Andreyev Engineering, Inc.

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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

March 27, 2025
GPGT-25-024

To: **Halff Associates, Inc.**
902 North Sinclair Avenue
Tavares, Florida 32778

Attention: **Mr. Chuck Hiott, P.E.**
Vice President
Director of Land Development

Subject: **Geotechnical Investigation, Proposed Stormwater Retention Areas and Paved Parking/Drive Area, Transitional Housing Project, 28123 CR 561, Tavares, Lake County, Florida**

Dear Mr. Hiott:

Andreyev Engineering, Inc. (AEI) has completed a geotechnical investigation of the above referenced project location. We understand that the proposed site improvements will route stormwater runoff into one proposed stormwater retention pond area. This report presents the results of our geotechnical investigation along with an evaluation of the soil and groundwater conditions encountered.

SITE LOCATION AND DESCRIPTION

The subject site is located in Section 8, Township 20 South, and Range 26 East, in Tavares, 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**. In addition, the Natural Resources Conservation Service (NRCS) Soil Map, which depicts the location and general soil types of the subject site and is presented on the attached **Figure 2**.

PURPOSE AND SCOPE OF SERVICES

The purpose of this geotechnical investigation and evaluation was to assess the encountered shallow soil and groundwater conditions and provide stormwater retention system design parameters.

The scope of this investigation included:

- Drilled two (2) machine auger borings, designated AB-1 and AB-2, to a depth of 15 feet below ground surface within the proposed stormwater retention areas.

- Collected two (2) undisturbed permeability tube samples from the proposed stormwater retention areas and conducted laboratory permeability testing on the samples to assess soil hydraulic conductivity.

- Drilled one (1) manual auger boring, designated HA-1, to a depth of 7 feet below ground surface within the proposed paved parking/drive area.

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**, and results of the machine and manual auger borings, in profile form, are presented on **Figure 4**. On the soil profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

NATURAL RESOURCES CONSERVATION SERVICE SOIL SURVEY

The publication titled "Soil Survey of Lake County, Florida" published by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) was reviewed. For your reference, we have included a portion of the NRCS Soil Map which depicts the location of the subject site on the attached **Figure 2**. Two soil map units were identified to exist at the subject project location and is described as:

Soil Map Unit 8: ***Candler Sand, 0 to 5 Percent Slopes***

Brief Description: "This soil is nearly level to gently sloping and is excessively drained. It is on ridges, knolls, and broad uplands. The slopes range from smooth to broken. Typically, the surface layer is dark grayish brown sand about 6 inches thick. The subsurface layer, to a depth of about 63 inches is light yellowish brown and yellowish brown sand. The next layers to a depth of 80 inches or more are yellow sand that has thin strong textural bands. This soil does not have a high water table within 80 inches of the surface. The available water capacity is very low throughout. Permeability is high to very high."

Soil Map Unit 45: ***Tavares Sand, 0 to 5 Percent Slopes***

Brief Description: "This is a nearly level to gently sloping, moderately well drained soil. It has a very dark grayish-brown sand surface layer about 7 inches thick. Below this is a layer of very pale brown sand that has faint yellowish-brown mottles to a depth of 25 inches. The next layer, to a depth of 34 inches, is a light yellowish-brown sand. Very pale brown sand that has faint yellow mottles is at depth between 34 and 61 inches. Below this is white sand mottled with very pale brown. The water table is at a depth of 40 to 60 inches for more than 6 months of the year. During periods of drought, it is below 60 inches. Tavares sand is very rapidly permeable. Available water capacity and organic matter content are low. This soil has slight limitations for use as foundations for low buildings, roads, airports, and paved parking areas. This soil has slight limitations for use as septic tank filter fields as possible contamination of ground water supplies can occur."

