

**SEE SHEET 3 FOR PLAN SHEET LAYOUT  
AT TIME OF INVESTIGATION**

**STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT**

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	N/A	1	

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO PERFORM INDEPENDENT SUBSURFACE INVESTIGATIONS AND MAKE INTERPRETATIONS AS NECESSARY TO CONFIRM CONDITIONS ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

- NOTES:
- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
  - BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PERSONNEL

ICE

OTHERS

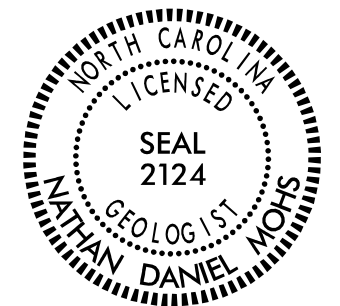
INVESTIGATED BY ICE

DRAWN BY N. MOHS, LG

CHECKED BY S. JOHNSON, PE, PG

SUBMITTED BY N. MOHS, LG

DATE OCTOBER 2025



DocuSigned by:

*Nathan Mohs*

10/10/2025

631A27605B4A4C3...

SIGNATURE

DATE

**DOCUMENT NOT CONSIDERED FINAL  
UNLESS ALL SIGNATURES COMPLETED**

**ROADWAY  
SUBSURFACE INVESTIGATION**

COUNTY CUMBERLAND  
PROJECT DESCRIPTION ALL AMERICAN FREEWAY  
NEAR HONEYCUTT ROAD

**INVENTORY**

**APPENDICES**

APPENDIX	TITLE	SHEETS
A	SITE PLAN	4
B	CPT LOGS	6-29
C	PAVEMENT CORE DEPTHS	31
D	GEOPHYSICAL REPORT	32-50
E	PIPE INSPECTION REPORT	52-73
F	2017 INVESTIGATION BORE LOGS	75-131

**REFERENCE: N/A**

**PROJECT: 49218.6**

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SUBSURFACE INVESTIGATION
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

Table with 4 main columns: SOIL DESCRIPTION, GRADATION, ROCK DESCRIPTION, and TERMS AND DEFINITIONS. Includes sub-sections like SOIL LEGEND AND AASHTO CLASSIFICATION, CONSISTENCY OR DENSENESS, TEXTURE OR GRAIN SIZE, SOIL MOISTURE - CORRELATION OF TERMS, PLASTICITY, COLOR, MISCELLANEOUS SYMBOLS, RECOMMENDATION SYMBOLS, ABBREVIATIONS, EQUIPMENT USED ON SUBJECT PROJECT, FRACTURE SPACING, BEDDING, INDURATION, and BENCH MARK.



# **Appendix A**

## **Site Plan**

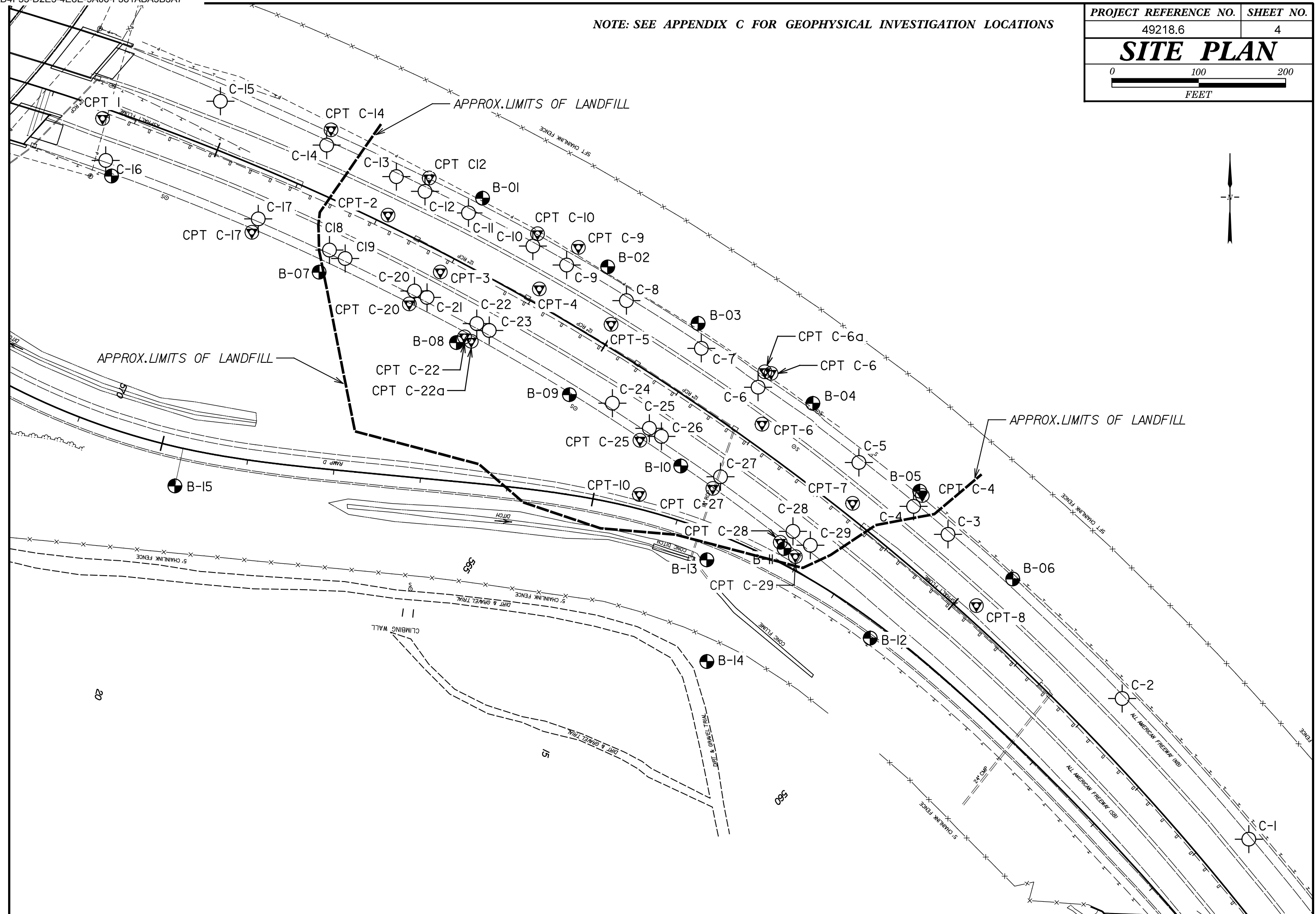
### **All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

---

NOTE: SEE APPENDIX C FOR GEOPHYSICAL INVESTIGATION LOCATIONS

PROJECT REFERENCE NO.	SHEET NO.
49218.6	4
<b>SITE PLAN</b>	
0 100 200 FEET	





# **Appendix B**

## **CPT Logs**

### **All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

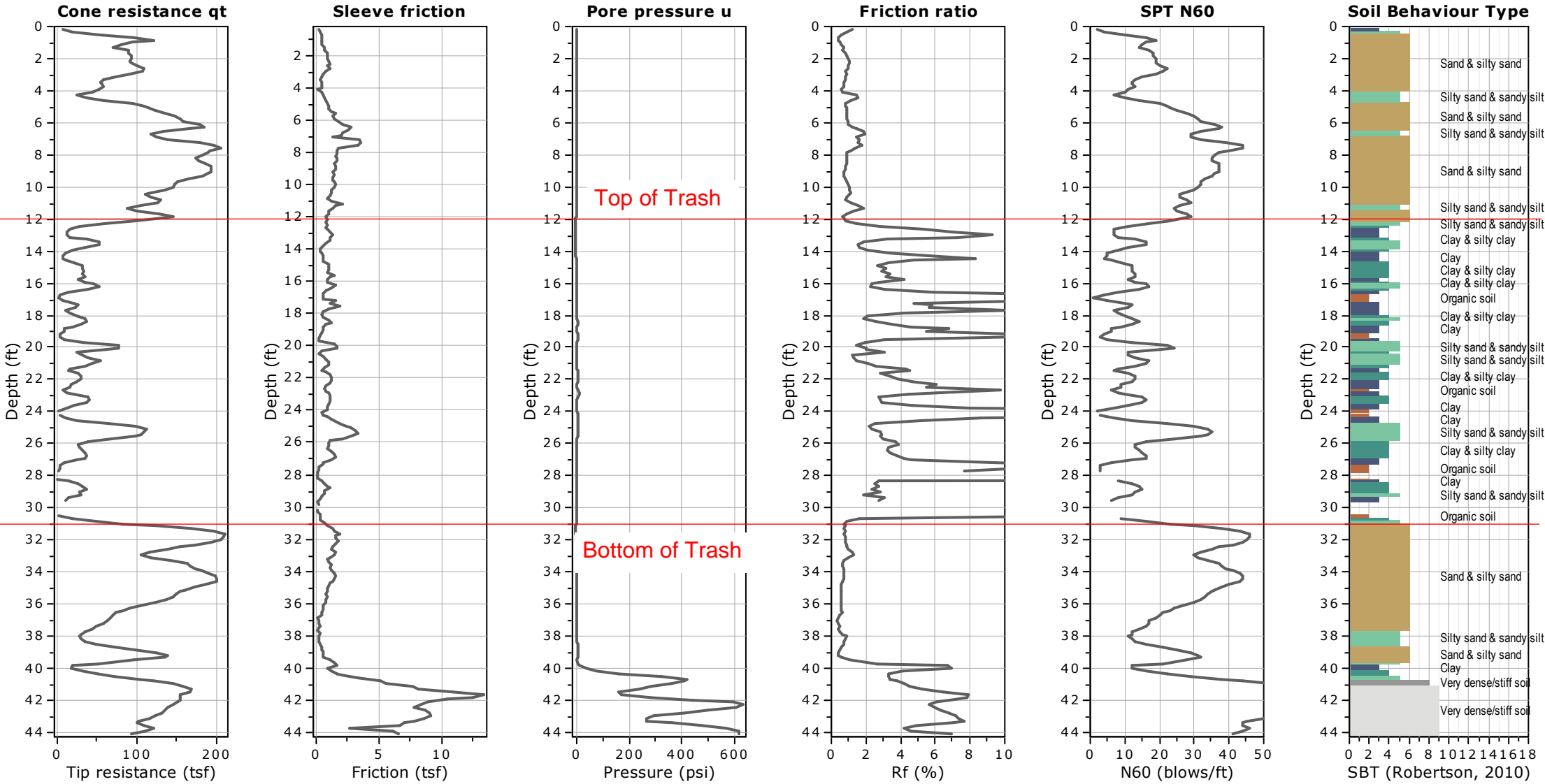
---



**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-4**

Total depth: 44.12 ft, Date: 5/16/2023  
 Surface Elevation: 241.40 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler



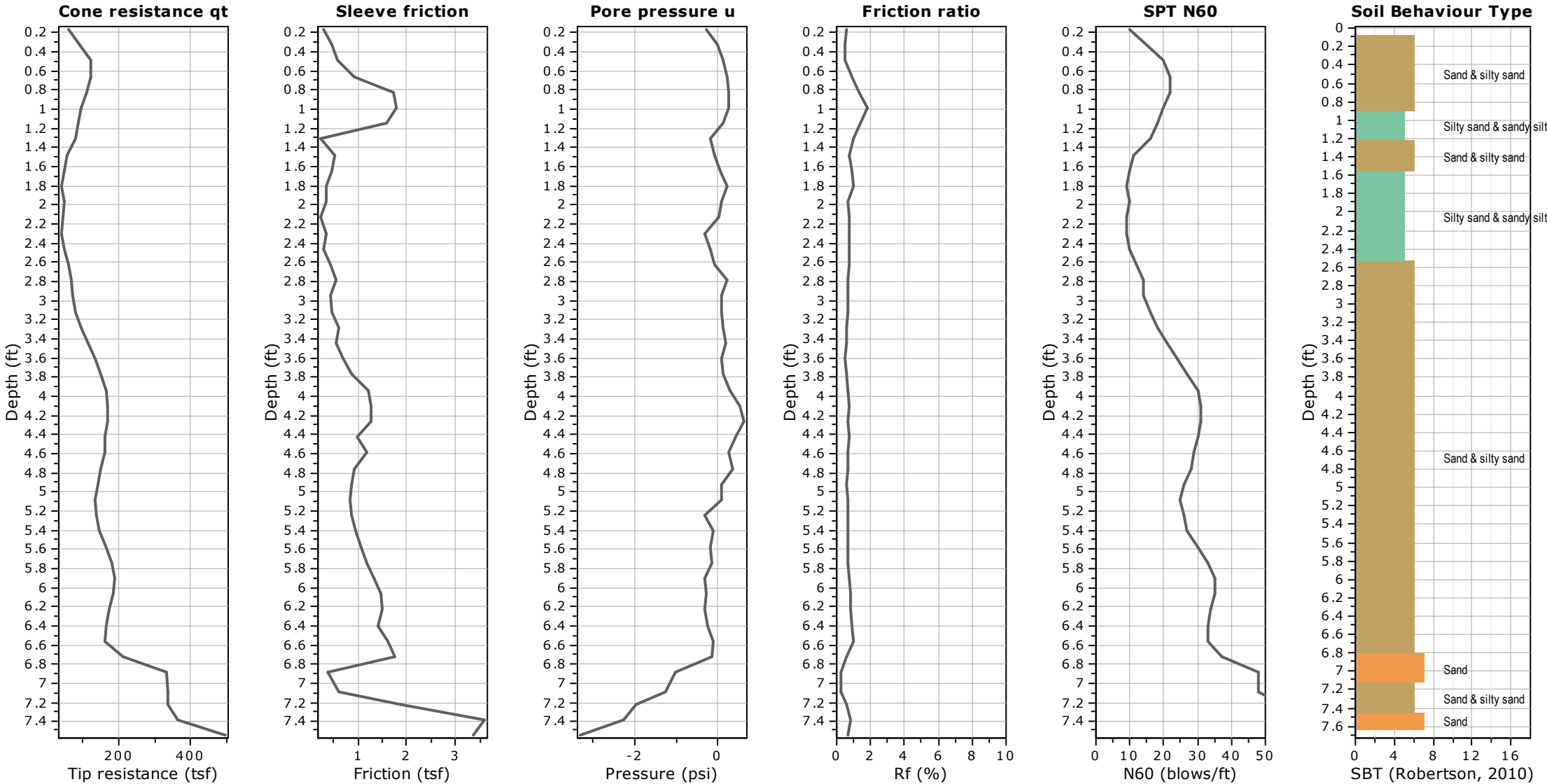


**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-6**

Total depth: 7.54 ft, Date: 5/16/2023  
 Surface Elevation: 245.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

**Shallow Refusal - Repushed**

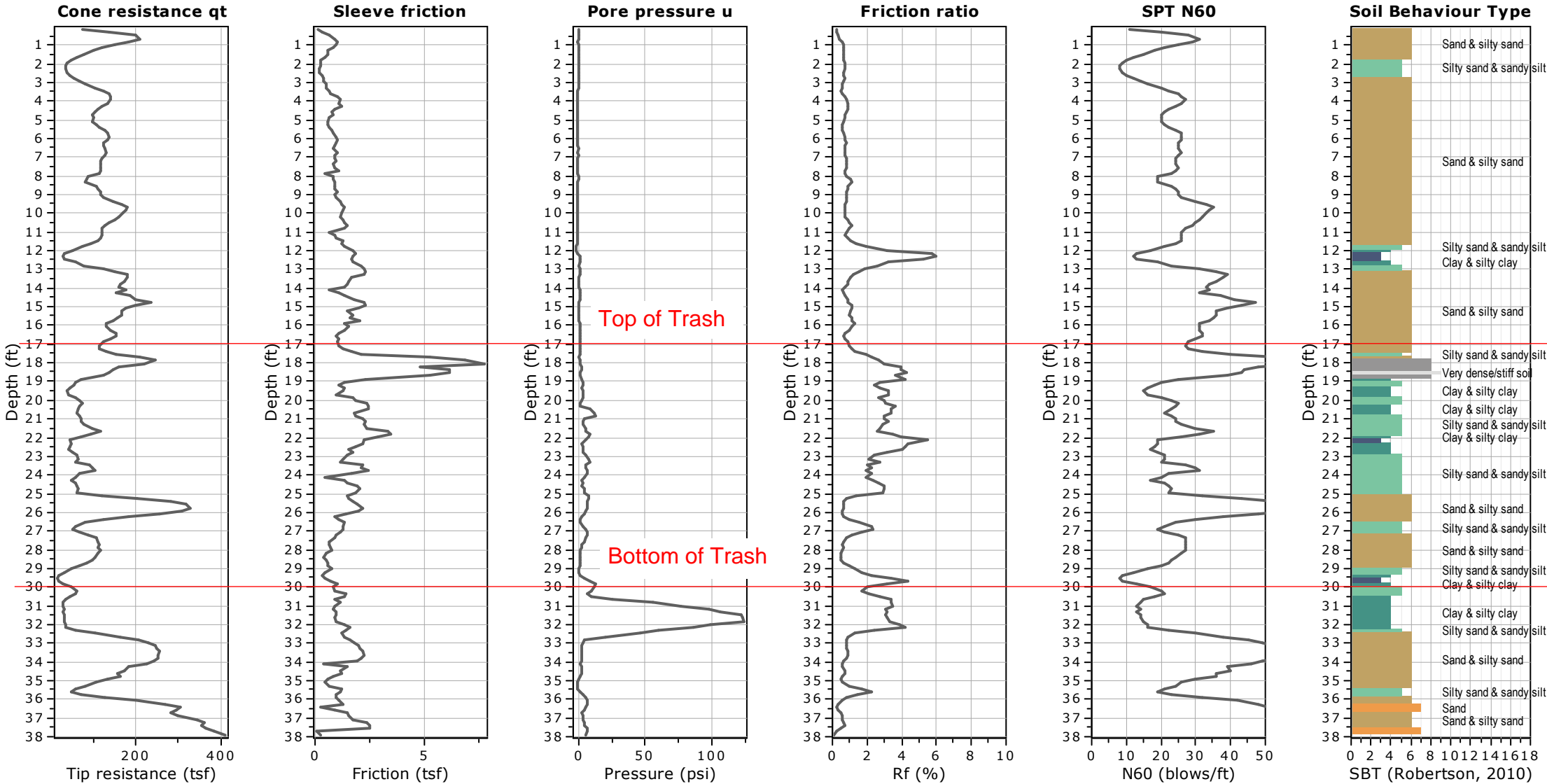




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-6a**

Total depth: 37.92 ft, Date: 5/16/2023  
 Surface Elevation: 245.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

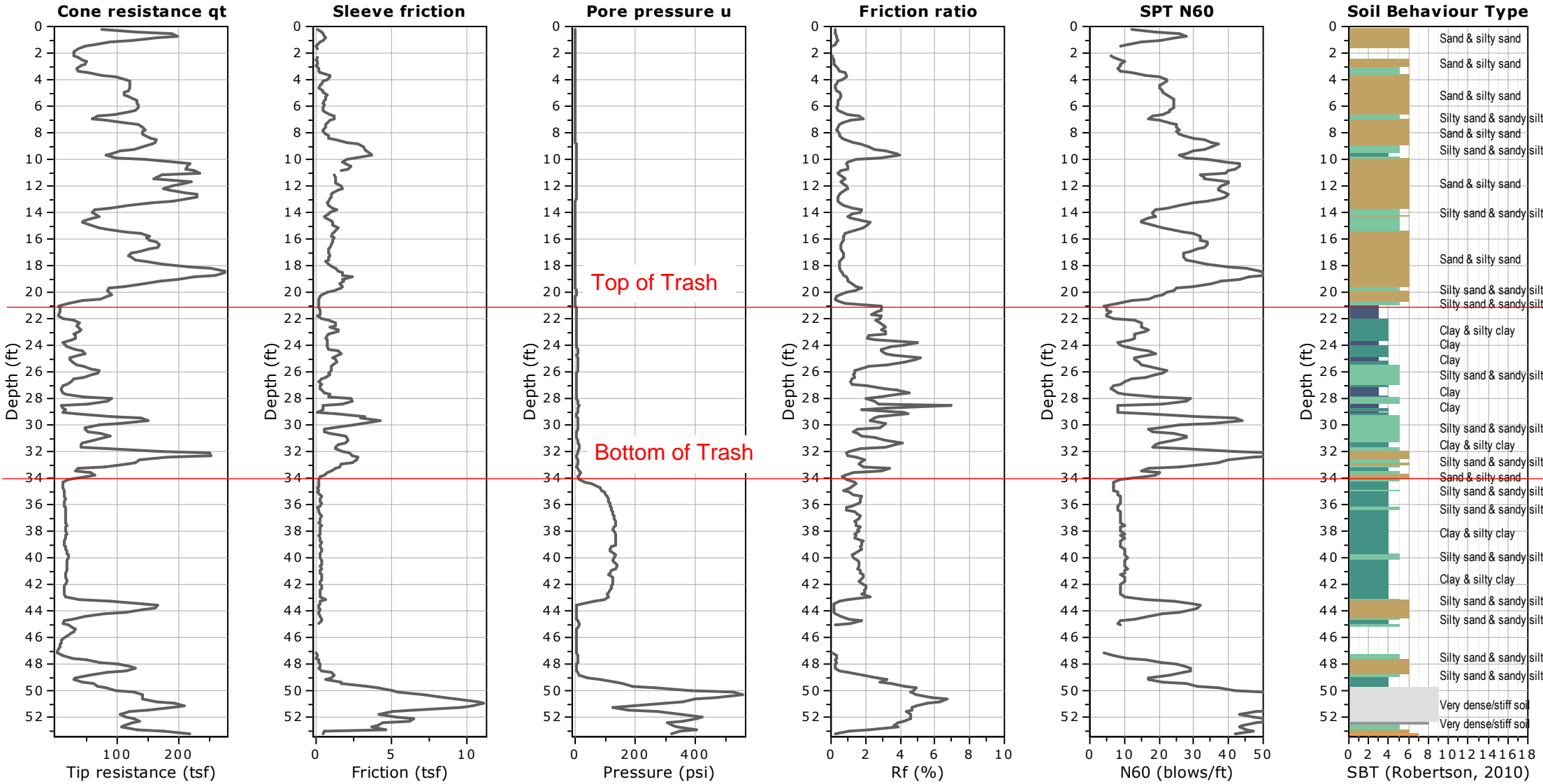




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-9**

Total depth: 53.30 ft, Date: 5/16/2023  
 Surface Elevation: 251.60 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

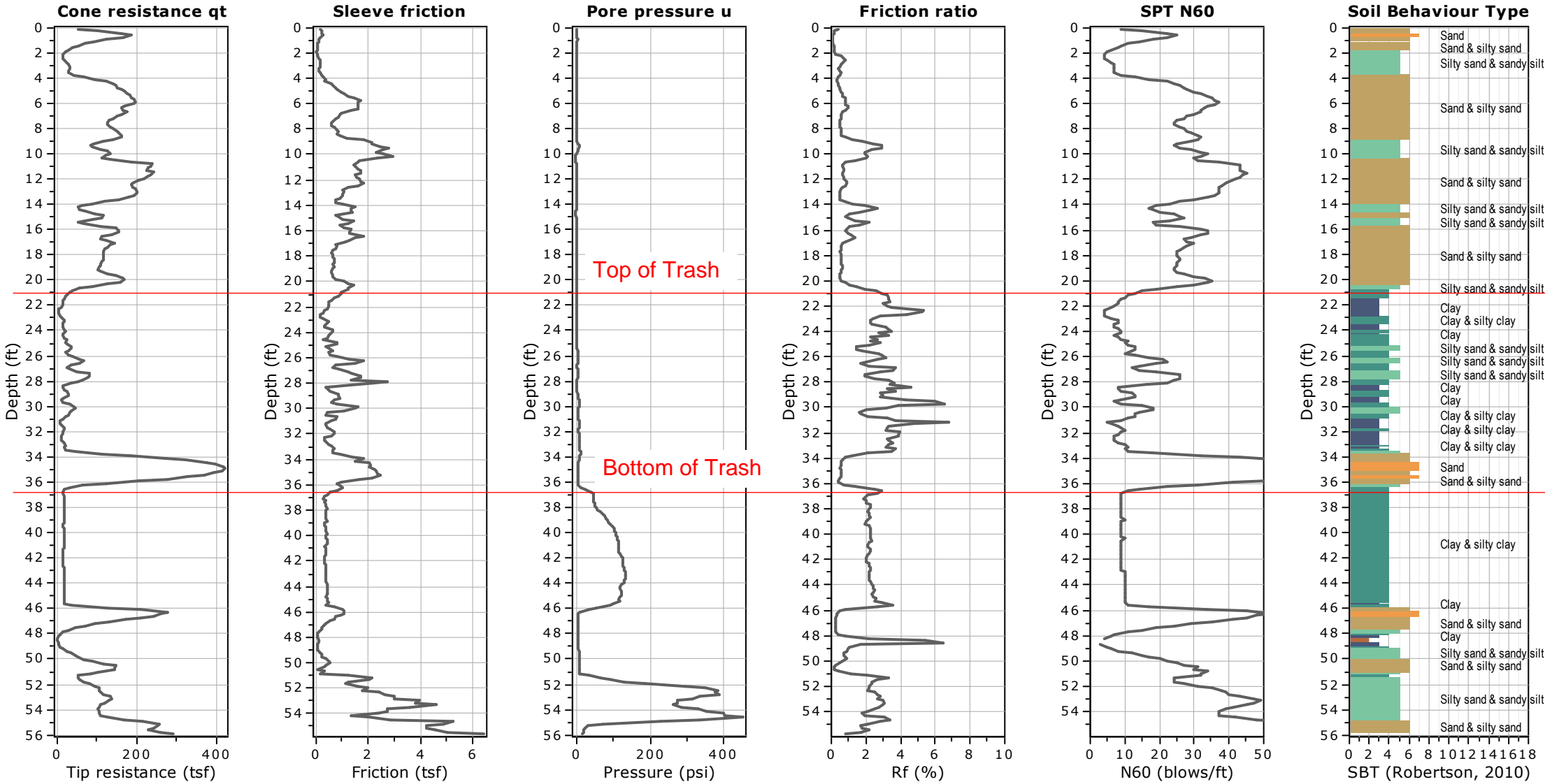




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-10**

Total depth: 55.92 ft, Date: 5/16/2023  
 Surface Elevation: 252.80 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

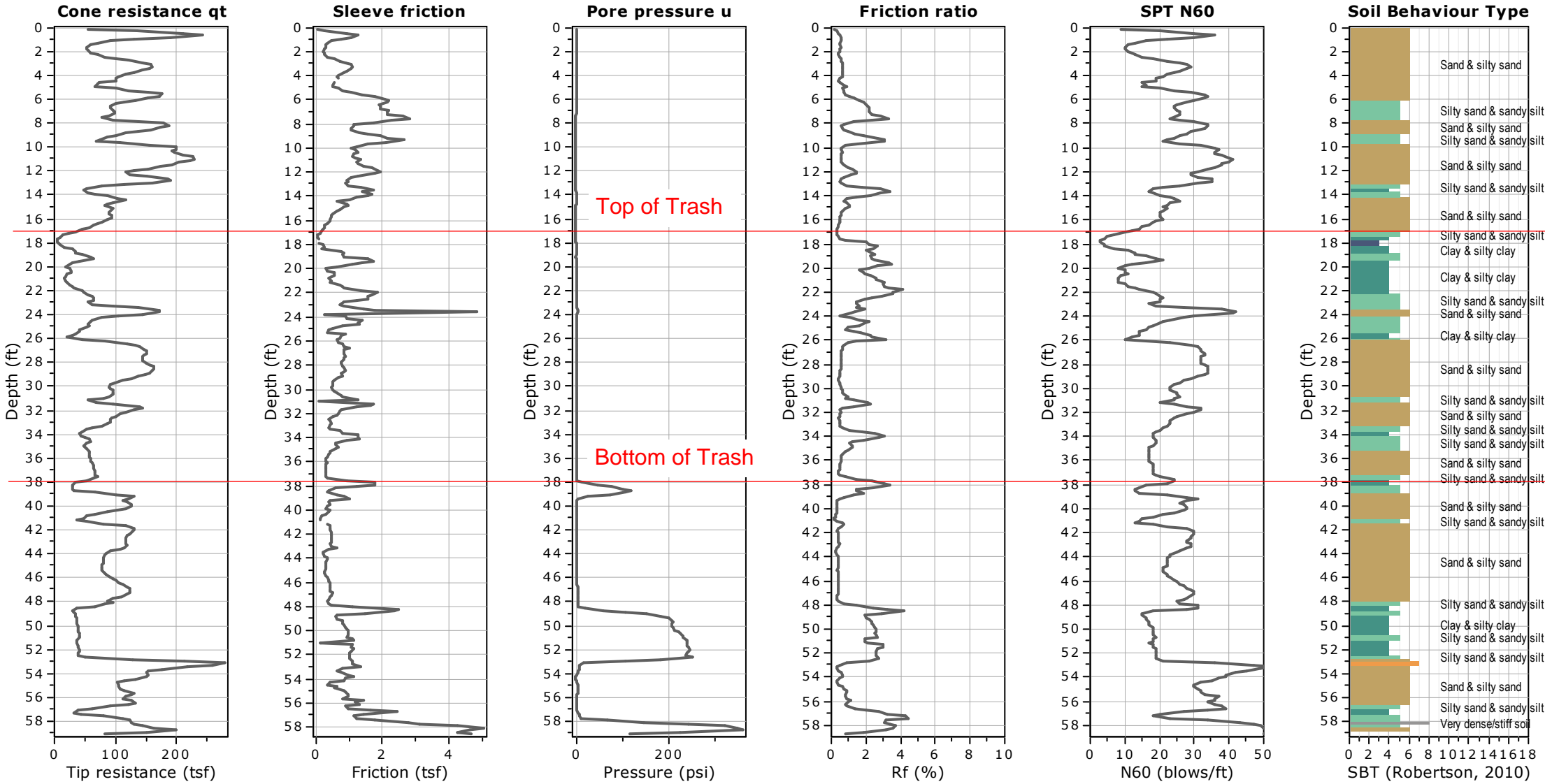




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-12**

Total depth: 59.04 ft, Date: 5/16/2023  
 Surface Elevation: 256.80 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler





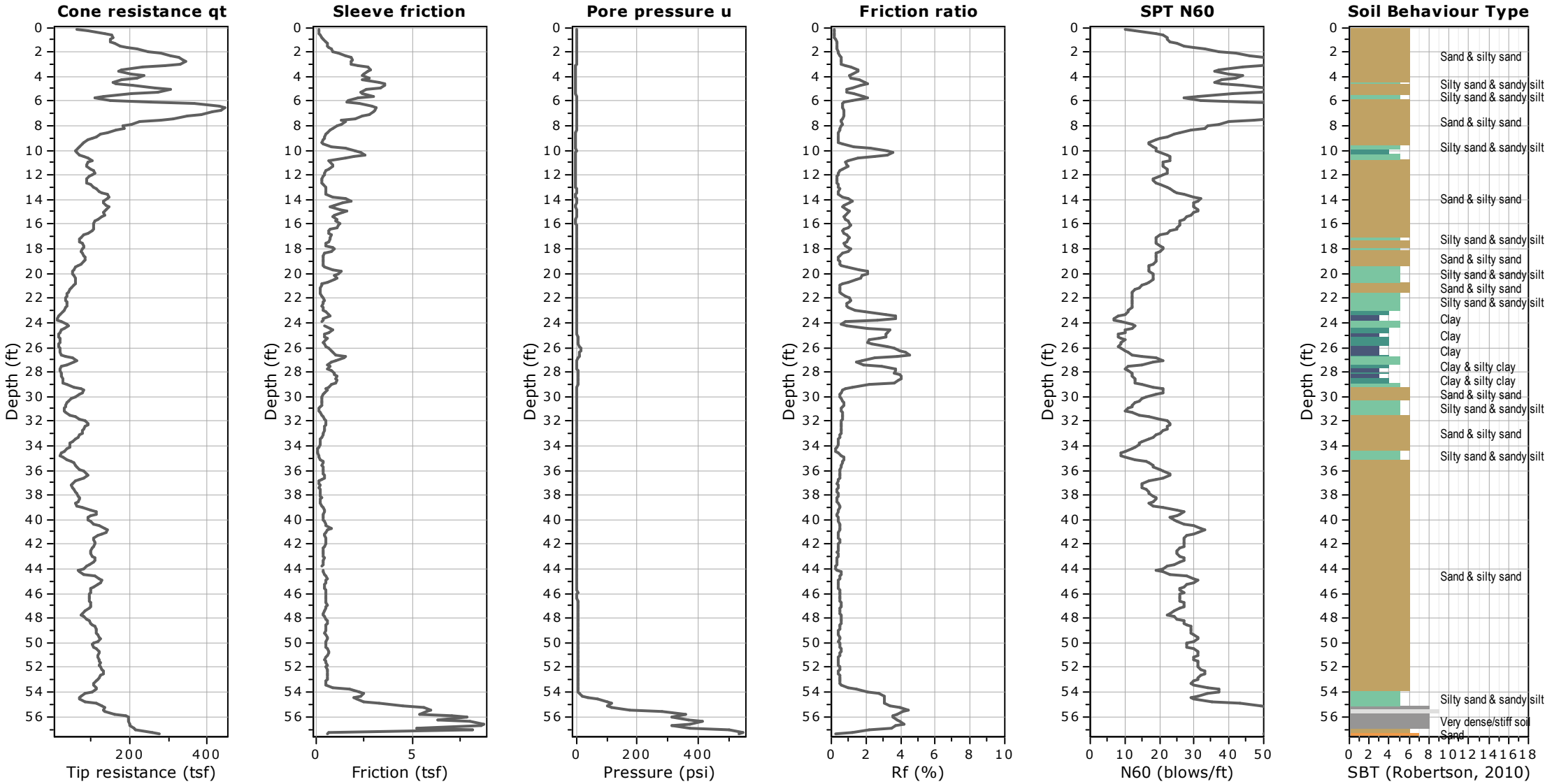


**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-17**

Total depth: 57.40 ft, Date: 5/17/2023  
 Surface Elevation: 257.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

No Trash

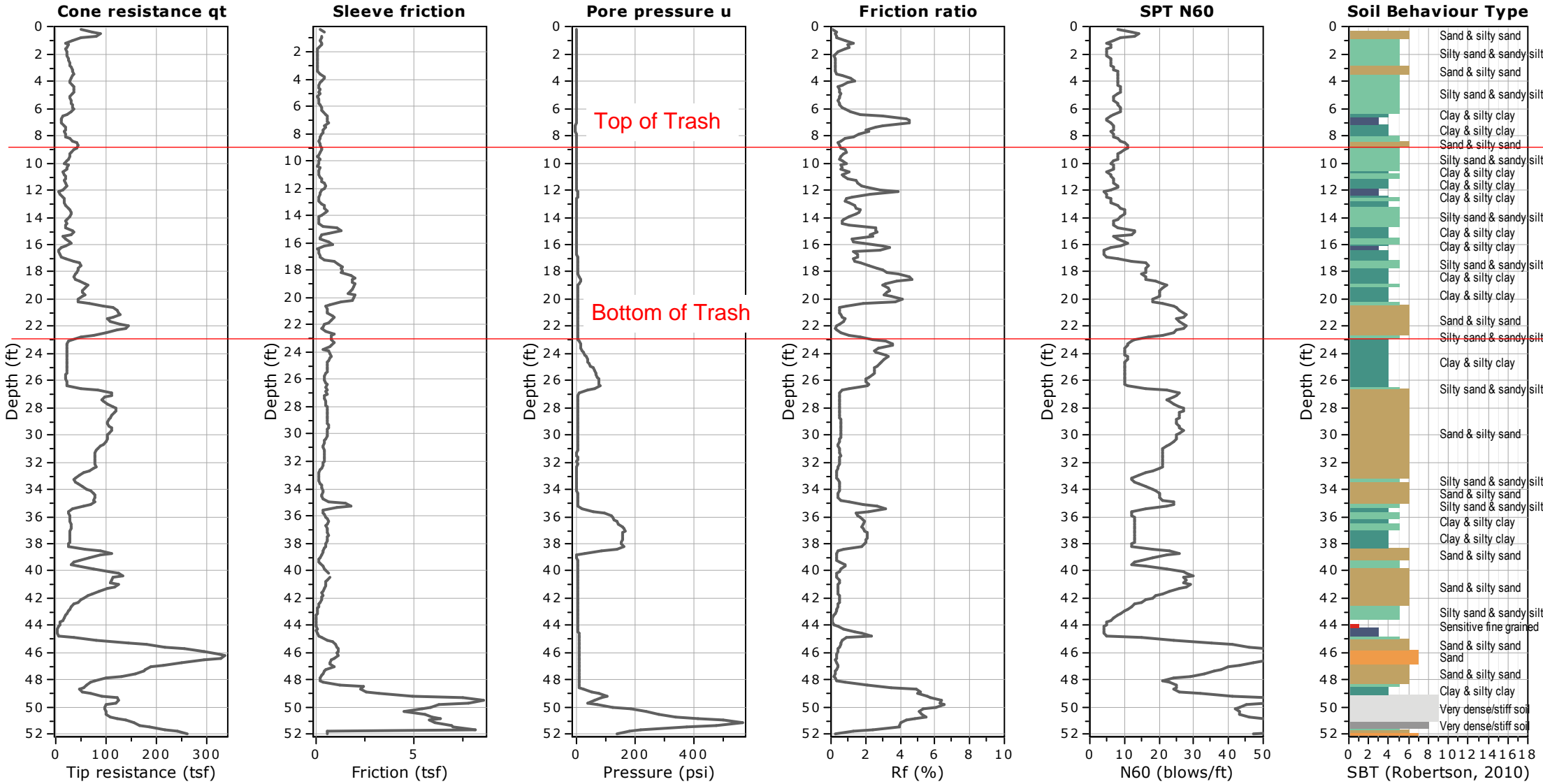




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-20**

Total depth: 51.99 ft, Date: 5/17/2023  
 Surface Elevation: 253.10 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler



