

May 23, 2007

**TBE Group, Inc.**  
380 Park Place Boulevard, Suite 300  
Clearwater, Florida 33759

Attention: Mr. E. Peter Nikolov, P.E.

Re: **Ground Penetrating Radar Study**  
Elgin Boulevard Roadway Widening  
Between Mariner Boulevard and Sand Ridge Boulevard  
Hernando County, Florida  
**PSI Project No. 775-65033**

Dear Mr. Nikolov:

This Ground Penetrating Radar (GPR) study was performed in general accordance with the Hernando County Scope of Services, the subconsultant agreement between TBE and PSI, and PSI proposal No. 775-6G0039 (Revision 1), dated November 3, 2006. The following report summarizes the field study and results of the limited GPR survey conducted at the referenced site in Spring Hill, Florida on April 15, 2007. The GPR survey was conducted to assess whether subsurface anomalies potentially related to sinkhole activity were present along a line approximately 30 feet north of Elgin Boulevard. Subsurface anomalies signify disrupted or discontinuous GPR reflectors and are typically associated with subsurface objects or variations such as may occur if downward raveling of soil such as occurs within a sinkhole. A description of GPR theory, data acquisition and limitations are located in Appendix B.

### **Methods**

The GPR survey was performed along the north side of Elgin Blvd utilizing a 250-megahertz (MHz) shielded antenna. Where accessible, the GPR transect was performed approximately 30 feet from the edge of the existing road. The approximate location of the GPR transect is located in Plate 1 (Appendix A). Initial calibration tests indicated an optimal time range for the 250-MHz antenna to be set at 188 nanoseconds (ns). This range provided a maximum depth of penetration at approximately 30 feet (ft) below land surface (bls) respectively.

### **Results**

One (1) subsurface anomaly was observed on the GPR profiles produced from the data collected, and is located in Figure 1. Subsurface anomalies signify disrupted or discontinuous GPR reflectors and are typically associated with increased depth of penetration. The anomaly is characterized by disrupted, high amplitude reflectors that deepen toward a common central point and is located approximately 30 feet from the intersection of Woodridge Lane and Elgin Blvd. This location was marked in the field with orange spray paint and an orange flag.

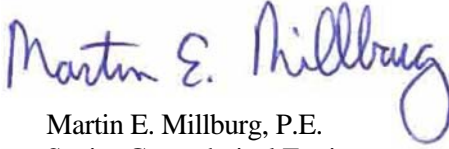
Please contact us if you have any questions or comments concerning this report.

