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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

June 13, 2024
Revised August 29, 2024
AEI Project No.: CPGT-24-121

To: Powell Studio Architecture
713 W. Montrose Street
Clermont, Florida 34711

Attention: Mr. Jeff Powell, A.I.A.
President

Subject: Geotechnical Investigation
Proposed Green Mountain Scenic Overlook Tower
Lake County, Florida

Dear Mr. Powell:

Per your request and authorization, Andreyev Engineering, Inc. (AEI) has completed a geotechnical subsurface investigation for the above referenced project. The purpose of this study is to obtain geotechnical data to provide geotechnical recommendations in order to assist in the support of the proposed Green Mountain Scenic Overlook Tower structure. This report presents the results of our geotechnical investigation along with an evaluation of the soil and groundwater conditions encountered. In addition, it provides geotechnical engineering and site preparation recommendations.

SITE LOCATION AND PROJECT DESCRIPTION

The subject site is located at the Green Mountain Scenic Overlook park, along the eastern side of the Lake Apopka Loop Trail in Lake County, Florida**.**

We have reviewed the structural plans for the Green Mountain Scenic Overlook & Trailhead Second Observation Tower, prepared by Powell Studio Architecture and TLC Engineering Solutions and dated 8-2-2024. Based on Sheet S-101, maximum compressive column loads are 155 kips. An aerial layout showing the boring locations is presented on **Figure 1**.

SCOPE OF FIELD EXPLORATION

The scope of our field exploration consisted of performing the following:

- Mobilized crew and drilling equipment to the site.

- Drilled two (2) Standard Penetration Tests borings to a depth of 50 feet below ground surface each, within the proposed tower area. Due to the location of the borings a limited access drill rig was utilized which uses a safety hammer.

- Measured the stabilized groundwater table at each boring location.

- Prepared a geotechnical report including results of the soil investigation, evaluation of encountered conditions, estimation of seasonal high groundwater levels, and geotechnical recommendations for site preparation, and geotechnical recommendations to assist with the tower structure foundation design.

Samples were recovered from the borings, neatly packaged, and returned to AEI's laboratory for visual classification and stratification. Soil strata were classified according to the Unified Soil Classification System (USCS). The boring locations are shown on **Figure 1**, results of the standard penetration test borings and power auger borings, in profile form, are presented on **Figure 2**. On the profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

SOIL AND GROUNDWATER CONDITIONS

The locations of the borings are shown on the attached **Figure 1**. Representative portions of each soil strata identified in the borings were packaged and sealed for transportation to our laboratory for further examination and visual classification.

Soil Conditions

The soil types encountered at the boring locations are presented in the form of soil profiles on the attached **Figure 2**. The stratifications presented on **Figure 4** are based on visual examination of the recovered soil samples and the interpretation of the field logs by a geotechnical engineer.

In general, the borings encountered the following soil types:

Stratum No.	Soil Description	USCS GROUP
1	Orange brown fine sand	(SP)
2	Orange to light orange to light gray clayey fine sand	(SC)

Please refer to the soil profiles on the attached **Figure 2** for specific boring data. The information presented on the soil profiles represents the subsurface conditions encountered at the noted boring locations. Accordingly, the materials between and away from the boring locations may vary from those encountered at the specific boring

locations. The strata boundaries presented on the soil profiles have been approximated. The actual boundaries may be gradual or otherwise not clearly defined.

Standard Penetration Tests (SPT) were conducted in general accordance with ASTM Standard D-1586. Closely spaced SPT tests with split barrel sampling were performed in the upper 10 feet, with successive tests carried out at 5-foot intervals thereafter. Upon completion of drilling, the SPT boreholes were filled with bentonite chips. The SPT blow counts "N-Values" are shown adjacent to the boring profiles in **Figure 4**. The "N" values have been empirically correlated with various soil properties and are considered to be indicative of the relative density of cohesionless soils and the consistency of cohesive material.

