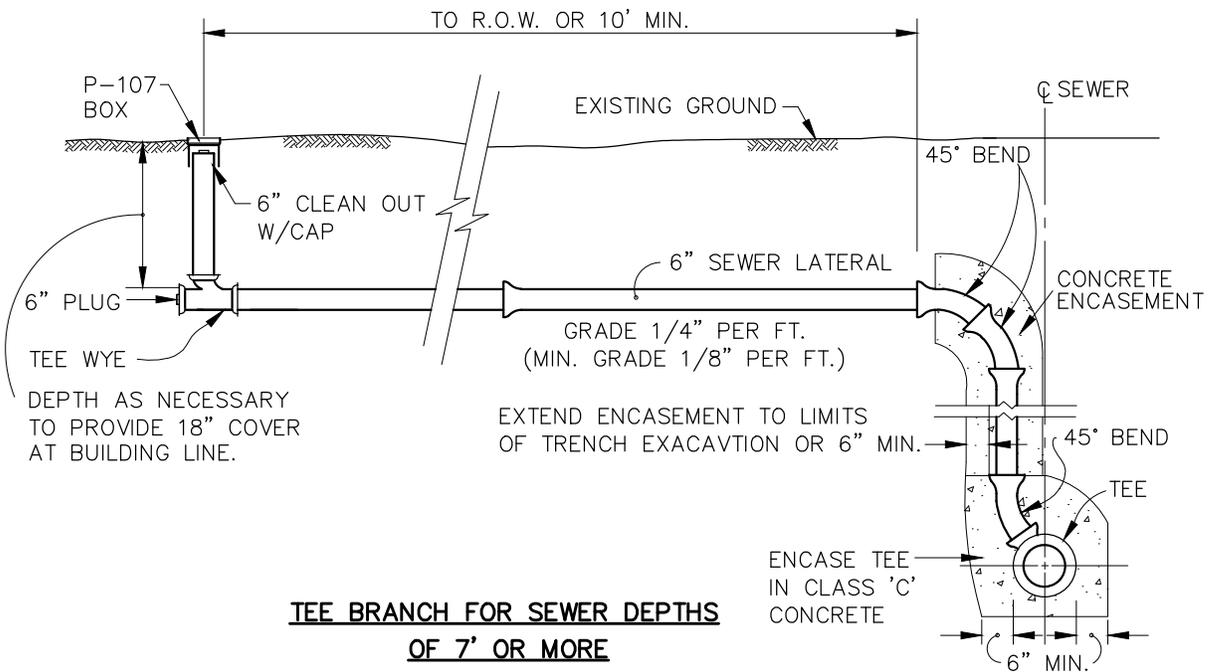
STANDARD DETAILS

GRAVITY SEWER

STD-WW-03



TEE BRANCH



TEE BRANCH FOR SEWER DEPTHS OF 7' OR MORE

SERVICE CONNECTION DETAIL

NTS



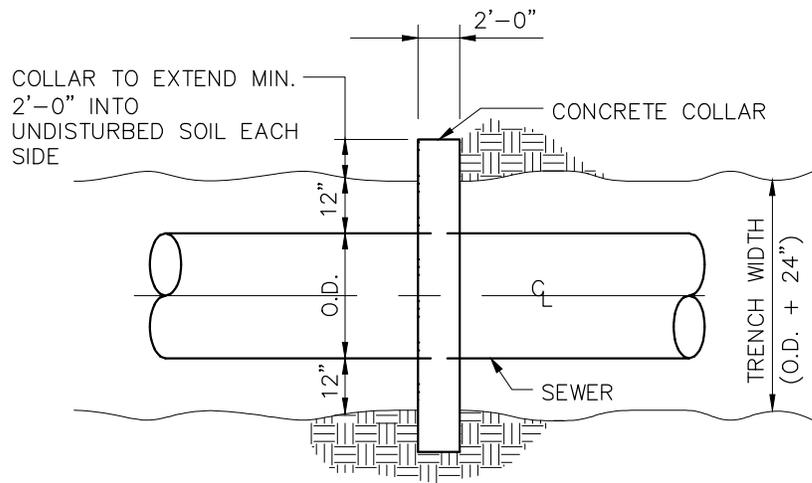
SEVIERVILLE WATER & SEWER DEPT.