Sincerely,

**PROFESSIONAL SERVICE INDUSTRIES, INC.**



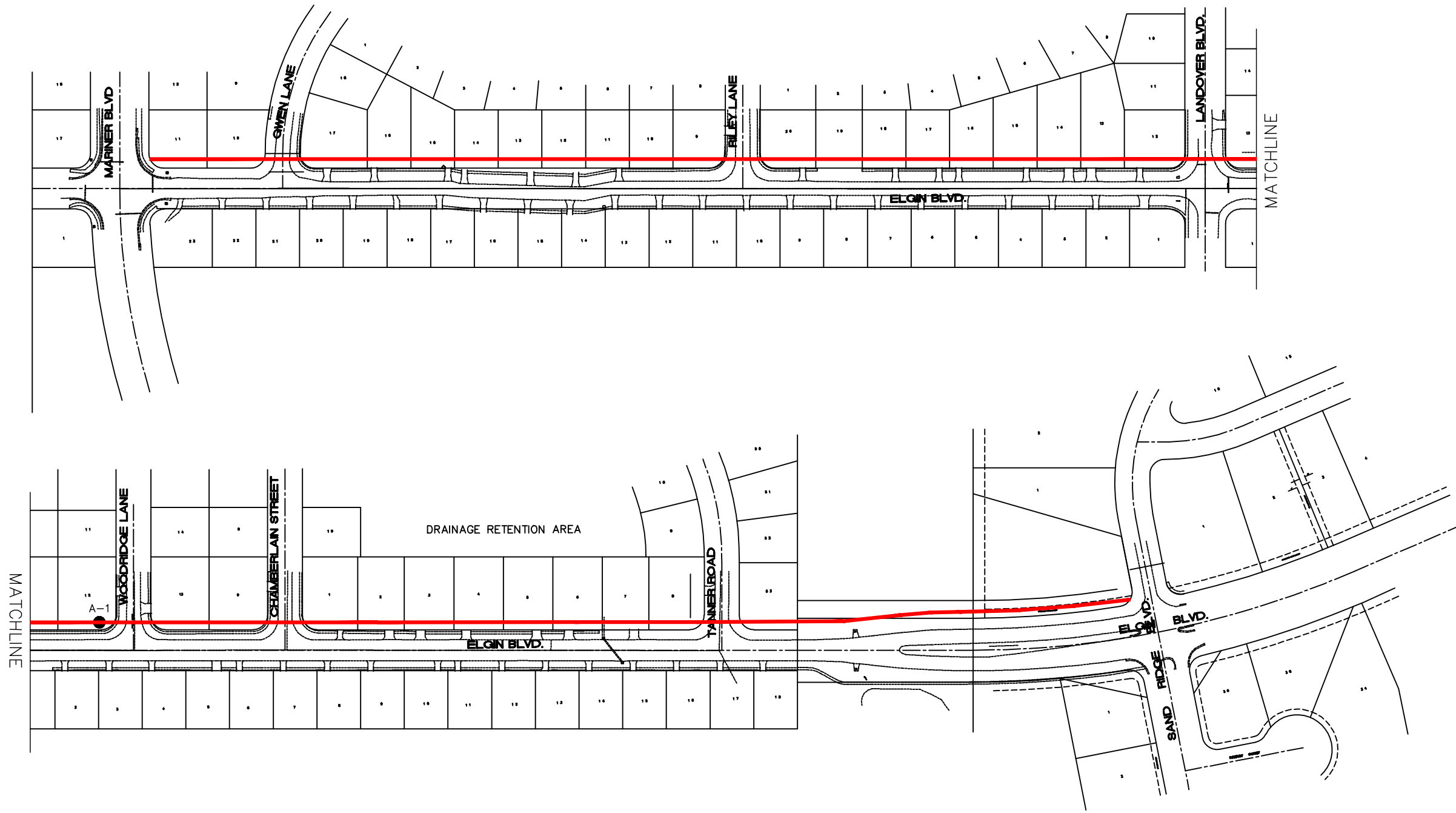
Jessica J. Hansen  
Project Geologist



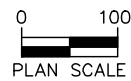
Martin E. Millburg, P.E.  
Senior Geotechnical Engineer  
Florida License No. 36584

Attachments: Appendix A: Plate 1 (250 MHz Antenna Transect Location Map)  
Figure 1  
Appendix B: Ground Penetrating Radar Theory

