

Lyon and Ivy Road Storm Drainage & Utility Improvements



APPENDIX B

Technical Specifications

SECTION 024113 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of existing asphalt pavement, existing asphalt, concrete, existing concrete sidewalk and curb ramps, existing concrete curbs, and gutter, existing lumber, milling of existing asphalt, concrete channel and headwalls, existing construction debris, materials, and existing storage containers on site, and other exterior site items indicated or not indicated which interfere with the Work.
 - 2. Removal and/or relocation of existing underground utilities.
 - 3. Removal and disposal of existing sanitary sewer pipe, water pipe, storm drainage pipe and appurtenances and structures indicated.

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reset, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- C. Remove and Reset: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect items indicated to remain against damage and soiling. When permitted by the Engineer, items may be removed to a suitable, protected storage location and then cleaned and reinstalled in their original locations.

1.04 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, remove demolished materials from the site with further disposition at the Contractor's option.
- B. Storage or sale of removed items or materials on-site will not be permitted.

- C. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.05 SUBMITTALS

- A. Photograph or videotape, sufficiently detailed, existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the Work.
- B. Record drawings at Project closeout.
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions, if applicable.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: All work shall comply with Federal, State and Local laws and regulations concerning hauling and disposal of demolition debris.
- B. Notify the proper agencies prior to the start of work and obtain all necessary permits for this work.

1.07 PROJECT CONDITIONS

- A. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. However, minor variations may occur due to Owner's removal and salvage operations prior to the start of demolition work.
- B. The location of existing underground utilities indicated is approximate only. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated. Call "Call Before you Dig" at 1-800-632-4949 (811) prior to the start of demolition work for assistance in the location of existing underground utilities.
- C. Should charted, uncharted or incorrectly charted utilities be encountered during demolition, contact the Engineer immediately for instructions. Cooperate with Owner and utility companies to keep services and facilities in operation.
- D. Do not interrupt existing utilities serving facilities occupied and used by the Owner and others, except when permitted in writing by the Owner. Provide acceptable temporary utility service as required to maintain Owner's operations.

1.08 SCHEDULING

- A. Notify and coordinate any required relocation and/or removal of existing underground utilities, poles, meters or other above ground appurtenances with the appropriate utility company (i.e. power, telephone, cable and natural gas/propane) prior to the start of selective demolition work.

1.09 USE OF EXPLOSIVES

- A. Do not use explosives to perform selective site demolition work.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Call "Call Before you Dig" at 1-800-632-4949 (811) prior to the start of demolition work for assistance in the location of existing underground utilities. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated.
- B. Should uncharted or incorrectly charted existing utilities be identified, contact the Engineer immediately for instructions. Provide a scale drawing with the location of the uncharted or incorrectly charted utilities for use by the Engineer in preparing additional direction.
- C. Verify that utilities indicated as removed, abandoned and/or relocated have been disconnected and capped.
- D. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- E. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged and turned over to the Owner.

3.02 PROTECTION OF PERSONS AND PROPERTY

- A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

- B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- C. Barricade areas of demolition occurring as part of this work, and post with warning lights as required by authorities having jurisdiction.
- D. Protect structures, buildings, utilities, walks, pavements, existing vegetation and other facilities to remain from damage caused by settlement, lateral movement, undermining, washout and other hazards created by demolition operations.

3.03 POLLUTION CONTROLS

- A. Perform all work in accordance with the requirements of the latest edition of the North Carolina Erosion and Sediment Control Manual and those of the local Erosion Control official.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by the Work. Return adjacent areas to condition existing before start of selective demolition.

3.04 DEMOLITION OF EXISTING FACILITIES

- A. Concrete Pavement, Walks and Curbs
 - 1. Remove concrete pavement and walks to the nearest joint. Sawcut concrete if joints are not present adjacent to the area of demolition.
 - 2. Sawcut concrete along straight lines to a depth of not less than 2 inches. Break out remainder of concrete, provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or sawcut entirely through concrete.
- B. Asphalt Pavement, Driveways, and Milling
 - 1. Remove full depth asphalt within the limits indicated on the plans by sawcutting to the full depth of the pavement. Provide neat sawcuts at the limits of pavement removal indicated.
 - 2. Milling adjoining asphalt surface to a depth of 2" below the finished grade. Remove milled asphalt. Provide a drivable surface in milled areas where traffic will still have access.
- C. Utilities
 - 1. Coordinate the removal and/or relocation of existing utilities with the appropriate utility companies.
 - 2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and to local jurisdictional codes.

3. Provide adequate means of support and protection during demolition and other construction operations for existing utilities that are to remain in place. Repair utilities damaged by construction operations to the satisfaction of the utility owner.

D. Concrete Channel

1. Remove sections of concrete channel entirely, leaving intact concrete not indicated to be demolished around existing pipes.
2. Provide continuous operation of a pump-around to divert stream channel base flow, if necessary or in-channel controls to maintain flow in the channel. Submit pumping or channel demolish plan to the Owner for review and approval a minimum of one week prior to the pre-construction meeting.

E. Construction debris, materials, storage containers

1. Remove existing remaining construction debris, materials, and storage containers on site.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Do not burn demolished materials or debris.
- C. Transport and legally dispose of demolished materials off of Owner's property.

3.06 CLEANUP AND REPAIR

- A. Upon completion of demolition work remove all tools, equipment and demolition materials from site. Remove demolition work area protection and leave areas clean.
- B. Repair any demolition performed in excess of that required for the Project. Return elements of construction and surfaces to remain to the condition existing prior to the start of construction. Repair adjacent construction or surfaces soiled or damaged by demolition work.

END OF SECTION 024113

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Form accessories.
 - 4. Form stripping.
- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.

1.02 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
 - 5. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 6. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. American Society of Mechanical Engineers:
 - 7. ASME A17.1 - Safety Code for Elevators and Escalators.
- E. ASTM International:
 - 8. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 9. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
 - 10. WCLIB - Standard Grading Rules for West Coast Lumber.

1.03 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

- B. Submit engineered shop drawings and calculations for shoring wherever required. Drawings are to be sealed by a licensed Professional Engineer in the State of North Carolina. All shoring drawings and calculations are a delegated design task to be solicited, procured, and completed at the Contractor's expense. Structural Engineer of Record will review submitted drawings and calculations for general design criteria only.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Submit formwork and shoring shop drawings.
 - 2. Indicate the following:
 - a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Means of leakage prevention for concrete exposed to view in finished construction.
 - c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
 - d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
 - e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
 - f. Procedure and schedule for removal of shores.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347, ACI 301, ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.

1.06 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.01 WOOD FORM MATERIALS

- A. Plywood: Southern Pine species; sound undamaged sheets with clean, true edges.

- B. Lumber Forms:
 - 1. Application: Use for edge forms and unexposed finish concrete.
 - 2. Boards: 6 inches or 8 inches in width, shiplapped or tongue and groove, Southern Pine or Spruce Pine Fir. Surface boards on four sides.
- C. Plywood Forms:
 - 1. Application: Use for exposed finish concrete.
 - 2. Forms: Conform to PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
 - 3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8 inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.
 - 4. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4 inch thick.

2.02 PREFABRICATED FORMS

- A. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.
- B. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.
- C. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.03 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, galvanized metal, fixed length, cone type with waterproofing washer, one inch back break dimension, free of defects capable of leaving holes larger than 1 inch in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
 - 1. Manufacturers:
 - g. Arcal Chemical Corporation Arcal-80.
 - h. Industrial Synthetics Company Synthex.
 - i. Nox-Crete Company Nox-Crete Form Coating.
 - j. Substitution requests will be reviewed upon submission.

- E. Corners: Chamfer, rigid plastic type or wood; 1 x 1 inch size; maximum possible lengths.
- F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- G. Bituminous Joint Filler: ASTM D1751.
- H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- I. Water Stops: Polyvinyl chloride, minimum 2,200 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 8 inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Earth forms are allowed for shallow depth footings only. Earth forms are not permitted for grade beams, slab edges, or structural concrete (pedestals, retaining walls, etc) or footings with exposed edges.
- B. Formwork - General:
 - 2. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 3. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 4. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 5. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 6. Complete wedging and bracing before placing concrete.

- C. Forms for Smooth Finish Concrete:
 - 1. Use steel, plywood or lined board forms.
 - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full size sheets of form lines and plywood wherever possible.
 - 5. Tape joints to prevent protrusions in concrete.
 - 6. Use care in forming and stripping wood forms to protect corners and edges.
 - 7. Level and continue horizontal joints.
 - 8. Keep wood forms wet until stripped.
- D. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.
- E. Framing, Studding and Bracing:
 - 1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
 - 2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Construct beam soffits of material minimum of 2 inches thick.
 - 4. Distribute bracing loads over base area on which bracing is erected.
 - 5. When placed on ground, protect against undermining, settlement or accidental impact.
- F. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- G. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- H. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.
- I. Install chamfer strips on external corners as indicated on drawings.
- J. Do not reuse wood formwork more than two times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- H. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1 inch away from finished surface of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- J. Construction Joints:
 - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 - 4. Arrange joints in continuous line straight, true and sharp.
- K. Embedded Items:
 - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 - 2. Do not embed wood or uncoated aluminum in concrete.

3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

B. Openings for Items Passing Through Concrete:

1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

L. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not be permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer, or 72 hours after completion of concrete placement, whichever is longer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301 & ACI 318

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

B. Related Sections:

1. Section 03 10 00 – Concrete Forming and Accessories.
2. Section 03 30 00 - Cast-In-Place Concrete.

1.02 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:

1. A1064/A1064M-18 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C. Concrete Reinforcing Steel Institute:

1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, tie spacing, bent bar diagrams, bar arrangement, splices and laps, and supports for concrete reinforcement.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1. Submit certified copies of mill test report of reinforcement materials analysis.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, and ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.

1.05 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60, deformed billet bars, uncoated finish.
- B. Welded Plain Wire Fabric: ASTM A1064/A1064M; in flat sheets; unfinished.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel type; size and shape to meet Project conditions.

2.03 FABRICATION

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.
- B. Form standard hooks for 180 degree bends, 90 degree bend, and tie hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318.
- D. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
- B. Accommodate placement of formed openings.
- C. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.
 - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- D. Maintain concrete cover around reinforcement as indicated on Design Drawings.

3.02 ERECTION TOLERANCES

- A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

- B. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. Building frame members.
2. Supported slabs.
3. Slabs on grade.
4. Control, expansion and contraction joint devices.

B. Related Sections:

1. Section 03 10 00 – Concrete Forming and Accessories.
2. Section 03 20 00 - Concrete Reinforcing.

1.02 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

C. California Department of Health Services:

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

D. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories, and admixtures.
- C. Design Data:
 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required.
 2. Identify mix ingredients and proportions, including admixtures.
 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.07 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I/II.
- B. Normal Weight Aggregates: ASTM C33.
 - 1. Coarse Aggregate Maximum Size: 3/4 inches or in accordance with ACI 318.
- C. Light Weight Aggregates: ASTM C330
 - 1. Coarse Aggregate Maximum Size: 3/4 inches or in accordance with ACI 318.
- D. Water: ASTM C94; potable

2.02 ADMIXTURES

- A. Air Entrainment: Do not use for concrete flatwork.
- B. Chemical: ASTM C494/C494M.
 - 1. Type A - Water Reducing.
 - 2. Type B - Retarding.
 - 3. Type C - Accelerating.
 - 4. Type D - Water Reducing and Retarding.
 - 5. Type E - Water Reducing and Accelerating.
- C. Fly Ash: ASTM C618 Class F.
- D. Plasticizing and Retarding: ASTM C1017/C1017M, Type II.

2.03 ACCESSORIES

- A. Bonding Agent: Two component modified epoxy resin.
- B. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.

2.04 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D994; Asphalt impregnated fiberboard or felt, 1/2 inch thick.
- B. Sealant and Primer: Polyurethane type.

2.05 CONCRETE MIX

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride ion content in hardened concrete to 1.00 percent by weight of cement.
- D. Provide concrete to the following criteria:
 - 1. Compressive Strength (28 day): As listed in Schedule at end of this Section or as listed in other related Sections.
 - 2. Slump Limit: 4 inches maximum +/- 1".
 - 3. Slump Limit for concrete containing water-reducing or plasticizing admixtures: 5 inches maximum at point of discharge.
 - 4. Maximum Water/Cement Ratio: 0.45
 - 5. Air Content unless noted otherwise: 6 percent, plus or minus 1.5 percent.
 - 6. Slabs on ground- use normal weight (145pcf) concrete.
- E. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
 - 1. Do not use calcium chloride nor admixtures containing calcium chloride.
- F. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.

- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- C. Remove water from areas receiving concrete before concrete is placed.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301 and ACI 318.
- B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
- D. Deposit concrete at final position. Prevent segregation of mix.
- E. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- F. Consolidate concrete using mechanical vibration.
- G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- H. Place concrete continuously between predetermined expansion, control, and construction joints.
- I. Do not interrupt successive placement; do not permit cold joints to occur. Excessive placement interruption may result in the remedial repairs, including (but not limited to) removal and replacement of concrete elements at Contractor's expense at the Engineer's directive.
- J. Saw cut joints 4 to 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness (or 1 1/4 inch minimum).

3.04 CONCRETE FINISHING

- A. Finish concrete surfaces in accordance with ACI 301 and ACI 318.

3.05 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.
- C. Cure concrete in accordance with ACI 308.1.

3.06 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Perform field inspection and testing in accordance with ACI 318 code.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Provide approved mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
 - 3. See Drawings for additional testing requirements, including Special Inspections.
- F. Strength Test Samples:
 - 1. Sampling Procedures: ASTM C172.
 - 2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured. Field cure during cold weather concreting.
 - 3. Sample concrete and make one set of four cylinders for every 75 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
 - 4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
 - 5. Make one additional cylinder during cold weather concreting, and field cure.
- G. Field Testing:
 - 1. Slump Test Method: ASTM C143/C143M.
 - 2. Air Content Test Method: ASTM C173/C173M, ASTM C231.

3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.
6. Fresh unit weight for early sample.

H. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.
2. Test Acceptance: In accordance with ACI 318 code.
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.
5. Retain one cylinder for 56 days for testing when requested by Architect.
6. Dispose remaining cylinders when testing is not required.

- I. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.07 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon cure.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.
- C. Patch imperfections as directed by Engineer.

3.08 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.09 SCHEDULE - CONCRETE TYPES

- A. Footings: 4,500 psi 28 day normal weight concrete, non-air entrained, 4" slump. HRWR admixtures not permitted unless concrete is conveyed via pumps.
- B. Vertical concrete surfaces (i.e. retaining walls and head walls): 4,500 psi 28 day normal weight concrete, air-entrained ($6\pm 1.5\%$), 4" slump. HRWR admixtures not permitted unless concrete is conveyed via pumps.

END OF SECTION 033000

SECTION 10 0000 - CIPP LINER SPECIFICATIONS

PART 1 – GENERAL

1.01 SCOPE

- A. This practice describes the procedures for the reconstruction of pipelines and conduits (4 to 96-in. diameter) by the installation of a resin-impregnated, flexible tube which is inverted into the existing conduit by use of a hydrostatic head. The resin is cured by circulating hot water within the tube. When cured, the finished pipe will be continuous and tight-fitting. This reconstruction process can be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, process piping, electrical conduits, and ventilation systems.
- B. The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.
- C. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the Contractor to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.02 REFERENCED DOCUMENTS

- A. ASTM Standards:
 - 1. D 543 Test Method for Resistance of Plastics to Chemical Reagents
 - 2. D 638 Test Method for Tensile Properties of Plastics
 - 3. D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Material
 - 4. D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds
 - 5. D 1600 Terminology for Abbreviated Terms Relating to Plastics
 - 6. D 3839 Practice of Underground Installation of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
 - 7. F 412 Terminology Relating to Plastic Piping Systems
- B. NASSCO Standard
 - 1. Recommended Specifications for Sewer Collection Systems

1.03 TERMINOLOGY

- A. Definitions
 - 1. Definitions are in accordance with Terminology F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise specified.
- B. Cured-in-place pipe (CIPP)

1. A hollow cylinder containing a non-woven or a woven material, or a combination of non-woven and woven material surrounded by a cured thermosetting resin.
 - (a) Plastic coatings may be included. This pipe is formed within an existing pipe. Therefore, it takes the shape of and fits tightly to the existing pipe.

C. Inversion

1. The process of turning the resin-impregnated tube inside out by the use of water pressure or air pressure.

D. Lift

1. A portion of the CIPP that has cured in a position such that it has pulled away from the existing pipe wall.

1.04 SIGNIFICANCE AND USE

- A. The rehabilitation of conduits through the use of resin-impregnated tube inserted through the existing conduit. As for any practice, modifications may be required for specific job conditions.

1.05 MATERIALS

A. Tube

1. The tube should consist of one or more layers of flexible needled felt or an equivalent non-woven material, or a combination of non-woven and woven materials, capable of carrying resin, withstanding installation pressures, and curing temperatures.
 - (a) The tube should be compatible with the resin system used.
 - (b) The material should be able to stretch to fit irregular pipe sections and negotiate bends.
 - (c) The outside layer of the tube should be plastic coated with a material that is compatible with the resin system used.
2. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit.
 - (a) Allowance should be made for circumferential stretching during inversion.
3. The tube thickness shall be specified by the owner manufacturer for the proposed utilizing pipe conditions and engineering formulas listed in ASTM F 1216-93.

TABLE I
CIPP Initial Structural Properties
Minimum Value

Property	Test Method	psi	(Mpa)Minimum Value
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	400,000	(2,755)
Tensile Strength (for pressure pipes only)	D 638	3,000	(21)

B. Resin

1. A general purpose, unsaturated, styrene based, thermoset resin and catalyst system that is compatible with the inversion process should be used.
2. The resin must be able to cure in the presence of water and the initiation temperature for cure should be less than 180°F (82.2W).
3. The CIPP system can be expected to have as a minimum the initial structural properties given in Table 1.

1.06 INSTALLATION

A. Cleaning and Inspection

1. Confined Space Entry
 - (a) Prior to entering access areas such as manholes, and performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations.
2. Cleaning of Pipeline
 - (a) All internal debris should be removed from original pipeline.
 - (b) Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment (see NASSCO Recommended Specifications for Sewer Collection System Rehabilitation).
 - (c) Pressure pipelines should be cleaned with cable-attached devices or fluid-propelled devices as shown in AWWA Manual on Cleaning and Lining Water Mains, M28.
3. Inspection of Pipelines

- (a) Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by doted closed circuit television or man entry.
- (b) The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross- sectional area of more than 40%. These conditions should be noted so that they can be corrected.

4. Line Obstructions

- (a) The original pipeline should be dear of obstructions such as solids, dropped joints, protruding connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 40% that will prevent the insertion of the resin-impregnated tube.
- (b) If inspection reveals an obstruction that cannot be removed by conventional sewer leaning equipment, then a point repair excavation should be made to uncover and remove or repair the obstruction.

B. Resin Impregnation

- 1. The tube should be vacuum impregnated with resin (wet-out) under controlled conditions.
- 2. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter.
 - (a) The volume should be adjusted by adding 5 to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

C. Bypassing

- 1. If bypassing of the flow is required around the sections of pipe designated for reconstruction, the bypass should be made by plugging the line at a point upstream or the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system.
- 2. The pump and bypass lines should be of adequate capacity and size to handle the flow.
- 3. Services within this reach will be temporarily out of service.
 - (a) Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

D. Inversion

- 1. Using Hydrostatic Head
 - (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of hydrostatic head sufficient to fully extend it to the next designated manhole of termination point.

- (b) The tube should be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out.
- (c) At the lower end of the inversion standpipe, the tube should be turned inside out and attached to the standpipe so that a leak proof seal is created.
- (d) The inversion head should be adjusted to be of sufficient height to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
- (e) Care should be taken during inversion to not over-stress the felt fiber.

2. Top Inversion

- (a) An alternative method of installation is a top inversion. In this case, the tube is attached to a top ring and is inverted to form a standpipe from the tube itself or another method accepted by the engineer.

Note - The tube manufacturer shall provide information on the maximum allowable tensile stress for the tube.

3. Using Air Pressure

- (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point.
- (b) The tube should be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes side out.
- (c) As the tube enters the guide chute, the tube should be turned inside out.
- (d) The inversion air pressure should be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
- (e) Care should be taken during the inversion so as not to overstress the woven and non-woven materials.

Note - Suitable precautions should be taken to eliminate hazards to personnel in the proximity of the construction when pressured air is being used.

4. Required Pressures

- (a) Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube.
- (b) Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.
- (c) Should the pressure deviate from within the range of the minimum and maximum pressures, the installed tube shall be removed from the existing conduit.

E. Lubricant

1. The use of a lubricant during inversion is recommended to reduce friction during inversion.
2. This lubricant should be poured into the inversion water in the down tube or applied directly to the tube.
3. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

F. Curing

1. Using Circulated Heated Water

- (a) After inversion is completed, a suitable heat source and water re-circulation equipment are required to circulate heated water throughout the pipe.
 - (i) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.
 - (ii) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.
- (b). Water temperature in the line during the cure period should be as recommended by the resin manufacturer.
- (c). Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.
- (d). After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer.
 - (i) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the re-circulation of the water and cycling of the boiler to maintain temperature continues.
 - (ii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).
- (e). Required Pressures
 - (i) Before the curing begins, the pressure required to hold the flexible tube tight against the existing conduit shall be provided by the tube manufacturer.
 - (ii) Once the cure has started and dimpling for laterals is completed, the required pressure shall be maintained until the cure has been completed.
 - (iii) Should the pressure deviate more than 2.3 ft. of water (1 psi) from the required pressure, the installed tube shall be removed from the existing conduit.

- (iv) If required by the owner, a continuous log of pressure during cure shall be maintained.

2. Using Steam

- (a) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.
 - (i) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.
 - (ii) The temperature in the line during the cure period should be as recommended by the resin manufacturer.
- (b) The steam-generating equipment should be fitted with a suitable monitor to gauge the temperature of the outgoing steam.
 - (i) The temperature of the resin being cured should be monitored by placing gauges between the impregnated tube and the existing pipe at both ends to determine the temperature during cure.
- (c) Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.
 - (i) After initial cure is reached, the temperature should be raised to post-cure temperatures recommended by the resin manufacturer.
 - (ii) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the distribution and control of steam to maintain the temperature continues.
 - (iii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

G. Cool-Down

1. Using Cool Water After Heated Water Cure

- (a) The new pipe should be cooled to a temperature below 100°F(38°C) before relieving the static head in the inversion standpipe.
- (b) Cool-down may be accomplished by the introduction of cool water into the inversion standpipe water being drained from a small hole made in the downstream end.
- (c) Care should be taken in the release of head so that a vacuum will not be developed that could damage the newly installed pipe.

2. Using Cool Water After Steam Cure

- (a) The new pipe should be cooled to a temperature below 113°F(45°C) before relieving the internal pressure within the section.
- (b) Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.
- (c) Care should be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

H. Workmanship

- 1. The finished pipe should be continuous over the entire length of an inversion run.
- 2. If the CIPP does not fit tightly against the original pipe at its termination point(s), the space between the pipes should be sealed by filling with a resin mixture compatible with the CIPP.

1.05 SERVICE CONNECTIONS

A. Reinstatement

- 1. After the new pipe has been cured in place, the existing active service connections should be reconnected.
 - (a) This should generally be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a remote-control cutting device.

1.06 INSPECTION AND ACCEPTANCE

A. Final Inspection

- 1. The installation may be inspected visually if appropriate, or by closed-circuit television if visual inspection cannot be accomplished.
- 2. Variations from true line and grade may be inherent because of the conditions of the original piping.
- 3. No infiltration of groundwater should be observed.
- 4. All service entrances should be accounted for and be unobstructed.

PART 2 - PRODUCTS

2.01 Tube

- 1. The tube should consist of one or more layers of flexible needled felt or an equivalent non-woven material, or a combination of non-woven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures.

- (a) The tube should be compatible with the resin system used.
 - (b) The material should be able to stretch to fit irregular pipe sections and negotiate bends.
 - (c) The outside layer of the tube should be plastic coated with a material that is compatible with the resin system used.
- 2. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit.
 - (a) Allowance should be made for circumferential stretching during inversion.
- 3. The tube thickness shall be specified by the manufacturer for the proposed pipe conditions and engineering formulas listed in ASTM F 1216-93.
- 4. CIPP designs will not be accepted when the wall thickness of the CIPP liner is greater than 2 inches.
- 5. CIPP to be installed in a casing pipe or an uncased carrier pipe shall be designed for a Fully Deteriorated condition. A Partially Deteriorated design condition will only be accepted for CIPP of carrier pipe that is already within a casing pipe. All CIPP calculations must be signed and sealed by a licensed Professional Engineer.

TABLE I

CIPP Initial Structural Properties

Property	Test Method	Minimum Value	
		psi	(Mpa)
Flexural Strength	D 790	4,500	(31)
Flexural Modulus	D 790	400,000	(2,755)
Tensile Strength (for pressure pipes only)	D 638	3,000	(21)

2.02 ISOPHTHALIC CIPP RESIN (COR72-AT-470HT) OR APPROVED EQUAL

A. General

- 1. A general purpose, unsaturated, styrene based, thermoset resin and catalyst system that is compatible with the inversion process should be used.
- 2. The resin must be able to cure in the presence of water and the initiation temperature for cure should be less than 180°F (82.2W).
- 3. The CIPP system can be expected to have as a minimum the initial structural properties given in Table 1.

- B. COR72-AT-470HT is a physical property enhanced, promoted, thixotropic, corrosion resistant, unsaturated polyester resin for use in the manufacture of liner pipe using cured-in-place techniques. This resin has been tested according to ASTM D2990 for flexural modulus creep.
- a. Pass Corrosion Resistance requirements of ASTM D5813, F1216, and F1743.

LIQUID PROPERTIES			RESULTS	
Viscosity, Brookfield Model RV #4 Spindle @ 20 rpm, 77°F (25°C), cps			4.000-5,000	
Thixotropic Index			4.0-5.0	
Gel Time run in a 140°F (60°C) water bath, catalyzed with 0.75 phr of Perkadox 16 and 0.38 phr of Trigonox 42S *				
Gel Time, 130°F-150°F (54-66°C), min:sec			7:00-13:00	
Gel to Peak Exotherm Time, 150°F (66°C) to Peak Exotherm, min:sec			1:00-6:00	
Peak Exotherm			250-340°F (121-171°C)	
Non-Volatile Content, %			64.0-72.0	
Room Temperature Catalyzed Stability (RTCS), hours			>20	
Specific Gravity			1.24-1.30	
TYPICAL PROPERTIES				
Thickness	1/8 inch (3.2 mm) Casting		1/4 inch (6 mm) Laminate	
Construction	Not Applicable		CIPP Felt Laminate	
Flexural Strength, ASTM D790	11,900 psi	81 MPa	8,400 psi	58 MPa
Flexural Modulus, ASTM D790	7.87 x 10 ⁵ psi	5,430 MPa	7.33 x 10 ⁵ psi	5,060 MPa
Tensile Strength, ASTM D638	7,400 psi	51 MPa	5,000 psi	34 MPa
Tensile Modulus, ASTM D638	7.42 x 10 ⁵ psi	5,120 MPa	7.50 x 10 ⁵ psi	5,170 MPa
Tensile Elongation, ASTM D638	1.3 %	1.3 %	0.81 %	0.81 %
Barcol Hardness, 934-1 gauge, ASTM D2583	50	50	44	44
Heat Distortion Temperature, ASTM D648	230 °F	110 °C	— °F	— °C
* The gel time and reactivity will vary due to the type and concentration of Free Radical Initiator (catalyst), shop temperature, humidity, and type of fillers used. In order to meet your individual needs, consult our technical sales representative for assistance.				

PART 3 - EXECUTION

3.01 INSTALLATION

A. Cleaning and Inspection

1. Confined Space Entry

- (a) Prior to entering access areas such as manholes, and performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations.

2. Cleaning of Pipeline

- (a) All internal debris should be removed from original pipeline.
- (b) Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment (see NASSCO Recommended Specifications for Sewer Collection System Rehabilitation).

3. Inspection of Pipelines

- (a) Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television or man entry.
- (b) The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 40%. These conditions should be noted so that they can be corrected.

4. Line Obstructions

- (a) The original pipeline should be clear of obstructions such as solids, dropped joints, protruding connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 40% that will prevent the insertion of the resin-impregnated tube.
- (b) If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation should be made to uncover and remove or repair the obstruction.

B. Resin Impregnation

- 1. The tube should be vacuum impregnated with resin (wet-out) under controlled conditions.
- 2. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter.
 - (a) The volume should be adjusted by adding 5 to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

C. Bypassing

1. If bypassing of the flow is required around the sections of pipe designated for reconstruction, the bypass should be made by plugging the line at a point upstream or the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system.
2. The pump and bypass lines should be of adequate capacity and size to handle the flow.
3. Services within this reach will be temporarily out of service.
 - (a) Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

D. Inversion

1. Using Hydrostatic Head
 - (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of hydrostatic head sufficient to fully extend it to the next designated manhole of termination point.
 - (b) The tube should be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out.
 - (c) At the lower end of the inversion standpipe, the tube should be turned inside out and attached to the standpipe so that a leak proof seal is created.
 - (d) The inversion head should be adjusted to be of sufficient height to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
 - (e) Care should be taken during inversion to not over-stress the felt fiber.
2. Top Inversion
 - (a) An alternative method of installation is a top inversion. In this case, the tube is attached to a top ring and is inverted to form a standpipe from the tube itself or another method accepted by the engineer.

Note - The tube manufacturer shall provide information on the maximum allowable tensile stress for the tube.

3. Using Air Pressure
 - (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point.
 - (b) The tube should be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes side out.
 - (c) As the tube enters the guide chute, the tube should be turned inside out.

- (d) The inversion air pressure should be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
- (e) Care should be taken during the inversion so as not to overstress the woven and non-woven materials.

Note - Suitable precautions should be taken to eliminate hazards to personnel in the proximity of the construction when pressured air is being used.

4. Required Pressures

- (a) Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube.
- (b) Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.
- (c) Should the pressure deviate from within the range of the minimum and maximum pressures, the installed tube shall be removed from the existing conduit.

E. Lubricant

- 1. The use of a lubricant during inversion is recommended to reduce friction during inversion.
- 2. This lubricant should be poured into the inversion water in the down tube or applied directly to the tube.
- 3. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

F. Curing

1. Using Circulated Heated Water

- (a) After inversion is completed, a suitable heat source and water re-circulation equipment are required to circulate heated water throughout the pipe.
 - (i) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.
 - (ii) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.
- (b) Water temperature in the line during the cure period should be as recommended by the resin manufacturer.
- (c) Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature

sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.

- (d) After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer.
 - (i) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the re-circulation of the water and cycling of the boiler to maintain temperature continues.
 - (ii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).
- (e) Required Pressures
 - (i) Before the curing begins, the pressure required to hold the flexible tube tight against the existing conduit shall be provided by the tube manufacturer.
 - (ii) Once the cure has started and dimpling for laterals is completed, the required pressure shall be maintained until the cure has been completed.
 - (iii) Should the pressure deviate more than 2.3 ft. of water (1 psi) from the required pressure, the installed tube shall be removed from the existing conduit.
 - (iv) If required by the owner, a continuous log of pressure during cure shall be maintained.

2. Using Steam

- (a) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.
 - (i) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.
 - (ii) The temperature in the line during the cure period should be as recommended by the resin manufacturer.
- (b) The steam-generating equipment should be fitted with a suitable monitor to gauge the temperature of the outgoing steam.
 - (i) The temperature of the resin being cured should be monitored by placing gauges between the impregnated tube and the existing pipe at both ends to determine the temperature during cure.
- (c) Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.
 - (i) After initial cure is reached, the temperature should be raised to post-cure temperatures recommended by the resin manufacturer.

- (ii) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the distribution and control of steam to maintain the temperature continues.
- (iii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

G. Cool-Down

1. Using Cool Water After Heated Water Cure

- (a) The new pipe should be cooled to a temperature below 100°F(38°C) before relieving the static head in the inversion standpipe.
- (b) Cool-down may be accomplished by the introduction of cool water into the inversion standpipe water being drained from a small hole made in the downstream end.
- (c) Care should be taken in the release of head so that a vacuum will not be developed that could damage the newly installed pipe.

2. Using Cool Water After Steam Cure

- (a) The new pipe should be cooled to a temperature below 113°F(45°C) before relieving the internal pressure within the section.
- (b) Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.
- (c) Care should be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

H. Workmanship

- 1. The finished pipe should be continuous over the entire length of an inversion run.
- 2. If the CIPP does not fit tightly against the original pipe at its termination point(s), the space between the pipes should be sealed by filling with a resin mixture compatible with the CIPP.

END OF SECTION 100000

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees which may or may not include tree root pruning.
 - 2. Clearing and grubbing
 - 3. Removal of trees and other vegetation.
 - 4. Topsoil stripping.

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items indicated. Removal includes digging out and off-site disposing of stumps and roots.
- B. Tree Protection Zone: The area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.
- C. Topsoil: Friable, clay loam surface soil, found in varying depths.

1.04 MATERIALS OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

- A. Photograph or videotape, sufficiently detailed, existing conditions of trees, plantings and other improvements adjoining the construction that might be misconstrued as damage caused by the Work.

1.06 PROJECT CONDITIONS

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect existing improvements on adjoining properties and on Owner's property.
 - 2. Restore existing improvements damaged by clearing operations to their original condition.
- C. The conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. However, minor variations may occur due to natural occurrences prior to the start of clearing work.
- D. Do not commence site-clearing operations until erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.01 TREE PROTECTION FENCING

- A. Tree protection fencing shall conform to standard and specification 6.05 of the North Carolina Erosion and Sediment Control Manual.

PART 3 – EXECUTION

3.01 PROTECTION OF EXISTING TREES AND VEGETATION

- A. Install tree protection fencing as indicated. Erect and maintain a temporary fence around the drip line of individual trees or around the perimeter drip line of groups of trees to remain.
 - 1. Do not store construction materials, debris, topsoil or other excavated material within the tree protection zone.
 - 2. Do not permit vehicles or other equipment within the tree protection zone.
 - 3. Maintain tree protection zones free of weeds and trash.
- B. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.
- C. Provide protection for roots over 1-1/2 inch diameter that are cut during construction operations. Coat cut faces with emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

- D. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to Engineer.

3.02 SITE CLEARING

- A. General: Remove trees, shrubs, grass and other vegetation as required to permit installation of the Work. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of the Work.
- B. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation within the clearing limits indicated.
 - 1. Completely remove stumps, roots, and other debris.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.
- C. Selective Clearing: Clear areas to be disturbed within the Project limits of all ground covers, underbrush and trees less than 6-inches in diameter at breast height. Coordinate extent of material removed with Engineer.
 - 1. Remove trees that appear to be dying or weakening for any reason and at any point during construction up to and including Substantial Completion at the Engineer's direction.
- D. Tree Removal: Remove indicated trees 6-inches or larger from the Project limits.
 - 1. Completely remove stumps, roots, and other debris.
 - 2. Fill depressions caused by tree removal operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

3.03 TOPSOIL STRIPPING

- A. Remove heavy growths of grass from areas before stripping.
- B. Strip topsoil to whatever depths are encountered, but to a minimum of at least 4 inches.
- C. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other material.
 - 1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, concrete, construction debris, and other waste materials.

- D. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
- E. Temporarily stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.
 - 1. Do not stockpile topsoil within tree protection zones.
- F. Dispose of unsuitable topsoil in a legal manner off-site.

3.04 DISPOSAL OF WASTE MATERIALS

- A. Removal from Owner's Property: Remove waste materials generated by clearing operations from Owner's property and dispose of in a legal manner off-site.
 - 1. Remove waste materials and debris from the site in a manner to prevent spillage. Pavements and the area adjacent to the site shall remain free from mud, dirt and debris at all times.
 - 2. Clean up debris resulting from site clearing operations continuously with the progress of the work.

END OF SECTION 311000

SECTION 31 2000 - EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Refer to Section 31 1000 for topsoil stripping and Section 32 9200 for topsoil placement.

1.02 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
 - 2. Excavating, backfilling, and grading indicated and necessary for proper completion of the work including for structures.
 - 3. Subbase course for concrete walks and pavements.
 - 4. Subsurface drainage backfill for walls and trenches.
 - 5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.03 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated. Excavation for this project shall be considered Unclassified excavation. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices changes in the Work for Select Fill and Undercut Allotment.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

- E. Fill: Soil materials used to raise existing grades.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

- A. Product Data: For each type of the following manufactured products/fill materials required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
 - 4. Pit certification for select borrow.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches.
 - 2. Warning Tape: 12 inches long; of each color.
- C. Qualification Data: For qualified testing agency.
- D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698 and ASTM D 1557.

1.05 ADDITIONAL WORK

- A. Due to the unknown nature of the existing soils, additional excavation work may be required. Claims for concealed, unknown, or unanticipated subsurface conditions are limited to those circumstances where:
 - 1. Additional excavation work is required below the contract limits indicated to provide acceptable bearing for structures or pavements.
 - 2. Additional excavation work is required below the utility trench design elevations to provide acceptable bearing for the utility.

- B. The risks of concealed, unknown, or unanticipated subsurface conditions from existing ground surface to the design subgrade elevations in cut areas and to subsoil elevations in fill areas shall be included in the Contract Amount and shall not be considered as grounds for additional costs to the Contract. The risks of concealed, unknown, or unanticipated subsurface conditions below the elevations stated shall be considered as Additional Excavation.
- C. Payment for additional Work
 - 1. Additional excavation shall be counted toward the unit price allowances established in the Bid Form, namely Select Fill, Undercut and Backfill allotments. *The Owner reserves the right to negotiate said unit price allowances prior to the Award of Contract.*
 - 2. No payment will be made for unauthorized excavation.

1.06 EARTHWORK BALANCE ADJUSTMENTS

- A. Adjustments of grades may be allowed with prior written approval of the Owner's representative in order to accommodate shortfall or surplus of material that may occur. Should adjustments be allowed, maintenance of designed drainage patterns and required adjustments to drainage structures shall be a Contractor responsibility. **No additional payment will be made for these adjustments.**

1.07 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- B. Environmental Compliance:
 - 1. Comply with the requirements of the latest edition of the North Carolina Erosion and Sediment Control Manual for erosion control during earthwork operations.
 - 2. Comply with the permit conditions for all work performed within wetlands.
- C. Testing and Inspection Service: Owner may employ and pay for an independent Geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations. Cooperate with Owner's Geotechnical Engineer as required for testing and inspection of work. These services do not relieve the responsibility for compliance with Contract Document requirements.

1.08 PROJECT CONDITIONS

- A. Site Information: Data concerning subsurface materials or conditions have not been obtained for use in designing the project. Normal earth conditions have been assumed throughout.
 - 1. The accuracy or completeness of the data is not warranted or guaranteed by the Owner or the Engineer. The Owner and Engineer expressly disclaim any responsibility for the data as being representative of the conditions and materials that may be encountered.

- B. Bidders and interested parties (prior to receipt of bids) are encouraged to conduct their own soil and subsurface investigations, examinations, tests, and exploratory borings to determine the nature of the soil conditions underlying the project site. Contact the Owner's office to make an appointment to enter the site for the purpose of conducting your own investigation prior to bid.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Owner not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Owner's written permission.
 - 3. Existing utilities across or along the line of work are indicated only in an approximate location. Locate all underground lines and structures. Call "Call Before you Dig" at 1-800-632-4949 (811) prior to construction. If utilities are marked that are not shown on the plans, locate utility vertically and horizontally and provide information to Engineer. Repair and correct any damage to underground lines and structures.
- D. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permits/permission from Owner and authorities having jurisdiction.
 - 2. Follow the Maintenance of Traffic (MOT) as provided in the plans or as otherwise approved by the Owner.
- E. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.
- F. Do not commence earth moving operations until plant-protection measures are in place.
- G. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- H. Do not direct vehicle or equipment exhaust towards protection zones.
- I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

1.09 SAFETY

- A. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
- B. Operate warning lights as recommended by authorities having jurisdiction and governing regulations and standards.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- D. Work within the road right-of-way shall meet all requirements of the latest edition of the North Carolina Department of Transportation Work Area Protection Manual and be OSHA compliant.

PART 2 - SOIL PRODUCTS

2.01 MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve. Crushed concrete or asphalt pavement will be allowed dependent on gradation requirements.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Sand: ASTM C 33; fine aggregate.
- I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.
- L. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

2.02 GEOTEXTILES

- A. Non-woven Geotextile Construction Fabric (for joint wraps): ACF Environmental #35, or equivalent.

2.03 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - 1. Establish and maintain temporary drainage ditches and other diversions outside excavation limits and outside of the travel way to convey rain water, groundwater, channel water, tidal water, and water removed from excavations to collecting or runoff areas. Do not use utility trench excavations as temporary drainage ditches.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
- C. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, filter sacks, cofferdams, inflatable plugs, and other dewatering system components necessary to convey water away from excavations.
- D. Should any springs or running water be encountered in the excavation, notify the Engineer and provide discharge by trenches (or other acceptable means) and drain to an appropriate point of disposal. Provide temporary drainage facilities to minimize the flow of rainwater onto adjacent property. Repair any damage to property or to subgrade as a result of construction and/or dewatering (or lack thereof) operations at no additional cost to the Contract. If permanent provision must be made for disposal of water other than as indicated, the Contract price shall be adjusted.

3.03 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and/or rock, replace with satisfactory soil materials.
2. This site has historically be used as a construction laydown area and may have construction materials and debris mixed into the surface and subsurface soils that are included as unclassified excavation.

3.05 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Structures and Foundations: Do not disturb bottom of excavation intended for bearing surface. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to the details on the Plans, as approved by the City Forester, and under the direction of a Certified Arborist.

3.06 EXCAVATION FOR WALKS, GRAVEL DRIVEWAYS, AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit less than 36 inches in diameter (or span S2 for elliptical pipe or conduit). 18 inches each side of pipe or conduit equal to or greater than 36 inches in diameter (or span S2 for elliptical pipe or conduit). See NCDOT Road and Bridge Standards for clarification.
- B. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 1. Excavate trenches 8 inches deeper than bottom of pipe and conduit elevations required in rock or other unyielding bearing material to allow for bedding course.

C. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to required lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to the details on the Plans, as approved by the City Forester, and under the direction of a Certified Arborist.

3.08 EXCAVATION STABILITY

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.09 SUBGRADE INSPECTION

- A. Notify Owner's representative/Testing Agency when excavations have reached required subgrade.
- B. If Owner's representative/Testing Agency determines that unsatisfactory soil is present, notify Owner's representative/Engineer. Do not continue excavation without direction, then replace with compacted backfill or fill material.
- C. Proof-roll subgrade below pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's representative, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.

- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's representative, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavations under other construction, pipe, or conduit with approved material, or as directed by Owner's representative.

3.11 STORAGE OF SOIL MATERIALS

- A. Temporarily stockpile excavated materials acceptable for use as backfill and fill. Place, grade, and shape stockpiles for proper drainage. Cover to prevent windblown dust.
- B. Stockpile excavated materials away from edge of excavations. Do not store within the drip line of trees to remain.
- C. Ensure proper erosion and sediment control measure on all stockpile material; refer to section 31 2500 Erosion Control.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
 - 8. Any required geotextile is properly placed.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Place and compact fill material in layers to required elevations as follows:
 - 1. Under walks and pavements, use satisfactory material.
 - 2. Under ramps, use satisfactory material.
 - 3. Under steps, use satisfactory material.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill voids with satisfactory material while removing shoring and bracing.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, in accordance with plans.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Place and compact final backfill of satisfactory material to final subgrade elevation.
- F. Install warning tape directly above utilities, **12 inches** below finished grade, except **6 inches** below subgrade under pavements and slabs.
- G. Do not backfill trenches until any required testing and inspections have been completed and Owner's representative authorizes backfilling. Backfill carefully to avoid damage or displacement of pipe systems.

3.14 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
 - 3. Stockpile, spread, disc, harrow, pulverize, or otherwise work wet materials as necessary to meet the moisture requirements, or as otherwise approved by the Owner's representative. No additional payment will be made for drying operations.

- B. Where subgrade or layer of material or soil material must be moisture conditioned before compaction, uniformly apply water to surface of material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Maintain the moisture content of the structural fill materials to within 2% of the optimum moisture content until permanently covered.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **8-inches** in loose depth for material compacted by heavy compaction equipment, and not more than **4 inches** in loose depth for material compacted by hand-operated tampers.
- B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 and ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches** of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 - 2. Under walkways, scarify and recompact top **6 inches** below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top **6 inches** below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 0.1 foot.
 - 2. Grass Pavers: Plus or minus 0.1 foot.
 - 3. Walks: Plus or minus 0.1 foot.
 - 4. Pavements/gravel driveway: Plus or minus 0.05 foot.

- C. Protection of Graded Areas: Protect newly graded areas and areas of cut, fill and design/subgrade elevations from the actions of the elements and from deterioration as a result of construction operations and weather conditions (frost, rains, snow, sleet, hail, etc.). Repair any settlement or washing that occurs prior to or after acceptance of the Work. Fill to required subgrade levels any area where settlement occurs. Protect trees to remain, and, at all areas of the Site where construction operations are in progress, provide protection for the safety of occupants of the existing facilities.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 2. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 3. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698 and ASTM D 1557.

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner may choose to engage a qualified special inspector to perform the following special inspections; this condition is not always the case, and contractor will be notified in advance when Owner/Engineer chooses to exercise the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. The Owner may engage, and pay for, the services of a Geotechnical Engineer whose function shall be to afford complete engineering control by testing of the conditions of the placement of all structural fills under structures and pavement areas, and all compaction where required, and to observe the proof rolling of the pavement areas.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area, but no less than 3 tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Owner's representative; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312500 - EROSION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. The NCDEQ Erosion Control Manual, latest edition.
- C. The City of Fayetteville Stormwater Design and Construction Manual, latest edition.

1.02 SUMMARY

- A. This Section includes the installation, maintenance and removal of erosion control measures required for prevention of sediment leaving the project site.

1.03 EROSION AND SEDIMENT CONTROL PERMIT

- A. Apply for the Land Disturbing Permit
- B. Schedule a pre-construction conference on-site with the City and Engineer. Hold this meeting prior to the start of any construction activities.

1.04 SUBMITTALS

- A. Responsible Land Disturber registration information.
- B. Copies of the weekly Erosion Control Measure inspection reports. *These may be submitted at the monthly progress meetings.*

PART 2 - PRODUCTS

2.1 EROSION CONTROL PRODUCTS:

- A. Construction Entrance
 - 1. A graveled area or pad located at points where vehicles enter and leave a construction site, complying with the requirements of Standard and Specification 6.06 of the NCDEQ Erosion Control Manual.
- B. Silt Fence
 - 1. A temporary sediment control measure consisting of fabric buried at the bottom, stretched,

and supported by posts, complying with the requirements of Standard and Specification 6.62 of the NCDEQ Erosion Control Manual.

C. Storm Drain Inlet Protection

1. A sediment control barrier formed around a storm drain inlet by the use of standard concrete block and gravel, complying with the requirements of Standard and Specification 6.52 of the NCDEQ Erosion Control Manual.

D. Outlet Protection

1. A structure designed to control erosion at the outlet of a channel or conduit, complying with the requirements of Standard and Specification 6.41 of the NCDEQ Erosion Control Manual.

E. Temporary Seeding

1. Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas, complying with the requirements of Standard and Specification 6.10 of the NCDEQ Erosion Control Manual.

F. Permanent Seeding

1. Refer to Section 32 9200 "Turf and Grasses" for permanent seeding requirements.

G. Tree Protection

1. Practices to preserve and protect desirable trees from damage during project development, complying with the requirements of Standard and Specification 6.05 of the NCDEQ Erosion Control Manual.

H. Check Dam

1. A small temporary stone dam constructed across a drainage way complying with the requirements of Standard and Specification 6.83 of the NCDEQ Erosion Control Manual.

I. Compost Sock

1. Three-dimensional tubular sediment control and storm water runoff device complying with the requirements of Standard and Specification 6.66 of the NCDEQ Erosion Control Manual.

J. Silt Bag

1. Contractor to provide silt bag adequate for pump-around and dewatering operations. Contractor shall provide a submittal to Engineer for review.

PART 3 - EXECUTION

3.01 INSTALLATION OF EROSION CONTROL MEASURES

- A. Install all erosion and sediment control measures per the requirements of the NCDEQ Erosion Control Manual.
- B. Protect all points of construction ingress and egress to the site to prevent tracking of mud onto public streets. Provide temporary construction entrances at all points of access to the site.
- C. Protect all stockpile locations from sediment erosion and install per the NCDEQ Erosion Control Manual.
- D. Clear only those areas necessary for installation of the perimeter erosion control measures. The balance of the site shall not be cleared or otherwise disturbed until the perimeter erosion control measures are installed, functional, and approved by the City Inspector.
- E. Follow the construction sequence and install erosion control measures as indicated on the Drawings and as directed by the City Inspector.
- F. Install additional measures as necessary to prevent sediment from leaving the project site.

3.02 MAINTENANCE OF EROSION CONTROL MEASURES

- A. Maintain all erosion and sediment control measures per the requirements of the NCDEQ Erosion Control Manual.
- B. At a minimum, the following maintenance is required:
 - 1. Construction Entrance
 - a) Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2- inch stone.
 - b) After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
 - c) Immediately remove all objectionable materials spilled, washed, or tracked onto public roadways.
 - 2. Silt Fence
 - a) Inspect sediment fences at least once a week and after each rainfall. Make any required repairs immediately.
 - b) Should the fabric of a sediment fence collapse, tear, decompose, or become ineffective, replace it promptly.
 - c) Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.
 - d) Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been prop el stabilized.

3. Storm Drain Inlet Protection

- a) Inspect the barrier at least weekly and after each significant (½ inch or greater) rainfall and make repairs as needed.
- b) Remove sediment as necessary to provide adequate storage volume for subsequent rains.
- c) When the contributing drainage area has been adequately stabilized, remove all materials and any unstable soil, and either salvage or dispose of it properly. Bring the disturbed area to proper grade, then smooth and compact it. Appropriately stabilize all bare areas around the inlet

4. Temporary Seeding

- a) Reseed and mulch areas where seedling emergence is poor, or where erosion occurs, as soon as possible.
- b) Do not mow.
- c) Protect from traffic as much as possible.

5. Tree Protection

- a) Continue to care for the site until the new owner takes possession. Take these steps after all materials and equipment have been removed from the site:
 - (1) Remove tree protection zone fences.
 - (2) Prune any damaged trees. In spite of precautions, some damage to protected trees may occur. In such cases, repair any damage to the crown, trunk, or root system immediately.
 - (a) Repair roots by cutting off the damaged areas and painting them with tree paint. Spread peat moss or moist topsoil over exposed roots.
 - (b) Repair damage to bark by trimming around the damaged area as shown in Figure 6.05d, taper the cut to provide drainage, and paint with tree paint.
 - (c) Cut off all damaged tree limbs above the tree collar at the trunk or main branch. Use three separate cuts as shown in Figure 6.05d to avoid peeling bark from healthy areas of the tree.
 - (3) Continue maintenance care. Pay special attention to any stressed, diseased, or insect-infested trees. Reduce tree stress caused by unintended construction damage by optimizing plant care with water, mulch, and fertilizer where appropriate. Consult your tree expert if needed.
 - (4) Inform the property owner about the measures employed during construction, why those measures were taken, and how the effort can be continued

6. Permanent Seeding

- a) The absence of or an incomplete landscape management specification and/ or complete maintenance schedule shall constitute grounds for disapproval of the plans. Proper maintenance is critical for the continued stabilization once vegetative cover is established. Although maintenance strategies for different sites may be

similar, no two construction sites in North Carolina have been or will be able to be controlled or protected in identical ways. Variations in climate, topography, soils, available moisture, size, and many other conditions will dictate the maintenance methodology to be used.

- b) A detailed schedule of maintenance will be required on the plans. This schedule will illustrate how the initial planting will be maintained to assure immediate, short term and permanent protection. The schedule will address topics such as appropriate irrigation of plants during the early establishment phase, drought conditions, excessive rainfall, mulch replacement, supplemental seeding, supplemental soils tests, application of nutrients and amendments, control of competitive and invasive species, disease and insect control, and corrective maintenance, measures to address failure of vegetation to become established.
- c) Contractual responsibility for maintenance after initial establishment of vegetative cover will be provided on the plans, in the construction sequence and on the bid list for the project.
- d) Maintenance bonds and/or warranty guarantee may be required of the responsible party, especially for areas in or adjacent to environmentally sensitive sites such as wetlands, riparian buffers, floodplains, and waters of the State.

7. Check Dam

- a) Inspect check dams and channels at least weekly and after each significant (1/2 inch or greater) rainfall event and repair immediately. Clean out sediment, straw, limbs, or other debris that could clog the channel when needed.
- b) Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam. Correct all damage immediately. If significant erosion occurs between dams, additional measures can be taken such as, installing a protective riprap liner in that portion of the channel (Practice 6.31, Riprap-line and Paved Channels).
- c) Remove sediment accumulated behind the dams as needed to prevent damage to channel vegetation, allow the channel to drain through the stone check dam, and prevent large flows from carrying sediment over the dam. Add stones to dams as needed to maintain design height and cross section.

8. Compost Sock

- a) Inspect compost socks weekly and after each significant rainfall event (1/2 inch or greater).
- b) Remove accumulated sediment and any debris.
- c) The compost sock must be replaced if clogged or torn.
- d) If ponding becomes excessive, the sock may need to be replaced with a larger diameter or a different measure.
- e) The sock needs to be reinstalled if undermined or dislodged.
- f) The compost sock shall be inspected until land disturbance is complete and the area above the measure has been permanently stabilized.

9. Outlet Protection

- a) Inspect riprap outlet structures weekly and after significant (1/2 inch or greater) rainfall events to see if any erosion around or below the riprap has taken place, or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.
- C. Remove accumulated sediment as required and at appropriate intervals to maintain the effective function of all erosion control measures.
- D. Inspect, repair and remove accumulated sediment from erosion control measures following significant (greater than 1/2") rainfall events.
- E. If erosion control measures become clogged, causing the impoundment of water, restore the measures immediately. Pooled water poses a potential drowning hazard and shall be relieved immediately by either pumping (through an approved dewatering structure) or by removal of the blockage.

3.03 REMOVAL OF EROSION CONTROL MEASURES

- A. Remove all temporary erosion control measures following the stabilization of the site. Do not remove erosion control measures until authorized by the City Inspector.
- B. Topsoil, permanently seed, and stabilize areas occupied by erosion control measures.

END OF SECTION 312500

SECTION 314000 – SHEETING, SHORING, AND BRACING

PART 1 GENERAL

1.01 SCOPE

- A. This section specifies requirements for sheeting, shoring, and bracing of trenches and open excavations greater than 4 feet in depth.
- B. Where shoring, sheeting, bracing, or other supports are necessary, they shall be furnished, placed, maintained and, except as shown or specified otherwise, removed by the Contractor. The Contractor shall be responsible for the design and selection of methods in conformance with the design criteria as specified herein. Shoring, sheeting, and bracing shall be incidental to the work unless it is outside of trench areas and needed to protect existing structures as noted on the plans.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
NC/OSH	North Carolina Occupational Safety and Health Division
OSHANC	Occupational Safety and Health Act of North Carolina
NCBC	2012 North Carolina Building Code

1.03 DESIGN REQUIREMENTS

A. GENERAL:

The Contractor shall design sheeting, shoring, and bracing in accordance with OSHANC and best safety practices for the work environment. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable. Excavation support system shall control inflow

of groundwater and/or river water to suit the requirements of Section 02142 "Dewatering Systems" and Section 310000 "Earthwork" and the work to be performed.