STANDARD DETAILS
GRAVITY SEWER

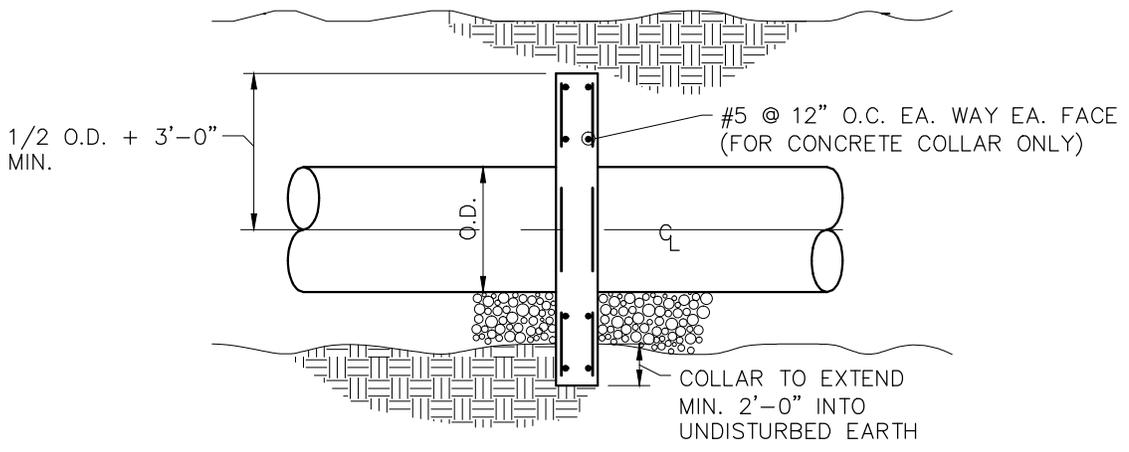
DATE : DEC. 2016

SCALE : N.T.S

STD-WW-04



PLAN



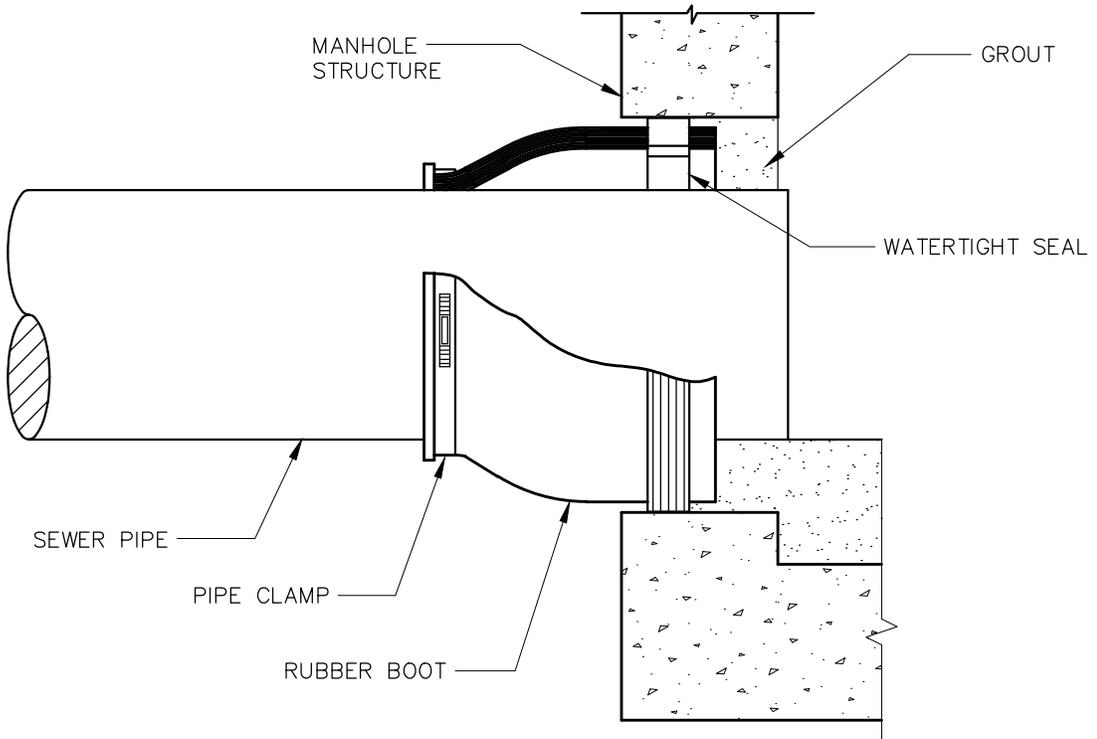
SECTION

CONCRETE/WATERSTOP COLLAR DETAIL
NTS



SEVIERVILLE WATER & SEWER DEPT.
STANDARD DETAILS
GRAVITY SEWER

DATE : DEC. 2016
SCALE : N.T.S
STD-WW-05



RUBBER BOOT DETAIL
 NTS



SEVIERVILLE WATER & SEWER DEPT.

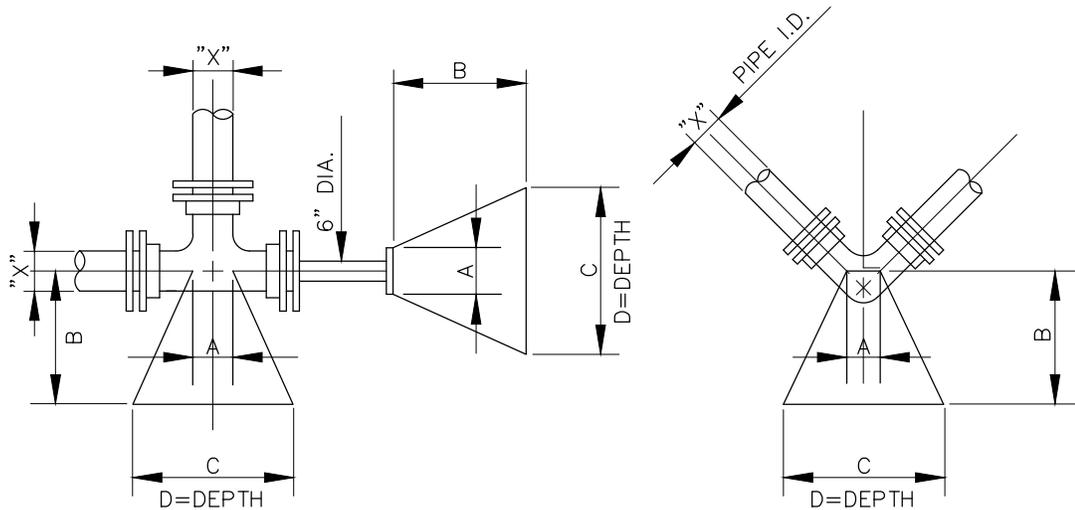
DATE : DEC. 2016

SCALE : N.T.S

STANDARD DETAILS

GRAVITY SEWER

STD-WW-06



200 PSI TEST PRESSURE (MAXIMUM)
2000 PSF SOIL BEARING

		BLOCKING DIMENSIONS					
DEAD END & TEES	X*	A	B	C	D		
		10"	1'-0"	2'-6"	4'-0"	2'-6"	
	8"	0'-10"	2'-3"	3'-3"	2'-0"		
	6"	0'-8"	1'-6"	2'-6"	1'-6"		
BENDS	90°	10"	1'-0"	3'-6"	5'-0"	2'-9"	
		8"	0'-10"	2'-9"	4'-0"	2'-3"	
		6"	0'-8"	2'-0"	3'-0"	1'-9"	
	45°	10"	1'-0"	1'-9"	3'-0"	2'-6"	
		8"	0'-10"	1'-6"	2'-6"	2'-0"	
		6"	0'-8"	1'-3"	2'-0"	1'-6"	
		1/2"	10"	1'-0"	1'-4"	2'-6"	1'-6"
			8"	0'-10"	1'-0"	2'-0"	1'-3"
			6"	0'-8"	0'-9"	1'-6"	1'-0"
		1/4"	10"	1'-0"	0'-6"	1'-6"	1'-3"
			8"	0'-10"	0'-6"	1'-4"	1'-0"
			6"	0'-8"	0'-6"	1'-0"	0'-9"

X* = DIAMETER OF PIPE TO BE BLOCKED

TYPICAL BLOCKING DETAIL

NTS



SEVIERVILLE WATER & SEWER DEPT.

