



Norris Water Commission

Monday, December 16, 2024, 6:00 P.M.

- I. Call to Order
- II. Approve the Agenda
- III. Hear the Public
- IV. Minutes
 - a. Consideration of Approving November 18, 2024 Regular Meeting Minutes
- V. New Business
 - a. A Representative from Cannon and Cannon to discuss ongoing projects including INI, Regionalization/Plant, and Alternative Water Supply
 - b. Consideration of Rescheduling the January and February NWC Meetings in Honor of MLK Jr Day and Presidents' Day
- VI. Old Business
 - a. Update on Activities at the Water Treatment Plant
 - b. Update on Activities at the Wastewater Treatment Plant
 - c. Update on the Water Distribution System
 - d. Update on the Sanitary Sewer Collection System
 - e. Update on Cross Connection Management System
 - f. Update on the Galvanized Pipe Project
- VII. Reports
 - a. Superintendent October Report
 - b. October Financial Report
 - c. October Unaccounted-for Water Report
- VIII. Adjournment



NORRIS WATER COMMISSION MEETING MINUTES
November 18, 2024

Members Present: Bill Grieve, Will Grinder, Loretta Painter, Mayor Chris Mitchell
Water Superintendent: Tony Wilkerson

- I. **Call to Order:** The meeting was called to order by Loretta Painter at 6:00 pm.
- II. **Approval of the Agenda** – Agenda was approved without change.
- III. **Hear the Public** – No comments from the public.
- IV. **Minutes**
 1. **October 28, 2024 NWC Minutes**

A motion was made by Will Grinder and seconded by Bill Grieve **to approve the October 28, 2024, 2024 meeting minutes.**
The proposal passing on a vote of 4 to 0 as follows:
Yes: Bill Grieve, Will Grinder, Loretta Painter, Mayor Chris Mitchell
- V. **New Business**
 1. **INI Project and Bid Packet**

City Manager Ledford reported that Cannon and Cannon expected to have a response on the proposed project from TDEC before the next regular NWC meeting and was planning to attend. An element of the project that needed further conversation was comparing open cut repairs compared to alternative options with potential cost and long-term impacts at the forefront.

Will Grinder requested a copy of the drawings used to plan the project before the next meeting.
- VI. **Continuing Business**
 1. **Benny Carden Memorial**

Superintendent Wilkerson reported that this project had been completed and recommended it be removed from future consideration.
 2. **Activities at the Water Treatment Plant**

Superintendent Wilkerson reported high service pump #2 is in need of repairs. He has made plans to bring in a contractor to review and repair the unit.
 3. **Activities at the Wastewater Treatment Plant**

Superintendent Wilkerson reported on new equipment given to the plant by EPA.
 4. **Water Distribution**

Superintendent Wilkerson shared recent line and meter repairs in addition to the new line at Creamery Park. A new Hydrant is in the process of being installed on the far end of West Norris Road.

5. **Sanitary Sewer Collection System**
Superintendent Wilkerson shared some recent work conducted along with some upgrades to old clay lines being replaced to PVC.
6. **Cross Connection Management System**
Superintendent Wilkerson reported it has been completed, billing of 8 locations is ongoing.
7. **Galvanized Pipe Project**
Superintendent Wilkerson talked about service line classifications based on TDEC interpretation of EPA rules. The update resulting any no service lines requiring personal notification letters. He reported that every 3 years the utility test for lead and the last test was this year. The test showed there was no threat to the system.
8. **Wastewater Regionalization Study**
City Manager Ledford reported that Cannon and Cannon indicated an updated draft of the study should be ready once the rate study is complete, but no date has been set for completion. The engineering firm had indicated to him that they would be sharing an update at the next commission meeting.
9. **Alternative Water Supply Study**
City Manager Ledford provided the commission with copies of the previous RFQ and the agreement with Cannon and Cannon. He further offered that he would work with the engineering firm to review an updated schedule.

VII. **Reports**

1. **Superintendent Report:** Superintendent Wilkerson shared that a part-time position had been recently filled and the new truck would arrive later this week.
2. **August Financial/Budget Report:** City Manager Ledford provided no additional data beyond written report.
3. **August Unaccounted-for Water Report:** Superintendent Wilkerson provided no additional data beyond written report.
4. **Training:** City Manager Ledford reminded the commission that a copy of the current year training record was included in the packet.

VIII. **Adjournment: 6:55 p.m.,** Motion by Will Grinder and seconded by Bill Grieve to adjourn, All: AYE



STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES

Davy Crockett Tower, 9th Floor
500 James Robertson Parkway
Nashville, Tennessee 37243-1204

December 3, 2024

Mr. Will Littlejohn, P.E.
e-copy: wlittlejohn@cci-corp.com
Cannon & Cannon, Inc.
10025 Investment Drive Ste. 120
Knoxville, TN 37932

Subject: **Norris**
 County: Anderson
 Wastewater Project Number: 24.0842
 Project: ARPA Sanitary Sewer Rehabilitation

Dear Mr. Littlejohn:

The Tennessee Department of Environment and Conservation, Division of Water Resources, acknowledges the receipt of your construction documents on November 15, 2024.

The project consists of 7,550 linear feet of cured-in-place pipe (CIPP) lining, pipe bursting, open cut replacement, and 250 vertical feet of manhole rehabilitation.

Approval is granted in accordance with certain requirements of the Water Quality Control (WQC) Act of 1977 and Regulations of the Water Quality Control Board. **On the coversheet(s) of the site's set of plans and specifications, an approval date and its expiration date will be stamped by the Division. Any indication of tampering with the bound set of documents will be subject to investigation and prosecution.** One complete set of construction documents, bearing the official stamp, must be kept at the construction site.

Approval expires one year from the stamped approval date (December 2, 2024) unless construction is either underway or complete. Any request for extension must be made prior to this expiration date. Significant deviations from the approved plan documents must be submitted and approved in writing before such changes are made. Minor changes made during construction need not have prior written approval. Modifications, however, may be required by this Department should the changes be deemed inappropriate. It is therefore advisable to obtain prior approval in cases where the significance of the change is uncertain.

The Division of Water Resources is authorized to inspect the construction work to verify compliance with the approved plans and specifications, which are on the site. Therefore, the engineer shall notify our staff at the Knoxville Environmental Field Office by calling (865) 594-6035 before the start of construction.

Approval of these construction documents should not be construed as a permit for any activities related to this project. Activities which may require a permit under the WQC Act and Regulations include, but are not limited to, the following: streambank vegetation removal; creek crossing(s) for equipment or utility lines; construction within twenty (20) feet of a stream bank; construction in or near a marshy area or wetland, and/or land disturbance equal to or greater than one acre. Additionally, this approval does not authorize connection and use of sewer that will cause or contribute to collection system overflow or overload of receiving wastewater treatment facility.

The Knoxville Environmental Field Office should also be contacted for determinations regarding whether modification of the existing NPDES or SOP permit, an Aquatic Resource Alteration Permit (ARAP) and/or a National Pollutant Discharge Elimination System (NPDES) construction stormwater permit will need to be obtained prior to the beginning of construction of this project.

The Division's most recent *Design Criteria for Review of Sewage Works Construction Plans and Documents* is available on our website: <https://www.tn.gov/environment/permit-permits/water-permits1/plans-review-and-approval-for-sewage-works-construction-projects.html>.

To expedite matters, please reference the assigned wastewater project number 24.0842 on any future correspondence. If you have any questions, please feel free to contact Mr. Tim Hill, P.E. at (865) 364-9535 or by E-mail at Timothy.Hill@tn.gov.

Sincerely,



Angela Jones, PE, CPM
Manager, Engineering Services Unit

cc: Water-Based Systems File
Mr. Tony Wilkerson, Superintendent, Norris Water Commission, watersuperintendent@norristn.gov
Mr. Michael J. Atchley, Unit Manager, TDEC Division of Water Resources, Michael.Atchley@tn.gov

Project Manual for
**Norris Sanitary Sewer Rehabilitation Phase I
Anderson County, TN**

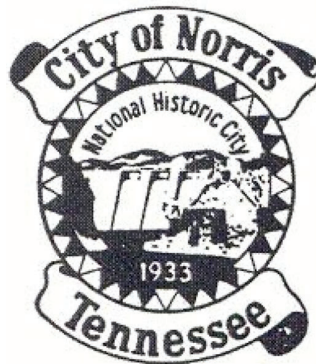


Owner:

**NORRIS WATER COMMISSION
20 Chestnut Drive
Norris, TN 37828**

**ARP Project ID 2022-8741
CCI Project No. 00292-0023**

November, 2024



SECTION 00 01 10
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The following Table of Contents outlines the list of the technical specifications for the **ARPA Sanitary Sewer Rehabilitation** project for Norris Water Commission. The CONTRACTOR is advised that this Project Manual, the Contract Drawings, and any and all addenda and/or change orders related thereto are hereby defined in whole as the “Contract Documents” and no separation of same will be considered.

Conflicts between any parts of the Contract Documents shall be brought to the OWNER’s attention prior to the receiving of bids.

The CONTRACTOR is responsible for verifying that all documents have been received.

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END OF SECTION 00 01 10



**SECTION 03 30 00.01
CONCRETE FOR UTILITIES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

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

1.03 REFERENCE STANDARDS

- A. American Concrete Institute

1. ACI 211 – Guide for Selecting Proportions for Concrete.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
4. ACI 305 – Guide to Hot Weather Concreting.
5. ACI 306 – Guide to Cold Weather Concreting.
6. ACI 308 – Guide for External Curing of Concrete.
7. ACI 309 – Guide for Consolidation of Concrete.
8. ACI 318 – Code Requirements for Reinforced Concrete.
9. ACI 347 – Guide to Formwork Concrete.
10. ACI 350 – Code Requirements for Environmental Engineering (Water & Wastewater) Concrete Structures.

- B. ASTM

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
3. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
4. ASTM C33 - Standard Specification for Concrete Aggregates.

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

1.04 SUBMITTALS

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

1.05 TESTING

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

PART 2 - PRODUCTS

2.01 FORMS

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

2.02 FORM COATINGS

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

2.03 REINFORCEMENT

- A. Reinforcing bars shall be Grade 60 and in accordance with ASTM A615.

- B. Welded plain and deformed steel wire fabric shall be in accordance with ASTM A1064.
- C. Provide supports for reinforcement, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Unless otherwise indicated on the drawings, use wire type bar supports. Wood and other materials will not be accepted as bar supports.

2.04 CONCRETE MATERIALS

- A. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cast-in-place concrete shall be Class A Type II cement unless otherwise noted:
 - 1. Class A shall be:
 - a. 4,000 psi compressive strength at 28 days
 - b. Maximum (water)/(cement) ratio = 0.45
 - c. Minimum cement content = 564 lbs/cu yd (6 bags per cubic yard of concrete)
 - d. Nominal maximum size coarse aggregate
 - 1) No. 67 (3/4-inch max) or
 - 2) No. 57 (1-inch max)
 - e. Air Content = 6 percent +/- 1 percent by volume
 - f. Slump = 3 to 4 inches in accordance with ASTM C143
 - 2. Class B may be used for non-structural and non-load bearing applications:
 - a. 3,000 psi compressive strength at 28 days
 - b. Maximum (water)/(cement) ratio = 0.56
 - c. Minimum cement content = 470 lbs/cu yd (5 bags per cubic yard of concrete)
 - d. Nominal maximum size coarse aggregate
 - 1) No. 67 (3/4-inch max) or
 - 2) No. 57 (1-inch max)
 - 3) Architectural treatment shall use No. 67 (3/4-inch max)
 - e. Air Content = 6 percent +/- 1 percent by volume
 - f. Slump = 3 to 4 inches in accordance with ASTM C143
- C. Flowable Fill concrete shall be Excavatable Type II cement unless otherwise noted:
 - 1. Excavatable
 - a. 100 psi compressive strength at 28 days
 - b. Maximum (water)/(cement) ratio = 0.19
 - c. Minimum cement content = 94 lbs/cu yd (1 bags per cubic yard of concrete)
 - d. Fine aggregate gradation shall meet TDOT section 903.01 (latest edition)
 - e. Air Content = 5 to 35 percent percent by volume
 - f. Slump = 8 to 12 inches in accordance with ASTM C143
 - 2. Non-Excavatable
 - a. 125 psi compressive strength at 28 days
 - b. Maximum (water)/(cement) ratio = 0.19
 - c. Minimum cement content = 150 lbs/cu yd (1.5 bags per cubic yard of concrete)
 - d. Fine aggregate gradation shall meet TDOT section 903.01 (latest edition)

- e. Air Content = 5 to 15 percent percent by volume
- f. Slump = 8 to 12 inches in accordance with ASTM C143

D. Minimum Requirements:

- 1. Portland Cement: ASTM C150, Type I or II, low-alkali.
- 2. Aggregate, general:
 - a. ASTM C33, uniformly graded and clean.
 - b. Do not use aggregate known to cause excessive shrinkage.
- 3. Aggregate, Coarse: Maximum 3/4-inch crushed rock or washed gravel.

2.05 ACCESSORIES AND OTHER MATERIALS

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

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, support, brace, and maintain formwork to support any vertical and lateral loads that may be applied until such loads can be supported by the concrete structure. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Construct forms complying with ACI 347 to the sizes, shapes, lines, and dimensions shown on the Construction Drawings so that in the finished structures the work will be level and plumb and have accurate alignment, location, and grade. Provide for openings, offsets, sinkage, keyways, recesses, moldings, rustication, reglets, chambers, blocking, screeds, bulkheads, anchorages, inserts, wall pipes, and other features that the work requires. Use selected materials to obtain the required finishes. But joints solidly, and provide backup at joint to prevent leakage of cement paste.
- C. Fabricate forms so that they can be easily removed without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep for the concrete to be placed with the bottom forms only. To form keyways, reglets, recesses, and the like, kerf wood inserts to prevent swelling and to permit easy removal.
- D. Clean thoroughly forms and adjacent surfaces that are to receive concrete. Remove chips, wood, sawdust, dirt, and any other debris just before the concrete is placed. After concrete placement, retighten the forms as necessary to eliminate mortar leaks.

3.02 EARTH FORMS

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

3.03 REINFORCEMENT

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

3.04 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in.
- B. Mix concrete in accordance with ASTM C94.
- C. Place concrete in accordance with ACI 304.
- D. Deposit concrete either continuously or in layers thick enough to prevent its being placed on concrete that has hardened enough to cause the formation of seams or planes of weakness within the section. Deposit concrete as close to its final location as practicable in order to avoid segregation due to rehandling or flowing.
- E. Deposit concrete in forms in horizontal layers no deeper than 24 inches. Avoid cold joints by placing each layer while the preceding one is still plastic.
- F. Use mechanical vibrating equipment supplemented by hand spading, ridding, or tamping to consolidate placed concrete. The equipment and procedures used to consolidate the concrete shall comply with the recommended practices of ACI 309 and suit both the type of concrete and project conditions. Provide standby mechanical vibrating equipment at all concrete placements.
- G. Consolidate concrete during placing operations so that it is thoroughly worked around reinforcement and other embedded items and into corners.
- H. Maintain reinforcement in the proper position during placement operations.

3.05 COLD WEATHER PLACEMENT

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

3.06 HOT WEATHER PLACEMENT

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

3.07 CONCRETE FINISHING

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

END OF SECTION 03 30 00.01

**SECTION 31 10 00
SITE CLEARING**

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.
- D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.
- E. Stripping: Removal of topsoil remaining after applicable scalping is completed.
- F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SCHEDULING AND SEQUENCING

- A. Prepare Site only after adequate erosion and sediment controls are in place.
- B. Contractor may clear and grub for linear pipe line projects 1,000 feet ahead of pipe laying, or a greater distance with written approval of the Owner. However, at Owner's discretion, areas cleared may require the application of soil stabilization seed mix. As the work progresses, the initial portion of the alignment shall be restored, in accordance with Specification 01 57 13, Temporary Erosion and Sediment Control, as additional alignment is cleared.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements within limits shown or specified.
- B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

- A. As follows, but not to extend beyond Project limits.

1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.
2. Trench Excavation for Utilities: width of permanent easement as shown on the drawings, or greater up to temporary easement, upon Owner approval.
3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
4. Structures: 15 feet outside of new structures.
5. Roadways: Clearing and grubbing: 10 feet from roadway shoulders, unless otherwise required for cut or fill sections.
6. Other Areas: As shown.

- B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 TEMPORARY REMOVAL OF INTERFERING PLANTINGS

- A. Remove and store plants, shrubs and trees that are not designated for removal but do interfere with construction or could be damaged by construction activities.
- B. Photograph and document location, orientation, and condition of each plant prior to its removal. Record sufficient information to uniquely identify each plant removed and to assure accurate replacement.

3.04 CLEARING

- A. Clear areas within limits shown or specified.
- B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
- C. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.05 GRUBBING

- A. Grub areas within limits shown or specified.

3.06 SCALPING AND STRIPPING

- A. Where required on the plans, do not remove sod until after clearing and grubbing is completed and resulting debris is removed. Scalp areas within limits shown or specified.
- B. Do not remove topsoil until after scalping is completed. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil. Stockpile strippings, meeting requirements of Section 32 91 13, Soil Preparation, for topsoil, separately from other excavated material.

3.07 TREE REMOVAL OUTSIDE CLEARING LIMITS

- A. Remove Within Project Limits:

1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
 2. Trees designated by Owner.
- B. Cut stumps off flush with ground, grub, and remove debris, and if disturbed, restore surrounding area to its original condition.

3.08 PRUNING

- A. Remove branches below the following heights:
1. 20 feet above roadways and shoulders.
 2. 9 feet above sidewalks.
 3. 6 feet above roofs.

3.09 SALVAGE

- A. Saleable log timber may be sold to Contractor's benefit. Promptly remove from Project Site.
- B. Other limbs or woody debris shall be chipped and used for erosion control or mulch, if practical, or disposed of off site.
- C. Sod with commercial value may be sold to Contractor's benefit. Promptly remove from Project Site.

3.10 DISPOSAL

- A. Clearing and Grubbing Debris:
1. Dispose of debris offsite. Burning is not permitted.
 2. If practical, woody debris may be chipped and used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4 inch by 2 inches. Dispose of chips that are unsuitable for landscaping or other uses with unchipped debris.
 3. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.
- B. Scalpings: As specified for clearing and grubbing debris.
- C. Strippings: Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION 31 10 00

SECTION 31 23 16.01

EXCAVATION FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

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

G. Pipe Zone:

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

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

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

1.4 MATERIAL OWNERSHIP

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

1.5 SUBMITTALS

A. Preconstruction Site Videos

1. Take digital videos along centerline of proposed pipe trench.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
3. Include Project description, date taken, and sequential number in the file name of each video.