The N-values ranged between 11 to 50+ blows/foot, indicating the density of the soil to range from medium dense to very dense. The majority of the soils in the upper 10 feet are in medium dense to dense condition. General correlations of the SPT N-values with relative density of sands and consistency of clay are provided in the following table:

Sand		**Clay**	
Penetration Resistance N (blows/ft)	Relative Density of Sand	Penetration Resistance N (blows/ft)	Consistency of Clay
0-4	Very Loose	<2	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium-Dense	4-8	Medium
30-50	Dense	8-15	Stiff
>50	Very Dense	15-30	Very Stiff
		>30	Hard

Soil Resistivity and pH Testing

Soil resistivity and pH Testing was completed on soils obtained from the tower area. The tests were conducted to help provide additional information for use in foundation design. The results of the testing are presented in following table:

Parameter	Test Method	Sample Location	Environmental Classification
		Tower Area	
Visual Description of Sample	ASTM D 2488	Orangish brown fine sand	N.A.
As-received moisture content (%)	ASTM D 2216	3.4	N.A.
pH	Florida Method FM-5-550	7.3	Slightly Aggressive
"As-is" Resistivity (ohm-cm)	Florida Method FM-5-551	577,000	Slightly Aggressive
Minimum Resistivity (ohm-cm)	Florida Method FM-5-551	36,100	
Chloride (ppm)	Florida Method FM-5-552	60	Slightly Aggressive
Sulfate (ppm)	Florida Method FM-5-553	141	Slightly Aggressive

Based on the results of our resistivity and pH testing and according to the FDOT Structures Design Guidelines 2024, the substructure environmental classification is considered "Slightly Aggressive" for Helical Piles. AEI recommends that the Helical Piles be provided with cathodic protection to minimize corrosion.

Soil Boring Soil Parameters Table

For analysis and foundation design of the deep foundation for the overlook tower, the recommended soil properties at the location of each boring are presented below. These soil characteristics were interpolated from the results of the field investigation and in general accordance with the FDOT Soils and Foundations Handbook, 2017.

Soil Boring B-1

Depth (ft)	Soil Type	Average N-Value	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Angle of Internal Friction	Modulus of Lateral Subgrade (Saturated) (pcf)
0-6	Fine Sand	20	110	122	32	43,200
6-50	Clayey Fine Sand	27	115	124	30	77,760

Soil Boring B-2

Depth (ft)	Soil Type	Average N-Value	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Angle of Internal Friction	Modulus of Lateral Subgrade (Saturated) (pcf)
0-6	Fine Sand	18	110	122	32	43,200
6-50	Clayey Fine Sand	27	115	124	30	77,760

For the calculation of lateral earth pressures, we recommend use of the following parameters: γ_{moist} = 110 lb/ft^3, γ_{sat} = 120 lb/ft^3, c' = 0, ϕ' = 30^o; Rankine active earth pressure coefficient, K_a = 0.33, Rankine passive earth pressure coefficient, K_p = 3.0; and coefficient of lateral earth pressure at rest, K_o = 0.5. For the calculation of safety of foundation against sliding, we recommend the use of a coefficient of friction, f = 0.35.

Groundwater Condition

At the time of our subsurface investigation (June 7, 2024), the groundwater table was not encountered within the upper 10 feet of the SPT borings (B-1 and B-2). Groundwater table measurements were not taken below a depth of 10 feet in the SPT borings due to the presence of drilling fluid in the boreholes. We estimate that the normal groundwater in this location is greater than 50 feet.

Fluctuation of the groundwater table should be anticipated throughout the year due to variations in seasonal rainfall. However, due to the presence of the clayey fine sand soils (Stratum 2) and the poorly permeable characteristics of this soil, we anticipate temporary perching of groundwater above these soils during periods of heavy or extended rainfall to occur on top of these soils. We anticipate that a temporarily perched groundwater table would occur at about 0.5 foot above the top of Stratum 2 depending on the depth and slope of the underlying layers.

EVALUATIONS AND RECOMMENDATIONS

General

The following conclusions and recommendations are based on the project characteristics previously described, the data obtained from our field exploration and our experience with similar subsurface conditions.