## Appendix A



### GPR LOCATION PLAN



LOCATION	
TOWNSHIP:	23 S
RANGE:	18 E
SECTION:	4,5,9

### LEGEND

- APPROXIMATE LOCATION OF GRP TRANSECT
- A-1 ● APPROXIMATE LOCATION OF SUBSURFACE ANOMALY

#### REVISIONS

Date	By	Description	Date	By	Description



PROFESSIONAL SERVICE INDUSTRIES, INC.  
5801 BENJAMIN CENTER DR., SUITE 112  
TAMPA, FL. 33634  
(813)-886-1075

FLORIDA ENGINEERING CERTIFICATE  
OF AUTHORIZATION No. 3684

STATE OF FLORIDA  
DEPARTMENT OF TRANSPORTATION

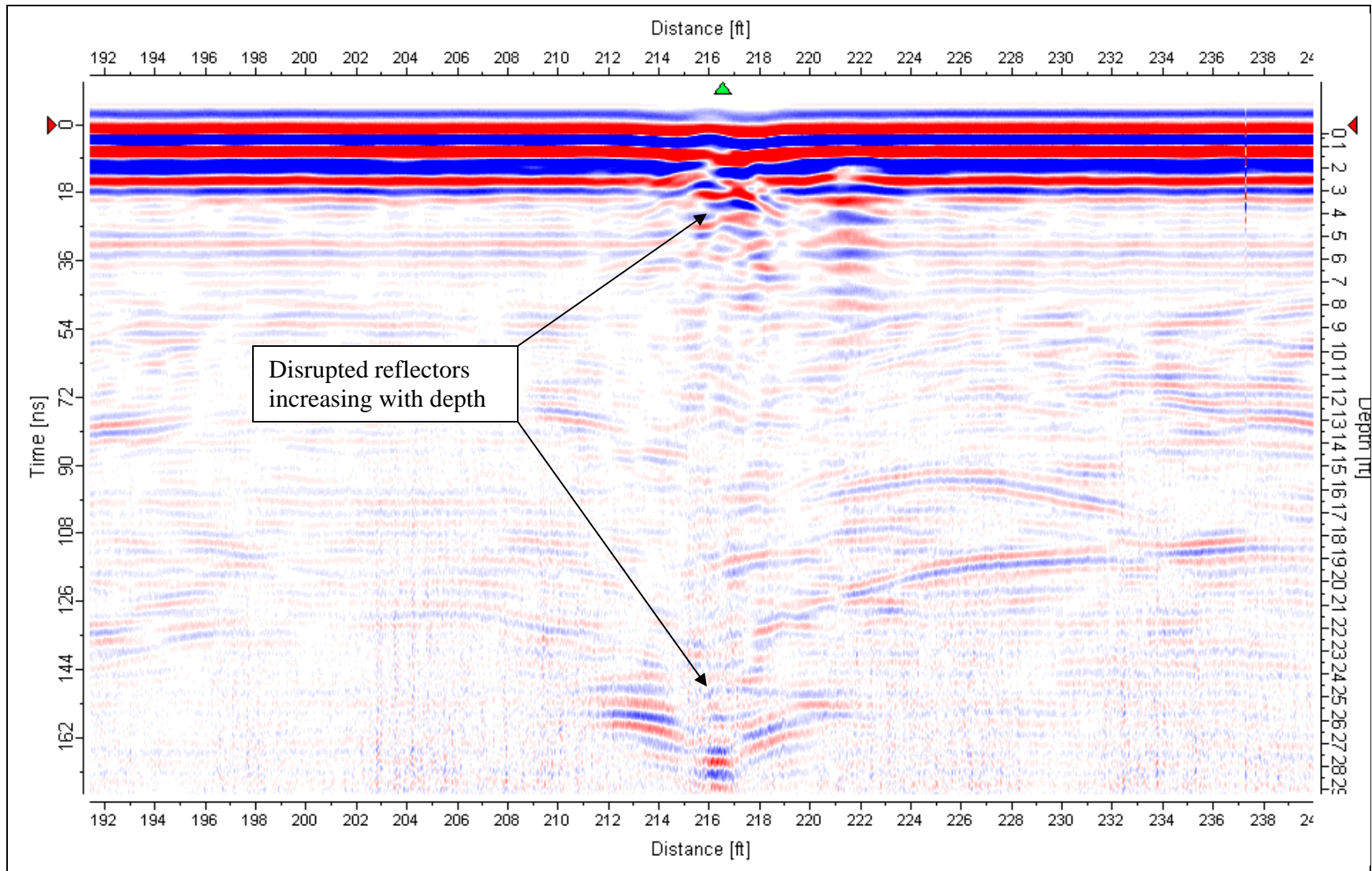
ROAD NO.	COUNTY	FINANCIAL PROJECT NO.
-	HERNANDO	-

#### GROUND PENETRATING RADAR SURVEY

ELGIN BOULEVARD WIDENING  
FROM MARINER BOULEVARD TO SAND RIDGE BOULEVARD

SHEET  
NO.