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

C. Site Clearing

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

D. Rock Removal

1. Shop Drawings: Indicate proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock removal method.

2. Survey Report: Submit survey report on conditions of buildings near locations of rock removal.

PART 2 - PRODUCTS

2.1 BACKFILL SOILS

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

2.2 TRENCH STABILIZATION MATERIAL

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

2.3 PIPE ZONE AND CRUSHED STONE BACKFILL MATERIAL

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

2.4 COMPACTED BACKFILL

- A. For backfill to be compacted during the installation of flexible pipe outside of paved areas, no rocks or foreign objects greater than 3 inches shall be allowed.
- B. For backfill to be compacted during the installation of rigid pipe outside of paved areas, no rocks or foreign material greater than 5 inches shall be allowed. If soil backfill material is unsuitable, crushed stone may be used for backfill to 18 inches over the pipe being installed.

2.5 TOPSOIL

- A. Topsoil shall be natural topsoil without admixture of subsoil material.
- B. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than ½ inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen, or its residue, boards, sticks, chips, or other desirable material harmful or unnecessary to plant growth.

- C. Topsoil shall be reasonably free from perennial weeds and perennial weed seeds, and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.
- D. The topsoil's pH shall range from 5.5 to 7.0. Topsoil shall contain not less than 5 percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven-dried samples to 65° C.
- E. Topsoil shall possess the following characteristics, shall be subject to testing as described above, and shall be subject to the approval of the Engineer:
 - 1. 20 – 60% sand (0.075 – 2 mm)
 - 2. 0 – 50% silt (0.002 – 0.075 mm)
 - 3. 0 – 30% clay (0.001 – 0.002 mm)
 - 4. 96% passing No. 10 sieve

2.6 FLOWABLE FILL

- A. Select and proportion ingredients to obtain compressive strength between 50 psi and 200 psi at 28 days in accordance with ASTM D4832.
- B. Materials:
 - 1. Cement: ASTM C150, Type I or Type II.
 - 2. Aggregate: ASTM C33, Size 7.
 - 3. Fly Ash (if used): ASTM C618, Class C.
 - 4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.7 MISCELLANEOUS CRUSHED STONE

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

2.8 ROCK REMOVAL

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

2.9 WARNING TAPE AND TRACER WIRE

- A. Detectable Warning Tape:
 - 1. All pipelines installed via open trench shall be installed with detectable warning tape. Detectable warning tape shall be:
 - a. 2 inches wide

- b. Inert, bonded layer plastic
- c. Metallized foil core
- d. Highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils
- e. Utility and Tape Color: Gas = Yellow; Sewer = Green; and Water = Blue.
- f. Marked with "CAUTION ### LINE BURIED BELOW".
 - 1) "###" shall be the utility being installed "GAS", "SEWER", or "WATER".

B. Tracer Wire:

- 1. All utility lines, including but not limited to ductile and PVC shall be installed with tracing wire.
- 2. Material: Minimum 10-gauge solid copper with high-density polyethylene (HDPE) or high-molecular weight polyethylene (HMWWPE) insulation suitable for direct bury.
- 3. Splices: Use wire nut or lug suitable for direct bury as recommended by tracer wire manufacturer.
- 4. Manufacturers:
 - a. Copperhead Industries, LLC.
 - b. Performance Wire & Cable Inc.
 - c. Pro-Line Safety Products Company.

2.10 UTILITY MARKER

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Wrap blue vinyl tie tape around each tree at an easily visible height.
- C. Protect existing site improvements to remain from damage during construction.

- D. Contact Tennessee One-Call location services at 811 not less than three working days before performing Work. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Keep utility locates up to date until excavation has received final backfill in that area.
- E. Setup and install traffic control around the work zone in accordance with roadway agency and OSHA regulations.

3.2 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within protection zones.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

3.3 STRIPPING TOPSOIL

- A. Remove sod and grass before stripping topsoil.
- B. Strip any available topsoil to its full depth at all areas to be regraded, resurfaced, or paved within contract limit work area.
- C. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
- D. Stockpile topsoil in a location acceptable to the Owner, for use in finish grading.
 - 1. Stockpile topsoil away from edge of excavations.
 - 2. Stockpiled topsoil shall be free from trash, brush, stones over 3" diameter, and other extraneous matter.
 - 3. Grade and shape stockpiles to drain surface water. Cover to prevent windblow dust and erosion by water.
 - 4. No topsoil shall be removed from the site. It is the property of the Owner.
- E. Protect all areas which are not to be resurfaced or regraded, and adjacent areas outside of the contract limits from damage due to site preparation.
- F. Unless otherwise specified, topsoil and other unsuitable materials at the site and at a minimum distance of 5 feet beyond the surfaced area, shall be removed in such a manner to minimize disturbance of the remaining subgrade soils, and to facilitate placement of embankment materials and/or base course materials.

3.4 PLACING TOPSOIL

- A. Contractor shall spread topsoil to a thickness of at least 4 inches over all surrounding site contours except areas requiring finishing with material other than topsoil in accordance with the Drawings. Use loose, dry topsoil. Do not use frozen or muddy topsoil. Place during dry weather.
- B. On-site sources of topsoil shall be approved by the Engineer prior to disturbance.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- D. Remove stones, roots, weeds, and debris while spreading topsoil materials. Rake surface clean of stones 1" or larger in any dimensional and all debris.

3.5 SITE IMPROVEMENTS

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

3.6 LAYOUT

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

3.7 EXCAVATION FOR TRENCHES

- A. Open cut excavation for pipelines shall be true to the lines and grades shown on the Construction Drawings or as established by the Owner's representative. Cut the banks of trenches between vertical parallel plans equidistant from the pipe centerline.
- B. Trenches shall be excavated to a depth sufficient to allow a minimum of 36 inches of cover over the installed pipeline.
- C. In areas of rock excavation, the trench shall be excavated such that there is 6 inches of separation between unexcavated stone and the bottom of the pipe and 12 inches of separation between solid stone and either side of the pipe. Pipes 24 inches and larger shall be provided with 12 inches of separation between unexcavated stone and the bottom of the pipe.
- D. The horizontal distance between the vertical planes (or between the inside faces of installed sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance standard details.
- E. Excavate bell holes for bell and spigot pipe so that the barrel of the pipe will rest for its entire length upon the bottom of the trench.
- F. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary access and bypass routes as the Owner deems necessary to maintain vehicular or pedestrian traffic.

- G. In all cases where materials are deposited along open trenches, place them so that in the event of rain or surcharge loading from such deposits no damage will result to the work and/or to adjacent property. Comply with all erosion and siltation control criteria during all excavation activities.
- H. Line construction across all stream corridors shall be in accordance with regulatory criteria, any required permits. Comply with criteria regarding erosion and siltation control measures, side cast of excavated materials, trench excavation during stream low flow conditions, etc. The Contractor shall be responsible for paying any fines or penalties resulting from the Contractor's failure to comply with these regulations.

3.8 EXCAVATION FOR MANHOLES AND STRUCTURES

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

3.9 SHORING

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

3.10 DEWATERING

- A. Furnish dewatering and surface water control systems to permit work to be completed on dry and stable subgrade.
- B. Provide standby equipment in the case of dewatering equipment failure.
 - 1. Standby equipment shall be stored at the Site and ready for immediate use.
 - 2. Provide one spare dewatering pump per dewatering system installed. The spare pump shall have a capacity equal to or greater than the largest pump in the dewatering system.
 - 3. Each pump shall be supplied with its own portable electric generator.

- C. Discharge removed water in accordance with the Tennessee Erosion & Sediment Control Handbook, latest edition.

3.11 GENERAL BACKFILLING METHODS

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

3.12 TRENCH STABILIZATION MATERIAL INSTALLATION

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

3.13 PIPE ZONE MATERIAL INSTALLATION

- A. Pipe Zone Bedding shall consist of a minimum of 6 inches of Class, Grade D crushed stone.

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

3.14 FLOWABLE FILL

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

3.15 WARNING TAPE AND TRACER WIRE

- A. Detectable Warning Tape:
 - 1. All pipelines installed via open trench shall be installed with detectable warning tape. Detectable warning tape shall be:
 - 1) Placed 18 inches above utility piping during the backfill process
- B. Tracer Wire:
 - 1. Splices: Use wire nut or lug suitable for direct bury as recommended by tracer wire manufacturer. Wire splices shall be taped with waterproof tape.
 - 2. Manhole Access:
 - a. Tracer wire shall be attached to the exterior of the manhole structure and connected to frame anchors in order to be accessible for pipe locating.
 - b. Wire shall be coiled within valve box so that it may extend 3-foot above grade.

3.16 UTILITY MARKER

- A. Post shall be installed on all manhole structures located on easement. Markers are not required on manholes located in or within 3 feet of paved areas.

3.17 DISPOSAL OF MATERIALS

- A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the Owner shall be used for these purposes. Any surplus materials not so used shall be managed by Contractor as either consisting solely of earth, rock, concrete or asphalt paving materials (“Clean Spoil”) or, if determined by OWNER to be something other than Clean Spoil, as Waste Materials.
- B. Clean Spoil may be deposited in spoil areas at site locations found by Contractor. For all such areas, the Contractor shall obtain written permission from the property owner and furnish to Owner in advance of depositing any such Clean Spoil on any such site location. Receipt by Owner of the written permission shall not relieve the Contractor of its responsibilities to comply fully with its obligations under the Contract Documents and all Laws and Regulations relating to such Clean Spoil.
- C. Unless otherwise provided in the Contract Documents, Waste Materials shall be properly classified by Contractor and lawfully transported to and disposed of in an appropriate permitted facility approved by Owner. Proof of each such transport and disposal shall be provided to Owner within 24 hours after such disposal.
- D. Once any part of the Work is completed, the Contractor shall properly manage all surplus Clean Spoil and lawfully dispose of all Waste Materials left within the construction’s limits of that Work. The Contractor is responsible for the removal, hauling and final management of Clean Spoil and Waste Materials. The Contractor is responsible for locating spoil sites for depositing of Clean Spoil and appropriate landfills for disposal of Waste Materials and for obtaining all related permissions from spoil site owners and landfill operators, as appropriate, and all required permits from all governmental agencies having jurisdiction over the depositing of such Clean Spoil or disposal of such Waste Materials.
- E. The depositing of Clean Spoil and the disposal of Waste Materials in the manner described above shall be considered an integral part of the excavation work, and one for which NO separate payment shall be allowed.

3.18 CLEAN-UP

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

3.19 MAINTENANCE

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

END OF SECTION 31 23 16.01

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 REFERENCES

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

1.04 SYSTEM DESCRIPTION

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

- D. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers, filter stone and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained in accordance with applicable regulations.
- E. Temporary Erosion and Sedimentation Control: In general, temporary erosion and sedimentation control procedures shall be directed toward the following:
 - 1. Preventing soil erosion at the source.
 - 2. Preventing silt and sediment from leaving the site if soil erosion cannot be prevented.
 - 3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from leaving the site.
- F. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the project site.
- G. Basic Principles
 - 1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type, and condition.
 - 2. Minimize the disturbed area and the duration of exposure to erosion elements.
 - 3. Stabilize disturbed areas immediately.
 - 4. Safely convey run-off from the site to an outlet such that erosion will not be increased off site.
 - 5. Retain sediment on site that was generated on site.
 - 6. Minimize encroachment upon watercourses.

PART 2 - PRODUCTS

2.01 GRASS SEED AND MULCH

- A. Temporary seeding shall be in accordance with TDEC Erosion & Sediment Control Handbook.
- B. Permanent seeding shall be in accordance with Section 33 92 00 – Turfs and Grasses.

2.02 TEMPORARY SILT FENCE

- A. Geotextile Fence
 - 1. Equivalent Opening Size per US Standard Sieve: 50-100 (maximum).
 - 2. Grab Tensile Strength per ASTM D4632: 160 lbs. (minimum).
 - 3. UV Stability per ASTM D4355: 70% Strength Resistance (minimum).
 - 4. With 14-gauge steel wire backing with maximum mesh size of 6 inches.
- B. Support Posts:
 - 1. Materials: Hardwoods, steel, or pressure treated softwoods.
 - 2. Wood posts shall be 2"x2" (minimum).

- C. Fasteners: Heavy-duty wire staples as least 1-inch long, tie wires, or hog rings as recommended by geotextile manufacturer.

2.03 WATTLES

- A. A wattle (a.k.a. sediment logs or tubes) shall be a tubular shaped product specifically manufactured for sediment control. They may be used for slope, perimeter, channel, or inlet sediment control and capture.
- B. Wattles shall be manufactured using interwoven biodegradable plant material such as straw, coir, or wood shavings (i.e. excelsior fibers) in a bio or photodegradable netting that is of sufficient strength to resist damage when handling.
- C. The diameter of and spacing between wattles shall be based on the gradient and length of slope in accordance with following table:

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

2.04 INLET PROTECTION

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

2.05 STONE RIPRAP

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

2.06 STRAW BALES

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

PART 3 - EXECUTION

3.01 CONSTRUCTION OF STRUCTURES

- A. Erosion & sediment controls shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook. Different measures than those stated herein and called for on the Drawings may be required during construction, and may be found in the TDEC Handbook.
- B. Temporary pollution control shall include construction activities outside the project area where such work is necessary as a result of construction. These areas include, but not limited to, borrow pits, equipment and material storage sites, and haul roads.
- C. Sequence:
 - 1. Install erosion and sediment controls prior to construction.
 - 2. Perform and document an initial inspection of the installed measures with the Owner to review that all measures have been properly installed.
 - 3. If at any time the Owner deems it necessary or if the Contractor observes problems during site inspections, the Contractor shall provide additional erosion prevention and sedimentation controls and mark changes on the plan or SWPPP. The site shall be provided with maximum protection from erosion and sediment loss at all times.
 - 4. Perform regular inspection of all installed measures and document in accordance with the SWPPP or regulations.
 - 5. Perform regular maintenance with clean any built up sediment and fix any broken or shifted control elements.
 - 6. Install permanent controls once construction is complete in an area, and remove temporary controls once permanent controls are established. Depose of temporary measures in accordance with regulations.
 - 7. With the Owner, complete and submit notice of completion paperwork to responsible agencies.
 - 8. Maintain permanent controls during the warranty period in accordance with the Contract.
- D. Temporary Silt Fence Installation
 - 1. Not to be installed across areas of concentrated flow such as streams and ditches.
 - 2. Install along the contour, never up or down a slope.
 - 3. Maximum drainage area for silt fence with wire backing is 1 acre per 150 feet.
 - 4. When installed at the base of a slope, install 5 to 7 feet away from the toe of slope.
 - 5. Height of fence shall be no more than 24 to 26 inches above grade.

6. Construct from a continuous roll of fabric. When fabric joints are necessary, overlap a minimum of 4 feet.
 7. Excavate a trench approximately 4 inches wide by 6 inches deep.
 8. Place 10 inches of fabric in trench and backfill with compacted soil.
 9. Install posts on downstream side of fabric, no more than 6 feet apart, and at least 20 inches into the ground.
- E. Wattle Installation
1. Install by laying flat on the ground on contour and perpendicular to flow.
 2. Excavate a small trench approximately 2-3 inches in depth, or per manufacturer's instructions.
 3. Overlap ends of adjacent tubes a minimum of 6 inches, or per manufacturer's instructions.
 4. Install wooden stakes at an angle, at 4 -foot intervals, and at least 12 inches deep, or per manufacturer's instructions.
 5. Terminate ends of wattles with a dog leg up slope to prevent channeling of sediment.
- F. Inlet protection filters shall be installed per the manufacturer's instructions.
- G. Check Dams
1. Check dams are barriers composed of riprap, sandbags, wattles, or other non-corrodible material placed across or partially crossing a natural or constructed drainageway.
 2. Check dams shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
 - a. If wattles are used, they may have to be stacked to meet required dimensions of check dams.
- H. Temporary Berms
1. Use temporary berms at the top or base of disturbed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.
 2. Berms shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
- I. Temporary Slope Drains
1. A temporary slope drain is a facility consisting of stone, concrete, and/or asphalt gutters, fiber mats, plastic sheets, and drain pipe that may be used to carry runoff down a slope or around an area to reduce erosion on the slope or area avoided until permanent controls are installed and stabilized.
 2. Slope drains shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.
- J. Temporary Construction Entrance/Exit
1. Construction entrance shall be constructed wherever construction traffic leaves a site and enters a public or private roadway.
 2. The entrance/exit shall be at least 50 feet long and at least 10 feet wide for one-way traffic, or at least 20 feet wide for two-way traffic. Shall have turning radii of at least 20 feet at the roadway (may be greater depending on speed of traffic). Install drain culvert as necessary for crossing ditches or streams.

3. Shall be constructed by:
 - a. Undercutting at least 3 inches;
 - b. Install geotextile fabric (TDOT Type III); and
 - c. Install clean washed stone with a gradation of 2 to 4 inches, in a layer at least 8 inches thick.
4. Additional gravel may have to be added periodically to maintain proper function.
5. Remove gravel entrance and replace with new base course prior to construction of permanent new roadway.

K. Sediment Traps

1. Sediment basins, ponds, traps, and bags are prepared or manufactured storage areas to trap and store sediment from eroded areas in order to protect properties and drainage channels below the construction area from excessive siltation.
2. Sediment traps shall be constructed, maintained, and removed in accordance with TDEC Erosion & Sediment Control Handbook.

L. Straw Bales:

1. Embed minimum of 4 inches in flat bottom trench.
2. Place with ends tightly abutting or overlapped. Corner abutment is not acceptable.
3. Install in order that bale bindings are oriented around the sides and not over the top and bottom of each bale.
4. Use two posts for each bale. Drive posts through bale until top of post is flush with top of bale.
5. Wedge loose straw in gaps between bales.

