OCTOBER 28, 2021
MODIFIED FOR SR400 PHASE 1
BRIDGE DESIGN-BUILD PROJECT

BFI GEOTECHNICAL DATA REPORT

Georgia Department of Transportation

[redacted]
Project No: [redacted] PI# 0001757
Fulton [redacted] Counties, Georgia

PREPARED FOR:
AECOM
1360 Peachtree Street NE, Suite 500
Atlanta, Georgia 30309

AECOM Project 60558412
NOVA Project Number 2018089 - Task Order 5

February 21, 2020 (Revision 1)

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OCTOBER 28, 2021
BODY OF REPORT REDACTED TO ONLY INCLUDE THE INFORMATION NEEDED FOR THE SR400 BRIDGE DESIGN BUILD PROJECT.

February 21, 2020 (Revision 1)

AECOM
1360 Peachtree Street NE, Suite 500
Atlanta, Georgia 30309

Attention: Scott A. Gero, P.E. - Project Manager

Subject: BFI Geotechnical Data Report
[redacted]S
Project No: MSL00-0001-00(757) PI No. 0001757
Fulton [redacted] Counties, Georgia
AECOM Project 60558412
NOVA Project Number 2018089 – Task Order 5

Dear Mr. Gero,

NOVA Engineering and Environmental, LLC (NOVA) has completed the Bridge Foundation Investigation (BFI) Geotechnical Data Report (GDR) for [redacted] bridges associated with the GDOT [redacted] SR 400 [redacted] project in Fulton [redacted] [redacted] Counties, Georgia. This work has been performed under Task Order 5 of this project with Purchase Order Number 102551 and in general accordance with GDOT requirements and modified based on scoping meetings with HNTB and United Consulting.

This December 27, 2019 report supersedes the October 18, 2019 version and includes data for borings subsequently drilled in the Chattahoochee River after obtaining approval from the National Park Service. An OMAT historical search for GDOT BFI reports, a Pavement Evaluation Study, a Soil Survey (SS) GDR, [redacted] reports were submitted previously under separate cover.

We thank you for the opportunity to assist you with this project and look forward to working with you on future projects.

Sincerely,
NOVA ENGINEERING AND ENVIRONMENTAL LLC

J. Stephen Willenborg

Mahalingam Bahiradhan, P.E.
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J. Stephen Willenborg, P.E.
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FIGURES

ATTACHMENTS: Proposed, Replaced or Modified Bridges - BFI Geotechnical Data Reports (Includes available historical GDOT BFI data)

[redacted]

[redacted]

ATTACHMENTS CONTINUED: Proposed Bridges – Historical GDOT BFI Data Only

SPT HAMMERS ENERGY CALIBRATIONS

S&ME- CME 55 (SN 328245)
S&ME- CME 550X (SN 292103)
S&ME- Diedrich D-50 Track (SN 382)
Betts- CME 75 (SN 164447)
Betts- CME 55 (SN 54005)
Tri-State-CME 45 Barge Rig (SN 31692402)

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

[redacted] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] [redacted]

2. *BRIDGE FOUNDATION INVESTIGATIONS*

This BFI GDR report includes compilation of geotechnical data for[redacted] bridges that are[redacted], proposed bridge replacements,[redacted] [redacted] where NOVA conducted foundation investigations. We note that the referenced attachment bridge numeric labelling may not be sequential as some of the previously requested bridge locations assigned for investigation were removed[redacted] from the planned scope of work, due to changes in the ongoing design-build scheme.[redacted]

Soil borings were drilled based on proposed bridge layouts provided by AECOM at the time of our field exploration. Please note that proposed bridge locations, configurations and number of spans, etc. may have changed since conducting our field explorations.

In addition, NOVA searched the archive files at GDOT Office of Materials and Testing (OMAT) to obtain historical BFI geotechnical data. Historical BFI geotechnical data found and compiled were provided to AECOM previously. Based on review of these historical BFI geotechnical data, NOVA was instructed to conduct additional foundation investigation borings on specific planned bridges. Excerpts of historical BFI data found at or in the immediate vicinity of the proposed bridges where NOVA conducted foundation investigations are included with the individual BFI GDR in Attachments[redacted].

We have also compiled excerpts of historical GDOT BFI reports for proposed bridges where NOVA was not requested to conduct additional foundation investigation drilling. These are compiled in Attachments[redacted] by bridge names and bridge structure numbers.

3. *GENERAL GEOLOGY*

The site is located in the Piedmont Geologic Region, a broad northeasterly trending province underlain by crystalline rocks up to 600 million years old. The Piedmont region is bounded by the Blue Ridge Range of the Appalachian Mountains to the northwest, and by the leading edge of Coastal Plain sediments, commonly referred to as the “Fall Line” to the southeast. Numerous episodes of crystal deformation have produced varying degrees of metamorphism, folding and shearing in the underlying rock. The resulting metamorphic rock types in the project area are predominantly a series of Precambrian-Paleozoic age.

Residual soils in the region are primarily derived from the in-situ parent rock by chemical weathering. The extent of the weathering is influenced by the mineral composition of the rock and defects such as fissures, faults and fractures. The residual profile can generally be divided into three zones:

- An upper zone near the ground surface consisting of red clays and clayey silts which have undergone the most advanced weathering,

- An intermediate zone of less weathered micaceous sandy silts and silty sands, frequently described as “saprolite”, whose mineralogy, texture and banded appearance reflects the structure of the original rock, and

- A transitional zone between soil and rock termed partially weathered rock (PWR).

The boundaries between zones of soil, partially weathered rock, and bedrock are erratic and poorly defined. Weathering is often more advanced next to fractures and joints that transmit water, and in mineral bands. Boulders and rock lenses are sometimes encountered within PWR or soil matrix. Consequently, significant fluctuations in depths to materials may occur over short horizontal distances.

The General Project Geology Map is shown as Figure 2.

4. *SCOPE OF WORK*

Our scope of work included the following:

1. Field Exploration
2. Soil Classification and Laboratory Testing
3. Preparation of BFI Geotechnical Data Report

4.1 FIELD EXPLORATION

The number of borings and their locations for each bridge were determined by reviewing available subsurface investigation data, proposed locations of the new (or to be replaced or modified) bridges, the planned number of bridge spans per structure, and given/estimated bent locations in general accordance with GDOT requirements and as modified based on scoping meetings with HNTB and United Consulting. Boring locations were established in the field by NOVA personnel using the provided (then-current) site plans, a handheld GPS device, and measuring distances from permanent site landmarks. Boring locations were selected close to the proposed bents as practically possible. Some boring locations were offset to safe distances from marked utility lines at the time of drilling. Utilities at the proposed boring locations were located by calling Georgia 811 prior to drilling test borings.

GDOT Intelligent Transportation System (ITS) buried fiber optics cables were not located by Georgia 811. NOVA coordinated with the GDOT ITS Department and were provided with drawings of the Advanced Traffic Management System (ATMS) Plans for the project corridor. NOVA's field engineers met with GDOT ITS Supervisor and personnel from the GDOT Traffic Management Center (TMC) on site at several locations to go over fiber optic line plans. Our field personnel also observed remnants of water-soluble paint markings and/or flags for marking of utilities for the Subsurface Utility Engineering (SUE) efforts for the project. Some of the boring locations required private utility locator services to locate utilities. Hand clearing/dozer clearing were required to access some of the boring locations.

Maintenance of Traffic (MOT) was provided by Area Wide Protective (AWP) Services for borings drilled in travel lanes or close to travel lanes/shoulders. A Law Enforcement Officer (LEO) and cruiser with "blue lights" were included at some locations for added safety. Traffic Interruption Reports (TIR) and MOT Plans were prepared and submitted to the GDOT Traffic Management Center (TMC) in advance for approval and to obtain TIR numbers. Our field engineers called in to the GDOT TMC prior to temporary lane closures and after completion of our daily field operations. Night work was conducted for drilling operations on SR 400.

Our drilling subcontractors, S&ME, Betts Drilling, and Tri-State Drilling, performed all test borings under the direction of a NOVA Project Engineer. Borings were drilled with All-Terrain Vehicle (ATV), truck mounted drill-rigs, or barge platform equipped with hollow-stem continuous flight augers and/or wash boring augers. Standard Penetration Test (SPT) were obtained using automatic hammers. Calibration information for the SPT hammers utilized on this project are included with this report.

The Standard Penetration Test (SPT) with a standard 1.4-inch I.D., 2.0-inch O.D., split-tube sampler as per ASTM D1586 was performed at depth intervals in general accordance with GDOT OMAT guideline. SPT includes driving the sampler through 18-inches using a 140 pounds hammer free falling through 30 inches. The number of blows required to drive the sampler through every 6 inches were recorded. The SPT “N-value” (Penetration Resistance) were recorded as the sum of the number of blows required to drive the sampler through the last 12 inches or a portion thereof. Representative portions of the soil samples, obtained from the sampler, were placed in air-tight glass jars and transported to our laboratory for further evaluation and laboratory testing.

Auger refusal occurs when very hard or very dense material, frequently boulders or the upper surface of bedrock, is encountered and cannot be penetrated by a power auger. In some cases, when auger refusal was encountered at shallow depths that were not supported by the surficial features, offset borings were required to verify auger refusal/presence of partially weathered rock (PWR) at deeper depths. Partially weathered rock (PWR) is a transitional material between soil and the underlying parent rock that is defined as residual materials that exhibit a standard penetration resistance (SPT N-value) exceeding 100 bpf.

In addition to the split-spoon samples, “undisturbed” Shelby tube samples were also obtained at some locations where boring depths exceeded 75 feet and loose strata were encountered. Shelby tube samples not tested are stored in a climate control storage facility for additional laboratory testing, if requested.

[redacted] Rock coring were done according to ASTM D2113–Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration.

The groundwater levels reported on the Test Boring Records represent measurements made at the completion of the soil test boring. The soil test borings were backfilled immediately after their completion with soil cuttings and patched with asphalt/concrete when needed.

Coordinates and elevations of the boring locations were surveyed and provided by ACCURA Engineering after the borings have been completed. The elevations at the borings are based on the North American Vertical Datum of 1988 (NAVD 88).

4.2 SOIL CLASSIFICATION AND LABORATORY TESTING

Soil Classification: Soil classification provides a general guide to the engineering properties of various soil types and enables the engineer to apply past experience to current problems. In our explorations, samples obtained during drilling operations are classified by an engineer using the visual-manual procedures in general accordance with ASTM D2488. The soils are classified according to relative density/consistency (based on SPT N-values), color and composition. Visual classification is confirmed/corrected based on the laboratory test results from representative soil samples obtained from each major soil layer. These final soil classification descriptions included on our "Test Boring Records" are based on using the Unified Soil Classification System in general accordance with ASTM D2487.

Laboratory Testing: The following laboratory index testing were performed on representative samples collected during the field exploration to assist in the soil classification:

- Grain Size Analysis – *ASTM D6913*
- Moisture Content – *ASTM D2216*
- Atterberg Limits – *ASTM D4318*
- Unconfined Compressive Strength of Rock– *ASTM D7012*
- Soil Resistivity – *ASTM G187*
- pH of Soil – *ASTM G51, AASHTO T289*
- Chloride of Soil – *ASTM D512, AASHTO T291*
- Sulfate of Soil – *ASTM C1580, D516, AASHTO T290*

Grain Size Analysis: The grain size analysis consists of determining the amounts of various sizes of soil particles using a series of standard sieve openings. The percentage of soil, by weight, passing the individual sieves is then recorded and generally presented in a graphical format. The percentage of fines passing through the No. 200 sieve is generally considered to represent the amount of silt and clay of the tested soil sample. The sieve analysis test was conducted in general accordance with ASTM D6913 - Standard Test Methods for Particle Size Distribution Using Sieve Analysis.

Moisture Content: In a given soil-air-water matrix, the moisture content is the ratio expressed as a percentage of the weight of water to the weight of the soil particles. This test was conducted in general accordance with ASTM D2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

Atterberg Limits: The Atterberg Limits are different descriptions of the moisture content of fine-grained soils as it transitions between a solid to a liquid-state. For classification purposes the two primary Atterberg Limits used are the Plastic Limit (PL) and the Liquid Limit (LL). The Plasticity Index (PI) is also calculated for soil classification, which is defined as the difference between Liquid Limit and Plastic Limit. The Plastic Limit (PL) is the moisture content at which a soil transitions from a semisolid state to a plastic state. The Liquid Limit (LL) is defined as the moisture content at which a soil transitions from a plastic state to a liquid state. Atterberg

Limits tests were performed in general accordance with ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Unconfined Compressive Strength: Unconfined strength test of rock was performed to assist the designers in determining the required embedded length of drilled shafts, if used, and to provide some input in selecting the core bit types and the capacity of the excavation equipment for drilled shafts, if used. Unconfined compressive strength tests of intact rock specimens were performed in general accordance with ASTM D7012 (Method C) - Standard Test Methods for determining unconfined compressive strength of intact rock core specimens.

Soil Resistivity: The resistivity of the surrounding soil environment is a factor in the corrosion of underground structures. Soil resistivity may affect the material selection of a structure. Soil resistivity tests were performed in accordance with ASTM G187 - Standard Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method.

pH of Soil: The principle use of the test is to supplement soil resistivity measurements to determine the corrosion potential of soils for the materials of a buried structure. Soil pH tests were performed in accordance with ASTM G51 - Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.

Chloride and Sulfate Contents of Soil: Attack on precast, cast-in-place concrete occurs in soils with high sulfate or chloride concentrations. The solubility of the sulfate or chloride are among factors influencing the rate of deterioration on concrete piles. Chloride content of soil were determined in accordance with ASTM D512, AASHTO T291 - Chloride Ion Content in Soil. Sulfate content of soil were determined in accordance with ASTM C1580, D516, AASHTO T290 - Sulfate Ion Content in Soil.

4.3 GEOTECHNICAL DATA REPORTS

The results of our study are presented as individual Geotechnical Data Report (GDR) for each bridge where NOVA conducted foundation investigation drilling. Each individual GDR (Attachments A through S) includes the following:

- **Introduction:** The introduction provides a description of proposed bridge location. Existing bridge structure IDs are referenced in the reports for replacement or widening bridges. Site photographs are referenced in the Appendix A of each Attachment.
- **Geology:** A brief general geology of the bridge area is included along with a geology map of the individual area in Appendix A of each Attachment.
- **Field and Laboratory Testing:** A description and summary of the field and laboratory testing performed are included. In Appendix A of each Attachment, a boring location plan is provided along with the proposed bridge location or modification. Subsurface data provided in Appendix B of each Attachment includes a subsurface data profile and Test Boring Records. Test Boring Records include the standard penetration test

(SPT) resistances, USCS soil types and their depths, engineering soil properties, rock descriptions, and depth of groundwater encountered in the borings. Laboratory data provided in Appendix C of each Attachment includes a summary of laboratory test results and laboratory test results sheets.

- **Historical Geotechnical Data:** If previous geotechnical data was available, excerpts of the relevant historical GDOT BFI data records are included in Appendix D of each of the individual geotechnical data reports. Please also note that historical records were not found for all of the project's bridge locations.

5. *OMAT HISTORICAL BFI GEOTECHNICAL DATA*

Excerpts of historical data are included as Appendix D in each GDR where NOVA conducted foundation investigation drilling. For proposed bridges where NOVA was not requested to conduct foundation investigation drilling, the excerpts of available historical GDOT BFI data are compiled as Attachments T through V by bridge names and bridge structure numbers. The historical boring location plans provided by us represents our understanding of the locations of historical soil borings with respect to the existing structures. We have assumed that the bridge locations on the historical reports are the same as the current locations of existing bridges. The user needs to verify this assumption prior to using the respective historical data.

6. *LIMITATIONS*

This report includes the summary of our data collection effort within the scope of our work and is based on the generally accepted geotechnical engineering practices. The stratification lines and depth designations in the Test Boring Records represent approximate boundaries between various subsurface strata. Actual transitions between soil strata may be gradual. No warranties/guarantees are expressed or implied. NOVA is not responsible for accuracy or missing information associated with the historical documents or the reports/documents prepared by others for this project.

This report is intended for the sole use of AECOM, HNTB and the Georgia Department of Transportation only. The scope of work performed during this study was developed for purposes specifically intended by AECOM, HNTB and the Georgia Department of Transportation and may not satisfy other users' requirements. Use of this report or the findings will be at the sole risk of the user. NOVA is not responsible or liable for the interpretation by others of the data in this report, nor their conclusions, recommendations or opinions.

Our professional services have been performed, our findings obtained and presented in accordance with generally accepted geotechnical engineering principles and practices in the State of Georgia. This report is intended to be a geotechnical data report with no engineering conclusions or recommendations provided.

FIGURES

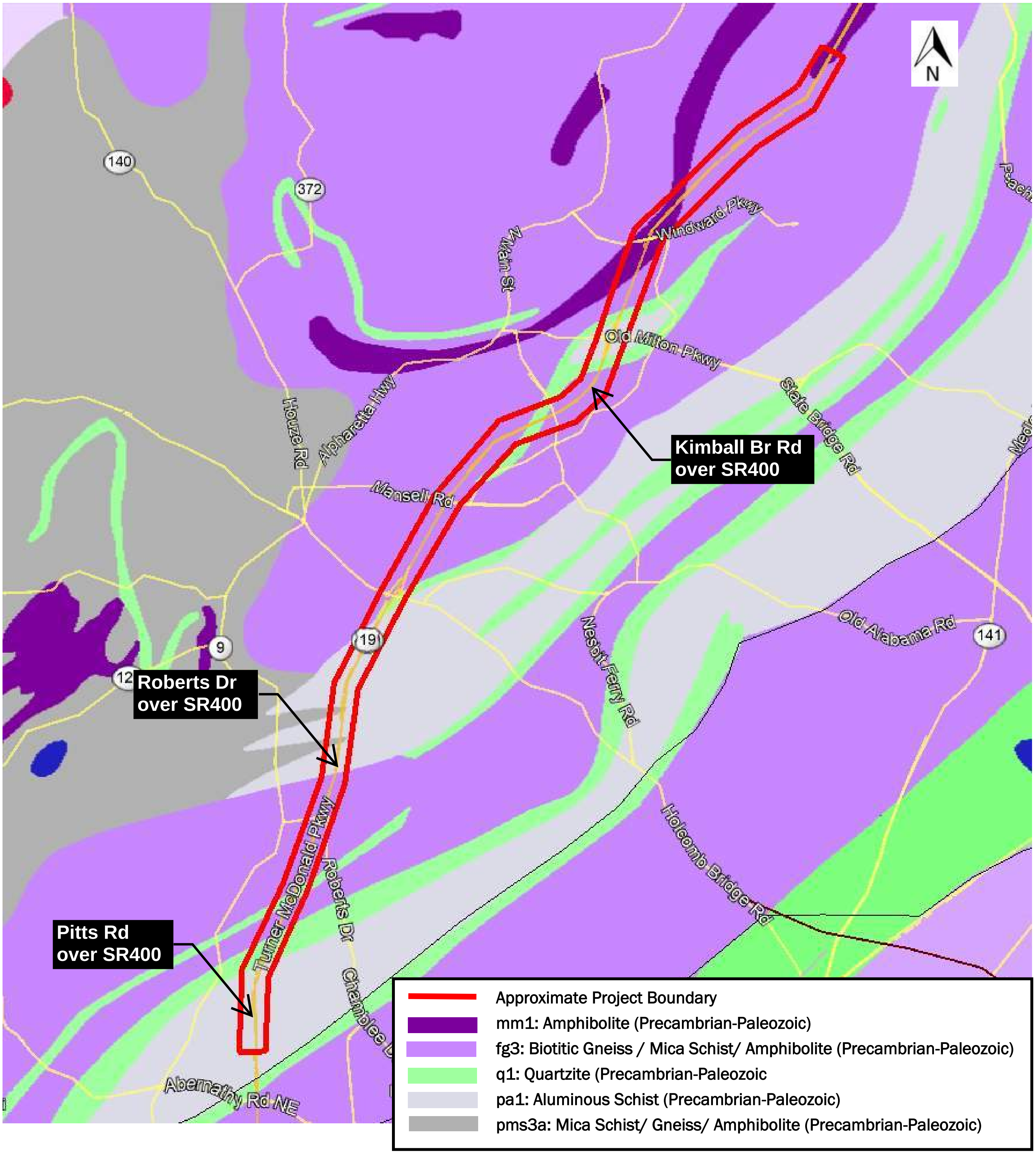

FIGURE 2
GENERAL PROJECT GEOLOGY MAP
Source: USGS Geologic Maps of US States
https://mrdata.usgs.gov/geology/state
Scale: NTS

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GDOT MMIP SR 400 EXPRESS LANES –
PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton & Forsyth Counties, Georgia
NOVA Project Number 2018089 –
Task Order 5

ATTACHMENTS

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ATTACHMENT B

Bridge 2 - Roberts Drive over SR 400

[redacted]

Project No: MSL00-0001-00(757) PI No. 0001757

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APPENDICES

1. INTRODUCTION

Existing bridge on Roberts Drive over SR 400 (Structure ID 121-0316-0), as shown in Figure 1 of Appendix A, is a four-span structure that crosses over SR 400 at a skew angle. The new longer bridge replaces the existing bridge at approximately 50 feet south of current location as part of the [redacted], PI No. 0001757).

2. SITE GEOLOGY

According to the "Geology of the Greater Atlanta Region" by McConnell and Abrams, 1984, the site as shown in Figure 2 of Appendix A, is generally underlain by the “fs: Sandy Springs Group” Formation. This geologic formation typically includes an upper unit of graphite-garnet-mica schist with lesser amounts of biotite gneiss and amphibolite.

3. FIELD AND LABORATORY PROCEDURES

3.1 FIELD EXPLORATION

Our field exploration included five soil test borings (B2-1 through B2-3A) drilled to depths of 4.1 to 18.7 feet below the existing ground surface. Table 1 shows a summary of field testing, locations and quantities. The approximate boring locations are shown on Figure 3 of Appendix A. The results of the field exploration, USCS soil classifications, and laboratory test results are presented in Test Boring Records in Appendix B.

Table 1: Summary of Field Testing and Test Hole Quantities

BORING No.	LOCATION		GROUND SURFACE ELEVATION (feet)	BORING DEPTH (feet)	TOTAL SPT
	LATITUDE	LONGITUDE			
B2-1	33.99145926	-84.33860112	1050.2	18.7	4
B2-2	33.99158441	-84.33817267	1034.4	4.1	2
B2-2A	33.99158441	-84.33817267	1034.4	6.6	3
B2-3	33.99149878	-84.33787676	1032.7	6.2	1
B2-3A	33.99149878	-84.33787676	1032.7	7.5	1
			Total	**43.1**	**11**

3.2 LABORATORY TESTING

The laboratory test results are presented in the Appendix C with Table A showing the summary of all laboratory test results. The Test Boring Records attached in Appendix B include Atterberg limits (Plastic Limit and Liquid Limit) and moisture content within the “Graphic Depiction” of the log. Table 2 provides number of laboratory tests performed.

Table 2: Number of Laboratory Tests Performed

BORING No.	LIQUID LIMIT	PLASTIC LIMIT	GRAIN SIZE	USCS CLASSIFICATION	MOISTURE CONTENT
B2-1	2	2	2	2	2
B2-2	1	1	1	1	1
B2-2A	1	1	1	1	1
B2-3	1	1	1	1	1
B2-3A	1	1	1	1	1
Total	6	6	6	6	6

4. HISTORICAL DATA

Previous soil boring data at the vicinity of the proposed bridge location was obtained from GDOT OMAT archive files and is included in Appendix D of this report. NOVA is not responsible for the presented historical BFI geotechnical data prepared by others and found in GDOT OMAT archive file storage. Both historical BFIs were described as bridges over SR 400 (North Fulton Expressway). Appears the historical BFI for the 5/9/68 is probably for the current bridge with four spans. Figure 4 of Appendix D represents our understanding of the locations of historical soil borings with respect to the existing structure. The user should review the attached documents and confirm these locations for their use.

APPENDIX A

FIGURES

FIGURE 1
BRIDGE 2 – Roberts Drive over SR 400
EXISTING BRIDGE
SOURCE: GDOT Bridge Inspection Report

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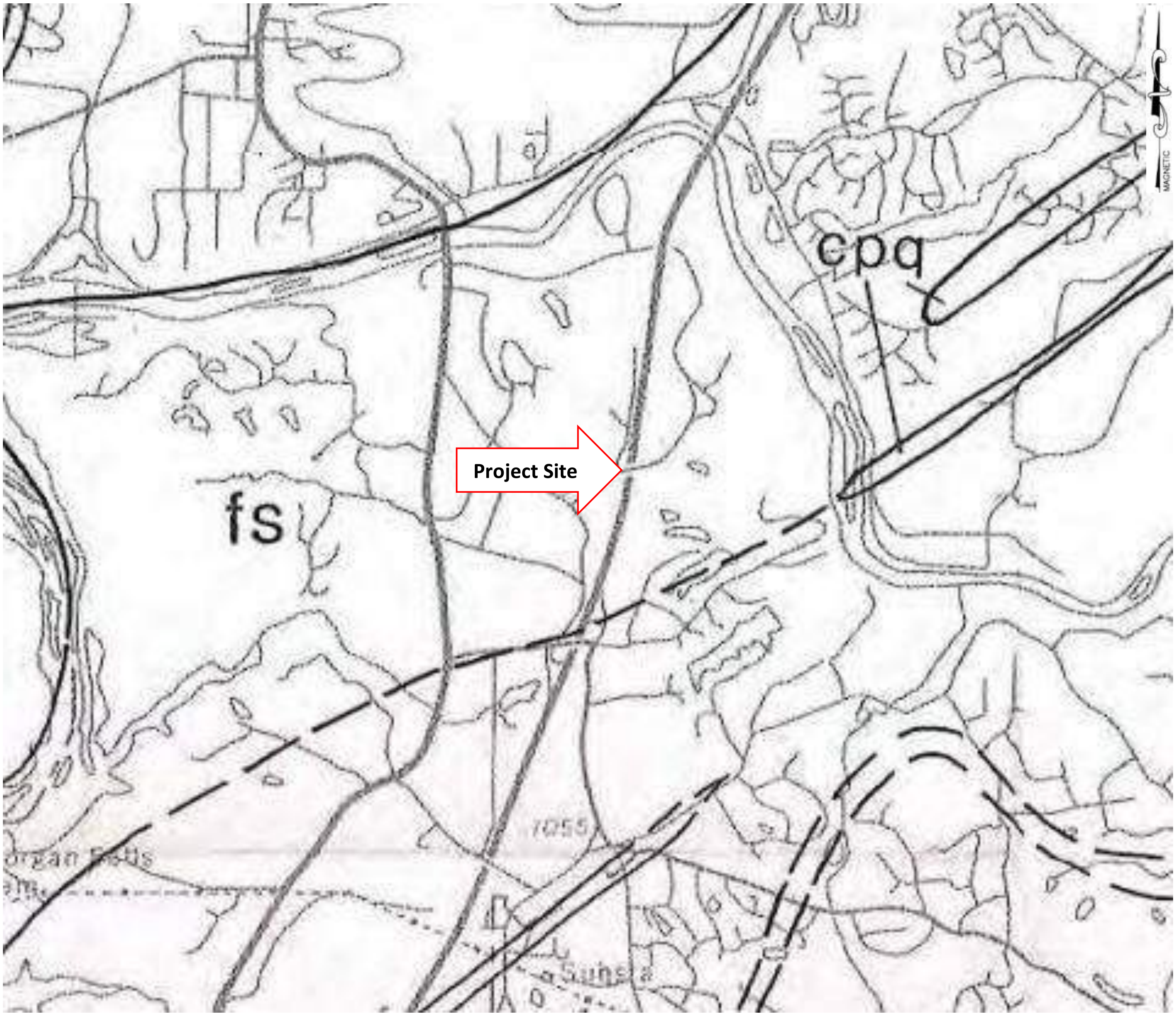

pfu
cpq
fs

Sandy Springs Group (Higgins and McConnell, 1978a: Kline, 1980; this report): Similar to sequence observed in northern Piedmont and at least partially equivalent to Atlanta Group (see text). Includes a lower unit of intercalated biotite gneiss, mica schist and amphibolite (pfu); a middle unit composed of micaceous quartzite, mica schist and graphitic schist (cpq); and an upper unit of graphite-garnet-mica schist with lesser amounts of biotite gneiss and amphibolite (fs).

FIGURE 2
BRIDGE 2 – Roberts Drive over SR 400
SITE GEOLOGY
SOURCE: McConnell & Abrams, 1984

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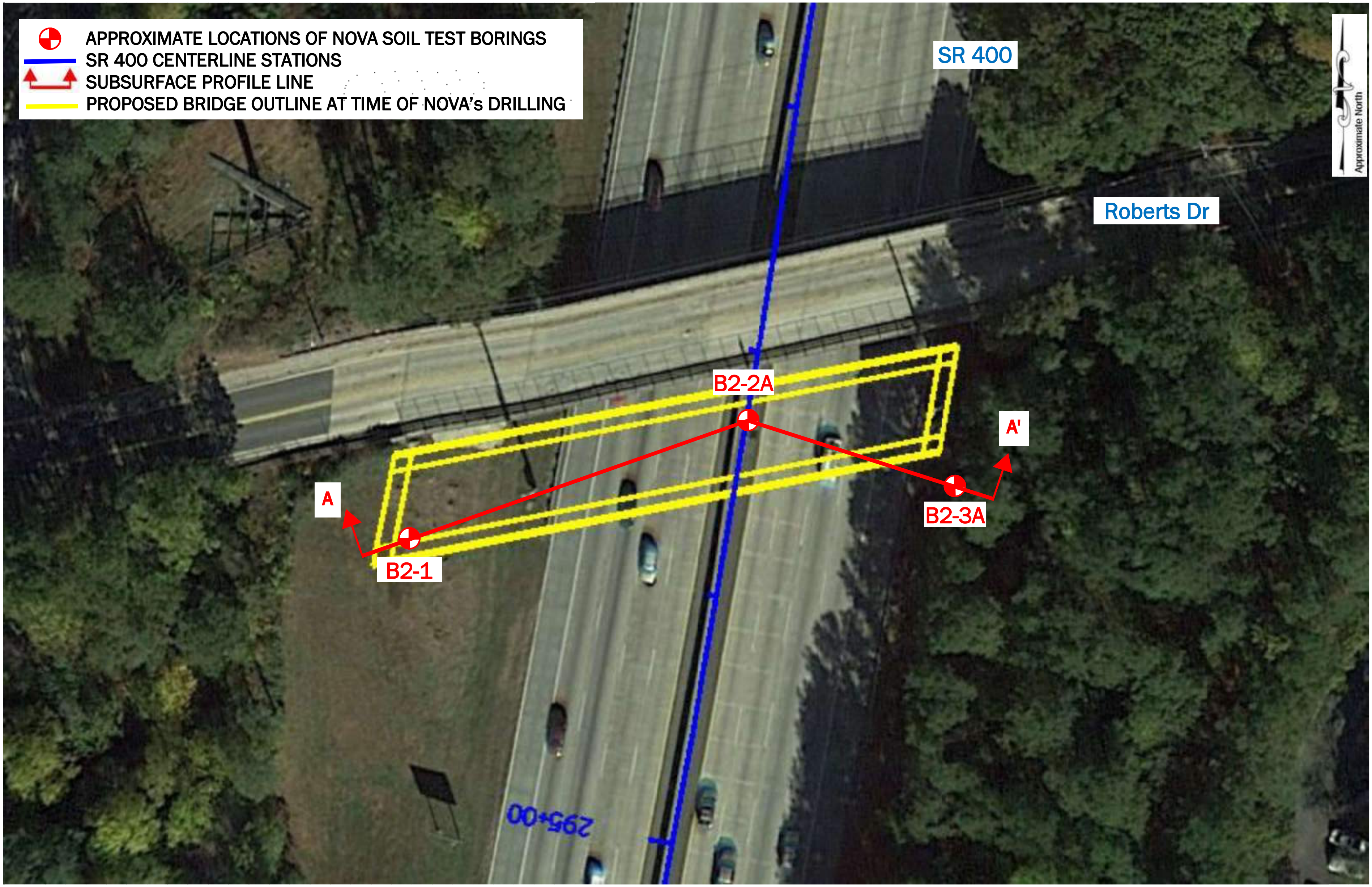

FIGURE 3
BRIDGE 2 – Roberts Dr over SR 400
BORING LOCATION PLAN
SOURCE: Google Earth Aerial Photos
SCALE: Not to Scale

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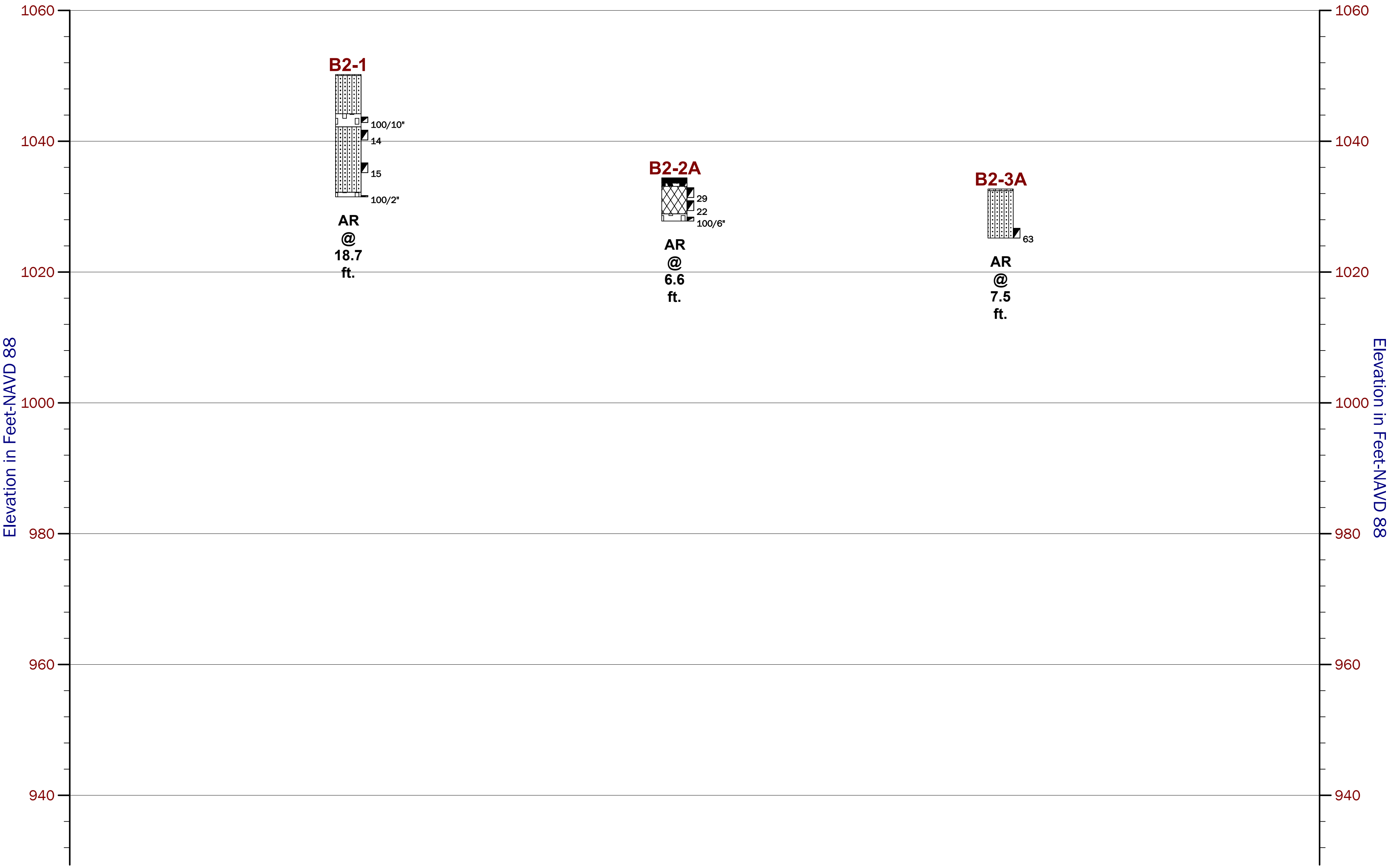
APPENDIX B

SUBSURFACE DATA



AR - Auger Refusal

▤ Topsoil
▦ Silty sand
▣ PWR
■ Paving
▩ Gravel

▩ Fill
◪ Standard penetration test

BRIDGE 2 - Roberts Drive over SR 400 - Profile A-A'

[redacted] - PI No. 0001757

BFI GEOTECHNICAL DATA REPORT

Fulton [redacted] Counties, Georgia

NOVA Project Number 2018089 - Task Order 5

KEY TO SYMBOLS AND CLASSIFICATIONS

Drilling Symbols

◩	Split Spoon Sample
▯	Undisturbed Sample (UD)
●	Standard Penetration Resistance (ASTM D1586)
▼	Water Table at least 24 Hours after Drilling
▽	Water Table 1 Hour or less after Drilling
100/2”	Number of Blows (100) to Drive the Spoon a Number of Inches (2)
NX, NQ	Core Barrel Sizes: 2⅛- and 2-Inch Diameter Rock Core, Respectively
REC	Percentage of Rock Core Recovered
RQD	Rock Quality Designation – Percentage of Recovered Core Segments 4 or more Inches Long
▶	Loss of Drilling Water
MC	Moisture Content Test Performed
N/E	Not Encountered
N/M	Not Measured
C	Caving

Strata Symbols

■	Paving
⁘	Gravel /Graded Aggregate Base
▩	Fill
▨	Clayey Sand
▥	Silty Sand
▥	Sandy Silt/Silt
▨	Low Plasticity Clay
⊡	Partially Weathered Rock
▧	High Plasticity Clay
✓	Topsoil
▓	Alluvium
░	Poorly Graded Sand with Silt

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Number of Blows, "N"	Approximate Relative Density
SANDS	0 – 4	Very Loose
	5 – 10	Loose
	11 – 30	Medium Dense
	31 – 50	Dense
	Over 50	Very Dense

	Number of Blows, "N"	Approximate Consistency
SILTS and CLAYS	0 – 2	Very Soft
	3 – 4	Soft
	5 – 8	Firm
	9 – 15	Stiff
	16 – 30	Very Stiff
	31 – 50	Hard
	Over 50	Very Hard

DRILLING PROCEDURES

Soil sampling and standard penetration testing performed in accordance with ASTM D1586. The standard penetration resistance is the number of blows of a 140 pound hammer falling 30 inches to drive a 2-inch O.D., 1⅖-inch I.D. split spoon sampler one foot. The undisturbed sampling procedure is described by ASTM D1587.

SOIL CLASSIFICATION CHART

COARSE GRAINED SOILS	**GRAVELS**	Clean Gravel less than 5% fines	GW	Well graded gravel
			GP	Poorly graded gravel
		Gravels with Fines more than 12% fines	GM	Silty gravel
			GC	Clayey gravel
	SANDS	Clean Sand less than 5% fines	SW	Well graded sand
			SP	Poorly graded sand
		Sands with Fines more than 12% fines	SM	Silty sand
			SC	Clayey sand
FINE GRAINED SOILS	**SILTS AND CLAYS** Liquid Limit less than 50	Inorganic	CL	Lean clay
			ML	Silt
		Organic	OL	Organic clay and silt
	SILTS AND CLAYS Liquid Limit 50 or more	Inorganic	CH	Fat clay
			MH	Elastic silt
		Organic	OH	Organic clay and silt
HIGHLY ORGANIC SOILS		Organic matter, dark color, organic odor	PT	Peat

PARTICLE SIZE IDENTIFICATION

GRAVELS	Coarse	¾ inch to 3 inches
	Fine	No. 4 to ¾ inch
SANDS	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40
SILTS AND CLAYS		Passing No. 200

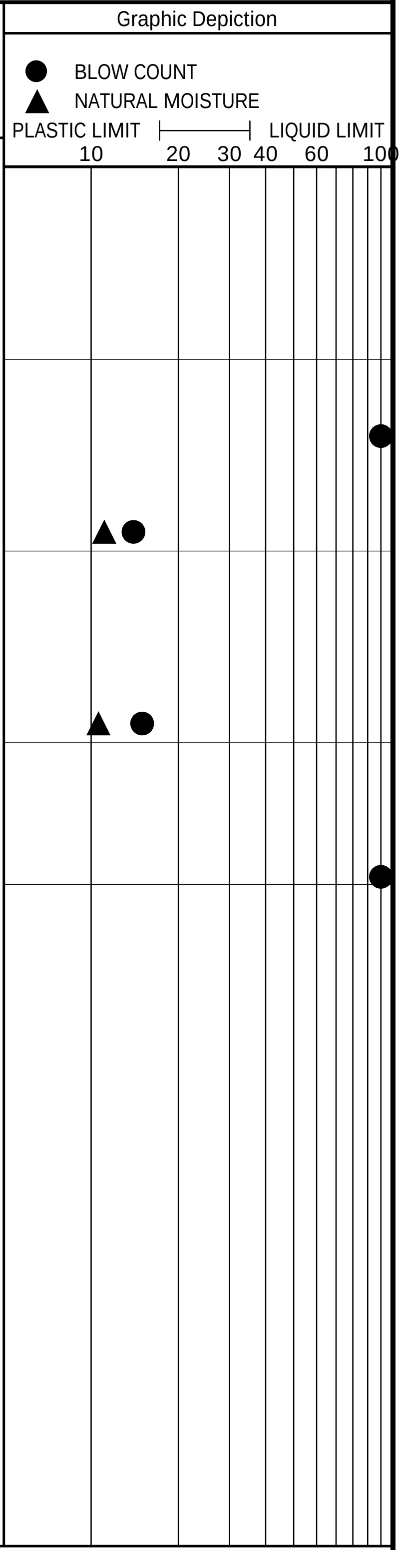
TEST BORING RECORD
B2-1

PROJECT: [redacted] - PI# 0001757
CLIENT: AECOM/GDOT
PROJECT LOCATION: SR 400 - Fulton and Forsyth Counties
LOCATION: BFI 2 - Roberts Drive over SR 400
DRILLER: S&ME CME-550X (SN 292103)
DRILLING METHOD: Hollow Stem Auger % ENERGY: 91.4
DEPTH TO - WATER> INITIAL: ∇ N/E AFTER 24 HOURS: ▼ N/M CAVING> C

PROJECT NO.: 2018089
LATITUDE: 33.99145926
LONGITUDE: -84.33860112
ELEVATION: 1050.2 feet
LOGGED BY: J. Cobkit
DATE: 2/8/2019

Depth (feet): 0, 5, 10, 15, 20, 25, 30, 35
Elevation (ft-NAVD 88): 1050, 1045, 1040, 1035, 1030, 1025, 1020, 1015

Description	N-Value
TOPSOIL: 2 inches	
RESIDUUM: White tan silty medium to fine SAND (SM)	
PARTIALLY WEATHERED ROCK: Sampled as very dense white tan silty medium to fine SAND	100/ 10"
RESIDUUM: Medium dense brown micaceous silty coarse to fine SAND (SM)	14
Medium dense brown micaceous silty medium to fine SAND (SM)	15
PARTIALLY WEATHERED ROCK: Sampled as very dense white red gray silty coarse SAND	100/2"
Auger Refusal at 18.7 ft.	



