FINAL REPORT
GEOPHYSICAL INVESTIGATION
COUNTY ROAD 623 SITE
SEBRING, FL

Prepared for ATC Associates, LLC
Tampa, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

March 16, 2020

Mr. Ed Zisman, P.E.
ATC Associates, LLC
5602 Thompson Center Court
Tampa, FL 33634

Subject: Transmittal of Final Report for Geophysical Investigation
County Road 623 Site - Sebring, FL
GeoView Project Number 31136

Dear Mr. Zisman,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation conducted at the County Road 623 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.

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1.0 Introduction

A geophysical investigation was conducted along County Road 623 located in Sebring, FL, Florida. The investigation was conducted on February 19, 2020. Prior to this investigation, several areas of surficial damage were observed along the northern lane of the asphalt road. It is noted that there was a substantial downward slope on the northern embankment of the road.

The purpose of the geophysical investigation was to help characterize near-surface geological conditions along the northern lane and north right-of-way (ROW) and to identify subsurface features that may be associated with potential anomalous soil disturbances undermining the roadway. The location of the geophysical survey area is provided on Figures 1 through 3. A discussion of the field methods used to generate the report figures is provided in Appendix A2.1.

2.0 Description of Geophysical Investigation

A ground penetrating radar (GPR) survey was conducted along a series of transects in the accessible portions of the interior of the units (Figure 1). The GPR data was collected with a GSSI 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 (feet (ft) below land surface (bls))
350 MHz 1/	60 & 165	10 to 28

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

The positions of the geophysical transect lines were recorded using a Trimble GeoXH Global Positioning System (GPS). A Wide Area Augmentation System (WAAS) was used to augment GPS with additional signals for increasing the reliability, integrity, accuracy and availability of the GPS signal. By using WAAS, an accuracy of less than 3 feet in the horizontal dimension was achieved. 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 Anomalous Soil Disturbances Using GPR

The features observed on GPR data that are most commonly associated with anomalous soil disturbances 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 underlying voids. If the GPR reflector sets are sharply downwarping and intersect, they can create a "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 of sediments.

The greater the severity of these features or a combination of these features the greater the likelihood that the soils are disturbed.

4.0 Survey Results

Results of the GPR survey indicated the presence of three well-defined, relatively continuous set of GPR reflectors at approximate depth ranges of 1 to 2 ft bls, 4 to 6 ft bls, and 7 to 16 ft bls. The upper reflector sets are likely associated with fill soils. The lower GPR reflector set is most likely associated with a variable clayey or weathered limestone surface.

The GPR reflector sets were continuous across the surveyed areas of the roadway. The upper reflectors were near horizontal with no observed areas of significant downwarping or other indicators of possible soil disturbances observed. Based on the lack of a significant possible soil disturbance, it is unlikely that the observed surficial damage in the roadway is associated with karst activity at depth undermining the asphalt. Alternatively, it is more likely that the observed damage is associated with settlement along the sloping embankment.

An example of the GPR data along the roadway is shown in Appendix 1. A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

APPENDIX 1

FIGURES AND EXAMPLE OF GPR DATA

FDOT AERIAL 2017

EXPLANATION

- BORING IN ROADWAY (by others)
- LARGE CRACKS IN ROADWAY
- 10 → GPR TRANSECTS & DESIGNATION

N

0 100'

SCALE: 1"=100' APPROXIMATE

GeoView

FIGURE 1 OVERALL SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION	COUNTY ROAD 623 SITE HIGHLANDS COUNTY, FLORIDA	
	ATC ASSOCIATES, LLC TAMPA, FLORIDA	PROJECT: 31136 DATE: 03/16/20

FDOT AERIAL 2017

EXPLANATION

BORING IN ROADWAY (by others)

LARGE CRACKS IN ROADWAY

10 GPR TRANSECTS & DESIGNATION

N

0 50'