- B. The design, planning, installation and removal of all sheeting, shoring, lagging and bracing shall be accomplished in such a manner as to create and support the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to that work.

1.04 SUBMITTALS

- A. INFORMATIONAL SUBMITTALS:

Excavation and trenching plan.

PART 2 – PRODUCTS (NOT USED)

PART 3 –EXECUTION

3.01 GENERAL

- A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

3.02 EXCAVATION AND TRENCHING PLAN – special cases as called for on the plans

- A. Trench excavation shall not be started until the excavation and trenching plan has been submitted to the Owner. Prepare excavation and trenching plan addressing following topics:
 - 1. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.
 - 2. Design assumptions and calculations.
 - 3. Methods and sequencing of installing excavation support.
 - 4. Proposed locations of stockpiled excavated material.
 - 5. Minimum lateral distance from the crest of slopes for vehicles and stockpiled excavated materials.
 - 6. Anticipated difficulties and proposed resolutions.
- B. Remove excavation support in a manner that will maintain support as excavation is backfilled.
- C. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.
- D. Remove excavation support in a manner that does not leave voids in the backfill.

3.03 TRENCHES

- A. For trench excavation exceeding 4 feet in depth, provide adequate safety system meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION 314000

SECTION 321216 - ASPHALT PAVEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving over prepared subbase.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt overlays.
 - 4. Asphalt surface treatments
 - a) Coal tar sealant

1.03 SUBMITTALS

- A. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- B. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.
- C. Traffic maintenance and Work Area Protection Plan: Submit a plan indicating sequencing and measures to be used for the maintenance and protection of traffic during operations within or immediately adjacent to existing roadways open to vehicular traffic. The Engineer and the City must approve this plan prior to commencement of work within the Right-of-Way.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Asphalt paving materials and installation shall conform to the requirements of the latest edition of the North Carolina Department of Transportation (NCDOT) Road and Bridge Specifications and Road and Bridge Standards.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum ambient temperature of 50 deg F (10 deg C), and when temperature has not been below 35 deg F (1 deg C) for 12 hours immediately prior to application.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.

1.06 TESTING AND INSPECTION

- A. Within the road Right-of-Way, City inspectors shall observe the asphalt placement. Coordinate the necessary inspection schedule with the City.

PART 2 - PRODUCTS

2.01 ASPHALT-AGGREGATE MIXTURE

- A. General: Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with the requirements of the NCDOT Road and Bridge Specifications and as recommended by local paving authorities to suit project conditions

2.02 ASPHALT MATERIALS

- A. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- B. Prime Coat: Asphalt emulsion prime conforming to NCDOT requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

- C. Notify Engineer in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.02 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. Utilize flagmen, barricades, warning signs and warning lights as required by the NCDOT.

3.03 PATCHING AND REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending a minimum of 6 inches (150 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt mix and, while still hot, compact flush with adjacent surface.
- B. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- C. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.
- D. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
 - 1. Allow tack coat to cure undisturbed before paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillage and clean affected surfaces.

3.04 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- C. Prime Coat: For asphalt sections less than 4" thick, apply uniformly over surface of compacted-aggregate base at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood surface. Allow prime coat to cure for 24 hours minimum.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use just enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

3.05 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.
 1. Place hot-mix asphalt base course in number of lifts and thickness indicated.
 2. Spread mix at minimum temperature of 225 deg F (107 deg C).
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide, except where infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt base course for a section before placing intermediate or surface courses.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.06 JOINTS

- A. Construct joints between old and new pavement, or between successive days work, to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 1. Clean contact surfaces and apply tack coat.
 2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
 3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
 4. Construct transverse joints as required by the NCDOT Road and Bridge Specifications.
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3.07 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and rerolling to required elevations.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve indicated density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 95 percent of reference laboratory density according to ASTM D 1559.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm. Surface course average density shall be 95 percent of reference laboratory density.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method. Edges adjacent to curbs and curb and gutter sections shall be flush with the edge of concrete.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.08 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
 2. Surface Course: 3/16 inch (3 mm).
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).
- C. Check surface areas at intervals as directed by Engineer.

3.09 ASPHALT PAVEMENT MILLING/PLANING WITH OVERLAY

- A. Asphalt overlay will take place over areas that are milled/planed where tying to existing pavement, as shown on the Plans. Planning depth shall be as required to match finish grade with a minimum 2" asphalt overlay. 2 inches of existing asphalt will be milled and paved with SM-9.5A asphalt surface course in conjunction with the final surface coarse of pavement over the full depth sections to provide a smooth connection from proposed to existing pavement surfaces.
- B. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
1. Allow tack coat to cure undisturbed before paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillage and clean affected surfaces.
- C. Follow Part 3.07 for compaction requirements and 3.08A.2 and 3.08B.2 and 3.08B.3 for installation tolerances.

3.10 FIELD QUALITY CONTROL

- D. Within the Right-of-Way, coordinate required inspections with the City.
- E. Testing Agency: Owner may engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- F. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with requirements.

END OF SECTION 321216

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydro-seeding

1.03 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.
- J. Landscaping Substantial Completion: Inspection by the City of Fayetteville Public Works Commission to ensure that all work encompassing this specification section and the contract documents is satisfactory to the City of Fayetteville. This inspection will precede the awarding of the project's substantial completion.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass seed. Include identification of source and name and telephone number of supplier.
 - 2. Certification of each seed mixture for native and bioretention seed mixture. Include identification of source and name and telephone number of supplier.
 - 3. For alternate seed request, submit request for approval of State-Certified alternate species.
 - 4. Submit seed manufacture's data on all seed mixtures.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- E. Material Test Reports: For standardized ASTM D 5268 topsoil existing native surface topsoil existing in-place surface soil and imported or manufactured topsoil. Copies of all testing results shall be submitted to the City of Fayetteville's Forester & Landscape Architect, and to the designated Public Works site inspector.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required initial maintenance periods.
 - 1. Recommended procedures for native mixtures and retention basin mixture to be established by seed supplier.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: For all turf/seed restoration work within the Right-of-Way OR less than 2,500-SF, the grass turf/seed installer and their Field Supervisor are NOT required to hold the memberships and Certifications from ANLA and Certified Turfgrass Professionals.
- B. For all grass establishment work outside the Right-of-Way OR greater than 2,500-SF, the planting should be performed by a qualified landscape Installer whose work has resulted in successful turf and meadow establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in turf installation.
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's field supervisor personnel assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with installation maintenance irrigation specialty area(s), designated CLT-Exterior.
 - b. Certified Turfgrass Professional designated CTP.
 - c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
 - 5. Pesticide Applicator: State licensed, commercial.
- C. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 - 2. The soil-testing laboratory shall be given soil sampling data, with depth, location, and number of samples taken to adequately represent each soil type on project site. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 - 3. Report suitability of tested soil for turf growth.
 - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

- b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- 4. If soil testing does not meet particle size distribution, physical and/or chemical properties specified; the soil shall be adjusted and re-tested, or another source secured, tested, and submitted for approval.
- E. Preinstallation Conference: Conduct conference at Project site with Client, Project Engineer, Landscape Architect and Contractor unless waived by all parties.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.07 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Seed Planting:
 - a. Bermuda – Unhulled: September 1st – April 30th
 - b. Bermuda – Hulled: May 1st – August 30th
 - c. Fescue: September 15th – November 1st and April 1st – May 1st
 - 2. Hydro-seeding: 'Savannah' Bermuda
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of **Landscaping Substantial Completion**.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

PART 2 - PRODUCTS

2.01 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
- C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed; refer to construction documents for appropriate seed type:
 - 1. Full Sun: Bermuda.
 - a. 100% 'Savannah' Bermuda
 - 2. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).
- D. Seed Species: Upon approval, alternate seeds maybe acceptable to match existing conditions of the site or adjacent sites:
 - 1. Submit request for approval of State-Certified alternate species.
 - 2. Submit seed manufacture's data on seed mix.

2.02 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.

2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 3. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
 - C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
 - D. Aluminum Sulfate: Commercial grade, unadulterated.
 - E. Perlite: Horticultural perlite, soil amendment grade.
 - F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
 - G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
 - H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
 - I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.03 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.04 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.05 PLANTING SOILS

- A. All soil mixing shall be performed at contractor's yard using appropriate soil mixing and shredding equipment of sufficient capacity to assure proper quality control. No mixing of soils shall occur at project location unless suitable portable equipment approved by the city forester & Landscape Architect is permitted. All soil testing shall be at the expense of the contractor:
- B. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Soluble salt level: less than 844ppm.
 2. Ratio of Loose Compost to Topsoil by Volume: 1:2.
 3. Ratio of Loose Sphagnum Peat to Topsoil by Volume: per soil test recommendations.
 4. Ratio of Loose Wood Derivatives to Topsoil by Volume: per soil test recommendations.
 5. Weight of Lime per 1000 Sq. Ft.: per soil test recommendations.
 6. Weight of Sulfur Iron Sulfate Aluminum Sulfate per 1000 Sq. Ft.: per soil test recommendations.
 7. Weight of Agricultural Gypsum per 1000 Sq. Ft.: per soil test recommendations.
 8. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft.: per soil test recommendations.
 9. Weight of Bonemeal per 1000 Sq. Ft.: per soil test recommendations.
 10. Weight of Superphosphate per 1000 Sq. Ft.: per soil test recommendations.
 11. Weight of Commercial Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
 12. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
- C. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
1. Supplement with another specified planting soil when quantities are insufficient.
 2. Mix existing, native surface topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - a. Ratio of Loose Compost to Topsoil by Volume: 1:2.
 - b. Ratio of Loose Sphagnum Peat to Topsoil by Volume: per soil test recommendations.
 - c. Ratio of Loose Wood Derivatives to Topsoil by Volume: per soil test recommendations.
 - d. Weight of Lime per 1000 Sq. Ft.: per soil test recommendations.
 - e. Weight of Sulfur Iron Sulfate Aluminum Sulfate per 1000 Sq. Ft.: per soil test recommendations.
 - f. Weight of Agricultural Gypsum per 1000 Sq. Ft.: per soil test recommendations.
 - g. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft.: per soil test recommendations.
 - h. Weight of Bonemeal per 1000 Sq. Ft.: per soil test recommendations.
 - i. Weight of Superphosphate per 1000 Sq. Ft.: per soil test recommendations.
 - j. Weight of Commercial Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
 - k. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
- D. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Surface Soil by Volume: 1:2.
 2. Ratio of Loose Sphagnum Peat to Surface Soil by Volume: per soil test recommendations.
 3. Ratio of Loose Wood Derivatives to Surface Soil by Volume: per soil test recommendations.
 4. Weight of Lime per 1000 Sq. Ft.: per soil test recommendations.
 5. Weight of Sulfur Iron Sulfate Aluminum Sulfate per 1000 Sq. Ft.: per soil test recommendations.
 6. Weight of Agricultural Gypsum per 1000 Sq. Ft.: per soil test recommendations.
 7. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft.: per soil test recommendations.
 8. Weight of Bonemeal per 1000 Sq. Ft.: per soil test recommendations.
 9. Weight of Superphosphate per 1000 Sq. Ft.: per soil test recommendations.
 10. Weight of Commercial Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
 11. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
- E. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.
1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
 2. Mix imported topsoil or manufactured topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - a. Ratio of Loose Compost to Topsoil by Volume: 1:2 per soil test recommendations.
 - b. Ratio of Loose Sphagnum Peat to Topsoil by Volume: per soil test recommendations.
 - c. Ratio of Loose Wood Derivatives to Topsoil by Volume: per soil test recommendations.
 - d. Weight of Lime per 1000 Sq. Ft.: per soil test recommendations.
 - e. Weight of Sulfur Iron Sulfate Aluminum Sulfate per 1000 Sq. Ft.: per soil test recommendations.
 - f. Weight of Agricultural Gypsum per 1000 Sq. Ft.: per soil test recommendations.
 - g. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft.: per soil test recommendations.

- h. Weight of Bonemeal per 1000 Sq. Ft.: per soil test recommendations.
- i. Weight of Superphosphate per 1000 Sq. Ft.: per soil test recommendations.
- j. Weight of Commercial Fertilizer per 1000 Sq. Ft.: per soil test recommendations.
- k. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: per soil test recommendations.

2.06 MULCHES

- A. Shredded or Chipped Mulch: Provide shredded or chipped hardwood, cypress or cedar wood mulch for use around trees, shrubs and other plants as designated in the Contract Documents. Chipped wood mulch is to be substantially free of mineral, organic or vegetative matter other than wood. The mulch is to have no more than one calendar year between the time of cutting and shredding or chipping and the time of application to the current project.

2.07 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.08 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
- C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner and replace with new planting soil.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply superphosphate fertilizer directly to subgrade before loosening.

2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply superphosphate fertilizer directly to surface soil before loosening.
 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Owner's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- 3.04 PREPARATION FOR EROSION-CONTROL MATERIALS
- A. Prepare area as specified in "Turf Area Preparation" Article.

- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.05 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 8 lb/1000 sq. ft..
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.06 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 4000-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
 - 3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 2000-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 2000 lb/acre in opposing direction from the first application.

3.07 TURF RENOVATION

- A. Renovate existing turf.
- B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

- J. Apply seed and protect with straw mulch and sod as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.08 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from **contractor supplied sources** and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow Bermuda grass to a height of 1 1/2 to 2 inches.
 - 2. Mow Kentucky bluegrass, annual ryegrass and chewings red fescue to a height of 1 1/2 to 2 inches.
 - 3. Mow Fescue to a height of 3 – 3 1/2 inches.
- D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.09 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Owner:

1. Satisfactory Turf: All turf must be installed and have been **maintained a minimum of 60 days** prior to acceptance.
 2. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory. Consider adding weed-control requirements during meadow establishment. Also consider adding a single fall mowing to a height of 4 to 6 inches (100 to 150 mm) if landscape Installer is required to maintain meadow during fall season.

3.10 PESTICIDE APPLICATION

- C. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- D. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- E. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- F. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- G. Remove nondegradable erosion-control measures after grass establishment period and approval/release by Owner's Erosion and Sediment Control Inspector.

PART 4 - INSPECTION AND ACCEPTANCE

4.01 LANDSCAPE SUBSTANTIAL COMPLETION

- A. The contractor shall perform all necessary weeding, mowing and trimming, and shall replace sections larger than 1 square foot that are bare or otherwise damaged.
- B. City of Fayetteville Public Works Commission shall inspect all work and materials for the Landscape Substantial Completion upon written request by the Contractor. The request shall

be received at least ten (10) calendar days before the anticipated date of inspection and sent to **City of Fayetteville Public Works Commission.**

- C. Upon correction and/or replacement of all substandard work and materials by the Contractor, the Owner shall issue a **Project Certificate of Substantial Completion**. The responsibility for obtaining the overall **Project Certificate of Substantial Completion** rests with the Contractor. Progress payments may be withheld unless the Contractor obtains the **Project Certificate of Substantial Completion**.
- D. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when written approval is given to the Contractor to incrementally complete the work. Acceptance and use of such areas by the Owner shall not waive any of the provisions of this Contract.

4.02 LANDSCAPE INSPECTION, GUARANTEE AND REPLACEMENT

- A. Landscape Inspection: Inspection of the work to determine its completion for beginning of the Landscape Guarantee and Maintenance Period will be made by the Owner upon request for such inspection submitted by the Contractor at least (10) days prior to the anticipated date. ALL SEEDED AREAS MUST BE ALIVE AND HEALTHY.
- B. After inspection, the Owner will notify the Contractor of the date of the beginning of the Landscape Guarantee and Maintenance Period by issuing a notice of Acceptance, or in the event of any deficiencies, of the requirements for beginning the Landscape Guarantee and Maintenance Period.
- C. Landscape Guarantee and Replacement: All seeded areas shall be guaranteed to be alive and healthy as determined by the Owner at the end of Guarantee and Maintenance Period. The Guarantee and Maintenance Period shall extend for a period of one (1) full calendar year from the date of Notice of Acceptance. The Contractor shall replace, in accordance with the drawings and specifications, any area that dies, or in the opinion of the Owner, is in an unhealthy or unsightly condition throughout the Guarantee and Maintenance Period.
- D. Re-seeding shall occur within the planting season following the death or rejection of any previously seeded areas. All costs incurred shall be borne by the Contractor. Seeding procedures shall comply with the requirements specified above. Newly seeded areas shall also be guaranteed to remain alive and healthy for one (1) full calendar year from time of seeding. The Guarantee and Maintenance Period for replacement seed shall begin on the date of re-seeding.
- E. Inspections shall be made at the discretion of the owner during the Guarantee and Maintenance Period to determine that maintenance work is being performed in accordance with the Contract. The Contractor shall accompany the Owner on these inspections.

4.03 FINAL ACCEPTANCE

- A. At the end of the Guarantee and Maintenance Period the City of Fayetteville Public Works Commission shall inspect all guaranteed work for Final Acceptance upon written request of the Contractor. The request shall be received at least ten (10) calendar days before the anticipated date for Final Inspection and sent to City of Fayetteville Public Works Commission.
- B. If the Owner's inspection reveals that the Contractor has satisfactorily completed the requirements of all the contract documents, the Owner shall issue a Certificate of Final Acceptance.

END OF SECTION 329200

SECTION 329300 – PLANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents and Drawings apply to the work of this section.

1.02 SUMMARY

- A. Work consists of furnishing, delivering, relocating, and planting trees, shrubs and other plant types as indicated on the plans. Work including all excavation and planting operations, plant establishment operations, disposal of waste and other incidentals needed to complete planting work. This Section includes the following:
 - 1. Plant Materials
 - a. Trees
 - b. Shrubs
 - c. Other Plant Materials
 - d. Initial Maintenance of Landscape Materials
 - 2. Topsoil
 - 3. Inorganic Soil Amendments
 - 4. Organic Soil Amendments
 - 5. Fertilizer
 - 6. Stakes and Guys
 - 7. Mulch
 - 8. Anti-desiccant
 - 9. Herbicides

1.03 SUBMITTALS

- A. Installer's Qualifications: Provide a list, with references, of the past three projects of similar scope. Provide proof of insurance papers, business license, and legal status of employees.
- B. Product Data: For each type of product indicated.
- C. Planting Schedule:
 - 1. Typewritten plant installation schedule.

2. Once accepted, revise dates only as approved in writing and submitted to Landscape Architect.
- D. Maintenance Schedules: Typewritten instructions recommending procedures for maintenance of landscape work for one full year. Submit prior to completion of project.
- E. Topsoil Amendment Plan:
 1. Provide copy of topsoil testing report from certified testing laboratory.
 2. List of amendments proposed including application rates.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed planting projects similar in size and complexity to this project. The installer's primary business (defined as a minimum of 60 percent of total billings) shall be exterior plant installation.
- B. Pre-installation Conference: Conduct conference at project site.
- C. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the project site when exterior planting is in progress.
- D. Exterior Plant Materials:
 1. Plant Materials: Use existing on-site plant materials, as noted on the Plan for landscape work. All plants shall be protected, removed, and relocated as listed on the Plan to locations as approved by the Owner.
 2. Source: All plants shall be taken from on-site, within the project limits.
 3. If specified landscape material is damaged, or unsuitable for relocation, submit proof to Owner, together with proposal for use of equivalent material.
 4. Inspection of Plant Materials: The Owner's representative may inspect plant materials on site before planting for compliance with requirements for genus, species, variety, size, and quality. Owner retains right to further inspect trees for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials:

1. Deliver packaged materials in original, unopened and undamaged containers showing weight, analysis and name of manufacturer.
2. Protect materials from deterioration during delivery and while stored at site.

B. Exterior Plant Materials

1. Protect bark, branches, and root systems from sun scald, drying, seating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during removal. Do not drop exterior plants during removal.
2. Relocation: Cover plants transported on open vehicles with a protective covering to prevent windburn. Remove and relocate exterior plant materials after preparations for planting have been completed and plant immediately. If planting is delayed more than six (6) hours after delivery, set trees in shade, protect from weather and mechanical damage, and keep roots moist and free from frost.
3. Balled and burlapped plants shall be dug so as to retain as many fibrous roots as practicable and shall come from soil which will form a firm ball. The soil in the ball shall be the original and undisturbed soil in which the plant has been grown. The plant shall be dug, wrapped, transported and handled in such manner that the soil in the ball will not be loosened to cause stripping of the small and fine feeding roots or cause the soil to drop away from such roots.
4. Balled and burlapped material shall be freshly dug. If trees are stored, untie and set vertically.
5. Handle planting stock by root ball strapping.

1.06 PROJECT CONDITIONS

- A. Examine the subgrade, verify the elevations and observe the conditions under which work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate as required.
- C. Protect existing utilities, paving and other facilities from damage caused by landscaping operations. When conditions detrimental to plant growth are encountered notify Owner's representative before planting.
- D. Coordination with Lawns: Install plant materials after finish grades are established and before planting lawns, unless otherwise acceptable to the Owner's representative.
 1. When planting exterior plants after lawns, protect lawn areas and promptly repair damage caused by planting operations.
- E. Provide all necessary safeguards for the protection of all planted areas until Final Acceptance.
- F. Planting Restrictions: Plant during one of the following periods.

1. Spring Planting: Unfrozen soil conditions March 1st - June 1st.
 2. Summer Planting: June 1st - September 15th with approved irrigation system.
 3. Fall Planting: September 15th - November 1st or until frozen soil conditions prevent work.
- G. Layout: Installer shall coordinate with Engineer and Owner's representative for approval of bed and planting layout.

1.07 WARRANTY

- A. Warranty exterior plant materials for a period of one (1) year after date of Final Acceptance against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Contractor's control.
- B. It shall be the Contractor's responsibility during the warranty period to provide written notice of any maintenance practice to the Owner which in their opinion will affect the guarantee if not remedied promptly. The Engineer will render an opinion of the conflict if necessary.
- C. Dead and unsatisfactory plants (more than 25 percent dead or dying) shall be promptly removed from the project. Make replacements of all dead or unsatisfactory plants in early spring/fall following installation meeting original specification. Replacements of dead or unsatisfactory plants should again be made prior to the expiration of the warranty period at the Installer's expense.

1.08 MAINTENANCE

- A. The Contractor is responsible for maintaining all exterior plant material until Final Acceptance. The Owner is responsible for maintaining all exterior plant material through the warranty period according to the submitted Maintenance Schedule.
- B. All stakes and guy wires shall be removed by Installer one year (12 months) after planting.

PART 2 - PRODUCTS

2.01 EXTERIOR PLANT MATERIALS

- A. Utilize existing plant materials.

2.02 STAKES AND GUYS

- A. Stakes: Oak Stakes shall be used.

- B. Guys: Twelve (12) gauge galvanized wire and rubber hose shall be used.

2.03 WATER

- A. Free of substances harmful to plant growth. Hoses or other methods of application furnished by Contractor.

2.04 MISCELLANEOUS PRODUCTS

- A. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Herbicides: Herbicide shall be an EPA-approved chemical to control and prevent re-growth of undesirable vegetation. The herbicide shall be approved for type and rate of application by the Landscape Architect before use.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing plants from damage caused by planting operations.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Plant Materials.
 - 1. Lay out individual tree locations. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's or Client's acceptance of layout before planting. Make minor adjustments as required.
- D. Anti-desiccant: Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again two (2) weeks after planting.

3.03 PLANTING BED ESTABLISHMENT

- A. Loosen subgrade of planting beds to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off of the Owner's property.
 1. Apply fertilizer directly to sub-grade before loosening.
 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
- B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.04 TREE PLANTING

- A. Set all plant materials plumb and in center of pit or trench.
 1. B&B Plants: Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Assure proper elevation with root flare above finished grade prior to setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Remove injured roots by cutting cleanly, do not break. Place native soil around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots. Tamp final layer of backfill. Water again after placing and tamping final layer of native soil.
 3. Dish top of backfill creating a water well. Edge for turf prior to compost and mulch application.
 4. Place 1 inch average thickness of compost extending 12 inches (300 mm) beyond edge of planting pit or trench.
 5. Apply 2-3 inch average thickness of organic mulch over compost layer. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.05 TREE PRUNING

- A. Prune, thin, and shape trees as indicated.

3.06 CLEANUP AND PROTECTION

- A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition. All reasonable precautions shall be taken to avoid damage to existing structures, utilities, signs, pavements, and plants. When planting in an area has been completed, the area shall be thoroughly cleaned.
- B. Protect exterior plants from damage due to landscape operations, operations by other Installer's and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.07 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 330596 – VIBRATION MONITORING

PART 1 GENERAL

1.01 GENERAL:

- A This Section specifies vibration monitoring related to the Work shown on the Contract Drawings and as specified herein. Vibration monitoring shall measure, record, and analyze the vibration levels as specific locations within the construction site.
- B The Contractor shall furnish all labor, material, equipment, and incidentals required for vibration monitoring.
- C Related Sections: The work of the following Sections is listed in this Section. Other Sections, not referenced below, may also be related to the proper performance of this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.
 - 1. Section 02200: Earthwork
 - 2. Section 02211: Rock Excavation

PART 2 PRODUCTS

- 2.01 The contractor shall provide manual or remotely operated portable seismograph monitoring equipment that continuously monitors construction vibration. The equipment shall include a triaxial geophone and an overpressure microphone to record the vibrations. Equipment to monitor transient vibration pulses shall collect data continuously over long periods of time and record peak velocity data at regular intervals. For manual equipment a trained technician shall review and verify that the threshold values are not exceeded, at least twice daily during vibration monitoring operations. Additionally the equipment shall be set to sound an alarm to notify on site construction personnel when the threshold value has been exceeded. The equipment shall be set at 1.92 in/sec peak particle velocity (PPV) with a threshold set at 0.5 in/sec (PPV).

PART 3 EXECUTION

3.01 GENERAL

- A Notify the Engineer at least one week in advance of beginning any vibration monitoring work so that placement of monitoring equipment can be reviewed prior to work beginning in close proximity to existing structures.

3.02 MONITORING LOCATIONS

- A Vibration monitoring is to be performed as determined necessary by the contractor to ensure no damage occurs to adjacent structures.

3.03 OPERATION PROCEDURES

- A Start and complete work in order or precedence as established by the latest approved project schedule.
- B The City shall be notified if the threshold value is exceeded at any time during the construction contract and the contractor shall stop work immediately. The contractor and City shall agree on a solution to the construction work causing the vibrations prior to work commencing.
- C A report shall be prepared by qualified professional analyzing and evaluating the results of the vibration monitoring for the project. The report shall be submitted to the City of Fayetteville.

END OF SECTION 330596

SECTION 334100 - STORM DRAINAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

1.02 SUMMARY

- A. This Section includes the storm sewerage system piping and structures.

1.03 SUBMITTALS

- A. Product data for:
 - 1. Concrete pipe
 - 2. Frames and covers and trash grates
- B. Certification, signed by material and contractor, that standard precast and cast-in-place concrete storm drainage manholes, junction boxes, drop inlets, curb inlets, headwalls, outlet structures, and endwalls comply with City and/or NCDOT standards and specifications.
- C. NCDOT approved job mix for bedding stone.
- D. Shop Drawings for:
 - 1. Standard and Non-standard precast or cast-in-place storm drainage structures.
- E. Record drawings of installed storm sewerage system.

1.04 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm sewer systems.
- B. Utility Compliance: Comply with state and local regulations and standards pertaining to storm sewerage systems.
- C. All materials shall be new and free of defects (i.e. pipe shall not have chipped spigots or bells).

1.05 PROJECT CONDITIONS

- A. Site Information: Perform site surveys, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

- B. Locate existing structures and piping to be removed and abandoned/capped.
- C. Existing Utilities: Do not interrupt existing storm sewer operations except after notifying the City not less than 48 hours in advance of proposed storm sewer interruptions and receiving approval, and then only after arranging to provide acceptable temporary storm sewer services.
- D. Existing utilities across or along the line of work are indicated only in an approximate location. Locate all underground lines and structures. Call "Call Before You Dig" at 1-800-632-4949 (811) prior to construction. If utilities are marked that are not shown on the plans, locate utility vertically and horizontally and provide information to the engineer.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate with existing storm drainage piping.
- B. Coordinate with other utility work.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials used for construction of the storm sewerage system shall comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.

2.02 PIPE AND FITTINGS

- A. Provide pipe and pipe fitting materials compatible with each other. Pipe materials are indicated on the drawings.
- B. Reinforced Concrete Pipe (RCP): Shall conform to the requirements of ASTM C76/AASHTO M170, Class III and Class IV as shown on the drawings, unless otherwise indicated.
- C. Single Offset Joint Raised Bell Reinforced Concrete Pipe: Shall conform to the requirements of ASTM C76/AASHTO M170, Class III and Class IV, unless otherwise indicated. Joint gaskets shall conform to the requirements of ASTM C443/AASHTO M198.

2.03 MANHOLES AND JUNCTION BOXES

- A. Precast Concrete Manholes: Comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.
- B. Cast-in-Place Manholes: Comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and

Road and Bridge Specifications.

- C. Manhole Steps, Safety Slabs and Inlet Shaping: Comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.
- D. Manhole Frames and Covers: Comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.
- E. Manhole Rim Adjustment: Comply with the requirements of the City of Fayetteville and/or the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.

2.04 CONCRETE AND REINFORCEMENT

- A. Concrete: Conform to the requirements of NCDOT standard concrete within the latest edition of the North Carolina Department of Transportation Road and Bridge Standards and Road and Bridge Specifications.
- B. Reinforcement: Steel conforming to the following:
 - 1. Fabric: ASTM A 185 welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

2.05 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete or precast reinforced concrete.
 - 1. Cast-in-place headwalls must be 18" in width with two rows of No. 4 bars at 12" on center each way (OCEW) or as shown on the Construction Drawings. Concrete to test 4000 PSI at 28 days.
- B. Flared End Sections: Precast reinforced concrete.

PART 3 – EXECUTION

3.01 GENERAL

- A. Install the storm sewerage system in accordance with the contract documents and the latest edition of the North Carolina Department of Transportation's Road and Bridge Standards and Road and Bridge Specifications.

3.02 PREPARATION OF FOUNDATION FOR BURIED STORM SEWERAGE SYSTEMS

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.
- C. Install pipe bedding conforming to the requirements of the contract documents and the latest edition of the North Carolina Department of Transportation's Road and Bridge Standards and Road and Bridge Specifications.

3.03 PIPE INSTALLATION

- A. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- B. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- C. Join and install concrete pipe and fittings per NCDOT specifications.
- D. Join and install HDPE pipe and fittings per manufacturer's recommendations.
- E. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.
- F. Joint or Structure Connection Repair: Where proposed pipe is connecting to existing structures, these units shall be connected as would new pipes and structures using proper sizes, specifications, and recommendations.

3.04 MANHOLES

- A. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches between inlets and outlet. Set tops of frames and covers flush with finish grade, unless otherwise indicated.
- B. Place precast concrete manhole sections as indicated and install in accordance with ASTM C 891.

- C. Construct cast-in-place manholes as indicated.
- D. Apply bituminous mastic coating at joints of sections.
- E. For Manholes with Adjusted Rims, the Contractor shall remove and reset the existing rim structure after rebuilding the top of the structure. The reset rim shall match the proposed elevation. The rebuilt structure and rim shall be installed undamaged.

3.05 INLET SHAPING

- A. Construct inlet shaping conforming to the latest edition of the North Carolina Department of Transportation's Road and Bridge Standards and Road and Bridge Specifications.

3.06 FIELD QUALITY CONTROL

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - 3. Flush piping between manholes, grate inlets/drop inlets, and catch basins to remove collected debris. Flush pipes through an approved erosion and sediment control measure.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects correct such defects and re-inspect.

END OF SECTION 334100

SECTION 414 – BOX CULVERT EXCAVATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Excavate all material necessary for the construction of box culverts with floor slabs in accordance with the contract or as directed. Excavate, blast, drain and divert water, bail, pump, brace, shore, provide sheeting, cribbing, cofferdams, culvert foundation conditioning, subsurface drainage and drawings; backfill, haul and dispose of materials.
- B. Do not deposit excavated materials, nor construct earth dikes or other temporary earth structures in rivers, streams or impoundment or so near to such waters that they are carried into any river, stream or impoundment by stream flow or surface runoff. As an exception to the above, obtain written approval for the use of confined earth materials in cofferdams for structure foundations.

1.02 MATERIALS

Refer to Division 10 (NCDOT Specifications)

Item	Section
Select Material	1016
Subsurface Drainage Materials	1044

Use Class V or VI select material for foundation conditioning material.

1.03 FOUNDATION EXCAVATION

- A. Notify the Engineer a sufficient time before beginning the excavation so measurements may be taken of the undisturbed ground. Do not disturb the existing ground at the culvert site without permission.
- B. Where necessary for safety, slope, shore, brace or protect by cofferdams the foundation openings in accordance with State and local safety standards. Perform foundation excavation and related work in such sequence that no portion of the culvert will be endangered by subsequent operations. Protect completed portions of a culvert from blasting.
- C. Remove and dispose of boulders, vegetative matter and any other objectionable material.
- D. Notify the Engineer after excavating each foundation. Do not place any concrete until obtaining approval of the excavation depth, the character of the foundation material and permission to proceed.

- E. Take special care not to disturb the bottom of the excavation until immediately before placing reinforcing steel and concrete.

1.04 CONDITIONING CULVERT FOUNDATION

- A. Excavate to a depth as directed below the bottom of the barrel or wing footing and replace the excavated material with foundation conditioning material.
- B. When the foundation material beneath a portion of the barrel or wing footing is rock or incompressible material and softer material is beneath the remainder of the barrel or wing footing, excavate the rock material within the neat lines of the barrel or footing to a depth of 12 inches below the bottom of the barrel and footings and backfill with foundation conditioning material.

1.05 PUMPING

- A. Pump from the interior of any foundation enclosure to preclude the possibility of the movement of water over or through any fresh concrete. Do not pump while placing concrete or for at least 24 hours thereafter, unless done from a suitable sump separated from the concrete work by a substantially watertight wall.

1.06 UTILIZATION OF EXCAVATED MATERIAL

- A. Use suitable excavated material in accordance with Article 410-7.

1.07 BACKFILLING AND FILLING

- A. As soon as practical after completing the box culvert, place the backfill and redirect the stream through the culvert.
- B. Use approved material for backfill that is free from large or frozen lumps, wood or other undesirable material. Where there is not an adequate quantity of suitable backfill material available from culvert excavation, provide suitable backfill material compensated in accordance with Subarticle 410-10(C).
- C. Eliminate any excavated slope adjacent to backfill areas by stepping or serrating to prevent wedge action.
- D. Place and compact all portions of the backfill that become a part of roadway typical sections or their foundations in accordance with Subarticles 235-3(B) and 235-3(C). Place all other portions of the backfill in layers not more than 10 inches in depth of loose measure and compact to a density comparable to the adjacent undisturbed material. Refill all excavated spaces not filled with permanent work with earth up to the ground surface existing before the excavation.
- E. Place backfill or embankment material simultaneously to approximately the same elevation on both sides of the culvert. Do not place backfill or embankment behind the walls of culverts to

an elevation higher than one foot above the top of footing or bottom slab until after placing the top slab and until the concrete develops the minimum required strength for the class of concrete specified as listed in Table 1000-1.

1.08 SUBSURFACE DRAINAGE AT WEEP HOLES

- A. Place a stone drain consisting of one cubic foot of subdrain coarse aggregate contained in a bag of Type 1 geotextile at each weep hole. Place subdrain fine aggregate beneath, around and over the stone drain, so the drain is covered by a layer of subdrain fine aggregate at least 1 foot thick. Connect all drains with a horizontal drain of subdrain fine aggregate at least 1 foot square in cross section. In the case of abutments and retaining walls, in addition to the above requirements, place a vertical drain of subdrain fine aggregate at least 1 foot square in cross section at each weep hole to an elevation 2 feet below the subgrade or surface of the embankment.

1.09 MEASUREMENT AND PAYMENT

- A. Refer to Section 01 29 01

END OF SECTION 414

SECTION 416 – CHANNEL EXCAVATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Excavate any material outside of the pay limits of foundation excavation, unclassified structure excavation or box culvert excavation, which is classified as channel excavation in the plans. Place suitable excavated material as directed, drain and divert water, pump, blast, haul, dispose of materials and backfill.
- B. Do not deposit excavated materials, nor construct earth dikes or other temporary earth structures in rivers, streams or impoundment or so near to such waters that they are carried into any river, stream or impoundment by stream flow or surface runoff.

1.02 CONSTRUCTION METHODS

- A. Notify the Engineer a sufficient time before beginning the excavation so measurements may be taken of the undisturbed ground. Do not disturb the existing ground without permission.
- B. Remove and dispose of boulders, vegetative material and any other objectionable material.
- C. Use and place suitable excavated material in accordance with Articles 410-7 and 410-8 (NCDOT Standards).

1.03 MEASUREMENT AND PAYMENT

- A. Channel excavation will be measured and paid on a cubic yard basis. Materials will be measured in their original position within the limits described below and computed by the average end area method, that are acceptably excavated in accordance with the contract or as directed. The upper limits for measurement are the actual ground surface at the time of starting work. The lower limits for measurement are established by the plans or as directed in writing.
- B. No measurement is made of the following excavation:
 - 1. Mud, muck or similar semi-solid material which can be drained away or pumped without the use of a jet or nozzle.
 - 2. Excavation before the Engineer makes measurements of the undisturbed ground.
 - 3. Excavation that is within the pay limits of other excavation.
 - 4. Excavation that is outside of the limits shown in the plans or as directed in writing.
- C. Where the item Channel Excavation is not included in the contract, no measurement or payment is made of any channel excavation, as payment at the contract unit or lump sum price for the various items in the contract will be full compensation for the work covered by this section.

END OF SECTION 416

SECTION 876 – RIP RAP (STREAM WORK)

1.01 DESCRIPTION

- A. Supply and place rip rap and, if necessary, filtration geotextiles in accordance with the contract and as directed.

1.02 MATERIALS

- A. Refer to Division 10. (NCDOT STANDARDS)

Item	Section
Geotextile for Drainage, Type 2	1056
Plain Rip Rap	1042

- B. Provide Type 2 geotextile for filtration geotextiles and plain rip rap classes in accordance with the contract.

1.03 PLAIN RIP RAP

- A. Grade locations for rip rap as shown in the plans. Use filtration geotextiles under rip rap when shown in the plans and as directed. Do not leave geotextiles exposed for more than 7 days before covering with rip rap. Place filtration geotextiles on surfaces free of obstructions, debris and soft pockets.
- B. Overlap adjacent geotextiles at least 18 inches in the downhill and downstream direction to prevent flow from lifting the edge of the top geotextile. Pull filtration geotextiles taut so they are in tension and free of kinks, folds, wrinkles or creases. Hold geotextiles in place as needed with wire staples or anchor pins. Do not displace or damage filtration geotextiles while placing rip rap. Replace any damaged geotextiles to the satisfaction of the Engineer.
- C. For rip rap at pipe outlets, place rip rap immediately after installing pipes. When rip rap is required for channel changes and drainage ditches, place rip rap before diverting water into channels and ditches.
- D. Place rip rap such that the smaller stones are uniformly distributed throughout rip rap. Install rip rap with mechanical methods and if necessary, by hand to form a well-graded, dense and neat layer of rip rap.

1.04 MEASUREMENT AND PAYMENT

- A. Refer to Section 01 29 01

END OF SECTION 876

Refer to the PWC Master Specifications for utility work. The following sections are provided for reference from the Public Works Commission MASTER SPECIFICATIONS, revised July 3, 2023.

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DIVISION 2 SITE WORK

02222 EXCAVATION AND BACKFILLING FOR UTILITY SYSTEMS

GENERAL

Work described in this section consists of the excavation, backfill, compaction, and finish grading required to install the utility systems. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Public Works Commission.

RELATED SECTIONS

- A. 02305 – Pipe Bursting
- B. 02660 – Water Distribution
- C. 02730 – Sanitary Sewer Systems
- D. 02732 – Sewage Force Mains
- E. Chapter 24 of the City of Fayetteville Ordinance (most recent version)

MATERIALS

Suitable soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-1, A-2-4, A-2-5 and A-3 (or in accordance with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, SC) as determined by the Public Works Commission. Suitable material shall be free from roots, organic matter, trash, debris, frozen material or stones larger than three (3) inches in any dimension.

Unsuitable soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, A-7 (or in accordance with ASTM D2487 soil classification groups GC, ML, MH, CL, CH, OL, OH, and PT) as determined by the Public Works Commission. Unsuitable material as defined above shall be replaced with select material as determined by the Public Works Commission.

Suitable materials determined by the Public Works Commission as too wet or too soft to provide a stable subgrade, foundation, or fill will be deemed as unsuitable regardless of soil classification. Materials deemed unsuitable shall be conditioned or replaced, as directed by the Public Works Commission. The Contractor shall recondition and stockpile the materials at no additional cost to the Public Works Commission.

EXCAVATION

All excavation shall be to the lines and grades indicated. The work shall consist of the excavation, placement, and compaction of suitable material as outlined in this Specification and proper disposal of all unsuitable materials. During excavation, suitable material for backfilling shall be stockpiled. The stockpiles shall be protected from contamination by unsuitable excavated material or other material. If

any material becomes unsuitable, such material, if directed, shall be removed and replaced with suitable on-site or imported material from approved sources at no additional cost to the Public Works Commission.

Where the line parallels a creek and/or ditch the excavated material shall be stockpiled opposite the creek, with the trench separating the two. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. Grading shall be done to prevent surface water from entering the excavation. Any water within the trench shall be removed.

Suitable excavated material shall be stockpiled or placed in the excavation's backfill. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Unauthorized over excavation shall be backfilled with select bedding material at no additional cost to the Public Works Commission. The Contractor, at their expense, shall properly dispose of all excess excavated material unless directed to place it in another area of the project by the Public Works Commission. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any rights of property in any material taken from any excavation.

It shall be the Contractor's responsibility to investigate the site and existing conditions. No compensation will be allowed due to excavation and/or grading being different than anticipated.

TRENCH EXCAVATION

The trench width shall be in accordance with the PWC standard details. All work shall be in accordance with the applicable OSHA regulations.

The subgrade beneath the centerline of the pipe shall provide uniform support for each section of the pipe. Stones three (3) inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed.

Where unsuitable material is encountered at the elevation established for installation of pipe or structures, additional undercut excavation shall be done as directed by the Public Works Commission. The additional undercut excavated area shall be backfilled with stone bedding material. Unauthorized undercut excavation shall be backfilled with stone bedding material and compacted as directed by the Public Works Commission. The Contractor shall conduct undercut operations in such a way that the Public Works Commission can take the necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the Public Works Commission, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation and will not be paid for such.

Where unsuitable material is encountered at the elevation established for installation of roads, parking lots, or other paved areas, additional undercut excavation shall be done as directed by the responsible agency (i.e., City of Fayetteville, Town of Hope Mills, NCDOT, etc.). The additional undercut excavated area shall be backfilled with stone bedding material. Unauthorized undercut excavation shall be backfilled with stone bedding material and compacted as directed by the responsible agency. The Contractor shall conduct undercut operations in such a way that the responsible agency can take the

necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the responsible agency, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation. All undercut excavation shall be in accordance with the NCDOT Standard Specification for Roads and Structures (most recent edition), or the responsible agency's specifications.

Excavation for manholes, meter vaults, or similar structures shall leave a minimum of 12-inches clear space around the structure. Removal of unsuitable material shall be as specified above. Preparation of the subgrade shall be in accordance with the applicable detail and as directed by the Public Works Commission.

PIPE LAYING

All pipe shall be installed in accordance with PWC Specification Section 02660 – Water Distribution, Specification Section 02730 – Sanitary Sewer Systems, and/or PWC Specification Section 02732 – Sewage Force Mains.

TRENCH SAFETY

All excavations shall comply with all Federal, State, and local rules and regulations. The Contractor shall have a trenching and shoring "competent" person on the job at all times when there is an open excavation. Under no circumstance shall an employee of the Public Works Commission be considered the "competent" person for the operation.

TRENCH STABILIZATION (SHORING)

The Contractor shall furnish, install, and maintain all necessary shoring to ensure a safe excavation. The method of shoring and excavation shall be in strict accordance with OSHA Regulations. The Contractor shall be responsible for installation, maintenance, and removal of all trench stabilization measures. The Contractor shall be responsible for any damage to adjacent structures resulting from the installation, maintenance, removal, or absence of trench stabilization measures.

DEWATERING

Excavations shall be kept dry at all times. Any required dewatering shall be the Contractor's responsibility. The Contractor shall be responsible for any damage to the adjacent property resulting from the installation, maintenance, discharge, and removal of the dewatering system. All discharge from the dewatering system shall be in accordance with the applicable erosion control rules and regulations.

BACKFILL

Backfill shall consist of suitable material free from debris, stone, etc. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. The backfill operation shall be conducted to prevent damage and/or movement of the pipe.

Backfill material in trenches shall be placed in layers not exceeding six (6) inches loose thickness to a point at least 12-inches above the pipe compacted to 90 percent maximum density. The remainder of the trench shall be backfilled in layers not exceeding six (6) inches in loose thickness compacted as specified in subparagraph COMPACTION. Each layer shall be thoroughly compacted by an approved mechanical tamping device.

Backfill material around structures shall be placed in a manner that the structure will not be damaged. No backfill shall be placed around manholes, thrust blocks, or similar structures until the concrete has been allowed to cure for three (3) days. The backfill material shall be compacted as specified in subparagraph COMPACTION.

No backfilling will be allowed when weather conditions prevent compliance with these Specifications.

BORROW EXCAVATION (Select Backfill)

Borrow excavation material shall be supplied by the Contractor when sufficient quantities of suitable materials are not available within the project limits. The borrow material shall be approved by the Public Works Commission and shall not contain roots, root mats, stumps, highly plastic clay or other unsatisfactory materials. All borrow material shall be in accordance with the NCDOT Standard Specification for Roads and Structures, most recent edition.

COMPACTION

Backfill shall be compacted in accordance with the following table as a percentage of the maximum density at optimum moisture content as determined by the Standard Proctor Test, ASTM D-698.

<u>Area</u>	<u>Percent ASTM D-698 Maximum Dry Density</u>
Around and 1' above top of pipe	95
Remaining trench (within 4' of subgrade)	95
Pavement subgrade and shoulders	
Last 1' of fill (below subgrade)	100
Last 3' of fill to 12" below subgrade	98
Base material	100
Adjacent to structures (Areas not paved)	95
Under structures	98
Utility Outfalls (Cross Country)	95

Compaction testing may be performed at the option of the PWC Project Coordinator, or as required by the responsible agency (i.e., City of Fayetteville, NCDOT, etc.). Compaction testing shall be done in

accordance with the responsible agency's requirements. Deficiencies shall be corrected by the Contractor without additional cost to PWC.

FINISHED EXCAVATION

All areas covered by the project shall be uniformly graded to the established elevations and approved cross sections. Ditches shall be graded to permit proper drainage. Newly graded areas shall be protected from traffic and/or from erosion, and any settlement or washing prior to acceptance shall be repaired and the required grades re-established. Ditches and drains along the subgrade shall be maintained to drain at all times. The finished subgrade shall be protected and maintained by the Contractor. The storage or stockpiling of materials on the finished subgrade shall not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved. All work shall be conducted in accordance with the environmental protection requirements of the Contract.

DIVISION 2 SITE WORK

02505 ADJUSTMENT OF EXISTING STRUCTURES

GENERAL

The work covered by this specification consists of the raising or lowering of existing manholes and valve boxes encountered within the limits of the project to match the adjacent finished work.

RELATED SECTIONS

- A. 02222 – Excavation and Backfilling for Utility Systems
- B. 02660 – Water Distribution
- C. 02730 – Sanitary Sewer Systems

Where conflicts occur between the specifications, the more stringent requirement shall apply.

MATERIALS

All materials shall be in strict accordance with the requirements of the Public Works Commission and as set forth in this standard.

Adjustable riser rings are not approved for use within the Public Works Commission water and/or sewer system. All manhole adjustments shall be done utilizing a concrete grade ring. If a concrete grade ring cannot be utilized, the manhole shall be broken down and rebuilt to the proper grade, in accordance with PWC standards.

INSTALLATION

Adjustment of structures shall not be performed until after placement of base course and/or any leveling course, and prior to placement of final course. All adjustments of structures shall be accomplished a minimum of 72 hours prior to placing the final surface course. All defective, damaged, or worn castings shall be replaced with new castings provided by the Public Works Commission at no cost to the Contractor. The Contractor shall be responsible for exchanging castings at the Public Works Commission's facility.

The Contractor shall take all necessary precautions to prevent debris from entering the sanitary sewer system. Any debris that falls into the manhole or valve box during adjustment shall be removed immediately.

Manholes

For all manholes that need adjustment, the Contractor shall remove all concrete grade rings to the top of the cone section. All loose material shall be removed and properly disposed of. The Contractor shall utilize new concrete grade rings to ensure that the new manhole ring and cover will be at final grade. If no concrete grade rings are required to adjust the structure to final grade, the Contractor shall set the ring and cover in a bed of clean fresh mortar.

If the manhole needs to be lowered, and there are no existing concrete grade rings, then the Contractor shall tear down the existing manhole and rebuild it, utilizing new riser and cone sections, in order to ensure that the installed ring and cover will be at final grade. The Contractor shall remove all necessary sections of the existing manhole in order to make the adjustment.

If the manhole needs to be raised, and there are 12-inches of concrete grade rings already in place, the Contractor shall tear down the existing manhole and re-build it. The Contractor shall utilize new riser and cone sections, as required, to ensure that the installed ring and cover will be at final grade. The Contractor shall remove all necessary sections of the existing manhole in order to make the adjustment.

Valve Boxes

In order to adjust valve boxes, the top section of the valve box shall be raised or lowered as required to meet the final grade. If the height of the final grade exceeds the length of the existing top section, the Contractor shall remove the existing valve box and install a new one at final grade.

All adjustments shall be protected for at least 72 hours before the placement of any surfacing material, in order to allow the concrete to properly set. The Contractor shall be responsible for protecting the raised structure from damage due to traffic. After the 72 hours, a temporary asphalt transition shall be placed around the raised structure, to allow vehicular traffic to pass over. The asphalt transition shall extend a minimum of 18 inches from the structure in every direction. The Contractor shall be responsible for maintaining this asphalt transition until such time the final surface course is placed. Immediately prior to paving, the asphalt transition shall be removed. In the event paving is stopped for the day prior to completing the work, the Contractor shall re-install the temporary asphalt transition. The finish surface tolerance shall not vary more than $\frac{1}{4}$ " (0.25 inch) in any direction. Every effort shall be made to ensure that the surface course and castings provide as smooth a ride as possible.

DIVISION 2
SITE WORK

02660 WATER DISTRIBUTION

GENERAL

Water lines and all appurtenant items shall be constructed of materials specified and/or as indicated on the approved drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defects in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Fayetteville Public Works Commission (PWC) at no expense to the Fayetteville Public Works Commission.

RELATED SECTIONS

- A. 02211 – Grading, Utilities
- B. 02222 – Excavation and Backfilling for Utility Systems
- C. 02301 – Boring And Jacking (Roadways And Railroads)

MATERIALS

MANUALLY OPERATED GATE VALVES

All manually operated gate valves four (4) inches and larger shall be ductile iron or cast iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to American Water Works Association (AWWA) C-509/C-515 and NSF 61. All valves must open counter-clockwise equipped with a two (2) inch square operating nut. The operating nut shall have an arrow cut in the metal, indicating the direction of opening. All valves shall have a non-rising stem. All valves up to and including thirty-six (36) inch diameter shall have triple "O" ring stem seals. The design and machining of valves shall be such as to permit the replacement of the upper two (2) "O" rings without undue leakage while the valve is wide open and in service. The wedge shall be ductile iron encapsulated in nitrile rubber (for four (4) inch through 12 inch) and SBR rubber for 14-inch through 24-inch sizes.. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating complying with ANSI/AWWA C550 applied electrostatically prior to assembly, conforming to AWWA C-550-90. All valves up to and including 36-inch diameter shall have a safe working pressure of 250 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500.

Gate valves installed in meter vaults shall have a wheel in lieu of a square operating nut and shall also have a non-rising stem. The wheel shall have an arrow cut in the metal indicating the direction of opening. Flanges shall not be buried. An approved pit shall be provided for all flange connections.

Resilient seated tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS-SP60.

Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the proper alignment required to prevent damage by a misaligned shell cutter. The interior of the waterway in the body shall be a full opening and capable of passing a full sized shell cutter equal to the nominal diameter of the valve.

All valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Valves shall be manufactured by: Mueller Company, Clow Corporation, or American Darling Company. Certification shall be furnished to the Fayetteville Public Works Commission by the manufacturer that all valves are in accordance with PWC standards. Where specified on the plans and approved by the Fayetteville Public Works Commission, resilient wedge gate valves may be furnished with spur gearing for valves installed in a vertical position and bevel gearing for valves installed in a horizontal position. All gate valves shall be installed in accordance with PWC standard details.

BALL VALVES

For all valves smaller than four (4) inches, ball valves shall be used. Ball valves shall be installed in accordance with PWC standard details.

Ball valves shall be all bronze construction, with tee head operator and having a removable disc. Ball valves shall have threaded connections, in accordance with PWC standard details. Ball valves shall be manufactured and tested in accordance with AWWA/ANSI C800. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM Specifications and shall also meet the approval of the Public Works Commission. The turn required to travel from fully closed to fully open on the ball valve shall be 90 degrees.

VALVE BOXES

Valve boxes shall be "slip-type" made of close-grained, gray cast iron metal painted with a protective asphaltic coating. Construction shall be in three pieces as follows: The lower of base pieces, which shall be flanged at the bottom, the upper part which shall be flanged on the lower end, and of such size as to telescope over the lower part, the upper end being constructed in the form of a socket to receive the cap or cover; and the cover or cap shall have cast on the upper surface, in raised letters, the word "WATER". All valve boxes shall be equal in quality and workmanship to those manufactured by Sigma Corporation (VB-462), Tyler Union (6855 Series), Star Pipe Products (VB-0004), or an approved equal. The valve box shall be installed in accordance with PWC standard details. The valve box shall have a 3/8-inch hole drilled in the upper part four (4) to six (6) inches from the top of the box to accommodate a 1/4-inch x 1-1/2-inch galvanized bolt for securing tracer wire.

Valve box protector rings shall be installed to protect valve boxes located outside pavement. The ring shall be constructed and installed in accordance with PWC standard details.