M. Soil Stockpiles

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

N. Seeding and Mulching

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

3.02 FIELD QUALITY CONTROL

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

3.03 MAINTENANCE AND CLEANING

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

END OF SECTION 31 25 00

DIVISION 32: EXTERIOR IMPROVEMENTS

SECTION 32 11 00.01
SURFACE RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 RELATED SECTIONS

- A. Section 03 10 00.01 - Concrete for Utilities

1.4 REFERENCES

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

1.5 DEFINITIONS

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

1.6 QUALITY ASSURANCE

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

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 SUBMITTALS

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

1.9 AMBIENT CONDITIONS

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

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

- A. Mineral Aggregate Base shall be Class A, Grading D crushed stone in accordance with TDOT Specifications, Section 303, Subsection 903.05
- B. Bituminous Prime Coats shall be cutback asphalt (Grade RD-250) or emulsified asphalt (Grade AE-P) in accordance with TDOT Specifications, Section 402, Subsections 904.02 and 904.03.
- C. Crushed Stone Chips shall be Size 6 or Size 7 in accordance with TDOT Specifications, Subsection 903.14.
- D. Double Bituminous Surface, for both courses, shall be either cutback asphalt (Grade RC-800 or RC-3000) or emulsified asphalt (Grade RS-2) in accordance with TDOT Specifications, Section 402, Subsections 904.02 and 904.03.
- E. Asphaltic Concrete Binder shall be Grading B or C, as directed by the Owner, in accordance with TDOT Specifications, Section 307.
- F. Bituminous Tack Coat shall be Grade AE-3 in accordance with TDOT Specifications, Section 403, Subsection 904.03.
- G. Asphaltic Concrete Surface shall be Grading E in accordance with TDOT Specifications, Section 411.
- H. Bituminous Seal Coat shall be in accordance with TDOT specifications, Section 405.
- I. Quick Dry Traffic Marking Paint shall be white or yellow and in accordance with TDOT Specifications, Subsection 910.05.

2.2 CONCRETE PAVING

- A. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Concrete paving shall be Class A mix design.
- C. Shall meet the requirements in section 03-30-00.01 of these specifications.

2.3 SOIL MATERIALS

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

2.4 SEED MIXTURE

- A. Seed mixtures shall be according to Region III Preferred Seed Mixes Table, TDEC EPSC Handbook, latest edition.
- B. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- C. Seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- D. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Engineer samples of seed may be taken for check against the grower's analysis.

2.5 FERTILIZER

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

2.6 AGRICULTURAL LIMESTONE

- A. Agricultural limestone (lime) shall contain a minimum of 85% calcium carbonate and magnesium carbonate combined. Agricultural limestone shall be crushed so that at least 85% of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.7 MULCH

- A. Mulch shall be composed of wood cellulose fiber, straw, or stalks, as specified herein that have been properly cured prior to bailing, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.
- B. Mulch shall be suitable for spreading with standard mulch blowing equipment.
- C. Wood-cellulose fiber mulch shall be as manufactured by Weyerhaeuser Company, Conway Corporation, or approved equal.
- D. Straw mulch shall be partially decomposed stalks of wheat, rye, oats, or other approved grain crops.
- E. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum, or other approved standing field crops.

2.8 MULCH BINDER

- A. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non-toxic to plant life and shall be acceptable to the Engineer.
- B. Emulsified asphalt binder shall be Grade SS-1, ASTM D977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

2.9 INOCULANTS FOR LEGUMES

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.10 WATER

- A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 DEMOLITION

- A. Saw cut and notch existing paving in straight, clean lines as necessary for the pipeline installation indicated on the Construction Drawings. After the pipeline installation, provide further cutback if damage occurred to the surrounding pavement during water line installation.
- B. Clean existing paving to remove foreign material, excess joint sealant, and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.3 REPLACING PAVEMENT

- A. Trench backfill along streets shall be covered with a temporary paving as specified above. This temporary paving shall be applied level with the existing paved surface. Prior to the application of the temporary paving the crushed stone backfill shall be maintained carefully at grade and dust free. Additionally, immediately prior to application of permanent paving, the Contractor shall again compact the top of all trench backfill in the streets with a hydrotamper and add sufficient crushed stone to bring surface back to bottom of permanent paving as shown on Drawings.
- B. Where pavement is specified for trench width only, any additional pavement or street surface removed or damaged beyond the limits shown on the Drawings shall be replaced or repaired by the Contractor at the Contractor's expense.
- C. Where pavement is for the complete width of the street, the following procedures shall be used:
 - 1. After the crushed stone backfill and temporary surface have settled thoroughly, the entire width of the street to be paved shall be cleaned of loose materials as specified in Section 407, "Bituminous Plant Mix Pavements," Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition. All areas which have settled shall be filled and leveled as described above in Paragraph B. Manholes shall be raised to match finished grade using brick and/or precast concrete rings. Before paving, a tack coat shall be applied to the full width of the street, as specified in Section 403 "Tack Coat," TDOT, Standard Specifications for Road and Bridge Construction, latest edition.
 - 2. During the time that the full width of the street is being paved, the Contractor shall extend the paving from the street into existing paved driveways in order to provide a smooth transition from the street to the existing driveway grade. This work shall be completed with no separate payment being allowed.

3.4 PAVING INSTALLATION

- A. Asphalt Paving
 - 1. Aggregate Subbase:
 - a. Place aggregate in equal thickness layers to a total compacted thickness of 6 inches or as indicated on the Construction Drawings.
 - b. Compact aggregate to 95% maximum density by rolling, vibrating, or tamping as determined by ASTM D698.
 - c. The backfill material shall be thoroughly compacted crushed stone from the top of bedding to finished grade unless otherwise specified on the Drawings. For all areas where subgrade has been prepared, test for uniformity of support by driving a loaded dump truck at a speed of 2 to 3 mph over the entire surface.
 - d. Install a mineral aggregate base of the type specified above in accordance with layer shall be 6", and the total thickness of the base shall be that indicated by the standard drawings or as shown on the plans.
 - e. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 12" beyond the limit of the joint between the old and new base course or as shown on the standard drawings.
 - f. Level and contour surfaces to elevations, profiles, and gradients indicated.
 - g. Maintain optimum moisture content of fill materials to attain specified compaction density.
 - 2. Tack Coat:

- a. Include tack coat to improve bond between new and existing paving.
 - b. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate of 0.3 gallon per square yard. Immediately after application, uniformly cover the entire area with Size 7 crushed stone chips at a rate of 12 pounds per square yard.
 - c. Apply tack coat to contact surfaces of curbs, gutters or any other surrounding concrete or asphalt fixture.
 - d. Coat surfaces of any frames/covers for manholes, vaults, etc. with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
3. Double Bituminous Surface:
- a. Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with either emulsified asphalt, Grade RS-2, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds per square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallon per square yard, and at once uniformly cover them with Size 7 chips at a rate of 20 to 25 pounds per square yard. Then roll the entire area.
 - b. After the application of the cover aggregate, lightly broom or otherwise maintain the surface for a period of 4 days. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess materials from the entire surface.
4. Asphaltic Concrete Binder:
- a. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, Grade RC-250, at a rate of 0.38 to 0.42 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.
 - b. Carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.
5. Asphaltic Concrete Surface:
- a. If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under PRODUCTS at a rate of 0.05 to 0.10 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.
6. Tolerances
- a. Flatness: Pavement shall have a maximum variation of 1/4 inch when measured with a 12-foot straight edge.
 - b. Scheduled Compacted Thickness: Pavement shall be within 1/4 inch of specified thickness.

B. Concrete Paving, Sidewalks, and Curbs

- 1. In accordance with Division 03.
- 2. Forms:
 - a. Forms shall be of wood or metal, shall be straight and free from warp, and shall be of sufficient length when in place to hold the concrete true to line and grade without springing or distortion.

- b. Place and secure forms and screens to correct location, dimension, profile, and gradient.
 - c. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
 - d. Wood forms: thoroughly wet with water before concrete is placed.
 - e. When a section of sidewalk is removed, the existing sidewalk 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 contraction joints unless such joints do not exist in which case the cut shall be made a minimum distance shown on the Drawings.
 - f. Existing concrete sidewalks that have been cut and removed for construction purposes shall be replaced with sidewalks of the same width and surface as the portion removed and shall have a minimum uniform thickness of 4 inches. The new work shall be neatly joined to the old concrete so that the surface of the new work shall form an even unbroken plane with the old sidewalk.
 - g. The subgrade for concrete sidewalks 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. Subgrade shall be compacted by hand tamping or rolling. Soft, yielding, or unstable material shall be removed and backfilled with satisfactory material. Two inches of porous compacted crushed stone base shall be placed and shall be compacted thoroughly and finished to a smooth, unyielding surface at proper line, grade, and cross section.
 - h. All existing curbs which are removed, damaged, or destroyed during construction of sewage or water works shall be replaced in accordance with the following:
 - 1) Asphaltic concrete curbs shall be constructed with the same dimensions as the existing curb using asphaltic concrete pavement Grading E, conforming to the paragraph entitled "Asphaltic Concrete Surface."
 - 2) Prior to constructing curbs on pavement, the pavement shall be dry and cleaned of loose material and a tack coat of RS-2 asphalt shall be applied to the curb area of the pavement at the rate of 0.08 to 0.20 gallons per 15 linear feet of curb area.
 - 3) Portland cement concrete curbs shall be constructed with the same dimensions as the existing curb using Class A concrete in accordance with Section 604, "Concrete Structures" and with Section 702, "Cement Concrete Curb," Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition.
3. Reinforcement:
- a. Place reinforcing as indicated on Drawings.
4. Placing Concrete:
- a. Place concrete using the slip form technique.
 - b. Ensure reinforcing, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
 - c. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
 - d. If existing concrete that is removed contains reinforcing steel, replace with new steel of same diameter and of equal or better quality.
5. Joints:
- a. Place expansion or contraction joints as indicated in the Drawings.
 - b. Place joint filler between paving components and building or other appurtenances.

- c. Place continuous transverse expansion joints at 5-foot intervals or width of sidewalk, whichever is less.
 - d. Preformed joints shall be ½-inch thick conforming to the latest edition of AASHTO Standard Specifications, M59, for preformed bituminous fiber joints.
 - e. Expansion joints shall be required to replace any existing expansion joints that are removed with the sidewalk or in new construction wherever shown on the Drawings. Expansion joints shall be true, even, shall present a satisfactory appearance, and shall extend to within ½ inch of the top of finished concrete surface.
- 6. Finishing:
 - a. Concrete shall be light broom finished with the lines of the broom finish being perpendicular to the path of travel.
 - 7. Curing and Protection
 - a. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - b. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 8. Backfilling: After curing, backfill, grade, and compact adjacent disturbed area as necessary.

3.5 FIELD QUALITY CONTROL

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

3.6 PROTECTION

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

3.7 PREPARATION OF SUBSOIL

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

3.8 PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage, and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen, or its residue, and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such materials shall be removed from the topsoil, or if required by the Engineer, the pit shall be abandoned.
- E. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.
- F. Place topsoil during dry weather and on dry unfrozen subgrade.
- G. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- H. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

3.9 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line free from unsightly variation, bumps, ridges and depressions, and all detrimental material, roots, and stones larger than ½ inch in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2 inches with a weighted disc, tiller, pulvimixer, or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.

- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition.

3.10 FERTILIZING

- A. Apply fertilizer and agricultural limestone uniformly over the seed bed, and lightly harrow, rake, or otherwise incorporate them into the soil at the following rates:
 - 1. Fertilizer: 15 lbs/1,000 square feet
 - 2. Agricultural Limestone: 40 lbs/1,000 square feet
- B. Do not apply fertilizer at same time or with same machine used to apply seed.
- C. Lightly water soil to aid dissipation of fertilizer. Irrigate the top level of soil uniformly.
- D. Agricultural limestone shall be thoroughly mixed into the soil at a rate of 20 lbs/1,000 square feet. The rate of application may be reduced by the Engineer if the pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.

3.11 SEEDING

- A. Sow seed uniformly with a rotary seeder, wheelbarrow seeder, or hydraulic equipment or by other satisfactory means.
- B. Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.
- C. The seeding rate and dates shall be according to Region III Preferred Seed Mixes Table, TDEC EPSC Handbook, latest edition.
- D. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- E. Leguminous seeds shall be inoculated prior to seeding with a approved and compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instruction.

3.12 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.

- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 - 1. Wood Cellulose Fiber – 1,400 lbs/acre
 - 2. Straw- 4,000 lbs/acre
 - 3. Stalks – 4,000 lbs/acre
- C. These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner depending on the texture and condition of the mulch material and the characteristics of the seeded area.
- D. Mulch on slopes greater than 3 to 1 ratio shall be held in place by the use of an approved mulch binder. Binder shall be thoroughly mixed and applied in accordance with manufacturer's specifications.
- E. The Contractor shall cover structure, poles, fence, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- F. Mulch and binder shall be applied in accordance with manufacturer's specifications.

3.13 WATERING

- A. Contractor shall be responsible for maintaining the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank trucks, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.14 MAINTENANCE

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

END OF SECTION 32 11 00.01

**SECTION 32 11 16.01
REMOVING AND REPLACING PAVEMENT**

PART 1 - GENERAL

1.01 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, sewer and utility appurtenances and structures.

1.02 SUBMITTALS

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

1.03 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 degrees F, when the underlying base is dry and when weather is not rainy.
 - 3. Place base course when air temperature is above 35 degrees F and rising.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.
- C. Work in accordance with the Authority Having Jurisdiction (AHJ): All work within, Town of Farragut (865 966-7057), or TDOT (865 594-2718) road rights-of-way shall be performed in accordance with the respective standards and requirements of the AHJ and its governing standards and specifications. Prior to commencing work on the Project, if work in road right of way is required, Contractor shall coordinate with the agency(s) and determine the appropriate procedures for notifications and execution of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Mineral Aggregate Base Course: Mineral aggregate base course shall conform to the requirements of the Tennessee Department of Transportation Bureau of Highways Standard Specifications for Road and Bridge Construction, Section 303, Type A base, Class A, Grading D base.
- B. Binder (Hot Mix): The base of all paved roadways shall conform to the requirements of Section 307 of the Tennessee Department of Transportation Bureau of Highways

Standard Specifications for Road and Bridge Construction.

- C. Asphaltic Concrete Surface (Hot Mix): The surface course for all pavement shall conform to the requirements of the Tennessee Department of Transportation Bureau of Highways Standard Specifications for Road and Bridge Construction, Section 411, Grading "E" or Grading "D".
- D. Double Bituminous Surface Treatment: The surface for all pavements shall conform to the requirements of the Tennessee Department of Transportation Bureau of Highways Standard Specifications for Road and Bridge Construction, Section 404.
- E. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of the Tennessee Department of Transportation Bureau of Highways Standard Specifications for Road and Bridge Construction, Section 501.
- F. 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.

2.02 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 Owner or Owner's Representative or required by the AHJ. Materials, equipment and construction methods used for paving work shall conform to the Tennessee Department of Transportation Bureau of Highways 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 Section 303, Class B, Grading D of the TDOT Standard Specifications for Road and Bridge Construction, latest version. 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 two or more layers of approximately equal thickness with a maximum lift thickness of 6-inches.
- 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 4-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 the Tennessee Department of Transportation Bureau of Highways Standard Specifications, Section 501. If edge of trench is within three feet of an expansion joint, concrete shall be removed and replaced to the edge of the joint.

- D. Asphalt Concrete Base, Binder and Surface Course: Asphalt concrete base, binder and surface course construction shall conform to the Tennessee Department of Transportation Bureau of Highways Standard Specifications, Section 307 for bituminous plant mix base course and Section 411. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared as specified herein, or as required by the AHJ. 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. Gravel Surfaces: Existing gravel road, drive and parking area replacement shall meet the requirements of aggregate base course.
- F. Temporary Measures: During the time period between pavement removal and complete replacement of permanent pavement, maintain highways, streets and roadways in accordance with the requirements of the AHJ.

PART 3 - EXECUTION

3.01 REMOVING PAVEMENT

- A. Remove existing pavement as necessary for installing the pipe line and appurtenances.
- B. Before removing any pavement, mark the pavement neatly paralleling pipe lines and existing street lines. Space the marks the width of the trench.
- C. Pavement or concrete must be cut or sawed to straight, clean lines before excavation begins.
- D. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.
- E. Any pavement removal which will include removal of traffic signal loops embedded in the pavement shall be coordinated with the Engineering Department having jurisdiction over the traffic signal, with proper advance notification prior to pavement removal.
- F. Remove and replace any sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
- G. Remove and replace any curb disturbed by construction to the nearest undisturbed joint.

3.02 REPLACING PAVEMENT

- A. Pavement shall be replaced within the timeframe established by the AHJ.
- B. During backfilling and preparation of the subgrade, arrange to have the compaction tested by an independent testing laboratory, if required by the AHJ. 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 Standard Detail Drawings, shall be done immediately prior to replacing the pavement.
2. Trench backfill shall be compacted for the full depth of the trench as specified in Section 31 23 23.15 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 or asphalt as directed by the Owner or Owner's Representative. 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 Owner or Owner's Representative and permission is granted to replace the street pavement.
4. When temporary crushed stone or chert surface is considered by the Owner or Owner's Representative 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.

C. Pavement Replacement:

1. 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.
2. 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.
3. Following this preparation, the crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.
4. 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 Standard Detail Drawings. Concrete base slabs and crushed stone bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.
5. 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.

D. Pavement Resurfacing:

1. Certain areas to be resurfaced may be 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 pipe line 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.
- E. 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 AHJ or Owner or Owner's Representative.
- F. 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 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.

3.03 SIDEWALK AND CURB REPLACEMENT

- A. Construction:
1. All concrete sidewalks and curbs shall be replaced with concrete.
 2. Prefomed joints shall be 1/2-inch thick, conforming to the latest edition of AASHTO M 59 for sidewalks and AASHTO M 123 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 to match existing.
 6. Wood forms may be used on sharp turns and for special sections, as approved by the Owner or Owner's Representative. 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 to match existing.

- 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.
- E. Joint for Curbs:
1. Joints shall be constructed to match existing 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. 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 to match existing.
 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 to match existing and as directed by the Owner or Owner's Representative.
 2. Provide sidewalk ramp openings to match existing, in conformance with the applicable regulations and as directed by the Owner or Owner's Representative.
- 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.

3.04 MAINTENANCE

- A. The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the Project and shall provide and comply with any warranty required by the AHJ. Maintenance shall include replacement, scraping, reshaping, wetting and rerolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Owner or Owner's Representative. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.05 SUPERVISION AND APPROVAL

- A. Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.
- B. Obtain the Owner or Owner's Representative'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 bonded period, promptly restore or repair defects.

