November 5, 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 Features - Spread 3
Milepost 260.5
Parcel FL-HA-043.000
Hamilton 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) 260.5 in Spread 3. The approximate coordinates of the feature are 30 27' 59.48" N 83 12' 48.24" W.

Feature Identification

A closed circular depression was identified just west of the proposed alignment in the power line easement during review of historical aerial photos, alignment maps and published topographic and geologic information.

Photo of Alignment from GIE GIS Viewer

Based on information from Google Earth, the depression is approximately 150 feet in diameter. The ground surface in the area surrounding the depression is approximately +80 feet above mean sea level while the ground surface elevation in the center of the depression is approximately +60 feet.

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.

Area Geology

The proposed pipeline alignment parallels the Withlacoochee River which comprises the western border of Hamilton County. Hamilton County has two geomorphic regions. These are the Northern Highlands and the Gulf Coastal Lowlands. The pipeline alignment crosses both of these zones. The Northern Highlands topography is typically gently rolling hills with large, flat swampy areas. Dissolution of the underlying limestone has modified the terrain in many areas producing numerous depressions and low, swampy areas called "bays." Many of the bays remain wet during the rainy season. Ground surface elevations range from approximately +70 to +160 feet above mean sea level. The Gulf Coastal Lowlands is generally flat, sandy land modified by Karst depressions. Ground surface elevations in these areas range from approximately +50 to +100 feet above mean sea level.

Based on the US Department of Natural Resources Recharge Map for Florida (1980) the pipeline alignment falls in a region of high recharge. The potentiometric surface along the alignment ranges from approximately +25 to +60 NAD83 (SJRWMD, May 2009). According to the Hamilton County Soil Survey the predominant features in the alignment area are the Suwannee Limestone formation underlain by the Ocala and Avon Park Formations. The top of the Suwannee formation is near elevation +50 feet above mean sea level in the vicinity of the pipeline alignment.

Overall the sinkhole risk is considered medium along the alignment. Sinkholes that do develop are typically shallow, small diameter (in the range 10 to 30 feet in diameter) and develop gradually. Solution sinkholes are the most common. Some larger diameter features are however possible in areas where the overburden is thicker.

Geophysical Testing Results

Geophysical testing consisting of a Ground Penetrating Radar Survey was conducted by GeoView on October 28. 2014 and the results were transmitted in a November 3, 2014 report, a copy of which is attached. The survey identified two anomalous areas characterized by down warping of the GPR reflector set and an increase in penetration depth of the GPR signal. Anomaly A-1 was located just east of the surface depression and west of the proposed alignment (see Geoview Figure 1).

Recommendation

Based on the results of the geophysical testing and field observations, we recommend a soil boring be performed along the alignment within the vicinity of the A-1 anomolous area as identified by GeoView. The soil boring should be used to evaluate the soil conditions in the area and confirm the geophysical test results. To evaluate the sinkhole potential, soil borings should be extended to competent limestone. The limestone formation is expected to be 30 to 40 feet below the existing ground surface, therefore a maximum boring depth of about 50 feet is anticipated. In any case, the boring will be extended to competent materials to evaluate geologic conditions.

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

Lloyd T. Lasher, Jr. P.E.
Principal Consultant
Florida License No. 56794

Ian Kinnear. P.E.
Chief Geotechnical Engineer
Florida License No. 32614

Attachments: Report of Geophysical Testing – GeoView

FINAL REPORT
GEOPHYSICAL INVESTIGATION
SABLE TRAIL PROJECT - KARST SITE MP 260.5
HAMILTON COUNTY, FL

Prepared for Professional Service Industries, Inc.
Orlando, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

November 3, 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 - Karst Site MP 260.5
Hamilton County, Florida
GeoView Project Number 21154.21

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 Karst Site MP 260.5 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.
Principal Geophysicist, President
Florida Professional Geologist
Number 1423

Chris Taylor, P.G.
Vice President
Florida Professional Geologist
Number 2256

4610 Central Avenue
St. Petersburg, FL 33711
Tel.: (727) 209-2334
Fax: (727) 328-2477

1.0 Introduction

A geophysical investigation was conducted at the Sabal Trail Project Karst Site MP 260.5 site located in Hamilton County, Florida. The investigation was conducted on October 28, 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 figure 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 north-south oriented transects spaced approximately 10 ft apart. The data was collected east of an existing surface depression. 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/	221	10 to 20 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 10 ft bls. The reflector set is most likely associated with some change in lithological conditions at that depth range.