FIRE HYDRANTS

All fire hydrants shall be dry barrel, traffic type and conform to the latest revision of AWWA Specification C-502 except as listed below or as otherwise directed by the Public Works Commission. All working parts shall be bronzed. The size of the fire hydrants (designated by the nominal diameter of the valve opening) shall not be less than four and one-half (4 ½) inches. All hydrants shall be able to deliver a minimum of 1,000 gallons per minute with a friction loss of not more than five (5) pounds per square inch (psi) total head loss through the hydrant. Hydrants shall be of compression type (opening shall be of such design that when the barrel is broken off the hydrant valve will remain closed and reasonably tight against leakage). All hydrants shall be mechanical joint to accommodate the spigot end of six (6) inch Pressure Class 150, AWWA Standard, ductile iron pipe. The installation of the fire hydrant shall be in accordance with PWC standard details. Bosses (6") may be substituted for tees in pipe sizes exceeding 24 inches in diameter, with prior approval from PWC. The boss shall be welded to the bottom of the main to provide effective flushing of the system.

All hydrants shall be furnished with two (2) two and one-half (2 ½) inch nozzles and one (1) four and one-half (4 ½) inch pumper nozzle. Outlets shall have American National Standard fire hose coupling thread, in accordance with the City of Fayetteville standard, and shall be provided with nozzle caps securely chained to the body of the hydrant. The base of the hydrant shall have two (2) cast lugs suitable for use in strapping the hydrant to the connecting pipe. The operating nut shall be pentagonal in shape, finished with a slight taper to one and one-half (1 ½) inches from point to flat to conform to the standard wrench used by the Fayetteville Public Works Commission. All hydrants shall open left or counter-clockwise. Hydrants shall be suitable for working pressure of 150 psi and a test pressure of twice the working pressure. Fire hydrants shall be specific models manufactured by Mueller Company (Model Centurian 200), Clow Corporation (Medallion), American Darling (Model Mark 73-1) or approved equal. The interior of the hydrant shoe shall be coated with a four (4) mil thickness FDA approved epoxy coating.

COMBINATION AIR VALVES ASSEMBLY

Combination air valves shall be of the single housing style that combines the operation features of both an air/vacuum and air release valve. The combination air valve shall have a two (2) inch inlet and one (1) inch outlet connections and an orifice diameter to be determined by the Design Engineer for each project for a maximum working pressure of 300 psi. The assembly shall be equipped with a two (2) inch cut-off valve as shown on the PWC standard detail. The combination air valve body shall be constructed of 316 stainless steel or reinforced nylon with the only exception being the Buna-N Rubber seat and gasket. Valves shall be as manufactured by Crispin (Model UX20), ARI (D-020), or approved equal. Combination air valves shall be installed in accordance with PWC standards.

WATER DISTRIBUTION PIPE

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of

America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe shall be designated as “Pressure Class”, unless otherwise specified. The pipe furnished shall have a minimum thickness calculated in accordance with ANSI A 21.50 (AWWA C-150), with a factor of safety of two (2); a working pressure of 150 psi to 350 psi, plus 100 psi water hammer allowance; and AASHTO H-20 live truck load with 2.5 feet of cover. In no case shall “Pressure Class” pipe’s nominal thickness be less than the following:

<u>SIZE</u>	<u>PRESSURE CLASS</u>	<u>NOMINAL THICKNESS (In.)</u>
4"	350	0.25
6"	350	0.25
8"	350	0.25
10"	350	0.26
12"	350	0.28
16"	250	0.30
24"	250	0.37

PUSH-ON JOINTS

Push-on joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Push on joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified. All ductile iron pipe shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). The pipe shall have an outside asphaltic coating as specified in AWWA Standard C-151.

RESTRAINED JOINTS

Factory Restrained Joints

Factory restrained joint pipe shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint pipe shall be furnished for the locations shown on the approved drawings. The pipe, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes.

All factory restrained joint pipe shall have the restraints internal to the pipe (i.e., “boltless”). All restrained joint ductile iron pipe and fittings larger than 12-inches shall be as manufactured by U.S. Pipe’s TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company's Flex-Ring Joint, or approved equal. The method of restraining the valves to the factory restrained ductile iron pipe shall be reviewed and approved by PWC on a case by case basis. The valves shall have the same working pressure as the pipe.

Flanged Joints

Flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable.

Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8 inch thickness. Linings and coatings shall be as previously outlined for all ductile iron pipe and fittings.

Mechanical Joints

Mechanical joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four (4) inch pipe through 12-inch pipe. Mechanical joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified.

Special accessories such as mechanical joint retainer glands or mega-lugs are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

Field Lok Gaskets

Special accessories such as US Pipe's Field-LOK gasket, Ford's Uni-Ring, or Romac's Grip-Ring are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

FITTINGS

Mechanical Joint

All fittings shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be mechanically restrained, ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for four (4) inch through 12 inch sizes only. Where thrust blocking is utilized, fittings shall be full body ductile iron in accordance with ANSI A 21.53 (AWWA C110).

All ductile iron fittings shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). All fittings shall have an outside asphaltic coating as specified in AWWA Standard C-151 and C-110, respectively.

Factory Restrained

Factory restrained joint fittings shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint fittings shall be furnished for the locations shown on the approved drawings. The fittings, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as previously specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes. All factory restrained joint fittings shall have the restraints internal to the fitting (i.e., “boltless”). All fittings shall be compatible with the factory restraint system. All restrained joint ductile iron fittings larger than 12-inches shall be as manufactured by U.S. Pipe’s TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company’s Flex-Ring Joint, or approved equal.

Bosses

Tangential welded on outlets (i.e., bosses) shall only be utilized on pipe 24-inches and larger, as approved by PWC. All bosses shall be factory welded; field fabrication is not allowed. The pipe shall be in accordance with these specifications. Bosses shall be of the size and location indicated on the approved drawings.

AERIAL CROSSINGS

For aerial crossings, the ductile iron pipe shall be thickness class, as specified on the plans and standard details. All thickness class pipe shall be in accordance with ANSI A21.51 and AWWA C-151, with a minimum working pressure of 200 psi.

For aerial crossings which are four (4) inches to 12 inches in diameter, Class 53 manufactured factory restrained joint or Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details. No other means of restraint are allowed for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details.

All aerial crossings shall be designed and installed in accordance with PWC standard details.

PIPE IN CASINGS

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

All restrained joint ductile pipe in casings shall be in accordance with the PWC standard details.

TRENCHLESS APPLICATIONS

All ductile iron pipe (regardless of diameter) utilized for trenchless installations (i.e., horizontal directional drilling, pipe-bursting, etc.) shall be factory restrained, in accordance with these specifications and the applicable specification section for the trenchless technology. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized.

PVC PIPE

Two (2) inch water main pipe shall be manufactured using Grade 1 PVC compound material as defined in ASTM D-1784 and shall be SDR21, pressure class 200 in accordance with ASTM D 2241. Fittings for two (2) PVC pipe shall be solvent weld Schedule 80 PVC. Brass FIP x pack joint for PVC fittings shall be used to transition from PVC to brass. The pipe shall be plainly marked with the manufacturer's name, size, material (PVC) type and grade or compound, NSF seal, date of manufacture, pressure rating and reference to appropriate product standards.

All PVC pipe (4-inches through 12-inches diameter) shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4,000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Class 150 and conform to the thickness requirements of DR18. The pipe shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1,000 hours tested in accordance with ASTM D-1598. The pipe joints shall be of the integral bell type with rubber gaskets and shall conform to the requirements of ASTM D-3139 or ASTM F-477.

PVC fittings are not acceptable for water mains four (4) inches or greater. Fittings and specials shall be ductile iron, bell end in accordance with AWWA C-110, 150 psi pressure rating unless otherwise shown or specified. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Ductile iron fittings and specials shall be cement mortar lined (standard thickness) in accordance with ANSI A21.4.

Mechanical restraining systems (i.e. mega-lug, grip-ring) shall not be used on PVC pipe.

TRACING WIRE

For the purpose of locating non-metallic pipes, a continuous "detectable" tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. Splices shall be accomplished utilizing a corrosion proof wire connector. The connectors shall "lock" the wires in place and contain a dielectric sealant to prevent corrosion. The connector shall be the "Snake Bite" connector manufactured by Copperhead Industries, LLC, or approved equal. The wire shall be buried continuously along the pipe. The wire shall be secured into valve boxes such that a direct/conductive metal detector may be used to trace the pipe location. Bolts shall be used to secure the wire and the attachment location shall be readily available from finished grade without special equipment.

POLYETHYLENE PLASTIC WATER TUBING

Polyethylene (PE) plastic water tubing shall be installed in accordance with PWC standard details. All services installed in new construction shall be one continuous run of pipe with no splices from the corporation stop to the meter. The PE water tubing shall meet the requirements of ASTM D2737, AWWA C901, and NSF Standards 14 and 61. Pipe dimensions shall meet Iron Pipe Size (IPS) standards.

The PE tubing material shall be high density polyethylene conforming to the minimum requirements of cell classification 445574E, as defined and described in ASTM D3350. The resin shall have a material designation code of PE4710 by the Plastic Pipe Institute.

The PE water tubing shall be SDR 7, with a minimum pressure rating of 250 psi. Fittings for the PE water pipe shall be cast brass compression fittings, made to the PE water pipe dimension. All brass fittings shall have a 300 psi minimum pressure rating.

For the purpose of locating plastic water services during trenching, a continuous tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. The wire shall be buried along the water service lateral from the main to the meter box. The wire shall extend a minimum of 12 inches into the meter boxes.

COPPER WATER TUBING

Copper water tubing shall be installed in accordance with PWC standards. All services installed shall be one continuous run of pipe with no splices from the corporation stop to the meter.

Copper water tubing shall be Type K, soft copper manufactured in accordance with ASTM B88. The minimum pressure rating for the copper water pipe shall be 655 psi. Fittings for the copper water pipe shall be brass compression fittings, made to the copper water pipe dimensions. All brass fittings shall have a 300 psi minimum pressure rating.

TAPPING SLEEVES

Tapping sleeves shall be ductile iron mechanical joint or stainless steel and have a minimum working pressure of 150 psi for all tapping of mains up to and including 24-inch diameter with a branch less than or equal to 12-inches diameter. Branch diameter greater than 12-inches on a 16-inch diameter pipe and larger shall require full body ductile iron mechanical joint tapping sleeve.

Ductile iron mechanical joint tapping sleeves shall be as manufactured by Clow, M&H, Mueller, American, or an approved equal and shall be furnished with complete joint accessories. The mechanical joint sleeve shall be compatible with type and class of pipe being tapped. The outlet flange shall be class 125 per ANSI B16.1 compatible with approved tapping valves.

Stainless steel tapping sleeves shall be as manufactured by Romac, Smith-Blair, or approved equal, and shall be furnished with all accessories. The sleeve, lugs, bolts and nuts shall be 18-8 type 304 stainless steel, as provided by the manufacturer. The outlet flange shall be ductile iron or stainless steel. The gasket shall be a grid pattern design and shall provide full circumferential sealing around pipe to be

tapped. The sleeve shall include a 3/4 NPT test plug. All welds shall be passivated. The outlet flange shall be class D per AWWA C-207-ANSI 150 lb. drilling compatible with approved tapping sleeves.

The tapping sleeve and valve shall be in accordance with PWC standard details.

All tapping sleeves shall be hydrostatically pressure tested prior to the tap being accomplished. **Use of air to complete the pressure test is not acceptable.** The tapping sleeve shall be tested to 150 psi. The PWC Project Coordinator shall witness and approve the testing.

WATER SERVICE SADDLES

All water service saddles for use on two (2) inch PVC shall be one (1) inch brass saddles as manufactured by Ford, McDonald, or Mueller.

Water service saddles for one (1) and two (2) inch taps on four (4), six (6), eight (8), 12-inch and larger size PVC and asbestos-cement (AC) and also four (4) inch and larger size iron pipe shall be ductile iron with stainless steel strap(s), bolts, nuts and washers. Ford Models FS 101, FS 202; Romac Models 101S, 202S; or Smith-Blair Model 315.317 shall be used. Stainless steel straps must be pre-formed at the factory to the specified outside diameters of the pipe.

Water service saddles with a two (2) inch outlet shall be double strap.

Water service saddles for pipe sizes 12-inch through 24-inch shall be double strap.

Water service saddles for pipe sizes exceeding 24-inches shall be as specified by the PWC Water Resources Engineering Department.

INSTALLATION

GENERAL

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE INSTALLATION

Pipe installation shall be in accordance with the manufacturer's instructions. All pipes and fittings shall be handled to prevent damage to the protective coatings and linings.

All dust, dirt, oil, tar, or other foreign matter shall be cleaned from the jointing surfaces, and shall be lubricated with lubricant recommended by the manufacturer.

All pipe shall be installed in accordance with the approved drawings and cut sheets, unless otherwise directed by PWC.

All dead ends on new mains shall have a two (2) inch blow-off assembly as indicated on the approved drawings. The blow-off assembly shall be in accordance with PWC standard details.

For pipe sizes up to 12-inches, mechanical equipment should not be utilized to assemble the pipe. For pipe sizes over 12-inches, mechanical equipment may be utilized, in accordance with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

When pipe installation is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is present, the plug shall remain in place until the water is lowered to a level that allows for proper installation. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

The Contractor shall be responsible for installing the pipe and appurtenances to proper line and grade.

All ductile iron pipe and fittings shall be installed in accordance with ANSI/AWWA C-110/A21.10. All C-900 pipe shall be installed in accordance with ASTM D-2774. The amount of deflection in the PVC or ductile iron pipe shall not exceed the applicable AWWA standards and the manufacturer's recommendations. If the required deflection exceeds the specified limitations or as determined by the Public Works Commission, mechanical joint bends shall be utilized.

Pipe passing through walls of NCDOT bridges, retaining walls, and other concrete structures shall be factory restrained joint ductile iron and be installed in casings/sleeves in accordance with NCDOT specifications. Annular space between walls and sleeves shall be filled with an approved cement mortar that meets NCDOT specifications. The annular space between the sleeve and the pipe shall be filled with an approved mastic.

Pipe passing through the walls of meter vaults, valve pits, and storm drainage structures shall be restrained joint ductile iron, as specified by PWC. Pipe shall be installed in a casing/sleeve if determined to be necessary. Annular space between walls and sleeves shall be filled with an approved cement mortar. Annular space between pipe and sleeves shall be filled with an approved mastic. Proposed conflict boxes with storm and water shall be reviewed by the PWC Water Resources Engineer and approved on a case by case basis.

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of mechanical restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

When pipe is field cut, the cut end shall be smooth and at right angles to the axis of the pipe. All sharp edges shall be removed. All field cut pipe shall be beveled. The beveled end of PVC pipe shall be removed, when installing into mechanical joint ductile iron fittings.

When connecting unlike (class, material, etc.) pipe, an approved PWC fitting shall be used. All pipe shall be installed in accordance with AWWA C-600 or C-605 as applicable, for buried lines and the manufacturer's recommendations. For mechanical joint pipe and fittings, all nuts shall be torqued to the manufacturer's recommendations.

Concrete thrust blocking shall be utilized on all PVC water mains. The concrete thrust blocking shall be in accordance with PWC standard details. When thrust blocking is to be utilized, backfilling shall not occur until the concrete has time to set. No hydrostatic pressure testing shall occur until the concrete thrust blocking has cured for a minimum of five (5) calendar days.

FIRE HYDRANTS

Fire hydrants shall be installed as shown on the approved drawings. Each fire hydrant shall be connected to the main with a six (6) inch branch line and shall have a minimum of 42-inches of cover. Fittings between the valve and fire hydrant may be utilized, with prior approval from PWC. The valve shall be located at the main unless otherwise approved by PWC. Hydrants shall be set plumb with pumper nozzle facing the roadway. The hydrant branch shall not be backfilled until inspected and approved by the PWC Project Coordinator. Fire hydrants shall be installed in accordance with PWC standard details.

HYDROSTATIC TESTS

All mains and laterals shall be subjected to a hydrostatic pressure test. Each valved section may be tested individually.

The Contractor shall furnish all labor and material, including test pumps, taps, and corporations, necessary to complete the work. Any taps which are not to be utilized shall be killed out at the main. If any taps are to be used for irrigation laterals they shall be installed in accordance with PWC standard details. A PWC Project Coordinator shall be present and observe all valve operation by the Contractor. Under no circumstances shall a Contractor operate any PWC-owned valves unless it is an emergency.

The duration of the pressure test shall be at least one hour or longer, as directed by the PWC Project Coordinator. The hydrostatic pressure shall be 200 psi. The pipe to be tested shall be slowly filled with water and the specified test pressure shall be applied. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow offs are not located to properly expel the air, taps shall be made as approved by PWC.

Damaged or defective materials discovered as a result of the pressure test shall be removed and replaced with new material, and the test shall be repeated until the test results are satisfactory to the Public Works Commission.

All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Public Works Commission. All repairs shall be reviewed and approved by PWC prior to backfill. The use of couplings, fittings, sleeves, etc. shall be reviewed and approved by PWC prior to use. The main must successfully pass the hydrostatic test prior to sterilization.

STERILIZATION

Sterilization shall be in accordance with the requirements of NCDEQ, the North Carolina Rules Governing Public Water Supply, AWWA C651, and AWWA C655 (most recent editions). The Contractor shall furnish all chlorinating equipment, sterilization solution, materials, excavation, barricades, backfilling, and any taps and corporations necessary to complete the work. The Contractor shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

Prior to performing the hydrostatic test, water mains, laterals, and appurtenances shall be flushed to remove air, sediment, contaminants, and/or foreign matter. After completion of a successful hydrostatic test, the water system shall be disinfected by the thorough dispersion of a chlorine solution. The chlorine level shall be between 50 parts per million (ppm) and 100 ppm throughout the water system. In no case shall the chlorine level exceed 300 ppm. If the chlorine level is over 300 ppm, the system shall be completely flushed and re-chlorinated. **In no case shall chlorine be introduced into the water system in a dry solid state.**

The chlorine solution shall remain in contact with the interior surfaces of the water system for a minimum period of 24 hours and shall result in not less than 10 ppm of chlorine throughout the system. Then the water system shall be flushed with water from the existing PWC water system until the chlorine solution is dispelled. The Contractor shall take all necessary measures to prevent downstream erosion caused by flushing the lines. All erosion/damages shall be repaired at no additional expense to the Public Works Commission. All environmental regulations governing the release and/or disposal of chlorinated testing water shall be met by the Contractor. AWWA C655 defines "highly chlorinated" water as water having more than four (4) ppm. Any water with a chlorine level greater than four (4) ppm shall be de-chlorinated by the Contractor prior to being released to the environment.

If any disruption to the disinfection process occurs, or if any repair procedure is necessary then the disinfection process shall start over.

After disinfection, the water supply shall not be accepted or placed into service until bacteriological tests results or representative water samples analyzed in the Public Works Commission's laboratory are found to be satisfactory. The disinfection shall be repeated until tests indicate the absence of pollution for at least two (2) full days. The PWC Project Coordinator shall be responsible for taking the sample(s) and transporting them to the PWC laboratory.

If the initial sample taken after disinfection and flushing does not indicate that the water main is sterilized, the Contractor shall, in conjunction with the PWC Project Coordinator, flush the lines. Once flushing is complete, another sample will be taken to the Public Works Commission's laboratory for analysis. Should this second sample also fail to indicate that the main is sterilized; the Contractor shall repeat the disinfection process. This process shall be repeated until the samples are satisfactory. The Contractor

shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

DIVISION 2 SITE WORK

02730 SANITARY SEWER SYSTEMS

GENERAL

Sanitary sewer lines and all appurtenant items shall be constructed of materials specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Public Works Commission.

RELATED SECTIONS

- A. 02211 – Grading, Utilities
- B. 02222 – Excavation and Backfilling for Utility Systems
- C. 02732 – Sewage Force Mains

MATERIALS

SEWER MAINS

Prior to shipment each joint of pipe shall be stamped by an independent testing laboratory, certifying compliance with the specifications stated therein. Pipe sizes indicated shall be understood to be nominal inside diameter of the pipe. All sewer pipe materials shall be either PVC (as specified herein) or ductile iron (as specified herein), unless otherwise approved in writing by the Public Works Commission. Written approval shall be obtained prior to installation.

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe and fittings shall be in strict accordance with ANSI A21.51 and AWWA C151, Class 50 or Class 51, as applicable, in every respect. The working pressure shall be a minimum of 200 psi. Pipe shall be furnished in 18 or 20-foot lengths. All pipe joints used in open trench construction shall be furnished with "push-on" joints, unless otherwise indicated on the drawings or specified. All joints and fittings shall be in accordance with ANSI A21.11 and AWWA C111. All ductile iron interior surfaces shall be lined with two (2) coats of ceramic epoxy to produce a total minimum dry film thickness of 40 mils (Protecto401 or approved equal). The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110. Specifications for the ceramic epoxy can be found in Specification Section 09802.

For aerial crossings which are 4 inches through 12 inches in diameter, manufactured restrained joint ductile iron pipe Class 53, or Class 53 flanged ductile iron pipe shall be utilized in accordance with the standard Public Works Commission detail for aerial crossings. Mega-lugs, field-lok, and gripper rings are not an allowable means of restraint for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, flange joint ductile iron pipe, Class 53, shall be utilized in accordance with the standard Public Works Commission details. The location of flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable. Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8" thickness. Linings and coatings shall be as outlined for ductile iron pipe.

If the Public Works Commission determines that an expansion coupling is required, it shall be installed as indicated on the drawings. The expansion coupling shall not be buried.

For subsurface water crossings (i.e., streams, wetlands), restrained joint ductile iron pipe shall be utilized. No mechanical restraint systems (e.g., mega-lugs, field-lok gaskets, etc.) shall be utilized. The pipe shall be installed in a casing, in accordance with the approved Public Works Commission detail, unless otherwise specifically approved by the Public Works Commission.

PVC PIPE

PVC sewer pipe and fittings 4 inches thru 15 inches shall be in accordance with ASTM D-3034 with a standard dimension ratio (SDR) of 26 for sewer mains and laterals. Larger diameter pipe (18 inches through 27 inches) shall be in accordance with ASTM F-679, with a SDR of 26. Both pipe and fittings shall be made of PVC plastic having a cell classification of 12454 as specified in ASTM D-1784.

Pipe joining shall be push on elastomeric gasket joints only and the joints shall be manufactured and assembled in accordance with ASTM D-3212. Elastomeric seals shall meet the requirements of ASTM F-477. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory and in accordance with ASTM D-3212 and contain a steel reinforcing ring. PVC sewer pipe shall be made by continuous extrusion of prime green unplasticized PVC and contain identification markings as required by the applicable ASTM standard.

SEWER FITTINGS

Ductile Iron Push-on Fittings:

Ductile iron sewer fittings on PVC mains shall be deep bell, gasketed joint, and air test rated. Gasket grooves shall be machined in the factory. Material shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12 and ASTM F1336. Wall thickness shall meet the requirements of AWWA C153. Gaskets shall have a minimum cross sectional area of 0.20 square inches, and conform to ASTM F477.

All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. All ductile iron fittings on PVC pipe shall provide a flow line that provides a smooth transition between the materials. Ductile iron fittings shall be as manufactured by the Harrington Corporation (Harco), or approved equal.

Mechanical Joint Fittings:

Joints shall be installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four inch (4") pipe and larger. Fittings and specials shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for 4" thru 24" sizes only. Note: mechanical joint wyes are not included in the AWWA C-153 specification. Pressure rating shall be not less than 200 psi unless otherwise specified. All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. Mechanical joint fittings shall be utilized on ductile iron mains and ductile iron laterals. Mechanical joint fittings shall not be utilized on PVC mains, unless otherwise approved by the Public Works Commission.

PVC Fittings:

PVC fittings shall be manufactured in accordance with ASTM D-3034, F-1336, and F-679. Molded fittings shall be utilized in sizes from 4" to 8" (or larger, if available). Fabricated fittings shall only be utilized with prior approval from the Public Works Commission. Fabricated fittings are defined as those fittings that are made from pipe or a combination of pipe and molded components. All PVC fittings shall contain identification markings as required by the applicable ASTM standard. All PVC fittings shall be gasketed joint, except as indicated for interior drop structures. Plastic fittings shall be as manufactured by GPK Products, Inc., Plasti-Trends, the Harrington Corporation (Harco), or approved equal.

Ductile Iron Pipe Size x SDR26 Transition Adapter:

All ductile iron x PVC transition adapters shall be one (1) piece, bell x bell (gasket x gasket). Transition adapters shall range in size from four (4) inches through 12 inches. Transition adapters for pipe larger than 12-inches shall be as specified by the Public Works Commission. All transition adapters shall have a flow way tapered to allow a smooth transition between the ductile iron and PVC. Transition adapters shall be either PVC or ductile iron, in accordance with the following:

PVC – All PVC transition fittings shall be made from DR 18 C900 pipe stock. The C900 pipe stock shall meet the requirements of AWWA C900/C905, and have a minimum cell classification of 12454 as defined in ASTM D1784. The wall thickness shall meet or exceed DR 18. PVC transition fittings shall have SBR gaskets in accordance with ASTM F477. All six (6) inch and eight (8) inch adapters shall be molded. Molded fitting joints shall be 235 psi rated, in accordance with ASTM D3139, and shall have SBR rubber gaskets. Four (4) inch, ten (10) inch and 12 inch transition adapters shall have SBR Rieber style gaskets meeting ASTM F477. Joints shall be 235 psi rated, in accordance with ASTM D3139 for the C900 (ductile iron) bell, and in accordance with ASTM D3212 for the sewer (SRD26) bell. Molded C900 bell depths shall comply with AWWA C907. Fabricated (4-inch, 10-inch and 12-inch) bell depths and molded sewer (SDR26) bell depths shall be in accordance with ASTM F1336. PVC transition adapters shall be manufactured by the Harrington Corporation (Harco), GPK Products, or approved equal.

Ductile iron – Ductile iron transition fittings shall be deep bell, push-on joint, and air test rated. The ductile iron material shall comply with ASTM A536, Grade 65-45-12 or 80-55-06. The bell depth shall be in accordance with ASTM F1336. Gaskets shall be of SBR rubber, in accordance with ASTM F477. Transition gaskets are not allowed. All ductile iron transition fittings shall have an interior coating of Protecto401 or approved equal. Ductile iron transition fittings shall be manufactured by the Harrington Corporation (Harco) or approved equal.

Saddles:

Sewer service saddles may be utilized for sewer lateral installations. All sewer service saddles shall be ductile iron with stainless steel straps, bolts, nuts, and washers. The nuts shall be coated to prevent galling. The saddle body shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12. The gasket material shall be SBR, in accordance with ASTM D2000. Saddles for PVC or DI laterals shall have an alignment flange. Sewer service saddles shall be as manufactured by Geneco, or approved equal. All stainless steel straps shall be pre-formed at the factory, to the specified outside diameters of the pipe.

SEWER LATERALS

Ductile iron laterals – For ductile iron mains, utilize mechanical joint fittings or an approved saddle with an alignment flange (Geneco or approved equal). For PVC mains, utilize an approved saddle with an alignment flange (Geneco or approved equal) or ductile iron fittings as specified above.

PVC laterals – utilize a saddle with an alignment flange (Geneco or approved equal) on PVC or ductile iron mains; utilize a mechanical joint tee with SDR 35 transition gaskets on ductile iron mains; or utilize PVC fittings as specified above on PVC mains.

The following table summarizes the materials to be utilized for sewer main to lateral connections:

	PVC Main	DI Main
DI Lateral	DI fitting or approved saddle	MJ fitting or approved saddle
PVC Lateral	PVC fitting or approved saddle	MJ fitting with transition gasket or approved saddle

Sewer laterals shall be in accordance with these Specifications and PWC standard details S.10, S.11, and S.12.

PRECAST CONCRETE MANHOLES

Pre-cast circular reinforced concrete manhole units shall be in accordance with ASTM C-478. The tongue and groove ends of the manhole sections shall be manufactured for jointing with rubber gaskets (i.e., con-seal). An eccentric cone shall be utilized on all manholes, unless otherwise approved by the Public Works Commission.

Manhole steps shall be placed in all manholes and shall be steel reinforced ($\frac{1}{2}$ " grade 60) copolymer polypropylene plastic steps in accordance with ASTM C-478 for material and design. The steps shall be spaced 16" on center with serrated treads and wide enough to stand on with both feet.

Manhole frames and covers shall be made of gray cast-iron, and the iron shall possess a tensile strength of not less than 18,000 psi. Cast iron shall conform to ASTM Specification A 48-83 Class 35. The frame and cover shall be manufactured by the same manufacturer. All castings shall be in accordance with Public Works Commission standard details. Any defective castings shall be removed and replaced.

Any special linings and coatings that are specified for a manhole and installed at the production facility, in the field, or during repairs, shall be applied in accordance with the applicable special coatings specification and the manufacturer's specifications for that material.

Camlock ring and covers shall be in accordance with Public Works Commission standard details. Camlock bolt head shall be compatible with PWC standard tool for turning camlock mechanism. Camlock ring and covers shall be installed as indicated on the drawings, in accordance with PWC standard details.

SELECT BEDDING MATERIAL

Select bedding material shall be crushed stone (No. 57 or No. 5), in accordance with Public Works Commission standard details. Bedding material shall be provided for all pipe materials.

INSTALLATION

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE LAYING

Pipe installation shall be in accordance with the manufacturer's instructions. Proper equipment shall be utilized to perform the work in a manner satisfactory to PWC. All pipes and fittings shall be carefully lowered into the trench in such a manner to prevent damage to the protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench. Pipe shall be carried into position and not dragged.

All dust, dirt, oil, tar (other than standard coating), or other foreign matter shall be cleaned from the jointing surfaces, and the gasket, bell, and spigot shall be lubricated with lubricant recommended by the manufacturer.

The pipe shall be laid upgrade, beginning at the lower end with the tongue or spigot ends pointing in the direction of the flow to the correct line and grade, unless otherwise approved by PWC. The pipe section to be installed shall be aligned by batter board or laser beam with the last installed pipe section. Mechanical equipment should not be used to assemble the pipe. Pipe shall be assembled in accordance

with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

At any time when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

All pipe shall be installed to the required lines and grades. Structures shall be installed at the required locations. The lines and grades of the pipe will generally be indicated by stakes parallel to the line of the pipe. The Contractor shall be responsible for installing the pipe to proper line and grade.

Pipe shall be visually inspected by shining a light between structures and /or by closed circuit television inspection. Any defects discovered, including poor alignment, shall be corrected as directed by the Public Works Commission.

The bottom of the trench shall be excavated to a minimum of four inches (4") below the outside bottom of the pipe being installed to allow adequate placement and compaction of bedding material prior to installation.

Select bedding material shall be placed a minimum of four inches (4") and a maximum of six inches (6") under the pipe for full width of the trench and halfway up the pipe on the sides. Bedding material shall be placed in layers not exceeding six inches (6") loose thickness for compacting by vibratory mechanical tamps under the haunches and concurrently on each side of the pipe for the full width of the trench. The final result shall be "Class B" bedding for rigid pipe. If the existing material under the pipe bedding material is unsuitable, the unsuitable material shall be removed and replaced with select bedding material (No. 57 or No. 5 stone), as authorized and approved by the Public Works Commission Project Coordinator.

The same material pipe shall be utilized from manhole to manhole, unless otherwise approved by PWC. If the section of pipe between manholes is 250 feet or less, no transitions will be allowed (either all PVC or all ductile iron). Should the length between manholes exceed 250 feet, only one transition will be allowed. Use of a C900 x SDR 26 adaptor shall be used to accomplish the transition. A transition is defined as the use of one C900 x SDR26 adaptor. No more than one (1) adaptor shall be utilized in any given manhole to manhole segment.

All manholes shall be constructed to Public Works Commission's standards. Installation shall be in accordance with ASTM C-891 and PWC standards.

Manholes shall be constructed of precast reinforced concrete circular sections installed on a base riser section with integral floor and shall be cored to accommodate the various pipe connections, as indicated on the drawings. Pipe connections to a manhole shall be by gasketed flexible watertight connections (boot for small diameter and A Loc for larger diameter pipe) or as approved by the Public Works Commission. The manhole size shall be in accordance with the following table, unless otherwise specified:

<u>Pipe Size</u>	<u>Manhole Diameter</u> **
24" and less	48" *
27" - 36"	60"
42"	72"

* Where interior drop structures are required, use 60" diameter as required in the Public Works Commission standard details.

** Where multiple connections or acute angles are required, larger diameter manhole may be required as indicated on the plans.

The invert channel shall be constructed of brick and mortar, in accordance with Public Works Commission standard details. **Precast inverts are not allowed.** The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel walls shall be constructed to three quarters (3/4) of the height of the crown of the outlet sewer and in such a manner not to obstruct maintenance, inspection or flow in the sewers. The inverts shall have a minimum slope of one (1) percent across the bottom of the manhole. A shelf shall be provided on each side of any manhole invert channel. Inverts in manholes with standing water will not be acceptable. The shelf shall be sloped not less than 1:12 (min) and no more than 2:12 (max). The bottom of the boot for the new sewer main or lateral shall be set one inch above existing shelf unless otherwise indicated.

When used in a paved street, the ring and cover shall be set in suitable mortar surrounded by a concrete collar in accordance with Public Works Commission standard details. When used in places other than in a paved street, the ring and cover shall be set to the grade shown on the plans or directed by the Public Works Commission. In unpaved areas cam-lock ring and cover shall be used. Camlock ring and cover shall be installed in accordance with Public Works Commission standard details.

The interior manhole riser joints, lift holes and grade adjustment rings shall be sealed with non-shrinking mortar to provide a watertight manhole. Lift holes sealed by the manufacturer with plastic caps do not require mortar seal. The hardened mortar shall be smooth to rub with no sharp edges. Use of grade rings with cam-lock ring and cover are not allowed, unless approved by the PWC Project Coordinator. **Use of grade rings is not allowed for above grade adjustments.**

All exterior manhole riser joints, including the joint at the cone, shall be sealed with an external rubber sleeve. The sleeve shall be made of stretchable, self-shrinking rubber, with a minimum thickness of 30

mils. The back side of each wrap shall be coated with a cross-linked reinforced butyl adhesive. The butyl adhesive shall be a non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the manhole joint and then overlap to create a fused bond between the rubber and butyl adhesive. The application shall form a continuous rubber seal for the life of the application. The sealing system shall be as manufactured by Concrete Sealants, Inc. (Con-Seal), Sealing Systems, Inc., or approved equal. The wrap shall be a minimum of six (6) inches in width, and shall be centered on the joint. All manhole joints (including the cone section to the last riser) shall be wrapped and sealed. Care shall be taken to prevent damage to the wrap during backfill operations. The manhole surface shall be prepared in accordance with manufacturer's specifications, prior to installing the joint wrap.

Materials shall not enter the sewer line during construction of the manhole. The manhole shall be kept clean of any and all debris or materials. Any debris or material that entered the manhole shall be immediately removed. This condition shall be maintained until final acceptance of the work.

CONNECTION TO EXISTING MANHOLES OR LIFT STATIONS

All connections to existing manholes and/or lift stations shall be approved by the Public Works Commission. Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manhole invert as is necessary shall be removed and a new invert shall be constructed to accommodate both new and existing flows. All work shall conform to the requirements specified for new manholes. The existing structure connection shall be cored and a flexible watertight connection (i.e., boot) installed. The boot shall be installed in accordance with Public Works Commission standard details and requirements. The Contractor shall coordinate and cooperate with the Public Works Commission's Project Coordinator.

PIPE TO MANHOLE CONNECTOR (BOOT)

A watertight, flexible pipe-to-manhole connector shall be utilized on all pipe to manhole connections, for both new and existing manholes and pipes, unless otherwise specifically authorized in writing by the Public Works Commission.

The connector assembly shall be the sole element to provide a watertight seal of the pipe to the manhole or other structure. The connector shall consist of a rubber gasket, an internal compression sleeve, and one or more external take-up clamps. The connector shall consist of natural or synthetic rubber and Series 300 non-magnetic stainless steel. No plastic components shall be allowed.

The rubber gasket shall be constructed of synthetic or natural rubber, and shall meet or exceed the requirements of ASTM C-923. The connector shall have a minimum tensile strength of 1,600 psi. The minimum cross-sectional thickness shall be 0.275 inches.

The internal expansion sleeve shall be comprised of Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction.

Installation of the connector shall be performed utilizing a calibrated installation tool furnished by the connector manufacturer. Installation shall require no re-tightening after the initial installation. Installation shall be done in accordance with the manufacturer's instructions.

The external compression take-up clamps shall be Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction. The clamps shall be installed utilizing a torque-setting wrench furnished by the connector manufacturer. Installation shall be done in accordance with the manufacturer's instructions.

The Contractor shall utilize the proper size connector in accordance with the connector manufacturer's recommendations. All dead-end pipe stubs shall be restrained in accordance with ASTM C-923.

The finished connection shall provide a sealing to a minimum of 13 psi, and shall accommodate a minimum pipe deflection of seven (7) degrees without the loss of seal.

The pipe to manhole connector shall be PSX: Direct Drive as manufactured by Press-Seal, or approved equal.

INSIDE DROP MANHOLE STRUCTURE

Inside manhole drop structures shall be constructed and installed in accordance with Public Works Commission standard details.

CLEANING

Prior to final inspection, all sanitary sewer laterals, mains, and manholes newly installed on the collection system shall be flushed and cleaned. During the flushing operation, the downstream manhole shall be closed with a watertight plug to protect the existing sewer main. All water and debris shall be removed and properly disposed of by the Contractor. This condition shall be maintained until the Public Works Commission issues final acceptance for the project.

TESTING

Completed sewers shall be tested in accordance with the provisions outlined below. The Contractor shall furnish all equipment, labor, materials, and pay all costs associated with the tests performed. The Contractor shall schedule all testing with the Public Works Commission's Project Coordinator, a minimum of 48 hours in advance. The Contractor shall cooperate with the Public Works Commission's Project Coordinator and furnish any needed assistance necessary to complete the required testing.

For annexation and/or retrofit projects: No testing shall be conducted prior to successful completion of the compaction testing.

For all other projects: No testing shall be completed until all utilities are installed, prior to preparation of the road subgrade. The Contractor may elect to perform testing to satisfy them that the sewer utility is

installed properly prior to commencing installation of other utilities. However, such testing shall not be construed as acceptance by PWC.

The deflection/mandrel test shall not be performed until a minimum of thirty (30) calendar days after backfill operations are completed and the area graded to final contours. In lieu of waiting thirty (30) calendar days, the Contractor has the option to have an independent testing laboratory verify that compaction has been completed to achieve the maximum density as shown in the detail. The location and elevation of the compaction testing shall be determined reviewed and approved by the Public Works Commission's Project Coordinator. The Contractor shall provide the Public Works Commission with a copy of the density testing results.

Compaction testing shall be done in accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems.

Vacuum Testing Manholes:

All precast sanitary sewer manholes installed by the Contractor shall be vacuum tested for leakage. This test shall be done in accordance with ASTM C-1244 and in the presence of a Public Works Commission Project Coordinator. The Contractor shall be responsible for providing all the necessary labor, materials, equipment, testing apparatus, and all other incidentals necessary to complete the vacuum test. All testing equipment utilized shall be approved for use in vacuum testing manholes.

Each manhole shall be tested after assembly. All lift holes shall be plugged with an approved non-shrink grout. All lines, including laterals, entering the manhole shall be temporarily plugged. The Contractor should take care to ensure that the pipes and plugs are secure in place to prevent them being drawn into the manhole. The test head shall be placed directly on top of the concrete surface of the manhole following the manufacturer's recommendations, rather than to the cast iron seating ring.

Manholes may be tested either prior to backfill or post backfill at the contractor's option. For pre-backfill testing, a vacuum of 10 inches of Mercury (inches Hg) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of Mercury (inches Hg). The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of Mercury to 9 inches of Mercury meets or exceeds the values indicated below:

<u>Manhole Depth</u>	<u>Diameter of Manhole</u>		
	<u>4' Diameter</u>	<u>5' Diameter</u>	<u>6' Diameter</u>
10' or less	25 sec	33 sec	41 sec
11' to 15'	38 sec	49 sec	62 sec
16' to 20'	50 sec	65 sec	81 sec
21' to 25'	62 sec	82 sec	101 sec

25' to 30'**74 sec****98 sec****121 sec**

Vacuum testing backfilled manholes is not recommended in the presence of groundwater. Vacuum testing a backfilled manhole that is subjected to hydrostatic pressure may exceed the design limits of the flexible connectors and could lead to failure of the structure, joints, and/or connectors. Where groundwater is present a reduction in the vacuum pressure applied to the manhole will be required. The vacuum shall be reduced by 1 inch of Mercury for every 1 foot of hydrostatic head between 12 feet and 21 feet. A vacuum test should not be performed when the hydrostatic head exceeds 22 feet. See the chart below:

Hydrostatic Head (ft)*	12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	**

*Hydrostatic head above the critical connector (critical connector is bottom most flexible connector)

**Do not perform vacuum test

If the manhole fails the initial test, the manhole shall be repaired by an approved method until a satisfactory test is obtained. All repair methods shall be approved by the Public Works Commission prior to being utilized. Retesting shall be performed until a satisfactory test is accomplished.

Mandrel Testing:

Deflection tests shall be performed on all PVC pipe installations. PVC pipe's maximum deflection after backfilling shall not exceed five (5) percent. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on the type of pipe manufactured and the applicable ASTM Standard. The PVC pipe shall be measured in compliance with ASTM D2122 "Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings". The Contractor shall supply all labor, equipment and materials necessary to perform the test in the presence of the Public Works Commission's Project Coordinator. The test shall be performed without mechanical pulling devices. The mandrel shall be constructed so as to preclude any yield in diameter, and with a pull line on each end to facilitate withdrawal. If the deflection exceeds the allowable, the Contractor shall remove and replace the pipe.

Air Testing:

Air testing shall be performed on all mains and laterals to determine acceptability. The length of sewer subject to an air test shall be the distance between two adjacent manholes. The tests shall be conducted in accordance with the appropriate ASTM standard. The air test shall be coordinated with the Public Works Commission. The Contractor is required to supply all equipment, labor, materials and pay all costs associated with the test performed.

Air Test for PVC Pipe

The low pressure air test on PVC pipe shall be performed with satisfactory results in accordance with ASTM F1417 "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using

Low-Pressure Air". The pipe, including lateral assemblies, shall be plugged and air added slowly until the internal pressure of the line is raised to 4.0 psi. After the pressure of 4.0 psi is obtained, regulate the air-supply so that the pressure is maintained between 3.5 and 4.0 psi for at least two (2) minutes, depending on air/ground temperature conditions. The pressure will drop slightly until equilibrium is obtained; however, a minimum of 3.5 psi is required. Once the 3.5 psi is maintained, the test will begin. If the pressure drops 1.0 psi within the time indicated below, the test fails.

Pipe Dia (in)	Minimum time (minutes)	Length for Min Time (ft)	Time for Longer Length (sec)
4	3:46	597	0.380L
6	5:40	398	0.854L
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	199	3.418L
15	14:10	159	5.342L
18	17:00	133	7.692L
21	19:50	114	10.470L
24	22:40	99	13.674L
27	25:30	88	17.306L
30	28:20	80	21.366L
33	31:10	72	25.852L
36	34:00	66	30.768L

The Contractor shall observe all safety precautions to include allowing no one in the manholes during testing, securing all plugs and providing additional plug bracing. The Contractor shall be required to furnish, install and remove after testing at no additional cost, a temporary glue cap/plug to be airtight for all cleanout stacks to accomplish air testing. The air pressure shall never exceed 8 psi. All gauges shall be accessible outside of the manholes.

HYDROSTATIC TESTS

After the ductile iron sewer pipe has been laid within the "protected" area and backfilled to finished grade, the pipe shall be subjected to a hydrostatic pressure test. All laterals within the "protected" area shall be ductile iron. All sewers subject to hydrostatic testing shall include (1) sewers entering or crossing streams, (2) sewers located less than 100 feet from any public or private water supply source including any WS-I waters or Class I or Class II impounded reservoirs, (3) where the minimum 18 inch vertical and 10 feet horizontal separation cannot be maintained between sewers and water mains (see NC DENR Regulations), or (4) as specified and/or indicated on the drawings. The Contractor will furnish all labor and material, including test pumps, plugs, and all other incidentals for making hydrostatic tests. Hydrostatic pressure testing shall be conducted on the completed main, including the laterals.

The duration of the pressure test shall be at least one hour or longer, as directed by the Public Works Commission. The hydrostatic pressure shall be 150 psi. Each section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the

pipe in a manner satisfactory to the Public Works Commission. Before applying the specified test pressure, all air shall be expelled from the pipe.

All joints showing visible leaks shall be made tight. Cracked or defective pipe, joints, laterals, and fittings discovered in consequence of the pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic test may be waived by the Public Works Commission in certain situations. The test shall be repeated until satisfactory to the Public Works Commission.

The results of the pressure tests shall be satisfactory as specified. All replacement, repair, or retesting shall be accomplished by the Contractor. All repairs shall be reviewed and approved by the Public Works Commission prior to backfill. The use of couplings, sleeves, etc. shall be reviewed and approved by the Public Works Commission prior to use.

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DIVISION 2 SITE WORK

02750 WASTEWATER FLOW CONTROL (BYPASS PUMPING)

GENERAL

The intent and purpose of these specifications is to provide wastewater flow control, i.e., bypass pumping, of the sanitary sewer flows during the Contractor's operations. The Contractor shall furnish all labor, materials, accessories, equipment and tools for performing all operations required to bypass pump sewage around a manhole or sewer section in which work is to be performed.

The Contractor shall provide all pumps, piping, and other equipment to accomplish this task; perform all construction; obtain all permits; pay all costs; and perform complete restoration of all existing facilities to equal or better condition to the satisfaction of the Fayetteville Public Works Commission. The Contractor shall be responsible for the design, installation, operation, and maintenance of the temporary bypass pumping system. The Contractor shall provide sufficient documentation to the Fayetteville Public Works Commission to demonstrate that he, or his designated subcontractor, have the experience in the design, installation, and maintenance of temporary bypass pumping systems.

RELATED SECTIONS

- A. Section 02305 – Pipe Bursting
- B. Section 02500 – Traffic Control
- C. Section 02730 – Sanitary Sewer System
- D. Section 02760 – Television Inspection
- E. Section 02766 – Sewer Line Cleaning
- F. Section 02780 – Cured-in-Place Lining

REQUIREMENTS

The Contractor shall be responsible for all aspects of the bypass operation, including but not limited to: providing access to install, move, and maintain the pumps in the proper position, traffic control, installation and removal of bypass equipment, pump monitoring, testing of the bypass system, re-fueling, maintenance, notification of property owners (should access to private property be necessary), wastewater and fuel spill containment, and removal and replacement of manhole cones (if necessary). The bypass system (pumps and piping) shall be monitored by Contractor personnel at all times, when the bypass operation is in effect.

The Contractor shall have all materials and equipment on site to immediately respond to any emergencies or other event that could impact the bypass system (i.e., leak in the discharge piping, pump failure, flooding, etc.). The Contractor shall have sufficient support staff and equipment to mobilize to repair and/or service any equipment within one (1) hour of notification, 24 hours a day, seven (7) days a week. In the event of an emergency, the Contractor shall provide an immediate response and fully cooperate with the Fayetteville Public Works Commission.

The Contractor shall install the bypass pumps, equipment, and discharge lines to minimize impacts to the property owners, residents, and environment. The Contractor shall be responsible for determining the best

location for the bypass equipment, to include, but not limited to, the need for any special provisions to ensure access for the customers, preventing the pumps and manholes from flooding, etc. Such special provisions include, but are not limited to: installation of ramps, excavation and burial of the bypass lines, temporary fencing, sandbagging, construction of berms, raising the pumps, etc. The Contractor bears all responsibility for the maintenance and restoration of any trenches, ramps, access, etc. necessary for the temporary bypass pumping operation.

The Contractor shall take appropriate steps to ensure that all pumps, piping and hoses that carry raw sewage are protected from traffic. The Contractor shall identify the proposed methods to protect the temporary bypass pumping system from traffic as part of the detailed temporary bypass pumping plan. Traffic control shall be performed in accordance with these Contract Documents.

The bypass pumping system shall be monitored by Contractor personnel at all times (24 hours a day, 7 days a week), when the bypass operation is in effect. The Contractor's personnel shall be on-site at all times (24 hours a day, 7 days a week), and stationed at the primary bypass pumps. Depending on the location and system set-up, it may be necessary for the Contractor to station personnel at each of the various bypass pump locations. Unless otherwise approved by the Fayetteville Public Works Commission, one (1) person cannot monitor multiple bypass pump locations. All bypass pumps, regardless of their location (primary or on secondary lines), shall be equipped with an automatic dialer (or other similar device). The Contractor personnel shall immediately respond to any issue regarding the temporary bypass pumping system. All temporary bypass piping shall be periodically monitored (patrolled from pumps to discharge), but no less frequently than once every 12 hours. The bypass pumping equipment shall be automated and capable of functioning without the assistance of an operator.

SUBMITTALS

All submittals shall be provided in accordance with these Contract Documents, and the requirements outlined herein. The Contractor shall submit a detailed bypass pumping plan to the Fayetteville Public Works Commission for approval, prior to initiating the bypass operation. The Contractor shall submit this information far enough in advance to allow sufficient time to complete the necessary coordination, including but not limited to obtaining permits (i.e., encroachments), getting permission from property owners to cross and/or utilize their property, and gaining any necessary regulatory approvals. Failure to submit a complete and comprehensive bypass pumping plan in a timely manner shall not be cause for any extension of the Contract Time.

The detailed temporary bypass pumping plan shall include the following information:

- Method of monitoring the pumps to ensure proper operation, to include method of notifying personnel (Fayetteville Public Works Commission and Contractor) in the event of an emergency, activation of back-up pumps, etc.
- Method of monitoring upstream system levels to ensure surcharging does not result in back-ups into buildings, overflows, etc.
- The amount, if any, of any required surcharging.
- Method to initiate back-up pumps.
- Map showing general location of the pumps and bypass lines. This shall include means to maintain access to driveways, etc.
- Measures to secure the bypass system (lines, pumps, etc.) from traffic, vandalism, high stream flows, etc.

- Method of plugging (and securing the plug(s)) and type of plugs.
- Size and location of manholes or other access points for suction and discharge piping.
- Size of pipeline(s) or conveyance system(s) to be bypassed.
- Number, size, material, location, and method of installation of suction piping.
- Number, size, material, location, and method of installation of discharge piping.
- Bypass pump sizes, capacities, and number of each size to be provided on-site, including all primary, secondary, and spare pumping units.
- Calculations of static lift, friction losses, minimum inlet submergence, and flow velocity (pump curves showing pump operating range shall be submitted). Calculations shall be signed and sealed by a licensed Professional Engineer registered in the State of North Carolina. Calculations shall be provided for both the peak flow rate and a normal daily rate (see PUMPING AND BYPASSING section for sizing requirements).
- Measures to protect discharge manhole(s) or structure(s) from erosion and damage due to the bypass operation.
- Erosion control measures.
- Emergency contact information for the personnel responsible for the pump operation.
- Emergency contact information for Contractor personnel to respond in the event of an emergency.
- List of available resources (equipment, materials, personnel) and contact information for emergency response.
- Method to contain potential releases of sewer flow from air release valves.
- Contingency plan for responding to potential sewer spills caused by weather, vandalism, acts of God, etc. The plan shall include communication protocols, available resources, and the steps to be taken in the event of an emergency.

No bypass operations shall proceed until all bypass submittals have been reviewed and approved by the Fayetteville Public Works Commission.

COORDINATION

The Contractor shall fully coordinate their temporary bypass pumping operations with the Fayetteville Public Works Commission. It is the Contractor's responsibility to fully determine the scope and location of the temporary bypass pumping system. As outlined in these Contract Documents, the Fayetteville Public Works Commission may provide assistance with the building and maintenance of access roads, clearing of easements, etc. All coordination (to include location of the pumps and discharge lines) shall be fully discussed and agreed to prior to commencement of bypass operations.

The Contractor shall schedule a coordination meeting with the Fayetteville Public Works Commission and other personnel (Contractor, bypass sub-contractor, etc.) a minimum of three (3) business days prior to starting the temporary bypass pumping system. The purpose of this coordination meeting is to ensure that the Contractor and their sub-contractors have a good understanding of the requirements and expectations of operating the temporary bypass pumping system, discuss contingency plans (to include protocols for emergency contacts), identify location(s) of pumps, verify necessary materials (repair sleeves, containment devices, etc.) are on-site and available, and any other items necessary to ensure that the Fayetteville Public Works Commission has confidence that the appropriate personnel can operate and maintain the temporary bypass pumping system. Should, for any reason, the Fayetteville Public Works Commission deem that the Contractor and/or their sub-contractor is not prepared to operate and maintain the temporary bypass pumping system, the temporary bypass pumping system shall not be started. The Contractor shall take all necessary steps to address any concerns to the satisfaction of the Fayetteville Public Works Commission. Upon

completion of those actions, another coordination meeting shall be held, in order for the Fayetteville Public Works Commission to confirm that the Contractor and their sub-contractor is prepared to operate and maintain the temporary bypass pumping system. This process will be repeated until the Fayetteville Public Works Commission is satisfied that the Contractor and their sub-contractor are prepared to operate and maintain the temporary bypass pumping system. No additional contract time will be granted for this delay.

The temporary bypass pumping system shall run for a minimum of 24 hours, or longer as deemed by the Fayetteville Public Works Commission, prior to any activity occurring (cleaning, closed circuit television {CCTV}, etc.) within the main(s) being bypassed.

FLOW CONTROL PRECAUTIONS

Where the raw sewage flow will be blocked during the Work as a result of the temporary bypass pumping operation, the Contractor shall take all necessary precautions to protect the public health. No septic conditions shall be allowed due to Contractor's operations. The sewer system (mains, manholes, laterals, etc.) shall also be protected from damage. The following occurrences shall not be allowed:

1. No sewage shall be allowed to back up into any homes or buildings.
2. No sewage shall overflow any manholes, cleanouts or any other access to the sewers.
3. Users upstream of the project area shall be able to use all their water and sewer utilities without interruption or limitations.

If any of the above occur or are expected to occur, the Contractor shall take immediate action to alleviate one or all of the conditions. Additionally, the Contractor is required to observe the conditions upstream of the plug and be prepared to immediately increase bypass pumping or release the flows, as required. Any damage claims resulting from the Contractor's failure to properly maintain sewer flows shall be the Contractor's responsibility.

All sump pumps, bypass pumps, trash pumps or any other type pump which pulls sewage or any type of material out of the sanitary sewer system shall discharge into another sanitary sewer manhole, or appropriate vehicle or container acceptable to the Fayetteville Public Works Commission. Under no circumstances shall untreated sanitary sewer be discharged, stored or deposited on the ground, swale, road or open environment. The Contractor shall not allow any flow of sewage onto private property, streets, or into creeks and drainage systems. Damage due to negligence of the Contractor, including, but not limited to, flooded dwellings, damaged property, damaged driveways, etc., shall be corrected immediately by the Contractor at no additional cost to the Fayetteville Public Works Commission.

PLUGGING AND BLOCKING

In some applications, the wastewater flow may be plugged and contained within the capacity of the collection system. This shall only be done when it has been determined the system can accommodate the surcharging without any adverse impact. The Contractor has the sole responsibility for determining whether the system can accommodate surcharging. If this option is selected, the Contractor shall be responsible for continuously monitoring the system to ensure no sewer spills or overflows occur.