3.06 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 32 11 16.01

**SECTION 32 92 00
TURF AND GRASSES**

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Maintenance Period: Begin maintenance immediately after each area is planted (seed, sod) and continue until all planting under this section is completed and a satisfactory stand has been established.
- B. Satisfactory Stand: Grass that has:
 - 1. No bare spots larger than 3 square feet.
 - 2. Not more than 10 percent of total area with bare spots larger than 1 square foot.
 - 3. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 SUBMITTALS

- A. Action Submittals: Product labels/data sheets.
- B. Informational Submittals:
 - 1. Seed: Certification of seed analysis, germination rate, and inoculation:
 - a. Mixtures: Proportions of each kind of seed.
 - 2. Certification of sod; include source and harvest date of sod, and sod seed mix.
 - 3. Description of required maintenance activities and activity frequency.

1.03 DELIVERY, STORAGE, AND PROTECTION

- A. Seed:
 - 1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
 - 2. Keep dry during storage.
- B. Sod:
 - 1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely effected.
 - 2. Harvest and deliver sod only after laying bed is prepared for sodding.
 - 3. Roll or stack to prevent yellowing.
 - 4. Deliver and lay within 24 hours of harvesting.
 - 5. Keep moist and covered to protect from drying from time of harvesting until laid.

1.04 WEATHER RESTRICTIONS

- A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.05 SEQUENCING AND SCHEDULING

- A. Prepare topsoil as necessary before starting Work of this section.
- B. Complete Work under this section within 3 days following completion of soil preparation.
- C. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice.

1.06 MAINTENANCE SERVICE

- A. Contractor: Perform maintenance operations during maintenance period to include:
 - 1. Watering: Keep surface moist.
 - 2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.
 - 3. Mulch: Replace wherever and whenever washed or blown away.
 - 4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.
 - 5. Reseed unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced.
 - 6. Reseed/replant during next planting season if scheduled end of maintenance period falls after September 15.
 - 7. Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

PART 2 - PRODUCTS

2.01 FERTILIZER

- A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.
- B. Application Rates: 20 pounds per 1,000 square feet.
- C. Mix:
 - 1. Nitrogen: 10.
 - 2. Phosphoric Acid: 10.
 - 3. Potash: 10.

2.02 SEED

- A. Fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.
- B. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer's instructions.
- C. Seed Mix:

<u>Seeding Dates</u>	<u>Species</u>	<u>Proportion By Weight</u>
February 1 to July 1	Kentucky 31 Fescue	80%
	Korean Lespedeza	15%
	English Rye	5%
June 1 to August 15	Kentucky 31 Fescue	55%
	Korean Lespedeza	20%
	English Rye	15%
	German Millet	10%
April 15 to August 15	Kentucky 31 Fescue	60%
	Korean Lespedeza	15%
	Kobe Lespedeza	15%
August 1 to December 1	Kentucky 31 Fescue	70%
	English Rye	20%
	White Clover	10%
February 1 to December 1	Kentucky 31 Fescue	70%
	Crown Vetch	25%
	English Rye	5%

2.03 SOD

- A. Certified, containing grass mix specified.
- B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.
 - 1. Grass Height: Normal.
 - 2. Strip Size: Supplier's standard.
 - 3. Soil Thickness: Uniform; 1 inch plus or minus 1/4 inch at time of cutting.
 - 4. Age: Not less than 10 months or more than 30 months.

5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted.

2.04 STRAW MULCH

- A. Threshed straw of oats, wheat, barley, or rye, free from (i) seed of noxious weeds or (ii) clean salt hay.

2.05 NETTING

A. Jute:

1. Heavy-duty, twisted, weighing 1 pound(s) per square yard.
2. Openings Between Strands: Approximately 1 inch square.

B. Plastic:

1. Extruded Polypropylene: 20 mils.
2. Opening Between Strands: 1 inch by 2 inch.

C. Matting:

1. Excelsior mat or straw blanket; staples as recommended by matting manufacturer.
2. Manufacturers and Products:
 - a. Akzo Industries, Ashville, NC; Curlex mat.
 - b. North American Green, Evansville, IN; S150 blanket.

2.06 TACKIFIER

- A. Derived from natural organic plant sources containing no growth or germination-inhibiting materials.
 1. Capable of hydrating in water, and to readily blend with other slurry materials.
 2. Wood Cellulose Fiber: Add as tracer, at rate of 150 pounds per acre.
 3. Manufacturers and Products:
 - a. Chevron Asphalt Co.; CSS 1.
 - b. Terra; Tack AR.
 - c. J Tack; Reclamare.

2.07 WEED BARRIER

- A. 6 mils (0.006 inch) black polyethylene sheet.

2.08 DIVIDER

- A. Cedar, Standard or Better Grade.

2.09 EDGING

- A. Steel: 1/8 inch by 4 inches wide in 15-foot minimum lengths, manufacturer's standard black, with 18-inch-long steel stakes and fastenings on curb.
- B. Plastic: Polyethylene edging 1/8 inch by 4 inches wide, black, with integral design to provide a firm hold without staking.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grade areas to smooth, even surface with loose, uniformly fine texture.
 - 1. Roll and rake, remove ridges, fill depressions to meet finish grades.
 - 2. Limit such Work to areas to be planted within immediate future.
 - 3. Remove debris, and stones larger than 1-1/2-inch diameter, and other objects that may interfere with planting and maintenance operations.
- B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.
- C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

3.02 FERTILIZER

- A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of topsoil, when applied by broad cast method.
- B. Application Rate: 20 pounds per 1,000 square feet.

3.03 SEEDING

- A. Start within 2 days of preparation completion.
- B. Mechanical: Broadcast seed in two different directions, compact seeded area with cultipacker or roller.
 - 1. Sow seed at uniform rate of 15 pounds per 1,000 square feet.
 - 2. Use Brillion type seeder.
 - 3. Broadcasting will be allowed only in areas too small to use Brillion type seeder. Where seed is broadcast, increase seeding rate 20 percent.
 - 4. Roll with ring roller to cover seed, and water with fine spray.
- C. Cover Crop Seeding: Apply seed at rate of 120 pounds per acre to areas that are bare or incomplete after September 15.
- D. Mulching: Apply uniform cover of straw mulch at a rate of 2 tons per acre.

- E. Netting: Immediately after mulching, place over mulched areas with slopes steeper than 3:1, in accordance with manufacturer's instructions. Locate strips parallel to slope and completely cover seeded areas.
- F. Tackifier: Apply over mulched areas with slopes steeper than 4:1 at rate of 5 gallons per 1,000 square feet in accordance with the manufacturers recommended requirements.
- G. Water: Apply with fine spray after mulching to saturate top 4 inches of soil.

3.04 SODDING

- A. Do not plant dormant sod, or when ground is frozen.
- B. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap.
 - 1. Stagger strips to offset joints in adjacent courses.
 - 2. Work from boards to avoid damage to subgrade or sod.
 - 3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.
 - 4. Complete sod surface true to finished grade, even, and firm.
- C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.
- D. Water sod with fine spray immediately after planting. During first week, water daily or more frequently to maintain moist soil to depth of 4 inches.
- E. Apply top dress fertilizer at recommended rate.

3.05 FIELD QUALITY CONTROL

- A. 8 weeks after seeding is complete and on written notice from Contractor that a satisfactory stand has been established, Owner or Owner's Representative will, within 15 days of receipt, determine if a satisfactory stand has been established.
- B. If a satisfactory stand has not been established, Owner or Owner's Representative will make another determination after written notice from Contractor following the next growing season.

END OF SECTION 32 92 00

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

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 COORDINATION

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

1.04 SUBMITTALS

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

1. Root treatment chemicals product data and MSDS
2. Applicator's Federal DOT number and EPA material registration number.

E. Closeout Submittal:

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

1.05 QUALITY ASSURANCE

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

1.06 ADDITIONAL REQUIREMENTS

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

1.07 SPECIAL GUARANTEES

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

1.08 NOTIFICATIONS

- A. Notify the Owner a minimum of 5 days before the anticipated beginning of all sewer inspection and cleaning activities. Notify the Owner 24 hours before the actual beginning of any sewer inspection and cleaning activities.
- B. Provide notification via Owner approved door hanger to affected sewer customers a minimum of two full working days before the beginning of any sewer inspection and cleaning activities.

1.09 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 CCTV INSPECTION

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

- b. The camera shall have a minimum of 460 lines of horizontal resolution and 400 lines of vertical resolution. The resolution of the camera should meet or exceed the resolution of the monitor.
- c. The camera shall be capable of 360-degree rotation and 270-degree pan and tilt with adjustable supports specifically designed and constructed for operation in connection with pipe inspection.
- d. Camera lights shall be mounted to and turn in the direction of the camera head.
- e. The viewing angle shall be a minimum of 65 degrees and have either automatic or remote focus and iris controls. Remote control adjustment for focus and iris shall be located in the monitoring studio.
- f. The camera shall be operative in 100% humidity conditions.
- g. The camera shall be able to achieve proper balance of tint and brightness, have a focal distance range from 6 inches to infinity, be capable of 40:1 zoom with 10:1 optical zoom, and have a light sensitivity of greater than 1.5 lux.
- h. Camera lighting shall minimize reflective glare, have remote variable intensity control, and have lighting quality that provides clear, in-focus picture of the entire inside periphery of the pipe.

C. Inspection Software:

- 1. The inspection software shall utilize software capable of providing complete survey reports, inspection database, and linked media files.
- 2. The inspection software shall be the latest version of PACP (Pipeline Assessment and Certification Program) certified by NASSCO.

D. The contractor shall maintain back-up equipment in the event that primary equipment fails to prevent delays in the completion of work.

E. Recording and Documentation:

- 1. Upon completion of CCTV inspection, all inspection data shall be transferred to an external hard drive. The codec required for proper playback of the video file must be included on the external hard drive.
- 2. Provide printed label on the external hard drive or other documentation that indicates the following:
 - a. Name of the Owner
 - b. Project Title
 - c. Dates of Inspection
 - d. Inspection Company
 - e. Deliverable Number
 - f. List of Asset IDs Inspected

F. Video:

- 1. Provide all inspections with a unique file name per inspection.
- 2. Video shall be encoded in .WMV, .MPG, or .AVI format.
- 3. The following information shall be displayed on the opening screen of each inspection:
 - a. Inspection Date and Time
 - b. Surveyor's Name
 - c. Project Name
 - d. Sewer Basin Name
 - e. Street Address and City
 - f. Upstream and Downstream Manhole ID
 - g. Direction of Inspection

- h. Pipe Material
 - i. Pipe Diameter/Size
 - 4. The following information shall be displayed continuously on-screen during inspection:
 - a. Inspection Date and Time
 - b. Continuous forward and reverse readout of camera distance from center of manhole starting reference.
 - c. Upstream and Downstream Manhole ID
 - d. Defect or Observation Code as Encountered

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

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

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

- J. Inspection Reports:
 - 1. Provide .PDF format inspection reports including:
 - a. A summary of the inspections completed
 - b. Pipe graphs of each inspection showing asset information and defects/observations
 - c. Header containing the following information:
 - 1) Date and Time
 - 2) Inspection Company, Address, and Telephone
 - 3) Surveyor's Name
 - 4) Project Name
 - 5) Sewer Basin Name
 - 6) Location code
 - 7) Street Address and City
 - 8) Weather
 - 9) Upstream and Downstream Manhole ID
 - 10) Upstream Manhole Depth
 - 11) Direction of Inspection
 - 12) Pipe Material
 - 13) Pipe Diameter/Size
 - 14) Pre-Cleaning Requirements
 - 15) Date Cleaned
 - 16) Mapping Length
 - 17) Surveyed Length

- 18) Survey Start and End Time
- 19) Additional Information as Needed
2. Provide field maps corrected to reflect actual field conditions:
 - a. Neatly strike out incorrect data with a green pen and clearly mark correct data using a red pen. Show notes that clarify changes in blue.

2.02 SEWER FLOW CONTROL SYSTEM

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

2. Be equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from the source and, if more stringent, comply with all local noise ordinances.
3. Include automatic transfer switch if the flow control system is to operate unattended.

2.03 SEWER CLEANING

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

2.04 CHEMICAL ROOT TREATMENT

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

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 CCTV INSPECTION

- A. General
 - 1. CCTV inspection shall be done one sewer line at a time, and the flow in the section being televised shall be suitably controlled. The depth of wastewater flow shall not exceed 25% in any pipe diameter. For new sewer lines, post-construction CCTV inspection shall be performed prior to releasing flow into the pipe.

2. When depth of flow in a section being worked is above the maximum allowable level for inspection, the flow shall be reduced in accordance with sewer flow control in accordance with this section.
3. Poor quality inspections including, but not limited to, loss of color, video distortion, outside interference, etc. will not be accepted by the Owner. Reinspection of pipes that do not meet minimum requirements shall be performed at the Contractor's expense.

B. Inspection

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

C. Reverse Inspection

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

used for securing the passage of the camera are to be at the discretion of the Contractor, with the approval of the Owner.

D. Measurement

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

E. Documentation

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

F. Quality Control

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

3.03 SEWER FLOW CONTROL

A. Performance Requirements

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

4. Any discharge of sewage including discharges into the construction trench shall not be permitted.

B. General

1. Notify Owner at least 48 hours prior to implementing any sewer flow control system.
2. Operate and maintain sewer flow control systems 24 hours per day, 7 days per week, including holidays, as required, to control flow.
3. Take all necessary precautions to ensure no private or public properties are subjected to a sewage backup or spill. The Contractor shall be solely responsible for all cleanup, damages, and resultant fines in the event of a backup or spill. In the event of a backup or spill, the Contractor shall immediately notify the Owner and begin clean-up procedures.
4. When depth of flow in a pipe section is above the maximum depth specified for inspection, reduce flow by plugging, diverting, or bypass pumping around the work area.
5. Eliminate all flow from sewer manhole-to-manhole segments during point repairs, service connection rehabilitation, manhole construction and sewer pipe replacement or lining within the segment.
6. If flow reaches peak estimated flow that flow control system was designed for, stop all Work that requires flow control, secure the work area, and restore flow in the sewer until flow recedes.
7. After the Work is completed, return flow to the sewer and remove temporary equipment.

C. Plugging or Blocking

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

D. Bypass Pumping

1. When blocking flow in upstream sewer is not appropriate or allowed by the Owner, use flow bypass pumping for reducing flow below the maximum depth or completely bypassing flow.
2. Design, furnish, install, and maintain all power, primary, and standby pumps, appurtenances, tanks, tucks, and bypass piping required to maintain existing flows and services.
3. The Contractor shall obtain approval and secure all permits for placement of temporary bypass pumping systems and pipelines within public right-of-way.
4. Site Verification
 - a. Locate existing utilities in the area of bypass pipelines.
 - b. Minimize disturbance of existing utilities
 - c. Confine bypass discharge pipeline within public rights-of-way, temporary construction easement, or permanent easement.
 - d. When bypass pipeline crosses local streets and private driveways, place bypass pipeline in a trench and cover with temporary pavement.

- e. Installation of bypass pipelines is prohibited in riparian/wetland areas unless approved by the Owner.
5. Flow bypass shall be done in such a manner that will not damage private or public property, or create a nuisance or public menace. Pumped sewage shall be in an enclosed pipe that is adequately protected from traffic, and shall be redirected into sanitary sewer system or alternatively into an enclosed tank for hauling to the wastewater treatment plant. Dumping or free flow of sewage on private or public property, gutters, streets, sidewalks, or into storm sewers is prohibited.
6. The Contractor shall equip pump engines with noise suppression devices to keep pump noise to a minimum and comply with applicable noise ordinances.

E. Service Lateral Bypassing

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

F. Field Quality Control and Maintenance

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

G. Cleaning

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

3.04 SEWER CLEANING

A. General

1. When sewer flow depth is greater than 25%, flow depth shall be decreased by sewer flow control in accordance with this section.

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

B. High-Velocity Cleaning

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

C. Mechanical Cleaning

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

D. Water Usage

1. Any and all Owner water used by Contractor shall be from a metered supply with an approved backflow device to protect the water supply. All metered water supply shall be paid to Owner through the regular billing system.
2. Contractor shall be responsible for obtaining transient water meter(s) from Owner, which shall be installed on the trucks or at fire hydrant(s). All related charges for the set-up shall be considered incidental to the cleaning of the existing sanitary sewer mains.
3. Contractor shall be responsible for preventing contamination of the potable water system. Contractor when drawing water from a public hydrant shall use a backflow preventer or an 18-inch air gap.
4. No fire hydrant shall be obstructed or used when there is a fire in the area.
5. It shall be Contractor's responsibility to obtain approval to use Owner's fire hydrants.
6. Contractor shall remove the water meter(s)/piping etc. from all fire hydrants at the end of each working day.

E. Removal and Disposal of Debris

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

3.05 CHEMICAL ROOT TREATMENT

A. General

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

B. Application

1. Perform the Work according to label instructions and in accordance with the best recommended practice for conditions present in the line under treatment. Application shall be done by foaming or other methods as provided on the product label.
2. Perform in such a way as to contact roots within the primary main line sewer to be treated. Make effort to penetrate secondary lateral sewers in order to contact roots residing in the "wye" connections.
3. Generate foam through the use of air injection equipment and pump the foam into the sewer under pressure as foam. Foam quality shall be sufficient to penetrate "wye"

connections, effectively treat large diameter pipe, and to enhance treatment effectiveness overall.

4. Hydraulic sewer cleaning machines will reduce treatment effectiveness by damaging root growths and inhibiting their uptake of chemical. Hydraulic sewer cleaning machines shall not be used prior to or during the treatment process.

C. Protection of Wastewater Treatment Plant

1. Contractor shall take all steps necessary and appropriate to prevent adverse effects on wastewater treatment plant processes during the application process.
2. In the event that a wastewater treatment plant experiences any reduction in operating efficiency during the execution of the Contract, Contractor shall immediately suspend all applications, at the direction of the Owner. Contractor shall continue operations only after problems at the wastewater treatment plant have been corrected, satisfactory to the wastewater treatment plant operator.

