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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

October 6, 2017
CPGT-17-132

To: **Dr. William Geiler**
731 Highway 50
Clermont, Florida 34711

Subject: **Geotechnical Investigation, Proposed Veterinary Building Hancock Road, Clermont, Lake County, Florida**

Dear Dr. Geiler:

Andreyev Engineering, Inc. (AEI) has completed a geotechnical investigation for the above referenced project location. We understand that the subject development will include one (1) office building with paved parking/drive areas and a dry retention pond. 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 recommendations for site preparation, foundation design, and pavement section design

SITE LOCATION AND DESCRIPTION

The subject site is located southeast of the intersection of Hancock Road and Pine Valley Road in Clermont, Lake County, Florida. The site is located in Section 27, Township 22 South, and Range 26 East in Lake County, Florida. We have included the U.S.G.S. Topographic Map which depicts the location of the site on the attached **Figure 1**.

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore subsurface soil and groundwater conditions at this site for foundation support of the proposed buildings on shallow foundations and provide general design recommendations for foundation support.

The scope of this investigation included:

- Drilled three (3) Auger Borings with penetrometer probes to a depth of 15 feet within the proposed building site for general foundation evaluation.
- Drilled two (2) Auger Borings to a depth of 7 feet within the proposed parking/drive pavement areas.
- Drilled two (2) Auger Borings to a depth of 15 feet within the proposed pond area.
- Collected two (2) relatively undisturbed soil samples for laboratory permeability testing.
- Estimated normal seasonal high groundwater table levels.

Samples were recovered from the borings and returned to AEI's laboratory for visual classification and stratification. Soil strata were classified according to the Unified Soil Classification System (USCS). Approximate boring locations are shown on **Figure 3**, results of the borings, in profile form, are presented on **Figure 4**. On the profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

NRCS Soil Survey

Based on the review of the United States Department of Agriculture, Soil Conservation Service, Soil Survey for Lake County, the site contains the following soil types:

Soil Unit #	Name	High Water Table Depth (inches)
8	Candler fine sand, 0 to 5% slopes	Deeper than 72"

A copy of the NRCS soil survey map is shown on the attached **Figure 2**.

SOIL AND GROUNDWATER CONDITIONS

Soil Conditions

Soil samples recovered from the borings were visually and tactually classified and stratified in the laboratory using the Unified Soil Classification System (USCS) and the interpretation of the field logs by a geotechnical engineer. The USCS classifications are presented adjacent to respective depths and soil profiles on **Figure 4**. Also included, adjacent to the building borings, are the equivalent "N" values. 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. Upon completion of drilling, the boreholes were backfilled with additional soil materials.

The results of this investigation indicate the site soil conditions at boring locations B-1 through B-3, drilled within the proposed building site areas, generally consist of Strata 1, and 2 fine sands extending from the ground surface to the termination depth of drilling of 15 feet.

The "N" values, which represent the relative density of the encountered soils, indicate that the granular soils generally exist in a very loose to medium dense condition from the ground surface to depths of 10.

Groundwater Conditions

Groundwater was not encountered in any of the borings to the deepest termination depth of 15 feet. Based on the encountered subsurface conditions, our local experience, and antecedent rainfall conditions, we anticipate the normal seasonal high groundwater level to be deeper than 15 feet.

EVAULATION AND RECOMMENDATIONS

General

Based on our test boring results and our settlement analyses, a conventional shallow foundation system can be utilized for support of the proposed building addition as described in this report, provided that the site subgrade preparation recommendations discussed herein are instituted.

Maximum foundation loads associated with the proposed building are estimated to be 3 kips per lineal foot and 40 kips for wall and column loads, respectively. Based on the assumed foundation loads above, we estimate maximum total and differential settlement of 1 inch and 0.5 inch, respectively.