A sewer line plug shall be inserted into the line at a manhole upstream from the section being surveyed or repaired. The plug shall be so designed that all or any portion of the operation flows can be released. The Contractor shall secure the plug, to prevent it from being dislodged and moving downstream. Flows shall be bypassed for the initial CCTV inspection and shall be bypassed throughout the duration of the work, to

include the final CCTV inspection. Flows shall be bypassed in accordance with the approved temporary bypass pumping plan. Upon acceptance of the work by the Fayetteville Public Works Commission, the temporary bypass pumping system shall be removed and flows restored.

PUMPING AND BYPASSING

The Contractor, when and where required, shall divert sewer flows for the sewer pipe rehabilitation process, cleaning, television inspection, pipe repairs, manhole replacement and/or rehabilitation, obstruction removals, or other related as required to complete the Work. The pumps and bypass lines shall be of adequate capacity and size to handle and prevent backup or overflow for all flows.

The temporary bypass pumping system shall be designed to maintain the flows necessary to meet the requirements of each particular location. The temporary sewer bypass system shall have the capacity to handle the flows outlined in these Contract Documents. The temporary sewer bypass system shall be sized to handle 2.5 times the average daily flow rate, or the specified peak flow – whichever is greater.

The Contractor shall be responsible for furnishing the necessary labor and supervision to set up, operate, and maintain the temporary bypass pumping system. A “set up” consists of the necessary pumps, conduits and other equipment to divert the flow of sewage, from the start to finish of work performed. Each “set-up”, regardless of location, shall have Contractor personnel on-site at all times (24 hours a day, 7 days a week) and stationed at the pumps, unless otherwise approved by the Fayetteville Public Works Commission. The temporary bypass pumping system shall include:

- A minimum of one (1) redundant pump so that the temporary bypass pumping system is capable of transmitting the peak flow with the largest duty pump out of service.
- Pumps shall be provided with a means of automatic control via level sensing. Systems requiring manual starting and/or stopping shall not be allowed.
- All equipment (primary and secondary pumps) shall be equipped in a manner to keep noise to a maximum of 65 dBA at 30 feet.
- An automatic dialer (or similar) to immediately notify (in a sequential operation) Contractor and Fayetteville Public Works Commission personnel in the event of equipment failure. The automatic dialer shall be set to issue notifications prior to flow level reaching critical elevations and having a spill occur. All bypass pumps (regardless of location) shall be equipped with an automatic dialer (or similar).

The temporary bypass pumping system shall be provided in such a way as to maintain access for businesses and residences. The Contractor shall be responsible for determining the best location for the bypass equipment, and the need for any special provisions to ensure access for the residents and businesses. Such special provisions include, but are not limited to: installation of ramps, excavation and burial of the bypass lines, etc. The Contractor shall use bridges over the bypass lines, temporary lines under driveways, alternate routes, or other means to accomplish this item. The bypass plan submittal shall indicate the means of maintaining access. The Contractor bears all responsibility for the maintenance of any trenches, ramps, etc. necessary for the bypass operation.

Pumps, equipment, and bypass lines shall be continuously (24 hours a day, 7 days a week) monitored by on site Contractor personnel capable of starting, stopping, refueling and maintaining these pumps during the Work. The temporary bypass pumping system shall be provided with an automatic dialer (or other similar device) that will immediately notify (in a sequential operation) the Contractor and the Fayetteville Public Works Commission in the event of equipment failure. All bypass pumps (regardless of location) shall be

equipped with an automatic dialer. This automatic dialer (or similar) shall be set to issue notifications prior to flow levels reaching critical elevations and having a spill occur.

The automatic dialer shall be set to issue notifications through a sequential operation. Automatic dialers that are not set up for sequential notifications shall not be acceptable. The Contractor's personnel shall be the first to receive any notifications from the automatic dialer. The automatic dialer shall only notify the PWC personnel after all Contractor notifications have been ignored and/or not responded to. The Contractor shall properly adjust the level at which the automatic dialer initiates notification to provide adequate time for the sequential notification to occur. If the PWC personnel are notified by the automatic dialer, the PWC personnel shall assume that a spill is occurring or is imminent, and respond accordingly. The Contractor shall be responsible for all costs for the PWC to mobilize and respond to the notification, regardless if a spill occurred or not.

In some applications, it may be necessary to surcharge the system in order to ensure proper pump operation. This shall only be done when it has been determined the system can accommodate the surcharging without any adverse impact. The Contractor has the sole responsibility for determining whether the system can accommodate surcharging. In the event surcharging is necessary, the Contractor shall be responsible for continuously monitoring the system to ensure no sewer spills occur.

All bypass piping shall successfully pass a hydrostatic test prior to bypassing the sewer flows. The hydrostatic test pressure shall be no less than the expected discharge pressures, and shall be held for a minimum of one (1) hour. All testing shall be observed by the Fayetteville Public Works Commission. Testing shall be coordinated with the Fayetteville Public Works Commission a minimum of 24 hours in advance.

SPILL RESPONSE

The Contractor shall not discharge or pump any sewage, solids, or debris on the ground, streets, storm water system, ditches, or streams. Any sewage spills shall be immediately reported to the Fayetteville Public Works Commission Water Resources Construction Department, (910) 223-4716. After normal business hours, the Contractor shall contact the Fayetteville Public Works Commission Dispatch Center, (910) 678-7400 or (910) 323-0178. The Contractor shall take complete responsibility for all costs related to the clean-up of the spill, including any fines issued by the North Carolina Department of Environmental Quality (NC DEQ).

In the event that raw sewage (in any quantity) is spilled, discharged, leaked or otherwise deposited in the open environment, due to the Contractor's work, the Contractor is responsible for any cleanup of solids and disinfection of the area affected. This work will be performed at the Contractor's expense with no additional cost to the Fayetteville Public Works Commission. The Contractor is also responsible for complying with any and all regulatory requirements in regards to the size spill with no additional cost to the Fayetteville Public Works Commission. The Contractor shall cooperate fully with the Fayetteville Public Works Commission and the applicable State agencies in responding to and cleaning up the spill. Any work completed by the Fayetteville Public Works Commission in responding to a spill caused by the Contractor's operations shall be billed to the Contractor.

Where sewage has backed up into a property due to any aspect of the Contractor's operation, the Contractor shall immediately notify the Fayetteville Public Works Commission, inspect the property with the Fayetteville Public Works Commission and agree on remedial measures. The Contractor shall be responsible for all cleaning, repair and/or replacement of damaged property, temporary relocation of all occupants of the affected properties, if required, all to the satisfaction of the property owner. These actions shall be undertaken

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immediately upon learning of the backup. Cleaning shall be performed by firms specializing in this type of work. All costs associated with the cleaning, repair, replacement of damages, occupant accommodations, insurance and spill remediation shall be borne by the Contractor. All remediation measures required as part of a spill response are part of acceptance of the project, and final payment shall not be made until such time all required measures are addressed and approved by the appropriate regulatory agency.

*** END OF SECTION ***

DIVISION 2 SITE WORK

02762 MANHOLE LINING – POLYMERIC

GENERAL

The Contractor shall furnish all labor, materials, equipment and incidentals required and install the monolithic polymeric manhole lining system and appurtenances as specified herein. The lining system shall be used to rehabilitate the interior of all designated existing sewer manholes as indicated within these Contract Documents and as shown on the Contract Drawings. The installed lining system shall withstand all loading conditions and hydrostatic pressure.

The manhole lining system shall consist of a cementitious base coat applied to the cleaned and prepared manhole surfaces, followed by the polymeric lining system. The Contractor shall furnish all necessary materials, labor, and equipment necessary to properly prepare the surfaces and apply the polymeric lining system as specified herein. The lining system shall be compatible with the applied chimney seal. The chimney seal shall be in accordance with these Contract Documents.

The Contractor is responsible for properly preparing the existing manhole for lining prior to the installation of the lining system, including stopping all leaks, flow control, patching voids, removing steps/manhole rungs, cleaning (to include water blasting), removing rubble, root removal, debris removal, etc.

The Contractor is advised that the presence or absence of any leakage through the manhole walls as seen in the Contractor's independent inspection prior to bidding is dependent upon the ground water levels and conditions at the time of the inspections. The Contractor shall reflect his/her assumptions and judgments on leakage through the manhole walls based on this information in the unit prices bid. All leakage shall be stopped prior to installing the lining system. No additional payment will be made to the Contractor for repairing leaks not visible prior to bidding.

Cleaning, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, the Contractor shall comply with the manufacturer's minimum recommendations.

RELATED SECTIONS

- A. Section 02500 – Traffic Control
- B. Section 02730 – Sanitary Sewer System
- C. Section 02750 – Wastewater Flow Control
- D. Section 02765 – Manhole Chimney Seals

REFERENCE STANDARDS

This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

A. American Concrete Institute (ACI)

- a. ACI 224.1R – Causes, Evaluation and Repair of Cracks in Concrete Structures
- b. ACI 301 – Specifications for Structural Concrete
- c. ACI 308R – Guide to Curing Concrete
- d. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
- e. ACI 515 – A Guide to the use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete
- f. ACI 546.R – Concrete Repair Guide
- g. ACI 546.3R – Guide for the Selection of Materials for the Repair of Concrete

B. ASTM International (ASTM)

- a. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
- b. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
- c. ASTM D 2794 – Standard Test Method for Resistance of Organic Linings to the Effects of Rapid Deformation (Impact)
- d. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser
- e. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air
- f. ASTM D 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- g. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
- h. ASTM D 4541 - Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers
- i. ASTM D 6944 Standard Test Method for Measuring Humidity with a Psychrometer
- j. ASTM D 7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
- k. ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- l. ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- m. ASTM F 2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
- n. ASTM G 210 – Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus

C. International Concrete Repair Institute (ICRI)

- a. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
 - b. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays
- D. National Association of Corrosion Engineers International (NACE)
- a. NACE Publication 6D-173 – A Manual for Painter Safety
 - b. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
 - c. NACE SP0892 – Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
 - d. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete
- E. Occupational Safety and Health Administration (OSHA)
- a. Safety and Health Standards (29 CFR 1910/1926)
- F. The Society for Protective Coatings (SSPC)
- a. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
 - b. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects
- G. Standard Practice for the Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test (S.W.A.T.)

Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents or the last version of the document before it was discontinued.

In case of conflicting requirements between this specification and these referenced documents, the more stringent shall govern.

SUBMITTALS

Submit, in accordance with Section 01300 – Submittals and Section 01000 – Special Conditions, letters, shop drawings, and product data showing materials of construction, installation equipment and details of installation for the monolithic lining system including:

1. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.
2. Safety Data Sheets: Copies of current SDS for any materials brought on-site including all clean-up solvents, repair or resurfacing mortars and lining materials.
3. Qualification Data: Approved Installer Training Certificates from manufacturer.

4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
5. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.
6. Construction Details: Copies of manufacturer's computer generated standard lining details for specified materials, including: leading edge termination, metal embedment in concrete, joint detail, wall-to-slab detail, pipe termination detail, and any other detail at the request of the Public Works Commission.

GUARANTEE

The installed lining system shall be guaranteed by the Contractor and Manufacturer for a period of five (5) years from the date of final acceptance. During this period, all defects discovered in the lining, as determined by the Public Works Commission, shall be repaired or replaced in a satisfactory manner by the Contractor at no cost to the Public Works Commission. All proposed repairs shall be submitted, reviewed, and approved by the Public Works Commission prior to the Contractor completing any work.

QUALITY ASSURANCE

The supplier shall be responsible for the provisions of all test requirements specified in the above referenced ASTM Standards as applicable. In addition, all lining products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Public Works Commission. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all lining products and materials approved for this Contract shall be borne by the Public Works Commission.

Inspections of the lining products and materials may also be made by the Public Works Commission after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

The Contractor shall initiate and enforce quality control procedures in accordance with the applicable ASTM, National Association of Corrosion Engineers (NACE), the Society for Protective Coatings (SSPC) standards, and in accordance with the manufacturer's instructions.

Acceptable Manufacturers: A company with a minimum of five (5) years experience in manufacturing of, and providing technical service for chemical resistant systems equivalent to those specified herein.

The manufacturer of the lining system of manholes shall be a company that specializes in the design and manufacture of corrosion protection systems for manholes. The Contractor shall be completely trained in leak repair, surface preparation, installation of the lining system, and corrosion materials application on manholes. The lining system materials/products shall be suitable for installation in a severe hydrogen sulfide

environment without any deterioration.

The applicator shall be trained and certified by the manufacturer for the handling, mixing, application and inspection of the manhole lining system as described herein.

DELIVERY, STORAGE AND HANDLING

Care shall be taken in shipping, handling and placing to avoid damaging the lining products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Public Works Commission.

Any lining product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

While stored, the lining products shall be adequately packaged and protected. The lining products shall be stored in a manner as recommended by the manufacturer. The Contractor shall comply with the following:

1. Store the materials in sealed, original manufacturer's containers.
2. Store materials in a protected area out of direct sunlight.
3. Keep containers clean and undamaged.
4. Comply with manufacturer's published storage temperature and shelf life recommendations.
5. Protect all materials from freezing.

Deliver products to the job site in manufacturer's original, unopened containers bearing manufacturer's name and label and the following information

1. Product name.
2. Product description (generic product classification).
3. Manufacturer's lot number.
4. Color.

All materials shall be handled in accordance with their Safety Data Sheets (SDS) and the manufacturer's instructions.

PRODUCTS

The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. The manufacturer of corrosion protection products shall have a minimum of 10 years experience in the production of the lining products utilized and shall have satisfactory installation record. All rehabilitation products shall be manufactured by a single manufacturer, or the Contractor shall provide documentation that the materials are compatible with each other.

All lining materials shall be approved by U.S. EPA for sewer system rehabilitation.

The lining system shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20°F to 100°F.

Any polymeric lining system that cannot provide test results of ASTM G 210 will not be approved for this application. (ASTM G 210– Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus).

The polymeric lining system shall provide a minimum service life of 50 years.

INFILTRATION CONTROL MATERIAL

Infiltration control materials shall be rapid-setting, high early strength, hand applied cementitious material for stopping infiltrating water and making repairs to concrete, brick or other masonry constructed manholes. The material shall be non-shrinking, non-metallic and non-corrosive. It shall be formulated at the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the lining material to be used. The material shall have the following minimum characteristics:

1. Compressive strength (in accordance with ASTM C-109):

1 hour	1,000 psi
1 day	2,400 psi
7 day	3,500 psi
28 day	4,500 psi

2. Tensile strength (in accordance with ASTM C-109):

1 day	175 psi
7 day	250 psi
28 day	350 psi

3. Bond Strength (in accordance with ASTM C-321)

30 minutes	50 psi
1 day	85 psi

4. Freeze-Thaw Durability (in accordance with ASTM C-666)

100 cycles	no loss
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5. Set Time (in accordance with ASTM C-191-92)

Initial	30 to 60 seconds
Final	1 hour

6. Shrinkage (in accordance with ASTM C-157) – 0%

Infiltration control material shall be CEMTEC Hydraulic Cement by A.W. Cook Cement; Mainstay ML-10 by Madewell Products Corporation; PLS-505 by Protective Liner Systems; Quad-Plug by Quadex; or approved equal.

Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to

otherwise prepare the manhole surfaces for the lining installation shall be suitable for the intended purpose and shall be compatible with the lining system as certified by the manufacturer.

All leaks shall be stopped prior to the installation of the lining system.

PATCHING MATERIAL

Voids in the existing manhole walls, benches, or damaged inverts must be repaired prior to installing the lining system. The patching material shall be a rapid setting, high early strength, corrosion resistant hand mixed and hand applied cementitious material intended for filling voids and repairing inverts in concrete, brick or other masonry constructed manholes. It shall be formulated in the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the lining material to be used. The material shall have the following minimum characteristics:

1. Compressive strength (in accordance with ASTM C-109):

1 day	3,500 psi
7 day	4,900 psi
28 day	5,500 psi
2. Tensile strength (in accordance with ASTM C-109):

1 day	200 psi
7 day	250 psi
28 day	550 psi
3. Freeze-Thaw Durability (in accordance with ASTM C-666)

100 cycles	no loss
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4. Set Time (in accordance with ASTM C-191-92)

Initial	15 to 20 minutes
Final	20 to 25 minutes

Patching material shall be CEMTEC Rapid Cure Vertical Grade by A.W. Cook Cement; Mainstay ML-72 by Madewell Products Corporation; Hyperform by Quadex; or approved equal.

All voids and other repairs shall be completed prior to the installation of the lining system.

CEMENTITIOUS BASE COAT

The cementitious base coat shall be a pumpable Portland based 100% pure calcium aluminate cement. The lining shall be installed via trowel or low-pressure application. The materials shall be suitable for all the specified design conditions.

The cementitious base coat shall be a system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes. The cementitious lining system shall be Mainstay ML-CA by Madewell Products Corporation; Aluminaliner by Quadex; CEMTEC Silatec CAM by A.W. Cook Cement; PLS-507 by Protective Liner Systems; or approved equal.

The cementitious base coat shall be applied to the following minimum total thicknesses for all lining systems:

- 1. For block and cast concrete manholes in good condition, apply to a minimum thickness of one-half (0.5) inch.**
- 2. For all brick manholes and for block or cast concrete manholes in poor condition, apply to a minimum thickness of one (1.0) inch.**

It is the Contractor's responsibility to determine the required thickness of the cementitious base coat, based on the manhole condition, groundwater conditions, etc. to ensure the long-term integrity of the installed lining system.

The cementitious base coat shall be installed on the walls of existing manholes, from the invert to the manhole frame, as further directed below. All cementitious lining shall be troweled to consolidate the material, and then brushed to provide a profile surface for application of the polymeric topcoat. The initial trowelling shall be done in an upward motion, to compress the material into voids. The Contractor shall ensure that the cement is not over-troweled. The cured cementitious base coat surface shall be continuous with proper sealing connections to all unsurfaced areas. The Contractor shall take all measures to ensure that the cementitious base coat properly cures. The use of curing compounds is prohibited.

The materials used in the cementitious base coat shall be mixed on site in accordance with the manufacturer's recommendations. Water shall only be added to the materials during the mixing process and prior to material pumping or spray application. No water shall be added at the nozzle.

The cementitious base coat, when cured, shall have the following minimum characteristics at 28 days as measured by the applicable ASTM standards referenced herein:

1. Density (when applied) – 135 pounds/cubic foot, plus/minus 5 pounds/cubic foot
2. Compressive strength (in accordance with ASTM C-109):

1 day	2,800 psi
28 day	8,000 psi
3. Bond Strength (in accordance with ASTM C-321)

28 day	1,700 psi
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4. Flexural Strength (in accordance with ASTM C-78)

28 day	1,500 psi
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5. Shrinkage (in accordance with ASTM C-157) – 0%
6. Freeze-Thaw Durability (in accordance with ASTM C-666)

300 cycles	no loss
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The cured cementitious base coat shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole.

Where the manhole to be rehabilitated is subject to vehicular traffic, the cementitious lining shall be installed to no closer than one (1) inch below the bottom of the manhole frame so as to avoid transfer of impact loads to the new liner. Where the manhole to be rehabilitated is not subject to vehicular loads, the cementitious liner shall be continuous up to the manhole frame.

POLYMERIC LINING SYSTEM

Materials

The lining system top coat shall be a polymeric system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes. The polymeric lining system may be a two part 100% solids epoxy, epoxy mortar or polyurethane resin system. Accepted manufacturers are:

Epoxy Systems: Mainstay DS-5 Epoxy by Madewell Products Corporation;
 PLS-614 by Protective Liner Systems;
 Raven 405 by Raven Lining Systems;
 Dura-Plate 5900 HB Epoxy by Sherwin-Williams;
 Dura-Plate 6100 HP Epoxy by Sherwin-Williams; or approved equal.

Epoxy Mortar: Dura-Plate 5900 HB Epoxy Mortar by Sherwin-Williams; or approved equal.

Polyurethanes: Sher-Flex by Sherwin-Williams; or approved equal.

The lining system top coat shall be a 100% solids, epoxy polymer protective barrier material specifically designed to protect concrete and steel surfaces in severe wastewater environments, including associated abrasive physical attack and chemical attack from sewer gases and organic acids generated by microbial sources.

Epoxy lining shall be capable of achieving the specified thickness in a single coat application.

The polymeric top coat materials shall be applied by low pressure spray or hand applied to the minimum dry film thickness of 150 mils.

The polymeric materials shall be suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic and/or commercial sewage. The polymeric material shall be compatible with the cementitious base coat material, as per manufacturer's recommendations.

Installation

The polymeric lining system shall be installed over the cementitious base coat previously applied on the inverts, benches, and walls of the designated manholes. The polymeric liner shall be applied only after the cementitious base coat has properly cured, in accordance with the manufacturer's instructions.

The Contractor shall saw-cut the existing walls, benches, and/or inverts in order to "tie-in" the polymeric lining.

The cured surface of the polymeric lining system shall be smooth and continuous with proper sealing connections to all unsurfaced areas. The sprayed-on liner shall be troweled to consolidate the product into the profile of the substrate or resurfacing mortar.

When cured, the monolithic polymeric lining system shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage. The polymeric lining shall be continuously bonded to the cementitious base coat.

Where the manhole to be rehabilitated is subject to vehicular traffic, the polymeric lining system shall be installed to no closer than one (1) inch below the bottom of the manhole frame so as to avoid transfer of impact loads to the new liner. In those locations where the manhole is subject to vehicular traffic, a chimney seal shall be installed to “bridge” the gap between the manhole frame and the polymeric lining system. Where the manhole to be rehabilitated is not subject to vehicular loads, the polymeric lining system shall be continuous up to the manhole frame. **The polymeric lining system shall not be applied to the manhole frame.**

SPECTRASHIELD LINING SYSTEM

In addition to the above products and materials, the “Spectrashield” lining system as furnished by CCI Spectrum, Inc. is an approved equal. All products and materials for the “Spectrashield” lining system shall be in accordance with CCI Spectrum, Inc. requirements. Manhole preparation shall be in accordance with the following:

- Stop all active leaks and infiltration utilizing an approved infiltration control material
- Patch all voids in the manhole utilizing an approved patching material
- Install the “Spectrashield” lining system to build back the manhole profile (the minimum thickness shall be **500 mills**)

All work shall be in accordance with these Contract Documents and as directed by the Public Works Commission.

INSTALLATION

GENERAL

All work shall be in accordance with these Contract Documents and as directed by the Public Works Commission.

The Contractor shall take appropriate action to comply with all local, state and federal regulations including those set forth by OSHA, EPA, the Public Works Commission and any other applicable authorities.

Prior to conducting any work, the Contractor shall perform an inspection of the structure to determine any need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.

The Contractor shall clean each sewer manhole and shall properly dispose of any resulting material. The Contractor shall take sufficient precautions prevent any debris from their operations to enter the sewer system.

All surface washing, abrasive blasting, waterjetting, grinding, patching, filling and preparation shall be completed by the Contractor in accordance with the lining system manufacturer's recommendations.

The Contractor shall notify all property owners who discharge sewage directly to the manhole being rehabilitated that their service will be discontinued while the lining system is being installed, cured and active pipe and service connections reopened. The Contractor shall notify individual property owners at least 48 hours in advance, giving the date, start time and estimated completion time for the work being conducted.

Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment. Material shall not be applied during freezing weather conditions. No material shall be placed when the ambient air temperature is below 40°F, or when the temperature is anticipated to fall below 32°F in the next 24 hours.

Spray equipment shall be specifically designed to accurately ratio and apply the liner system.

SURFACE PREPARATION

Surface preparation methods may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, detergent water cleaning, and shall be suited to provide a surface compatible for installation of the liner system. Remove all dust, biological growths, grease, oil, paint or any other surface contaminants or coatings from all surfaces to be lined, including manhole walls, corbelling and manhole frame. The choice of surface preparation lies solely with the Contractor. The Contractor shall determine the required surface preparation method based upon the condition of the manhole, the presence of potential contaminants, access to perform the work, and the required condition of the surface to apply to specified lining system, as required by the manufacturer.

The surface preparation method shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, brick or mortar, contaminants or debris, and shall display a surface profile suitable for application of the manhole lining system. The Contractor shall prepare the surface in accordance with the applicable NACE and/or SSPC recommendations for the specified lining system.

Coatings that cannot be removed shall be properly prepared (in accordance with these Specifications) to obtain and insure adequate bonding of the cementitious base coat material.

The Contractor shall conduct a visual inspection of each manhole after it is cleaned. All active infiltration leaks shall be plugged or sealed with an appropriate infiltration control material compatible with the cementitious base coat. The Contractor shall remove all loose mortar and rubble from existing walls, benches and inverts. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method. The Contractor shall prepare manhole to receive the cementitious base coat as necessary by reshaping and repairing benches, inverts, and walls where required. All interior surfaces shall be prepared as recommended by the base coat lining manufacturer. Minimum requirements are as listed below.

1. All cracks and other voids must be repaired and filled with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and manhole walls. Patching compounds shall be compatible with the proposed lining system. All patches shall be smooth and even with the manhole wall.
2. All existing manhole rungs/steps shall be removed and the void patched or cut off and ground smooth.
3. All surfaces shall be suitably prepared for the required bonding of the cementitious base coat as recommended by the manufacturer.

Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to the start of the protective coating system application, the Contractor shall pre-clean as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6, Severe Service. Surface preparation procedures shall be in accordance with NACE SP0892, SSPC-SP13/NACE No. 6 and ICRI Guideline No. 310.2. Surface preparation shall expose aggregate and obtain a uniform surface texture resembling the minimum recommended concrete surface ICRI-CSP profile. The Contractor shall remove all dust, biological growths, grease, oil, paint or any other surface contaminants or coatings from all surfaces to be lined, including any metal work to be coated.

Existing Concrete Application: Existing concrete structures to receive the protective coating system must be capable of withstanding imposed loads. All oil, grease, waste and chemical contaminants shall be removed from the surface of the concrete prior to preparation in accordance with NACE SP0892 and SSPC-SP13/NACE No. 6. Concrete surfaces must be sound and capable of supporting the proposed polymeric lining system. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP. The appropriate cementitious repair mortar or epoxy cementitious repair material shall be applied to the entire, prepared surface to level surface suitable for coating.

Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor, and will produce a finished product meeting the requirements of these Contract Documents. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.

All concrete surfaces shall be prepared to a minimum of SSPC-SP13 prior to installation of the polymeric lining system.

Level or grind concrete substrates to produce a uniform and smooth surface, including removal of all sharp edges, ridges, form fins, and other concrete protrusions.

FLOW CONTROL

It is the intent of these Contract Documents that the Contractor will utilize flow-through plugs or other means to complete the manhole rehabilitation without the use of a temporary sewer bypass system. All temporary flow-through plugs shall be removed upon the completion of each step of the rehabilitation process (cementitious base coat, polymeric top coat). The Contractor shall be responsible for ensuring that their flow control system does not result in any sanitary sewer being discharged to the environment.

If required to properly complete the lining, the Contractor shall provide temporary bypass pumping of sewage flows where and when the rehabilitation work is being performed. The temporary bypass pumping shall be in accordance with Specification Section 02750 – Wastewater Flow Control and these Contract Documents.

INFILTRATION CONTROL

After surface cleaning, any visible leaks or infiltration shall be stopped, prior to installation of any patching material or the cementitious base coat. Infiltration and leaks shall be stopped utilizing hydraulic cement or other “typical” methods (i.e., oakum). It is the intent of these Contract Documents that the Contractor will take all necessary steps to stop all but the very large leaks without the use of chemical grout. Should a significant, very large leak be encountered that would require significant effort, large quantities of chemical grout, and/or other extreme measures, the method and cost to stop that leak shall be mutually agreed upon by the Contractor and the Public Works Commission, prior to commencing work.

A complete, watertight seal shall be provided at pipe and manhole wall connections. The Contractor shall submit details of how the watertight connections will be made to the Public Works Commission for review and approval.

REPAIR OF BENCHES AND INVERTS

The Contractor shall complete any necessary repairs to the bench and/or invert of the manhole, prior to installation of the specified lining system. All repairs shall be completed in accordance with the requirements of the Public Works Commission, and as outlined herein.

The invert channel shall be constructed of brick and mortar, in accordance with Public Works Commission standard details. The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. A shelf shall be provided on each side of any manhole invert channel. Inverts in manholes with standing water will not be acceptable.

CEMENTITIOUS BASE COAT

The Contractor shall furnish and place the cementitious base coat in each manhole as and where directed by the Public Works Commission. The installation of the cementitious base coat shall be in complete accordance with the manufacturers' specifications.

Prior to placing the cementitious base coat, the Public Works Commission and the Contractor must inspect and approve the surface preparation work. The Contractor shall notify the Public Works Commission when the manholes are ready for inspection. The Contractor is responsible for ensuring proper installation conditions including surface preparation, temperature, and moisture.

All bottom and horizontal surfaces shall have the cementitious base coat material applied to the required thickness by hand troweling or spray-on methods. All cementitious lining shall be troweled to consolidate the material, and then brushed to provide a profile surface for application of the polymeric

topcoat. The initial troweling shall be done in an upward motion, to compress the material into voids.

All side vertical surfaces shall have the cementitious base coat applied to the required thickness in one pass or application. Non-vertical surfaces may be completed in multiple passes to prevent sloughing of material.

Temperature limitations must be handled as appropriate and as approved by the manufacturer.

POLYMERIC TOP COAT

The Contractor shall furnish and place the polymeric lining over the previously installed cementitious base coat and all other surfaces to be lined, and as may be directed by the Public Works Commission. The installation of the polymeric lining top coat shall be in complete accordance with the applicable provisions of the manufacturers' specifications.

The Contractor shall provide documentation that the mixing of materials is in accordance with the manufacturer's instructions.

Prior to placing the top coat, the Public Works Commission and the Contractor must inspect and approve the cementitious base coat. The Contractor shall notify the Public Works Commission when the manholes are ready for inspection. The Contractor is responsible for ensuring proper installation conditions including cementitious base coat conditions, temperature and moisture.

The Contractor shall saw-cut the existing walls, benches, and/or inverts in order to "tie-in" the polymeric lining.

All surfaces shall have the monolithic polymeric lining applied by a spray-on method or by hand troweled applications in multiple passes to gradually build up to the required thickness.

Temperature limitations must be handled as appropriate and as approved by the manufacturer.

SPECTRASHIELD LINING SYSTEM

Installation of the "Spectrashield" lining system, as furnished by CCI Spectrum, Inc. shall be in accordance with the manufacturer's requirements. Manhole preparation shall be in accordance with the requirements outlined in these Contract Documents.

FIELD QUALITY CONTROL

The Contractor to perform the quality control procedures listed below in conjunction with the requirements of this Specification Section.

- A. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.
- B. Surface pH Testing: The pH of the concrete substrate will be measured using pH indicating papers. The pH testing is to be performed once every 50 square feet. Acceptable pH values shall be a minimum 9.0 as measured using color indicating pH paper with readable color calibrations and a

scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 1-12, or approved equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH. Spot check any questionable areas with a 1% phenolphthalein solution. The phenolphthalein solution shall turn bright pink on concrete.

TESTING

During application of the polymeric top coat, the Contractor shall measure the thickness and uniformity of the material by the use of a wet film thickness gage meeting the requirements of ASTM D 4414. Measurements shall be completed in the presence of the Public Works Commission. The Contractor shall document all measurements for each manhole and submit the documentation to the Public Works Commission. The documentation shall be submitted with each pay application.

Field acceptance of the manhole lining system shall be based on the Public Works Commission's evaluation of the appropriate installation of the base coat and top coat per field inspections and on observation of the measurements of the wet film thickness. Acceptance shall also be based on the Public Works Commission's evaluation of the curing test data and final testing.

The polymeric lining top coat shall provide a continuous monolithic surfacing with uniform thickness throughout the manhole interior and be free of pinholes, slumps and drips. A visual inspection shall be conducted to ensure that no pinholes are in the monolithic coating. The visual inspection shall include terminations and transitions of the polymeric liner.

Once the lining system has fully cured, it shall be checked via high voltage spark detection, in accordance with NACE SP0188 and the manufacturer's instructions. All defects shall be corrected at no cost to the Public Works Commission. The high voltage spark detection shall be done in accordance with:

1. The manhole environment shall be properly vented prior to testing to ensure hazardous conditions do not exist.
2. The high voltage spark detection equipment shall be set at 100 volts per one (1) mil of applied film thickness, or as recommended by the manufacturer.
3. All detected holidays shall be marked and the area of the liner shall be repaired. The surface area around the defect in the liner shall first be abraded using an appropriate grit paper or other hand abrasion tool. After abrading and cleaning the area, the area shall be patched by hand application of the polymeric lining topcoat material. All repair procedures shall follow manufacturer's recommended procedures.
4. All repaired areas shall be spark tested.

The Contractor is expected to perform preliminary spark testing prior to scheduling a final test with the Public Works Commission. Any defects noted during this preliminary testing shall be repaired in accordance with these specifications and the manufacturer's recommended procedures.

ACCEPTANCE

The Public Works Commission shall complete a final inspection of each manhole, to include a visual

inspection to verify that no leakage through the manhole wall is occurring, the manhole has been rehabilitated in accordance with the Contract Documents, and witness the final spark test. The Public Works Commission shall visually inspect every manhole and shall observe the final spark testing for every manhole. The Contractor shall coordinate with the Public Works Commission to schedule the final inspection. Any deficiencies noted during the final inspection shall be repaired in accordance with these specifications and the manufacturer's recommended procedures.

Inspection by the Public Works Commission does not absolve the Contractor from their responsibility for quality control inspection and testing as specified in these Contract Documents or as required by the manufacturer's instructions.

There shall be no groundwater infiltration or other leakage through the manhole wall after it has been lined. If leakage is found, it shall be eliminated with an appropriate method as recommended by the liner manufacturer and approved by the Public Works Commission. Any leakage shall be sealed utilizing materials compatible with the lining system, in accordance with the manufacturer's directions, and as approved by the Public Works Commission. The repair materials shall have the same life expectancy of the installed lining system. All repair materials shall be properly cured in accordance with the manufacturer's instructions. The use of curing compounds is prohibited.

All pipe connections shall be open and clear.

There shall be no cracks, voids, pinholes, slumps, drips, uncured spots, dry spots, lifts, delaminations or other type defects in the lining. The polymeric lining shall provide a continuous monolithic surface with uniform thickness throughout the manhole.

If any defective lining is discovered after it has been installed, it shall be repaired or replaced in accordance with the manufacturer's recommendations and in a satisfactory manner to the Public Works Commission. This requirement shall apply for the entire guarantee period.

The Contractor shall demonstrate that the installed lining system does not interfere with the proper sealing and locking (as applicable) of the manhole cover. Upon completion of the spark testing, all manholes shall be locked (if so equipped). For those manholes within paved areas, the Contractor shall apply four (4) dollops of roofing tar to the frame, to eliminate the cover from rattling. The dollops shall be equally spaced around the frame. The Public Works Commission Project Coordinator shall verify that the manholes are secured (locked and/or tarred).

At the completion of the Work, the Contractor shall remove all materials and debris associated with the Work of this Section.

The Contractor shall clean all surfaces not designated to receive the specified lining system. The Contractor shall restore all other work in a manner acceptable to the Public Works Commission.

The installed lining system shall be protected from damage until Final Acceptance of the Work. Any damage to the installed lining system shall be repaired or replaced at the discretion of the Public Works Commission, at no additional cost to the Public Works Commission.

revised July 2017

*** END OF SECTION ***

DIVISION 2 SITE WORK

02765 MANHOLE CHIMNEY SEALS

GENERAL

The Contractor shall furnish all labor, materials, equipment, and incidentals required and install the manhole chimney sealing system and appurtenances as specified herein. The internal manhole sealing system shall seal the manhole, from the top of cone up to, and including, the joint between the manhole cone (including all extensions to the chimney area) and the manhole ring. The Contractor shall furnish all necessary materials, labor, and equipment necessary to properly prepare the surface and apply the sealing system. Installation of the sealing system shall be in accordance with these Contract Documents and the manufacturer's recommendations.

All manhole chimney sealing systems shall be installed after the manhole has been relined, unless otherwise directed by the Public Works Commission.

The Contractor shall accurately field measure and size each individual manhole. The Contractor is responsible for performing any and all necessary field measurements, in order to ensure that the sealing system is properly installed in accordance with the requirements of these Contract Documents and the manufacturer.

RELATED SECTIONS

- A. Section 02500 – Traffic Control
- B. Section 02762 – Manhole Lining – Polymeric
- C. Section 02763 – Manhole Lining – Cured-in-Place

REFERENCE STANDARDS

The following American Society for Testing and Materials (ASTM) standards are incorporated by reference into this specification. The latest edition of the reference shall be used.

- A. ASTM D412-06ae2 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
- B. ASTM D2240-97e1 – Standard Test Method for Rubber Property - Durometer Hardness

In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

SUBMITTALS

All submittals shall be provided in accordance with Section 01000 – Special Conditions and Section 01300 – Submittals.

GUARANTEE

All sealing systems installed shall be guaranteed by the Contractor for a period of five (5) years from the date of final acceptance. During this period, all defects discovered in the sealing system, as determined by the Public Works Commission, shall be repaired or replaced in a satisfactory manner by the Contractor at no cost to the Public Works Commission.

QUALITY ASSURANCE

The supplier shall be responsible for the provisions of all test requirements specified in the above referenced ASTM Standards as applicable. In addition, all products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Public Works Commission. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all products and materials approved for this Contract shall be borne by the Public Works Commission.

Inspections of the products and materials may also be made by the Public Works Commission after delivery. The products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

The manufacturer and/or applicator of the sealing system shall be a company that specializes in the design, manufacture or installation of corrosion protection systems for manholes. The applicator shall be completely trained in the installation of the sealing system in manholes. The sealing system shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner.

The applicator shall be trained and certified by the manufacturer for the handling, mixing, application and inspection of the manhole sealing system as described herein.

DELIVERY, STORAGE AND HANDLING

Care shall be taken in shipping, handling and placing to avoid damaging the sealing system products. Extra care may be necessary during cold weather construction. Any sealing system product or material damaged in shipment shall be replaced as directed by the Public Works Commission.

Any sealing system product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

While stored, the sealing system products shall be adequately packaged and protected. The sealing system products shall be stored in a manner as recommended by the manufacturer.

PRODUCTS

SEALING SYSTEM

The materials to be utilized in the sealing of manhole chimneys shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

The manhole seal shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include, but are not limited to: concrete adjustment rings, brick, and/or block material that may have been used to achieve grade.

The manhole seal shall remain flexible allowing for the repeated vertical or horizontal movements of the frame due to frost lift, ground movement or the thermal movement of pavements.

The manhole sealing material shall be made no less than 170 mils of corrosion resistant aromatic flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above.

The product shall have a minimum elongation of 800% and hardness (Durometer) of 75.

The installed sealing system shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb./in. respectively.

The manhole sealing system shall conform to the physical requirements of ASTM D- 412.

The lining product shall have an aromatic urethane primer resin on the complete surface.

The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting.

If the manhole has been relined prior to the seal installation the seal shall cover a minimum of 12 vertical inches, as measured from the casting.

PATCHING MATERIAL

Voids in the existing manhole walls must be repaired prior to installing the manhole chimney sealing system. The patching material shall be a rapid setting, high early strength, corrosion resistant hand mixed and hand applied cementitious material intended for filling voids and making repairs in concrete, brick or other masonry constructed manholes. It shall be formulated in the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the sealing system to be used. The material shall have the following minimum characteristics:

- | | | |
|-------------------------|-----------|-----------------------|
| 1. Compressive strength | ASTM C109 | 2,000 psi at 24 hours |
|-------------------------|-----------|-----------------------|

2. Shrinkage	ASTM C 596	0 percent at 90 percent relative humidity
3. Set time	ASTM C 191-92	3 to 5 minutes

Product shall be Permacast-Patch as manufactured by Action Products Marketing Corp., Strong-Seal QSR by Strong Company, Preco-Patch by Fosroc Inc. or approved equal.

INSTALLATION

The Contractor shall remove all loose and protruding mortar and brick that would interfere with the sealing system's performance. Any protrusions on the casting shall be cut flush to the casting.

Any voids or repairs to the concrete, brick, or block manhole walls shall be repaired and filled with suitable non-shrinking cements, sealants, or grouts. The patching material shall be compatible with the chimney sealing system. All patches shall be smooth and even with the manhole wall. The Contractor shall allow the patching cement to completely cure prior to beginning installation of the chimney sealing system.

The Contractor shall prepare the surface by sandblasting and utilizing an acetone wet wipe to ensure a clean surface as required by the manufacturer. The substrate surface must be free of sand, loose debris, laitances, dust, oil, grease or chemical contamination. A blower or torch may be required to completely dry the substrate surface or as recommended by manufacturer.

All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the sealing system.

The Contractor shall properly mix the sealing system agents (if necessary), in accordance with the manufacturer's instructions.

The Contractor shall ensure that the casting and structure surfaces are clean and dry, prior to application of the primer. Primer shall be applied in accordance with the manufacturer's instructions.

Once the primer has dried in accordance with the manufacturer's instructions, the sealing system shall be applied to the entire chimney area, to include the frame joint area, the area above the manhole cone, and all extensions in the chimney area. The sealing system shall be installed in accordance with the manufacturer's instructions.

The chimney sealing system shall be as manufactured by Sealing Systems, Inc., or approved equal.

**DIVISION 2
SITE WORK**

03301 CONCRETE CONSTRUCTION (UTILITY)

GENERAL

Concrete construction specified in this section shall be applicable to all "site work" and is not intended to cover general building specifications. The concrete work shall include all furnishing, hauling, fine grading and subgrade, form work, etc. and all incidentals necessary for completion of the work as it pertains.

MATERIALS

Concrete

The Contractor shall furnish and place concrete in strict accordance with the requirements of ACI 318 (most recent edition). Ready-mixed concrete from an approved mixing plan shall be used throughout the work and conform to the requirements of ASTM C-94 for batch, mixing, and transporting. Concrete shall be in accordance with the following requirements:

- | | |
|---|------------------------|
| A. Under Ground - Regular Weight Concrete | |
| 28-day compressive strength | 3000 psi |
| Coarse aggregate | 1 ½" max. size stone |
| Slump | 2" minimum, 4" maximum |
| Air Entrainment | No requirement |
| B. Walls, Slabs, Sidewalks, Curb and Gutter - Regular Weight Concrete | |
| 28-day compressive strength | 3000 psi |
| Coarse aggregate | ¾" max. size stone |
| Slump | 2" minimum, 4" maximum |
| Air Entrainment | 5 more or less 1 |

The Contractor shall submit for approval mix designs, designed and tested by an approved testing laboratory, following the requirements of ACI 318 for each class of concrete to be used on this project. Mix designs in excess of one year old shall be verified. The Contractor will be responsible for all costs involved in the mix design. Material suppliers and material proportions incorporated in the mix design and certification shall not change without written permission from the Public Works Commission.

Admixtures used to produce entrained or air shall be sulforated hydrocarbons or neutralized vinsol resins conforming to ASTM C-260. Calcium chloride, other accelerators, or "anti-freeze"

shall not be used without written approval by the Public Works Commission.

Reinforcing Steel

Reinforcing bars shall be new billet stock and shall conform to ASTM A-615, Grade 60. Bars shall be deformed to conform to ASTM A-305. The Contractor shall check and submit for approval four (4) sets of shop and erection drawings prepared by the fabricator. Reinforcement detailing and placement shall conform to ACI 318. All reinforcing bars shall be tied in place according to approved erection drawings, using bar supports and accessories conforming to ACI 315. Laps or splices shall conform to ACI 318, and consist of the following minimum dimensions:

Tension Splices	36 Bar Diameters
Compression Splices	30 Bar Diameters

All reinforcing bars shall be tagged and stored in such manner as to be readily available at the time needed. Tag mark substitutions will not be made.

Welded wire mesh fabric reinforcing shall conform to the requirements of ASTM A-185. Lap splices shall be at least one full mesh plus 2" staggered to avoid continuous laps in either direction and securely wired or clipped.

GRADING

The Contractor shall use every effort to observe any possible misalignments in line or grade of the installed forms and will call such to the attention of the Public Works Commission promptly. The Contractor is cautioned that he shall be responsible for any damage to utility lines caused by his negligence. The Public Works Commission or his representative shall then inspect the forms and if approved, pouring operations may begin. Where unstable material exists, the Contractor shall remove such material to a depth required to provide a stable subgrade at no additional cost to the Public Works Commission.

FORM WORK

Metal forms shall be used throughout the work except for short, odd length sections and in accordance with ACI 301 and ACI 347 (most recent editions). Earth cuts may be used as forms for unexposed vertical surfaces on footings, provided the soil and workmanship allow an accurate and curable excavation. Forms shall be kept in good condition at all times. Any forms which have become out of shape or otherwise unsuitable shall be removed from the work. Forms shall be of such section and design that they will adequately support the concrete and any construction equipment used in the work. Form sections shall be provided with interlocking joints to insure that the forms are tightly jointed together free from movement. Forms shall be held in place by metal pins, not less than eighteen (18) inches in length, with fastenings of metal and wedges to insure a correct, rigid setting.

Forms shall be of the dimension required for the designed cross-section shown on the plans. Built up sections to attain the required depth will not be permitted.

Forms shall be set true to the lines and grades established by the Design Engineer or as indicated on the plans.

Forms shall be held rigidly in position and shall be of sufficient strength to resist springing out of line when concrete is placed.

PLACING CONCRETE

Prior to placing concrete, the subgrade shall be moistened and the contact side of the forms shall be cleaned and coated with a heavy oil. The Contractor shall not place any concrete without the forms, reinforcing steel and subgrade being inspected and approved by the Design Engineer. Placing of concrete is to be in accordance with ACI 304 (most recent edition). Water shall be removed from the excavation before placing concrete and water shall be diverted to prevent washing over freshly deposited concrete.

Concrete shall be placed as not to disturb concrete already in place and in such a manner as to require the minimum amount of lateral movement. Concrete shall be deposited in the forms without segregation. A tremie shall be used when the fall exceeds five (5) feet. Care shall be taken not to upset any forms during the concrete pouring operations. Any concrete showing misalignment due to form movement shall be removed and replaced at no additional cost to the Public Works Commission.

All concrete shall be consolidated in accordance with ACI 309 (most recent edition). Mechanical vibrators shall be operated by experienced workmen. Spading and rodding may be required to supplement mechanical vibration. Consolidation shall be adequate to remove any voids and after removal of the forms, no honeycomb shall be present. Should any honeycomb be present, the Design Engineer shall determine if the honeycomb is of a minor nature, the voids may be filled with mortar as approved by the Design Engineer.

All concrete within forms shall be brought to true section by the use of an approved straight edge and shall be tamped with straight edge to bring mortar to the surface, after which it shall be floated smooth by means of wood floats. No steel floats will be permitted. After true surface of section has been obtained, and after initial set has taken place, the entire surface shall be brushed with a dampened brush. All joints and all exposed edges shall be rounded off with approved jointing and edging tools. The type of finish required will be specified in the specific item of work specified or indicated on the drawings. All exposed surfaces of retaining walls, structures, etc. shall be given a Class 2 finish with ¼ inch chamfered edges.

No more concrete shall be laid than can be properly finished and covered during the daylight, unless adequate artificial light satisfactory to the Design Engineer is provided.

Immediately after finishing operations have been completed, the entire surface of the concrete shall be sprayed with an approved curing compound. The use of liquid retarding agents shall conform to standards specified by current AASHTO or ASTM Specifications.

Cold weather concreting shall be in accordance with ACI 306 (most recent edition) and hot weather concreting shall be in accordance with ACI 305 (most recent edition). Concreting shall be done when weather conditions are favorable unless otherwise directed by the Design Engineer. Concrete operations shall be discontinued when the temperature of 40 degrees Fahrenheit is reached on a falling thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw or other thermal insulation satisfactory to the Design Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather or hot weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Design Engineer and/or the Public Works Commission at the Contractor's expense.

Forms shall not be removed from the concrete for a minimum of 7 days, unless approved by the Design Engineer. The Contractor shall apply a curing compound or provide measures to maintain moisture for proper curing at his expense, if early form removal is approved. Immediately after the forms have been removed, all honeycomb areas shall be repaired (with one part cement and two parts sand) and earth backfill material shall be placed adjacent to the finished concrete and smoothed off to prevent an accumulation of standing water, subgrade saturation or under wash in the event of rain.

Both pedestrian and vehicle traffic shall be excluded from crossing the concrete for a period of 14 days by the erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 14 day period and he shall remove and replace any concrete damaged as directed by the Design Engineer and/or Public Works Commission.

MASONRY MATERIALS

Brick shall be in accordance with ASTM C-32 Grade MS laid in full beds of mortar with shove joints.

Concrete masonry blocks shall be in accordance with ASTM C-139. Blocks shall be at least 5", but not more than 8" in thickness nor less than 8" in length and of such shape that the joints can be effectively sealed and bonded with cement mortar.

Cement mortar for brick work shall be in accordance with ASTM C-270, Type M. Use Type IIA cement in accordance with ASTM C-150.

TESTING

The requirements of ACI318 (most recent edition) shall be used to control the evaluation of all concrete strengths. The strength is to be checked during construction by four (4) cylinders at the option and cost of the Public Works Commission, of which 1 shall be broken at 7 days, 2 at 28 days. If the specified strength is not achieved in 28 days, 1 reserved shall be stored and broken as specified by the Design Engineer. Cylinders shall be made and stored in accordance with ASTM C-13. Cylinders shall be for each day concrete is poured in excess of 10 cubic yards of each different type of concrete, as determined by the Design Engineer. All additional expenses required because of the failure of the materials to meet routine testing requirements, or poorly scheduled concrete deliveries, shall be borne by the Contractor.

DIVISION 2 SITE WORK

09801 ANTI-MICROBIAL ADMIXTURE

GENERAL

All reinforced concrete precast manholes shall include a liquid anti-microbial admixture to render the concrete uninhabitable for bacterial growth. The admixture shall be included in the fabrication of the manhole by an approved concrete precast manhole manufacturer. Coatings applied to the interior walls of the manhole shall not be acceptable.

Further, all field mixed mortar, utilized in concrete precast manholes, shall include the anti-microbial admixture. The intent and purpose of this specification is to render all concrete and/or mortar within sanitary sewer service uninhabitable for bacterial growth. Any defects shall be cause for the replacement and correction of such defect as directed by the Fayetteville Public Works Commission (PWC), at no expense to the Fayetteville Public Works Commission.

RELATED SECTIONS

- A. 02730 – Sanitary Sewer Systems
- B. 02732 – Sewage Force Mains

REFERENCES

- A. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
- B. ASTM C1443 – Standard Specification for Precast Reinforced Concrete Pipe
- C. ASTM C1577 – Standard Specification for Precast Reinforced Concrete Pipe

SUBMITTALS

All submittals shall be provided in accordance with the Contract Documents, and the requirements outlined herein. The Contractor shall submit, in accordance with the Contract Documents, product data, certifications, and product data, to include the following:

1. U.S. Environmental Protection Agency (EPA) registration number.
2. Documentation that the product has a minimum of 10 years of successful prevention of microbial induced corrosion in sanitary sewers.
3. Documentation that the precast facility is certified by the anti-microbial manufacturer.
4. Documentation from the precast facility stating that the correct amount and correct mixing procedure was followed for all anti-microbial concrete.

QUALITY ASSURANCE

A color identifier shall be applied to the interior of each concrete piece fabricated with the anti-microbial admixture. Each piece shall also be plainly stenciled with the name of the anti-microbial admixture on the exterior of each piece.

MATERIALS

All manholes shall conform to PWC standard specifications and details, unless otherwise approved in writing by the Fayetteville Public Works Commission. All concrete and mortar utilized in the construction of the manholes shall contain an anti-microbial admixture.

Anti-Microbial Admixture:

The liquid anti-microbial admixture shall be used in accordance with the manufacturer's recommendations. The amount of the admixture shall be included in the total water content of the concrete or mortar mix design. The admixture shall be added to the concrete or mortar mix water, to ensure even distribution of the admixture throughout the concrete or mortar mix. When properly prepared, the anti-microbial admixture shall render the concrete or mortar uninhabitable for bacterial growth.

The anti-microbial admixture shall be ConShield, ConBlock, or approved equal. The ConShield liquid anti-microbial admixture can be obtained from ConShield Technologies, Inc. or an approved precast facility. TheConBlock liquid anti-microbial admixture can be obtained from ConSeal Concrete Sealants, Inc., or an approved precast facility.

Field Repairs:

Field repairs to the precast concrete or mortar shall be in accordance with the admixture manufacturer's recommendations. All field repairs shall be completed in accordance with PWC requirements.

ACCEPTANCE

Acceptance of the concrete and mortar with the anti-microbial admixture shall be based on conformance with the requirements herein, the Fayetteville Public Works Commission's review of the installed manhole, and results of all testing.

DIVISION 2 SITE WORK

09802 SPECIAL COATINGS - CERAMIC EPOXY (PROTECTO401)

GENERAL

The interior surfaces of all ductile iron pipe and fittings shall be full coated with a ceramic epoxy lining. The ceramic epoxy lining shall be applied to ductile iron pipe free of any other interior lining material. The finish coat shall be applied to yield a minimum dry film thickness of 40 mils for a complete lining.

MATERIALS

The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quarts pigment.

The epoxy material shall meet the following minimum performance requirements:

Permeability Rating: 0.00 perms when tested according to ASTM E-96 Procedure A with a test duration of 30 days.

ASTM 6-95 Cathodic Disbandment: 1.5 volts at 77° F.

ASTM B-117 Salt Spray: 0.00 undercutting after one year.

<u>Immersion Testing ASTM D-714</u>	<u>Duration</u>
20% Sulfuric Acid	1 Year
25% Sodium Hydroxide at 140° F	1 Year
160° F Distilled Water	1 Year
120° F Tap Water	1 Year

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Public Works Commission, certified by the Supplier.

APPLICATION OF LININGS

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with sand or grit media. The entire surface to be lined shall be struck with blast media so

that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen:

The lining shall be applied by a competent firm with a five year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Public Works Commission shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the ceramic epoxy to a minimum dry film thickness of 40 mils. No lining shall take place when the substrate or ambient temperature is below 40° F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge, the thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. The interior linings shall also be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired as noted above.

Markings: Each joint, manhole unit, or pipe bend special shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damage which does occur shall be repaired prior to the installation of the pipe in accordance with the manufacturer's recommendations, so the repaired area is equal to the undamaged lining in all respects.

DIVISION 2 SITE WORK

09804 SPECIAL COATINGS – EPOXY LINING (PERMOX OR TNEMEC)

GENERAL

The interior surfaces of all ductile iron pipe and fittings in sanitary sewer service shall be fully coated with a ceramic epoxy lining. The lining system shall be a two component, amine cured novalac epoxy. The ceramic epoxy lining shall be applied to ductile iron pipe free of any other interior lining material. The finish coat shall be applied to yield a minimum dry film thickness of 40 mils for a complete lining. Any defects in the lining shall result in the pipe or fitting being replaced, at no additional cost to the Public Works Commission.

