



October 18, 2018

John L. Pilipchuk, L.G., P.E. and Chris Chen, Ph.D., P.E.  
Geotechnical Engineering Unit  
State of N.C. Department of Transportation  
Division of Highways  
P.O. Box 25201  
Raleigh, North Carolina 27611-5201

**Reference: REPORT ON GEOPHYSICAL SERVICES**  
ESP Project No. GR22.305

WBS Number: 51215.01N  
TIP Number: 51215.01N  
Project ID: 33505  
County: New Hanover  
Description: Sanders Street Settlement/Sinkhole  
Site Description: Sanders Street, Wilmington, North Carolina

Dear Mr. Pilipchuk and Mr. Chen:

ESP Associates, Inc. (ESP) is pleased to provide this report on the geophysical services for the referenced project. This work was performed under a limited Notice to Proceed (NTP) received on August 6, 2018. The purpose of the work was to help identify possible voids beneath the area of the sinkhole on Sanders Road and provide information on the subsurface conditions.

## **1.0 BACKGROUND**

The east-bound lane of Sanders Road by the entrance to the Heyward C. Bellamy Elementary School has experienced subsidence for an extended period of time. In 2007, Schnabel Engineering performed a geophysical investigation and identified the approximate center of the subsurface depression using ground-penetrating radar (GPR). Schnabel Engineering reported GPR imaging depths of approximately 30 feet before encountering the water table.

This area of North Carolina was experiencing an extreme drought at the time, which would explain the relatively deep water table.

During the week of July 30, 2018, a sinkhole developed in the east-bound lane. The NCDOT made a temporary repair at that time. The NCDOT requested that ESP perform a GPR study prior to making final repairs.

## **2.0 GEOPHYSICAL DATA COLLECTION AND ANALYSIS**

Edward D. Billington, PG of ESP collected GPR data at the site on August 5, 2018 using our Sensors and Software Noggin GPR with a 250 MHZ antenna. The data were collected along east-west lines spaced approximately one foot apart in a 40-foot by 100-foot grid established on the site (Figure 1). The corners of the grid were marked with nails for later location by the NCDOT (Figure 2).

The GPR data were reviewed in the field as the NCDOT began excavating the sinkhole location. One possible void was noted northwest of the excavation (Figure 2). Subsequent excavation by the NCDOT did not indicate any voids at this location.

The GPR data were reviewed as 2D cross-sections and processed as a 3D data volume using the program EKKO\_Project. Time-depth slices were made of the 3D GPR volume for evaluation of the lateral extent of the sinkhole and possible voids. Figures 3 through 5 show time/depth slices at approximate depths of 1.5, 4.0 and 7.75 below asphalt surface with example 2D GPR cross-sections.

## **3.0 DISCUSSION OF RESULTS**

Our review of the GPR data does not suggest the presence of significant subsurface voids within the imaging depth range of the GPR. The depth limit of the GPR signal appears to be the water table at approximately 9.5 feet. The GPR data shows the geometry of the subsurface depression. The depression is centered at approximate GPR grid coordinates 52X, 13Y. Evidence of the previous grouting can be seen on the GPR data by diffractions from the grout holes and reflections from what appears to be subsurface grout.

## **4.0 SUMMARY AND RECOMMENDATIONS**

The GPR data do not suggest the presence of significant subsurface voids within the depth range scanned with GPR. It is possible that voids are present below the maximum imaging depth of approximately 9.5 feet. If present, deeper voids could eventually work their way

towards the surface causing sags or collapses. At that time, it would be prudent to repeat the GPR study.

## 5.0 LIMITATIONS

These services have been provided to NCDOT in accordance with generally accepted guidelines for performing geophysical surveys. It is recognized that the results of geophysical surveys are non-unique and subject to interpretation.

Thank you for the opportunity to be of service to NCDOT on this project. Please contact us if you have any questions or need further information.

