Standard Construction Specifications

For

SJWD Water District Lyman, South Carolina

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SECTION 01090 REFERENCE STANDARDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Throughout the Project Documents, reference is made to specifications and standards issued by nationally recognized professional and/or trade organizations.
 - 1. These referenced standards are generally identified by abbreviating the name of the organization following with the specification/standard number.
 - 2. Unless specifically indicated otherwise, all reference to standards refer to the latest edition available at the time of the bidding.
- **A.** Wherever the following abbreviations are used in these Project Documents, they are to be construed the same as the respective expressions represented:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ALS	American Lumber Standards
ANSI	American National Standards Institute, Inc.
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
AWPA	American Wood Preservers Association
AWS	American Welding Society
FSS	Federal Specifications and Standards, General Services Administration
IBC	International Building Code
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
NSF	Formerly: National Sanitary Foundation
OSHA	Occupational Safety and Health Administration
SPIB	Southern Pine Inspection Bureau
SSPC	Steel Structures Painting Council

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION

REFERENCE STANDARDS 01090-1

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REFERENCE STANDARDS 01090-1

SECTION 02110

CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Remove trees, underbrush, undesirable growth, stumps, roots, etc., from the area to the limits shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 02260 Erosion and Sediment Control.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.
- C. Comply with requirements of governmental agencies having jurisdiction.

PART 2 – PRODUCTS

No products are required for this work.

PART 3 – EXECUTION

3.1 AREA INCLUDED

A. All roadway right of ways affected by the project and any other areas as indicated on the Drawings.

B. In highway or other utility rights of way, include only the area necessary for construction of the proposed upgrades/improvements.

3.2 PROTECTION

- A. The Contractor shall protect all areas outside the designated construction zones. These areas shall not be used for site access, vehicle parking, or stockpiling of soil or construction materials.
- B. The Contractor shall protect any tees within the designated construction zones that have been marked by the landowner for preservation. The Contractor shall not park vehicles or stockpile soil or construction materials within the drip line of these trees.
- C. Contractor shall protect trees outside the construction zone whose drip line extends into the construction zone. The Contractor shall not park vehicles or stockpile soil or construction materials within the drip line of these trees.

3.3 PROCEDURES

- A. Site Walkthrough: Following the layout of the construction work the Contractor and Owner shall walk through the site to identify potential conflicts with the project requirements.
- B. Clearing and grubbing: The entire area within the limit lines described above shall be cleared and grubbed. Remove all incidental vegetation, trees, brush, stumps, etc., from the area. All debris from this operation shall be disposed of off the Owner's property or right-of-way. There will be no burning of debris allowed.
- C. Selective clearing shall be done in areas where directed by the Owner or Engineer. Selective clearing shall consist of removing vegetation, brush, stumps, etc. from the area. Selected trees shall be left standing and care shall be taken not to damage trees to be left. All debris from this operation shall be disposed of off the Owner's property right-of-way. Grubbing will not be required in areas designated for selective clearing.
- D. Removal of trees and shrubs: All trees to be removed shall be felled in such a manner as to avoid injury to remaining trees and to other features not proposed for removal. Trees shall be cut up and the trunks, limbs, and other debris shall be removed from the site. Undesirable shrubs and small trees shall be selectively removed as directed.

- E. Stumps and roots: All stumps and roots larger than 2" in diameter shall be completely removed by grubbing except in areas of building site, parking areas and drives; they may be cut off not less than 18" below any subgrade. The area of operation then shall be cleared of resulting debris and matted roots, weeds and other extraneous matter and such shall be hauled away from the site. Generally, all material that cannot be compacted to 95% of maximum density in lawn areas and 95% of maximum density elsewhere shall be removed.
- F. Erosion control: Install and maintain erosion control facilities in accordance with the Drawings and Specifications.

END OF SECTION

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SECTION 02221

TRENCHING, BACKFILLING FOR UTILTIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work Included: Trench, backfill, and compact as specified herein and as needed for installation of underground utilities associated with the Work.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division I of these Specifications.
 - 2. Section 02660 Water Distribution System

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.3 JOB CONDITIONS

- A. Existing Utilities:
 - 1. There now exists in the construction areas, waterworks, storm drainage, sanitary sewers, street paving, gas mains and other utilities.
 - 2. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures are not shown.
 - 3. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.
 - 4. Locate, excavate, and expose all existing underground lines in advance of trenching operations.

- 5. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of his work under this Section.
- 6. The Contractor shall familiarize himself with the existing conditions and be prepared to adequately care for and safeguard himself and the Owner from damage.
- B. Notification of intent to excavate:
 - South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - 2. Notification of intent to excavate may be given by calling this toll-free number: 1-888-721-7877 or 811.
- C. Protecting trees, shrubbery, and lawns:
 - 1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless necessary, and subject to the approval of the Engineer.
 - a. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.
 - 2. Where trenches cross private property through established lawns, sod shall be cut removed, stacked, and maintained in suitable condition until replacement is approved by the Engineer.
 - a. Topsoil underlying lawn areas shall be removed and kept separate from general excavated materials.
- D. Clearing:
 - 1. Perform all clearing necessary for installation of the complete work.
 - 2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the work.

- 3. All timber of merchantable size shall remain the property of the Owner and shall be trimmed and cut in such lengths as directed and stacked along the edge of the right-of-way.
- 4. All other material, including trimmings from above, shall be completely disposed of in a satisfactory manner.
- E. Removing and resetting fences:
 - 1. Where existing fences must be removed to permit construction of utilities:
 - a. Remove such fences and, as the work progresses, reset the fences in their original location and condition.
 - b. Provide temporary fencing or other safeguards as required to prevent stock and cattle from wandering to other lands.
- F. Restoration of disturbed areas:
 - 1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 - a. For existing areas with sod type grasses, replace with new sod. Existing sod may be reused where properly removed and stored.
 - 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.
- G. Minimizing silting and bank erosion during construction:
 - 1. During construction, protective measures shall be taken and maintained to minimize silting and bank erosion of creeks and rivers adjacent to the work being performed during construction.
- H. Blasting:
 - 1. Store all explosives in a secure manner, complying with all laws, ordinances, and regulations.
 - 2. Contractor shall be responsible for damage caused by blasting operations.

PART 2 – PRODUCTS

2.1 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

2.2 BACKFILL MATERIALS

- A. Provide from materials excavated for installation of utility.
 - 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in greatest dimension for backfill up to 12" above top of utility being covered.
 - 2. Do not permit rocks larger than 2" in greatest dimension in top 6" of backfill.

2.3 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, provide suitable borrow material as approved by the Engineer at no additional expense to the Owner.
- C. Provide select materials from on-site if acceptable material as approved by the Engineer is available on-site. Otherwise, provide approved select material from an off-site source.

PART 3 – EXECUTION

3.1 PROCEDURES

- A. Existing utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted because of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer, and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the engineer.
- B. Locations within streets or highways:
 - 1. Comply with South Carolina Department of Transportation's (SCDOT) "Encroachment Permit" issued for the Work, and the South Carolina Department of Transportation's (SCDOT) "A Policy for Accommodating Utilities on Highway Rights-of-Way".
 - 2. Take all precautions and comply with all requirements as may be necessary to protect the improvements, including barricades for protection of traffic.
 - 3. Keep a minimum of one lane open to traffic at all times where utility crosses street or highway.
- C. Protection of persons and property:
 - 1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.

- 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
- 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.
- D. Dewatering:
 - 1. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.
 - 2. Maintain the ground water level a minimum of 3-feet below the trench bottom during excavation, installation, and backfilling.
 - a. Material disturbed below the invert elevation due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 - b. Use sumps, pumps, drains, trenching, wells, vacuum or well point system as necessary to maintain the ground water level a minimum of 3-feet below the trench bottom and maintain a dry excavation.
 - c. Dewatering by trench pumping will not be permitted if migration of fine-grained natural material (running sand) from bottom, side walls or bedding material will occur.
 - d. Provide monitoring wells sufficient in size, location, number, and depth to monitor the ground water level in the construction area during excavation and backfill operations.
 - e. Maintain dewatering operations until backfilling and compaction operations are complete.
 - 3. Dispose of water pumped from excavations in storm drains having capacity, canals, trenches, or other approved locations.
 - a. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.

- b. Prevent flooding of streets, roadways, or private property.
- c. Provide engines driving dewatering pumps with residential type mufflers.
- E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- F. Always maintain access to adjacent areas.

3.2 TRENCH EXCAVATION (Classified)

- A. Remove all materials of whatever substance encountered, additional payment to be made for rock excavation as hereinafter defined and specified.
 - 1. Rock excavation to consist of the removal and disposal of the following materials:
 - a. Boulders $\frac{1}{2}$ cubic yard or more in volume.
 - b. Solid rock.
 - c. Materials that cannot be removed without systematic drilling and blasting, such as rock material in ledges or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock.
 - d. Concrete and masonry structures exceeding ½ cubic yard in volume except sidewalks and paving.
 - 2. Rock excavation does not include:
 - a. Boulders, concrete masonry structures less than ½ cubic yard in volume.
 - b. Hard and compact materials such as cemented gravel and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting.
 - c. Material removed by intermittent drilling and blasting performed to increase production.
 - 3. Do not remove material claimed as rock until the Engineer has classified and cross-sectioned same.

Note: For payment purposes of classified excavation, the maximum trench width shall be 3'-0". Classified excavation beyond the maximum trench width will not be paid for.

- B. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
- C. Open cut:
 - 1. Excavate for utilities by open cut.
 - 2. If conditions at the site prevent such open cut, and if approved by the Engineer, tunneling may be used.
 - 3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.
 - 4. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner.
 - 5. Remove wet or otherwise unstable soil incapable of properly supporting the utility, as determined by the Engineer, to depth required and backfill to proper grade with stone bedding material, at no additional cost to the Owner.
 - 6. Excavating for appurtenances:
 - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 - b. Over depth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.
- D. Trench to the minimum width necessary for protection of the Work and for the safety of personnel.
- E. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel.

- 1. Remove in units when level of backfilling has reached the elevation necessary to protect the utility work and adjacent property.
- 2. Sheeting at the bottom of trenches over 10' deep for sewers 15" and larger in size, shall remain in place and be cut off no less than 2" above the top of the pipe, at no additional cost to the Owner.
- F. Depressions:
 - 1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 - 2. Except where rock is encountered, do not excavate below the depth indicated or specified.
 - 3. Where rock is encountered, excavate rock to a minimum over depth of 4" below the trench depth indicated or specified, and to provide 6" clearance in any horizontal direction from all parts of the utility and appurtenances.
- G. Comply with pertinent OSHA regulations in regard to the excavation of utilities.

3.3 BACKFILLING

A. General:

- 1. Backfill trenches and excavations immediately after the pipes are laid unless other protection is directed or indicated.
- 2. Select and deposit backfill materials with special reference to the future safety of the pipes.
- 3. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.
- 4. Surplus material shall be deposed of as directed by the Engineer.
- 5. Original surface shall be restored to the approval of the Engineer.
- 6. Maintain proper dewatering during backfill and compaction operations.

- B. Lower portion of trench:
 - 1. Deposit approved backfill and bedding material in layers of 6" maximum thickness and compact with suitable tampers to the density of the adjacent soil until there is a cover of not less than 24" over sewers and 12" over other utility lines.
 - 2. Take special care in backfilling and bedding operations not to damage pipe and pipe coatings.
- C. Remainder of trench:
 - 1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or ½ the layered thickness, whichever is smaller, in any dimension.
 - 2. Deposit backfill material in layers not exceeding the thickness specified and compact each layer to the minimum density equivalent of not less than 95% of an ASTM D 698 Proctor Curve.
- D. Adjacent to buildings: Mechanically compact backfill in 6" layers within ten (10') feet of buildings.
- E. Under roads, streets, and other paved areas:
 - 1. Mechanically tamp in 6" layers using heavy duty pneumatic tampers or equal.
 - 2. Tamp each layer to a density equivalent of not less than 100% of an ASTM D 698 Proctor Curve.
 - 3. Provide additional compaction by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone.
 - 4. Refill any settlement with crushed stone and continue such maintenance until replacement of pavement is authorized by the Engineer.
- F. Undeveloped areas:
 - 1. Backfill in wooded, swampy, or undeveloped areas shall be accomplished to maintain not less than 90% of an ASTM D 698 Proctor Curve.

3.4 EXCAVATION BY JACKING-BORING

- A. Install casings where indicated by jacking and boring.
- B. Comply with Section 02601.

END OF SECTION

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SECTION 02222

ROCK EXCAVATION

PART 1: GENERAL

1.1 SCOPE OF WORK

A. The work covered by this section consists of the blasting and excavation of rock material in cut areas. Rock excavation shall be classified material which cannot be removed with normal construction equipment such as hydraulic excavators, bulldozers with "rippers" and requires the construction practice of blasting.

1.2 DEFINITIONS

- A. Rock is defined as being sandstone, limestone, flint, graphite, quartzite, slate, hard shale, or similar material that cannot be excavated without systematic drilling and blasting.
- B. Should rock be encountered in two or more ledges, each ledge being not less than 3" thick and with interlaying strata of earth, clay or gravel not more than 12" thick in each stratum, the entire volume between the top of the top ledge and the bottom of the bottom ledge will be classified as rock.