RELATED SECTIONS

- A. 02730 – Sanitary Sewer Systems
- B. 02732 – Sewage Force Mains

REFERENCES

- A. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
- B. ASTM C 413 – Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- C. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
- D. ASTM D 714 – Standard Test Method for Evaluating Degree of Blistering of Paints
- E. ASTM D 870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
- F. ASTM D 1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- G. ASTM D 1653 – Standard Test Methods for Water Vapor Transmission of Organic Coatings
- H. ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness
- I. ASTM D 2370 – Standard Test Method for Tensile Properties of Organic Coatings
- J. ASTM D 2583 – Standard Test Method ofr Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- K. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- L. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- M. ASTM D 4400 – Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
- N. ASTM D 4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- O. ASTM G 8 – Standard Test Methods for Cathodic Disbonding of Pipeline Coatings
- P. ASTM G 95 – Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings
- Q. ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet Lamp Apparatus for Exposure of Nonmetallic Materials

Unless otherwise specified, references to documents shall mean the documents in effect at the time of bid. If the referenced document(s) have been discontinued by the issuing organization, references to those documents shall mean the replacement documents or the last version of the document before it was discontinued.

Where conflicts exist between the standards and this specification, the more stringent shall apply.

MATERIALS

All ductile iron pipe and fittings shall be in accordance with the Public Works Commission standard specification 02730 – Sanitary Sewer Systems, Public Works Commission standard specification 02732 – Sewage Force Mains, and these Contract Documents.

The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment (no silica fume, fly ash, or alumina dust). The lining shall be both coal tar (polycyclic aromatic hydrocarbons) free and hazardous air polluting solvents (HAPS) free. The lining system shall be 100% solids by volume.

The ceramic epoxy lining system shall be the Perma-Shield PL Series 431 as manufactured by Tnemec Company, Inc., Permax-CTF as manufactured by Permite Corporation, or approved equal.

The ceramic epoxy lining system shall meet the following minimum performance requirements:

- A. Abrasion (ASTM D 4060, CS-17 wheel, 1,000 grams) – 76 mg loss
- B. Adhesion (ASTM D 4541) – not less than 1,860 psi
- C. Severe Wastewater Analysis Test (150°F, 500 ppm H₂S, 4,000 ppm NaCl, 10% sulfuric acid, EIS Permeation Analysis) – Initial impedance of 11.2 (log-z). No blistering, cracking, checking, or loss of adhesion. Reduction in electrical impedance of 0.5 after 28 days of exposure.
- D. Cathodic Disbondment (ASTM G 8, 1.5 V, Classification Group A) – no more than 0.000 inch disbanded equivalent circle diameter.
- E. Dielectric Strength (ASTM D 149) – greater than 600 V per mil
- F. Hardness (ASTM D 2240) – Shore D hardness of 79
- G. Impact (ASTM D2794) – No visible cracking or delamination after 160 inch-pounds direct impact.
- H. Chemical resistance by immersion testing, in accordance with ASTM D 714, as outlined in the following table:

20% Sulfuric Acid at 77° F	2 years, no effect
25% Sodium Hydroxide at 140° F	2 years, no effect
5% Sodium Chloride at 77° F	2 years, no effect
Distilled Water at 160° F	2 years, no effect

- I. Salt Spray (ASTM B 117) – No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 1,000 hours.
- J. Sag Resistance (ASTM D 4400) – Not less than 90 mills wet film thickness.

- K. Water Absorption (ASTM C 413) – 0.0 percent water absorption
- L. Water Vapor Transmission (ASTM D 1653, Method B, Wet Cup, Condition C) – 1.25 g/m² per 24 hour water vapor transmission and 0.09 perms water vapor permeance.

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Public Works Commission upon written request and certified by the Supplier.

QUALITY ASSURANCE

The manufacturer of the specified coating system shall have a minimum of 10 years experience in manufacturing high performance epoxy coating systems. The epoxy coating material shall be from a single manufacturer.

Application of the ceramic epoxy lining system shall be in accordance with the manufacturer's requirements. Preparation of the ductile iron pipe to be lined shall be completed by an installer approved by the lining system manufacturer.

SUBMITTALS

In accordance with these Contract Documents, the Contractor shall submit the following:

1. Manufacturer's certification that the coatings comply with the specified requirements and are suitable for the intended application.
2. Product data sheet.
3. Material Safety Data Sheet.
4. Copies of test data for all the physical, chemical, and permeation properties listed within this specification.

WARRANTY

The ceramic epoxy lining manufacturer shall warranty its products as free from material defects for a period of five (5) years. The Public Works Commission will solely determine whether the pipe should be replaced if any defects are discovered in the lining within the warranty period. All costs to replace the pipe or fitting, including but not limited to, bypass pumping, excavation, and traffic control shall be the manufacturer's responsibility.

APPLICATION OF LININGS

Application of the ceramic lining system shall be completed by an installer approved by the manufacturer of the lining system.

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance, form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with

sand or grit media. The entire surface to be lined shall be struck with blast media so that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen: The ceramic epoxy lining shall be applied by a competent firm with a ten (10) year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Public Works Commission shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the ceramic epoxy to a minimum dry film thickness of 40 mils. No lining shall take place when the substrate or ambient temperature is below 40°F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired by the lining manufacturer prior to shipment, in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. The interior linings shall also be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired as noted above. All ceramic epoxy lined pipe and fittings shall be visually inspected for any defects, including runs, sags, or debris within the lining. All repairs shall be performed by the manufacturer prior to shipment.

Markings: Each joint, manhole unit, or fitting shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damaged pipe or fitting shall be replaced at no cost to the Public Works Commission.

INSTALLATION

Cutting Pipe: The Contractor shall cut the pipe without damaging the pipe or interior ceramic epoxy coating. All cuts shall be at right angles to the pipe axis. All cut ends shall be dressed with a power grinder to remove all sharp edges. The cut ends of push-on joint pipe shall be beveled in accordance with the pipe manufacturer's instructions. All field cuts shall be coated and sealed prior to installation. Application of the lining shall be done in accordance with the ceramic epoxy lining manufacturer's recommendations.

Handling: All ceramic epoxy lined pipe and fittings shall be handled only from the outside. No forks, chains, straps, hooks, cables, or other equipment shall be placed inside the pipe and fittings for lifting, positioning, or installation. The pipe and fittings shall not be dropped or unloaded by rolling. The pipe and fittings shall not strike sharp objects while moving or unloaded. Ductile iron pipe shall not be placed on grade utilizing hydraulic pressure from machinery or hammers. The use of nylon straps or other similar lifting devices are to be used.

Pipe Installation: All pipe and fittings shall be installed in accordance with PWC standard specifications 02222 – Excavation, Trenching, and Backfilling for Utility Systems, 02730 – Sanitary Sewer Systems, 02732 – Sewage Force Mains, and these Contract Documents.



TECHNICAL SPECIFICATIONS

SEPTEMBER 2024

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SECTION 00127

UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Delineation of measurement and payment criteria applicable to Work performed under Contract by the unit price payment method.

1.02 FIELD MEASUREMENT

- A. Take measurements and compute quantities for submittal of the monthly pay request unless specified otherwise in the measurement paragraphs as indicated in this Section.

1.03 CHANGE IN QUANTITIES

- A. Increase in the quantity of a bid item up to 100% may be authorized by the Engineer above what is indicated in the Bid Form, after 100% increase the contract unit price will be negotiated only by a Change Order as required by the Contract Documents. Revised contract unit prices pertaining to quantity increases will be applicable only to that portion of the overrun in excess to the percentages stated above.
- B. A final adjusting Change Order may be made for adjustment of the actual quantities installed prior to submittal of the final pay request.

1.04 GENERAL

- A. Items with a "(X)" in the title of the following bid items represents the size or depth as indicated on the Bid Form.
- B. Method of measurement for the individual Bid Items shall be as specified in each section.
- C. Payment for each item shall be in accordance with the Contract Unit Price times the number of units installed in accordance with the Contract Documents.
- D. Work for each bid item shall include, but not be limited to, the work listed in each execution section of the bid item and the labor, materials, equipment, and services required and reasonably implied by the Contract Documents for a complete installation.
- E. Administrative cost including, but not limited to, video and photographic records, coordination of construction activities (including but not limited to updating master construction schedule, providing weekly tasks schedule, coordination with owner, engineer, utility providers, permitting agencies, etc.), as-built documentation, and office administration for the Project construction shall be included in the individual unit price items. If a Contractor elects to use a trailer, it is at no cost to the Owner.
- F. Unit prices will be listed in each section unless otherwise specified.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION
NOT USED

END OF SECTION 00127

SECTION 00132

PROJECT MANAGEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
 - 1. Project Management.
 - 2. Coordination.
 - 3. Administrative and supervisory personnel.
 - 4. General installation provisions.
 - 5. Cleaning and protection.

1.02 GENERAL COORDINATION REQUIREMENTS

- A. Responsibilities of Contractor:
 - 1. Coordinate construction activities for the Project to assure efficient and proper installation of each part of the Work.
 - 2. Where availability of space is limited, coordinate installation of components to assure maximum accessibility for maintenance. Make adequate provisions to accommodate components scheduled for later installation.
 - 3. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. A copy of all memoranda shall be submitted to the Engineer.

1.03

- A. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of schedules.
 - 2. Installation and removal of temporary facilities.
 - 3. Delivery and processing of submittals.
 - 4. Progress meetings.
 - 5. Installation meetings.
 - 6. Project Close-out activities.
 - 7. Payment Applications.
- B. Project Meetings: A Pre-construction conference shall be held prior to the beginning of the Work. Construction progress meetings shall be held monthly. Project close-out conference shall be held during the final phases of the Work. The Engineer may schedule additional meetings. The location of meetings is to be determined by the Engineer. The Contractor's project superintendent shall attend meetings. Suppliers and subcontractors will be notified to attend meetings as appropriate or as required by the Engineer. The Contractor shall schedule pre-installation conferences as required in the individual specification sections and shall notify the Engineer of project meetings scheduled by the Contractor. The Engineer will schedule and administer meetings throughout the progress of the Work, except for meetings held by the Contractor for normal coordination of the Work. The meeting agenda shall include, but not be limited to, the following: Project Administration, Submittals, Construction Schedules and Methods, Safety and Health Regulations, Project Coordination,

Payment Application, Change Orders, and Site Inspections. Engineers will prepare an agenda with copies to participants, preside at meetings, prepare minutes, and distribute to participants for meetings scheduled by the Engineer.

- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
- D. Salvage materials and equipment involved in the performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

1.04 CLOSE-OUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected and is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit a set of Record Documents indicating changes during construction as required in Section, Submittal Procedures.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and final amount due.
- E. Submit the following with final Application for Payment: (As Applicable)
 - 1. Release of Claims
 - 2. Consent of Surety for Final Payment
 - 3. Final Certified Payroll Information
 - 4. 1 Year Labor Warranty
 - 5. Sales Tax Use Form (with invoices)
- F. Submit warranties as required by individual equipment specifications.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00132

SECTION 00133

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
- B. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is evaluated. If necessary, additional requirements will be issued by Change Order.
- C. Types of allowance include the following:

1.02 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise the Owner of the date when the final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the work.
- B. At the Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the work.
- C. Purchase products and systems selected by the Owner from the designated supplier.

1.03 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.04 CONTINGENCY ALLOWANCES

- A. Use the allowance(s) only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Change Orders authorizing use of funds from the allowance(s) will include Contractor's related cost and maximum fifteen (15) percent combined overhead and profit. (7.5% overhead plus 7.5% profit).

1.05 UNUSED MATERIALS

- A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
- B. When requested by the Owner, prepare unused material for storage where it is not economically practical to return the material for credit. When directed by the Owner, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine products covered by an allowance promptly upon delivery for damage or defects.

3.02 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION 00133

SECTION 00150

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, telephone service, water, and sanitary facilities.
- B. Work on public right-of-way.
- C. Traffic control.
- D. Temporary Controls: Barriers, enclosures and fencing, water control, dust control, erosion and sediment control, and protection of the work.
- E. Construction Facilities: Access roads, parking, project cleaning, project signage, and field offices.

1.02 TEMPORARY UTILITIES

- A. Electricity
 - 1. Provide and pay for required power service for construction from Utility source.
- B. Lighting
 - 1. Provide and maintain lighting for construction operations as required by Contractor.
 - 2. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required by Contractor.
- C. Telephone Service
 - 1. Provide, maintain, and pay for telephone service to field office as required by Contractor.
- D. Water
 - 1. Provide, maintain, and pay for suitable quality water, including any necessary service(s) required for construction operations. Exercise measures to conserve water during construction.
- E. Sanitary Facilities
 - 1. Provide and maintain required facilities and enclosures as necessary to comply with the laws and ordinances of the authority having jurisdiction and the State of North Carolina.
 - 2. General Contractor shall provide the above sanitary facilities for all contractors, sub-contractors, Owner, and Engineer at the Project Site.

1.03 WORK ON PUBLIC RIGHTS-OF-WAY

- A. Work on this Project is along rights-of-way under jurisdiction of the following N.C. Department of Transportation (NCDOT) and/or City of Fayetteville offices and Owner:
 - 1. NCDOT Division 6, District 2, District Engineer
 - 2. City of Fayetteville, City Engineer
- B. Work shall comply with requirements of the Encroachment Agreement(s) and Driveway Permit as attached to Project Supplementary Conditions.
- C. Post Bonds as required.
- D. Prior to start of Work notify the Office of the NCDOT as indicated in the encroachment agreement and driveway permit. Also notify the Owner.

- E. Work shall conform to the requirements and be subject to the approval of the above agency (ies).
- F. Contractor shall be responsible to the Owner for the cost of all DOT inspection that is billed to the Owner by the NCDOT as indicated in the Special Provisions of the Encroachment Agreement.
- G. Submit letter to the above District Engineer(s) when work is complete as required by the Encroachment Agreement.
- H. Submit letter of approval for completed Work from the above agency(ies) with Final Payment Request.
- I. Clean right-of-way as work progresses and daily.
- J. Power broom existing pavement as work progresses.
- K. Work shall be in accordance with the latest edition of the N.C. Division of Highways, "Policies and Procedures for Accommodating Utilities on Highway Right-of -Way" and City of Fayetteville standards.
- L. Consult with the above agency (ies) in establishing public thoroughfares to be used for haul routes and site access. Truck route permit and bond may be required.
- M. Confine construction traffic to designated haul routes.
- N. Provide traffic control along haul routes to regulate traffic and to minimize interference with public.
- O. Provide and maintain access to fire hydrants, free of obstructions.

1.04 TRAFFIC CONTROL

- A. On public and private road right-of-way provide traffic control devices when construction encroaches within the right-of-way. Devices shall include, but not be limited to, cones, drums, flares, warning signs, temporary pavement marking, warning lights, and flagman.
- B. Traffic control devices shall provide the following:
 - 1. Protection of motorists, pedestrians, and workers from accident hazards.
 - 2. Advance public information of proposed work sites.
 - 3. Establishment of an orderly and safe flow of traffic and to minimize traffic congestion.
 - 4. Provision of access for emergency vehicles.
- C. Traffic control devices shall be used in accordance with the latest edition of the NCDOT Standard Drawings and "Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)."
- D. Provide personnel trained and certified in traffic control, as required by NCDOT and City of Fayetteville.

1.05 TEMPORARY CONTROLS

- A. General
 - 1. Temporary controls shall be the responsibility of each Contractor for their respective work unless noted otherwise.
- B. Barriers
 - 1. Provide barriers to prevent unauthorized entry to construction areas for the safety of the public, the protection of the work, and to protect existing facilities and adjacent properties from damage from construction operations.

2. Provide barricades required by agency in (ICS) 1.03A of this section for public rights-of-way and for public access to existing buildings.
 3. Provide protection for plant life designated to remain. Replace damaged plant life.
 4. Protect vehicular traffic, stored materials, site, and structures from damage.
- C. Water Control
1. Grade site to drain. Provide, operate, and maintain pumping equipment to maintain excavations free of water.
 2. Protect site from running water.
- D. Dust Control
1. Execute Work by methods designed to minimize raising dust from construction operations.
 2. Provide positive means to prevent airborne dust from dispersing into atmosphere.
- E. Erosion and Sediment Control
1. Provide Erosion and Sediment Control as indicated on the approved Drawings and Specifications.
- F. Protection of Installed Work
1. Protect installed Work and provide special protection where specified in individual specification Sections.
 2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
 3. Prohibit traffic from landscaped areas.
- 1.06 CONSTRUCTION FACILITIES
- A. General
1. Construction facilities shall be the responsibility of each Contractor for their respective work unless noted otherwise.
- B. Access Roads
1. Contractor shall construct and maintain temporary drives as necessary to access public thoroughfares and existing drives to serve the construction area.
 2. Provide means of removing mud from vehicle wheels before entering streets.
- C. Parking
1. When site space is not adequate, arrange for temporary off-site surface parking areas to accommodate construction personnel.
 2. Do not allow vehicle parking in existing right-of-way or to block existing drives.
 3. Do not allow vehicle parking on private property without prior approval.
- D. Progress Cleaning
1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
 2. Remove waste materials, debris, and rubbish from site periodically and dispose off site.
- 1.07 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
- A. Remove temporary above grade or buried utilities, equipment, facilities, and materials, prior to Final Inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS
NOT USED

PART 3 EXECUTION
NOT USED

END OF SECTION 00150

SECTION 00170

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination
- B. Cutting and patching
- C. General installation provisions
- D. Cleaning and protection
- E. Final inspection and tests

1.02 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specifications sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.03 CUTTING AND PATCHING

- A. General
 - 1. Do not cut or alter the work of other contractors without written approval of the Engineer.
 - 2. work removed shall be replaced or repaired by the Contractor who removed or damaged the work, and a craftsman, skilled in the trade that the particular replacement requires, shall do the work. (i.e.: A mason, not an electrician, shall replace masonry removed by the Electrical Contractor.)
 - 3. Conduct removal operations in a manner that will eliminate hazards to persons and property and prevent the release of dust and rubbish into the air. Existing work, which is to remain and is damaged by contract operations shall be replaced with new materials at no additional cost to the Owner.
 - 4. For replacement of work removed, comply with specifications for type of work to be done.
- B. Inspection
 - 1. Inspect existing conditions of work including elements subject to movement or damage during cutting and patching and excavating and backfilling.
 - 2. After uncovering work, inspect conditions affecting installation of new products.
- C. Preparation prior to cutting.
 - 1. Provide shoring, bracing, and support as required to maintain structural integrity of project.
 - 2. Provide protection for other portions of project.
 - 3. Provide protection from elements.

D. Performance

1. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, finishes.
2. Execute cutting and demolition by clear sawcut methods, perpendicular to prevent damage to other work and provide proper surfaces to receive installation of repairs and new work.
3. Execute excavating and backfilling as specified in Section, Trenching for Utilities.
4. Restore work, which has been cut or removed; install new products to provide completed work in accordance with requirements of contract documents.
5. Refinish surfaces as necessary to provide an even finish.

1.04 GENERAL INSTALLATION PROVISIONS

- A. Require Installer of each major component to inspect conditions under which work is to be performed. Clean substrate surfaces prior to applying next material or substance. Do not proceed until unsatisfactory conditions have been corrected.
- B. Comply with manufacturer's recommendations to the extent that they are more explicit or stringent than requirements contained in Contract Documents.
- C. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
- D. Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.
- E. Check dimensions before starting each installation.
- F. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- G. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- H. Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the application indicated. Refer questionable mounting height decisions to the Engineer for final decision.

1.05 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration.
- B. Clean and maintain completed construction as frequently as necessary through the construction period. Adjust and lubricate components as required to ensure proper operation.
- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, or dangerous exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 1. Excessive static or dynamic loading.
 2. Excessive internal or external pressures.
 3. Excessively high or low temperatures.
 4. Thermal shock.
 5. Air contamination or pollution.

6. Water or ice.
 7. Abrasion.
 8. Heavy traffic.
 9. Misalignment.
 10. Improper shipping or handling.
 11. Theft.
 12. Vandalism.
- D. Clean Project prior to final inspection. Project clean up shall include, but not be limited to, the following:
1. Clean glass.
 2. Clean surfaces exposed to view as recommended by manufacturer.
 3. Remove temporary labels.
 4. Vacuum carpeted areas.
 5. Clean fixtures to a sanitary condition.
 6. Repaint damaged paint surfaces.
 7. Clean debris from roofs, gutters, down spouts, and drainage systems.
 8. Sweep paved areas.
 9. Rake clean landscaped surfaces.
 10. Remove waste and surplus materials.
 11. Remove temporary construction facilities.
- 1.06 FINAL INSPECTION
- A. Complete punch list items within contract time to avoid liquidated damages.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00170

SECTION 00400

MOBILIZATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. This work consists of preparatory work and operations to mobilize personnel, materials, and equipment to the project site.

1.02 MEASUREMENT AND PAYMENT

- A. *Mobilization* will be paid as contract lump sum price.
- B. Partial payments for *Mobilization* will be made with the first and second partial pay estimates paid on the contract and will be made at the rate of 50% lump sum price on each of these partial pay estimates, provided the amount bid for *Mobilization* does not exceed 5% of the total amount bid for the contract. Where the amount bid for *Mobilization* Exceeds 5% of the total amount bid for the contract, 2.5% of the total amount bid will be paid on each of the first two partial pay estimates. That portion exceeding 5% will be paid on the last partial pay estimate.
- C. As an exception to the above where the work covered by the contract is limited exclusively to the resurfacing of an existing pavement, payment of the entire lump sum price for *Mobilization* will be made with the first partial pay estimate paid on the contract, provided the amount bid does not exceed 5% of the total amount bid on the contract. Where the amount bid for *Mobilization* exceeds 5% of the total amount bid for the contract, 5% of the total amount bid will be paid on the first partial pay estimate. That portion exceeding 5% will be paid on the last partial pay estimate.
- D. Such price and payment includes, but is not limited to, the movement of personnel, equipment, supplies and incidentals to the project site, for the establishment of offices, buildings and other facilities necessary for work on the project; the removal and disbandment of those personnel, equipment, supplies, incidentals or other facilities that were established for the prosecution of work on the project; and for all other work and operations that shall be performed for costs incurred before beginning work on the various items on the project site.
- E. For projects that have delayed availability date of 90 calendar days or more after contract execution, the first mobilization payment may be for the verified actual cost of paid bond premiums. This payment will only be made upon request by the contractor with supporting documentation including invoice and proof of payment. This payment will be limited to 1% of the amount bid for the contract and the subsequent mobilization payment will be reduced by an equal amount to follow the payment schedule as shown above. In no case will more than 5% of the amount bid for the contract be paid before the last partial pay estimate.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION
NOT USED

PAY ITEM:
Mobilization

PAY UNIT:
LS

END OF SECTION 00170

SECTION 00401

EROSION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work consists of providing all labor, material, equipment, and services required to conduct erosion control as described herein and indicated on drawings in accordance with the requirements of the North Carolina Sedimentation Pollution Control Act of 1973 and the rules and regulations promulgated pursuant to the provisions of said act. Erosion control devices shall be selected based on field conditions.

PART 2 PRODUCTS

- A. Products specified are for establishing the type, design and quality required. Products of equal type, design and quality produced by other manufacturers will be considered.
- B. Filter Cloth (Silt Fence, including High Hazard) shall be a synthetic, permeable barrier sheet that is resistant to soil chemicals and mildew, stable under freeze-thaw cycles, will not shrink or expand under wet conditions, and will not unravel or become clogged during use. The filter cloth shall have a minimum tensile strength of 120 pounds. Allowable open area shall not exceed 36 percent and shall not be less than 4 percent. Percent open area is defined as the summation of the open areas divided by the total area of the filter cloth. Equivalent opening size (EOS) shall not be finer than the U.S. Standard Sieve No. 70. EOS is defined as the number of the U.S. Standard sieve having openings closest in size to the filter cloth openings.
 - 1. Determination of Measurement: Measurement shall not be made for this item.
 - 2. Basis for Payment: Payment for Erosion Control shall be made over the life of the project. Initially, 40% of the lump sum for erosion control shall be paid on the first payment application, then 5% on each subsequent payment application until the final payment application, where the remaining balance will be paid.
- C. Erosion Control Stone
 - 1. Use field stone or rough unhewn quarry stone for plain rip rap. Use stone that is sound, tough, dense, resistant to the action of air and water and suitable in all other respects for the purpose intended. Where broken concrete from demolished structures or pavement is available, it may be used in place of stone provided that such use meets with the approval of the Engineer. However, the use of broken concrete that contains reinforcing steel will not be permitted.
 - 2. All stone shall meet the approval of the Engineer. While no specific gradation is required, there shall be equal distribution of the various sizes of the stone within the required size range. The size of an individual stone particle will be determined by measuring its long dimension.
 - 3. Stone or broken concrete for rip rap shall meet the following for the class and size distribution.

ACCEPTANCE CRITERIA FOR RIP RAP AND STONE FOR EROSION CONTROL

Class	Required Stone Sizes, Inches		
	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

No more than 5.0% of the material furnished can be less than the minimum size specified nor no more than 10.0% of the material can exceed the maximum size specified.

D. Erosion Control Matting:

Matting for erosion control shall be excelsior matting or straw matting. Furnish a material certification certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the Engineer in writing before being used. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.

1. Excelsior Matting

Excelsior matting shall consist of a machine produced mat of curled wood excelsior at least 47" in width and weigh 0.975 lb/sy with a tolerance of $\pm 10\%$. At least 80% of the individual excelsior fibers shall be 6" or more in length. Evenly distribute the excelsior fibers over the entire area of the blanket. Cover one side of the excelsior matting with an extruded plastic mesh. The mesh size for the plastic mesh shall be no more than 1" x 1".

2. Straw Matting

Straw matting shall consist of a machine produced mat of 100% grain straw. The straw matting shall have a width of at least 48" and no more than 90" and weighing at least 0.50 lb/sy and no more than 0.75 lb/sy. Evenly distribute the straw over the entire area of the blanket. Cover one side of the blanket with photodegradable netting with a maximum mesh (netting) size of 0.75" x 0.75" sewn together with a degradable thread. The grain straw shall contain no weed seeds. Package each roll separately.

3. Wire Staples

Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape. The size when formed shall be not less than 6" in length with a throat of not less than 1" in width.

PART 3 EXECUTION

- A. Work: Shall include labor, equipment, tools, saw cutting, legal disposal, and all other incidentals necessary to complete the work.
- B. Install Erosion Control Devices:
 - 1. Install erosion control devices, which shall be in place and operational prior to other land disturbing activity.
 - 2. After installing erosion control devices as indicated on the Drawings, verify that reasonable measures have been taken to prevent the sedimentation of nearby watercourses, existing and new facilities, and adjacent property.
 - 3. Should Contractor believe that additional measures are necessary to adequately prevent erosion, immediately notify Engineer. If rain is predicted before the Engineer can be notified, take measures as necessary to prevent siltation of nearby water courses.
 - 4. After installing erosion control devices, request an inspection by the local agency having jurisdiction and the Engineer.
 - 5. Incorporate permanent erosion control work into the project at the earliest practicable time. Coordinate temporary erosion control measures with permanent erosion control measures and other work on the project to assure effective and continuous erosion control throughout the construction and post construction period.
 - 6. Maintain erosion control devices during construction until the disturbed areas are stabilized and the agency having jurisdiction, and the Engineer have approved the removal of the erosion control devices.
- C. Borrow and Disposal Areas:
 - 1. Obtain and pay for erosion control permit for borrow and disposal areas as required by Engineer and the local agency having jurisdiction. (NC Department Environmental Quality)
 - 2. Install and maintain erosion control devices in accordance with Contractor's approved plan.
- D. Silt Fences: Provide posts and metal fence fabric as detailed on the drawings and cover with filter cloth as indicated to furnish an effective filtering medium to separate soil sediment from the storm water runoff. The filter cloth shall be permanently attached to the fence to prevent displacement, and the bottom of the filter cloth shall be buried to prevent underwashing in heavy rainstorms.
- E. Filters: Gravel filters as detailed on the drawings, consisting of piles of #57 stone shall be placed around permanent and temporary drainage structures to allow storm water to flow into natural drainage channels while separating soil sediment from the storm water runoff.
- F. Rock Inlet Sediment Traps: Provide posts, staples, hardware cloth and stone of type and class as detailed on the drawings. Structural stone, per class specified, shall be placed around the outside perimeter of the inlet structure with approximately 2:1 side slope and plate the upstream side with #57 stone.
- G. Rock Pipe Inlet Sediment Traps: Provide stone of type and class detailed on the drawings. Surround structure with a sediment storage area built to 3600 cubic feet per disturbed acre. Dam must be a minimum of 18 inches high.

- H. Temporary Swales and Ditches: Temporary swales and ditches shall be graded to the profiles and sections indicated and, in the locations, directed. Slope all swales and ditches to drain to the basins and/or filters as indicated.
- I. Erosion Control Matting:
- Matting for erosion control shall be excelsior matting or straw matting. Furnish a material certification certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the Engineer in writing before being used. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.
1. Excelsior Matting

Excelsior matting shall consist of a machine produced mat of curled wood excelsior at least 47" in width and weigh 0.975 lb/sy with a tolerance of $\pm 10\%$. At least 80% of the individual excelsior fibers shall be 6" or more in length. Evenly distribute the excelsior fibers over the entire area of the blanket. Cover one side of the excelsior matting with an extruded plastic mesh. The mesh size for the plastic mesh shall be no more than 1" x 1".
 2. Straw Matting

Straw matting shall consist of a machine produced mat of 100% grain straw. The straw matting shall have a width of at least 48" and no more than 90" and weighing at least 0.50 lb/sy and no more than 0.75 lb/sy. Evenly distribute the straw over the entire area of the blanket. Cover one side of the blanket with photodegradable netting with a maximum mesh (netting) size of 0.75" x 0.75" sewn together with a degradable thread. The grain straw shall contain no weed seeds. Package each roll separately.
 3. Wire Staples

Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape. The size when formed shall be not less than 6" in length with a throat of not less than 1" in width.
- J. Seeding: Refer to Section 00480.
- K. Maintenance
1. The Contractor shall be responsible for periodic reviews of the conditions of the erosion control measures and shall remove all soil sediment and debris as it accumulates in and around the sediment collection structures.
 2. The Contractor shall make all necessary repairs to the erosion control measures to insure their proper operation and function throughout the duration of the project.
- L. Self-Inspection and Monitoring:
1. Provide self-inspection and reporting as required by the Sedimentation Pollution Control Act for the duration of the project. These inspections will be performed to ensure that the approved sedimentation and erosion control measures on the Drawings are installed, maintained, and working adequately.
 1. The inspections need to be conducted after each phase of the project and continue until permanent ground cover is established.
 2. The self-inspection forms and information regarding this program are provided at the following website:
http://www.dlr.enr.state.nc.us/pages/sedimentation_new.html.
 3. Documentation of inspections shall be recorded on a single copy of the approved erosion and sedimentation control drawings. These Drawings and inspection reports shall be made available at the project site.

2. Provide weekly self-monitoring in accordance with the NPDES Stormwater permit for all construction activities
- M. Removal of Temporary Erosion Control Measures: Remove erosion control devices upon the approval of the permanent stabilization of the site by the agency having jurisdiction of the area (NCDEQ) and the Engineer. Dress sediment deposits remaining in place after the erosion control devices are removed to conform to the existing grade, prepared and seeded. Include cost of removal and cleanup in the cost of the installation of the device. All grassed areas disturbed as a result of this removal shall be re-grassed as called for in Section 00480.

Pay Item

Erosion Control

Pay Unit

LS

END OF SECTION 00401

SECTION 00402

FILTER FABRIC

REFERENCE – North Carolina Department of Transportation (Raleigh, N.C.) – Standard Specifications for Roads and Structures, current edition, and any revisions.

PART 1 GENERAL

- 1.01 The fabric shall consist of strong rot-proof synthetic fibers formed into a woven fabric or a nonwoven needle punched fabric meeting all applicable requirements of this section.
- 1.02 The fabric shall be free from any treatment or coating which might significantly alter in physical properties before or after installation. The fabric fibers shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from ultraviolet or heat exposures. The fabric shall be a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other. The edge of the fabric shall be finished to prevent the outer fibers from pulling away from the fabric. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties. Sheets of fabric may be sewn or bonded together with a fungus resistant material. No deviation from any physical requirements will be permitted due to the presence of the seam.
- 1.03 During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protective covering to protect the fabric from direct sunlight, mud, dust, dirt, and debris. The fabric shall not be exposed to temperatures greater than 140°.
- 1.04 When anchor pins are required, they shall be fabricated of steel and installed per manufacturer's recommendation unless otherwise specified by the Engineer.

PART 2 INSTALLATION

- 2.01 This item shall include all labor, equipment, and materials necessary for the placement of filter fabric under Rip Rap and Reno Mattress as required by the plans. Filter fabric shall be placed as shown on the plans and in strict accordance with manufacturer's written instructions. To be acceptable for use, all filter fabric must be certified by the manufacturer to meet the specified requirements (minimum roll average) and shall be packaged and labeled according to ASTM procedures. Filter fabric for this job shall meet the following specifications:

<u>PROPERTY</u>	<u>TEST PROCEDURE</u>	<u>VALUE</u>
Grab Tensile	ASTM D-4632	300 lbs.
Grab Elongation	ASTM D-4632	15%
Mullen Burst	ASTM 3786	600 lbs.
Puncture	ASTM D-4633	120 lbs.
Trapezoidal Tear	ASTM D-4633	120 lbs.
AOS	ASTM D-4751	30/70 US Sieve

PART 3 ACCEPTANCE

- 3.01 The Contractor shall furnish a Type I Certified Mill Test Report, Type 2 Typical Certified Mill Test Report, or Type 4 Certified Test Report for the fabric in accordance with Article 106-3 of the NCDOT Standard Specifications for Roads and Structures, current edition, and any revisions.

Additionally, the material shall be subject to inspection, test, or rejection by the Engineer at any time.

- 3.02 Fabric will be rejected if more than 72 hours has elapsed between the time the protective wrapping has been removed and the fabric is covered up during installation except where the fabric is used for temporary silt fence.

Pay Item
Filter Fabric

Pay Unit
SY

END OF SECTION 00402

SECTION 00403

RIP RAP SWALE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work includes all stone placement used to reduce the velocity of flow within the swale and control the amount of erosion that takes place.
- B. All swales shall be constructed of materials specified or indicated in the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation. Any defect in manner or workmanship shall be cause for the replacement and correction of such defect as directed by the Engineer at no expense to the Owner.
- C. Determination of Measurement: Measurement shall be per ton of riprap installed.
- D. Basis for Payment: Payment will be on a contract unit price per ton of rip-rap swales installed. Contractor shall furnish a "certified scale ticket" with each load of stone to the Engineer within 24 hours.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All rip-rap lining shall be in accordance with the North Carolina Department of Transportation (NCDOT) – Standard Specifications for Roads and Structures, current edition, and any revisions. 1042-2 for Class A Riprap. The stones should vary in size from 2" to 6".
- B. Filter fabric shall conform to NCDOT – Standard Specifications for Roads and Structures, current edition, and any revisions Section 1056. The fabric shall consist of strong rot-proof synthetic fibers formed into a woven fabric or a non-woven needle punched fabric. The fabric shall be free from any coatings or treatments which might significantly alter its physical properties. The fabric fibers shall contain a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with each other. The edge of fabric shall be finished to prevent the outer fibers from pulling away from the fabric. Sheets of fabric may be sewn or bonded together with a fungus resistant material. The fabric shall meet the requirements for Type 2 fabric as stated in the NCDOT – Standard Specifications for Roads and Structures, current edition and any revisions, Table 1056-1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Furnishing, hauling, placing materials, fabric, staples, grading, equipment, tools, labor, and other incidentals required to install swale.
- B. The riprap shall be placed and graded as specified in the NCDOT – Standard Specifications for Roads and Structures, current edition and any revisions, Section 876 and other applicable sections. The stone shall be placed on the slopes as indicated on the plans, or as the Engineer directs. The stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing, provided that when completed, the riprap shall be at a depth of at least that which is shown on the plans.

- C. Surfaces to receive filter fabric shall be graded to the lines and grades shown on the plans, unless otherwise directed by the Engineer. The surface shall be free of obstructions, debris, and pockets of soft or low-density material. The fabric shall be laid smooth and free from tension, stress, folds, wrinkles, or creases. Horizontal overlaps shall be a minimum of 18" with the upper fabric overlapping the lower. Vertical overlaps shall be a minimum of 18" with the upstream fabric overlapping the downstream. The Engineer reserves the authority to reject any material that is felt to not meet the necessary requirements.
- D. The stone lining shall be placed upon the filter fabric and smooth graded to a depth as shown on plans in such a way as to not damage the underlining fabric liner. Any damage to the fabric liner shall necessitate the removal and replacement of the damaged area.
- E. The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the proper distribution. The finished grade of the riprap should blend with the surrounding area. No over fall or protrusion of riprap should be apparent.

Pay Item

Rip-Rap Swale - Common

Rip-Rap Swale - Uncommon

Pay Unit

LF

SY

END OF SECTION 00403

SECTION 00405

CLEARING, GRUBBING, AND SELECTED TREE REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item should consist of the furnishing of all labor, equipment, and materials in performing all operations in connection with clearing and grubbing and selected tree removal, in accordance with this section of the specifications and the applicable drawings or as designated by the Engineer, and subject to the terms and conditions of the contract.

PART 2 PRODUCTS

2.01 MATERIALS

- A. For cut or scarred surfaces, damaged area should be trimmed with a sharp blade to remove shredded or loose outer layer(s) and left to heal on its own. No paint or dressing is required.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Protection: Locate and protect property corners and survey control stakes prior to start of clearing operations. Contractor shall protect underground utilities in the area.
- B. Clearing: Clearing shall consist of the felling and cutting up of trees, the trimming of trees, and the satisfactory disposal of trees and other vegetation together with down timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation as may be indicated on the drawings or designated by the Engineer to be left standing, and all stumps, roots, and brush in areas to be cleared shall be cut off flush with or slightly below the original ground surface. Trees and stumps that are to be grubbed under the same contract may be cut to any height up to three feet (3'). When it is necessary to remove limbs and branches from trees which are to be left standing, the cut shall be neatly made close to the bole of the tree or to main branches. Individual trees, groups of trees, and other vegetation to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by other approved means. Clearing operations shall be conducted to prevent damage by falling trees to trees to be left standing, existing structures and installations, and to those under construction, and to provide safety of employees and others.
- C. No trees, brush, stumps, or other refuse from clearing shall be thrown upon adjacent property, but trees unavoidably falling outside the specified limits shall be removed to within the clearing and disposed of there.
- D. Grubbing: Grubbing shall consist of the removal and disposal of all stumps, roots larger than three inches in diameter and matted roots from the areas designated to be grubbed. All stumps, roots, logs, or other timber more than three inches in diameter, matted roots, and other suitable debris shall be excavated and removed to a depth not less than three feet below any subgrade, shoulder, or slope. All depressions excavated for or by the removal of stumps and roots, shall be refilled with suitable material thoroughly compacted.

- E. Selective Tree Removal (Determination of Measurement): By the number of various sizes of selected trees removed. Diameters will be measured at a height of 4'-6" above the ground. Selected trees to be removed shall consist of trees six inches or more in diameter either shown on the plans or as designated by the Engineer. All roots, or other timber more than three inches in diameter, and matted roots shall be excavated and removed to a depth not less than three feet below any subgrade, shoulder, or slope. Selected trees shall NOT be paid for within an area designated as clearing and grubbing.

1. Basis for Payment: Payment shall be for each selected tree removed as indicated in the sizing chart below. Selected trees shall NOT be paid for within an area designated as clearing and grubbing. Trees measuring less than 4" in diameter shall be considered saplings. Payment for saplings is paid for under clearing and grubbing and shall not be paid as selective tree removal.

<u>PAY ITEM SIZE</u>	<u>ACTUAL TREE DIAMETER</u>
6"	4" up to 8"
10"	8" up to 12"
15"	12" up to 18"
18"	Above 18"

2. Work: Price and payment shall be full compensation for furnishing all labor, equipment, material, tools, and all other incidentals necessary for complete removal and legal disposal of selected trees.

- F. Clearing and Grubbing (Determination of Measurement): The area to be paid for shall be the area in acres, measured horizontally of the areas designated on the plans or directed by the Engineer to be cleared and/or grubbed as called for in the Proposal. Measurement shall be made to the nearest square foot. No measurement or allowance will be made for removing isolated trees within an area designated by the Engineer to be cleared and/or grubbed, nor for cutting and removal of grain, grass, weeds, or other plants. Clearing and grubbing shall include all selective tree removal unless otherwise specified by the Contract. The combined item of clearing and grubbing shall also include the removal and satisfactory disposal of fences, steps, walls, chimneys, slabs, building foundations, basements, signs and other rubble and debris unless otherwise specified by the Engineer.

1. Work: Price and payment shall be full compensation for furnishing all labor, equipment, material, tools, legal disposal of material and all other incidentals necessary to complete the work.

- G. Disposal of Cleared and Grubbed Material and Trees: All timber, logs, stumps, roots, brush, rotten wood, and other debris from the clearing and grubbing operations shall be disposed of legally by the Contractor.
- H. Erosion Control: Clear areas required to install erosion control devices, which shall be in place and operational prior to other land disturbing activity. Install erosion control devices in accordance with Project Manual and Drawings and Erosion Control Permit.
- I. Access Roads: Clear for access roads. Limit clearing and grubbing for access roads to maximum width necessary or as shown on plans.

Pay Item
Clearing and Grubbing
Selective Tree Removal

Pay Unit
AC
EA

END OF SECTION 00405

SECTION 00406

REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. REMOVE EXISTING PAVEMENT

1. Determination of Measurement: By the square yard of existing pavement removed. The existing pavement shall be measured by the Engineer prior to its removal.
2. Basis for Payment: Payment will be on a contract unit price per square yard for removal and proper disposal of existing pavement.
3. Work: Shall include labor, equipment, tools, saw cutting, legal disposal, and all other incidentals necessary to complete the work.

B. REMOVE EXISTING SIDEWALK

1. Determination of Measurement: By the square yard of the existing sidewalk removed. The existing walks shall be measured by the Engineer prior to its removal.
2. Basis for Payment: Payment will be on a contract unit price per square yard for removal and proper disposal of existing sidewalks.
3. Work: Shall include labor, equipment, tools, saw cutting, legal disposal, and all other incidentals necessary to complete the work.

C. REMOVE AND REPLACE CONCRETE CURB AND GUTTER

1. Determination of Measurement: Measurement shall be per linear foot. Measurement of the curb and gutter shall be along the top of the curb excluding catch basin openings.
2. Basis for Payment: Payment shall be on a contract unit price per linear foot.
3. Work: Removal and disposal of existing concrete curb, furnishing, hauling, fine grading sub grade, compacting sub grade, seeding, backfilling behind curb with topsoil, adding soil amendments, placing all materials, and all equipment, materials, tools, labor, and incidentals necessary to complete the work.

D. REMOVE AND REPLACE CONCRETE DRIVEWAYS (no overages allowed)

1. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Engineer.
2. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of four (4) inches for residential, six (6) inches for commercial, or matching existing concrete thickness, whichever is greater.
3. Work: Saw cutting and removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction, expansion joint materials, curing and placing all materials, forms and all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.

E. REMOVE AND REPLACE ASPHALT DRIVEWAYS (no overages allowed)

1. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Engineer.

2. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of two (2) inches or matching existing asphalt thickness, whichever is greater.
 3. Work: Saw cutting and removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction, placing all materials, forms and all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.
- F. REMOVE AND REPLACE GRAVEL DRIVEWAYS WITH AGGREGATE BASE COURSE (no overages allowed)
1. Determination of Measurement: Measurement shall be in square yards.
 2. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted. Existing gravel and/or soil driveway shall be replaced with six (6) inch thick stone, compacted Aggregate Base Course (ABC) or whichever matches existing type stone.
 3. Work: Removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction, all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.
- G. REMOVE AND REPLACE CONCRETE SIDEWALK
1. Determination of Measurement: Measurement shall be in square yards.
 2. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted.
 3. Work: Saw cutting and removal to the nearest joint, proper disposal of the existing concrete sidewalk and unsuitable materials, compaction, furnishing, hauling, and placing all materials, fine grading the sub-grade, installation of necessary expansion joints, installation and removal of forms, concrete placement, curing and all equipment, tools, labor, and incidentals necessary to complete the work.
- H. REMOVAL OF PAVEMENT MARKING LINES
1. Determination of Measurement: Will be measured and paid as the actual number of linear feet of pavement marking lines satisfactorily removed and accepted by the Engineer. The quantity of solid lines will be the summation of the linear feet of solid line measured end-to-end of the line. The quantity of skip or broken lines will be the summation of the linear feet derived by multiplying the nominal length of lines by the number of marking lines satisfactorily removed.
 2. Basis for Payment: The quantity of pavement marking lines removed will be paid for at the contract unit price for each linear foot. No payments will be made for the removal of removable pavement marking tape.
 3. Work: Layout, materials, tools, traffic control, equipment, labor, and all other requirements necessary to complete the work
- I. REMOVAL OF PAVEMENT MARKING SYMBOLS AND CHARACTERS
1. Determination of Measurement: Will be measured and paid as the actual number of pavement marking symbols and characters satisfactorily removed and accepted by the Engineer.
 2. Basis for Payment: The quantity of pavement marking symbols and characters removed will be paid for at the contract unit price.
 3. Work: Layout, materials, tools, traffic control, equipment, labor, and all other requirements necessary to complete the work

J. FENCE REMOVAL

1. Determination of Measurement: Measurement shall be by the linear foot measured from center post to center post. No deduction will be made for gates
2. Basis for Payment: Payment will be per linear foot per type of fence removed. Gates will be included in the linear foot price.
Work: Shall include labor, material, equipment, grading, and any other incidentals required for removal.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EXECUTION

- A. Work: Shall include all labor, material, tools, equipment,, disposal, hauling and any other incidentals required for removals.

Pay Item	Pay Unit
Removal Existing Asphalt	SY
Removal Existing Concrete	SY
Removal Existing Brick Pavers	SY
Removal Existing Gravel Drive	SY
Removal Existing Curb	LF
Removal Existing Fence	LF
Removal Existing Pavement Lines	LF
Removal Existing Signs	EA
Removal Existing Pavement Symbols	EA
Removal Existing Mailbox	EA

END OF SECTION 00406

SECTION 00410

PROOFROLLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item shall consist of furnishing and operating, at the direction of the Engineer, heavy pneumatic tired compaction equipment or fully loaded tandem dump truck for compacting the roadbed and testing the roadbed for stability and uniformity of compaction.
- B. The Contractor may operate the proofrolling equipment at times other than when directed by the Engineer. Such use is at the Contractor's option and is not to be considered as work performed under this section and will not be considered for payment.
- C. The requirement for proofrolling may not be eliminated or modified without the approval of the Engineer.

PART 2 PRODUCT

2.01 EQUIPMENT

- A. The Engineer shall check to see that the equipment conforms to the requirements of this article. A tandem dump truck legally fully loaded (not less than 28 tons) with soil or stone may be used to proofroll.
- B. If requested weight tickets signed by a licensed public weighmaster may be used to determine the weight of the dump truck and the weight of load to be used.
- C. Requests by the Contractor to substitute other types of equipment shall be forwarded to the Engineer for approval or disapproval.
- D. The Contractor shall not be permitted to drive the loaded dump truck over existing structures or curbing. The Contractor shall use rubber tired or other types of tractive equipment for operation on the roadbed. The Contractor shall protect all structural facilities within the project area, such as, but not limited to, bridges, box culverts, pipe culverts and utilities. Damage resulting from proofrolling equipment shall be repaired by contractor at no cost to the City. The entire assembly, including motivating equipment, shall be capable of executing a 180° turn.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Proofrolling is to be done when the roadbed is within plus or minus 0.5 feet of finished grade and the roadbed shall be rolled for a width located between points 2 feet outside the proposed edges of pavement including shoulder pavement.
- B. A coverage is considered to be at that stage in the rolling procedure when the entire area to be proofrolled has been in contact with the pneumatic tires of the roller or loaded dump truck. One complete coverage shall be made with additional coverage as required when failure is suspected. Areas which have failed and been repaired shall be given a complete coverage after repair has been completed.
- C. Equipment shall be operated at a speed between 225 ft/min and 300 ft/min.
- D. The Engineer shall follow (walking is preferable) a short distance behind the proofroller observing the action of the roadbed produced immediately behind the tires of the roller.

When the roadbed material compresses and remains compressed, the roadbed is satisfactory. When the roadbed material compresses and then rebounds to any appreciable extent, further testing and investigation shall be made. Horizontal slippage or crust breakage is not considered as failure. Any slippage or breakage shall be repaired.

- E. The Engineer shall take immediate steps to determine the cause of any failure observed. Failures are usually due to the necessity for underdrains, unsuitable materials, or excessively wet materials. These conditions may be found to be as much as 6 feet below the roadbed surface. Assistance in determining corrective action required when needed, may be obtained from the Engineer.
- F. Should it be determined that the failure is due to negligence or weather, the City Engineer shall so inform the Contractor, verbally and in writing and shall document all work (including equipment, personnel, and time) necessary for correction of the area.

END OF SECTION 00410

SECTION 00412

INCIDENTAL STONE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. DESCRIPTION

1. Perform the work covered by this section including but not limited to, furnishing, hauling, placing and shaping a graded stone material for use in driveways, temporary maintenance of traffic, adjacent to mailboxes, beneath traffic island, median covers and at any other locations, other than use as a part of any base course on which pavement is to be placed; shaping; tamping when required; maintaining the base; and disposing of any surplus stockpiled material.

2. This section specifically does not include bedding stone for pipes and other structures.

B. MEASUREMENT AND PAYMENT

1. Incidental Stone Base will be measured and paid at the contract unit price per ton that has been stockpiled or incorporated into the completed and accepted work. This quantity will be measured as provided for in this section. Incidental Stone base which has been stockpiled will not be measured more than one time. The Incidental stone will be measured by being weighed in trucks on certified platform scales or other certified weighing devices. No deductions will be made for any moisture contained in the stone at the time of weighing.

2. Determination of Measurement: Measurement shall be per ton of each type placed as approved by the Engineer prior to placement. Contractor shall remove a minimum of two (2) inches of soil or aggregate base course, place and compact stone in order for this item to be applicable.

3. Basis for Payment: Payment shall be on a contract unit price per ton. Contractor shall furnish a "certified scale ticket" with each load of stone to the Engineer within 24 hours in order to be considered for payment. Incidental stone that is stockpiled or not placed will not be considered for payment. No separate payment shall be made for incidental stone placed in mainline or service lateral trenches unless approved by the Engineer.

PART 2 PRODUCTS

2.02 MATERIALS

1. Use stone gravel or recycled concrete for the graded stone material which is well graded from the 1-1/2 inches through the No. 200 sieve. The liquid limit of the recycled concrete is raised 5 points to no more than 35.

PART 3 EXECUTION

3.01 INSTALLATION

A. WORK

1. Work: Labor, tools, materials, equipment, furnishing, placing, supplementing stone required for maintenance, grading/leveling stone, hauling, wetting, blading, compacting, removing and disposal of incidental stone immediately prior to asphalt pavement patch.

B. GRADATION SAMPLING, TESTING AND ACCEPTANCE

1. Acceptance of the graded stone material will be made by visual inspection and approval by the Engineer as being satisfactory for the purpose intended before it use. No sampling for testing of the graded stone material will be performed.

C. PLACING AND SHAPING STONE

1. Spread the stone material uniformly over the area required and then shape and dress to the satisfaction of the Engineer.

2. Uniformly spread, grade to the required depth and firmly tamp the stone material beneath traffic island and median covers. If the Contractor desires, the surface of the stone material me be covered with a sufficient amount of fine material to facilitate grading and shaping.

D. MAINTENANCE

1. Maintain the stone material until final acceptance of the project by reshaping and by the addition of incidental stone base material when directed by the Engineer.

Pay Item

Incidental Stone Base

Pay Unit

Ton

END OF SECTION 00412

SECTION 00415

SOIL TYPE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of the construction of a base composed of one or more natural materials proportioned and blended on the road, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans and established by the Engineer.
- B. Conditioning Existing Base: The work covered in this section consists of scarifying, shaping, and compacting the existing base to conform to the required lines, grades, depths, and typical sections established by the plans or modified by the Engineer.

1.02 SOIL TYPE BASE COURSE

- A. Determination of Measurement: Measurement shall be based on truck quantity minus 25% from certified scale ticket for each load of material. Certified scale tickets must be provided within 24 hours.
- B. Basis for Payment: Soil base course will be paid on a contract price per cubic yard.

1.03 SELECT BORROW

- A. Determination of Measurement: Measurement shall be in cubic yards installed. The cubic yards of excavation and the cubic yards of select granular material backfill to be paid for shall be 75 percent of the volume obtained by multiplying the gross volume of the trucks hauling the material by the number of loads hauled.
- B. Basis of Payment: The quantity of subsoil will be paid for at the contract unit price per cubic yard of subsoil installed.

1.04 TOPSOIL

- A. Determination of Measurement: Measurement shall be in cubic yards installed.
- B. Basis of Payment: The quantity of topsoil will be paid for at the contract unit price per cubic yard of topsoil installed.

1.05 DESIGN REQUIREMENTS

- A. The soil type base course is to conform to the Table below:

<u>Requirements</u>	<u>Limits Type A</u>	<u>Limits Type B</u>	<u>Limits Type C</u>
Passing 2" Sieve		100%	
Passing 1" Sieve	100%	70% - 100%	
Passing ½" Sieve		55% - 100%	
Passing No. 4 Sieve		35% - 100%	
Passing No. 10 Sieve	65% - 100%	25% - 65%	100%
Passing No. 40 Sieve		15% - 45%	
Passing No. 200 Sieve		5% - 25%	

- B. The base course material shall be free from vegetative matter and lumps or balls of clay.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Soil type base course shall be either Type A, B, or C.

2.02 SOURCE QUALITY CONTROL AND TESTS

- A. Samples will be tested for gradation in accordance with AASHTO T-88. The liquid limit test will be in accordance with AASHTO T-89 and the plasticity index will be tested in accordance with AASHTO T-90.
- B. Gradation testing shall be performed a minimum of one test per road or every 2,000 feet for roads less than 27 feet in width and every 1,000 feet for roads greater than 27 feet in width.
- C. Sand cone test shall be utilized for density testing. Density testing shall be performed a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.

PART 3 EXECUTION

3.01 WORK

- A. **SOIL TYPE BASE COURSE**
 - 1. Excavating, loading, hauling, spreading, and compacting, etc. as required for placement of soil base course.
- B. **SELECT BORROW**
 - 1. Shall include material loading, hauling, placing, and compacting, equipment, labor, supplying suitable subsoil material and any other incidentals required for installation.
- C. **TOPSOIL**
 - 1. Shall include removal of unusable topsoil including rocks and debris, excavation, grading, loading, hauling, equipment, labor, compaction, supplying suitable topsoil material and any other incidentals required for installation.

3.02 INSTALLATION

- A. Soil type base course shall be placed on a sub-grade that has been cut to the required depth as shown on the plans. Sub-grade should be checked by the inspector or Engineer before any base course can be placed. Upon the placing of the base material the Contractor shall start mixing operations. Mixing shall be done in a manner which will produce a thoroughly and uniformly mixed soil base course.
- B. The base shall be finally shaped to conform to the lines, grades, and typical sections shown on the plans. Care shall be taken to prevent the formation of slippage planes in the surface. All soft or unstable areas shall be thoroughly dried, re-mixed, or reworked and replaced.