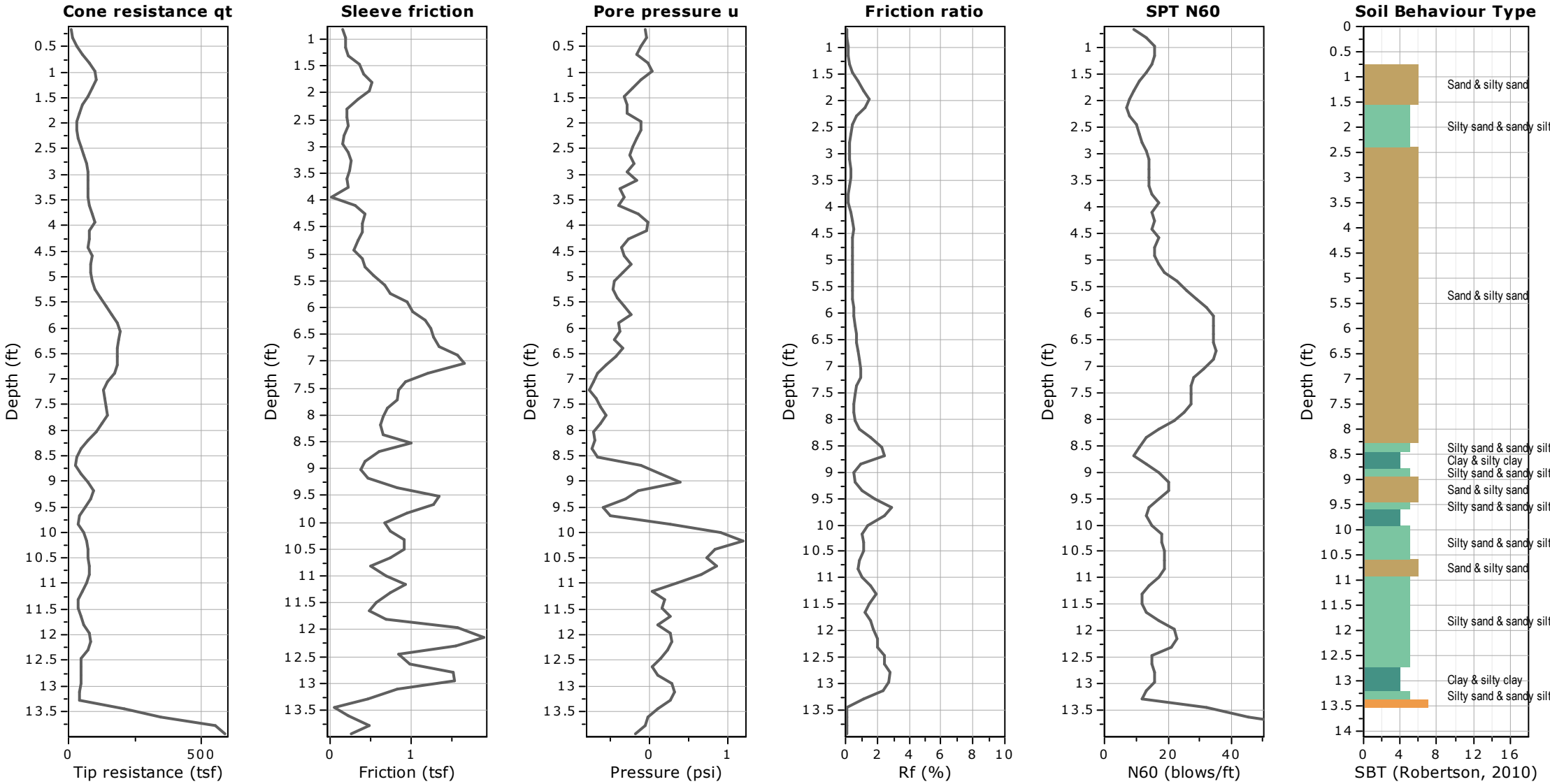


**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-22**

Total depth: 13.94 ft, Date: 5/17/2023  
 Surface Elevation: 250.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

**Shallow Refusal - Repushed**

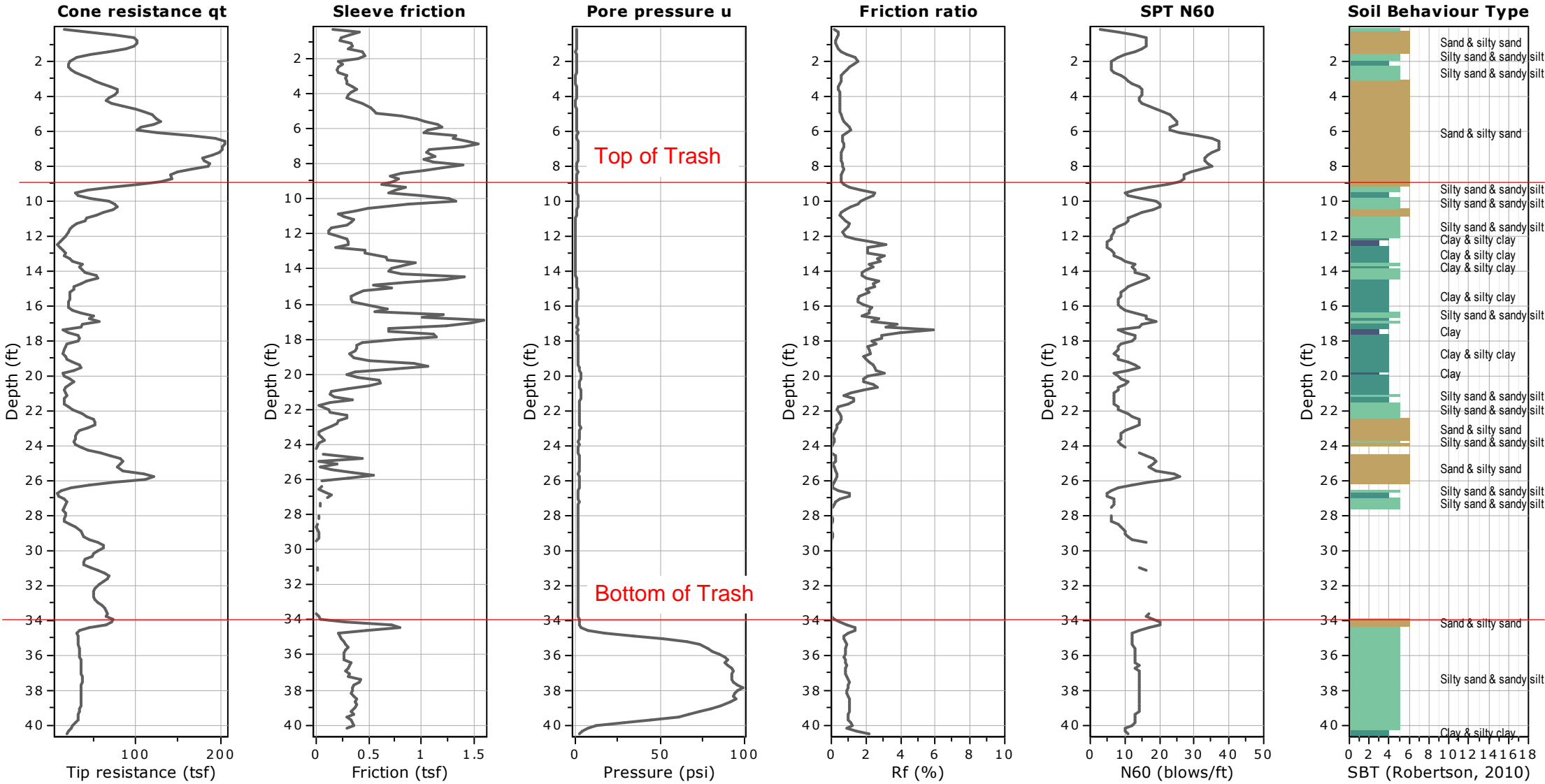




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-22a**

Total depth: 40.51 ft, Date: 5/17/2023  
 Surface Elevation: 250.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

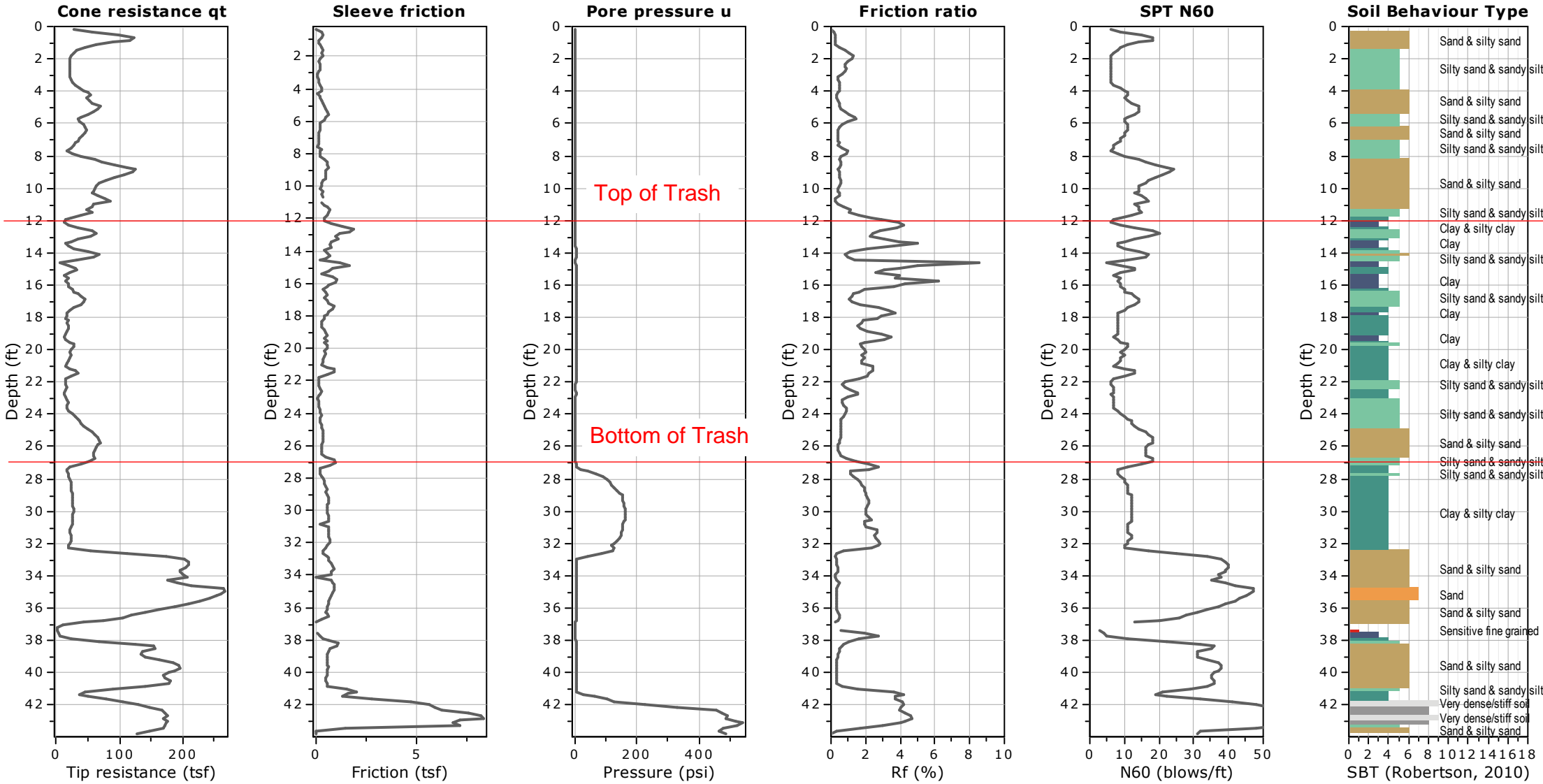




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-25**

Total depth: 43.79 ft, Date: 5/17/2023  
 Surface Elevation: 245.80 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

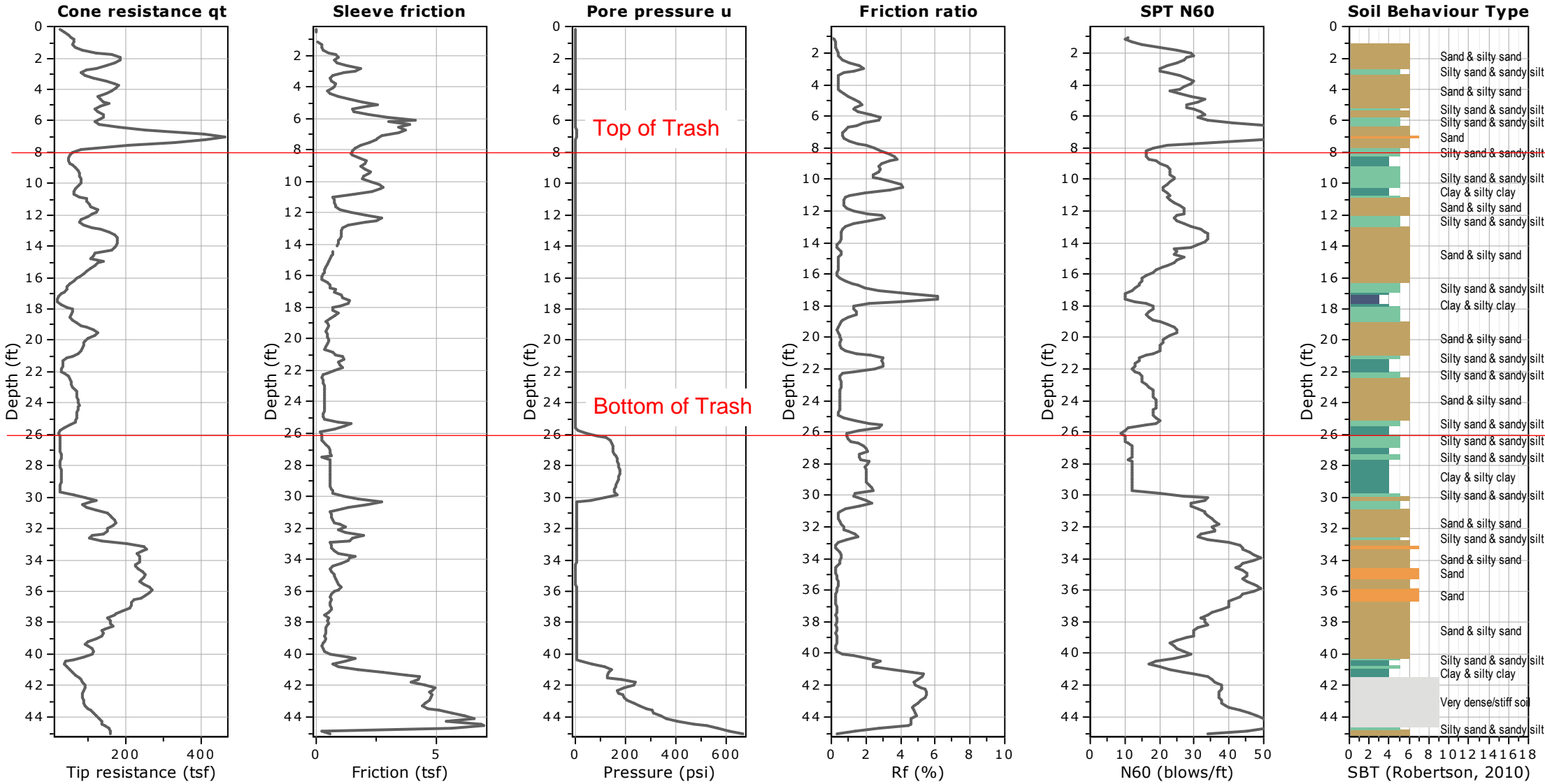




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-27**

Total depth: 45.10 ft, Date: 5/17/2023  
 Surface Elevation: 244.20 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

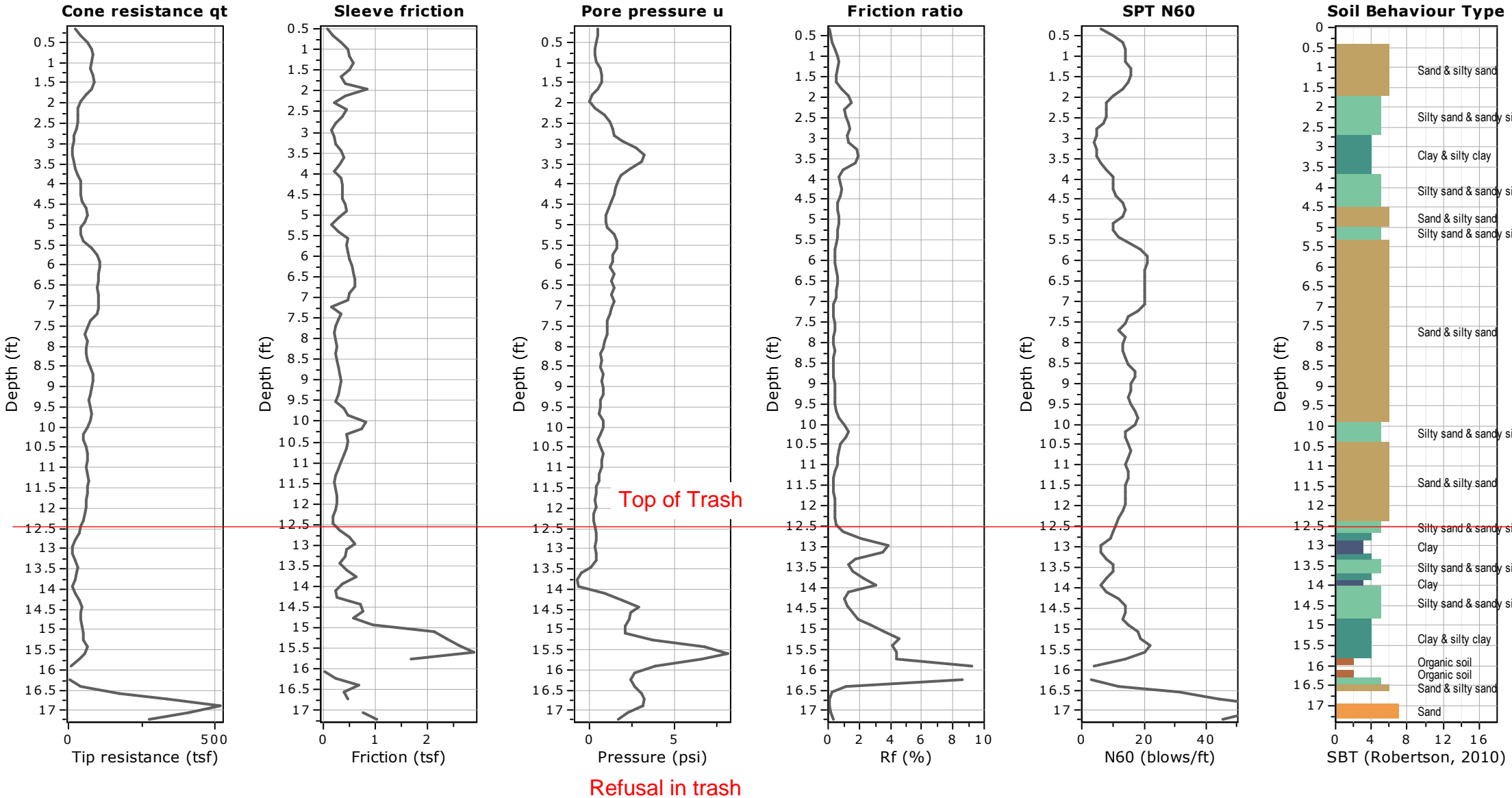




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-28**

Total depth: 17.22 ft, Date: 5/17/2023  
 Surface Elevation: 241.10 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler

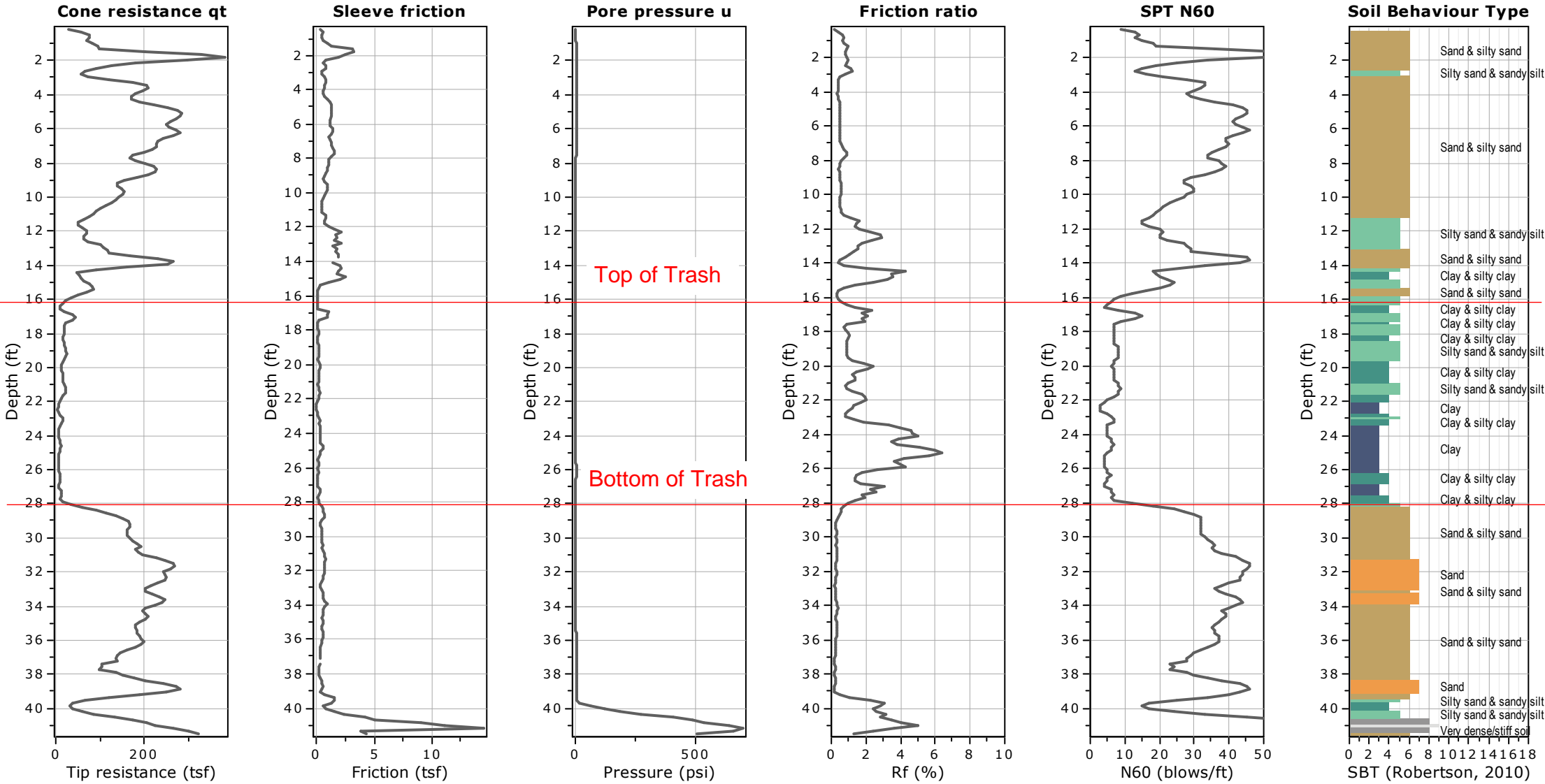




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: C-29**

Total depth: 41.49 ft, Date: 5/17/2023  
 Surface Elevation: 240.70 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler



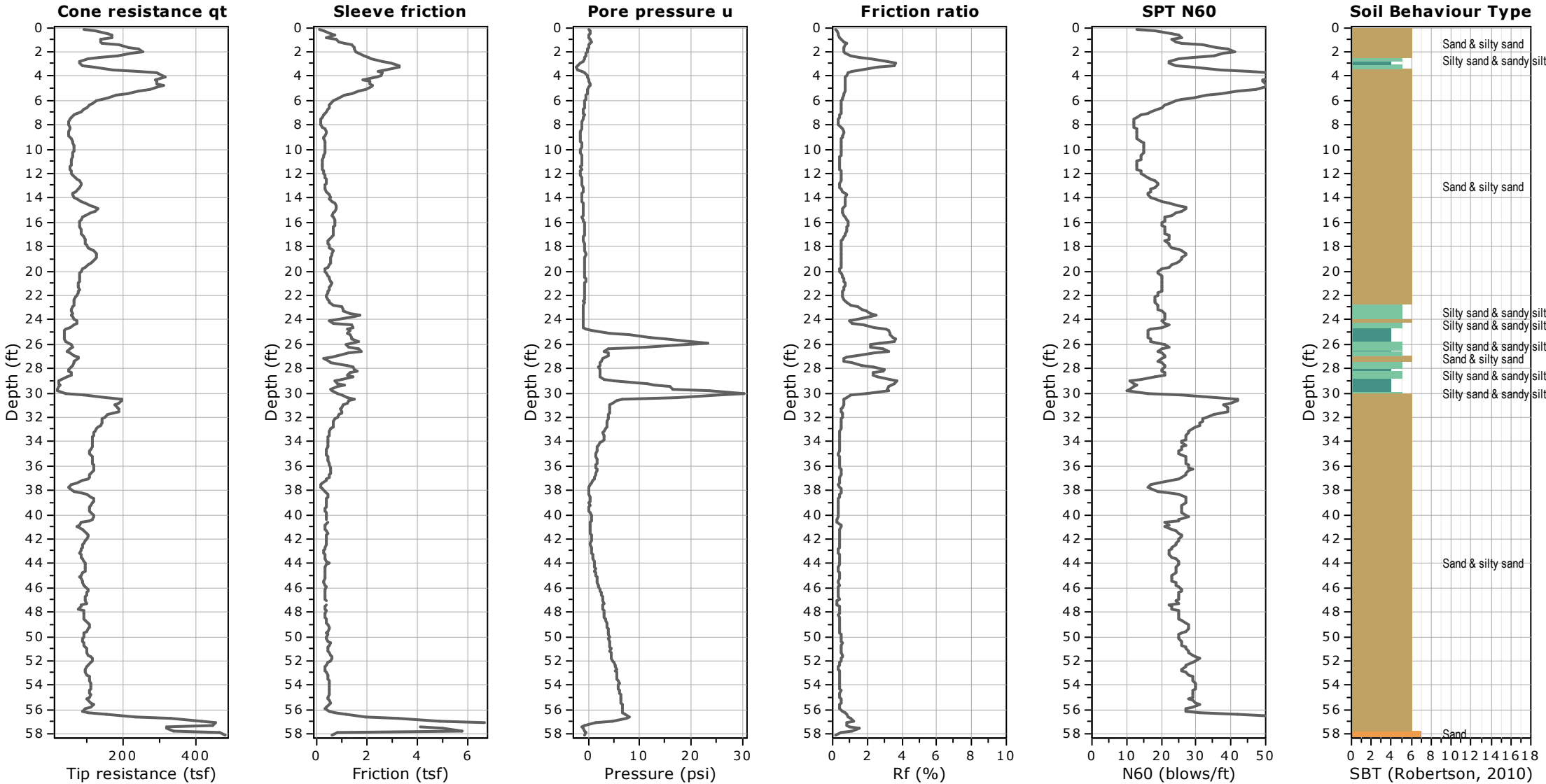


**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**No Trash**

**CPT: CPT-1**

Total depth: 58.09 ft, Date: 5/16/2023  
 Surface Elevation: 262.60 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

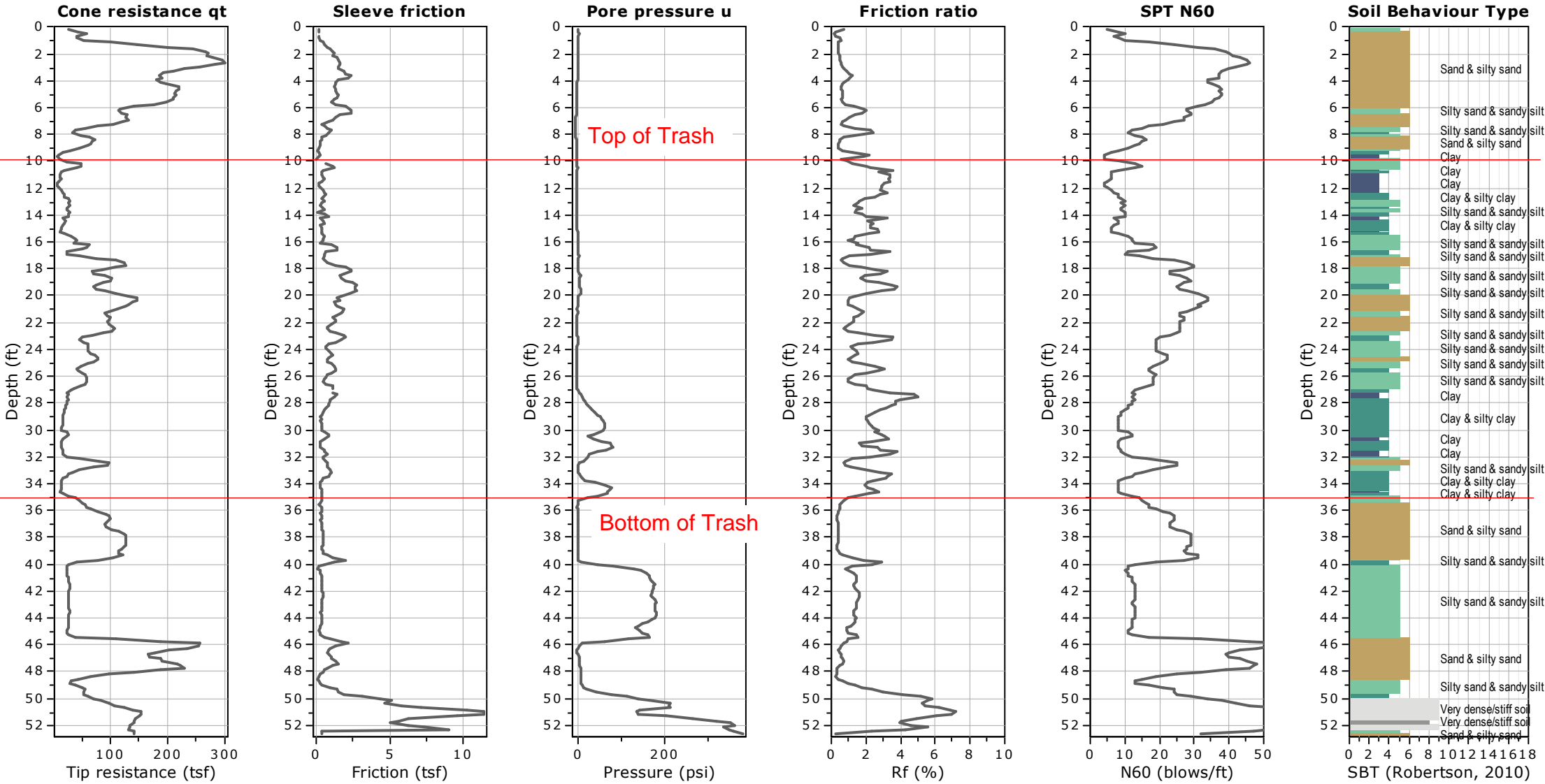




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-2**

Total depth: 52.64 ft, Date: 5/16/2023  
 Surface Elevation: 252.60 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

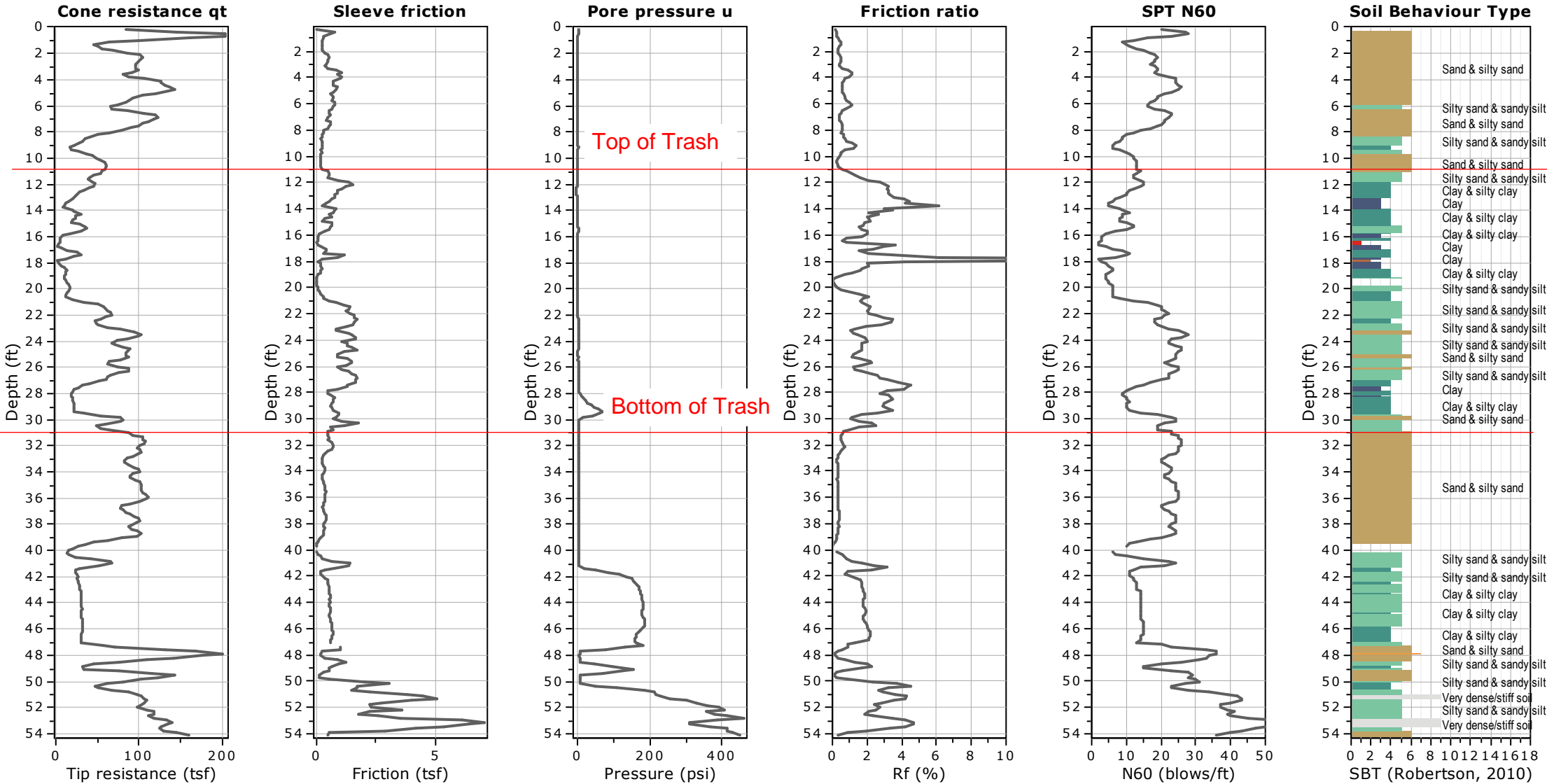




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-3**

Total depth: 54.12 ft, Date: 5/16/2023  
 Surface Elevation: 253.60 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