Sincerely,

**ESP ASSOCIATES, INC.**



DocuSigned by:

*Edward D. Billington*

7402544DC92F4E0...

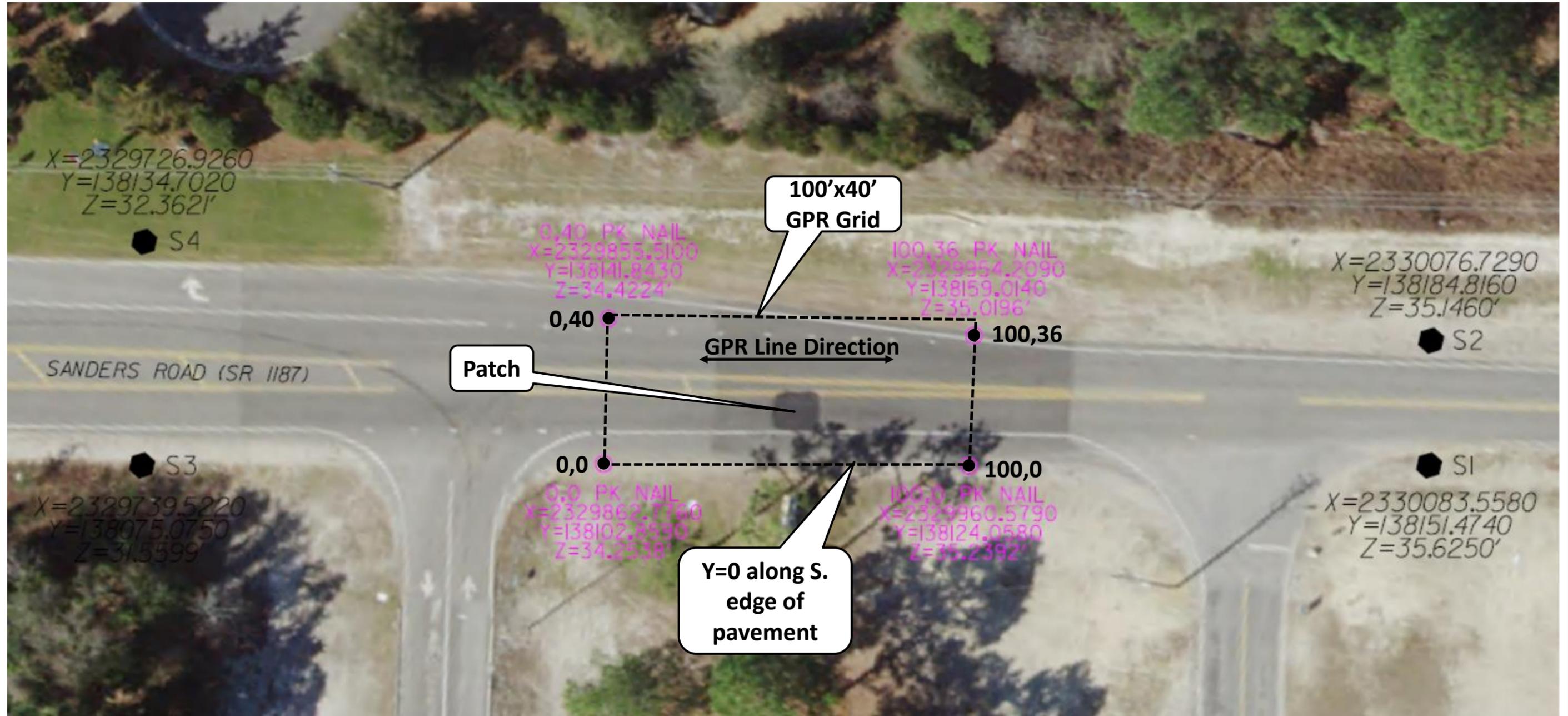
10/30/2018

not considered Final unless all signatures are completed

Edward D. Billington, P.G.