END OF SECTION 33 01 30

SECTION 33 01 30.23

PIPE BURSTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 COORDINATION

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

1.4 SUBMITTALS

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

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

1.5 QUALITY ASSURANCE

- A. The Contractor shall be certified by pipe bursting system manufacturer as a fully trained user of the pipe bursting system. Operation of the pipe bursting system shall be performed by trained personnel. Such training shall be conducted by a qualified representative of the pipe bursting system manufacturer. The Contractor shall provide certificates of training for any employee directly involved in the supervision or operation of the pipe bursting system. Contractor shall have a minimum of 40,000 linear feet of pipe during preceding 3 years using pipe bursting technology as specified herein.

- B. Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and the recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Such training shall be certified and conducted by a qualified representative of the pipe manufacturer. Personnel shall have a minimum of 2 years' experience of fusion welding of HDPE pipe.
- C. Installation of other materials shall be performed by personnel qualified by the specific product manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PIPE:

- A. High-Density Polyethylene (HDPE):
 - 1. Confirm to requirements of AWWA C906.
 - 2. In compliance with NSF 61.
 - 3. Resin:

- a. Polyethylene resin shall meet or exceed requirements of ASTM D3350 for PE 4710 material with cell classification of 445474C, or better. Pressure rating shall be based on hydrostatic design stress of 1,000 psi at 73.4 degrees F.
- b. Unless specified in the project drawings, the minimum Pressure Rating shall be 125 PSI and nominal DR of 17.
- 4. Pipes 4” and larger shall have Ductile Iron Pipe Size outside diameter.
- 5. Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of a compatible resin mix for the fusion process.
- 6. Fittings:
 - a. PE:
 - 1) Shall be thermal butt-fusion type.
 - 2) Shall have same or higher pressure rating as pipe.
 - b. Ductile Iron:
 - 1) Join to mechanical joint ductile iron fittings w/ restraining gland follower with internal stiffener.
 - 2) Restraining follower glands shall be manufactured by EBAA Iron “Mega-Lug” Model 2000PV or 2100.
- 7. Electrofusion Couplings:
 - a. May be used for repairs or connecting pipe burst segments in the trench with approval of the Owner.
 - b. Manufacturers:
 - 1) Central Plastics Company; Central Electrofusion System.
 - 2) IPEX, Inc; Friatec.

2.2 SERVICE CONNECTION AT MAINLINE SEWER

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

2.3 PIPE CONNECTION TO EXISTING MANHOLES

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

2.4 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.1 EQUIPMENT:

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

3.2 PREPARATION

- A. General:
 - 1. Work shall be supervised by personnel experienced in installation of similar pipe and shall be onsite at all times from time of commencement to time of completion.
 - 2. Locate insertion or access pits so that the total number is minimized and footage of pipe installed in a single run is maximized. Use excavations at point repair locations for insertion pits where possible.
- B. Pre-CCTV Inspections:
 - 1. The Contractor shall perform a pre-installation CCTV inspection.
 - 2. Existing pipe shall be clean and free of obstructions so as not to prohibit pipe bursting operations.
 - 3. CCTV inspections shall be completed in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
- C. Locating Utilities:
 - 1. The Contractor shall, prior to starting work, verify the location of all adjacent utilities. The minimum clearance from other utilities shall be approximately two feet. The Owner may at its discretion reduce the minimum clearance with justification from the Contractor.
 - 2. The Contractor shall expose all interfering and crossing utilities by spot excavating at the planar intersection of the pipe and removing the soil from around the utility. The cost of

exposing these utilities shall be borne by the Contractor as part of the pipe bursting operation.

D. Sub-Surface Conditions:

1. Owner will furnish the Contractor with available information listed in the Contract Documents, if any are available. The Contractor shall verify this information in the field. All additional subsurface investigations deemed necessary by the Contractor to complete the work shall be included in the Contract at no additional cost to Owner.
2. Copies of all reports and information obtained by additional subsurface investigations by the Contractor shall be provided to the Owner.

E. Point Repairs:

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

F. Locating Service Connections:

1. Sewer service connections shall be identified and located by CCTV prior to start of pipe bursting operation and pipe insertion.
2. The Contractor shall locate all and expose all sewer service connections prior to pipe insertion to expedite reconnection.
3. The Contractor shall exercise due diligence in excavating the existing pipe sufficiently to allow for uniform circumferential expansion of the existing pipe through the service connection pit.

3.3 PIPE JOINING

A. General:

1. When requested by the Owner, prior to pipe installation, two trial fusion welds shall be performed, and reviewed and approved by the Owner. Full penetration welds shall provide homogeneous material across the cross section of weld. Fusion machine employed for trial welds shall be same machine utilized for project installation.

2. The HDPE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted.
 3. All equipment and procedures used shall be in strict compliance with ASTM F2620 and with the pipe manufacturer's recommendations.
 4. Terminal sections of pipe that are joined within the insertion pit shall be connected with an electrofusion coupling (e.g., Central Plastics couplings).
 5. All connections shall be completed in the absence of flow and in conformance with the manufacturer's installation procedures.
- B. Joint Preparation:
1. Inside and outside of pipe ends shall be cleaned with cotton or non-synthetic cloth to remove dirt, water, grease, and other foreign materials.
 2. Pipe ends shall be cut square and carefully aligned prior to heating.
- C. Joining:
1. Fusion shall be performed by technicians certified by a manufacturer of pipe fusion equipment.
 2. Using an alignment jig, the butt-fused joint shall be true alignment, brought together in firm, rapid motion, applying sufficient pressure to form a uniform rollback bead (1/8 inch to 3/16 inch) on the entire outer and inside circumference of pipe. The joint shall be allowed adequate cooling time before removal of pressure.
 3. The fused joint shall be watertight and shall have tensile strength equal to or greater than that of the pipe.
 4. All joints shall be subject to acceptance by the Owner prior to insertion.
 5. The Contractor shall cut out and replace defective joints at no additional cost to Owner.
- D. Weld De-beading:
1. Internal beads shall be removed with an approved de-beading device without inducing any defects to the pipe or bead. The pipe and bead must be completely cooled before the bead is removed.
 2. The removed beads shall be in one continuous strip without splitting or defect. The contractor shall remove any joint with defective beads and fuse a new joint.
- E. Defects:
1. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10 percent of the wall thickness (ASTM F585), shall not be used and shall be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above.
 2. Any section of the pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner shall be discarded and not used.

3.4 BYPASSING OF FLOWS

- A. Use flow bypass pumping for reducing flow below the maximum depth or for completely bypassing flow.

- B. Bypassing of flows shall be provided in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

3.5 PIPE INSTALLATION

A. General:

1. The minimum depth of cover over the installed pipe shall be 4 feet for size-on-size pipe bursting, and shall be 8 feet for increased pipe size pipe bursting. The Contractor may request approval of the Owner reduce the minimum depth of cover.
2. A minimum amount of ground heaving may be allowed, as determined by the Owner, if soil conditions are not favorable and up-sizing of the pipe is required.
3. Unless otherwise noted, settlement or heaving of the ground surface during or after construction will not be allowed. The Contractor is solely responsible for the costs for repairing any surface heaving at no additional cost to the Owner, unless specified otherwise.
4. Existing pipe shall be clean and free of obstructions so as not to prohibit pipe bursting operations.
5. Pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Owner
6. Lay pipe true to lines and grades within existing sewer as indicated on the Project Drawing
7. Conduct pipe insertion operations to prevent damage to the installed pipe and adjacent facilities.
8. Advancement of bursting head with “chain” is prohibited.
9. Void created by bursting device shall be sufficient in size to accommodate HDPE pipe.

B. Pit Shaft:

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

C. Existing Manhole:

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

7. Reconstruct benches and channels after new pipe is installed to form a smooth transition to eliminate sharp edges.

D. Manhole Drop Connections:

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

E. Rescue Shafts:

1. In the event that the pipe-bursting machine encounters an obstruction and is halted, the Contractor will be required to excavate down to the machine to free the obstruction and continue the installation.
2. The Contractor is notified that the construction of such shafts will be considered incidental to the installation by the pipe bursting construction method.
3. Any rescue shafts will be properly braced, shored, or utilize trench boxes to meet applicable Federal, State, and local requirements.
4. Backfill and compaction for such rescue shafts shall be in accordance with Section 31 23 16.01 - Excavation for Utilities.

3.6 LUBRICATION

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

3.7 Service Lateral Connection:

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

3.8 RESTORATION

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

3.9 POST INSTALLATION CCTV INSPECTIONS

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

3.10 TESTING OF GRAVITY SEWERS

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

3.11 FINAL CLEANING

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

END OF SECTION 33 01 30.23

**SECTION 33 01 30.72
CURED-IN-PLACE PIPE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 COORDINATION

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

1.4 DESIGN CRITERIA

- A. Design liner thickness in accordance with ASTM F1216, F1743, or F2019 (as appropriate for the proposed liner product) using the following criteria:
 - 1. Pipe Diameters: Per Project Drawings
 - 2. Ovality: 3 percent, or as shown on plans.
 - 3. Pipe Condition: Fully deteriorated.
 - 4. External Water: Ground Surface
 - 5. Short-Term Tensile Strength (ASTM D638):
 - a. Unreinforced: 3,000 psi
 - b. Reinforced: 9,000 psi
 - 6. Tensile Strength Reduction Factor: 50 percent
 - 7. Long-Term Tensile Strength:
 - a. Unreinforced: 1,500 psi
 - b. Reinforced: 4,500 psi
 - 8. Flexural Strength (ASTM D790):
 - a. Unreinforced: 4,500 psi
 - b. Reinforced: 6,500 psi
 - 9. Short-Term Flexural Modulus (ASTM D790):
 - a. Unreinforced: 250,000 psi, or as shown on plans
 - b. Reinforced: 700,000 psi, or as shown on plans

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

1.5 SUBMITTALS

A. Action Submittals

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

B. Informational Submittals

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

10. Dye testing results
11. External hard drive of both pre- and post CCTV inspections in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 SPECIAL GUARANTEE

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

PART 2 - PRODUCTS

2.1 CURED-IN-PLACE PIPE

- A. Resin:
 1. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester, epoxy, isophthalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst

- system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
2. Resistant to municipal wastewater environment and immersion in septic sewage at temperatures up to 75° F.
 3. Curing:
 - a. Designed to cure properly within selected curing method.
 - b. Initiation temperature: 180° F, maximum for water cure.
 4. Resins shall be chemical resistant and tested and manufactured in accordance with ASTM F1216 and ASTM D543.
 5. All resin fillers, resin additives, and resin enhancement agents are subject to Owner approval. All enhanced resins shall meet all design requirements and be submitted as part of the action submittal process.
 6. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
 7. Produce a cured tube resistant to shrinkage that will not corrode or oxidize and is resistant to abrasion from solids, grit, and sand in wastewater.
 8. Bond between tube layers shall be strong and uniform. Layers, after cure, shall be saturated with resin.
 9. Styrenated resins are prohibited for pipes that will discharge directly to the environment such as treatment plant effluent lines.
 10. Manufacturers and Products:
 - a. Reichhold
 - b. Interplastic Corporation
 - c. Ashland Specialty Chemical Company
 - d. AOC
- B. Catalysts:
1. Primary catalyst shall not exceed 1% of the resin by volume.
 2. Secondary catalyst shall not exceed 0.5% of the resin by volume.
 3. Catalysts shall be:
 - a. Primary: Akzo Products, or as required to meet the performance requirements of the liner.
 - b. Secondary: Akzo Products or Puritan Products; or as required to meet the performance requirements of the liner.
- C. Tube:
1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality-controlled conditions set by manufacturer and applicable requirements set forth in ASTM F1216 and ASTM F1743 that, when cured, will be chemically resistant to reagents as defined in ASTM D543.
 2. Lining shall be correct diameter; after installation, there shall be no wrinkles or form permanent fins. Tube shall be capable of stretching to fit irregular pipe sections and fabricated and sized for each section to ensure snug and firm fit inside existing sewer; produce required thickness after resin is cured.
 3. Wastewater-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt and shall not be a dark or non-reflective nature that inhibits proper CCTV inspection.
 4. For lines 24 inches and larger: if reinforcement is utilized it shall consist of impregnated flexible fiberglass. Each lot of fiberglass liner shall be inspected for defects and tested in accordance with ASTM F2019.

5. Manufacturers:
 - a. Applied Felt
 - b. Insituform Technologies
 - c. Liner Products
 - d. National Liner
 - e. Layne Inliner
 - f. Mississippi Textile

- D. Interface Seal:
 1. Structural properties in accordance with ASTM F1216 and as referenced in the design criteria and compatible with the main line liner and proposed lateral liner.
 2. Meet the 50-year design life of the CIPP lateral liner.
 3. Designed to be installed via remote device without excavation or installation of cleanout.
 4. One piece construction and designed such that when expanded shall tightly fit both T and Y connections at interface between mainline and lateral pipe.
 5. Provide a watertight connection between service connection and mainline.
 6. Interface seal shall be a full-circle 16-inch long CIPP mainline liner integrally manufactured to lateral liner providing a seamless connection between mainline liner and lateral liner.
 7. Shall extend inside the lateral pipe a distance specified on the project drawings; or at a minimum to the first service cleanout.

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

PART 3 - EXECUTION

3.1 WORKER SAFETY

- A. Contractor shall implement all current recommendations, guidelines, and regulations of the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Health and Safety Administration (OSHA) for the safety of workers and the public affected by the CIPP installation.

- B. Records of any complaints or incidents shall be provided to the Owner.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Wet Out:
1. Verify lengths in the field before cutting liner to length.
 2. Wet out shall be vacuum impregnated with resin under controlled conditions.
 3. Use roller system to uniformly distribute resin throughout the tube.
 4. Resin shall fill all voids in the tube material with no air spaces or pockets.
 5. Handle resin impregnated tube to retard or prevent settling until it is ready for insertion.
 6. Use of alternative methods of resin impregnation shall be approved by the Owner prior to implementation.
- B. Insertion:
1. Install CIPP in accordance with ASTM F1216 (direct inversion), ASTM F1743 (pull installations), F2019 (reinforced liners), or as appropriate for the liner product being used.
 2. Dewater existing host pipe prior to installation.
 3. Insert wet out tube through an existing manhole or approved access point by means of an inversion method and application of sufficient hydrostatic head to extend the tube to the next designated termination point.
 4. A pull in method using a bladder to expand the tube may be employed if approved by the Owner.
 5. After insertion, maintain sufficient pressure to hold tube tight against the host pipe.
- C. Interface Seal:
1. Install from mainline sewer and extend inside lateral for a distance specified on the project drawings; or at a minimum to the first service cleanout
 2. No clean out is required for installation of connection seal to lateral liner system.
 3. Do not install in presence of active infiltration. To control infiltration at lateral interface seal use materials compatible with both mainline liner and lateral line.

D. Curing:

1. Complete a curing process control sheet for every lining completed.
2. Control sheets shall provide required temperatures and time for the different steps of the curing process: Initial cure, post cure, and cooling as outlined in ASTM F1216. Initial cure may be considered completed when exposed portions of the flexible tube pipe take a hard set and temperature is adequate, as recommended by the manufacturer.
3. After installation, apply steam, hot water, or ultraviolet light as recommended by the liner manufacturer.
 - a. Steam:
 - 1) Provide safety system specifically structured for use of steam.
 - 2) Thermoset Resin: Designed to cure properly when using steam.
 - 3) CIPP Tube Thermoplastic Coating:
 - a) Formulated from material designed specifically to withstand high temperature curing process utilizing steam.
 - b) Polypropylene/polyethylene blend or equal.
 - 4) Equipment:
 - a) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above the temperature required to affect cure of resin.
 - b) Install temperature gauges at the incoming steam supply, the outgoing steam supply, and between the impregnated tube and pipe invert at lining termination point (lowest elevation point).
 - 5) Steam temperature shall be 230 °F minimum.
 - 6) Minimum interface temperature between liner and tube shall be 120°F.
 - 7) Pressure required to keep tube inflated shall be per manufacturer's instructions.
 - 8) Cool Down:
 - a) Send air through steam cured CIPP liner until liner cools down to 120 °F interface temperature.
 - b) Once 120 °F has been reached, water may be introduced to finish cooling line down to 90 °F.
 - c) During release of water, prevent vacuum that could damage newly installed CIPP.
 - b. Hot Water:
 - 1) Equipment
 - a) Heat source shall be capable of delivering hot water throughout the section and uniformly raising water temperature to above the temperature required to affect cure of the resin.
 - b) For diameters smaller than 24 inches in diameter, install temperature gauges at the incoming water supply, outgoing water supply, and between impregnated tube and pipe invert at lining termination point (lowest elevation point).
 - c) For diameters 24 inches and larger, utilize a curing temperature monitoring system.
 - d) To monitor the temperature inside the tube wall and verify proper curing, temperature sensors shall be placed between the hose pipe and the liner and in the bottom of the host pipe throughout the reach to record the heating and cooling that takes place on the outside of the liner during processing.
 - e) The sensors shall be spaced apart at intervals no greater than 10 feet.

- f) Sensors shall be strategically placed at points where a significant heat sink is likely to be anticipated, such as areas where the host pipe is exposed, changes materials, or is submerged such as under a stream crossing.
 - g) Prior to installing the liner in the host pipe, the temperature monitoring system's functionality shall be confirmed by measuring the ambient temperature with the temperature sensors.
 - h) No more than two sensors per segment can be found faulty during this test. If three or more sensors are discovered to be faulty, a new sensor array shall be pulled into the host pipe replacing the previously installed array and the new array shall be again tested for proper functionality at the expense of the Contractor.
 - i) Curing of the resin system shall be as per the directions of the CIPP manufacturer. The temperatures achieved and the duration of holding of the liner at those temperatures shall be per the CIPP manufacturer's established procedures.
 - j) If any sensor or sensors along the reach indicates that there is a localized issue with respect to achieving proper curing per the written installation procedure, the Contractor shall address the issue immediately using previously established protocols for such an event.
 - k) The sensor array's database required in the above paragraph shall have an output report that identifies each sensor by its station in the reach and shows the maximum temperature achieved during the processing of the CIPP and the time sustained at or above the manufacturer's required curing temperature at each sensor.
- 2) Minimum Interface Temperature between Liner and Tube: 120 °F.
 - 3) Time: 3 hours, minimum unless manufacturer recommends otherwise and approved by the OWNER.
 - 4) Cool Down:
 - a) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
 - b) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
 - c) During release of water, prevent vacuum that could damage newly installed CIPP.
- c. UV: If this method of curing is selected, material shall be a polyester needle felt or fiberglass based CIPP liner impregnated with an isophthalic neopentyl glycol resin.
 - 1) Curing parameters, such as curing speed, inner air pressure, and wattage, per the manufacturer.
 - 2) Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
 - 3) Invert liner into pipe with standard pressure drum or pull into pipe using a slip sheet.
 - 4) After completion of inversion process introduce light chain in liner and close ends with couplings.
 - 5) Remove and discard inner film material after curing to provide optimal quality of final product.
 - 6) Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.