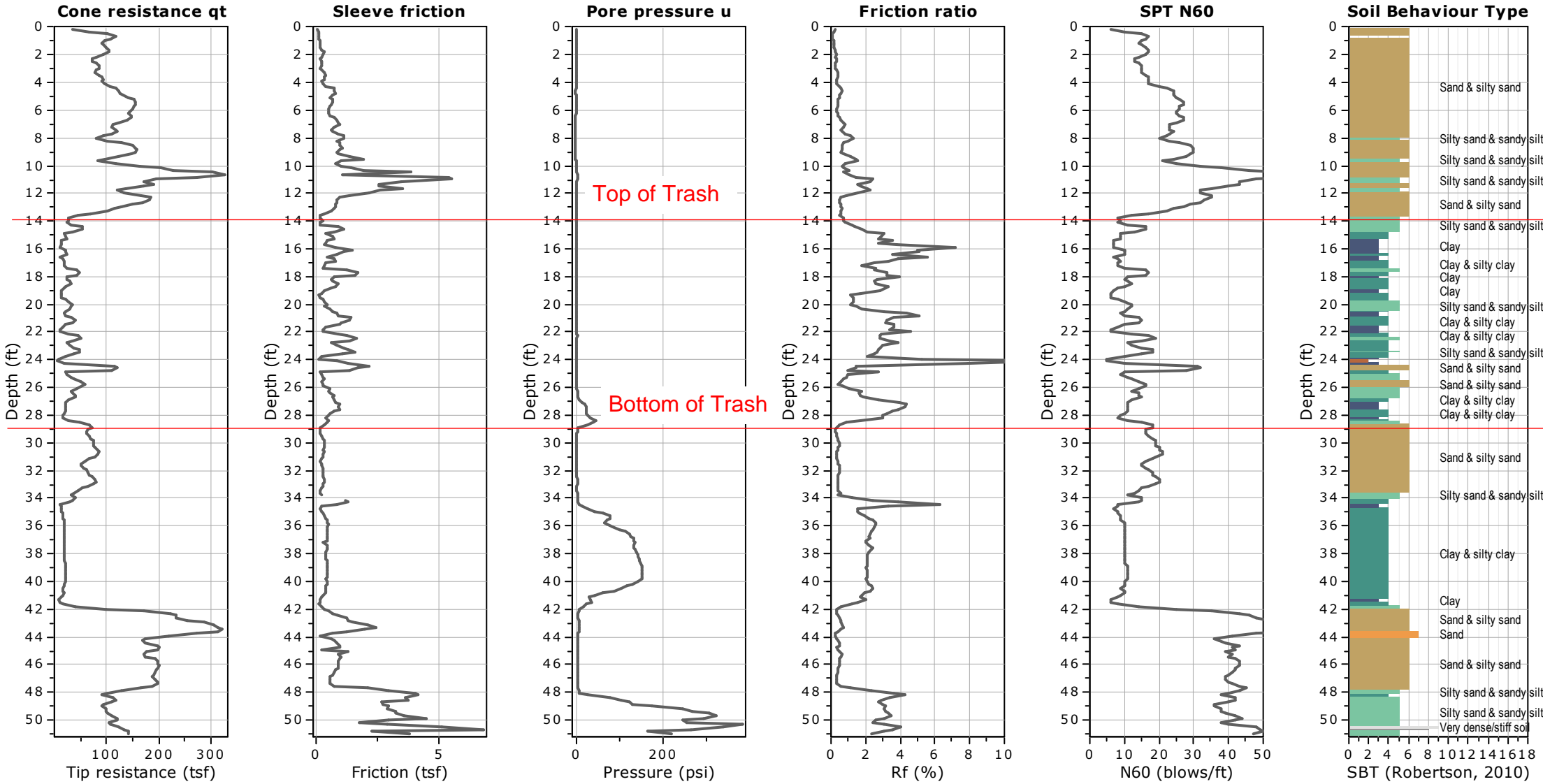




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-4**

Total depth: 51.00 ft, Date: 5/16/2023  
 Surface Elevation: 247.80 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

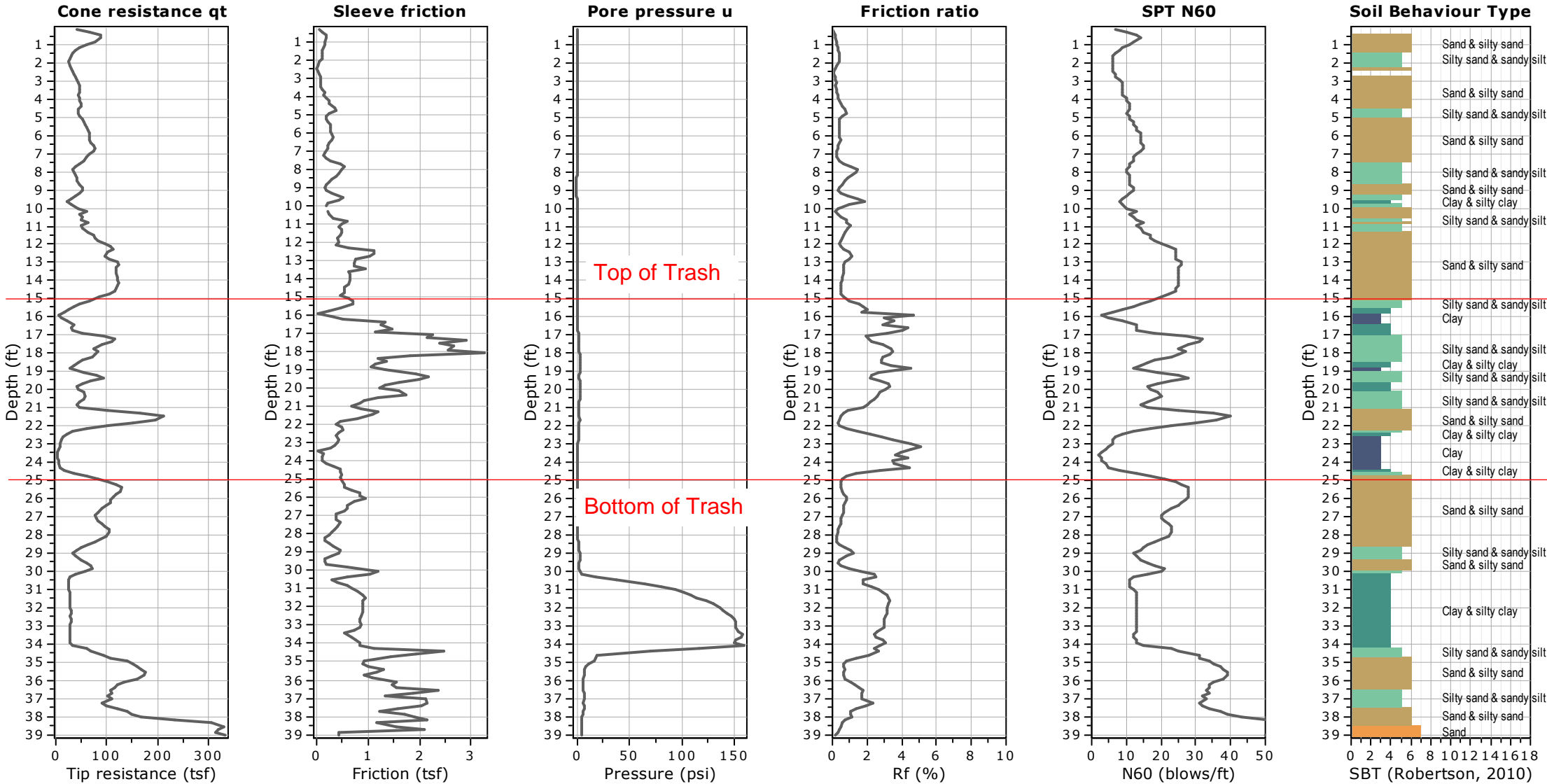




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-5**

Total depth: 39.03 ft, Date: 5/16/2023  
 Surface Elevation: 247.00 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

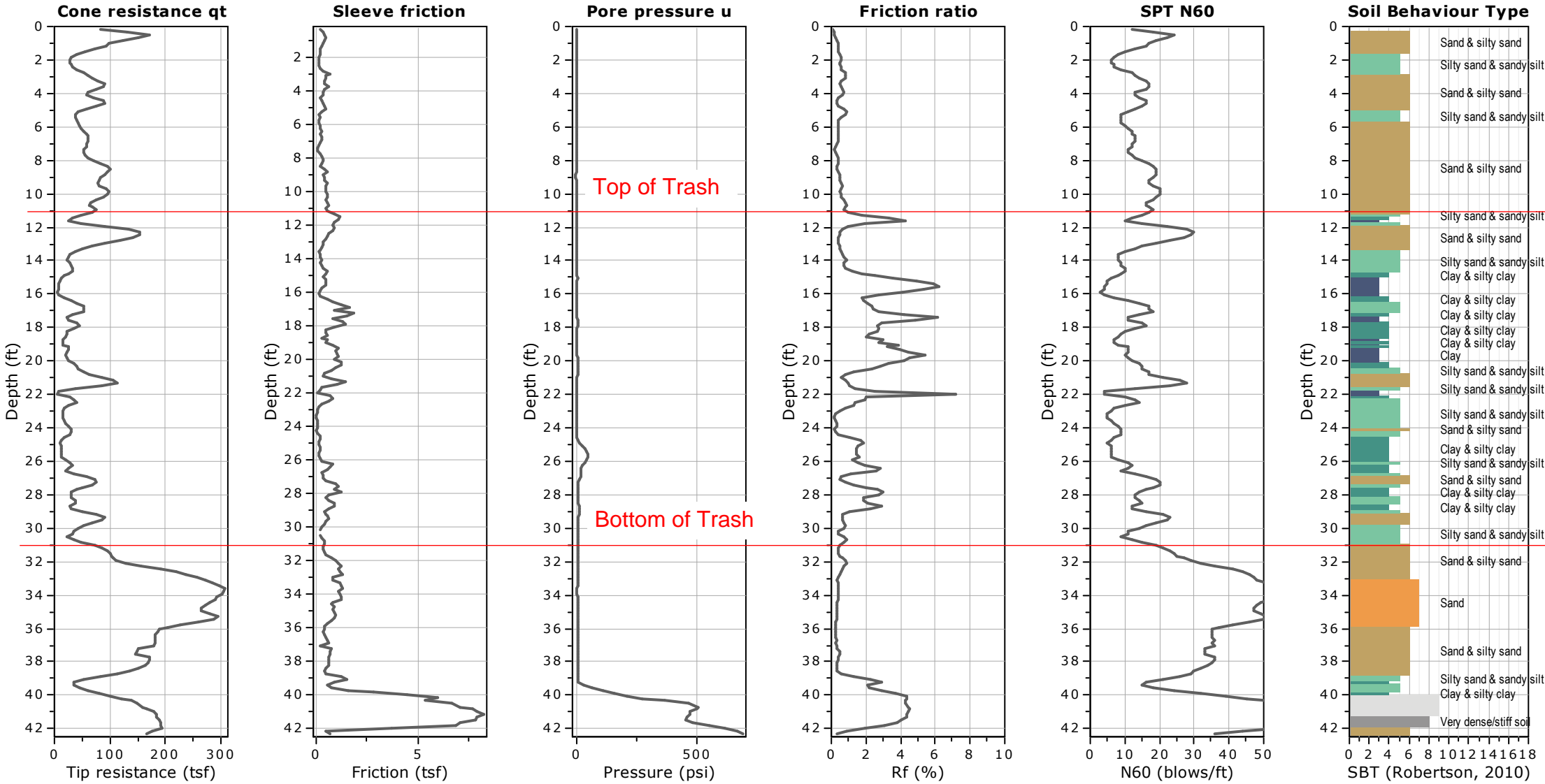




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-6**

Total depth: 42.31 ft, Date: 5/16/2023  
 Surface Elevation: 242.90 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

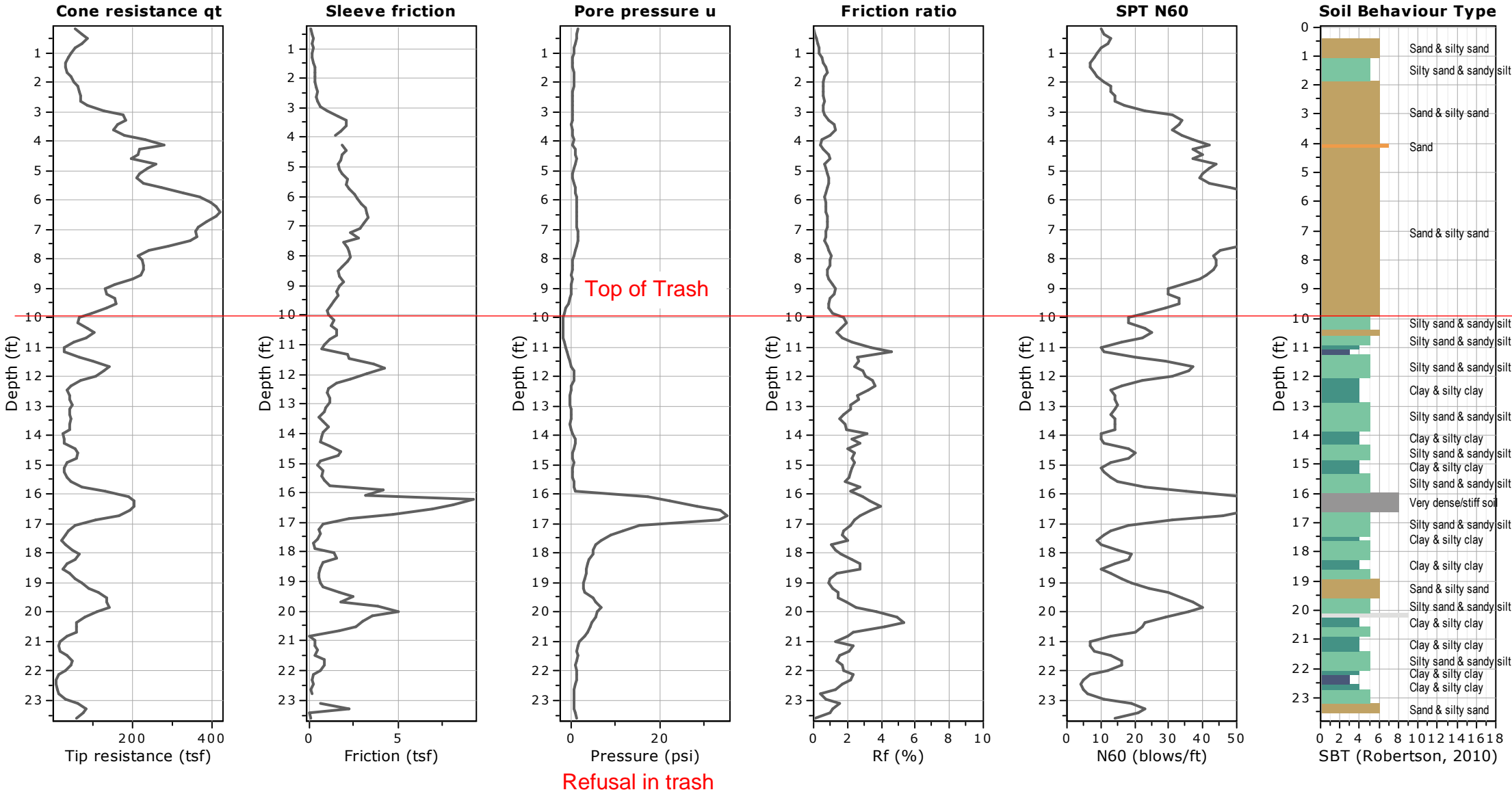




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-7**

Total depth: 23.62 ft, Date: 5/16/2023  
 Surface Elevation: 238.40 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler



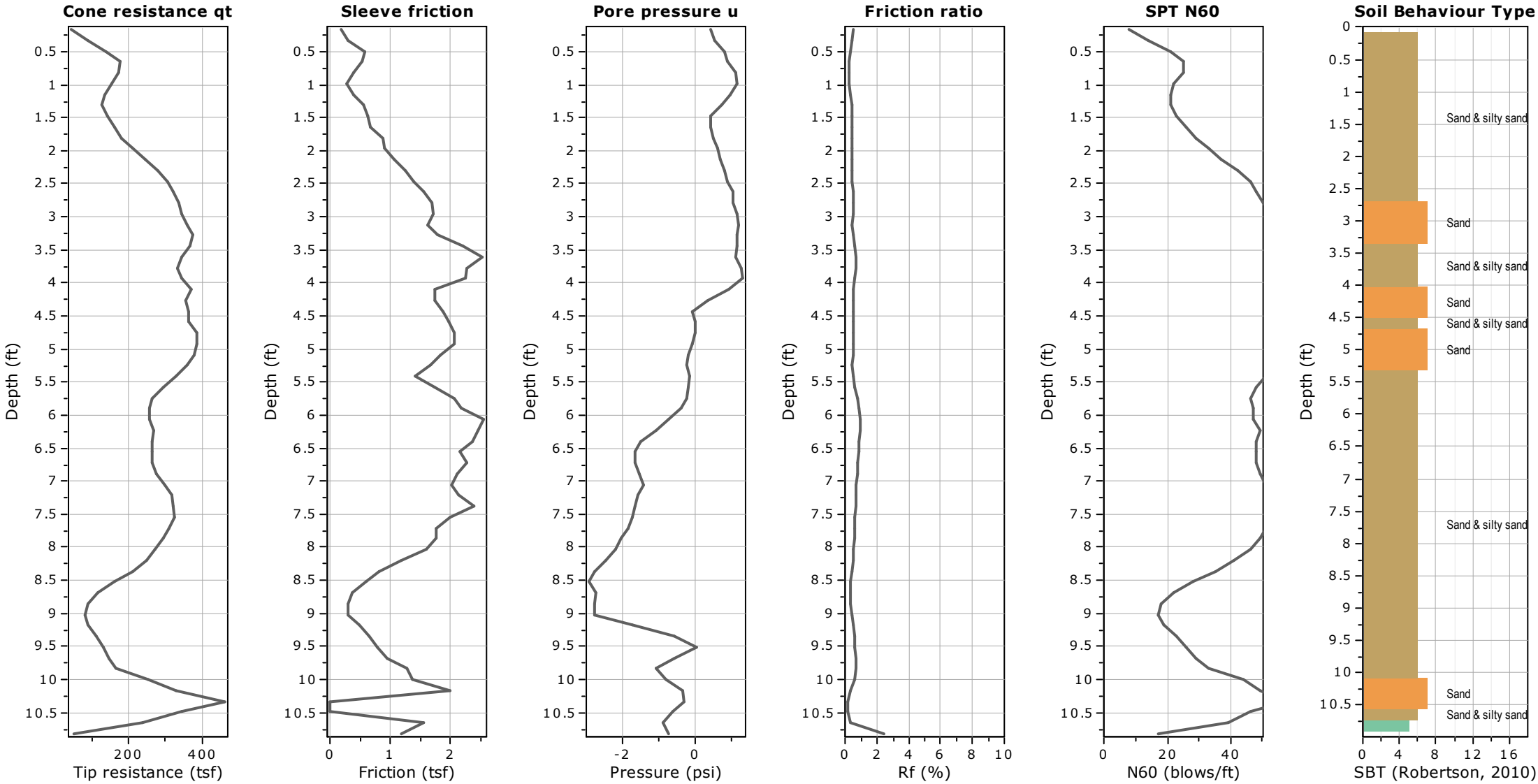


**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**No Trash**

**CPT: CPT-8**

Total depth: 10.82 ft, Date: 5/16/2023  
 Surface Elevation: 235.00 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DDG1577  
 Cone Operator: Austin Fowler

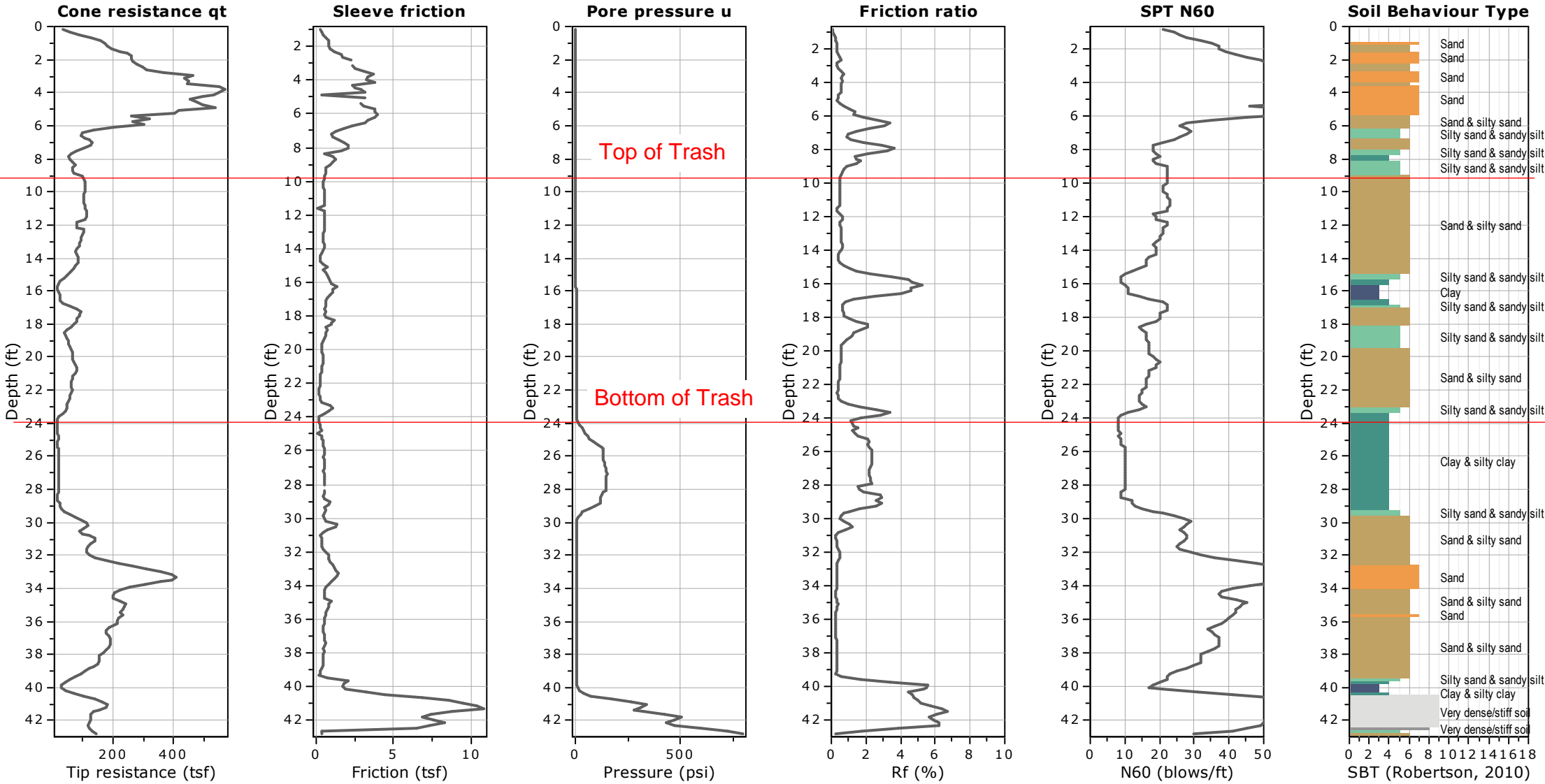




**Project:** All American Freeway Near Honeycutt Road  
**Location:** Fort Bragg, North Carolina

**CPT: CPT-10**

Total depth: 42.80 ft, Date: 5/17/2023  
 Surface Elevation: 253.20 ft  
 Coords: X:0.00, Y:0.00  
 Cone Type: DSG1156  
 Cone Operator: Austin Fowler





# **Appendix C**

## **Pavement Core Depths**

**All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

---

## Pavement Thickness Measurements

A Diedrich D-50 drill rig was used to auger an approximately 6 inch diameter hole in the asphalt pavement at selected locations. The depth of the asphalt was measured within the open borehole using a scraping device with measurement marking. Based on direct measurement of the pavement thickness performed by ICE, the asphalt typically extends to depths ranging from 0.7 to 6.5 feet below the current pavement surface. See **Table C** below for asphalt boring locations and measured pavement depths, as well as the corresponding estimate generated via GPR at each location.

**Table C: Pavement Core Data**

Core Location	CPT Location	GPR Depth of Pavement(ft)	Cored Pavement Depths (ft)	GPS-Easting (17S)	GPS-Northing (17S)
C-1		0.9	0.7	683694.18	3889657.9
C-2		1.3	1.2	683647.77	3889708.07
C-3		1.4	1.4	683585.05	3889764.07
C-4	CPT C-4	4.8	5.3	683573.11	3889773.44
C-5		1.8	2.1	683553.33	3889788.93
C-6	CPT C-6 CPT C-6a	3.6	3.7	683516.83	3889813.71
C-7		2.3	2.8	683496.35	3889827.92
C-8		3.6	4.2	683469.43	3889843.55
C-9	CPT C-9	2.9	3.7	683447.33	3889855.42
C-10	CPT C-10	3.6	3.7	683443.17	3889857.67
C-11		1.9	2.4	683412.35	3889873.37
C-12	CPT C-12	2.4	2.3	683396.64	3889880.6
C-13		1.8	1.9	683385.55	3889885.39
C-14	CPT C-14	1.3	1.1	683360.67	3889895.27
C-15		1.0	0.8	683322.69	3889910.19
C-16		1.0	0.9	683290.54	3889886.39
C-17	CPT C-17	1.4	1.3	683343.48	3889867.23
C-18		2.9	3.7	683369.03	3889856.4
C-19		1.9	2.3	683374.61	3889853.7
C-20	CPT C-20	3.5	2.7	683398.73	3889842.23
C-21		2.6	3.4	683403.34	3889839.91
C-22	CPT C-22 CPT C-22a	4.1	2.3	683421.41	3889830.95
C-23		3.2	4.0	683425.73	3889828.75
C-24		4.6	5.3	683469.87	3889803.66
C-25	CPT C-25	5.5	6.5	683482.38	3889795.85
C-26		3.5	5.0	683487.18	3889792.88
C-27	CPT C-27	2.1	2.0	683508.23	3889779.36
C-28	CPT C-28	5.9	2.4	683533.89	3889760.47
C-29	CPT C-29	2.3	2.8	683540.13	3889755.36



# **Appendix D**

## **Geophysical Report**

**All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

---



## REPORT ON GEOPHYSICAL SERVICES

### **ALL AMERICAN FREEWAY, FORT LIBERTY**

Fayetteville, North Carolina  
ESP Project No. 23-00250

**Prepared For:**

ICE of Carolinas, PLLC  
4505 Falls of Neuse Road, Suite 110  
Raleigh, NC 27609

**Prepared By:**

ESP Associates, Inc  
7011 Albert Pick Road  
Suite E  
Greensboro, NC 27409

August 14, 2023



August 14, 2023

Mr. Shane Johnson, PE, PG  
ICE of Carolinas, PLLC  
4505 Falls of Neuse Road, Suite 110  
Raleigh, North Carolina 27609

Reference: **REPORT ON GEOPHYSICAL SERVICES**  
**ALL AMERICAN FREEWAY, FORT LIBERTY**  
Fayetteville, NC  
ESP Project No. 23-00250

Dear Mr. Johnson:

ESP Associates, Inc. (ESP) is pleased to submit this report to ICE of Carolinas, PLLC (ICE) on the geophysical work ESP performed along a section of the All American Freeway in April and May 2023 (Figure 1). This work was performed in accordance with our Proposal GS1-22620 dated June 30, 2022. The purpose of the geophysical work was to obtain subsurface information to aid ICE in developing remedial alternatives for this section of the freeway.

## 1.0 BACKGROUND

Approximately 1200 feet of the All American Freeway south of the Honeycutt Road overpass was built over an unlined municipal landfill (SWMU 9) that operated from 1970 to 1975 (Zapata, 2018). This section of the freeway has experienced differential settlement over time, with linear areas of settlement likely corresponding to landfill cells or trenches (Figure 2, Image A). The settlement has required multiple episodes of repaving to level out the roadway.

Borings drilled by Building and Earth Sciences, LLP in 2017 indicated the general stratification was topsoil/asphalt, embankment fill/landfill cover, and landfill trash overlying Coastal Plain sediments (Zapata, 2018). The maximum of the range of typical thickness for each stratum was 13 inches of topsoil/asphalt, 22 feet of embankment fill/landfill cover, and 27 feet of landfill waste.

ESP performed geophysical data collection in the area of interest shown on Figure 1 to help determine the following:

- Approximate thickness of the roadway asphalt using ground-penetrating radar (GPR),
- Approximate lateral and vertical extents of the buried waste using electromagnetic induction (EM) and electrical resistivity imaging/induced potential (ERI/IP), and
- Approximate location of the two known storm drain pipes and additional unmapped buried pipes using the EM and GPR data.



## 2.0 DATA ACQUISITION

The geophysical field work was performed by ESP geophysicists Edward (Ned) Billington, PG, Ryan Pastrana, PG, and Cody Allen, GIT. Traffic control was provided by Traffic Control Safety Services (TCSS) under contract to ICE. The GPR and EM data were collected on April 12 and 13, 2023; the ERI data and some additional GPR data were collected on May 1 and 2, 2023.

Real-time positioning of the GPR and EM data was obtained using a Geode DGPS, reported by the manufacturer to provide submeter accuracy. Wooden stakes were placed at the start, end, and at 100-foot stations along the ERI lines; the approximate coordinates of the stakes were obtained using the Geode DGPS.

The specifics of the data acquisition are presented below. The results of the data analysis and interpretation are discussed in Section 3.

### 2.1 GPR Imaging

GPR data was collected on 7 lines along the northbound (NB) lanes, the southbound (SB) lanes, and the SB on-ramp using a Sensors and Software Noggin cart equipped with a 500 MHz cart towed behind a vehicle (Figure 2, Image B); some data also were collected by pushing the GPR cart by hand. GPR data were collected along the NB outside shoulder, the NB outside lane, the SB inside lane, the SB outside lane, the SB outside shoulder, and the SB on-ramp shoulders (Figure 3). The purpose of the GPR data collection was to estimate the approximate thickness of the asphalt and the approximate lateral extent of the landfill waste (Figures 4, 5, and 6).

### 2.2 EM Data Collection

Electromagnetic induction (EM) data were collected along the freeway lanes and outside shoulders using an Geonics EM61 metal detector and a Geophex GEM2 multi-frequency instrument (Figure 2, Image C). Data also were collected in the wooded area between the SB lanes and the SB on-ramp using the GEM2. The purpose of the EM61 data collection was to help identify possible subsurface metal pipes. The goal of GEM2 data collection was to help identify the lateral limits of the buried waste. It was expected that the buried municipal waste would have a relatively high conductivity due to the presence of metal and other conductive material. Figure 7 shows the GEM2 data collection lines superimposed on the 5310 Hz frequency response.

### 2.3 ERI/IP Data Collection

The ERI/IP data were collected using three lines located along the NB outside shoulder, the SB outside shoulder, and the inside shoulder of the SB on-ramp (Figure 8). Figure 8 also shows the locations of the 2017 borings that were used for correlation with the resistivity models. The purpose of the ERI/IP work was to help determine the approximate thickness of the waste. The ERI/IP data were collected using an R8 Supersting resistivity system with 56 electrodes spaced 10 feet apart for an initial array length of 550 feet (Figure 2, Image D). The roll-along method was used to extend each line by moving 14 electrodes at a time to the end of the array and collecting additional data.



### **3.0 DATA ANALYSIS AND INTERPRETATION**

ESP processed the geophysical data to develop 2D cross-sections and plan view images, then performed an interpretation of the results to map the approximate asphalt thickness and to estimate the lateral and vertical extents of the waste. However, our review of the GPR data and the EM data did not indicate consistent responses that could be attributed to buried pipes.

#### **3.1 GPR Analysis and Interpretation**

The GPR data were reviewed in the field for quality control, then processed using the software EKKO\_Project. The reflector interpreted to represent the bottom of asphalt was selected on each 2D cross-section. Recommended coring locations were provided to ICE so they could obtain representative asphalt thickness measurements. The 2023 ICE asphalt thickness measurements were compared to the GPR asphalt thicknesses, then used to establish a velocity of 3.6 nanoseconds/foot to convert the GPR data from time to depth.

The GPR cross-sections for the NB and SB lanes and shoulders show the interpreted bottom of asphalt reflector and lateral limits of the roadway subsidence (Figures 4 and 5). The asphalt thickness ranges from approximately one to 5.3 feet on the NB side and from one to 5.8 feet on the SB side. On the SB side, there is a section of the bottom-of-asphalt reflector from approximately Sta 850 to 925 that is relatively flat and shallow; this may represent a gap in the waste (Figure 5).

The GPR sections for the ramp were collected on the dirt shoulders so do not show asphalt deformation. Possible limits of waste were picked for each section based on correlations with the other data.

The GPR data were reviewed for reflectors that could represent buried pipes. A number of possible pipes were identified but these did not show a correlation from line to line that could represent linear buried pipes.

#### **3.2 EM Analysis and Interpretation**

The GEM2 data were gridded and contoured in the program Surfer to develop plan view maps of the conductivity and in-phase (metal detection) responses. As expected, the waste provided a higher conductivity response, relative to the adjacent soils. The 5310 Hz conductivity data were selected as being representative of the buried waste (Figure 7). The approximate limits of the waste were selected for each data collection line on the plan view plot. There is an area of low conductivity within the overall conductive anomaly that may represent a gap in the waste.

The EM61 data were gridded and contoured then reviewed to look for lateral anomalies that could indicate buried pipes. Lateral conductive anomalies were not observed, suggesting that the storm drain pipes known to be present are too deep and contain insufficient metal at that depth to be detected.

#### **3.3 ERI and IP Analysis and Interpretation**

The ERI and IP data were inverted using the software Earthmager 2D to produce cross sections of the modeled resistivity and chargeability (IP response) (Figure 9 and 10). As expected, the waste had a higher conductivity and higher chargeability compared to the surrounding soils. The vertical extent of the waste from the 2017 borings was superimposed on the ERI cross-sections and show good correlation with the conductive anomaly representing the waste (Figure 9). The chargeability models showed less correlation



with the known waste thickness but showed clearer ends of the waste than the resistivity models (Figure 10).

#### 4.0 DISCUSSION OF RESULTS

The edges of the waste have been estimated from the GPR data, the GEM2 data, and the chargeability response, based on the following assumptions:

- The limits of the asphalt subsidence on the GPR sections are assumed to be the limits of the waste.
- The GEM2 conductive anomaly represents the waste. This assumption is valid unless there are areas of non-conductive waste.
- The edges of the chargeability anomalies represent the edges of the waste. This assumption is valid unless there are areas of waste with relatively low chargeability.

The approximate edge points from the geophysical data were plotted with the 2017 borings (those with waste in red) and the combined data points were used to draw a polyline representing the approximate edge of the waste (Figure 11). The points from each data set showed good correlation and the confidence level in boundary is considered relatively high with the following caveats:

- The apparent gap in the waste noted just east of 2017 Boring B-10 is not fully defined due to lack of data on the southern side in the on-ramp area.
- The boundary of waste in the on-ramp area is lower confidence due to the lack of GEM2 data in this area and the lack of a defined edge on the ERI/IP data.

The ERI data interpretation indicates a good correlation with the 2017 boring data. The average waste thickness from the 2017 boring logs is 21 feet. This average thickness and the plan view limits of the waste within the approximate freeway embankment footprint were used to estimate the volume of waste beneath the freeway: This estimate could be used to help develop costs for removing the waste.

Approximate area of waste below freeway:	2.6 acres
<u>Approximate average waste thickness:</u>	<u>* 21 feet</u>
Estimated volume of waste beneath freeway embankment:	= 54.6 acre-feet
Convert to cubic yards by multiplying by 1613:	88,069 cy

Likewise, the average thickness and plan view limits of the waste were used to estimate the volume of waste beneath the combined footprint of the freeway embankment and ramp.