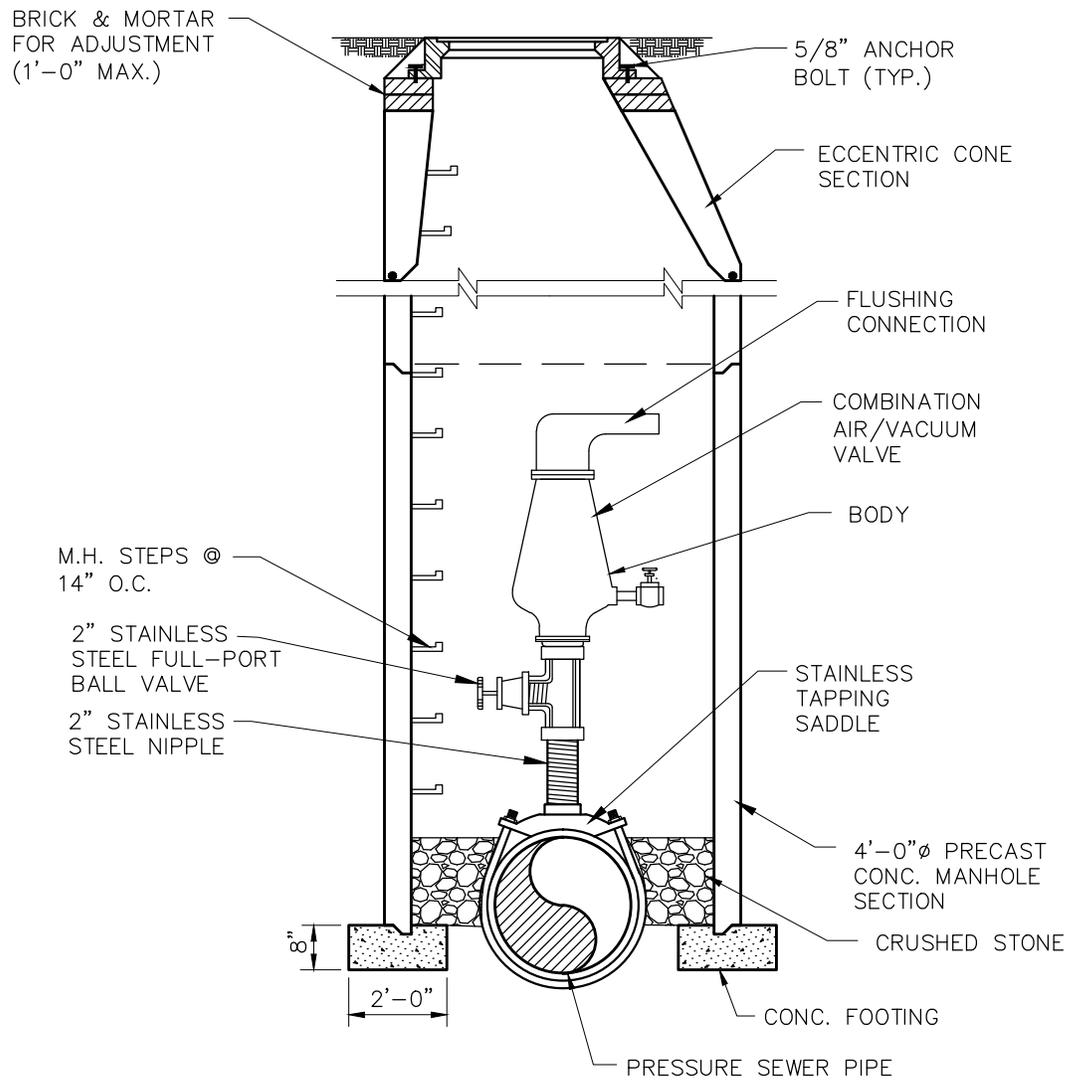
STANDARD DETAILS

PRESSURE SEWER

DATE : DEC. 2016

SCALE : N.T.S

STD-WWP-01



WASTEWATER
AIR RELEASE MH. DETAIL
 NTS



SEVIERVILLE WATER & SEWER DEPT.