PART 2: EXECUTION

2.1 CONSTRUCTION REQUIREMENTS

- A. <u>Hydraulic Hammer</u>: Removal of rock by hydraulic means is the Owner's preferred method of rock excavation.
- B. <u>Blasting</u>: The use of explosives shall conform to be strict accordance with all Federal, State, County, and local regulations and only after the approval of the Engineer. The Contractor shall be responsible for all damage caused by blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of excavation of trench.
- C. When rock is encountered, all lines and grades will be held in accordance with the plans or adjusted only after approval of the engineer.
- D. When rock is encountered within the limits of construction, the Contractor shall notify the Engineer prior to any removal. Upon the

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Engineer's authorization, the Contractor shall remove the rock. The Contractor shall not be paid for rock removed without prior approval from the Engineer.

E. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

END OF SECTION

SECTION 02225

CONTROLLED DENSITY FILL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide controlled density fill (flowable fill) at the locations shown on the drawings, as specified, and as required for a complete and proper installation.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Supplementary Conditions of these specifications.
 - 2. Section 02221 Trenching, Backfilling for Utilities
 - 3. Section 02616 Milling, Cutting, and Replacing Pavements

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with the applicable sections of the South Carolina Department of Transportation's Standard Specification for Highway Construction.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 2. Concrete mix design, prepared by the manufacturer of the controlled density fill, showing compliance with the specified properties.

1.4 PRODUCT HANDLING

CONTROLLED DENSITY FILL 02225-1

A. Comply with pertinent provisions of Section 01640.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide a slurry of the specified Portland cement, fly ask, sand and water.
 - 1. Use Portland cement complying with ASTM C 150, Type I or II.
 - 2. Use fly ash approved by the manufacturer of the flowable fill.

B. Additives:

- 1. Admixtures for entrained air many be used if specifically recommended by the manufacturer.
- 2. Do not use calcium chloride.
- C. Water: Use water which is potable and free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time of strength of the concrete.
- D. Sand: Use fine aggregate conforming to ASTM C 33-82.
- E. Slump:
 - 1. 7" to 10".
 - 2. Provide lower slump fill around pipelines to a point above the top of the pipe to prevent floating.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

CONTROLLED DENSITY FILL 02225-2

- A. Pace in forms or cast against earth.
- B. Weather conditions:
 - 1. Avoid freezing before initial set of the concrete.
 - 2. Do not place at temperatures of less than 40°F, or when freezing conditions are expected in less than 24 hours.
- C. Remove any form materials prior to earth backfilling.
- D. Protect the flowable fill mass and do not permit fill of any kind to be placed thereon until the concrete has attained a compressive strength of at least 30 psi.
- E. In roadways, provide metal traffic plates over the fill until it has obtained it s compressive strength. Meet all SCDOT standards for applications and installations.

3.3 CLEANING UP

A. Completely remove all traces of concrete from surfaces on which it was not scheduled to be placed.

3.3 MEASUREMENT AND PAYMENT

A. All work under this section will be measured and paid for as specified in Section 01400 (Measurement and Payment).

END OF SECTION

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CONTROLLED DENSITY FILL 02225-4

SECTION 02260

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work included: Provide protection of the environment during the construction of this project to reduce soil erosion and siltation to the lowest reasonably achievable level. Provide protection of wetlands, stream buffers, bed and bank areas outside of work limits.

1.2 GENERAL

- A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Health and Environmental Control Regulations.
- B. Contractor shall comply with the requirements of the NPDES General Permit for Stormwater Associated with Construction Activities and the Stormwater Pollution Prevention Plan for the project.

PART 2 – PRODUCTS

2.1 CRUSHED STONE

- A. Provide 2" 3" diameter crushed stone for project entrance and exit.
- B. Provide 9" 12" depth #57 stone for temporary sediment barriers around inlets.

2.2 GRASSING

A. Comply with Section 02930 – Grassing

2.3 SILT FENCE

A. Provide silt fence for each project Erosion and Sediment Control BMP. The geotextile filter fabric must conform to the SCDOT Standard Specifications for Highway Construction (SSHC), Section 815.2.5 and must be listed on the SCDOT Material Approval Sheet No. 34:

EROSION AND SEDIMENT CONTROL 02260-1

- 1. Limit splices in filter fabric using continuous rolls whenever possible.
- 2. Whenever splices are necessary a minimum overlap of 6" is required and all splices must occur at a post so that the integrity of the silt fence is not comprised.
- 3. Securely attach filter fabric to top of woven wire and at posts with wire ties.
- 4. Silt fences should be continuous and transverse to the flow. The silt fence should follow the contours of the site as closely as possible. Place the fence such that the water cannot runoff around the end of the fence.
- B. Posts:
 - 1. Only steel posts shall be used. Steel posts shall be self-fastener angle steel type, 5' in length.
- C. Provide not less than No. 9 wire staples, 1.5" long for fastening wire mesh.
- D. Woven wire shall conform to the requirements of ASTM A116, Class I zinc coating for wire. Each woven square shall measure 5.33" x 12". The top and bottom wires shall be 10 gauge. All other wires shall be 12-1/2 gauge.
- E. Filter fabric shall be Mirafi 600X as manufactured by Celanese fibers Co., or Bidim C34 as manufactured by DuPont or equivalent.
- F. Double Silt Fence: Same as single silt fence, tow rows with approximately 1'-6" separation.

2.4 EROSION CONTROL BLANKET (ECB)

A. Use erosion control blanket S150, from North American Green or approved equal.

2.5 TURF REINFORCMENT MAT (TRM)

A. Turf reinforcement mat must conform to SCDOT Standard specifications for Highway Construction, Section 815.03. Permanent Erosion Control Mat must be listed on the SCDOT Material Approval Sheet No. 56.

2.6 SEDIMENT TUBE

A. Provide sediment tubes for each project Erosion and Sediment Control BMP. The sediment tube must conform to the SCDOT Standard Specifications for Highway Construction (SSHC) and Supplement Specification Sections reference and must be listed on the SCDOT Material Approval Sheet No. 57:

2.7 FILTER FABRIC

- A. Provide non-woven geotextile fabric for each project Erosion and Sediment Control BMP. The non-woven geotextile fabric must conform to the SCDOT Standard Specifications for Highway Construction (SSHC), Specifications Sections 804.11, Supplement Sections referenced and must be listed on the SCDOT Material Approval Sheet No. 44:
 - 1. Sediment Traps: Non-woven geotextile fabric, SCDOT SSHC Specification Section 804.11 Class 2, Type C unless otherwise shown or specified.
 - 2. Rock Dich Check: Non-woven geotextile fabric, SCDOT SSHC Specification Section 804.11, Class 2, Type C unless otherwise shown or specified.
 - 3. Stabilized Construction Entrance: Non-woven geotextile fabric, SCDOT SSHC Specification Section 804.11, Class 2, Type C unless otherwise shown or specified and Supplemental Specification for Stabilized Construction Entrance dated July 7, 2005.

2.8 INLET FILER

A. Provide surface course inlet filters for each project Erosion and Sediment Control BMP. The sediment tube must conform to the SCDOT Supplement Section for Inlet Structure Filters dated July 5, 2005 and must be listed on the SCDOT Material Approval Sheet No. 58.

PART 3 – EXECUTION

3.1 GENERAL

A. Construct and maintain all erosion control measures until the substantial completion of the project.

3.2 CONSTRUCTION ENTRANCE/EXIT

A. Construct a gravel area or pad at points where vehicles enter and leave a construction site.

EROSION AND SEDIMENT CONTROL 02260-3

- B. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade and place gravel to the grade and dimensions shown on the plans.
- C. Construction drainage channels to carry water to a sediment trap or other suitable outlet.
- D. Use geotextile fabrics to improve stability of the foundation in locations subject to seepage or high-water table.
- E. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site by periodic top dressing with two inches of stone.
- F. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
- G. Immediately remove objectionable materials spilled, washed, or tracked onto public roadways.
- H. Remove the stabilized construction entrance(s) after all disturbed areas are stabilized and the entrance is no longer needed for access (unless otherwise shown on the drawings for specified.

3.3 TEMPORARY GRASSING

- A. Provide a temporary cover for erosion control on disturbed areas within 14 days after construction activity is complete unless construction activity is going to resume within 21 days in accordance with Section 02930.
 - 1. Provide soil test for pH. Lime is required if pH is less than 5.
 - 2. Provide fertilizer.
- B. This practice applies to cleared areas, diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles where vegetation is needed for less than 1 year.
- C. Provide grassing on slope 5% or greater within 14 days of disturbance. Comply with Section 02930.

3.4 SILT FENCE

A. Provide silt fence barrier where shown on the plans and on utility construction parallel to the disturbed trench where perpendicular sheet flow runoff occurs on disturbed areas with slopes greater than 4%.

EROSION AND SEDIMENT CONTROL

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- 1. A double row of silt fence is required when the silt fence is within fifty feet of a wetland area. The double row of silt fence consists of two individual single silt fences with a typical separation of 1'-6" between them.
- B. Place at the extreme limits of the area to be disturbed as shown.
- C. Construct temporary sediment barriers of filter fabric, buried at the bottom, stretched and supported by posts and install below small disturbed areas as indicated on the drawings to retain sediment by reducing the flow velocity to allow sediment deposition.
- D. Space posts 5'-0" on center, minimum.
- E. Fasten wire mesh to steel posts with wire staples.
- F. Remove sediment deposits prior to reaching one-third height of the fence.
- G. Monitor site frequently and place additional silt fencing should evidence indicate that erosion is about to occur at locations other than those shown on the plans.

3.5 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans or on all embankments with slopes equal to or steeper than 2:1.
- B. Provide on all stream banks from top of bank to bottom of bank on all streams, creeks, drainage swales and other storm water channels and where shown on the wetland delineation on the drawings.

3.6 TEMPORARY SEDIMENT TRAPS

- A. Utilize temporary sediment traps at eh bottom of all disturbed slopes where runoff is parallel to the utility trench and draining into an existing ditch or stream and where slopes are 5% or greater along the trench.
- B. Provide at intervals of 75'.

3.7 MAINTENANCE

A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.

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- B. Inspect erosion control devices every seven days and clean or otherwise remove silt buildup as necessary.
- C. Clean and maintain all erosion and sediment control BMPs as recommended and prior to rainfall events.
- D. Dispose of all sediment and other debris in an acceptable manner and above the 100 year flood plain.

3.8 REMOVAL

A. Remove temporary structures after protected areas have been stabilized.

3.9 INSPECTION

A. Contractor shall provide inspection of erosion and sediment control measures shown on the drawings and described in this section and the Stormwater Pollution Prevention Plan for the project. Inspections shall be performed by a qualified person as described in the NPDES General Permit for Stormwater Associated with Construction Activities, GAR 100000, and in accordance with the schedule in the Stormwater Pollution Prevention Plan.

END OF SECTION

SECTION 02513

ASPHALTIC CONCRETE PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Provide asphaltic concrete paving where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limit to, General Conditions and Supplementary Conditions of these Specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Sections 01340.
- B. Product Data: Within <u>30</u> calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Certificates, signed by the materials producer and the asphalt paving Subcontractor, stating that materials meet or exceed the specified requirements.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01640.

PART 2 – PRODUCTS

2.1 GENERAL

A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications for Highway Construction".

2.2 ASPHALTIC CONCRETE MIXTER (BINDER COURSE)

- A. Materials and composition of mixture shall comply with Section 402 of the SCDOT's "Standard Specifications for Highway Construction", current edition.
- B. Paving material will be HMA Intermediate Course Type B.
- C. Provide hot plant mixed asphaltic concrete paving materials.
- D. Comply with SCDOT Standard Specifications (latest revisions).
- E. Mix must not consist of more than 25% recycled asphalt.
- F. Contractor shall be required to submit an approve SCDOT design mix prior to the start of paving.

2.3 ASPHALTIC CONCRETE MIXTURE (SURFACE COURSE)

- A. Materials and composition of mixture shall comply with Section 403 of the SCDOT "Standard Specifications for Hot Mixed Asphaltic (HMA) Pavment".
- B. Paving material will be HMA Intermediate Course Type C.
- C. Provide hot plant mixed asphaltic concrete materials.
- D. Comply with SCDOT Standard Specifications (latest Revision).
- E. Mix must not consist of more than 25% recycled asphalt.
- F. Contractor shall be required to submit an approved SCDOT design mix prior to the start of paving.

2.3 EQUIPMENT

A. Comply with requirements of Section 401 of SCDOT's "Standard Specifications".

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of the Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Sweep primed surfaces if needed.
 - 2. Adjust frames and covers if needed.

3.2 WEATHER RESTRICTIONS

A. Do not apply asphalt mixtures to a wet or frozen surface or when air temperature is below 40°F in the shade and falling, or below 35°F in the shade and rising.

3.3 SPREADING AND FINISHING

- A. On arrival at point of use, dump directly into mechanical spreader.
- B. Immediately spread and strike off true to the line, grade and cross section indicated, to such loose depth that when work is completed, the indicated thickness or weight per square yard will be secured.
- C. Correct irregularities while the mixture is still hot.
- D. At locations not readily accessible to mechanical spreaders, acceptable hand spreading methods may be used.
- E. Finished surfaces placed adjacent to curbs, gutters, manholes, etc., shall be approximately ¹/₄" above the edges of these structures.