SOIL AND GROUNDWATER CONDITIONS

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

Soil Conditions

In general, the borings encountered the following soil Strata:

- Dark Gray to Dark Brown to Dark Grayish Brown Fine Sand (Stratum 1)
- Brown to Yellowish Brown Fine Sand (Stratum 2)
- Light Brown to Light Gray to Light Yellowish Brown Fine Sand (Stratum 3)

Some variations within the soil profiles have been further classified and are described as presented below:

A. With Small Rocks

Groundwater Conditions

At the time of drilling, groundwater was encountered at depths of 12.3 and 12.4 feet at AB-1 and AB-2, respectively. Based on the encountered subsurface conditions, our local experience, review of the NRCS Soil Survey, and antecedent rainfall conditions, the normal seasonal high groundwater level is estimated to exist about 1 to 2 feet above the measured levels.

Percent of Fines Passing a U.S # 200 Sieve Test Results

The results of the laboratory classification tests selected for moisture content and percent of fines passing a U.S. #200 Sieve are shown adjacent to the corresponding soil profile and depth on **Figure 4** and are also presented as follows:

AB-1		**AB-1**	
Sample Depth:	2.0 feet	Sample Depth:	6.5 feet
Classification:	Fine Sand	Classification:	Fine Sand
Moisture Content:	6.7%	Moisture Content:	1.7%
Percent of Fines:	4.1%	Percent of Fines:	0.7%
AB-2		**HA-1**	
Sample Depth:	5.0 feet	Sample Depth:	3.0 feet
Classification:	Fine Sand	Classification:	Fine Sand
Moisture Content:	3.9%	Moisture Content:	3.5%
Percent of Fines:	1.1%	Percent of Fines:	1.0%

EVALUATIONS AND RECOMMENDATIONS

Based on the results of this investigation and dependent on planned site grades, conventional pavement section design and construction using flexible or semi flexible pavement sections will be possible at this site, provided that a two-foot separation is maintained between the bottom of the pavement base course and the estimated normal seasonal high groundwater table levels.

Dependent on planned site grades, the proposed stormwater retention pond areas, located in the vicinities of AB-1 and AB-2, appear suitable for dry stormwater retention design. On-site Strata 1, 2, and 3 sandy soils, excavated from the proposed stormwater retention areas, should be suitable for general fill purposes.

Preliminary Site Preparation Recommendations

The initial step in routine site preparation should be the complete removal of all topsoil, trees, major root systems, and any other deleterious materials to a minimum of 5 feet beyond outer lines of proposed structures and roadways. After this initial stripping, the site should be proof-rolled using a large vibratory roller prior to fill placement. The purpose of the proof-rolling will be to detect any areas where unsuitable soils are present as well as to densify the near-surface loose soils. Materials which yield excessively during the proof-rolling should be undercut and replaced with well-compacted, engineered structural fill. All backfilling of over-excavated areas shall follow the “Fill Placement” recommendations below.

Preliminary Fill Placement Recommendations

For mass grading purposes, after removal of any existing unsuitable materials, all fill required to bring the site to final grade shall be incrementally placed and properly compacted, including for any proposed filling of existing onsite ponded areas. All fill should be inorganic, non-plastic, granular soil with less than 10% passing the number 200 sieve. The fill should be placed in level lifts not to exceed 12 inches loose and should be compacted to a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Specification D-1557. In-place density tests should be performed on each lift by an experienced engineering technician working under the direction of a registered geotechnical engineer to verify that the recommended degree of compaction has been achieved. For fill placed in restricted working areas, compaction should be accomplished with lightweight, hand-guided compaction equipment and lift thicknesses should be limited to a maximum of 4 inches loose in thickness.

Paved Roadways

In general, the compacted subsurface soils will be suitable for support of a flexible (limerock) or semi-flexible (soil-cement or crushed concrete) type pavement base after subgrade preparation. The use of one system over another is normally governed by the depth to the encountered and/or seasonal high groundwater table. Soil cement is typically used in areas where the wet season groundwater table levels are within 12 inches of the proposed bottom of the pavement subbase. Crushed concrete is typically used in areas where the wet season groundwater table is within 18 inches of the proposed bottom of the proposed bottom of pavement base. For a limerock pavement base pavement section, a two-foot separation should be maintained between the bottom of the pavement base course and the estimated normal seasonal high groundwater table level. As a possible pavement design alternative, AEI also presents recommendations for a rigid pavement section.