SCALE: 1"=50' APPROXIMATE

GeoView

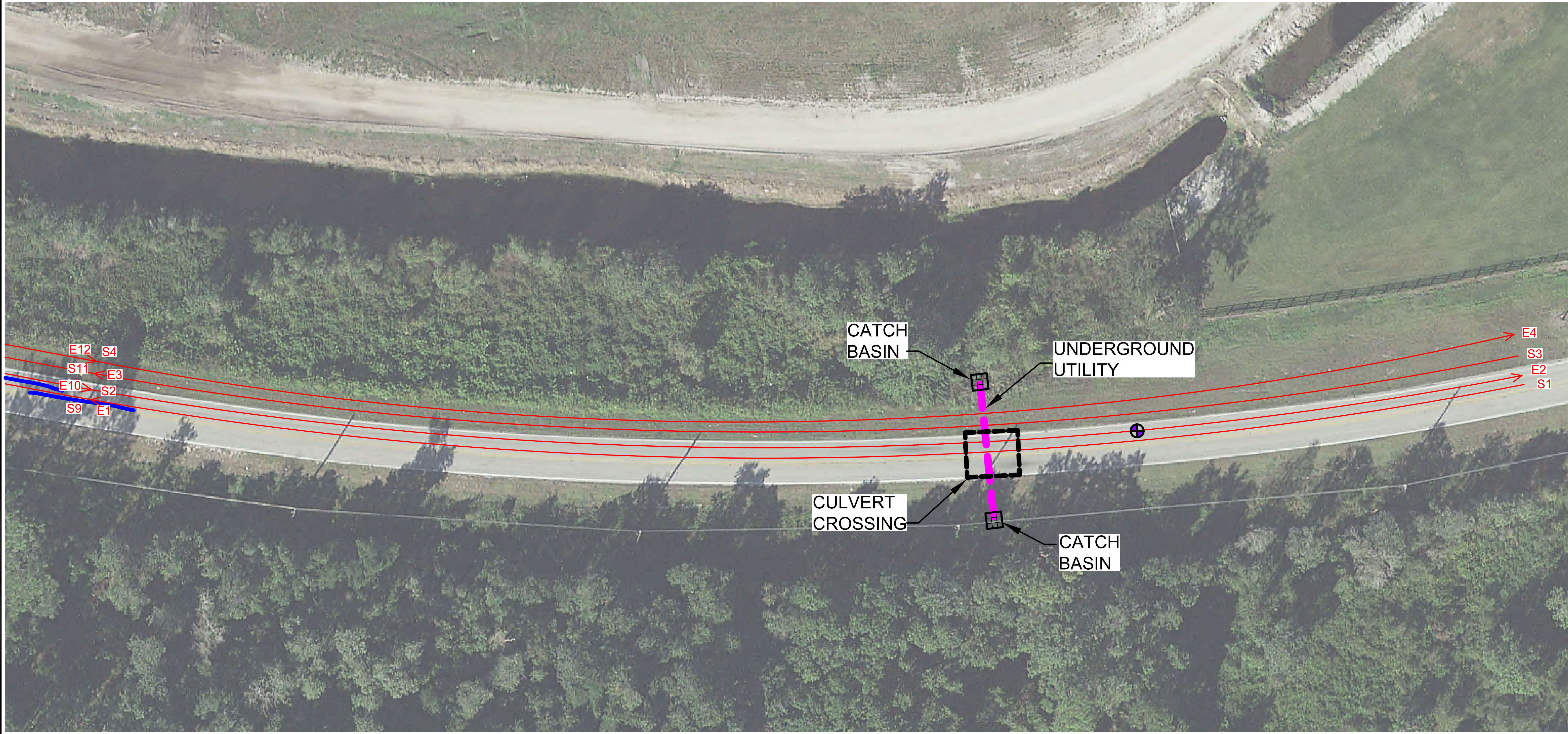
FIGURE 2

WESTERN SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION

COUNTY ROAD 623 SITE
HIGHLANDS COUNTY, FLORIDA

ATC ASSOCIATES, LLC
TAMPA, FLORIDA

PROJECT: 31136
DATE: 03/16/20



FDOT AERIAL 2017

EXPLANATION

- BORING IN ROADWAY (by others)
- LARGE CRACKS IN ROADWAY
- 10 → GPR TRANSECTS & DESIGNATION

N

0 50'