Based on the results of our study, we are of the opinion that the soil and groundwater conditions encountered in the area of borings B-1 and B-2 are generally suitable for construction of the proposed overlook tower using a shallow or deep foundation system.

Shallow Foundation System

Based on our test boring results and our settlement analyses, it is our opinion that the proposed structure can be supported by a shallow foundation system. The foundation system should bear on properly placed and compacted cohesionless (sand) structural fill.

The recommended value of modulus of subgrade reaction for the medium dense sand at the site, ks = 100 kcf.

Provided that the site soils have been properly prepared and compacted, as specified in this report, the structure can be supported on conventional shallow foundations, sized on the basis of an allowable soil contact pressure of up to 3,000 pounds per square foot (psf). Any individual spread or column footings must be a minimum of 3 feet wide and also sized based on an allowable soil contact pressure of up to 3,000 psf. The bottom of all footings shall be placed a minimum of 18 inches below the lowest adjacent finished grade.

Fill Placement and Subgrade Preparation

The following are our recommendations for overall site preparation and mechanical densification work in the structure and pavement areas, based on the anticipated construction and our test boring results. These recommendations should be incorporated into the project general specifications prepared by the Design Engineer.

1. The structure areas plus a five (5) foot margin beyond the outer lines should be stripped and cleared of all surface vegetation, root laden topsoil, and grubbed of roots and stumps. Additionally, any existing construction and utilities should be removed from the proposed construction areas.

2. Following completion of the stripping procedures, the areas should be compacted. Compaction should continue until a minimum density requirement of 95% of the maximum modified Proctor dry density established in accordance with ASTM D-1557, is achieved for a minimum

depth of 2 feet below the exposed subgrade as determined by field density (compaction) tests.

3. Following satisfactory completion of the initial compaction of the excavated bottom areas at specified minimum depths, the area may be brought up to finished subgrade levels. The fill should consist of fine sand with less than 10% passing the No. 200 sieve, free of rubble, organics, clay, debris and other unsuitable materials. Fill materials should be tested and approved prior to acquisition. Approved sand fill should be placed in loose lifts not exceeding 12 inches in thickness and should be compacted to a minimum of 95% of the maximum modified Proctor dry density (ASTM D-1557). Density tests to confirm compaction should be performed in each fill lift before the next lift is placed.

4. In-place density tests within the structure areas should be performed at a minimum frequency of one test per 2,500 square feet for a depth of 2 feet below exposed subgrade and for each 1-foot lift of placed fill. In-place density tests should be performed at each column footing.

5. Earthwork operations should take place under the full-time observation of a field technician from Andreyev Engineering, Inc.

Deep Foundation System

It is our opinion that helical pier is the choice deep foundation system for this project. The primary advantage to using helical piers is due to the minimum amount of heavy equipment needed to install the piers in a hard to access location. The installation depths will be determined by the torsional resistance encountered at each specific location. Another advantage of this type of deep foundation system is that installation does not produce much spoil material. Pile capacities will need to be determined and verified by the product manufacturer as this type of foundation system is proprietary. We recommend that the allowable design capacities be ½ of the ultimate capacities (factor of safety of 2). For preliminary design/cost estimating purposes, we estimate that pile depths will range from 35 to 45 feet below existing grade.

As stated above, the type, configuration and installation specifications will be provided by the engineer working directly with the manufacturer chosen for the project. When the final design and installation specifications become available, please notify us so that we may review. In addition, a static pile load test should be performed to verify the capacity of a helical pier installed in the field.

Excavations

All excavations should be constructed in accordance with applicable local, state and federal regulations including those outlined by the Occupational Safety and Health Administration (OSHA). It is the contractor's responsibility for designing and constructing safe and stable excavations. Excavation should be sloped, benched or braced as required to maintain stability of the excavation sides and bottoms. Excavations should

take into account loads resulting from equipment, fill stockpile and existing construction. Any shoring needed to maintain a safe excavation should be designed by a professional engineer registered in the State of Florida in accordance with local, state and federal guidelines.