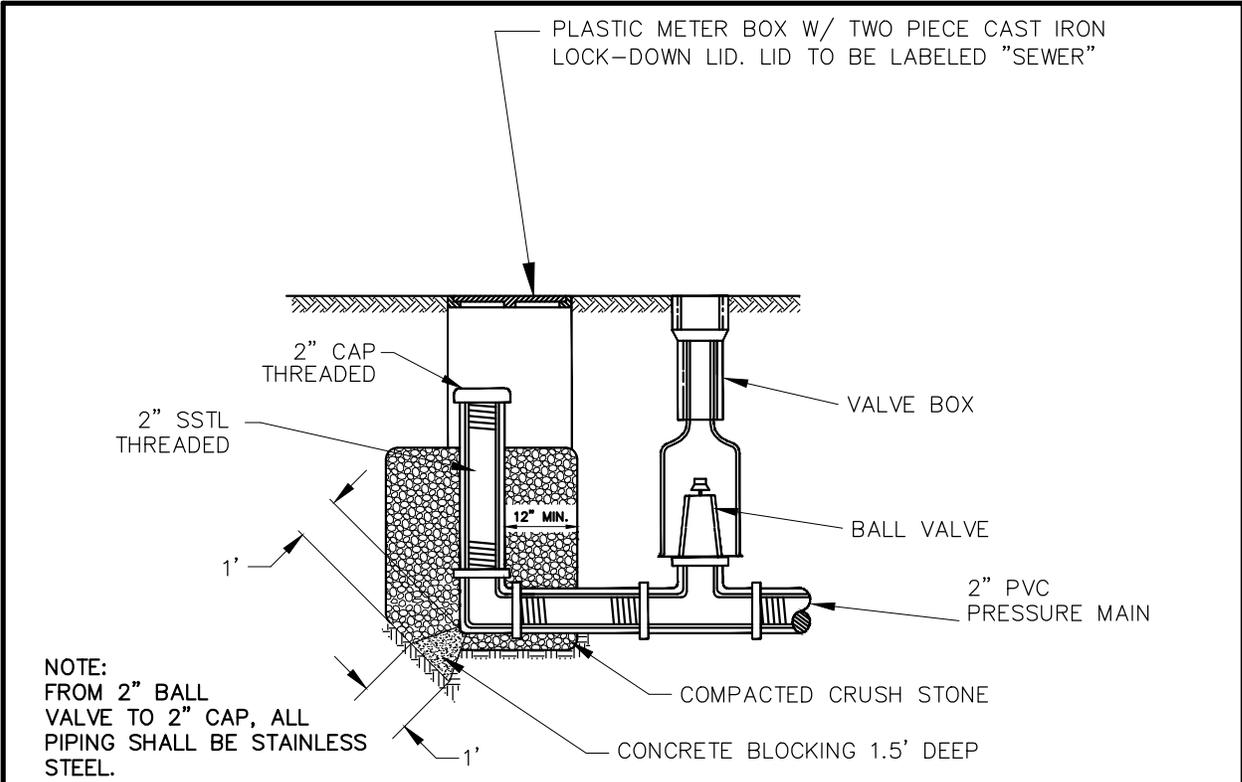
DATE : DEC. 2016

SCALE : N.T.S

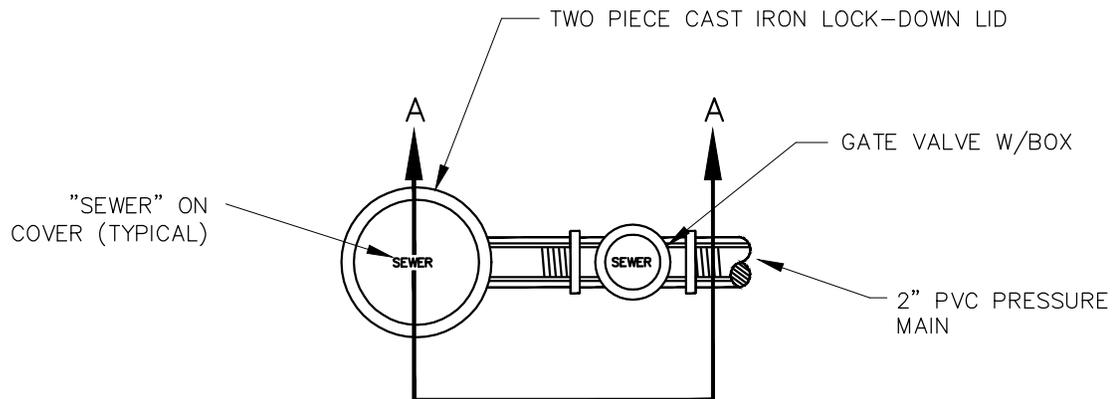
STANDARD DETAILS

PRESSURE SEWER

STD-WWP-02

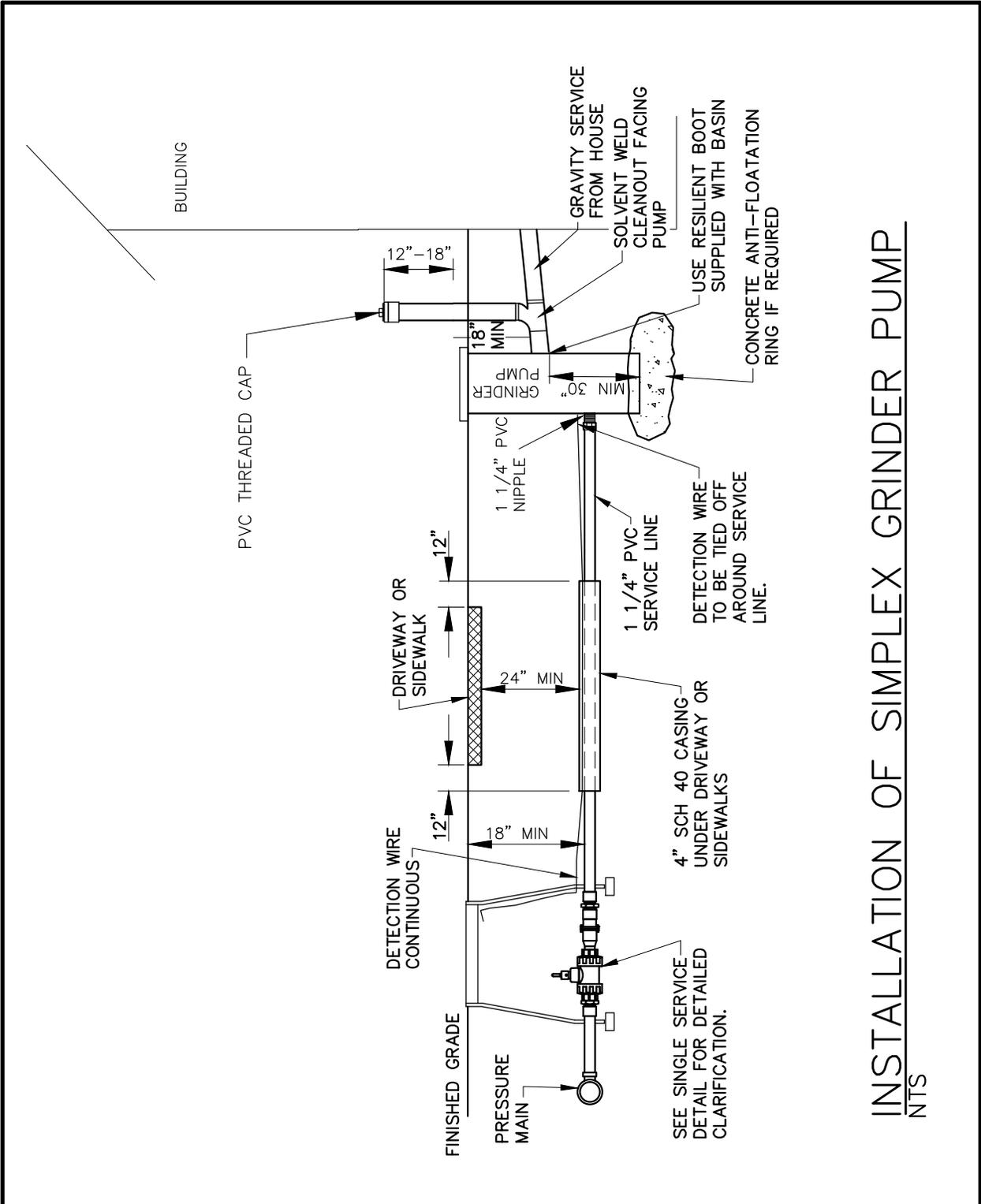


END-LINE FLUSHING STATION
SECTION A-A'



TYPICAL END-LINE FLUSHING STATION
NTS

	SEVIERVILLE WATER & SEWER DEPT.	DATE : DEC. 2016
	STANDARD DETAILS	SCALE : N.T.S
	PRESSURE SEWER	STD-WWP-03



INSTALLATION OF SIMPLEX GRINDER PUMP

NTS



SEVIERVILLE WATER & SEWER DEPT.