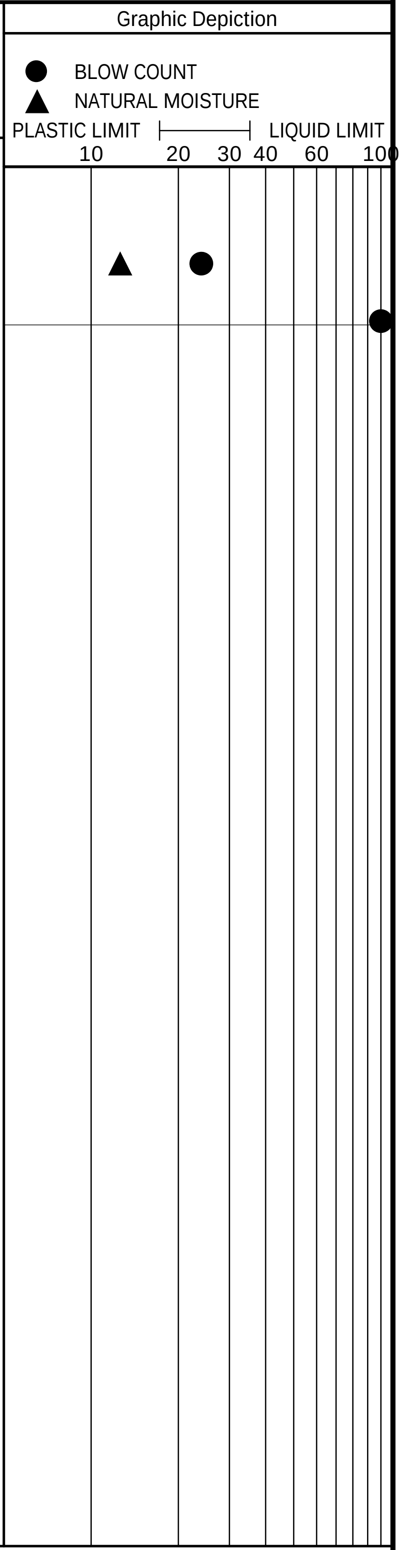
Boring was offest 3 times, the first 3 borings all refused at 6 feet.
Auger only upper 6 ft.

This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD
B2-2

PROJECT: [redacted] - PI# 0001757
PROJECT NO.: 2018089
CLIENT: AECOM/GDOT
LATITUDE: 33.99158441
PROJECT LOCATION: SR 400 - Fulton and Forsyth Counties
LONGITUDE: -84.33817267
LOCATION: BFI 2 - Roberts Drive over SR 400
ELEVATION: 1034.4 feet
DRILLER: S&ME Diedrich D-50 Track (SN 382)
LOGGED BY: J. Cobkit
DRILLING METHOD: Hollow Stem Auger % ENERGY: 98.1
DATE: 5/20/2019
DEPTH TO - WATER> INITIAL: ∇ N/E AFTER 24 HOURS: ▼ N/M CAVING> C

Depth (feet)	Elevation (ft-NAVD 88)	Description	Graphic	Groundwater	Sample Type	N-Value
0						
		CONCRETE: 9.25 inches				
		GRADED AGGREGATE BASE: 6 inches				
		FILL: Medium dense brown white gray black micaceous silty medium to fine SAND with rock fragments (SM)				24
5	1030	PARTIALLY WEATHERED ROCK: Sampled as very dense brown silty medium to fine SAND, trace mica and rock fragments				100/6"
		Auger Refusal at 4.1 ft.				
10	1025					
15	1020					
20	1015					
25	1010					
30	1005					
35	1000					

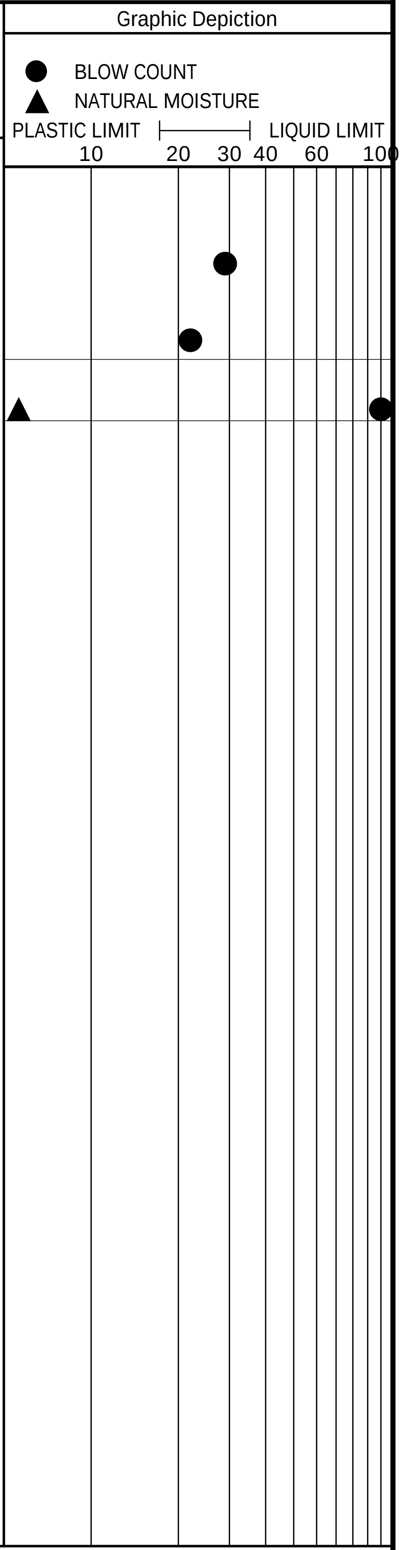


This information pertains only to this boring and should not be interpreted as being indicative of the site.

TEST BORING RECORD
B2-2A

PROJECT: [redacted] - PI# 0001757
PROJECT NO.: 2018089
CLIENT: AECOM/GDOT
LATITUDE: 33.99158441
PROJECT LOCATION: SR 400 - Fulton and Forsyth Counties
LONGITUDE: -84.33817267
LOCATION: BFI 2 - Roberts Drive over SR 400
ELEVATION: 1034.4 feet
DRILLER: S&ME Diedrich D-50 Track (SN 382)
LOGGED BY: J. Cobkit
DRILLING METHOD: Hollow Stem Auger % ENERGY: 98.1
DATE: 5/20/2019
DEPTH TO - WATER> INITIAL: ▽ N/E AFTER 24 HOURS: ▼ N/M CAVING> C

Depth (feet)	Elevation (ft-NAVD 88)	Description	N-Value
0			
		CONCRETE: 9.5 inches	
		GRADED AGGREGATE BASE: 6 inches	
		FILL: Medium dense gray silty medium to fine SAND (SM)	29
5	1030	Medium dense brown silty medium fine SAND with rock fragments (SM)	22
		PARTIALLY WEATHERED ROCK: Sampled as very dense white well-graded coarse to fine GRAVEL with silt and sand	100/6"
		Auger Refusal at 6.6 ft.	
10	1025		
15	1020		
20	1015		
25	1010		
30	1005		
35	1000		



This information pertains only to this boring and should not be interpreted as being indicative of the site.

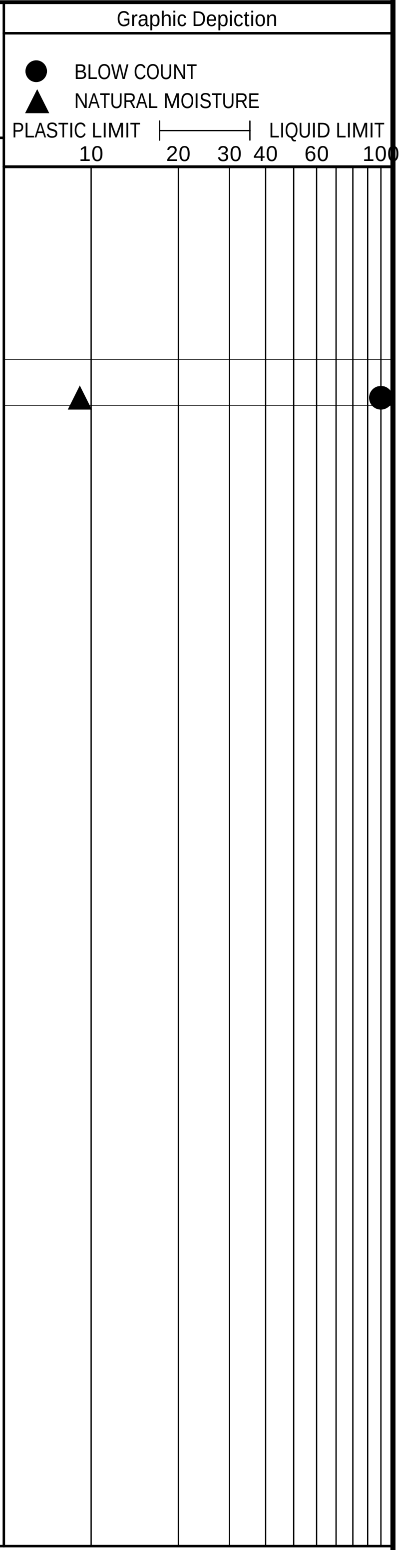
Boring B2-2A was offset 10 feet south of boring B2-2

TEST BORING RECORD
B2-3

PROJECT: [redacted] - PI# 0001757
PROJECT NO.: 2018089
CLIENT: AECOM/GDOT
LATITUDE: 33.99149878
PROJECT LOCATION: SR 400 - Fulton and Forsyth Counties
LONGITUDE: -84.33787676
LOCATION: BFI 2 - Roberts Drive over SR 400
ELEVATION: 1032.7 feet
DRILLER: S&ME CME-550X (SN 292103)
LOGGED BY: J. Cobkit
DRILLING METHOD: Hollow Stem Auger % ENERGY: 91.4
DATE: 4/30/2019
DEPTH TO - WATER> INITIAL: ▽ N/E AFTER 24 HOURS: ▼ N/M CAVING> C

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Depth (feet)	Elevation (ft-NAVD 88)	Description	Graphic	Groundwater	Sample Type	N-Value
0		TOPSOIL: 3 inches				
		RESIDUUM: Gray silty medium to fine SAND (SM)				
	1030					
5						
		PARTIALLY WEATHERED ROCK: Sampled as very dense grayish brown silty coarse to fine SAND				100/2"
	1025	Auger Refusal at 6.2 ft.				
10						
	1020					
15						
	1015					
20						
	1010					
25						
	1005					
30						
	1000					
35						



Auger only upper 6 ft.

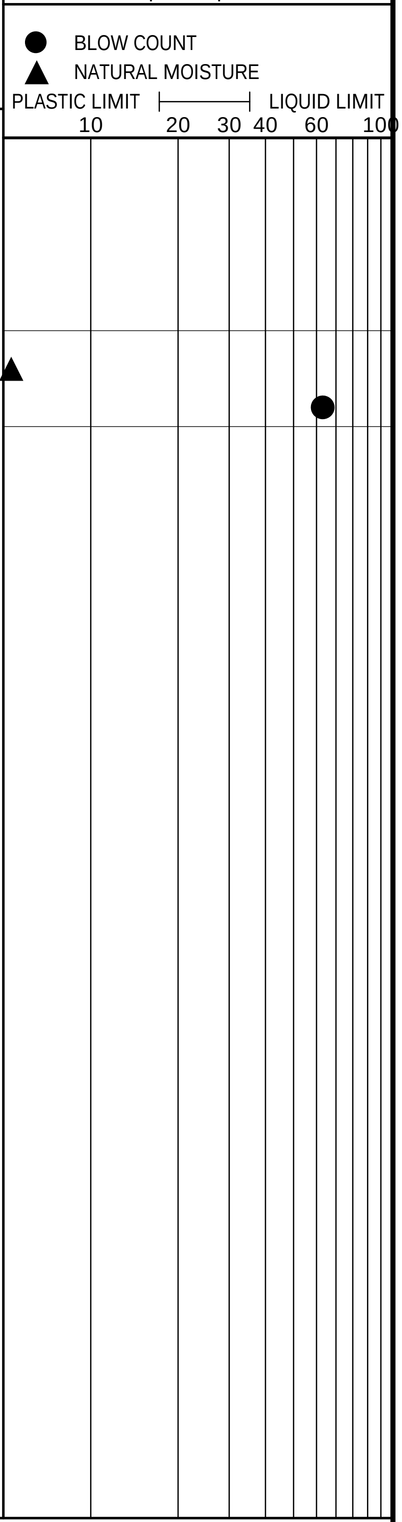
NOVA

TEST BORING RECORD
B2-3A

PROJECT: [redacted] - PI# 0001757
PROJECT NO.: 2018089
CLIENT: AECOM/GDOT
LATITUDE: 33.99149878
PROJECT LOCATION: SR 400 - Fulton and Forsyth Counties
LONGITUDE: -84.33787676
LOCATION: BFI 2 - Roberts Drive over SR 400
ELEVATION: 1032.7 feet
DRILLER: S&ME CME-550X (SN 292103)
LOGGED BY: J. Cobkit
DRILLING METHOD: Hollow Stem Auger % ENERGY: 91.4
DATE: 4/30/2019
DEPTH TO - WATER> INITIAL: ∇ N/E AFTER 24 HOURS: ▼ N/M CAVING> C

Depth (feet)	Elevation (ft-NAVD 88)	Description	Graphic	Groundwater	Sample Type	N-Value
0		TOPSOIL: 3 inches				
	1030	RESIDUUM: Gray well-graded GRAVEL with silt and coarse to fine sand (GW-GM)				
5		Very dense gray well-graded GRAVEL with silt and coarse to fine sand (GW-GM)			◣	63
	1025	Auger Refusal at 7.5 ft.				
10						
	1020					
15						
	1015					
20						
	1010					
25						
	1005					
30						
	1000					
35						

Graphic Depiction



This information pertains only to this boring and should not be interpreted as being indicative of the site.

Boring B2-3A offset 10 feet north of boring B2-3
Auger only upper 6 ft.

APPENDIX C

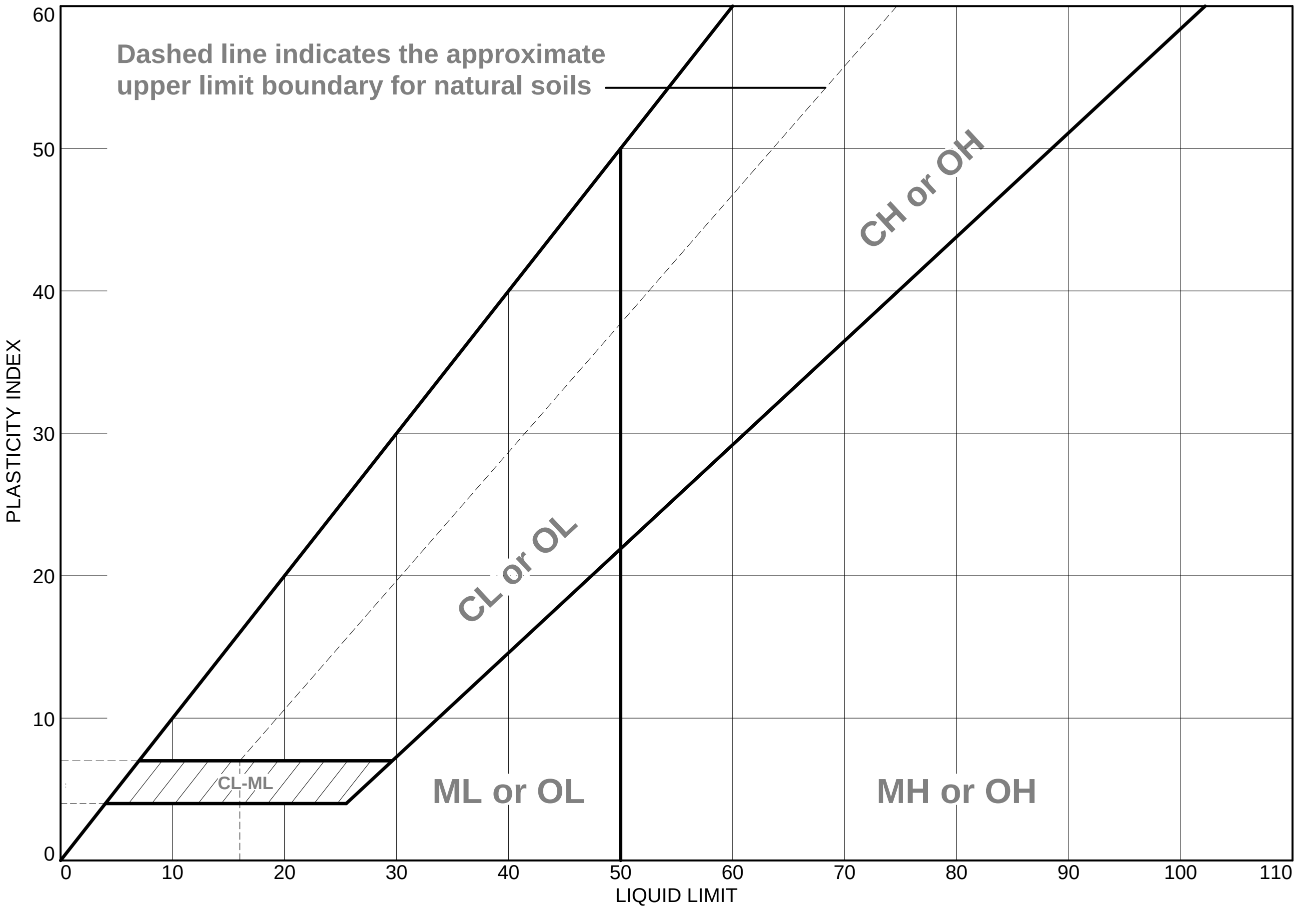
LABORATORY TEST DATA

Table A: Bridge 2 Summary of Laboratory Tests Results

BORING No.	SAMPLE DEPTH (Feet)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT FINER #40	PERCENT FINER #200	USCS CLASSIFICATION	MOISTURE CONTENT (%)
B2-1	10.0	NP	NP	NP	65.7	22.6	SM	11.1
B2-1	15.0	NP	NP	NP	65.7	21.9	SM	10.6
B2-2	3.0	NP	NP	NP	46.3	23.2	SM	12.6
B2-2A	7.0	NP	NP	NP	21.1	8.9	GW-GM	1.7
B2-3	7.5	NP	NP	NP	54.6	27.7	SM	8.7
B2-3A	7.5	NP	NP	NP	21.3	7.5	GW-GM	0.9

NP: Non-Plastic

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown micaceous silty medium to fine SAND	NP	NP	NP	65.7	22.6	SM

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

●**Source of Sample:** B2-1 @ 8.5-10 **Depth:** 8.5-10 **Sample Number:** B2-1

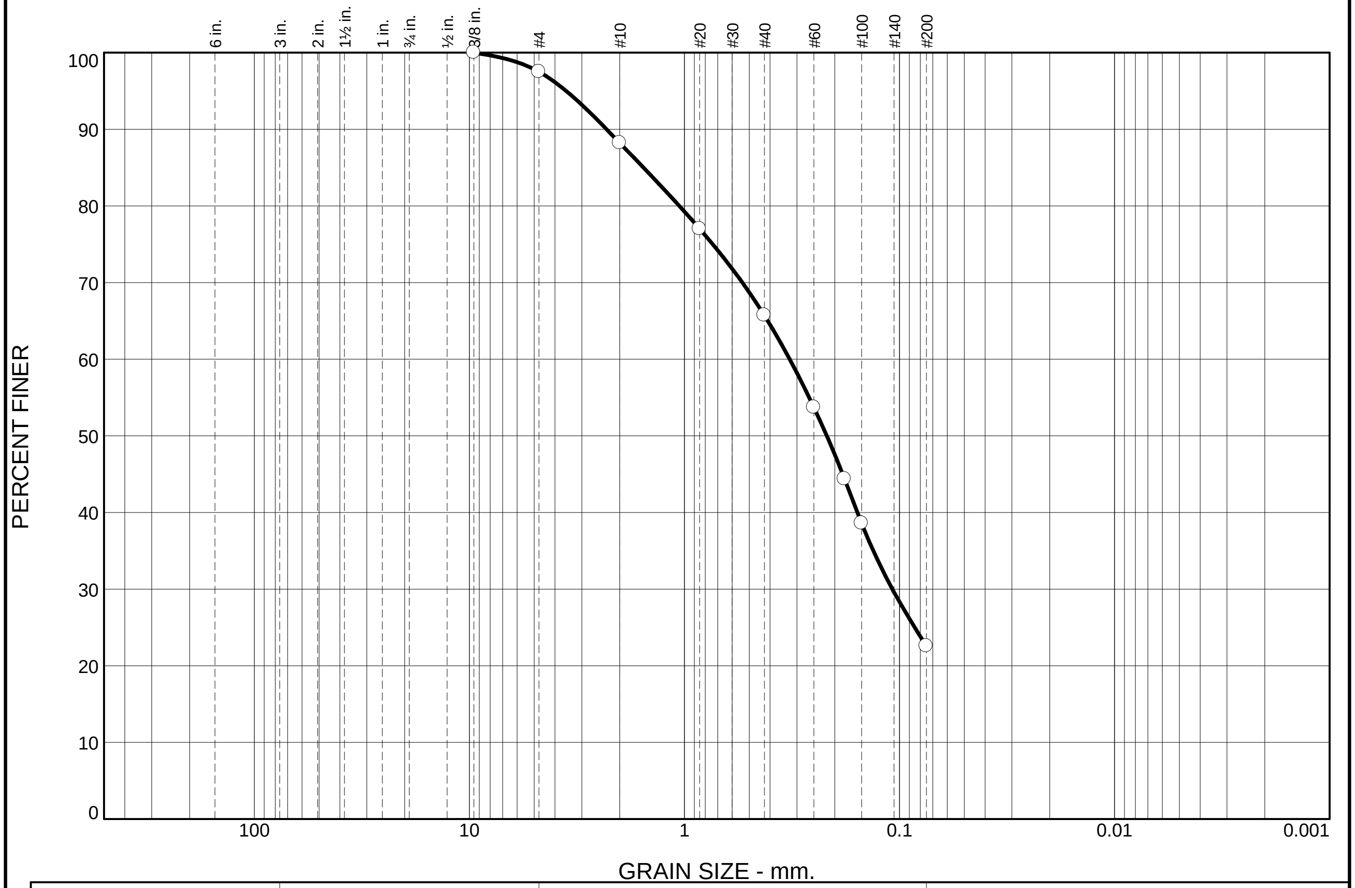
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: ML Smith

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.5	9.3	22.5	43.1	22.6	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.5510	0.3240	0.2177	0.1079				

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Brown micaceous silty medium to fine SAND	3/14/19	SM	11.1

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-1 @ 8.5-10 **Depth:** 8.5-10 **Sample Number:** B2-1

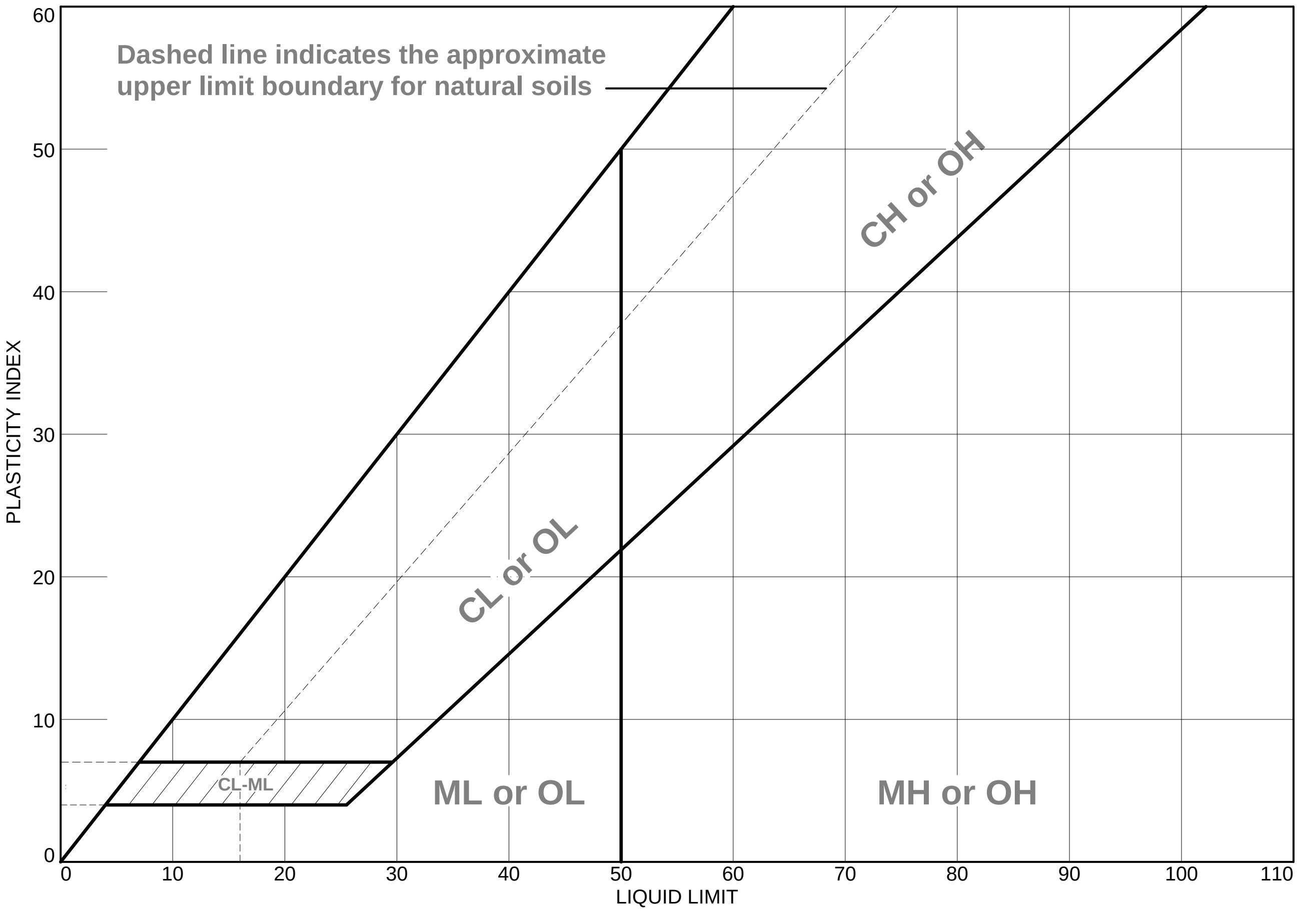
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: ML Smith

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	White and brown micaceous silty medium to fine SAND	NP	NP	NP	65.7	21.9	SM

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

● **Source of Sample:** B2-1 @ 13.5-15 **Depth:** 13.5-15 **Sample Number:** B2-1

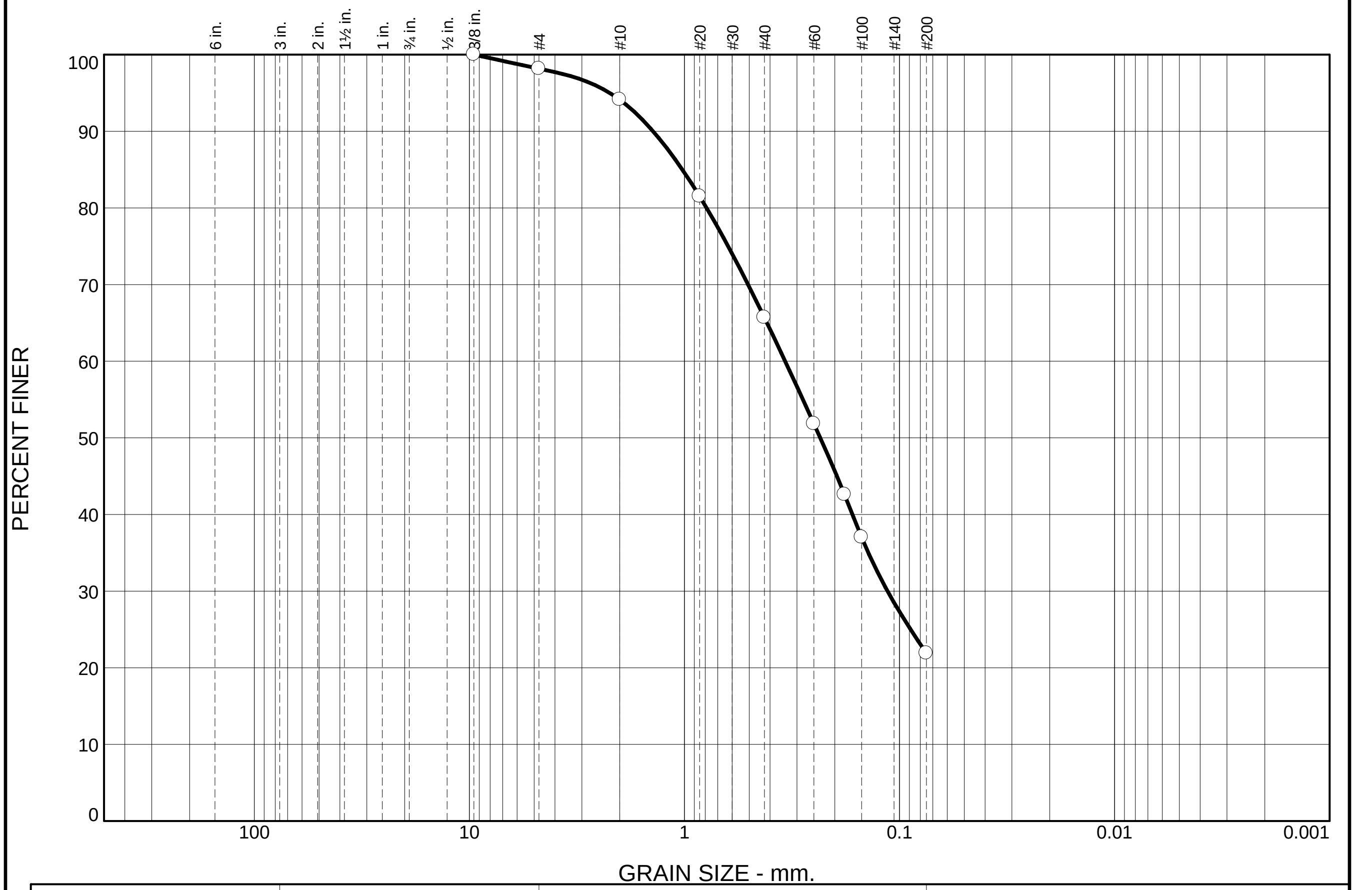
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: ML Smith

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	4.1	28.4	43.8	21.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.0227	0.3402	0.2336	0.1137				

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ White and brown micaceous silty medium to fine SAND	3/14/19	SM	10.6

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-1 @ 13.5-15 **Depth:** 13.5-15 **Sample Number:** B2-1

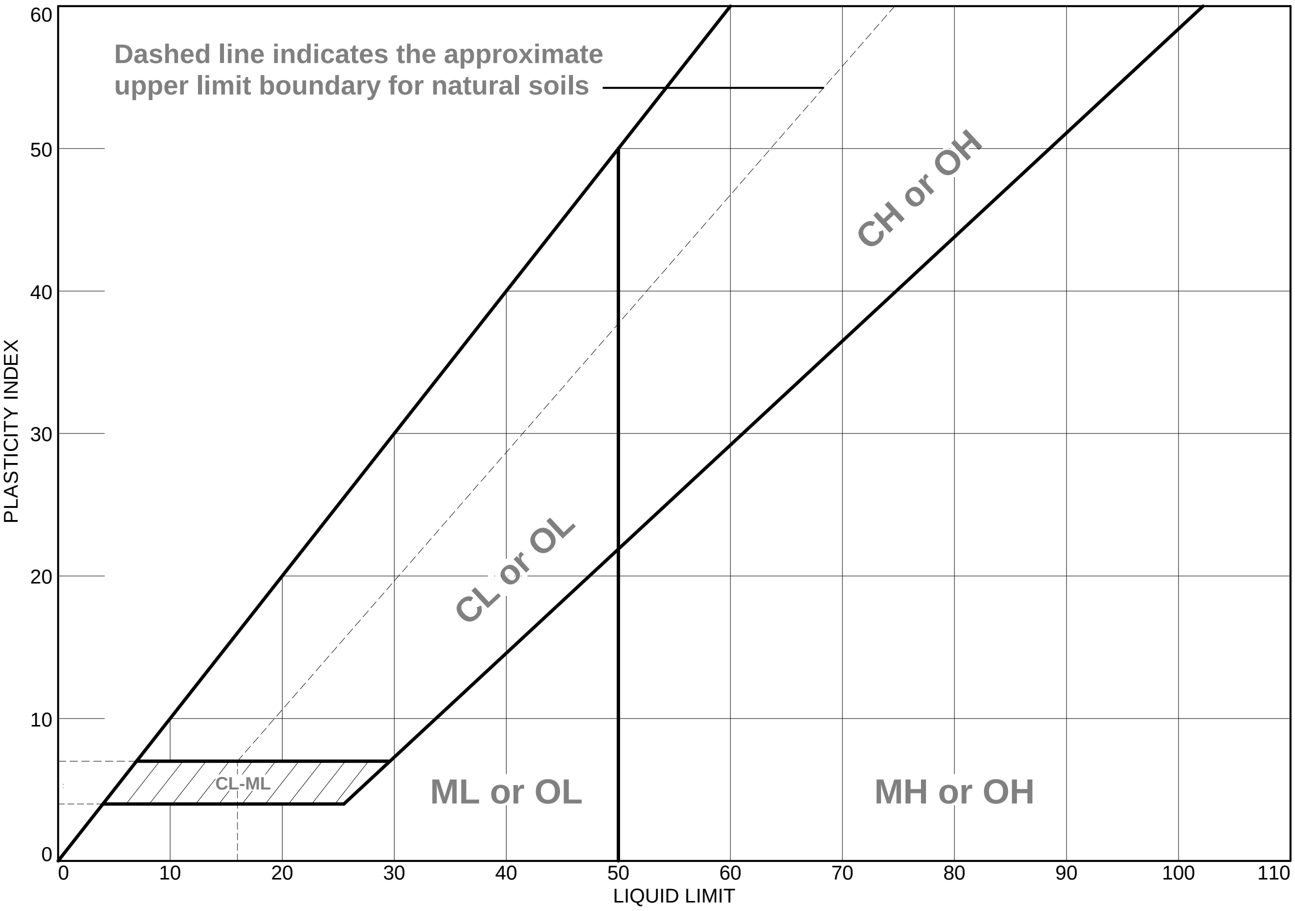
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: ML Smith

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown, white, gray and black micaceous silty medium to fine SAND with coarse to fine gravel	NP	NP	NP	46.3	23.2	SM

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

●**Source of Sample:** B2-2 @ 1.5-3.0 **Depth:** 1.5-3.0 **Sample Number:** B2-2

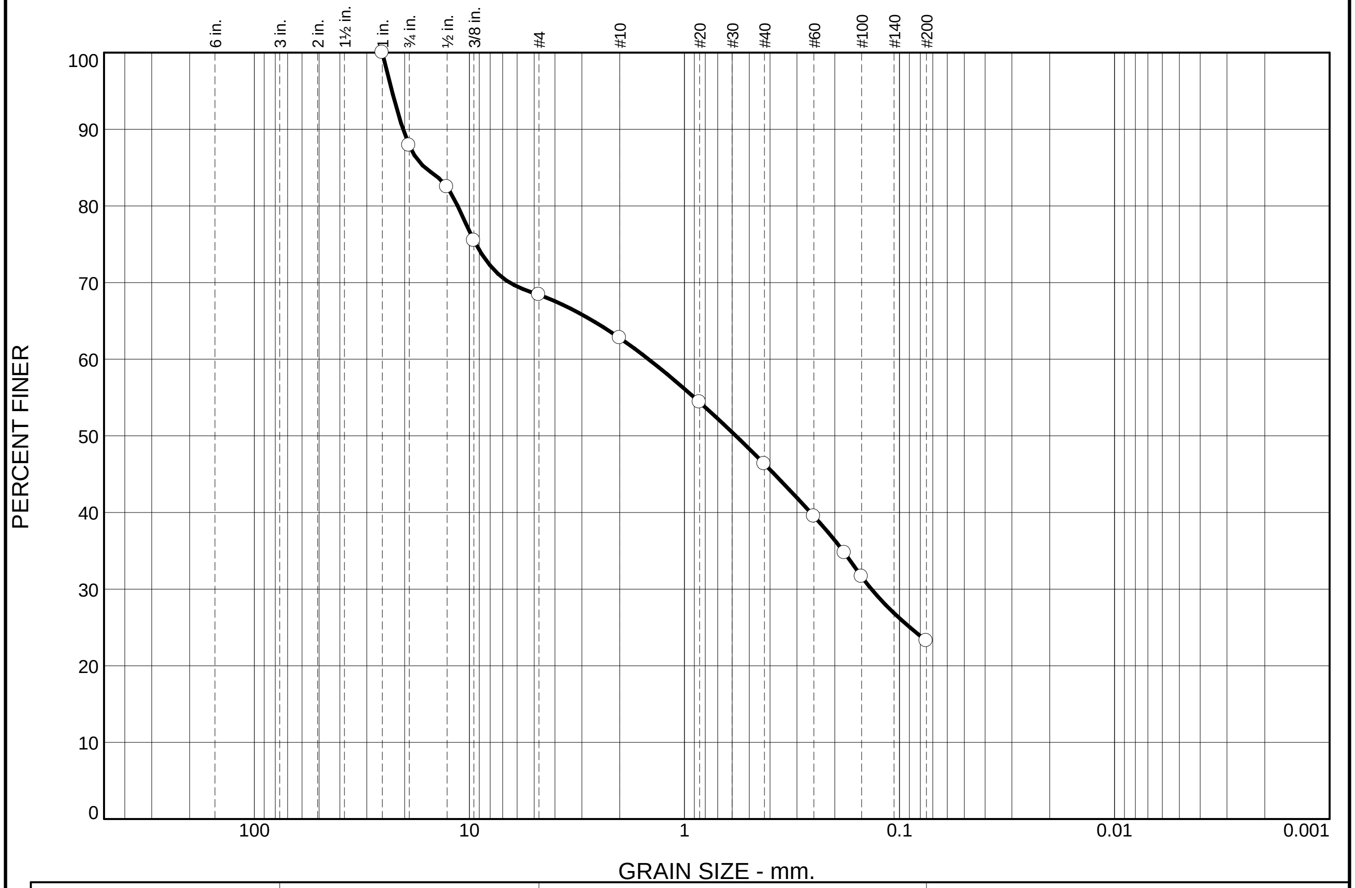
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: MLS

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	12.1	19.5	5.6	16.5	23.1	23.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	16.0914	1.4693	0.5767	0.1351				

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Brown, white, gray and black micaceous silty medium to fine SAND with coarse to fine gravel	6/11/19	SM	12.6

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-2 @ 1.5-3.0 **Depth:** 1.5-3.0 **Sample Number:** B2-2

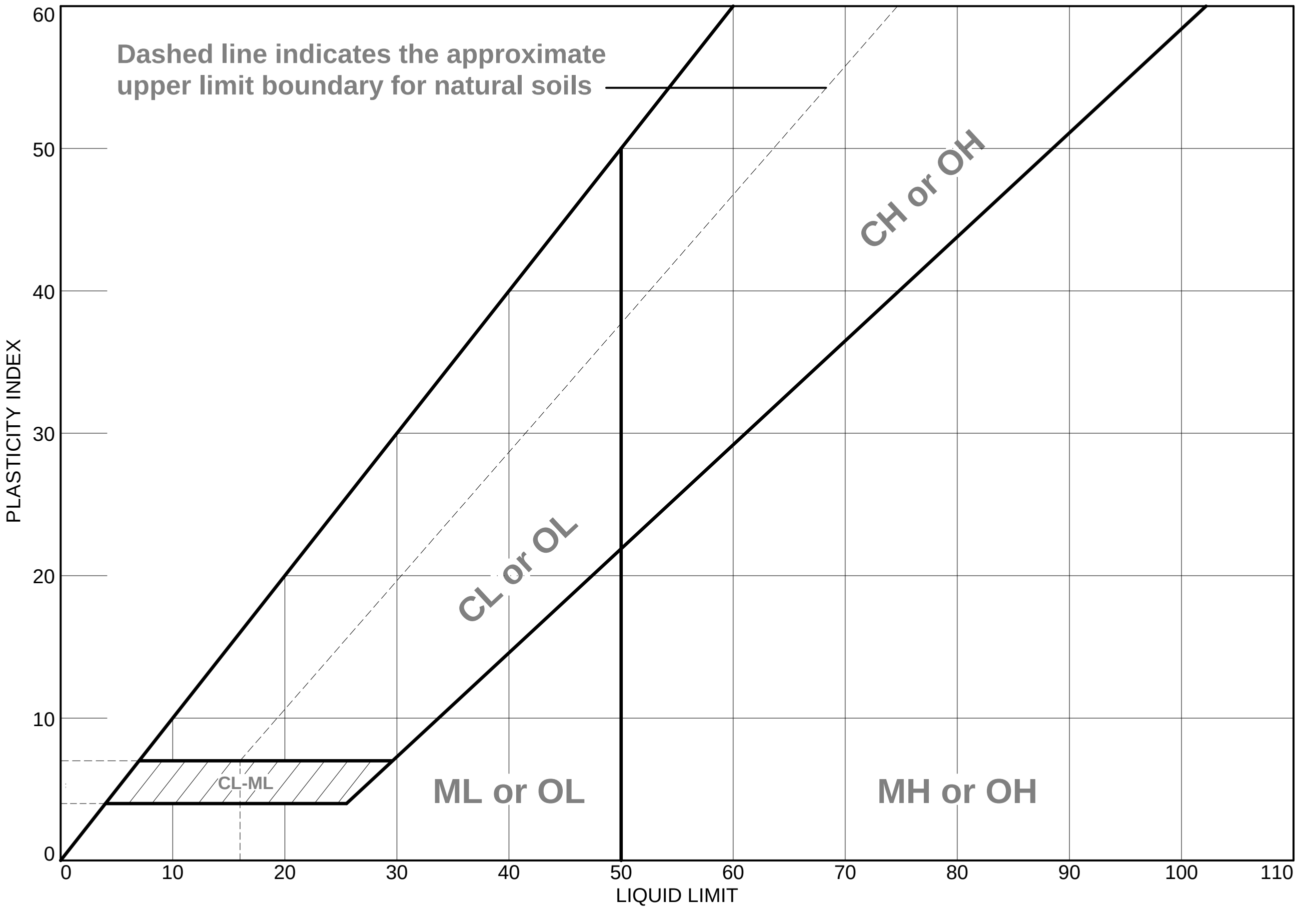
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: AB

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	White well-graded coarse to fine GRAVEL with silt and sand	NP	NP	NP	21.1	8.9	GW-GM

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

●**Source of Sample:** B2-2A @ 5.5-7.0 **Depth:** 5.5-7.0 **Sample Number:** B2-2A