7) Flushing of UV cured CIPP liner to reduce styrene residual is not required.

E. The finished CIPP shall:

1. Be continuous over entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
2. For lines 24 inches or larger the CIPP shall have no radially positioned (perpendicular to flow) wrinkles, fins or other discontinuities in the lower third of the pipe which exceed more than 3% of the host pipe inside diameter. Have no radial wrinkles, fins or other discontinuities in the upper 2/3rds of the pipe having a height of 5% or more of the host pipe inside diameter, unless approved.
3. When passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by OWNER.
4. Annular space between existing pipe and the CIPP shall be sealed with a hydrophilic rubber joint seal per manufacturer's instructions.
5. Tested using low-pressure air as specified in Section 33 05 05 – Sanitary Sewer Testing prior to reinstating sewer services. Testing shall be performed in the presence of the Owner or Owner's representative and testing reports shall be provided.

3.4 SEALING AND BENCHES IN MANHOLE

- A. CIPP shall make a tight-fitting seal with existing pipe(s) in manhole. For CIPP that is installed continuous through manhole, the top half of the pipe shall be neatly cut off and not broken or sheared off at least 2 inches away from wall. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other pipes or channels, if any.
- B. At each pipe opening into manhole, hydrophilic rubber joint seal shall be bonded with adhesive to the host sewer pipe or to the opening in the manhole barrel to hold it in place during inversion and creating a water-tight seal after curing.
- C. Seal CIPP and existing pipe in manhole as stated above before proceeding on to next manhole section. Manholes shall be individually inspected for liner cut-offs, benches, and sealing of liner annular space.

3.5 MANHOLE DROP CONNECTIONS

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

3.6 SERVICE LATERALS

- A. Prior to commencing CIPP lining, all service lateral and property line cleanouts shall be located and recorded using mainline CCTV inspection, lateral launch CCTV inspection, field

investigation, sonde location, or any other required methods to accurately determine the location of the service lateral and property line cleanout.

- B. If investigation determines that a property line cleanout does not exist, a property line cleanout shall be installed at the direction of the Owner and paid for under the appropriate line item.
- C. Shutdown:
 - 1. Notify Owner at least five (5) working days prior to the shutdown when it is necessary to shut down a private service line while Work is in progress and before the service lines are reconnected. Notify building occupants with an Owner approved door hanger not less than 36 hours prior to shut down.
 - 2. When a residential service lateral will be disconnected for more than eight (8) hours or outside of standard working hours, the flow shall be controlled in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.
 - 3. No service is to remain shut down without sewer flow control or a leak free temporary connection. Otherwise, Contractor shall then provide temporary living quarters (i.e., hotel) for the resident at no additional cost to Owner or the resident. Temporary living quarters shall be approved by Owner and coordinated through Owner’s Customer Support Representative. Commercial sewer services shall be maintained when businesses are open.
- D. Temporary Service Reinstatements:
 - 1. Unless otherwise indicated in the Drawings, reinstatement of services after CIPP lining shall be performed internally.
 - 2. Prior to service reinstatement, the location of the service connection shall be confirmed by “lamping” the connection using the property line cleanout for access.
 - 3. Should damage occur to the liner due to inaccurately located service connections, the Contractor shall remedy the damage in the new liner at no cost to the Owner.
 - a. Remedy shall be performed by the installation of a CIPP repair patch covering the abandoned or capped service connection.
 - b. The CIPP repair patch shall be isolated and tested using low-pressure air to ensure the repair patch has not created a path for infiltration.
 - 4. Contractor shall perform temporary service cut outs at active service connections immediately after liner has cured and low-pressure air testing has been performed. Initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90 percent of the original diameter of the connection. Do not damage liner pipe and allow to normalize to ambient temperature before 6-inch diameter hole is drilled out.
 - 5. Services shall not be reconnected from abandoned or vacant properties, unless directed by the Owner. Restore and correct missed or faulty reconnections as well as damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners.
 - a. Contractor is responsible for diligently identifying the activity of a sewer connection.
 - b. If a property is vacant the contractor is shall coordinate with the Owner to identify prior connections to the property.
 - 6. Should an abandoned or capped service connection be reinstated through neglect of the Contractor, the Contractor shall remedy the opening in the new liner at no cost to the Owner.
 - a. Remedy shall be performed by the installation of a CIPP repair patch covering the abandoned or capped service connection.

- b. The CIPP repair patch shall be isolated and tested using low-pressure air to ensure the repair patch has not created a path for infiltration.
- E. Permanent Service Connection by Excavation:
1. Excavate existing active service connections. Disconnect at joints and existing sewer (now the carrier pipe for the liner) and remove to expose the liner to the extent necessary. Coat cut out hole in liner with approved resin/epoxy that will cure at the ambient temperature.
 2. Install PVC saddle tee for the new sewer service lateral over the cut out. Saddle shall be a one-piece saddle attached to the liner with epoxy so that a complete seal is accomplished when the strap-on saddle is tightened with two stainless steel bands; one on each side. The stub-out attached to the saddle shall protrude into liner a distance equal to the wall thickness of liner.
 3. All permanent lateral re-instatements shall be completed within 30 days of the initial temporary cut out.
 4. Services which are reconnected to rehabilitated liner shall be shown on therecord drawings with the distance from the nearest downstream manhole, depth at clean out, and the cleanout distant from mainline.
 5. Replace sewer service laterals per Section 33 31 30 – Sanitary Sewer Services.

3.7 TESTING FOR ACCEPTANCE

- A. Sampling and Measuring: Two minimum 12-inch-long samples shall be cut from the cured liner installation; sample shall be collected and prepared in accordance with restrained sample method described in ASTM F1216 or ASTM F2019. Samples removed for testing shall be individually labeled and logged to record the following:
1. Owner's project number and title.
 2. Sample number.
 3. Segment number of line as noted on supplements.
 4. Date and time of sample.
 5. Name of Contractor.
 6. Location and by whom tested.
 7. Street name and address.
 8. Test results
- B. Field Thickness testing shall be in accordance with ASTM D2122. The average thickness, calculated from four measurements on each specimen, shall be equal to or greater than the required design thickness. Plate samples may be used in lieu of restrained samples for pipes greater than 18 inches in diameter and in accordance with ASTM F1216.
- C. Send samples to an independent accredited laboratory and test for modulus of elasticity and flexural strength in accordance with ASTM D790, as directed by Owner. Failure of any test can be grounds for rejection of the CIPP liner. At the direction of Owner, the second sample shall be tested. Testing results shall be provided to the Owner within 7 days of receipt.
- D. Destructive Testing: In cases where test results of samples from the 12-inch-long pipe section are lower than required values, at the direction of Owner, Contractor shall cut samples from liner along length of pipe. The size and shape of the samples shall be determined by Owner. The Contractor shall repair the CIPP liner and host pipe at no additional cost to Owner. Failure of the thickness test shall be grounds for rejection for the CIPP liner.

- E. Resin Sampling: “Wet-out” facility resin mixing equipment shall have a valve downstream of the mixing functions and immediately upstream of the application of the mixed resin to the tube where Owner can draw resin samples.
- F. Contractor’s batch mix facilities, if any, shall provide for sampling of the mixed batch. Submitted “wet-out” schedule cannot be modified without 24-hour notice to Owner. Resin samples shall be drawn at times determined by Owner. The Owner drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.
- G. CCTV shall be as specified in Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control. Televising shall be done after service connections have been made, unless required earlier by Owner. Provide CCTV DVD’s or external hard drive within two weeks after permanent lateral reinstatements have been completed.
- H. CIPP lined pipes 18-inches and less in diameter shall be air tested as specified in Section 33 05 05 – Sanitary Sewer Testing after liner has been installed and prior to service lateral reinstatement.
- I. No visible leak around liner at manhole connections will be allowed.
- J. Correct failed liner or liner deemed unacceptable by OWNER as a result of the post-video inspection or test reports for structural values and thickness.
 - 1. Remedy shall be defined as shown in Table 1 and shall be based upon lowest test in each test category. Where pipe replacement is required, payment shall be made in full for the cured-in-place pipe. No payment will be made to construct a new sewer segment.

Table 1: CIPP Remediation

END OF SECTION 33 01 30.72

**SECTION 33 01 30.81
MANHOLE REHABILITATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Epoxy products shall be manufactured in an ISO 9001-2015 certified facility. Manufacturer IOS 9001-2015 certification shall be submitted to the Owner.
- B. Installers shall have a minimum of 5 years of experience installing the product provided, and shall be certified by the manufacturer. Installers of liners, coatings, and wall repair systems shall submit qualifications and include:
 - 1. Manufacturer's approved equipment list, by name and model number for application of product and Contractor's equipment list showing approved equipment available for use in product application.
 - 2. List of Contractor's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each crew person.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PERFORMANCE REQUIREMENTS

- A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against corrosion
- B. Manufacturer's Product Support:
 - 1. Through the Contractor, manufacturers of wall sealing, coating or lining systems shall submit to the Engineer for review and approval a detailed description of the proposed rehabilitation process. Describe surface preparation, independent laboratory test results, mix design procedures and methods of controlling uniform thickness.

1.7 PROJECT CONDITIONS

- A. Manholes Containing Mechanical or Electrical Equipment:
 - 1. Contract Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, do not remove or disturb and immediately notify the Owner or Inspector.
 - 2. Reschedule work in such manholes until equipment has been removed by Owner and further instructions are given.
 - 3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
 - 4. Damage to installed equipment, due to negligence of Contractor, will be repaired by Owner and cost of repairs charged to Contractor.

- B. Field Location of Manholes, Cleanouts and Inlets:
 - 1. Contractor is responsible for locating and uncovering all manholes and cleanouts in lines being rehabilitated. If difficulty is encountered in locating a manhole or clean-out covered by ground or pavement, notify the Owner or Inspector and await instructions.
 - 2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

PART 2 - PRODUCTS

- A. GENERAL
 - 1. The materials used shall be designed, manufactured and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
 - 2. Each lining system shall be designed for application over wet (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.

- B. Chemical Pressure Grouting System:
 - 1. Where pressurized injection of chemical grout behind manhole chimney and joints is required, material supplied shall be urethane gel or polyurethane resin with the following properties:
 - a. During injection, chemical sealant shall be able to react/perform in the presence of infiltrating water.
 - b. Cured sealant capable of withstanding submerged conditions, freeze/thaw cycles, and wet/dry cycles without degradation. Must prevent passage of water and must be flexible, chemically stable, and resistant to sewer environments.
 - 2. Urethane Gel shall be AV-350 multi-grout or AV-254 urethane gel as manufactured by Avanti International.
 - 3. Polyurethane resin grout shall have the following properties:
 - a. Viscosity of 120 to 350 centipoise
 - b. Weight of 8.65 pounds to 9.48 pounds per gallon
 - c. Solids content of 88% to 100% by ASTM D2834
 - d. Induction time of 3 to 4 minutes

- e. Cure time of 5 to 6 minutes
 - f. Tensile strength of 40 to 450 psi by ASTM D3574
 - g. Elongation of 3% to 350% by ASTM D3574
 - h. Shrinkage of less than 2% by ASTM D1042
 - i. Tear resistance of 21 pounds per inch by ASTM D3574
 - j. Density of 28 to 119 pounds per cubic foot by ASTM D3574
 - k. No catalyst required; single component product
- C. Spray Applied Epoxy Coating for Manholes
1. Products shall meet federal, state, and local requirements limiting emissions of volatile organic compounds. Materials, including underlayment and monolithic lining shall be produced by the same manufacturer.
 2. Characteristics:
 - a. Materials: 100 percent solids, plural component epoxy, capable of spray or roller application.
 - b. Moisture tolerant: System capable of application to damp concrete surfaces in high relative humidity environment.
 - c. Chemical resistance: Resistant to attack from hydrogen sulfide and sulfuric acids generated from microbiological sources.
 3. Properties:
 - a. Bond Strength (ASTM C478): Concrete Failure.
 - b. Tensile Strength (ASTM C307): 2,500 psi, minimum
 - c. Flexural Strength (ASTM C580): 4,800 psi
 - d. Moisture Absorption (ASTM C413): 0.1 percent
 - e. Shrinkage (ASTM C631) : 0.11 percent, maximum

PART 3 - EXECUTION

3.1 REHABILITATION OF MANHOLE STRUCTURES

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

accordance with the manufacturer's recommendation. Remove existing roots prior to application by cutting them flush with the manhole wall.

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

3.2 APPLICATION OF SPRAY APPLIED EPOXY COATING

- A. Surface must be clean, dry, and in sound condition. Remove all oil, grease, dirt, water or other contaminants in accordance with ASTM and SSPC standards. Abrasive grit blast, wet abrasive blast, or high-pressure water blast all surfaces to be coated to remove all laitance, efflorescence, surface hardeners, curing compounds, old coatings, and loose concrete/mortar.
- B. Inspect and repair the concrete, brick, or mortar for cracks and other defects. Inspect the construction joints, edges, corners, etc. Thoroughly clean blasted surfaces to remove all dust and debris after dry blasting or to remove all water, sludge, and debris after wet blasting.
- C. Clean frame assembly and remove existing rust and corrosion using abrasive methods.
- D. Primer Application (if required)
 1. Ensure the area to be primed is clean and dry. Apply the recommended primer over an area of the prepared surface that can be completed within the primer's re-coat window. Apply epoxy when primer becomes tacky to the touch.
- E. Coating Application
 1. Adhesion Layer: Apply in a single monolithic layer to a nominal dry film thickness of 50 mils using a high-pressure plural component spray reactor at the required pressure.
 2. Closed Cell Foam Surfacer: Apply using high pressure plural component proportioning equipment with primary and hose heaters at the appropriate pressure and temperature. Apply foam at a moderate speed, repeat the process until the foam rise covers the voids.
 3. Corrosion Barrier: Apply in a single monolithic layer to a minimum nominal dry film thickness of 50 mils using a high-pressure plural component spray reactor at the required pressure.
- F. The entirety of the interior of the manhole shall be continuously lined, including the interior of the frame, chimney, barrel, bench, and channel.

- G. Testing
 - 1. Holiday/Spark testing shall be conducted in accordance with ASTM 4787 to detect discontinuities or pinholes in the lining system.
 - 2. Repair and retest discovered discontinuities and pinholes.
 - 3. Testing shall be performed in the presence of the Owner or Owner's representative.

3.3 MANHOLE REHABILITATION ACCEPTANCE

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

3.4 MANHOLE LINING SYSTEM REPAIRS

- A. If a manhole lining system is damaged during construction, the lining shall be repaired in accordance with the manufacturers requirements and retested at no additional cost to the Owner.
- B. If a manhole lining system is required to be altered or partially removed due to alteration of the manhole, the lining system shall be repaired in accordance with the manufacturers requirements and tested to ensure a continuous coating. The cost of removal and repair of the lining shall be inclusive to the line item requiring lining removal and repair.

END OF SECTION 33 01 30.81

SECTION 33 05 05

SANITARY SEWER TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hydrostatic and Leakage Testing.
 - 2. Infiltration and Exfiltration Testing
 - 3. Vacuum Testing
 - 4. Low Pressure Air Testing
 - 5. Mandrel Testing (new gravity sewer only)
- B. Related Requirements:
 - 1. Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control
 - 2. Section 33 05 61 – Concrete Manholes
 - 3. Section 33 31 11 – Gravity Sewer Pipe

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 REQUIRED EQUIPMENT

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

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

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

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

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

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 HYDROSTATIC AND LEAKAGE TESTING FOR SEWER PIPING

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

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

3.3 EXFILTRATION TESTING FOR GRAVITY SEWER PIPE

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

3.4 VACUUM TESTING OF MANHOLES

- A. Vacuum Testing shall be performed on all new sewer manholes.
- B. Prior to Vacuum Testing, ensure all manhole components have been installed and backfilled as specified, including all required sealant and manhole frame/cover assembly.
- C. Vacuum testing shall be in compliance with ASTM C1244.

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

3.5 HOLIDAY/SPARK TESTING

- A. Holiday/Spark Testing shall be performed on all manholes rehabilitated using a non-conductive lining system, such as polyurea or epoxy.
- B. Testing shall be conducted in accordance with ASTM 4787 to detect discontinuities or pinholes in the lining system.
- C. Repair and retest discovered discontinuities and pinholes in accordance with the lining system manufacturers requirements.

3.6 LOW PRESSURE AIR TESTING OF GRAVITY SEWER PIPE

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

- G. The duration that the section of pipe shall be tested depends on the size and length of the section of pipe and can be found in Table 3 below.

Table 2: Low Pressure Air Minimum Testing Duration			
Pipe Size (Inches)	Duration per 100 ft (Minutes)	Pipe Size (Inches)	Duration per 100 ft (Minutes)
4	0.3	18	2.4
6	0.7	21	3.0
8	1.2	24	3.6
10	1.5	27	4.2
12	1.8	30	4.8
15	2.1	33	5.4
18	2.4	36	6.0

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

3.7 MANDREL TESTING

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

3.8 FIELD QUALITY CONTROL

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

END OF SECTION 33 05 05

SECTION 33 05 61
CONCRETE MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data:
1. Precast Concrete Manholes
 2. Butyl Rubber Sealant
 3. Frame/Cover Assembly
 4. Precast Concrete Grade Rings
 5. Manhole Steps
 6. Pipe Connections
 7. Drop Connections
 8. Manhole Coatings

- B. Shop Drawings:
 - 1. Indicate structure locations and elevations.
 - 2. Indicate sizes, elevations, and orientation of piping and inverts.
 - 3. Signed and sealed by the qualified professional engineer responsible for their preparation, when requested by Owner.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Products: Do not deliver products until concrete has attained a 100% compressive strength.
- B. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling:
 - 1. Comply with manufacturer instructions for unloading, storing, and moving manhole sections.
 - 2. Lift manhole sections from designated lifting points.
- D. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store manhole sections to prevent damage to Owner's property or other public or private property.
 - 3. Repair property damaged from materials storage.

