November 11, 2014

Sabal Trail Pipeline Project
Evaluation of Karst Topography and Sinkhole Potential for Pipeline and Facilities

Gulf Interstate Engineering
Attention: Mr. Denys Stavnychyi - Project Engineer

RE: Evaluation of Karst Feature - Spread 5
Milepost 340
Parcel FL-AL-016.000
Alachua County, FL

Mr. Stavnychi,

In general accordance with our proposal dated September 23, 2013 and subsequent agreement, Professional Service Industries, Inc. (PSI) has been carrying out geotechnical services directed at evaluating Karst Topography and sinkhole potential for the pipeline and facilities that will be constructed in connection with the Sabal Trail Pipeline Project.

As part of our work on the assignment, we have performed further evaluation of karst features identified from the desktop study performed or field observations. This report addresses the karst feature identified at Milepost (MP) 340 in Spread 5. The approximate coordinates of the features are 29 33' 04.68" N, 82 39' 15.47" W.

Feature Identification

Two circular depressions were identified just east of the proposed alignment during review of historical aerial photos, alignment maps and published topographic and geologic information. The depressions were not visible until the 2007 aerial and first appeared as a cluster of several smaller depressions later resulting in two distinct features approximately 30 to 40 feet in diameter as can be seen on the following images.

Photo of Alignment from GIE GIS Viewer

Historic Aerial Photo of Area from Google Earth (Image Date January 30, 1998)

Historic Aerial Photo of Area from Google Earth (Image Date January 18, 2012)

Based on the desktop study and field observations, the feature was classified as having a moderate potential for sinkhole development and a MEDIUM risk ranking and further evaluation of the area was recommended. Ground surface elevations at the site are on the order of 60 to 65 feet above mean sea level.

Area Geology

Based on the Alachua County Soil Survey, the county is divided into three geomorphic units. These are the plateau-like region, the western plains region and the south-central/southeastern transitional area. The proposed pipeline appears to fall in the western plains region. This region has low relief with elevations ranging from 50 to 80 feet above mean sea level. The Ocala Limestone is near the surface at this location. Many of the old relic sinks have been filled in this region.

Based on the US Department of Natural Resources Recharge Map for Florida (1980) the pipeline alignment falls in a high recharge region. The potentiometric surface along the alignment ranges from approximately +35 to +40 NAD83 (SJRWMD, May 2009).

Overall the sinkhole risk is considered medium along the alignment in Alachua County. Sinkholes that do develop are typically shallow, small diameter (less than 10') and develop gradually. Cover-subsidence sinkholes are most common.

Geophysical Testing Results

Geophysical testing consisting of a Ground Penetrating Radar Survey was conducted by GeoView on September 4, 2014 and the results were transmitted in a September 9, 2014 report, a copy of which is attached. The survey did not identify any indicators of possible sinkhole activity.

Geotechnical Soil Borings

Based on the results of the geophysical testing and field observations, a single boring was performed at a location offset slightly from the pipeline centerline towards the identified feature but still within the alignment right-of-way. The boring encountered clean to silty fine sands to a depth of approximately 100 feet below the current ground surface. Groundwater was not apparent within the upper 10 feet of the soil boring.

In general, SPT resistance values increased with depth to approximately 50 to 55 feet and no loss of drilling fluid circulation was noted. The approximate boring location is provided on the attached Boring Location Plan and a boring log summarizing the subsurface conditions encountered is also attached for reference.

Conclusions

At this time the pipeline appears to be outside the zone of influence of the identified feature and the surficial depressions are outside of the alignment boundaries. Based on the geophysical and geotechnical testing, the feature was reclassified with a LOW risk ranking and no mitigation is necessary. If the alignment shifts or is rerouted to the east, additional geophysical testing and evaluation may be warranted.