Typical flexible and semi-flexible pavement sections are as follows:

Limerock Base

1-1/2" to 2-1/2" asphaltic concrete wearing surface

6" to 8" limerock base course, quality of limerock to be in accordance with current Florida Department of Transportation specifications and compacted to a minimum density equivalent to 98 percent of the modified Proctor maximum density (AASHTO T-180).

12" stabilized subbase with minimum Limerock Bearing Ratio (LBR) of 40 percent. The subbase should be compacted to a minimum density equivalent to 98 percent of the modified Proctor maximum density (AASHTO T-180). The subgrade material, below the subbase, shall be compacted to minimum density of 98% of the modified Proctor maximum density of the soil.

Soil-Cement Base

1-1/2" to 2-1/2" asphaltic concrete wearing surface

6" to 8" soil-cement base designed and constructed in accordance with current Portland Cement Association recommended methods.

12" subgrade consisting of free draining natural fine sand or fine sand fill with less than 7 percent passing a U.S. #200 sieve. The subgrade should be compacted to a minimum density of 98 percent of the modified Proctor maximum density (AASHTO T-180).

Crushed Concrete Base

1-1/2" to 2-1/2" asphaltic concrete wearing surface

6" to 8" crushed concrete base with the quality of crushed concrete to be in accordance with current Florida Department of Transportation specifications and should have a minimum Limerock Bearing Ratio (LBR) of 150 and be compacted to at least 98 percent of the Modified proctor maximum dry density per ASTM D-1557.

12" stabilized subbase with minimum Limerock Bearing Ratio (LBR) of 40 percent. The subbase should be compacted to a minimum density equivalent to 98 percent of the modified Proctor maximum density per ASTM D-1557. The subgrade material, below the subbase, shall be compacted to minimum density of 98% of the modified Proctor maximum density of the soil per ASTM D-1557.

Type of Development	ADT (average daily traffic)	Base Thickness	Wearing Surface Thickness
Residential	< 1,500	6"	1 ½"
	>1,500	8"	2 ½"

The pavement section should be designed based on expected traffic including truck loads. Traffic should not be allowed on the subgrade prior to placement of the base to avoid rutting. The final pavement thickness design should be checked by the project civil engineer using data contained in this report and anticipated traffic conditions.

As a possible pavement section design alternative, AEI presents recommendations for a rigid pavement section as follows:

Rigid Pavement

6" reinforced concrete wearing surface: Designed 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.

12" subgrade: consisting of free draining natural fine sand or fine sand fill. Subgrade to be compacted to a minimum density equivalent to 98 percent of the modified Proctor maximum density (AASHTO T-180).

Proposed Stormwater Retention Areas

Based on the results of the machine auger borings and permeability tests and dependent on planned site grades, the proposed stormwater retention areas, located in the vicinities of AB-1 and AB-2, appear suitable for dry stormwater retention pond design.

Strata 1, 2, and 3 fine sand, excavated from the stormwater retention area during pond construction, are considered suitable for use as general fill with minimal soil preparation efforts provided that the soil's moisture content is maintained near optimum prior to fill placement and compaction.

For analysis and design purposes the following aquifer characteristics should be used. These aquifer characteristics were determined from the results of the field and laboratory investigations, adjusting for depth and soil variability:

Boring Locations	Bottom of Aquifer *	Avg. Unsat. Vertical Hydraulic Conductivity (ft/day)	Avg. Horizontal Hydraulic Conductivity (ft/day)	Depth to Seasonal High Groundwater Level *	Soil Storage Coefficient
AB-1	15.0	10.0	21.8	11.0	0.25
AB-2	15.0	9.6	21.1	11.0	0.25

* Feet below existing land surface

The permeability rate of the Stratum 3 soil is estimated based on our visual and tactile classification and experience with similar soil types. Factors of safety have not been applied to the above weighted average permeability values. For the purpose of recovery analysis in accordance with water management district rules, a factor of safety of 2 should be applied to the permeability rate or the recovery time.