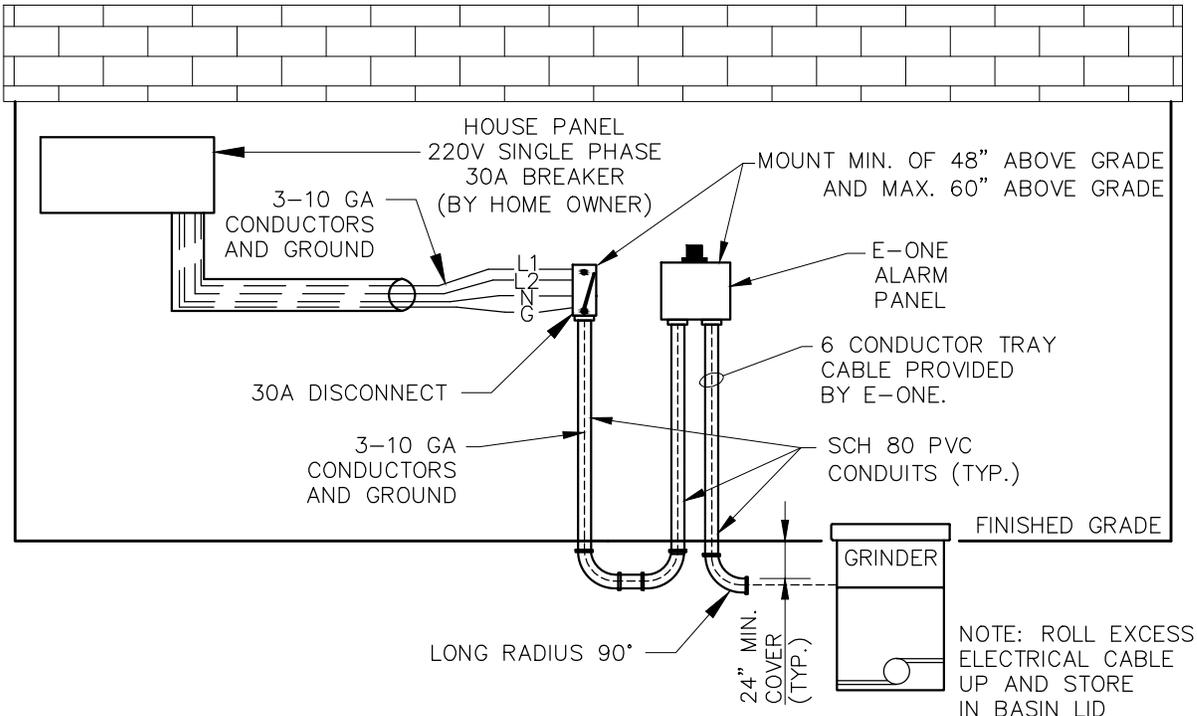
STANDARD DETAILS

PRESSURE SEWER

DATE : DEC. 2016

SCALE : N.T.S

STD-WWP-04



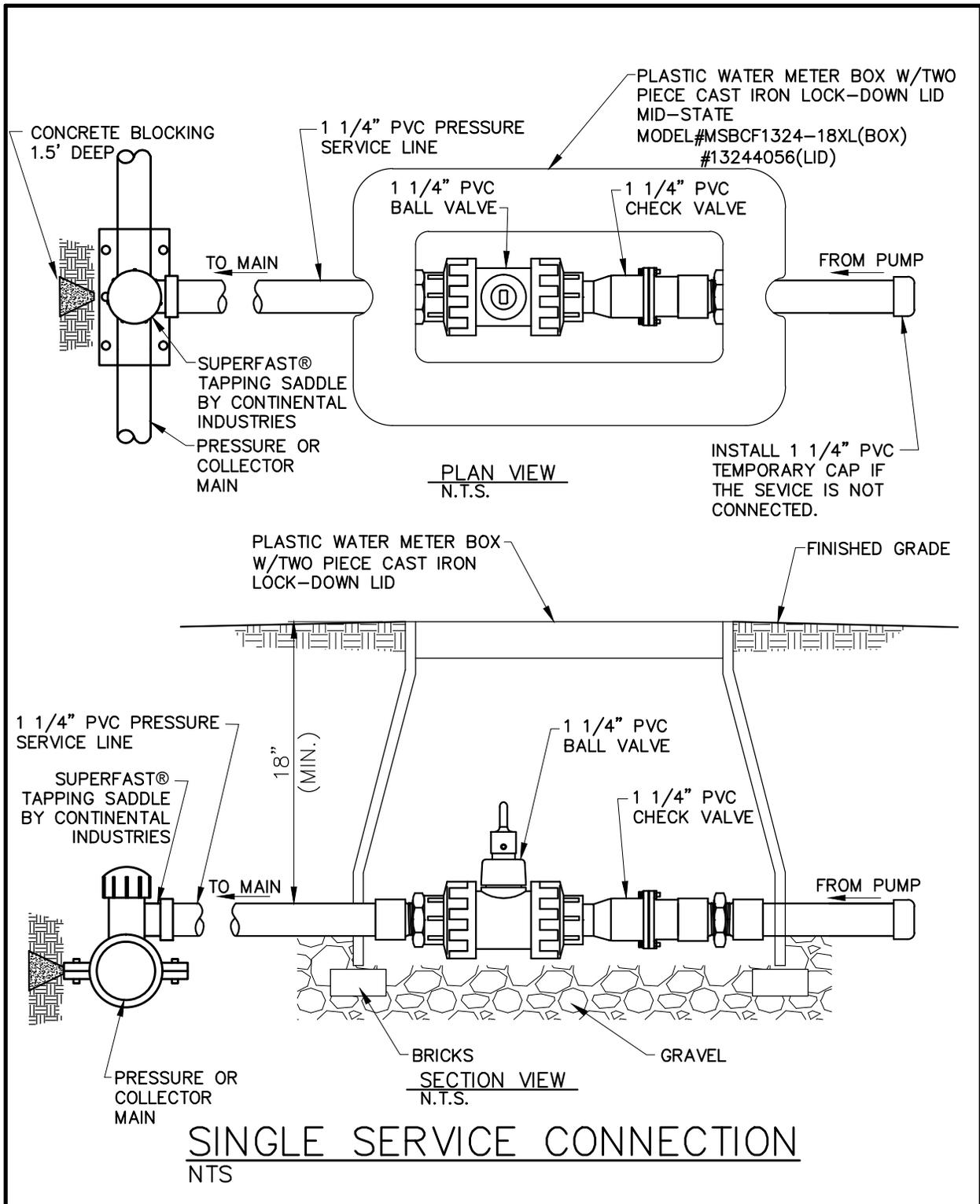
NOTE: VERIFY MOTOR AMPERAGE AND ALL NAMEPLATE REQUIREMENTS PRIOR TO INSTALLATION
 ALL CONNECTIONS SHALL BE IN ACCORDANCE WITH LOCAL CODES AND NEC

ELECTRICAL INSTALLATION
FOR SIMPLEX GRINDER
PUMPS
 NTS



SEVIERVILLE WATER & SEWER DEPT.
 STANDARD DETAILS
 PRESSURE SEWER

DATE : DEC. 2016
 SCALE : N.T.S
 STD-WWP-05



SEVIERVILLE WATER & SEWER DEPT.