We appreciate the opportunity to be of service on this project and we trust that the foregoing and accompanying attachments are of assistance to you at this time. In the event that you have any questions or if you require additional information, please call.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.
Certificate of Authorization No. 3684

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Attachments: Report of Geophysical Testing – GeoView
Boring Location Plan
Soil Boring Logs

FINAL REPORT
GEOPHYSICAL INVESTIGATION
SABLE TRAIL PROJECT - SPREAD 5 MP 340
ALACHUA COUNTY, FL

Prepared for Professional Service Industries, Inc.
Orlando, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

September 30, 2014

Mr. Ian Kinnear, P.E.
Professional Service Industries, Inc.
1748 33rd Street
Orlando, FL 32839

**Subject: Transmittal of Final Report for Geophysical Investigation
Sable Trail Project - Spread 5 MP 340 - Alachua County, FL
GeoView Project Number 21154.09**

Dear Mr. Kinnear,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation conducted at the Spread 5 MP 340 site. Ground penetrating radar was used to evaluate near-surface geological conditions. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

GEOVIEW, INC.

Michael J. Wightman, P.G.
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Florida Professional Geologist
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1.0 Introduction

A geophysical investigation was conducted at the Sabal Trail Project Spread 5 MP 340 site located in Alachua County, Florida. The investigation was conducted on September 4, 2014.

The purpose of the geophysical investigation was to help characterize near-surface geological conditions in the survey area and to identify subsurface features that may be associated with sinkhole activity. The location of the geophysical survey area is provided on Figure 1. A discussion of the field methods used to generate the report figures is provided in Appendix A2.1.

2.0 Description of Geophysical Investigation

2.1 Ground Penetrating Radar Survey

A Ground Penetrating Radar (GPR) survey was conducted along a series of parallel transects spaced 10 ft apart. The locations of the GPR transects are shown on Figure 1. The GPR data was collected with a Mala radar system. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for Survey

Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
250 MHz [1/]	134	10 to 13 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna.

A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Sinkhole Features Using GPR

The features observed on GPR data that are most commonly associated with sinkhole activity are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into voids in the underlying limestone. If the GPR reflector sets are sharply downwarping and intersect, they can create "bow-tie" shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration sediments.

The greater the severity of these features or a combination of these features the greater the likelihood that the identified feature is a sinkhole. It is not possible based on the GPR data alone to determine if an identified feature is a sinkhole or, more important, whether that feature is an active sinkhole.

4.0 Survey Results

Results of the GPR survey indicated the presence of one well-defined, relatively continuous set of GPR reflectors at a depth range of approximately 3 to 5 ft bls. The reflector set is most likely associated with some change in lithological conditions at that depth range.

The GPR reflector set was continuous across the surveyed areas of the project site. No observed areas of significant downwarping or other indicators of possible sinkhole activity were observed. Accordingly, based on the results of the GPR survey the following is concluded:

1) No indication of potential sinkhole activity was observed within the depth limits of the GPR signal collected across the project site.
2) Soils from the top of the previously discussed GPR reflector set to the maximum depth of penetration of the GPR signal (10 to 13 ft bls) appear to be relatively homogeneous (similar).

A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

APPENDIX 1

FIGURE

EXPLANATION

(10) PATH OF GPR TRANSECT LINES WITH DESIGNATION NUMBER

MP440 SABAL TRAIL CENTER LINE WITH MILE MARKER POINTS

N

0 30'

SCALE: 1"=30' APPROXIMATE

GeoView	FIGURE 1 SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION	SABAL TRAIL PROJECT SPREAD 5 MP 340 SITE ALACHUA COUNTY, FLORIDA	
		PROFESSIONAL SERVICE INDUSTRIES, INC. ORLANDO, FLORIDA	PROJECT: 21154.09 DATE: 09/30/14

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to create the site map were made using a fiberglass measuring tape and a sub-meter GPS system.

A2.2 Ground Penetrating Radar

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components that transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses a Mala GPR system.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids or geological features.