Approximate area of waste below combined footprint:	4.4 acres
<u>Approximate average waste thickness:</u>	<u>* 21 feet</u>
Estimated volume of waste beneath freeway embankment:	= 92 acre-feet
Convert to cubic yards by multiplying by 1613:	148,396 cy



## 5.0 RECOMMENDATIONS

The interpretation of the boundary of the waste could be improved by collecting additional GEM2 data in the SB on-ramp area and by collecting an additional ERI/IP line along the outside shoulder of the on-ramp extending to where it merges with the SB lanes. This work would require one day on site with 2 personnel.

The primary concern with building over buried municipal waste is the amount of consolidation of the waste and subsidence of the overlying fill over time, as has been seen on the All American Freeway. A geophysical method that could be used to help estimate the current relative density of the waste is 2D surface wave seismic. The 2D surface wave seismic method would provide 2D cross-sections of the approximate subsurface shear wave velocity, a direct indication of the stiffness of the waste and the surrounding soils. Areas of low shear wave velocity (low stiffness) could be targeted with a dynamic compaction or a grouting program, for example, to stabilize the subsurface and reduce the potential for future subsidence. A post-compaction surface wave seismic survey could be performed to provide evidence of the improvement in stiffness.

## 6.0 LIMITATIONS

ESP’s professional services have been provided in accordance with generally accepted guidelines for performing geophysical surveys. It is recognized that the results of geophysical surveys are non-unique, subject to interpretation, and limited by the specific equipment, methodology, and site conditions. It is possible that not all subsurface features of interest have been identified or delineated by this work. The passage of time may result in a change in the conditions at this site. ESP does not warrant against future operations or conditions, or against operations or conditions present of a type or at a location not included as part of this work.

## 7.0 CLOSING

We appreciate the opportunity to assist you during this phase of the project. If you should have any questions concerning this report, or if we may be of further assistance, please contact us.

Sincerely,

ESP Associates, Inc.

Edward D. Billington, PG  
 Senior Managing Geophysicist

EDB/CRP/PMW  
 Attachments: Figures 1 - 11



## FIGURES



From: Google Earth, Date: 2019



PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 1**  
**SITE MAP SHOWING GEOPHYSICAL STUDY AREA**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



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



A. Photograph of median showing differential settlement as evident by variation in guardrail height, looking west from northbound lanes.



B. Noggin GPR cart with 500 MHz antenna set up to tow behind vehicle. Data also was collected by pushing the GPR cart by hand.



C. GEM2 multi-frequency EM instrument used to collect EM data at site (photograph from different project).



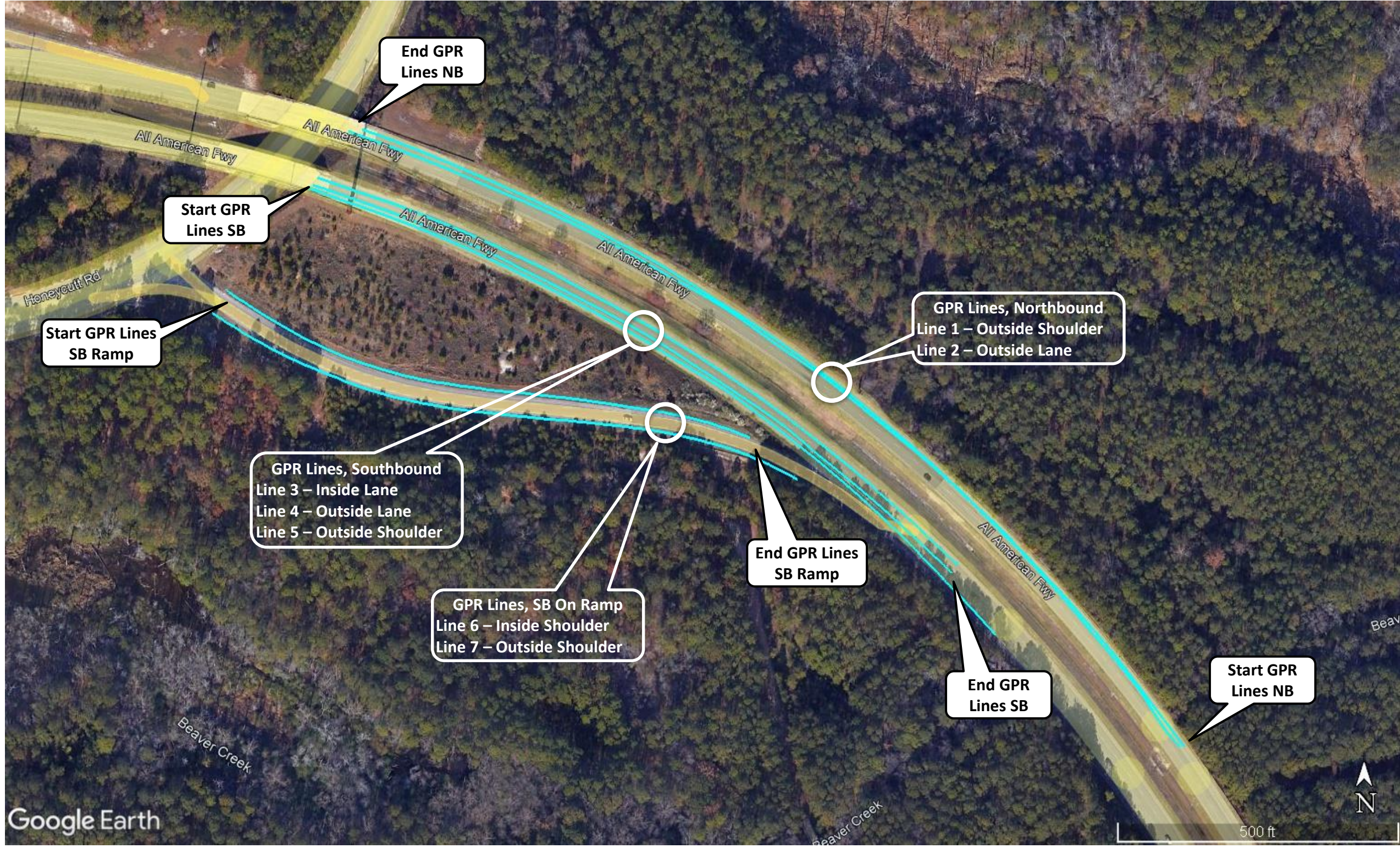
D. Electrical Resistivity Imaging (ERI) being collected on outside shoulder of northbound lane using R8 Supersting resistivity system with 56 electrodes.

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 2**  
**DATA ACQUISITION PHOTOGRAPHS**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



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



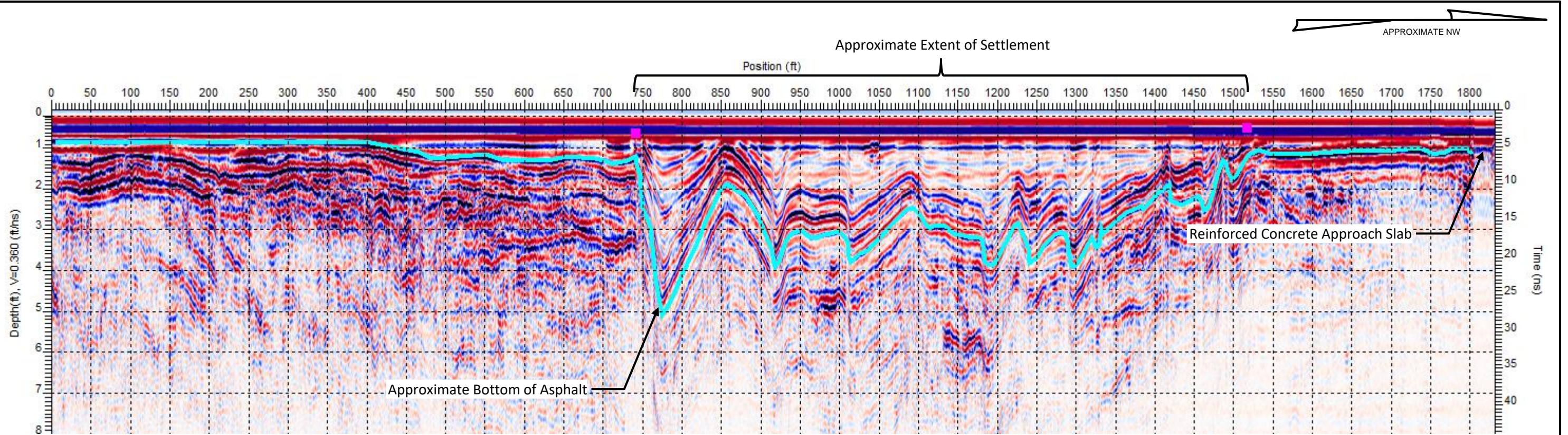
Google Earth

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

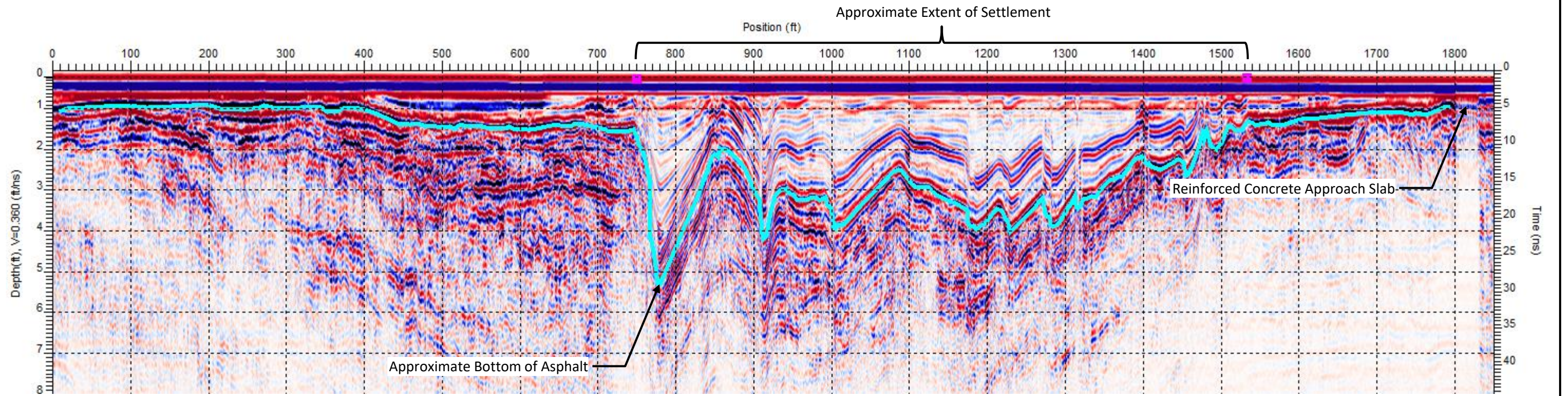
**FIGURE 3**  
**GPR LINE LOCATIONS**  
 ROADWAY SETTLEMENT EVALUATION PROJECT  
 ALL AMERICAN FREEWAY  
 FORT LIBERTY, NORTH CAROLINA



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



A. GPR Line G1 along NB outside shoulder showing interpreted depth of asphalt.



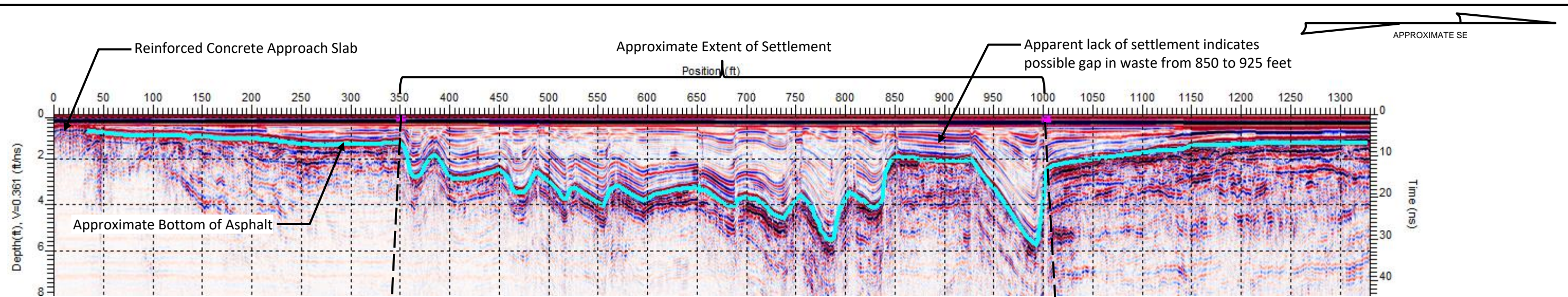
B. GPR Line G2 along NB outside lane showing interpreted depth of asphalt.

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

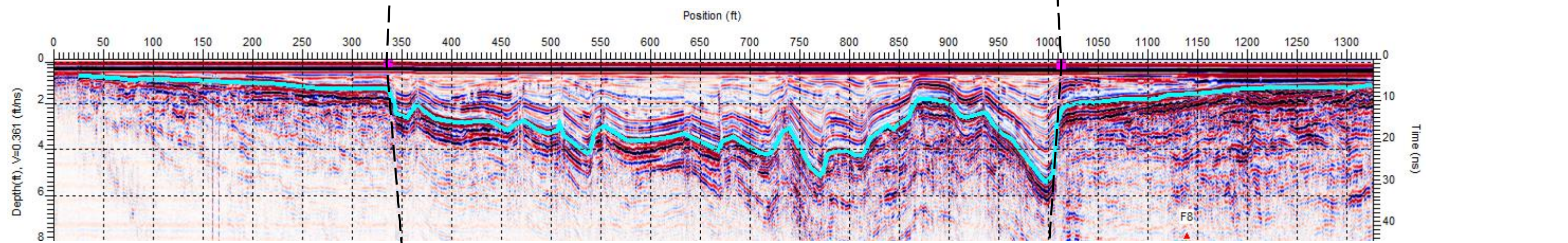
**FIGURE 4 – GPR DATA INTERPRETATION  
NORTHBOUND LINES**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



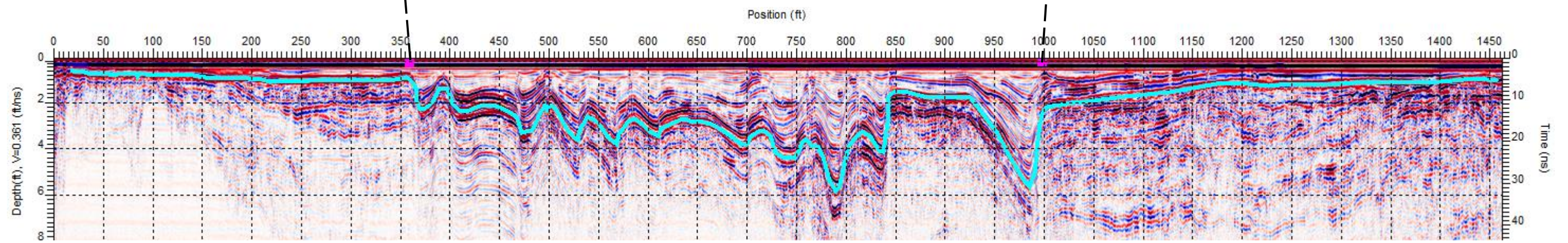
ESP Associates, Inc.  
7011 Albert Pick Rd.,  
Suite E  
Greensboro, NC 27409  
336.334.7724  
www.espassociates.com



A. GPR Line G3 along NB outside shoulder showing interpreted depth of asphalt.



A. GPR Line G4 along NB outside lane showing interpreted depth of asphalt.



A. GPR Line G5 along NB outside lane showing interpreted depth of asphalt.

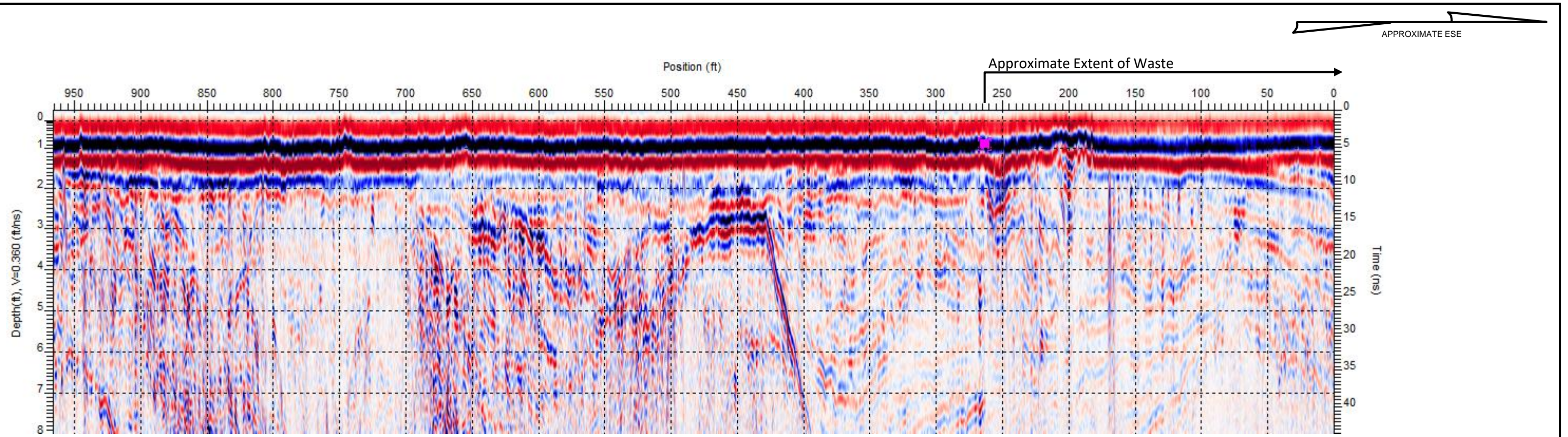
PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 5 – GPR DATA INTERPRETATION  
SOUTHBOUND LINES**

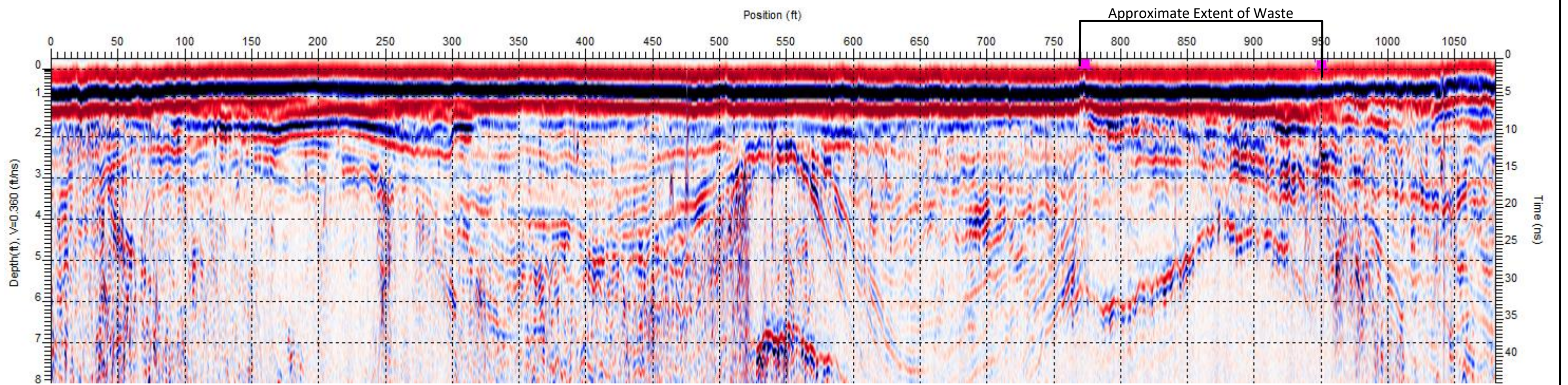
**ROADWAY SETTLEMENT EVALUATION PROJECT  
ALL AMERICAN FREEWAY  
FORT LIBERTY, NORTH CAROLINA**



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



A. GPR Line G6 along inside shoulder of SB on-ramp, showing approximate western extent of waste.



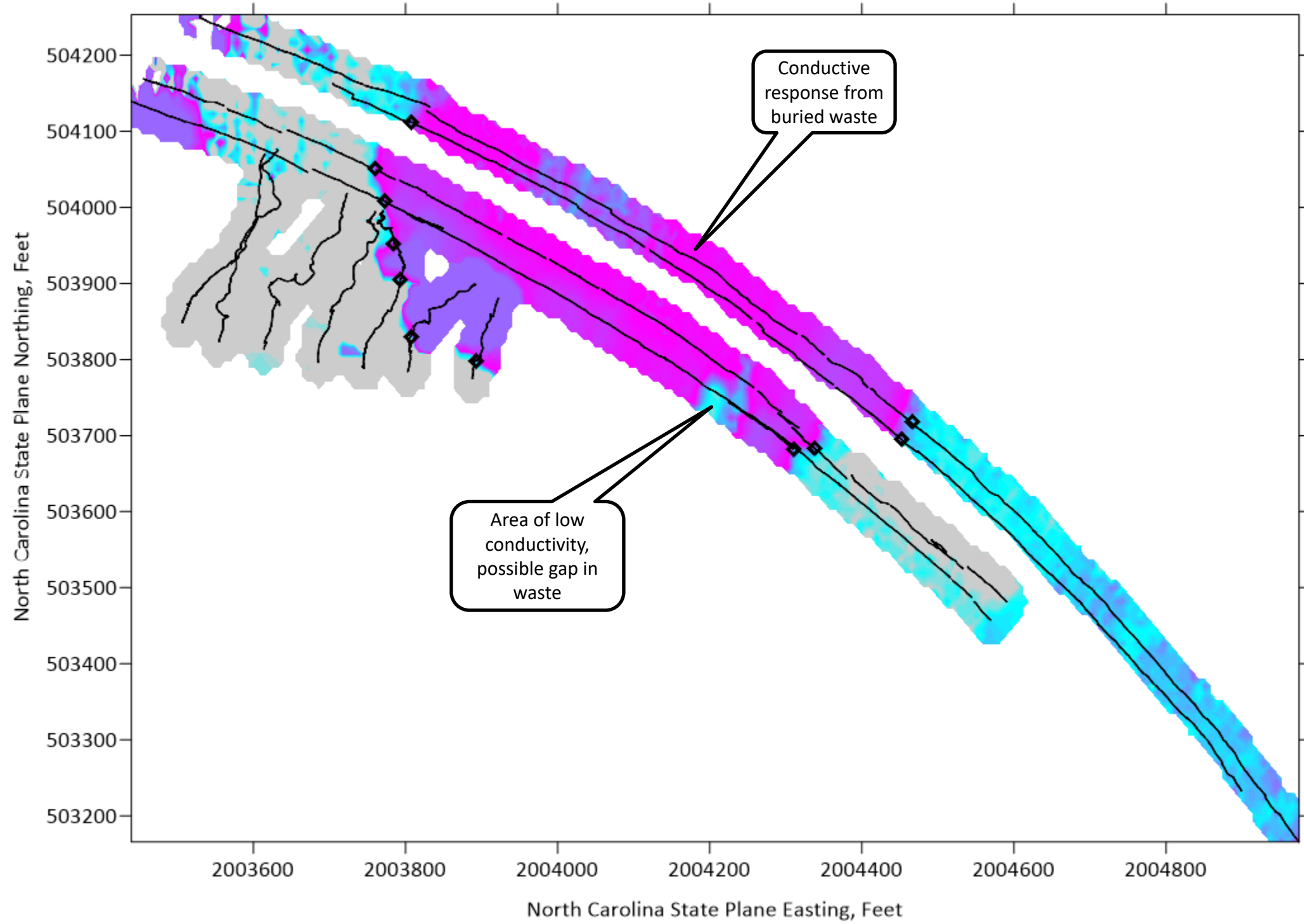
B. GPR Line G7 along outside shoulder of SB on-ramp, showing approximate extent of waste.

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 6 – GPR DATA INTERPRETATION**  
**SOUTHBOUND ON-RAMP LINES**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



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



EXPLANATION	
	Data Collection Line
	Approximate Edge of Waste



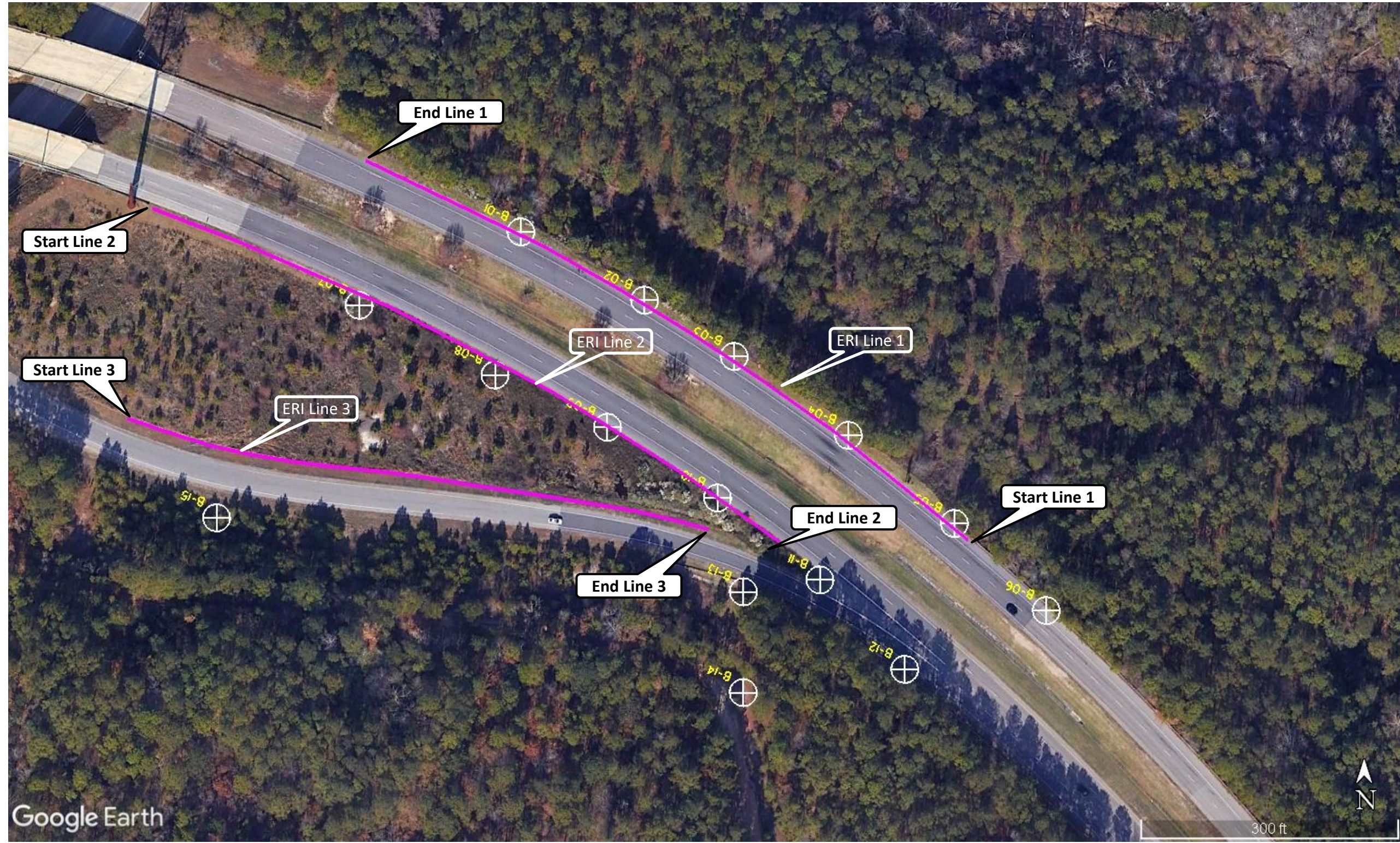
PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 7 – GEM2 5310 HZ QUADRATURE RESPONSE WITH INTERPRETED CONDUCTIVE WASTE LIMITS**

**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



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



Google Earth

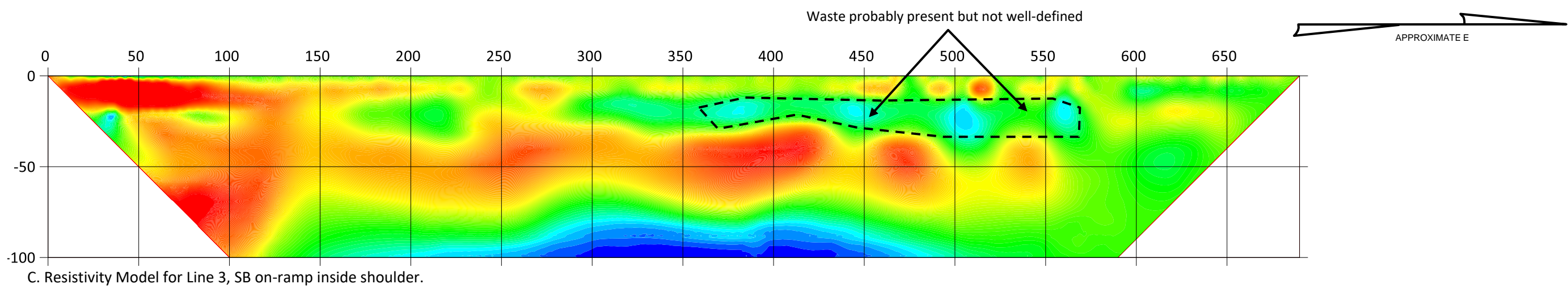
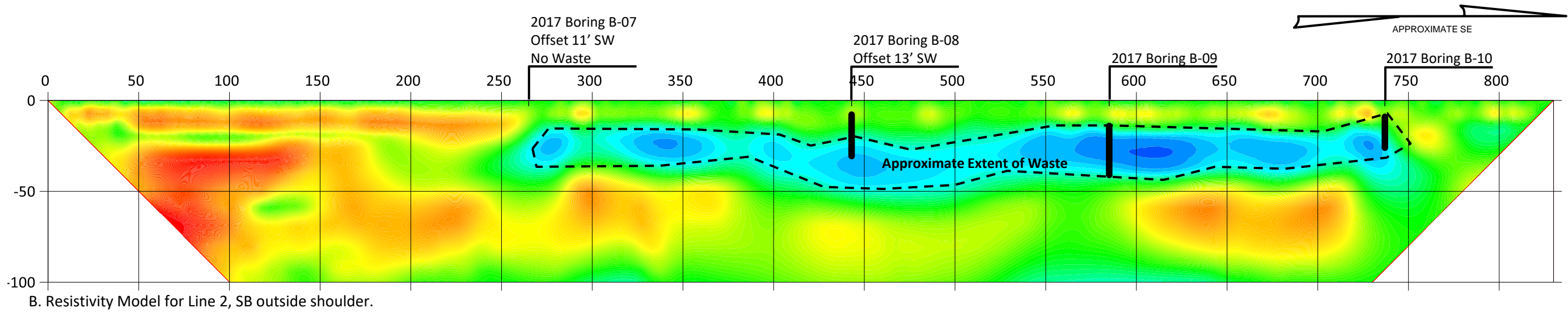
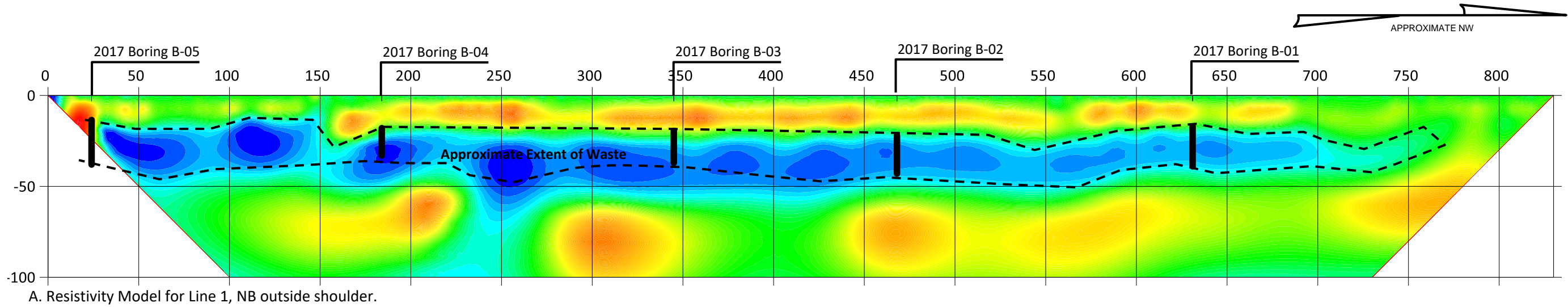
300 ft

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 8 - ERI LINE LOCATIONS WITH LOCATIONS OF 2017 BORINGS**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



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



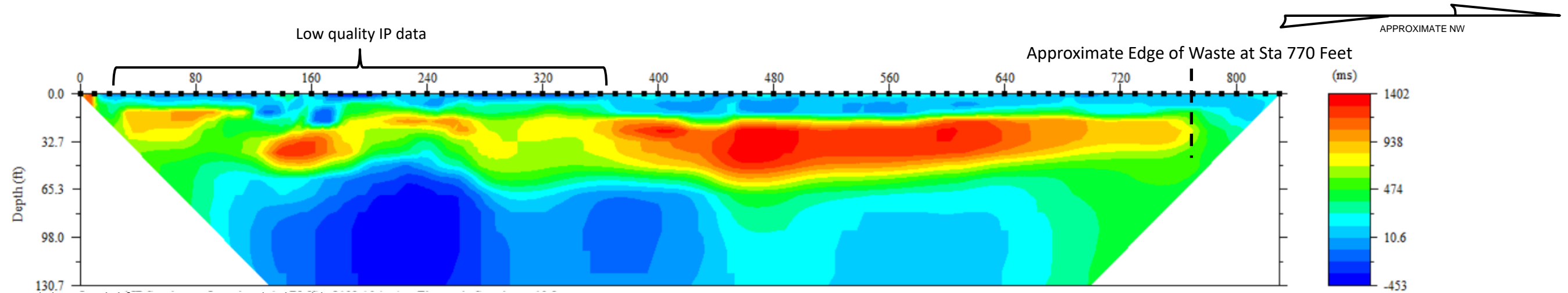
Vertical extent of waste per 2017 boring

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

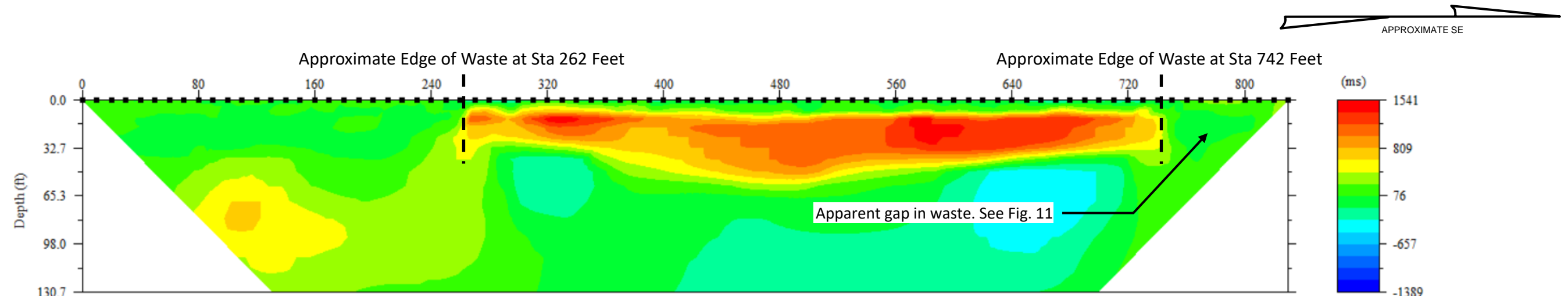
**FIGURE 9**  
**RESISTIVITY MODELS FOR LINES 1, 2, AND 3**  
**ROADWAY SETTLEMENT EVALUATION PROJECT**  
**ALL AMERICAN FREEWAY**  
**FORT LIBERTY, NORTH CAROLINA**



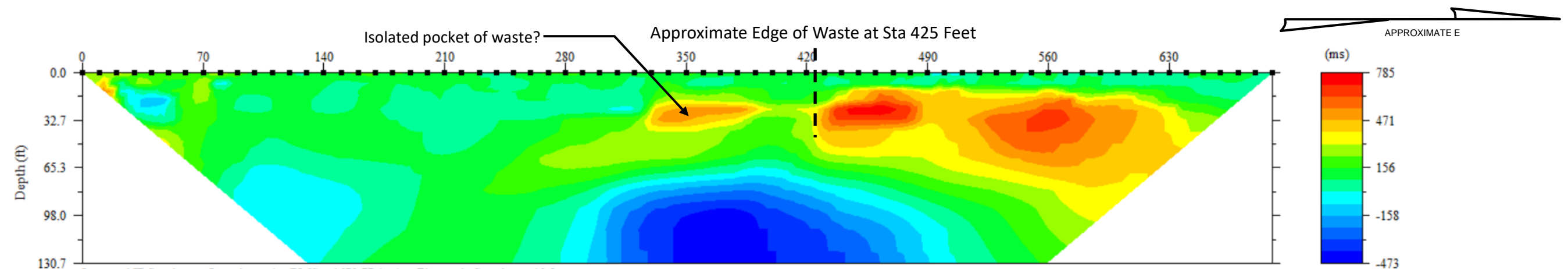
ESP Associates, Inc.  
 7011 Albert Pick Rd.,  
 Suite E  
 Greensboro, NC 27409  
 336.334.7724  
 www.espassociates.com



A. Chargeability Model for Line 1, NB outside shoulder.



B. Chargeability Model for Line 2, SB outside shoulder.



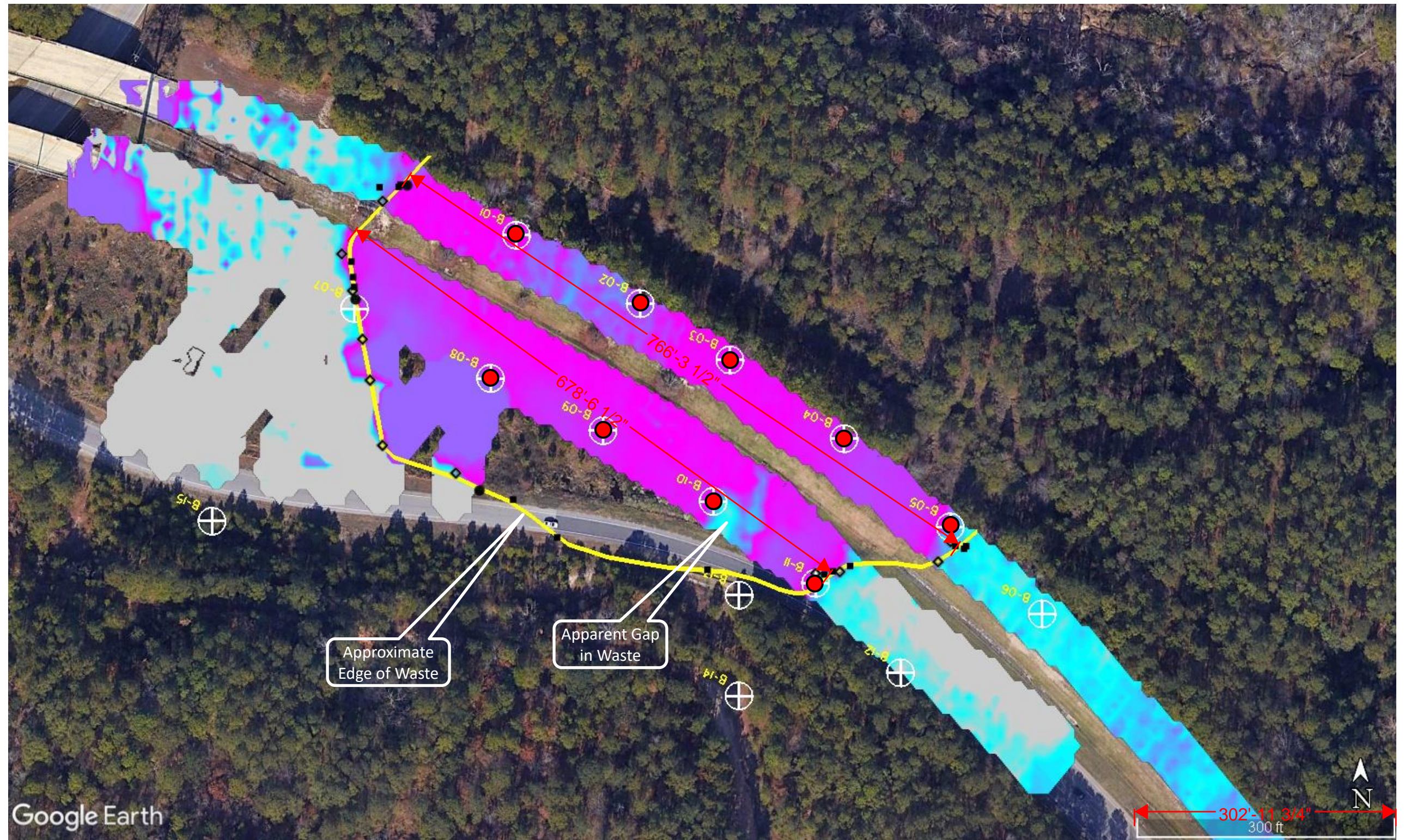
C. Chargeability Model for Line 3, SB on-ramp inside shoulder.

PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 10**  
**CHARGEABILITY MODELS FOR LINES 1, 2, AND 3**  
 ROADWAY SETTLEMENT EVALUATION PROJECT  
 ALL AMERICAN FREEWAY  
 FORT LIBERTY, NORTH CAROLINA



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



Google Earth

EXPLANATION	
●	IP Approx. Edge of Waste
■	GPR Approx. Edge of Waste
◆	GEM2 Approx. Edge of Waste
⊕	2017 Boring Location (red dot indicates waste was encountered)



PROJECT NO.	23-00250
SCALE	AS SHOWN
DATE	8/14/2023
BY	EDB/CRP

**FIGURE 10 – APPROXIMATE EDGE OF WASTE  
BASED ON GEOPHYSICAL AND BORING DATA**

**ROADWAY SETTLEMENT EVALUATION PROJECT  
ALL AMERICAN FREEWAY  
FORT LIBERTY, NORTH CAROLINA**



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



# **Appendix E**

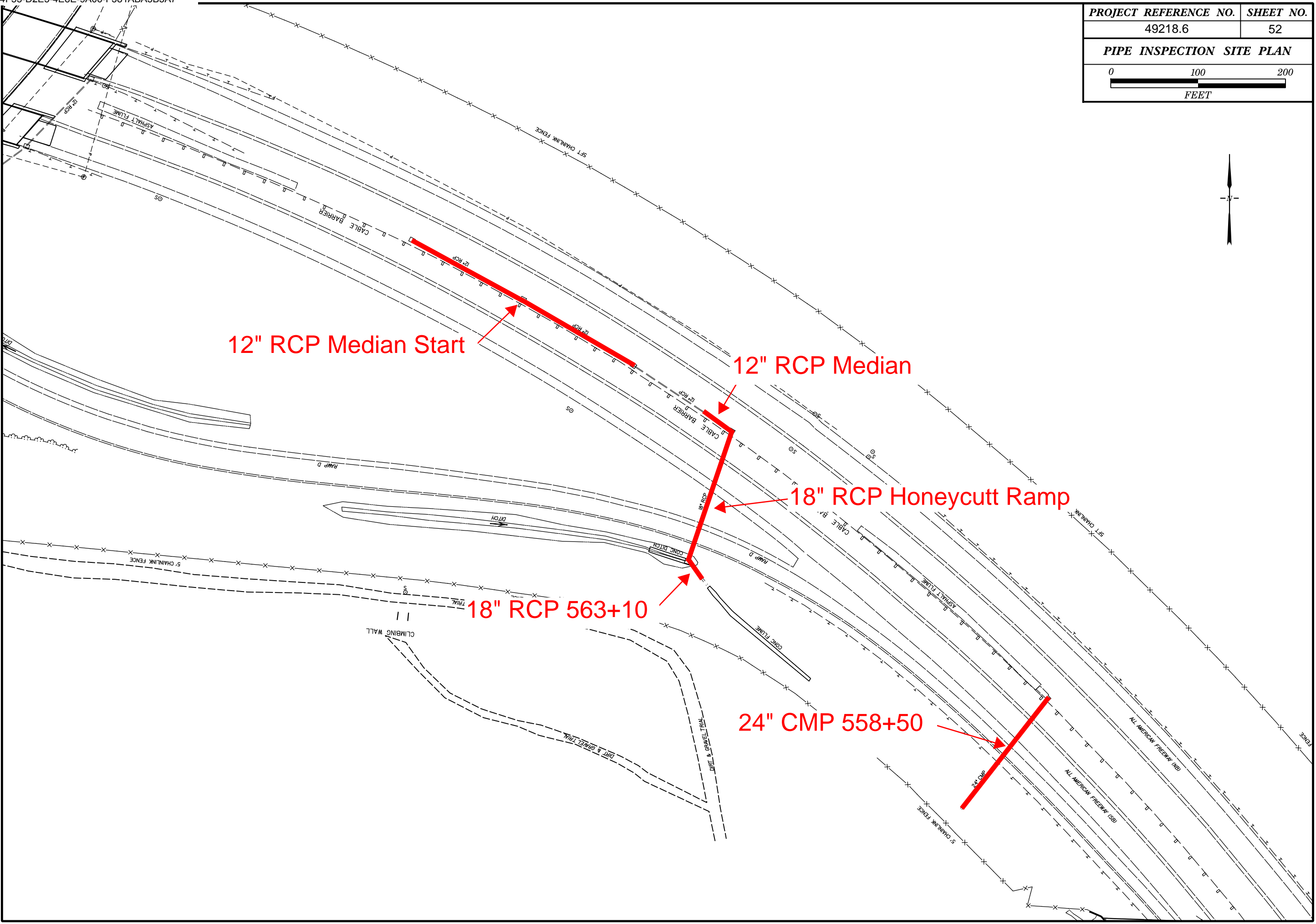
## **Pipe Inspection Report**

**All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

---

<b>PROJECT REFERENCE NO.</b>	<b>SHEET NO.</b>
49218.6	52
<b>PIPE INSPECTION SITE PLAN</b>	
0 100 200 FEET	



12" RCP Median Start

12" RCP Median

18" RCP Honeycutt Ramp

18" RCP 563+10

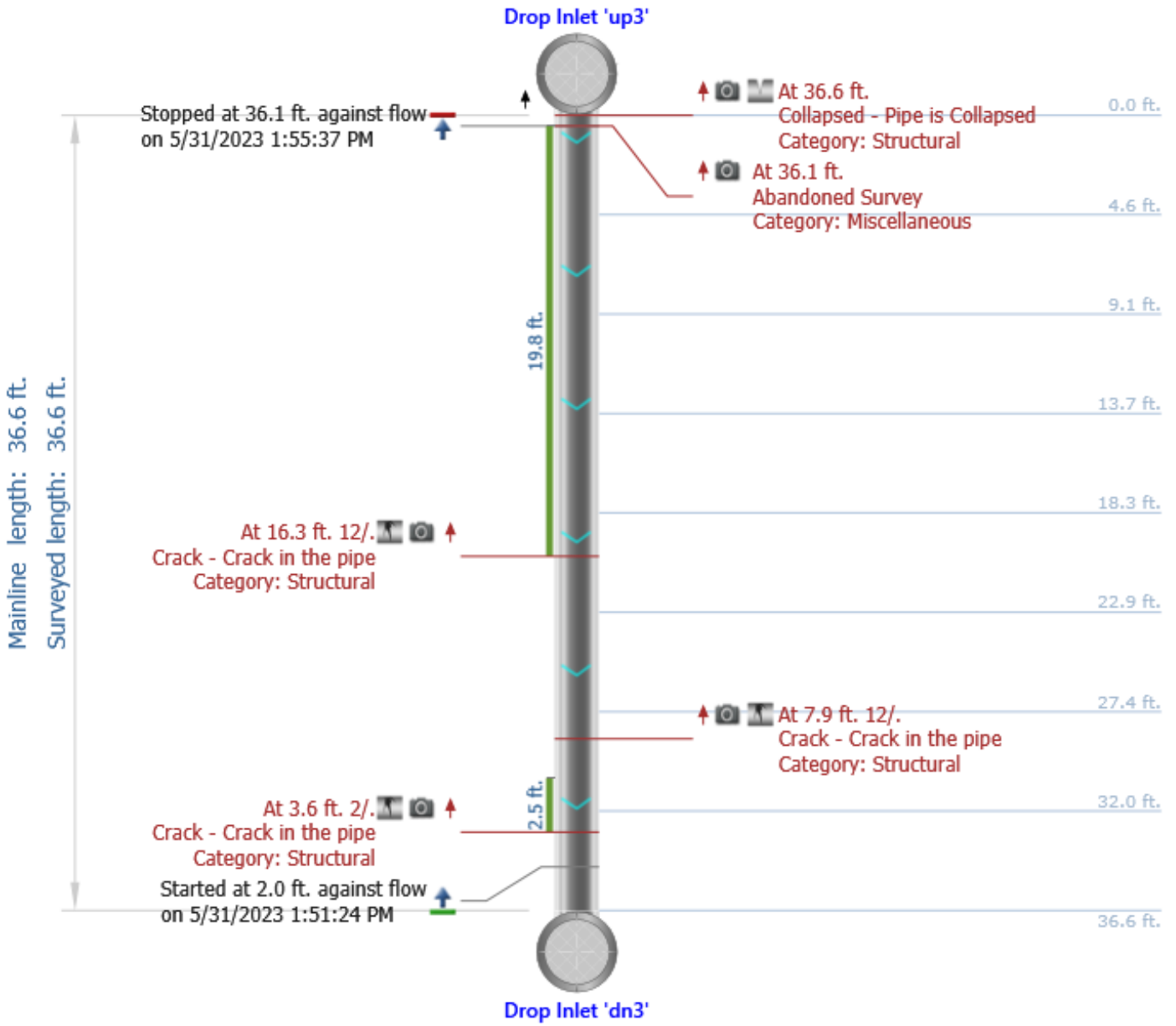
24" CMP 558+50



AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Pipe Run

Project name: <b>Fort Bragg</b>	Mainline ID: <b>12"RCP Median</b>	City: <b>Fort Bragg, NC</b>	Address: <b>All American Freeway</b>
Start date/time: <b>5/31/2023 1:51 PM</b>	Direction: <b>Against the flow</b>	Weather: <b>Dry</b>	Surface condition: <b>Other</b>
Pipe shape: <b>Circular</b>	Pipe material: <b>Concrete Reinforced</b>	Pipe height: <b>15.0 in.</b>	Pipe width: <b>15.0 in.</b>





AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Small Photos

Mainline ID: <b>12"RCP Median</b>	City: <b>Fort Bragg, NC</b>	Address: <b>All American Freeway</b>	Project name: <b>Fort Bragg</b>
Start date/time: <b>5/31/2023 1:51 PM</b>	Asset length: <b>36.6 ft.</b>	Weather: <b>Dry</b>	Operator: <b>Adam</b>
Upstream node: <b>up3</b>	Depth US: <b>36.6 ft.</b>	Downstream node: <b>dn3</b>	Depth DS: <b>36.6 ft.</b>
Pipe shape: <b>Circular</b>	Pipe material: <b>Concrete Reinforced</b>	Pipe height: <b>15.0 in.</b>	Pipe width: <b>15.0 in.</b>
Comments:			

## Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
3.6 ft.	U	2.5 ft.	2 /	Crack			



7.9 ft.	U		12 /	Crack			
---------	---	--	------	-------	--	--	--



## Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
----------	------	--------	---------	------	-------------------	--------	----------

16.3 ft. U 19.8 ft. 12 / Crack



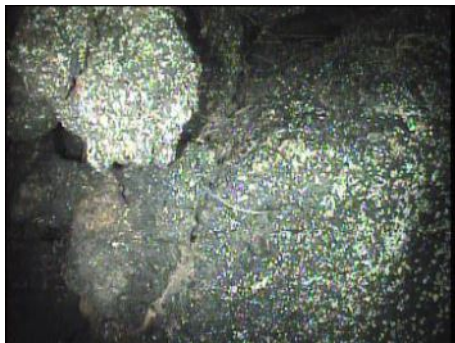
---

36.1 ft. U / Abandoned Survey



---

36.6 ft. U / Collapsed



---

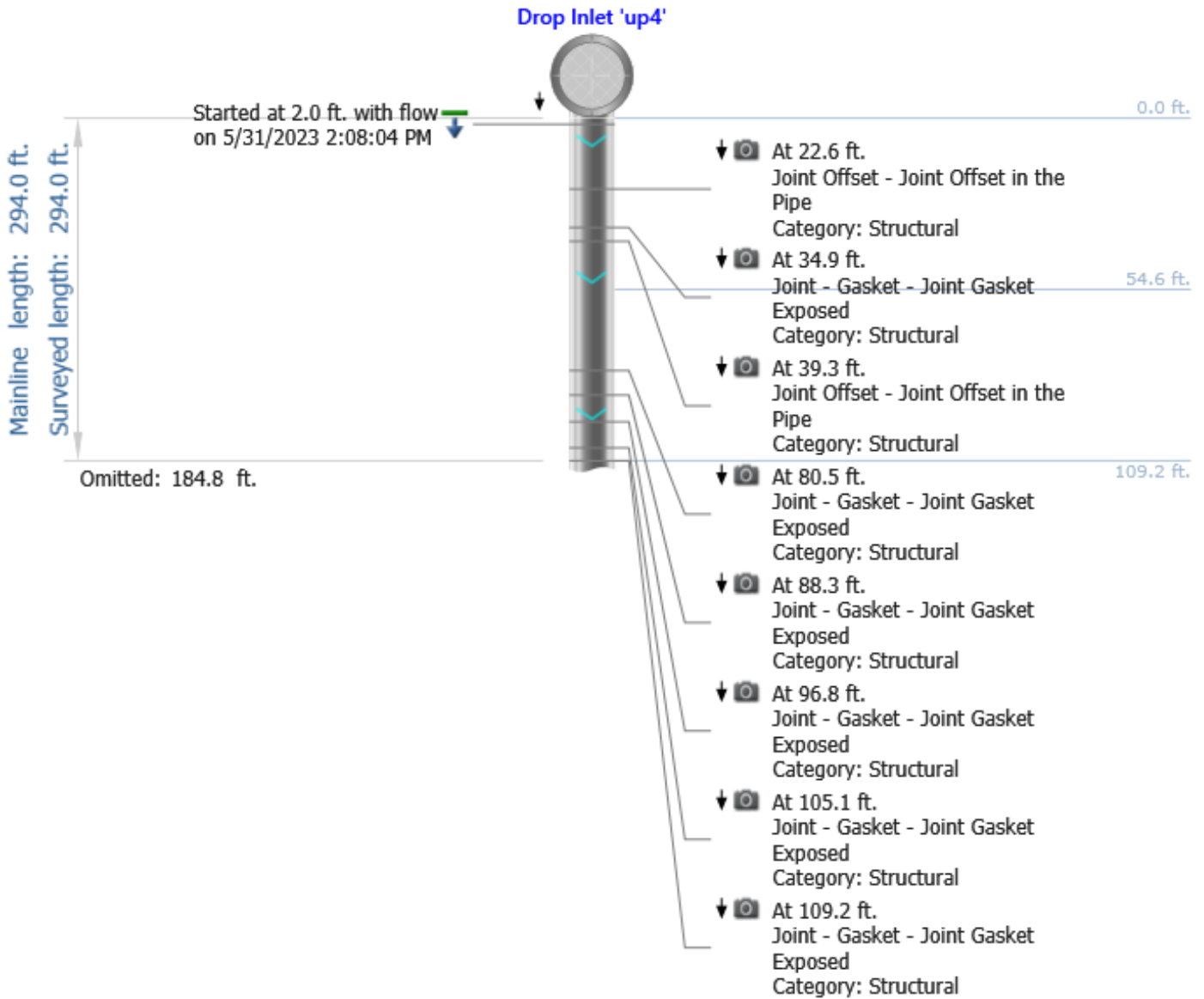
## Inspection's photos



AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Pipe Run

Project name:	Mainline ID:	City:	Address:
<b>Fort Bragg</b>	<b>12"RCP Median Start</b>	<b>Fort Bragg,NC</b>	<b>All American Freeway</b>
Start date/time:	Direction:	Weather:	Surface condition:
<b>5/31/2023 2:08 PM</b>	<b>With the flow</b>	<b>Dry</b>	<b>Other</b>
Pipe shape:	Pipe material:	Pipe height:	Pipe width:
<b>Circular</b>	<b>Concrete Reinforced</b>	<b>15.0 in.</b>	<b>15.0 in.</b>



Project name:

Mainline ID:

Start date/time:

Direction:

**Fort Bragg**

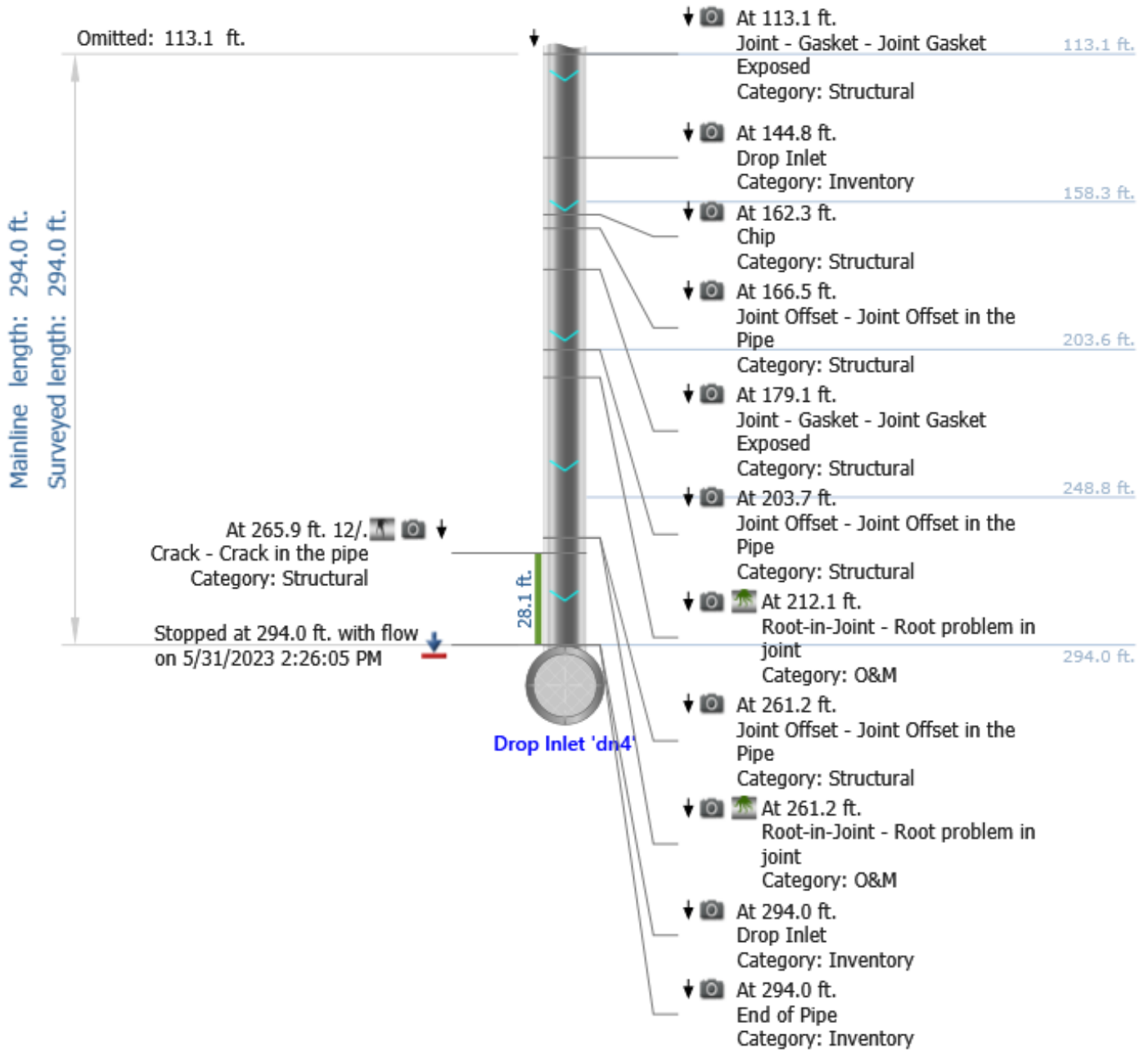
**12"RCP Median Start**

**5/31/2023 2:08 PM**

**With the flow**

Weather:

**Dry**





AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Small Photos

Mainline ID: <b>12"RCP Median Start</b>	City: <b>Fort Bragg,NC</b>	Address: <b>All American Freeway</b>	Project name: <b>Fort Bragg</b>
Start date/time: <b>5/31/2023 2:08 PM</b>	Asset length: <b>294.0 ft.</b>	Weather: <b>Dry</b>	Operator: <b>Adam</b>
Upstream node: <b>up4</b>	Depth US:	Downstream node: <b>dn4</b>	Depth DS:
Pipe shape: <b>Circular</b>	Pipe material: <b>Concrete Reinforced</b>	Pipe height: <b>15.0 in.</b>	Pipe width: <b>15.0 in.</b>
Comments:			

### Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
22.6 ft.	D		/ Joint Offset			



34.9 ft.	D		/ Joint - Gasket			
----------	---	--	------------------	--	--	--



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

39.3 ft. D / Joint Offset



80.5 ft. D / Joint - Gasket



88.3 ft. D / Joint - Gasket



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

96.8 ft. D / Joint - Gasket



---

105.1 ft. D / Joint - Gasket



---

109.2 ft. D / Joint - Gasket



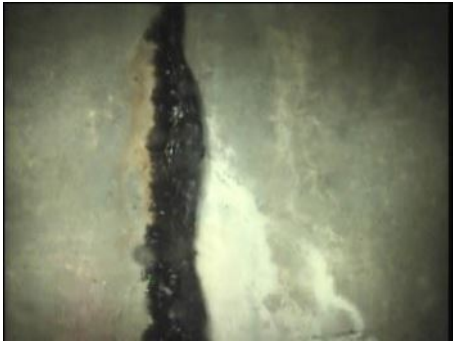
## Observations

---

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

---

113.1 ft. D / Joint - Gasket



---

144.8 ft. D / Drop Inlet



---

162.3 ft. D / Chip



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

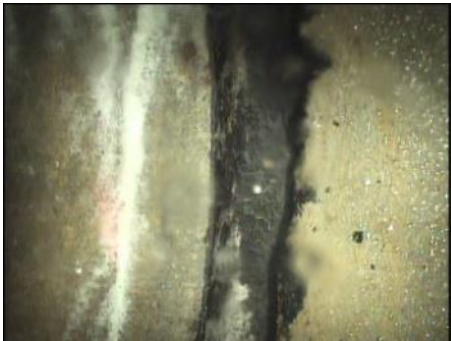
166.5 ft. D / Joint Offset



179.1 ft. D / Joint - Gasket



203.7 ft. D / Joint Offset



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

212.1 ft. D / Root-in-Joint



261.2 ft. D / Joint Offset



261.2 ft. D / Root-in-Joint



## Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
----------	------	--------	---------	------	-------------------	--------	----------

265.9 ft. D 28.1 ft. 12 / Crack



294.0 ft. D / Drop Inlet



294.0 ft. D / End of Pipe



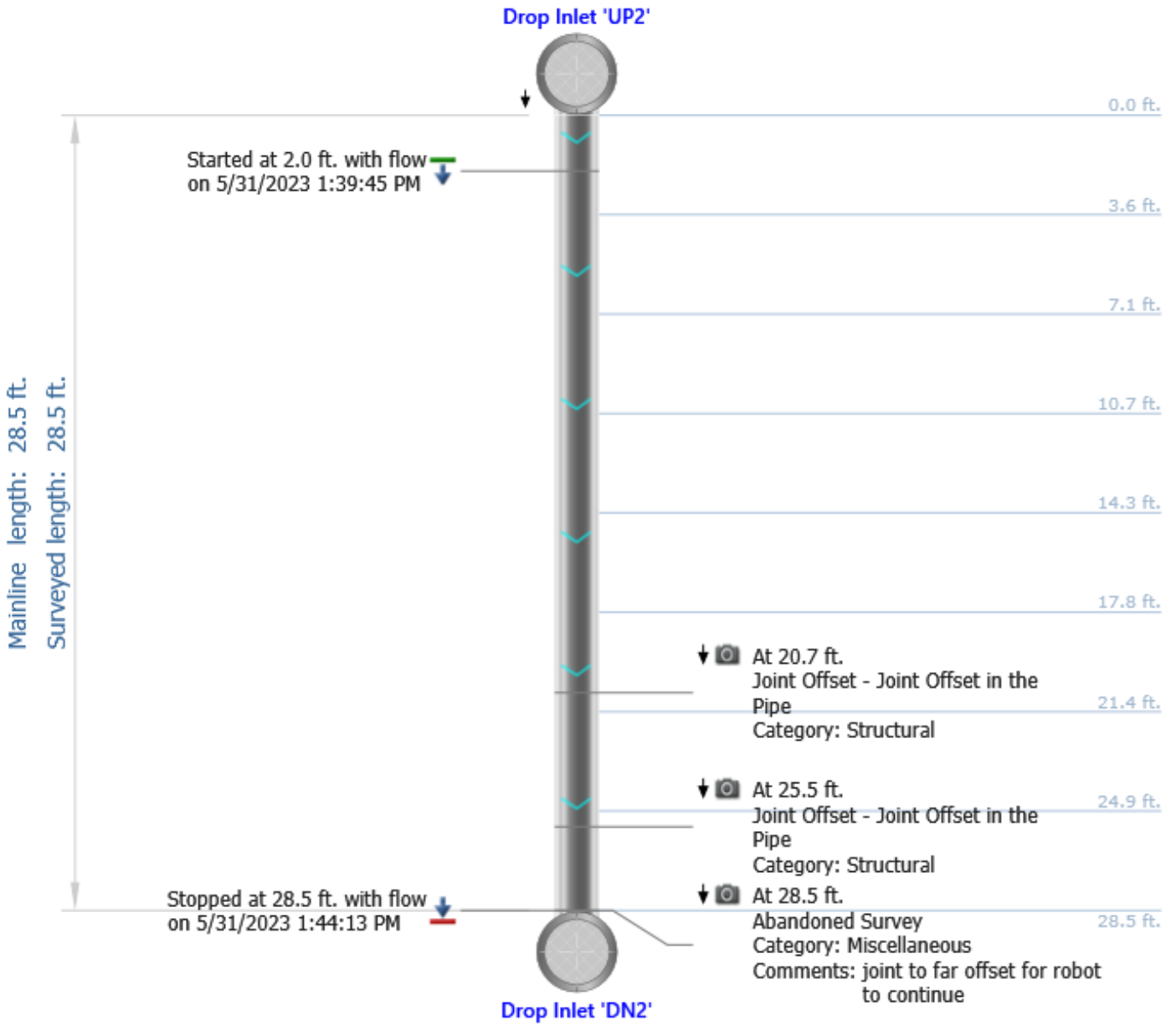
## Inspection's photos



AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Pipe Run

Project name:	Mainline ID:	City:	Address:
<b>Fort Bragg</b>	<b>18"RCP 563+10</b>	<b>Fort Bragg, NC</b>	<b>All American Freeway</b>
Start date/time:	Direction:	Weather:	Surface condition:
<b>5/31/2023 1:39 PM</b>	<b>With the flow</b>	<b>Dry</b>	<b>Asphalt</b>
Pipe shape:	Pipe material:	Pipe height:	Pipe width:
<b>Circular</b>	<b>Concrete Reinforced</b>	<b>18.0 in.</b>	<b>18.0 in.</b>





AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Small Photos

Mainline ID: <b>18"RCP 563+10</b>	City: <b>Fort Bragg, NC</b>	Address: <b>All American Freeway</b>	Project name: <b>Fort Bragg</b>
Start date/time: <b>5/31/2023 1:39 PM</b>	Asset length: <b>28.5 ft.</b>	Weather: <b>Dry</b>	Operator: <b>Adam</b>
Upstream node: <b>UP2</b>	Depth US:	Downstream node: <b>DN2</b>	Depth DS:
Pipe shape: <b>Circular</b>	Pipe material: <b>Concrete Reinforced</b>	Pipe height: <b>18.0 in.</b>	Pipe width: <b>18.0 in.</b>
Comments:			

### Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
20.7 ft.	D		/	Joint Offset			



25.5 ft.	D		/	Joint Offset			
----------	---	--	---	--------------	--	--	--



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
28.5 ft.	D		/	Abandoned Survey		joint to far offset for robot to continue



## Inspection's photos

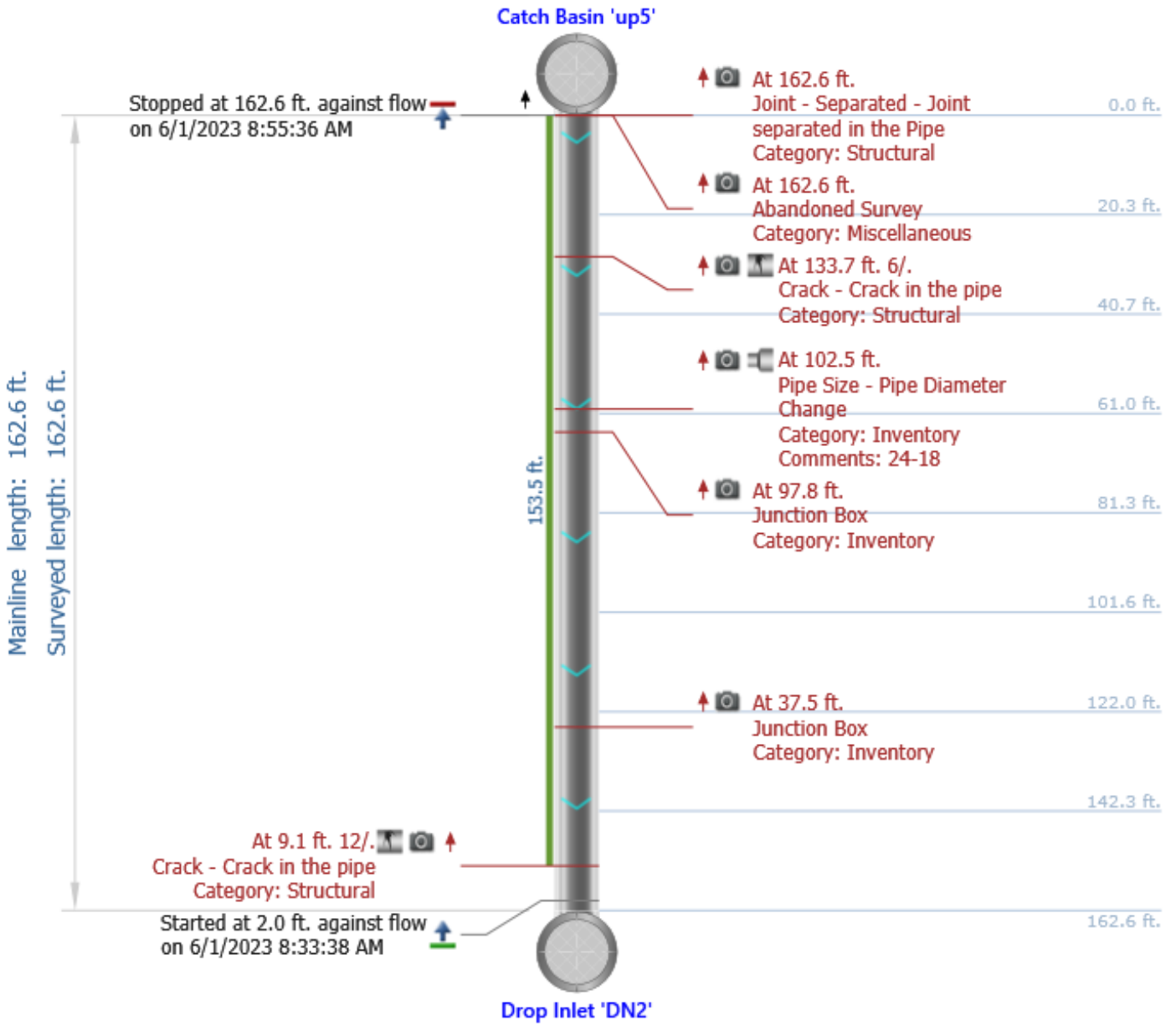




AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Pipe Run

Project name:	Mainline ID:	City:	Address:
<b>Fort Bragg</b>	<b>18"RCP Honeycut Ramp</b>	<b>Fort Bragg,NC</b>	<b>Honeycut Ramp</b>
Start date/time:	Direction:	Weather:	Surface condition:
<b>6/1/2023 8:33 AM</b>	<b>Against the flow</b>	<b>Dry</b>	<b>Asphalt</b>
Pipe shape:	Pipe material:	Pipe height:	Pipe width:
<b>Circular</b>	<b>Concrete Reinforced</b>	<b>24.0 in.</b>	<b>24.0 in.</b>





AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Small Photos

Mainline ID: <b>18"RCP Honeycut Ramp</b>	City: <b>Fort Bragg,NC</b>	Address: <b>Honeycut Ramp</b>	Project name: <b>Fort Bragg</b>
Start date/time: <b>6/1/2023 8:33 AM</b>	Asset length: <b>162.6 ft.</b>	Weather: <b>Dry</b>	Operator: <b>Adam</b>
Upstream node: <b>up5</b>	Depth US:	Downstream node: <b>DN2</b>	Depth DS:
Pipe shape: <b>Circular</b>	Pipe material: <b>Concrete Reinforced</b>	Pipe height: <b>24.0 in.</b>	Pipe width: <b>24.0 in.</b>
Comments:			

## Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
9.1 ft.	U	153.5 ft.	12 /	Crack			



37.5 ft. U / Junction Box



## Observations

Distance	Dir.	Length	From/To	Code	Modifier/Severity	Rating	Comments
----------	------	--------	---------	------	-------------------	--------	----------

97.8 ft. U / Junction Box



102.5 ft. U / Pipe Size

24-18



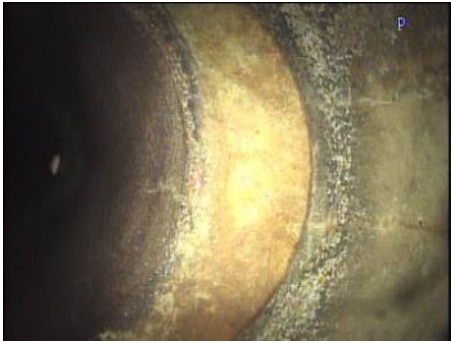
133.7 ft. U 6 / Crack



## Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
----------	------	--------	--------------	-------------------	--------	----------

162.6 ft. U / Joint - Separated



162.6 ft. U / Abandoned Survey



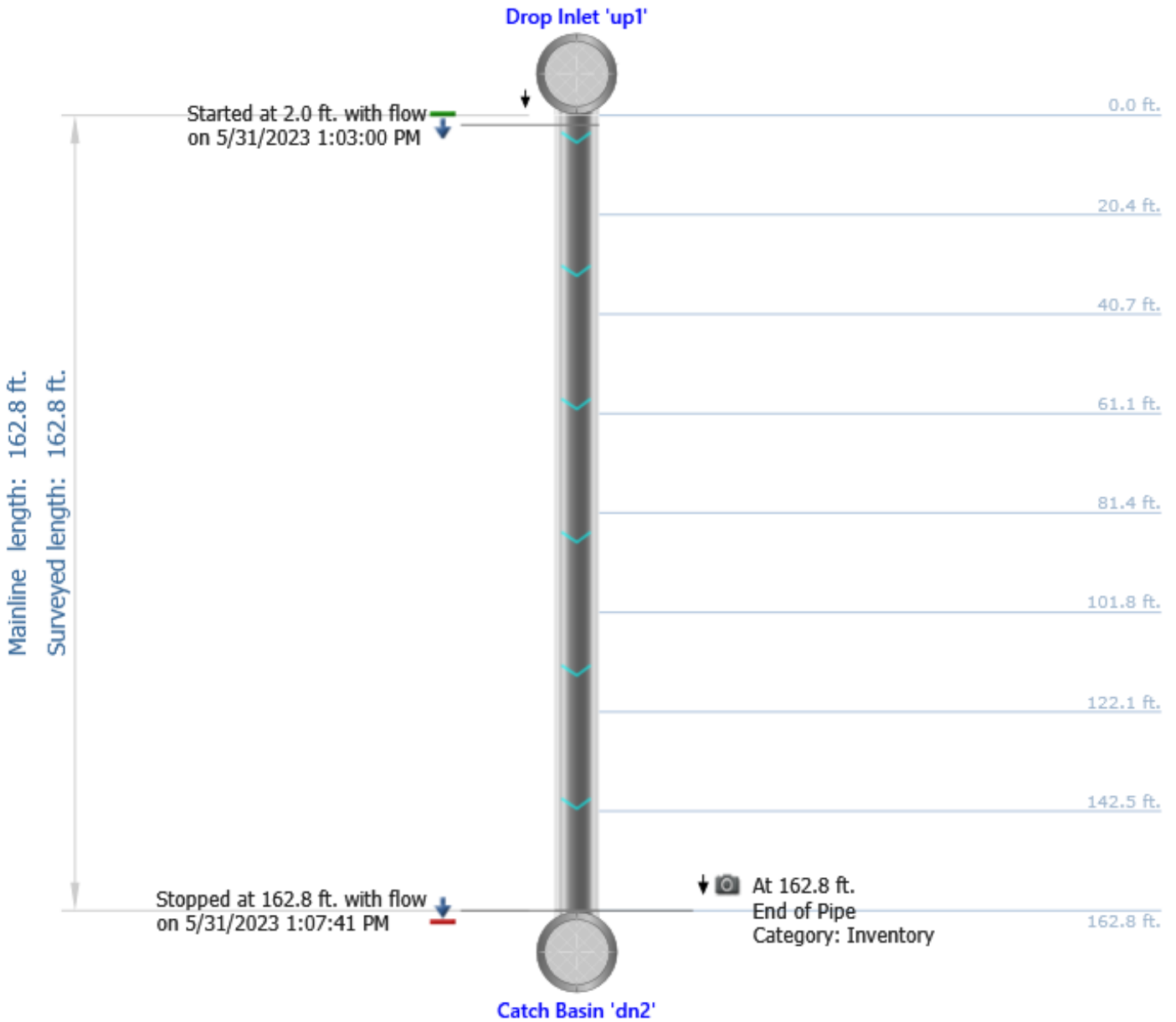
## Inspection's photos



AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Pipe Run

Project name:	Mainline ID:	City:	Address:
<b>Fort Bragg</b>	<b>24"CMP 558+50</b>	<b>Fort Bragg, NC</b>	<b>All American Freeway</b>
Start date/time:	Direction:	Weather:	Surface condition:
<b>5/31/2023 1:03 PM</b>	<b>With the flow</b>	<b>Dry</b>	<b>Asphalt</b>
Pipe shape:	Pipe material:	Pipe height:	Pipe width:
<b>Circular</b>	<b>Corrugated</b>	<b>18.0 in.</b>	<b>18.0 in.</b>





AET Services, LLC  
 623 Rices Creek Road  
 Liberty, SC 29657  
 2504 River Road  
 Piedmont, SC 29673  
 844-8TOPGUN

## Main Inspections Small Photos

Mainline ID: <b>24" CMP 558+50</b>	City: <b>Fort Bragg, NC</b>	Address: <b>All American Freeway</b>	Project name: <b>Fort Bragg</b>
Start date/time: <b>5/31/2023 1:03 PM</b>	Asset length: <b>162.8 ft.</b>	Weather: <b>Dry</b>	Operator: <b>Adam</b>
Upstream node: <b>up1</b>	Depth US:	Downstream node: <b>dn2</b>	Depth DS:
Pipe shape: <b>Circular</b>	Pipe material: <b>Corrugated</b>	Pipe height: <b>18.0 in.</b>	Pipe width: <b>18.0 in.</b>
Comments:			

### Observations

Distance	Dir.	Length	From/To Code	Modifier/Severity	Rating	Comments
162.8 ft.	D		/ End of Pipe			



### Inspection's photos



## **Appendix F**

# **Building & Earth Boring Logs from 12/2017**

**All American Freeway Near Honeycutt Road**

Roadway Subsurface Investigation  
Fort Bragg, North Carolina

---



## SOIL CLASSIFICATION METHODOLOGY

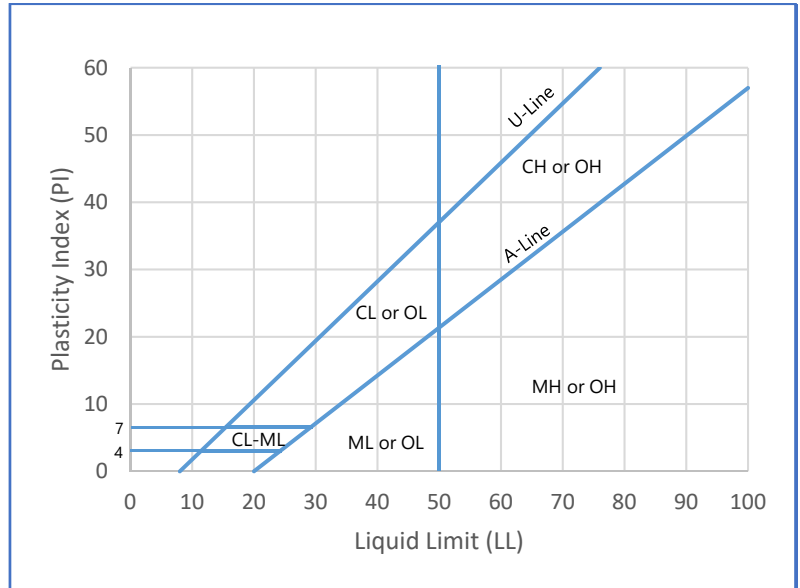
Major Divisions			Symbols		Group Name & Typical Description
			Lithology	Group	
<b>Coarse Grained Soils</b>  More than 50% of material is larger than No. 200 sieve size	<b>Gravel and Gravelly Soils</b>  More than 50% of coarse fraction is larger than No. 4 sieve	<b>Clean Gravels</b>  (Less than 5% fines)		<b>GW</b>	Well-graded gravels, gravel – sand mixtures, little or no fines
				<b>GP</b>	Poorly-graded gravels, gravel – sand mixtures, little or no fines
		<b>Gravels with Fines</b>  (More than 12% fines)		<b>GM</b>	Silty gravels, gravel – sand – silt mixtures
				<b>GC</b>	Clayey gravels, gravel – sand – clay mixtures
	<b>Sand and Sandy Soils</b>  More than 50% of coarse fraction is smaller than No. 4 sieve	<b>Clean Sands</b>  (Less than 5% fines)		<b>SW</b>	Well-graded sands, gravelly sands, little or no fines
				<b>SP</b>	Poorly-graded sands, gravelly sands, little or no fines
		<b>Sands with Fines</b>  (More than 12% fines)		<b>SM</b>	Silty sands, sand – silt mixtures
				<b>SC</b>	Clayey sands, sand – clay mixtures
<b>Fine Grained Soils</b>  More than 50% of material is smaller than No. 200 sieve size	<b>Silts and Clays</b>  Liquid Limit less than 50	<b>Inorganic</b>		<b>ML</b>	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity
				<b>CL</b>	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		<b>Organic</b>		<b>OL</b>	Organic silts and organic silty clays of low plasticity
	<b>Silts and Clays</b>  Liquid Limit greater than 50 sieve	<b>Inorganic</b>		<b>MH</b>	Inorganic silts, micaceous or diatomaceous fine sand, or silty soils
				<b>CH</b>	Inorganic clays of high plasticity
		<b>Organic</b>		<b>OH</b>	Organic clays of medium to high plasticity, organic silts
<b>Highly Organic Soils</b>				<b>PT</b>	Peat, humus, swamp soils with high organic contents

Table 1: Soil Classification Chart (based on ASTM D2487)



## SOIL CLASSIFICATION METHODOLOGY

Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.





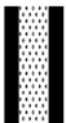





**Figure 1: Plasticity Chart (based on ASTM D2487)**

Non-cohesive: Coarse-Grained Soil		Cohesive: Fine-Grained Soil				
SPT Penetration (blows/foot)		Relative Density	SPT Penetration (blows/foot)		Consistency	Estimated Range of Unconfined Compressive Strength (tsf)
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

**Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)**





\* - Modified based on 80% hammer efficiency

 Standard Penetration Test ASTM D1586 or AASHTO T-206	 Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
 Shelby Tube Sampler ASTM D1587	 No Sample Recovery
 Rock Core Sample ASTM D2113	 Groundwater at Time of Drilling
 Auger Cuttings	 Groundwater as Indicated

**Table 1: Symbol Legend**

Soil	Particle Size	U.S. Standard
<b>Boulders</b>	Larger than 300 mm	N.A.
<b>Cobbles</b>	300 mm to 75 mm	N.A.
<b>Gravel</b>	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
<b>Sand</b>	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
<b>Fines</b>	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

**Table 2: Standard Sieve Sizes**

<b>N-Value</b> 	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.	<b>Atterberg Limits</b> 	A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
<b>Qu</b> 	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).	<b>% Moisture</b> 	Percent natural moisture content in general accordance with ASTM D2216.

**Table 3: Soil Data**

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

**Table 4: Soil Drilling Methods**

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

**Table 5: Descriptors**



<b>Manual Hammer</b>	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
<b>Automatic Trip Hammer</b>	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
<b>Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399</b>	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

**Table 6: Sampling Methods**

<b>Non-plastic</b>	A 1/8-inch thread cannot be rolled at any water content.
<b>Low</b>	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
<b>Medium</b>	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
<b>High</b>	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

**Table 7: Plasticity**

<b>Dry</b>	Absence of moisture, dusty, dry to the touch.
<b>Moist</b>	Damp but no visible water.
<b>Wet</b>	Visible free water, usually soil is below water table.

**Table 8: Moisture Condition**

<b>Stratified</b>	Alternating layers of varying material or color with layers at least 1/2 inch thick.
<b>Laminated</b>	Alternating layers of varying material or color with layers less than 1/4 inch thick.
<b>Fissured</b>	Breaks along definite planes of fracture with little resistance to fracturing.
<b>Slickensides</b>	Fracture planes appear polished or glossy, sometimes striated.
<b>Blocky</b>	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
<b>Lensed</b>	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
<b>Homogeneous</b>	Same color and appearance throughout.

**Table 9: Structure**



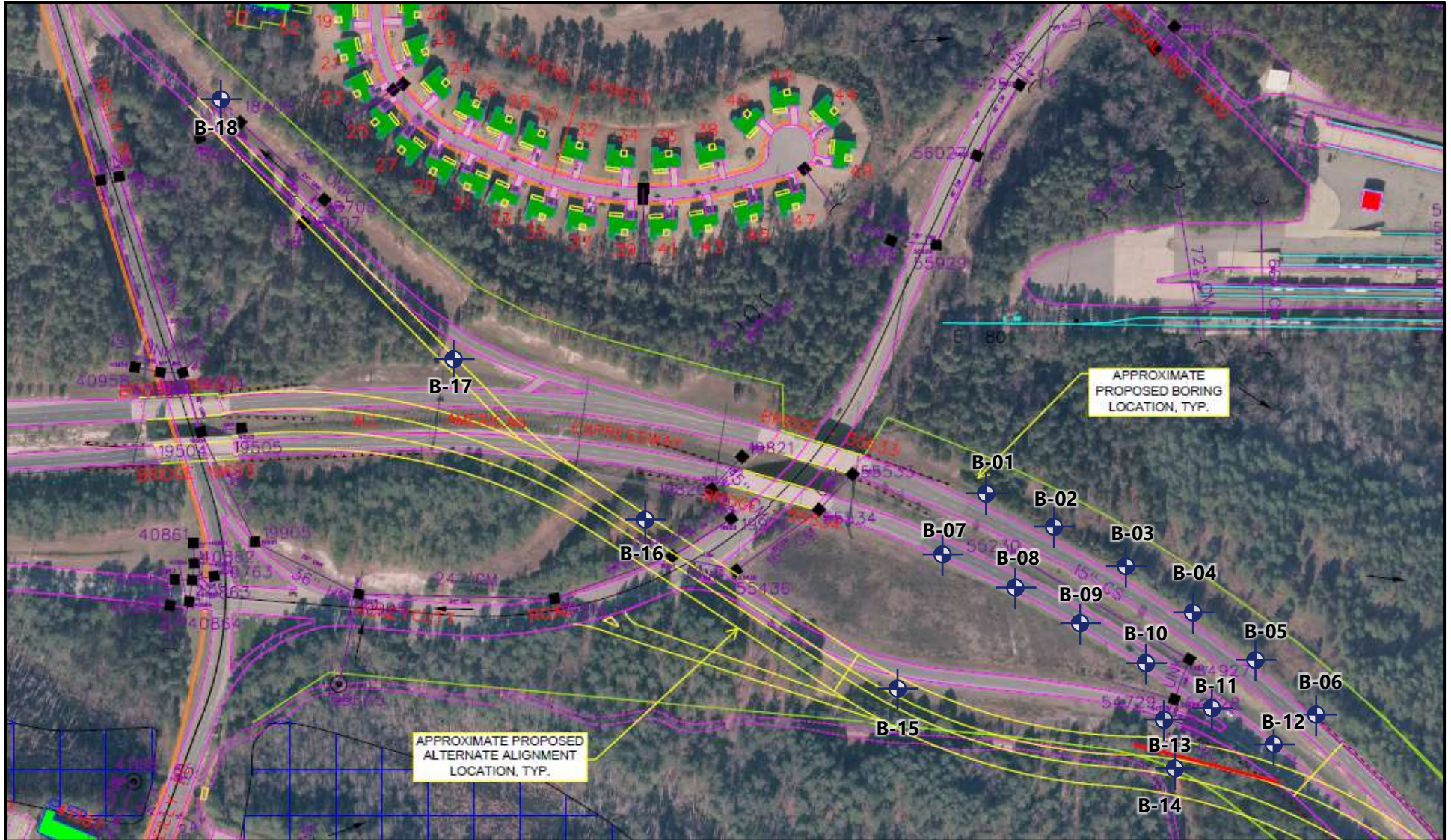
Geotechnical, Environmental, and Materials Engineers

KEY TO HATCHES

Hatch	Description	Hatch	Description	Hatch	Description
	<b>GW</b> - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	<b>GP</b> - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	<b>GM</b> - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	<b>GC</b> - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	<b>SW</b> - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	<b>SP</b> - Poorly-graded sands, gravelly sands, little or no fines		<b>CL-ML</b> - Silty Clay		Gravel with Silt
	<b>SM</b> - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	<b>SC</b> - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	<b>ML</b> - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	<b>CL</b> - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	<b>OL</b> - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	<b>MH</b> - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	<b>CH</b> - Inorganic clays of high plasticity		Weathered Rock		Coral
	<b>OH</b> - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	<b>PT</b> - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock


Table 1: Key to Hatches Used for Boring Logs and Soil Profiles

## **BORING LOCATION PLAN**

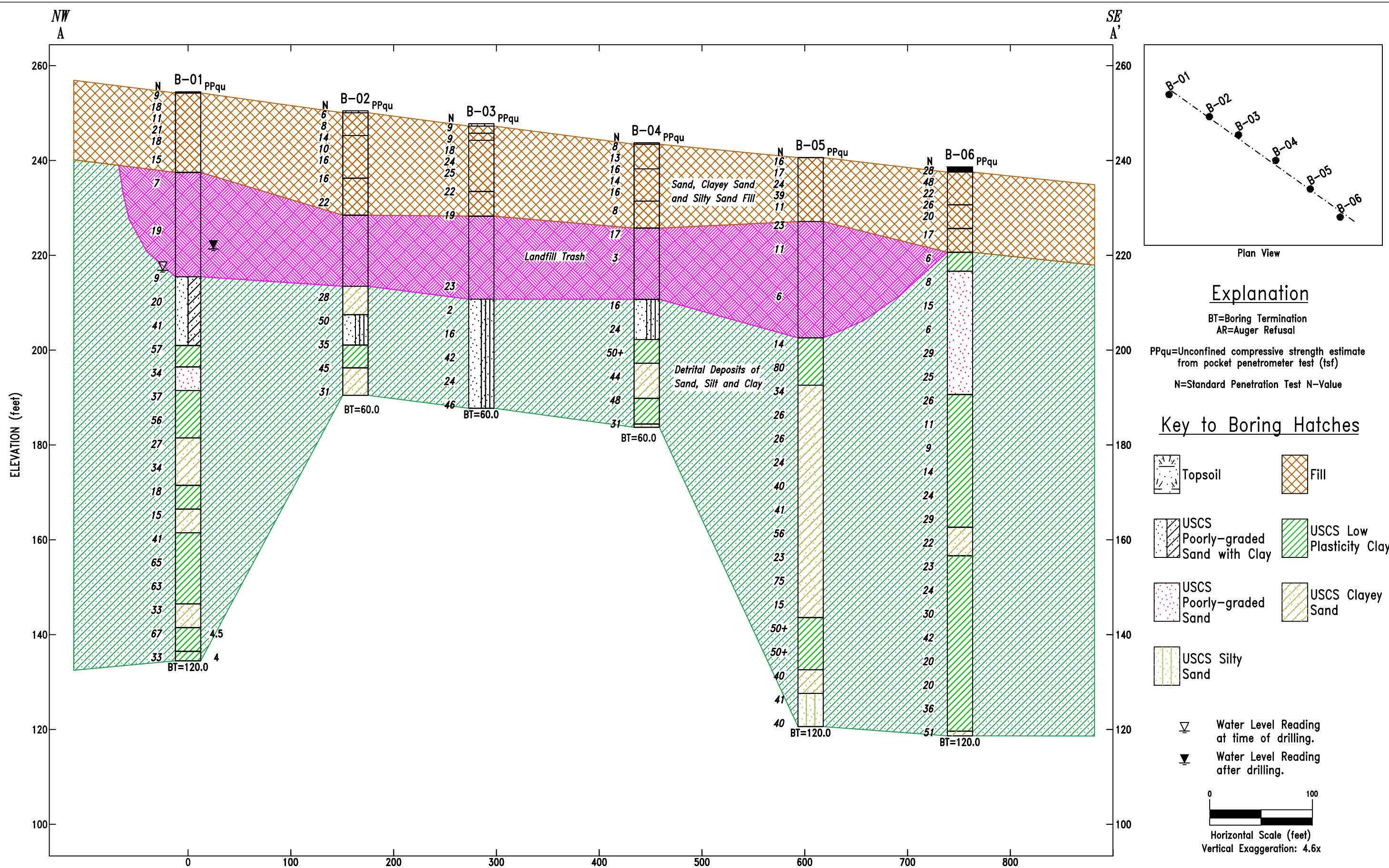



**B-01**  **Approximate Boring Location**

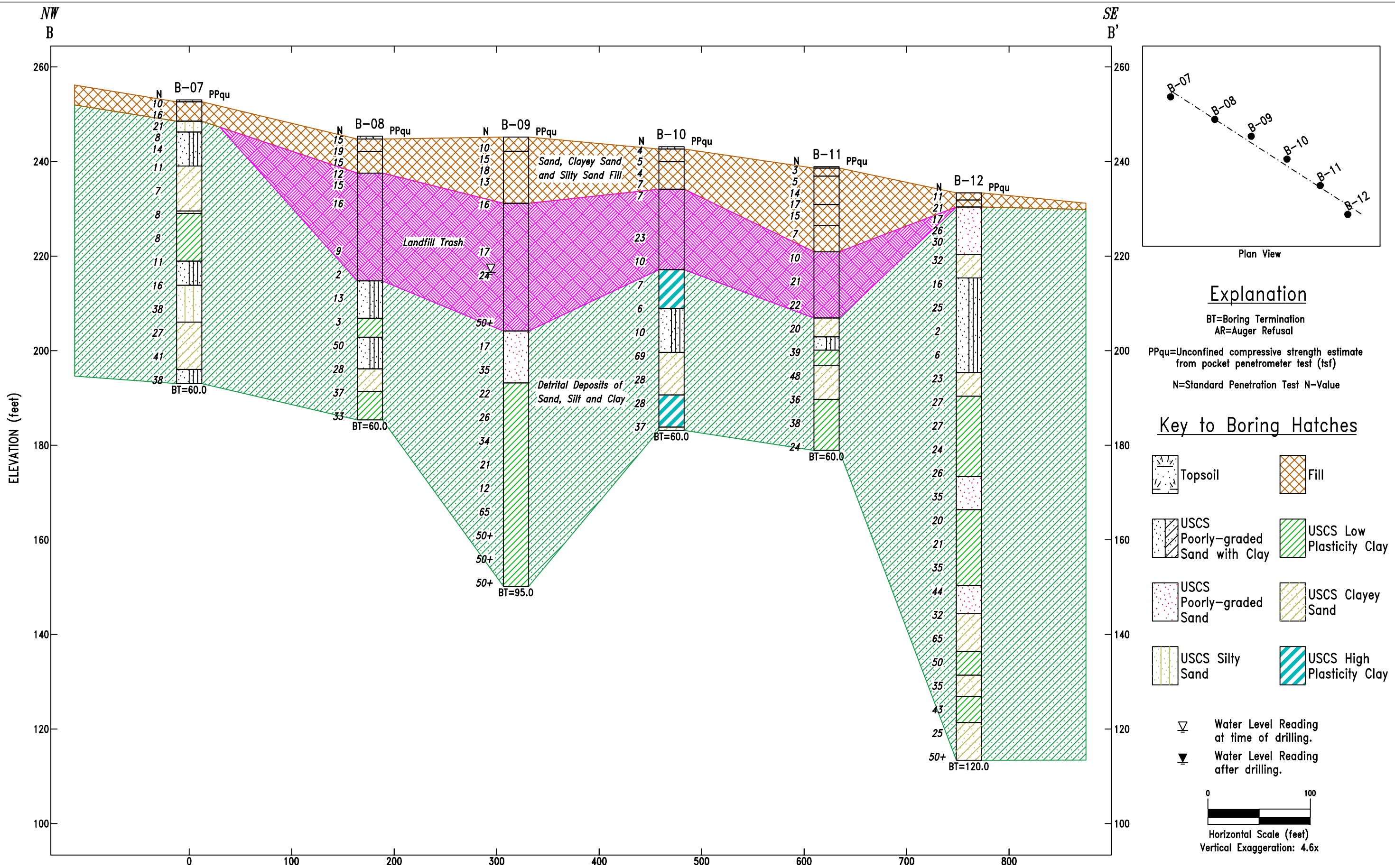
0 150 300  
Approximate Scale (feet) 

<b>Boring Location Map</b>				
	<b>BES Project #:</b>	RD170384	<b>Address:</b>	All American Freeway
	<b>Drawing Source:</b>	Google Earth, Zapata	<b>City:</b>	Fort Bragg, North Carolina
	<b>Client:</b>	Zapata, Inc.	<h1 style="margin: 0;">Figure 1</h1>	
	<b>Project:</b>	Repair All American Freeway		

## **SUBSURFACE SOIL PROFILES**



Date:	Scale:	Project No.:	Project Name/Location:	 Geotechnical, Environmental, and Materials Engineers	Subsurface Profile A-A'
11/29/2017	1"=89' Hor.	RD170384	All American Freeway Repair - Phase I Fort Bragg, North Carolina		



Date:	Scale:	Project No.:	Project Name/Location:	 Geotechnical, Environmental, and Materials Engineers	Subsurface Profile B-B'
11/29/2017	1"=67' Hor.	RD170384	All American Freeway Repair - Phase I Fort Bragg, North Carolina		

## **BORING LOGS**



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

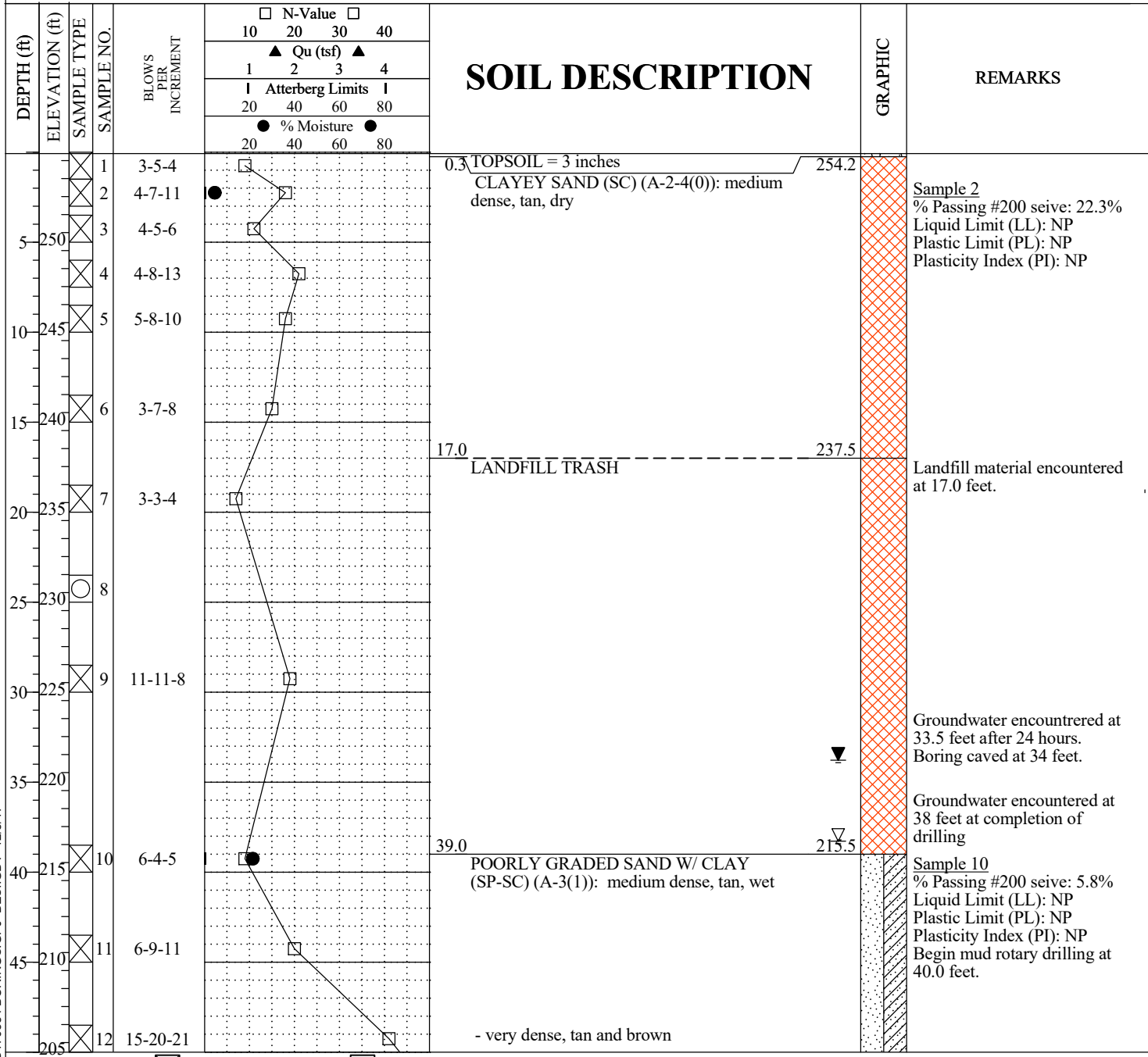
Designation: B-01

Sheet 1 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504076.5587, E2003960.837

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/29/17  
**Weather Conditions:** Clear, 60  
**Surface Elevation:** 254.4654  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 **Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST      **UD** UNDISTURBED



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

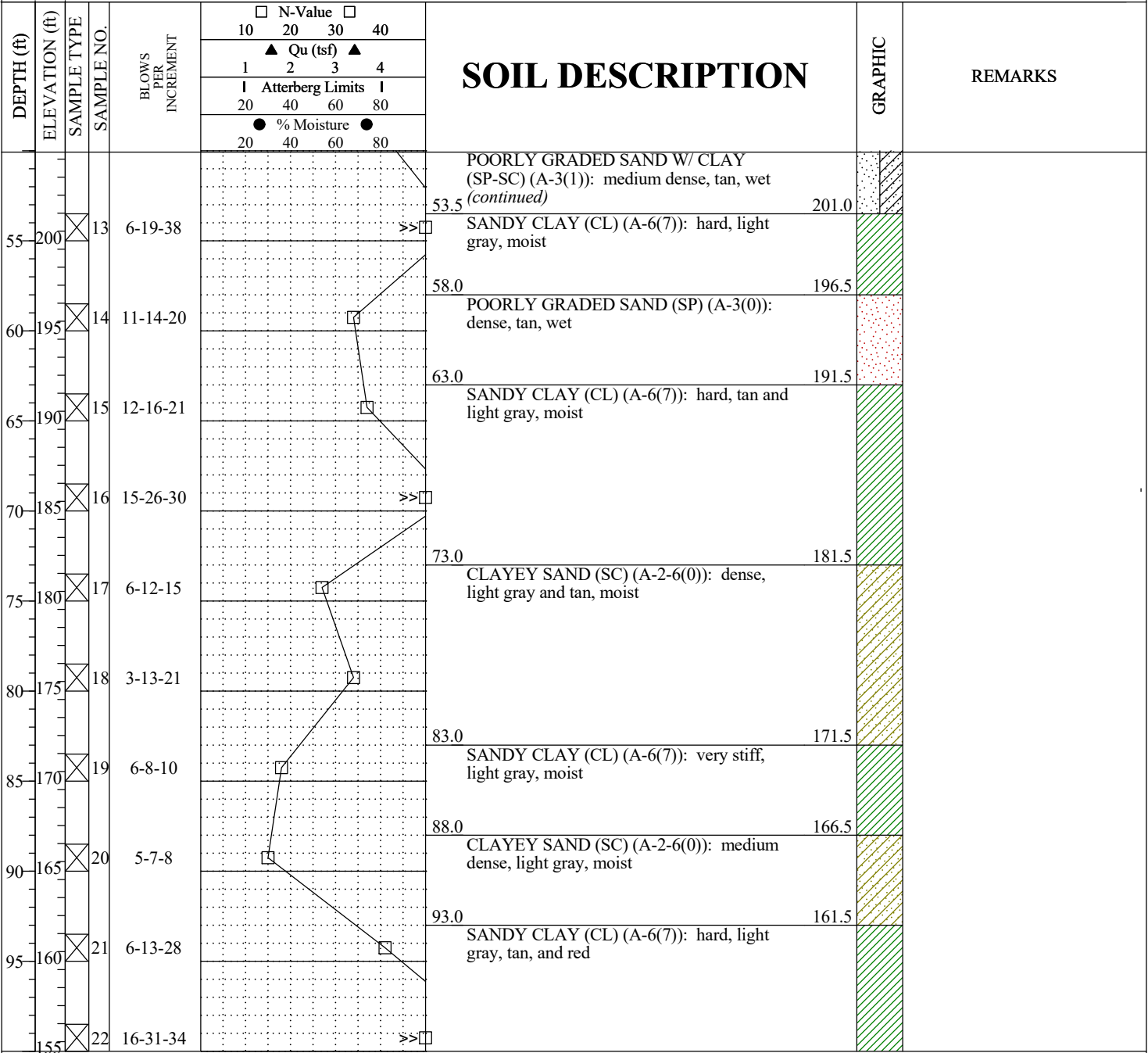
Designation: B-01

Sheet 2 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504076.5587, E2003960.837

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/29/17  
**Weather Conditions:** Clear, 60  
**Surface Elevation:** 254.4654  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-01

Sheet 3 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504076.5587, E2003960.837

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/29/17  
**Weather Conditions:** Clear, 60  
**Surface Elevation:** 254.4654  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40			
05	150	⊗	23	21-30-33	>>				SANDY CLAY (CL) (A-6(7)): hard, light gray, tan, and red (continued)		
10	145	⊗	24	13-16-17				108.0	CLAYEY SAND (SC) (A-2-6(0)): dense, light gray, moist		
15	140	⊗	25	18-27-40				13.0	CLAY (CL) (A-6(7)): hard, light gray, reddish brown		
20	135	⊗	26	10-13-20				18.0	SANDY CLAY (CL) (A-6(7)): hard, light gray, moist		
								20.0	(Residual) Boring terminated 120 feet in Sandy Clay.		
25	130										Consistency / Relative density based on correction factor for automatic hammer Boring backfilled after 24-hour groundwater reading on 10/29/2017.
30	125										
35	120										
40	115										
45	110										

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

Split Spoon       No Recovery  
**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