Two GPR anomaly areas possibly associated with karst activity were identified within the survey area. The anomaly areas are designated as GPR Anomalies A-1 and A-2 on Figure 1. The anomalies are characterized by a localized downwarping of the GPR reflectors and an increase in penetration of the GPR signal. Anomaly A-1 was located east of the existing surface depression.

The coordinates of the centers of the GPR anomalies are provided in Table 2. Examples of the GPR data collected across the anomaly areas are provided in Appendix 1. A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

Table 2
Coordinates of Anomaly Centers

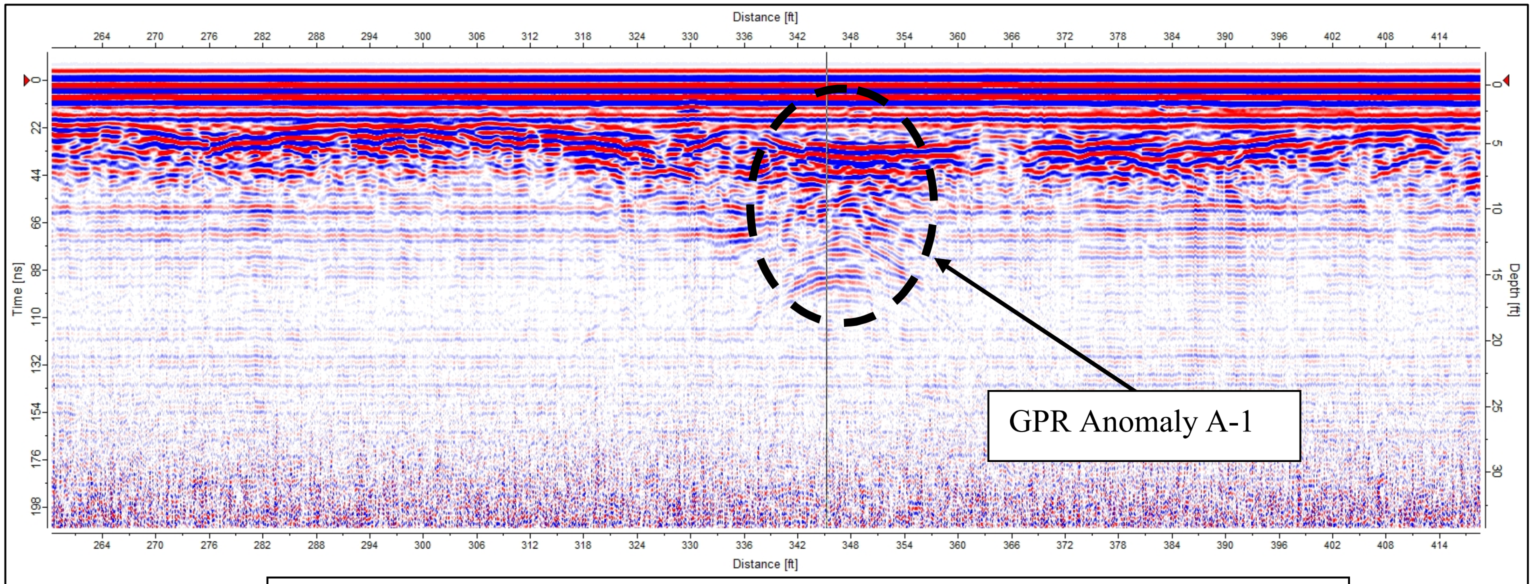
Anomaly	Easting	Northing	Latitude	Longitude
A-1	2373961	535621	30.46650437	-83.21302539
A-2	2373924	535901	30.46727563	-83.21313238