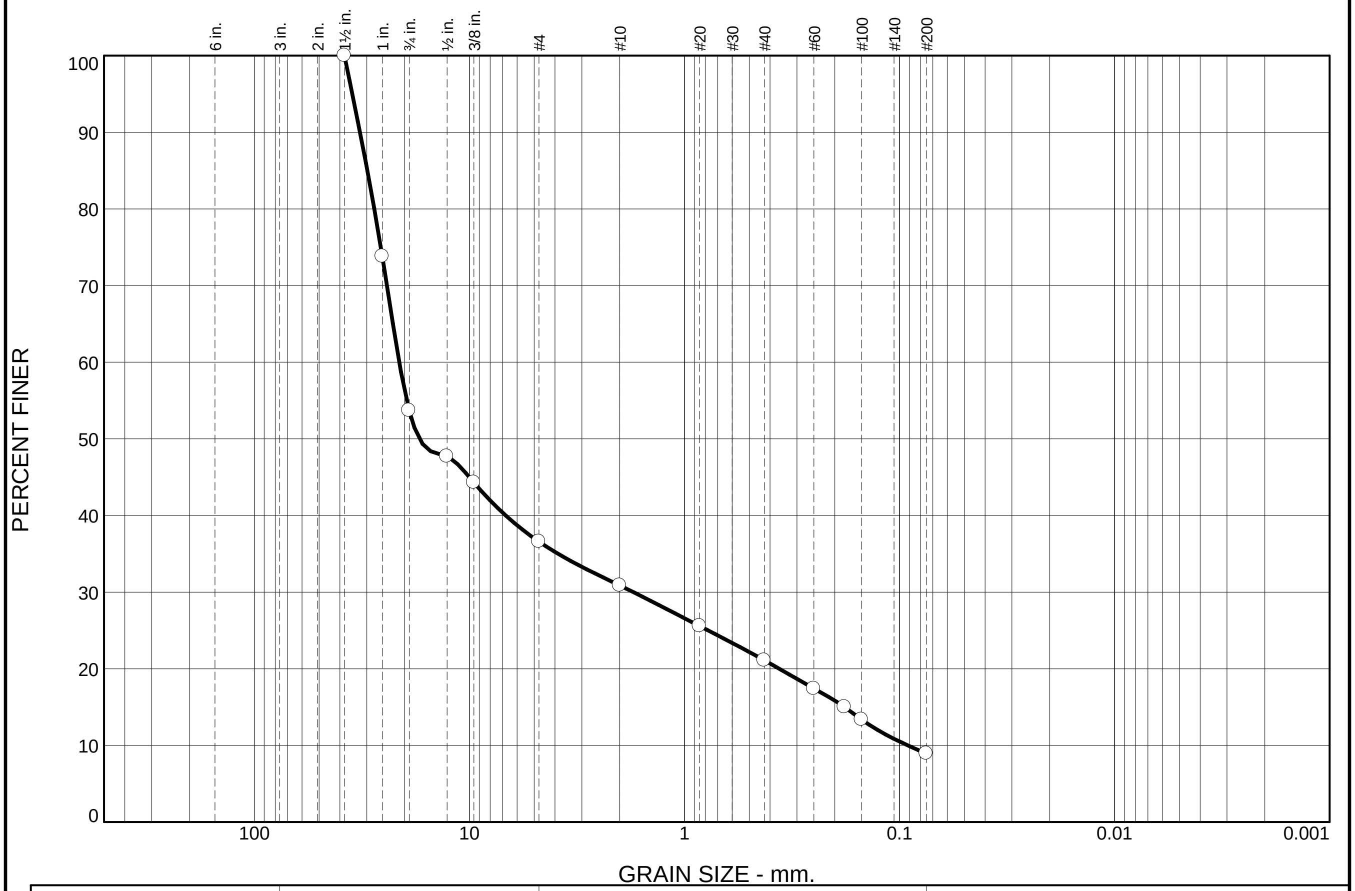
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: MLS

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	46.3	17.1	5.7	9.8	12.2	8.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	29.8181	21.1808	17.0906	1.7290	0.1800	0.0914	1.54	231.69

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ White well-graded coarse to fine GRAVEL with silt and sand	6/11/19	GW-GM	1.7

Project No. 2018089 **Client:** AECOM

Project: [redacted]BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-2A @ 5.5-7.0 **Depth:** 5.5-7.0 **Sample Number:** B2-2A

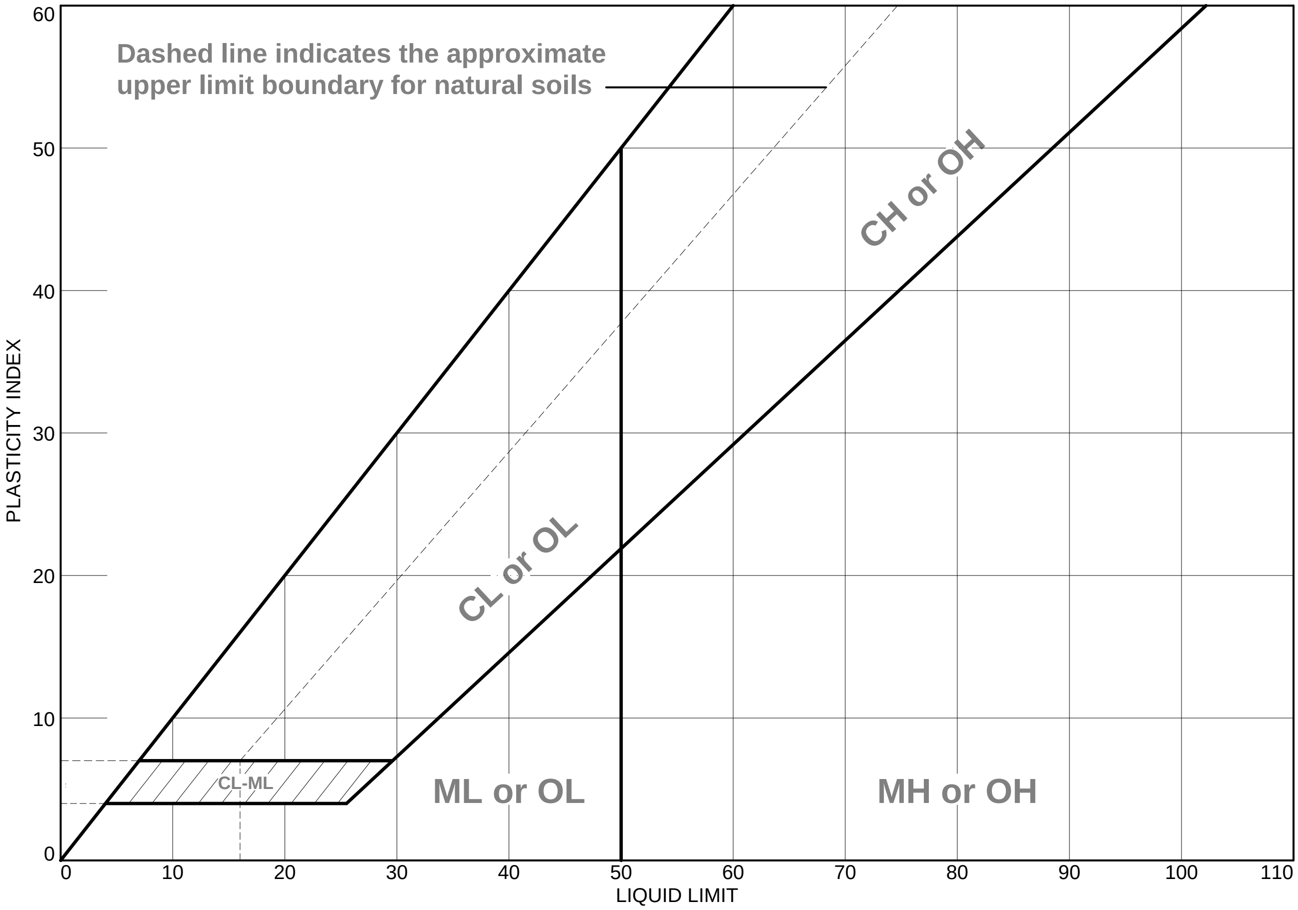
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: AB

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Grayish brown silty coarse to fine SAND	NP	NP	NP	54.6	27.7	SM

Project No. 2018089 **Client:** AECOM

Project: [redacted]BFI 2 Roberts Drive over SR 400

●**Source of Sample:** B2-3 @ 6-7.5 **Depth:** 6-7.5 **Sample Number:** B2-3

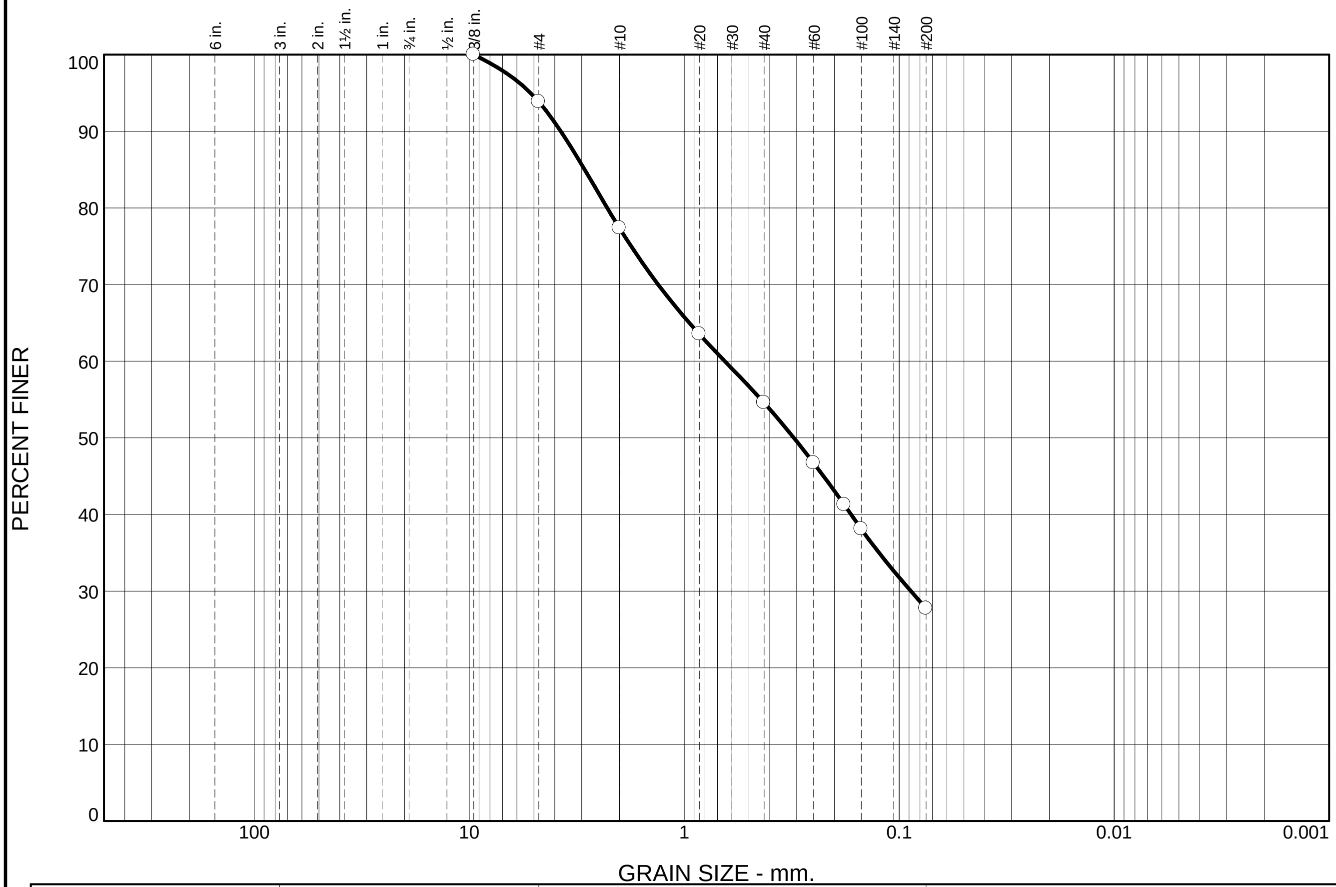
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: MLS

Particle Size Distribution Report - ASTM D6913



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.1	16.5	22.8	26.9	27.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	2.9035	0.6473	0.3090	0.0882				

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Grayish brown silty coarse to fine SAND	6/3/19	SM	8.7

Project No. 2018089 **Client:** AECOM

Project: [redacted]BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-3 @ 6-7.5 **Depth:** 6-7.5 **Sample Number:** B2-3

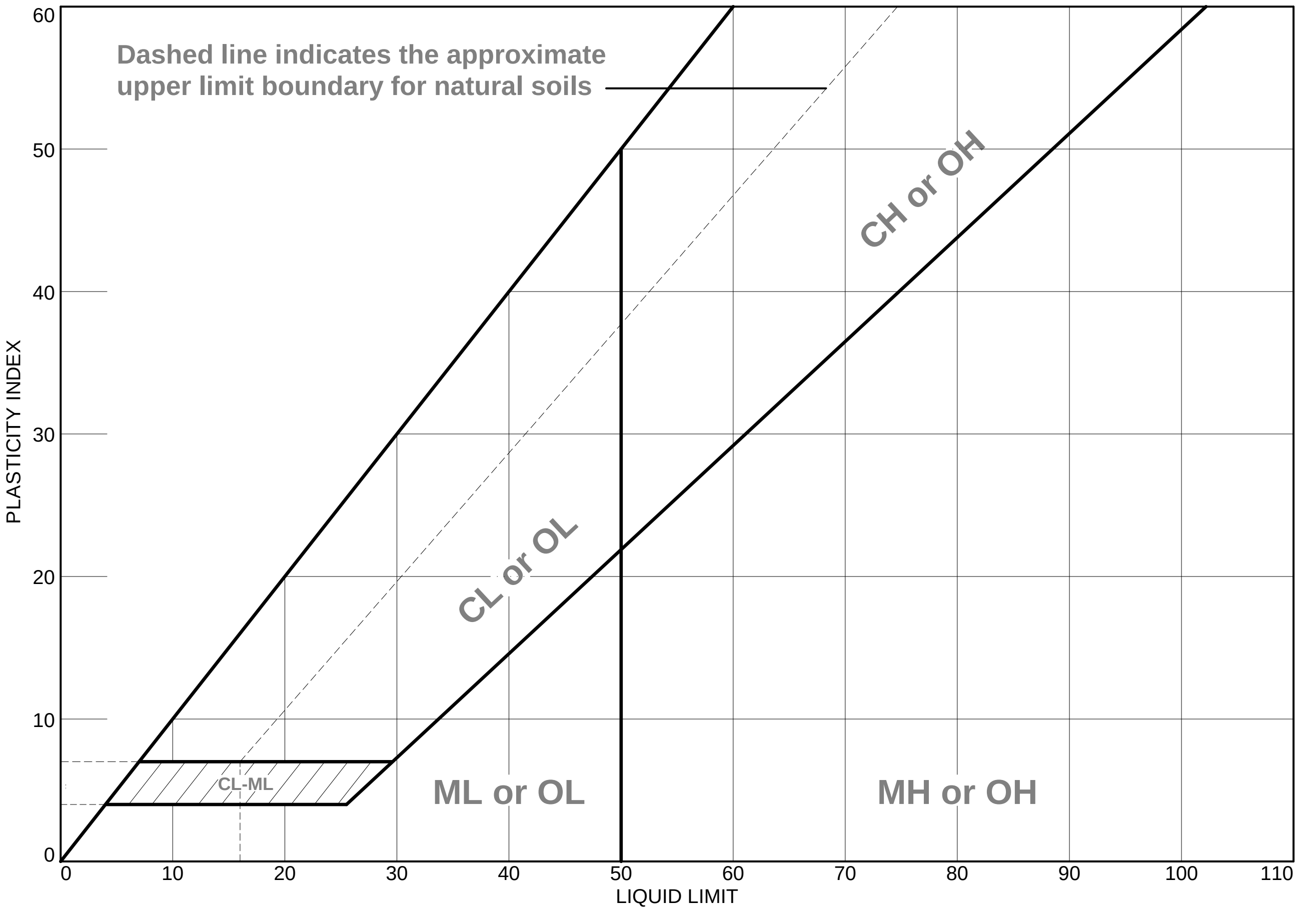
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: AB

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray well-graded GRAVEL with silt and coarse to fine sand	NP	NP	NP	21.3	7.5	GW-GM

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

●**Source of Sample:** B2-3A @ 6-7.5 **Depth:** 6-7.5 **Sample Number:** B2-3A

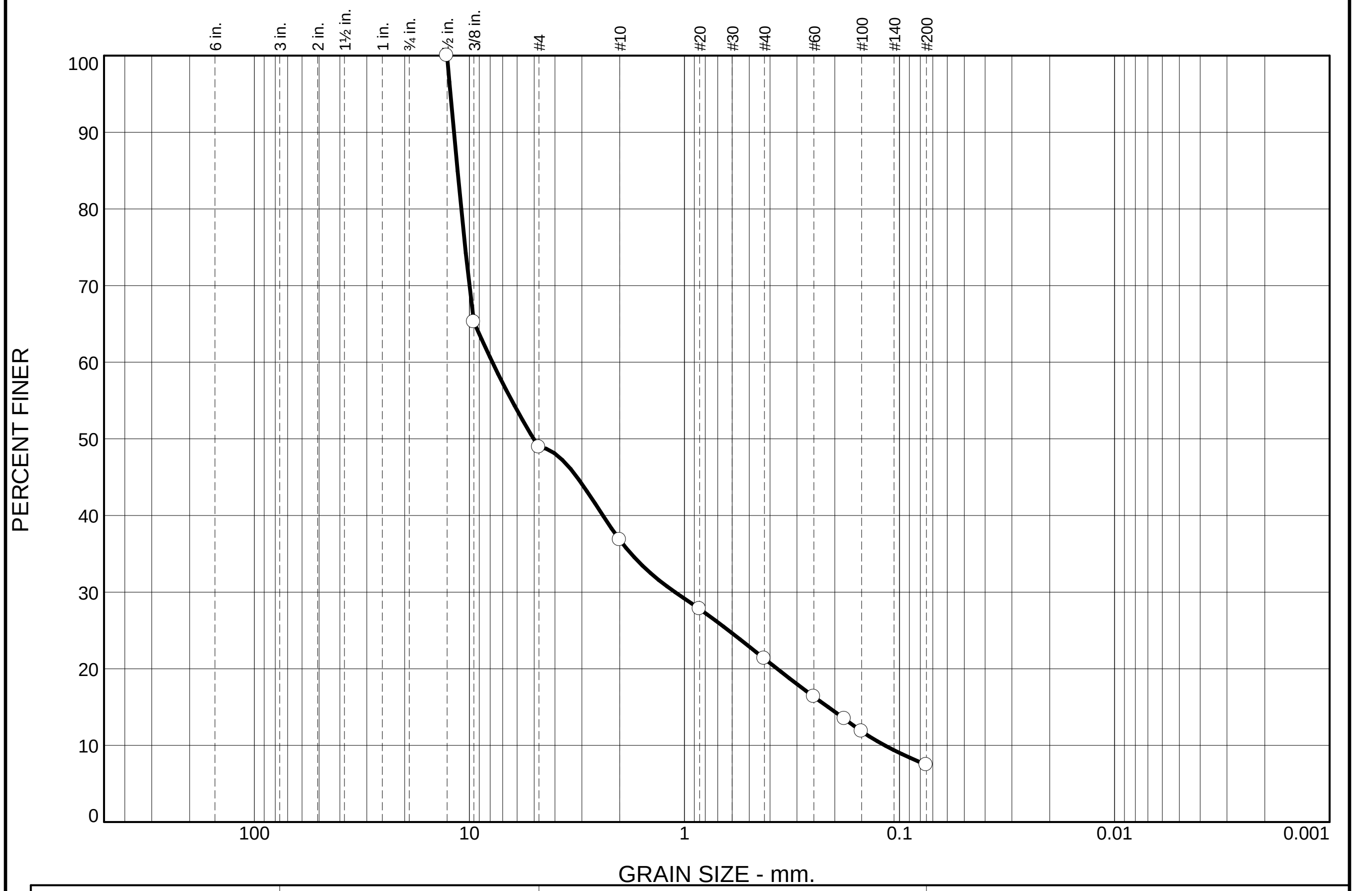
Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: MLS

Particle Size Distribution Report - ASTM D6913



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	51.1	12.1	15.5	13.8	7.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	11.3531	7.8191	5.0233	1.1056	0.2146	0.1171	1.34	66.79

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Gray well-graded GRAVEL with silt and coarse to fine sand	6/3/19	GW-GM	0.9

Project No. 2018089 **Client:** AECOM

Project: [redacted] BFI 2 Roberts Drive over SR 400

○ **Source of Sample:** B2-3A @ 6-7.5 **Depth:** 6-7.5 **Sample Number:** B2-3A

Remarks:

NOVA ENGINEERING
Kennesaw, Georgia
770-425-0777

Figure

Tested By: AB

APPENDIX D

HISTORICAL DATA

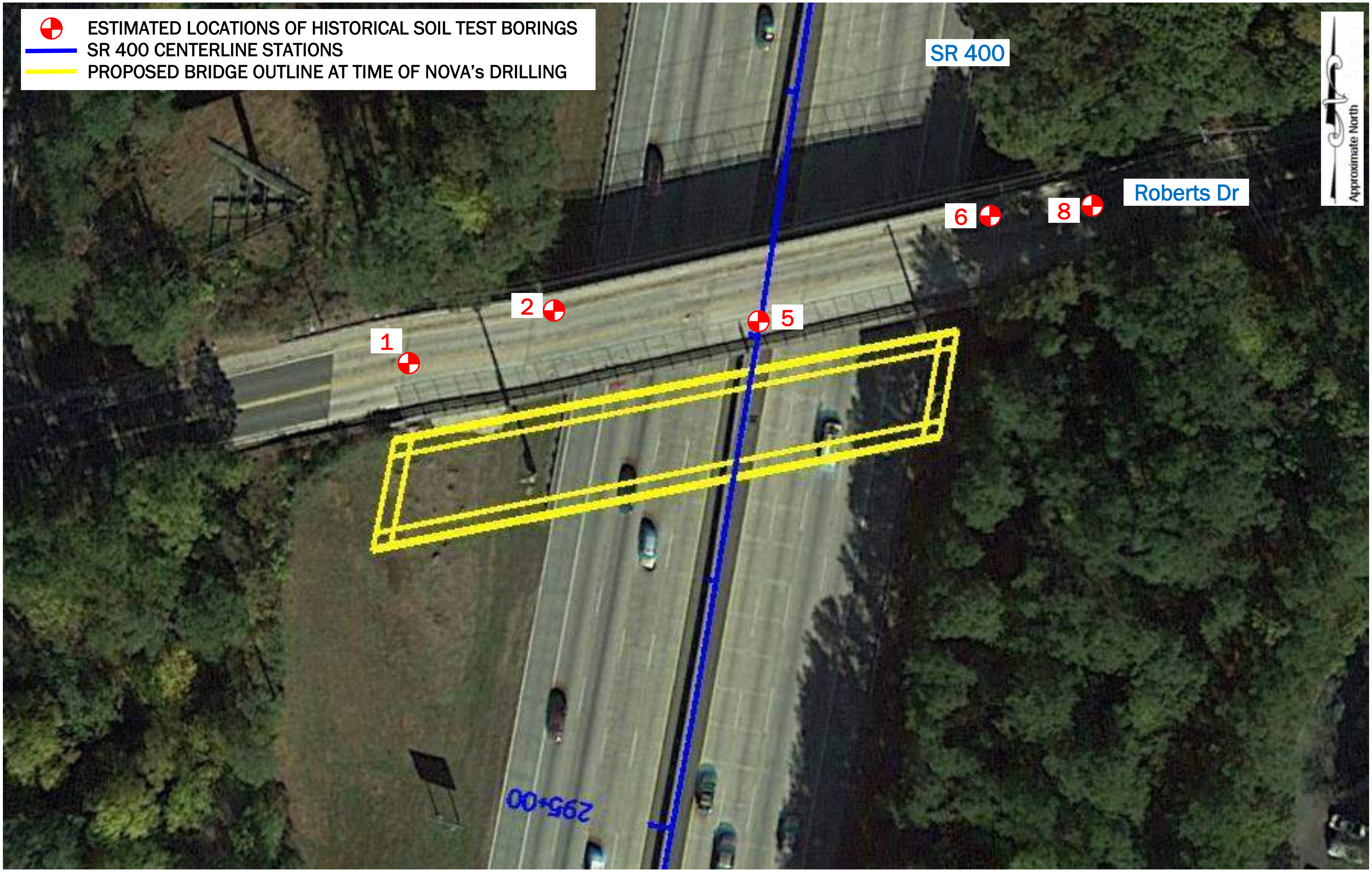


FIGURE 4

BRIDGE 2 – Roberts Dr over SR 400

HISTORICAL BORING LOCATION PLAN

SOURCE: Google Earth Aerial Photos

SCALE: Not to Scale

NOVA

PROFESSIONAL | PRACTICAL | PROVEN

[redacted] – PI No. 0001757

BFI GEOTECHNICAL DATA REPORT

Fulton & Forsyth Counties, Georgia

NOVA Project Number 2018089 - Task Order 5

FORM H. D. 66

TDM

STATE HIGHWAY DEPARTMENT OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE APD-F-056-1 (6) Fulton
Not Let to Contract

OFFICE Atlanta, Georgia

DATE March 29, 1967

FROM W. F. Abercrombie, Engineer of Materials and Tests

TO C. A. Marmelstein, State Highway Bridge Engineer

SUBJECT Bridge Foundation Investigation
APD-F-056-1 (6) Fulton
North Fulton Expressway Underpass
Roberts Drive
Bridge No. 14

As requested, a bridge foundation investigation has been made at the above listed project. Attached are the results of this work. If any additional information is needed, please notify us.

Very truly yours,

W. F. Abercrombie
Engineer of Materials and Tests

WFA:TDM:kab

BRIDGE FOUNDATION INVESTIGATION

APD-F-056-1 (6) FULTON
NORTH FULTON EXPRESSWAY UNDERPASS
ROBERTS DRIVE
BRIDGE NO. 14

1. LOCATION-

This bridge is to be located over the proposed North Fulton Expressway approximately 1.3 miles south of the Chattahoochee River crossing. It will be geologically located in a cut section containing dense residual soils underlain by weathered granite gneiss bedrock.

2. SUBSURFACE DETAILS-

Reference should be made to the attached boring logs and subsurface details. Some pertinent details are as follows:

a. The ground water table was between elevation 1024 and 1026.5 during this investigation.

b. Soils encountered near proposed footing elevations consisted chiefly of dense silty micaceous sands (residual soils) except at bent 4 right (boring #7). Soils encountered in boring 7 were noticeably looser.

c. Dense soil is located conveniently for safe support of spread footing foundations at all bents. These highly micaceous soils are easily disturbed when exposed to weathering; consequently, footings should be poured immediately after excavation.

3. END BENT FOUNDATIONS-

Steel "H" piles used in pile bents are suitable foundations for the end bents. The maximum bridge borings recommended for "H" piles at this site, based on soil strength are as follows:

10" BP 42's	40 Tons
12" BP 53's	55 Tons

These piles will be chiefly end bearing piles with pile tips seated in weathered rock. Pile tip elevations are estimated to range near elevation 1037 at bent 1 and near elevation 1050 at bent 7. Piles may be driven to bearing by the dynamic formula.

Spread Footings - Spread footings are also applicable for end bent foundations. These footings may be placed on dense soil as follows:

Bent	Footing Elevation	Max. Safe Design Press.
1	1062.5	4 ksf
7	1052.0	4 ksf

Slope paving and a cap to shoulder point berm width of at least 2' are recommended with this spread footing design. A minimum cover of 2' should also be provided.

4. <u>INTERMEDIATE BENT FOUNDATIONS</u>- Spread footings are recommended for all intermediate bent foundations. These footings may be placed on medium dense to dense soils as follows:

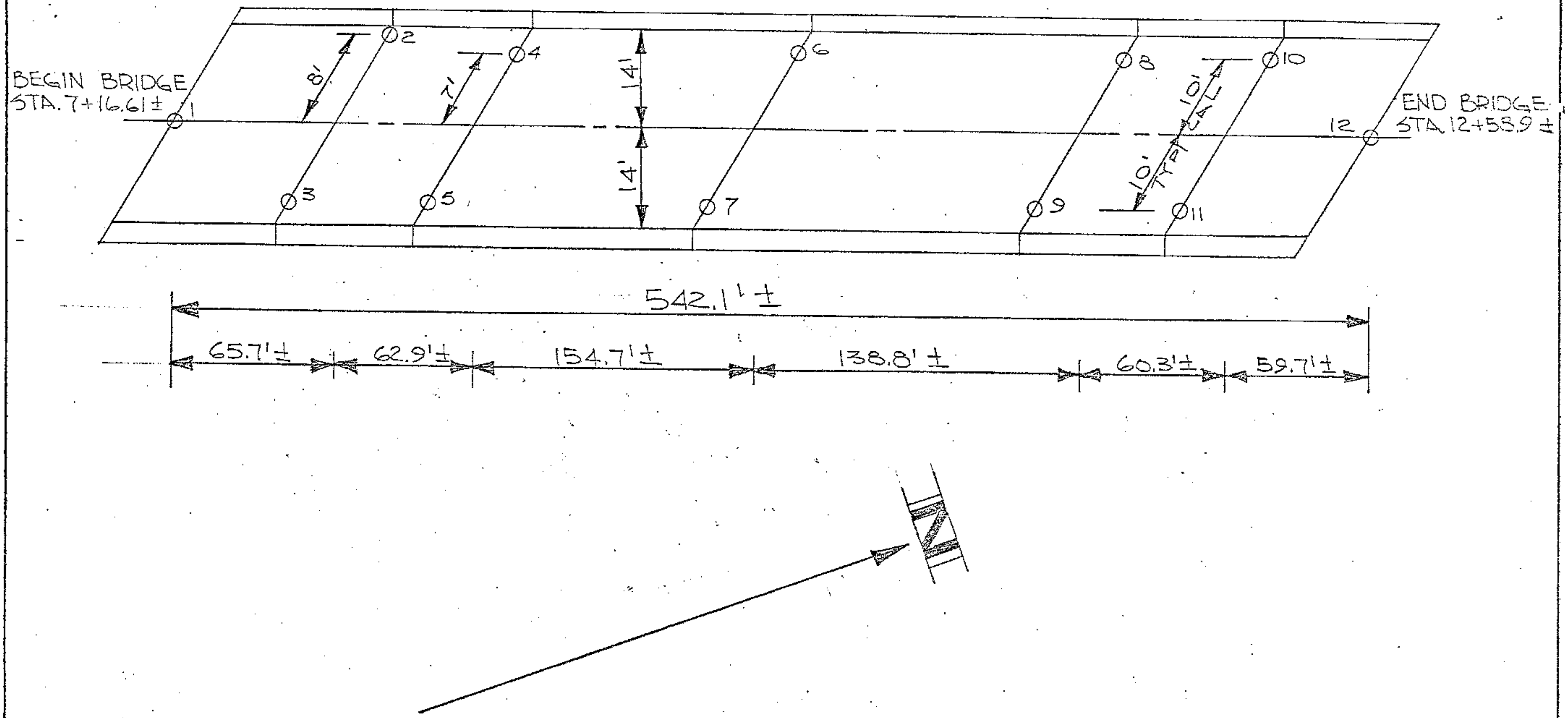
Bent	Footing	Elev.	Maximum Safe Design Press.
2	left	1036	4 ksf
2	right	1036	5 ksf
3	left	1034	5 ksf
3	right	1034	4 ksf
4	left	1034	4 ksf
4	right	1034	3.5 ksf

All spread footingsat this site should be poured as soon after excavation as possible to prevent disturbance of underlying soil.

Thomas D. Moreland
Civil Engineer V

TDM:DAM:kab

March 29, 1967



STATE HIGHWAY DEPARTMENT OF GEORGIA

Bridge Foundation Investigation

DRW. RT	APD-056-1(6) FULTON ROBERTS DR. BR. #14
CKD.	
APP.	NO SCALE 3-27-67

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-8-67

LOCATION ROBERTS DR. BR.#14 BORING NO. 1

BENT NO. 1 FOOTING ℄ GROUND ELEV. 1067.1

PROPOSED FOOTING ELEV. ______ PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST)	1S	14	SM										
1060	WEATHERED ROCK	2S	60=.6'	SM										
		3S	60=.7'	SM										
1050		4S	60=.0'	SM										
	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-13-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 2

BENT NO. 2 FOOTING LT. OFFSET 2' RT. GROUND ELEV. 1061.5

PROPOSED FOOTING ELEV. PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1060	DENSE MULTICOLORED SANDY SILT													
1050														
1040														
		1S	30	SM										
		2S	27	SM										
1030	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-14-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 3

BENT NO. 2 FOOTING RT. GROUND ELEV. 1063.0

PROPOSED FOOTING ELEV. PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1060	VERY DENSE MULTICOLORED SANDY SILT													
1050														
1040														
	DENSE (SAME)	1S	53	SM										
		2S	42	SM										
		3S	46	SM										
1030	VERY DENSE (SAME)													
		4S	60=.5'	SM										
	END DRILLING													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-14-67

LOCATION ROBERTS DR. BORING NO. 4

BENT NO. 3 FOOTING LT. OFFSET 3' RT. GROUND ELEV. 1057.3

PROPOSED FOOTING ELEV. PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	DENSE MULTICOLORED SANDY SILT (MOIST)													
1050														
1040														
		1S	40	SM										
	VERY DENSE (SAME)	2S	60=.6'	SM										
1030		3S	HAMMER BOUNCED											
		4S												
	WEATHERED ROCK	5S	24	SM										
GWT														
1020														
	REFUSAL ON ROCK?													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-14-67
LOCATION ROBERTS DR. BR. #14 BORING NO. 5
BENT NO. 3 FOOTING RT. GROUND ELEV. 1058.1
PROPOSED FOOTING ELEV. PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
1060	GR. ELEV.													
	DENSE MULTICOLORED SANDY SILT (MOIST)													
1050														
1040														
		1S	43	SM										
	MEDIUM DENSE (SAME)	2S	18	SM										
		3S	22	SM										
1030		4S	24	SM										
	WEATHERED ROCK	5S	60=.7'	SM										
1020														
	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-9-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 6

BENT NO. 4 FOOTING LT. GROUND ELEV. 1052.6

PROPOSED FOOTING ELEV. PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1050	DENSE MULTICOLORED SANDY SILT (MOIST)													
1040														
		1S	31	SM										
1030		2U												
SIUT		3S	42	SM										
		4S	43	SM										
1020		5S	26	SM										
	WEATHERED ROCK	6S	60=.5'	SM										
	REFUSAL ON ROCK													
1010														

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-8-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 7

BENT NO. 4 FOOTING RT. GROUND ELEV. 1051.6

PROPOSED FOOTING ELEV. PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1050	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST)													
1040														
		1S	23	SM										
		2S	15	SM										
1030														
		3S	12	SM										
		4S	24	SM										
GWT														
		5S	12	SM										
1020														
	WEATHERED ROCK	6S	60=.6'	SM										
	DENSE MULTICOLORED SANDY SILT	7S	26	SM										
1010	REFUSAL ON ROCK?													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-9-67

LOCATION ROBERTS DR. BR# 14 BORING NO. 8

BENT NO. 5 FOOTING LT. GROUND ELEV. 1057.7

PROPOSED FOOTING ELEV. ______ PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR.ELEV.													
	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST)													
1050	WEATHERED ROCK													
1040														
		1S	60=.9'	SM										
		2S	60=.5'	SM										
		3S	60=.5'	SM										
1030		4S	60=.6'	SM										
		5S	60=.5'	SM										
GWT														
1020		6S	60=.5'	SM										
		7S	60=.0'	SM										
	END DRILLING													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-17-67

LOCATION ROBERTS DR. BR. # 14 BORING NO. 9

BENT NO. 5 FOOTING RT. GROUND ELEV. 1057.4

PROPOSED FOOTING ELEV. PARTY CHIEF CRISLER

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	DENSE MULTICOLORED SANDY SILT													
	BOULDERS													
1050														
	DENSE BROWN SANDY SILT W/ BOULDERS													
1040	WEATHERED ROCK													
		1S	60=.5'	SM										
		2S	60=.5'	SM										
		3S	60=.5'	SM										
1030		4S	60=.1'	SM										
		5S	60=.0'	SM										
	END DRILLING													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-8-67

LOCATION ROBERTS DR. BR.#14 BORING NO. 10

BENT NO. 6 FOOTING LT. GROUND ELEV. 1059.5

PROPOSED FOOTING ELEV. PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY
1060	GR.ELEV.													
	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST													
1050	WEATHERED ROCK													
1040														
	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-9-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 11

BENT NO. 6 FOOTING RT. GROUND ELEV. 1059.3

PROPOSED FOOTING ELEV. ______ PARTY CHIEF STONE

ELEV.	BORING LOG	SAM-PLE	BLOW	REMARKS	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY
060	GR. ELEV.													
	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST)													
1050	WEATHERED ROCK													
1045														
		15	HAMMER BOUNCED	SM										
1030	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 3-8-67

LOCATION ROBERTS DR. BR. #14 BORING NO. 12

BENT NO. 7 FOOTING ℄ GROUND ELEV. 1059.8

PROPOSED FOOTING ELEV. PARTY CHIEF STONE

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
1060	GR. ELEV.													
	MEDIUM DENSE MULTICOLORED SANDY SILT (MOIST)	1S.	18	SM										
	WEATHERED ROCK	2S	60=.5'	SM										
1050														
		3S	49	SM										
1040														
		4S	60=.2'	SM										
		5S	60=.9'	SM										
1030														
	DENSE MULTICOLORED SILTY SAND	6S	47.	SM										
	REFUSAL ON ROCK													
1020														

FORM H. D. 66

STATE HIGHWAY DEPARTMENT OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE APD-F-056-1 (6) Fulton
Not Let to Contract

OFFICE Atlanta, Georgia

DATE May 9, 1968

FROM Thomas D. Moreland, State Highway Materials Engineer

TO R. L. Chapman, Jr., State Highway Bridge Engineer

SUBJECT Bridge Foundation Investigation
APD-F-056-1 (6) Fulton
Roberts Drive Relocation
Over North Fulton Expressway
Bridge No. 14
Mainline Station 41+50.0

As requested, a bridge foundation investigation has been made at the above listed site. Attached are the results of that work. If any additional information is needed, please notify us.

Very truly yours,

Thomas D. Moreland
State Highway Materials Engineer

TDM:DAM:kab

BRIDGE FOUNDATION INVESTIGATION

APD-F-056-1 (6) FULTON
ROBERTS DRIVE RELOCATION
OVER NORTH FULTON EXPRESSWAY
BRIDGE NO. 14
MAINLINE STATION 41+50.0

1. LOCATION- This bridge is to be located over the proposed North Fulton Expressway approximately 1.2 miles south of the Chattahoochee River crossing. It will be geologically sited in a cut section containing dense residual soils underlain by weathered granite gneiss bedrock.

2. SUBSURFACE DETAILS- Reference should be made to the attached boring logs and subsurface profile. Some pertinent details are as follows:

a. Hard rock was encountered above the footing elevations at bents 2 and 3. Blasting will be necessary to reach the footing elevations at these bents.

b. Rock cores were taken at bents 2, 3, and 4 at this site.

3. END BENT FOUNDATIONS- Pile bents using steel "H" piles are suitable foundations for the end bents. The maximum recommended design bearings for "H" piles at this site are as follows:

10" BP 42	55 Tons
12" BP 53	70 Tons

Estimated tip elevations for the end bent piles are listed below:

Bent	Est. Tip Elev.
1	1029
5	1010

Plan Driving Objectives - The plan driving objective for the end bent piles is practical refusal after the following minimum tip elevations are reached; 1035.0 at bent 1 and 1025.0 at bent 5.

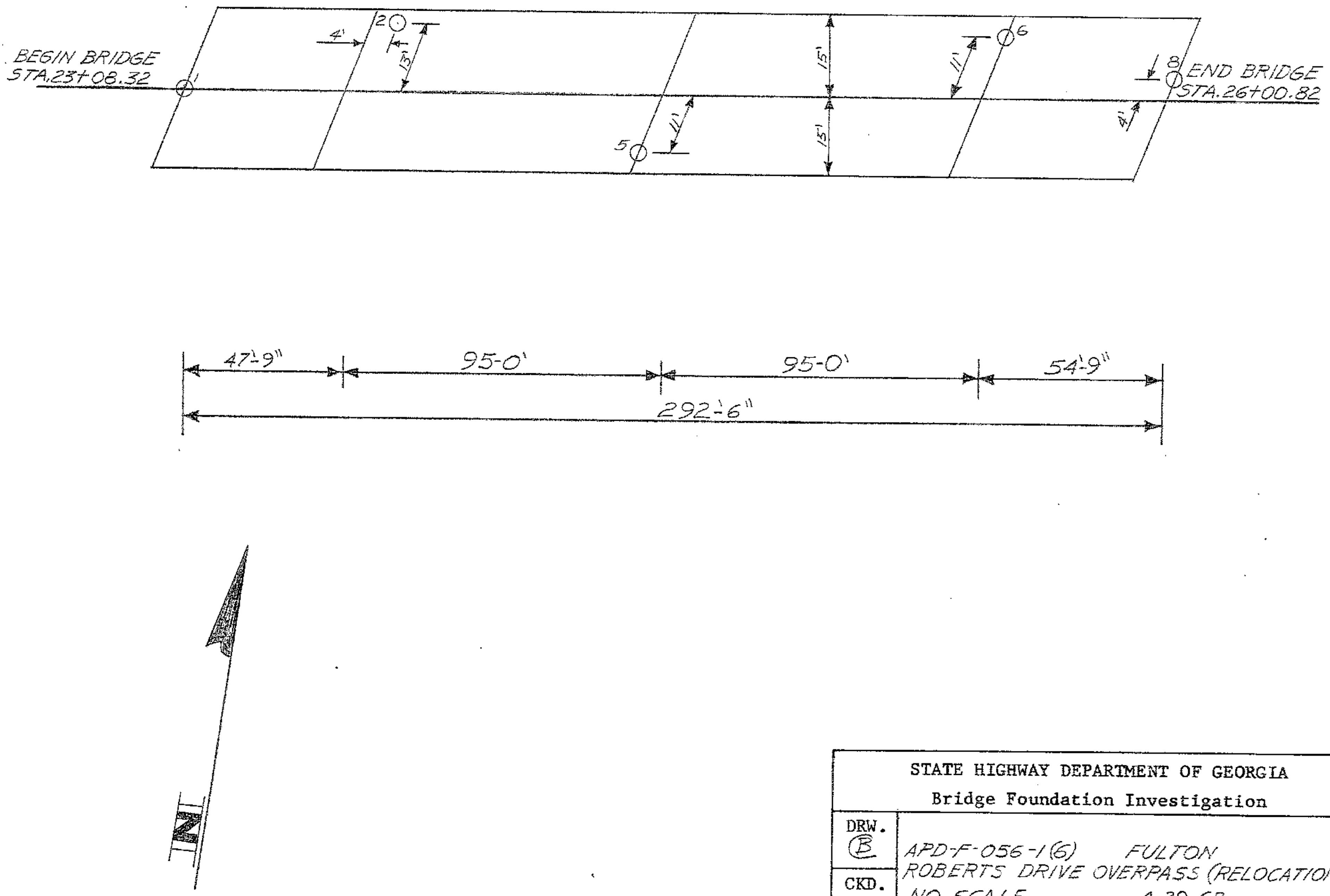
4. INTERMEDIATE BENT FOUNDATIONS- Spread footings are recommended for the intermediate bent foundations. These footings may be spread on

hard rock as follows:

Bent	Elev.	Max. Safe Design Pressure
2 Lt.	1024.0	5 tsf
2 Rt.	1024.0	5 tsf
3 Lt.	1023.0	5 tsf
3 Rt.	1023.0	5 tsf
4 Lt.	1017.5	5 tsf
4 Rt.	1017.5	5 tsf

David A. Mitchell, Sr.
Civil Engineer IV

DAM:JLM:kab
May 9, 1968



STATE HIGHWAY DEPARTMENT OF GEORGIA

Bridge Foundation Investigation

DRW. B	APD-F-056-1(6) FULTON ROBERTS DRIVE OVERPASS (RELOCATION) NO SCALE 4-29-68
CKD. R	
APP.	