EDB/PMW

Attachments: Figures 1 – 5



● GPR Grid Points, set with PK nails

Note: Location of PK nails and base map provided by NCDOT Location & Survey's Unit.

PROJECT NO.	GR22.305
SCALE	AS SHOWN
DATE	10/18/18
BY	EDB

**FIGURE 1**  
**LOCATION OF GPR GRID**

**SANDERS STREET SETTLEMENT/SINKHOLE**  
**WILMINGTON, NORTH CAROLINA**



ESP Associates, Inc.  
 7011 Albert Pick Rd.,  
 Suite E  
 Greensboro, NC 27409  
 336.334.7724  
 www.espassociates.com



A. Photo showing PK nail (at arrow) set at one of four corners of GPR grid.



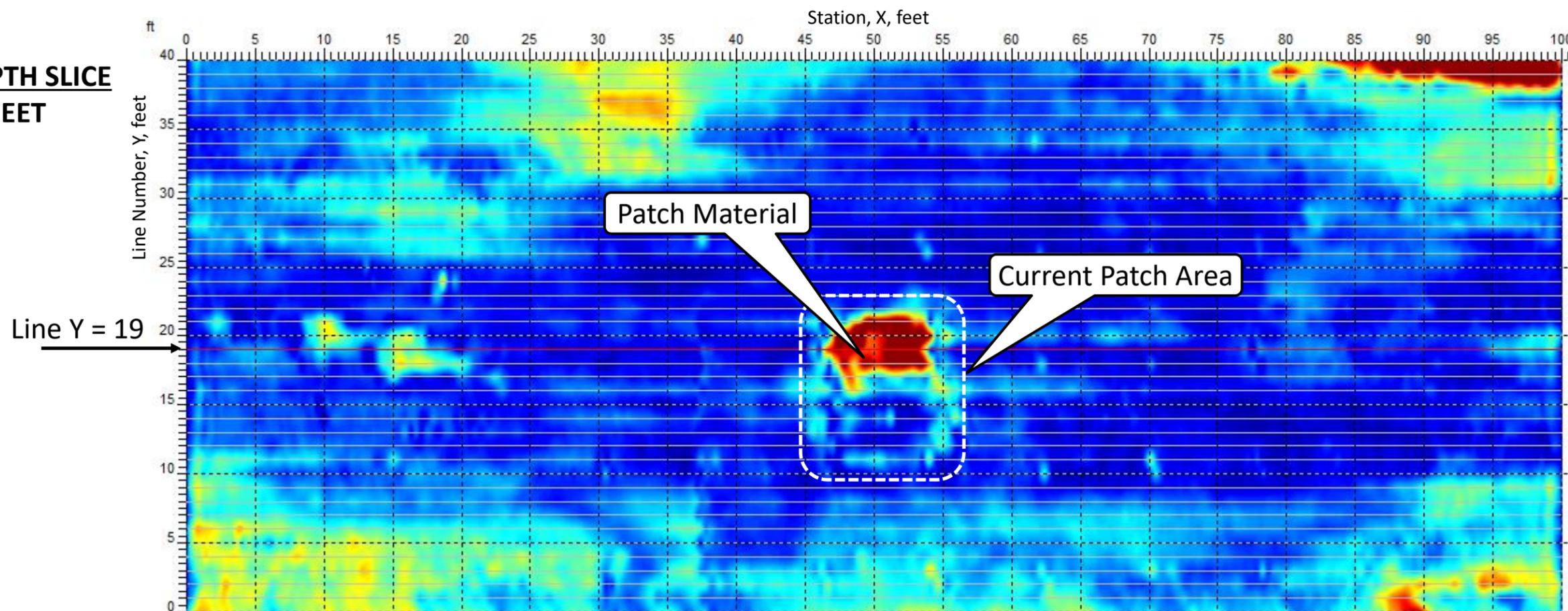
B. Photo looking north showing excavation of sinkhole location by NCDOT personnel. NCDOT person in upper left is marking area to expand excavation based on preliminary GPR results.