P:\775-Geo\2006\65033-Elgin\_boulevard\_widening\GPR\65033p1



**Figure 1: GPR profile of subsurface anomaly by Woodridge Lane (250-MHz Antenna)**

## Appendix B

### Description

Ground Penetrating Radar (GPR) is a high-resolution non-intrusive geophysical method typically used to provide a two-dimensional profile of the shallow subsurface. GPR equipment typically consists of an antenna, a radar control unit and a digital recorder. The antenna acts as both a transmitter and a receiver of energy waves, the radar control unit synchronizes the rate at which the waves are propagated into the subsurface and received by the antenna and the digital recorder stores the data. Professional Service Industries (PSI) Inc. uses the MALA GPR system with shielded 250-megahertz (MHz), 500-MHz and 1,600-MHz antennas. The 1,600-MHz antenna is used for concrete evaluation.

### Theory

While conducting a GPR survey, the antenna converts electric current into electromagnetic waves and then radiates those waves into the subsurface. As the electromagnetic waves (typically from 10-MHz to 1,600-MHz) travel downward into the subsurface, the waves encounter material materials that exhibit varying dielectric permittivities. Dielectric permittivity is a measure of a materials ability to polarize itself when inflicted with an electrical charge. Differences in dielectric permittivities within the subsurface will reflect or scatter part of the electromagnetic wave that is propagating downward. The electromagnetic waves that are reflected back to the surface are received by the antenna and stored by the digital recorder. The remaining non-reflected electromagnetic waves continue to travel downward until other dielectric permittivity contrasts are encountered and the previously mentioned process records those reflected waves as well.

The attenuation of the electromagnetic wave and the frequency of the antenna principally control the depth of penetration for a GPR survey. Attenuation describes how energy is lost or dissipated and is predominantly the result from conversion of the electromagnetic wave to thermal energy (heat) due to relatively high conductivities of certain materials within the subsurface. Consequently, complete dissipation of an electromagnetic wave signifies the extent of penetration depth. Hence, shorter wavelengths emitted by higher frequency antennas (1,600-MHz) have considerably less penetration depth.

Dependent upon the specific goals of a particular survey, the desired resolution must also be considered. As previously mentioned, lower frequency antennas provide much greater depth of penetration, but at the cost of resolution. Lower frequencies from a 10-MHz antenna only obtain resolution of a few feet, while higher frequencies from a 1,600-MHz antenna may obtain resolution of an inch.

## **Data Acquisition**

The acquisition of GPR data is typically obtained along inline surveys called transects and represents an individually measured and recorded subsurface two-dimensional profile. The survey configuration itself consists of a set of perpendicular transects in order to delineate the typical asymmetry of subsurface features. Surveys requiring more detail are conducted with 10-foot grid spacing up to 50-foot grid spacing when a general overview is desired. When initial observations indicate a potential subsurface feature, additional transects with closer grid spacing are often executed to acquire greater detail. Concrete surveys require extreme detail are typically conducted with grid spacing of 4 inches. Each configuration is site specific and limited to the logistical constraints dictated by the property.

## **Limitations**

While due care has been exercised in the performance of the measurements and their interpretations, PSI can make no representations, warranties or guarantees with respect to latent or concealed conditions, which may exist and that may be beyond the limits of detection with the methods used.

The most predominant limitation for detection is controlled by the dielectric permittivity of the subsurface material. GPR records electromagnetic waves reflected back to the surface when an interface with distinct dielectric permittivity differences is encountered. If there is no significant contrast between materials, a subsurface feature may go undetected. Alternatively, attenuation from near-surface clays and/or fluids with extremely high dielectric permittivity may considerably hinder or prohibit the desired depth of penetration. In addition, GPR is sensitive to local noise such as buildings, vehicles, power lines and cell phones. Shielded antennas are used to limit these particular types of interference, but they can not be eliminated.