LIMITATIONS OF REPORT

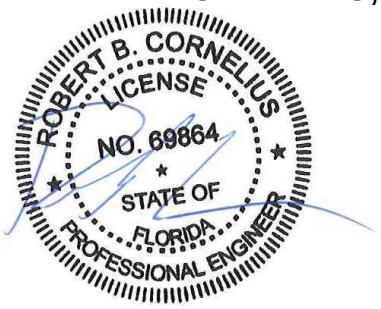
This geotechnical report has been prepared for the exclusive use of Powell Studio Architecture and their designers, based on our understanding of the project as stated in this report. Any modifications in design concepts from the description stated in this report should be made known to AEI for possible modification of recommendations presented in this report. This exploration was performed in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice presented herein. Statements regarding all geotechnical recommendations are for use by the designers and are not intended for use by potential contractors. The geotechnical exploration and recommendations submitted herein are based on the data obtained from the soil borings presented on **Figure 2**. The report does not reflect any variations which may occur adjacent to, between, or away from the borings. The nature and extent of the variations between the borings may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report. An on-site visit may be required by a geotechnical engineer to note the characteristics of the variations during the construction period. This geotechnical study investigated the soil conditions drilled to a depth of 50 feet below ground surface and was not intended to investigate deeper soil conditions with regard to the presence or absence of Karst activity.

CLOSURE

AEI appreciates the opportunity to participate in this project and we trust that the information provided herein is sufficient for your immediate needs. If you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