PROJECT NO.	GR22.305
SCALE	N/A
DATE	10/18/18
BY	EDB

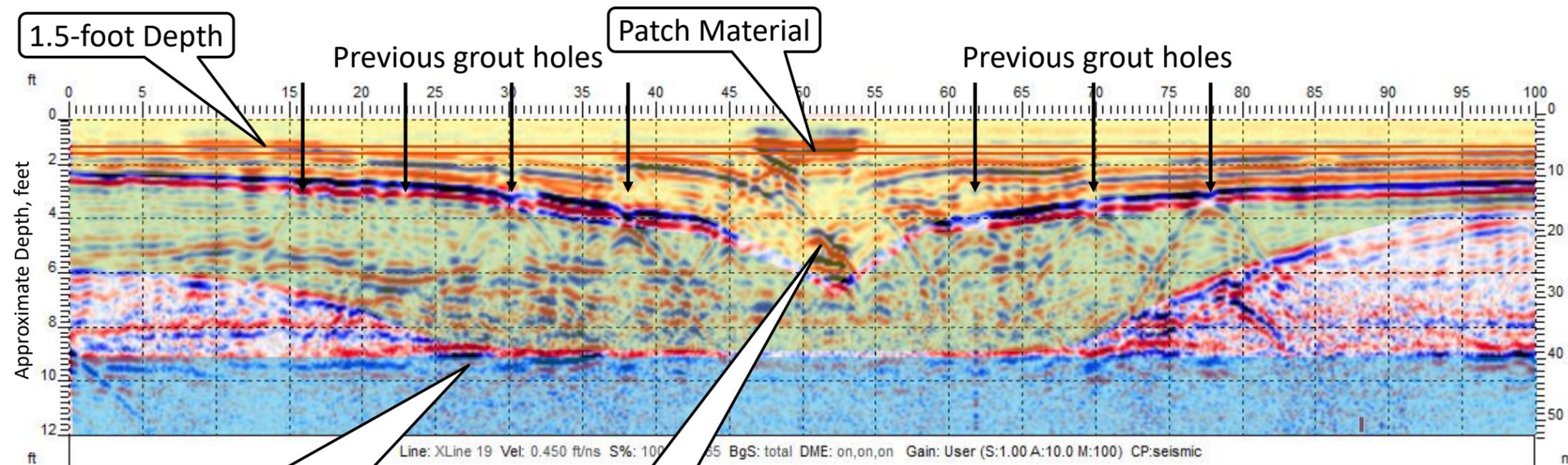
**FIGURE 2**  
**PHOTOS OF GPR GRID AREA**  
**SANDERS STREET SETTLEMENT/SINKHOLE**  
**WILMINGTON, NORTH CAROLINA**

	ESP Associates, Inc.
	7011 Albert Pick Rd., Suite E Greensboro, NC 27409
	336.334.7724
	www.espassociates.com