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

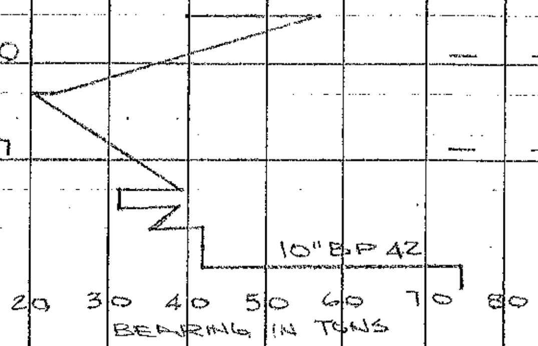
PROJECT APD.F-056-1(6) COUNTY FULTON DATE 4-9-68

LOCATION ROBERTS DRIVE OVERPASS (RELOCATION) BORING NO. 1

BENT NO. 1 FOOTING ℄ GROUND ELEV. 1057.99

PROPOSED FOOTING ELEV. 1051.5 PILE CUTOFF PARTY CHIEF CRISLER

ELEV.	BORING LOG	SAM-PLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	DENSE RED SILTY CLAY W/ BOULDERS													
	MED. DENSE-DENSE	1S	30	SM	22.7						—	—	23.1	6.2
1050	MLTC. MICACEOUS	2S	13	SM	32.2						—	—	23.8	5.2
	SANDY SILT	3S	15	SM	22.3						—	—	20.0	2.8
		4S	60=2	SM	32.6						—	—	29.0	4.9
	WEATHERED ROCK													
1040	VERY DENSE WHITE & TAN MICACEOUS SANDY SILT	5S	59	SM	27.0						—	—	28.8	2.9
		6S	77	SM	25.7						—	—	25.4	3.7
1030	WEATHERED ROCK													
	REFUSAL ON ROCK													
1020														
1010														



H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

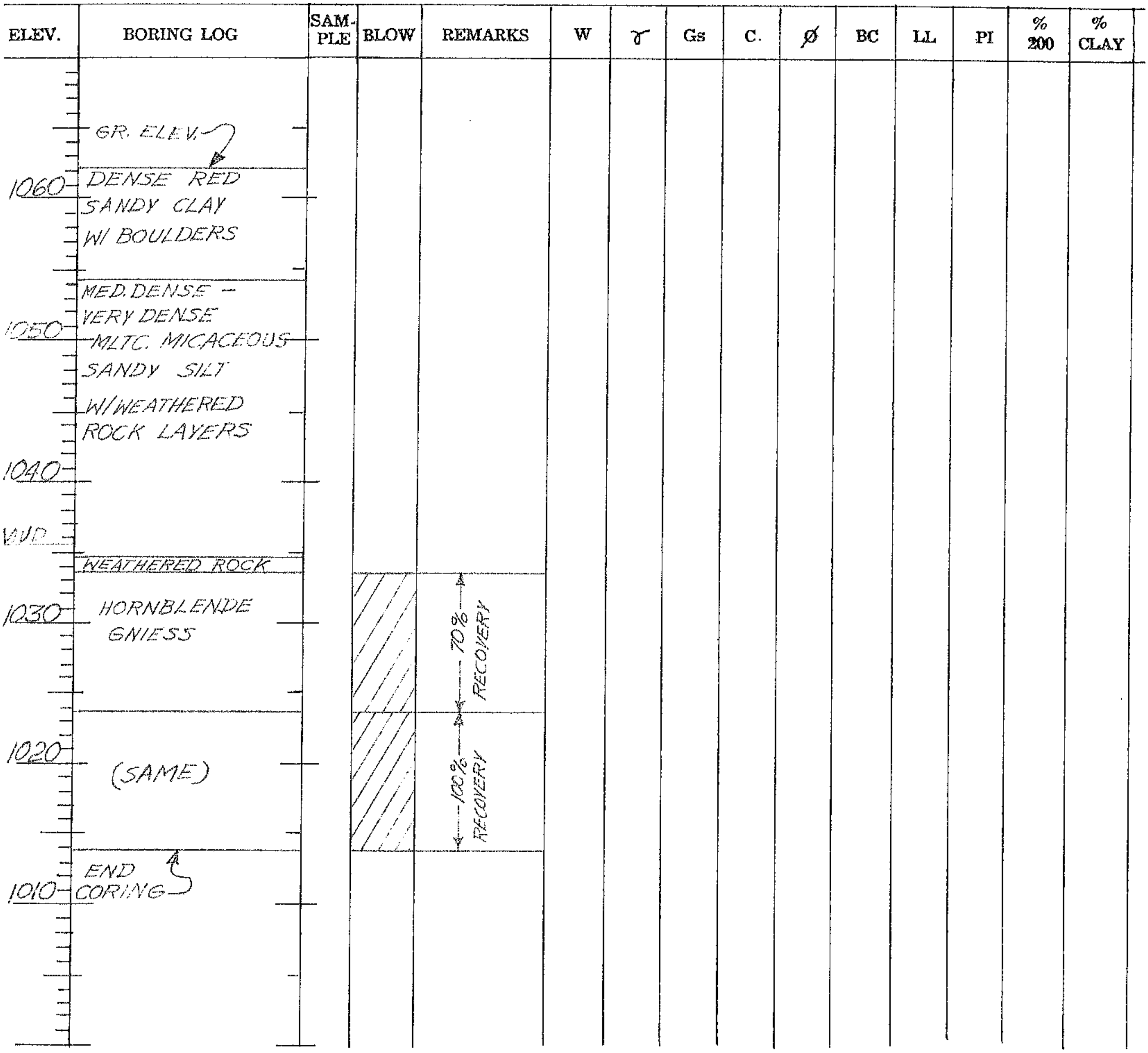
BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-9-68

LOCATION ROBERTS DR. OVERPASS (RELOC.) BORING NO. 2

BENT NO. 2 FOOTING LT. OFFSET 2'LT. & 4' FORWARD GROUND ELEV. 1062.25

PROPOSED FOOTING ELEV. 1024.0 PARTY CHIEF CRISLER



H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-9-68

LOCATION ROBERTS DR. OVERPASS (RELOC.) BORING NO. 5

BENT NO. 3 FOOTING RT. GROUND ELEV. 1063.15

PROPOSED FOOTING ELEV. 1023.25 PARTY CHIEF CRISLER

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV													
1060	DENSE RED SANDY CLAY W/ BOULDERS													
1050	MED. DENSE - VERY DENSE MLTC. MICACEOUS SANDY SILT W/ WEATHERED ROCK LAYERS													
1040														
W.D.														
	WEATHERED ROCK													
1030	HORNBLENDE		▨	100% RECOVERY										
1020	HORNBLENDE & GRANITE GNIESS		▨	100% RECOVERY										
1010	END CORING													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-16-68

LOCATION ROBERTS DR. OVERPASS (RELOC.) BORING NO. 6

BENT NO. 4 FOOTING LT. GROUND ELEV. 1060.15

PROPOSED FOOTING ELEV. 1021.75 PARTY CHIEF CRISLER

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
1060	GR. ELEV.													
	DENSE RED CLAY W/ BOULDERS													
	WEATHERED ROCK													
	DENSE MLTC. MICAS. SANDY SILT													
1050	WEATHERED ROCK													
	MED. DENSE-DENSE MLTC. MICACEOUS SANDY SILT													
1040														
	DENSE-VERY DENSE BROWN & TAN SANDY SILT													
1030														
	VERY DENSE GRAY	1S	60=.2'	SM										
1020	SANDY SILT W/	2S	60=.4'	SM										
	WEATHERED ROCK	3S	60=.1'											
	WEATHERED ROCK													
	HORNBLENDE GNIESS		▨	95% RECOVERY										
1010														
	END CORING													
1000														

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-9-68

LOCATION ROBERTS DR. OVERPASS (RELOC.) BORING NO. 8

BENT NO. 5 FOOTING ℄ OFFSET 4' LT. GROUND ELEV. 1060.53

PROPOSED FOOTING ELEV. 1053.31 PILE CUTOFF PARTY CHIEF CRISLER

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1060	DENSE RED SANDY CLAY W/BOULDERS													
	DENSE MLTC. MICAS. CLAYEY SANDY SILT	1S	42	SM	28.1								25.4	7.5
		2S	37	SM	35.3						43.4	9.9	40.2	20.3
1050	VERY LOOSE BROWN & TAN MICACEOUS SANDY SILT	3S	4	SM	48.4						46.9	15.9	45.2	18.8
		4S	10	SM	42.4								33.8	4.4
	MED. DENSE	5S	19	SM	42.8								34.2	6.8
1040	(SAME)	6S	20	SM	25.5								21.0	2.8
		7S	15	SM	47.2								31.0	4.3
1030	MED. DENSE BROWN & BLACK MICAS. SILT W/ WEATHERED ROCK	8S	23	SM	43.3								29.1	7.1
MUD	VERY DENSE	9S	60	SM	32.2								36.9	6.5
1020	(SAME)	10S	58	SM	34.4								29.7	5.2
	MED. DENSE (SAME)	11S	22	SM	46.1								46.0	5.5
	VERY DENSE (SAME)													
1010	VERY HARD ROCK													
	REFUSAL ON ROCK													

TEST PILE DRIVING DATA

4-24-69
BOR#1

PROJECT NO. [illegible] COUNTY [illegible]

BRIDGE AT [illegible] STATION [illegible] TO STATION [illegible]

PILING

UT . . . . x ____ '
TT . . . . x ____ '
H. 10 BP 42 x 50 '
C-I-P ____ IN. O.D. x ____ '
PSC ____ IN ____ x ____ '
PCC ____ IN. ____ x ____
OTHER: ____

PLAN DRIVING OBJECTIVE (PDO)

☒ PRACTICAL REFUSAL
☐ REFUSAL ☐ ROCK
☐ TONS. ____

LOCATION

TEST PILE NO.	BRIDGE NO.	BENT NO. / PILE NO.
1	14	BENT NO. [illegible] PILE NO. 22

HAMMER

GRAVITY, ____ LB.
MKT DE — ____
DELMAG D — ____
VULCAN NO. 1
LINK-BELT MODEL ____
OTHER: ____

SUMMARY

ELEVATIONS, IN WHOLE FEET ONLY

(1) CUT-OFF [illegible]
GROUND ____
(2) TIP, FINAL [illegible]
(3) TIP, ACCEP. [illegible]
(1) — (2) = [illegible]
(1) — (3) = [illegible]
NAME: [illegible]

DID BRIDGE FOUNDATION INVESTIGATION REPORT RECOMMEND, SPECIFY, OR INDICATE . . . ? (INSERT)

A MIN. PILE TIP ELEV.? [illegible]
A PILE TIP ELEV.? ____
ANY PILE LENGTHS? ____
DRIVING TO A STRATUM? ____
DRIVING TO AN "N" OF? ____
OTHER? ____

TEST BEGAN WITH A PENT. OF 2 FEET BELOW CUT-OFF AND A TIP ELEVATION OF ____ (WHOLE NO.'S ONLY)

*HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	[illegible]	.175	1039	42	[illegible]
		3/4	.075		55	[illegible]
		3/4	.062		57	
		[illegible]	.1		[illegible]	
		1 3/4	.175		40	
		1 3/4	.175		41	ORDER LENGTHS 21
		2	.2	↓	37	
		2	.2		38	[illegible]
		2 3/4	.275	1038	35	
		3	.3		30	
		3	.3		30	
		2 1/2	.25		[illegible]	
		2 1/2	.25	↓	33	
		1 3/4	.175	1037	[illegible]	
		2	.2		38	
		2 3/4	.275		[illegible]	
		3 1/2	.35	↓	27	
		3 1/2	.35	1036	27	
		3 3/4	.375		26	
		3 1/2	.35		27	
		3 1/2	.35	↓	27	
		4 1/2	.45	1035	23	
		4 1/2	.45	↓	20	
		6 1/4	.625	1034	18	
		5	.5	↓	21	
		4 1/2	.45	1033	23	
		4 1/2	.45	↓	23	
		4 1/2	.45	↓	25	
		4 3/4	.475	1032	22	
		4 1/2	.45	↓	23	1031.77

*FOR GRAVITY AND POWER HAMMERS.
FOR DIFFERENTIAL OR DOUBLE ACTING STEAM OR AIR HAMMERS, USE MANUFACTURER'S ENERGY RATING.
FOR LINK-BELT, CONVERT BOUNCE CHAMBER PRESSURE READING TO "WH" VALUE BY MEANS OF CHART; USE IN S. A. FORMULA.

R.D. 520-J
50-00

TEST PILE DRIVING DATA

TEST PILE NO [illegible] CONTINUED. PAGE NO. 2 OF [illegible]

PROJECT NO. [illegible] COUNTY [illegible]

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	4 1/2	.45	1031	23	[illegible]
		4	.4		25	
		3 1/2	.35		28	
		3	.3		30	
		2 1/2	.25		33	
		2 1/2	.25		33	
		2	.2	1030	38	
		2 1/2	.25		33	
		2 1/2	.25		33	
		2 1/2	.25		33	
		2 1/2	.25	1029	33	
		2 1/2	.25		33	
		2 1/4	.225		35	
		2	.2		38	
		2 1/4	.225		35	
		2 1/4	.225	1028	35	
		2 1/4	.225		35	
		2 1/2	.25		33	
		2	.2		38	
		2	.2		38	
		1 3/4	.175		40	
		1 1/2	.15		43	
		1 1/2	.15	1027	43	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 3/4	.175		40	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 1/2	.15	1026	43	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 1/2	.15		43	
		1 1/4	.125		46	
		1 1/4	.125		46	
		1 1/4	.125		46	
		1	.1		50	
		1/2	.05		61	
		1/4	.025		67	
		1/4	.025		67	
		1/4	.025		67	
		1/8	.012		71	
		0	.0		75	
		0	.0	1025	75	1025 [illegible]

STATE HIGHWAY DEPARTMENT OF GEORGIA
DIVISION OF MATERIALS AND TESTS
Atlanta, Georgia

SOIL SURVEY REPORT

Proj. F-056-1 (6)
County Fulton
Submitted by
Date Sampled Reported 4-22-68

Lab. No.						
Sample No.	1-1S	1-2S	1-3S	1-4S	1-5S	1-6S
Sample from	Roberts Drive Overpass					
Description						

PHYSICAL TESTS

% Passing 2½" Sieve						
% Passing ~~1½"~~ Sieve #4	100	100	100	100	100	100
% Passing No. 10 Sieve	95.5	94.4	98.4	98.8	98.3	98.0
% Passing No. 40 Sieve	71.1	63.2	71.1	69.0	68.5	74.1
% Passing No. 80 Sieve	48.1	41.3	44.2	54.9	54.3	56.3
% Passing No. 200 Sieve	23.1	23.8	20.0	29.0	28.8	25.4
% Clay	6.2	5.2	2.8	4.9	2.9	3.7
% Total Volume Change						
% Swell						
% Shrinkage						
Maximum Dry Density						
% **~~Optimum~~ Moisture**	22.7	32.2	22.3	32.6	27.0	25.7
Liquid Limit	----	----	----	----	----	----
Plasticity Index	NP	NP	NP	NP	NP	NP
Bearing Value, Psi						
Shearing Value, Psi						

CLASSIFICATION

Sec. 810.01 Mod.						
Unified	SM	SM	SM	SM	SM	SM
A. A. S. H. O.						

SPECIAL REMARKS:

Respectfully submitted ____________________
ENGINEER OF MATERIALS & TESTS

Variations From Specifications

STATE HIGHWAY DEPARTMENT OF GEORGIA
DIVISION OF MATERIALS AND TESTS
Atlanta, Georgia

SOIL SURVEY REPORT

Proj. F-056-1 (6)
County Fulton
Submitted by
Date Sampled Reported 4-22-68

Lab. No.						
Sample No.	8-1S	8-2S	8-3S	8-4S	8-5S	8-6S
Sample from	Roberts Drive Overpass					
Description						

PHYSICAL TESTS

% Passing 2½" Sieve						
% Passing ~~1½"~~ Sieve #4	100	90.7	100	100	100	100
% Passing No. 10 Sieve	90.3	88.2	99.2	97.0	96.7	94.2
% Passing No. 40 Sieve	57.6	67.5	71.0	62.4	63.7	55.1
% Passing No. 60 Sieve	45.7	58.6	63.1	52.7	53.7	42.1
% Passing No. 200 Sieve	25.4	40.2	45.2	33.8	34.2	21.0
% Clay	7.5	20.3	18.8	4.4	6.8	2.8
% Total Volume Change						
% Swell						
% Shrinkage						
Maximum Dry Density						
% **~~Optimum~~ Moisture**	28.1	35.3	48.4	42.4	42.8	25.5
Liquid Limit	----	43.4	46.9	----	----	----
Plasticity Index	NP	9.9	15.9	NP	NP	NP
Bearing Value, Psi						
Shearing Value, Psi						

CLASSIFICATION

Sec. 810.01 Mod.						
Unified	SM	SM	SM	SM	SM	SM
A. A. S. H. O.						

SPECIAL REMARKS:

Respectfully submitted ____________________
ENGINEER OF MATERIALS & TESTS

Variations From Specifications
Indicated Thus: → **Sufficient for Rejection** * Immaterial

STATE HIGHWAY DEPARTMENT OF GEORGIA
DIVISION OF MATERIALS AND TESTS
Atlanta, Georgia

SOIL SURVEY REPORT

Proj. F-056-1 (6)
County Fulton
Submitted by
Date Sampled Reported 4-22-68

Lab. No.						
Sample No.	8-7S	8-8S	8-9S	8-10S	8-11S	
Sample from	Roberts Drive Overpass					
Description						

PHYSICAL TESTS

% Passing 2½" Sieve						
% Passing ~~1½"~~ Sieve #4	100	100	100	100	100	
% Passing No. 10 Sieve	96.5	94.0	92.3	97.8	95.2	
% Passing No. 40 Sieve	75.7	66.8	74.1	69.4	89.0	
% Passing No. 60 Sieve	59.0	52.3	59.3	58.7	79.6	
% Passing No. 200 Sieve	31.0	29.1	36.9	29.7	46.0	
% Clay	4.3	7.1	6.5	5.2	5.5	
% Total Volume Change						
% Swell						
% Shrinkage						
Maximum Dry Density						
% **~~Optimum~~ Moisture**	47.2	43.3	32.2	34.4	46.1	
Liquid Limit	----	----	----	----	----	
Plasticity Index	NP	NP	NP	NP	NP	
Bearing Value, Psi						
Shearing Value, Psi						

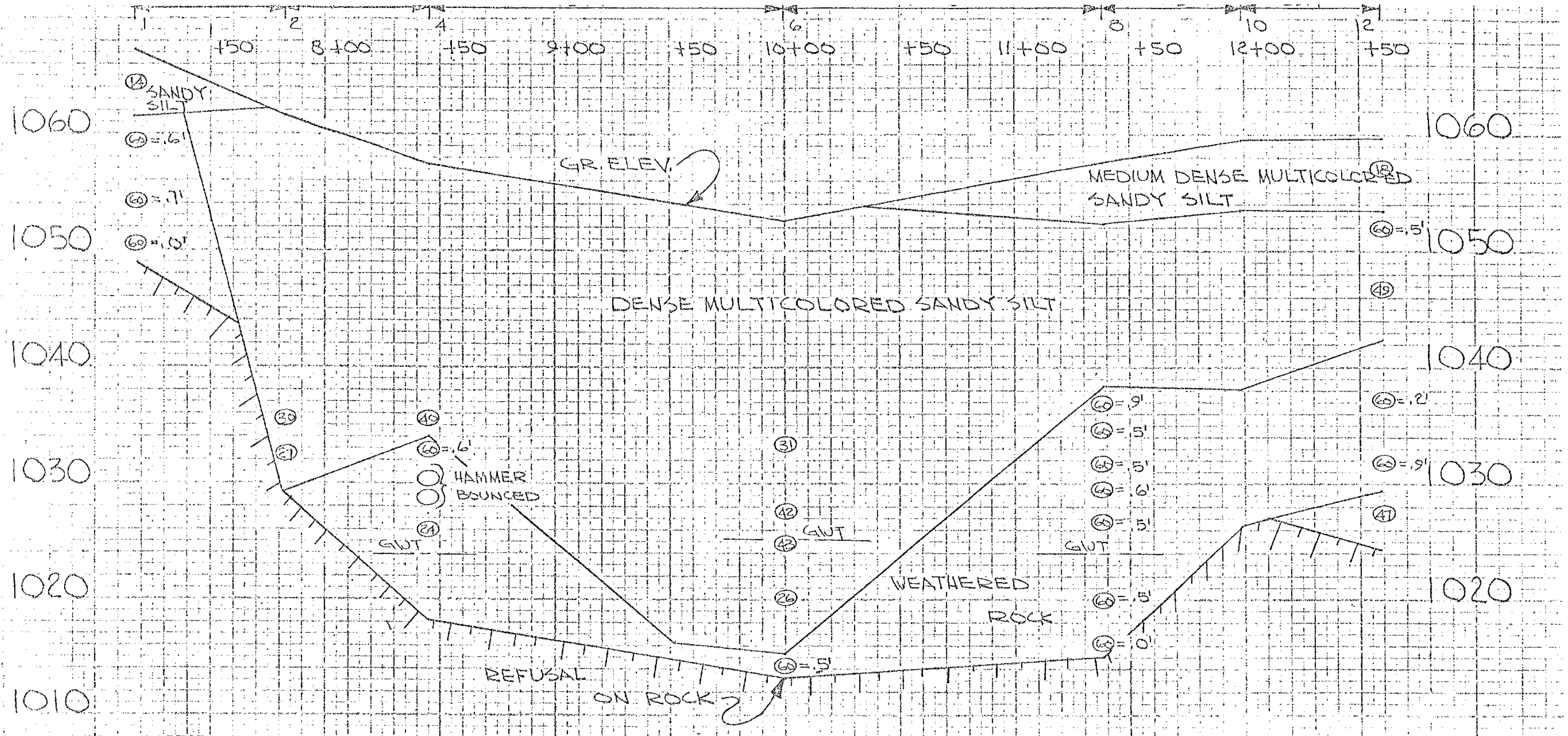
CLASSIFICATION

Sec. 810.01 Mod.						
Unified	SM	SM	SM	SM	SM	
A. A. S. H. O.						

SPECIAL REMARKS:

Respectfully submitted
ENGINEER OF MATERIALS & TESTS

Variations From Specifications



APD-056-1(6) FULTON
ROBERTS DR.
1"=50' 3-27-67

ATTACHMENT T

Pitts Road over SR 400 – BSN: 121-0476-0

[redacted]

Project No: MSL00-0001-00(757) PI No. 0001757

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

Existing bridge on Pitts Road over SR 400 (Structure ID 121-0476-0), as shown in Figure 1 of Appendix A, is a four-span structure that crosses over SR 400 at a skew angle. The new longer bridge replaces the existing bridge at approximately 40 feet south of current location to accommodate the SR 400 widening associated with the [redacted] project (Project No: MSL00-0001-00(757), PI No. 0001757).

2. SITE GEOLOGY

According to the "Geology of the Greater Atlanta Region" by McConnell and Abrams, 1984, the site as shown in Figure 2 of Appendix A, is generally underlain by the "pfu: Sandy Springs Group" Formation. This geologic formation typically includes a lower unit of intercalated biotite gneiss, mica schist and amphibolite.

3. HISTORICAL DATA

Previous soil boring data at the vicinity of the proposed bridge location was obtained from GDOT OMAT archive files and is included in Appendix B of this report. NOVA is not responsible for the presented historical BFI geotechnical data prepared by others and found in GDOT OMAT archive file storage. Figure 3 of Appendix B represents our understanding of the locations of historical soil borings with respect to the existing structure. The users should review the attached documents and confirm these locations for their use.

APPENDIX A

FIGURES

FIGURE 1
Pitts Road over SR 400
EXISTING BRIDGE
SOURCE: GDOT Bridge Inspection Report

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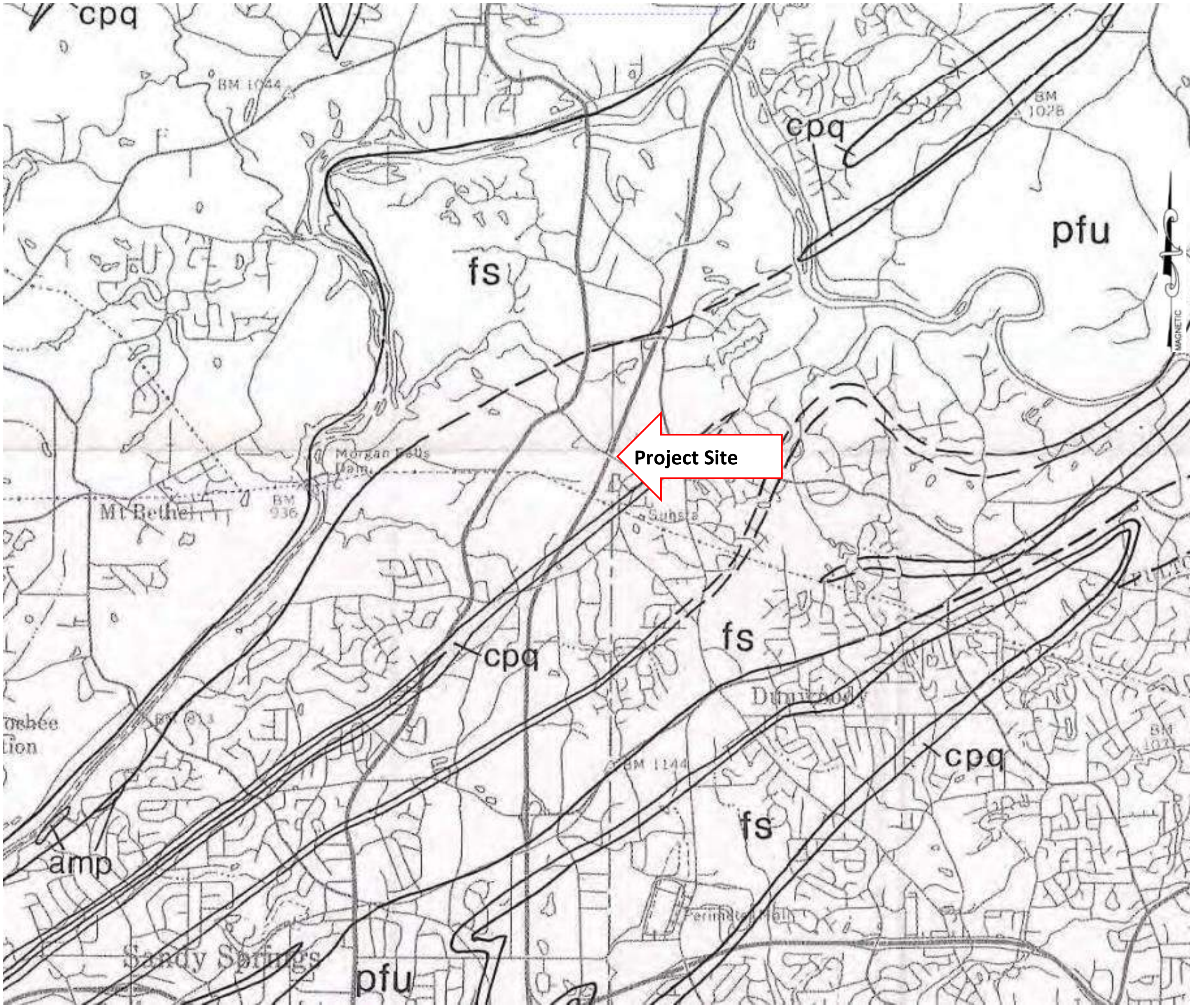
[redacted]– PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton & Forsyth Counties, Georgia
NOVA Project Number 2018089 - Task Order 5



pfu
cpq
fs

Sandy Springs Group (Higgins and McConnell, 1978a: Kline, 1980; this report): Similar to sequence observed in northern Piedmont and at least partially equivalent to Atlanta Group (see text). Includes a lower unit of intercalated biotite gneiss, mica schist and amphibolite (pfu); a middle unit composed of micaceous quartzite, mica schist and graphitic schist (cpq); and an upper unit of graphite-garnet-mica schist with lesser amounts of biotite gneiss and amphibolite (fs).

FIGURE 2
Pitts Road over SR 400
SITE GEOLOGY
SOURCE: McConnell & Abrams, 1984

NOVA
PROFESSIONAL | PRACTICAL | PROVEN

[redacted] –
PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton [redacted] Counties, Georgia
NOVA Project Number 2018089 –
Task Order 5

APPENDIX B

HISTORICAL DATA

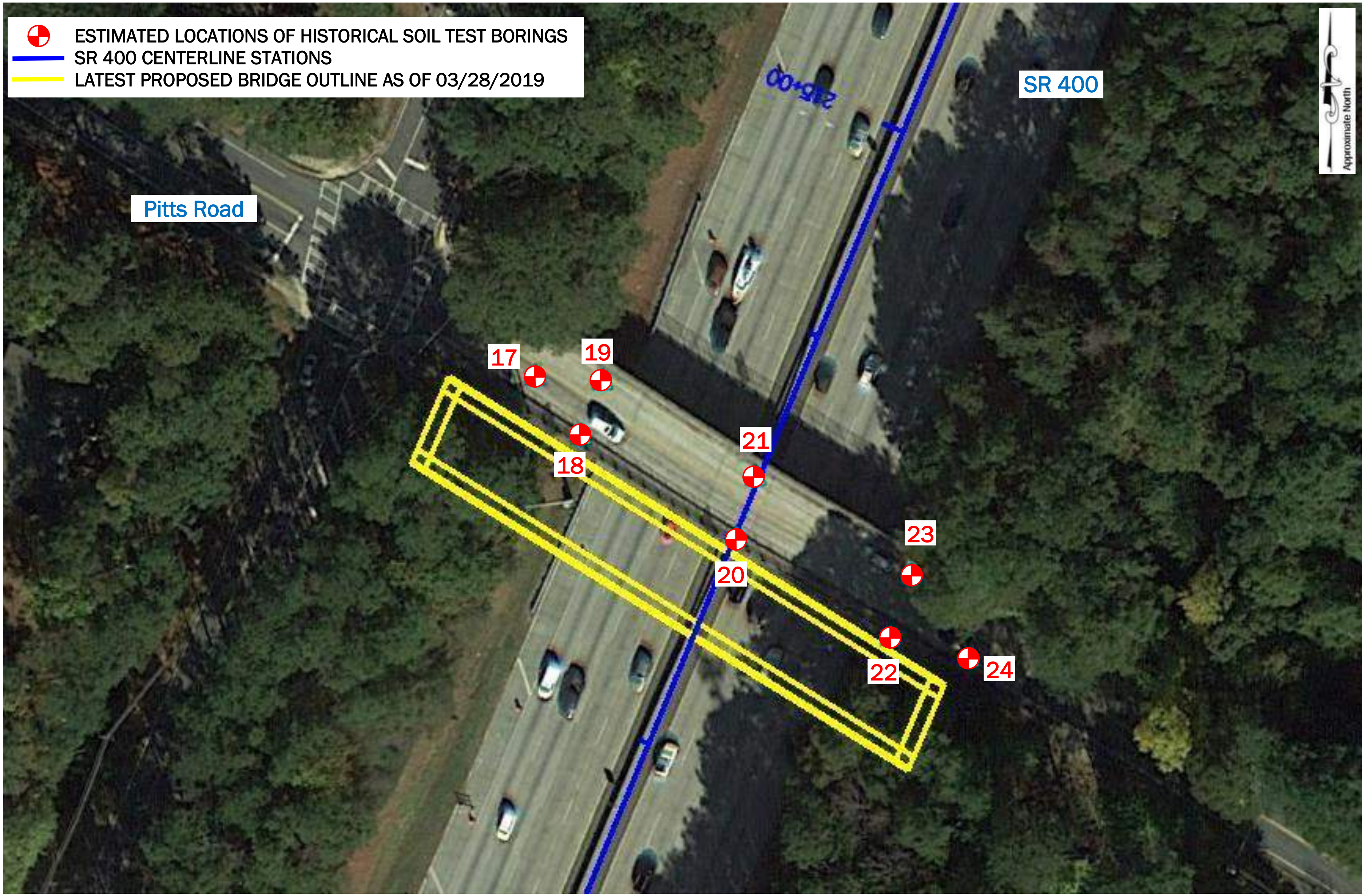


FIGURE 3
Pitts Road over SR 400
HISTORICAL BORING LOCATION PLAN
SOURCE: Google Earth Aerial Photos
SCALE: Not to Scale

[redacted] – PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton [redacted] Counties, Georgia
NOVA Project Number 2018089 - Task Order 5

TDM

STATE HIGHWAY DEPARTMENT OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE PR-5610 D Fulton County
Not Let to Contract

OFFICE Atlanta, Georgia

DATE July 27, 1965

FROM W. F. Abercrombie, Engineer of Materials and Tests

TO C. A. Marmelstein, State Highway Bridge Engineer

SUBJECT Bridge Foundation Investigation
PR-5610 D Fulton County
Pitts Road Over N. Fulton Expressway

As requested, a bridge foundation investigation has been made at the above listed site. Attached are the results of that work. If any additional information is needed, please notify us.

Very truly yours,

W. F. Abercrombie
Engineer of Materials and Tests

WFA:TDM:sev

BRIDGE FOUNDATION INVESTIGATION

PR-5610 D Fulton County
Pitts Road Over N. Fulton Expressway

1. Location - This bridge is to be located approximately 2.5 miles south of Roswell, Georgia. It will be geologically located on residual soil and underlying biotite gneiss bedrock of the Carolina Series.

2. Work Done - A total of 8 test borings were made at this site with a truck mounted power auger drill. Standard penetration tests were performed in these borings to determine the relative density of soils encountered.

3. Subsurface Details - Reference sould be made to the attached boring logs and subsurface profile. Some pertinent details are as follows:

   a) The ground water table was encountered between elevation 1024.5 and 1031.2. Footing excavations should be dry.

   b) Medium to dense soils were encountered near proposed footing elevations.

   c) A loose compressible soil stratum was encountered between elevation 1028.5 and 1031.5 at bent 4 right.

4. End Bent Foundations - Steel "H" piles used in pile bents are suitable for end bent foundations. Maximum bearings recommended for "H" piles at this site are as follows:

   10" BP 42 = 55 Tons
   12" BP 53 = 70 Tons

   Estimated pile tip elevations for these bearings are as follows:

Bent	Estimated Tip Elevation
1	1010.0
5	1020.0

   These will be chiefly end bearing piles.

5. Intermediate Bent Foundations - Spread footings are recommended for all intermediate bent foundations except bent 4 right. These footings may be safely placed at or below elevation 1037.5 with a maximum safe design pressure of 5 ksf.

The footing at bent 4 right could be spread at elevation 1028.5 with a safe design pressure of 7 ksf. However, a "H" pile footing appears more suitable with the footing near elevation 1037.5. Estimated pile tip elevation for the maximum bearings given in section 3 of this report is 1027.0 at this footing.

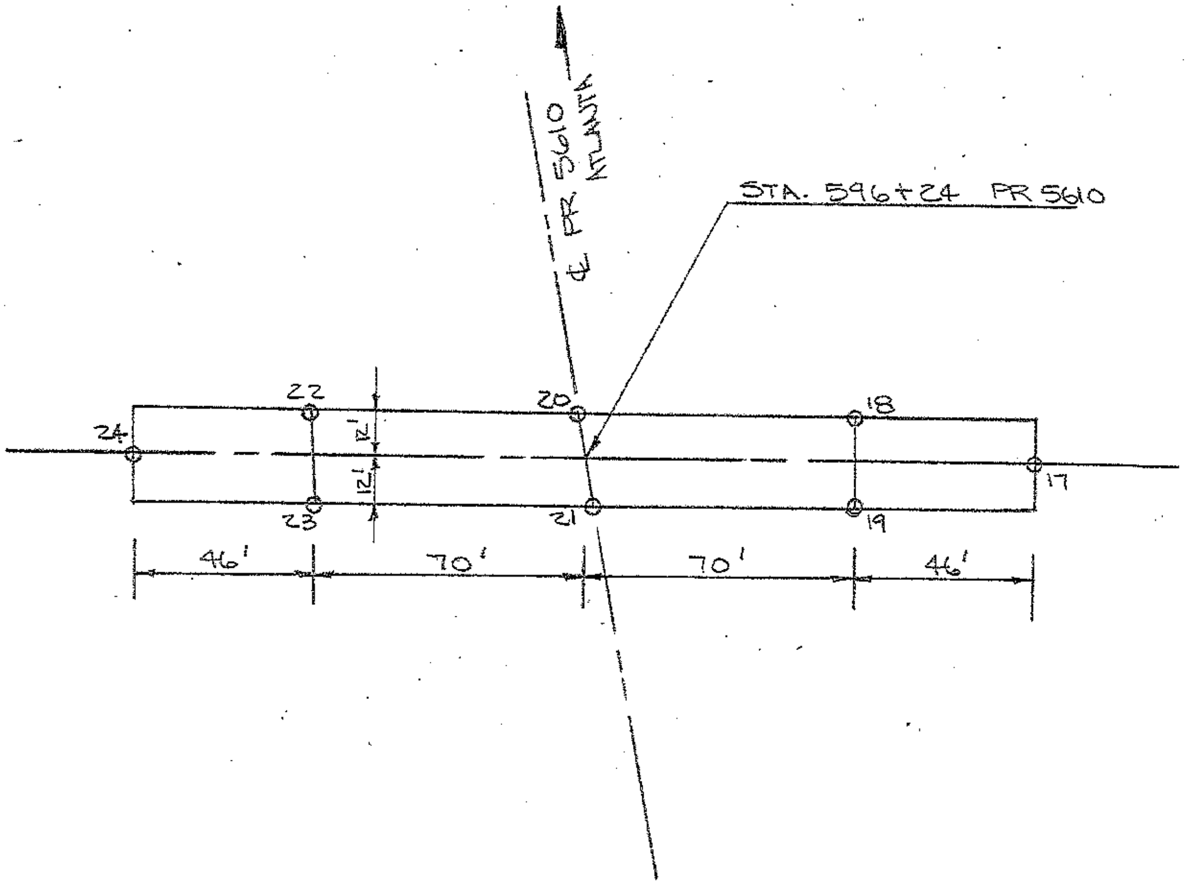
6. Danger From Fill Settlement - No danger.

7. Displacement Piles - Displacement piles were not recommended because of the limited penetration available at bent 4 right and because of possible driving difficulty at bent 5. Irregular pile lengths are also indicated by the dense layered soil and soft rock strata.