The following formulas were used in the calculation of both the weighted average horizontal and weighted average vertical permeabilities:

$$\text{Weighted Average Vertical Permeability} = \frac{\sum L}{\frac{L_1}{Kv_1} + \frac{L_2}{Kv_2} + \frac{L_3}{Kv_3} + \ldots\ldots\ldots \frac{L_n}{Kv_n}}$$

$$\text{Weighted Average Horizontal Permeability} = \frac{Kh_1.L_1 + Kh_2.L_2 + Kh_3.L_3 + \ldots . Kh_n.L_n}{\sum L}$$

AB-1:

Unsaturated Vertical Hydraulic Conductivity
Kv unsat = 11.0 ft / (4.5 ft/11.3 ft/day + 5.0 ft/15.0 ft/day + 1.5 ft/25.0 ft/day) X 2/3 = 10.0 ft/day

Horizontal Hydraulic Conductivity
Kh = (6.0 ft. x 11.3 ft/day + 7.5 ft. x 15.0 ft/day + 1.5 ft. x 25.0 ft/day) / 15.0 ft) X 1.5 = 21.8 ft/day

AB-2:

Unsaturated Vertical Hydraulic Conductivity
Kv unsat = 11.0 ft / (3.5 ft/10.0 ft/day + 7.5 ft/18.2 ft/day) X 2/3 = 9.6 ft/day

Horizontal Hydraulic Conductivity
Kh = (7.5 ft. x 10.0 ft/day + 7.5 ft. x 18.2 ft/day) / 15.0 ft) X 1.5 = 21.1 ft/day

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 need 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

This report has been prepared for the exclusive use of Halff Associates, Inc., 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 foundation 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 4**. 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, within the proposed pavement area and stormwater retention areas, to the drilled depths of 7 to 15 feet, 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 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.