The greater the electrical contrast between the surrounding earth materials and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as is passes through earth materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. As the conductivity of the earth materials increases, the attenuation of the GPR signal increases thereby reducing the signal penetration depth. In Florida, the typical soil conditions that severely limit GPR signal penetration are near-surface clays and/or organic materials.

The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used. For geologic surveys, a low-frequency (250 MHz) antenna is used. This allows for maximum signal penetration and thereby maximum depth from which information will be obtained.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. An integrated survey wheel electronically records the distance of the GPR system along the transect lines.

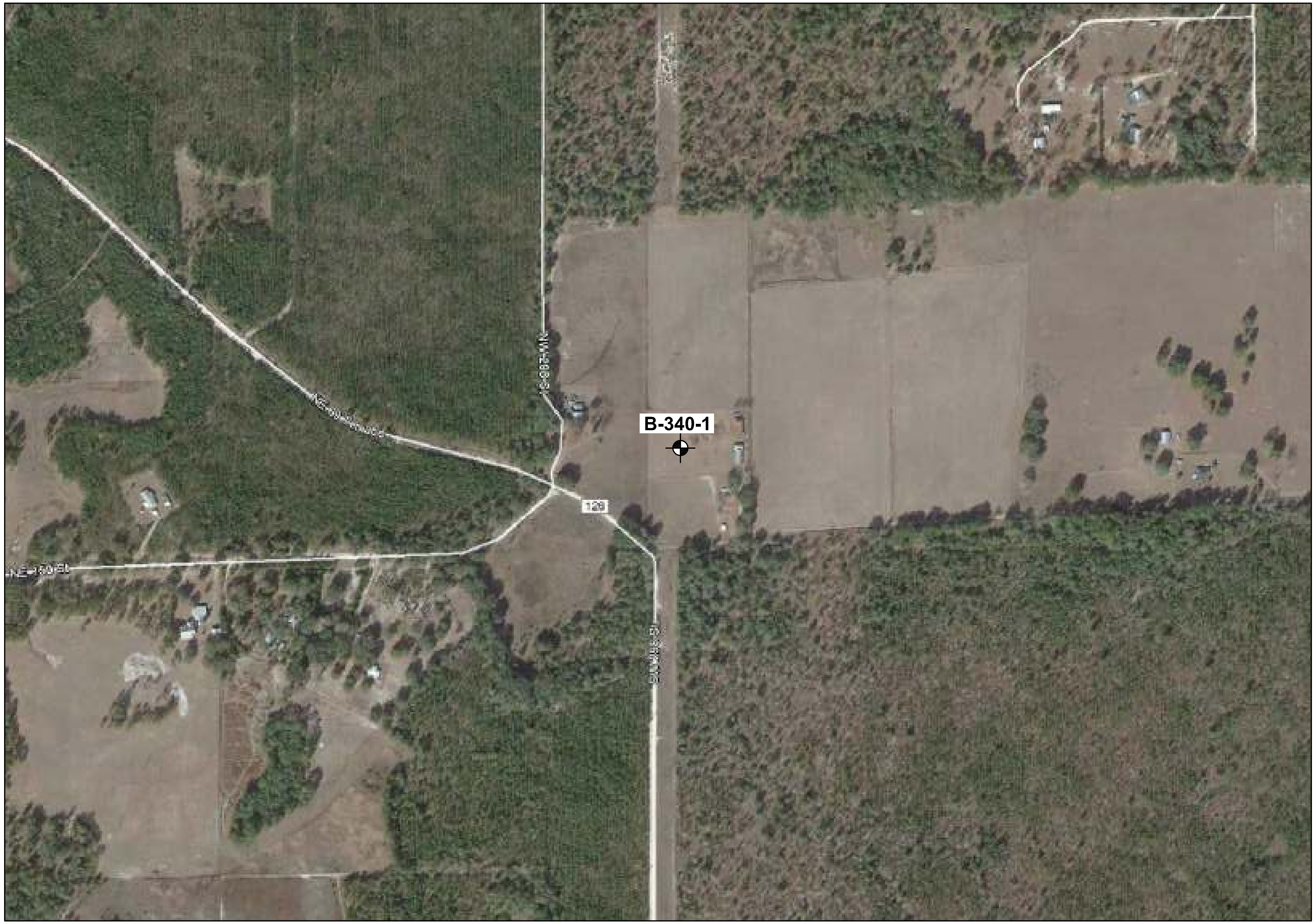
For geological characterization surveys, the GPR survey is conducted along a set of perpendicularly orientated transects. The survey is conducted in two directions because subsurface features such as sinkholes are often asymmetric. Spacing between the transects typically ranges from 10 to 50 ft. Closely spaced grids are used when the objective of the GPR survey is to identify all sinkhole features within a project site. Coarser grids are used when the objective is to provide a general overview of site conditions. After completion of a survey using a given grid spacing, additional more-closely spaced GPR transects are often performed to better characterize sinkhole features identified by the initial survey. This information can be used to provide recommended locations for geotechnical borings.