Thomas D. Moreland
Highway Materials Engineer

TDM:DAM:sev

7-27-65



STATE HIGHWAY DEPARTMENT OF GEORGIA
Bridge Foundation Investigation

DRW. CL	PR-5610 D FULTON
CKD.	PITTS RD. OVER N. FULTON EXP.
APP.	NO SCALE 7-20-65

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

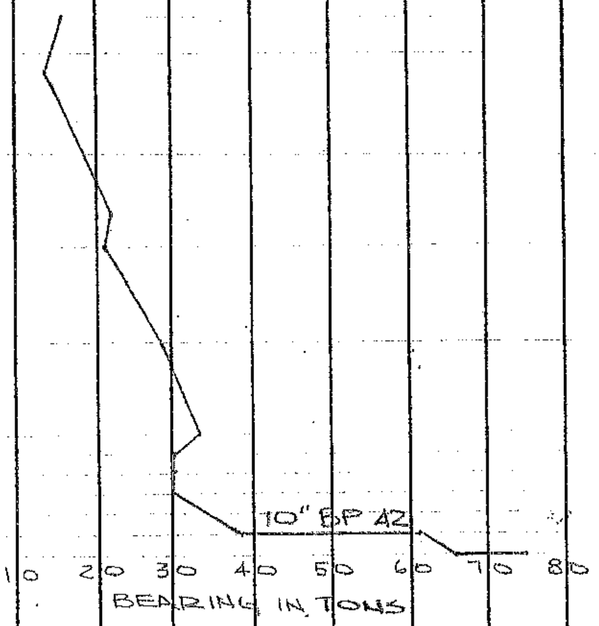
PROJECT PR-5610 D COUNTY Fulton DATE 7-7-65

LOCATION Pitts Road over N. Fulton Expressway Sta.596+24 BORING NO. 17

BENT NO. 1 FOOTING Center GROUND ELEV. 1056.18

PROPOSED FOOTING ELEV. End Bent PARTY CHIEF Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	DENSE RED MICACEOUS SILTY CLAY (MOIST)	1S	29											
1050	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT (MOIST)	2S	17											
		3S	27											
1040		4S	19											
		5S	28											
1030		6S	17											
W.L.														
	SAME (LOOSE)	7S	11											
1020	SAME (DENSE)	8S	34											
		9S	34											
1010		10S	60=.2'											
	SAME (VERY DENSE)	11S	60=.3'											
	VERY HARD DRILLING													
1000	REFUSAL ON ROCK													



STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR-5610 D **COUNTY** Fulton **DATE** 7-6-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 **BORING NO.** 18

BENT NO. 2 **FOOTING** Right **GROUND ELEV.** 1055.67

PROPOSED FOOTING ELEV. 1037.50 **PARTY CHIEF** Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT (MOIST)													
1040														
		1S	19											
		2S	22											
		3S	23											
1030		4S	16											
N.L.		5S	18											
		6S	23											
1020		7S	34											
	SAME (DENSE)													
	SAME (MEDIUM DENSE)	8S	21											
1010		9S	60=.9'											
	SAME (VERY DENSE)	10S	22											
1000	SAME (MEDIUM DENSE)													
	SAME (VERY DENSE)	11S	61											
990	REFUSAL ON ROCK													

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR-5610 D COUNTY Fulton DATE 7-9-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 BORING NO. 19

BENT NO. 2 FOOTING Left GROUND ELEV. 1055.75

PROPOSED FOOTING ELEV. 1037.5 PARTY CHIEF Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	RED & BROWN MICACEOUS SILT (MOIST)													
1040	DENSE MULTI-COLORED MICACEOUS SANDY SILT (MOIST)	1S	38											
		2S	32											
		3S	27											
1030		4S	49											
	SAME (VERY DENSE)	5S	55											
N.L.Y.	SAME (MEDIUM DENSE)	6S	17											
1020		7S	30											
	SAME (DENSE)	8S	28											
1010		9S	26											
		10S	34											
1000	VERY HARD DRILLING													
	REFUSAL ON ROCK													
990														

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR-5610 D COUNTY Fulton DATE 7-2-65

LOCATION Pitts Road Over N. E. Exp.Station 396+24 BORING NO. 20

BENT NO. 3 FOOTING Right GROUND ELEV. 1055.20

PROPOSED FOOTING ELEV. 1037.5 PARTY CHIEF Maxwell

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV. ▽													
	RED SANDY CLAY													
1050	BROWN AND RED MICACEOUS SILT													
1040	DENSE BROWN AND WHITE MICACEOUS SANDY SAPROLITE													
		1S	36											
		2S	41											
		3S	25											
1030	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT	4S	17											
		5S	20											
N.L. ▽	VERY DENSE RED & BROWN SANDY SAPROLITE													
		6S	62											
1020														
		7S	60											
1010														
	REFUSAL ON ROCK													
1000														

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR-5610 D **COUNTY** Fulton **DATE** 7-7-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 **BORING NO.** 21

BENT NO. 3 **FOOTING** Left **GROUND ELEV.** 1055.41

PROPOSED FOOTING ELEV. 1037.5 **PARTY CHIEF** Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	MULTI-COLORED MICACEOUS SILT (MOIST)													
1040														
		1S	44											
		2S	27											
		3S	20											
1030		4S	17											
N.L.	SAME (MEDIUM DENSE)	5S	18											
		6S	60=8'											
1020														
		7S	60=.5'											
	SAME (DENSE)	8S	40											
1010														
	VERY HARD DRILLING													
1000	REFUSAL ON ROCK													
990														

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR--5610 D **COUNTY** Fulton **DATE** 7-8-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 **BORING NO.** 22

BENT NO. 4 **FOOTING** Right **GROUND ELEV.** 1055.20

PROPOSED FOOTING ELEV. 1037.5 **PARTY CHIEF** Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	RED & BROWN MICACEOUS SILT (MOIST)													
1040	LOOSE MULTI-COLORED MICACEOUS SILT (MOIST)	1S	12											
		2S	22											
		3S	15											
1030		4S	8											
W.L.	SAME (VERY DENSE)	5S	60=3'											
1020														
	REFUSAL ON ROCK													
1010														
1000														

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT PR-5610 D **COUNTY** Fulton **DATE** 7-8-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 ML **BORING NO.** 23

BENT NO. 4 **FOOTING** Left **GROUND ELEV.** 1055.02

PROPOSED FOOTING ELEV. 1037.5 **PARTY CHIEF** Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	LL	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	RED AND BROWN MICACEOUS SILT (MOIST)													
1040	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT (MOIST)													
		1S	21											
1030 N.L.	VERY DENSE GREY & WHITE MICACEOUS SANDY SILT (MOIST)	2S	54											
	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT (MOIST)	3S	23											
1020	VERY HARD DRILLING													
	REFUSAL ON ROCK													
1010														
1000														

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

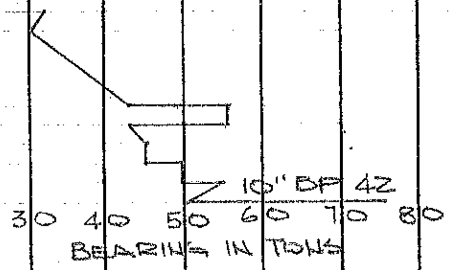
PROJECT PR-5610 D **COUNTY** Fulton **DATE** 7-8-65

LOCATION Pitts Road Over N. Fulton Exp. Station 596+24 **BORING NO.** 24

BENT NO. 5 **FOOTING** Center **GROUND ELEV.** 1055.61

PROPOSED FOOTING ELEV. End Bent **PARTY CHIEF** Porter

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C	Ø	BC	PI	L.L.	% 200	% CLAY
	GR. ELEV.													
	RED MICACEOUS SILTY CLAY (MOIST)													
1050	MEDIUM DENSE MULTI-COLORED MICACEOUS SILT (MOIST)	1S	19											
	SAME (LOOSE)	2S	12											
		3S	11											
1040		4S	17											
℄N.L. 1030														
	SAME (MEDIUM DENSE)	5S	18											
		6S	60=.9'											
1020	SAME (VERY DENSE)	7S	60=.4'											
	REFUSAL ON ROCK													
1010														



H.D. 500-A
(10-66)

12-26-66
BJR#17

TEST PILE DRIVING DATA

DATE 8-29-68

PROJECT NO. APD 056-1(10) CT 2. COUNTY Fulton

BRIDGE AT Pitts Road & N. Fulton Ave STATION 84 81.75 TO STATION 11+18.58

PILING

UT . . . . x ______ '
TT . . . . x ______ '
H. 10 BP 42 x ______ '
C-I-P ______ IN. O.D. x ______ '
PSC ______ IN ______ x ______ '
PCC ______ IN. ______ x ______ '
OTHER: ______

PLAN DRIVING OBJECTIVE (PDO)

☐ PRACTICAL REFUSAL
☑ REFUSAL ☐ ROCK
☐ TONS. 30

LOCATION

TEST PILE NO.	BRIDGE NO.	
1	12	BENT NO. 1 PILE NO. 7

HAMMER

GRAVITY, ______ LB.
MKT DE — ______
DELMAG D — ______
VULCAN NO. [illegible]
LINK-BELT MODEL ______
OTHER: ______

SUMMARY

ELEVATIONS, IN WHOLE FEET ONLY

(1) CUT-OFF 10'54
GROUND 1053
(2) TIP, FINAL 1014
(3) TIP, ACCEP. 1050
(1) — (2) = 40.00
(1) — (3) = ~~[illegible]~~
NAME: [illegible]

DID BRIDGE FOUNDATION INVESTIGATION REPORT RECOMMEND, SPECIFY, OR ESTIMATE . . . ? (INSERT)

A MIN. PILE TIP ELEV.? ______
A PILE TIP ELEV.? 1010 (Es
ANY PILE LENGTHS? ______
DRIVING TO A STRATUM? ______
DRIVING TO AN "N" OF? ______
OTHER? ______

TEST BEGAN WITH A PENT. OF 3 FEET BELOW CUT-OFF AND A TIP ELEVATION OF 1051 {WHOLE NO.'S ONLY

*HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	36		1049		1051.17 ~~1049.37~~
		24				
		29				PLAN ORDER LENGTH 54.00
		12				
		7	.70	1042	17	~~1042.[illegible]~~
		8	.80		15	
		9	.80			
		8	.80			
		8	.80		15	
		7	.70	1039	17	1039.19
		7	.70			
		7	.70			
		7	.70			
		7	.70			ORDER LENGTH = 44'
		7	.70			
		7	.70			
		7	.70			
		7	.70		17	
		6	.60		19	
		6	.60		19	
		5	.50		21	
		5	.50		21	
		4½	.45	1032	23	1032.84
		4½	.45		23	
		4½	.45		23	
		5½	.55	1031	20	
		5½	.55		20	
		5	.50	1030	21	
		4½	.45		23	
3	10	4	.40	1029	25	1030.00 ~~[illegible]~~

*FOR GRAVITY AND POWER HAMMERS.

FOR DIFFERENTIAL OR DOUBLE ACTING STEAM OR AIR HAMMERS, USE MANUFACTURER'S ENERGY RATING.

FOR LINK-BELT, CONVERT BOUNCE CHAMBER PRESSURE READING TO "WH" VALUE BY MEANS OF CHART: USE IN S. A. FORMULA.

H.D. 560-B
(10-66)

TEST PILE DRIVING DATA

TEST PILE NO. 1 CONTINUED, PAGE NO. 2 OF 3

PROJECT NO. APD 056-1(10) CT 2 COUNTY FULTON

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP. WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	4	.40	1029	25	~~1030.00~~ 1029.68 2 ~~[illegible]~~
		4	.40		25	1029.66
		3¾	.375		26	
		3¾	.375	1028		
		3¾	.375			
		3¾	.375		26	
		3½	.35		27	
		3½	.35	1027	27	
		3¼	.325		29	1026.54
		3¼	.325		27	
		3¼	.325	1026	29	
		3¼	.325			
		3¼	.325			
		3¼	.325			
		3¼	.325	1025		
		3¼	.325			
		3¼	.325			
		3¼	.325			
		3¼	.325	1024		
		3¼	.325			
		3¼	.325			
		3¼	.325			
		3¼	.325		29	
		3	.30	1023	30	1022.64
		3	.30			
		3	.30		30	
		2¾	.275		32	
		3	.30	1022	30	
		2¾	.275		32	
		2½	.25		33	1021.66
		2½	.25			
		2½	.25	1021		
		2½	.25			
		2½	.25			
		2½	.25			
		2½	.25	1020	33	
		2⅜	.237		34	
		2½	.25		33	
		2½	.25			
		2½	.25			
		2½	.25		33	
		3	.30	1019	30	1019.17
		3	.30			
		3	.30			
		3	.30			
		3	.30	1018		
		3	.30			
		3	.30			
		3	.30			
		3	.30			
3	10	3	.30	1017	30	1016.92

H.D. 500-B
(10-66)

TEST PILE DRIVING DATA

TEST PILE NO. 1 CONTINUED. PAGE NO. 3 OF 3

PROJECT NO. APD 056-1(10) CT 2 COUNTY Fulton

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	2 3/4	.275		32	1016.66
		2 1/2	.25		35	
		2 1/2	.25		35	
		2	.20	1015	38	
		2	.20		38	
		1 3/4	.175		40	
		1 3/4	.175		40	
		1 1/2	.15		43	
		1	.10		50	
		1	.10		|	
		1	.10		|	
		1	.10		56	
		3/4	.075		55	1014.94
		3/4	.075		|	
		3/4	.075		|	
		3/4	.075		|	
		3/4	.075		|	
		3/4	.075		55	
		1/2	.050	1015	66	
		1/2	.050		60	
		1/2	.050		67	
		1/2	.050	1014	67	
		3/8	.037		63	1014.49
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		|	
		3/8	.037		63	
		1/4	.025		67	
		1/4	.025		|	
		1/4	.025		67	
		1/8	.012		71	
		1/8	.012		|	
		1/8	.012		|	
		1/8	.012		|	
		1/8	.012		|	
		1/8	.012		|	
		1/8	.012		|	
		1/8	.012		71	
		0	0		75	
		0	0		|	
		0	0	1014	75	1013.98
3	10					

H.D. 500-A
(10-36)

9-20-68
BOP #2A

TEST PILE DRIVING DATA

DATE 8-27-68

PROJECT NO. APD 056-1 (10) CT 1 COUNTY FULTON

BRIDGE AT PITTS RD + N. FULTON STATION 8+81.75 TO STATION 11+13.88

PILING

UT x
TT x
H. 10 BP 42 x
C-I-P ____ IN. O.D. x
PSC ____ IN ____ x
PCC ____ IN. ____ x
OTHER:

LOCATION

TEST PILE NO.	BRIDGE NO.	BENT NO. / PILE NO.
2	12	BENT NO. 5 PILE NO. 18

HAMMER

GRAVITY, ____ LB.
MKT DE —
DELMAG D —
VULCAN NO. 1 15000 FTLBS
LINK-BELT MODEL
OTHER:

PLAN DRIVING OBJECTIVE (PDO)

☐ PRACTICAL REFUSAL
☒ REFUSAL ☐ ROCK
☐ TONS. 30

SUMMARY

ELEVATIONS, IN WHOLE FEET ONLY

(1) CUT-OFF 1054
GROUND 1053
(2) TIP, FINAL 1020
(3) TIP, ACCEP. ~~1020~~ 1018
(1) — (2) = 34.00
(1) — (3) = ~~[illegible]~~ 36
NAME: [illegible]

DID BRIDGE FOUNDATION INVESTIGATION REPORT RECOMMEND, SPECIFY, OR ESTIMATE . . . ? (INSERT)

A MIN. PILE TIP ELEV.?
A PILE TIP ELEV.? 1020 (E)
ANY PILE LENGTHS?
DRIVING TO A STRATUM?
DRIVING TO AN "N" OF?
OTHER? 55 TONS MAXIUM

TEST BEGAN WITH A PENT. OF 1.00 FEET BELOW CUT-OFF AND A TIP ELEVATION OF 1053 {WHOLE NO.'S ONLY

*HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
0	0	30	3.0			1050.06
3	10	12	1.2			
		12	1.2			PLAN Length 49.00
		12	1.2			
		12	1.2			Length in Place 33.40
		12	1.2			
		12	1.2			HEAT NO. 5664
		12	1.2			
		12	1.2			
		12	1.2			
		12	1.2			
		12	1.2			
		12	1.2			
		10	1.0			1035.56
		8	.8			
		2¾	.275			
		3	.30			
		2¾	.275			
		3	.30			1033.35
		3	.30			
		3	.30			
		3	.30			
		2½	.25			ORDER LENGTH = 36'
		2½	.22			
		2¼	.22			
		2¼	.22			
		2¼	.22			
		2¼	.22			
		2¾	.275			
3	10	2¾	.275			1030.97

*FOR GRAVITY AND POWER HAMMERS.
FOR DIFFERENTIAL OR DOUBLE ACTING STEAM OR AIR HAMMERS, USE MANUFACTURER'S ENERGY RATING.
FOR LINK BELT, CONVERT BOUNCE CHAMBER PRESSURE READING TO "WH" VALUE BY MEANS OF CHART: USE IN S. A. FORMULA.

H.D. 500-B
(10-66)

TEST PILE DRIVING DATA

TEST PILE NO. 2 CONTINUED. PAGE NO. 2 OF 3

PROJECT NO. APD 056-1(10) Ct 2 COUNTY Fulton

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	2 3/4	.275	1031	32	/ 1030.74
		2 3/4	.275		32	
		3	.30	1031	30	
		3	.30	1030		
		3	.30			
		3	.30		30	
		2 3/4	.275	1030	32	
		2 3/4	.275	1029		
		2 3/4	.275		32	
		3	.30		30	1028.60
		3	.30			
		3	.30	1029		
		3	.30			
		3	.30			
		3	.30		36	
		2 1/2	.25	1028	33	
		2 1/4	.22		35	
		2	.20		38	
		2	.20			
		2	.20	1027		
		2	.20			
		2	.20		38	
		1 3/4	.175		40	
		1 1/2	.15	1026	43	1025.72
		1 1/4	.125		46	
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125		46	
		1	.10		50	
		1	.10		50	
		3/4	.075		55	
		3/4	.075			
		3/4	.075			
		3/4	.075		55	
		5/8	.067		57	
		5/8	.067	1025		
		5/8	.067			
		5/8	.067			
		5/8	.067		57	
		3/4	.075		55	
		3/4	.075			
		3/4	.075		55	
		1	.10		50	
		1	.10		50	
		1 1/4	.125		46	
		1 1/4	.125			
		1 1/4	.125		46	
		1 1/2	.15		43	
		1 1/4	.125	1024	46	
		1 1/4	.125			
3	10	1 1/4	.125	1023	46	1023.42

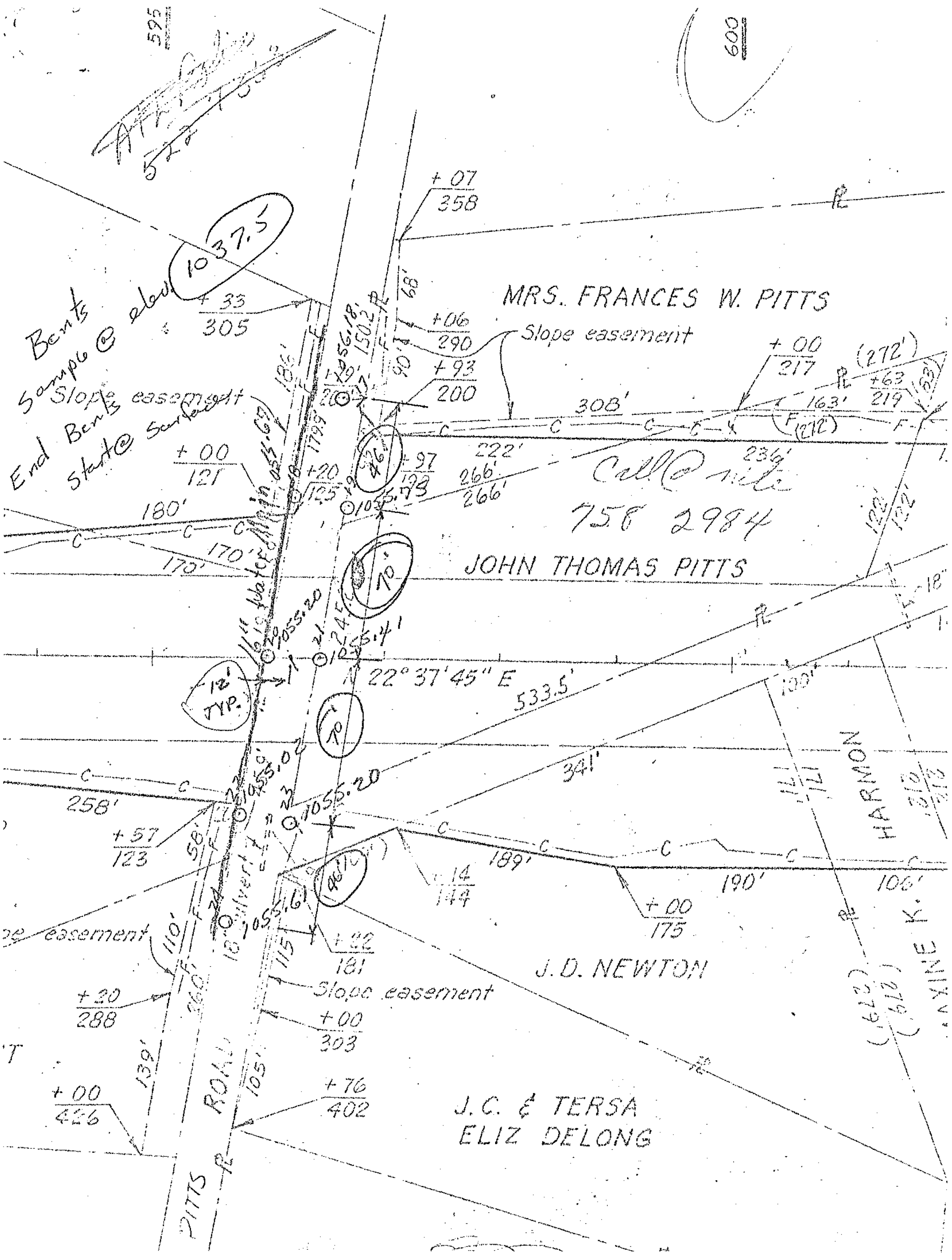
H.D. 500-B
(10-66)

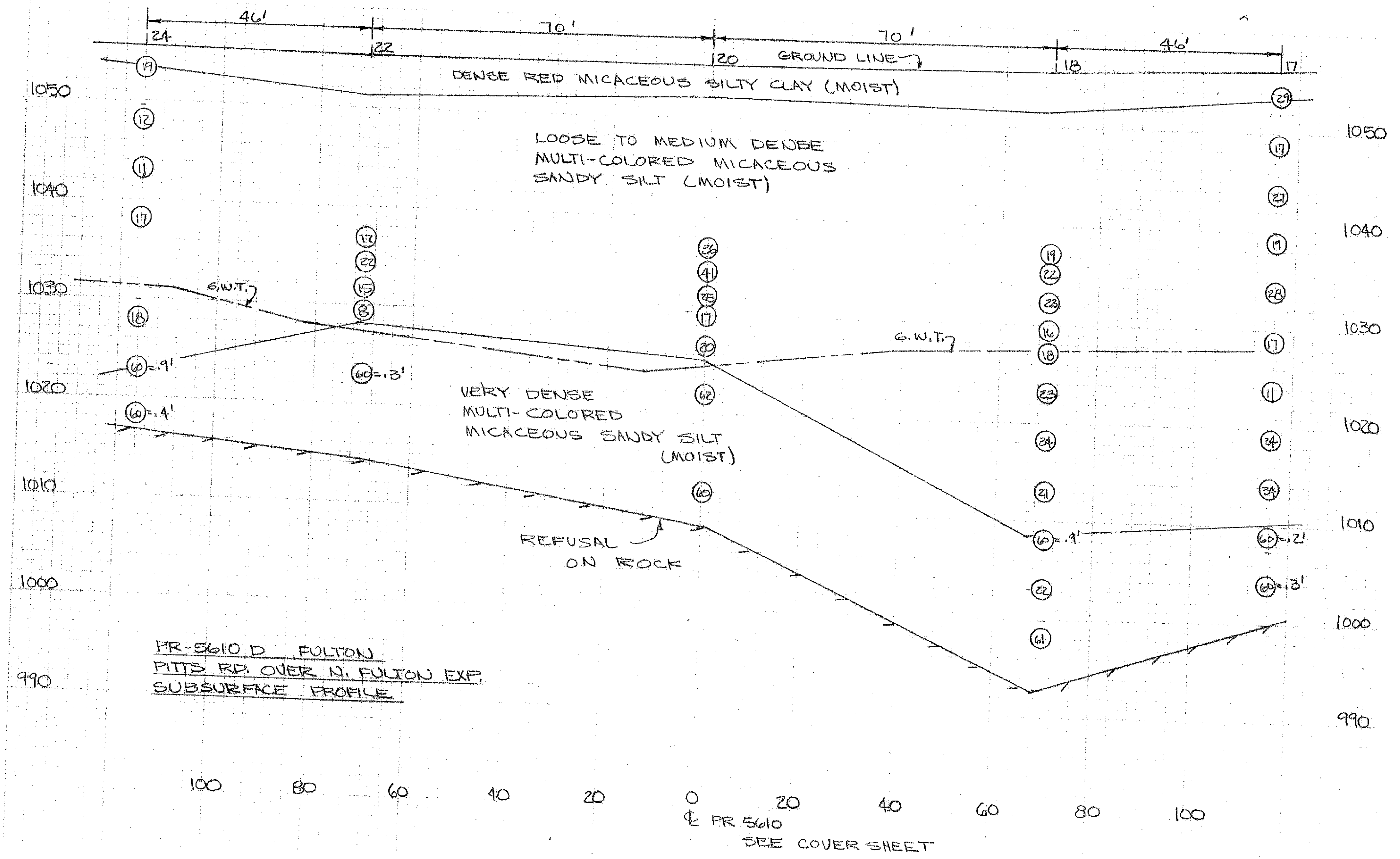
TEST PILE DRIVING DATA

TEST PILE NO. 2 CONTINUED. PAGE NO. 3 OF 3

PROJECT NO. APD056-1-10-4T2 COUNTY Fulton

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	1 1/4	.125	1023	46	1023.31
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125		46	
		1	.10	1023	50	
		1	.10	1022	50	
		3/4	.075		55	1022.41
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075			
		3/4	.075		55	
		1	.10	1022	50	1021.66
		1	.10			
		1	.10	1021		
		1	.10			
		1	.10			
		1	.10			
		1	.10		50	
		3/4	.075		55	
		3/4	.075		55	
		1/2	.050		60	
		1/2	.050			1020.96
		1/2	.050			
		1/2	.050		60	
		3/8	.037		63	
		3/8	.037			
		3/8	.037		63	
		1/4	.025		67	
		1/4	.025			
		1/4	.025			
		1/4	.025			
		1/4	.025			
		1/4	.025		67	
		1/8	.012		71	
		1/8	.012			
		1/8	.012		71	
		0	0		75	
		0	0			
		0	0			
3	10	0	0	1021	75	1020.54


595
600
522
MRS. FRANCES W. PITTS
JOHN THOMAS PITTS
J.D. NEWTON
J.C. & TERSA
ELIZ DELONG
PITTS ROAD
HARMON
K.
Slope easement
Slope easement
Slope easement
easement
+07
358
+33
305
+06
290
+93
200
+00
217
+63
219
+00
121
+20
125
+97
198
+57
123
+14
144
+00
175
+22
181
+20
288
+00
303
+00
426
+76
402
68'
90'
186'
179'
179'
308'
163'
(272')
(272')
(63')
222'
236'
266'
266'
180'
170'
170'
122'
132'
18"
22° 37' 45" E
533.5'
341'
100'
171'
171'
258'
58'
189'
190'
106'
110'
260'
115'
105'
139'
(279)
(279)
(212)
(212)
Bents
Sample @ elev 1037.5
End Bents
Start @ Surface
6" Water Main
12' TYP.
Call @ ...
758 2984
46'
70'
70'
46'
1056.18
1050.2
1055.69
1055.79
1055.20
1055.41
1055.02
1055.20
1055.61
19
20
21
22
23
24
18" culvert



PR-5610 D FULTON
PITTS RD. OVER N. FULTON EXP.
SUBSURFACE PROFILE

This report has been produced for the sole and exclusive use of AECOM, HNTB and the Georgia Department of Transportation. Distribution of this report to others shall be for information purposes only. Use and reliance on this report or any of its contents by others is at their sole risks.

ATTACHMENT U

Kimball Bridge Road over SR 400 –
BSN: 121-0475-0

[redacted]

Project No:[redacted] PI No. 0001757

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

Existing bridge on Kimball Bridge Road over SR 400 (Structure ID 121-0475-0), as shown in Figure 1 of Appendix A, is a four-span structure that crosses over SR 400 at a skew angle. The new bridge replaces the existing bridge at approximately 63 feet south of current location to accommodate the SR 400 widening associated with the [redacted], PI No. 0001757).

2. SITE GEOLOGY

According to the "Geology of the Greater Atlanta Region" by McConnell and Abrams, 1984, the site as shown in Figure 2 of Appendix A, is generally underlain by the “pfu: Sandy Springs Group” Formation. This geologic formation typically includes a lower unit of intercalated biotite gneiss, mica schist and amphibolite.

3. HISTORICAL DATA

Previous soil boring data at the vicinity of the proposed bridge location was obtained from GDOT OMAT archive files and is included in Appendix B of this report. NOVA is not responsible for the presented historical BFI geotechnical data prepared by others and found in GDOT OMAT archive file storage. Figure 3 of Appendix B represents our understanding of the locations of historical soil borings with respect to the existing structure. The users should review the attached documents and confirm these locations for their use.

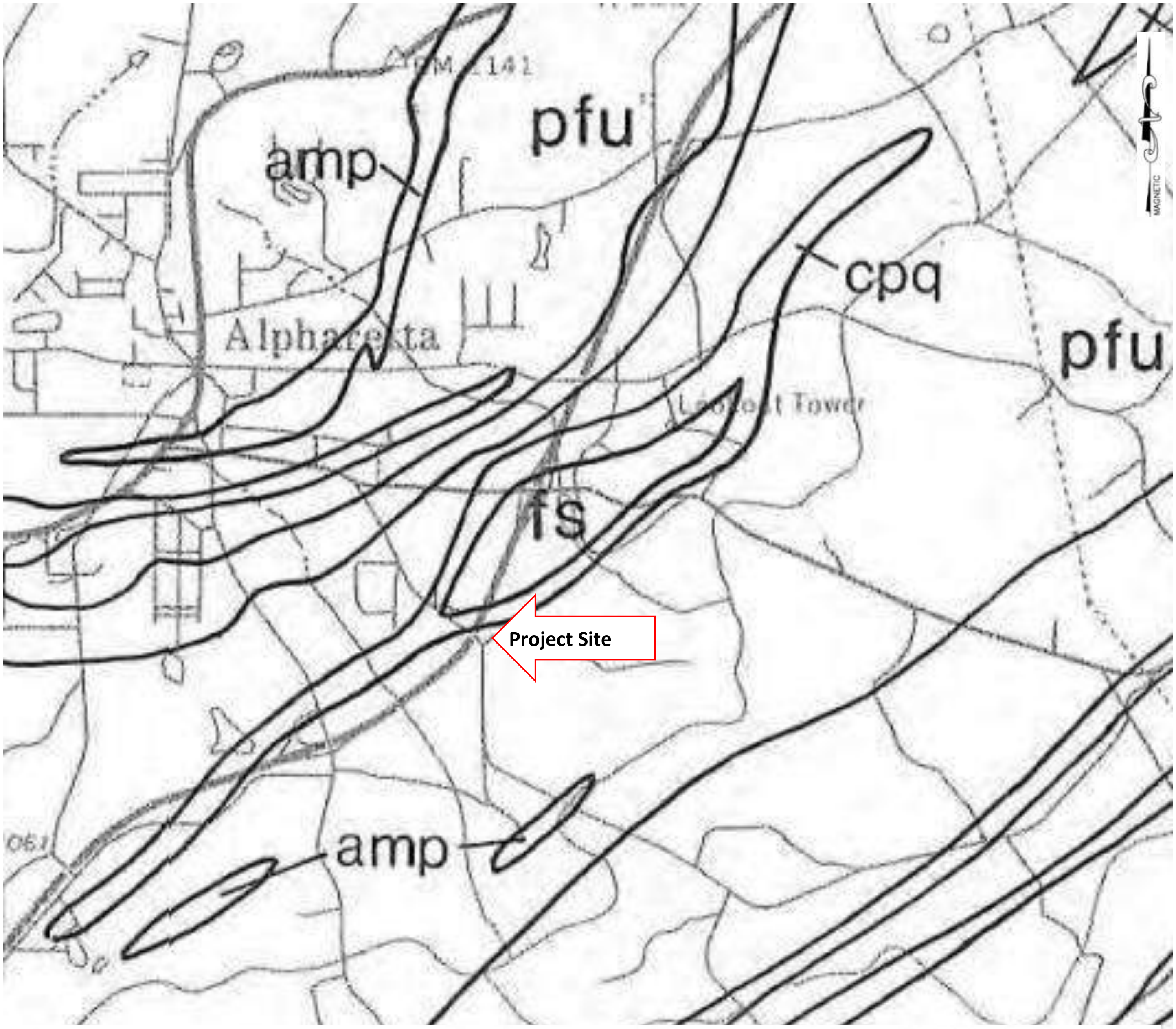
APPENDIX A

FIGURES

FIGURE 1
Kimball Bridge Road over SR 400
EXISTING BRIDGE
SOURCE: GDOT Bridge Inspection Report

PROFESSIONAL | PRACTICAL | PROVEN

[redacted] – PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton [redacted] Counties, Georgia
NOVA Project Number 2018089 - Task Order 5



pfu
cpq
fs

Sandy Springs Group (Higgins and McConnell, 1978a: Kline, 1980; this report): Similar to sequence observed in northern Piedmont and at least partially equivalent to Atlanta Group (see text). Includes a lower unit of intercalated biotite gneiss, mica schist and amphibolite (pfu); a middle unit composed of micaceous quartzite, mica schist and graphitic schist (cpq); and an upper unit of graphite-garnet-mica schist with lesser amounts of biotite gneiss and amphibolite (fs).

FIGURE 2
Kimball Bridge Road over
SR 400
SITE GEOLOGY
SOURCE: McConnell & Abrams, 1984

NOVA
PROFESSIONAL | PRACTICAL | PROVEN

[redacted] –
PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton [redacted] Counties, Georgia
NOVA Project Number 2018089 –
Task Order 5

APPENDIX B

HISTORICAL DATA

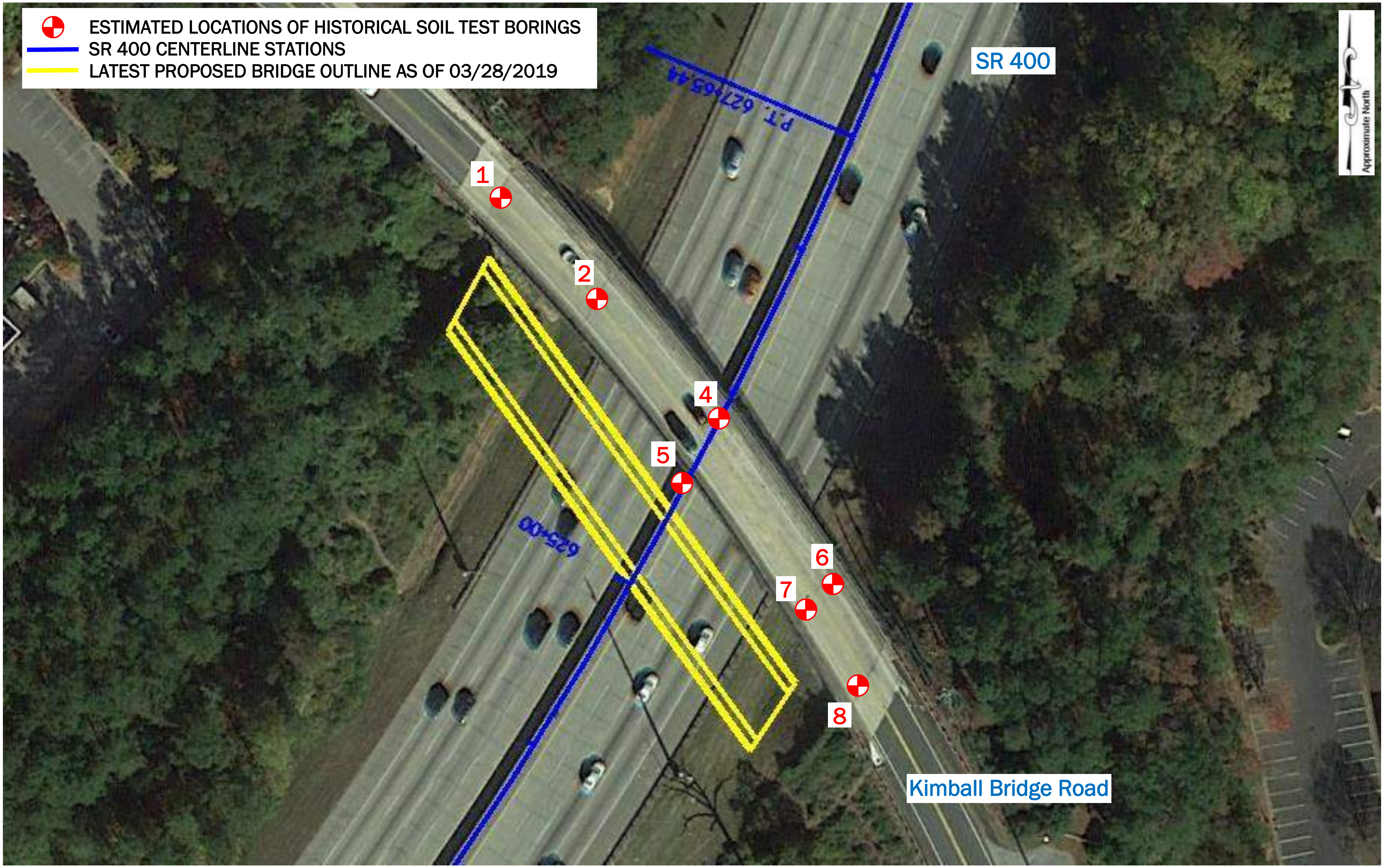


FIGURE 3
Kimball Bridge Road over SR 400
HISTORICAL BORING LOCATION PLAN
SOURCE: Google Earth Aerial Photos
SCALE: Not to Scale

[redacted] – PI No. 0001757
BFI GEOTECHNICAL DATA REPORT
Fulton [redacted] Counties, Georgia
NOVA Project Number 2018089 - Task Order 5

STATE HIGHWAY DEPARTMENT OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE APD-F-056-1 (6) Fulton
Not Let To Contract

OFFICE Atlanta, Georgia

DATE May 29, 1968

FROM Thomas D. Moreland, State Highway Materials Engineer

TO R. L. Chapman, Jr., State Highway Bridge Engineer

SUBJECT Bridge Foundation Investigation
APD-F-056-1 (6) Fulton
Kimball Bridge Road
Bridge No. 24

As requested, a bridge foundation investigation has been made at the above listed site. Attached are the results of this work. If any additional information is needed, please notify us.

Very truly yours,

Thomas D. Moreland
State Highway Materials Engineer

TDM:DAM:pml

BRIDGE FOUNDATION INVESTIGATION

APD-F-056-1 (6) FULTON
KIMBALL BRIDGE ROAD
BRIDGE NO. 24

1. LOCATION - This bridge is to be located 4 miles east of Alpharetta, Georgia. It will be geologically sited in the Biotite Gneiss and Schist Formation of the Georgia Piedmont Region.

2. SUBSURFACE DETAILS - Reference should be made to the attached boring logs and subsurface profile. Some pertinent details are as follows:

   a. The ground water table was at or near elevation 1073.0 during this investigation.

   b. Soils present consist chiefly of loose to medium dense sandy silt underlain by very dense shallow rock.

3. END BENT FOUNDATIONS - Pile bents using steel "H" piles are suitable foundations for the end bents. Maximum recommended design bearings for "H" piles at this site are as follows:

10" BP 42	50 Tons
12" BP 53	65 Tons

Estimated pile tip elevations for these bearings are as follows:

BENT	EST. TIP ELEV.
1	1078.0
5	1075.0

4. PLAN DRIVING OBJECTIVE - The PDO for end bent piles should be dynamic bearing after a minimum tip elevation of 1085.0 is achieved.

5. INTERMEDIATE BENT FOUNDATIONS- Spread footings are recommended for intermediate bents. These footings may be placed on very dense sandy silt with a maximum design bearing of 2 T.S.F. as follows:

BENT	ELEVATION
2	1070.0
3	1075.0
4	1070.0

The footings at Bents 2 and 3 are below the ground water table; therefore, extreme care should be taken to keep footings dry during construction. Pumping should be done from a sump outside the footing area, and at least 12" deeper than footing excavation. Footing excavation should not be done until immediately before the forms are to be set.

6. <u>DANGER FROM FILL SETTLEMENT</u> - No danger is anticipated.

David A. Mitchell, Sr.
Civil Engineer IV

DAM:JCK:pml
May 29, 1968

(8-67)

9-10

"AS-BUILT" BRIDGE FOUNDATION REPORT

DATA FOR BRIDGE ENGINEER, ATLANTA

PROJECT NO. APD-066-1(12) CT 2 COUNTY FULTON

BRIDGE NO. 24 (Lt.) (Rt.) [✓ OVER]/AT North Fulton Xway AT STA. 370 +26.07

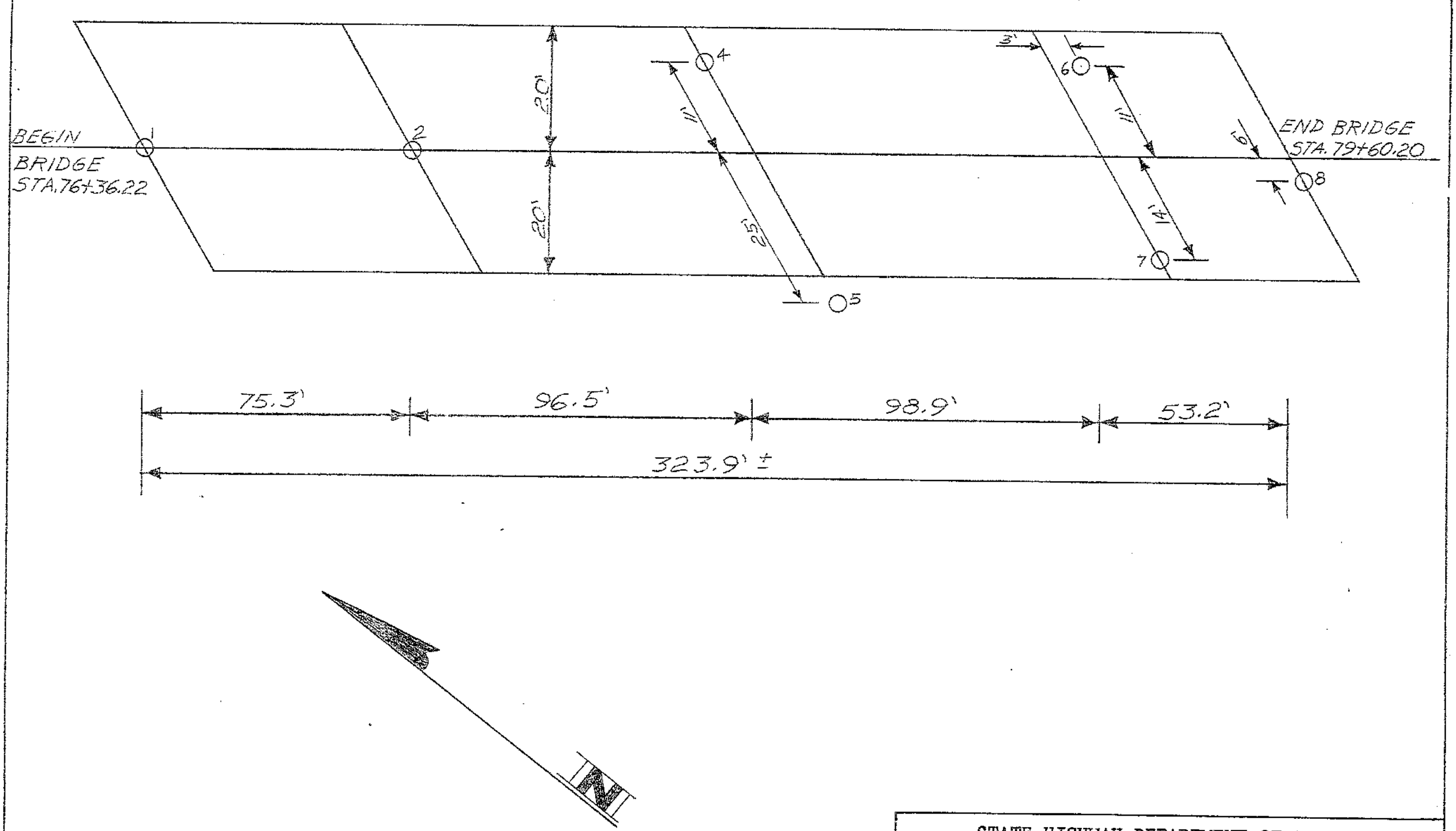
DATE OF THIS REPORT 7-24 19 78 BY EAIT ENGINEEI

ELEVATIONS OF BOTTOMS OF FOOTINGS (= BF) & LOWEST AND HIGHEST ELEVATIONS OF PILE TIPS (= LOW, HIGH)
(Express this data in whole numbers only — **NO DECIMALS**)

BENT NO.	FOR FOUNDATION BENTS ONLY							FOR PILE BENTS ONLY		REMARKS, INCLUDING SURVEY ORIENTATION
	ELEVATION OF	AT								
		LEFT FOOTING		MIDDLE FOOTING		RIGHT FOOTING		LOW	HIGH	
1	BF			1106						
	LOW HIGH			1067	1082					END BENT
2	BF	1070				1070				
	LOW HIGH									
3	BF	1092				1093				
	LOW HIGH									
4	BF	1075				1070				
	LOW HIGH									
5	BF			1082						
	LOW HIGH			1059	1066					END BENT
6	BF									
	LOW HIGH									
7	BF									
	LOW HIGH									
8	BF									
	LOW HIGH									
9	BF									
	LOW HIGH									
10	BF									
	LOW HIGH									
11	BF									
	LOW HIGH									
12	BF									
	LOW HIGH									
13	BF									
	LOW HIGH									
14	BF									
	LOW HIGH									
15	BF									
	LOW HIGH									
16	BF									
	LOW HIGH									
17	BF									
	LOW HIGH									
18	BF									
	LOW HIGH									
19	BF									
	LOW HIGH									
20	BF									
	LOW HIGH									
21	BF									
	LOW HIGH									
22	BF									
	LOW HIGH									

ORIGINAL TO: BRIDGE ENGINEER
COPY TO : DIVISION OFFICE

NOTE: COMPLETE THIS FORM FOR EVERY BRIDGE AS SOON AS THE INFORMATION IS KNOWN AND MAIL PROMPTLY.