Mark L. Jung
Senior Project Manager

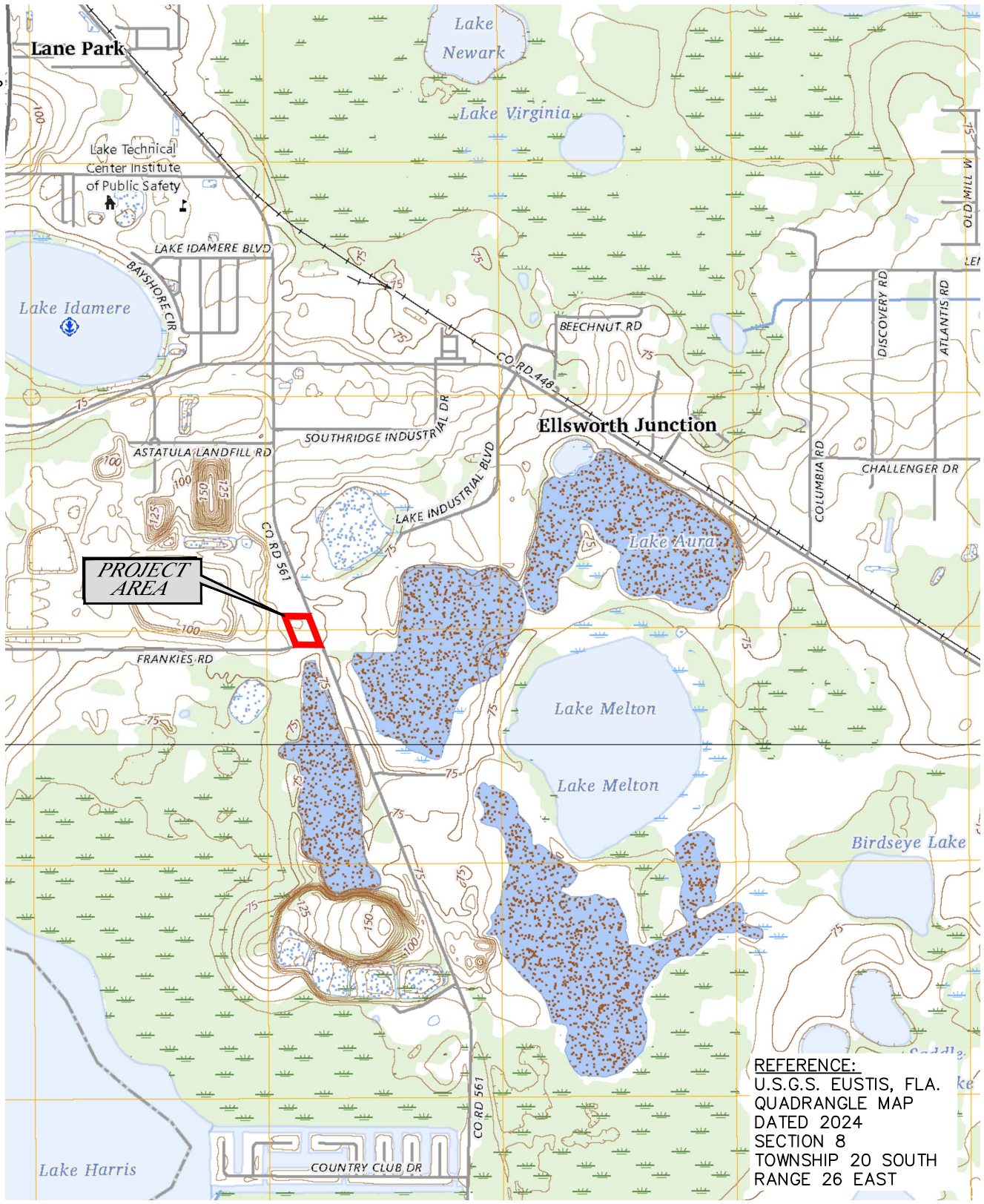
This item has been digitally signed and sealed by Ray Jones, P.E. on 3/28/25.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