**TIME/DEPTH SLICE  
1.5 FEET**



**GPR LINE Y = 19**



Approximate water table, 9.5 feet

Possible grout

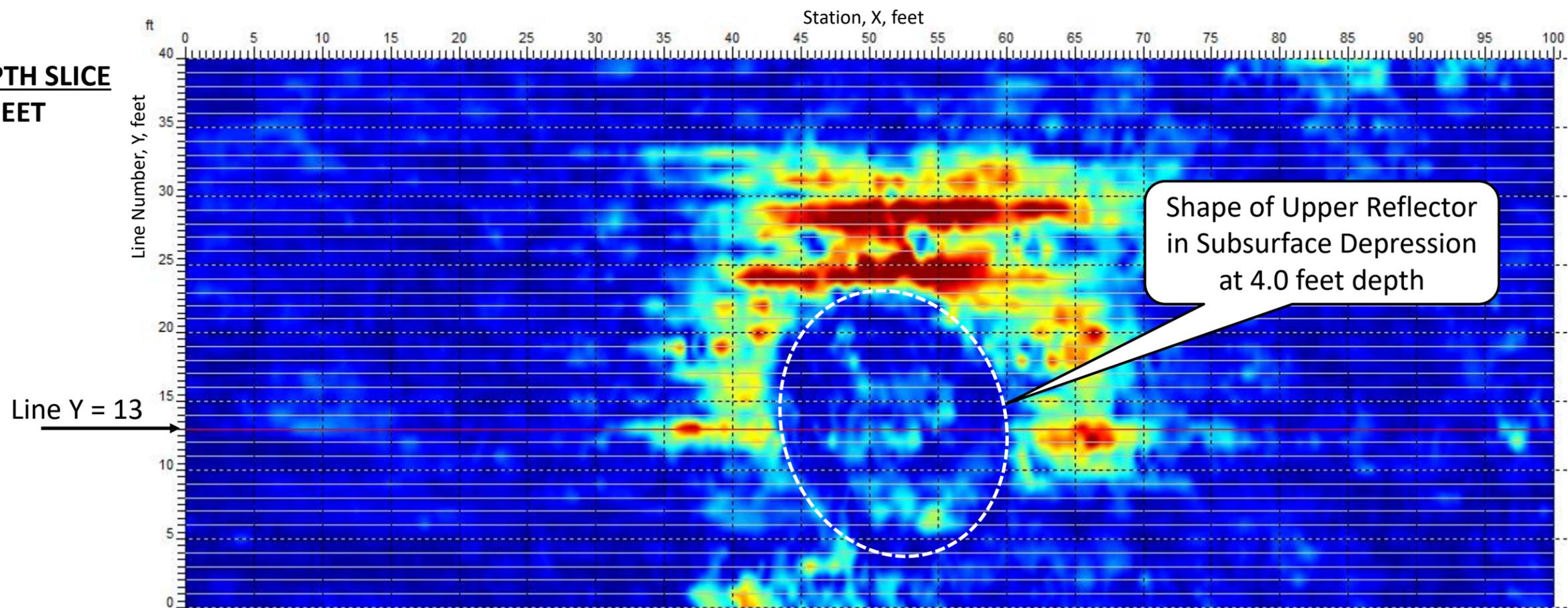
PROJECT NO.	GR22.305
SCALE	AS SHOWN
DATE	10/18/18
BY	EDB

**FIGURE 3**  
**GPR TIME/DEPTH SLICE, 1.5 FEET DEPTH**  
**SANDERS STREET SETTLEMENT/SINKHOLE**  
**WILMINGTON, NORTH CAROLINA**