Depth estimates to the top of lithological contacts or sinkhole features are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

<u>Interpretation and Limitations of GPR data</u>

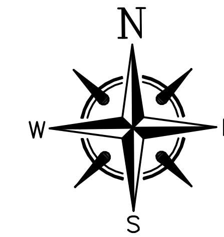
The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for geological characterization studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. In addition, GPR data can only resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified. GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.



LOCATION PLAN

SCALE: 1"=500'



LEGEND

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

BORING LOCATION PLAN

GULF INTERSTATE ENGINEERING

SABAL TRAIL - KARST MP 340

BRONSON, ALACHUA COUNTY, FLORIDA

Information To Build On

Engineering • Consulting • Testing

DRAWN: DJW	SCALE: NOTED	PROJ. NO: 07571055
CHKD: JKT	DATE: 11-19-14	SHEET: 1

psi *Information To Build On*

Engineering • Consulting • Testing

BORING LOG

BORING NO. B-340-1 SHEET 1 OF 2

BORING LOC. SEE SHEET 1

DRILLER BRANDON LOGGED BY BRANDON

CLIENT GULF INTERSTATE ENGINEERING JOB NO. 07571055

STARTED 10-30-14 FINISHED 10-30-14

JOB NAME SABAL TRAIL – KARST MP 340

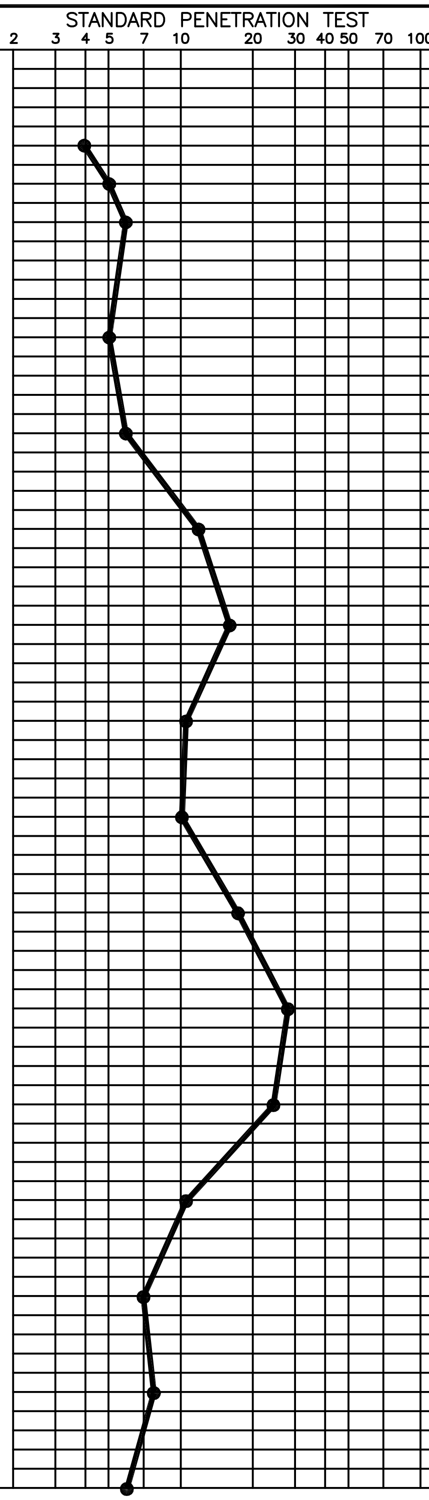
GROUND ELEV. – CASING LENGTH –

JOB LOC. ALACHUA COUNTY, FLORIDA

GROUNDWATER TABLE GNE

DEPTH (FEET)	DESCRIPTION OF SOIL
