SECTION 02220
STRUCTURE EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the excavation and backfill or disposal of all materials required for the construction of structures for which excavation is not otherwise provided, in accordance with these specifications and in reasonably close conformity with the lines, grades, and typical cross sections shown on the Drawings. The work specified in this section includes removing and satisfactorily disposing of all materials of whatever nature encountered in the excavation necessary for the construction of the foundations for all structures; all pumping, bailing, and draining; the necessary construction and subsequent removal of all cribs, cofferdams, or caissons; the replacement of backfill to the required ground level; the disposal of surplus materials; and final clean-up.

B. All excavation and backfilling shall be in accordance with “Report of Phase III Geotechnical Exploration”, performed by Law Engineering and issued June 7, 2000.

C. Complete all clearing and grubbing operations for excavation areas before starting excavation operations. The Subcontractor shall be responsible for and shall take all necessary precautions to protect and preserve any and all existing structures, culverts, pipelines, conduits, wires, subdrains, or parts thereof that may be affected by his operations. The Contractor, at their own expense, satisfactorily repair or replace any damaged part of any such structure, culvert, pipeline, conduit, wire, or subdrain that may result from his operations or negligence during the life of the contract.

D. Strip and stockpile all topsoil in cut and fill areas at a location directed by the Construction Manager (CM).

E. At all times during construction, maintain the area so that it will be well drained.

F. All excavation, trenching, or other activities shall be in accordance with OSHA safety regulations. Trenches more than four feet in depth shall be shored or laid back to a stable slope or provided with some other equivalent means of protection. Promptly backfill trenches to keep free of water.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions apply to this Section.

1.3 SUBMITTALS

A. Submit shop drawings for all products specified in this section in accordance with the requirements of General and Supplementary Conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material for earthfill shall be obtained from excavations or borrow areas specified by the CM and shall be free of stones (larger than six inches), roots, brush, rubbish, organic matter and other debris.

B. Material for granular fill shall be Tennessee Department of Transportation (TDOT) Class A, Grade D, Base Stone.

Grain Size Analysis

Screen Size	% Passing
1-1/2 inches	100
1 inch	85-100
3/4 inches	60-95
3/8 inches	50-80
No. 4	40-65
No. 16	20-40
No. 100	9-18

The granular material shall be free of thin, flat, or elongated pieces and shall consist of sound durable particles. The material shall be free of soft friable particles, shale, salt, organic matter, or an adherent coating (other than dust).

C. Clean-graded aggregate, crushed stone, compacted structural fill shall be ASTM D 448, size 57 or 67.

D. Flowable fill: For backfill in areas shown on the Drawings. Provide a controlled density concrete fill with 28-day compressive strength equal to 100 psi, with constituent materials having no noticeable odor during or after installation, and that comply with chemical criteria for project backfill.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove all material to the full depth of the foundation, and use it for backfilling, place it in embankments, or dispose of it at locations approved by CM.

B. Cut all excavation true to alignment and grade without rounded corners and edges, and allow no projections of any kind to extend into the neat lines of the structures.

C. Earth surfaces upon which earthfill is to be placed, shall be firm and free of loose rock, oil, organic material, construction debris, and other deleterious matter. There shall be no standing water on the earth surface when the earthfill is being placed.

D. Except when otherwise noted on the drawings, complete the backfill to the elevation of the required ground, and shape the area lying outside the limits of embankment to a uniform finish.

E. Place no backfill against any concrete or masonry structure until approval has been given by the CM.

F. Dispose of excess materials on-site in locations approved by the CM.

3.2 FOOTING EXCAVATION

A. Whenever practicable, construct all substructures in open excavation. Shore, brace, or protect foundation openings with cofferdams in accordance with approved methods whenever necessary.

B. Excavate the foundation pits to permit placement of the full width and length of the footings shown on the drawings with full horizontal beds. Rounded or undercut corners and edges of footings will not

be permitted. All rock and other hard foundation material shall be free from all loose material, cleaned, and cut to a sound surface (clean, solid rock) that is level, stepped, or roughened. Clean all seams, and fill with concrete, mortar, or sand. When concrete is to rest on an excavated surface other than rock, take special care not to disturb the bottom of the excavation, and do not remove the final two inches of the foundation material to grade until the day before the concrete is to be placed. Maintain excavation free from standing water.

C. When the condition of the excavation for footings is such that concrete cannot be placed without mud becoming mixed with the concrete but is otherwise satisfactory, perform special operations to remedy such conditions. Place enough sand, crushed stone, or a combination of such aggregates to prevent the infiltration of mud; otherwise, remove the entire mass of mud, and replace with suitable stable material.

D. Place no concrete in the foundation until the depth of excavation and the character of the foundation material have been inspected by the CM and approved.

