SECTION 01500

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART I - GENERAL

1.0 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 South Carolina Department of Transportation (SCDOT) - Standard Specifications for Highway Construction (Latest Edition)

1.2 American Association of State Highway and Transportation Officials (AASHTO) Publications:

T 88-86	Particle Size Analysis of Soils
T 180-86	Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop
T 191-86	Density of Soil In-Place By the Sand-Cone Method
T 205-86	Density of soil In-Place by the Rubber-Balloon Method
T 238-86	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
T 239-86	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.3 American Society of Testing and Materials (ASTM) Publications:

D 422-63	Particle-Size Analysis of Soils (R 1972)
D 1556-82	Density of Soil In Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
D 2167-84	Density and Unit Weight of Soil In Place by the Rubber Balloon Method
D 2487-85	Classification of Soils for Engineering Purposes
D 2922-81	Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

PART II - PRODUCTS

2.0 DEFINITIONS:

2.1 Satisfactory Materials: Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, GM, GC, SP, and SW.

2.2 Unsatisfactory Materials: Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 3 inches, and materials classified in ASTM D 2487, as CH, MH, SM, SC, CIL, ML, PT, OH, and OL. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

2.3 Cohesionless and Cohesive Materials: Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.4 Rock: Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements will not be considered as rock.

2.5 Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.5 Unstable Material: Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.6 Select Granular Material: Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and not less than 95 percent by weight passing the I inch sieve. The maximum allowable aggregate size shall be ¾ inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.7 Initial Backfill Material: Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

2.8 Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D.

2.9 Plastic Marking Tape: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick. The tape is to be solid in color as specified in Table 1 and shall bear a continuous printed inscription in black letters describing the specific utility.

TABLE 1
Tape Color

Blue:	Water Systems
Green:	Sewer Systems

PART III - EXECUTION

3.1 General Quality Control Testing: shall be the responsibility of the Contractor and shall be performed at no additional cost to the Owner.

3.1.1 Testing Facilities: Tests shall be performed by an approved commercial testing laboratory.

3.1.2 Testing of Backfill Materials: Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils AASHTO T 88 or ASTM D 422, classification tests, and moisture-density relations of soils, AASHTO T 180, Method D. A minimum of one particle size analysis and one moisture density relation test shall be performed on each different type of material used for bedding and/or backfill as required by the Engineer.

3.1.3 Construction Quality Control: Quality control sampling and testing during construction shall be performed as required in paragraph FIELD QUALITY CONTROL.

3.2 Submittals: Copies of all laboratory and field test reports shall be submitted to the Engineer within 24 hours of the completion of the test.

3.3. Excavation: Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph DEFINITIONS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Adequate drainage and erosion control shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory onsite or imported material from approved sources at no additional cost to the Owner. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water

accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained.

Unauthorized over excavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Owner.

3.3.1 Trench Excavation: The trench shall be excavated as recommended by the manufacturer of the pipe to be installed and required by OSHA regulations. Trench walls below and above the top of the pipe shall be sloped, or made vertical, as recommended in the manufacturer's installation manual. The trench width below the top of the pipe shall not exceed that recommended in the installation manual. Where no manufacturers' installation manuals are available, trench walls below the top of the pipe shall be vertical, and trench walls above the top of the pipe shall be sloped as required to properly complete the work. Trench walls more than five (5) feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than five (5) feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. Trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe O.D. for larger sizes. Where recommended trench widths are exceeded, redesign shall be performed by the Contractor using stronger pipe or special installation procedures. The cost of redesign and the increased cost of pipe or installation procedures shall be borne by the Contractor without any additional cost to the Owner.

3.3.1.1 Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.3.1.2 Removal of Unyielding Material: Where unyielding material is encountered in the bottom of the trench, such material shall be removed four (4) inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.3.1.3 Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, such material shall be removed to a minimum depth of 12 inches and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Owner.

3.3.1.4 Bedding:

a) Bedding Classes A, B, C or crushed stone as described in ASTM C12 or as defined as selected granular material (Para. 2.6) shall be used and carefully compacted for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the soil encountered and potential ground water conditions.

b) Embedment materials for bedding, haunching and initial backfill, Classes I, II, or III, as described in ASTM D 2321, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the type of soil encountered and the potential groundwater conditions.

c) Bedding shall be used in all new water or sewer construction unless written approval is obtained from the Commission that the existing soils and ground water conditions allow for use of in-situ soils.

3.3.2 Excavation for Appurtenances: Excavation for manholes, catch basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.3.3 Jacking, Boring, and Tunneling: Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled, if, in the opinion of the Engineer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly tamped in such sections.

3.3.4 Stockpiles: Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubbertired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Engineer.

3.4 Backfilling And Compaction: Backfill material shall consist of satisfactory material. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.4.1 Trench Backfill: Trenches shall be backfilled to the grade shown.

3.4.1.1 Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with satisfactory material.

3.4.1.2 Replacement of Unstable Material: Unstable material removed from bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.4.1.3 Bedding and Initial Backfill: Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.4.1.4 Final Backfill: The remainder of the trench shall be backfilled with satisfactory material. Backfill material shall be deposited and compacted as follows:

3.4.1.4.1 Roadways, Driveways and Other Paved Areas: Backfill shall be deposited in layers of a maximum of 8-inch loose thickness, and compacted to SCDOT requirements or 93 percent maximum density for cohesive soils and 97 percent maximum density for cohesionless soils, whichever greater. Compaction by water flooding or jetting will not be permitted.

3.4.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.4.2 Backfill for Appurtenances: After the manhole, catch basin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for three (3) days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of failing earth. The backfill

material shall be deposited and compacted as specified for final backfill, and shall be placed in such a manner as to prevent eccentric loading and excessive stress on the structure.

3.5 SPECIAL REQUIREMENTS For Both Excavation And Backfill Relating To The Specific Utilities Are As Follows:

3.5.1 Water Lines: Trenches shall be of a depth to provide a minimum cover of three (3) feet or four (4) feet within SCDOT road right-of-way from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. At locations parallel to SCDOT roadways, the depth of cover over the pipe shall be measured from a reference elevation at the centerline of the road.

3.5.2 Force Mains: Trenches shall be of a depth to provide a minimum cover of three (3) feet or four (4) feet within SCDOT road right-of-way from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. At locations parallel to SCDOT roadways, the depth of cover over the pipe shall be measured from a reference elevation at the centerline of the road.

3.5.3 Plastic Marking Tape: Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.6 Field Quality Control: Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Owner.

3.6.1 Field Density Tests: Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 1000 feet or fraction of installation shall be performed, unless indicated otherwise in writing by the engineer. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with AASHTO T 191. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each difference type of material encountered, at intervals as directed by the Engineer. Copies of results of field and laboratory density tests shall be furnished to the Engineer within 24 hours of conclusion of the tests. Trenches improperly compacted to the density specified shall be re-compacted at no additional cost to the Owner.

END OF SECTION