Pay Item	Pay Unit
Soil Type Base Course	CY
Select Borrow	CY
Topsoil	CY

END OF SECTION 00415

SECTION 00420

AGGREGATE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.
- B. Determination of Measurement: Measurement shall be by certified scale ticket with each load of material. Tickets must be provided within 24 hours. Penalties may be assessed if tickets are not received in a timely manner.
- C. Basis for Payment: Contractor will be paid on a contract unit price per ton of stone that is placed.
- D. Work: The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.

1.02 REFERENCES

- A. Standard Specifications for Roads and Structures: Section 520, most recent edition by the North Carolina Department of Transportation will govern the work under these specifications except as they are modified hereinafter.

1.03 SCHEDULING

- A. No aggregate base course will be laid until the sub-grade is approved for grade and density by the Engineer.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL AND TESTS

- A. Gradation testing may be required by Engineer if visible segregation in material is noted.
- B. Sand cone test shall be utilized for density testing. Density testing shall be performed at a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.
- C. Proofrolling is required for roadway subbase and base courses.

PART 3 EXECUTION

NOT USED

Pay Item
Aggregate Base Course

Pay Unit
Ton

END OF SECTION 00420

SECTION 00425

EXCAVATION/BACKFILLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roadway: This item shall consist of the removal and satisfactory disposal of all materials excavated within the area of the street to be paved, the removal and replacement of unsuitable sub-grade material with satisfactory material, the formation, compacting, and shaping of all embankments to the lines and grades established by the Engineer, excavation from borrow areas of suitable materials to be hauled in and used as fill or back-fill, when sufficient quantities of suitable material are not available from the roadway, all in accordance with this section of the specification, and subject to the terms and conditions of the contract. The classification of all material excavated shall be either "Unclassified Excavation" or "Undercut Excavation."
- B. Storm Sewer: The Contractor shall provide labor, equipment, and material to perform required excavating, backfilling, and compacting for storm sewer utilities and related structures to the depths shown on the plans or as directed by the Engineer. The width of the trench shall not exceed the width required to properly tamp backfill material around pipe or to adequately shore trench but shall be limited to pipe diameter plus two feet or pipe diameter plus $\frac{1}{2}$ pipe diameter, whichever is greater.
- C. All pipes shall be laid true to lines and grades shown on the plans or as designated by the Engineer. Recesses shall be excavated to receive the bells of the pipe.
- D. When the foundation materials are of poor supporting value, the pipe foundation shall be reinforced by one of the following methods:
 - 1. By replacing the unsuitable material in a minimum depth of six inches, or as directed by the Engineer with sand, sand-clay, gravel, or crushed stone and thoroughly tamped.
 - 2. By constructing supporting cradles of concrete under each joint.
- E. Excavation below grade shall be backfilled at the Contractor's expense, as directed by the Engineer, and thoroughly tamped. When select borrow material is required by the Engineer, it shall be paid for as Select Borrow.
- F. The ground adjacent to all excavation shall be graded to prevent surface water running in. The Contractor shall, at his expense, remove by pumping or other means approved by the Engineer any water accumulated in the trench.
- G. All banks or trenches shall conform to City and OSHA safety standards (whichever more stringent). The Contractor shall, at his expense, do all bracing, sheeting, and shoring necessary to perform and protect all excavations, as required for safety, and as directed by the Engineer or when the Contractor deems it necessary.
- H. The excavation for manholes and catch basins shall be of sufficient width and depth to permit ready construction.
- I. Determination of Measurement: The number of cubic yards of Unclassified Excavation measured in original position by cross sectioning and computed by the average end area method. When it is not feasible to cross section the volume of excavation which is to be replaced with borrow back-fill, the loads of material hauled in shall be counted. Undercut Excavation will be measured by the volume (cubic yards) of unsuitable material excavated, authorized by the Engineer, to the depths and widths so established. Excavation to greater

depths and/or widths, unauthorized, shall be refilled with select backfill material used for backfilling and compacted at no additional cost to the City.

- J. Basis for Payment: Contractor will be paid on a contract unit price per cubic yard for unclassified/undercut excavation, which price and payment shall be full compensation for the excavation and hauling; formation and compaction of embankments; removal and disposal of surplus drain pipes, existing walls, steps and surplus materials within the right-of-way, removal and disposal of all roots, stumps, logs, and other debris excavated from drainage ditches; for all sloping and trimming of the ditches, preparation and completion of the sub-grade and shoulders, ditches, slopes, and furnishing of all labor, equipment, tools, and incidentals necessary to complete the work

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Complete removal and disposal of unstable soil including, but not limited to, excavating, loading, hauling, properly disposing of excavated material, and providing select granular material for backfill. Providing select granular material for backfilling shall include, but not be limited to, material, loading, hauling, placing and compacting.
- B. Construction Methods: The Contractor shall proceed with excavation and disposal of material at such locations and in such sequence as the Engineer may approve.
 - 1. All excess excavated material from a project shall be disposed of by the Contractor at his expense unless ordered to another project by the Engineer. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any right of property in any material taken from any excavation.
- C. Sub-Grade: The sub-grade shall be graded and regulated either by hand labor, the use of one-man motor graders or other approved methods. The sub-grade of the area to be paved shall be in a true plane parallel with and to the grade line established by the Engineer. Should soft or yielding places develop in the sub-grade, the unsuitable material shall be removed and replaced with suitable material and thoroughly compacted. Care shall be taken to ensure that all utility excavations have been thoroughly backfilled and compacted. Any settlement evident after base has been placed shall be corrected at the Contractor's expense. No soil, sand-clay or other base material shall be placed on the sub-grade until the sub-grade has been checked and approved by the Engineer. A variation of more than one-half inch ($\frac{1}{2}$ ") shall be cause for rejection of the sub-grade. Compaction testing for subgrade and for base is 100% compaction.
- D. Unclassified Excavation: All excavation of every description and of whatever substance including rock and rock-like material encountered shall be to the lines and grades indicated or otherwise as specified. The classification of all material excavated shall be "Unclassified Excavation." The work shall consist of the excavation, placement, compaction or satisfactory disposal of all materials encountered within the limits of the work, necessary for the construction of the roads, parking lots, building pads, and utilities. Suitable material excavated shall be transported to and placed in fill areas within the work limits. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all

times. All excess unsuitable excavated material from the project shall be legally disposed of by the Contractor at his expense.

- E. Undercut Excavation: All undercut excavation consists of the excavation, placement, and compaction and/or satisfactory disposal of materials removed from a location below finished grade roadway cross section.
- F. Drainage Ditches: Drainage ditches shall be excavated in accordance with the plans, sections, and grades, and at the time directed by the Engineer. No deviation from alignment, grade, or section will be allowed except by the Engineer.
 - 1. The Contractor shall, in general, be required to excavate all drainage ditches in proper sequence or at the time directed by the Engineer. All roots, stumps, and objectionable matter in the sides and bottom of the ditch shall be cut to conform to the slope, grade, and shape of the section. The Contractor shall dispose of the excavated material as directed by the Engineer and no excavated material or spill from a drainage ditch shall be deposited or left within three feet of the edge of the ditch, but shall be scattered back and not left piled up in a ridge along the ditch, unless otherwise shown on the plans or directed by the Engineer in writing.
- G. Removal of Old Pipe, Walls, Steps, Curb, Gutter, Sidewalk and Pavement: All old pipe, walls, steps, curb, gutter, sidewalks, and pavement shall be removed (including saw cutting) as directed by the Engineer, and legally disposed of by the Contractor. None of the above pay items shall be removed until measured in place by the Engineer.
- H. Private Driveways: The Contractor shall keep private driveways open and unobstructed as far as practicable and shall regrade same from curb to property line when directed by the Engineer.

Pay Item

Excavation and Backfilling

Pay Unit

CY

END OF SECTION 00425

SECTION 00426

SOIL MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Subsoil materials.
- B. Topsoil materials.

1.02 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12-inch (304.8 mm) Drop.
- C. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18-inch (457 mm) Drop.
- E. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- F. ASTM D2487 - Classification of Soils for Engineering Purposes.
- G. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS FOR INFORMATION

- A. Materials Source: Submit name of imported materials source.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of North Carolina standards. Maintain one copy on site.

PART 2 PRODUCTS

2.01 SUBSOIL MATERIALS

- A. Subsoil Type S1: Conforming to State of North Carolina standard.
- B. Subsoil Type S2:
 - 1. Excavated and re-used material.
 - 2. Graded.
 - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

2.02 TOPSOIL MATERIALS

- A. Topsoil Type S3: Conforming to State of North Carolina standard.
- B. Topsoil Type S4:
 - 1. Excavated and reused material.

2. Graded.
 3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
- C. Topsoil Type S5:
1. Imported borrow.
 2. Friable loam.
 3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
 4. Acidity range pH of 5.5 to 7.5.
 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.

PART 3 EXECUTION

3.01 SOIL REMOVAL

- A. Excavate subsoil and topsoil from areas designated.
- B. Remove lumped soil, boulders, and rock.
- C. Stockpile excavated material on approved site and remove excess material, not being used, from site.
- D. Remove excavated material from site. When no onsite, stockpile area is approved.

3.02 STOCKPILING

- A. Stockpile materials on approved site.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.03 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition, with permanent ground cover. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition, with permanent ground cover. Grade site surface to prevent free standing surface water.

Pay Item
Soil Material

Pay Unit
CY

END OF SECTION 00426

SECTION 00440

MILLING BITUMINOUS PAVEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Summary Of Work: The work covered by this section consists of milling bituminous pavement at locations, depths, widths, and typical sections indicated in the plans and special provisions or as directed by the Engineer.
- B. The work also includes removing, transporting, and disposing of the milled material and cleaning the milled pavement surface.
- C. The milled material shall become the property of the Contractor. All milled material shall be legally disposed of by the Contractor in areas provided by him which are outside the right-of-way, except where the milled material is used in the work. Milled material must be removed and disposed of on the same day.
- D. Determination of Measurement: The quantity of milled bituminous pavement and incidental milling to be paid for will be the actual number of square yards of pavement surface which has been milled to depth indicated on drawings in accordance with the requirements of the contract. In measuring this quantity, the length will be the actual length milled, measured along the pavement surface. The width will be the width required by the plans or directed by the Engineer, measured along the pavement surface.
- E. Basis of Payment: The quantity of milled bituminous pavement will be paid for at the contract unit price per square yard for "Milling Bituminous Pavement" or "Incidental Milling" as the case may be.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Equipment shall include a self-propelled unit capable of removing the existing bituminous pavement to the depths, widths, and typical sections shown in the plan, special provisions or as directed by the Engineer. The equipment shall have been designed and built exclusively for pavement milling operations and shall have sufficient power, traction, and stability to accurately maintain depth of cut and slope. The milling machine shall be equipped with a grade control system which will automatically control the longitudinal profile and cross slope of the milled surface by the use of one or more skid sensors moving along the pavement surface. The machine shall be capable of leaving a uniform surface suitable for handling traffic without excessive damage to the underlying pavement structure. The milling machine and other loading equipment shall be capable of loading milled material to be used in other parts of the work without excessive segregation. The milling machine must be on tracks, not wheels.
- B. Additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb and gutter, and other obstructions shall be provided.
- C. The milling equipment shall be equipped with a means of effectively limiting the amount of dust escaping from the removal operation in accordance with local, State and Federal air pollution control laws and regulations.

2.02 TOLERANCES

- A. Tolerance: Removal of the existing pavement shall be to the depth required by the plans or project special provisions. The Engineer may vary the depth of milling by not more than one inch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Shall include milling and re-milling the pavement, cleaning the milled surface, loading, hauling, stockpiling the milled material for use in recycled bituminous mixtures and disposal of any excess milled materials. Any equipment necessary to remove asphalt in the areas of manholes, water valves, curb and gutter and any other obstructions shall be part of milling contract price.
- B. The existing pavement shall be milled in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section at the locations and in accordance with typical sections shown in the plans. Where indicated in the plans or project special provisions, removal shall be to a specified depth and shall produce a specified cross slope. The Contractor shall mill intersections and other irregular areas as indicated in the plans, project special provisions, or as directed by the Engineer.
- C. The Contractor may elect to make multiple cuts to achieve the required depth of cut or cross slope required by the plans.
- D. The longitudinal profile of the milled surface shall be established by a mobile string line on the side of the cut nearest the centerline of the road or as directed by the Engineer. The cross slope of the milled surface shall be established by an automatic cross slope control mechanism or by a second skid sensing device located on the opposite edge of the cut. The Engineer may waive the requirement for automatic grade and cross slope controls where conditions warrant.
- E. The milling equipment shall be operated in such a manner as to prevent damage to the underlying pavement structure, utilities, drainage facilities, curb and gutter, paved surfaced outside the milled area, and reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage as determined by the Engineer. Any leveling or patching required as a result of negligence by the Contractor shall be repaired with hot bituminous plant mix at no cost to the City of Fayetteville and in a manner acceptable to the Engineer. The Contractor shall coordinate the adjustment of manholes, meter boxes and valve boxes with the milling operation.
- F. Milling limits will be determined by Engineer before operation begins.
- G. Inspector must be present during milling.
- H. The Engineer may require re-milling of any area exhibiting defects such as lamination or other defects. If the defects are determined to be the result of the Contractor's negligence, then measurement of the re-milling, as specified in Unit Prices, will not be made. If, however, the Engineer directs the re-milling of an area which is not due to the Contractor's negligence, measurement of the re-milled area will be made under provisions of Unit Prices.
- I. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust and other objectionable material by the use of power brooms, power blowers, power vacuums or other means. Disposal or wasting of oversized pavement or loose aggregate material will not be permitted within the right-of-way.

- J. The pavement removal operations shall be conducted to effectively minimize the amount of dust being emitted. The operations shall be planned and conducted so that it is safe for persons and property adjacent to the work including the traveling public.

Pay Item	Pay Unit
Milling Bituminous Pavement	SY
Incidental Milling	SY

END OF SECTION 00440

SECTION 00445

PAVEMENT JOINT SEALER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of the furnishing and placement of joint sealer material in accordance with these specifications.
- B. Determination of Measurement: Measure total number of pounds of joint sealer placed on the roadway.
- C. Basis for Payment: Payment will be on a contract unit price per pound of joint sealer placed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Joint sealer shall be hot poured rubber asphalt conforming to AASHTO M 173, except as otherwise provided below.
- B. The joint sealer shall be free of all foreign material. When melted it shall be free of lumps. The composition of the material shall be a mixture of virgin synthetic rubber, or a combination of both, with asphalt, plasticizers, and tackifiers. Under no circumstances shall ground cured rubber scrap be used in place of virgin or reclaimed rubber.
- C. The requirements of AASHTO M 173 for flow and bond shall be modified as follows:
 - 1. Flow test at 140 degrees F. 1.0 CM Max.
 - 2. Bond test shall be performed at minus 20 degrees F. instead of 9 degrees F.
 - 3. Ductility shall be not less than 40 CM when tested in accordance with ASTM D113.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Material, equipment, labor, clean up and all associated appurtenances for installation of pavement joint sealer.
- B. Construction Methods: All existing pavement cracks in excess of 1/8 inch but not more than 1 ½ inches will be cleaned using a hot compressed air lance. The cracks shall be sealed with hot poured rubber asphalt meeting the requirements with these specifications.
- C. The joint sealer shall be allowed to dry tack free prior to placing traffic on a sealed area of roadway. Apply DeTack (brand name) or equivalent to remove tackiness. Material shall be placed using the wand followed by a "V- shaped" asphalt squeegee. This method will allow uniform filing of the cracks and reduce excess material due to over-banding.
- D. The Contractor shall provide all traffic control in accordance with the Manual on Uniform Traffic Control Devices.

Pay Item
Pavement Joint Sealer

Pay Unit
Lb.

END OF SECTION 00445

SECTION 00450

PLANT MIX BITUMINOUS CONCRETE SURFACE COURSE AND BITUMINOUS CONCRETE BASE COURSE (TYPE B 25.0 C; TYPE I 19.0 C; TYPE S 9.5 B; TYPE S 9.5 C)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of the production, delivery, placement and compaction of all types of bituminous plant mixed bases and surface courses.
- B. Determination of Measurement: Measurement shall be per ton of each ton of type placed.
- C. Basis for Payment: Payment on a contract price per ton.

1.02 REFERENCES

- A. The "Standard Specification for Roads and Structures" current edition and any revisions by the North Carolina Department of Transportation (NCDOT) will govern in its entirety the work under these specifications except as they are modified hereinafter.
- B. Bituminous Plants Production: All bituminous plants shall meet specification 610 of the Standard Specifications of Roads and Structures current edition and any revisions by the NCDOT. All bituminous plants that produce bituminous mixes that are to be used within the rights-of-way of the City of Fayetteville, or on any new street that is to be accepted by the City of Fayetteville, shall have a current and up to date certification of the asphalt plant on file with the City of Fayetteville.
 - 1. Any bituminous mix that is produced by a plant that does not have NCDOT certification is unacceptable for use within the City of Fayetteville.
- C. Quality Management System for Asphalt Pavements: The Contractor shall produce and construct asphalt mixtures and pavements in accordance with a quality management system as described in Section 609 of the NCDOT Standard Specifications. The Contractor shall submit only NCDOT approved mix design and must be approved by the Engineer prior to delivery. Apply these specifications to all materials and work performed in accordance with Division 6 of the NCDOT Standard Specifications. Perform all quality control activities in accordance with NCDOT "Hot Mix Asphalt Quality Management System (HMA/QMS)" Manual.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Weather and Temperature Limitations: This section addresses air temperature, road surface temperatures, seasonal limitations, weather requirements, the layer thickness that apply when producing and/or placing the various mixture types. Bituminous mixtures shall not be produced or placed during rainy weather, when the sub-grade or base course is frozen, nor when the moisture on the surface to be paved would prevent proper bond. Bituminous material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the following temperatures:

Material Type	TEMPATURE OF LAYER BEING PLACED	
	Minimum	Minimum
	Air Temperature	Road Surface Temperature
ACBC, Types B 25.0C, B 37.5 C, PADC	35 degree F (2 degree C)	35 degree F (2 degree C)
ACIC, Types I 19.0C	35 degree F (2 degree C)	35 degree F (2 degree C)
ACSC, Types S 4.75A, SF 9.5B	40 degree F (5 degree C)	40 degree F (5 degree C)
ACSC, Types S 9.5C	40 degree F (5 degree C)	40 degree F (5 degree C)

* For final layer of surface mixes containing recycled asphalt shingles (RAS) the minimum surface and air temperature shall be 50°F.

1. In addition, surface course material, which is to be the final layer of pavement, shall not be placed between December 15 and March 16, except that open-graded asphalt friction courses (OGAFC) will not be placed between October 31 and April 1 of the next year, unless otherwise approved by the Engineer.
2. As an exception to the above, when in any day's operations the placement of a layer of bituminous base course material or binder material 2" or greater in thickness has started, it may continue until the temperature drops to 32 degrees Fahrenheit (F).

PART 2 PRODUCTS

2.01 MATERIALS

- A. Composition of Mixtures (Job Mix Formula): All bituminous plant mixes that shall be used within the rights-of-way of the City of Fayetteville shall be produced in a NCDOT certified bituminous plant.
- B. All bituminous base courses and surface course mixes that are to be use within the rights-of-way of the City of Fayetteville shall be NCDOT approved and have all job mix formulas on file with the City of Fayetteville. No other bituminous mixes will be acceptable. Must submit mix design for the project.
- C. All binder shall meet the appropriate requirements of Section 610 of the NCDOT Standard Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Production, delivery, placement, and compaction to successfully install bituminous pavement.
- B. Construction Requirement: The production, spreading, finishing, weather limitation, joints, compaction, density and surface requirements shall be in accordance with the Standard Specifications for Roads and Structures current edition and any revisions by the NCDOT.
- C. Transportation of Bituminous Mixture: The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been sprayed with a lime solution, a soap and oil solution, or other approved material, to prevent the mixture from adhering to the beds. Fuel oil is not permitted for this purpose. Truck beds shall be drained prior to loading. Each load of mixture shall be fully covered with a canvas or other suitable material. All covers shall be so constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8-inch diameter hole shall be provided on each side of the vehicle body near the center of the body and 6 inches above the bed of the vehicle for the purpose of inserting a thermometer.
- D. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15 degrees F to minus 25 degrees F of the specified job mix temperature.

TABLE 610-1 MIXING TEMPERATURE AT THE ASPHALT PLANT	
Binder Grade	JMF Temperature
PG 64-22	300°F
PG 70-22	315°F

- E. The contractor is required to have a certified Roadway Technician with each paving operation at all times. This person is responsible for monitoring all roadway paving operations and directly supervising all quality control processes and activities. Provide a certified nuclear gauge operator when nuclear density control is being used. Provide the City of Fayetteville with an organizational chart, including names, telephone numbers, and current certification numbers of all personnel responsible for the quality control program while asphalt paving work is in progress.
- F. Utilize the 30-foot minimum length mobile grade system to control longitudinal profile when placing the initial lanes and all adjacent lanes of all courses, including resurfacing, leveling courses, and asphalt in-lays, unless otherwise approved by the Engineer. Where public traffic is being maintained, apply only as much tack coat as can be covered during the same day's operation. In addition, the Engineer may limit the application of tack coat in advance of the paving operation depending on traffic conditions, project location, proximity to business or residential areas, or other reasons. In the event that tack coat material is not covered in the same day's operation; the Engineer may require the application of suitable granular material or other means to provide a safe traffic condition at no additional cost to the City of Fayetteville. The contractor will be responsible for any clean-up of the materials that was placed at no cost to the City of Fayetteville.
- G. Contractor will furnish with each load of asphalt a scale ticket by a certified weigh master showing the amount of asphalt on the truck. Contractor will be paid on a unit price per ton of asphalt that is actually placed and rolled to a finish asphalt surface or base course.
- H. The Engineer may prohibit or restrict the use of vibratory rollers where damage to the pavement being placed, the underlying pavement structure, drainage structures, utilities, or other facilities is likely to occur or is evident.
- I. The final surface course material shall be compacted using two steel-wheel rollers and a pneumatic tired roller. For any paving operations, two rollers required on site.
 - 1. Initial rolling shall be achieved using an 8-to-10-ton steel wheel roller.
 - 2. Intermediate rolling shall be achieved using a pneumatic tired roller.
 - 3. Final rolling shall be achieved using an additional steel wheel roller.
- J. Surface Smoothness:
 - 1. Base Course – 1/4" in 10 feet.
 - 2. Surface Course – 1/8" between any two contact points, 10-foot straight edge.

3.02 SPECIAL CONSIDERATION

- A. Traffic Loops: When paving intersections requiring loop installations, the Owner shall be given ten (10) calendar days between completion of the first course and beginning of the second course in which to execute said loop installation. Contractor shall install loops before final layer, no later than five (5) days from when milled or as approved by the Engineer.

Pay Item
Plant Mix Bituminous Concrete

Pay Unit
Ton

END OF SECTION 00450

SECTION 00451

PERMANENT PAVEMENT PATCH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removing pavement in parking lots, roads, sidewalks, curb and gutters, drives etc. Installation of the permanent patch shall be completed in accordance with City of Fayetteville Specifications and Drawings. Maximum widths for trenches have been established for all sanitary sewer mains, force mains, sewer laterals, water mains, water laterals and storm drainage, regardless of the depth of excavation or type of existing pavement. Maximum widths shown include a minimum cutback of twelve (12) inches each side of the trench prior to placing pavement trench patch. Any pavement removed or damaged beyond the limits specified herein, shall be replaced by the Contractor at his own cost unless directed otherwise by the Engineer. No payment for overage beyond the quantity shown in the Bid Form will be made.

Maximum Widths for Pavement Trench Patch

Storm Drainage	6'	(for pipe 24" in diameter and less)
Storm Drainage	8'	(for pipe 30" up to 42" in diameter)
Storm Drainage	10'	(for pipe 48" up to 54" in diameter)
Storm Drainage	12'	(for pipe greater than 54")
Sanitary Sewer	10'	(0' to 10' depth, measured to invert of pipe)
Sanitary Sewer	12'	(greater than 10' depth, measured to invert of pipe)
Sewer Laterals	6'	
Water Main	4'	
Water Services	4'	

- B. Contractor shall be required to remove installed patch, re-compact base and sub-base, dispose of unsuitable material off-site and re-patch any areas of settlement at no expense to the Owner. When excavating prior to paving, transitions shall be made to accommodate road travel at no additional cost to the Owner.
- C. After completion of the excavation, etc., any trench or opening in any street or sidewalk shall be properly backfilled following City standards for compaction. The material used in replacing the surface course shall be of the same type and thickness and equal in quality to that which was removed. Excavatable flowable fill in accordance with the City's specifications may be used instead of backfill from the invert to the base layer elevation at the discretion of the Engineer.
- D. Any street that is degraded 25% or greater between intersection shall be overlaid with a minimum of 1 inch of asphalt for the entire length between the intersecting streets. Percentage of degradation will be determined prior to excavation including existing and new degradation. A temporary patch flush with the existing asphalt elevation is to be used for one (1) year to allow settlement prior to final asphalt layer. The contractor may elect to pay in-lieu-of overlay in accordance with the City's fee schedule. For additional requirements on excavation in the right of way, refer to Chapter 24, Article 11.
- E. Contractor shall repair any pavement markings, signal loops and any other traffic device damaged during work.
- F. All work shall be performed with the appropriate traffic control standards and in accordance with the latest edition of MUTCD and City Standards.

- G. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Project Coordinator.
- H. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of two (2) inches or matching existing asphalt thickness, whichever is greater and eight (8) inches of Aggregate Base Course or matching existing, whichever is greater.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 WORK

- A. Labor, materials, tools, and equipment necessary to complete the work which shall include saw cutting (NO WHEEL CUTTING ALLOWED) pavement to straight uniform widths parallel and perpendicular to the road with no jagged edges, removal and disposal of asphalt offsite, re-compaction, removing and disposing of excess soil base course, re-compaction of pavement sub-grade, placement and compaction of ten (10) inches of ABC, maintaining ABC as necessary to maintain stone at pavement grade until removal of upper two (2) inches of stone for paving, adjusting castings as required, tack coat, placing and compacting asphalt material, cleanup and all other incidental work as shown on the details.

3.02 PERMANENT ASPHALT PAVEMENT PATCH

- A. Remove and replace asphalt pavement as described in the unit prices section and as indicated on the bid form. Asphalt and stone shall be installed as indicated in applicable specifications and details or as directed.

3.03 REPLACE GRAVELS/SOIL DRIVEWAYS WITH AGGREGATE BASE COURSE (NO OVERAGE ALLOWED)

- A. Existing gravel and/or soil driveway shall be replaced with six (6) inch thick stone; compacted Aggregate Base Course (ABC) or whichever matches existing type stone. Replacement of the drive shall be to existing or better condition.

Pay Item	Pay Unit
Permanent Pavement Patch	SY

END OF SECTION 00451

SECTION 00452

EMULSIFIED ASPHALT SLURRY SEAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of furnishing and applying and emulsified asphalt slurry seal in accordance with the North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition, hereinafter referred to as the Specifications, and these Special Provisions.
- B. Determination of Measurement: Measurement shall be in square yards installed.
- C. Basis of Payment: The quantity of emulsified slurry seal will be paid for at the contract unit price per square yard.

1.02 REFERENCES

- A. The Specifications will govern in its entirety the work under these specifications except as they are modified hereinafter.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphalt Emulsion: The emulsified asphalt shall conform to the requirements of Section 1020 of the NCDOT Specifications.
- B. Quick Setting Emulsion: Quick setting emulsion shall be used and the following requirements shall apply:
 - 1. The emulsion shall meet the requirements of Cationic Type CRS-1H of ASTM D 2397. Each change in formulation requires a test as referenced in NCDOT Specifications indicated above.
- C. Fine Aggregate: Fine aggregate shall be polish resistant natural or manufactured sand, slag, or a combination thereof. The quality of fine aggregate shall conform to the requirements of Section 1014 of the NCDOT Specifications.
- D. Mineral Filler: Mineral filler shall conform to the requirements of Section 1012.1 of the NCDOT Specifications.
- E. Water: Water used in the mix shall conform to the requirements of Section 1024.4 of the NCDOT Specifications.
- F. Mix Requirements: The Contractor shall submit to City of Fayetteville a mix design and results of the wear loss by the Wet Track Abrasion Test (WTAT) as prepared by an approved testing laboratory. The WTAT will be performed in accordance with ADSTM D 3910. The wear loss by the WTAT shall not be greater than 100 grams per square foot. The wear loss shall apply to the asphalt content limits designated on the job mix formula.
 - 1. The Contractor shall place a test strip for approval by the Engineer prior to beginning the work. Once the consistency of the mix has been approved by the Engineer, the total water content shall be maintained within 3 percent of the approved blend during the course of operation.
 - 2. The gradation of the mix produced shall conform to the job mix range. The asphalt content (residual asphalt)* shall not vary more than 1.5 percent from the approved mix design.

JOB MIX RANGE	
<u>TYPE SIEVE SIZE</u>	<u>C PERCENT PASSING</u>
3/8"	100
# 4	90-100
# 8	70-90
# 16	32-54
# 30	23-38
# 50	16-29
#100	9-20
#200	5-15

Design Asphalt Content, Percent # 8.5-11.5

* Residual Asphalt content by Weight of Dry Aggregate.

- G. Sampling Requirements: Samples for gradation will be taken from aggregate stockpiles designated by the Contractor for use. Samples for asphalt content and total water content shall be taken from the completed mixture. Samples of aggregate, filler, and emulsion for WTAT will be taken from the job site. The frequency of sampling and testing will be established by the Engineer.

2.02 EQUIPMENT

- A. General: All equipment and tools used in the performance of this work shall be furnished and maintained in satisfactory working condition. The mixing and spreading equipment shall be combined in a single mobile operating unit. A burlap drag approximately 19 inches wide shall be attached to the back of the unit for the purpose of smoothing the slurry seal.
1. The mobile unit shall be equipped with an approved feeder which will accurately meter or otherwise introduce a predetermined amount of material into the mixer simultaneously with the aggregate. The feeder shall be used whenever mineral fill is added to the mix.
 2. The mobile unit shall be equipped with a water pressure system and fog spray bar capable of completely fogging the surface to which slurry seal is to be applied.
 3. The mobile unit shall be capable of an operative speed of at least 60 ft/min and have sufficient storage capacity to mix and apply a minimum of 5 tons of slurry.
- B. Mixer: The mixer shall be a continuous flow type mixer and shall be capable of delivering water and a predetermined proportion of aggregate and asphalt emulsion to a revolving multi-blade mixer tank. The mixer shall discharge the thoroughly mixed product on a continuous basis. The blades of the mixing unit shall be capable of thoroughly blending all ingredients.
- C. Spreader: The spreader shall be equipped with a flexible type squeegee positioned in contact with the pavement surface. The spreader shall be designed to apply a uniform spread with a minimum loss of slurry.
- D. Auxiliary Equipment: Hand squeegees, shovels, and other hand equipment shall be provided as necessary to perform work in areas which are inaccessible to the unit.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Shall include cleaning, loading, hauling, equipment, labor, compaction, material and any other incidentals required for installation.
- B. The Contractor shall notify the Engineer at least five (5) working days prior to beginning work. The Contractor shall give the Engineer sufficient notice of all operations for any sampling, inspections or acceptance testing required.
- C. Preparation of Surface: the surface upon which slurry seal is to be applied shall be thoroughly cleaned of all loose material, vegetation, silt spots, and other objectionable materials immediately preceding application by either brooming or the use of compressed air.
- D. Application: Aggregate shall be wetted immediately prior to mixing with the emulsion. The Engineer may direct that the surface of the pavements be fogged with water (approximately 0.05 gallon per square yard) immediately preceding the pass of the spreader. The slurry mixture shall be of a consistency such that it “rolls” in the spreader box in a continuous mass. Slurry that segregates in the spreader box, so that flowing of liquids (water and emulsion) is evident, is not acceptable and shall not be applied. The liquid portion of slurry mixture shall not flow from either the spreader box or the applied slurry. Evidence of such flow shall be sufficient cause for rejection of the applied material. The slurry shall be placed on the road in full lane widths up to and including 12 feet. A mechanical device such as an auger shall be used to distribute the slurry mix in the spreader box.
 - 1. Excess buildup of slurry on longitudinal and transverse joints shall be corrected.
 - 2. Treated areas shall not be opened to traffic until such time as the slurry seal has cured to the extent that it will no longer be damaged by traffic. The applied slurry mixture shall be uniform in texture and shall not flush under traffic. Any areas not considered satisfactory by the Engineer shall be corrected by the Contractor at no additional cost to the City of Fayetteville. Nothing contained herein is intended to relieve the Contractor from sharing in the responsibility and performance of the treatments, should a failure occur prior to acceptance of the contract.
 - 3. Slurry Seal surface shall not be applied on surfaces containing ponding water and the minimum surface temperature shall be 50 degrees F.
 - 4. The Engineer may require the surface area to which the slurry has been applied by hand to be rolled using a pneumatic-tire roller. The roller shall be operated at an approximate tire pressure of 50 pounds per square inch and the paved area shall be subjected to a minimum of two coverages.
 - 5. Should oversize aggregate be encountered in the stockpile, the Contractor shall immediately cease operations and remove the oversize aggregate by screening.
- E. Thickness of Application: The average minimum thickness of application shall not be less than 5/16” for Type C unless otherwise specified.
- F. In the event of a test failure on compatibility and/or WTAT (loss greater than 100 grams per square foot) for a sample of material being applied to the road, corrective action shall be taken by the Contractor prior to start-up of another’s day run. Should the sample taken following adjustment also fail the compatibility and/or WTAT, the Contractor shall cease application on the road. The Contractor shall be responsible for furnishing additional compatibility and/or WTAT results and field application site(s) and will not be permitted to return to the road until he clearly demonstrates the acceptability of seal.

Pay Item
Emulsified Asphalt Slurry Seal

Pay Unit
SY

END OF SECTION 00452

SECTION 00455

CONCRETE (CURB AND GUTTER, SIDEWALK, DRIVEWAY)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This work shall consist of Portland cement concrete combination curb and gutter, sidewalk and driveway constructed on a prepared sub-grade, in one course, in conformity with the lines, grade and typical cross section shown on the plans and in accordance with these specifications.

1.02 CONCRETE CURB AND GUTTER

- A. Determination of Measurement: The quantity to be paid for in this section shall be the actual number of linear feet of combination curb and gutter measured in place, completed and accepted. This measurement of curb and gutter shall be along the top of the curb.
- B. Basis for Payment: Payment shall be on a contract unit price per linear foot.

1.03 CONCRETE SIDEWALK

- A. Determination of Measurement: The quantity shall be measured in square yards of concrete sidewalk in place, completed and accepted.
- B. Basis for Payment: Payment shall be on a contract unit price per square yard. The amount of grade work required to obtain the proper sub-grade from the finished grade of the sidewalk will be included as part of the per square yard price for concrete sidewalk.

1.04 WHEELCHAIR RAMP

- A. Determination of Measurement: By the number installed (per type).
- B. Basis of Payment: Payment will be for the contract unit price for handicap curb ramps installed.

1.05 DRIVEWAY APRON (CONCRETE)

- A. Determination of Measurement: By square yard per thickness specified by the Engineer. Measurement from back of curb to edge of apron.
- B. Basis of Payment: Payment shall be per unit contract price per square yard installed.

1.06 DESIGN REQUIREMENTS

- A. Proportioning of Concrete: The concrete shall be mixed in proportions approved by the Engineer. The concrete shall develop at 28 days a minimum compressive strength of 2,500 pounds per square inch (Class B). The consistency range in slump of the concrete shall be two to four inches.
- B. Air Entrainment of Concrete: All exposed concrete shall have 6 percent (+ or - 1.5 percent) entrained air as discussed in ASTM C 494-80. Measurement shall be with a roll-meter in accordance with ASTM C173-81 or a pressure meter in accordance with ASTM C281-81. Use of other testing procedures will be considered if requested in writing.
 - a) The concrete from a central plant shall be delivered by a mobile agitator type mixer and deposited at the consistency specified without segregation. The time lapsing from mixing to placing the concrete shall be in accordance with NCDOT requirements.
 - b) Concrete shall be mixed only in such quantities as are required for immediate use and all such material shall be used while fresh and before initial set has taken place. Any concrete in which set has begun shall not be used in the work. Re-tempering of concrete will not be allowed.

- C. Finished grade of the sidewalk shall be based on the top of curb elevation.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather and Night Concreting: Concreting shall be done when weather conditions are favorable unless otherwise directed by the Engineer. Concrete operations shall be discontinued when the temperature of 40° Fahrenheit is reached on a falling thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw and plastic or other thermal insulation satisfactory to the Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Engineer at the Contractor's expense.
 - a) No more concrete shall be laid than can be properly finished and covered during daylight, unless adequate artificial light satisfactory to the Engineer is provided.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement: The cement used in this item shall be a standard brand of Portland cement or high-early-strength Portland cement conforming to the requirements of AASHTO Specifications. Different brands of cement, or the same brand from different mills, shall not be mixed nor shall they be used alternately in any one continuous pouring between transverse joints.
- B. Concrete Joint Sealer –

2.02 SOURCE QUALITY CONTROL

- A. Testing: The Engineer shall engage and pay an approved independent testing agency to conduct the routine testing of material for compliance in accordance with ACI 301-72, Chapter 16.
- B. Test reports shall be furnished to the Engineer in quadruplicate at the earliest possible date following the testing.
- C. If cylinder test results indicate that the concrete has not or will not reach the required 28-day compressive strength, the Engineer shall have the right to require any additional testing as necessary to determine the actual in-place strength of the concrete. Such additional testing will be at the Contractor's expense.
- D. The Engineer shall have the right to require the removal and subsequent replacement of any concrete not meeting the minimum 28-day compressive strength. Such removal and replacement shall be at the Contractor's expense.

2.03 CONCRETE

- A. The concrete shall be an approved NCDOT certified mix.

PART 3 EXECUTION

3.01 WORK

- A. Furnishing, hauling, and placing all materials, fine grading of sub-grade, installation and removal of forms, compacting subgrade, truncated dome, soil amendments, backfilling behind curb with topsoil, all equipment, tools, curing and labor and incidentals necessary to complete the work.

3.02 PREPARATION

- A. Cleaning Site: Prior to the acceptance of the work, unsightly objects such as stones, stumps, limbs, roots, concrete, etc., shall be removed from the site and disposed of to the satisfaction of the Engineer. Work shall not be considered complete until all cleaning up has been done and the site is of a neat appearance.

3.03 INSTALLATION

- A. Sub-grade: The sub-grade shall be excavated to the required depth below the finished surface in accordance with the plans and lines and grades established by the Engineer. All soft and yielding material or other unsuitable material shall be removed and replaced with approved material and compacted thoroughly at the expense of the Contractor. If the sub-grade is in a filled section, the entire area shall be compacted to an unyielding surface.
- B. Forms: Forms shall be set true to the lines and grades established by the Engineer. Sections less than 5 feet will not be accepted. Forms shall be held rigidly in position and shall be of sufficient strength to resist springing out of line when the concrete is placed. Forms shall be metal of the necessary dimensions to construct the combined curb and gutter, sidewalk or driveway shown on the drawings or specified. Wood forms may be used only where conditions make the use of metal forms impractical, and then only when approved by the Engineer. Forms for straight curb and gutter or radius curb and gutter having a radius of 350 feet or over shall be of steel of an approved type. Bent steel forms or steel forms with top or bottom flanges out of square sides or forms without pin lugs shall not be used and shall be removed from the construction site. Flexible steel forms shall be used on all radius curb having less than a 350-foot radius.
- C. Placing of Concrete (Curb and Gutter): The curb and gutter shall be constructed in place in uniform sections 10 feet in length. The joints between sections shall be formed by steel templates 3/16 inches in thickness. Templates shall conform strictly to the curb and gutter section. All joints shall be at right angles to straight curb and in radius line in radius curb. Any broken edges or joints may be cause for rejection. Templates must be pulled halfway out before concrete is set in order that concrete may run under the template. After concrete is set and while the forms are still in place, the templates are to be completely removed. When a curbing machine is used, the Contractor should use all precautions to prevent curb from settling when first starting, especially when grade is critical (below 1 percent). Contractor shall check grade on new poured curb before concrete has set so that correction can be made to the flow line of the curb.
 - a) Expansion joints of approved material for curb and gutter shall be provided every 90 feet or as directed by the Engineer. Joint material shall be not less than ½ inch in thickness, cut true to section, and shall be placed against the steel template forming the joint. Care shall be taken not to disturb the position of the expansion joint filler material during the removal of the templates.
 - b) Prior to placing of concrete, the sub-grade shall be moistened, and the contact side of the forms shall be coated with a heavy oil. After the placing of the concrete within the forms, the sides of the forms shall be spaded with a flat spade of approved type. All voids that may appear after forms have been removed, shall be wetted thoroughly and plastered. An excess of voids will be cause for rejection. A slip form concrete machine may be used only on a trial basis and must meet the approval of the Engineer.
- D. Placing of Concrete (Driveways and Sidewalks): Thickness shall be minimum of 4" for residential driveway aprons and 6" for commercial driveway aprons. Expansion joints of approved material shall be provided every 50 feet and contraction joints every 5 feet or as directed by the Engineer. Joint material shall be not less than ½ inch in thickness, cut true to section, and shall be placed against the template forming the joint. Care shall be taken not to disturb the position of the expansion joint filler materials during the removal of the

templates. Seal expansion joints where sidewalk and curb ramps are placed adjacent to concrete curb and/or gutter. Seal all joints to include expansion and contraction joints.

- a) Prior to placing of concrete, the sub-grade shall be moistened, and the contact side of the forms shall be coated with heavy oil. After the placing of the concrete within the forms, the sides of the forms shall be spaded with a flat spade of approved type. All voids that may appear, after forms have been removed, shall be wetted thoroughly and plastered. An excess of voids will be cause for rejection. A Slip Form Concrete Machine may be used only on a trial basis and must meet the approval of the Engineer.
- E. Finishing: All concrete within forms shall be brought to true section by the use of an approved straight edge and shall be tamped with straight edge to bring mortar to the surface, after which it shall be floated smooth by means of wood floats. No steel floats will be permitted. After true surface of section has been obtained, and after initial set has taken place, the entire surface shall be broom finished with a dampened broom. Broom finished in direction of flow, all joints and all exposed edges shall be rounded off with approved jointing and edging tools.
- F. Curing: Immediately after finishing operations have been completed, the entire surface of the concrete shall be sprayed with white curing compound (type 11 white pigment). The use of liquid retarding agents shall conform to standards specified by current AASHTO or ASTM specifications.
- G. Removal of Forms: Forms shall not be removed from freshly placed concrete until it has set for at least 24 hours. They shall be carefully removed and in such a manner as to prevent damage to the edges of the concrete. Honeycombed areas shall be promptly filled with mortar composed of one part cement and two parts sand.

3.04 FIELD QUALITY CONTROL

- A. The Engineer shall have the authority to require the Contractor to remove and replace any curb and gutter, sidewalk, or driveway which has been placed at grade elevations other than those shown on the plans and/or cut sheet. The finished grade of sidewalk is based on the top of curb. Such curbing, sidewalk, or driveway shall be removed and replaced at the Contractor's expense.
- B. Curbing, sidewalk, or driveway found to be holding "ponding" water will be removed and replaced at the Contractor's expense.

3.05 PROTECTION OF FINISHED WORK

- A. Protection of Concrete: After 72 hours the forms may be removed. Immediately after the forms have been removed and all honeycombed areas repaired, the back of the curb shall be backfilled to prevent under-wash. Traffic shall be excluded from crossing the concrete for a period of approximately 7 days by erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 7-day period and he shall remove and replace any concrete damaged as directed by the Engineer.

Pay Item	Pay Unit
Concrete Curb and Gutter	LF
Concrete Sidewalk	SY
Wheelchair Ramp	EA
Driveway Apron	SY

END OF SECTION 00455

SECTION 00465

ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of adjustment to existing manhole covers and valve boxes.
- B. Determination of Measurement: Measurement shall be for each manhole adjusted.
- C. Basis of Payment: The quantity of adjusted manholes will be paid for at the contract unit price per each adjustment made.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work shall include cleaning, equipment, labor, material, leveling, adjustments and any other incidentals required for installation.
- B. Excavate all material from around casting to a width of 12 inches and to a depth of at least 2 inches below existing brickwork, existing structure or valve box. Remove and dispose of all loose material.
- C. The height of any casting adjustment shall be determined by the use of a string line. The string line is to be pulled across casting and for at least 10 feet on each side of casting parallel to curb. Hold string at height of adjustment. Example: 1 inch above existing pavement for resurfacing and/or 2 inches above sand/clay or stone base. Then string is pulled perpendicular across casting from edge of pavement at curb to center line of street. The string shall be set at same adjustment height. Every effort shall be taken to ensure that the surface course and casting shall provide as smooth a ride as possible.
- D. When setting casting higher than existing, all bricks are to be placed in a "spoke" pattern and laid in a bed of clean fresh mortar. The Contractor is to ensure all brick are set firm to eliminate movement of casting.
- E. When setting casting lower than existing, all brick and concrete are to be cut away, leaving a smooth surface. A cap of clean fresh mortar shall be applied to surface as a setting bed for casting.
- F. The casting is then placed back on brick and care shall be taken to ensure that it is set on a bed of clean fresh mortar to eliminate movement. Mortar shall meet requirements of N.C. Department of Transportation Standard Specifications current edition and any revisions Section 1040-9 for mortar and Section 1014-1 for mortar sand.
- G. The excavated area shall be backfilled with Class B concrete to within 1 to 1-1/2 inches of finished grade. Concrete shall comply with NCDOT mix design. Casting is to be cleaned of any concrete spillage. Asphalt shall not be used to back-fill around casting.

- H. All adjustments shall then be protected for at least 72 hours before the placement of any surfacing material. A finish surface tolerance shall not vary more than 1/4 inch in any direction.
- I. After casting has been adjusted to grade, all excess debris and mortar shall be removed from manhole or valve box.

Pay Item
Manhole Adjustment

Pay Unit
EA

END OF SECTION 00465

SECTION 00471

NEW MANHOLE COVERS AND VALVE BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of new manhole cover and valve box installations.
- B. Measurement: By the number of various sizes and at the depth installed. Measure depths from manhole cover to lowest pipe invert.
- C. Basis of Payment: Payment shall be per unit contract price for each manhole installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manhole covers and valve boxes shall be constructed in accordance with the *North Carolina Department of Transportation Standard Specifications for Roads and Structures*, latest edition and revisions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Excavating, backfilling, stone subbase, concrete sections as required for the depth, top adjusting rings, steps, ring and cover, invert and joint sealer.
- B. Excavate all material from around casting to width of 18 inches and to a depth of at least 2 inches. Remove and dispose of all loose material.
- C. The height of casting adjustment shall be determined by the use of a string line. The string line is to be pulled across casting and for at least 10 feet on each side of casting parallel to curb. Hold string at height of adjustment. Example: 1 inch above existing pavement for resurfacing and/or 2 inches above sand/clay or stone base. Then string is pulled perpendicular across casting from edge of pavement at curb to centerline of street. The string shall be set at same adjustment height. Every effort shall be taken to ensure that the surface course and casting shall provide as smooth a ride as possible.
- D. When setting new casting higher than existing, all bricks are to be placed in a "spoke" pattern and laid in a bed of clean fresh mortar. The Contractor is to ensure all brick are set firm to eliminate movement of casting.
- E. When setting new casting lower than existing, all brick and concrete are to be cut away, leaving a smooth surface. A cap of clean fresh mortar shall be applied to surface as a setting bed for casting.
- F. The casting is then placed back on brick and care shall be taken to ensure that it is set on a bed of clean fresh mortar to eliminate movement. Mortar shall meet requirements of NC DOT Standard Specifications current edition and any revisions, Section 1040-9 for mortar and Section 1014-1 for mortar sand.
- G. The exposed brick work and face of the existing asphalt shall be cleaned. The excavated area shall be backfilled with Class B concrete to within 1 to 1-1/2 inches of finished grade. Concrete shall comply with NCDOT mix design. Casting is to be cleaned of any concrete spillage.

- H. All adjustments shall then be protected for at least 24 hours before the placement of any surfacing material. A finish surface tolerance shall not vary more than 1/4 inch in any direction.
- I. After casting has been adjusted to grade, all excess debris and concrete shall be removed from manhole cover or valve box.

Pay Item

New Manhole Cover

New Valve Boxes

Pay Unit

EA

EA

END OF SECTION 00471

SECTION 00472

MANHOLE ADJUSTMENT RINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division I Specification Sections, apply to this Section.
- B. The work covered in this section includes furnishing and installing adjustment rings for manholes requiring a rise of one inch or greater. Adjusting rings less than one inch are not acceptable.
- C. The adjustment of manholes and valve boxes shall not be attempted until after the placement of the base course and any leveling course, and prior to placement of the overlay. Any debris that has fallen into the manholes or water valves during the adjustment process shall be removed before cleanup is complete.
- D. Badly damaged or worn castings shall be replaced with new castings provided by OWNER at no cost to the contractor. Contractor is responsible for exchanging castings at the OWNER'S facility.
- E. Final surface overlay will be placed within 10 days after adjustments have been completed on each individual street.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Riser rings shall consist of domestic A-36 steel 3/4-inch thickness steel inner ring, and domestic A-36 1/2-inch thickness steel outer ring. The riser system shall be anchored to the manhole frame to prevent any movement from traffic loads and shall be pre-approved by the Engineer. The adjustment device shall be fabricated from stainless steel, have a positive lock and be in line with the lower bearing bar. It shall be capable of adjustment plus or minus 3/8 inches from nominal.
- B. The manhole adjustment ring shall fit within the existing casting without interference and the manhole lid shall have bearing on all of the surface of the inner ring to prevent locking. The lid shall be able to be removed without binding.
- C. The inner and outer ring shall be securely welded to prevent any differential movement between the inner and outer rings under traffic loads and shall be fabricated to plus or minus 1/16-inch concentricity. The outer riser ring shall have an inside diameter no greater than 3/16 inch larger than the outside diameter of the manhole lid.
- D. All material shall be bituminous asphalt coated.
- E. All welding shall be in accordance with AWS D1.5 by certified welders.

PART 3 EXECUTION

3.01 MEASUREMENT

- A. Each manhole to receive adjusting rings shall be inspected and properly measured, with the measurements following all manufacturers' guidelines. Measurement for the height of

adjustment shall be made only after any asphalt-leveling course has been placed. The contractor will be required to provide personnel to individually measure each structure in the presence of the OWNER. The measurements will include top and bottom lid diameters, lid thickness, as well as the required rise.

- B. Adjustment rings for rise less than one inch shall be unacceptable.
- C. Special attention shall be given to structures needing replacement rings due to wear or other factors which may not be suitable for adjustment rings. Adjustment rings shall not be placed on any existing casting which has been deemed unacceptable by the OWNER.

3.02 INSTALLATION

- A. The adjusting ring shall be adjusted to the outside diameter of the manhole lid before placement can proceed. The outer ring shall have an inside diameter of no greater than 3/16 inch larger than the outside diameter of the lid. The area on the existing casting where the ring will seat shall be thoroughly cleaned using a steel wire brush. The ring can then be placed making sure there is full bearing of the lower section to the existing casting. The set screws can be tightened to assure no movement due to traffic.
- B. Frames and covers shall be set to proposed grade and sloped to match slope and crown of road within 0.25 inches of the final surface.
- C. The contractor shall provide personnel to assist the OWNER in inspecting the adjustment. The height of adjustment shall be checked by the following procedure:
 - 1. Pull string line parallel to the curbing across the casting for at least 10 feet on either side of the casting.
 - 2. Hold string at a height of 1 inch above the required adjustment and subtract 1 inch from the measurements.
 - 3. Measurements shall be made from the top of lid (and ring) to the string line.
 - 4. The height shall then be checked with the same string line pulled perpendicular to the curbing.
 - 5. The final adjustment height shall not vary more than 1/4 inch from the thickness of the over lay, in either direction.
- D. The contractor shall open the manhole for inspection of how the lid fits and a field check to assure the ring is secure.
- E. Any unacceptable adjustments shall be repaired by the Contractor or replaced with a concrete adjustment, with no additional expense to the OWNER.

Pay Item
Manhole Adjustment Rings

Pay Unit
EA

END OF SECTION 00472

SECTION 00474

TRENCHING STABILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The Contractor shall design, furnish, and install any trench stabilization necessary to maintain excavations for pipe and drainage structure installation. The Contractor shall be responsible for installation and removal of any trench stabilization. The Contractor shall also be responsible for any damage to adjacent structures resulting from the installation, removal, or absence of trench stabilization. Payment for all labor, equipment, and materials involved in this specification will be considered incidental to the cost of construction.
- B. It is the responsibility of the contractor to comply with all current safety regulations issued by all regulatory agencies.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00474

SECTION 00475

STORM SEWER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This item shall consist of storm sewer pipes and structures of the classes, sizes, and dimensions designated, furnished and installed at such places as are designated in accordance with the lines and grades given and in conformity to these specifications. This item shall also include furnishing and construction of such joints and connections to other pipes, catch basins, manholes, endwalls, etc., as may be required to complete the work as shown on the plans.
- B. Determination of Measurement: Measure horizontally or from station to station as shown or indicated on the Drawings for the various types and sizes of pipes installed or by the number of Storm Sewer Structures installed.
 - 1. (X) inch Storm Sewer: Measure pipe inside wall to inside wall of structures and from pipe end to longest point of opposing pipe end. Depth of pipe will not effect measurement.
- C. Basis for Payment: Payment shall be on a contract unit price per linear foot of storm sewer that is installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipes: All pipes shall be of the type and class indicated on the plans.
 - 1. Reinforced concrete pipe shall conform to A.S.T.M. Specifications C-76, Class III, and 15" through 36" diameter shall be of modified or improved tongue and groove type. No plain or straight wall grooves shall be used.
 - 2. Corrugated galvanized metal pipe shall conform to latest AASHTO Specifications. All metal pipe culverts used shall be fully coated inside and outside with an asphalt cement to a minimum thickness of 0.05 of an inch when measured on the crest of the percent soluble in carbon disulfide. The pipe shall be coated with the bituminous material in a manner so that a smooth pavement will be formed in the invert (inside bottom of pipe when installed), filling the corrugation for at least 25 percent of the periphery of the pipe. The pavement shall have a minimum thickness of 0.125 of an inch then measured on the crests of the corrugations.
 - 3. Castings: All casting shall be of the type and duty shown on the plans and shall be approved by the Engineer prior to installation. Castings shall be made of gray iron, ASTM A-48 – class 30, or ductile iron, ASTM A536, grade 65-45-12. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16 inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame. All covers and gratings shall seat firmly without rocking. The Contractor shall replace all faulty castings installed by him at his expense.

4. Mortar: Mortar used in brick masonry and joints shall be composed of one-part Portland cement and hydrated lime, (not more than 10 percent of lime, based on the volume of cement, shall be used) and two-parts sand. Portland cement and hydrated lime shall meet the requirements of the latest A.S.T.M. specifications. The sand shall be composed of clean, well graded aggregate. The mortar shall be mixed in a tight mortar box or in an approved mechanical mixer. Mortar shall be used within 45 minutes after mixing.
5. Bedding material shall be #57 washed stone. Stone depth shall be 6" below the pipe (or as specified by the Engineer) and full width of trench as specified in Section 00435 and in standard details.
6. Tracer wire shall be installed on non-metallic pipe. Tracer wire shall be #12 AWG solid-copper wire with green insulation.