* US State Plane, Florida North, NAD83 (Conus), Feet

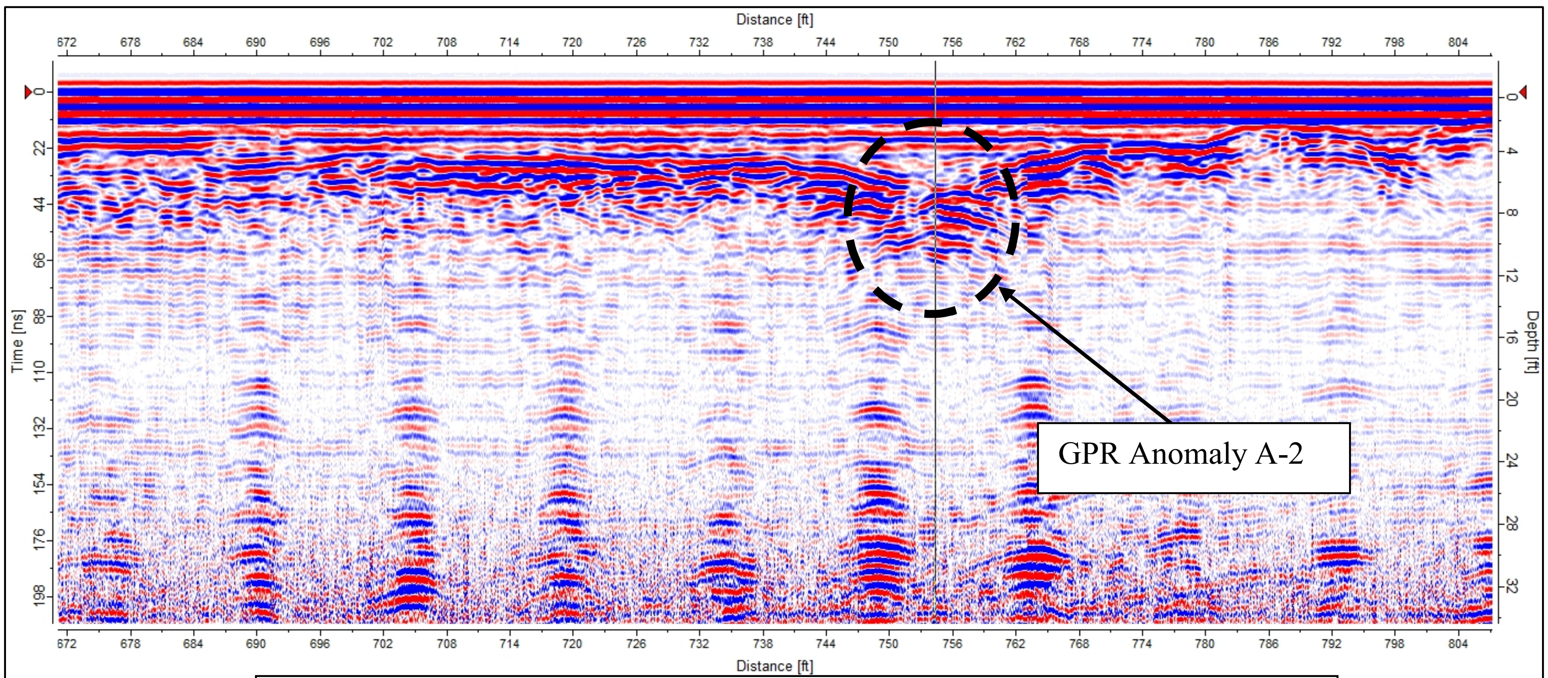
APPENDIX 1

FIGURE AND EXAMPLES OF GPR ANOMALIES

GeoView	FIGURE 1 SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION	SABAL TRAIL PROJECT SPREAD 4 MP 260.5 SITE HAMILTON COUNTY, FLORIDA PROFESSIONAL SERVICE INDUSTRIES, INC. ORLANDO, FLORIDA	PROJECT: 21154.21 DATE: 11/03/14



GPR Transect 2 Showing Example of GPR Anomaly A-1



GPR Transect 1 Showing Example of GPR Anomaly A-2

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.