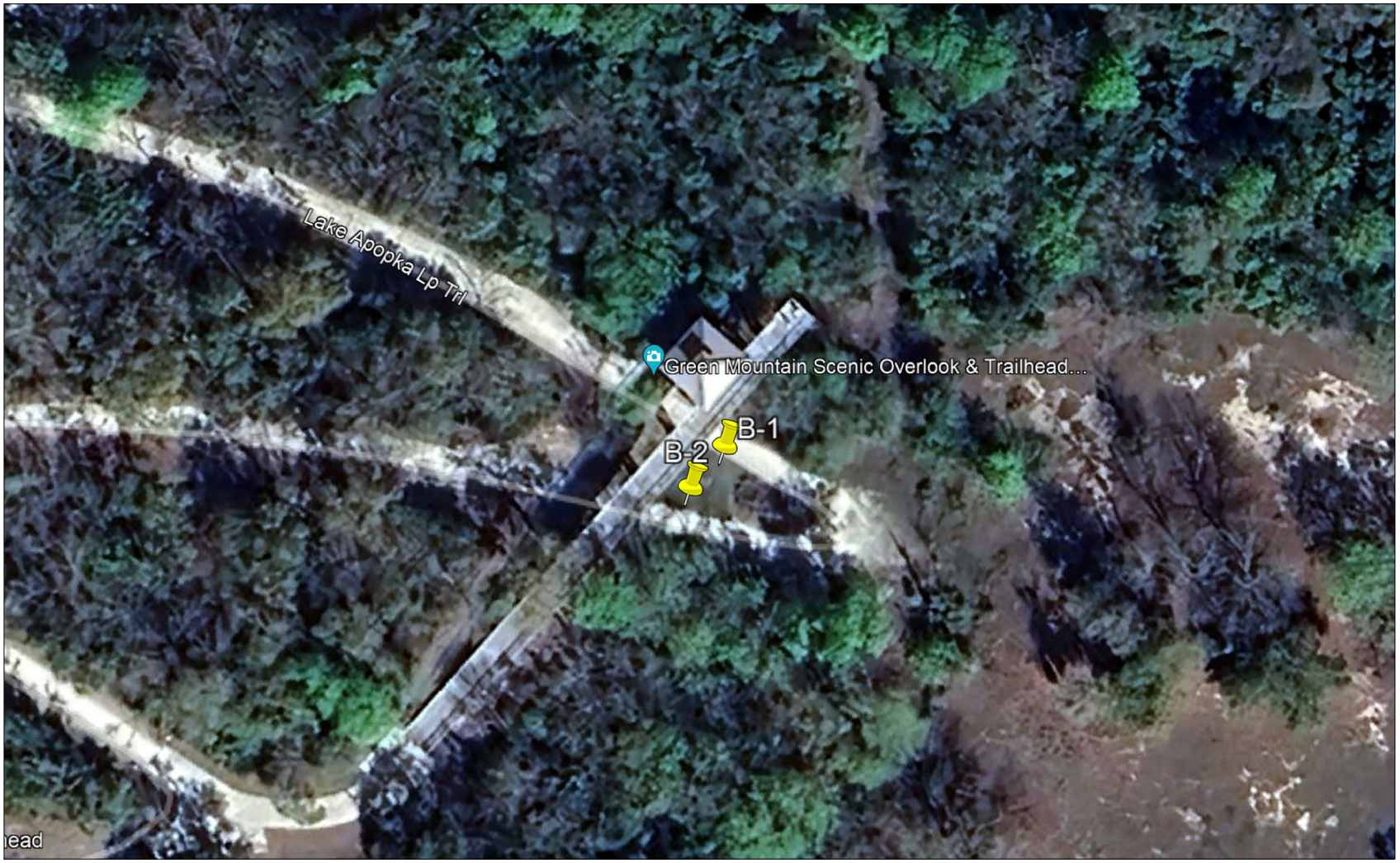
Sincerely,

ANDREYEV ENGINEERING, INC.



Robert B. Cornelius, P.E.
Vice President
Florida Registration No.69864

FIGURES



0 15 30 60

GRAPHIC SCALE: 1"=30'

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

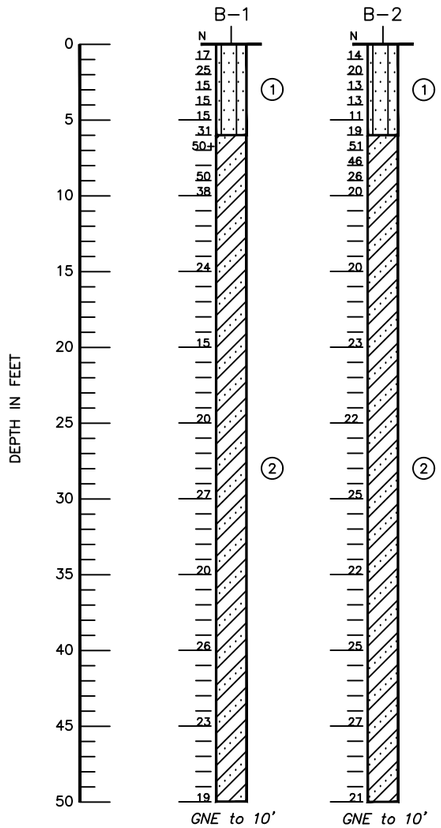
GREEN MOUNTAIN SCENIC TOWER

MINNEOLA, LAKE COUNTY, FLORIDA

BORING LOCATION

APPROXIMATE SCALE:	DATE: 06/10/2024	ENGINEER: RC
1"=30'	PN: CPGT-24-121	DRAWN BY: JM

FIGURE 1



LEGEND:

(1) ORANGE BROWN FINE SAND (SP)

(2) ORANGE TO LIGHT ORANGE TO LIGHT GRAY CLAYEY SAND

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

GNE GROUNDWATER NOT ENCOUNTERED

NOTE:
SAFETY HAMMER WAS USED FOR THE SPT BORINGS AT THIS SITE.

Andreyev Engineering, Inc.			GEOTECHNICAL INVESTIGATION **GREEN MOUNTAIN SCENIC OVERLOOK TOWER** MINNEOLA, LAKE COUNTY, FL
APPROXIMATE SCALE: 1"=10'	DATE: 06/11/24	ENGINEER: RB	SOIL PROFILES
	PN: CPGT–24–121	DRAWN BY: JM	FIGURE 2