2.02 INCLUDED ITEMS

A. General work items:

1. Adjust Existing Manhole Cover with Portland Cement Concrete: Excavating at existing manhole cover as necessary. Raise or lower existing manhole cover as necessary to set cover at desired elevation. Concrete backfill (collar) and clean up. Ramping included if necessary.
2. Adjust Existing Valve Box with Portland Cement Concrete: Excavating at existing valve box as necessary. Raise or lower existing valve box as necessary to set box at desired elevation, installing new valve box extension if necessary. Concrete backfill (collar) and clean up. Ramping included if necessary.
3. New Manhole Cover with Portland Cement Concrete: Excavating at existing manhole cover and removal as necessary. Set new manhole cover to desired elevation. Concrete backfill (collar) and clean up.
4. New Valve Box with Portland Cement Concrete: Excavating at existing valve box and removal as necessary. Set new valve box to desired elevation, installing valve box extension if necessary. Concrete backfill (collar) and clean up.

B. Storm sewer work items:

1. (X) inch Concrete Flared-End Section: Excavation, backfilling, and compacting for flared-end section.
2. Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert, steps, and weep holes.
3. Double Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert, steps and weep holes.
4. Open Throat Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, invert, steps, weep holes, and precast top.
5. Drop Inlet: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert steps and weep holes.
6. Junction Box: Excavation, backfilling and compacting, concrete base, brick work as required for the depth, grate and frame.
7. Concrete Pipe Collar: Excavation, forms, backfilling, compacting, concrete, and hauling.
8. Precast Concrete Box: Excavation, materials, pipe boots, grout, backfilling, compaction, grading.
9. New catch basin frame and grate: Remove and properly dispose of existing grate, frame, and hood. Provide new grate, frame, and hood adjusting to grade of new curb and gutter elevations.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. Excavating, shoring and bracing where required, dewatering as required, installing, backfilling (including Class I material as specified for the pipe bedding, haunching, and initial backfill).
 - 2. Installation of warning / identification tape over utilities.
 - 3. Temporary support and protection of existing underground facilities.
 - 4. Pipe, concrete blocking and encasement, connection to existing piping, and fittings.
 - 5. Flushing and treatment, as required.
 - 6. Adjust existing and new manhole and valve boxes to finished surface elevations, if applicable.
 - 7. Grade disturbed areas to original surface profile prior to seeding.
 - 8. Pipe bedding.
 - 9. Joint materials.
 - 10. Traceable wire.
 - 11. Clean up
- B. The trench shall be shaped true to line and grade, and bedding surface for the pipe shall provide a firm foundation. Grooves shall be cut in the trench for bells so that each joint of pipe shall be bedded for its full length.
- C. Concrete pipe culverts shall be carefully seated with bells or grooves upgrate and ends fully closed. Joints of concrete pipe shall be thoroughly wet before making the mortar joint. RAM-NEK can be used instead of mortar to seal joints.
- D. Modified Tongue and Groove Concrete Pipes: Before succeeding sections of pipe are laid, the lower portions of the bell or groove of the pipe shall be filled on the inside with cement mortar of sufficient thickness to bring the inner surface of the abutting pipes flush and even. After the pipe is laid, the remainder of the joint shall be solidly filled with mortar and sufficient additional mortar to form a bead or ring around the outside of the joint. The inside of the joint shall be wiped and finished smooth. All pipe runs 100 LF or greater shall be videoed to ensure proper alignment and joint sealing. Pipe which is not true to alignment or which shows any settlement after laying shall be taken up and reinstalled without extra compensation.
- E. Manholes, Inlets, Junction Boxes, Catch Basins, Etc.: Excavation shall be made to the required depth. The foundation on which the brick masonry is to be laid shall be approved by the Engineer prior to the laying of bricks. The bricks shall be laid so that they will be thoroughly bonded into the mortar by means of the "*shove joint*" method; buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to bond the mass. Brick work shall be of alternate headers and stretchers with consecutive courses breaking joints. All mortar joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a corner. Competent bricklayers shall be employed on the work and all details of construction shall be in accordance with approved practice and to the satisfaction of the Engineer.
 - 1. Steps shall be in accordance with ASTM C478 and made of ½-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.

Steps as shown on the plans shall be placed in all manholes, catch basins and inlets when they are greater than 42" in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded and accurately spaced and aligned. Place steps on narrow side of structure.

2. Existing manholes, catch basins and inlets shall be adjusted by the Contractor when designated by the Engineer. The work will be considered an adjustment where the manhole, catch basin or inlet in question is extended or lowered three feet or less in elevation, or where a catch basin can be adjusted to line without tearing out and rebuilding an entire wall. More work than this will not be considered an adjustment but shall be classified as reconstruction.
3. Inverts in appurtenances shall be shaped to form smooth and regular surfaces free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation.
4. The casting shall be set in full mortar beds. All castings when set shall conform to the finished grade as established by the Engineer. Any castings not conforming shall be adjusted to the correct grade without extra compensation.
5. Concrete pipe collars may be used for repairing storm drainpipes. Concrete collars may not be installed within 16' of any structure. Damage within 16' of structures shall be replaced with new pipe. See detail for more information on installation.

Pay Item

Storm Sewer Pipe

Storm Sewer Structures

Pay Unit

LF

EA

END OF SECTION 00475

SECTION 00476

PRECAST DRAINAGE STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section includes round and rectangular pre-cast concrete drainage structures including inlet structure components, sub-grade structure components, grates, covers and accessories.
- B. The Contractor shall build inverts in all drainage structures in accordance with NCDOT standards. The additional work and materials required to install inverts will not be measured for payment as this work will be considered incidental to the construction of Drainage Structures.
- C. Determination of Measurement: By the number installed per type.
- D. Basis of Payment: Payment will be for the contract unit price per end-wall/ headwall/flared end section per type installed.

1.02 REFERENCES

- A. Pre-stressed Concrete Institute: Manual for Quality Control for Plants and Production of Pre-cast and Pre-stressed Concrete Products.
- B. National Pre-cast Concrete Association: Quality Control Manual for Pre-cast Concrete Plants.
- C. American Society for Testing and Materials:
 - 1. ASTM C478: Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C890: Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Pre-cast Concrete Water and Wastewater Structures.
 - 3. ASTM C891: Standard Practice for Installation of Underground Pre-cast Concrete Utility Structures.
 - 4. ASTM C913: Standard Specification for Pre-cast Concrete Water and Wastewater Structures.
- D. American Association of State Highway and Transportation Officials Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets (AASHTO M198).
- E. American Concrete Institute: Building Code Requirements for Reinforced Concrete (ACI 318).
- F. Occupational Safety and Health Administration: Standard 1926.704, Requirements for Pre-cast Concrete.

1.03 SUBMITTALS

- A. The following information must be submitted to the project Engineer:
 - 1. Schedule of the drainage structure components to be provided on the project including the following:
 - a. Sheet number where the structure plan and profile are shown.
 - b. Line number when applicable.
 - c. Drainage structure number or station number.
 - d. Invert elevation of the influent and effluent lines as shown on the plans.
 - e. Inlet structure flow-line elevation as shown on the plans.

- f. Total height required from top of base slab to top of structure.
 - g. Total height of the individual and assembled drainage structure components.
 - h. Top and bottom elevation of the drainage structure as calculated.
 - i. Manufacturer's part or catalog number and number required of each component.
 - j. Each pipe size, type and hole size and its distance from top of base slab.
 - k. Pipe location in degrees clockwise from step centerline on round structures.
 - l. Pipe location on rectangular structures by wall and intersecting angle relative to wall.
 - m. Minimum round inside diameter or rectangular inside dimensions required.
- B. Detail of each pre-cast concrete component to be provided, sealed by the registered Professional Engineer including the following:
 - 1. Manufacturer's part number or catalog number.
 - 2. Inside diameter or dimensions and lay length.
 - 3. Wall thickness and base or top thickness where applicable.
 - 4. Handling weight and lift hole or insert or loop description and location.
 - 5. Wire size, spacing and area provided per vertical foot (when applicable).
 - 6. Reinforcing bar size and spacing or location.
 - 7. Design loads for all rectangular components and round top slab components.
 - 8. Step locations on round structures.
 - 9. Concrete design strength and manufacturer's mix number.
 - 10. Height, width, slope and annular space of the tongue and groove for products requiring tongue and groove joints.
- C. Step detail and material specifications.
- D. Joint material detail, material specifications and calculations showing that the joint material cross section is greater than the joint's annular space times its height.
- E. Lifting device and hole detail including design loads.
- F. At the request of the Engineer or owner, submit the following:
 - 1. Structural analysis and design calculations for precast rectangular components and round top slab components, performed in accordance with applicable codes and standards, showing that allowable stresses will not be exceeded. All calculations must be sealed by a Registered Professional Engineer.
 - 2. Calculations or test results verifying that the lifting device components and holes are designed in accordance with OSHA Standard 1926.704.
 - 3. Concrete 28-day compression strength results for every day production of Pre-cast Components for the project was performed, showing the required strength according to the guidelines established in ACI 318.
 - 4. Reinforcing and cement mill reports for materials used in the manufacture of Pre-cast Components for this project.
 - 5. The above test reports for similar Pre-cast Components recently produced, submitted prior to production of Pre-cast Components for this project.

1.04 QUALIFICATIONS

- A. The pre-cast manufacturer shall comply with the following requirement:
 - 1. The Precast Manufacturer shall be a NCDOT approved manufacturer of precast concrete structures and have a minimum of 5 years of experience in manufacturing the required components.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to a minimum 40 degrees F prior to, during, and 48 hours after completion of masonry, grouting or concreting work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete shall conform to ASTM C478, C858 and as follows:
 - 1. Compressive strength: 4000 psi minimum at 28 days.
 - 2. Air Content: 6% $\pm$ 1.5%.
 - 3. Cementitious Materials: Minimum of 564 pounds per cylinder yard.
 - 4. Course Aggregates: ASTM C33, bound, crushed, angular granitic stone only.
 - 5. Fine Aggregates: ASTM C33 free from organic impurities.
 - 6. Chemical Admixtures: ASTM C494 calcium chloride or admixtures containing calcium chloride shall not be used.
 - 7. Air Entraining Admixtures: ASTM C260.
- B. Reinforcing steel shall be ASTM A615 Grade 60 deformed bar, ASTM A82 wire or ASTM A185 welded wire fabric.
- C. Lift Loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars shall not be allowed.
- D. Flexible joint sealants shall be butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1 percent volatile matter and suitable for application temperatures between 10 and 100 degrees F.
- E. Epoxy gels shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

2.02 COMPONENTS

- A. Pre-cast Components shall be designed and manufactured as described in this paragraph and in the following paragraphs for the specific components.
 - 1. Lifting Inserts, Holes and Devices shall comply with OSHA Standard 1926.704. Lift holes and inserts shall be sized for a precision fit with the lift devices. Lifting devices shall be provided by the Pre-cast Manufacturer.
 - 2. Joints shall be sealed internally between the tongue and groove and additionally around the external perimeter of the joint as follows:
 - a. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than 1/16 inch thick and 6 inches wide applied to the outside perimeter of the joint.
 - b. Internal Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 14 feet long and having a cross-sectional area no less than the annular space times the height of the joint
 - c. At the option of the Contractor, Internal Seals on round joints may consist of an O-Ring Gasket conforming to ASTM C443, installed according to the Pre-cast manufacturer's recommendation.
 - 3. Rings, Covers, Grates, and Frames shall be Class 30 gray cast iron and shall be designed for 16,000-pound wheel loads when located in roadways.
 - 4. Pre-cast Base Sections shall be cast monolithically without construction joints or with approved galvanized or PVC water-stop cast in the cold joint between the base slab and the walls. The minimum size of the base section shall be as specified in the schedules.
 - 5. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable. Form ties through the wall are not allowed. Exterior slab surfaces below grade shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be as set forth in the appropriate References. Exposed Drainage Structure Top Components shall have a form finish or a light broom

- finish on their exposed surfaces. Fins, voids, chips, or fractures over 3/8 inch in diameter shall be filled with thin cement paste and finished to a color and texture reasonably consistent with that of formed finish. Rings and covers cast in exposed tops shall be free from cement paste build up.
6. Provisions for pipe entrances in the structures shall be cast or cored openings.
 - a. Pipe openings in round structures shall remain 6 inches clear of other pipe openings.
 - b. Pipe openings in rectangular structures shall not extend into the corners and may extend across a joint only when structural analysis shows stresses to be within the allowable.
 7. Components shall be designed in accordance with ACI, ASTM C890 and following loads:
 - a. Horizontal Load on Walls: An earth load of 80 psf per foot of burial depth plus a live lateral surcharge due to HS20 traffic loads of 80 psf.
 - b. Vertical Load on Below Grade Adapter Slabs and Tops: An earth load of 120 psf per foot of overburden plus a live HS20 traffic load.
 - c. Vertical Load on Exposed Inlet tops: A live 300 psf load.
 - d. Vertical Load on Cast Iron Covers and Grates Supported Around Perimeter: A live HS20 load.
- B. Round Sub-grade Components shall be designed and manufactured in conformance with ASTM C478 and as follows:
1. Riser Sections shall have a minimum lay length of 16 inches.
 2. Pre-cast Concentric and Eccentric Cone Sections shall have an inside diameter at the top of 24 inches. The width of the top ledge shall be no less than the wall thickness required for the cone section.
 3. Pre-cast Transition Cone or Top Sections may be used to provide an eccentric transition from 60 inch and larger structures to 48-inch diameter risers, cones, and adaptor slabs. Transition tops shall only be used in areas not subject to vehicle traffic with no more than 20 feet of cover.
 4. Provide Steps in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on 16-inch centers when 42" deep or greater. Secure steps to the wall with a compression fit in cast or drilled holes or cast in place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a 1/2 inch diameter grade 60 bar and have serrated tread and tall end lugs. Pullout strength shall be a minimum of 2,000 pounds when tested according to ASTM C497.
 5. Joints of Bases, Risers and Cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361.
- C. Rectangular Sub-grade Components shall be no less than 22 inches wide, 34 inches long, designed and manufactured in conformance with ASTM C913 and as follows:
1. Riser sections shall not be allowed on boxes smaller than 4 feet long by 4 feet wide.
 2. Pre-cast Transition Top Sections may be used to provide an eccentric transition from 4 foot by 4 foot and larger storm drain structures to 48-inch diameter risers, cones and adaptor slabs. The maximum amount of fill over the transition top section shall be 20 feet.
 3. Joints between precast components shall be keyways or tongue and groove. Joints to accept cast iron frames shall be flat and no less than 5" wide.
- D. (Access Manhole) Inlet Components shall have cast iron rings and covers shall be as shown in the details with an opening diameter of 22 inches. Adapter slabs and cones shall have a minimum opening diameter of 24 inches. Precast grade rings conforming to ASTM C478,

with a minimum lay length of 4 inches and totaling no more than 12 inches in height shall be used to adjust rings and covers to finished grade.

2.03 CONFIGURATION

- A. Construct (Access Manhole) Structures to the elevations shown on the plans and as follows:
 - 1. A 24-inch diameter Cast Iron Ring and Cover
 - 2. A Concentric or Eccentric Cone or an Adapter Slab and a Round or Rectangular Subgrade Structure sized according to the schedule.
- B. Drainage Structures greater than 8 feet deep shall be no less than 48 inches in diameter or 48 inches wide by 48 inches long.

PART 3 EXECUTION

3.01 WORK

- A. Work shall include the block, brick, concrete, reinforcing steel, materials, excavation, bedding, grading and all other incidentals in order to build end-wall.
- B. Work shall include the materials, excavation, bedding, grading and all other incidentals needed to construct headwall/flared end section.

3.02 EXAMINATION

- A. Inspect Precast components prior to unloading from the delivery truck.

3.03 PREPARATION

- A. Product Delivery, Storage and Handling: Coordinate delivery with the manufacturer, handle and store the Precast Components in accordance with ASTM C891 and the manufacturer's recommendations using methods that will prevent damage to the components and the joint surfaces.

3.04 PLACING PRECAST CONCRETE SECTIONS

- A. Excavate to the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6" beyond the precast base and follow ASTM C891 excavation standards.
- B. Set base plumb and level, aligning pipe opening with pipe invert.
- C. Thoroughly clean joint tongue and grooves to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against bottom groove. Leave protective wrapper attached until sealant is entirely unrolled against groove. Do not stretch. Overlap from side to side, not top to bottom.
- D. Set risers and tops, aligning internal wall surfaces, so that proper alignment is achieved, taking particular care to clean, prepare and seal joints.
- E. When recommended by the manufacturer, fill the void between horizontal joint surfaces with a sand cement grout around the outside perimeter as risers are set.
- F. After joining precast sections, apply the butyl sealant sheet around the outside perimeter of the joints below grade.
- G. Secure Pipe Connectors to Pipe according to the Connector Manufacturer Instructions. When pipe stub outs are installed, provide restraint from longitudinal movement before backfilling.
- H. Lift Holes leaving less than 2" of wall thickness shall be plugged from the outside using a sand cement mortar and then covered with butyl sealant sheet. Lift Holes penetrating the

wall shall be additionally sealed with an interior application of an epoxy gel 1/8" thick extending 2" beyond the penetration.

- I. Perform the final finishing to the Structure interior by filling all chips or fractures greater than 1/2" in length, width or depth and depressions more than 1/2" deep in inverts with a sand cement mortar. Clean the interior of the Structure, removing all dirt, spills or other foreign matter.

3.05 SCHEDULES

A. Round Storm Drain Structures.

1. Provide round sub-grade structures with minimum inside diameters in inches based on the pipe's outside diameter and the angle formed with the adjacent entering pipe as shown in the table below:

Largest Pipe OD	Minimum Degrees Between Pipe Entering Structure										
	180	165	150	135	120	105	90	75	60	45	30
15	48	48	48	48	48	48	48	48	48	72	96
21	48	48	48	48	48	48	48	60	60	84	120
27	48	48	48	48	48	48	60	60	72	96	NA
33	48	48	48	48	48	60	60	72	84	120	NA
39	48	48	48	60	60	60	72	84	96	NA	NA
45	60	60	60	60	72	72	84	96	108	NA	NA
51	72	72	72	72	72	84	84	108	120	NA	NA
57	72	72	72	72	84	84	96	108	NA	NA	NA
63	84	84	84	84	84	96	108	120	NA	NA	NA
69	84	84	84	84	96	108	120	NA	NA	NA	NA
75	96	96	96	96	96	108	120	NA	NA	NA	NA
81	96	96	96	96	108	120	NA	NA	NA	NA	NA

2. Structures with smaller inside diameters may be supplied when pipes are of different diameters and calculations or shop drawings show that a minimum of 6 inches clearance will be maintained between pipe openings.
3. The minimum lay length of the base section shall be no less than the diameter of the pipe opening for pipe OD up to 87 inches.

B. Rectangular Storm Drain Structures

1. Provide rectangular sub-grade structures with minimum inside wall widths based on the entering pipe's outside diameter and the angle formed with the penetrated wall as shown in the chart below:

Largest Pipe OD	Minimum Degrees Between Pipe and Wall						
	90	80	70	60	50	40	30
15	22	22	22	22	22	34	34
21	22	22	22	34	34	34	46
27	34	34	34	34	46	46	58
33	34	34	46	46	46	58	70
39	46	46	46	46	58	70	82
45	46	46	58	58	70	70	94
51	58	58	58	70	70	82	106
57	58	58	70	70	82	94	118
63	70	70	70	82	82	106	130
69	70	70	82	82	94	118	142
75	82	82	82	94	106	118	154
81	82	82	94	94	106	130	166
87	94	94	94	106	118	142	178

2. Structures with narrower walls may be supplied when pipes are different diameters than shown and calculations of shop drawings show that the pipe will not penetrate the corners of the structure.

Pay Item

Precast Drainage Structures - Type

Pay Unit

EA

END OF SECTION 00476

SECTION 00485

FLOWABLE FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this specification consists of furnishing and placing flowable fill. Flowable fill is a controlled low strength material consisting of Portland cement, fly ash, fine aggregate, and water. It is suitable for filling underground storage tanks and pipe culverts and for back-filling culverts, bridges (where culverts or pipes are installed under a bridge), retaining walls, and roadway trenches.
- B. The Contractor shall state on Form 312 the intended use of the flowable fill. The Form shall be accompanied by a listing of compressive strength of at least three 4" x 8" cylinders at the age of 7 and 28 days. The Engineer will advise the Contractor in writing of the acceptability of the mix design.
- C. The Contractor may use flowable fill as an option to conventional fill and backfill methods with the approval of the Engineer.
- D. Determination of Measurement: Measure by the cubic yard of flowable fill delivered and placed.
- E. Basis for Payment: Payment shall be on a contract unit price per cubic yard that is installed.

1.02 DELIVERY, HANDLING, AND STORAGE

- A. Mixing and Delivery: The Contractor shall comply with the applicable portions of Section 00455.
- B. Temperature Requirements: The temperature requirements of Section 00455, Paragraph 1.03A., shall apply.

1.03 DESIGN REQUIREMENTS

- A. Composition and Design: The Contractor shall submit to the Engineer the proposed mix design(s) on M&T Form 312 at least 35 day prior to use. Mix proportions shall be determined by a testing laboratory which has been approved by NCDOT and shall be based on laboratory trial batches meeting the following requirements:

BATCH ITEM	FILL TO BE EXCAVATED	FILL TO REMAIN IN PLACE
Compressive Strength @ 28 Days	80-150 PSI Max	500 PSI Min.
Approximate Quantities Per C.Y.		
Cement	40-100 Lbs. Min.	150 Lbs. Min.
Fly Ash	250-600 Lbs. Min.	300 Lbs. Min.
Fine Aggregate	2000-2500 Lbs. SSD	2650 Lbs. SSD
Water	60 Gals	60 Gals

- 1.04 To achieve desired placement consistency, flowability may be adjusted by varying the water content approximately + or - 5 gallons per cubic yard without quantitative changes in other materials. This decision can only be made by the project Engineer or their designee. Less flowable mixes are desirable when it is necessary to put traffic back on a roadway quickly (i.e., within 8 to 10 hours) or when less buoyant fill is needed to backfill pipes that could float out of position. Pipes that could float shall be anchored or placement shall be in stages to prevent the pipe from floating.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials shall meet the requirements of N.C. Department of Transportation Standard Specifications dated January 2018, or current edition, Division 10 shown below:

Fine Aggregate	Article 1014-1
Portland Cement	Article 1024-1
Type IP Blended Cement	Article 1024-1
Fly Ash	Article 1024-5
Type IS Blended Cement	Article 1024-1
Water	Article 1024-4
Chemical Admixtures	Article 1024-3

- B. Steel plates shall be Grade A36 steel and of a size to cover openings completely and shall be of suitable thickness to support all traffic that may pass over the plate. Steel plates shall be solid with only small holes on the sides to aid in lifting and moving the plates.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Material, placement, steel plating, backfilling, tools, equipment, etc.
- B. Placing: Flowable fill shall be discharged directly from the truck into the space to be filled, or by other methods approved by the Engineer. The mix may be placed full depth or in lifts as site conditions dictate. In roadway trenches, the flowable fill shall be brought level with the bottom of the pavement and then paved over. Between filling and paving operations, steel plates may be placed over the trench to accommodate traffic.

Pay Item
Flowable Fill

Pay Unit
CY

END OF SECTION 00485

SECTION 00491

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of furnishing, erecting, maintaining, relocating and removing traffic control devices for maintenance of traffic during construction operations.
- B. Determination of Measurement: Measurement shall not be made for this item.
- C. Basis of Payment: Traffic control shall be billed and compensated as a lump sum item based on the following percentage schedule:

50%	First Payment
25%	Completion of 50% of project
15%	Completion of 75% of project
10%	Final Payment

1.02 REFERENCES

- A. All work performed is to be in accordance with:
 - 1. The North Carolina Department of Transportation Standards and Specifications for Road and Structures, current edition and any revisions.
 - 2. The North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings, January 2018 edition and revisions or current edition and any revisions.
 - 3. The Manual on Uniform Traffic Control Devices (MUTCD).
 - 4. The North Carolina Supplement to the MUTCD.
 - 5. Any project plans or sketches.
 - 6. Any project special provisions.

1.03 SUBMITTAL

- A. If the traffic control plan is not included as a part of the project plans, the individual project traffic control plan must be submitted to the City Traffic Engineer within two weeks of being declared the lowest responsible bidder. The City Traffic Engineer will approve or revise and approve the traffic control plan within 5 working days of submittal.

PART 2 PRODUCTS

2.01 MATERIALS

- A. The Contractor shall use interim pavement marking paint as described in the most recent edition of The North Carolina Department of Transportation Standard Specifications for Roads and Structures.
- B. Traffic cones may be used when approved by the City Traffic Engineer. When cones are used, they shall be either double stacked or have special heavy bottoms such that they will not be blown over by traffic.
- C. All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise required by the Special Provisions.

PART 3 EXECUTION

3.01 PREPARATION

- A. Street Closure
 - 1. Intended street closures must be requested, in writing to the City of Fayetteville Traffic Engineer, a minimum of five (5) working days prior to the desired closure date. The request shall state the street name, the from and to locations, and the length of closure time of the individual street to be closed.
 - 2. The request must also be accompanied by a traffic control plan, showing the detour information of through traffic. This plan must be in accordance with the current edition of the MUTCD.
 - 3. After approval, in writing, the Contractor bears full responsibility for the closure to include installation, maintenance and removal of all traffic control devices, as well as all implied liability.
- B. No work shall start until all the traffic control devices required for the particular work activity have been installed, inspected, and approved by the Traffic Engineer or his representative.

3.02 TEMPORARY ROAD CLOSURE

- A. Conditions represented are for work that requires closings during daytime hours only.
- B. This application is intended for a planned temporary closing not to exceed 15-20 minutes.
- C. The flaggers shall stop the first vehicle from the position shown, then move to the centerline to stop approaching traffic.
- D. A portable message sign may be used in addition to the initial warning sign.
- E. NOTE: The spacing between signs has a recommended standard of 200' but can be modified by the City Inspector according to the location of the workspace.

3.03 LANE CLOSURE ON MINOR STREET

- A. The traffic control procedure shown is appropriate only for low volume, low speed facilities, such as local residential streets.
- B. Traffic can regulate itself when volumes are low and the length of the workspace is short, thus enabling drivers to readily see the roadway beyond.
- C. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
- D. NOTE: The spacing between signs has a recommended standard of 200' but can be modified by the City Inspector according to the location of the workspace.

3.04 SIDEWALK CLOSURES

- A. Additional advance warning may be necessary.
- B. Only the traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets. Use lane closure signing as required.

3.05 INSTALLATION

- A. The furnishing, erecting, maintaining, relocating and removing of traffic control devices will be in accordance with the current edition of *The Manual on Uniform Traffic Control Devices* for streets and highways.

- B. All traffic control devices must be in place before beginning work each day, removed during intervals when work is not ongoing and removed at the end of the workday.
- C. The Contractor shall not obstruct or impede any of the traffic on adjacent streets while installing traffic control or doing construction work.
- D. The Contractor shall not close a lane to through traffic at night and during periods of construction inactivity, unless otherwise approved by the Engineer.
- E. The Engineer may restrict the Contractor from placing lane closures during certain hours, holidays, or special events because traffic may be unusually heavy. All lane closure types, hours of installation and lengths, will be controlled by and required to be approved by the Engineer.
- F. When working within the travelway, the Contractor shall use a standard lane closure or a moving operation caravan utilizing a shadow vehicle and truck mounted impact attenuator, as approved by the City Traffic Engineer. A moving operation caravan shall only be used if the marker operation maintains a minimum speed of 3 MPH at all times with no stops that would narrow or close a lane of travel.
- G. The use of police and/or trained flaggers to control traffic through the work site will be provided by the Contractor as required. The Contractor will be responsible for obtaining trained personnel to direct traffic and contacting local authorities for use of police for traffic control where applicable.
- H. Time limitation for placement and replacement on pavement markings and markers completed by contractors on newly resurfaced areas:
 - 1. Marking By Contractor
 - a. Divided and Multi-Lane Facilities
 - 1) For all Interstate highways and access ramps, place all markings including symbols and legends, by the end of each workday's operation.
 - 2) For all divided and multi-lane facilities, place all center line and lane line markings and railroad and school symbols and stop bars by the end of each workday's operation. Place all edge lines, gore lines, and other symbols within 3 calendar days after they have been obliterated by the resurfacing operation.
 - 3) A multi-lane facility is defined as any roadway having more than two lanes to include a two-lane, two-way with two-way center left turn lane.
 - b. Two-Lane, Two-Way Facilities
 - 1) For all two-lane, two-way facilities, place all centerline markings, railroad and school symbols within 5 calendar days after they have been obliterated by the resurfacing operation. Place all edge lines and other symbols within 15 calendar days after they have been obliterated by resurfacing operations.
 - c. All Facilities
 - 1) Place two applications of paint on newly resurfaced asphalt which will remain in place over three (3) months. Place the second application of paint upon ample drying time of the first, as determined by the Engineer.
 - 2) Install permanent markers within sixty (60) calendar days after completing the resurfacing on each map.

Pay Item
Traffic Control

Pay Unit
LS

END OF SECTION 00491

SECTION 00495

THERMOPLASTIC PAVEMENT MARKINGS (Alkyd/Maleic)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section consists of the furnishing and placement of Alkyd/Maleic Thermoplastic Reflective Markings in the form of lines and symbols as shown on the pavement marking plans. These markings shall be installed at the locations shown on the pavement marking plans or where directed by the City Traffic Engineer. Installation shall be performed in accordance with the lines, symbols, and dimensions shown on the pavement marking plans or as directed by the City Traffic Engineer. The Contractor shall furnish all materials, services, labor, and equipment necessary for the required pavement preparation and pavement marking installation. The Contractor shall provide sufficient personnel experienced in handling and applying the thermoplastic pavement marking materials to assure that the work is done properly.
 - 1. The work shall meet the requirements of this section and the *North Carolina Department of Transportation Standard Specifications for Roads and Structures*, current revision, and any attached standard pavement marking typical drawings and/or project plans.
- B. This special provision covers machine applied hot Alkyd/Maleic Thermoplastic Pavement Marking Material with both incorporated glass beads and drop-on glass beads. The material shall be plainly visible to the motorist both day and night. Nighttime visibility shall be enhanced by retroreflection induced by standard automobile headlights.

1.02 THERMOPLASTIC PAVEMENT MARKING LINES

- A. Determination of Measurement: The quantity of thermoplastic pavement marking lines to be paid for will be the actual number of linear feet of thermoplastic pavement marking lines which have been satisfactorily placed. The quantity of solid lines will be the summation of the linear feet of solid line measured end to end of the line. The quantity of skip or intermittent lines will be the summation of the linear feet derived by multiplying the nominal length of the marking lines by the number of marking lines in place.
- B. Basis for Payment: The quantity of thermoplastic pavement marking lines measured will be paid for at the contract unit price per linear foot for thermoplastic pavement marking lines.

1.03 THERMOPLASTIC PAVEMENT MARKING SYMBOLS

- A. Determination of Measurement: The quantity of thermoplastic pavement marking symbols to be paid for will be the actual number of thermoplastic pavement marking symbols satisfactorily placed.
- B. Basis for Payment: The quantity of thermoplastic pavement marking symbols measured will be paid for at the contract unit price per each for thermoplastic pavement marking symbols.

1.04 QUALIFICATIONS

- A. All Alkyd/Maleic thermoplastic reflective pavement marking products shall be pre-qualified by the City of Fayetteville Traffic Services Division. The process of pre-qualification shall be handled through the Traffic Services Division.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All thermoplastic and glass bead material shall be delivered to the project in containers filled by the manufacturer. Each material container shall be clearly and adequately marked to

indicate the material, the date of manufacture, the process, batch or lot number, and the manufacturer's name and location.

- B. Dry mixed thermoplastic material shall be shipped in leak proof moisture proof containers.
- C. The thermoplastic pavement marking material shall be in block or granular form packaged in either suitable corrugated containers or thermal degradable plastic bags to which it will not adhere during shipment or storage. The packages shall weigh approximately 23 kg (50 pounds). The corrugated containers shall consist of blocks approximately 14 inches x 28 inches x 2 1/4-inch size. Each container shall designate the color, manufacturer's name, batch number and date of manufacture. The label shall warn the user that the material shall be heated in the range of 204° to 227°C (400° to 440° Fahrenheit [F]) during application.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Thermoplastic pavement markings shall not be applied on existing pavement surfaces or new concrete pavements unless the ambient air temperature and the temperature of the pavement is 50° Fahrenheit and rising.
- B. Thermoplastic pavement markings shall not be applied on new asphalt surfaces unless the ambient air temperature is 50° F and rising and the temperature of the pavement is 50° F.
- C. Thermoplastic pavement markings shall not be placed when the pavement surface shows visible evidence of containing moisture.

1.07 WARRANTY

- A. Thermoplastic Pavement Marking Observation Period
 - 1. The Contractor shall warrant the thermoplastic pavement markings in accordance with the Contract.
 - 2. During the warranty period the thermoplastic pavement marking material furnished and installed under this contract shall be warranted against failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing, or spreading under heat, deterioration due to contact with oil, grease deposits, diesel fuel or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, loss of reflectivity, damage from traffic, and wear.
 - 3. The Contractor, at no expense to the City of Fayetteville shall replace any pavement markings that will not perform satisfactorily under traffic during the warranty period due to defective materials and/or workmanship in manufacture and/or application. (Failure to comply with any portion of this specification shall be considered as unsatisfactory performance of the thermoplastic pavement marking material.)
 - 4. Marking replacement shall be performed in accordance with the requirements specified herein for the initial application, including but not limited to surface cleaning, pavement marking removal, seasonal and weather limitations, etc.
 - 5. Traffic shall be operating on the facility during the warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The material manufacturer has the option of formulating the Thermoplastic Material according to his own specifications, however, the Contractor shall provide to the City Traffic Engineer a certificate of certification that the thermoplastic meets North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition and any revision, Division 10, Section 1087.

PART 3 EXECUTION

3.01 WORK

- A. Work: Layout, materials, testing, tools, traffic control necessary to install markings, pre-marking, or interim lines/markings, equipment, labor and all other requirements necessary to complete the work.

3.02 PREPARATION

- A. To ensure maximum possible adhesion, the pavement surface upon which the thermoplastic markings are to be placed shall be properly cleaned and free of oil, mud, dust, dirt, grass, loose gravel, and other deleterious material, prior to the application of the thermoplastic pavement markings. Cleaning shall be performed on all surfaces which are to receive new thermoplastic pavement markings. The area to be cleaned shall be a minimum of 2 inches wider than the thermoplastic pavement markings to be placed, such that, an additional 1 inch of cleaned area is on each side of the thermoplastic pavement markings after they are applied.
- B. Where cleaning of objectionable material is obscuring existing pavement markings of a lane occupied by public traffic, the residue including but not limited to dust, shall be removed immediately from the surface being treated. Such removal shall be by methods approved by the City Traffic Engineer.
- C. On Portland Cement Concrete surfaces, a liquid epoxy resin primer-sealer or equivalent shall be applied to the area where new thermoplastic pavement markings are to be placed unless otherwise recommended by the manufacturer or Engineer. The primer-sealer shall be that recommended by the manufacturer of the thermoplastic material and shall be approved by the City Traffic Engineer. The material shall form a continuous film which shall dry rapidly, and which shall adhere to the pavement surface, thermoplastic material. The primer-sealer shall not discolor nor cause any noticeable change in the appearance of the thermoplastic pavement markings and/or the pavement outside the edge of the finished pavement markings. A sample of the primer-sealer shall be submitted to the City Traffic Engineer and shall be approved by the City Traffic Engineer prior to application.
- D. No direct payment shall be made for this surface preparation (pavement cleaning and application of primer-sealer) as such work shall be considered incidental to the work being paid for by the various thermoplastic pavement marking items in this contract.

3.03 PREMARKING

- A. Where no existing markings are in place, the existing markings are not visible, and/or the existing markings are to be removed, the Contractor shall be required to pre-mark each installation of thermoplastic pavement marking materials prior to application. The pre-marking shall be of a manner that will be helpful to the Contractor and the Engineer in placing the thermoplastic pavement markings as directed in the plans. The actual placement of the thermoplastic pavement marking materials shall not be performed until the pre-marking has been inspected and approved by the Engineer.
- B. No direct payment shall be made for this pre-marking as such work shall be considered incidental to the work being paid for by the various thermoplastic pavement marking items in the contract.

3.04 METHODS OF APPLICATION

- A. The Contractor shall furnish and install by the specified method of application, thermoplastic pavement markings as directed by and in accordance with the pavement markings plans:
 - 1. Machine applied, hot extruded thermoplastic with glass spheres in the proper ratio to immediately produce a highly reflective marking as described elsewhere in this proposal conventional extrusion equipment or “ribbon gun” extrusion devices.
 - 2. Machine applied, hot sprayed thermoplastic with glass spheres in the proper ratio to immediately produce a highly reflective marking as described elsewhere in this proposal form. This method shall be approved by the Engineer prior to application.
- B. The thermoplastic pavement markings shall be applied to the road surface in a molten state with a homogenous surface application of glass spheres. When applied properly and at the designated uniform thickness and width, the marking shall, upon cooling, be uniformly reflectorized and have the ability to resist deformation caused by traffic throughout its entire length.
- C. Application of Thermoplastic Marking Material
 - 1. The parts of the application and pre-melting equipment shall be thoroughly cleaned of foreign material prior to the introduction of the thermoplastic pavement marking proposed in this specification.
 - 2. Openings of three to six inches in length shall be provided at intervals of 250 feet in edge-lines placed on the inside of curves and in edge-lines on the low side of tangents as directed by the City Traffic Engineer.
 - 3. The material shall be heated uniformly throughout and shall have a homogenous dispersant of binder, pigment, and glass beads when applied to the surface of the pavement.
 - 4. To avoid blistering and poor adhesion, the thermoplastic pavement marking material shall be applied to dry pavements in a molten state at a minimum temperature of 205° C (400° F) for Bituminous Pavements and at a minimum temperature of 218° C (425° F) for Portland Cement Concrete Pavements. The temperature shall be checked every 10 minutes for compliance with the specified application temperature range.
 - 5. “Drop-on Beads” shall be uniformly applied to the surface of the molten thermoplastic pavement marking material so that the beads are partially embedded. The beads shall be applied at a rate of 7 pounds per 100 square feet of marking. The cross-sectional thickness of the thermoplastic pavement marking material above the surface of the pavement for center lines, skip lines, transverse lines, mini skip lines, legends, and median islands shall be a minimum of 0.120 inches; edgelines, gorelines, 12-inch crosswalk lines, arrows and diagonals shall be a minimum of 0.90 inches.
 - 6. The thermoplastic pavement marking materials, when formed into traffic symbols and lines, shall have a uniformly thick and smooth surfaced cross-section throughout its entire length.
 - 7. All pavement marking widths, as a minimum, shall not vary by more than ½ inch.
 - 8. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as specified in the plans and/or directed by the City Traffic Engineer. Longitudinal lines shall be offset a minimum of 2 inches from longitudinal construction joints of pavements. Longitudinal lane lines of multilane roads shall be offset 2 inches toward the median.
 - 9. The finished lines shall have well defined edges and be free of horizontal fluctuations. The lateral deviation of the finished lines shall not exceed ½ inch from the proposed location alignment, as specified in the plans and/or directed by the City Traffic Engineer, at any point. Any greater deviations shall be sufficient cause for requiring the Contractor to remove and correct such pavement markings at no additional expense to the City of Fayetteville.

10. All pavement marking lines shall be applied with one pass of the pavement marking equipment, except the “X” of the railroad crossing symbol, 24-inch stop bars and 24 inch transverse bands, where two passes of the equipment will be permitted.
11. The stem portion of the straight arrows is to be applied in a single pass and the stem portion of turn arrows is to be applied in a maximum of two passes of the application equipment. Arrow heads may be applied by multiple passes of the application equipment, not to exceed three passes.
12. All pavement marking lines and symbols installed by multiple passes of the application equipment shall exhibit no gaps separating the application passes.
13. The various letters and symbols shall conform to the size and shape outline in the most recent edition of the Manual on Uniform Traffic Control Devices for Street and Highways, and NCDOT Standard, and as shown on the pavement marking plans.
14. The thermoplastic pavement marking material, when formed into traffic symbols and stripes, shall be readily renewable by placing a thin overlay of compatible new material directly over the old material.
15. The Contractor shall protect the pavement markings until they are track free by placing warning devices as directed by the Engineer.
16. Any molten pavement marking which is crossed by a vehicle shall be reapplied, and any subsequent marking made by the vehicle shall be removed by methods acceptable to the Engineer and at no additional expense to the Owner.
17. The Contractor shall be responsible for removing all pavement marking materials spilled upon the road surface by a method acceptable to the Engineer.

Pay Item

Thermoplastic Pavement Marking Lines
Thermoplastic Pavement Marking Symbols

Pay Unit

LF
EA

END OF SECTION 00495

SECTION 00496

RAISED REFLECTIVE PAVEMENT MARKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this section consists of furnishing and installing raised reflective pavement markers.
- B. All work performed is to be in accordance with:
 - 1. The North Carolina Department of Transportation Standard and Specifications for Roads and Structures, current edition.
 - 2. The North Carolina Department of Transportation's Highway Design Branch Roadway Standard Drawings, current edition.
 - 3. The Manual on Uniform Traffic Control Devices (MUTCD).
 - 4. The North Carolina Supplement to the MUTCD.
 - 5. Any project plans or sketches.
 - 6. Any project special provisions as attached.
 - 7. The Engineer.
- C. All work will be subject to inspection by the City of Fayetteville Traffic Services Division before final payment is made.
- D. Under this contract, the Contractor is to install materials identified by the City of Fayetteville. Any tools and/or installation equipment not specifically shown as being furnished by the City of Fayetteville in these special provisions is the responsibility of the Contractor.
- E. Determination of Measurement:
 - 1. The quantity of raised reflective pavement markers to be paid for will be the actual number of markers which have been satisfactorily installed and accepted. Any reference to quantities is provided as an estimate only and shall not serve to obligate the City to purchase any minimum amount, nor shall such reference serve to furnish any maximum amount which the Contractor is required to furnish.
 - 2. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The City of Fayetteville may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient.
 - 3. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided for the contract.
- F. Basis for Payment: The quantity of raised reflective pavement markers measured will be paid for at the contract unit price per each raised reflective pavement marker installed.

1.02 REFERENCES

- A. Refer to Roadway Standard Drawing in pavement marking section of the North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings, current edition for placement of pavement markers.

1.03 QUALIFICATIONS

- A. Pre-qualifications: Raised reflective pavement markers are required to be pre-qualified by the City of Fayetteville Traffic Services Division. The process of pre-qualification will be accomplished through the City of Fayetteville Traffic Services Division at (910) 433-1660.

1.04 REGULATORY REQUIREMENTS

- A. The Contractor shall comply with all applicable local ordinances and regulations prior to beginning work. He shall obtain all permits and licenses required by state and local agencies having jurisdiction in his area of work.

PART 2 PRODUCTS

2.01 MATERIALS

2.02 All materials for raised reflective pavement markers, shall meet the requirements of the most recent edition of the North Carolina Standard Specifications for Roads and Structures.

- A. Your quote shall be at the contract unit price each for the following items for all work involved in this project and needs to be submitted on the enclosed bid sheet.
 - 1. Type 1 - Raised non-snow-plowable crystal/white.
 - 2. Type 2 - Raised non-snow-plowable yellow/yellow.
 - 3. Type 3 - Raised non-snow-plowable crystal/red.
- B. The work to be performed by the Contractor includes the material, labor, equipment, and traffic control necessary to install these devices.
- C. Hot bitumen adhesive shall be used for mounting the pavement markers to the pavement. Other adhesives such as epoxy or cold bituminous adhesive pads will not be acceptable.
- D. The pavement marker reflector lens shall be of the glass face type and as illustrated in the most recent edition of North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Adhesive, required traffic control devices, equipment and incidentals, cleaning of pavement surface and furnishing and installing raised reflective pavement markers.
- B. Construction Methods
 - 1. Construction methods shall meet the requirements of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition and any revisions.
 - 2. The markers shall be seated on the bituminous adhesive with all edges of the marker lapped by adhesive. Markers shall not be installed on the asphalt seam or joint.
 - 3. Traffic control will be installed in accordance with the most recent edition of North Carolina Department of Transportation Standard Specifications for Roads and Structures.
- C. Completion and final acceptance of the project shall be contingent upon successful completion of the observation period. The observation period shall be considered a part of the work required to be completed after the final completion date specified herein (15 days after the date of availability of the work).
- D. After the completion of the work, the Contractor shall have the work inspected as required by local inspectors having jurisdiction in the area and receive written approval of his work. The Contractor shall be responsible for maintaining traffic in a safe and efficient manner at all work sites. Local ordinances involving the time of day the Contractor may work are to be observed.

Pay Item
Raised Reflective Pavement Markers

Pay Unit
EA

END OF SECTION 00496

SECTION 00499

TEMPORARY PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work covered in this section consists of furnishing and applying temporary pavement marking tapes.
- B. All work performed is to be in accordance with:
 - 1. The North Carolina Department of Transportation Standard and Specifications for Roads and Structures, current edition.
 - 2. The North Carolina Department of Transportation's Highway Design Branch Roadway Standard Drawings, current edition.
 - 3. The Manual on Uniform Traffic Control Devices (MUTCD).
 - 4. The North Carolina Supplement to the MUTCD.
 - 5. Any project plans or sketches.
 - 6. Any project special provisions as attached.
 - 7. The Engineer.

1.02 TEMPORARY PAVEMENT MARKING LINES

- A. Determination of Measurement: The quantity of temporary pavement marking tape to be paid for lines will be the actual number of linear feet which has been satisfactorily installed and accepted. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Engineer may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work.
- B. Basis for Payment: The quantity of temporary marking tape measured will be paid for at the contract unit price per linear foot installed.

1.03 TEMPORARY PAVEMENT MARKING SYMBOLS

- A. Determination of Measurement: The quantity of temporary pavement marking tape to be paid for symbols will be the actual number of symbols which have been satisfactorily installed and accepted by the City Traffic Engineer. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Engineer may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work.
- B. Basis for Payment: The quantity of temporary marking tape measured will be paid for at the contract unit price for each symbol installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials to be used are 3-M Scotch Lane removable tape #5710 (white or yellow) and Black Line mask #145 or approved equal.

- B. Materials other than those listed above must be determined to be an approved equal by the City Traffic Engineer prior to use.

PART 3 EXECUTION

3.01 WORK

- A. Work: Labor, placement, removal, disposal, materials, equipment and any other necessary incidentals.

3.02 TEMPERATURE

- A. Air and pavement temperature must be at least 50 degrees F and rising.

3.03 PREPARATION

- A. Road surface shall be cleaned with high pressure air or by sweeping.
- B. Mark pavement where tape is to be applied.

3.04 INSTALLATION

- A. Temporary pavement marking tapes shall be applied per manufacturer's instructions.
- B. Do not overlap material--use butt splices.

3.05 TAMPING

- A. Tape must be tamped, a minimum of three (3) passes back and forth, using one of the following methods:
 - 1. Roller tamper cart with a minimum load of 200 pounds.
 - 2. Driving a vehicle tire slowly (2-3 MPH) over the tape.
- B. Do not twist or turn the tamping device on the tape.
- C. Ensure all edges have firmly adhered before opening to traffic.

3.06 REMOVAL

- A. For your own safety, wear gloves and eye protection when removing temporary pavement marking tape.
- B. Use a chisel-like tool to pry up the edge of the tape.
- C. Pull the tape up at a 90-degree angle to the pavement.
- D. Burning or grinding is not recommended.

Pay Item

Temporary Pavement Marking Lines
Temporary Pavement Marking Symbols

Pay Unit

LF
EA

END OF SECTION 00499

SECTION 02810

IRRIGATION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work to be done includes furnishing all labor, materials, equipment and services required to complete all irrigation work indicated on the Drawings, as specified herein, or both.
- B. The mechanical point of connection for the irrigation system shall be a new tap of the domestic water supply provided by others, as specified.
- C. The electrical point of connection for the irrigation system shall be to a 120-volt, 20-amp building electrical circuit provided by others.
- D. The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Engineer for decision, and his interpretation shall be final, conclusive and binding.
- E. All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Engineer.
- F. Trench excavation, backfilling and bedding materials, together with the testing of the completed installation shall be included in this work.
- G. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.
- H. Record Drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall also be included in this work.
- I. The irrigation system shown on the Drawings and described within these Specifications represents a single controller, turf and landscape irrigation system supplied from municipal water. The system is designed for 27 gallons per minute. Minimum 65-psi static and 55-psi dynamic pressure at full system flow is required from the point of connection.
- J. Determination of Measurement: No measurement shall be made for this item.
- K. Basis of Payment: Payment will be lump sum for complete installation of the irrigation system as shown.

1.02 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements that affect the Work of this Section.

1.03 ORDINANCES, PERMITS AND FEES

- A. The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.

- B. The Contractor shall obtain and pay for any and all permits, tests and certifications required for the execution of Work under this Section, including water supply tap fee.
- C. Furnish copies of Permits, Certifications and Approval Notices to the Owner's Representative prior to requesting payment.
- D. The Contractor shall include in his bid any charges by the Water Department, Utility Company, or other authorities for work done by them and charged to the Contractor.

1.04 EXAMINATION OF CONDITIONS

- A. The Contractor shall fully inform himself of existing conditions on the site before submitting his bid and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the GENERAL CONDITIONS.

1.05 QUALITY ASSURANCE

- A. Installer: A qualified firm which has experience in work of the type and size required by this Section, and which is acceptable to the Engineer.
- B. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
 - 1. American Society for Testing & Materials (ASTM)
 - 2. National Plumbing Code (NPC)
 - 3. National Electric Code (NEC)
 - 4. National Sanitary Foundation (NSF)
 - 5. American Society of Agricultural Engineers (ASAE)
 - 6. Underwriters Laboratories, Inc. (UL)
 - 7. Occupational Safety and Health Regulations (OSHA)

1.06 TESTS

- A. Observation: The Engineer will be on site at various times to ensure the system is being installed according to the Specifications and Drawings.
- B. Operational Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Engineer. Demonstrate to the Engineer that all irrigated areas are being adequately covered (See Part 3 - Execution).

1.07 SHOP DRAWINGS

- A. The Contractor shall provide copies of product specification sheets on all proposed equipment to be installed to the Engineer for approval prior to the start of work, in accordance with the parameters of Division-1. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:
 - 1. Sprinkler Heads
 - 2. Valves: Manual and Automatic
 - 3. Controller
 - 4. Valve Boxes
 - 5. Pipe and Fittings
 - 6. Wire and Connectors
 - 7. Quick Coupling Valves
 - 8. Rain Sensor
 - 9. Backflow Preventer/ Enclosure

10. Miscellaneous Materials

- B. The Contractor shall maintain complete Record Drawings of the system as the project proceeds. Record Drawings shall specify sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller, rain sensor, quick coupling valves, water meters, back flow prevention device and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types).

1.08 DELIVERY, STORAGE AND HANDLING

- A. Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage.

1.09 GUARANTEE

- A. The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.
- B. In addition to the manufacturer's guarantees, the Contractor shall warrant the entire irrigation system, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.
- C. As part of the one-year warranty the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system.

1.10 COORDINATION

- A. The Contractor shall at all times coordinate his work closely with the Engineer to avoid misunderstandings and to efficiently bring the project to completion. The Engineer shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the changes are made. The Contractor shall also coordinate his work with that of his sub-contractors.
- B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Engineer.

1.11 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. Contractor shall include in his Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Engineer shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).
- B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE "Project Name", shall be submitted to the Engineer's office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:
 - 1. Table of Contents
 - 2. Written description of Irrigation System.
 - 3. System drawings:
 - a. One (1) copy of the original irrigation plan;
 - b. One (1) copy of the Record Drawing;

- c. One (1) reproducible of the Record Drawing;
 - d. One (1) copy of the controller valve system wiring diagram
- 4. Listing of Manufacturers.
- 5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
 - a. "APPROVED" submittals of all irrigation equipment;
 - b. Operation:
 - c. Maintenance: including complete troubleshooting charts.
 - d. Parts list.
 - e. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.
- 6. Winterization and spring start-up procedures.
- 7. Guarantee data.

1.12 PROCEDURE

- A. Notify all city departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.
- B. Provide temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Engineer.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.
- B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Engineer.

2.02 PVC IRRIGATION PIPE

- A. All pipe in sizes 1-1/2 inches and smaller shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 and D3036 as manufactured by Certainteed, Cresline, JM or equal.

2.03 PVC PIPE SLEEVES

- A. All pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Certainteed, Cresline, JM or equal. Minimum sleeve size to be 2-inch.

2.04 WIRE CONDUIT

- A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-80 conduit, as manufactured by Certainteed, Cresline, JM or equal.

- B. Conduit for above ground wiring to rain sensor or controller shall be galvanized, rigid metallic conduit.

2.05 PVC IRRIGATION FITTINGS

- A. Fittings for solvent weld PVC pipe, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.
- B. All PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 male threads will not be approved for installation.
- C. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 fittings. Cement is to meet ASTM D2564 and FF493 for potable water pipes. PVC solvent cement shall be Rectorseal Gold, or equal, and shall be used in conjunction with the appropriate primer.
- D. All nipples to be schedule 80 PVC.

2.06 SPRAY SPRINKLERS

- A. Full and part circle pop up spray sprinklers shall be pressure regulating, plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the Drawings and in the legend. Pop-up height shall be 6 inches for turf and ground cover, 12 inches for shrubs and annual beds.
- B. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Toro model 570Z-PRX, Rain Bird model 1800-SAM-PRS or approved equal.

2.07 ROTARY SPRINKLERS

- A. Rotary sprinklers shall be gear-driven, rotary type heads, designed for in-ground installation with integral check valves. Sprinkler shall be capable of covering a 34-40 foot radius and flow range of 1.6-6.8 gpm at 40 pounds per square inch of pressure. Sprinklers shall have a one hundred percent warranty for two years minimum against defects in workmanship.
- B. The nozzle assembly shall elevate a minimum of four inches when in operation and retraction shall be achieved by a stainless steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.
- C. All sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. The sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.
- D. Sprinkler shall be manufactured by Toro, model S700C-XX-15/30/60-LA, Hunter Industries, model I20-ADV-15/35/80 or approved equal.

2.08 ELECTRIC CONTROL VALVES

- A. Electric control valves shall be one, one and one half and two-inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 150 psi pressure rating. Valves shall be globe/angle combination configuration.
- B. Valves shall be manufactured by Toro, model 252, Rain Bird, model PGA or approved equal.

2.09 VALVE BOXES

- A. Valve boxes for single electric valves, isolation valves and quick coupling valves shall be 10-inch round valve boxes with metal detection and bolt down covers
- B. Valve boxes for dual electric valves shall be 12-inch standard valve boxes with metal detection and bolt down covers.
- C. Valve box extensions shall be provided as required for proper box depth.
- D. Valve boxes shall be manufactured by Ametek or approved equal.

2.10 AUTOMATIC CONTROLLER

- A. Controller shall be electronic in construction with capability of up to 10 hour run times per zone in increments of 1 or 10 minutes. Controllers to have minimum two independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, sensor input terminal, locking, weather resistant plastic cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120 volt, 60 Hertz, A.C. type.
- B. Controller shall be as manufactured by Toro, Custom Command Series, model CC-P-24, Rain Bird, Model ESP-24LX+ or approved equal.
- C. Station quantity shall be minimum of 24.