Provided that the site soils have been properly prepared and compacted, as specified in this report, the proposed structure can be supported on a conventional shallow foundation, sized on the basis of a maximum allowable soil contact pressure of 2,500 pounds per square foot (psf). For continuous wall footings, a minimum width of 1.5 feet is recommended. Any individual spread or column footings must be a minimum of 2 feet wide and also sized based on a maximum allowable soil contact pressure of 2,500 psf. The bottom of all footings shall be placed a minimum of 18 inches below the lowest adjacent finished grade.

Floor Slabs

Provided that the site subgrade preparation recommendations discussed herein are instituted, slab-on-grade construction may be used for the ground floor of the building.

Any cuts that are made in the building pad for utility installation should be backfilled with clean granular materials that are compacted to at least 95 percent of the soils' modified Proctor maximum dry density per ASTM D-1557.

The floor slabs should be reinforced with steel mesh or a suitable equivalent. To avoid potential problems with cracking because of differential loadings, the floor slabs should be liberally jointed and separated from columns and walls. An impervious membrane should be installed between the soil subgrade and bottom of floor slab areas to be overlain with moisture sensitive coverings. Use of such a moisture barrier should minimize slab moisture problems.

We recommend a modulus of subgrade reaction (k) of 150 pci for floor slab design.

Fill Placement and Subgrade Preparation

The following are our recommendations for overall site preparation and mechanical densification work in the structure area, 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.

The structure area plus a five (5) foot margin beyond the outer lines should be stripped and cleared of trees, surface vegetation, topsoil, root laden soils, debris and any deleterious materials. A representative from our firm should observe the stripped grades to verify an adequate depth of stripping.

The exposed subgrade should be leveled sufficiently to permit equipment traffic, and then proof-rolled. Careful observations should be made during proof-rolling of the subgrade soils to identify any areas of soft yielding soils that may require over-excavation and replacement.

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 1 foot below the exposed subgrade as determined by field density (compaction) tests.

Following satisfactory completion of the initial compaction of the exposed subgrade soils at the specified minimum depth, the area may be brought up to finished subgrade levels. 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. Fill within 12 inches below the bottom of the slab shall have less than 7% passing the No. 200 sieve. Approved sand fill should be placed in loose lifts not exceeding 8 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.

Backfill soils placed adjacent to footings or walls below or above grade should be carefully compacted with a light rubber-tired roller or vibratory plate compactor to avoid damaging the footings or walls. Approved sand fills placed in footing excavations above the bearing level, and in other areas which are expected to provide support or foundation embedment constraint, should be placed in loose lifts not exceeding 6 inches and should be compacted to a minimum of 95% of the maximum modified Proctor dry density (ASTM D-1557).

In-place density tests within the structure pad area should be performed at a minimum frequency of one test per 2,500 square feet for a depth of 1 foot below exposed subgrade and for each 1-foot lift of placed fill. In-place density tests should be performed for a depth of 2 feet below the bottom of each column footing. For continuous footings, in-place density tests should be performed at a minimum frequency of 1 test for every 50 linear feet for a depth of 2 feet below the bottom of the footing.

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

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 sole responsibility for designing and constructing safe and stable excavations. Excavations 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 stockpiles 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.

Pavement Areas

The pavement areas subgrade preparation should follow the general recommendations presented in the “Site Preparation” and “Fill Placement” sections of this report. Proofrolling of the subgrade soils in the pavement areas should continue for the required number of passes and until the soil at a depth of 12 inches below the compaction surface has attained a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Standard D-1557. In-place density tests should be performed by an experienced geotechnical engineering technician working under the direction of a geotechnical engineer to verify the required degree of compaction. We suggest a minimum testing frequency of one (1) test for every 5,000 square feet of proposed pavement areas.

Pavement/Base Recommendations: The shallow surface soils are considered acceptable for construction and support of flexible (limerock) or semi-flexible (soil-cement) base. If a minimum separation of 24 inches between the bottom of the base and the seasonal high groundwater table is maintained, then either soil-cement or limerock can be used. Where the separation will be consistently less than 24 inches, soil-cement should be used and pavement underdrains may be necessary. In no case should the separation be less than 12 inches.