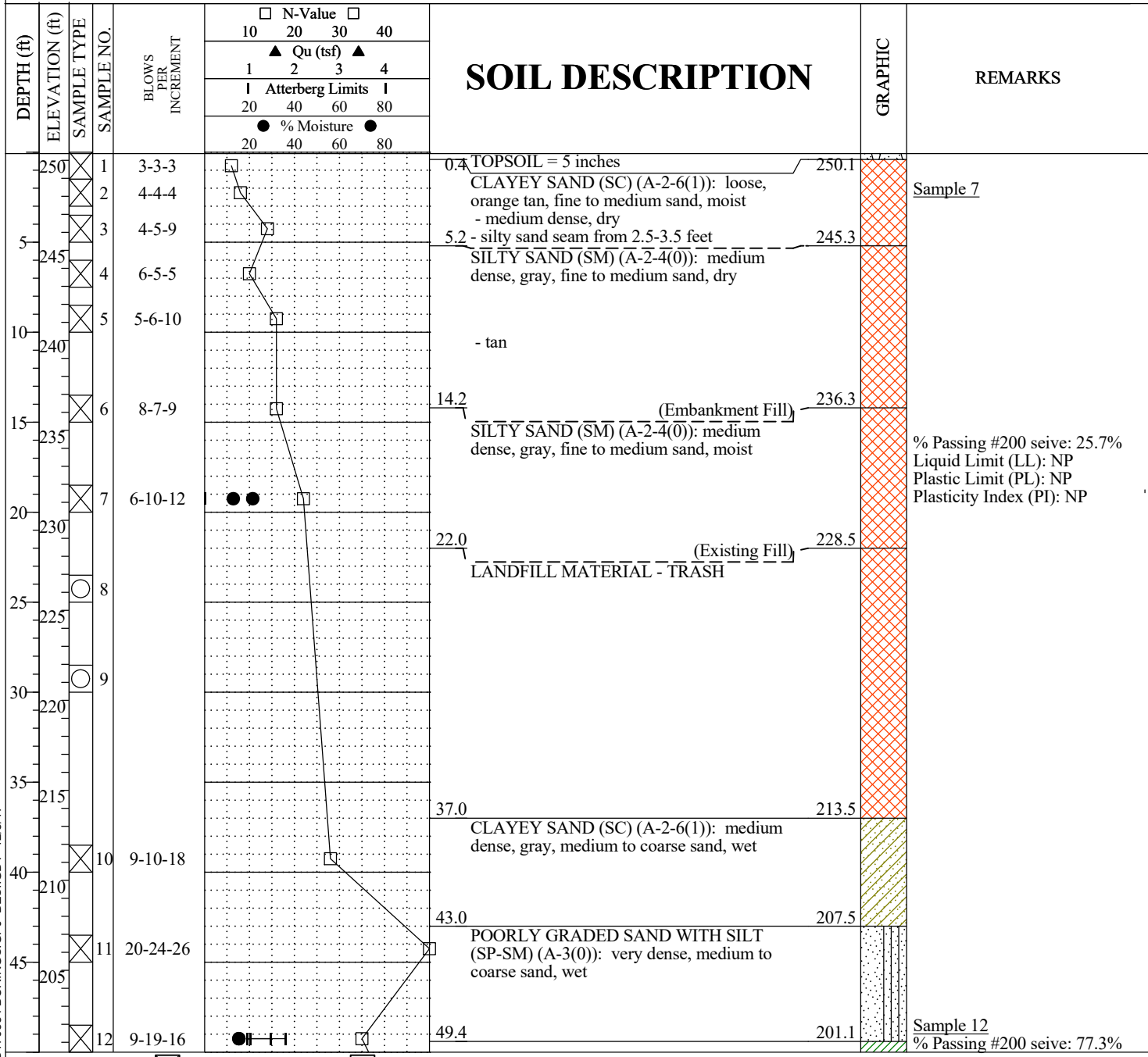
Designation: B-02

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503997.6359, E2004104.535

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/9/17  
**Weather Conditions:** Overcast, 45  
**Surface Elevation:** 250.4518  
**Drill Crew:** MG Drilling  
**Logged By:** KM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

<b>N-VALUE</b> STANDARD PENETRATION RESISTANCE (AASHTO T-206)	<b>REC</b> RECOVERY
<b>% MOISTURE</b> PERCENT NATURAL MOISTURE CONTENT	<b>RQD</b> ROCK QUALITY DESIGNATION
<b>▽</b> GROUNDWATER LEVEL IN THE BOREHOLE	<b>UD</b> UNDISTURBED
<b>Qu</b> UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST	



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-02

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503997.6359, E2004104.535

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/9/17  
**Weather Conditions:** Overcast, 45  
**Surface Elevation:** 250.4518  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40			
					□ N-Value □ 10 20 30 40 ▲ Qu (tsf) ▲ 1 2 3 4   Atterberg Limits   20 40 60 80 ● % Moisture ● 20 40 60 80						
200									LEAN CLAY W/ SAND (CL) (A-4(5)): Hard, fine to medium sand, gray, moist <i>(continued)</i>		Liquid Limit (LL): 36 Plastic Limit (PL): 19 Plasticity Index (PI): 17
55	195	⊗	13	17-21-24				54.2	CLAYEY SAND (SC) (A-2-6(0)): very dense, gray and red orange, fine to coarse sand, wet		
60	190	⊗	14	13-13-18				60.0	- dense (Residual)		Consistency / Relative density based on correction factor for automatic hammer
									Boring terminated at 60.0 feet in Clayey Sand.		Groundwater was not encountered at the time of drilling Boring backfilled on 11/09/2017
65	185										
70	180										
75	175										
80	170										
85	165										
90	160										
95	155										

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

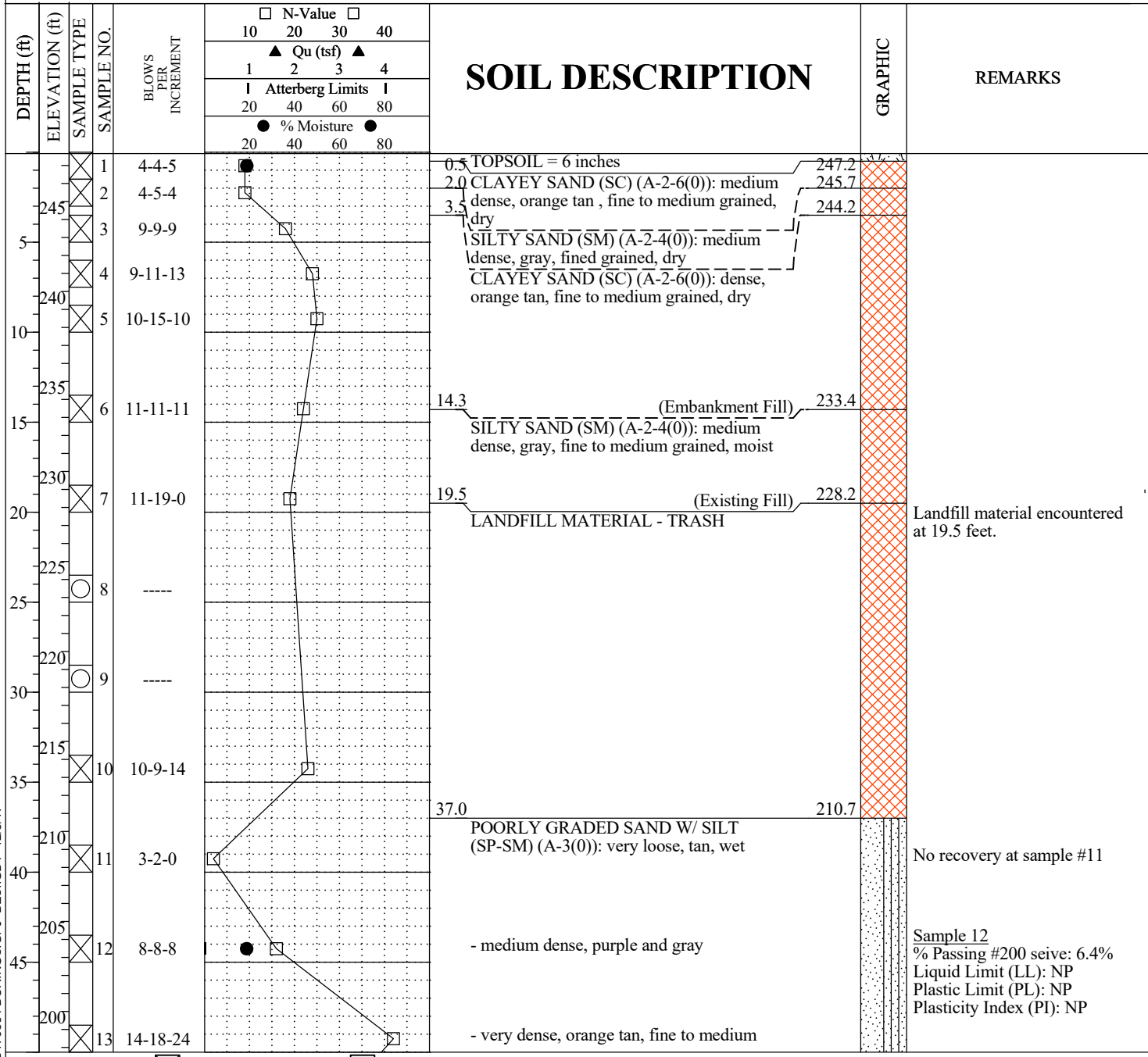
Designation: B-03

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503932.6027, E2004208.657

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/8/17  
**Weather Conditions:** Rain, 50  
**Surface Elevation:** 247.7358  
**Drill Crew:** MG Drilling  
**Logged By:** KM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-03

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503932.6027, E2004208.657

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/8/17  
**Weather Conditions:** Rain, 50  
**Surface Elevation:** 247.7358  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4		20	40	60	80			
55	195	Split Spoon	14	11-11-13														grained, moist POORLY GRADED SAND W/ SILT (SP-SM) (A-3(0)): very loose, tan, wet (continued) - dense		
60	190	Split Spoon	15	12-22-24														- very dense, gray, moist 60.0 (Residual) 187.7		Consistency / Relative density based on correction factor for automatic hammer
Boring terminated at 60.0 feet in Poorly Graded Sand.																				
Groundwater was not encountered at time of drilling Boring backfilled on 11/10/2017																				

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-04

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503841.4701, E2004341.292

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/9/17  
**Weather Conditions:** Overcast, 45  
**Surface Elevation:** 243.7134  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture				SOIL DESCRIPTION	GRAPHIC	REMARKS		
					10	20	30	40	1	2	3	4		20	40	60	80				20	40
55	190	⊗	14	15-22-26	●	—	—	—	—	—	—	—	—	—	—	—	—	53.9	189.8	CLAYEY SAND (SC) (A-2-6): very dense, orange and tan, fine to medium grained, moist (continued)	Sample 14	% Passing #200 sieve: 73.2% Liquid Limit (LL): 42 Plastic Limit (PL): 21 Plasticity Index (PI): 21
60	185	⊗	15	12-12-19	—	—	—	—	—	—	—	—	—	—	—	—	—	59.3	184.4	SANDY LEAN CLAY (CL) (A-4(0)): hard, gray, fine to medium grained, moist	Consistency / Relative density based on correction factor for automatic hammer	Groundwater was not encountered at time of drilling Boring backfilled on 11/10/2017
60	185	⊗	15	12-12-19	—	—	—	—	—	—	—	—	—	—	—	—	60.0	183.7	CLAYEY SAND (SC) (A-2-6): dense, gray, fine to course grained, wet (Residual) Boring terminated at 60.0 feet in Clayey Sand.			

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

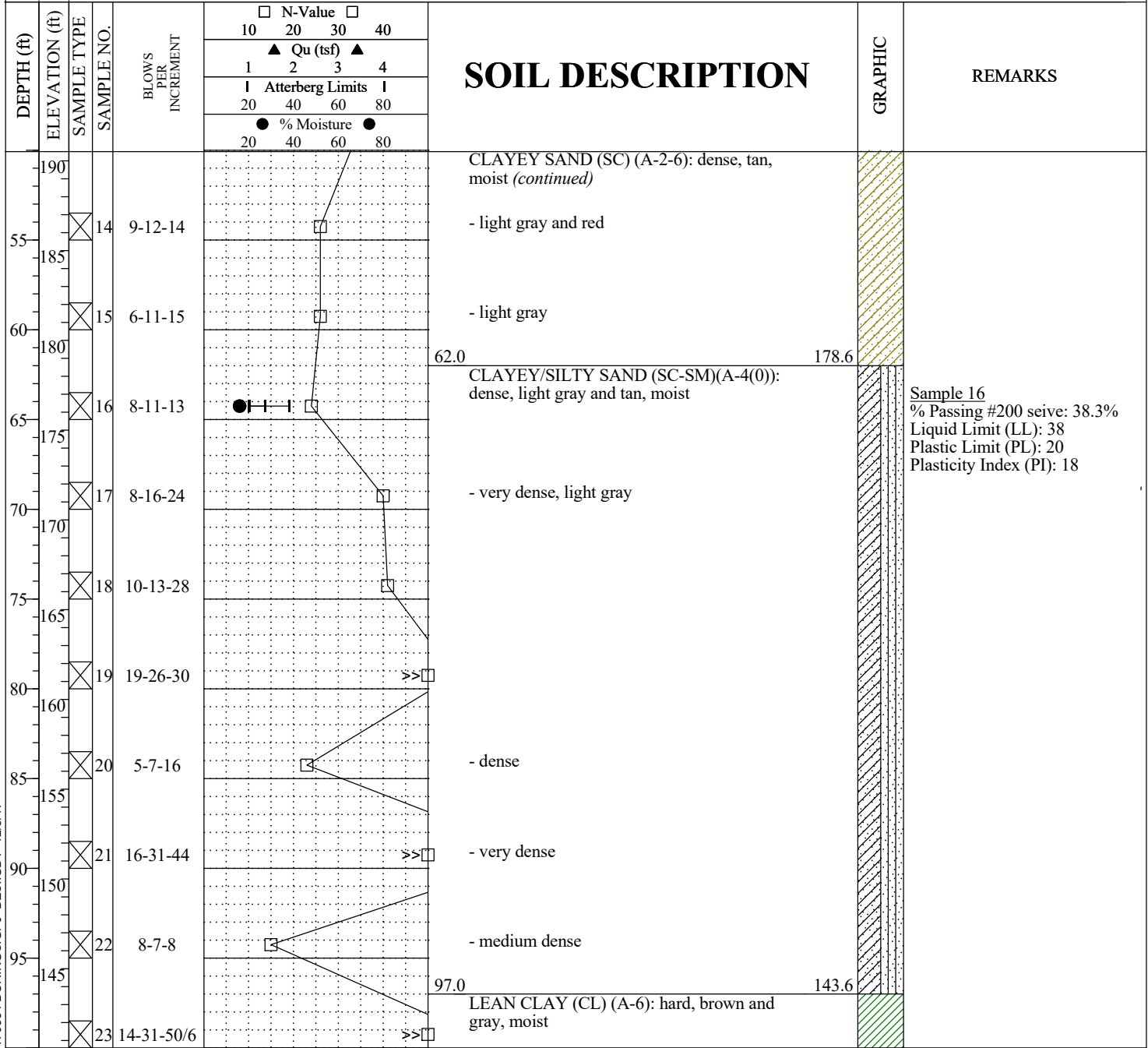
Designation: B-05

Sheet 2 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503739.5887, E2004464.491

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/25/17  
**Weather Conditions:** Clear, 60  
**Surface Elevation:** 240.5904  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST







Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-06

Sheet 2 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503638.9624, E2004571.216

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/23/17  
**Weather Conditions:** Stormy  
**Surface Elevation:** 238.6326  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40			
					□ N-Value □ 10 20 30 40 ▲ Qu (tsf) ▲ 1 2 3 4   Atterberg Limits   20 40 60 80 ● % Moisture ● 20 40 60 80						
55	185	14	4-3-8						LEAN CLAY (CL) (A-6): hard, tan w/ trace sand, moist (continued)		
									- stiff, light gray		
60	180	15	4-4-5								
65	175	16	4-7-7								
									- very stiff		
70	170	17	7-9-15								
									- hard		
75	165	18	9-9-20								
									76.0	162.6	
80	160	19	5-10-12						CLAYEY SAND (SC) (A-2-6): medium dense, light gray, moist		
85	155	20	5-9-14								
90	150	21	5-11-13								
95	145	22	5-10-20								
	140	23	8-14-28								

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-06

Sheet 3 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503638.9624, E2004571.216

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/23/17  
**Weather Conditions:** Stormy  
**Surface Elevation:** 238.6326  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				SOIL DESCRIPTION	GRAPHIC	REMARKS	
					10	20	30	40	1	2	3	4				
					Atterberg Limits				% Moisture							
					20	40	60	80	20	40	60	80				
05	135	⊗	24	7-12-8									LEAN CLAY (CL) (A-6): very stiff, reddish brown and light gray, moist (continued)			
													- very stiff, dark gray and brown, moist			
10	130	⊗	25	8-10-10									- light gray			
15	125	⊗	26	9-15-21									- hard, light gray and red			
20	120	⊗	27	15-25-26									CLAYEY SAND (SC) (A-2-6): very dense, light gray, moist		Consistency / Relative density based on correction factor for automatic hammer	
													(Residual)			
													Boring terminated at 120.0 feet in Clayey Sand.		Groundwater was not encountered at time of drilling Boring backfilled on 10/23/2017	

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDIT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY

**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION

**∇** GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED

**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-07

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503991.7784, E2003772.874

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/8/17  
**Weather Conditions:** Rain, 50  
**Surface Elevation:** 253.0249  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture	SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4					
55	195	Split Spoon	14	12-20-21										CLAYEY SAND (SC) (A-2-6): dense, gray and purple, fine to medium grained, moist (continued) - very dense			
60	190	Split Spoon	15	9-16-22									POORLY GRADED SAND W/ SILT (SP-SM) (A-3(0)): dense, tan, medium grained, wet Boring terminated at 60.0 feet in Poorly Graded Sand.		Consistency / Relative density based on correction factor for automatic hammer		
65	185																
70	180																
75	175																
80	170																
85	165																
90	160																
95	155																

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST

Birmingham, AL ■ Huntsville, AL ■ Auburn, AL ■ Montgomery, AL ■ Columbus, GA

Raleigh, NC ■ Tulsa, OK ■ Little Rock, AR ■ Springdale, AR ■ New Orleans, LA ■ Louisville, KY

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

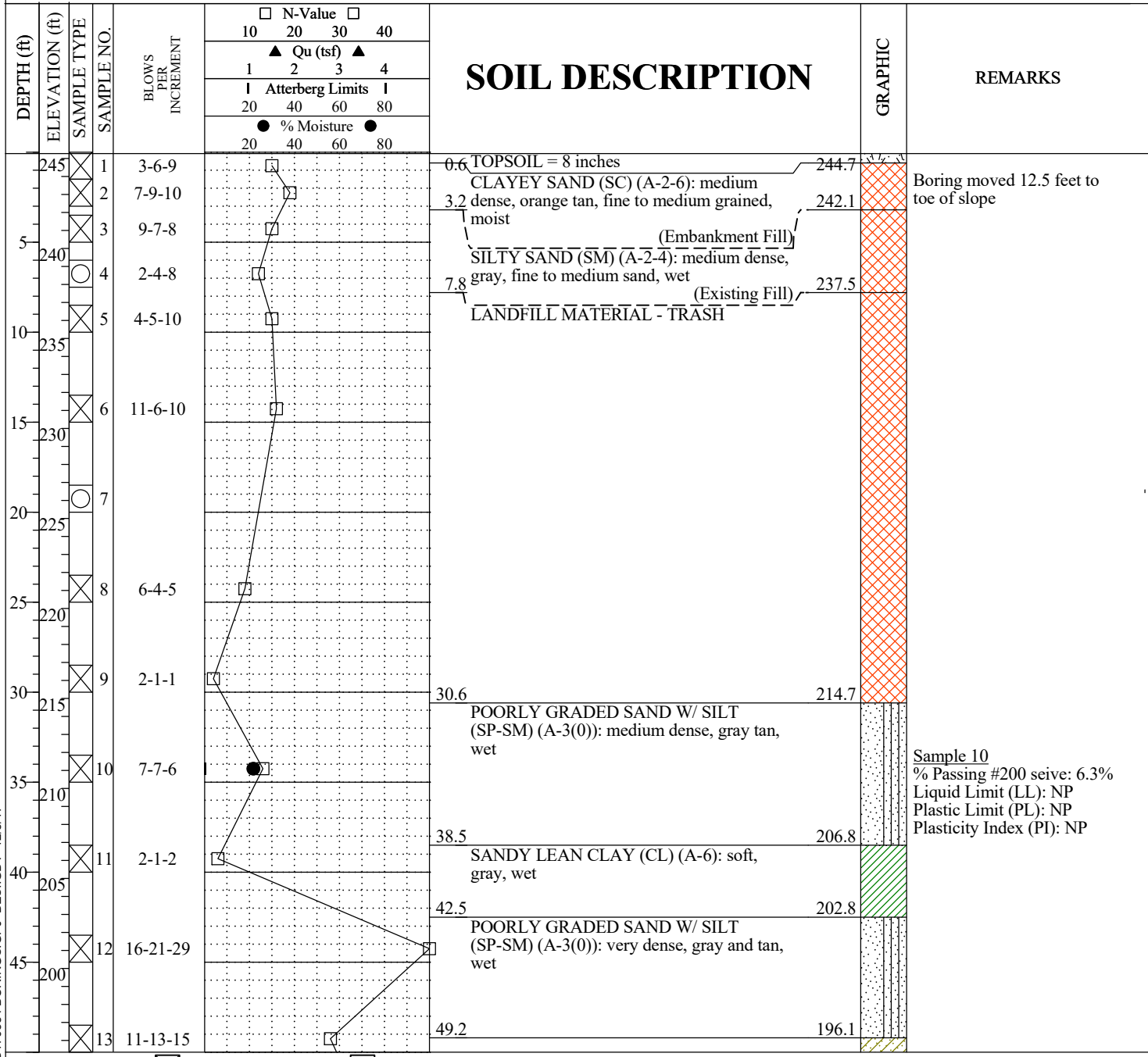
Designation: B-08

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503911.1826, E2003930.769

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/8/17  
**Weather Conditions:** Rain, 50  
**Surface Elevation:** 245.3479  
**Drill Crew:** MG Drilling  
**Logged By:** KM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE    ⊗ Split Spoon    ⊙ No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 ▽ GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-08

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503911.1826, E2003930.769

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/8/17  
**Weather Conditions:** Rain, 50  
**Surface Elevation:** 245.3479  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture	SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4					
195																	
55	190	⊗	14	9-14-23											54.0	191.3	CLAYEY SAND (SC) (A-2-6): dense, purple and tan, fine to medium grained, wet (continued)
60	185	⊗	15	14-16-17											60.0	185.3	SANDY LEAN CLAY (CL) (A-6): hard, orange and gray, fine to medium grained, moist
																	(Residual)
																	Boring terminated at 61.0 feet in Sandy Lean Clay.
65	180																
70	175																
75	170																
80	165																
85	160																
90	155																
95	150																

Consistency / Relative density based on correction factor for automatic hammer

Groundwater was not encountered at time of drilling  
Boring backfilled on 11/10/2017

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDGT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206) **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

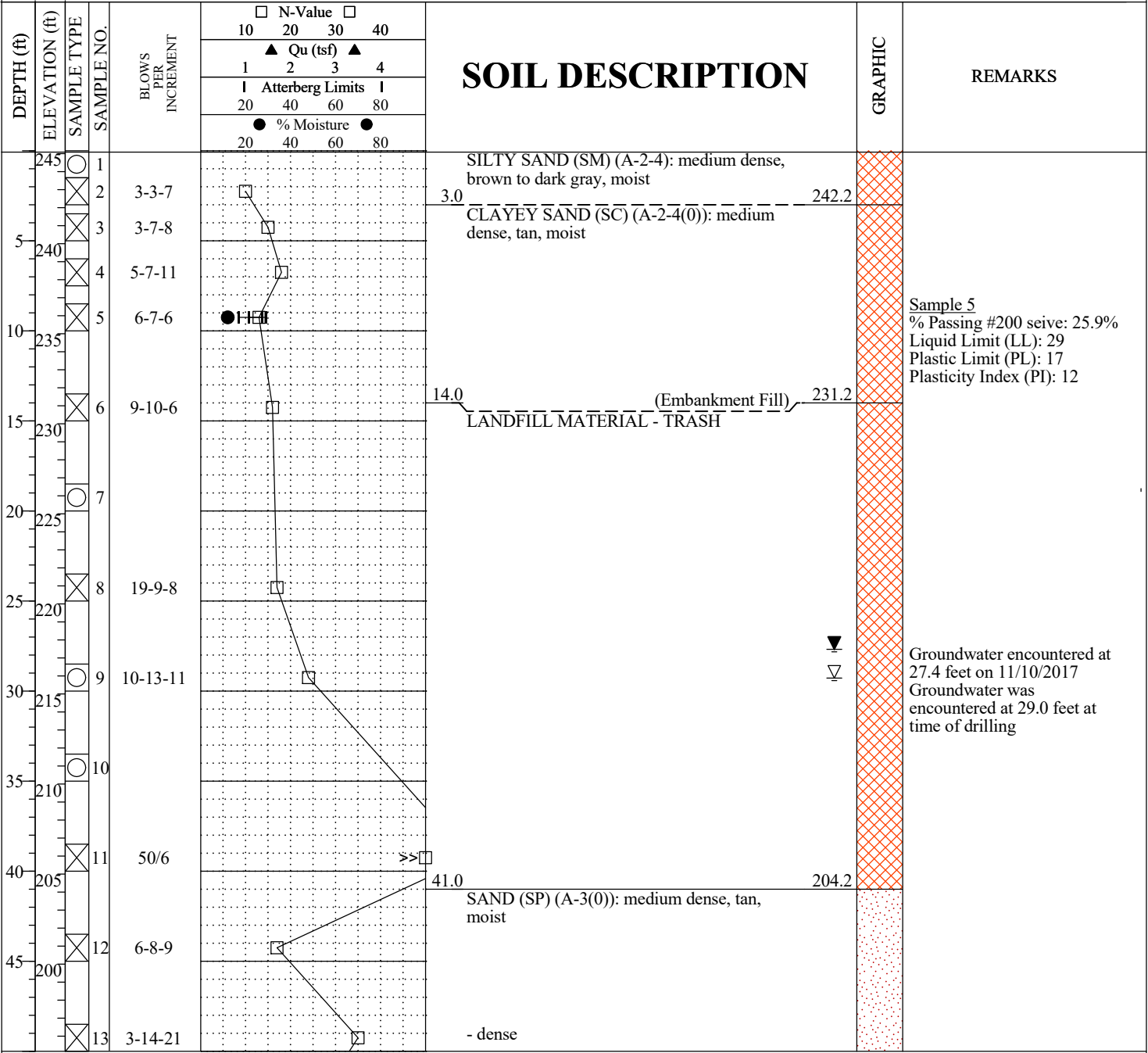
Designation: B-09

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503850.6842, E2004061.415

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/31/17  
**Weather Conditions:** Sunny, warm  
**Surface Elevation:** 245.1597  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE ○ No Recovery ⊗ Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 ∇ GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

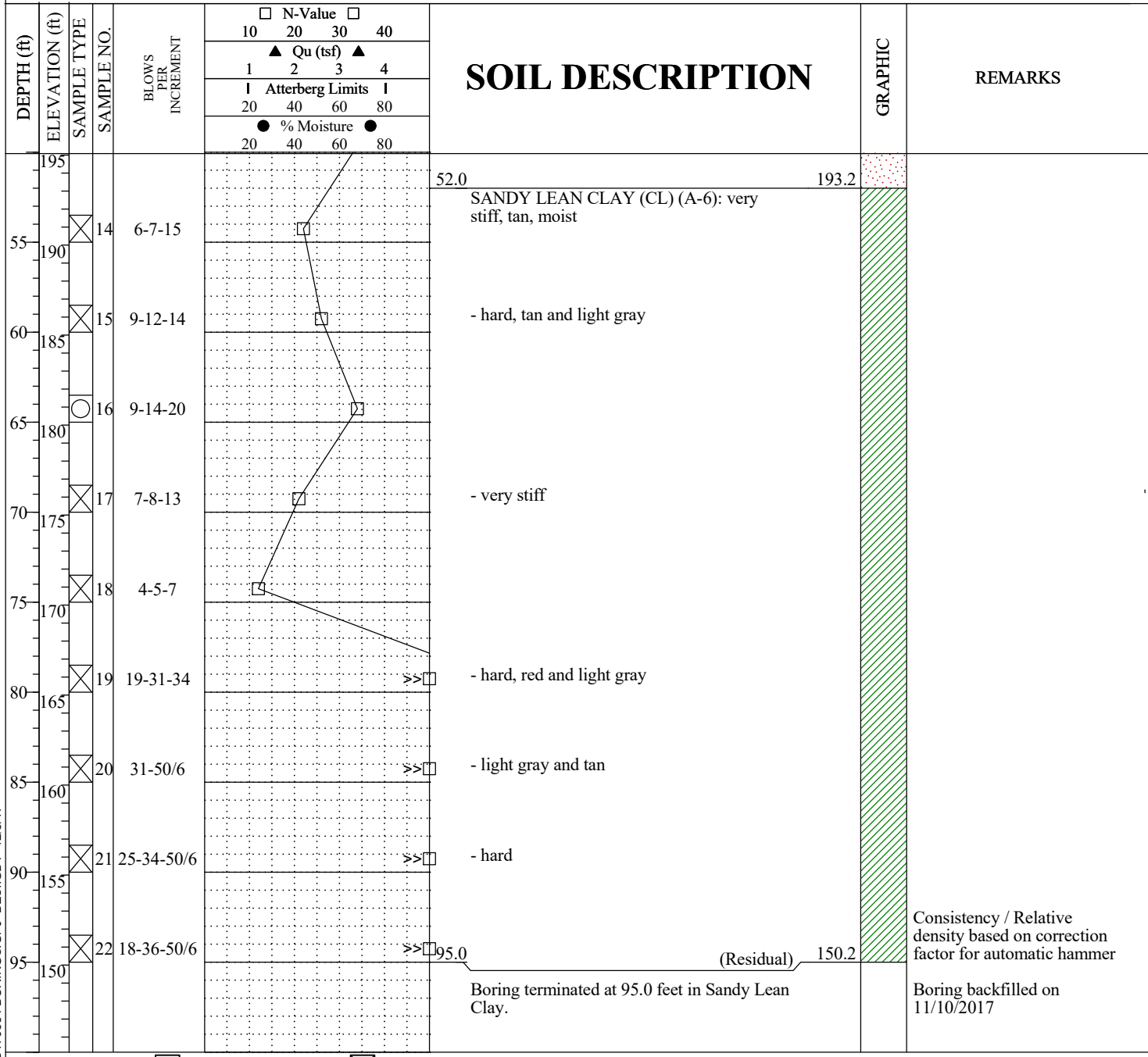
Designation: B-09

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503850.6842, E2004061.415

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/31/17  
**Weather Conditions:** Sunny, warm  
**Surface Elevation:** 245.1597  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDGT 12/8/17

SAMPLE TYPE  No Recovery  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST

Consistency / Relative density based on correction factor for automatic hammer  
 Boring backfilled on 11/10/2017

Birmingham, AL ■ Huntsville, AL ■ Auburn, AL ■ Montgomery, AL ■ Columbus, GA

Raleigh, NC ■ Tulsa, OK ■ Little Rock, AR ■ Springdale, AR ■ New Orleans, LA ■ Louisville, KY









Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-11

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503674.3361, E2004308.206

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/9/17  
**Weather Conditions:** Overcast, 45  
**Surface Elevation:** 238.9011  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture	SOIL DESCRIPTION	GRAPHIC	REMARKS		
					10	20	30	40	1	2	3	4							
55	185	⊗	14	12-18-20											SANDY LEAN CLAY (CL) (A-6): hard, gray w/ fine sand, moist (continued)	[Green Hatched Box]	Consistency / Relative density based on correction factor for automatic hammer		
60	180	⊗	15	8-12-12															
					60.0 (Residual) 178.9													Boring terminated at 60.0 feet in Sandy Lean Clay.	
Boring backfilled on 11/09/2017																			

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-12

Sheet 1 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503570.9498, E2004406.831

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/27/17  
**Weather Conditions:** Clear, cool  
**Surface Elevation:** 233.3615  
**Drill Crew:** MG Drilling  
**Logged By:** KM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture	SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4					
230	231.9	⊗	1	2-5-6										1.5	SAND (SP): medium dense, redish tan, moist		
230	230.4	⊗	2	8-10-11										3.0	CLAYEY SAND (SC) (A-2-6): medium dense, tan, moist (Embankment Fill)		
225		⊗	3	3-5-12											SAND (SP) (A-3(0)): medium dense, tan, moist - dense		
225		⊗	4	8-12-14											- tan and brown		
220	220.4	⊗	5	8-14-16										13.0	CLAYEY SAND (SC) (A-2-6): dense, tan, moist		
215	215.4	⊗	6	5-13-19										18.0	POORLY GRADED SAND W/ SILT (SP-SM) (A-3(0)): medium dense, tan and red, moist		Sample 7 % Passing #200 sieve: 9.9% Liquid Limit (LL): NP Plastic Limit (PL): NP Plasticity Index (PI): NP
210		⊗	7	6-7-9											- dense, brown and tan		
205		⊗	8	4-10-15											- very loose, tan, course grained, moist		Began mud drilling
200		⊗	9	1-1-1											- loose, brown and red		
195	195.4	⊗	10	1-1-5										38.0	CLAYEY SAND (SC) (A-2-6): medium dense, light gray and reddish brown, moist		
190	190.4	⊗	11	10-12-11										43.0	SANDY LEAN CLAY (CL) (A-6): hard, tan and light gray, moist		
185		⊗	12	10-11-16													
		⊗	13	9-12-15													

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

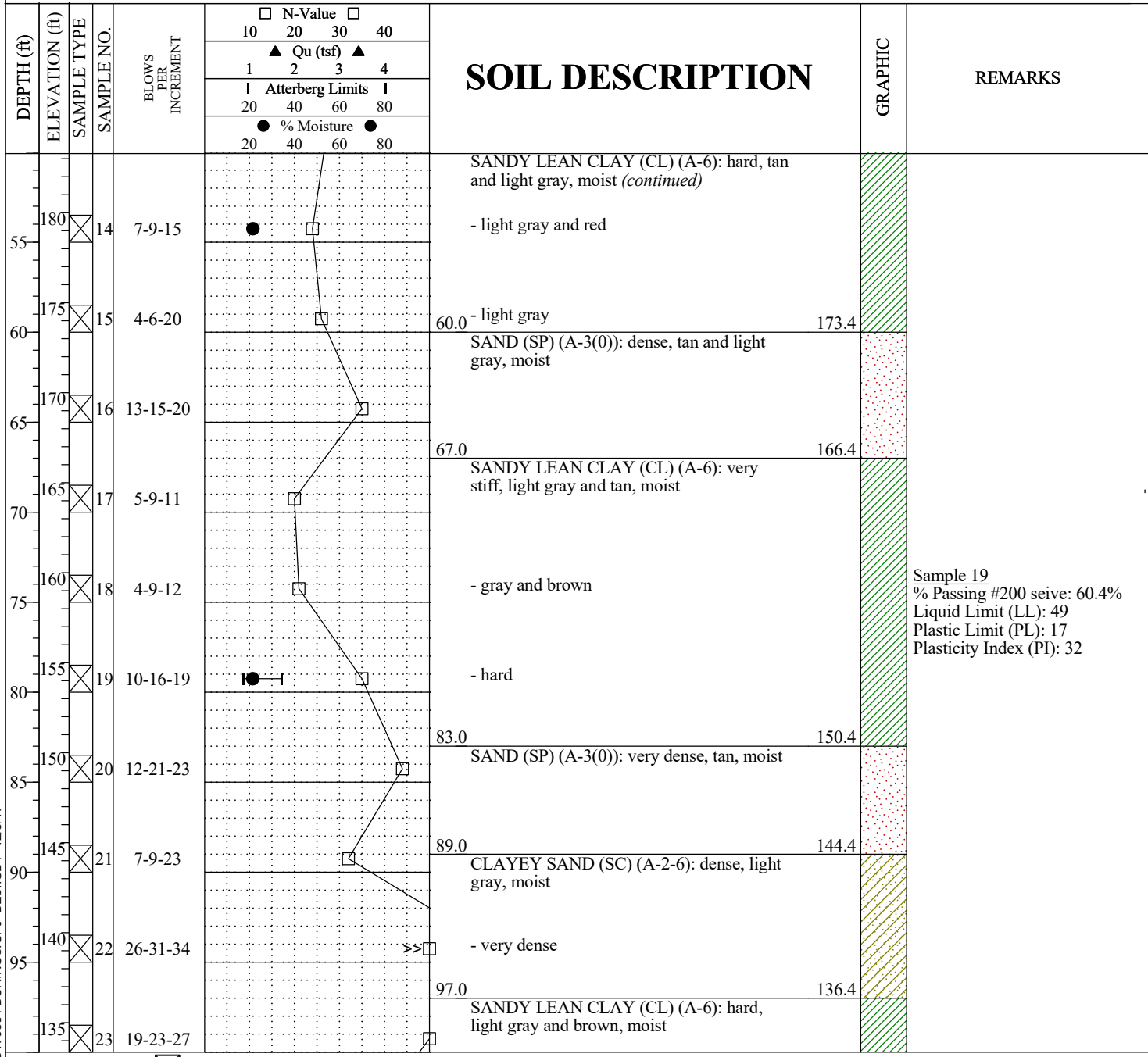
Designation: B-12

Sheet 2 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503570.9498, E2004406.831