RAYMOND W. JONES LICENSE NO. 58079 STATE OF FLORIDA PROFESSIONAL ENGINEER

Raymond W. Jones, P.E.
Vice President
Florida Registration No.58079

FIGURES



REFERENCE:
U.S.G.S. EUSTIS, FLA.
QUADRANGLE MAP
DATED 2024
SECTION 8
TOWNSHIP 20 SOUTH
RANGE 26 EAST

0 2000 4000 Feet

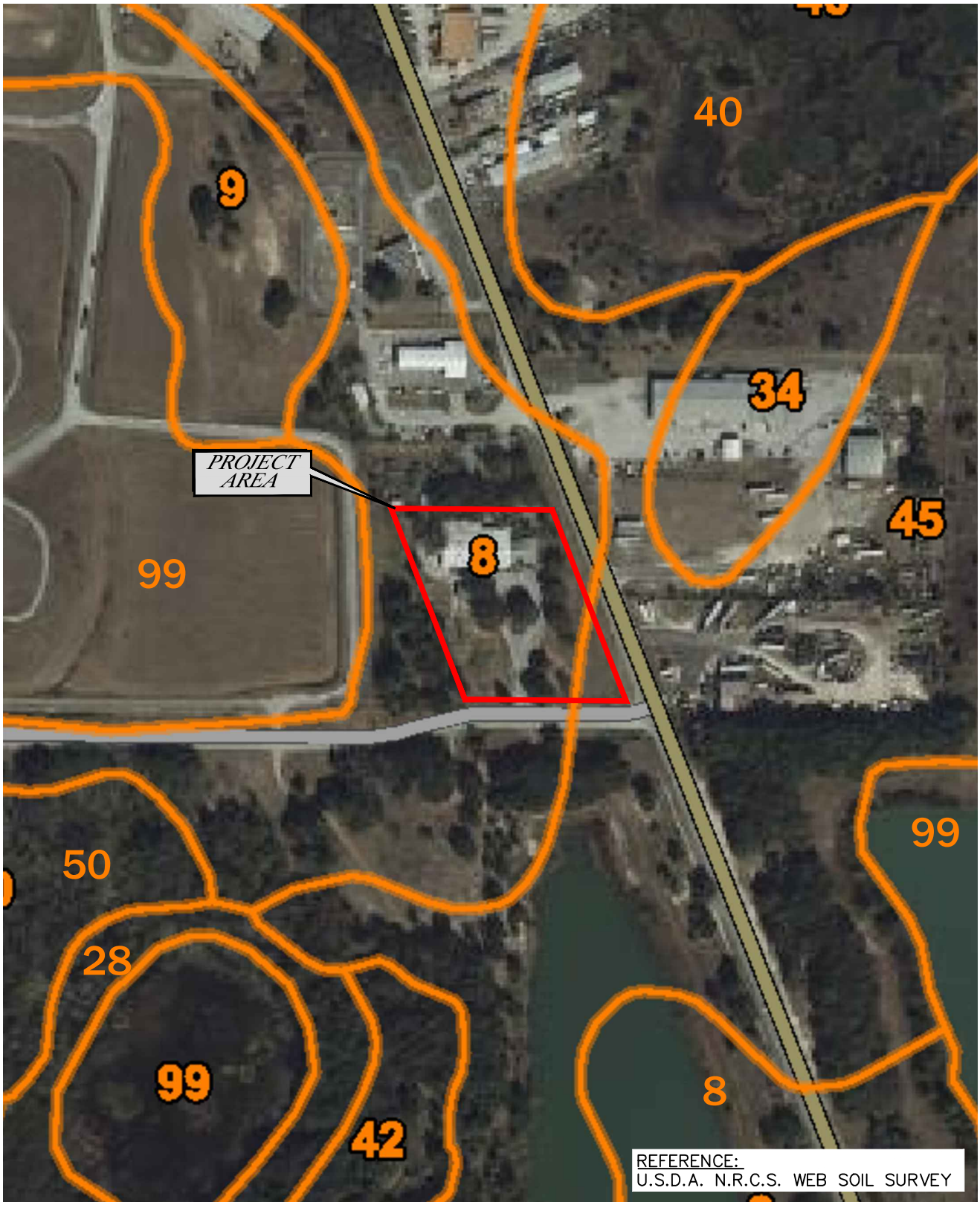
Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION
TRADITIONAL HOUSING PROJECT
PROPOSED STORMWATER RETENTION & PAVEMENT AREAS
TAVARES, LAKE COUNTY, FL

APPROXIMATE SCALE:	DATE: 03/25/25	ENGINEER: RJ
1"=2000'	PN: GPGT-25-024	DRAWN BY: DLS

U.S.G.S. TOPOGRAPHIC MAP

FIGURE 1



LEGEND:

8 CANDLER SAND
0 TO 5% SLOPES

45 TAVARES SAND
0 TO 5% SLOPES

0 300 600 Feet

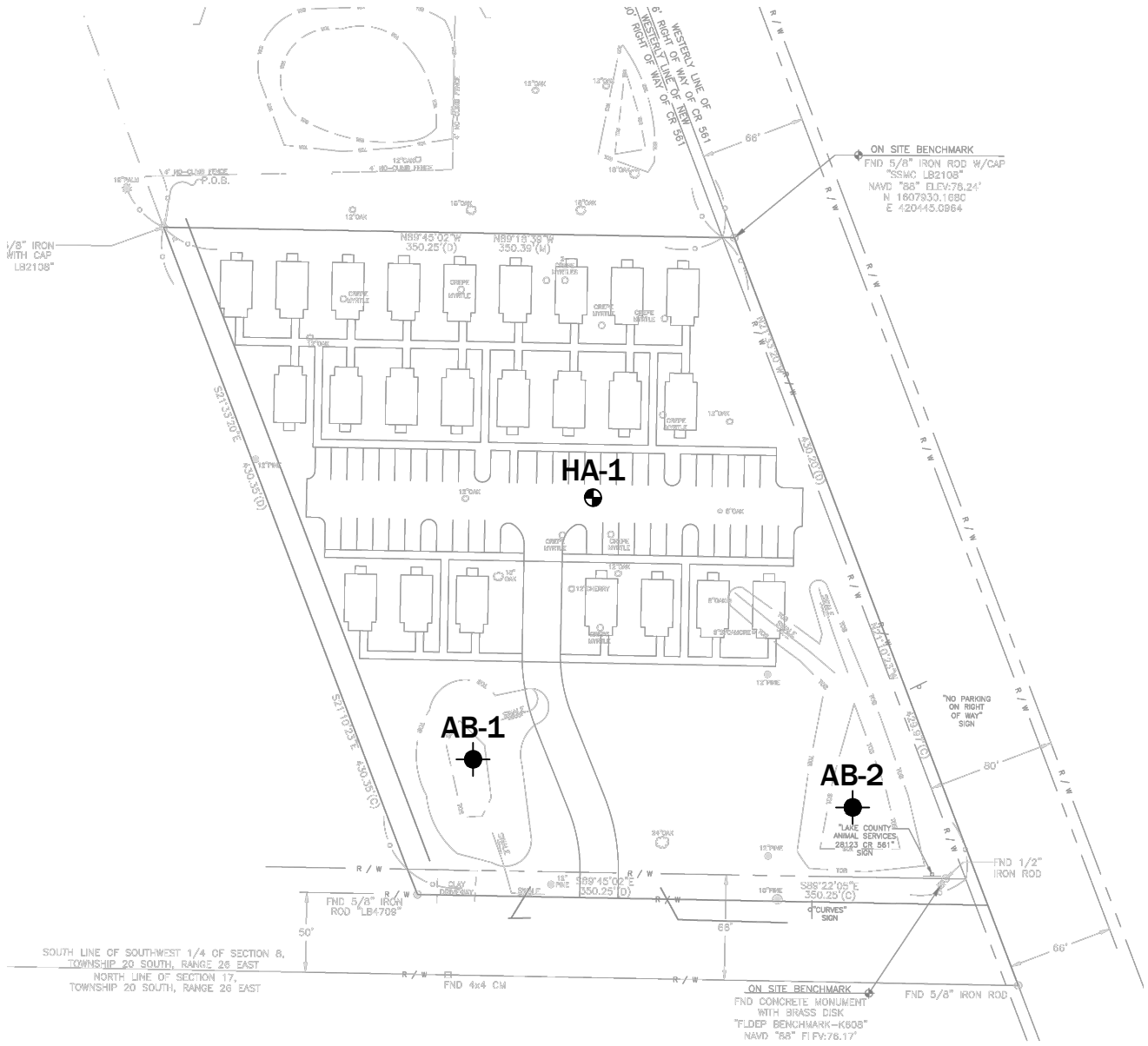
Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 03/25/25	ENGINEER: RJ
1"=300'	PN: GPGT-25-024	DRAWN BY: DLS

GEOTECHNICAL INVESTIGATION
TRADITIONAL HOUSING PROJECT
PROPOSED STORMWATER RETENTION & PAVEMENT AREAS
TAVARES, LAKE COUNTY, FL

N.R.C.S. SOIL SURVEY MAP

FIGURE 3



LEGEND:

- APPROXIMATE LOCATION OF MACHINE AUGER BORING
- APPROXIMATE LOCATION OF HAND AUGER BORING

0 100 200 Feet

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

TRADITIONAL HOUSING PROJECT

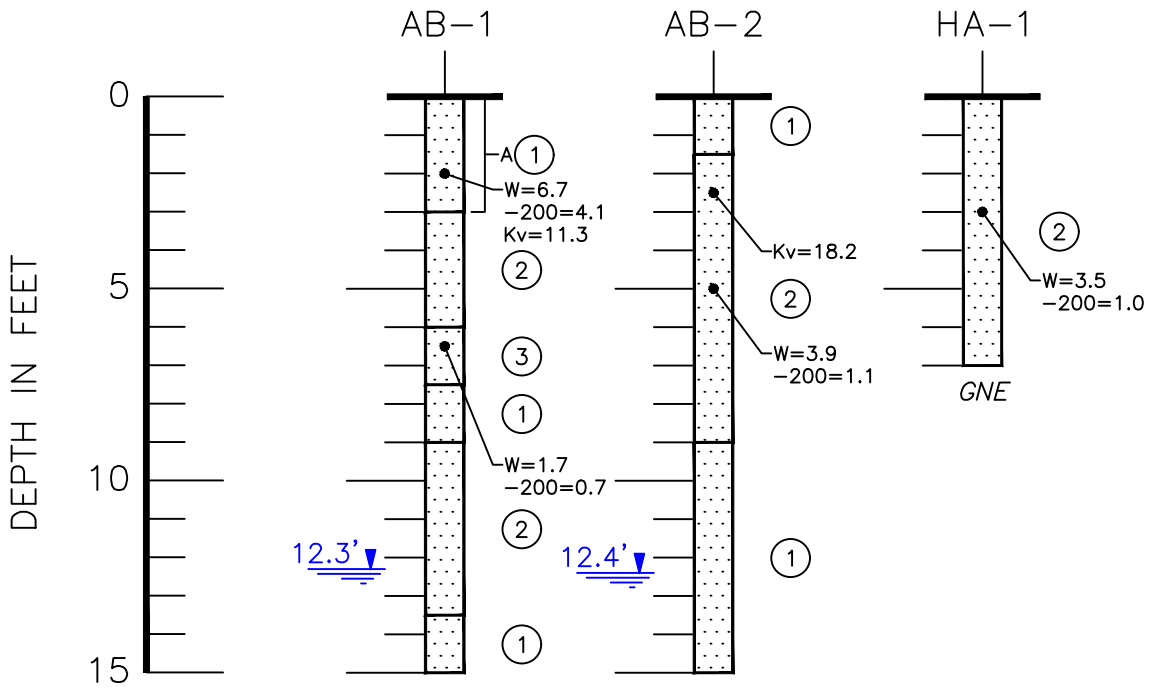
PROPOSED STORMWATER RETENTION & PAVEMENT AREAS

TAVARES, LAKE COUNTY, FL

BORING LOCATION PLAN

APPROXIMATE SCALE:	DATE: 03/25/25	ENGINEER: RJ
1"=100'	PN: GPGT-25-024	DRAWN BY: DLS

FIGURE 3



LEGEND:

(1) DARK GRAY TO DARK BROWN TO DARK GRAYISH BROWN FINE SAND (SP)

(2) BROWN TO YELLOWISH BROWN FINE SAND (SP)

(3) LIGHT BROWN TO LIGHT GRAY TO LIGHT YELLOWISH BROWN FINE SAND (SP)

A WITH SMALL ROCKS

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0' MEASURED DEPTH TO GROUNDWATER, MARCH 7, 2025

GNE GROUNDWATER NOT ENCOUNTERED

W MOISTURE CONTENT, IN PERCENT

–200 PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE

Kv VERTICAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=5'	DATE: 03/26/25	ENGINEER: RJ
	PN: GPGT–25–024	DRAWN BY: DLS

GEOTECHNICAL INVESTIGATION

TRADITIONAL HOUSING PROJECT

PROPOSED STORMWATER RETENTION & PAVEMENT AREAS

TAVARES, LAKE COUNTY, FL

SOIL PROFILES

FIGURE 4