3.4 COMPACTION

A. Perform initial rolling with 3-wheel steel roller or a steel wheel 2-axle tandem roller.

- B. Follow initial rolling with at least four complete coverages by a pneumatic tired roller.
- C. Complete rolling with steel wheel 2-axle tandem roller.
- D. Rolling shall start longitudinally at the sides and proceed gradually toward the center of the pavement, overlapping on successive trips approximately $\frac{1}{2}$ the width of the roller.
- E. Use hand or mechanical tampers in areas not accessible to powered rollers.
- F. Surface mixture after compaction shall be smooth and true to the established crown and grade.
- G. Feather and smooth the edges of fill so that the joint between fill and original surface is invisible.
- H. Finished paving smoothness tolerance:
 - 1. Free from birdbaths.
 - 2. No deviations greater than 1/8" in 6'.

3.5 PROTECTION OF SURFACE

A. All work under this section will be measured and paid for as specified in Section 01400 (Measurement and Payment).

END OF SECTION
SECTION 02601

BORE AND ENCASEMENT

PART 1 – GENERAL

1.1 Scope of Work

- A. The work under this section consists of furnishing all materials, labor, equipment and services required for the complete installation of sewer line encasement and carrier pipes under highways and railroads by boring and jacking as shown on the drawings and specified herein.
- B. All work in connection with construction encasement pipes under highways and railroads shall comply with all current requirements of governing highway and railroad agencies. The Contractor shall be familiar with these requirements.
- C. The Contractor shall inspect the locations at the proposed crossings and shall familiarize himself with the conditions under which the work will be performed, and with all necessary details and the suitability of his equipment and methods for the work required.

PART 2 – PRODUCTS

- 2.1 Materials
 - A. Steel encasement pipes shall be smooth wall welded steel pipe conforming to ASTM Designation A139, Grade B. Minimum pipe wall thickness shall be as follows:

Pipe-Nominal	Wall Thickness	
Diameter Inches	Inches	
14" and Under	0.188	
16"	0.25	
20"	0.25	
24"	0.25	
30"	0.312	
36"	0.500	

B. The minimum inside diameter of the encasement pipe shall be:

BORE AND ENCASEMENT 02601-1

1. 2" greater than the largest outside diameter of the carrier pipe, joints and couplings for carrier pipe less than 6" in diameter.

PART 3 – EXECUTION

- 3.1 Installation
 - A. Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor's responsibility to notify the Engineer immediately if conditions do not permit a jack and bore installation.
 - B. The encasement pipe shall be of the diameter indicated on the drawings.
 - C. Installation of encasement pipe shall include all related work and services such as mobilization of equipment, constructing and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring, bracing for embankments, operating pits, and as elsewhere required shall be placed and maintained in order that work may proceed safely and expeditiously.
 - D. Installation of the casing pipe shall be carried out without disturbance of the embankment, pavement, tracks, or other railroad or highway facilities and without obstructing the passage of traffic at any time.
 - E. The driven portions of the casing shall be advanced from the lower end of the casing unless specific permission to do otherwise is obtained by the Contractor from the Engineer.
 - F. The alignment and grade shall be carefully maintained and the encasement pipe installed in a straight line.
 - G. The space outside the encasement and the ground shall be filled with grout, sand or pea gravel, as directed by the Engineer. The Engineer will direct that this space be filled if the space is large enough to cause any earth settling.
 - H. Before the pipe is installed in the casing, bolt-on metal skids painted with bitumastic paint shall be rigidly fastened to the barrel of the pipe. After completion of the casing, the Contractor shall insert the pipeline in prejointed segments. No contact will be permitted between casing and the carrier pipeline.

END OF SECTION

BORE AND ENCASEMENT 02601-2

SECTION 02615 REMOVING AND REPLACING PAVEMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Removal and replacement of existing pavements for installation of utility lines, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 02221 Trenching, Backfilling for Utilities.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods for proper performance of the work of the Section.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

1.4 PRODUCT HANDLING

A. Comply with pertinent provision of Section 01640.

1.5 WARRANTY

- A. All removed and replaced pavement work within the South Carolina Department of Transportation (SCDOT) rights-of-way shall be warranted for two years beginning on the date to acceptance by the SCDOT.
- B. All removed and replaced pavement work within individual county road rightsof-way shall be warranted for two years beginning on the date of acceptance by the individual county.

REMOVING AND REPLACING PAVEMENTS 02615-1

PART 2 – PRODUCTS

2.1 CONCRETE

A. Comply with Section 03300, using strength specified herein.

2.2 ASPHALTIC CONCRETE

A. Use Types 1 and 2 complying with South Carolina Department of Transportation Standard Specifications, Section 403.

2.3 AGGREGATE BASE COURSE WITH PRIME

- A. Comply with applicable portions of South Carolina Department of Transportation Standard Specifications, Section 306.
- PART 3 EXECUTION

3.1 GENERAL

- A. Remove to neat lines and dispose of as directed.
- B. Replace with bases and pavements similar to type removed, unless otherwise indicated.

3.2 CUTTING

- A. Concrete pavement or base:
 - 1. Cut on straight and true lines, to a minimum depth of 2", using powered concrete saw.
 - 2. Shear off remaining depth with pneumatic tools.
- B. Concrete sidewalks shall be removed back to the nearest joint on each side of the crossing.
- C. Asphaltic concrete pavements: Cut to straight and true lines with powered concrete saw.

3.3 REPLACEMENT

A. Concrete pavements:

REMOVING AND REPLACING PAVEMENTS 02615-2

- 1. Use 300 psi concrete.
- 2. Replace to 6' below existing slab and undercut each edge 6" to form shelf.
- 3. Finish surface to match existing surface.
- B. Concrete sidewalks:
 - 1. Replace with 3000 psi concrete.
 - 2. Depth shall be equal to existing section removed, but not less than 4".
 - 3. Finish surface to match existing sidewalk.
- C. Flexible pavements (Ditch Line) Secondary and Primary Roads:
 - 1. Compact subgrade thoroughly.
 - 2. Undercut each edge 6" to form a shelf.
 - 3. Place 8" 2500 psi concrete leaving surface rough and depressed 2".
 - 4. Top with 2" of asphaltic concrete.
- D. Flexible Pavements (Ditch Line) Driveways:
 - 1. Compact subgrade thoroughly.
 - 2. Place 8" deep aggregate base course with prime.
 - 3. Top with 2" of asphaltic concrete.
- E. Flexible pavements (Resurfacing):
 - 1. In some instances where utilities are installed within existing pavements, resurfacing of the entire width of the original pavement will be required.
 - 2. Replace pavement in ditch line as specified above.
 - 3. Prime and resurface with $1 \frac{1}{2}$ " of asphaltic concrete.

REMOVING AND REPLACING PAVEMENTS 02615-3

- 4. Taper resurfacing to existing pavement evenly for a distance of 50 feet beyond repaired area.
- 5. Comply with Section 02513.

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Part I of these specifications.
 - 2. Section 02221 Trenching Backfilling for Utilities.
 - 3. Section 02615 Removing and Replacing Pavements.
 - 4. Section 02661 Water Service Connections.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

- 1. Materials list of items proposed to be provided under this Section.
- 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 **PRODUCT HANDLING**

- A. Comply with pertinent provisions of Section 01640.
- B. Shipment of Pipe:
 - 1. Protect pipe with tarp or other means during shipment to prevent truck exhaust from damaging pipe.
- C. Storage of PVC pipe:
 - 1. Store in unit packages as received from manufacturer until just prior to use.
 - 2. Stack units in such manner as to prevent deformation to pipe barrel and bells.
 - 3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.
- D. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to Section C of the AWWA Standards. (*State Primary Drinking Water Standard R.61-58.4.D.(1)*).
- B. Natural rubber or other material which will support microbiological growth may not be used for any appurtenances which will expose the material to the water. (*State Primary Drinking Water Standard R.61-58.4.D.(3)*).

2.2 PIPE AND FITTINGS

A. General:

- 1. Pipe sizes 8" and larger: Use ductile iron unless otherwise indicated. No asbestos cement pipe allowed.
- 2. Pipe sizes 6" or less: Use plastic pipe unless otherwise indicated.
- 3. Any pipe, solder, or flux used shall be lead free (lead free is defined as less than 0.2% lead in solder or flux and less than 8.0% lead in pipes and fittings).
- 4. Gaskets are to be factory-installed and integral with the pipe.
- 5. All materials and products that contact potable water shall be third party certified as meeting the specifications on ANSI/NSF Standard 61.
- 6. All chemical or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
- 7. For valves cast all markings integral on the valve body with the size of valve, year of manufacture and the class working pressure.
 - a. Certifications to rate a 150B valve body to a Class 250 valve will not be acceptable.
- 8. For valves spray coat all interior wetted ferrous surfaces with twocomponent epoxy applied to a nominal thickness of 3 to 4 mils.
 - a. Coating material to be AWWA and U.S. Food and Drug Administration approved for use with potable water.
- 9. Exterior Coatings: For ductile iron pipe
 - a. For buried service provide bituminous coating.
- B. Pipe:
 - 1. Ductile iron pipe (DIP):
 - a. Comply with ANSI/AWWA C150/A21.50 or AWWA C151/A21.51, latest revision.
 - b. The class or nominal thickness, new weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year

in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

- c. Wall thickness in accordance with Table 50.5 of ANSI/AWWA C150/A21.50, depth of cover indicated and Type 3 bedding conditions, minimum Pressure Class 350.
- d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
- 2. Plastic Pipe (PVC):
 - a. General:
 - 1) Marked with National Sanitation Foundation approval at 18" intervals.
 - 2) Gaskets to comply with ASTM F 477.a) Natural rubber gaskets are not acceptable.
 - b. 4" 12": Comply with ANSI/AWWA C900, Table 2, Pressure Class 305 (DR 14).
 - c. Plastic pipe 3" and smaller: Comply with ASTM D 2241 for PVC 1120, SDR 21.3" and below.
 - d. The use of solvent-weld PVC pipe and fittings in water mains 4 inches and larger is prohibited.
- 3. Polyethylene (PE) pipe:
 - a. Comply with AWWA C-906, DR 9 and working pressure of 200 psi.
 - b. The pipe supplied under this Specification shall be SDR high performance, high molecular weight, high density polyethylene pipe, and shall conform to ASTM D 1248 (Type III C, Category 5, P34). Minimum cell classifications values shall be 345434C as referenced in ASTM D 3350 latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself, in accordance with these specifications to ensure complete resin compatibility and total product accountability.

The fittings supplied in this specification shall be molded or manufactured from a polyethylene compound having a cell

classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all fitting supplied under this specification shall be of the same manufacture as the pipe being supplied.

- c. Physical Properties:
 - 1) The pipe shall conform to the physical properties as described herein.
 - 2) Typical pipe physical properties:

Property	Test Method	Unit	Value
Density Melt	ASTM Method	gms/cc gms/10	0.955
Index	ASTM D-1238	min	
	(190/2.16)		
Environmental Stress Cracking I	Resistance:		
Condition A, B, & C, F-0	ASTM D 1693	hrs	>5000**
Compressed Ring, F-60 Tensile Strength	ASTM F 1248	hrs	>1500
Yield	ASTM D 638	psi	3200
Type IV Speciment	(2"/min)		
Elongation at Break	ASTM D 638	%	>750
Victate Softening Temp	ASTM D 1525	°F	257
Brittleness Temp	ASTM D 746	°F	<-180
Flexural Modulus	ASTM D 790	psi	135,000
Modulus of Elasticity	ASTM D 638	psi	130,000
Hardness	ASTM D 2240	Shore D	65
Linear Thermal Expansion Coef.	ASTM D 696	in./in./°F	1.2x10-4
Thermal Conductivity	Dynatech-Colora BTU	In./Thermoconductor	
		ft./2 hrs./°F	2.7
Long Term Strength:			
73° F	ASTM D 2837	psi	1600
UV Stabilizer	ASTM D 1603	%C	2.5
Material Cell Classification	ASTM D 1248		345434C
Material Description	PPI Recommendation		PE 3408

d. Quality Control: The resin used for manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall

contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties. The polyethylene resin used shall have all ingredients pre-compound prior to extrusion of pipe, in plant blending is not acceptable. Owner may request, as part of the quality control records submit, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer's testing or random sampling by the Engineer that do not meet appropriate ASTM standards or manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9. Certified lab data may be requested to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

- e. Rejection: The Owner reserves the right to reject any polyethylene pipe and fittings failing to meet any of the requirements of this specification.
- f. Pipe Dimensions: Pipe supplied under this specification shall have a nominal DIP (ductile iron pipe) size O.D. unless otherwise specified. The DR (Dimension Ratio) of the pipe supplied shall be as specified.

C. Joints:

- 1. Ductile iron pipe:
 - a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.
 - b. Use gaskets and lubricant complying with ANSI/AWWA C111/A21.11. Natural rubber gaskets are not acceptable.
 - c. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints. They shall be NSF approved.

- d. Exposed pipe:
 - 1) Class 51 Minimum.
 - 2) Use flanged joints complying with ANSI/AWWA C115/A21.11, latest revision; and
 - i. Flanges to be solid type
 - ii. Use full face, red rubber, factory cut, 1/16" thick for pipe up to 10" diameter and 1/8" thick for larger sizes.
 - iii. Bolts and nuts shall be standard carbon steel machine bolts, hex head complying with ANSI A21.11/AWWA C111.
- 2. Plastic pipe:
 - a. Use integral bell or coupling type with elastomeric gaskets.
 - b. Integral bells to comply with ASTM D2672.
 - c. Couplings to comply with ANSI/AWWA C900.
 - d. Gaskets to comply with ASTM F477.
 - 1) Natural rubber gaskets are not acceptable.
 - e. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints. They shall be NSF approved.
- 3. Polyethylene pipe joining:
 - a. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by the manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and

fusion pressures. Prior approval of equipment and personnel shall be obtained before fusion begins. The completed pipe joints shall be guaranteed for five years in writing to the Owner and its Contractor.