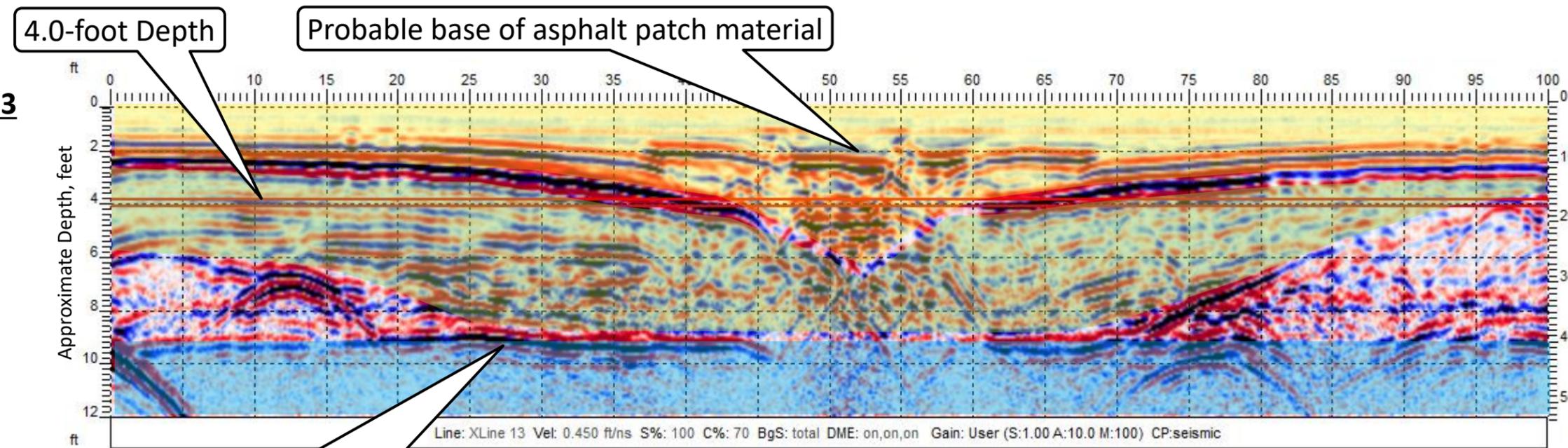


ESP Associates, Inc.  
7011 Albert Pick Rd.,  
Suite E  
Greensboro, NC 27409  
336.334.7724  
www.espassociates.com

**TIME/DEPTH SLICE  
4.0 FEET**



**GPR LINE Y = 13**



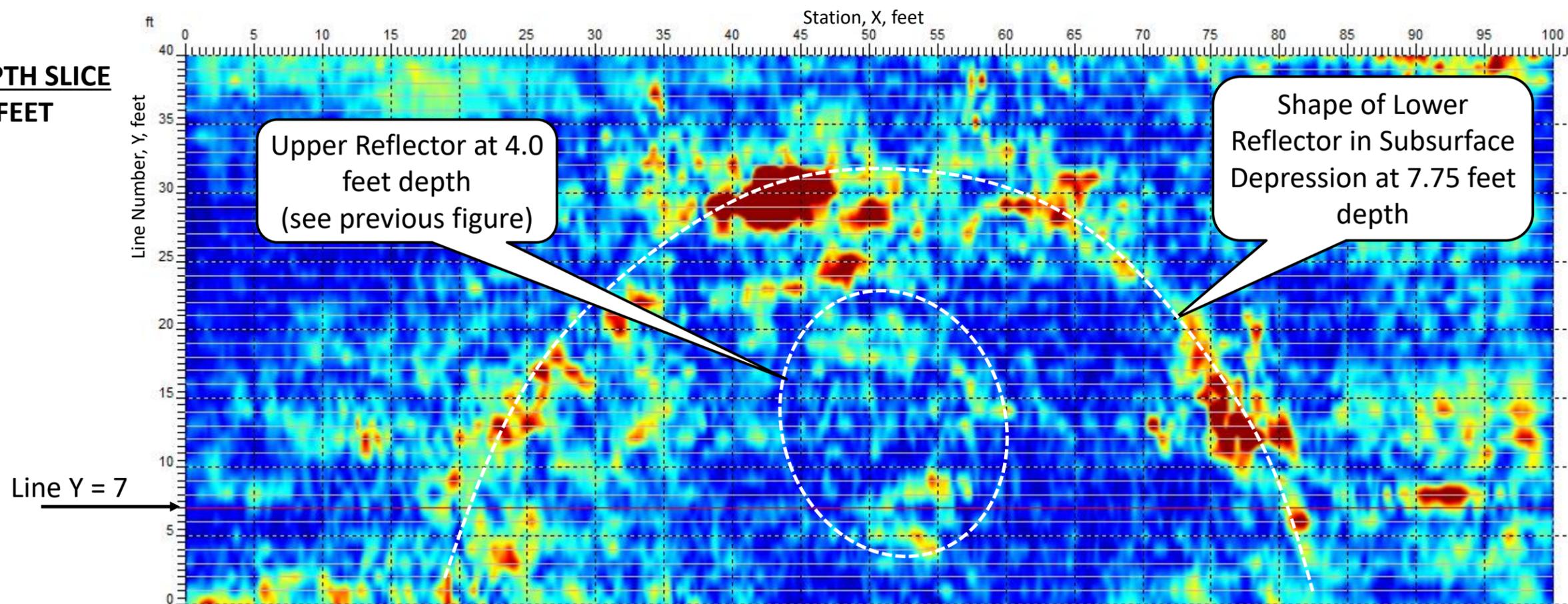
PROJECT NO.	GR22.305
SCALE	AS SHOWN
DATE	10/18/18
BY	EDB