Although a comprehensive pavement design is not within the scope of this study, below are recommendations on the use of pavement base for the proposed driveways/parking areas.

A limerock base should have a minimum thickness of 6 inches for light duty pavement and 8 inches for heavy duty pavement and should meet Florida Department of Transportation (FDOT) standards, including a minimum Limerock Bearing Ratio (LBR) of 100. A stabilized sub-base with a minimum Limerock Bearing Ratio (LBR) of 40 and a thickness of 12 inches would be required. Both base and sub-base should be compacted to at least 98% of the AASHTO T-180 Maximum Density.

In lieu of using a limerock base material for flexible pavement structure, consideration can be given to using a crushed concrete base material. The crushed concrete base material should have a minimum Limerock Bearing Ratio (LBR) of 120 and be compacted to at least 98 percent of the Modified proctor maximum dry density per ASTM D-1557. The crushed concrete material should meet FDOT specifications. The base course should be underlain by at least 12 inches of stabilized sub-base for both light and heavy duty pavement sections having an LBR of at least 40 and compacted to a minimum of 98 percent of the Modified proctor. The thickness for light and heavy duty areas shall be the same as the limerock base thicknesses provided above.

If a soil-cement base is used, the base thickness should be a minimum of 6 inches for light duty pavement and 8 inches for heavy duty pavement. A stabilized sub-base would not be required. However, the subgrade soils to a depth of 12 inches should be compacted to a minimum density of 98% of AASHTO T-180. The soil-cement base should be compacted to at least 95% of AASHTO T-134 and should have a minimum 7-day compressive strength of 300 psi. Please note that reflective cracking tends to be more common in pavement constructed with a soil soil-cement base. Therefore, it is also recommended that the pavement surface be seal coated within 1 year after construction and receive regular inspections and maintenance for long term performance.

The wearing surface may consist of Type S asphalt concrete meeting current FDOT specifications. A minimum of 1.5 inches of asphalt for light duty pavement and 2.0 inches of asphalt for heavy duty pavement are recommended. The mixture should be compacted in-place to achieve a density equivalent of at least 95% of the laboratory density for the approved mix as determined by the Marshall Stability Test method (AASHTO T-245).

As an alternative to the asphalt pavement, a concrete section could be used. For a rigid concrete pavement section, we recommend a minimum thickness of 6 inches within light duty areas and 8 inches within heavy duty areas. The concrete should be reinforced sufficiently to withstand the design traffic loads and jointed to reduce the chances for crack development. The concrete should have a minimum unconfined compressive strength of 3,000 psi. The sub-grade soils underlying the concrete pavement should consist of well-draining fine sand with less than 7 percent passing the No. 200 sieve and should be compacted to at least 98 percent of the Modified proctor maximum dry density to a depth of at least 12 inches. We would be pleased to review the final pavement design for consistency with our recommendations.

For limerock/crushed concrete pavement sections, the bottom of the base course should be set at least 2 feet above the normal wet season high groundwater table. A minimum separation of 1 foot is recommended between the bottom of a soil-cement base/concrete pavement and the normal wet season high groundwater table. If these minimum separations cannot be achieved, then an underdrain system can be used to artificially lower groundwater levels. Any underdrain system will require a positive outfall.

The recommended pavement thicknesses presented herein are minimum thicknesses typical of local construction practices. Actual pavement section thicknesses should be designed by the project civil engineer based on traffic loads, volumes and the selected design life. All pavement materials should conform to the requirements of FDOT, American Concrete Institute (ACI) and city/county requirements.

Stormwater Retention System

Based on the results of our findings, it is our opinion that dry bottom pond design appears to be suitable for this site. Our recommended design are presented in the following table. Please note that the hydraulic conductivity values presented in the following table do not include a factor of safety.