2.11 QUICK COUPLING VALVES

- A. The valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under all conditions when the key is not inserted.
- B. The top of the valve body receiving the key shall be equipped with a single slot and smooth face to allow the key to open and close the valve slowly with a one-half turn. The quick coupling valve shall be equipped with a locking vinyl cover.
- C. The valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.
- D. Keys shall be single lug with 1-inch male thread and 3/4 inch female thread at the top.
- E. Contractor shall provide two (2) keys for quick couplers, two (2) 1 inch x 1 inch swivel hose ends and two (2) cover keys for quick coupling valves.
- F. Quick coupling valves, keys and swivels shall be manufactured by Toro models 474-03, 464-01 and 477-02, Rain Bird models 44NP, 44K and SH-2 or approved equal.

2.12 WIRE

- A. All valve control wire shall be minimum #14-awg, common #12-awg, single strand, solid copper, 600v, direct burial (UF) and shall meet all state and local codes for this service. Individual wires must be used for each zone valve. Common wire shall be white in color, control wire for spray and rotor zones shall be red in color, and spare wires, installed where indicated on the drawings shall be blue.
- B. In ground wire connections shall be UL listed, manufactured by 3M, model DBY-6 splice kits or approved equal. All wire splices shall be made in valve boxes, at controller, or at valves.
- C. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

2.13 ISOLATION VALVES

- A. Isolation valves 2-1/2 inches and smaller in size shall be gate type, of bronze construction, US Manufacture, 600 WOG with steel cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco, model T-113-irr, or approved equal.

2.14 SWING JOINTS

- A. Sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.
- B. Quick coupling valves to be installed on one-inch brass swing joint, minimum 12-inches in length with Leemco model LS-120 stabilizer, or approved equal.

2.15 AUTOMATIC RAIN SENSOR

- A. Rain sensor shall be plastic in construction with adjustable interruption point and 1/2-inch IPS threads. Rain sensor shall be manufactured by Hunter Industries, model Mini-Clik-C or approved equal.

2.16 BACKFLOW PREVENTION DEVICE

- A. Back flow prevention device shall be 1-1/2-inch Reduced Pressure Assembly. Back flow prevention device shall have maximum 8-psi pressure loss at system flow.
- B. Back flow prevention device shall be as manufactured by Watts model 909-M1 or approved equal.

2.17 CRUSHED STONE

- A. Crushed stone shall be used under valve boxes and below all sprinklers.

2.18 SAND

- A. Sand shall be used for backfilling of trenches; under, around and over PVC lines.

2.19 CONCRETE

- A. Cement concrete for concrete base under enclosure shall be 2,500 psi, 1-1/2 inch aggregate.

2.20 BACK FLOW ENCLOSURE

- A. The back flow prevention device enclosure shall be of a vandal and weather resistant nature manufactured entirely of marine grade aluminum alloy 5052-H32, with a wall thickness of 1/8 inch.
- B. The mounting base shall be manufactured entirely of stainless steel. The main housing shall be of solid sheet construction punched on the sides with a rectangular pattern for viewing back flow prevention device operation. The length of the enclosure shall be expandable to allow for site adjustment. The enclosure shall have a mounting lip on one end and a locking mechanism on the other end. The mounting base shall be submerged into the concrete a minimum of two inches, and position the enclosure two and one half inches above the concrete for drainage purposes.
- C. The locking mechanism shall be of the full release type, which allows for complete removal of the enclosure from its mounting base without the use of tools. The handle controlling the locking mechanism shall be concealed within the surface of the enclosure and provide for a padlock.
- D. The enclosure shall be 30 inches high, 16 inches wide and 45 inches long. Unit shall be as manufactured by VIT Products, Inc., model SBBC-45AL or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Work: Shall include labor, material, equipment, services and any other incidentals required for installation.
- B. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Engineer for timely resolution.
- C. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Engineer prior to proceeding.
- D. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.

3.02 PIPE AND FITTINGS INSTALLATION

- A. Using proper width trencher chain, excavate a straight and true trench.
- B. Loam encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.
- C. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1 inch or sharp edges; if not, excavate to 2 inch below pipe invert and provide sand base or #57 washed stone upon which to lay pipe.
- D. Back filling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock larger than 1 inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment matching adjacent undisturbed area. Frozen material shall not be used for backfill.
- E. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow connections to set minimum 24 hours before pulling or pressure is applied to the system. Provide for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).
- F. Mainline pipe shall have minimum 24 inches of cover (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of cover (excavate to invert as required by pipe size).
- G. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.
- H. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that

day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 35°F or below. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

- I. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1 inch and larger.
- J. Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.
- K. Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

3.03 ELECTRICAL WIRE CONDUIT INSTALLATION

- A. Electrical conduit shall be installed in all non-soil areas, as well as for all above ground wiring to controllers and rain sensor.

3.04 PIPE SLEEVING INSTALLATION

- A. Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 24 inches as shown on the detail.

3.05 ISOLATION VALVE INSTALLATION

- A. Install isolation valves per detail where indicated on the Drawings. Install all isolation valves on a level #57 washed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

3.06 VALVE BOX INSTALLATION

- A. Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, and wire splice.
- B. All valve access boxes shall be installed on a minimum 4-inch #57 washed stone base. Finish elevation of all boxes shall be at grade. All stone to be supplied by the Contractor and installed before valve box. Stone shall not be poured into previously installed valve boxes.

3.07 24 VOLT CONTROL VALVE INSTALLATION

- A. Control valves shall be installed on a level #57 washed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening.
- B. Adjust zone valve operation after installation using flow control device on valve.

3.08 WIRING INSTALLATION

- A. Wiring shall be installed along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

- B. All wire shall be laid in trenches and shall be carefully backfilled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and backfilled. The wires shall have a minimum of 12 inches of cover. Wire not to be installed that day shall not be laid out.
- C. An expansion curl shall be provided within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.
- D. Provide a common ground wire of white color. No white color shall be used for power wire. Control wire shall be red, and spare wiring shall be blue in color.
- E. Service wiring in connection with Drawings and local codes for 24-volt service. All in-ground wire connections shall be waterproofed with 3M DBY, or approved equal, splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided in splice box--valve box shall be used). Splice locations shall be shown on the Record Drawings.
- F. Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

3.09 CONTROLLER INSTALLATION

- A. Contractor to install controller on wall in mechanical room, generally where shown on the drawings. Contractor to wire valves and rain sensor into controller and set proper program.
- B. Wire controller to 120-volt electrical supply provided to the controller locations by OTHERS.
- C. Keys shall be turned over to Engineer.

3.10 RAIN SENSOR INSTALLATION

- A. Install rain sensor on exterior building wall, generally where indicated on the drawings. Coordinate final location of rain sensor with Engineer. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.
- B. Install rain sensor wiring within ½ inch conduit where exposed. All above ground wires shall be installed in conduits.

3.11 SPRINKLER INSTALLATION

- A. Spray and rotary sprinklers shall be installed flush to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.
- B. Adjust sprinkler zone pressure with flow control on valve.
- C. Sprinkler installation prohibited inside City of Fayetteville right-of-way.

3.12 QUICK COUPLING VALVE INSTALLATION

- A. Provide quick coupling valves where indicated on the Drawings.
- B. Quick coupling valves to be mounted on 1-inch brass swing joint with stabilizer as per details.

3.13 BACKFLOW PREVENTION INSTALLATION

- A. Install 1-1/2-inch reduced pressure back flow prevention assembly in above grade enclosure as specified.

3.14 BACK FLOW ENCLOSURE INSTALLATION

- A. Install enclosure on concrete pad as indicated on the detail, generally where indicated on the drawings. Final location of enclosure shall be coordinated with the Engineer as to best screen the enclosure and deter vandalism. Final location shall also be coordinated with utility department to ensure proper placement of water supply line.
- B. Concrete pad for back flow enclosure shall be 53 inches long by 24 inches wide by 8 inches deep.

3.15 CHECK/TEST/START-UP/ADJUST

- A. Flushing:
 - 1. After all piping, valves and sprinkler bodies are in place and connected, but prior to installation of sprinkler internals, flush piping under a full head of water.
- B. Testing:
 - 1. Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.
 - 2. Coverage test: perform a coverage test in the presence of the Engineer (notify Engineer at least seven (7) days in advance of scheduled coverage test). Engineer will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.
 - 3. All testing shall be at the expense of the Contractor.

3.16 CLEANING AND ADJUSTING

- A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves, and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.
- B. Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.
- C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.
- D. Each control zone shall be operated for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced, and tested until they meet the manufacturer's standards.

3.17 ACCEPTANCE AND OPERATION BY OWNER

- A. Upon completion of the work and acceptance by the Owner, the Contractor shall be responsible for the training of the Owner's Representative(s) in the operation of the system (provide minimum 48 hours written notice in advance of test). The Contractor shall furnish, in addition to the Record Drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. The Contractor shall guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.

3.18 CLEAN UP

- A. Upon completion of all installation work, Contractor shall remove all leftover materials and equipment from the site in a safe and legal manner.

3.19 WINTERIZATION

- A. Winterization: The irrigation system is designed to be completely drained to protect pipe from bursting prior to freezing temperatures. To adequately drain the system the following procedure must be followed:
 - 1. Air blow-out
 - a. Set automatic controller stations to 2-1/2 minutes timing.
 - b. Attach hose from portable air compressor to 1-inch air inlet installed on main line at back flow preventer.
 - c. Operate compressor at 100 cubic feet per second at 60-80 psi.
 - 2. Manual drain valves: Open manual drain valves located at low points on the main line to drain main completely after air blow-out has been completed.
 - 3. Backflow Preventer: Rotate backflow unit at unions and open petcocks and drain. Reverse operation and tighten unions to resume irrigation.

Pay Item
Irrigation System

Pay Unit
LS

END OF SECTION 02810

SECTION 02831

FENCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Provide chain link fencing where indicated on the Drawings and specified herein.
- B. Work shall include, but not be limited to, the following major items and necessary accessories for a complete and operational system:
 - 1. Clearing as necessary for installation of fence.
 - 2. Fence post, frame, and concrete foundation.
 - 3. Chain link fabric and barbed wire.
 - 4. Gates.
- C. Determination of Measurement: Measurement shall be by the linear foot measured from center post to center post. No deduction will be made for gates.
- D. Basis of Payment: Payment will be per linear foot per type of fence installed.

1.02 SYSTEM DESCRIPTION

- A. Fencing Location
 - 1. Fence Height: As shown on drawings
 - 2. Provide posts, bottom intermediate and top rails as indicated. Provide corner and brace assemblies.
 - 3. Provide fabric gauges as indicated and install fabric on outside of fence and anchor to framework such that fabric remains in tension after pulling force is released.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section, Submittal Procedures:
 - 1. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Equipment to be furnished for the Project shall be clearly indicated including all options to be provided.
 - a. Individual components of the fencing system.
 - 2. Shop Drawings: Submit Project specific shop drawings for the following:
 - a. Layout drawing showing spacing of posts and location of gate, corner, end, and pull posts.
 - 3. Manufacturer's Installation Procedures.

PART 2 PRODUCTS

2.01 FABRIC

- A. Selvage: Fabric shall be twisted and barbed at both selvages. Both selvages of meshes less than 2 inches shall be knuckled. Bottom tension wire shall be 7 gauge and shall terminate at posts.
- B. Galvanized Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufactures Institute (CLFMI) "Product Manual" and with requirements indicated below:
 - 1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gage).

2. Coating: ASTM A 392-74, Class 2, galvanized.

2.02 FRAMING

- A. Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts are often referred to in ASTM standard specifications by Nominal pipe sizes (NPS) or the equivalent trade sized inches. The following indicates these equivalents all measured in inches:

Actual OD Size (in)	NPS Size	Trade
=====		
1.660	1 1/4	1 5/8
1.900	1 1/2	2
2.375	2	2 1/2
2.875	2 1/2	3
4.000	3 1/2	4

- B. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669. Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per square foot. Type coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual OD Size (in)	Weight (lb/ft)	NPS Size
=====		
1.660	2.27	1-1/4
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2 1/2
4.000	9.11	3 1/2

- C. Top Rail: Manufacturer's longest lengths (21 feet) with expansion-type coupling, approximately 6 inches long for joining. Provide rail ends of other means for attaching top rail securely to each gate, corner, pull, and end post.
 1. Round Steel: 1.660-inch OD Type.
- D. Steel posts for all fabric heights:
 1. Round Line or Intermediate Posts: 2.375-inch OD Type I steel pipe.
 2. Round End, Corner, and Pull Posts: 2.875-inch OD Type I steel pipe.
- E. Swing Gate Posts: Furnish post to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows.
 1. Steel posts for fabric height of 8 feet or less and gate leaf width:
 - a. Up to and including 4 feet: 2.875-inch OD pipe weighing at least 5.79 lb per foot.
 - b. Over 4 to 10 feet: 4.000-inch OD pipe weighing at least 9.11 lb per ft.

2.03 FITTINGS AND ACCESSORIES

- A. Material: Comply with ASTM F 626. Galvanized iron or steel to suit manufacturer's standards.
 1. Steel and Iron: Unless specified otherwise, hot-dip galvanize steel or cast-iron fence fittings and accessories with at least 1.2 oz. Zinc per sq. ft. as determined by ASTM A 90.

- B. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive top rail.
- C. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast iron or cast-aluminum cap for each end.
 - 1. Round Steel: 1.6600-inch OD Type I steel pipe.
- D. Bottom and Center Rail: (Where indicated on drawings). Same material as top rail unless indicated otherwise. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.
- E. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4, and a minimum of 1.2 oz of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.
- F. Tension and Brace Bands: 3/4 -inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of Zinc coating per sq. ft.
 - 1. Tension Bands: 0.074-inch thick (14 gauge) minimum.
 - 2. Brace Bands: 0.105-inch thick (12 gauge) minimum
- G. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.
 - 1. Coating Type II zinc in the following class as determined by ASTM A 90.
 - a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.
- H. Tie Wire: (9-gauge) aluminum wire alloy 1350-H19 or equal.

2.04 BARBED WIRE

- A. Provide three lines of 4-point pattern barbed wire. Barbed wire shall be double strand 12-1/2 gauge twisted wire with 14-gauge, 4 point round aluminum barbs spaced on approximately 5 inch centers conforming to the requirements of ASTM A121. Extension arms to accommodate barbed wire shall withstand a 250-pound pulldown load from end of arm and have a 3-inch apron around post. The topmost barbed wire shall be approximately 18 inches above the fabric and approximately 18 inches out from fence line. Barbed wire shall be securely fastened in slots by heavy wire pins. Arms having projections to bend down over barbed wire will not be acceptable.

2.05 CONCRETE

- A. Concrete: Provide concrete consisting of Portland cement per ASTM C150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.
- B. Package Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2-inch to 3-inch slump.

2.06 GATES

- A. General: Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members a maximum of 8 feet apart unless otherwise indicated.

1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
 2. Bracing: Install an adjustable truss rod diagonally on gates six foot wide and greater to prevent sagging.
- B. Swing Gates: Comply with ASTM F 900.
1. Framework: Fabricate using 1.660-inch minimum OD Type I steel pipe or 1-inch-square galvanized steel tubing weighing 1.84 lb per sq. ft.
 2. Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:
 - a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
 - b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.
 - c. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
 - d. Gate stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Shall include labor, material, equipment, grading and any other incidentals required for installation. Fence to match existing fence material or as specified by the Engineer.
- B. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
- C. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameter and spacings indicated, in firm, undisturbed or compacted soil.
 1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
 2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.
- D. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and hold in position during placement and finishing operations.
 - a. Pour concrete footings to a level 2" below finished grade and cover with fresh earth from excavation.
- E. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.
- F. Center Rails: Install center rails in one piece between posts and flush with post on fabric side, using rail ends and special offset fittings where indicated.

- G. Brace Assemblies: Install braces at end and gateposts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric. Install so posts are plumb when diagonal rod is under proper tension.
- H. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.
- I. Fabric: Pull fabric taut and tie to post, rails, and tension wires.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and Gateposts with tension bands spaced not over 15 inches o.c.
- K. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
 - 1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.
- M. Netting Ties: Fasten safety netting to tension cable and fence top rail with cable ties at 12" o.c.
- N. Barbed Wire: Install three parallel wires on each extension arm on security side of fence, unless otherwise indicated. Pull wires taut.
- O. Gates: Install gates plumb, level and secure for full opening without interference. Install ground set items in concrete for anchorage as recommended by the manufacturer.

Pay Item
Fencing
Gates

Pay Unit
LF
EA

END OF SECTION 02831

SECTION 02832

HANDRAILS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Determination of Measurement: By the linear foot installed.
- B. Basis of Payment: Payment will be for the contract unit price for handrail installed.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work shall include the fabrication, primer, paint, installation, core holes, grout and any other incidental required for installation.

Pay Item
Handrails

Pay Unit
LF

END OF SECTION 02832

SECTION 02931

SOD

PART 1 GENERAL

Restoration of existing lawn areas disturbed by construction activities shall be by installation of new sod where indicated on plans or otherwise directed to install sod by the Engineer. Restoration and sod shall be performed as soon as practical, but the time period between initial disturbance, the utility installation and sod placement shall not exceed 60 days. Sod is defined as blocks, squares, strips of turf grass and adhering soil used for vegetative planting. Sodding and preparation of the sod bed shall be performed by an experienced landscape subcontractor specializing in this type of operation unless otherwise approved by the Engineer in writing. The Contractor shall adhere to the standards set forth by the American Association of Nurseryman and the Associated Landscape Contractors of America. All personnel shall be appropriately trained with regard to the degree of involvement so to assure the owner of the highest level of workmanship. Sod species suitable in this area are Hybrid Bermuda, Centipede and Zoysia; however, the sod placed for each individual's lawn shall be the same species of sod as existing. Sodding may be performed at any time of the year except frozen sod shall not be placed nor shall sod be placed on frozen ground. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of a vigorous, disease free and weed free sod lawn.

1.01 SECTION INCLUDES

- A. Determination of Measurement: Measurement shall be to the nearest square yard.
- B. Basis of Payment: Payment will be at the contract unit price per square yard of sod installed.
- C. Work: Sod, pest control, disease control, anchoring, placing, soil amendments, fertilizer, topsoil, grading, raking, sod bed preparation, water, maintenance, sod replacement, protection, damage repair and other incidentals required.

1.02 MATERIAL

- A. Materials, equipment and products incorporated in the work shall be approved by the Engineer. The Contractor shall submit a list of the proposed materials with samples, if required. Package materials should be delivered in unopened original containers showing weight, analysis and name of manufacturer. Protect material from deterioration.
- B. Sod shall contain 95 percent permanent grass; not more than 5 percent weeds and undesirable grasses, good texture and free from obnoxious grasses, roots, stones and foreign materials. Sod shall be uniformly 1 1/2 to 2 inches thick with a well-developed fibrous root mat system in topsoil with clean cut edges. The sod shall be sufficiently dense and cut to the minimum required thickness such that if one corner suspends the sod, the sod will not tear apart. The sod shall be recently mowed to a height of not more than 3 inches prior to harvest. The sod shall be supplied and maintained in a healthy condition as evidenced by the grass being a normal green color in appearance, dense, and free from insects, pests, disease or injury. Sod shall be delivered to the job site within 24 hours after being cut and shall be installed within 24 hours after delivery. Any sod which is torn, broken or too dry will be rejected.
- C. Sod shall be sourced locally depending on availability.

1.03 SOIL BED PREPARATION

- A. Before landscape construction is to begin, the site shall be cleaned and disposed of brush, rubbish, stones, gravel and other foreign material within the area to be landscaped. Exposed ground surfaces disturbed during construction activities shall be graded to the original contours (allowing for the thickness of the sod) or as in the case of an altered contour such as

a fill slope, graded as directed by the Engineer to finish grade, or typical cross section. The sod bed shall be excavated to such a depth that after sod placement the top of the sod shall be flush with surrounding grade or contours. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions. Do not start work until conditions are satisfactory and do not work during inclement or impending inclement weather.

- B. The surface area to receive sod shall contain a minimum of 4 inches of good, fertile, friable, organic natural topsoil loam as a base for laying the sod. Topsoil shall be free of clumps, brush, sticks, weeds, stones, roots, trash or other objectionable material. Contractor shall ensure all topsoil to be free of plants or plant parts of Quackgrass, Johnson grass, nut sedge, poison ivy or other noxious weeds. Soil preparation shall not be performed in frozen or extremely wet conditions. The finished topsoil bed shall be uniform in grade, with a yard like appearance. All changes in grade shall have smooth, rounded peaks and valleys.
- C. The soil shall be scarified or otherwise loosened to a depth of not less than 5 inches and all clods shall be broken. The top 4 inches shall be worked into an acceptable smooth, friable and uniformly fine texture sod bed by use of soil pulverizes, drags, harrows or by other methods approved by the Engineer. Commercial grade fertilizer (8% Nitrogen, 8% Phosphate, 8% Potash) shall be applied at a rate of 20 pounds per 100 square feet, Super-Phosphate at 12 pounds per 1000 square feet and lime (Dolomite limestone containing not less than 85% total carbonates) shall be applied at a rate of 25 pounds per 1000 square feet or at a rate recommended for the type of sod being placed. Apply soil amendments within 24 hours after raking topsoil base surface and not more than 48 hours prior to laying sod. Mix thoroughly a minimum depth into the upper 4 inches of topsoil and lightly water to aid in dissipation. Sod placement shall not begin until the soil preparation is inspected and approved by the Engineer. During application of soil amendment fertilizer etc., adequate precautions shall be taken to prevent damage to existing features such as traffic, structures, landscape, trees, vegetation, utilities or any other appurtenances. The Contractor shall be required to repair or clean any damages.

1.04 PLACING SOD

- A. The Contractor and his landscape subcontractor shall coordinate the placing of the sod to begin within 24 hours after the topsoil base preparation is completed and accepted by the Engineer. Sod shall be brought to the site as near to the time of placing as possible. Store sod in the shade and keep watered particularly in extreme hot and dry condition to insure vitality and to prevent the dropping off of soil during handling. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing. Handling shall be done in a manner which will prevent tearing, breaking, drying or other damage. Carefully place sod in rows with the longer side perpendicular to slopes and the ends staggered in each successive row in a brick-like pattern. Butt the ends and sides together tightly and do not overlap or stretch the sod. Do not leave any voids or gaps.
- B. Ensure sod that abuts valve box covers, manhole covers and/or utility poles, walks, etc. is 1/4" below the edge of the structure to allow for positive drainage. Soil shall not dam up water adjacent to walks, etc. or exhibit ponding. Unavoidable gaps shall be closed with small pieces of torn or broken sod if kept moist and approved by the Engineer. After the sod is laid, irrigate thoroughly to allow water to penetrate a minimum 6 inches into the soil below the sod. Sod shall not be placed when the atmospheric temperature is below 32° F.
- C. Tamp and roll completed sod installation with a manual roller or approved equipment to eliminate minor irregularities and to form close contact with the soil bed immediately after placing and watering. The type of rolling and tamping equipment to be used shall be submitted to the Engineer for approval prior to construction. On steep slopes 3:1 (horizontal

and vertical) or greater, in drainage ditches or any areas where sod slipping may occur, anchor sod with approved wooden stakes (1/2"x 3/4" x 12") or staples spaced not over 2 feet apart in any direction and/or in sufficient number to prevent slippage or displacement. The anchors shall be driven flush with the surface of the sod. The wide flat side of the stake shall be driven parallel to the slope. Staking shall be done concurrently with sod placement and prior to tamping. Sod shall be laid with the long horizontal edge of the strips parallel to the contour starting at the bottom of the slope. The edge of the sod shall be turned slightly in the ground at the top of a slope and a layer of earth placed over it and compacted so as to conduct the surface water over and onto the top of the sod. Upon completion of the above-described work, the surface of the sodded areas shall coincide with the finished grade and not exceed 1/4" plus or minus variation to adjoining grade or proposed contour. Extreme care shall be taken to prevent the installed sod from being torn or displaced. Where sod is placed adjacent to travel way Contractor shall protect sod from vehicular or other shoulder traffic by roping off temporarily or providing other suitable means of protection until sod has set.

1.05 MAINTENANCE

- A. The Contractor shall, at no additional cost to the Owner, make whatever arrangements necessary to ensure an adequate supply of water to meet the needs of this Contract. The Contractor shall supply water of suitable quality and purity to sustain and encourage vigorous plant growth and supply all equipment for proper delivery and application to planted areas. Water obtained from PWC fire hydrant shall be metered and properly protected with an approved backflow prevention device. All costs for bulk water use where applicable shall be borne by the Contractor. PWC must inspect and approve any connections to their water system to include the proposed water application and storage equipment. The Contractor shall not use private resident's water. The Contractor is solely responsible to provide watering of the sod. The Engineer shall approve the method of application of water. Limit watering to early morning or late afternoon to enable the soil to absorb the maximum amount of water with limited runoff.
- B. Maintenance shall begin immediately after sodding operation. Contractor shall provide a written schedule to the Engineer of proposed maintenance methods and scheduled maintenance. The Contractor shall maintain all sodded areas until sod is firmly established and as outlined below. Maintenance will include watering, fertilizer, pest control, soil amendments, disease control, erosion repair, mowing, protecting turf area from traffic (i.e. temporary fences, barriers, signs, etc.) and replacement of any dead or damaged sod.
 - 1. Watering
 - a. Water lawn areas once a day with a minimum 1/2-inch water for the first 3 weeks after area sodded.
 - b. After the 3-week period, water twice a week with a 3/4-inch of water each time unless a comparable amount of rainfall has occurred.
 - c. Make weekly inspections to determine moisture content of soil and supplement the above watering schedule as needed.
 - d. Excessive runoff, puddling, and wilting shall be prevented.
 - 2. Fertilizer and Pest Control
 - a. Evenly spread fertilizer composite at a rate of 40 pounds per 5000 square feet or as recommended by the manufacturer. Fertilizer shall not be applied until 2 weeks after initial placement of the sod or prior to the advent of winter
 - b. Treat areas of weed and insect infestation as recommended by the treatment manufacturer.
 - 3. Mowing
 - a. The Contractor shall do mowing operations, (in yards not being mowed by residents) until provisional acceptance.

- b. Mowing shall be done only when the grass is dry with a rotary type mower having a blade height set not lower than 1 1/2 inches nor higher than 3 inches.
- c. Mowing operations shall be conducted at intervals, which ensure grass height does not exceed 4 inches between mowing.
- d. The Contractor shall complete at least one mowing operation before the work will be considered for provisional acceptance.
- e. The Contractor shall protect and not allow access of vehicular traffic into any newly sodded areas and shall repair any damaged turf to original grade. Maintenance shall continue for a period of one (1) year after placement or until provisional acceptance by the Engineer. A written record shall be furnished to the Engineer of the maintenance work performed. At least two weeks shall elapse after chemical control is applied before a request of inspection.

1.06 ACCEPTANCE

- A. Fifteen (15) days prior to the end of the one (1) year maintenance period, the Contractor shall make written request to the Engineer for an inspection and provisional acceptance of the sod. Failure to notify the Engineer will not relieve the Contractor of the maintenance provisions required and the Contractor will continue to be responsible for the maintenance of the sod.
- B. Replacement of dead sod shall be performed within 7 days after notification by the Engineer and the maintenance period for these areas or individual lawns shall be extended for the 90-day maintenance period. Failure to replace dead sod within the specified 7-day period will result in the Owner having the work performed and deducting the cost from the Contract, however, the Contractor shall be responsible for the maintenance and if necessary replacement of sod.
- C. Final acceptance will be given upon satisfactory contract performance exhibited at final inspection and acceptance. Sodded areas are to be fully rooted prior to acceptance. The Engineer shall be the sole judge as to whether or not the lawns are acceptable. Should any deficiencies be disclosed at final inspection, the Contractor shall make the necessary corrections in a timely manner and request re-inspection.
- D. After the completion of the project, the Contractor will provide a warranty letter for one (1) year.

1.07 GUARANTEE

- A. The Contractor shall guarantee a dense, vigorous stand of turf free of weeds, disease, pests or any dead areas more than one half of a square foot in size for a period of one (1) year from initial placement or replacement whichever is greater. Total dead area shall not exceed 1% of total square footage for each individual resident's lawn.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

Pay Item
Sod

Pay Unit
SY

END OF SECTION 02931

SECTION 02950

TREES, PLANTS, AND GROUND COVER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of soil.
- B. Topsoil bedding.
- C. Relocation of trees, plants and ground cover.
- D. Mulch and fertilizer.
- E. Maintenance.
- F. Tree Pruning.
- G. Determination of Measurement: Measurement shall be for each unit.
- H. Basis of Payment: Payment will be at the contract unit price per each unit installed.

1.02 REFERENCES

- A. ANSI Z60.1 - Nursery Stock.
- B. NAA (National Arborist Association) - Pruning Standards for Shade Trees.

1.03 DEFINITIONS

- A. Weeds: Any plant life not specified or scheduled.
- B. Plants: Living trees, plants, and ground cover specified in this Section [, and described in ANSI Z60.1].

1.04 SUBMITTALS - PROJECT CLOSEOUT

- A. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.
- B. Submit list of plant life sources.

1.05 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years' experience.
- B. Installer Qualifications: Company registered and specializing in installing and planting the plants with 3 years' experience.
- C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.
- D. Tree Pruning: NAA - Pruning Standards for Shade Trees.
- E. Maintenance Services: Performed by installer.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Plant Materials: Certified by state department of agriculture. Described by ANSI Z60.1, free of disease or hazardous insects.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

- B. Protect and maintain plant life until planted.
- C. Deliver plant life materials immediately prior to placement. Keep plants moist.
- 1.08 COORDINATION
 - A. Install plant life after and coordinate with installation of underground irrigation system piping and watering heads specified in Section 02810.
- 1.09 WARRANTY
 - A. Provide one year warranty.
 - B. Warranty: Includes coverage for one continuous growing season; replace dead or unhealthy plants.
 - C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.
- 1.10 MAINTENANCE SERVICE
 - A. Maintain plant life for 12 months after Date of Substantial Completion.
 - B. Maintain plant life immediately after placement until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.
 - C. Maintenance to include:
 - 1. Cultivation and weeding plant beds and tree pits.
 - 2. Applying herbicides for weed control in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
 - 3. Remedy damage from use of insecticides.
 - 4. Irrigating sufficient to saturate root system.
 - 5. Pruning, including removal of dead or broken branches, and treatment of pruned areas or other wounds.
 - 6. Disease control.
 - 7. Maintaining wrapping, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.
 - 8. Replacement of mulch.

PART 2 PRODUCTS

2.01 TREES, PLANTS, AND GROUND COVER

- A. Trees, plants and ground cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.02 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, capable of sustaining vigorous plant growth; free of subsoil, clay or impurities, plants, weeds and roots

2.03 SOIL AMENDMENT MATERIALS

- A. Fertilizer: Nitrogen 5 percent, phosphoric acid 10 percent, soluble potash 5 percent.
- B. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.
- C. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of plants.

2.04 MULCH MATERIALS

- A. Mulching Material: Hardwood mulch.

2.05 ACCESSORIES

- A. Wrapping Materials: Burlap.
- B. Stakes: Softwood lumber w/ pointed end. Mild steel angle, galvanized, pointed end.
- C. Cable, Wire, Eye Bolts [and Turnbuckles]: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.
- D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches.

PART 3 EXECUTION

3.01 WORK

- A. Preparation of subgrade and topsoil, placing soils, planting, watering and maintenance.

3.02 EXAMINATION

- A. Verify that prepared subsoil is ready to receive work
- B. Saturate soil with water to test drainage.
- C. Verify that required underground utilities are available, in proper location, and ready for use.

3.03 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas. Maintain 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 subsoil.
- C. Scarify subsoil to a depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- D. Dig pits and beds 6 inches larger than plant root system.

3.04 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.
- B. Place topsoil during dry weather and on dry unfrozen sub-grade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.

3.05 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches of topsoil.
- D. Lightly water to aid the dissipation of fertilizer.

3.06 PLANTING

- A. Place plants for best appearance for review and final orientation by Architect/Engineer.
- B. Set plants vertical.
- C. Remove non-biodegradable root containers.
- D. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth as indicated on drawings under each plant. Loosen burlap, ropes, and wires, from the root ball.

- E. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch lifts. Maintain plant life in vertical position.
- F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.07 PLANT RELOCATION AND RE-PLANTING

- A. Relocate plants as directed by Engineer.
- B. Re-plant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth as indicated on drawings under each plant. Loosen burlap, ropes, and wires, from the root ball.
- C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch layers. Maintain plant materials in vertical position.
- D. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.08 FIELD QUALITY CONTROL

- A. Field inspection and testing.
- B. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.09 MAINTENANCE

- A. Neatly trim plants where necessary.
- B. Immediately remove clippings after trimming.
- C. Water to prevent soil from drying out.
- D. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- E. Apply pesticides in accordance with manufacturer's instructions.

Pay Item

Trees, Plants and Ground Cover

Pay Unit

EA

END OF SECTION 02950

SECTION 02951

SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.
 - 1. Work specified in this section:
 - a. Preparation and placement of topsoil. Seeding required within 24 hours after preparation.
 - b. Initial maintenance of all planting.
- B. Measurement: Per acre seeded.
- C. Basis for Payment: Payment shall be on a contract unit price per acre that is seeded.

1.02 SUBMITTALS

- A. Construction sequence and time schedule.
- B. Soil additives and mulch materials.
- C. Fertilizers, sterilants, herbicides.
- D. Monthly maintenance record: List all herbicides, insecticides, and disease control chemicals used; list a corrective action or replacement of work performed.
- E. Suggested maintenance plan for maintenance by City to include chemical recommendations, amount of watering and all other proper care necessary to assure quality plant growth.
- F. All other materials: Manufacturer and the product designation.

1.03 MAINTENANCE

- A. The Maintenance Period shall extend for a period of one (1) year dating from final inspection.
- B. Maintenance requirements:
 - 1. Maintenance shall include mowing, watering, weeding, leaf raking, fertilizing, and all other care dictated by the standard of the best horticultural practices. (In the event the irrigation system is inoperable or in the absence of such system, it shall be the responsibility of the landscape Contractor to supply sufficient watering from the beginning of planting through the one (1) year warranty period at no additional cost to the City).
 - 2. Maintain all seeded areas from the time of installation until final acceptance of the entire work.
 - 3. Keep all seeded areas clean and free of weeds, rubbish, and debris at all times.
 - 4. Seeded areas shall be protected at all times against trespassing and damage of all kinds for the duration of the maintenance period. If any areas become damaged or injured, they shall be treated or replaced as directed by the City at no additional cost to the City.
- C. Final inspection and acceptance:
 - 1. Prior to request for final inspection, Contractor shall again thoroughly clean all seeded areas.
 - 2. Final inspection will be made upon request and upon notification that Maintenance Period has ended.

3. Acceptance will be given upon satisfactory findings in the final inspection or upon satisfactory correction of any deficiencies disclosed by the final inspection.

1.04 REGULATORY REQUIREMENTS

- A. City Contract Policies

1.05 COORDINATION

- A. Coordinate with installation of irrigation system.
- B. Coordinate with all earth work and site work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Substitutions for any materials will not be permitted unless authorized in writing by the City.
- B. Topsoil:
 1. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality. The topsoil shall be stripped so that there is no admixture of subsoil and shall be free from clay clumps, stones, roots, or similar substances two inches or more in diameter, debris, or other objects which might be a hindrance to planting operations. The City reserves the right to reject topsoil in which more than 60 percent of the materials passing V.S.S. #100 sieve consist of clay as determined by the Bonyoucou Hydrometer by the dried weights of the materials.
- C. Soil Additives:
 1. Manure: Well-rotted, unleached, sterilized stable manure which is free of wood shavings, sawdust, or other undesirable litter and contains no chemical or other ingredients harmful to plants and shall not be less than 9 months old and not more than 2 years.
 2. Peat: Domestic product consisting of partially decomposed vegetable matter of natural occurrence. It shall be brown, clean, and low in content of mineral and wood material, mildly acid, and granulated or shredded.
 3. Lime: Shall be ground limestone (Dolomite) containing not less than 85 percent of total carbonates and shall be ground to such a fineness that 50 percent will pass through a 100-mesh sieve and 90 percent will pass through a 20-mesh sieve. Coarser material will be acceptable, provided the specified rates or application are increased proportionately on the basis of quantities passing through the 100-mesh sieve.
 4. Fertilizer:
 - a. Turf Areas, Ground Covers, and Flowers shall be a controlled release formula and shall conform to the applicable State Board of Agriculture fertilizer laws. It shall be uniform in composition, dry and free-flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which has become caked or otherwise damaged making it unsuitable for use will not be acceptable.
 - b. All fertilizer and soil conditioners shall be first quality, standard brand agricultural products.
- D. Mulch: Use grain straw as mulch at any time of the year. If permission to use material other than grain straw is requested and the use of such material is approved by the Engineer, the season limitations, the methods and rates of application, the type of binding material or other conditions governing the use of such material will be established by the Engineer at the time of approval. Apply mulch within 24 hours of seeding unless otherwise permitted. Spread mulch uniformly by hand or by approved mechanical spreader or blower.

- E. Plant Materials: Certificates of inspection shall accompany the invoice for each shipment of seeds as may be required by laws for transportation. File certificates with the City prior to acceptance of the material.

2.02 SOURCE QUALITY CONTROL AND TESTS

- A. Testing and Inspection: Within ten days following acceptance of the bid, the City shall be notified of the sources of the materials required, desired to be inspected or tested.
- B. Testing:
 - 1. Topsoil: All new loam or stripped topsoil used in the work of this section of the specifications shall be tested and approved for use by the Engineer prior to being spread. Stripped material may be used if approved and shall be stockpiled so as not to interfere with the other work or with other subgrade or fill materials.
 - 2. Testing other than soil testing shall be paid for by the City if the City deems the testing necessary.
- C. Inspections:
 - 1. All areas to be planted shall be inspected by the Planting Contractor before starting work. Any defects, such as incorrect grading, etc., shall be reported to the City prior to beginning this work. The commencement of work by the Contractor shall indicate his acceptance of the areas to be planted, and he shall assume full responsibility for the work of this Section.
 - 2. During construction and installation, onsite inspections by the City will be made periodically to ensure proper implementation of design. The City retains the right to accept or reject any material or other incidentals needed to complete the project in whole or part and also may stop all work until all discrepancies are resolved.
 - 3. Any work scheduled beyond normal working hours or on weekends, shall be brought to the attention of the City Inspector for approval. Any work accomplished during these hours and in question will be subject to being done over at the request of the City, at no additional cost to the City.
 - 4. The City will inspect topsoil to be used to determine whether or not it meets the requirements specified.
 - 5. City representative shall be present during the application of post emergent sterilization.
 - 6. After completion of project, Contractor will provide a one (1) year warranty letter.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Work: Shall include the full width of the disturbed area for the cleanup and seeding. Work shall include, but not be limited to, the following:
 - 1. Removal and proper disposal of debris and excess material.
 - 2. Grade disturbed areas to original or proposed surface profile.
 - 3. Cleaning of paved surfaces.
 - 4. Proper seeding, fertilizing, mulching and other incidentals necessary to properly seed project area.
- B. Soil Preparation:
 - 1. Add any amendments necessary to bring topsoil up to City Standards.
 - 2. All topsoil must be approved by Engineer.
 - 3. Coordinate with irrigation work, if any, to assure all lines have been installed prior to placement of topsoil or any other preparation for planting areas.
 - 4. Rough grades for planting areas have been left 8-12 inches below adjacent paving and/or curbing under work of General Contractor. (Landscape Contractor should plan to provide soil and labor to backfill curbing and sidewalk and should coordinate the

work with the general Contractor as his work progresses. It shall be the responsibility of the Landscape Contractor to provide the specified grade for planting areas -- City will not be responsible for any excavation needed to acquire desired depth.)

5. Debris removal: In all seeding areas, remove and dispose of all wire, rubbish, debris, concrete waste, base rock, or other plant materials which might hinder soil preparation, grading, seeding, or subsequent maintenance. Rake to smooth soil.
 6. Scarify existing earthwork: Soil in all on-grade paling areas shall be ripped or cultivated to depth of 10 inches. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed to the specified depth and shall be removed from the site.
 7. Place approved topsoil at grade in seeding areas.
 8. Rake soil smooth to finished grade, pitched evenly for drainage. Round all changes in gradient and eliminate all depressions where water will pool.
 9. Water areas to settle soil. After drying, correct low spots, irregularities, and reestablish finished grade.
- C. Finished Grading: When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all planting areas shall be smooth graded, ready for placement of plant materials and for seeding and/or sodding.
- D. Seeded Lawn Areas:
1. General:
 - a. Once site is prepped with lime and fertilizer, it shall be seeded within a 24 hour period.
 - b. Seed all lawn areas not covered by sod or other planting areas within scope of construction.
 - c. After the areas have been loosened, conditioned, and finish graded as previously specified, they shall be hand raked to remove all clods, weeds, roots, debris and rocks 1 inch in diameter and larger.
 - d. Final grades shall be approved by the City prior to seeding.
 - e. After final grading has been accepted, no heavy equipment (except lawn rollers) will be allowed onto planting surfaces. Any damaged areas will be prepared using previous method.
 - f. De-thatching shall be done in areas not requiring topsoil and grading work and in areas where existing lawn will be top seeded. Use a motor driven de-thatcher to remove all thatch buildup and loosen all areas to be seeded. Area should be hand raked and all debris promptly removed. All seeding shall take place within 24 hours following dethatching. City shall approve all areas for seeding prior to doing so.
 2. Seed Selection:
 - a. Seed quantities and mixtures as specified on drawings.
 - b. Provide seed complying with the official seed analysis of North America with respect to purity and germination percentages.
 - c. Seed should be newly packaged seed (not greater than one year) and should arrive at the job site in the original container. City retains the right to inspect seed specification tag remaining intact on container.
 - d. Do not use any seed that has been dampened, moldy, or suffered any other damage in transit or storage.

3. Seed Schedule

COMMON NAME	MIN SEED PURITY	MIN GERMINATION	MAX WEED SEED
Bermuda	90%		1.00%
Fescue tall, (Ky, 31)	98%		1.00%
Wheat	98%	MIN 90%	0.10%
German Millet	98%	MIN 90%	0.10%

POUNDS PER ACRE				
	K-31 Fescue	German Millet	Bermuda Hulled	Bermuda Unhulled
March 15 – Sept 15	100	25	25	--
	K-31 Fescue	Wheat	Bermuda Hulled	Bermuda Unhulled
Sept 15 – March 15	100	30		30

4. Once the seed is applied, the area shall be very lightly raked, either by hand or by mechanical means. All road right-of-ways and/or private grounds shall also be reseeded or sodded with the same type of grass previously found. The seed mixture specifications shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.
5. All seeded areas will be mulched with 4000 pounds per acre of small grain straw spread uniformly. Approximately 1/4 of the ground should be visible to avoid smothering seedlings. Asphalt emulsion may be used to anchor the straw applied at 150 gal/ton of straw. If asphalt emulsion is used, the Contractor shall not deface buildings, curbs or plantings with asphalt materials. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage which may occur.

3.02 CLEANING

- A. Any soil or similar material which has been brought into paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all times.
- B. Upon completion of work under this section, all excess stones, debris, and soil resulting from work under this section which have not previously been cleaned up shall be cleaned up and removed from the project site.
- C. All pavements shall be broomed and hosed clean.

3.03 CONTRACT CLOSEOUT

- A. Final Inspection:
 1. Prior to requesting final inspection, Contractor shall have completed all of the work of seeding. All seeding areas shall be cleaned of all rubbish and debris, all adjacent pavement or surfaces shall be clean, and entire work shall be neat and presentable.
 2. The final inspection will be made upon request and upon notification that all work installation is completed.
 3. Approval will be given upon satisfactory findings in the final inspection or upon satisfactory correction of any deficiencies disclosed by the final inspection.

PAY ITEM:

Seeding

PAY UNIT:

AC

END OF SECTION 02951

SECTION 04000

MASONRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

- A. Mortar
- B. Brick masonry
- C. Cast Stone
- D. Unit pavers

1.03 QUALITY ASSURANCE

- A. All products and execution shall conform to applicable standards and specifications published by the following:
 - 1. The American Society for Testing and Materials (ASTM)
 - 2. American National Standards Institute (ANSI)
 - 3. National Concrete Masonry Institute (NCMA)
 - 4. Structural Clay Products Institute (SPCI)
 - 5. Underwriters Laboratories, Inc. (UL)

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and other data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Include instructions for handling, storage installations and protections.

1.05 JOB CONDITIONS

- A. Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1.06 COLD WEATHER PROTECTION

- A. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
- B. Remove all masonry determined to be frozen or damaged by freezing conditions.
- C. Perform the following construction procedures while the work is progressing:
 - 1. When air temperature is from 40 degrees F (4 degrees C) to 32 Degrees F (0 degrees C), heat sand or mixing water to produce mortar temperatures between 40 degrees F (4 degrees C) and 120 degrees F (49 degrees C)
 - 2. Do not lay masonry when the temperature of the surrounding air is 32 degrees F (0 degrees C) and falling.

- D. Perform the following protections for completed masonry and masonry not being worked on:
1. When the mean daily air temperature is from 40 degrees F (4 degrees C) to 32 degrees F (0 degrees C), protect masonry from rain or snow for at least 24 hours by covering with weather resistive membrane.
 2. When mean daily air temperature is from 32 degrees F (0 degrees C) to 25 degrees F (-4 degrees C), completely cover masonry with weather-resistive membrane for at least 24 hours.
 3. When mean daily air temperature is from 25 degrees F (-4 degrees C) to 20 degrees C) completely cover masonry with insulating blankets or similar protection for at least 24 hours.
 4. When mean daily temperature is 20 degrees F (-7 degrees C) and below, maintain masonry temperature above 32 degrees F (0 degrees C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other acceptable methods.

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

- A. Portland Cement: ASTM C150, Type I. Provide natural color or white cement as required to produce the required mortar color.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregates: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
- D. Mortar Color: Supply mortar color with fast-color, mineral pigments to produce color of mortar selected by architect.
- E. Water: Clean, free of deleterious materials which would impair strength or bond.

2.02 CAST STONE

- A. Ornamental Ball: Ornamental Ball shall be design PC-3/12, 12" diameter without pier cap, S-15 color, SK finish, as manufactured by Dura Art Stone, Conley Georgia or approved equal.
- B. Balustrade: Balustrade shall consist of the following components, all of which manufactured by Dura Art Stone of Georgia:
 1. Base Rails shall be BR4, 8' sections with appropriate end sections. Provide with dowels for anchoring to bridge deck. Fabricated for equal baluster spacing of approximately 8.4".
 2. Baluster shall be RB2, round, spaced approximately 8.4" on center. Provide with dowels for anchoring to base rails and gap rails. Provide half balusters each side of intermediate piers and inside of end piers. Balusters shall be 31" high.
 3. Piers: Intermediate piers shall be 12" straight, provincial. End piers shall be 7" end, provincial.
 4. Cap Rail shall be CR4, 8' sections with appropriate end sections. Fabricate for equal baluster spacing of approximately 8.4".

5. Keystone for arch shall be fabricated according to dimensions on details. Composition, color, and finish shall match other cast stonework. Cast dowels into keystone for anchoring into brick arch.
6. System Design: Balustrade system shall be designed by the manufacturer. Submit drawings showing complete elevation, spacing of balusters, piers, and details for installation. Color for all components shall be S-15 (silica white), finish shall be SK (sharked smooth).

2.03 UNIT PAVERS

- A. Solid concrete interlocking paving stones: ASTM C936-82 paving stones shall be Holland Stone as manufactured by Metromont Materials, Spartanburg, South Carolina or approved equal. Paving stones shall be 2 3/8" x 4" x 8" with hidden spacer and meet the following physical requirements:
 1. Compression Strength- At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit strength less than 7,200 psi with testing procedures in accordance with ASTM Standard C-140.
 2. Absorption- The average absorption shall not be greater than five percent (5%) with no individual unit absorption greater than seven percent (7%).
 3. Proven Field Performance – Satisfying field performance is indicated with units similar in composition and made with the same manufacturing equipment as those to be supplied to the purchaser, do not exhibit objectionable deterioration after at least one (1) year.
 4. All units shall be manufactured with a separate surfaced hardened mix to ensure consistent texture and concentration of color on the wearing surface.
- B. Visual Inspection
 1. All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength of performance of the construction. Minor cracks incidental to the usual methods of manufacture, or minor chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
- C. Sampling and Testing
 1. The purchaser or his authorized representative shall be accorded facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.
 2. Sample and test units in accordance with ASTM Methods C-140.
- D. Rejection
 1. In case the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the purchaser from the retained lot and tested at the expense of the manufacturer. In case the second set of test unit fails to confirm to the specified requirements, the entire lot shall be rejected.
- E. Expense of Tests
 1. The expense of inspection and testing shall be borne by the purchaser unless otherwise agreed.

F. Sand Laying Course

1. The sand laying course shall be a well graded, clean washed sharp sand with 100% passing 3/8" sieve size and a maximum of 3% passing a No. 200 sieve size. This is commonly known as manufactured concrete sand, river sand, granite screenings, or similar. DO NOT USE MASON SAND.
2. Bedding sand to conform to ASTM C-33 – The sand-laying course should be the responsibility of the paving stone installer.

PART 3 EXECUTION

3.01 MORTARED BRICK MASONRY

- A. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents.
- B. Do not use calcium chloride in mortar by use of admixtures or antifreeze agents.
 1. Type M: ¼ part lime per part of Portland cement.
 2. Type S: Over ¼ up to ½ part lime per part Portland cement.
- C. Thickness: Build masonry construction to the full thickness shown, except, build single-width walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.
- D. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible.
- E. Do not wet concrete masonry units.
- F. Frozen Materials and Work: Do not use frozen materials or materials mixed or coated with ice or frost. For masonry, which is specified to be wetted, comply with BIA recommendations. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
- G. Lay-up walls plumb and true and courses level accurately spaced and coordinated with other work.
- H. Stopping and Resuming Work: Rack back ½-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted) and removed loose masonry units and mortar prior to laying fresh masonry.
- I. Mortar Bedding and Jointing:
 1. Use Type M mortar for masonry below grade and in contact with earth, interior and exterior load bearing walls.
 2. Use Type S mortar for exterior above grade and in contact with earth, interior and exterior load bearing walls.
 3. Measure and batch materials either by volume or weight, such that the required proportions for mortar can be accurately controlled and maintained. Measurement of sand exclusively by shovel will not be permitted.
 4. Mix mortars with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.
 5. Mix mortar ingredients for a minimum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.

6. Mix mortar ingredients of a minimum of 5-minutes in a mechanical batch mixer. Use water clean and free of deleterious materials, which would impair the work. Do not use mortar, which has begun to set, or if more than 2 ½ hours has elapsed since initial mixing. Re-temper mortar during 2 ½ hour period as required to restore workability.
7. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also, bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns, and pilasters, and where adjacent to cells, or cavities to be reinforced or to be filled with concrete or grout.
8. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials.
9. Remove masonry units disturbed after laying, clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.
10. Formwork for Supporting Reinforced Masonry: Construct formwork to fully support reinforced arch for its entire length. Tolerance for formwork shall be 1/8" true to radius, 1/16" true to level. Leave formwork in place for 14 days after erection.

3.02 CAST STONE

- A. Cast stone shall be constructed per manufacturer's recommendations. Drawings and recommendations shall be submitted for review prior to beginning of construction. Joints shall be ½", slightly concave, color to match cast stone. Base rails and bridge shall be drilled and dowelled and grouted securely.

3.03 UNIT PAVERS

- A. The paving stone installer/contractor must have related experience in the installation of interlocking concrete paving stones.
- B. Base Course Preparation
 1. A suitable base must be prepared as detailed in other sections of the project specifications.
 2. The base course shall be shaped to grade and cross section with an allowable tolerance of 1.4" (5mm).
 3. The compacted base thickness is as follows: Patios, sidewalk, pool decks, and other designated areas for pedestrian walkways shall be at least 4" (100mm) on well drained soils. For other areas such as driveways, receiving wheeled traffic loads, a minimum of 6" (150mm) base thickness is required. A minimum of 8" (200mm) base thickness is required on low volume residential street application. Heavier traffic loads shall require a layer of Geotextile fabric or Geogrids as needed. Reference Tables 1 and 2 of National Concrete Masonry Association's TEK 87-A for minimum physical requirements for Soil Separation Geotextile or Base Reinforcement Geogrids.

C. Construction of the Sand Laying Course

1. The finished base course shall be approved before the placement of the sand-laying course.
2. The uncompacted sand-laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce 1" (25mm) thickness when the paving stones have been placed. Normally, it is good practice to have final elevation of paving stones slightly higher than adjacent curb, gutter, other paving, to allow for any minor settling that may occur within the base. Maximum bedding sand thickness shall not exceed 1 ½".
3. Once screeded and leveled to the desired elevation, this sand laying course shall not be disturbed in any way.

D. Laying of Concrete Paving Stones

1. The paving stones shall be laid in the approved pattern as noted or shown on the drawings. Layering pattern shall be Runner bond.
2. The paving stones shall be laid in such a manner that the desired pattern is maintained and the joints between the stones are as tight as possible. Joints between stones shall not exceed 1/8" (3mm).
3. String lines should be used to hold all pattern lines true.
4. The gaps at the ends of the paver surface be filled with standard edge stone or with stones cut to fit. Cutting shall be accomplished to leave clean edge to the traffic surface using a masonry saw. Whenever possible, no cuts should result with a paver less than 1/3 of original dimension.
5. Paving stones shall be vibrated into the sand-laying course using a vibrator capable of 3,000 to 5,000 pounds of compaction force with the surface clean and joints open. At least two passes with the vibrator should be made across the surface.
6. After vibration, clean masonry type sand containing at least 30% of the 1/8" (3mm) particles shall be spread over the paving stones surface, allowed to dry, and vibrated into joints with additional vibrator passes and brushing so as to completely fill joints. Sweep sand to meet ASTM C-144.
7. Surplus materials shall then be swept from the surface or left on surface during construction time to ensure complete filling of joints during initial use. This sand also may provide surface protection from construction debris.
8. Do not vibrate within three feet of unrestrained edge. All work within three feet of the laying face must be fully compacted edge of the laying face and sand with a waterproof coverage. Sweep off excess sand when the job is complete.
9. Upon completion of work covered in the Section, the Contractor shall cleanup all work areas by removing all debris, surplus material, and equipment from the site.
10. Cleaning- all dirt, grime, and fresh oil and grease shall be removed from the concrete paver surface prior to job being complete. Spray or brush cleaner onto paver surface and then rinse away with clean, potable water. Flammable ingredients or acids are not to be used. Use Addiment Dirt and Grim Remover, or Addiment Efflorescence Remover and General Cleaner, or approved equal.

11. Sealers- No sealer shall be applied until after a thorough cleaning of paver surface. Sealer shall be sprayed or rolled onto clean, dry surface, using Addiment Paver Seal - WB, or approved equal.

PAY ITEM

PAY UNIT

MASONRY - PAVERS

SY

MASONRY – RETAINING WALL

LF

END OF SECTION 04000