SCALE: 1"=50' APPROXIMATE

GeoView

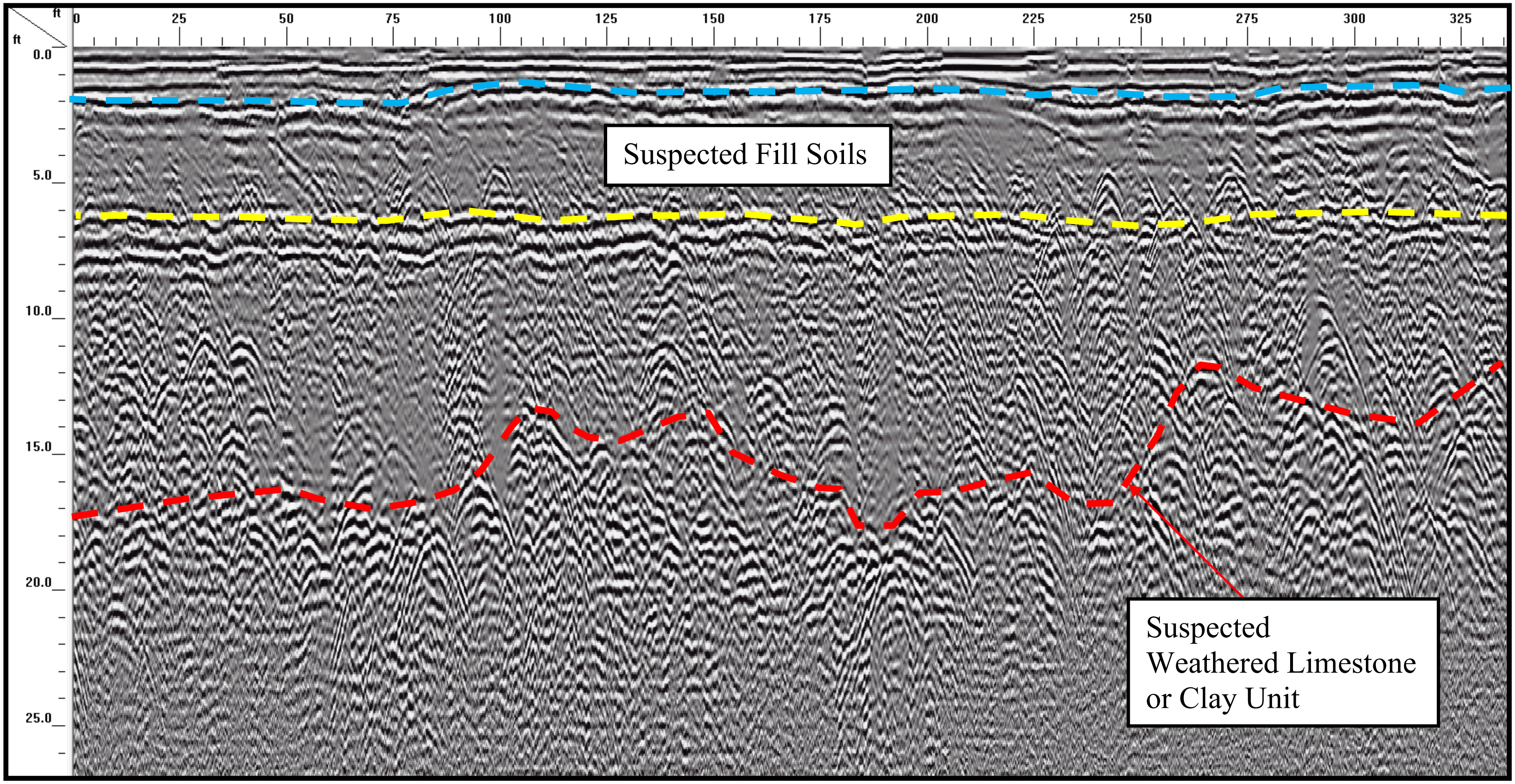
FIGURE 3

EASTERN SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION

COUNTY ROAD 623 SITE
HIGHLANDS COUNTY, FLORIDA

ATC ASSOCIATES, LLC
TAMPA, FLORIDA

PROJECT: 31136
DATE: 03/16/20



GPR Transect Showing Example of GPR Reflectors below Asphalt Roadway

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The positions of the geophysical transect lines were recorded using a Trimble GeoXH Global Positioning System (GPS). These GPS systems typically have an accuracy of 1 to 3 ft.

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 or GSSI 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 shallow investigations, a mid-range frequency (350 to 500 MHz) antenna is used. The 350 to 500 MHz antenna sometimes provides higher quality data on concrete surfaces.

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 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 soil disturbances 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 anomalous 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 anomalous 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.

Interpretation and Limitations of GPR data

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.