Boring No.	Depth to Bottom of Aquifer (feet below pond bottom)	Unsaturated Vertical Hydraulic Conductivity (ft./day)	Horizontal Hydraulic Conductivity (ft./day)	Depth to Seasonal High Groundwater Table (feet below pond bottom)	Soil Storage Coefficient
P-1	15.0	30	40	14.0	0.25
P-2	15.0	23	40	14.0	0.25

LIMITATIONS OF REPORT

The analyses and recommendations submitted in this report are based on the anticipated location and type of construction discussed herein and the data obtained from the soil borings performed at the locations indicated, and does not reflect any variations which may occur beyond these borings. If any variations became evident during the course of construction, or if the structure location(s), type or loading changes, a re-evaluation of the recommendations contained in this report will be necessary after we have an opportunity to observe and evaluate the characteristics of the conditions encountered. Shifting or moving the structure location(s) will require additional evaluation. When final design plans and specifications are available, a general review by our office is strongly recommended as a means to check that the assumptions made in preparation of this report are correct, and that earthwork and foundation recommendations are properly interpreted and implemented. In addition, this investigation did not include a sinkhole evaluation of the site.

CLOSURE

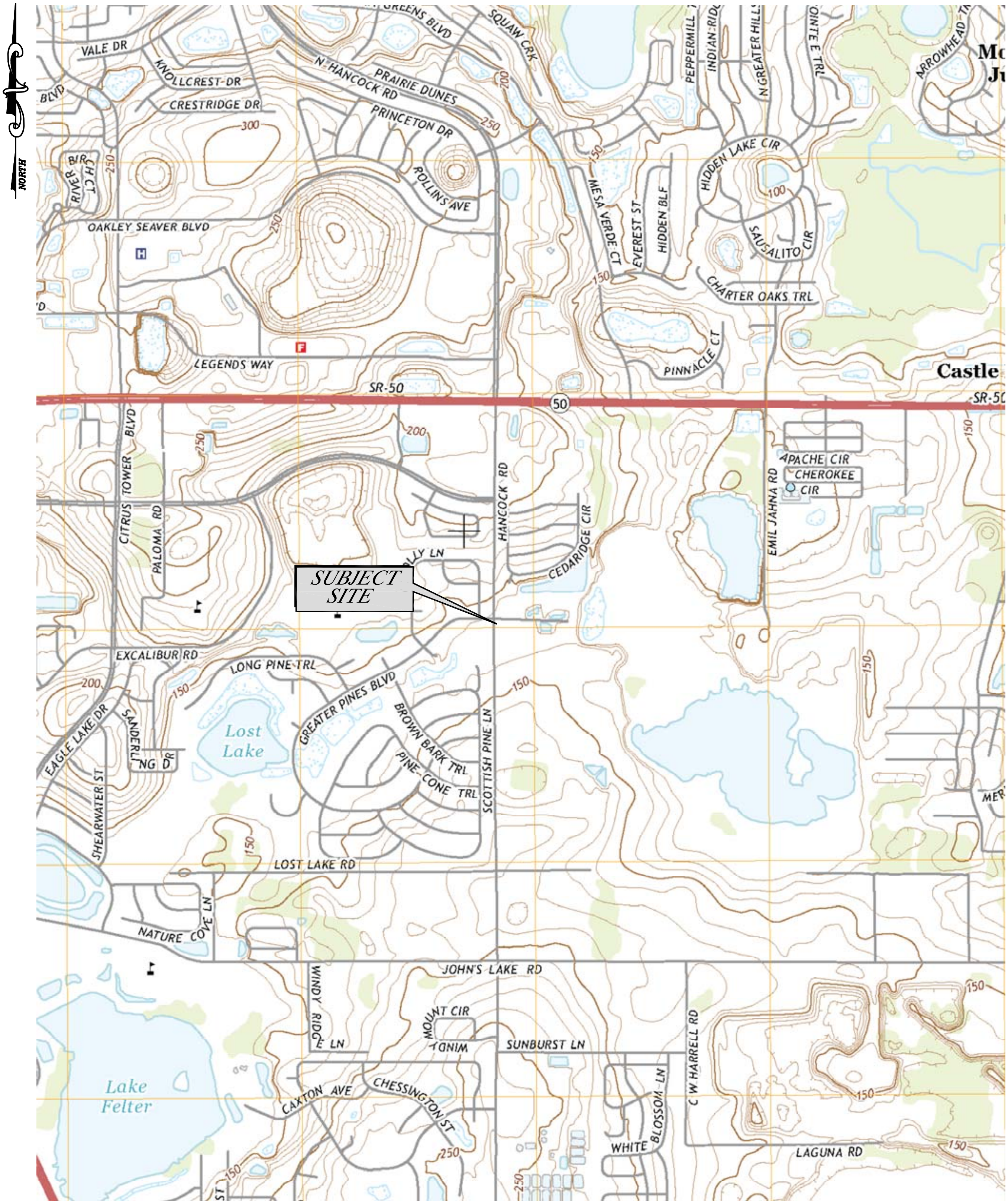
AEI appreciates the opportunity to participate in this project, and we trust that the information herein is sufficient for your immediate needs. If you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,