- b. Provide restrained joint mechanical joint adapters for each end of the P.E. pipeline.
 - 1) Include any special end configuration and polyethylene ring to hold a standard mechanical joint.
- c. Expansion joint: Provide one on each end of the polyethylene pipeline.
 - 1) Ductile iron conforming to ANSI/AWWA C153/A21.53.
 - 2) Minimum 15 mil fusion bonded epoxy lining meeting ANSI/AWWA C213 and C550.
 - 3) Restrained mechanical joint.
 - 4) Minimum pressure rating of 350 psi.
 - 5) Provide minimum of 8" of expansion capability for expansion joint.
 - 6) Provide Ex-Tend 200 by EBBA Iron Sales, Inc.
- D. Fittings and specials:
 - 1. Ductile Iron Pipe:
 - a. Use 350 psi pressure rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10.
 - b. Compact fittings for piping 3"-16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
 - c. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.
 - d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.

- e. The maximum phosphorous level in the casting will be 0.08%.
- f. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
- g. The manufacturer shall be ISO 9000 certified.
- h. Markings: Each fitting shall have the following markings cast integrally to the fitting:
 - 1. Manufacturer's Name or Logo
 - 2. "MJ"
 - 3. Country or origin
 - 4. Manufacturer's Foundry Mark
 - 5. AWWA C-153 or C110
 - 6. Pressure Rating
 - 7. Nominal Diameter (each leg)
 - 8. "DI" or "Ductile"
 - 9. No. of Degrees (bends)
- 2. Plastic pipe 3" and smaller: PVC fittings may be used 160 psi at 73°F pressure rating, joint design to conform to pipe joints.
- E. Couplings:
 - 1. Provide couplings where needed to make piping connections and where located on the plans.
 - 2. Provide mechanical joint ductile iron sleeve, full length, minimum 12".
 - Provide cutting-in sleeve where installing fittings in an existing line.
 a. Provide ductile iron with mechanical joint.
 - 4. Provide restrained joint couplings where restrained joints are indicated on the plans.
- F. Restrained joint pipe and fittings:
 - 1. Provide restrained joint pipe and fittings on all piping at each fitting, including valve and fire hydrant connections, in accordance with the following table:

	negoneo neorio inteo sonti tento in more							
		11.25°	22.5°	45°	90°	DE		
щ	6" DIP	4 FT	8 FT	16 FT	35 FT	60 FT		
SIZ	8" DIP	5 FT	10 FT	18 FT	40 FT	70 FT		
z	10" DIP	6 FT	12 FT	22 FT	50 FT	90 FT		
-	12" DIP	8 FT	15 FT	28 FT	60 FT	100 FT		

REQUIRED RESTRAINED JOINT LENGTH TABLE

ASSUMPTIONS:

1. TEST PRESSURE = 150 PSI. IF GREATER, CONSULT DISTRICT ENGINEER

2. PIPE COVER = 4 FT. IF LESS, CONSULT DISTRICT ENGINEER

3. IF PIPE SUBMERGED, DOUBLE REQUIRED RESTRAINED JOINT LENGTH

4. IF PIPE ENCASED WITH POLYWRAP CONSULT DISTRICT ENGINEER

- a. Restrained Joint Pipe (Push-On DIP). Provide one of the following for push on pipe:
 - 1) American Cast Iron Pipe Company
 - a) Flex-Ring (4"-36")
 - 2) TR-Flex by U.S. Pipe
 - 3) Fast Grip Gasket by American Cast Iron Pipe Company.
 - 4) Field Lok by U.S. Pipe.
 - 5) McWane Ductile Sure Stop 350 Gasket
- b. Restrained Joint Fittings (mechanical joint DIP):
 - 1) Provide retainer glands for use with mechanical point pipe and fittings.
 - 2) Provide wedge type.
 - Provide ductile iron gland conforming to ASTM A 536-80. Provide split gland where standard gland cannot be installed.
 - 4) Provide ductile iron set screws, heat-treated to a minimum hardness of 370 BHN with twist-off nuts and permanent standard hex head remaining.
 - 5) Provide for the following rated pressure with minimum 2 to 1 safety factor; 3"-16" 350 psi, 18"-48" 250 psi.
 - 6) Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest revision.
 - 7) Provide "MEGALUG" series 1100 or series 1200 as manufactured by EBAA Iron, Inc. of Eastland, Texas or approved equal.

- c. Provide restraint for C900 PVC by mechanical means separate from the mechanical joint gasket sealing gland.
 - 1) Provide wide, supportive contact around full pipe circumference as follows:

<u>Size</u>	Restraint Width
4"-6"	1-1/2"
8",10",12"	1-3/4"

- 2) Provide means of restraint by machined serrations on inside surface of restraint device designated to provide circumferential loading over the entire restrainer.
 - a) Design to be such that restraint increases with increased in-line pressure.
 - b) Provide a minimum of 8 serrations per inch of restraint width.
- Restraint device to be pressure rated at 350 psi, or equal to the pipe on which it is used and capable of withstanding test pressures of 2 times pressured rating.
- 4) Fusion applied epoxy coating finish per AWWA C-213.
- 5) Provide series 1600 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.
- d. Provide restraint between PVC and mechanical joint ductile iron fitting where indicated on the plans.
 - 1) Provide device consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C111/A21.11.
 - 2) The device will have a working pressure rating equal to the pipe of which it is used and include a minimum design pressure safety factor of 2:1.
 - Gland body, wedges and wedge actuating components will be cast from glade 64-45-12 ductile iron material in accordance with ASTM A536.
 - 4) An identification number consisting of year, day, plant and shift will be cast into each gland body.
 - 5) Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 - 6) Provide series 2000 PV by EBBA Iron, Inc. or equal.
- G. Tee head bolts: Provide Cor-Ten steel tee head bolts for use on mechanical joints complying with ASTM A242. Provide Domestic Only.

- H. Plugs or caps:
 - 1. Provide at all pipe ends and unused branches of fittings.
 - 2. All plugs and caps shall be tapped 2" and provided with 2" plug.
 - 3. Plugs and caps to be restrained.

2.3 COPPER TRACER WIRE

- A. Provide a continuous **10 gauge** blue insulated copper tracer wire when PVC or polyethylene pipe is used.
- B. Tracer wire to be approved for direct burial by the manufacturer. **THHN wire shall NOT be used.**
- C. Terminate tracer wire at each valve and meter and make provisions to allow for connection of testing apparatus without interfering with the proper operation of valves and meters.
- D. Connect to the water line with duct tape at every bell connection or every 20' to ensure that the wire is directly over the top of the pipe.
- E. Place in the trench with all service lines.
- F. Splice at each service lateral and tee connection with an approved copper compression lug.

2.4 GATE VALVES

- A. General:
 - 1. 1-1/2-inch and smaller: Use gate valves or ball valves.
 - 2. 2-inch through 12-inch: Use gate valves.
 - 3. 14-inch and larger: Butterfly.
 - 4. Open by turning counterclockwise.
 - 5. End connections as required for the piping in which they are installed.
 - 6. Two-inch metal operating nut with arrow indicating direction of opening.

- 7. Use valves designed for a working pressure of not less than 250 psi.
- 8. Provide stem extensions on all valves where the top of the operator nut is located greater than 36 inches below the top of the valve box.
- 9. Fully coat all internal ferrous metal surfaces with two-part thermosetting epoxy.
- 10. Design for external stem failure when excessive closing torque is applied with no failure of the pressure retaining parts.
- 11. Provide two-part thermosetting epoxy coating on valve exterior.
- 12. Provide stainless steel bolting.
- 13. Valves to be manufactured in the United States. Manufacturer shall be Mueller or American Flow Control.
- 14. Provide all wetted rubber compounds of synthetic rubber.
- B. Gate Valves 1-1/2-Inch and Smaller:
 - 1. Use all bronze ball valves, ¹/₄ turn with stop, 2-inch square nut operator.
 - 2. Provide American 2502 or equal.
- C. Gate Valves 2-inch through 12-inch:
 - 1. Use resilient seated wedge valves complying with ANSI/AWWA C515.
 - 2. Provide integrally cast bronze stem nut on resilient seated wedge valves.
 - 3. Suitable for working pressure of not less than 250 psi.
 - 4. Design for external stem failure outside of the valve body or bonnet when excessive closing torque is applied with no failure of the pressure retaining parts per AWWA Section 3.2.

- a. Factory test with no leakage from either side of the disc.
- b. Test shell to 500 psig.
- 5. Provide certified to NSF/ANSI Standard 61.
- 6. Resilient wedge valves:
 - a. Completely encapsulate resilient iron wedge by an elastomer, without thin spots or voids.
 - b. Provide polymer wedge guide bearing caps bearing surface between the encapsulated wedge and the interior epoxy coating, lowering operation torque and extending service life of the valve.
 - c. The manufacturing plant to have ISO9001 certification.
- 7. For 2" blow-off assemblies, provide Mueller A-2362 or approved equal.
- D. Valve Operator:
 - 1. Provide one T-handle operator for each ten buried valves with nut operator.
 - 2. Provide one stainless steel T-handle operator for each four buried valves with "T" head.
- E. Connection
 - 1. All valve inlets 4-12" shall be the "Alpha" joint design furnished by American Flow Control or the "Aquagrip" by Mueller.

2.5 HYDRANTS

- A. Fire Hydrants
 - 1. Compression type, opening against pressure and closing with pressure, complying with ANSI/AWWA C502 dry-barrel fire hydrants, existing national standards and ANSI/NSF 61 and 372. Fire hydrants shall meet all test requirements.

- 2. Waterway valve opening, 4-1/2-inch with EPDM main valve. Minimum 250 psi working pressure. Factory tested to a minimum of 250 psi.
- 3. Six-inch bell connection, two 2-1/2-inch hose connections, one 5-inch pumper nozzle (STORZ CONNECTION), set screw, lock ring, etc., and shall conform to existing national standard specifications and ANSI B26. Provide a cap and chain on 2-1/2 inch hose connections and a 5 inch Locking Quick Disconnect Storz Connection Assembly.
- 4. National Standard screw threads on outlet nozzles. Open by turning counterclockwise, cast in top indicating direction of opening.
- 5. Two-part breakable safety flange shall be an integral part of barrel casting at least 2" above the bury line.
- 6. Barrel lengths shall generally be for 4'-0".
- 7. Interior shall be two (2) part thermosetting, or fusions bonded, and coated holiday free to a minimum thickness of 4 mil conforming to AWWA C550 protective interior coatings for valves and hydrants.
- 8. Finish exterior coating shall be <u>RED</u> industrial enamel, color to match Owner's standard.
 - a. Exterior hydrants parts below ground will be asphaltic or epoxy coated.
- 9. An all-bronze seat ring shall thread directly into an all bronze drain ring or heavy bronze bushing located between the lower hydrant barrel and shoe securely retained in this position, or it may be threaded into a heavy bronze bushing in the hydrant shoe. Drain rings cast into the iron body are not acceptable.
- 10. All bronze or brass internal working parts in contact with service water are to be maximum 16% zinc content and 79% minimum copper.
- 11. Retaining bolts of shoe to lower barrel shall be 316 stainless steel.

- 12. Provide one hydrant wrench for each ten hydrants.
- 13. Provide Mueller Super Centurion 250 only.
- B. Reflector:
 - 1. Provide industry standard blue hydrant reflector for paved roadway.

2.6 VALVE BOX

- A. Provide at each buried valve.
- B. Cast iron slip type, suitable for minimum cover of 3'-6 inches over the pipe.
- C. Minimum inside diameter at the top of 5-inch, minimum wall thickness 3/16-inch.
- D. Have the word <u>WATER</u> cast into the cover.
- E. Provide No. 107 or approved equal.
- F. Provide 6" PVC Schedule 40 pipe for riser extension.
- G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.7 VALVE BOX PROTECTION RING

A. Provide at each valve box a pre-cast concrete protection ring.

2.8TAPPING SLEEVE AND VALVE

- A. Tapping Sleeve:
 - 1. Provide Type 304L stainless steel per ASTM A240.
 - 2. Provide rolled thread stainless steel bolts per ASTM A153, Type 304.
 - 3. Provide Type 304 stainless steel hex head nuts, coated to prevent galling.
 - 4. Virgin SBR gaskets, compounded for water and wastewater service.

- 5. Provide ³/₄" NPT stainless steel test plug.
- 6. Maximum working pressure of 200 psi.
- 7. Provide ROMAC Industries Model SST, Ford Fast SST, Mueller H-615, or approved equal.
- B. Tapping Valve:
 - 1. Construct of material compatible with tapping sleeve.
 - 2. Valve to conform to Paragraph 2.3 above.
 - 3. Joints Flange to tapping sleeve, push-on (**mechanical joint**) (**restrained joint**) for pipe end.

2.9 TRANSITION/REPAIR COUPLING

- 1. Restrained Coupling: HYMAX GRIP, Romac ALPHA, or equal.
- 2. Standard Repair Coupling: Smith

2.11 MISCELLANEOUS PARTS AND ACCESSORIES

A. Use standard commercial grade suitable for the type of installation or system involved and conforming to the applicable standards and specifications of the AWWA.

