Technical Memorandum

U.S. Department
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Subject: Geotechnical Recommendations
FL PFH 12-1(1)
River Styx Bridges
Apalachicola National Forest, Liberty County, FL

INTRODUCTION

This memorandum presents geotechnical recommendations for the replacement of two bridge structures and 0.35 miles of road realignment. The project is located between mileposts 2.3 and 2.5 miles west of the FR 115/SR 379 intersection on FR 115, in the Apalachicola National Forest, Liberty County, Florida.

SUBSURFACE CONDTIONS

Southern Earth Sciences, Inc. conducted a subsurface investigation, including laboratory testing of collected samples, in November 2004. A Geotechnical Investigation Report for each bridge was completed in December 2004 for the Forest Service that includes foundation recommendations. Two soil borings were performed at both existing bridge structures.

At MP 2.3, the site soils may be divided into four (4) strata. The Stratum 1 soils generally consisted of loose to firm sands and clayey sands to depths ranging from about 12 to 17 feet below existing grades. Stratum 2 consisted of soft silty sandy clays to depths of about 20 to 22 feet below existing grades. The Stratum 3 soils consisted of firm to very firm sands to depths ranging from about 42 to 47 feet below existing grades. Stratum 4 consisted of stiff to very stiff silty sandy clays and highly plastic clays to the termination depth of the borings at 50 feet below existing grades. At the time of drilling, the groundwater level was measured at a depth of 8 feet below existing grades. Fluctuations in the ground water level due to seasonal and climatic effects should be expected.

At MP 2.5, the site soils may be divided into three (3) strata. The Stratum 1 soils generally consisted of loose to very firm slightly silty sands, silty/clayey sands, and clayey sands to a depth of about 12 feet below existing grade. Stratum 2 consisted primarily of firm clean sands to the depth of 47 or 50 feet below existing grade. The Stratum 3 soils consisted of very soft to very hard highly elastic silt with limestone fragments to the termination depth of 60 feet below grade. At the time of drilling, the groundwater level was measured at a depth of 7.5 feet below existing grades. Fluctuations in the groundwater level due to seasonal and climatic effects should be expected.

FOUNDATION RECOMMENDATIONS

Three options were initially identified for bridge reconstruction: (1)install a 42-ft CON/SPAN precast modular concrete bridge just upstream of each existing bridge location, (2) install multiple barrel box culverts, or (3) install a single concrete culvert. After the 30% design review, the Central and Eastern Federal Lands Cross-Functional Team, along with Forest Service representatives, decided to move forward with the box culvert option using 2-16'x8' box culverts.

Spread Footings

The Geotechnical Investigation Reports recommend that a shallow foundation system for the end supports and interior supports could be designed using an allowable soil bearing pressures of 2,000 psf and 1,000 psf, respectively. The value assumes that the water table is at the bottom of the footing elevation and that the bearing soil has a cohesion value of 250 psf.

Additionally, the following design and construction details should be observed for spread footings:

1. The interior support footing bearing elevation should be a minimum of 3 feet below the scour elevation.
2. End support footings should be protected from erosion by construction of wing walls or equivalent alternative. Additionally, 2-foot deep inlet and outlet cut-off walls are recommended across the toe of the box to minimize seepage and scour under the box.
3. Dewatering and/or re-routing of the creek would be required to allow construction of the interior footing 'in the dry".
4. Spread footing foundations for the proposed box structure can be designed for a presumptive maximum bearing pressure of 4,500 psf at the Service Limit State for Load Resistance Factor Design (LRFD). A resistance factor of 0.45 for the above nominal pressure should be applied.
5. Due to the presence of loose silty sand material encountered during the subsurface investigation, subexcavation of one foot of material and replacement with structural backfill should be anticipated. Foundation preparation should comply with FP-03 Section 204.07.
6. Resistance to sliding at the bottom of the footing can be calculated based on a coefficient of friction of 0.40 for the structural backfill material.

7. All footing excavations should be observed by an experienced engineering geologist or geotechnical engineer prior to placement of concrete.

A settlement calculation was performed based on the assumed loading conditions mentioned above. Total settlement of less than 1 inch is anticipated.

Retaining Structures

Retaining structures can be supported on spread footings designed in accordance with the recommendations listed above. Wing walls and retaining structures should be designed to resist lateral earth pressures. Walls that are able to rotate to mobilize shear strength of the retained soils can be designed for active earth pressure conditions. Wall rotation on the order of 1 to 2 percent of the wall height is typically sufficient. For the active condition, walls can be designed using an equivalent fluid density of 35 pcf, this equivalent fluid density assumes a horizontal, free-draining backfill. If walls are braced and rotation is restricted, an equivalent fluid density of 45 pcf should be used. Lateral resistance to sliding can be calculated base on a coefficient of friction of 0.55. A resistance factor of 0.80 is recommended for LRFD. Passive pressure against the footing can be calculated using an equivalent fluid density of 450 pcf for backfill consisting of free-draining material. For the passive pressure case, a resistance factor of 0.50 for LRFD is recommended. Wall designs should consider the influence of surcharge loading such as traffic and construction equipment.

Pavement Section

At the request of the Forest Service, the pavement section will consist of a geotextile separator and 12-inches of FDOT Class 3 coarse aggregate. Based on the on-site material and the FDOT Class 3 grain-size distribution, a Type II-B geotextile was selected. Geotextile properties should be in accordance with FP-03 Section 714 and Table 714-2. The geotextile should be installed in accordance with FP-03 Section 207.

Material Source

Structural backfill and FDOT Class 3 coarse aggregate material will not be available on site. The Contractor will provide material meeting the soil specifications from an offsite borrow area.

Shrink/Swell Factor Recommendations

Based on the available information, it is estimated that on-site soils will have an average shrink/swell factor of 0.90.

Corrosion Recommendations

The substructure environment at the proposed box culvert locations are considered to be extremely aggressive in both the soil and water due to low pH values. The low pH values are most likely the result of decomposition of organic matter in low, wet areas, which is known to produce acidic conditions.

CONSTRUCTION CONSIDERATIONS

Topsoil: The "topsoil" excavation (FP-3 Section 204.05) may contain organics, soft fine-grained soil, or other deleterious materials. It should be anticipated that one foot of surface material may be wasted and unable to be re-used as backfill for embankment construction.

Subexcavation: Due to anticipated loose materials in the foundation area, one foot of subexcavation and structural backfill below the footing elevation should be anticipated. The foundation should be prepared in accordance with FP-03 Section 209.08 and subexcavation in accordance with Section 204.07.

Embankment Construction: The foundation for embankment construction not associated with the box culvert foundation excavation can be prepared according to FP-03 Section 204.09(a).

LIMITATIONS

The recommendations in this memorandum are based on the data obtained from exploratory borings, field review, and the laboratory test results. The results of these explorations and tests represent conditions at the specific locations indicated. Subsurface variations across the site are likely and may not become evident until excavation is performed. The Foundation Recommendations and Construction Considerations sections include interpretations and recommendations developed by the Government in the process of preparing the design. These interpretations are not intended as a substitute for the personal investigation, independent interpretation, and judgment of the Contractor.

REFERENCES

Southern Earth Sciences, Inc., 2004 "Geotechnical Investigation, Forest Service Bridge No. 115-2.3, Liberty County, FL": File No. T04-303, dated December 21.

Southern Earth Sciences, Inc., 2004 "Geotechnical Investigation, Forest Service Bridge No. 115-2.5, Liberty County, FL": File No. T04-303, dated December 22.