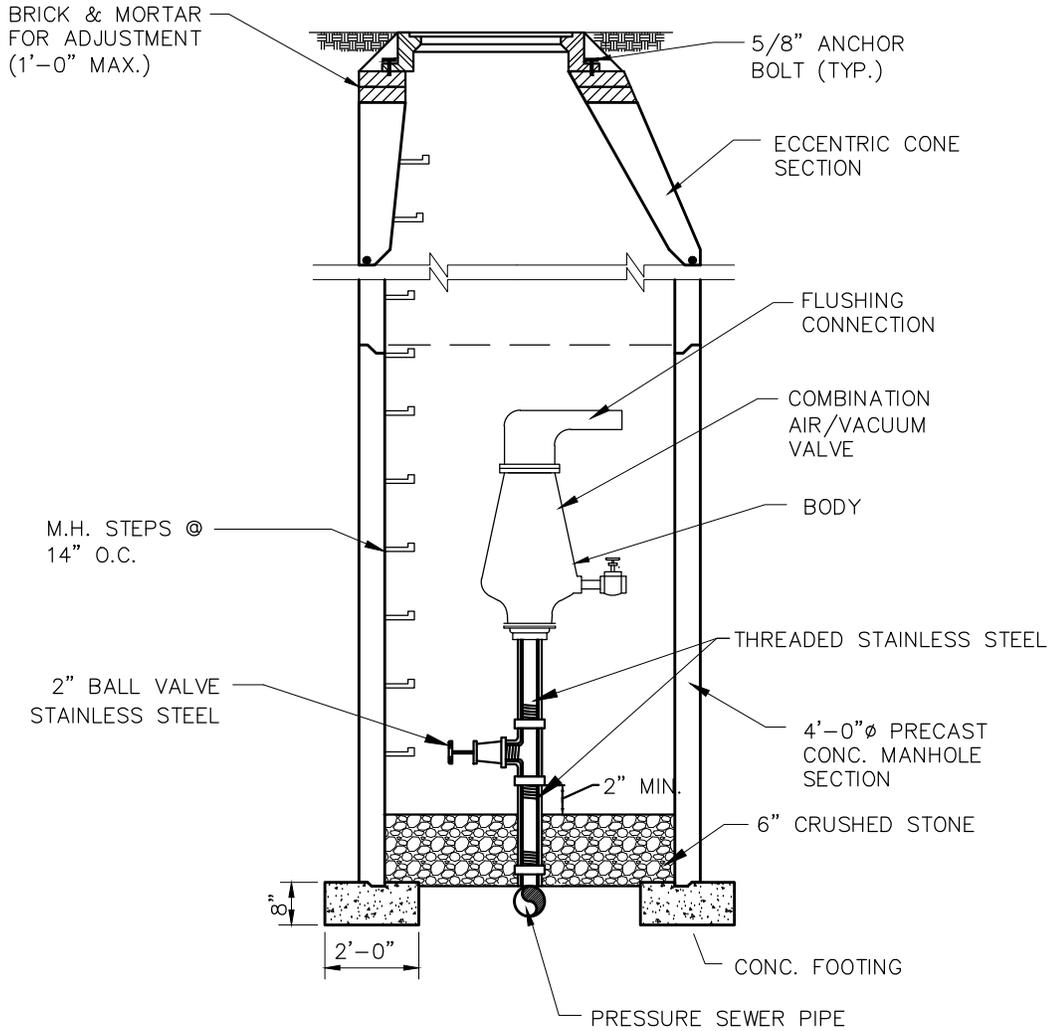
DATE : DEC. 2016

SCALE : N.T.S.

STANDARD DETAILS

PRESSURE SEWER

STD-WWP-06



AIR VALVE DETAIL FOR SMALLER
DIAMETER PRESSURE SEWER
 NTS



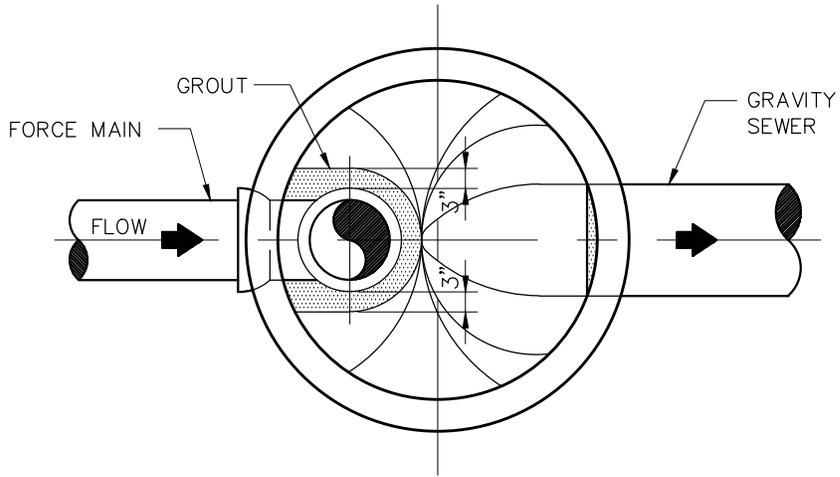
SEVIERVILLE WATER & SEWER DEPT.