PART 3 – EXECUTION

3.1 HANDLING

- A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:
 - 1. Carry pipe into position do not drag.
 - 2. Use pinch bars or tongs for aligning or turning the pipe only on the flare end of the pipe.
 - 3. Use care not to injure pipe linings.
 - 4. Do not damage pipe with chokers or lifting equipment.

- B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer.
- C. Before installation, inspect each piece of pipe and each fitting for defects.
 - 1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.
- D. Rubber Gaskets: Store in a cool dark place until just prior to time of installation.

3.2 PIPE CUTTING

- A. Cut pipe neatly and without damage to the pipe.
- B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only.
 - 1. Use wheel cutters when practicable.
 - 2. Cut plastic pipe square and remove all burrs and grind bevel on end.

3.3 LOCATING

- A. All water mains shall be detectable within 3 feet with electronic locating equipment. (*State Primary Drinking Water Standard R.61-58.4.D.(11)(g)*).
- B. Where possible, locate water line at least ten feet away, horizontally, from sewer pipes.
- C. Should ten-foot separation not be practical, then the water main may be located closer with South Carolina Department of Health and Environmental Control (SCDHEC) approval provided:
 - 1. It is laid in a separate trench.
 - 2. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.

- 3. In either of the above cases, crown elevation of the sewer shall be at least 18" below inert elevation of water line.
- D. Where water lines cross over sewers, maintain 18" minimum clearance between crown of sewer and invert of water line.
- E. Where water lines cross under sewers, each line shall be cast iron or ductile iron.
 - 1. A full length of water line shall be located over the sewer so that joints will be as far from each other as possible.
 - 2. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing each other
- F. No water pipe shall pass through or come in contact with manholes.
- G. Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile field or spray field.
- H. Water lines shall not be laid within 25' horizontally from any portion of a wastewater tile or spray field.
- I. Water lines shall be located outside all contaminated areas, unless using pipe materials that will protect the water supply.
- J. No flushing device or drain directly connected to any type of sewer is allowed.
- K. No cross connections between water lines and any pipes, valves, tanks or pumps that are not part of the potable water system are allowed.
- L. Water lines may come in contact with storm sewers or catch basins if there are no other practical alternatives provided that ductile iron is used, and no joints of the water line are within the storm sewer or catch basin and provided that the joints are located as far as possible from the storm sewer or catch basin.
- M. Structures containing valves, blow-offs, meters, air release valves, etc., shall not be connected directly to any storm drainage or sewer system.

3.4 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02221 and Section 02615 of these Specifications.
- B. For P.E. Pipe, comply with manufacturer's recommendation.

3.5 ALIGNMENT OF PIPE

- A. Pipe lines intended to be straight shall be so laid.
- B. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer.
- C. If alignment required deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

3.7 PLACING AND LAYING

- A. General:
 - 1. Installation of water mains and appurtenances shall be conducted in accordance with Section C of the AWWA Standards and/or manufacturer's recommended installation procedures. (*State Primary Drinking Water Standard R.61-58.4.D.(11)(a)*).
 - 2. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
 - 3. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer.
 - 4. Do not dump or drop any of the materials of this Section into the trench.
 - 5. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.

- 6. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
- 7. Take up and relay pipe that has the grade or joint disturbed after laying.
- 8. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
- 9. Securely close open ends of pipe, fittings, and valves when work is not in progress.
- 10. Where any part of coating or lining is damaged, repair to the approval of the Engineer and at no additional cost to the Owner.
- 11. Structures containing valves, blow-offs, meters, air release valves, etc., shall not be connected to any storm drain or sewer system.
- B. Ductile Iron Pipe:
 - 1. Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600.
 - 2. Gaskets: Handle, lubricate where necessary and install in strict accordance with manufacturer's recommendations.
- C. Plastic Pipe:
 - 1. Clean gasket, bell or coupling interior, especially groove area.
 - 2. Lubricate and insert gasket as recommended by manufacturer.
 - 3. Align spigot to bell, insert spigot into bell until is contacts gasket uniformly.
 - 4. Bell pipe using manufacturer's approved leverage bar.
 - a. Do not use machinery to push pipe "home".

- 5. Push pipe "home" until reference mark is at proper location and clearly visible.
- 6. Follow all pipe manufacturers' installation instructions.
- D. Flanged joints:
 - 1. Provide true face flanges, field clean and fit with one full face gasket and make bolts up finger tight.
 - 2. Use torque wrench to alternately tighten bolts 180° apart until full gasket flow and seal are secured.
 - 3. Bias cut or unusual refacing of any flange will not be acceptable.
- E. Restrained joints:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Tighten set screws to the manufacturer's rated torque using a torque wrench.
 - 3. If twist-off nuts are provided, tighten screws until nut breaks loose.
- F. HDPE pipe:
 - 1. Install in accordance with manufacturer's recommendation and ASTM D 2321.
 - 2. Provide factory-trained personnel to conduct effusion joint work.
- G. Polyethylene Encasement: Comply with AWWA A105.

3.8 SETTING VALVES AND VALVE BOXES

- A. General:
 - 1. Center valve boxes on the valves, setting plumb.

- 2. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.
- 3. Install shaft extensions plumb without any binding.
- 4. Fully open and close each valve to assure that all parts are in working condition.
- 5. Place valve box protection ring around top of valve box as indicated on the plans.
 - a. Install ring level with top 1" above finished grade.
 - b. Top of ring to be level with or no more than 1" above the top of the valve box.

3.9 INSTALLATION OF HYDRANTS

- A. General:
 - 1. Inspect carefully, ensuring that all foreign material is removed from the barrel.
 - 2. Set plumb and at such elevation that connecting pipe and distribution main have same depth of cover.
 - 3. Install stone drainage bed and thrust blocking as indicated.
 - 4. No connection or location of hydrant drains within 10' of sewer systems is allowed.
 - 5. Hydrant leads to be a minimum of 6" in diameter and to include an auxiliary gate valve.
 - 6. Fully open and close each hydrant to assure that all parts are in working condition.

3.10 THRUST BLOCKS

- A. General:
 - 1. Provide thrust blocks, or metal tie rods and clamps or lugs, on plugs, caps, tees, hydrants and bends deflecting 11-1/4° or more either vertically or horizontally, and on water lines

4" in diameter or larger. Thrust blocking is not required where restrained joints are indicated.

- 2. Provide concrete thrust blocking with a compressive strength of 3000 psi in 28 days.
- 3. Size of the blocking will be determined by the Engineer, based on soil bearing capacity.
- 4. Provide 8 mil. Polyethylene film between the thrust block and fitting.
- B. Installation:
 - 1. Locate thrust blocking between solid ground and the fitting to be anchored.
 - 2. Unless otherwise shown or directed by the Engineer, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
 - 3. Sides of thrust blocking not subject to thrust may be placed against forms.
 - 4. Place thrust blocking so the fitting joints will be accessible for repair.
 - 5. Protect steel rods and clamps by hot dipped galvanizing.

3.11 HYDROSTATIC TESTING

- A. Water Test
 - 1. Pressure and leakage testing must be conducted in accordance with AWWA Standards C600.
 - 2. The pressure test shall not be less than 150 psi at the highest point. Along the test section, the test pressure shall not exceed pipe or thrust-restraint design pressure, shall be of at least 2 hour duration, and shall not vary by more than 5 psi for the duration of the test.
 - 3. Before testing, all air shall be expelled and all caps, plugs and fittings shall be properly braced. Air is expelled by

opening a fire hydrant or air release vents or corporation cocks at eh high points of the line. Once all the air is released, the valves between the existing distribution system and the pipe to be tested are closed. Pressure is then applied to the portion of the pipeline being tested by means of a hand or motor driven pump.

- 4. Test pump, pipe connection, pressure gauges, measuring devices and all other necessary appurtenances to conduct tests are to be provided by the contractor.
- 5. The pipeline shall be pressurized to 150 psi and held at this test pressure for at least two (2) hours duration, with the leakage and pressure recordings being conducted simultaneously. Any make-up water shall be carefully measured by a meter or by pumping the water from a vessel of know volume. After every five (5) psi drop (in the event of psi drop should occur) the pressure shall be returned to 150 psi and leakage recorded.
- 6. The witness to the hydrostatic testing shall be SJWD.
- B. Leakage test:
 - 1. Allowable make up water formula

L = S x D x \sqrt{P} /133,200; where

L = allowable leakage in gallons per hour;

- S = length of pipe tested in feet;
- D = nominal diameter of pipe in inches; and
- P = average test pressure psi gauge.

Allowable Leakage Table per 1000 feet of pipeline in gph at test pressure of 150 psi											
Pipe Size-in.	4	6	8	10	12	16	20	24	30	26	42
Leakage-gph	0.33	0.5	0.66	0.83	0.99	1.32	1.66	1.99	2.48	2.98	3.48

2. Repair all visible leaks regardless of test results without additional cost to the Owner.

C. Documentation

Each Hydrostatic test shall be documented using the following format:

HYDROSTATIC WATER PIPELINE TEST REPORT

Date:	Tester:
Project Name:	
Location:	
Pipe Diameter: Pipe Length:	Pipe Material:
Meter Number & Size:	Meter Reading:
Allowable Leakage (for two hour test Pe	riod):
Test Start Time:	Test Ending Time:
Test Pressure Used:	Leakage Recorded:
Test Analysis (U-Unsatisfactory S-Satis	sfactory):

Sketch of pipe layout being tested (include fittings, caps, and plugs, etc in the sketch) to be noted below or to be attached.

3.12 STERILIZATION

A. General:

- 1. Upon completion of testing, sterilize all water lines to meet requirements of the South Carolina Department of Health and Environmental Control.
- 2. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.
- 3. Should initial treatment fail to meet results specified, repeat procedures until satisfactory results are obtained, at no additional cost to the Owner.
- 4. All pipe taps, feeders, chemicals, etc., for sterilization shall be provided by the Contractor.
- B. Procedure:
 - 1. Flush line to extent possible with available pressure and outlets, prior to sterilization.
 - 2. Hydrant openings required to produce flushing velocity at 40 psi are:

Pipe Size (Inches)	Hydrant Openings
4 through 12	One 2-1/2"
14 through 18	Two 2-1/2"
20	One 4-1/2"

- 3. Comply with the latest revision of AWWA C651 Section 4.3 Tablet/Granule Method of Chlorination:
 - a. The tablet method consists of placing a calcium hypochlorite granules or tablets in the water main during installation and then filling the main with potable water to create a chlorine solution. This method may be used on if the pipes and appurtenances are kept clean during construction.
 - b. Calcium hypochlorite tables (5-grams) shall be placed in the upstream end of each section of pipe to be

disinfected, including branch lines. At least on tablet shall be placed in each hydrant branch and in other appurtenances. The number of 5-g tablets required for each pipe section shall be $0.0012d^2$ rounded to the next higher integer, where *d* is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. The Table below shows the number of tablets required for commonly used sizes of pipe.

	Length of Pipe Section, ft.					
Pipe Diameter	13 or less	18	20	30	40	
inches	Number of 5-	g Calcium H	ypochloi	rite Table	ts	
4	1	1	1	1	1	
6	1	1	1	2	2	
8	1	2	2	3	4	
10	2	3	3	4	5	
12	3	4	4	6	7	
16	4	6	6	10	13	

- c. Calcium hypochlorite tables shall be attached by an adhesive meeting the requirements of NSF/ANSI 61. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attached tablets inside and at the top of the main. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the pipe exterior to indicate that the pipe has been installed wit the tablets at the top.
- d. When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater that 1 ft/sec. Fill rate must be carefully controlled to ensure tablets do not come loose from pipe. Precautions shall be taken to ensure that air pockets are eliminated. Water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with degree of hazard, for backflow protection of the active distribution system.
- e. Retain chlorinated water in main not less than 24 hours.

- f. At the end of the retention period, a detectable free chlorine residual greater than or equal to 0.2 mg/L shall be found at each sampling point after 24 or 48 hour period.
- g. Dechlorinate and flush line thoroughly.
- C. Acceptance:
 - 1. Provide two separate samples for each sample location, taken at 24-hour intervals, free from coliform bacteria.
 - a. Contractor to take 1st and 2nd samples, deliver to South Carolina Department of Health and Environmental Control (SCDHEC) approved laboratory for testing.
 - b. The first and second sample results shall include the free chlorine residual at the time the samples were collected.
 - c. Notify SCDHEC to take a 3rd sample.
 - 2. At a minimum, sample locations shall be as required by SCDHEC and the following:
 - a. The tie-in location of new and existing water lines.
 - b. The end of all dead-end lines.
 - c. At the intervals of no more than 1,200' for all new lines longer than 1,200' in length.
 - 3. All sample locations are to be given an identifying label and a corresponding identification label is to be included on the record drawings indicating each sample location.