- E. Protection:
 - 1. Protect materials in clean location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Manhole sections shall be reinforced precast concrete in accordance with ASTM C478.
- B. Concrete mix shall include XYPEX admix C-1000 Red.
- C. The minimum compressive strength of the concrete in precast section shall be 4,000 psi.
- D. The maximum allowable absorption of the concrete for all sections shall not exceed 8 percent of the dry weight.
- E. The minimum wall thickness shall be 5-inches or one-twelfth of the inside diameter of the base, riser, or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of rubber boots.
- F. Precast manhole top sections shall be eccentric cones with a clear opening of 27 inches.
- G. Each precast section shall have tongue and groove joints and lifting holes to facilitate handling.
- H. Manhole base shall be monolithic and joints shall be located such that pipe holes are not within 12-inches of a seam.
- I. The circumferential reinforcement in the riser sections, conical top sections, and base wall sections shall consists of one line of steel and shall not be less than 0.17 square inches per lineal foot.
- J. The ends of each reinforced concrete manhole riser section and the bottom end of all manhole top sections shall be so formed that when the manhole risers and the top are assembled, they will make a continuous and uniform manhole.
- K. Pipe openings shall provide clearance for pipe projecting a minimum of 2 inches inside the manhole. The height of the transition from the pipe opening to the invert trough shall be equal to $\frac{1}{2}$ of the opening inside diameter minus pipe inside diameter.
- L. Trough shall be formed and poured by the manufacturer. If condition is unavoidable, the floor shall be 1-inch minimum below lowest pipe opening to provide clearance for grouting of flow channel.
- M. When influent pipes are smaller in diameter than effluent pipes, the elevation of the crown of the influent pipe shall be no lower than the crown of the effluent pipe.

- N. The minimum fall through a manhole shall be 0.1 feet. The minimum radius of the trough centerline is to be 1.5 times the pipe inside diameter.
- O. Structures shall be designed and constructed by the manufacturer to resist anti-flotation with minimum safety factor greater one of 1.25.
- P. The height of the manhole barrel shall be designed to minimize precast concrete grade rings. If necessary, a maximum of four precast concrete grade rings will be allowed to bring the casting to finished grade.
- Q. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall penetrate no closer than 2-inches from inside surface. These holes shall be mortared and coated with coal tar epoxy.
- R. Joints of the manhole sections shall be of the tongue and groove type. Sections shall be filled with two approved gaskets, and coated outside with coal-tar epoxy, and one strip of masking wrap. Inside joints shall not be grouted.
- S. Flat-top slabs may only be used as noted on the plans or with prior approval from the Engineer.
- T. Minimum interior diameter of manhole based on largest connected pipe:
 - 1. Less than 18-inch: 4-foot,
 - 2. 18 – 24-inch: 5-foot,
 - 3. Greater than 24-inch: 6-foot,
 - 4. Or as required based on leg spacing.

2.2 BUTYL RUBBER SEALANT

- A. Butyl Rubber Gasket
 - 1. A butyl rubber gasket shall be installed continuously between each component of the manhole as indicated in the Standard Details, including precast manhole sections, precast concrete grade rings, and the frame and cover attachment to the manhole.
 - 2. Shall be in accordance with ASTM C990.
 - 3. Butyl rubber gasket shall be one of the following or approved equal:
 - a. CS-102 as manufactured by Conseal.
 - b. Kent-Seal No. 2 as manufactured by Hamilton Kent Manufacturing Company.
- B. Butyl Rubber Joint Tape
 - 1. Butyl rubber joint tape shall cover the joint of all precast concrete manhole components as indicated in the Standard Details, including the base, riser sections, cone/cap, and grade rings.
 - 2. Butyl rubber joint tape shall be the following or approved equal:
 - a. CS-212 as manufactured by Conseal.

2.3 FRAMES AND COVERS

- A. Manhole frames and covers shall be cast iron, heavy traffic pattern with solid covers marked with “SANITARY SEWER” with a 24-inch minimum clear opening.

- B. Metal used in the manufacture of castings shall conform to minimum requirements of ASTM A 48 Class 30 for Gray Iron or Federal Specifications WW-I-652.
- C. All bearing surfaces shall be machined.
- D. Total weight of frame and cover shall be at least:
 - 1. Standard - 350 lbs
 - 2. Water Tight – 590 lbs
- E. Shall be H-20 Traffic rated, minimum.
- F. Manhole frames and covers shall be manufactured by Acheson Foundry of Chattanooga Tennessee:
 - 1. Standard – A-2024-81H
 - 2. Water-tight – A-2624-71H
- G. Anchor bolts and hardware shall be Type 304 or 316 stainless steel.

2.4 GRADE RINGS

- A. Concrete grade rings shall be 4 inches or 6 inches in height and be in accordance with ASTM C478.
- B. Composite grade rings shall not be less than 0.5 inches or greater than 3 inches in height and shall be manufactured by East Jordan Iron Works, Infra-Riser, or approved equal.

2.5 MANHOLE STEPS

- A. Provide steps in precast manholes on 16-inch centers throughout the structure with a minimum width of 13 inches.
- B. Secure steps to the wall via cast-in-place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place.
- C. Manhole steps shall be copolymer polypropylene coated, textured, and provided with cleats to prevent slippage. Core shall be 3/8-inch steel reinforced rod.
- D. Manhole steps shall be one of the following or approved equal:
 - 1. No. PS-1 as manufactured by M.A. Industries.
 - 2. No. 81213R as manufactured by Meadow Burke.

2.6 PIPE CONNECTIONS

- A. A flexible pipe to manhole connector shall be used in the connection of the sewer pipe to precast manholes. The flexible pipe connector shall be installed in a round hole cast or cored in the manhole wall.
- B. Shall be in accordance with ASTM C923.

- C. The flexible pipe connector shall be secured to the manhole wall with the stainless-steel retainer that presses the connector to the wall and a separate stainless-steel band to seal to the pipe.
- D. The flexible pipe connector shall be one of the following or approved equal:
 - 1. Kor-N-Seal as manufactured by Trelleborg.
 - 2. A-lok as manufactured by A-lok Corp.
 - 3. PS-10 as manufactured by Press Seal Gasket Corp.
 - 4. Lock Joint Flexible as manufactured by Interface Corp.

2.7 DROP CONNECTIONS

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

2.8 MANHOLE COATINGS

- A. Coatings for Existing Manholes:
 - 1. All new and existing manholes that are connected to a sewer force main or low-pressure sewer pipe shall include polyurea coating.
 - 2. See Section 33 01 30.81 – Manhole Rehabilitation for polyurea coating requirements.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION OF PRECAST CONCRETE MANHOLES

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Excavation:
 - 1. As specified in Section 31 23 16.01 – Excavation for Utilities and below.
 - 2. Excavate for manholes to the dimensions, shapes, and elevations as indicated and as required by mechanical and/or hand methods. Excavations for manhole bases shall be plumb, level, firm, clean, and free of loose earth, loose rock, vegetation, mud, water, frozen earth, topsoil, and other unsatisfactory materials immediately before concrete placement. The outside dimensions of manhole excavations shall be at least 12 inches greater than the manhole outside dimensions to facilitate manhole construction and backfilling around the structure.
 - 3. If excavation is carried below indicated or authorized elevations or is the subgrade should be spoiled in any way, fill the over-excavated or spoiled areas with 3,000-psi concrete unless otherwise specified or authorized.
 - 4. Unsuitable Subgrade: Where the existing subgrade will not provide a sufficiently firm foundation to support the manhole and superimposed loads, remove the unsuitable material down to the depth required and replace with the specified granular material.
 - 5. Maintaining Drainage: Provide and maintain in proper working order all dewatering equipment required to remove water from the excavations and to keep the excavation bottoms stable until the work has been installed properly and will be unaffected by submersion. Where the excavation bottom is mucky or otherwise unstable because of ground water, lower the ground water level and stabilize the trench bottom by the use of bailing, pumps, or other suitable method. Where quicksand or other water bearing strata are encountered, install and connect the necessary number of well points with pumping equipment of sufficient capacity to prevent rise of water in the excavation.
 - 6. Bracing: Adequately brace excavation as required to protect personnel, adjacent structures, and adjacent property.
- C. Placing Manhole Sections
 - 1. Excavate the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6 inches beyond the manhole base.

2. Set base plumb and level, aligning manhole invert with pipe invert.
3. After the base section has been allowed to set for a period of not less than 24 hours, the precast manhole sections shall be placed thereon, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevation.
4. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the butyl rubber gasket directly against base of spigot. Leave protective wrapper attached until sealant is unrolled against spigot. Do not stretch. Overlap from side to side, not top to bottom.
5. Set risers and cones so that steps align above the effluent pipe connection, taking particular care to clean, prepare and seal joints.
6. After joining manhole sections, apply the butyl rubber joint tape around the outside perimeter of the joint.
7. Lift holes leaving less than 2 inches of wall thickness shall be plugged from the outside using a sand cement mortar. Lift holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8-inch-thick extending 2 inches beyond the penetration.
8. Set the manhole frames to the required elevation using no more than 12 inches of precast concrete grade rings, sealing all joints between cone, grade rings, and manhole frame with the butyl sealant rope and sheet.
9. A maximum of 1 concrete ring may be used to complete the precast manhole.
10. Perform the final finishing to the manhole interior by filling all chips or fractures greater than ½-inch in length, width or depth and depressions more than ½-inch deep in inverts with a high strength grout or SikaSet Plug. Do not fill the joints between the precast concrete sections. Clean the interior of the manhole, removing all foreign matter.

D. Manholes Installed on Existing Lines

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

E. Pipe Connections

1. For PVC pipe, a minimum of 3 pipe gaskets per pipe spaced 2 inches apart, a Kor-N-Seal Rubber Boot, or approved equal, with stainless steel bands shall be installed in the manholes as a waterstop.
2. The openings through which pipe enter the structures shall be completely and firmly filled with non-shrink mortar or otherwise constructed to ensure watertightness.

3.3 FIELD QUALITY CONTROL

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

END OF SECTION 33 05 61

SECTION 33 31 00.13
ABANDONMENT OF SEWER MAINS BY GROUTING

PART 1 - GENERAL

1.01 SCOPE

- A. Abandonment in place of existing sewers and force mains using flowable fill as shown on the Drawings. Flowable fill will be utilized when abandoning existing sewers and force mains underneath structures and sensitive areas and at the direction of the Engineer as field conditions dictate, or as specified on the Drawings.

1.02 SUBMITTALS

- A. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.
- B. At least 15 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

PART 2 - PRODUCTS

2.01 PLUGS

- A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C1107, Grade B ore.

2.02 FLOWABLE FILL REQUIREMENTS

- A. Flowable Concrete shall be in accordance with these specifications 03 30 00.01 Concrete for Utilities

2.03 BALLAST

- A. Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.
- B. Ballast Composition: Free of regulated waste material.

PART 3 - EXECUTION

3.01 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT

- A. Remove manhole frames and covers and castings from other existing pipeline structures. Deliver castings to nearest Owner's maintenance facility for future use. Alternatively, salvaged castings may be used upon approval by the Owner, for constructing new manholes on this project.
- B. Demolish and remove precast concrete adjustment rings and corbel section, or brick and mortar corbel and chimney, or other pipeline structures, to minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.
- C. Drain manholes and punch holes in manhole floors and walls prior to filling.
- D. Backfill:
 - 1. Paved Areas – back fill with crushed stone to existing road base course. Remaining base course, binder and finish coat to meet the standards of these specifications.
 - 2. Non-Paved Areas – back fill with crushed stone to within 12 inches below final grade. Remaining 12 inches shall be filled with suitable soil for producing vegetation, then seed and straw per these specifications.
- E. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.
- F. Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to the specification section for Excavation and Backfill for Utilities. Cut existing force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

3.02 CUTTING AND CAPPING OF MAINS

- A. Do not begin cut, plug, and abandonment operations until replacement sewer or force main, has been constructed and tested, all service connections have been installed, and main has been approved for use.
- B. Install plug, clamp, and concrete reaction block and make cut as directed by the Engineer.
- C. After main to be abandoned has been cut and capped, check for other sources feeding abandoned sewer main. If sources are found, notify the Engineer immediately. Cut and cap abandoned main at point of other feeds as directed by the Engineer.
- D. Plug or cap ends or opening in abandoned main in manner approved by the Engineer. Install concrete around cap and over pipe to ensure it is not penetrable by groundwater.

- E. Remove and dispose of surface identifications such as cleanouts. Clean-outs in improved streets shall be filled with concrete.
- F. Backfill excavations in accordance with Section 31 23 33 - Excavation and Backfill for Utilities.

3.03 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

- A. Have fill mix design reports and other submittals required by Paragraph 2.2 accepted by the Engineer prior to start of placement. Notify the Engineer at least 24 hours in advance of grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the Engineer. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.
- D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.
- E. Remove free water prior to starting fill placement.

3.04 EQUIPMENT FOR FLOWABLE FILL

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.05 INSTALLATION OF FLOWABLE FILL

- A. Abandon existing sewer lines and force mains underneath structures by completely filling sewer line with flowable fill.
- B. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

- D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.
- G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- H. Remediate placement of flowable fill which does not fill voids in sewer, in force main, and in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.
- I. Plug each end of force main being abandoned, if not filled with flowable fill.
- J. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
- K. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
- L. When using manufactured plug or cap, install fitting as recommended by manufacturer's instructions, to form water tight seal.
- M. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 23 33 - Excavation and Backfill for Utilities.
- N. Collect and dispose of excess flowable fill material and other debris in accordance with local requirements or as directed by the Owner.

3.06 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions as required by OSHA and applicable State and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to Work.

END OF SECTION 33 31 00.13

SECTION 33 31 11
GRAVITY SEWER PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

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

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE (DIP)

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

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

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- A. PVC pipe shall be manufactured in accordance with ASTM D3034 or ASTM F679 as applicable.
 - 1. PVC pipe sizes 8-inch to 15-inch shall have an SDR 26.
 - 2. PVC pipe sizes 18-inch and greater shall have a pipe stiffness of 115 psi.
- B. PVC material shall be 12454-B, as defined by ASTM D1784.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 - 1. Manufacturer's name or trademark.
 - 2. Manufactured date.
 - 3. Nominal pipe size.
 - 4. PVC compound used.
 - 5. ASTM material code designation.
 - 6. ASTM specification designation.
- D. Joints
 - 1. Joints for PVC pipe used in gravity sewer shall be push-on or restrained joint, as specified or shown in the Drawings.

2. Gaskets for push-on and restrained joints shall conform to ASTM F477.
3. Gaskets shall be factory installed and positively retained by means of a stainless steel, polypropylene, or PVC ring.
4. Push-on joints and restrained joints shall conform to ASTM D3212.

2.3 COUPLINGS FOR GRAVITY SEWER PIPE

A. Steel Shielding Coupling:

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

B. Flexible Couplings:

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

C. Ductile Iron Coupling:

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

2.4 WARNING TAPE AND UTILITY MARKER

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

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 DIP AND PVC PIPE INSTALLATION

- A. All pipe shall be installed in accordance with the Drawings, manufacturer's recommendations, and in the presence of the Inspector. Do not begin the backfilling of trenches until the pipe in place has been visually inspected by the Inspector. Pipe installation shall begin at the lowest elevation, unless otherwise approved by the Owner. PVC pipe installation shall be in accordance with ASTM D2321.
- B. Lower pipe, fittings, and appurtenances into trench by means of crane, slings, or other suitable tools and equipment in such a manner as to prevent damage to pipe materials, protective coatings, and linings. Do not drop or dump pipe into trenches.
- C. Lasers shall be used to install sewers to the line and grade indicated on the Drawings. Reference points for both line and grade shall be set at each manhole. Check for pipe alignment and grade after each joint has been made. Measure for grade at pipe the invert, not at the top of pipe.
- D. The Contractor shall stake check pegs at all manholes throughout the job. Check pegs midway between manholes and any other check point deemed necessary to assure accuracy of the equipment.
- E. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trench than the available dewatering and pumping facilities are able to dewater.
- F. Trench bottoms that are found to be unsuitable shall be stabilized as specified in section 31 23 16.01 – Excavation for Utilities.
- G. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed up grade, starting at the lower end of the grade and with the bells up grade. Ensure that the bottom of the pipe is in contact with bottom of trench for the full length of each section. Place sufficient pipe bedding material to secure pipe from movement before the next joint is installed. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

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

3.3 CONNECTIONS TO MANHOLES

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

3.4 SERVICE LATERALS

- A. Installation and reconnection of service laterals shall be in accordance with Section 33 31 30 – Sanitary Sewer Services.
- B. If the work consists of the construction of a sewer that is to replace an existing sewer, all of the existing service lines shall be kept in operation and connected to the new line.

3.5 SPECIAL INSTALLATIONS

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

3.6 POINT REPAIRS

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

3.7 TESTING

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

3.8 POST-CONSTRUCTION CCTV

- A. CCTV newly constructed sewer mains after backfill and prior to placing into service.
- B. May be used by Owner to determine acceptability of work performed.

- C. Shall be performed in accordance with Section 33 01 30 – Sewer Inspection, Cleaning, and Flow Control.

END OF SECTION 33 31 11

**SECTION 33 41 00
STORM SEWERS AND PIPE CULVERTS**

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered in this section shall include the furnishing and laying of precast concrete pipe or corrugated metal pipe with fittings as called for on the Drawings and specified, including trench excavation and backfill.

1.02 QUALITY ASSURANCE

- A. Each pipe shall be clearly marked as required by the governing ASTM standard specifications to show its class or gauge, date of manufacture, and the name or trademark of the manufacturer. Elliptical reinforced concrete pipe shall be clearly marked top and bottom and the minor axis clearly noted on the interior surface of the pipe.
- B. Any pipe or specials which have been broken, cracked, or otherwise damaged before or after delivery or which have failed to meet the required tests shall be removed from the site and shall not be used therein.

PART 2 - PRODUCTS

2.01 CORRUGATED METAL DRAINAGE PIPE

- A. Corrugated metal pipes shall conform to the latest revision of AASHTO M36, minimum 16 gauge.
- B. Joints for corrugated metal drainage pipes shall be the standard type single piece of corrugated coupling bands fabricated of the same material as the drainage structure. Coupling bands shall be fabricated according to AASHTO M 190, and the minimum band length shall be 12 inches.

2.02 BEDDING

- A. Bedding shall be constructed of a well graded, granular material that meets the requirements of AASHTO M145. Backfill beneath roadways shall be compacted granular material as used for bedding. Backfill shall be compacted to a minimum of 90 percent density per AASHTO T180.