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/27/17  
**Weather Conditions:** Clear, cool  
**Surface Elevation:** 233.3615  
**Drill Crew:** MG Drilling  
**Logged By:** KM



Sample 19  
% Passing #200 sieve: 60.4%  
Liquid Limit (LL): 49  
Plastic Limit (PL): 17  
Plasticity Index (PI): 32

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY

**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION

GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED

**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

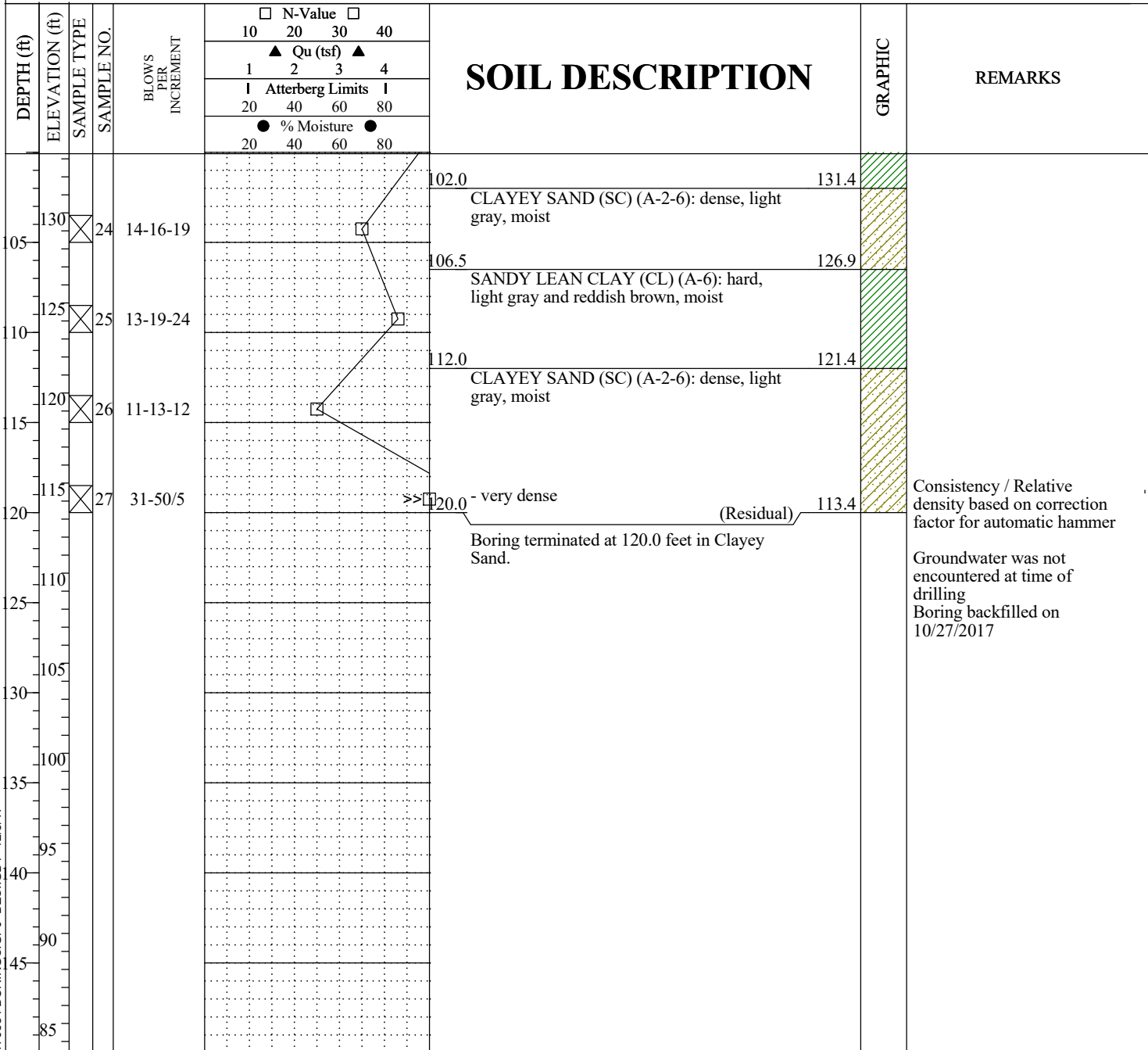
Designation: B-12

Sheet 3 of 3

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503570.9498, E2004406.831

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 10/27/17  
**Weather Conditions:** Clear, cool  
**Surface Elevation:** 233.3615  
**Drill Crew:** MG Drilling  
**Logged By:** KM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

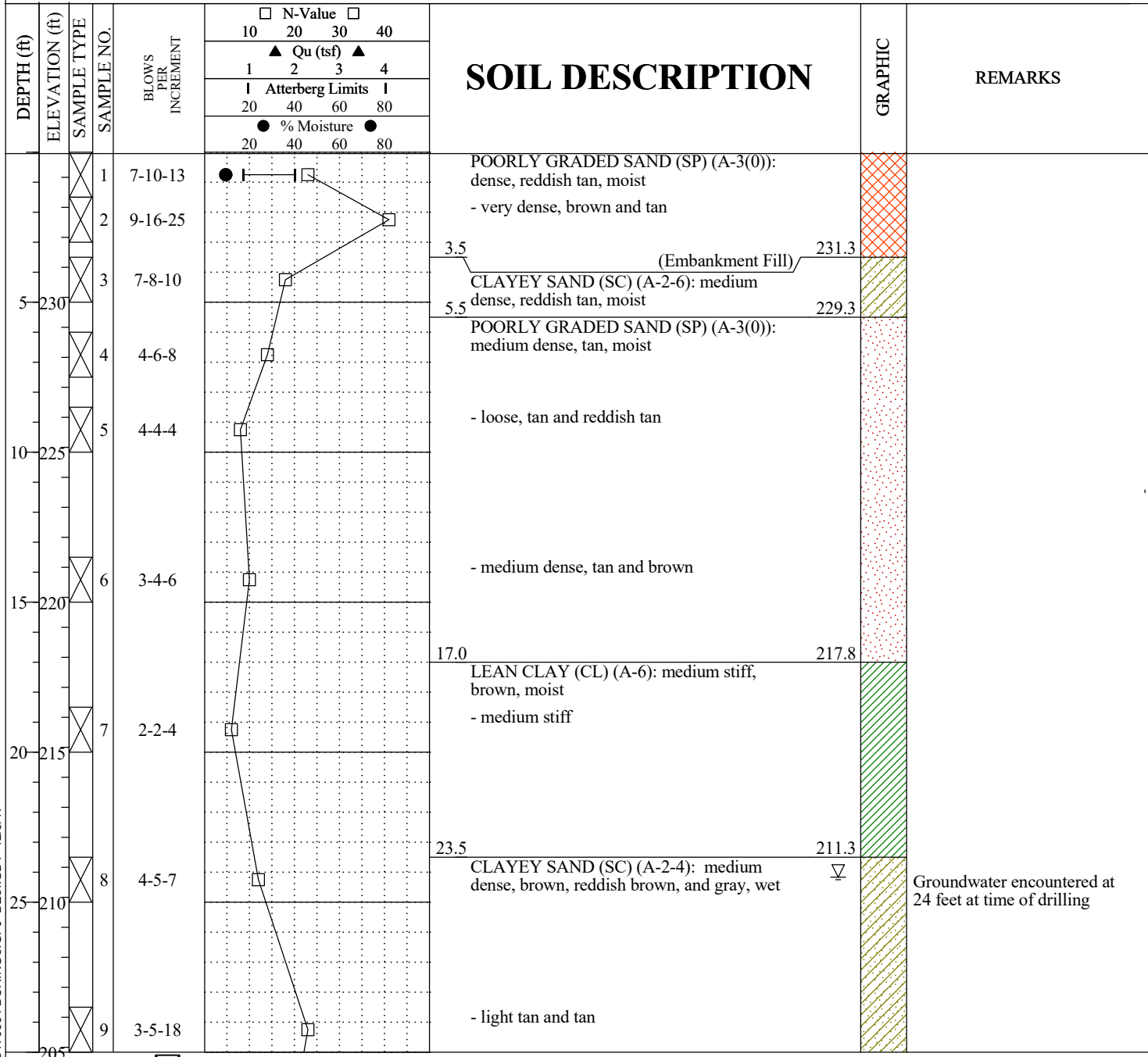
Designation: B-13

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503660.5916, E2004219.37

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/3/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 234.8375  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

**SAMPLE TYPE**  Split Spoon

<b>N-VALUE</b> STANDARD PENETRATION RESISTANCE (AASHTO T-206)	<b>REC</b> RECOVERY
<b>% MOISTURE</b> PERCENT NATURAL MOISTURE CONTENT	<b>RQD</b> ROCK QUALITY DESIGNATION
<b>∇</b> GROUNDWATER LEVEL IN THE BOREHOLE	<b>UD</b> UNDISTURBED
<b>Qu</b> UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST	





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-14

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503544.112, E2004219.209

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/2/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 226.5259  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				ATTERBERG LIMITS	% MOISTURE	SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4					
225		Split Spoon	1	9-10-11											POORLY GRADED SAND (SP) (A-3(0)): medium dense, tan, moist		
		Split Spoon	2	4-5-7											- tan and reddish tan		
5		Split Spoon	3	7-7-13											- loose		
220		Split Spoon	4	7-5-3											7.5	219.0	
		Split Spoon	5	2-2-2											13.0	213.5	Sample 5 % Passing #200 sieve: 81.6% Liquid Limit (LL): 34 Plastic Limit (PL): 25 Plasticity Index (PI): 9
10		Split Spoon	6	2-3-4											POORLY GRADED SAND (SP) (A-3(0)): loose, light gray, moist		
15		Split Spoon	7	5-7-9											- medium dense		Groundwater encountered at 19 feet at time of drilling
20		Split Spoon	8	8-12-16											- dense		
25		Split Spoon	9	5-11-17											28.5	198.0	Charged augers with water
		Split Spoon													LEAN CLAY (CL) (A-6): hard, light gray and reddish brown, moist		

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 **GROUNDWATER LEVEL** IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

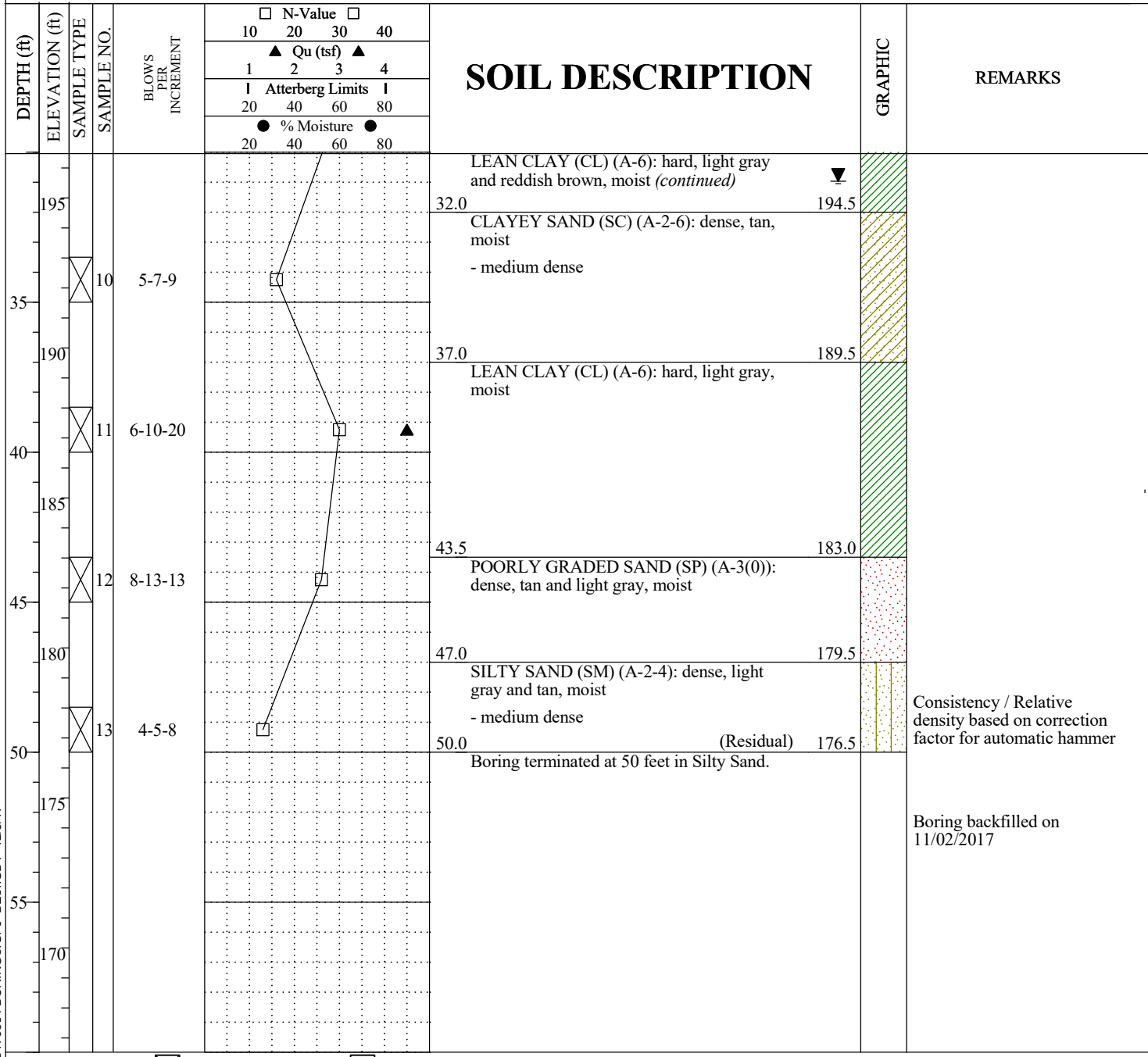
Designation: B-14

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503544.112, E2004219.209

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/2/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 226.5259  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-15

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N503746.031, E2003607.384

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/1/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 242.9543  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4			
					Atterberg Limits				% Moisture						
					20	40	60	80	20	40	60	80			
210			10	3-8-9									POORLY GRADED SAND W/ SILT (SP-SM) (A-3(0)): medium dense, tan and white, moist (continued)		
35													- medium dense		
205			11	4-12-16									- dense, coarse		
40															
200			12	5-9-15											
45															
195			13	6-15-20									- dense		
50													50.0 (Residual) 193.0		Consistency/Relative Density based on correction factor for automatic hammer
													Boring terminated at 50 feet in Poorly Graded Sand with silt.		Boring backfilled on 11/01/2017
190															
55															
185															

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST

Birmingham, AL ■ Huntsville, AL ■ Auburn, AL ■ Montgomery, AL ■ Columbus, GA

Raleigh, NC ■ Tulsa, OK ■ Little Rock, AR ■ Springdale, AR ■ New Orleans, LA ■ Louisville, KY

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-16

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504117.6007, E2003062.296

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/2/17  
**Weather Conditions:** Partly Cloudy  
**Surface Elevation:** 260.4058  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				Atterberg Limits	% Moisture	SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4					
260			1	7-8-10											0.2 TOPSOIL = 2 inches		Sample 2 % Passing #200 sieve: 13.3% Liquid Limit (LL): NP Plastic Limit (PL): NP Plasticity Index (PI): NP
			2	11-19-20											SILTY SAND (SM) (A-2-4(0)): medium dense, tan and reddish tan, moist - very dense, tan		
			3	5-6-6											- medium dense		
5	255		4	6-8-7													
			5	6-7-7											- reddish tan		
10	250		6	4-4-4											12.0 CLAYEY SAND (SC) (A-2-6): loose, tan, moist	248.4	
15	245		7	4-5-5											17.0 SILTY SAND (SM) (A-2-4): medium dense, white, tan, and reddish tan, moist	243.4	
20	240		8	4-2-2											23.5 POORLY GRADED SAND (SP) (A-3(0)): loose, tan and reddish brown, moist	236.9	
25	235		9	7-11-8											27.0 LEAN CLAY (CL) (A-4(5)): very stiff, light gray, moist	233.4	

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-16

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504117.6007, E2003062.296

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/2/17  
**Weather Conditions:** Partly Cloudy  
**Surface Elevation:** 260.4058  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40			
230									LEAN CLAY (CL) (A-4(5)): very stiff, light gray, moist (continued)		
35	225	10	5-6-8								
40	220	11	13-13-16						SILTY SAND (SM) (A-2-4): dense, white, tan and brown, moist		
45	215	12	5-3-2						- loose		
50	210	13	4-2-3						POORLY GRADED SAND (SP) (A-3(0)): loose, tan and reddish tan, wet		Consistency/Relative Density based on correction factor for automatic hammer
55	205	14	6-18-19						- dense		Boring backfilled on 11/2/2017
									55.0 (Residual) 205.4		
									Boring terminated at 55 feet in Poorly Graded Sand.		

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

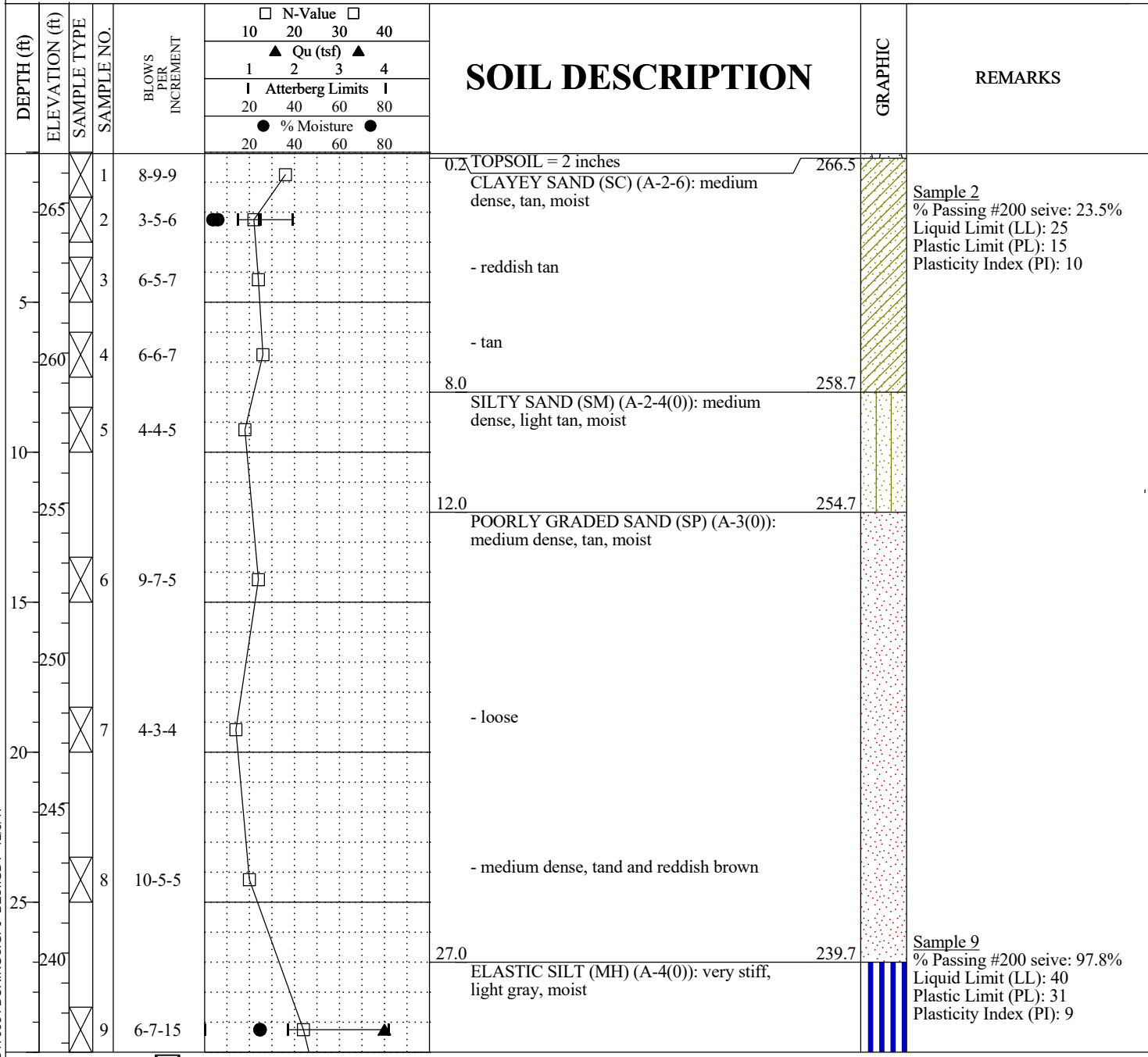
Designation: B-17

Sheet 1 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504475.0325, E2002644.392

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/3/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 266.696  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY

**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION

GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED

**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST



Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

Designation: B-17

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504475.0325, E2002644.392

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/3/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 266.696  
**Drill Crew:** MG Drilling  
**Logged By:** DM

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value				Qu (tsf)				SOIL DESCRIPTION	GRAPHIC	REMARKS
					10	20	30	40	1	2	3	4			
35	235	10	7-11-19	7									ELASTIC SILT (MH) (A-4(0)): very stiff, light gray, moist (continued)		
35	235												- hard		
40	230	11	5-11-16	11									SILTY SAND (SM) (A-2-4): dense, light tan and reddish brown, moist		
45	225	12	11-15-23	12									POORLY GRADED SAND (SP) (A-3(0)): dense, tan and brown, moist		
50	220	13	4-7-14	13									- medium dense, light tan and red		Consistency/Relative Density based on correction factor for automatic hammer
50	215												Boring terminated at 50 feet in Poorly Graded Sand with silt.		Groundwater was not encountered at time of drilling
55	210														Boring backfilled on 11/3/2017

LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon

<b>N-VALUE</b>	STANDARD PENETRATION RESISTANCE (AASHTO T-206)	<b>REC</b>	RECOVERY
<b>% MOISTURE</b>	PERCENT NATURAL MOISTURE CONTENT	<b>RQD</b>	ROCK QUALITY DESIGNATION
<b>∇</b>	GROUNDWATER LEVEL IN THE BOREHOLE	<b>UD</b>	UNDISTURBED
<b>Qu</b>	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		





Geotechnical, Environmental, and Materials Engineers

# LOG OF BORING

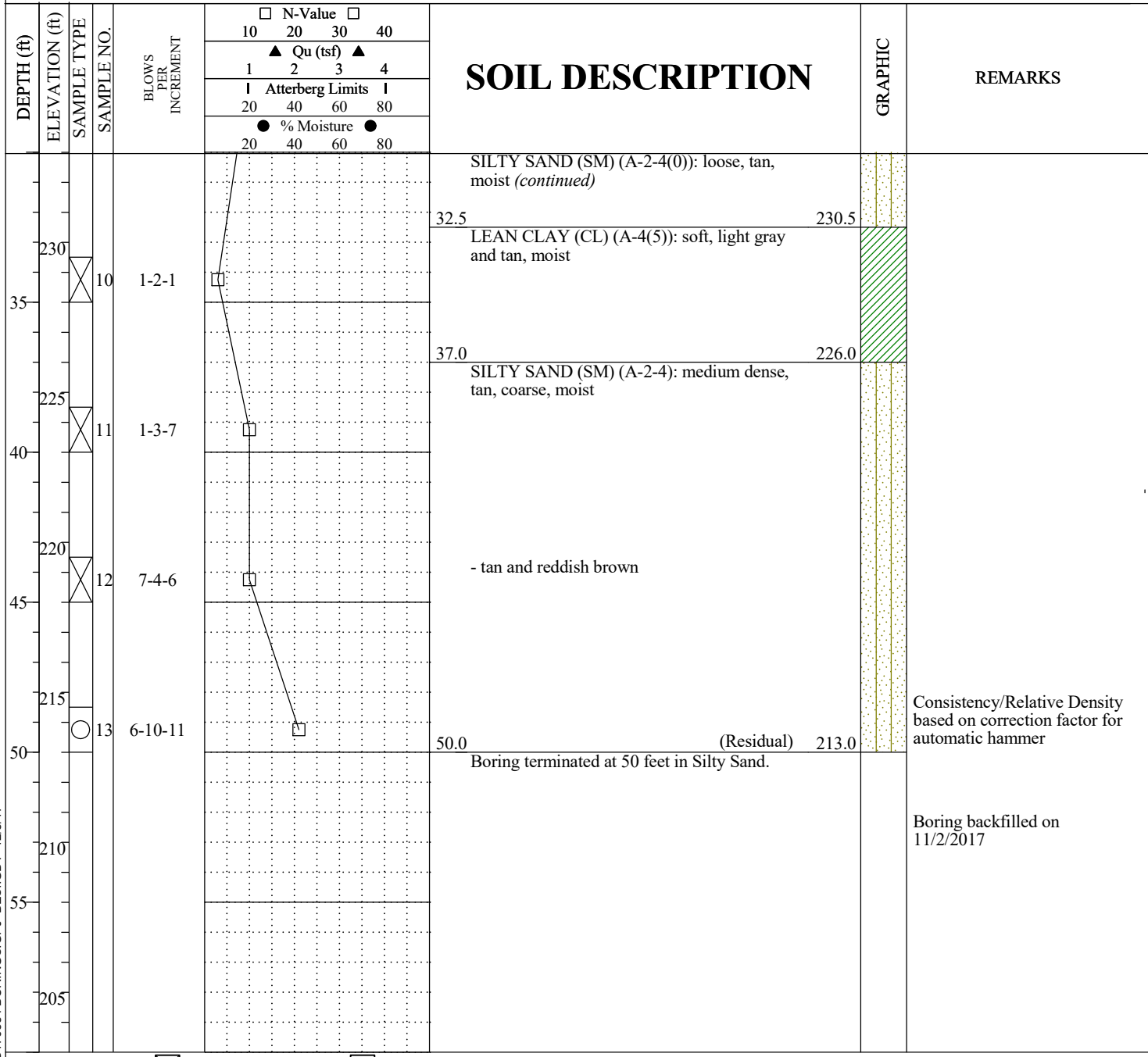
Designation: B-18

Sheet 2 of 2

610 Spring Branch Road  
Dunn, NC  
Office: (910) 292-2085  
Fax: (910) 292-2087  
www.BuildingAndEarth.com

**Project Name:** Repair All American Freeway - Phase I  
**Project Number:** RD170384  
**Drilling Method:** Hollow Stem Auger  
**Equipment Used:** Diedrich D50  
**Hammer Type:** Automatic  
**Boring Location:** N504917.339, E2002145.724

**Project Location:** Fort Bragg, NC  
**Date Drilled:** 11/2/17  
**Weather Conditions:** Sunny  
**Surface Elevation:** 263.0041  
**Drill Crew:** MG Drilling  
**Logged By:** DM



LOG OF BORING 2 RD170384 BORINGS.GPJ BESIGDT 12/8/17

SAMPLE TYPE  Split Spoon  No Recovery

**N-VALUE** STANDARD PENETRATION RESISTANCE (AASHTO T-206)      **REC** RECOVERY  
**% MOISTURE** PERCENT NATURAL MOISTURE CONTENT      **RQD** ROCK QUALITY DESIGNATION  
 GROUNDWATER LEVEL IN THE BOREHOLE      **UD** UNDISTURBED  
**Qu** UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST

Boring Location	Boring No.	Depth (ft)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	% Pass 200	D50 (mm)	USCS	AASHTO Classification
N504076.5587, E2003960.837	B-01	1.5	4.3	NP	NP	NP	0.0	0.0	22.3		SM	A-2-4(0)
N504076.5587, E2003960.837	B-01	38.5	21.2	NP	NP	NP	0.0	0.0	5.8		SP-SM	A-3(0)
N503997.6359, E2004104.535	B-02	18.5	21.2	NP	NP	NP	0.0	0.0	25.7		SM	A-2-4(0)
N503997.6359, E2004104.535	B-02	48.5	15.0	29	20	9	0.0	0.0	77.3		CL	A-4(5)
N503932.6027, E2004208.657	B-03	43.5	18.5	NP	NP	NP	0.0	0.0	6.4		SP-SM	A-3(0)
N503841.4701, E2004341.292	B-04	8.5	9.2	NP	NP	NP	0.0	0.0	11.6		SP-SM	A-2-4(0)
N503841.4701, E2004341.292	B-04	53.5	17.3	24	22	2	0.0	0.0	73.2		ML	A-4(0)
N503739.5887, E2004464.491	B-05	3.5	4.4	NP	NP	NP	0.0	0.0	20.1		SM	A-2-4(0)
N503739.5887, E2004464.491	B-05	28.5	17.3	NP	NP	NP	0.0	0.0	20.3		SM	A-2-4(0)
N503739.5887, E2004464.491	B-05	63.5	15.7	27	20	7	0.0	0.0	38.3		SC-SM	A-4(0)
N503739.5887, E2004464.491	B-05	108.5	15.7	28	26	2	0.0	0.0	76.8		ML	A-4(1)
N503638.9624, E2004571.216	B-06	28.5	16.7	NP	NP	NP	0.0	0.0	11.8		SP-SM	A-2-4(0)
N503991.7784, E2003772.874	B-07	1.5	21.1	23	20	3	0.0	0.0	23.0		SM	A-2-4(0)
N503991.7784, E2003772.874	B-07	43.5	18.5	NP	NP	NP	0.0	0.0	5.6		SP-SM	A-3(0)
N503911.1826, E2003930.769	B-08	33.5	21.4	NP	NP	NP	0.0	0.0	6.3		SP-SM	A-3(0)
N503850.6842, E2004061.415	B-09	8.5	11.8	27	21	6	0.0	0.0	25.9		SC-SM	A-2-4(0)
N503768.9744, E2004189.209	B-10	3.5	15.0	NP	NP	NP	0.0	0.0	23.5		SM	A-2-4(0)
N503768.9744, E2004189.209	B-10	38.5	20.2	NP	NP	NP	0.0	0.0	8.8		SP-SM	A-3(0)
N503674.3361, E2004308.206	B-11	8.5	22.8	24	20	4	0.0	0.0	72.0		CL-ML	A-4(1)
N503570.9498, E2004406.831	B-12	18.5	21.3	NP	NP	NP	0.0	0.0	9.9		SP-SM	A-3(0)
N503570.9498, E2004406.831	B-12	78.5	21.2	34	17	17	0.0	0.0	60.4		CL	A-6(7)
N503660.5916, E2004219.37	B-13	0.0	9.2	40	17	23	0.0	0.0	21.3		SC	A-2-6(1)
N503660.5916, E2004219.37	B-13	33.5	15.8	NP	NP	NP	0.0	0.0	16.6		SM	A-2-4(0)
N503544.112, E2004219.209	B-14	8.5	30.0	34	25	9	0.0	0.0	81.6		ML	A-4(7)
N503746.031, E2003607.384	B-15	18.5	9.5	NP	NP	NP	0.0	0.0	9.0		SP-SM	A-3(0)
N504117.6007, E2003062.296	B-16	1.5	3.5	NP	NP	NP	0.0	0.0	13.3		SM	A-2-4(0)
N504475.0325, E2002644.392	B-17	1.5	3.5	39	24	15	0.0	0.0	23.5		SC	A-2-6(0)
N504475.0325, E2002644.392	B-17	28.5	24.4	NP	NP	NP	0.0	0.0	97.8		ML	A-4(0)
N504917.339, E2002145.724	B-18	3.5	8.7	NP	NP	NP	0.0	0.0	15.4		SM	A-2-4(0)



610 Spring Branch Road  
 Dunn, North Carolina 28334  
 Phone: (910) 292-2085  
 www.BuildingAndEarth.com

Soil Classification Summary

Client: Zapata, Inc.  
 Project Name: Repair All American Freeway - Phase I  
 Location: Fort Bragg, North Carolina

## LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

### *DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)*

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

### *POCKET PENETROMETER*

Pocket Penetrometer tests were performed on cohesive soil samples. The pocket penetrometer provides a consistency classification, and an indication of the soils unconfined compressive strength ( $Q_u$ ).

### *NATURAL MOISTURE CONTENT (ASTM D2216)*

Natural moisture contents (M%) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

### *ATTERBERG LIMITS (ASTM D4318)*

The Atterberg Limits test was performed to evaluate the soil's plasticity characteristics. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index ( $PI = LL - PL$ ) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

### *MATERIAL FINER THAN NO. 200 SIEVE BY WASHING (ASTM D1140)*

Grain-size tests were performed to determine the partial soil particle size distribution. The amount of material finer than the openings on the No. 200 sieve (0.075 mm) was determined by washing soil over the No. 200 sieve. The results of wash #200 tests are presented on the boring logs included in this report and in the table of laboratory test results.

### *LABORATORY TEST RESULTS*

The results of the laboratory testing are presented in the following tables.

Boring Location	Sample Depth (ft)	LL	PL	PI	% Passing #200 Sieve	Moisture Content (%)
B-01, S-02	1.5-3.0	NP	NP	NP	22.3	4.3
B-01, S-10	38.5-40.0	NP	NP	NP	5.8	21.2
B-02, S-07	18.5-20.0	NP	NP	NP	25.7	21.2
B-02, S-13	48.5-50.0	29	20	9	77.3	15.0
B-03, S-12	43.5-45.0	NP	NP	NP	6.4	18.5
B-04, S-05	8.5-10.0	NP	NP	NP	11.6	9.2
B04, S-14	53.5-55.0	24	22	2	73.2	17.3
B-05, S-03	3.5-5.0	NP	NP	NP	20.1	4.4
B-05, S-09	28.5-30.0	NP	NP	NP	20.3	17.3
B-05, S-16	63.5-65.0	27	20	7	38.3	15.7
B-05, S-25	113.5-115.0	28	26	2	76.8	15.7
B-06, S-09	28.5-30.0	NP	NP	NP	11.8	16.7
B-07, S-02	18.5-20.0	23	20	3	23.0	21.1
S-07, S-12	43.5-45.0	NP	NP	NP	5.6	18.5
B-08, S-10	33.5-35.0	NP	NP	NP	6.3	21.4
B-09, S-05	8.5-10.0	27	21	6	25.9	11.8
B-10, S-03	3.5-5.0	NP	NP	NP	23.5	15.0
B-10, S-1	38.5-40.0	NP	NP	NP	8.8	20.2
B-11, S-05	8.5-10.0	24	20	4	72.0	22.8
B-12, S-07	18.5-20.0	NP	NP	NP	9.9	21.3
B-12, S-19	53.5-55.0	34	17	17	60.4	21.2
B-13, S-01	0.0-1.5	40	17	23	21.3	9.2
B-13, S-10	38.5-40.0	NP	NP	NP	16.6	15.8
B-14, S-05	8.5-10.0	34	25	9	81.6	30.0
B-15, S-07	18.5-20.0	NP	NP	NP	9.0	9.5
B16, S-02	1.5-3.0	NP	NP	NP	13.3	3.5
B-17, S-02	1.5-3.0	39	24	15	23.5	3.5
B-17, S-09	28.5-30.0	33	31	9	97.8	24.4
B-18, S-03	6.0-7.5	NP	NP	NP	15.4	8.7

**Table A-1: General Soil Classification Test Results**

*Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic. Soils with a LOI value greater than 3 percent are usually not suitable for supporting building and pavement sections.*



## Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

### Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

### Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

### Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

### Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

### Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

### A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

### A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

### Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention.* Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

### Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



8811 Colesville Road/Suite G106, Silver Spring, MD 20910  
Telephone: 301/565-2733 Facsimile: 301/589-2017  
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2015 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, or its contents, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document as a complement to or as an element of a geotechnical-engineering report. Any other firm, individual, or other entity that so uses this document without being a GBA member could be committing negligent or intentional (fraudulent) misrepresentation.