3.13 DECHLORINATION OF CHLORINTED STERILIZATION WATER

- A. Dechlorinate the chlorinated water used for sterilizing water lines.
- B. Apply dechlorinating agent as liquid sulfur dioxide or sulfite salts.
- C. Prepare a mixing chamber using a 55-gallon tank. Feed the discharge and dechlorinating agent at the bottom of the tank with overflow at the top.
- D. Discharge total chlorine residual to be less than 0.5 milligrams per liter.
END OF SECTION

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WATER DISTRIBUTION SYSTEM 02660-31

SECTION 02661

WATER SERVICE CONNECTIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water service connections, including service pipe, and other appurtenances as shown on the drawings, specified herein, and needed for a complete and proper installation.
 - 1. Service connections include connection to the distribution main, service line between main and the meter/meter box assembly.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications
 - 2. Section 02221 Trenching, Backfilling for utilities.
 - 3. Section 02260 Water Distribution

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

WATER SERVICE CONNECTIONS 02661-1

A. Comply with pertinent provisions of Section 01640.

PART 2 – PRODUCTS

2.1 SERVICE SADDLES:

- A. Provide Ford S70, S90 (C900 pipe), Mueller S-1300 Series Service Saddle, or approved equal.
- B. 200 psi minimum working pressure.
- C. Meets AWWA C800.
- D. Connect to pipeline using a 6" stainless steep nipple. DO NOT USE a threaded PVC connection.

2.2 CORPORATION STOPS:

- A. Provide ball type corporation valves suitable for system operating pressures of 175 psi and maximum valve working pressure of 300 psig.
- B. Valves shall be manufactured and tested to comply with ANSI/AWWA C800 standard.
- C. Valve to be supplied with double o-ring seals supported in precision machined grooves to provide secure, leak-tight sealing.
- D. Heavy brass components shall be constructed of 85-5-5-5 ASTM B62 brass.
- E. Ball shall be PTFE coated to ensure smooth, easy turning operation. Rotation of ball shall be 360 degrees.
- F. Outlet connection shall be compression type connection.
- G. Corporation stop and valve shall be Ford #F600-3.

2.3 BRASS MATERIALS

- A. Provide materials complying with AWWA Standard C800, unless otherwise indicated or specified.
- B. Corporation Stops: Provide Mueller model H-15008, Ford 100-3-Q, or approved equal.

WATER SERVICE CONNECTIONS 02661-2

- C. Copper Adapter: Provide Mueller model H-15428, Ford C28-44, or approved equal.
- D. Curb Stop: Mueller B20200R, Mueller B-25172N, Ford B11-233, Ford B41-444-W-Q-DL (1"), Ford B41-233-W-Q-DL (3/4") or approved equal.
- E. Brass nipples shall conform to ASTM B687-88. Nipples shall be threaded with American Standard taper pipe threads (NPT) in accordance with screw-thread standard for Federal Services Handbook H-28. Nipples shall have NSF/ANSI 61 certification.
- F. All Brass and Stainless-Steel fittings shall be Domestic Only.

2.4 SERVICE PIPE:

- A. ³/₄-inch copper tubing with a minimum working pressure of 250 psi.
- B. Manufacturers of copper tubing shall be Cerro. Howell, Reading, Mueller Streamline or approved equal.

2.5 METER ASSEMBLIES:

A. Provided by the owner.

2.6 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install service lines from the distribution main to the new meter, or at each location indicated or directed by the Engineer.
- B. Depth of the service connection shall be no less than the top of main connection.
- C. Install insulating couplings between ferrous and non-ferrous pipe, fittings, etc. of such shape to effectively prevent metal-to-metal contact between the dissimilar metals.

WATER SERVICE CONNECTIONS 02661-3

3.2 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02221, except as otherwise specified herein.
- B. Under paved areas install service lines dry boring, unless otherwise directed by the Engineer.

3.3 INSTALLATION – SERVICE LINES

- A. Install flexible service lines in one continuous piece from main to service stop.
- B. Connections to PVC and DIP mains:
 - 1. Use approved service saddle on existing and new mains.
 - 2. Provide corporation stop at all connections.
- C. Terminate each service line with connection to the existing meter assembly or as shown on the detail on the plans.
- D. All work performed shall be in accordance with the latest revision of the International Plumbing Code.

3.4 INSTALLATION – METER BOXES AND METERS

- A. Install boxes level in both directions and with top flush with finished grades.
- C. Do not let weight of box rest on the service line.
- C. Make installation in such manner that meter may be removed at any time without disturbing box setting.

3.5 FLUSHING

A. Flush each service line thoroughly after installation to clear of sand, dirt, or other construction debris.

B. When meters are to be installed, accomplish flushing prior to meter installation.

END OF SECTION

WATER SERVICE CONNECTIONS 02661-4

SECTION 02780

CASING PIPES FOR UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Provide and install casing pipes or tunnels under surface structures, where indicated, as specified herein, and as needed for a complete and proper installation.
- B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 **PRODUCT HANDLING**

A. Comply with manufacturer's recommendations.

CASING PIPES FOR TUNNELS FOR UTILITIES 02780-1

PART 2 – PRODUCTS

2.1 CASING PIPE FOR DRY BORES

- A. Steel complying with ASTM A 139 for Grade B with minimum yield strength of 35,000 psi.
- B. Provide ends suitable for field welding.
- C. Minimum wall thickness as follows:

Diameter of Casing	Minimum Wall Thickness		
(Inches)	(Inches)		
6 thru 14	1/4		
16 and 18	5/16		

2.2 PIPELINE CASING SPACERS

- A. For piping installed in casing provide pipeline casing spacers.
- B. Provide a minimum of 1 spacer per ten linear feet of pipe for ductile iron pipe and a minimum of 1 spacer per six linear feet for PVC pipe.
- C. Provide spacer with shell of 14-gauge T-304 stainless steel.
- D. Provide shell liner of .090" thick PVC, 85-90 durometer.
- E. Provide 5/16" stainless steel connecting bolts and lock nuts, minimum three (3) per flange.
- F. Runners from 2" wide ultra-high molecular weight polymer with a high resistance to abrasion and a coefficient of friction of 0.11 -0.13 in accordance with ASTM D 1894.
- G. Support runners on 14-gauge reinforced T-304 stainless steel risers welded to shell.
- H. All metal surfaces to be fully passivated.
- I. The diameter as measured over the runners shall exceed the pipeline bell or coupling outside diameter.
- J. Provide pipeline casing spacers as manufactured by Cascade

CASING PIPES FOR TUNNELS FOR UTILITIES 02780-2

Manufacturing, Pipeline Seal and Insulator, Inc. or approved equal.

2.3 END SEALS

- A. Provide 1/8" thick rubber end seal to seal each end of the casing.
- B. Secure to casing and carrier pipe with T-304 stainless steel bands.
- C. Acceptable manufacturers: Cascade Manufacturing, Pipeline Seal and Insulator, Inc. or approved equal.

PART 3 – EXECUTION

3.1 ENTRY PITS

- A. Locate to avoid interference with traffic, adjacent structures, etc., to such extent possible.
- B. Excavate to required depth, providing sheeting and shoring necessary for protection of the Work and for safety of personnel.
- C. Maintain in dry condition by use of pumps, drains or other approved method.

3.2 INSTALLATION

- A. Install casings by dry-boring through the casing while simultaneously jacking the casing.
- B. Any proposed alternate method shall be approved in writing by the Engineer.
- C. Weld joints to provide a watertight joint.
- D. Casings for gravity sanitary sewer, storm drainage, or water lines to be installed to grade, shall not vary more than 3/32" per foot of length from the indicated grade.
 - 1. Remove and replace any improperly installed or otherwise defective casing at no additional cost to the Owner.

3.3 INSTALLING PIPE IN CASING

A. GENERAL:

CASING PIPES FOR TUNNELS FOR UTILITIES 02780-3

- 1. Inspect carefully, ensuring that all foreign material is removed from the casing and the casing meet alignment criteria for the type of carrier pipe being used.
- 2. For pressure systems, the casing deflection shall not exceed the maximum deflection recommended by the carrier pipe.
- 3. Install casing spacers on the carrier pipe per the manufacturer's instructions.
- 4. For sanitary and storm sewer provide spacer sizing and length necessary to obtain the pipe slope and elevations as shown on the plans.
- 5. Provide centered or restrained configuration.
- 6. Install the carrier pipe in the casing ensuring each joint is pushed "home" before the joint is installed into the casing.
- 7. Provide restrained joint carrier pipe for all joints inside of casing.

3.4 CASING ENDS

A. Install rubber end seals in accordance with manufacturer's instructions.

END OF SECTION

SECTION 02781

HORIZONTAL DIRECTIONAL DRILLING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Furnish and install underground utilities using the horizontal directional drilling (HDD) method of installation of pipe, commonly referred to as directional boring or guided horizontal boring. This work includes all services, equipment, materials, and labor necessary for a complete and proper installation, testing, and restoration of underground utilities, environmental protection and restoration.
- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 02660 Water Distribution System.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Requirements set forth in this document specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Strict adherence is required under specifically covered conditions outlined in these specifications. Adherence to these specifications or the Engineer's approval of any aspect of any directional bore operation in no way relieves the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.
- C. Use the latest version of standards referenced herein.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

- B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 2. Encroachment permit requirements to SCDOT for all directional bores. Contractor is responsible for satisfying any and all requirements of SCDOT and obtaining approval to bore within SCDOT Right-of-Ways. Contractor shall not bore without approval from SCDOT.
- C. Work plan: Prior to beginning work, Contractor must submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan should be based on actual working conditions for this project and include the following:
 - 1. Description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience, list of subcontractors, and a schedule of work activity.
 - 2. Safety plan.
 - 3. Traffic control plan (if applicable).
 - 4. Environmental protection plan.
 - 5. Contingency plans for possible problems.
 - 6. SCDOT requirements plan
- D. Equipment: Contractor will submit specifications on directional drilling equipment to be used to ensure that the equipment is adequate to complete the project. Equipment shall include, but not limited to, the following:
 - 1. Drilling rig.
 - 2. Mud system.
 - 3. Mud motors (if applicable).
 - 4. Down-hole tools.
 - 5. Guidance system.
 - 6. Rig safety systems.
 - 7. Calibration records for guidance equipment.
 - 8. Specifications for any drilling fluid additives that might be used.
- E. Material: Submit to Engineer specifications on any material such as pipe, fittings, or any other item to be an installed component of the project.
- F. Contractor Qualifications: Provide a qualification submittal for the directional drilling contractor with he bid. Include the qualifications for the horizontal directional drilling contractor, the superintendent, the tracking specialist, and the driller to demonstrate compliance with the requirements.

- G. Schedule Submittal: Provide with the bid a work sequence and schedule as required under submittal procedures.
- H. Traffic and Safety Control Plan.
- I. Drill Method: Provide this submittal a minimum of ten (10) days before starting drilling for review and approval. This submittal shall be in compliance with he Drill Plan. Include the following information:
 - 1. Scaled plan showing the following: The work zone equipment configuration at each end of the drill; location of security fencing and access points; staging and storage areas; and the location of bentonite slurry, cuttings, and pit spoil handling areas.
 - 2. Equipment list including make and model number and specifications of all major equipment proposed for use on this project. The Contractor is responsible for the final determination of the drill rig size. The Contractor shall submit a suitably sized drill rig for the project and provide in the submittal documentation demonstrating that the selected drill rig has completed similarly sized and length drills in similar soil conditions.
- J. Drilling procedure: It is recognized and accepted that the Contractor may need to adjust drilling procedures and equipment as new information is developed during the drill. The intent of this requirement is providing the contractor's initial approach to the project to demonstrate constructability.
- K. Material list including bentonite and bentonite additives proposed for the project, and water source for drilling operations.
- L. Bentonite Slurry Control and Tracking Coordination: Provide a minimum of ten (10) days prior to drilling. The intent of this submittal is to coordinate the contractor activities with the drill fluid and tracking specialist.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01640.

PART 2 – EQUIPMENT REQUIREMENTS

2.1 GENERAL

- A. Directional drilling equipment to consist of the following:
 - 1. Directional drilling rig of sufficient capacity to perform the bore and pullback the pipe.

- 2. Drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing.
- 3. Drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used.
- 4. Guidance system to accurately guide boring operations.
- 5. Vacuum truck of sufficient capacity to handle the drilling fluid volume.
- 6. Trained and competent personnel to operate the system.
- 7. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.2 DRILLING SYSTEM

- A. Drilling rig:
 - 1. Hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.
 - a. Anchor the machine to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing.
 - b. Hydraulic power system to be self-contained with sufficient pressure and volume to power drilling operations and to be free of leaks.
 - 2. Rig to have a system to monitor and record maximum pull-back pressure during pull-back operations.
 - 3. Electrically ground the rig during drilling and pull-back operations.
- B. Construct drill pipe of high quality 4130 seamless tubing, Grade D, or better, with threaded box and pins. Toll joints should be hardened to 32-36 RC.

2.3 GUIDANCE SYSTEM

- A. Provide a guidance system of a proven, accurate type with an interface meeting the following requirements:
 - 1. Must provide a continuous and accurate determination of the location of the drill head during the drilling operation.
 - 2. Must be capable of tracking at all depths up to 100' in any soil condition (including hard rock).
 - 3. Probe must provide immediate information on the tool face, azimuth (horizontal direction) and inclination (vertical direction) and must be accurate to $\pm 2\%$ of the vertical depth of the bore hole at sensing

position at depths up to 100' and accurate within 1.5 meters horizontally.

4. System must be setup and operated by personnel trained and experienced. Operator must be aware of any geo-magnetic anomalies and must consider such influences in the operation of the guidance system if using a magnetic system.