STATE HIGHWAY DEPARTMENT OF GEORGIA
Bridge Foundation Investigation

DRW. Ⓑ	APD-F-056-1(6) FULTON UNDERPASS @ KIMBALL BR. RD. BR. #24 NO SCALE 5-20-68
CKD. RT	
APP.	

Bent

Bent

Bent 1 North end El. 1108.16
South end El. 1106.32
Bent 5 North end El. 1098.3
South end El. 1096.0

Note
All bents are parallel.
Handrail and handrail posts not shown in plan.

PLAN
SCALE: 1" = 20'-0"

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

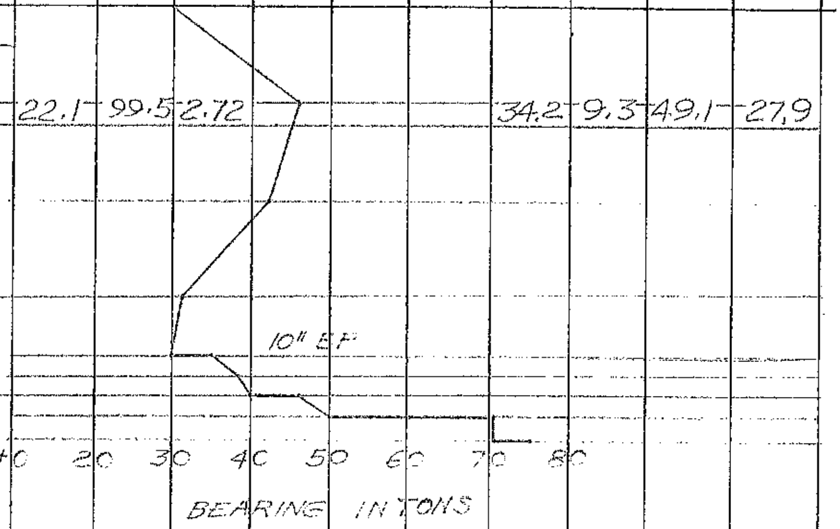
PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-17-68

LOCATION UNDERPASS @ KIMBALL BRIDGE RD, BR. #2A BORING NO. 1

BENT NO. 1 FOOTING CENTER GROUND ELEV. 1087.55

PROPOSED FOOTING ELEV. ________ PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	RED SANDY CLAYEY SILT	1U			22.1	99.5	2.72				34.2	9.3	49.1	27.9
	VERY DENSE MICA. SANDY SILT	2S	60=.9'	SM										
1080		3S	60=.9'	SM										
	REFUSAL ON ROCK													
1070														
1060														



H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-036-1(6) COUNTY FULTON DATE 4-19-68

LOCATION BRIDGE #24 BORING NO. 2

BENT NO. 2 FOOTING CENTER GROUND ELEV. 1097.93

PROPOSED FOOTING ELEV. 1078.0 PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	BOULDER													
1090	MED. DENSE-DENSE MLTC, MICACEOUS SANDY SILT			ML-SM										
1080														
GWT 1070	VERY DENSE MLTC, MICACEOUS SANDY SILT	1S	60=.4'	SM										
		2S	60=.1'	SM										
	MED. DENSE (SAME)	3S	19	SM										
	VERY DENSE	4S	60	SM										
1060	MLTC. MICACEOUS	5S	60=.9'	SM										
	SANDY SILT													
		6S	60=.3'	SM										
1050		7S	60=.3'	SM										
		8S	60=.6'	SM										
	END DRILLING													
1040														

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-16-66

LOCATION BRIDGE #24 BORING NO. 4

BENT NO. 3 FOOTING LT. GROUND ELEV. 1092.56

PROPOSED FOOTING ELEV. 1076.0 PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
1090	MED. DENSE - DENSE MLTC. SANDY SILT													
				ML										
1080														
BF SWT	DENSE - VERY DENSE MULTICOLORED SANDY SILT	1S	60=.5'	SM	25.1								40.2	5.8
		2S	60=.5'	SM										
1070		3S	60=.5'	SM	14.6								32.0	5.0
		4S	60=.8'	SM	14.4								31.7	5.5
		5S	25	SM	29.1								36.9	6.0
		6S	42	SM	27.1								46.5	6.5
1060		7S	35	SM	26.1								32.3	5.8
		8S	60	ML										
1050		9S	60	ML-SP										
		10S	60=.5'											
	END DRILLING													
1040														

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-I-056-1 (6) COUNTY FULTON DATE 4-17-65

LOCATION BRIDGE #24 BORING NO. 5

BENT NO. 3 FOOTING RT. OFFSET 14' RT. GROUND ELEV. 1089.50

PROPOSED FOOTING ELEV. 1076.0 PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	MED. DENSE MLTC. MICACEOUS SANDY SILT													
1080														
B.F.	DENSE—VERY DENSE MLTC. SANDY SILT	1S	60	SM										
GWT		2S	60=.8'	SM										
1070		3S	60=.5'	SM										
		4S	50=.7'	SM										
		5S	60=.5'	SM-SP										
		6S	35	ML										
		7S	60=.5'	SM										
1060														
		8S	60=.5'	SM										
		9S	60=.8'	SM-SP										
250														
		10S	60=.3'	SM										
	END DRILLING													
1040														

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-15-68

LOCATION BORING NO. 6

BENT NO. 4 FOOTING LT. OFFSET 3' FWD. GROUND ELEV. 1096.47

PROPOSED FOOTING ELEV. 1076.0 PARTY CHIEF COBBIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	MED. DENSE MLTC. MICAS. SANDY SILT													
1090														
1080														
		1S	24	SM										
SNT		2S	20	SM										
1070		3S	34	SM										
F	DENSE - VERY DENSE	4S	60=.2'	SM										
	(SAME) W/	5S	60=.6'	SM										
	WEATHERED ROCK	6S	60=.1'											
1060		7S	HAMMER BOUNCED											
		8S	HAMMER BOUNCED											
1050														
	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-12-68

LOCATION BRIDGE #24 BORING NO. 7

BENT NO. 4 FOOTING RT. OFFSET 5' RT. GROUND ELEV. 1096.0

PROPOSED FOOTING ELEV. 1076.0 PARTY CHIEF COGGIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
	GR. ELEV.													
	LOOSE-MED. DENSE													
	MLTC.													
1090	SANDY SILT													
1080														
BNT														
		1S	10	ML	40.0								56.3	9.3
1070 F	VERY DENSE	2S	60=.6'	SM	20.0								31.6	5.2
	(SAME) W/	3S	60=.5'	SM	19.2								23.6	4.0
	WEATHERED ROCK	4S	60=.9'	SM	45.0								43.7	6.0
		5S	60=.5'	SM	22.6								29.0	5.1
1060		6S	60=.2'											
		7S	60=.2'											
		8S	HAMMER BOUNCED											
1050	REFUSAL ON ROCK													

H.D.490

STATE HIGHWAY DEPARTMENT OF GEORGIA

DIVISION OF MATERIALS AND TEST, ATLANTA, GEORGIA

BRIDGE SUBSURFACE INVESTIGATION

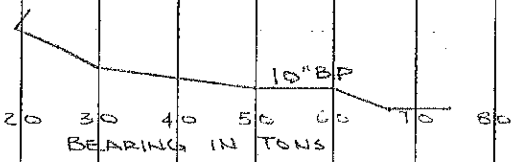
PROJECT APD-F-056-1(6) COUNTY FULTON DATE 4-16-68

LOCATION BRIDGE #24 BORING NO. 8

BENT NO. 5 FOOTING CENTER OFFSET 6'RT. GROUND ELEV. 1098.30

PROPOSED FOOTING ELEV. ______ PARTY CHIEF COSEIN

ELEV.	BORING LOG	SAMPLE	BLOW	REMARKS	W	γ	Gs	C.	Ø	BC	LL	PI	% 200	% CLAY
BF	GR. ELEV.													
	RED MICAS, SANDY CLAYEY SILT	1U			30.8	96.5	2.65				49.1	12.0	69.0	45.3
	MED. DENSE RED SANDY SILT	2S	23	ML										
1090		3U												
		4S	12											
	VERY DENSE MLTC. SANDY SILT	5U												
		6S	60	SM										
1080		7S	60=4'	SM										
		8S	60=.5'	SM										
1070		9S	60=.9'	SM										
		10S	60=.5'	SM										
	END DRILLING													
1060														



FORM H. D. 66

7-7-70
BOR. #1

STATE HIGHWAY DEPARTMENT OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE APD-056-1 (13) Ct. 2 Dawson
Rogers Bridge Company, Inc.

OFFICE Atlanta, Georgia

DATE June 30, 1970

FROM R. L. Chapman, Jr., State Highway Bridge Engineer

TO Mark M. Johnson, Field Division Engineer, Cartersville, Ga.

SUBJECT Pile Order Lengths - Bridge No. 24, UP Kimball Bridge Road.

This letter acknowledges receipt of the following Test Pile Driving Data:

Bridge No.,	Test Pile No.	Bent No.	Pile Type
24	1	1	10 BP 42

This office concurs in the use of the following Pile Order Lengths:

Bridge No.	Bent No.	Order Length-ft.	Pile Type
24	1	27	10 BP 42

Yours very truly,

R. L. Chapman, Jr.
State Highway Bridge Engineer

RLCJr./LRP/kg

✓ cc: T. D. Moreland
State Highway Materials Engineer

cc: McRay Newsom, A.F.D.E.
21 Claire Drive, S. W.
Atlanta, Georgia 30315

cc: Rogers Bridge Company, Inc.
P. O. Box 87220 (2730 Sullivan Road)
College Park, Georgia 30337

cc: J. T. Kratzer

H.D. 500-A
(10-66)

TEST PILE DRIVING DATA

DATE 6-19-70

PROJECT NO. APD 056 (1) (13) CT.2 COUNTY FULTON

BRIDGE AT KIMBALL & NORTH FULTON STATION 76+36.22 TO STATION 79+60.20

PILING

UT . . . . x ______ '
TT . . . . x ______ '
H. 10 BP 42 x ______ '
C-I-P ______ IN. O.D. x ______ '
PSC ______ IN ______ x ______ '
PCC ______ IN. ______ x ______ '
OTHER: ______

PLAN DRIVING OBJECTIVE (PDO)

☐ PRACTICAL REFUSAL
☐ REFUSAL ☐ ROCK
☐ TONS. 35

LOCATION

TEST PILE NO.	BRIDGE NO.	BENT NO. 1 PILE NO. 8
1	24	

HAMMER

GRAVITY. ______ LB.
MKT DE – ______
DELMAG D – ______
VULCAN NO. 15,000 @ 3 FT
LINK-BELT MODEL ______
OTHER: ______

SUMMARY

ELEVATIONS, IN WHOLE FEET ONLY

(1) CUT-OFF 1108
GROUND 1107
(2) TIP, FINAL 1068
(3) TIP, ACCEP. 1081
(1) – (2) = 40.00
(1) – (3) = 27
NAME: Sm Oglthe EA IV

DID BRIDGE FOUNDATION INVESTIGATION REPORT RECOMMEND, SPECIFY, OR ESTIMATE . . . ? (INSERT)

A MIN. PILE TIP ELEV.? 1085
A PILE EST TIP ELEV.? 1079
ANY PILE LENGTHS? ______
DRIVING TO A STRATUM? ______
DRIVING TO AN "N" OF? ______
OTHER? ______

TEST BEGAN WITH A PENT. OF 1.00 FEET BELOW CUT-OFF AND A TIP ELEVATION OF 1007 {WHOLE NO.'S ONLY

*HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
0	0	36		1107		~~1107.32~~ 1107.46
3	10	46	4.60			
		20	2.00			
		15	1.50			
		12	1.20			
		8	.80		15	
		6½	.65	1096	18	~~1095.90~~ 1096.05
		5½	.55		26	
		5½	.55	1095		
		5½	.55		26	LENGTH IN PLACE
		5	.50		25	39.90
		5	.50	1094	21	CAST NO. 5560
		4¾	.475		22	
		4½	.45		23	ORDER LENGTH = 27'
		4	.40	1093	25	ell.AMW
		3½	.35		27	
		4	.40	1092	26	~~1091.75~~ 1091.90
		4	.40			
		4	.40		25	
		3½	.35	1091	27	
		3½	.35			
		3½	.35		27	
		3	30	1090.	30	
		3	.30		30	
		3½	.35		33	
		3½	.35	1089	33	
		2¾	.275		32	
		2½	.25		33	
↓	↓	2½	.25			
3	10	2½	.25	1088	33	~~1088.15~~ 1088.30

*FOR GRAVITY AND POWER HAMMERS.
FOR DIFFERENTIAL OR DOUBLE ACTING STEAM OR AIR HAMMERS, USE MANUFACTURER'S ENERGY RATING.
FOR LINK-BELT, CONVERT BOUNCE CHAMBER PRESSURE READING TO "WH" VALUE BY MEANS OF CHART; USE IN S. A. FORMULA.

H.D. 500-B
(10-66)

TEST PILE DRIVING DATA

TEST PILE NO. 1 CONTINUED. PAGE NO. 2 OF 4

PROJECT NO. APD-056-(1) 13 CT 2 COUNTY FULTON

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	2 1/4	.225	1088	35	~~1087,94~~ 1088.09
		2 1/4	.225			
		2 1/4	.225		35	
		2	.20		38	
		2	.20		38	
		1 3/4	.175		40	
		1 3/4	.175		40	
		1 1/4	.125	1087	46	
		1	.10		50	
		1	.10			
		1	.10			
		1	.10			
		1	.10		50	
		1 1/4	.125		46	
		1 1/2	.150		43	
		1 1/2	.150		43	
		1 1/4	.125		46	
		1	.10	1086	50	~~1085,77~~ 1085.92
		1	.10			
		1	.10			
		1	.10			
		1	.10			
		1	.10			
		1	.10			
		1	.10		50	
		1 1/4	.125		46	
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125	1085		
		1 1/4	.125			
		1 1/4	.125		46	
		1 1/2	.15		43	
		1 1/4	.125		46	
		1 1/4	.125		46	
		1	.10		50	~~1084.15~~ 1084.30
		1 1/4	.125		46	
		1 1/4	.125		46	
		1 1/2	.15	1084	43	
		1 1/4	.125		46	
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125			
		1 1/4	.125		46	
		1 1/2	.15		43	
		1 1/2	.15			
		1 1/2	.15	1083		
↓	↓	1 1/2	.15			
3	10	1 1/2	.15		43	~~1082.40~~ 1082,55

H.D. 500-B
(10-66)

TEST PILE DRIVING DATA

TEST PILE NO. 1 CONTINUED. PAGE NO. 3 OF 4

PROJECT NO. APD-066 (1) 13 672 COUNTY FULTON

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	1½	.15	1082	43	~~1083.39~~ 1082.42
		1½	.15			
		1½	.15			
		1½	.15		43	
		1¼	.125		46	
		1¼	.125		46	
		1½	.15		43	
		1½	.15			
		1½	.15			
		1½	.15			
		1½	.15			
		1½	.15			
		1½	.15			
		1½	.15	1081		
		1½	.15			
		1½	.15			
		1½	.15			
		1½	.15		43	
		1¼	.125		46	~~1033.37~~ 1080.21
		1¼	.125		46	
		1½	.15		43	
		1½	.15			
		1½	.15	1080		
		1½	.15		43	
		1¾	.175		40	
		1¾	.175			
		1¾	.175		40	
		2	.20		38	
		2	.20			
		2	.20	1079		
		2	.20			
		2	.20		38	
		2¼	.225		35	~~1073.39~~ 1078.23
		2¼	.225		35	
		2½	.25		33	
		2½	.25	1078	33	
		2¼	.225		35	
		2¾	.275		32	
		2½	.25	1077	33	
		2¼	.225		35	
		2¾	.275		32	
		2¾	.275		32	
		3	.30	1076	30	~~1076.03~~ 1076.17
		2¾	.275		32	
		2¾	.275			
		2¾	.275			
		2¾	.275	1075		
		2¾	.275			
		2¾	.275			
↓	↓	2¾	.275		32	
3	10	3	.30	1074	30	~~1074.17~~ 1074.32

*H.D. 500-B
(10-66)

TE T PILE DRIVING DA A

TEST PILE NO. 1 CONTINUED, PAGE NO. 4 OF 4

PROJECT NO. APD-056-(1) 13 C72 COUNTY FULTON

HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	3	.30	1074	30	~~1073.92~~ 1074.07
		3	.30			
		3	.30			
		3	.30			
		3	.30	1073		
		3	.30			
		3	.30			
		3	.30	1072		
		3	.30		30	
		2½	.25		33	
		2½	.25		33	
		2¼	.225		35	
		2	.20	1071	38	
		2¼	.225		35	
		2	.20		38	
		2¼	.225		35	~~1070.55~~ 1070.69
		2¼	.225		35	
		2	.20		38	
		1¾	.175	1070	40	
		1¾	.175		40	
		1½	.15		43	
		1¾	.175		40	
		1¾	.175		40	
		1½	.15		43	
		1½	.15		43	
		1¼	.125		46	
		1¼	.125		46	
		1	.10	1069	50	1068.98 ✓
		1	.10			
		1	.10		50	
		¾	.075		55	
		1	.10		50	
		1	.10			
		1	.10			
		1	.10		50	
		¾	.075		55	1068.34 ✓
		¾	.075			
		¾	.075		55	
		½	.05		60	
		½	.05			
		½	.05			
		½	.05		60	
		¼	.025		67	
		¼	.025			
		¼	.025		67	
		⅛	.0175		71	
		⅛	.0125	1068	71	1067.90 ✓
		0	0		75	
		0	0			
		0	0			
3	10					

H.D. 500-A
(10-66)

125-69
BOR #0

TEST PILE DRIVING DATA

DATE 11-18-69

PROJECT NO. APD-056-1(13)CT 2 COUNTY FULTON

BRIDGE AT KIMBALL & N. FULTON XWAY STATION 76+36.22 TO STATION 79+60.20

PILING

UT x

TT x

H. 10 BP 42 x

C-I-P ____ IN. O.D. x

PSC ____ IN ____ x

PCC ____ IN. ____ x

OTHER:

PLAN DRIVING OBJECTIVE (PDO)

☑ PRACTICAL REFUSAL

☐ REFUSAL ☐ ROCK

☐ TONS. 40

LOCATION

TEST PILE NO. 2

BRIDGE NO. 24

BENT NO. 5

PILE NO. 19

HAMMER

GRAVITY. ____ LB.

MKT DE –

DELMAG D –

VULCAN NO. ONE 15,000 @3 FT.

LINK-BELT MODEL

OTHER:

SUMMARY

ELEVATIONS, IN WHOLE FEET ONLY

(1) CUT-OFF 1098

GROUND 1097

(2) TIP, FINAL 1086

(3) TIP, ACCEP. 1085

(1) – (2) = 12

(1) – (3) = 13

NAME: Sam Oglthr EA IV

DID BRIDGE FOUNDATION INVESTIGATION REPORT RECOMMEND. SPECIFY. OF ESTIMATE . . . ? (INSERT)

A MIN. PILE TIP ELEV.?

A PILE TIP ELEV.? 1075

ANY PILE LENGTHS?

DRIVING TO A STRATUM?

DRIVING TO AN "N" OF?

OTHER?

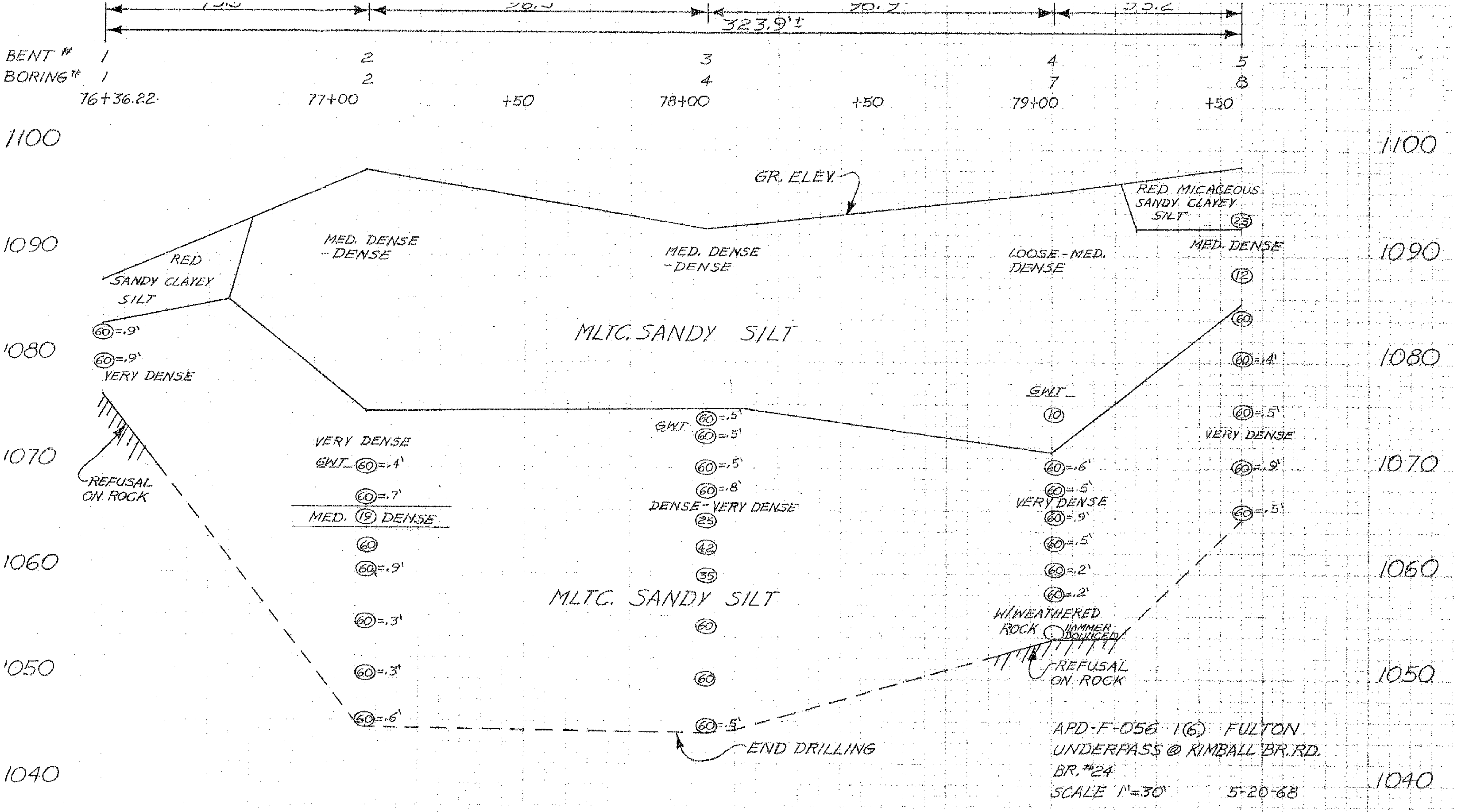
TEST BEGAN WITH A PENT. OF 0 FEET BELOW CUT-OFF AND A TIP ELEVATION OF 1098 {WHOLE NO.'S ONLY}

*HAMMER FALL (FEET)	NO. OF BLOWS	TOTAL PENT. (INCHES)	AVER. PENT. PER BLOW (INCHES)	ELEVATION OF TIP, WHOLE FEET	BEARING IN WHOLE TONS	OCCASIONAL CORRECTED TIP ELEVATION, FINAL TIP ELEVATION, ORDER LENGTHS, ETC.
3	10	12	1.2	1097		1097.03 ✓
		18	1.8	1096		1096.03 ✓
		24	2.4	1095		1094.53 ✓
		9½	.95	1093		1092.53 ✓
		9½	.95			
		5	.5	1091	21	1090.95 ✓
		5	.5			LENGTH IN PLACE 11.85 FT.
		5	.5		21	
		6	.6	1090	19	1089.69 ✓
		5½	.55		20	1089.20 ✓
		4	.9	1089	25	1088.74 ✓
		4	.4			
		4	.4		25	
		3	.3	1088	30	1087.74 ✓
		3	.3			
		3	.3			
		3	.3		30	
		1	.1	1687	50	1086.74 ✓
		1	.1			
		1	.1		56	
		½	.05		60	1086.49 ✓
		½	.65			
		½	.65		66	
		¼	.025	1086	67	1086.36 ✓
		¼	.025		67	
		⅛	.0125		71	1086.32 ✓
		⅛	.6125	1086	71	1086.30 ✓
		0	0		75	
		0	0			ORDER LENGTH = 13'
		0	0		75	

*FOR GRAVITY AND POWER HAMMERS.

FOR DIFFERENTIAL OR DOUBLE ACTING STEAM OR AIR HAMMERS, USE MANUFACTURER'S ENERGY RATING.

FOR LINK-BELT, CONVERT BOUNCE CHAMBER PRESSURE READING TO "WH" VALUE BY MEANS OF CHART; USE IN S. A. FORMULA.



APD-F-056-1(6) FULTON
UNDERPASS @ KIMBALL BR. RD.
BR. #24
SCALE 1"=30' 5-20-68
]

SPT HAMMERS ENERGY CALIBRATIONS

S&ME- CME 55 (SN 328245)

Report of SPT Energy Measurements
S&ME CME 55 Truck (SN 328245)
Black River, North Carolina
S&ME Project No. 6235-17-020

PREPARED FOR:

North Carolina Department of Transportation
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699

PREPARED BY:

S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, NC 28273

September 20, 2018

September 20, 2018

North Carolina Department of Transportation
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699

Attention: Dr. Shunyi (Chris) Chen, Ph.D., P.E.

Cc: Ms. Cheryl A. Youngblood, L.G.

Reference: **Report of SPT Energy Measurements**
S&ME CME 55 Truck (SN 328245)
Charlotte, North Carolina
S&ME Project No. 6235-17-020

Dear Dr. Chen:

We have completed the Standard Penetration Test (SPT) energy measurements on the automatic hammer mounted on our CME 55 truck-mounted drill rig with a serial number of 328245. This service was performed by our Mr. Robert E. Kral, P.E. on September 6, 2018. SPT energy testing was performed in general accordance with ASTM D4633 and the most recent revision of the North Carolina Department of Transportation (NCDOT), Geotechnical Engineering Unit's requirements. The testing procedures, equipment used during testing, and detailed results are presented in this report.

1.0 Dynamic Testing Methodology

Testing was performed using a model PAX (Serial No. 3733L) Pile Driving Analyzer^{TM} (PDA) manufactured by Pile Dynamics, Inc. The PDA was used to record and interpret data from two piezoresistive accelerometers (Serial Nos. K10181 and K10182) bolted to a 2-foot long AWJ drill rod (SN203) internally instrumented with two strain transducers. The instrumented AWJ drill rod has a cross-sectional area of 1.20 square inches, an outside diameter of approximately 1.75 inches, and an inside diameter of 1.25 inches at the gauge location. The accelerometers and strain gauges, which are mounted on opposing axis near the middle of the instrumented rod, monitor acceleration and strain for each hammer blow. The analyzer converts the data to velocities and forces and computes the maximum transferred hammer energies with the "EFV" method described in ASTM D4633. Preliminary results are recorded and displayed in real time for each blow. Calibration sheets for the accelerometers and the instrumented rod are included in the Appendix.

2.0 Testing and Observations

S&ME personnel were on site on September 6, 2018, to observe and perform high-strain dynamic testing during SPT sampling on the CME 55 truck-mounted drill rig operated by T. Miller of S&ME. The measurements were taken during drilling operations for the NCDOT I-5986A project in Black River, North Carolina. High-strain dynamic testing was performed at Boring EB1-Y10, the Field Borelog (not redlined) is attached in Appendix II. SPT energy measurements were recorded during three intervals at depths of approximately 43½, 48½, and 53½ ft below the existing ground surface. The information presented in the tables below summarizes the equipment tested and tooling used during the SPT energy measurements.

Table 2-1: Drill Rig Information

Manufacturer	CME
Model	55
Serial Number	328245
Operator	T. Miller
Carrier	Truck

Table 2-2: Hammer Information

Model / Type	CME / Auto
Serial Number	328245
Anvil Height (inches)	11.5
Anvil Diameter (inches)	2.5
Drop Height (inches)	30
Ram Weight (pounds)	140
Ram Serial Number	N/A

Table 2-3: Drilling and Instrumented Rod Information

Drill Rod Type	AWJ
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in^2)	1.20
Typical Lengths (feet)	5
Instrumented Rod Type	AWJ (SN 203)
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in^2)	1.20
Total Instrumented Rod Length (feet)	2.00
Length Below Gages (feet)	0.75
Split-Spoon Length (feet)	2.85

3.0 Dynamic Testing Results

The total rod length from the instrumentation to the tip of the split-spoon sampler was determined by adding 3.60 ft to the required drill rod length at each sample depth. Based on the test data, the automatic hammer on the CME 55 truck-mounted drill rig operated at a rate of about 51.4 to 52.0 blows per minute (bpm) during dynamic testing. The measured transferred hammer energy (EFV) was generally in the range of about 292.1 to 325.6 ft-lbs, which corresponds to Energy Transfer Ratio (ETR) values of about 83.5 to 93.0%, respectively. The SPT Energy Measurement Data Summary tables in the Appendix present the test data from every hammer blow at each sampling interval along with representative force and velocity traces for each test interval. The reported blow counts, obtained by the drill rig personnel, and a summary of the test data and average computed hammer energy and transfer ratio values are provided in Table 3-1. Plots and tables of the following are also included in the Appendix and present the test data with depth for each test interval:

- Penetration vs. BLC
- Penetration vs. FMX
- Penetration vs. EFV
- Penetration vs. CSX
- Penetration vs. VMX
- Penetration vs. ETR
- Average ETR vs. Rod Length
- ETR vs. Rod Length

Table 3-1: Summary of Dynamic Testing Results

Data Set ID	Sample Depth (ft)	Drill Rod Length (ft)	Instrumentation to Sampler Tip Length (ft)	Blows per 6" Increment / N-value	Soil Sample Description (Piedmont Residual)	Avg. BPM	Avg. EFV (ft-lbs)	Avg. ETR (%)
1	43½ - 45	45	48.6	2-3-5 / 8	CLAY	51.8	310.6	88.7
2	48½ - 50	50	53.6	7-11-15 / 26	CLAY	51.7	322.1	92.0
3	53½ - 55	55	58.6	7-12-15 / 27	CLAY	51.6	312.1	89.2
					Overall Average	**51.7**	**316.2**	**90.3**

The average hammer rate, transferred energy, and transfer ratio were calculated for each depth interval. Per ASTM D4633, only the blows from the final foot of each sample interval (i.e. the blows that determine the N-value) were included when computing the average values shown in Table 3-1. The overall average transferred hammer energy for the automatic hammer on the CME 55 truck-mounted drill rig (for all the depth intervals tested) was 316.2 foot-pounds, with an average ETR of 90.3%.

4.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report were based on the applicable standards of our profession in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

5.0 Closing

S&ME appreciates the opportunity to provide this report to the North Carolina Department of Transportation, Geotechnical Engineering Unit. Please let us know if you have any questions concerning this report.

Sincerely,

S&ME, Inc.

SEAL 042642
ROBERT E. KRAL

rkral@smeinc.com
2018.09.20 08:32:
15-05'00'

Kristen H. Hill, L.G., P.E.
Principal Engineer

Robert E. Kral, P.E.
Transportation Services Project Manager
N.C. Registration No. 042642

Appendices:

- Appendix I - CME 55 Truck (SN 328245) SPT Energy Measurements Summary Plots and Tables
- Appendix II - SPT Energy Evaluation Form (Field Log) and Field Borelog
- Appendix III - Instrumented Rod and Accelerometer Calibration Sheets
- Appendix IV - Certificate of Proficiency

Appendices

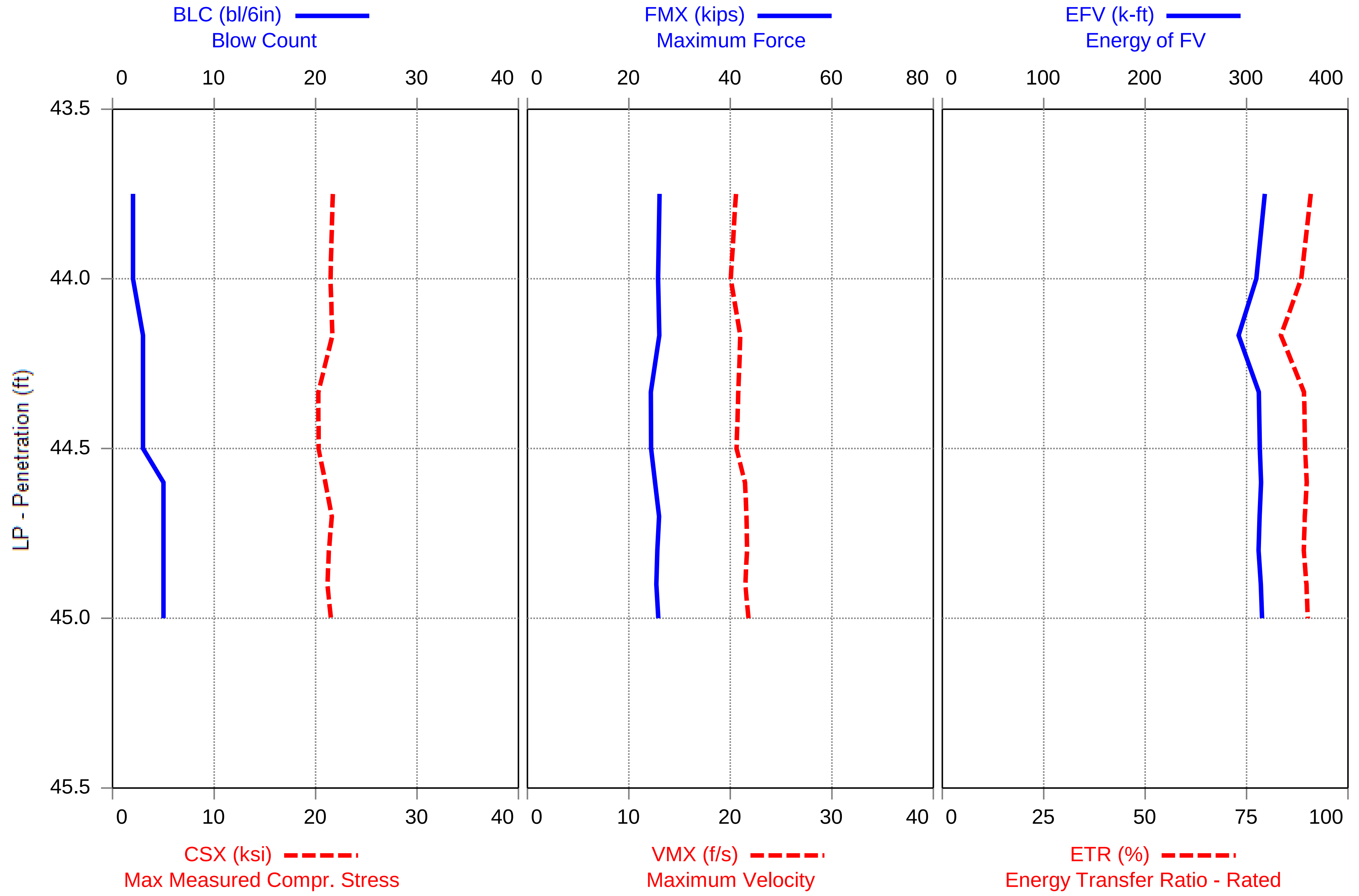
Appendix I

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.5 - Case Method & iCAP® Results

Printed: 19-September-2018

Test started: 06-September-2018

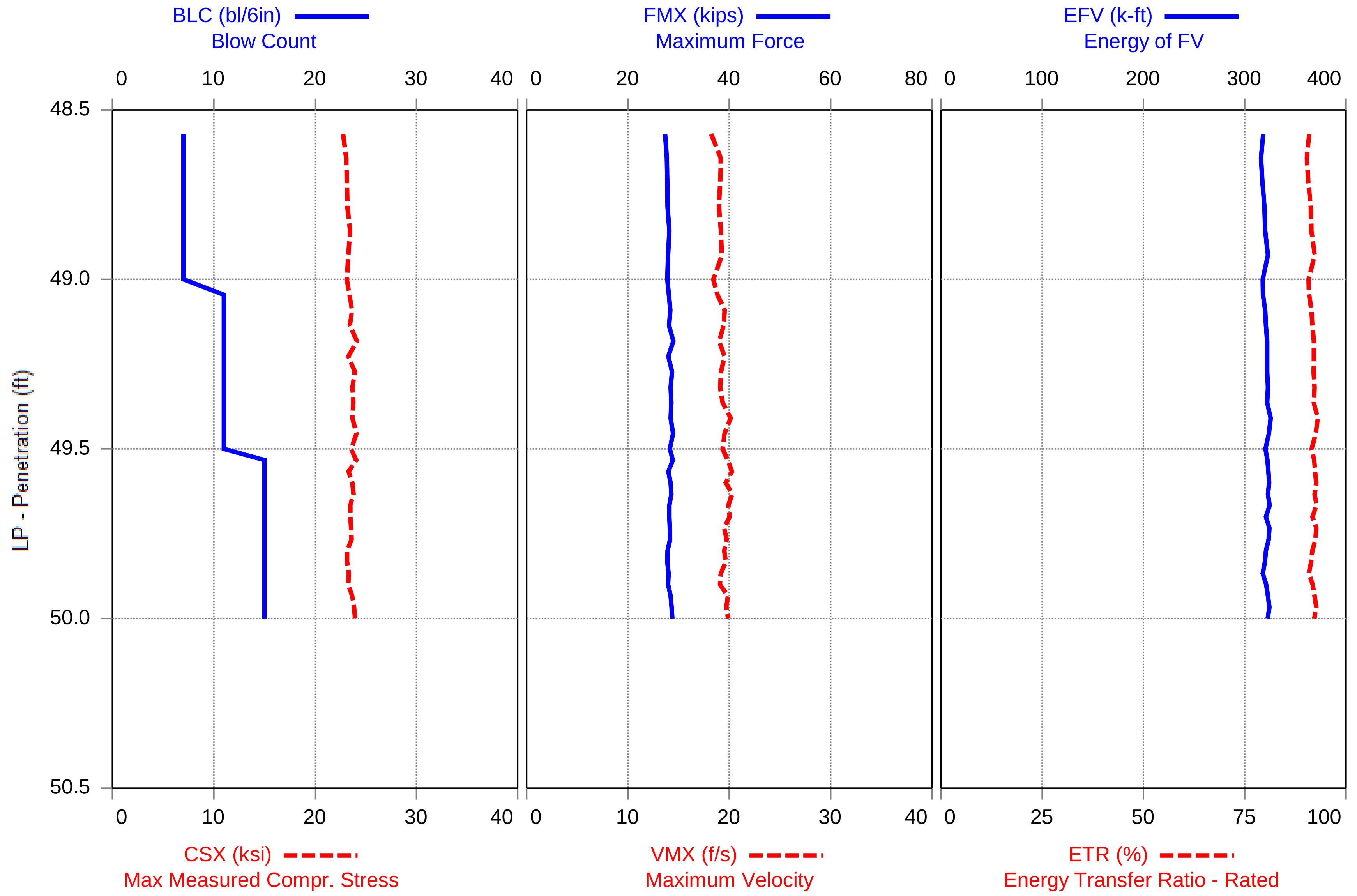
CME 55 (328245) - 43.5 to 45.0



Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.5 - Case Method & iCAP® Results

Printed: 19-September-2018 Test started: 06-September-2018

CME 55 (328245) - 48.5 to 50.0

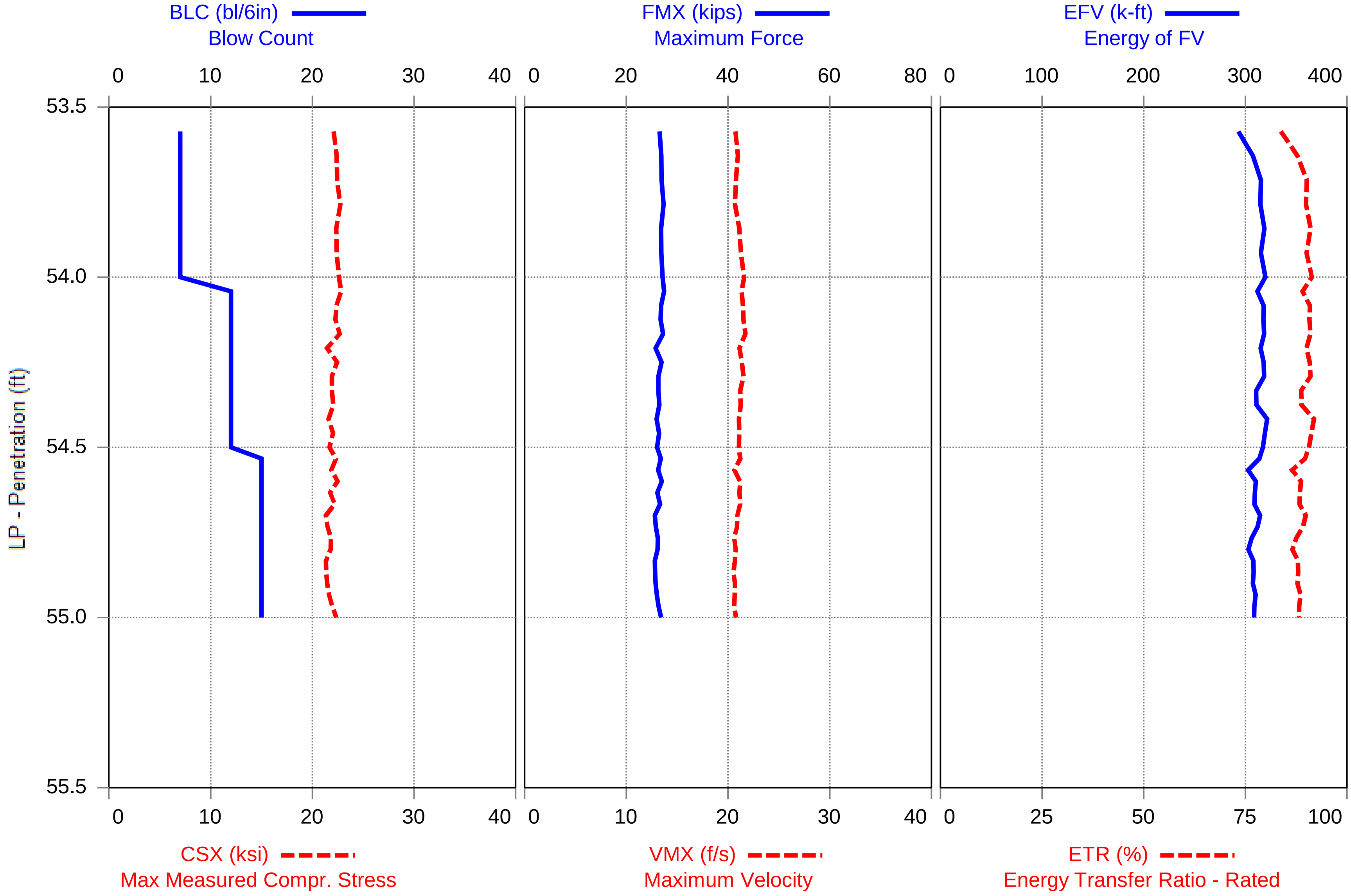


Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.5 - Case Method & iCAP® Results

Printed: 19-September-2018

Test started: 06-September-2018

CME 55 (328245) - 53.5 to 55.0



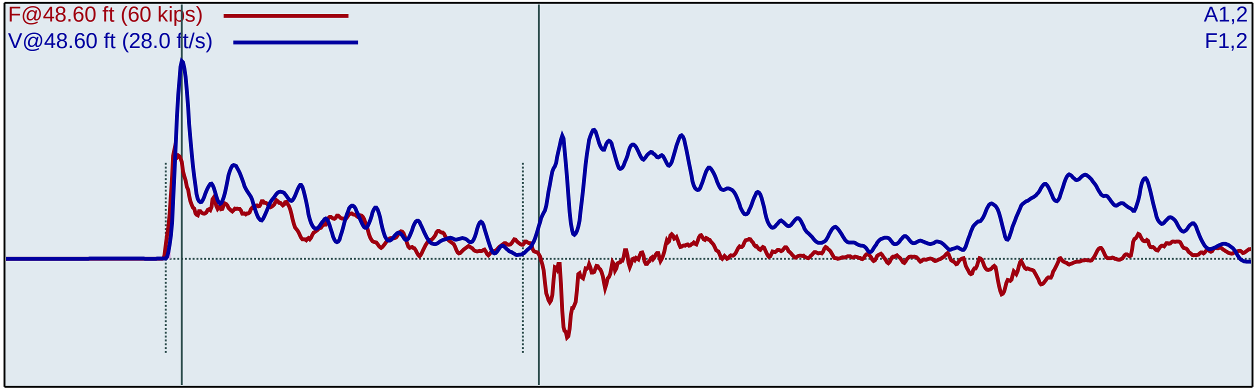
CME 55 (328245)
REK
EB1-Y10

EB1-Y10
Test date: 9/6/2018

AR: 1.20 in^2
LE: 48.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (43.50 - 45.00 ft], displaying BN: 8



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	43.75	2	1.9	26	20.5	3.00	21.7	3.00	317.8	90.8
2	44.00	2	51.9	26	20.0	3.16	21.5	3.00	309.6	88.4
3	44.17	3	51.8	26	21.0	2.09	21.7	1.99	292.1	83.5
4	44.33	3	51.9	24	20.8	2.00	20.3	2.00	311.9	89.1
5	44.50	3	51.9	24	20.6	2.00	20.3	2.00	312.9	89.4
6	44.60	5	51.9	25	21.4	1.47	21.0	1.20	314.3	89.8
7	44.70	5	52.0	26	21.6	1.37	21.6	1.20	312.7	89.3
8	44.80	5	51.6	26	21.6	1.29	21.3	1.20	311.8	89.1
9	44.90	5	51.9	25	21.5	1.22	21.2	1.20	314.0	89.7
10	45.00	5	51.6	26	21.8	1.20	21.5	1.20	315.2	90.1
		Average	51.8	25	21.3	1.58	21.1	1.50	310.6	88.7
		Std Dev	0.1	1	0.4	0.36	0.5	0.39	7.1	2.0
		Maximum	52.0	26	21.8	2.09	21.7	2.00	315.2	90.1
		Minimum	51.6	24	20.6	1.20	20.3	1.20	292.1	83.5

N-value: 8

Sample Interval Time: 10.40 seconds.