0 – 6	LIGHT ORANGE-BROWN TO BROWN FINE SAND TO FINE SAND WITH SILT, (SP), (SP-SM)
6 – 47.5	LIGHT BROWN TO ORANGE-BROWN SILTY FINE SAND, (SM)
47.5 – 57.5	LIGHT BROWN FINE SAND WITH SILT, (SP-SM)
57.5 – 75	LIGHT GRAY-BROWN TO ORANGE-BROWN SILTY FINE SAND, (SM)

STANDARD PENETRATION TEST



SAMPLE FEET	BLOWS ON SAMPLER	N VALUE
	AUGERED	HA
	AUGERED	HA
5	2,2,2	4
	3,2,3	5
	4,3,3	6
15	2,3,2	5
20	4,3,3	6
25	5,7,6	13
30	8,8,9	17
35	5,4,7	11
40	4,4,6	10
45	8,7,11	18
50	9,13,15	28
55	10,11,14	25
60	5,5,6	11
65	3,4,3	7
70	2,3,5	8
75	2,2,4	6

REMARKS

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BORING LOG

BORING NO. B-340-1 SHEET 2 OF 2

BORING LOC. SEE SHEET 1

CLIENT GULF INTERSTATE ENGINEERING JOB NO. 07571055

JOB NAME SABAL TRAIL – KARST MP 340

JOB LOC. ALACHUA COUNTY, FLORIDA

DRILLER BRANDON LOGGED BY BRANDON

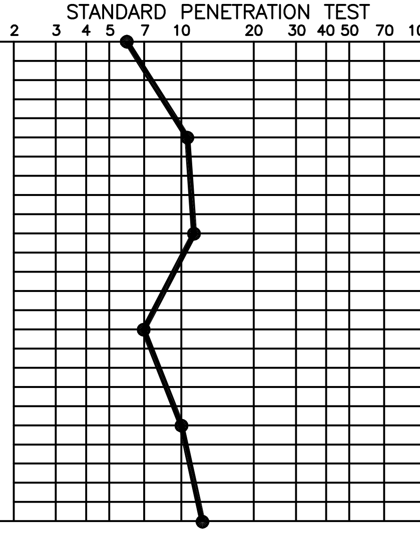
STARTED 10-30-14 FINISHED 10-30-14

GROUND ELEV. – CASING LENGTH –

GROUNDWATER TABLE GNE

FEET	DESCRIPTION OF SOIL	BLOWS ON SAMPLER	N VALUE
75–100	LIGHT GRAY-BROWN TO ORANGE-BROWN SILTY FINE SAND, (SM)		
80		5,6,5	11
85		4,7,5	12
90		5,3,4	7
95		3,4,6	10
100		5,4,9	13

STANDARD PENETRATION TEST



BORING TERMINATED AND GROUTED AT 100.0'

GNE = GROUNDWATER NOT EVIDENT IN UPPER 10 FEET OF BORING

AUTOMATIC HAMMER USED FOR SAMPLING

REMARKS