3.3 BACKFILLING

A. Before placing backfill, all pieces of wood and any other deleterious materials shall be removed from the surface receiving backfill.

B. Before earthfill operations begin, representative samples of the proposed fill material shall be collected and tested to determine the maximum dry density, optimum moisture content and natural moisture content. These tests are needed to determine if the material is acceptable for fill and for quality control during compaction.

C. The earthfill material shall be spread, leveled, and compacted in layers. Loose lift thickness shall not exceed eight inches. Compaction shall be performed by large tamping (sheepsfoot) rollers. Other types of rollers are subject to approval by the CM. Scarification depth of the previously placed layer of fill should be approximately two inches, but not more than one third the thickness of the compacted lift.

D. The earthfill shall be compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698). The upper 12 inches beneath grade slabs shall be compacted to at least 100 percent of standard Proctor maximum dry density.
   1. The moisture content of the soils compacted to 95 percent standard Proctor that support load bearing foundations shall be maintained within +2 to –2 percentage points of the optimum moisture content as determined from the standard Proctor compaction test. General earthfill compacted to 95 percent standard Proctor shall be placed within three percent of optimum moisture content. This requirement may require drying the soils during periods of wet weather or wetting the soils during dry weather. The fill soils shall have a maximum dry density of no less than 90 pounds per cubic foot (pcf).
   2. The fill surface must be adequately maintained during construction in order to achieve an acceptable compacted fill. The fill surface shall be sloped to achieve sufficient drainage to prevent ponding of water on the fill. If precipitation is expected while fill construction is temporarily halted, the surface shall be rolled with rubber-tired or steel drummed equipment to improve surface run-off. If the surface soils become excessively wet or frozen, fill operations shall be halted.
   3. In areas where thin slivers of earthfill are to be placed upon slopes steeper than 5:1, a series of localized benching excavations shall be made into the existing slopes prior to placing the overlying compacted earthfill.

E. Heavy compactors and grading equipment should not be allowed to operate within ten feet of the walls during backfillings. Backfill adjacent to walls should be densified by light compaction equipment.

F. Place and compact backfill material in uniform horizontal layers no more than eight inches thick (loose measurement). Compact each layer with mechanical tampers. Do not allow successive blows of the tamper to overlap less than 1/4 of the width of the tamper head. Dampen each layer whenever necessary to ensure the maximum density obtainable, as directed by the CM. Backfill that will be beneath or within a proposed embankment shall meet the compaction requirements for embankment required by the contract.

G. In-place density tests for earthfill shall be performed in accordance with ASTM D 1556 or ASTM D 2167 or ASTM D 2922. A minimum of one density test shall be performed on any day of compaction activity. Additionally, a minimum of one density test shall be made for each 500 cubic yards of compacted fill. A moisture content test shall be performed with each in-place density test. The moisture content of the material shall be determined in accordance with ASTM D 2216 or ASTM D 3017.

H. As a precaution against introducing unbalanced stresses in walls or columns, place and compact backfill to the same elevation on both sides of walls or piers, and then proceed to the next layer using lift heights approved by the CM.

I. Quality control tests for density and moisture content shall be performed during the course of the work to assure the required densities and moisture contents are achieved. Any lift of earthfill not meeting this acceptance criteria shall be recompacted and retested for compliance. No new earthfill material shall be placed until the underlying lift has been verified to meet the acceptance criteria.

J. Flowable fill placement shall not cause any FRP pipe chase to deform more than 1.5%.

3.4 GRANULAR FILL BACKFILL

A. The granular fill material shall be spread, leveled, and compacted in layers with large smooth drum vibratory rollers. Other types of rollers are subject to approval by the CM.

B. Testfills or testpads shall be constructed to select appropriate compaction equipment, number of equipment passes, and lift thickness best suited to produce optimum densification. A minimum of three in-place density tests in accordance with ASTM 2922 shall be conducted for each variation in compaction equipment, number of passes, and lift thickness.

C. The CM will determine the location for the testfills and/or testpads. These may be located outside the immediate work area.

D. Based upon the results of the testfills or testpads, the CM will develop procedural specifications for the compaction of the granular fill. The procedural specification will stipulate the required compaction equipment, number of equipment passes per lift, and lift thickness.

E. To insure quality control and the adequacy of the procedural specification, a minimum of one in-place density test in accordance with ASTM D 2922 shall be performed for each lift. Fill that fails the density acceptance criteria shall be reworked, recompacted, and retested.

F. There are no moisture content requirements for compacted granular fill; however, the maximum inplace unit weight of the Class A, Grade D, base stone shall not exceed 125 pcf.

G. Large vibratory rollers shall not be used to compact any backfill immediately behind a structure, e.g. retaining walls. In these areas, approved mechanical tampers may be used to compact materials in successive uniform horizontal layers not exceeding eight inches.

END OF SECTION 02220