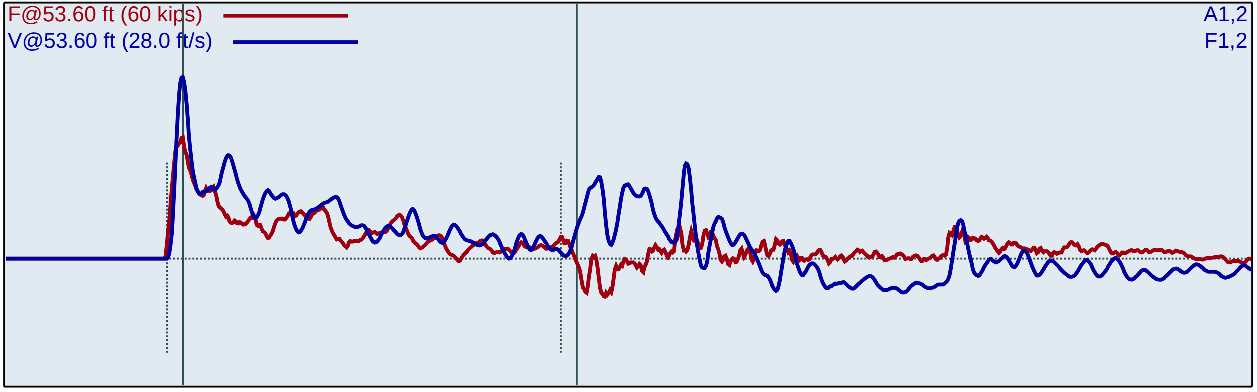
CME 55 (328245)
REK
EB1-Y10

EB1-Y10
Test date: 9/6/2018

AR: 1.20 in^2
LE: 53.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (48.50 - 50.00 ft], displaying BN: 31



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BL#	LP ft	BC /6"	BPM bpm	FMX kips	VMX ft/s	DMX in	CSX ksi	DFN in	EFV ft-lb	ETR %
1	48.57	7	1.9	27	18.2	1.45	22.8	0.86	318.1	90.9
2	48.64	7	52.0	28	19.2	1.01	23.1	0.86	316.0	90.3
3	48.71	7	51.5	28	19.1	0.88	23.1	0.86	317.3	90.7
4	48.79	7	51.9	28	19.0	0.86	23.2	0.86	319.5	91.3
5	48.86	7	51.7	28	19.2	0.86	23.5	0.86	320.0	91.4
6	48.93	7	51.5	28	19.3	0.86	23.3	0.86	322.9	92.3
7	49.00	7	51.8	28	18.4	0.86	23.1	0.86	317.7	90.8
8	49.05	11	51.8	28	18.8	0.73	23.4	0.55	318.0	90.9
9	49.09	11	51.6	28	19.5	0.72	23.6	0.55	320.1	91.5
10	49.14	11	51.8	28	19.4	0.72	23.4	0.55	320.9	91.7
11	49.18	11	51.6	29	19.0	0.72	24.1	0.55	322.2	92.1
12	49.23	11	51.7	28	19.5	0.69	23.3	0.55	322.1	92.0
13	49.27	11	51.7	29	19.2	0.69	23.9	0.55	322.0	92.0
14	49.32	11	51.6	28	19.1	0.66	23.7	0.55	322.7	92.2
15	49.36	11	51.7	29	19.3	0.63	23.8	0.55	322.1	92.0
16	49.41	11	51.7	28	20.1	0.63	23.7	0.55	325.6	93.0
17	49.45	11	51.8	29	19.5	0.62	24.1	0.55	323.8	92.5
18	49.50	11	51.5	28	19.3	0.61	23.5	0.55	320.2	91.5
19	49.53	15	51.8	29	19.8	0.61	24.0	0.40	322.4	92.1
20	49.57	15	51.7	28	20.3	0.60	23.3	0.40	323.2	92.4
21	49.60	15	51.7	28	19.6	0.60	23.7	0.40	324.2	92.6
22	49.63	15	51.7	29	20.3	0.58	23.8	0.40	322.8	92.2
23	49.67	15	51.7	28	19.9	0.57	23.5	0.40	324.5	92.7
24	49.70	15	51.8	28	20.0	0.56	23.5	0.40	320.9	91.7
25	49.73	15	51.5	28	19.5	0.56	23.6	0.40	324.3	92.7
26	49.77	15	51.6	28	19.7	0.55	23.6	0.40	323.6	92.4
27	49.80	15	51.7	28	19.5	0.53	23.2	0.40	320.8	91.7
28	49.83	15	51.6	28	19.6	0.52	23.2	0.40	319.8	91.4
29	49.87	15	51.5	28	19.2	0.52	23.3	0.40	317.7	90.8
30	49.90	15	51.7	28	19.1	0.52	23.3	0.40	321.2	91.8
31	49.93	15	51.8	28	19.9	0.52	23.7	0.40	322.8	92.2

32	49.97	15	51.7	29	19.7	0.51	23.9	0.40	324.3	92.7
33	50.00	15	51.7	29	19.9	0.49	23.9	0.40	322.5	92.2
		Average	51.7	28	19.6	0.60	23.6	0.46	322.1	92.0
		Std Dev	0.1	0	0.4	0.07	0.3	0.07	1.9	0.5
		Maximum	51.8	29	20.3	0.73	24.1	0.55	325.6	93.0
		Minimum	51.5	28	18.8	0.49	23.2	0.40	317.7	90.8

N-value: 26

Sample Interval Time: 37.08 seconds.

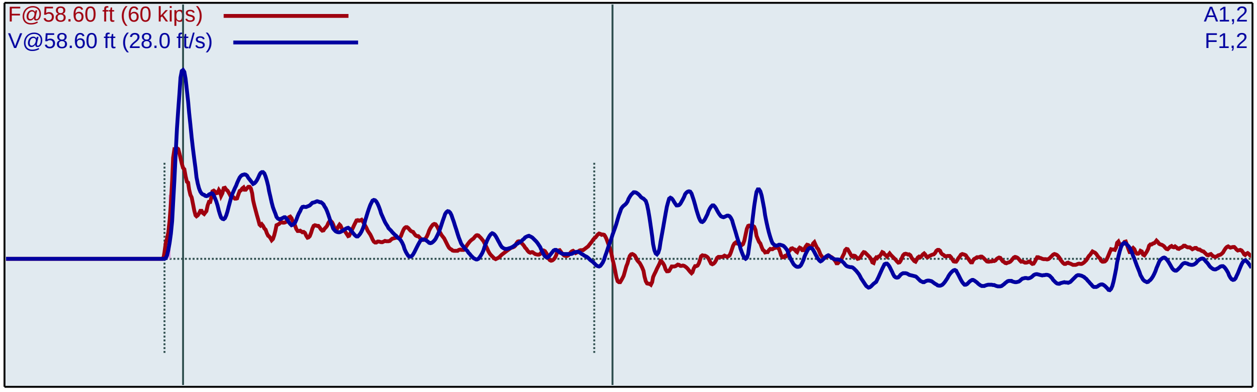
CME 55 (328245)
REK
EB1-Y10

EB1-Y10
Test date: 9/6/2018

AR: 1.20 in^2
LE: 58.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (53.50 - 55.00 ft], displaying BN: 32



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	53.57	7	1.9	27	20.7	0.96	22.1	0.86	293.0	83.7
2	53.64	7	51.5	27	21.0	0.95	22.4	0.86	307.2	87.8
3	53.71	7	51.6	27	20.8	0.95	22.4	0.86	315.3	90.1
4	53.79	7	51.7	27	20.7	0.92	22.7	0.86	314.6	89.9
5	53.86	7	51.5	27	21.1	0.87	22.4	0.86	318.6	91.0
6	53.93	7	51.7	27	21.3	0.86	22.4	0.86	315.1	90.0
7	54.00	7	51.6	27	21.6	0.86	22.6	0.86	319.7	91.3
8	54.04	12	51.8	27	21.3	0.65	22.8	0.50	311.7	89.1
9	54.08	12	51.7	27	21.5	0.67	22.4	0.50	318.0	90.8
10	54.13	12	51.5	27	21.5	0.65	22.3	0.50	317.6	90.7
11	54.17	12	51.7	27	21.7	0.64	22.7	0.50	318.4	91.0
12	54.21	12	51.6	26	21.1	0.63	21.4	0.50	315.1	90.0
13	54.25	12	51.5	27	21.3	0.63	22.4	0.50	317.8	90.8
14	54.29	12	51.6	26	21.5	0.62	21.9	0.50	318.5	91.0
15	54.33	12	51.6	26	21.2	0.58	21.9	0.50	310.5	88.7
16	54.38	12	51.7	26	21.2	0.57	22.1	0.50	310.7	88.8
17	54.42	12	51.5	26	21.1	0.61	21.6	0.50	321.4	91.8
18	54.46	12	51.8	26	21.1	0.60	22.0	0.50	319.2	91.2
19	54.50	12	51.5	26	21.1	0.58	21.7	0.50	317.1	90.6
20	54.53	15	51.4	27	21.2	0.55	22.3	0.40	313.7	89.6
21	54.57	15	51.5	26	20.6	0.51	21.9	0.40	302.5	86.4
22	54.60	15	51.7	27	21.2	0.53	22.5	0.40	310.3	88.7
23	54.63	15	51.8	26	21.1	0.53	21.7	0.40	309.3	88.4
24	54.67	15	51.5	27	21.2	0.52	22.2	0.40	308.9	88.3
25	54.70	15	51.5	26	20.9	0.55	21.3	0.40	314.4	89.8
26	54.73	15	51.4	26	20.9	0.54	21.5	0.40	312.0	89.1
27	54.77	15	51.8	26	20.6	0.51	21.8	0.40	306.2	87.5
28	54.80	15	51.6	26	20.8	0.50	21.8	0.40	303.0	86.6
29	54.83	15	51.6	26	20.7	0.51	21.3	0.40	307.7	87.9
30	54.87	15	51.5	26	20.5	0.51	21.4	0.40	307.9	88.0
31	54.90	15	51.7	26	20.7	0.50	21.5	0.40	307.3	87.8

32	54.93	15	51.5	26	20.7	0.50	21.6	0.40	310.0	88.6
33	54.97	15	51.6	26	20.6	0.50	22.0	0.40	308.8	88.2
34	55.00	15	51.7	27	20.8	0.50	22.4	0.40	308.6	88.2
		Average	51.6	26	21.0	0.56	21.9	0.44	312.1	89.2
		Std Dev	0.1	1	0.3	0.06	0.4	0.05	5.0	1.4
		Maximum	51.8	27	21.7	0.67	22.8	0.50	321.4	91.8
		Minimum	51.4	26	20.5	0.50	21.3	0.40	302.5	86.4

N-value: 27

Sample Interval Time: 38.32 seconds.

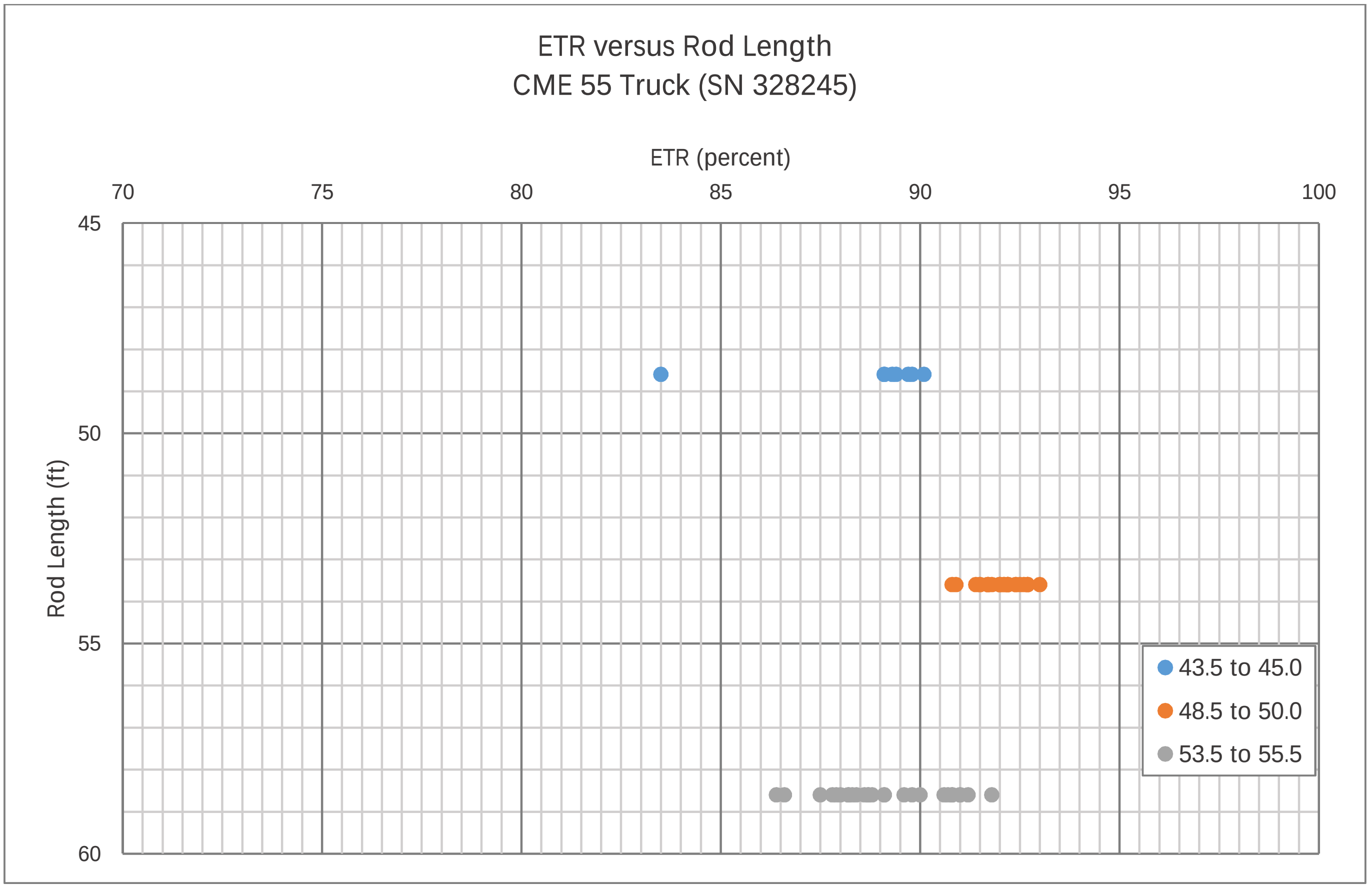
Summary of SPT Test Results

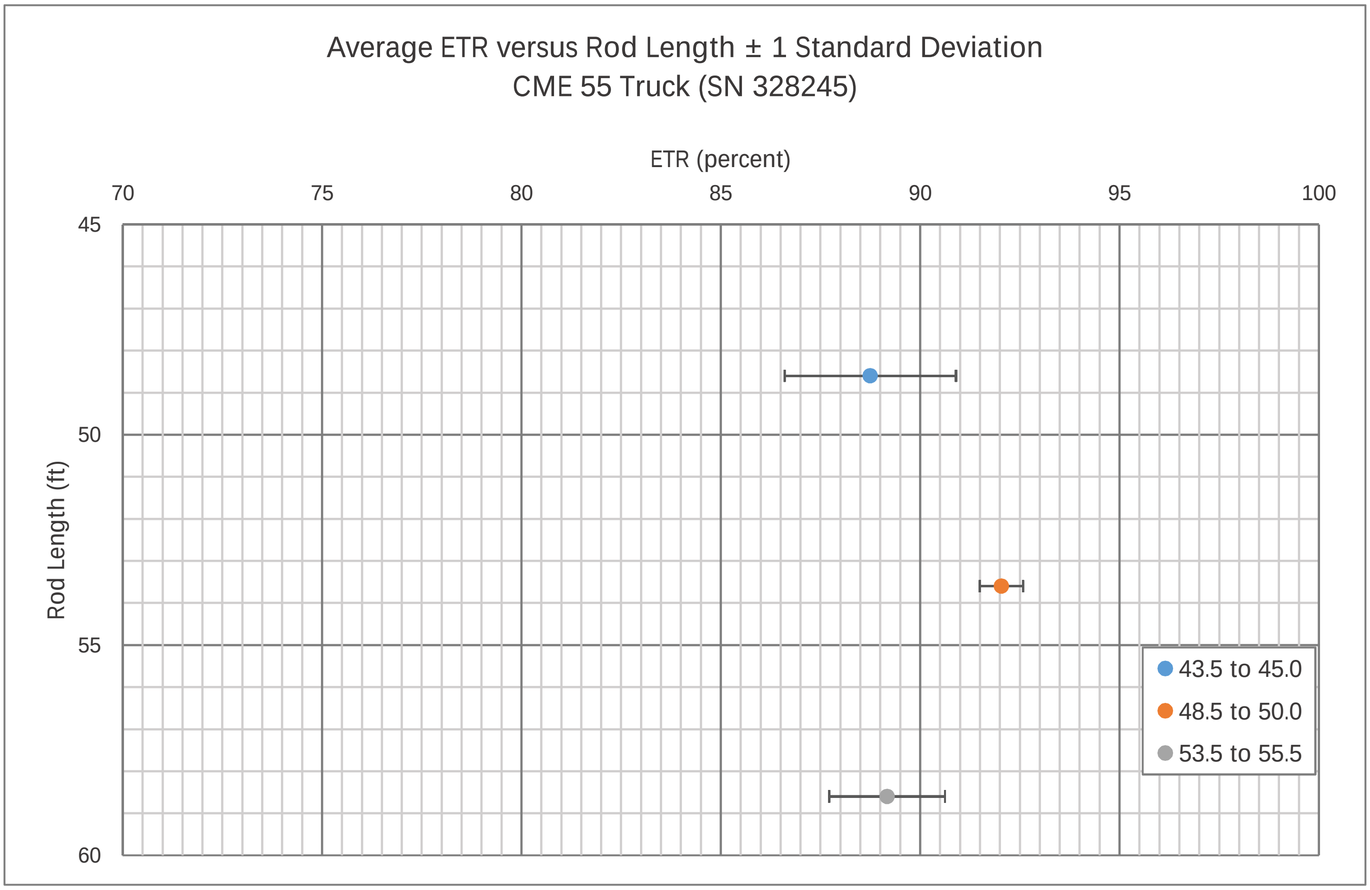
Project: CME 55 (328245), Test Date: 9/6/2018

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average CSX ksi	Average DFN in	Average EFV ft-lb	Average ETR %
48.60	43.50	45.00	**2-3-5**	**8**	**12**	51.8	25	21.3	1.58	21.1	1.50	310.6	88.7
53.60	48.50	50.00	**7-11-15**	**26**	**39**	51.7	28	19.6	0.60	23.6	0.46	322.1	92.0
58.60	53.50	55.00	**7-12-15**	**27**	**40**	51.6	26	21.0	0.56	21.9	0.44	312.1	89.2
					Overall Average Values:	51.7	27	20.4	0.71	22.5	0.59	316.2	90.3
					Standard Deviation:	0.1	1	0.8	0.37	1.0	0.38	6.8	1.9
					Overall Maximum Value:	52.0	29	21.8	2.09	24.1	2.00	325.6	93.0
					Overall Minimum Value:	51.4	24	18.8	0.49	20.3	0.40	292.1	83.5


ETR versus Rod Length
CME 55 Truck (SN 328245)
ETR (percent)
70
75
80
85
90
95
100
Rod Length (ft)
45
50
55
60
43.5 to 45.0
48.5 to 50.0
53.5 to 55.5


Average ETR versus Rod Length ± 1 Standard Deviation
CME 55 Truck (SN 328245)
ETR (percent)
70
75
80
85
90
95
100
Rod Length (ft)
45
50
55
60
43.5 to 45.0
48.5 to 50.0
53.5 to 55.5

Appendix II

SPT Energy Evaluation Form

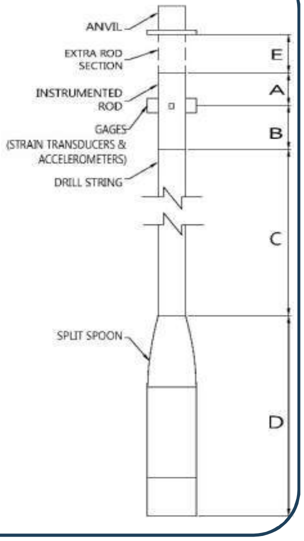
Project: SPT ENERGY TESTING
Project No.: 6235-17-020
Boring No.: EB1-Y10
Date: 9/6/2018
Weather: CLEAR (NIGHT) / 70's
Drill Rod Type: AWJ

On-site Personnel

Drilling Company: S&ME, INC.
Rig Operator: T. MILLER
Engr/Geologist: G. GOSLIN
Client Rep.: N/A
Analyzer Oper.: R. KRAL

Rod Info

(A + E) Impact Surface to Gages Length: 1.31 ft
(B) Instr. Rod Length below Gages: 0.75 ft
(A) + (B) Instr. Rod Length: 2.00 ft
(D) Spoon Length: 2.85 ft
(E) Rod Length Above Instr. Rod (if applicable): 0.06 ft
Instr. Rod S/N: 203AWJ
Instr. Rod Outside Dia.: 1.75 in.
Instr. Rod Area: 1.20 in^2
PDA Make/Model: PAX
PDA Serial No.: 3733L
Calib. Pulse Test (y/n): Y



Rig/Hammer Info

Drill Rig Make/Model: CME 55
Carrier Type: TRUCK
Rig Serial No.: 328245
Hammer Type/Model: CME
Hammer Serial No.: N/A
Hammer Drop System: AUTOMATIC
Lubrication Condition: PER MANUFACTURER
Manufacturer Recommended Operation Rate (bpm): 55
Drop Height (in.): 30
Hammer Weight (lbs): 130
Anvil Dimension (in.): 11.5
Drilling Method: MUD ROTARY

Gage Info

Gage		Serial No.	Calibration No.
Accel.	A3	K10181	356
	A4	K10182	368
Strain	F3	203AWJ-1	212.63
	F4	203AWJ-2	212.32

Date of Test	Test Depth Increment (ft to ft)	Test Time Start / Stop (military)	Length of Drill String (ft) ***(C)***	(LE) Length below Gages (ft) ***(B) + (C) + (D)***	Avg. Meas. Hammer Rate (BPM)	SPT Blow Counts				Drop Height in Tolerance (y/n)	
						6"	12"	18"	N-Value		
9/6/18	43.5 to 45.0	2216/2216	45	48.6	51	2	3	5	8	Y	SA CL
9/6/18	48.5 to 50.0	2231/2231	50	53.6	51	7	11	15	26	Y	SA CL
9/6/18	53.5 to 55.0	2243/2244	55	58.6	51	7	12	15	27	Y	SI CL

Notes:

NOTE: (1) Note any unusual hammer operating conditions that affect the hammer performance, or changes in operating conditions (e.g. veritcality, weather, or lubrication between trials). (2) Note any changes in rod diameter along drill string and record locations of short rod sections.

Digitally signed by: rkral@smeinc.com
DN: CN = rkral@smeinc.com
Prepared By (print/signature)

9/6/2018
Date

NCDOT GEOTECHNICAL ENGINEERING UNIT

FIELD BORELOG (ENGLISH)

SHEET 1 OF 3

PROJECT NUMBER	47523.1.3	ID	I-5986A	CO	Cumberland	GEO	G. Goslin
SITE DESC	Baggett Road over I-95						
BORING NUMBER	EB1-Y10	STA		OFFSET	FT	ALIGNMENT	Y10
ELEVATION	FT	TOTAL DEPTH	95.0 FT	NORTH		EAST	
DRILL MACHINE	CME 55	DRILL EQMT NUMBER	328245	DRILL METHOD	Mud rotary	HAMMER TYPE	Auto
START DATE	9/6/18	COMP DATE	9/7/18	SURFACE WTR DEPTH	– FT	DEPTH TO ROCK	– FT
DRILLER	T. Miller						

GROUND WATER	0 HOUR	24 HOUR
Depth to WATER	11.5	Backfilled ATD
Depth to BTTM	89.0	
DATE mm/dd	09/07	

DEPTH (ft)	BLOW COUNT 0.5 ft	BLOW COUNT 0.5 ft	BLOW COUNT 0.5 ft	BLOWS PER FOOT	SAMPLE NO. & INTERVAL	MOI	ORIGIN	SOIL & ROCK DESCRIPTION SOIL or ROCK NAME (w/ color, density/consistency, texture, plasticity, organics, other)
								ASPHALT- 8 INCHES 0.7'
1.0'	2	2	4	6		–	ROADWAY EMBANKMENT (R.E.)	(NO RECOVERY) - wood in shoe
3.5'	3	3	4	7		W	R.E.	pink grey silty CLAY (A-7-5) m. stiff
								5.5'
6.0'	4	6	7	13		W	R.E.	pink grey clayey fn SAND (A-2-7) m. dense
								8.0
8.5'	5	5	8	13		W	R.E.	brown grey fine sandy CLAY (A-6) stiff
13.5'	3	9	15	24		W	RE.	(same as previous) - brown, v. stiff
								17.0'
18.5'	5	6	10	16		W	Undivided Coastal Plain (UCP)	yellow grey fine sandy CLAY (A-6) v. stiff
								22.0'
23.5'	4	6	9	15		W	UCP	gray yellow silty CLAY (A-7-6) v. stiff
								27.0'
28.5'	2	4	6	10	SS-220 28.5'-30.0'	W	UCP	tan grey fine sandy CLAY (A-6) stiff
								32.0'
33.5'	3	2	4	6		W	UCP	grey fine-med SAND (A-3) loose
38.5'	3	4	4	8		W	UCP	(same as previous) - trace fine gravel

NOTES Mixed mud after 3.5' sample; used water from surface; Added 5' casing after 3.5' sample; 10.7'-2.2'=8.5' (b/2 stick up calc) 5.0' casing - 2.0' stick-up = 3.0' depth; (10' rod + 3.0' sampler) - 4.5' stickup = 8.5' sample on stroke

DECK TO DATUM DISTANCE – FT

DRILLING FLUID PROPERTIES Bentonite slurry

FINAL CASING DEPTH 3.0 FT

SIGNATURE

DATE 9/6/18

RED LINE NOTES

Form GEU-001e Revised 2/6/2007

NCDOT GEOTECHNICAL ENGINEERING UNIT
FIELD BORELOG (ENGLISH)

SHEET 2 OF 3

PROJECT NUMBER 47523.1.3	**ID** I-5986A	**CO** Cumberland	**GEO** G. Goslin	**GROUND WATER**	**0 HOUR**	**24 HOUR**	
SITE DESC Baggett Road over I-95				**Depth to WATER**	SEE Pg 1		
BORING NUMBER EB1-Y10	**STA**	**OFFSET** FT	**ALIGNMENT** Y10	**Depth to BTTM**			
ELEVATION FT	**TOTAL DEPTH** 95.0 FT	**NORTH**	**EAST**	**DATE** mm/dd			
DRILL MACHINE CME 55	**DRILL EQMT NUMBER** 328245	**DRILL METHOD** Mud rotary		**HAMMER TYPE** Auto			
START DATE 9/6/18	**COMP DATE** 9/7/18	**SURFACE WTR DEPTH** – FT	**DEPTH TO ROCK** – FT	**DRILLER** T. Miller			

DEPTH (ft)	BLOW COUNT 0.5 ft	0.5 ft	0.5 ft	BLOWS PER FOOT 0 25 50 75 100	SAMPLE NO. & INTERVAL	MOI	ORIGIN	SOIL & ROCK DESCRIPTION SOIL or ROCK NAME (w/ color, density/consistency, texture, plasticity, organics, other)
								40.0
43.5'	2	8	5	8		W	CAPE FEAR FORMATION (C.F.)	tan grey fine sandy CLAY (A-6) tr. mica, m. stiff
45								
48.5'	7	11	15	26		W	C.F.	(same as previous) – v. stiff
50								
								52.0'
53.5'	7	12	15	27		W	C.F.	grey silty CLAY (A-7-6) v. stiff
55								
58.5'	10	16	20	36		W	C.F.	(same as previous) – hard
60								
								62.0'
63.5'	8	9	13	22		W	C.F.	grey fine sandy CLAY (A-6) tr. mica, v. stiff
65								
68.5'	10	12	14	26		W	C.F.	(same as previous)
70								
								72.0'
73.5'	11	20	24	44	SS-221 73.5'-75.0	W	C.F.	red grey silty CLAY (A-7-5) hard *BEARING*
75								
78.5'	14	20	26	46		W	C.F.	(same as previous)

NOTES

DECK TO DATUM DISTANCE – FT

DRILLING FLUID PROPERTIES Bentonite slurry

FINAL CASING DEPTH 3.0 FT

RED LINE

SIGNATURE

DATE 9/6/18

NOTES

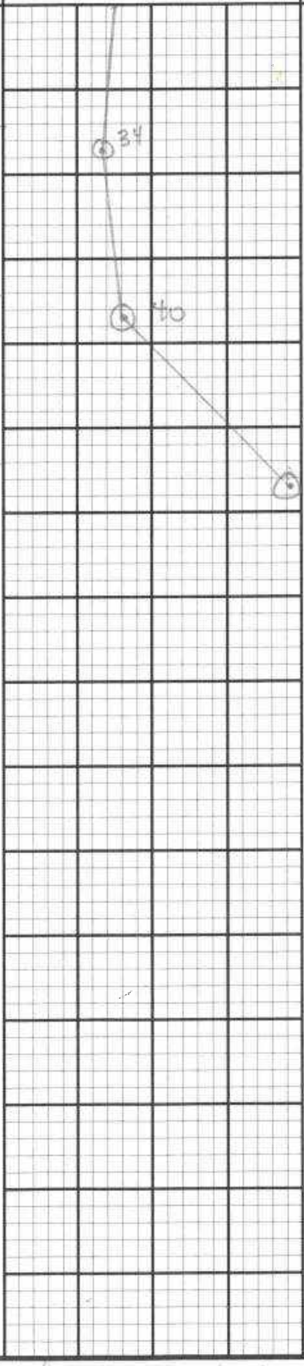
Form GEU-001e Revised 2/6/2007

NCDOT GEOTECHNICAL ENGINEERING UNIT
FIELD BORELOG (ENGLISH)

SHEET 3 OF 3

PROJECT NUMBER	47523.1.3	**ID**	I-5986A	**CO**	Cumberland	**GEO**	G. Goslin
SITE DESC	Baggett Road over I-95						
BORING NUMBER	EB1-Y10	**STA**		**OFFSET**	FT	**ALIGN-MENT**	Y10
ELEVATION	FT	**TOTAL DEPTH**	95.0 FT	**NORTH**		**EAST**	
DRILL MACHINE	CME 55	**DRILL EQMT NUMBER**	328245	**DRILL METHOD**	Mud rotary	**HAMMER TYPE**	Auto
START DATE	9/6/18	**COMP DATE**	9/7/18	**SURFACE WTR DEPTH**	— FT	**DEPTH TO ROCK**	— FT
DRILLER	T. Miller						

GROUND WATER	**0 HOUR**	**24 HOUR**
Depth to WATER	SEE	PG
Depth to BTTM		1
DATE mm/dd		



DEPTH (ft)	BLOW COUNT 0.5 ft	0.5 ft	0.5 ft	BLOWS PER FOOT	SAMPLE NO. & INTERVAL	MOI	ORIGIN	SOIL & ROCK DESCRIPTION SOIL or ROCK NAME (w/ color, density/consistency, texture, plasticity, organics, other)
83.5'	12	16	18	34		W	C.F.	(same as previous)
85								
								87.0'
88.5'	11	17	23	40		W	C.F.	green grey clayey mud SAND (A-2-7) dense
90								
								92.0'
93.5'	19	46	50	96		W	C.F.	red grey silty CLAY (A-7-5) hard
95								95.0'
								BORING TERMINATED AT 95.0 FT IN HARD SILTY CLAY
100								
105								
110								
115								

NOTES Boring backfilled with bentonite chips to ~1.5' from surface, closure device, and asphalt patch to surface

DECK TO DATUM DISTANCE — FT

DRILLING FLUID PROPERTIES Bentonite slurry

FINAL CASING DEPTH 3.0 FT

SIGNATURE

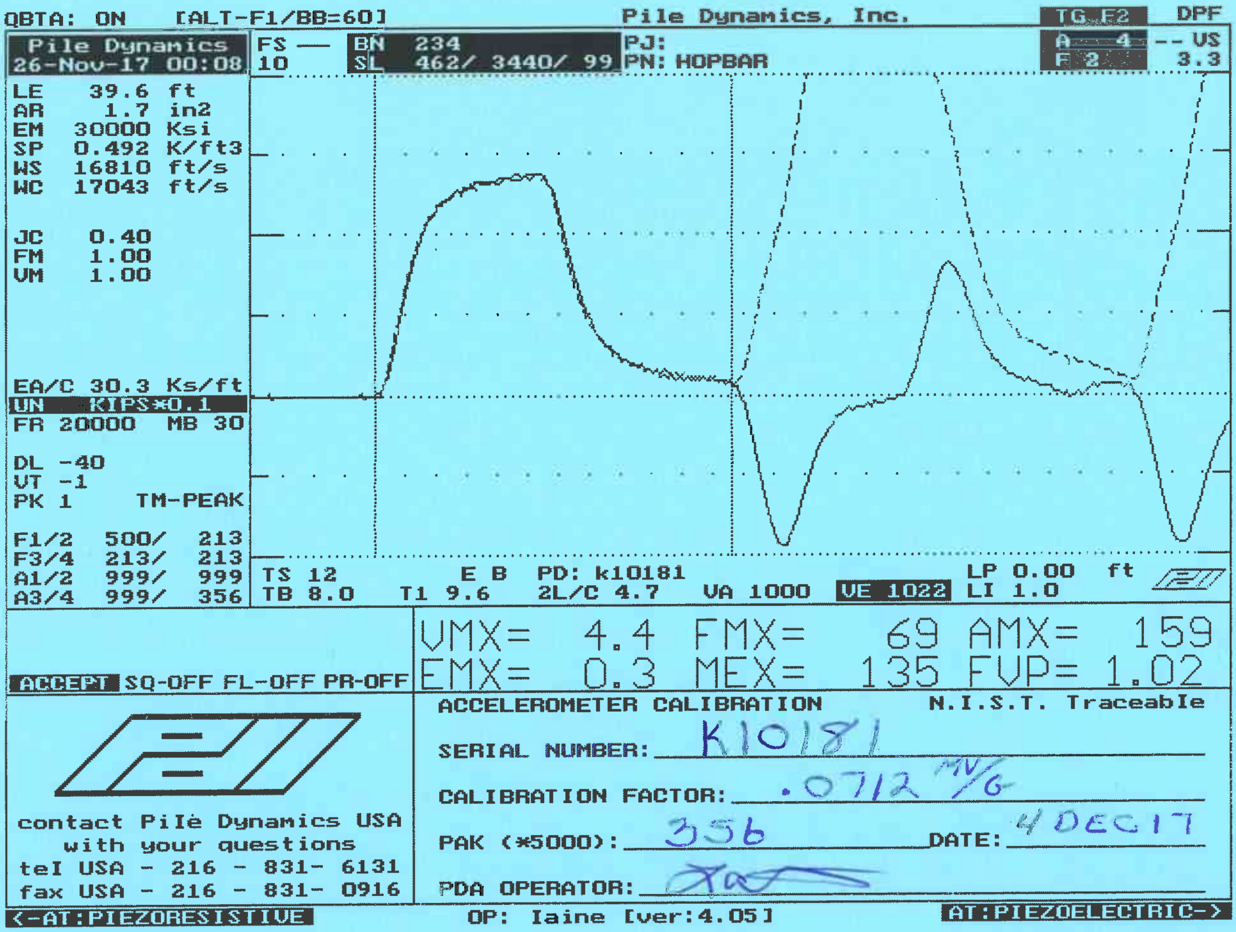
DATE 9/6/18

NOTES

RED LINE

Form GEU-001e Revised 2/6/2007

Appendix III



```
QBTA: ON    [ALT-F1/BB=60]              Pile Dynamics, Inc.          TG F2    DPF
 Pile Dynamics  FS —   BN  234            PJ:                        A    4  -- VS
26-Nov-17 00:08 10     SL  462/ 3440/ 99  PN: HOPBAR                 F 2        3.3
LE     39.6  ft
AR      1.7  in2
EM   30000  Ksi
SP   0.492  K/ft3
WS   16810  ft/s
WC   17043  ft/s

JC     0.40
FM     1.00
VM     1.00


EA/C 30.3 Ks/ft
UN     KIPS*0.1
FR 20000    MB  30

DL  -40
VT  -1
PK  1       TM-PEAK

F1/2   500/    213
F3/4   213/    213
A1/2   999/    999  TS  12          E  B     PD: k10181                   LP 0.00   ft
A3/4   999/    356  TB  8.0     T1  9.6      2L/C 4.7      VA 1000  VE 1022  LI 1.0
                     VMX=   4.4  FMX=     69  AMX=   159
ACCEPT SQ-OFF FL-OFF PR-OFF  EMX=   0.3  MEX=   135  FVP= 1.02
```

ACCELEROMETER CALIBRATION   N.I.S.T. Traceable

SERIAL NUMBER: K10181

CALIBRATION FACTOR: .0712 MV/G

PAK (*5000): 356 DATE: 4 DEC 17

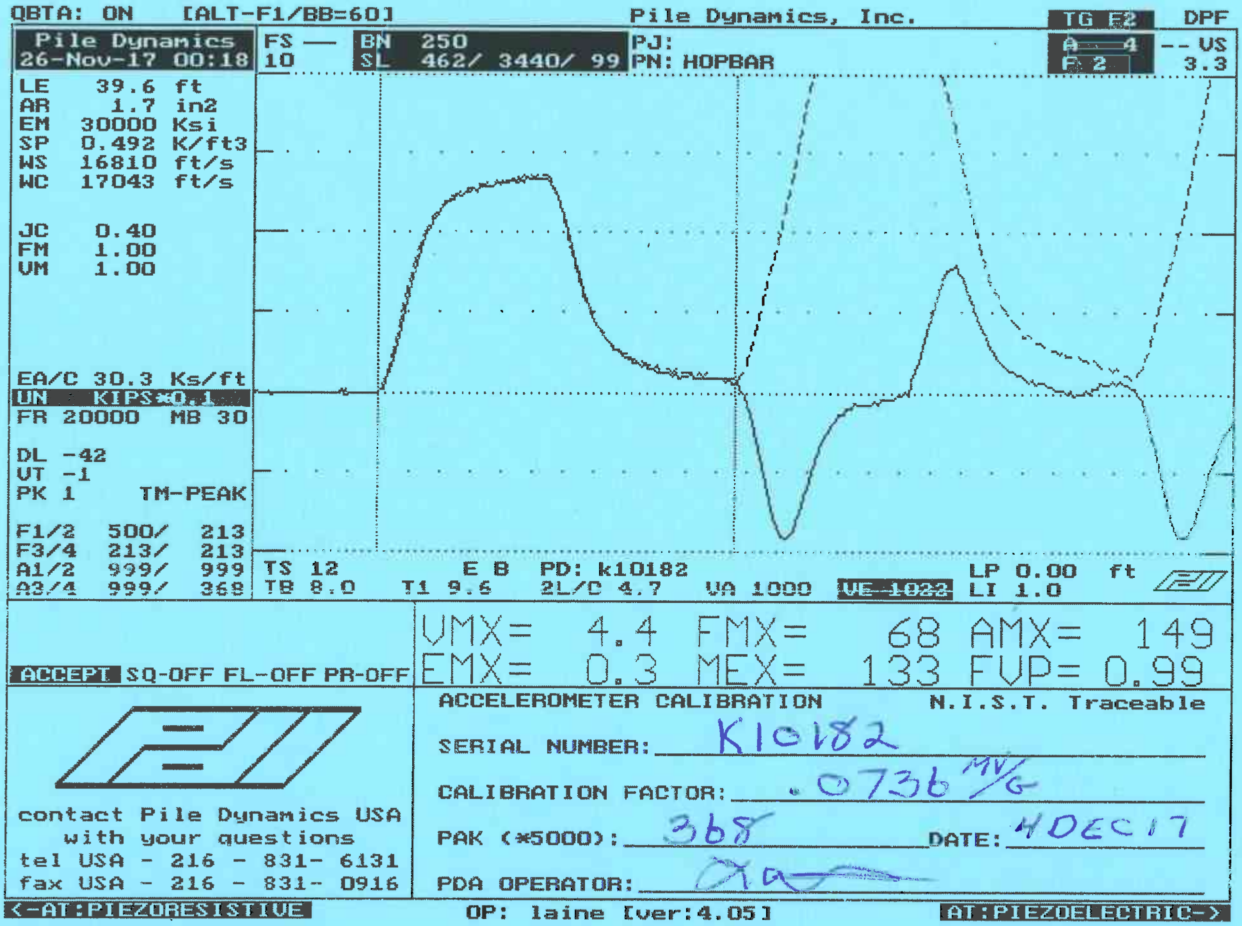
PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE   OP: laine [ver:4.05]   AT:PIEZOELECTRIC->

Smart Sensor

Smart Chip Programmed By J.M.W. **on** 4 DEC 17 **CRC Value** 6AD7



QBTA: ON [ALT-F1/BB=60]
Pile Dynamics, Inc.
TG E2
DPF

Pile Dynamics
26-Nov-17 00:18

FS —— 10
BN 250
SL 462/ 3440/ 99
PJ:
PN: HOPBAR
A —— 4
F 2
-- VS 3.3

LE 39.6 ft
AR 1.7 in2
EM 30000 Ksi
SP 0.492 K/ft3
WS 16810 ft/s
WC 17043 ft/s

JC 0.40
FM 1.00
VM 1.00

EA/C 30.3 Ks/ft
VN KIPS*0.1
FR 20000 MB 30

DL -42
VT -1
PK 1 TM-PEAK

F1/2 500/ 213
F3/4 213/ 213
A1/2 999/ 999
A3/4 999/ 368

TS 12 E B PD: k10182 LP 0.00 ft
TB 8.0 T1 9.6 2L/C 4.7 VA 1000 VE 1022 LI 1.0

ACCEPT SQ-OFF FL-OFF PR-OFF

VMX= 4.4 FMX= 68 AMX= 149
EMX= 0.3 MEX= 133 FVP= 0.99

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: K10182

CALIBRATION FACTOR: .0736 mV/G

PAK (*5000): 368 DATE: 4DEC17

PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE
OP: laine [ver:4.05]
AT:PIEZOELECTRIC->

Smart Sensor

Smart Chip Programmed By J.M.W. **on** 4DEC17 **CRC Value** 1798

Quality Assurance for Deep Foundations

Pile Dynamics, Inc.