**FIGURE 4**  
**GPR TIME/DEPTH SLICE, 4.0 FEET DEPTH**  
**SANDERS STREET SETTLEMENT/SINKHOLE**  
**WILMINGTON, NORTH CAROLINA**

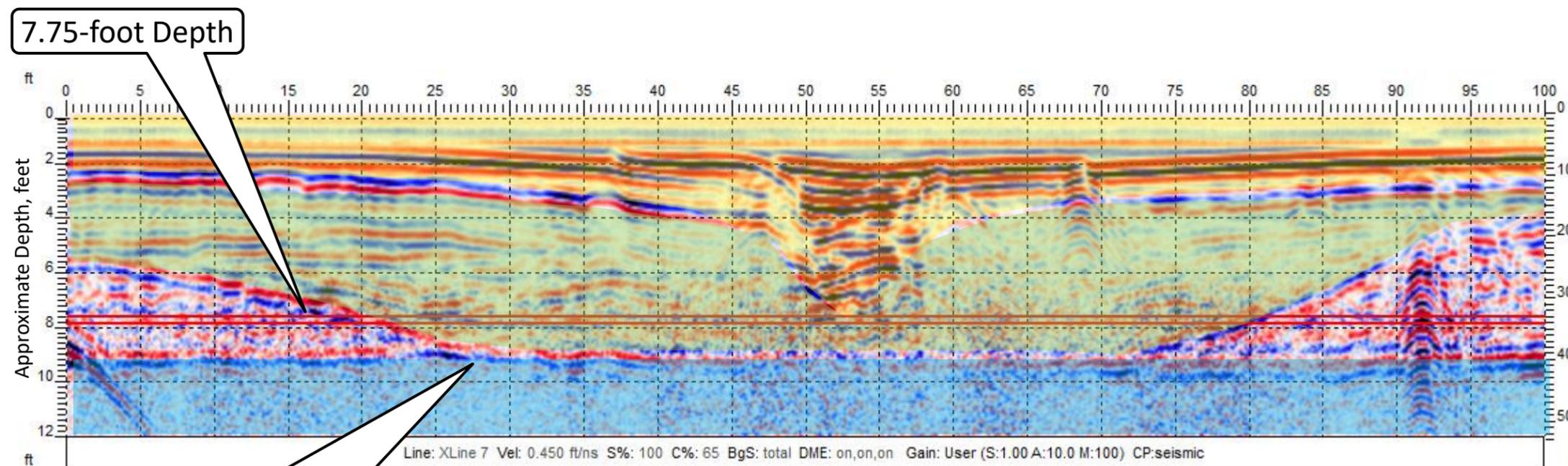


ESP Associates, Inc.  
7011 Albert Pick Rd.,  
Suite E  
Greensboro, NC 27409  
336.334.7724  
www.espassociates.com

**TIME/DEPTH SLICE  
7.75 FEET**



**GPR LINE Y = 7**



Approximate water table, 9.5 feet

PROJECT NO.	GR22.305
SCALE	AS SHOWN
DATE	10/18/18
BY	EDB

**FIGURE 5**  
**GPR TIME/DEPTH SLICE, 7.75 FEET DEPTH**  
**SANDERS STREET SETTLEMENT/SINKHOLE**  
**WILMINGTON, NORTH CAROLINA**



ESP Associates, Inc.  
7011 Albert Pick Rd.,  
Suite E  
Greensboro, NC 27409  
336.334.7724  
www.espassociates.com