STANDARD DETAILS
 PRESSURE SEWER

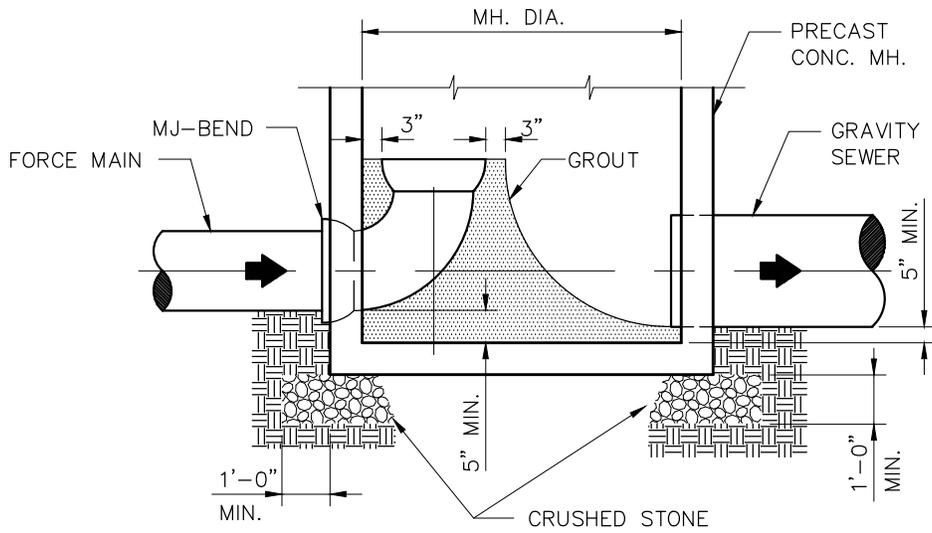
DATE : DEC. 2016

SCALE : N.T.S

STD-WWP-07



PLAN



SECTION

(END OF LINE CONNECTION)
FORCE MAIN DISCHARGE MANHOLE DETAIL
 NTS



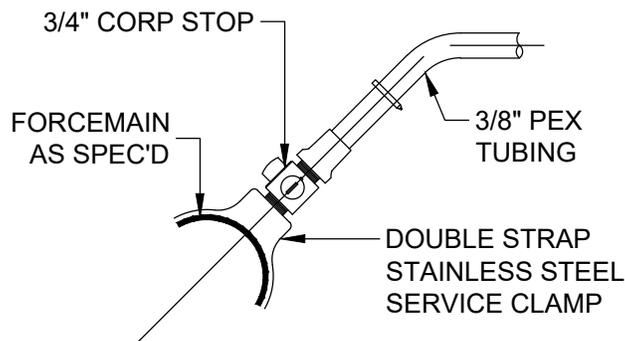
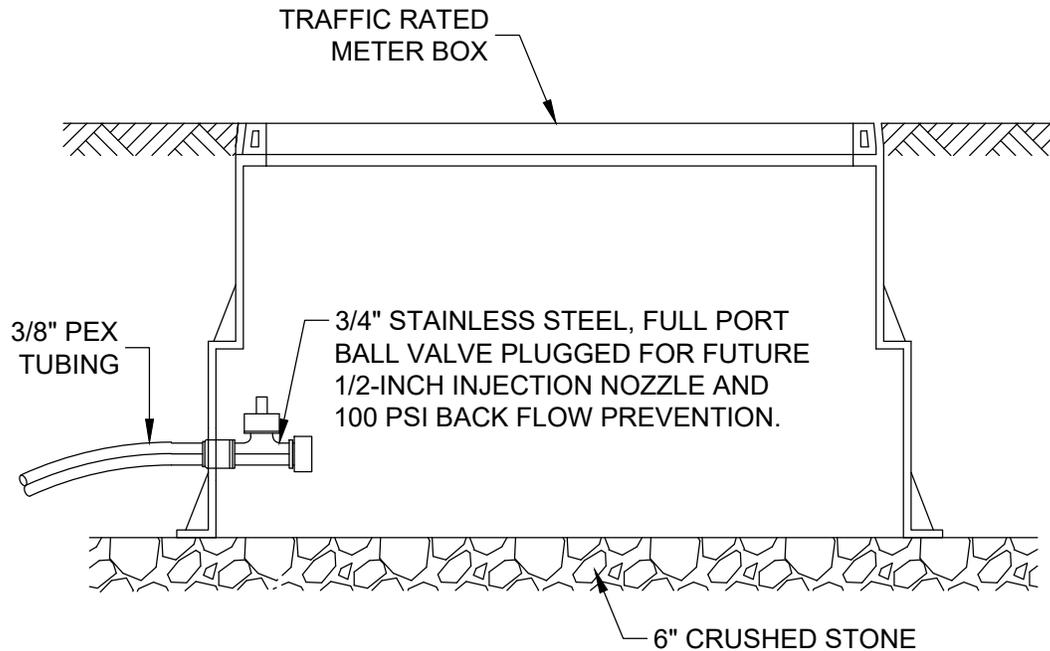
SEVIERVILLE WATER & SEWER DEPT.

STANDARD DETAILS
 GRAVITY SEWER

DATE : DEC. 2016

SCALE : N.T.S

STD-WWP-08



NOTES:

1. TWO (2) ODOR CONTROL INJECTION TAPS REQUIRED PER PUMP STATION.
2. DOUBLE STRAP STAINLESS STEEL SERVICE CLAMPS TO BE LOCATED 1-3 FEET APART.