2.4 DRILLING FLUID (MUD) SYSTEM:

A. Mixing system:

- 1. Provide self-contained, closed drilling fluid mixing system of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water and appropriate additives.
- 2. Mixing system must be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing.
- 3. System to continually agitate the drilling fluid during drilling operations.
- B. Fluids:
 - 1. Fluid to be composed of clean water, bentonite clay and approved additives.
 - 2. Use water from an authorized source with a pH of 8.5 10.
 - 3. Water of a lower pH or with excessive calcium to be treated with the appropriate amount of sodium carbonate, or equal.
 - 4. Mix water and bentonite clay thoroughly, absent of any clumps or clods.
 - 5. No additional material may be used in drilling fluid without prior approval from the Engineer.

2.5 OTHER EQUIPMENT

- A. Pipe rollers:
 - 1. Provide pipe rollers of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations.
 - 2. Provide a sufficient number of rollers to prevent excess sagging of pipe.
- B. Pipe rammers: Use hydraulic or pneumatic pipe rammers only if necessary and with the authorization of the Engineer.

2.6 HDPE PIPE

A. Polyethylene (PE) pipe:

- 1. Pipe shall be made from HDPE material having a material designation code of PE4710 or higher. The material shall meet the requirements of ASTM D3350 and shall have a minimum cell classification of PE445474C. The pipe shall also conform to ASTM F714.
- 2. The pipe and fittings shall meet the requirements of AWWA C906.
- 3. The pipe shall be DIPS size and shall have a DR of 11 with a working pressure of 200psi.
- 4. All pipe resin shall be manufactured by the same company that manufactures the pipe itself, in accordance with these specifications, to ensure complete resin compatibility and total product accountability.
- B. Fittings:
 - 1. The fittings supplied in this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe and shall conform to ASTM F1055. To ensure compatibility or polyethylene resins, all fittings supplied under this specification shall be of the same manufacture as the pipe being supplied. Molded and fabricated fittings shall have a pressure rating equal to the pipe. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of four times the Working Pressure Rating of the fitting.
- C. Quality control:
 - 1. The resin used for manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties. The polyethylene resin used shall have all ingredients pre-compound prior to extrusion of pipe, in plant blending is not acceptable. Owner may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer's testing or random sampling by the Engineer that do not meet appropriate ASTM standards or manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D3350. Certified lab data may be requested to verify the physical properties of the materials supplied under this specification or may

take random samples and have them tested by an independent laboratory.

- D. Rejection:
 - 1. The Owner reserves the right to reject any polyethylene pipe and fittings failing to meet any of the requirements of this specification.
- E. Pipe dimensions:
 - 1. Pipe supplied under this specification shall have a nominal DIP (ductile iron pipe) size O.D. unless otherwise specified. The DR (Dimension Ratio) of the pipe supplied shall be as specified.
- F. Polyethylene pipe joining:
 - 1. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by the manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures. Prior approval of equipment and personnel shall be obtained before fusion begins. The completed pipe joints shall be guaranteed for five years in writing to the Owner and its Contractor.
 - 2. End connections: Special restrained joint mechanical joint adapters shall be required for each end of the P.E. pipeline. The price quoted shall include any special end configuration and polyethylene ring to hold a standard mechanical joint.

2.7 DUCTILE IRON PIPE

A. General:

- 1. Ductile iron pipe used for directional drilling shall meet all requirements of ANSI/AWWA C151/A21.51. Unless otherwise specified, pipe shall be lined with cement mortar per ANSI/AWWA C104/A21.4, with all operations completed in a single facility by one manufacturer. Pipe shall be AMERICAN Flex-Ring[®] or approved equal.
- 2. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was

produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

- B. Pipe Joints General:
 - 1. Joints used for directional drilling shall be boltless, flexible restrained, with smooth contoured bells and shall have the minimum properties as shown in Table 1. Joints with bulky glands or flanges that may prevent the smooth flow of the drilling fluid/soil slurry over the joint are not acceptable. Pipe shall be AMERICAN Flex-Ring® or approved equal.
- C. Pressure and Thrust (Pulling):
 - 1. Flex-Ring® joint pipe used for HDD shall be a minimum pressure class of 350psi. The Flex-Ring® joint, when properly assembled and installed, shall be capable of dependably handling the specified internal pressure and pulling loads, in straight alignment or at maximum rated joint deflection. Maximum internal pressure and allowable pulling loads for all sizes are provided in Table 1; please contact AMERICAN for any application requiring capabilities greater than those shown.
- D. Proof-of-Design Tests:
 - 1. The manufacturer shall make available to the Engineer representative proof-of-design tests for each size and type of flexible restrained joint pipe used. These tests shall establish the basis for maximum allowable pulling loads shown in Table 1. Proof-of-design tests for the pulling heads shall also be made available to the Engineer.
- E. External Loads and Buckling:
 - 1. In cases where the bore path alignment is at an extreme depth or if the Contractor anticipates high pumping pressures particularly for large sizes of pipes, the Contractor shall consult the pipe Manufacturer to assure that the buckling strength of the pipe has been properly evaluated.
- F. Lining and Coating
 - 1. Ductile iron pipe for water service shall be lined with cement mortar per ANSI/AWWA C104/A21.4.
- G. Pipe Weight Net Unit Buoyancy:

- 1. Pipe buoyant force or buoyant weight required in Section 3.4.1 shall be calculated bases on the density of drilling fluid(s) to be used.
- 2. Any counterweight placed inside the pipe shall be free from any dirt, grease, oil, or other contaminants that may prevent proper disinfection for waterlines.

Table 1 - Flex-Ring Dimensions and Other Parameters®								
Nomial Pipe Size (in.)	Maximum Working Pressure ¹ (psi)	Pipe Barrel O.D. (in.)	Pipe Bell Outside Diameter (in.)	Unit Weight Lined PC 350 Pipe (Ib/ft)	Bulk Density of Empty Pipe (lb/ft ³)	Net Unit Buoyancy ² , Empty Pipe in Water (Ib/ft)	Allowable Pulling Loads (Ibs)	Allowable Deflection (Deg.)
4	350	4.8	7.06	13	100	Minus 5	10,000	5
6	350	6.9	9.19	18	69	Minus 2	20,000	5
8	350	9.05	11.33	25	55	3	30,000	5
10	350	11.1	13.56	31	46	11	45,000	5
12	350	13.2	15.74	40	42	19	70,000	5
14	350	15.3	19.31	53	41	27	75,000	4
16	350	17.4	21.43	65	40	38	95,000	3.75
18	350	19.5	23.7	78	37	52	120,000	3.75
20	350	21.6	25.82	90	35	69	150,000	3.5
24	350	25.8	29.88	122	34	104	210,000	3
1Working pressure is the maximum pressure rating of the joint and is based on its capability to resist thrust due to internal pressure. If higher working pressure is required, check AMERICAN. Pressure rating of the joint is limited by the pressure rating of the parent pipe.								

2Bsed on weight of empty (full of air) Pressure Class 350 Flex-Ring pipe with standard cement lining immersed in water positive numbers indicate such pipe will float.

3Allowable pulling loads are based on pressure class 350 for all sizes.

H. Minimum Radius of Curvature:

1. The Contractor shall maintain the bore path alignment and a minimum radius equal to 100-feet per inch of nominal diameter, using 20-foot joint lengths radii that are indicated on the project drawings. Any alternate designs must be submitted to the Engineer for approval prior to commencement of drilling operations and shall be based on a radius of not less than 50-feet per inch of nominal diameter.

- I. Bore Path Inside Diameter:
 - 1. The finished inside diameter of the bore path shall be nominally 1.5 times the outside diameter of the Flex-Ring bell (see Table 1) for pipe sizes 4-inch through 24-inch. The inside diameter of the bore path for pipe sizes 30-inch through 48-inch shall be equal to the outside diameter of the Flex-Ring bell (see Table 1) plus 12-inches. To assure proper bore path size and integrity, the bore path shall be swabbed prior to final pipe pullback.

PART 3 – EXECUTION (HDPE)

3.1 GENERAL

A. The Engineer must be notified 48 hours in advance of starting work. Directional bore shall not begin until the Engineer's representative is present at the job site.

3.2 PERSONNEL REQUIREMENTS

- A. General:
 - 1. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety.
 - 2. A competent and experienced supervisor representing the Contractor and drilling subcontractor shall be present at all times during the actual drilling operations.
 - 3. A responsible representative, thoroughly familiar with the equipment and type of work to be performed, must be in direct charge and control of the operation at all times.
 - 4. Supervisor must be continually present at the job site during the actual directional bore operation at all times.
 - 5. A sufficient number of competent workers must be provided at all times to ensure the directional bore is made in a timely and satisfactory manner.

3.3 DRILLING PROCEDURE

- A. Site preparation:
 - 1. Contractor to provide photograph or video tape of the entire work area, including entry and exit points prior to any alterations to work site, including:
 - a. Provide Engineer with one copy of photograph or video tape.

- b. One copy to remain with Contractor for a period of one year following the completion of the project.
- B. Drill path survey: Accurately survey the entire drill path with entry and exit stakes placed in the appropriate locations. If Contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations of anomalies.
- C. Environmental protection:
 - 1. Place silt fence between all drilling operations and any drainage, wetland, waterway, or other area designated for such protection by contract documents, state, federal and local regulations.
 - 2. Install berms, liners, turbidity curtains and any other measures necessary to contain any hydraulic or drilling fluid spills for additional environmental protection.
 - 3. Adhere to all applicable environmental regulations.
 - 4. Do not store fuel in bulk containers within 20' of any water-body or wetland.
- D. Pipe: Weld/fuse pipe together in one length prior to placing in bore hole. Place pipe on rollers before pulling into bore hole. Space rollers close enough to prevent excessive sagging of pipe.
- E. Pilot hole:
 - 1. Drill pilot hole or bore path with no deviations greater than 5% of depth over a length of 100'. In the event that pilot does deviate from bore path more than 5% of depth in 100', the Engineer may require pull-back and re-drilling from the location along bore path before the deviation.
 - 2. In the event that a drilling fluid fracture, inadvertent returns, or returns loss, occurs during pilot hole drilling operations, cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, cease operations and notify Engineer.
- F. Pull-back:
 - 1. After successfully reaming bore hole to the required diameter, contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel and barrel reamer to compact bore hole walls. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole.

2. Do not apply more than the maximum safe pipe pull pressure during pull-back operations.

3.4 SITE RESTORATION

- A. De-mobilize equipment to restore the work site to original condition once drilling operations are terminated.
- B. Backfill and compact all excavation to 95% of original density.

3.5 RECORD KEEPING AND AS-BUILTS

- A. Maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer at completion of the project.
- B. A professional surveyor must complete and certify as-built drawings.

PART 4 – EXECUTION (DIP)

4.1 GENERAL

A. The Engineer must be notified 48 hours in advance of starting work. Directional bore shall not begin until the Engineer's representative is present at the job site.

4.2 PERSONNEL REQUIREMENTS

A. General:

- 1. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety.
- 2. A component and experienced supervisor representing the Contractor and drilling subcontractor shall be present at all times during the actual drilling operations.
- 3. A responsible representative, thoroughly familiar with the equipment and type of work to be performed, must be in direct charge and control of the operation at all times.
- 4. Supervisor must be continually present at the job site during the actual directional bore operation at all times.

5. A sufficient number of competent workers must be provided at all times to ensure the directional bore is made in a timely and satisfactory manner.

4.3 DRILLING PROCEDURE

- A. Site Preparation:
 - 1. Contractor to provide photograph or video of the entire work area, including entry and exit points prior to any alterations to work site, including:
 - a. Provide Engineer with one copy of photograph or video tape.
 - b. One copy to remain with Contractor for a period of one year following the completion of the project.
- B. Drill Path Survey: Accurately survey the entire drill path with entry and exit stakes placed in the appropriate locations. If Contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.
- C. Environmental protection:
 - 1. Place silt fence between all drilling operations and any drainage, wetland, waterway, or other area designated for such protection by contract documents, state, federal and local regulations.
 - 2. Install berms, liners, turbidity curtains and any other measures necessary to contain any hydraulic or drilling fluid spill for additional environmental protection.
 - 3. Adhere to all applicable environmental regulations.
 - 4. Do not store fuel in bulk containers within 20' of any water-body or wetland.

4.4 CARTRIDGE ASSEMBLY (OPTION 1)

Cartridge assembly option shall be defined by the assembling of individual sections of Flex-Ring®, flexible restrained joint ductile iron pipe in a secured entry and assembly pit. The pipe sections are assembled individually and then progressively pulled into the bore path a distance equivalent to a single pipe section. This assembly-pull process is repeated for each pipe length until the entire line is pulled through the bore path to the exit point. At all times prior to the pipe entering the bore path the Contractor shall monitor the pipe to assure that the allowable joint deflection, as shown in Table 1, is not exceeded.

4.4 ASSEMBLED-LINE (OPTION 2)

Assembled-line option shall be defined by the pre-assembly of multiple pieces of Flex-Ring®, flexible restrained joint ductile iron pipe, with subsequent pulling installation into the bore path as one continuous pipe string. With this option the Contractor shall provide an entry ramp to the entrance of the bore path. The ramp should be of sufficient length and grade such that no pipe joint exceeds the allowable joint deflection as shown in Table 1, at any point prior to the pipe string entering the properly designed and prepared bore path. The Contractor shall be responsible for providing the necessary equipment or ground surface preparation to allow the pipe to be pulled back along the surface prior to the entry ramp and bore path. If polyethylene encasement is required, the contractor shall provide a sufficient number of pipe rollers such that the pipe is supported every 20-feet for the entire length of the assembled pipe length. At all times prior to the pipe entering the bore path the Contractor shall monitor the pipe to assure that the allowable joint deflection, as shown in Table 1, is not exceeded.