2.03 PRECAST CONCRETE STRUCTURES

- A. Precast concrete sections shall consist of a flat slab top section, riser sections if necessary, and a base section conforming with the nominal dimensions as shown on the Drawings.

- B. Precast concrete sections shall be manufactured, tested and marked in accordance with the latest provisions of ASTM C 478.
- C. The minimum compressive strength of the concrete for all sections shall be 4,000 psi.
- D. The maximum allowable absorption of the concrete shall not exceed eight percent of the dry weight.
- E. The circumferential reinforcement in the riser sections and base wall sections shall consist of one line of steel and shall be not less than 0.17 square inch per lineal foot.
- F. The ends of each reinforced concrete riser section and the bottom end of the top section shall be so formed that when the risers and the top are assembled, they will make a continuous and uniform structure.
- G. Joints of the sections shall be of the tongue and groove type. Sections shall be joined using O-ring rubber gaskets conforming to the applicable provisions of ASTM C 443, latest revision, or filled with an approved preformed plastic gasket meeting the requirements of Federal Specifications SS-S-00210, "Sealing Compound, Preformed Plastic for Pipe Joints", Type 1, Rope Form.
- H. Each section shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.
- I. Manhole steps shall be installed in each section on 16-inch centers.
- J. Catch basins and area drains in unpaved, grassed areas shall have openings suitable for round bee hive grates. Additional catch basins shall be addressed on a case-by-case basis.
- K. All catch basins and area drains in unpaved, grassed areas shall have castings equal to Bouchard 2280 bee hive grates.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Excavation shall be performed in accordance with the requirements of Section 31 23 33 of these Specifications.

3.02 PIPE LAYING – CORRUGATED METAL PIPE AND PIPE ARCH

- A. Corrugated metal pipe or pipe arch shall be laid true to line and grade on a bed which is uniformly firm throughout its entire length.
- B. Pipes shall be laid only on a foundation which is substantially free of water.
- C. The ends of sections shall be fully and closely jointed according to applicable standards and true to lines and grades given. Each section or joint of pipe shall be securely attached to the

adjoining section or joint of pipe with connecting bands or other approved type of joint. The bands or other type of joint shall be tightly drawn or connected so as to form a rigid joint.

- D. Any breaks in the bitumen or treatment of bituminous coated pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally.
- E. The ends of pipe shall be rigidly supported to prevent any movement pending which might occur during the construction of end supports.
- F. Any pipe which is not in true alignment or which shows any settlement after laying or is damaged shall be taken up and re-laid at the Contractor's expense.

3.03 CASTINGS

- A. Cast iron frames shall be set accurately to line and finished elevation so that subsequent adjustments will not be necessary.
- B. Where inlets are constructed in paved areas or integral with curb and gutter, the top surface of the frame and grate shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement or curb and gutter.
- C. Frames shall be set in full cement mortar beds to match the finished concrete surface.

3.04 EXISTING UTILITIES

- A. All existing sewers, water lines, gas lines, underground conduits, telephone lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work shall be carefully protected by the Contractor from damage at all times. Where it is necessary for the proper accomplishment of the work to repair, remove and/or replace any such utility, the work shall be done as directed by the Engineer. No separate payment shall be made for removing and replacing and/or repairing damaged existing sewers, water, gas, electric, or telephone lines, or conduits, or other utilities, culverts, drains, or similar existing services or structures that are to remain in service. The removal, replacement and/or repair of these items shall be paid for in the unit price bid by the Contractor on other items of work. Similar repair and replacement of sidewalks, curbs, gutters, and pavements are provided elsewhere herein.

3.05 CLEANING

- A. After completing each section of the storm sewer or culvert, the Contractor shall remove all debris and construction materials and equipment from the site, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean, neat and serviceable condition in accordance with the requirements of the General Conditions of these Specifications.

END OF SECTION 33 41 00

V. NEW BUSINESS

N-a: Wastewater Regionalization Study-(Grant awarded notification \$ 3.3 M with a match of \$177,000) Open for discussion-**Updates Cannon/Cannon Representative**

: Alt. Water Supply: Open for discussion (schedule) Updates

N-b. Jan/Feb 2025 Meeting dates

VI. Continuing OLD Business

0-a: **WTP-Telemetry/Tank Project** - see #5-Supt Report

0-b: **WWTP:** Update on the following Directors Order/ City Council Update, CCI up-date-Open for Discussion

SEWER Rehab Projects:

Letter of REQUEST to TDEC requesting of delaying SHORT-TERM Improvements was APPROVED by Michael Landcaster, TDEC as long as effluent results are in compliance. see #4 Supt Report pertaining to WWTP

0-c: **Distribution System:** See #6 in Supt Report

0-d: **Collection System:**

- NWC is reviewing Public Identified issues/NWC side
- On-going

0-e: **Cross Connection: OPEN**

0-f: **Galvanized Pipe replacement/Eliminate Projects**

- **NEXT STEP:** NWC continue work to eliminate any galvanized in the system per TDEC
- **NEXT:** Engineers (with Board approval) -provide replacement specifications/design-(LSLI Grant Funds)
 - Hilltop Place (in-house project)
 - Dead-end of Oak Road (in-house project)
 - NWC work on (West Norris Road upgrade)

VII. REPORTS

To: Norris Water Commission Board

From: Tony Wilkerson, Waterworks Superintendent

Date: December 16 ,2024

RE: **R-a.- Waterworks Superintendent Report for October 2024**

Water Pumped MG/Sold/% loss—See attached

Sold to ACWA: Alley 637,500/Alley Rd 533,700/Reservoir Road 1,307,400 --- each location

1. **Water Budget**-see financial report see attached in packet
2. **Rainfall September _2.23"@Water Treatment Plant "- 47.75" inches YTD Source ok presently The 1.10" received 11-14-2024 -GOOD**
3. **Operations Building/Equipment Shed. -Clean**
4. **. WWTP-Non-Compliance (1)-in month of NOVEMBER 2024**
 - 11-14-24-2 hours ONLY- REASON-1.35" of rain fell**
 - a. Dailey Inspections (84 points to inspect) and Operations
 - i. Recorded Dailey on Log Book and Computer
 - ii. Dailey Testing performed
 - iii. Monthly Reports-NWC Emor/DMR/NDSP Report(3 reports-16 hrs)
 - b. **WWTP-Training-NOVEMBER 2024** Xan Ridenour in training at STP-Performing Very Well!!
 - c. **Press Sludge-__4_** times this month.
 - d. **Supernatant- __2_** times
 - e. **Pumped Aeration to Digester- _10_** times mth
 - Tons of sludge hauled-9.54
 - **Rain:- 2.33" inches of rainfall recorded at Wastewater Treatment Plant**
 - Ferm Zone-Dailey mixing/logging
 - Fill PT-190 /Bleach Barrel (chemical barrels-TP and filamentous protection)
 - Ground Maintenance-2 mth
 - EPA Nutrient Removal Case Study Project-Norris, TN-ON GOING each month and Operator Xan is collecting samples with Snelson. EPA sends cooler and bottles for the sampling process and pays postage.
 - **Instruments-PH/DO/ORP: replaced batteries-twice in the month-utilizing on going is the reason**
 - **Fermentation ZONE-** Introduced more RAS into the ZONE and less in Zone 1 of aeration
 - **PH Meter and Probe: (\$1500-\$2000) need-on order**

5. WTP-Water Plant:

- a. -Reports-Monthly-to TDEC completed (5 monthly-16 hrs) CN1119 Water Pumpage Data -entered into TDEC system monthly
- b. -Dailey Inspections conducted (7 days a week) morning-evening inspection (52 points of inspection each time entered the plant) (Sometimes up to 3 times of inspections daily)
- c. Dailey Testing conducted morning /evening

- i. Record Daily on Log Book and Computer
- d. – Samples- Bacteriological ,Lagoon, Nitrite (annual) and quarterly Samples collected
- e. -Backwashed Filters- 2 times this month-Requires 6 hours each BW. (coating)
 - i. -Kevin Jeffers-is training in the operations of the WTP/Distribution System
- f. Ground Maintance- 1 day this month and Reservoir Hill and Spring/Blowed leaves from around the tanks
- g. **Alarms: WTP-(2) Power Outage Alarm-11-10-24 (2am) 11-20-24 -NWC worked with CUB in identifying the area where trees fell on the main Line feeding the Water Plant- Overtime Required**
- h. **Raw Water Pump #2- NEW** – NWC Team assisted Tenn Asst. Electric in removing the RWP #2 to be taken in for repairs-Turn around time -3-4 weeks.
- i. **High Service Pump #2-Tenn Asst. Electric assisted NWC Team in repacking the sleeve-Supt. has requested cost to remove-take out of service-repair shaft VS new pump install. As**

6. Distribution System:

- a. -Read Meters/Rereads-4 day
- b.-Bact Samples-Collected 2-regular
- c.-Spring – checked 2 times this month
- d. -Service Calls- for the month of November 2024 (109) Qty
- e. Meter Pits: ACWA (Reservoir Road, Alley Rd x2), TVA and NDSP-READ DAILY
- f. 193 West Norris Road-Fire Hydrant wet tap, valve and fire hydrant installed-Good Job NWC TEAM!!
- g. Water Valve Inspection: COMPLETED
- h. METER PROGRAM: Changed out (23) Water Meters
- i. Seasonal Meters: Pulled ALL seasonal Meters- (9)
- j. SERVICE CALLS
- k. Check Meter for leak on customer:1 Misc. Calls-39
Check Pressure: 2 Read/leave On: 13
Meter Change Out: 23 TN811 47 :

7. Flushing Program: NWC Team flushed -Orchard Road, Dogwood Road- -West Circle , Cedar Place

8. Sewer Collection System:

- Sewer stoppages- Supt has a copy and will provide upon request

9.. Training/Health & Safety/Public Education

10.. **Equipment:** service trucks-check weekly

2025-Chev Service Truck-received

2015-checked-ok

2021 -GMC-checked -ok

2009- F150-checked-ok

1995 Dump truck-check weekly Issue-slave cylinder-have to have it checked-keeping fluid topped off-pending

Backhoe-OK

Sewer machine-check weekly

E48 Bobcat-Track hoe: OK

11. Administration: Calls/emails response-Field site inspection-Plants and operation, reports

Water Works Fund Balance Report

	2019-20	2020-21	2021-22	2022-23	2023-24	2023-24	2023-24	2023-24	2023-24	2023-24	2024-25	2024-25	2024-25	2024-25	2024-25	2024-25	2024-25		
	ADJ Totals	ADJ Totals	ADJ Actual	ADJ Actual	Jul Actual	Aug Actual	Sep Actual	Oct Actual	Nov Actual	Actual	Budget	Jul Actual	Aug Actual	Sep Actual	Oct Actual	Nov Actual	Actual		
Revenues																			
<i>Water Billing</i>	\$ 455,106	\$ 507,434	\$ 484,052	\$ 521,523	\$ 47,818	\$ 47,769	\$ 50,094	\$ 48,348	\$ 48,391	\$ 561,747	\$ 555,000	\$ 51,233	\$ 49,738	\$ 50,343	\$ 51,782	\$ 48,842	\$ 251,938	45.4%	
<i>Sewer Billing</i>	\$ 420,373	\$ 418,523	\$ 425,397	\$ 493,633	\$ 42,896	\$ 42,896	\$ 47,428	\$ 43,532	\$ 43,714	\$ 528,371	\$ 520,700	\$ 46,398	\$ 46,298	\$ 46,007	\$ 45,616	\$ 44,213	\$ 228,532	43.9%	
<i>Water Works Charges</i>	\$ 46,446	\$ 43,576	\$ 53,837	\$ 22,569	\$ 5,558	\$ 744	\$ 1,926	\$ 6,823	\$ 4,755	\$ 67,875	\$ 5,138,535	\$ 7,928	\$ 103,231	\$ 3,551	\$ 102,295	\$ 257,025	\$ 474,030	9.2%	
<i>Interest Income</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Total Revenues	\$ 921,925	\$ 969,533	\$ 963,286	\$ 1,063,371	\$ 96,272	\$ 91,409	\$ 99,448	\$ 98,703	\$ 96,860	\$ 1,157,993	\$ 6,214,235	\$ 105,559	\$ 199,267	\$ 99,901	\$ 199,693	\$ 350,080	\$ 954,500	15.4%	
Expenses																			
<i>Admin & General</i>	\$ 254,371	\$ 245,123	\$ 186,711	\$ 276,417	\$ 24,468	\$ 24,948	\$ 26,691	\$ 61,765	\$ 23,415	\$ 359,779	\$ 397,248	\$ 40,722	\$ 23,053	\$ 71,501	\$ 34,442	\$ 26,659	\$ 196,377	49.4%	
<i>Customer Billing</i>	\$ 13,996	\$ 11,335	\$ 12,849	\$ 16,453	\$ 14,765	\$ 2,383	\$ -	\$ -	\$ 1,821	\$ 26,778	\$ 21,000	\$ 179	\$ -	\$ -	\$ 73	\$ 6,738	\$ 6,990	33.3%	
<i>Wastewater Treatment & Disposal</i>	\$ 172,800	\$ 175,163	\$ 154,499	\$ 196,258	\$ 18,587	\$ 31,386	\$ 28,540	\$ 19,620	\$ 14,941	\$ 240,638	\$ 3,221,589	\$ 22,179	\$ 39,121	\$ 284,205	\$ 143,170	\$ 76,280	\$ 564,955	17.5%	
<i>Wastewater Collection</i>	\$ 29,325	\$ 34,139	\$ 177,102	\$ 50,248	\$ 1,001	\$ 22,999	\$ 4,423	\$ 7,479	\$ 3,502	\$ 173,695	\$ 2,172,198	\$ 7,876	\$ 14,212	\$ 4,397	\$ 4,082	\$ 4,989	\$ 35,556	1.6%	
<i>Water Transmission & Distribution</i>	\$ 61,579	\$ 95,431	\$ 108,268	\$ 59,283	\$ 2,921	\$ 5,379	\$ 12,812	\$ 30,662	\$ 9,409	\$ 143,469	\$ 199,641	\$ 13,296	\$ 6,969	\$ 21,236	\$ 8,967	\$ 15,961	\$ 66,429	33.3%	
<i>Water Purification</i>	\$ 111,894	\$ 108,789	\$ 122,416	\$ 213,445	\$ 17,325	\$ 25,516	\$ 13,526	\$ 13,356	\$ 23,397	\$ 204,834	\$ 219,145	\$ 20,565	\$ 25,988	\$ 20,876	\$ 13,872	\$ 22,750	\$ 104,051	47.5%	
Total Expenses	\$ 643,965	\$ 669,980	\$ 761,845	\$ 957,533	\$ 79,067	\$ 112,611	\$ 85,992	\$ 132,882	\$ 76,485	\$ 1,149,193	\$ 6,230,822	\$ 104,817	\$ 109,343	\$ 402,215	\$ 204,606	\$ 153,377	\$ 974,358	15.6%	
Balance	\$ 277,960	\$ 299,553	\$ 201,441	\$ 105,838	\$ 17,205	\$ (21,202)	\$ 13,456	\$ (34,179)	\$ 20,375	\$ 8,800	\$ (16,587)	\$ 742	\$ 89,924	\$ (302,314)	\$ (4,913)	\$ 196,703	\$ (19,858)		
Depreciation	\$ 98,000	\$ 104,004	\$ 107,316	\$ 95,740	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 95,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	0.0%
Operating Available Flow	\$ 179,960	\$ 195,549	\$ 94,125	\$ 10,098	\$ 17,205	\$ (21,202)	\$ 13,456	\$ (34,179)	\$ 20,375	\$ 8,800	\$ (111,587)	\$ 742	\$ 89,924	\$ (302,314)	\$ (4,913)	\$ 196,703	\$ (19,858)		
Beginning Fund Balance	\$ 728,258	\$ 908,218	\$ 1,103,767	\$ 1,197,892	\$ 1,207,990	\$ 1,225,195	\$ 1,203,993	\$ 1,217,449	\$ 1,183,270	\$ 1,207,990	\$ 1,216,790	\$ 1,216,790	\$ 1,217,532	\$ 1,307,456	\$ 1,005,142	\$ 1,000,229	\$ 1,216,790		
Ending Fund Balance	\$ 908,218	\$ 1,103,767	\$ 1,197,892	\$ 1,207,990	\$ 1,225,195	\$ 1,203,993	\$ 1,217,449	\$ 1,183,270	\$ 1,203,645	\$ 1,216,790	\$ 1,105,203	\$ 1,217,532	\$ 1,307,456	\$ 1,005,142	\$ 1,000,229	\$ 1,196,932	\$ 1,196,932		
Capital Outlays					\$ 625	\$ 23,635	\$ 9,511	\$ 16,706	\$ 9,250	\$ 176,636	\$ 5,213,735	\$ 2,721	\$ 34,209	\$ 280,723	\$ 127,019	\$ 68,629	\$ 513,301	9.8%	

NORRIS WATER COMMISSION Unaccounted for Water Report July 2024-June 2025

MONTH	WATER PUMPED	WATER SOLD/METERED	METERED FOR	FIRE DEPT. USAGE	FLUSHING	Tank Clean/Fill	Water BILL ADJ.	Water LOST	% LOST	# Cust.
			CONSUMPTION NOT SOLD							
July	8,244,000	7,091,800	644,800	20,000	460,000			47,400	0.57%	796
August	8,267,000	6,643,500	652,700		395,000			575,800	6.97%	
Sept.	7,908,000	6,993,800	680,800		130,000			103,400	1.31%	
Oct.	7,856,000	6,451,600	688,000		140,000			576,400	7.34%	
Nov.	7,308,000	6,385,600	686,600		70,000			165,800	2.27%	791
Dec.								0	#DIV/0!	
Jan.								0	#DIV/0!	
Feb.								0	#DIV/0!	
March								0	#DIV/0!	
April								0	#DIV/0!	
May								0	#DIV/0!	
June								0	#DIV/0!	
Total	39,583,000	33,566,300	3,352,900	20,000	1,195,000	0	0	1,468,800		

A B C D E F G H I J
 November 2024

West Norris Road-Valve
 West Circle-Valve 10,000
 Fire Hydrant/Deadend Flushing
 Garden Rd, West Norris Road, Laurel Place 50,000
 East Circle -water valve 10,000

Total 70,000

Tony Wilkerson
 Waterworks Superintendent