3. HALF INCH INJECTION NOZZLE AND 100 PSI BACK FLOW PREVENTION FURNISHED AND INSTALLED BY ODOR CONTROL CONTRACTOR.

FORCE MAIN ODOR CONTROL INJECTION TAP NTS



SEVIERVILLE WATER & SEWER DEPT.

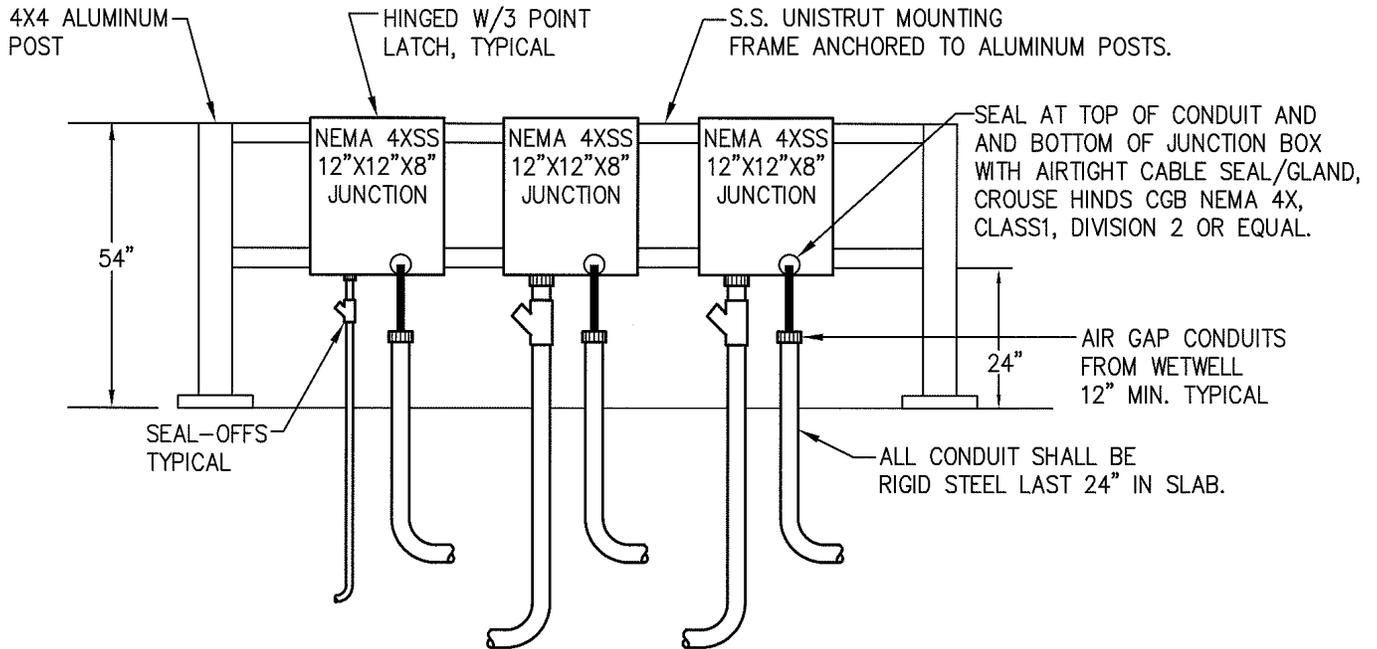
STANDARD DETAILS

PRESSURE SEWER

DATE: JULY 2020

SCALE: N.T.S.

STD-WWP-09



PUMP CONNECTIONS JUNCTION BOX DETAIL

NTS



SEVIERVILLE WATER & SEWER DEPT.

DATE: JULY 2020

SCALE: N.T.S.

STANDARD DETAILS

PRESSURE SEWER

STD-WWP-10



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