4.5 SITE RESTORATION

- A. De-mobilize equipment to restore the work site to original condition once drilling operations are terminated.
- B. Backfill and compact all excavation to 95% of original density.

4.6 RECORD KEEPING AND AS-BUILTS

- A. Maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer at completion of project.
- B. A professional surveyor must complete and certify as built drawings.

END OF SECTION

SECTION 02930

GRASSING

PART 1 – GENERAL

1.1 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, equipment, tools, and materials necessary to perform all tasks required to complete all grassing within the limits of right-of-way and other disturbed areas shown on the plans, in coordination with all other divisions of WORK. Any incidental work, material, or appurtenances not specifically shown, but necessary for completion of the WORK, shall be furnished as required. All unpaved areas cleared and grubbed, graded, filled, excavated, or otherwise disturbed during construction, both within and beyond the right-of-way limits shown on the plans, shall be grassed. Grassing includes both temporary and permanent grassing.

1.2 GENERAL

The CONTRACTOR shall be responsible for verifying the condition and suitability of areas to receive grassing. The WORK to be performed under this section consists of preparing the seedbed or area to be sodded, furnishing, and placing sod, furnishing, placing, and covering limestone, fertilizer, and seed, compacting seedbeds, furnishing and securing mulch, mowing, and other operations necessary for the permanent establishment of grasses. All disturbed areas are to be grassed.

The CONTRACTOR shall adapt his operations to variations in the weather, seasons of the year, and soil conditions as necessary for the establishment of temporary and permanent grass cover.

Before acceptance and final payment is made for the grassing work, a complete and full coverage of all areas are to be filled, reseeded, and completely covered with grass.

Areas where washing is evident are to be regraded, stabilized with degradable woven mesh, secured with stakes in accordance with the manufacture's recommendations, and re-grassed.

PART 2 – PRODUCTS

2.1 GENERAL

A. Permanent grassing shall be established on all unpaved areas graded or disturbed during construction.

B. Materials shall be approved by the Engineer prior to use and shall include limestone, fertilizer, seed, and mulching materials.

2.2 FERTILIZER

A. Provide a mixed fertilizer with a designation such as 10-10-10, where the first number represents the minimum percent of nitrogen required, the second number represents the minimum percent of available phosphoric acid required, and the third number represents the minimum percent of water soluble required in the fertilizer. For centipede grass, use only 15-0-15 or 16-4-8 fertilizer. Fertilizer shall be delivered to the site in bags labeled with the manufacturer's guaranteed analysis.

2.2 GRASS SEED

- A. Provide grass seed which is:
 - 1. Free from noxious weed seeds, and recleaned.
 - 2. Grade A recent crop seed.
 - 3. Treated wit appropriate fungicide at time of mixing.
 - 4. Delivered to the site in sealed containers with dealer's guaranteed analysis.

2.3 LIME

- A. Limestone shall be agricultural grade limestone containing no less than 85 percent by weight of combined calcium and magnesium carbonate. All limestone shall be graded so the 100 percent will pass through U.S. Standard 10 mesh screen and 40 percent will pass through U.S. Standard mesh screen. Any hardened or caked limestone shall be pulverized to its original condition before being used.
- B. Bag tags or delivery slip for bulk loads shall indicate brand or trade name, calcium carbonate equivalent, and other pertinent data to identify the lime.

2.4 WOOD CELULOSE FIBER

- A. Provide wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer.
- B. Material to be heat processed to contain no germination or growth inhibiting factors.
- C. It shall be dyed (non-toxic) an appropriate color to facilitate metering.

2.5 STRAW MULCH

- A. Provide straw or hay material.
 - 1. Straw to be stalks of wheat, rye, barley, or oats.
 - 2. Hay to be timothy, peavine, alfalfa, or coastal bermuda.
- B. Material to be reasonably dry and reasonably free from mature seed-bearing stalks, roots, or bulblets or Johnson Grass, Nutgrass, Wild Onion and other noxious weeds.

2.6 EXCELSIOR FIBER MUCLH

- A. To consist of 4" to 6", average length, wood fibers cut from sound, green timber.
- B. Make cut in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood.

2.7 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans.
- B. Provide Erosion Control Blanket S150, from North American Green, or approved equal.

2.8 SODDING

Sodding shall be required in established lawn areas or where seeding will not remain due to washing. All sod shall comply with State Seed Laws of the State of South Carolina. Sod shall be of similar variety of that displaced. Sod shall be cut in strips or rectangular sections which may vary in length but shall be of equal width and of a size that will permit the sections to be lifted and rolled without breaking. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. When the soil is too dry, the sod shall be cut only after the CONTRACTOR has watered the sod sufficiently to moisten the soil to a depth at which the sod is to be cut. Torn or unevenly cut strips or sections will not be acceptable.

Sod shall be placed after the soil has been prepared as specified. Care shall be always exercised to retain the native soil on the roots of the sod during the process of stripping, transporting, and planting. Dumping from vehicles will not be permitted. The sod shall be transplanted within 24 hours from the time of stripping, unless stored in a satisfactory manner. During delivery and while in stacks, the sod shall be kept moist and shall be protected from exposure to the air and sun.

Sod shall be laid smoothly, edge to edge, with staggered joints. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with acceptable equipment to eliminate all air pockets, provide a true and even surface, and assure knitting. Small gaps or voids remaining after the sod is laid shall be filled with topsoil.

Staking of sod on slopes will not be required; however, the CONTRACTOR shall be solely responsible for replacing sod displaced by erosion or other causes.

After rolling, sod shall be irrigated to a depth sufficient that the underside of the sod section and the soil four (4) inches below the sod is thoroughly wet. Sod shall be watered during the first three to four weeks as necessary to maintain moist soil to a depth of at least two (2) inches.

2.9 TEMPORARY GRASSING

Temporary grassing shall be performed in selected areas in advance of permanent grassing operations for the purpose of minimizing erosion in graded and disturbed areas during construction operation. Temporary grassing is a supplement to and not a substitute for, permanent grassing operations, erosion, or sediment control measures. The WORK shall include preparing seedbeds; furnishing, placing, and covering fertilizer and seeds; mowing; and any other operations necessary for establishing temporary grassing of the required areas.

Temporary Grassing shall be done promptly at the location and times directed by the Engineer and under the following conditions:

- 1. When a graded area cannot be brought to final grade and remain undisturbed and permanently grassed during construction, temporary grassing shall be provided until final grade can be obtained, and the graded area permanently grassed.
- 2. When washing or erosion can occur on disturbed areas where temporary suspension of construction activity has taken place.
- 3. When an immediate ground cover is desirable to minimize washing, erosion, sedimentation, or pollution on any area.
- 4. When the season of the year is not suitable for establishing permanent grassing.

Areas to be grassed shall be loosened to a depth of five (5) inches. The surface to be seeded shall have adequate terraces and other irregularities in which seed and fertilizer can lodge so that the grassing materials cannot be easily dislodged by wind, rain, or surface runoff.

Seed and Fertilizer shall be applied uniformly at the required application rates over the prepared area to be grassed.

10-10-10 Fertilizer shall be applied at a rate of 500 pounds per acre.

Mulch shall be spread uniformly by hand or by mechanical spreader and blowers in the amount of 60 bales per acre.

Areas of Temporary Grassing shall be maintained in satisfactory condition until being permanently grassed. The maintenance shall include repair of erosion, reseeding, and mowing. All WORK to maintain areas of temporary seeding shall be done promptly at the direction of the District Engineer.

PART 3 – EXECUTION

3.1 GENERAL

- A. Seed these areas immediately upon completion of grading or construction and clean-up operations.
 - 1. Slopes greater than four horizontal to one vertical.
 - 2. Utility rights-of-way adjacent to stream banks.

3.2 SEEDING SCHEDULE

A. Unless otherwise provided, select the type of seeding from the tables shown below for the upper state and the lower state regions as applicable to the project. The total seed rate in pounds per acre is the sum shown for all the varieties of seed opposite the schedule number in the seeding schedules included herein.

Seeding Schedule for Permanent Vegetation Upper State					
Schedule No.	Common Name of Seed	Pounds/acre Rural1	Pounds/acre Urban1	Planting Dates	
1	Common				
	Bermuda				
	(hulled)3	23	23		
	Sericea				
	Lespedeza			March 1E to August 14	
	(scarified)2	50	50	March 15 to August 14	
	Kentucky 31				
	Fescue	50	60		
	Weeping				
	Love Grass2	10	10		
-	Kentucky 31				
	Fescue	50	80		
	Sericea				
	Lespedeza				
	(unhulled,				
	unscarified)2	80	80		
	Common				
	Bermuda				
2	(unhulled)3	30	30	August 15 to March 14	
	Weeping				
	Love Grass2	10	10		
	Reseeding				
	Crimson				
	Clover4	20	0		
	Annual Rye				
	Grass5	5	15		
	Rye Grain	20	0		

B. Adhere to the following permanent seeding schedules:

1 Includes rural areas adjacent to well-developed lawns.

2 Not required on shoulders, medians, etc. and on slopes under 5 feet in height.

3Do not use Giant Bermuda seed

including NK-3.

4Provide an inoculant for treating reseeding crimson clover seed of a pure culture of nitrogen-fixing bacteria selected for a maximum vitality and ability to transform nitrogen from the air into soluble nitrates and deposit them in the soil. Ensure that inoculants consist of purebred cultures and are not more than one year old. Do not plant clover in medians or in rural areas adjacent to well-developed lawns. 5the use of Italian Rye Grass is prohibited on all projects.

C. Temporary seeding schedule

Seeding Schedule for Temporary Vegetation					
Schedule No.	Common Name of Seed Pounds/act		Planting Dates		
1	Brown Top Millet	50	April 1 to August 15		
	Rye Grain	55	August 16 to March 31		
2	Annual Rye Grass1	15			
1 The use of Italian Rye Grass is prohibited.					

3.3 GROUND PREPARATION

- A. Bring all areas to proper line, grade and cross section indicated on the plans.
- B. Repair erosion damage prior to commencing seeding operations.
- C. The seedbed shall be prepared in topsoil placed by the CONTRACTOR. The soil shall be scarified or otherwise loosened to a depth of five (5) inches or more. All clods are to be broken up and all rocks and debris removed. The upper three (3) inches of soil shall be worked into an acceptable seedbed using a pulverizer, drags, or harrow. Seeding and fertilizing shall not be done during periods of such severe drought, high winds, or excessive moisture, as determined by the Engineer, that satisfactory results are not likely to be obtained.
- D. Limestone shall be uniformly applied at a minimum amount of 2000 pounds per acre and worked into the soil prior to incorporation of the seed.
- E. Fertilizer, limestone, and seed shall be applied within 24 hours of completing seedbed preparation.

3.4 APPLICATION OF FERTILIZER

A. Spread uniformly over areas to be seeded.

- 1. Rate of 1,000 lbs. per acre.
- 2. Fertilize centipede at the application rate of 20 pounds per acre of 16-4-8 or 15-0-15.
- 3. Use approved mechanical spreaders.
- B. Mix with soil to depth of approximately 3 inches.

3.5 SOWING METHODS

- A. General:
 - 1. Perform seeding during the periods and at the rates specified in the seeding schedules.
 - 2. Do not conduct seeding work when ground is frozen or excessively wet.
 - 3. Produce satisfactory stand of grass regardless of period of the year the Work is performed.

3.6 MULCHING

Mulch shall be applied to the seedbed area within 36 hours after completion of the seeding operation.

- **1.** Prior to applying mulch, all roots, debris, and rocks greater than two (2) inches in diameter are to be removed from the seedbed area.
- **2.** Care shall be taken not to displace soil or seed during mulching operations.
- **3.** Mulch shall be spread uniformly by hand or by mechanical spreaders and blowers in the amount of 60 bales per acre.
- **4.** Mulch on slopes greater than 5 percent is to be held in place by applying emulsified asphalt in the amounts of 250 gallons of emulsified asphalt per acre or shall be held in place by woven mesh properly staked.
- **5.** Mulch in ditch lines is to be held in place by woven mesh and replaced as required if washed away by heavy rains.

Other suitable means of holding the mulch in place may be used with prior approval of the District Engineer.

3.7 SECOND APPLICATION OF FERTILIZER

- A. When plants are established and showing satisfactory growth, apply nitrogen at the rate of 1.0 pound per 1000 square feet.
- B. Apply in dry form unless otherwise directed by the Engineer.
- C. Do not apply to stands of temporary grasses.

3.8 MAINTENANCE

- A. Maintain all seeded areas in satisfactory condition until final acceptance of the work.
- B. Areas not showing satisfactory evidence of germination within six weeks of the seeding date shall be immediately reseeded, fertilized and/or mulched.
- C. Repair any eroded areas.
- D. Maintenance shall include mowing, repair of areas of erosion and washing, repair of damaged areas, areas of soft material likely to cause rutting, and reseeding as necessary to establish a sufficient uniform grass cover.

3.9 ACCEPTANCE

- A. Permanently seeded areas (Schedule "B") will be accepted when the grass attains a height of two inches.
- B. No acceptance will be made of temporary seeded areas (Schedule "A"); Rework and seed with Schedule "B".

END OF SECTION