ANDREYEV ENGINEERING, INC.

Rob B. Cornelius, P.E.
Project Engineer
FL Registration # 69864

FIGURES



REFERENCE:
U.S.G.S. CLERMONT EAST, FLA.
QUADRANGLE MAP
DATED 2015
SECTION 27
TOWNSHIP 22 SOUTH
RANGE 26 EAST

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION
PROPOSED VETERINARY DEV.
HANCOCK ROAD
CLERMONT, LAKE COUNTY, FL

APPROXIMATE SCALE:	DATE: 10/05/17	ENGINEER: RC	U.S.G.S. TOPOGRAPHIC MAP
1"=2000'	PN: CPGT-17-132	DRAWN BY: DLS	FIGURE 1

LEGEND:

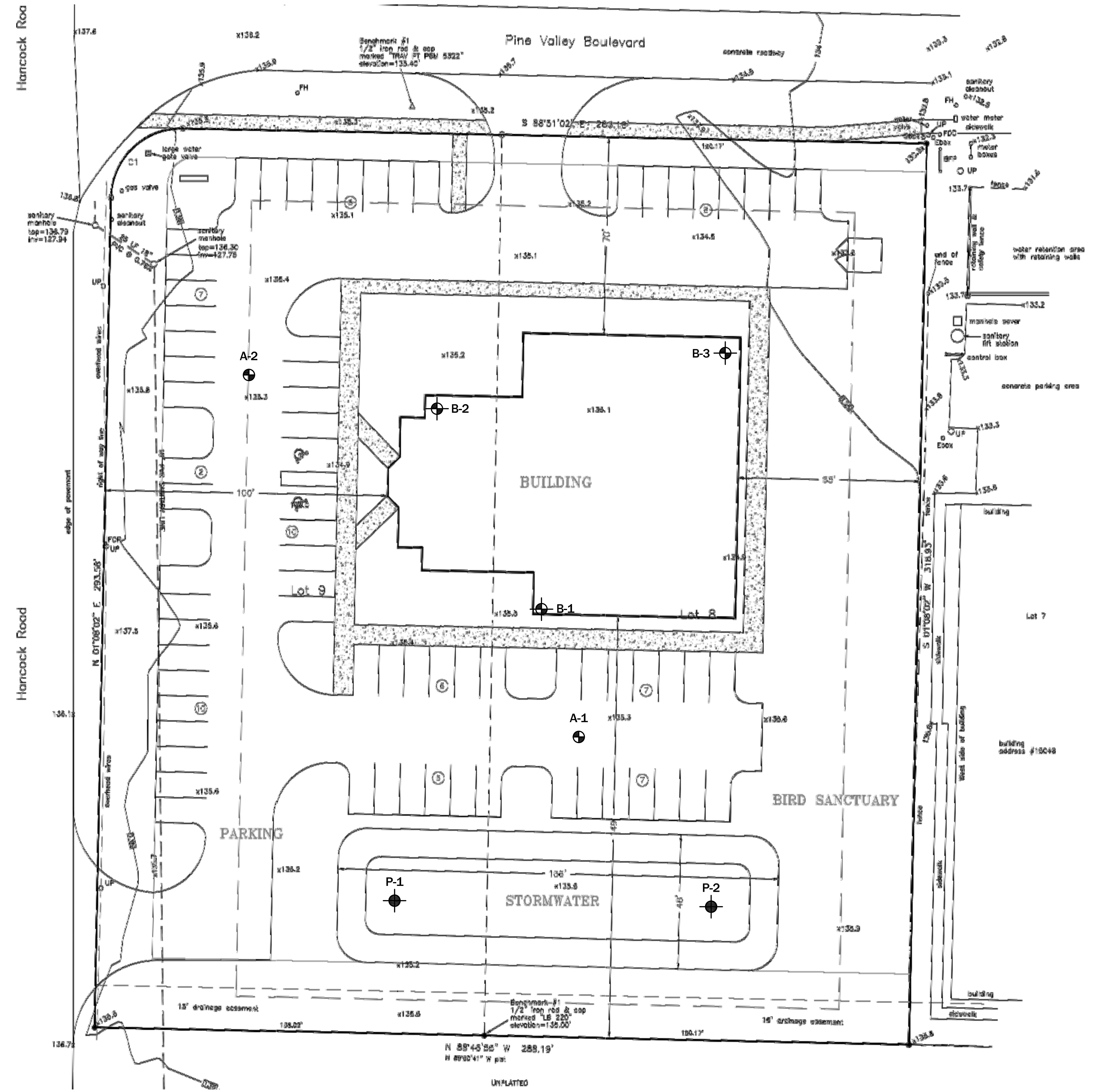
8 CANDLER SAND 0 TO 5% SLOPES
9 CANDLER SAND 5 TO 12% SLOPES
21 LAKE SAND

REFERENCE:
U.S.D.A. N.R.C.S. WEB SOIL SURVEY

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION
PROPOSED VETERINARY DEV.
HANCOCK ROAD
CLERMONT, LAKE COUNTY, FL

APPROXIMATE SCALE: 1"=300'	DATE: 10/05/17	ENGINEER: RC	N.R.C.S. SOIL SURVEY MAP
	PN: CPGT-17-132	DRAWN BY: DLS	FIGURE 2



NORTH

LEGEND:

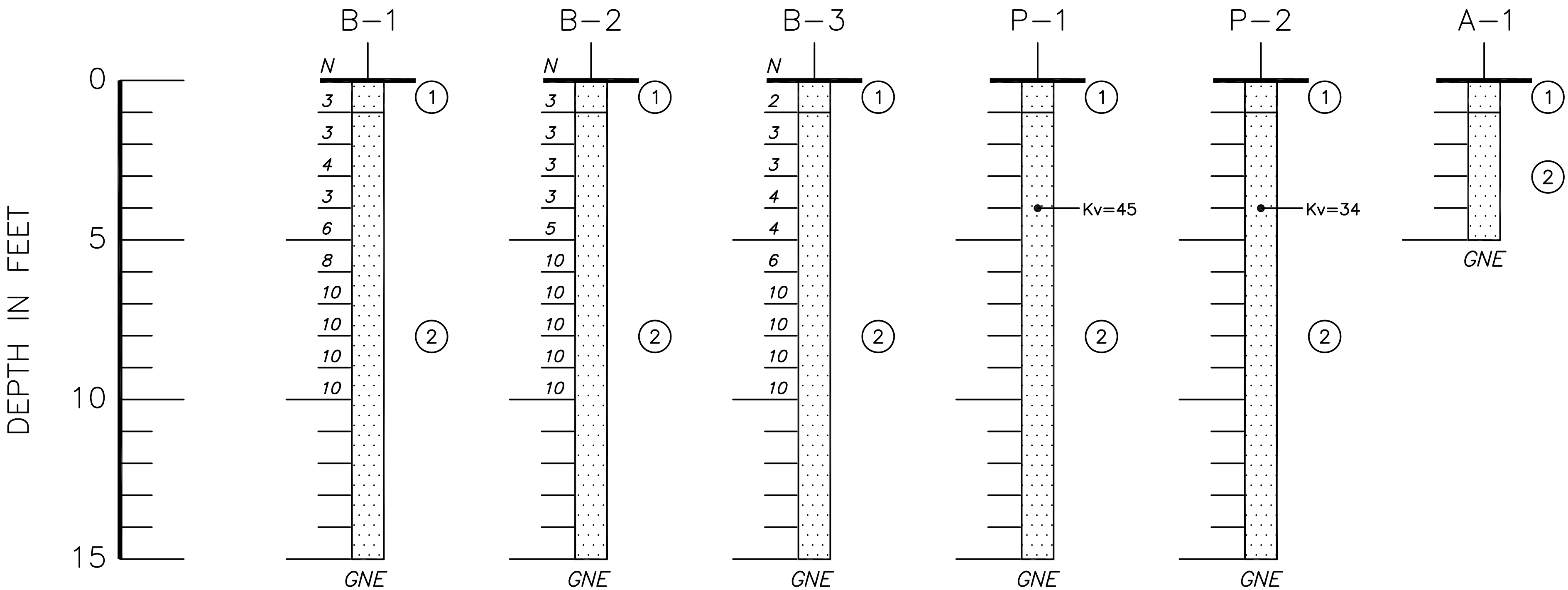
- APPROXIMATE LOCATION OF SPT BORING
- APPROXIMATE LOCATION OF POWER AUGER BORING
- APPROXIMATE LOCATION OF HAND AUGER BORING

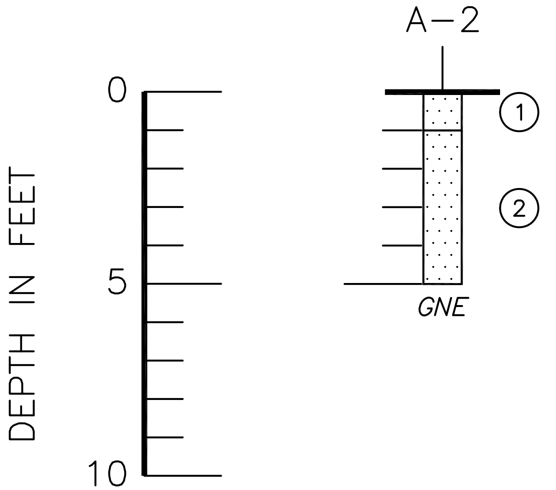
0 20 40 80

GRAPHIC SCALE: 1"=40'

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION **PROPOSED VETERINARY DEV.** HANCOCK ROAD CLERMONT, LAKE COUNTY, FL	
APPROXIMATE SCALE: 1"=40'	DATE: 10/05/17
ENGINEER: RC	PN: CPGT-17-132
DRAWN BY: DLS	BORING LOCATION PLAN
FIGURE 3	





LEGEND:

(1) DARK BROWN FINE SAND (SP)

(2) LIGHT BROWN TO ORANGISH BROWN FINE SAND (SP)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

GNE GROUNDWATER NOT ENCOUNTERED

N STANDARD PENETRATION RESISTANCE, IN BLOWS PER FOOT

Kv VERTICAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

PROPOSED VETERINARY DEV.

HANCOCK ROAD

CLERMONT, LAKE COUNTY, FL

SOIL PROFILES

APPROXIMATE SCALE: 1"=5'	DATE: 10/05/17	ENGINEER: RC
	PN: CPGT-17-132	DRAWN BY: DLS

FIGURE 4