PDI Certificate of Calibration

PDI SPT Drill Rod Serial # 203 AWJ

Cal Date: 3-6-17

Cal Due : 3-6-19

Temperature: 69.2 deg. F

Humidity 42 %

Manufactured by Pile Dynamics, Inc.
Calibrated at: Pile Dynamics, Inc., 30725 Aurora Road, Cleveland, OH 44139
Procedure used: SPT Drill Rod Calibration Procedure 2016-4, Revision 20160422
Calibration Data: Attach SPT Rod Data Sheet DS-17

Equipment was found to be

✓ in tolerance As Received

_____ out of tolerance As Received

✓ in tolerance As Returned

_____ out of tolerance As Returned

Calibration Standards Utilized

1. PDI SPT Calibration Signal Conditioning Unit #000001, verified on 20160302
2. PDI Load Cell #75, Certificate #3482090006
3. Capacitec Displacement Sensor #2034, Certificate #3482090004
4. Capacitec Displacement Sensor #2040, Certificate #3482090004
5. Capacitec Displacement Mainframe #4004-671, Certificate #3482090004
6. Brown & Sharpe Digital Caliper #8G028506, Certificate #3482090001
7. National Instruments USB-6210 DAQ serial number 159AFDE, Certificate #3482090002

Calibration performed by:

David Burrell Technician

Reviewed by:

Robert Sprenger, Production Manager

SPT CC-16 Issued 20160425

Pile Dynamics, Inc.

Quality Assurance for Deep Foundations

SPT Calibration Data Sheet Revision number 20160426
Use Calibration Procedure Number 2016-8, Revision 20160422

SPT Drill Rod Data

Serial Number: 203 AWJ　　Calibration Date: 3-6-17

Temperature: 69.2 °F　　Humidity: 42%

Calibration performed in accordance with PDI SPT Calibration Procedure 2016-4, Revision 20160422

As Received (circle one): [✓ Operational] - Malfunctioning - Damaged

Calibration data
Pre-Load: 1. 8152 2. 8045 3. 8081

Total Load: 1. 18645 2. 17966 3. 9859

Common typical theoretical EA values based on SPT Rod Type:
AW: 35400 NW: 43100 or 68100 N3: 70800 BW:52344

EA Theoretical 35,400 EA Measured 36076.68 Error 1.91 %
Within 4% Tolerance: [✓ Y] / N

Alternative EA verification: Measure wall thickness, calculate area and multiply by 30000. (use spreadsheet for calculation)

Calibration values
Channel 1: As Found: (last cal): 215.76 As Left: 212.63 Within 5% Tolerance: [✓ Y] / N
Channel 2: As Found: (last cal): 215.53 As Left: 212.32 Within 5% Tolerance: [✓ Y] / N
EA: As Found: (last cal): 35465 As Left: 36096.68 Difference: 1.7 %

Calibration performed by:

David Burrell, Technician

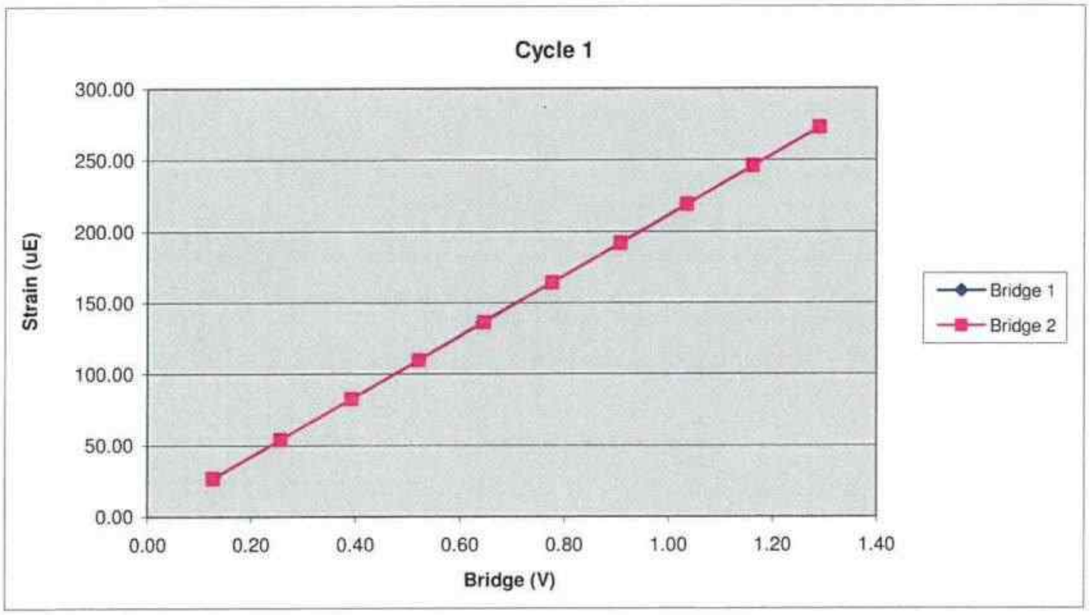
Reviewed by:

Robert Sprenger, Production Manager

203AWJ		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	980.36	26.90	0.13	0.13
3	1968.60	54.22	0.26	0.26
4	3007.18	82.91	0.39	0.39
5	3992.07	109.88	0.52	0.52
6	4933.68	136.53	0.64	0.65
7	5952.40	164.15	0.78	0.78
8	6953.03	191.85	0.91	0.91
9	7927.29	218.90	1.04	1.04
10	8900.18	245.69	1.16	1.16
11	9893.92	272.74	1.29	1.29

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7662.50**	**Force Calibration (lb/V)**	**7652.99**
Offset	-1.78	Offset	1.71
Correlation	0.999999	Correlation	0.999997
Strain Calibration (µE/V)	**211.52**	**Strain Calibration (µE/V)**	**211.26**
Offset	-0.14	Offset	-0.05
Correlation	0.999998	Correlation	0.999999

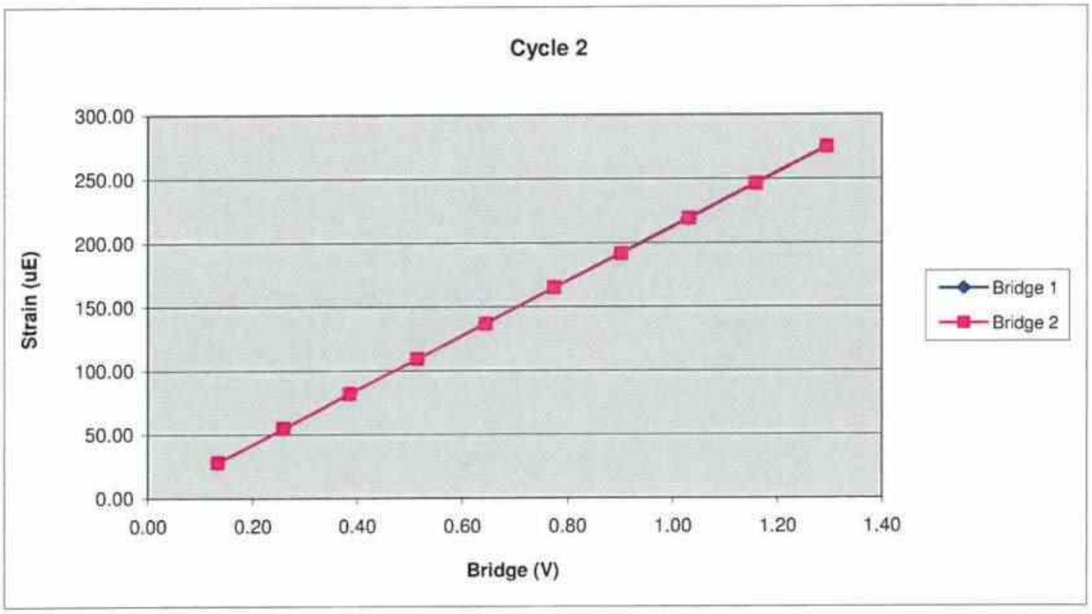
Force Strain Calibration	
EA (Kips)	**36225.50**
Offset	3.39
Correlation	0.999997



203AWJ		Cycle 2		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1014.59	28.23	0.13	0.13
3	1983.94	54.87	0.26	0.26
4	2963.12	81.94	0.39	0.39
5	3939.16	109.15	0.51	0.51
6	4924.05	136.83	0.64	0.64
7	5932.34	164.92	0.77	0.78
8	6919.00	191.62	0.90	0.90
9	7908.80	219.00	1.03	1.03
10	8881.89	246.36	1.16	1.16
11	9921.85	274.90	1.29	1.29

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7681.97**	**Force Calibration (lb/V)**	**7665.41**
Offset	**-11.43**	Offset	**-6.15**
Correlation	**0.999999**	Correlation	**0.999998**
Strain Calibration (µE/V)	**212.92**	**Strain Calibration (µE/V)**	**212.46**
Offset	**-0.28**	Offset	**-0.14**
Correlation	**0.999998**	Correlation	**0.999998**

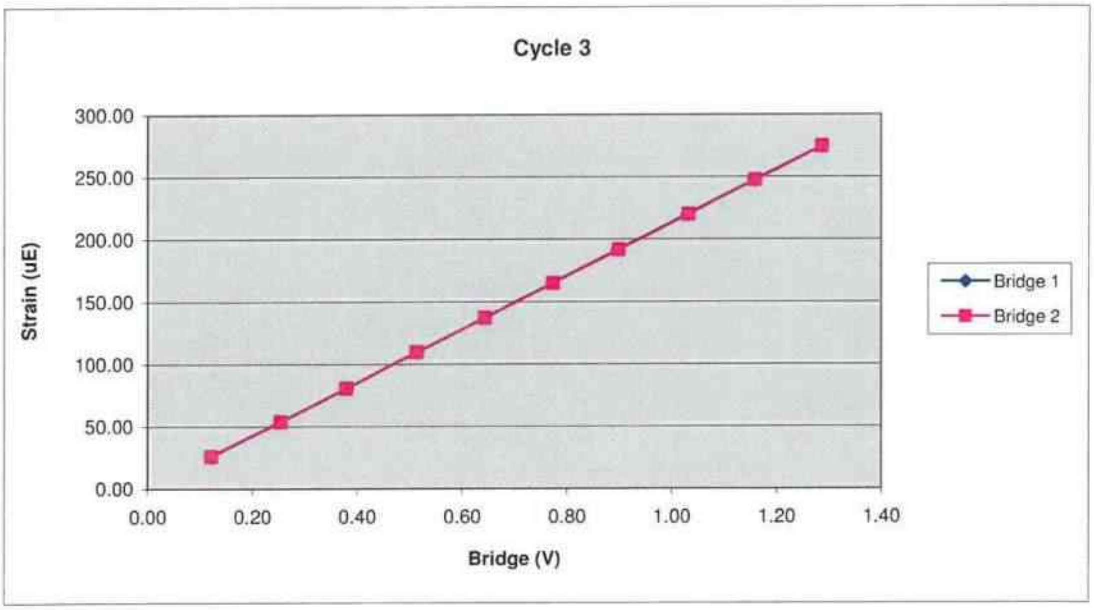
Force Strain Calibration	
EA (Kips)	**36079.71**
Offset	**-1.25**
Correlation	**0.999996**



203AWJ		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	931.98	26.11	0.12	0.12
3	1944.40	53.79	0.25	0.25
4	2911.39	80.73	0.38	0.38
5	3940.93	109.71	0.51	0.51
6	4935.26	137.15	0.64	0.64
7	5929.39	164.84	0.77	0.77
8	6888.90	191.71	0.90	0.90
9	7914.90	219.99	1.03	1.03
10	8887.40	247.28	1.16	1.16
11	9859.30	274.46	1.29	1.29

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7667.78**	**Force Calibration (lb/V)**	**7660.59**
Offset	**2.72**	Offset	**1.09**
Correlation	**0.999999**	Correlation	**1.000000**
Strain Calibration (µE/V)	**213.44**	**Strain Calibration (µE/V)**	**213.24**
Offset	**-0.06**	Offset	**-0.11**
Correlation	**0.999998**	Correlation	**0.999997**

Force Strain Calibration	
EA (Kips)	**35924.82**
Offset	**4.97**
Correlation	**0.999998**



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

Calibration Factors	**203AWJ**		
Bridge 1 (µE/V)	**212.63**	**Bridge 2 (µE/V)**	**212.32**
EA Factor (Kips)	**36076.68**	**Area (in^2)**	**1.20**

Calibrated by: David
Calibrated Date: 2/24/2017

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

Appendix IV

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Robert E. Kral
S&ME, Inc.

has on May 20, 2016 achieved the rank of

ADVANCED

on the **Dynamic Measurement and Analysis Proficiency Test**.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that Individuals at the Advanced level seek Master or Expert levels through additional study within six years of the date of this document.**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. **This certificate can be verified at www.PDAproficiencytest.com.** The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate.

Steven A. Hall
Steven A. Hall, Executive Director
Pile Driving Contractors Association

Garland Likins
Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 2072

S&ME- CME 550X (SN 292103)

Report of SPT Energy Measurements
S&ME CME 550X ATV (SN 292103)
Duluth , Georgia
S&ME Project No. 1280-18-100

PREPARED FOR:

NOVA Engineering and Environmental, LLC
3900 Kennesaw 75 Parkway, Suite 100
Kennesaw, Georgia 30144

PREPARED BY:

S&ME, Inc.
4350 River Green Parkway, Suite 200
Duluth, Georgia 30096

April 22, 2019

April 22, 2019

NOVA Engineering and Environmental, LLC
3900 Kennesaw 75 Parkway, Suite 100
Kennesaw, Georgia 30144

Attention: Mr. Eric Tay, P.E.

Reference: **Report of SPT Energy Measurements**
S&ME CME 550X ATV (SN 292103)
Duluth, Georgia
S&ME Project No. 1280-18-100

Dear Mr. Tay:

S&ME, Inc. (S&ME) completed the Standard Penetration Test (SPT) energy measurements on the automatic hammer mounted on our CME 550X ATV-mounted drill rig with a serial number of 292103. This service was performed by our Mr. Adam Jennings of S&ME on January 21, 2019 prior to field exploration on the State Route 400 Major Mobility Improvement Project (MMIP) in Atlanta, Georgia. SPT energy testing was performed in general accordance with ASTM D4633. The testing procedures, equipment used during testing, and detailed results are presented in this report.

1.0 Dynamic Testing Methodology

Testing was performed using a model PAX (Serial No. 3733L) Pile Driving Analyzer^{TM} (PDA) manufactured by Pile Dynamics, Inc. The PDA was used to record and interpret data from two piezoresistive accelerometers (Serial Nos. K10181 and K10182) bolted to an approximately 2-foot long AWJ drill rod (SN203) internally instrumented with two strain transducers. The instrumented AWJ drill rod has a cross-sectional area of 1.20 square inches, an outside diameter of approximately 1.75 inches, and an inside diameter of approximately 1.25 inches at the gauge location. The accelerometers and strain gauges, which are mounted on opposing axes near the middle of the instrumented rod, monitor acceleration and strain for each hammer blow. The analyzer converts the data to velocities and forces and computes the maximum transferred hammer energies with the "EFV" method described in ASTM D4633. Preliminary results are recorded and displayed in real time for each blow. Calibration sheets for the accelerometers and the instrumented rod are included in the Appendix.

2.0 Testing and Observations

On January 21, 2019, we perform high-strain dynamic testing during SPT sampling on the CME 550X ATV-mounted drill rig operated by Mr. Michael Burnash of S&ME. The measurements were taken during drilling operations at the Western Gwinnett Bikeway Project in Duluth, Georgia. The energy measurements were obtained during SPT sampling at a test location labeled B-1, which was about 5 feet from a previously completed boring, labeled RW10-03. The boring log for RW10-03 is included in the Appendix. SPT energy measurements were recorded during three intervals at depths of approximately 23½, 28½, and 33. The information presented in the tables below summarizes the equipment tested and tooling used during the SPT energy measurements.

Table 2-1: Drill Rig Information

Manufacturer	CME
Model	550X
Serial Number	292103
Operator	M. Burnash
Carrier	ATV

Table 2-2: Hammer Information

Model / Type	CME / Auto
Serial Number	292103
Anvil Height (inches)	11.5
Anvil Diameter (inches)	2.5
Drop Height (inches)	30
Ram Weight (pounds)	140
Ram Serial Number	N/A

Table 2-3: Drilling and Instrumented Rod Information

Drill Rod Type	AWJ
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in^2)	1.20
Typical Lengths (feet)	5
Instrumented Rod Type	AWJ (SN 203)
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in^2)	1.20
Total Instrumented Rod Length (feet)	2.00
Length Below Gages (feet)	0.8
Split-Spoon Length (feet)	2.85

3.0 Dynamic Testing Results

The total rod length from the instrumentation to the tip of the split-spoon sampler was determined by adding 3.65 ft to the required drill rod length at each sample depth. Based on the test data, the automatic hammer on the CME 550X ATV-mounted drill rig operated at a rate of about 50 to 51 blows per minute (bpm) during dynamic testing. The measured transferred hammer energy (EFV) ranged from 307.0 to 336.8 ft-lbs, which corresponds to Energy Transfer Ratio (ETR) values of 87.7 to 96.2%, respectively. The SPT Energy Measurement Data Summary tables in the Appendix present the test data from every hammer blow at each sampling interval, along with representative force and velocity traces for each test interval. The reported blow counts, obtained by the drill rig personnel, and a summary of the test data and average computed hammer energy and transfer ratio values are provided in Table 3-1. Plots and tables of the following are also included in the Appendix and present the test data with depth for each test interval:

- Penetration vs. BLC
- Penetration vs. FMX
- Penetration vs. EFV
- Penetration vs. CSX
- Penetration vs. VMX
- Penetration vs. ETR
- Average ETR vs. Rod Length
- ETR vs. Rod Length

Table 3-1: Summary of Dynamic Testing Results

Data Set ID	Sample Depth (ft)	Drill Rod Length (ft)	Instrumentation to Sampler Tip Length (ft)	Blows per 6" Increment / N-value	Soil Sample Description (Coastal Plain)	Avg. BPM	Avg. EFV (ft-lbs)	Avg. ETR (%)
1	23½ - 35	25	28.65	8-15-37 / 52	Sandy Silt	50.2	320.0	91.4
2	28½ - 45	30	33.65	7-17-24 / 24	Sandy Silt	50.5	319.5	91.3
3	33½ - 45	35	38.65	6-9-50/3" / 50/3"	Sandy Silt	50.4	320.3	91.5
Overall Average						**50.3**	**320.0**	**91.4**

The average hammer rate, transferred energy, and transfer ratio were calculated for each depth interval. Per ASTM D4633, only the blows from the final foot of each sample interval (i.e. the blows that determine the N-value) were included when computing the average values shown in Table 3-1. The overall average transferred hammer energy for the automatic hammer on the CME 550X ATV-mounted drill rig (for all the depth intervals tested) was 320.0 foot-pounds, with an average ETR of 91.4%.

4.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report were based on the applicable standards of our profession in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

5.0 Closing

We appreciate the opportunity to be of service on this project. Please let us know if you have any questions concerning this report.

Sincerely,

S&ME, Inc.

Chelsea *for* Jones

David L. Schoen, P.E. (SC)
Project Engineer
dschoen@smeinc.com

Jeffrey A. Doubrava, P.E.
Vice President / Senior Engineer
jdoubrava@smeinc.com

Appendices:
- Appendix I - CME 550X ATV (SN 292103) SPT Energy Measurements Summary Plots and Tables
- Appendix II - SPT Energy Evaluation Form (Field Log) and nearby SPT Field Boring Log
- Appendix III - Instrumented Rod and Accelerometer Calibration Sheets

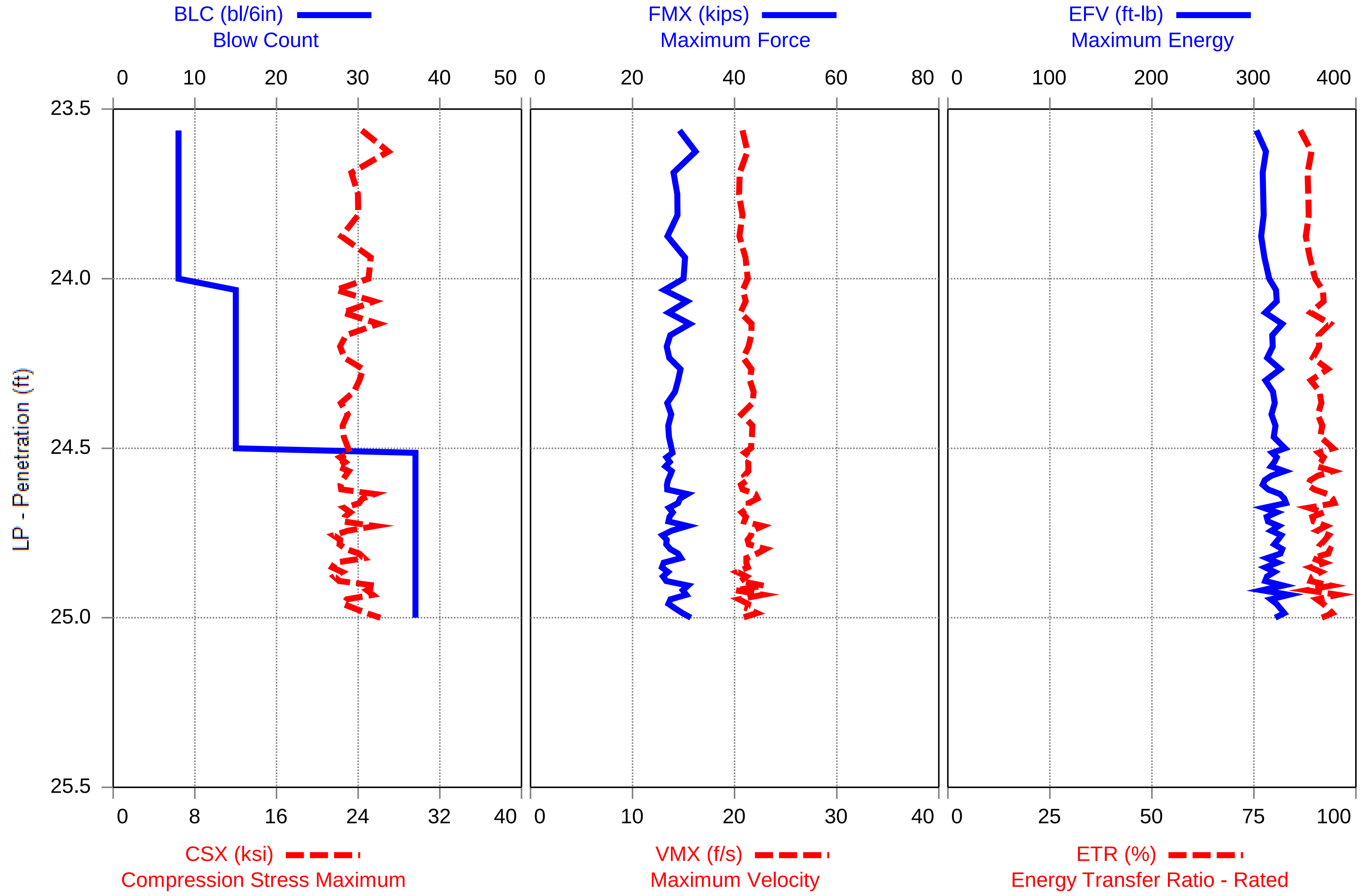
Appendices

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 03-April-2019

Test started: 21-January-2019

CME-550X (SN 292103) - 23.5 to 25.0

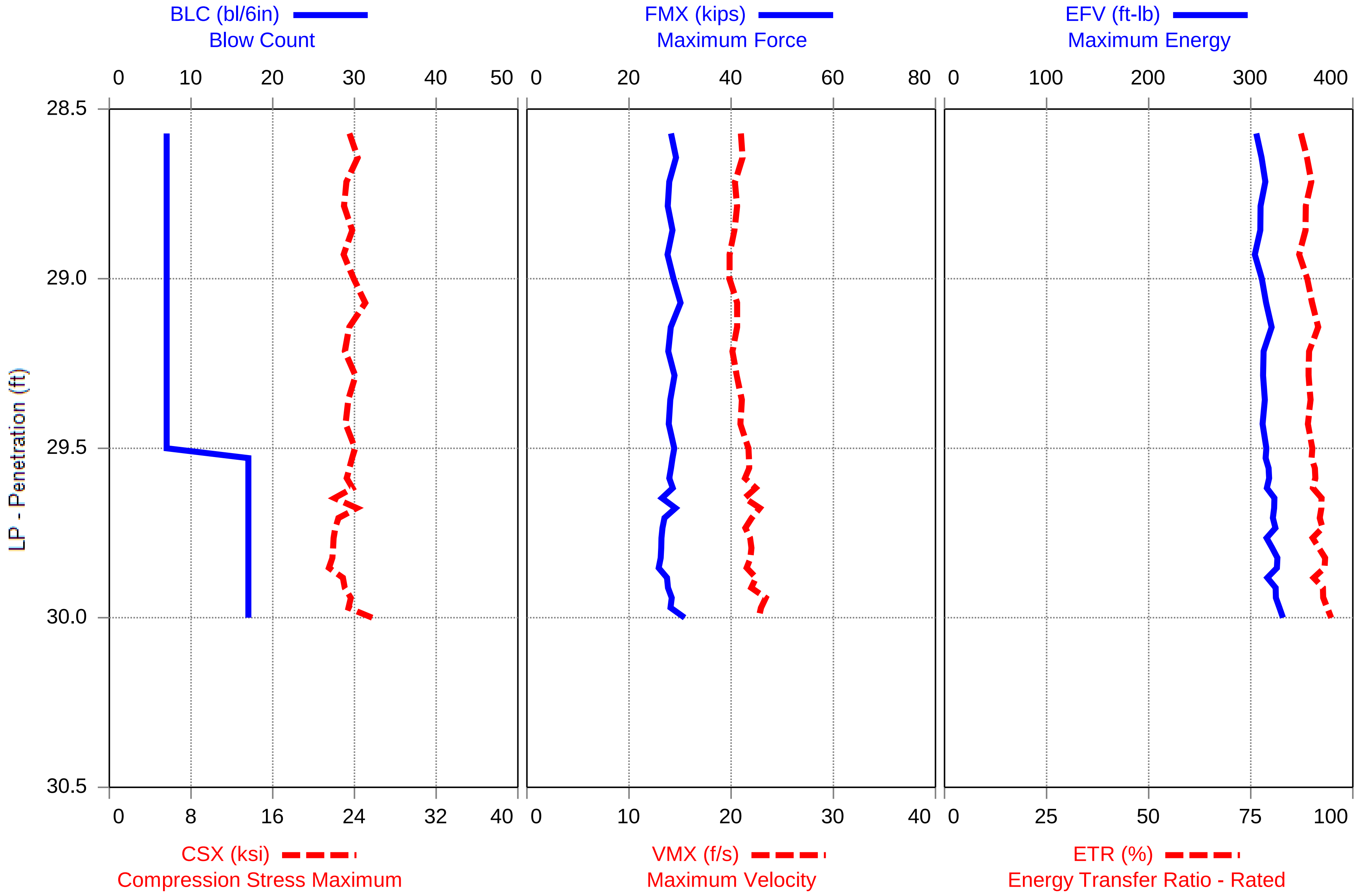


Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 03-April-2019

Test started: 21-January-2019

CME-550X (SN 292103) - 28.5 to 30.0

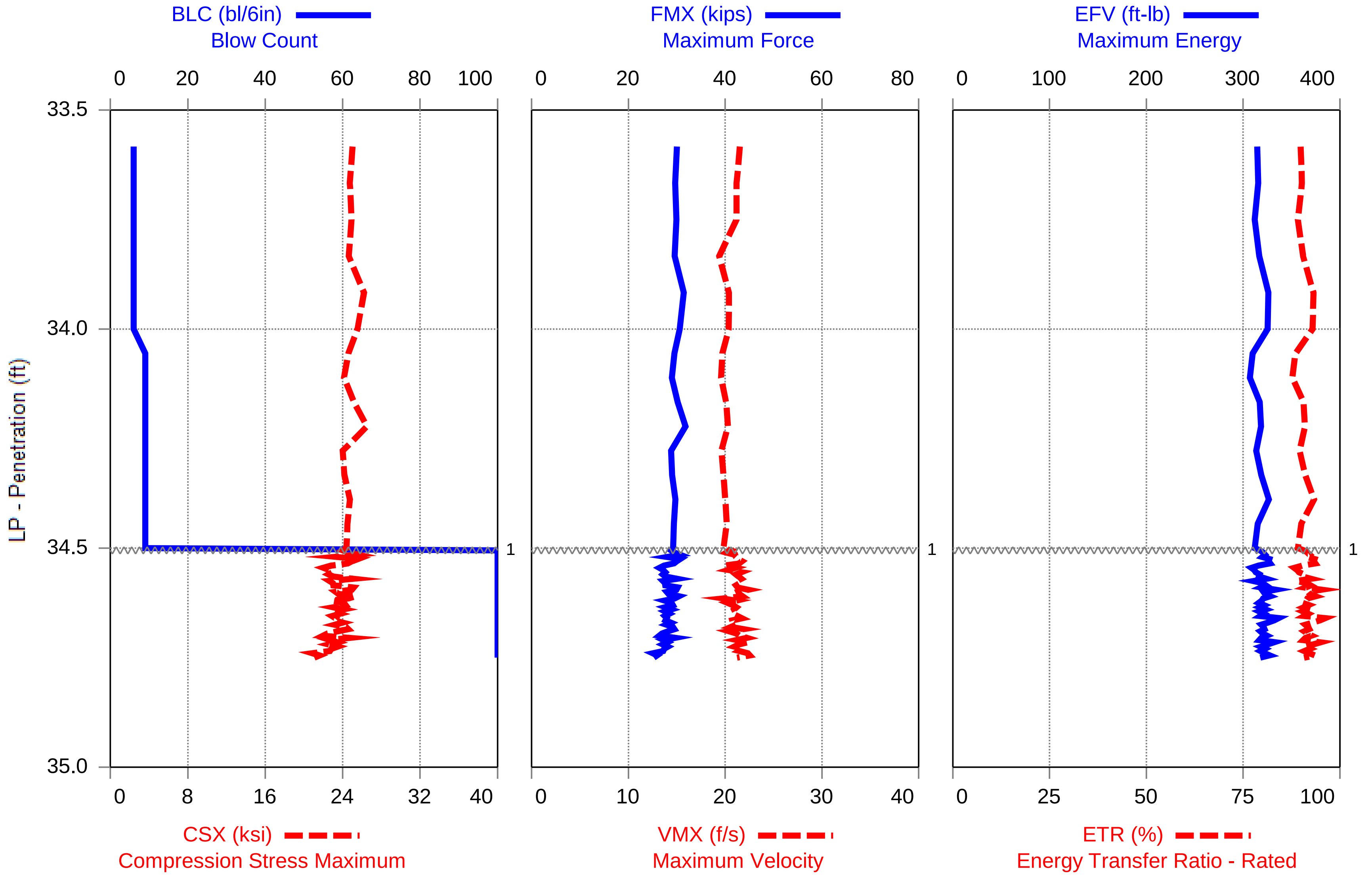


Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 03-April-2019

Test started: 21-January-2019

CME-550X (SN 292103) - 33.5 to 35.0



1 - Final increment is 50 blows over 3 inches

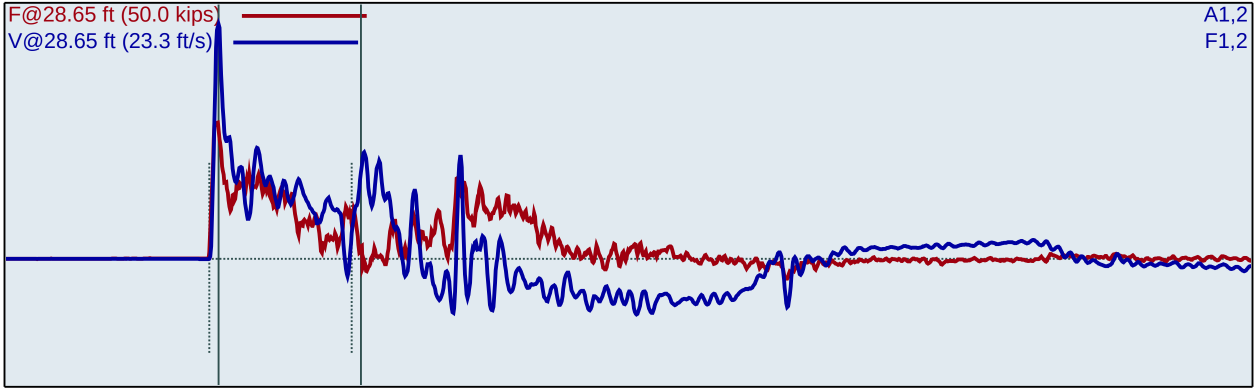
CME-550X (SN 292103)
A. Jennings
B-4

23.5 to 25.0
Test date: 1/21/2019

AR: 1.20 in^2
LE: 28.65 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (23.50 - 25.00 ft], displaying BN: 44



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	DFN	CSX	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	in	ksi	ft-lb	%
1	23.56	8	1.9	29.2	20.8	1.74	0.75	24.3	302.3	86.4
2	23.63	8	50.3	32.3	21.3	1.43	0.75	26.9	311.8	89.1
3	23.69	8	51.4	28.0	20.5	1.21	0.75	23.3	308.5	88.1
4	23.75	8	50.6	28.8	20.4	1.10	0.75	24.0	309.0	88.3
5	23.81	8	51.0	28.8	20.8	0.99	0.75	24.0	309.5	88.4
6	23.88	8	50.7	26.8	20.5	0.93	0.75	22.3	306.9	87.7
7	23.94	8	50.5	30.3	21.1	0.80	0.75	25.2	310.4	88.7
8	24.00	8	50.5	30.0	21.3	0.84	0.75	25.0	315.0	90.0
9	24.03	15	50.5	26.2	20.8	0.68	0.40	21.8	321.5	91.9
10	24.07	15	50.6	30.7	21.1	0.51	0.40	25.6	322.3	92.1
11	24.10	15	50.5	27.0	20.6	0.51	0.40	22.5	311.0	88.9
12	24.13	15	50.5	31.2	21.7	0.49	0.40	26.0	327.8	93.7
13	24.17	15	50.6	27.4	21.6	0.54	0.40	22.8	317.8	90.8
14	24.20	15	50.7	26.7	21.4	0.54	0.40	22.2	318.4	91.0
15	24.23	15	50.3	27.2	20.8	0.49	0.40	22.6	312.9	89.4
16	24.27	15	50.3	29.4	21.6	0.48	0.40	24.5	325.8	93.1
17	24.30	15	50.5	28.9	21.5	0.48	0.40	24.1	311.2	88.9
18	24.33	15	50.3	28.3	21.8	0.49	0.40	23.6	318.7	91.0
19	24.37	15	50.5	26.8	21.8	0.47	0.40	22.3	320.3	91.5
20	24.40	15	50.4	27.6	20.6	0.45	0.40	23.0	317.2	90.6
21	24.43	15	50.6	27.0	21.7	0.46	0.40	22.5	321.1	91.7
22	24.47	15	50.5	27.1	21.7	0.44	0.40	22.6	319.4	91.3
23	24.50	15	50.5	27.6	21.6	0.46	0.40	23.0	330.4	94.4
24	24.51	37	50.5	27.8	21.0	0.43	0.16	23.2	317.9	90.8
25	24.53	37	50.3	26.6	21.6	0.43	0.16	22.2	322.3	92.1
26	24.54	37	50.5	27.3	21.3	0.41	0.16	22.7	320.1	91.4
27	24.55	37	50.0	26.4	21.3	0.41	0.16	22.0	316.8	90.5

28	24.57	37	50.1	27.7	21.3	0.40	0.16	23.1	330.1	94.3
29	24.58	37	50.0	27.3	20.9	0.37	0.16	22.7	317.0	90.6
30	24.59	37	50.3	26.9	21.2	0.37	0.16	22.4	310.6	88.8
31	24.61	37	50.3	26.7	20.6	0.38	0.16	22.3	308.6	88.2
32	24.62	37	50.1	26.8	20.8	0.37	0.16	22.3	314.0	89.7
33	24.64	37	49.9	30.8	22.0	0.37	0.16	25.6	325.5	93.0
34	24.65	37	50.0	29.3	22.2	0.38	0.16	24.4	329.8	94.2
35	24.66	37	50.1	28.9	21.4	0.38	0.16	24.1	331.5	94.7
36	24.68	37	50.2	27.1	21.4	0.35	0.16	22.6	309.5	88.4
37	24.69	37	50.1	27.9	20.7	0.36	0.16	23.2	322.3	92.1
38	24.70	37	49.9	27.2	21.1	0.35	0.16	22.7	312.6	89.3
39	24.72	37	50.1	27.0	20.9	0.35	0.16	22.5	313.7	89.6
40	24.73	37	50.1	30.8	22.7	0.36	0.16	25.6	324.4	92.7
41	24.74	37	50.1	27.6	21.7	0.36	0.16	23.0	316.9	90.5
42	24.76	37	50.0	25.9	21.6	0.37	0.16	21.6	326.7	93.4
43	24.77	37	50.2	26.7	21.3	0.36	0.16	22.2	323.5	92.4
44	24.78	37	50.0	26.6	21.4	0.36	0.16	22.2	319.8	91.4
45	24.80	37	50.1	27.4	23.0	0.36	0.16	22.8	327.7	93.6
46	24.81	37	50.0	28.9	22.2	0.36	0.16	24.1	326.1	93.2
47	24.82	37	50.0	29.5	21.1	0.35	0.16	24.6	312.8	89.4
48	24.84	37	50.0	26.1	21.1	0.36	0.16	21.7	323.0	92.3
49	24.85	37	50.1	25.7	21.3	0.35	0.16	21.5	311.0	88.9
50	24.86	37	50.2	26.9	20.2	0.36	0.16	22.4	320.1	91.5
51	24.88	37	50.0	26.0	21.2	0.34	0.16	21.6	312.7	89.3
52	24.89	37	50.1	26.6	20.6	0.35	0.16	22.1	311.0	88.9
53	24.91	37	50.0	30.9	22.9	0.36	0.16	25.7	328.7	93.9
54	24.92	37	49.8	29.8	20.0	0.34	0.16	24.8	307.7	87.9
55	24.93	37	50.3	30.5	22.7	0.36	0.16	25.4	334.4	95.5
56	24.95	37	50.1	27.4	20.4	0.35	0.16	22.9	316.5	90.4
57	24.96	37	50.0	27.0	21.3	0.36	0.16	22.5	322.0	92.0
58	24.97	37	49.9	28.4	21.2	0.36	0.16	23.7	326.1	93.2
59	24.99	37	50.1	29.8	22.2	0.36	0.16	24.8	329.7	94.2
60	25.00	37	50.1	31.4	20.8	0.35	0.16	26.2	320.7	91.6
		Average	50.2	27.9	21.4	0.41	0.23	23.2	320.0	91.4
		Std Dev	0.2	1.5	0.6	0.07	0.11	1.3	6.7	1.9
		Maximum	50.7	31.4	23.0	0.68	0.40	26.2	334.4	95.5
		Minimum	49.8	25.7	20.0	0.34	0.16	21.5	307.7	87.9

N-value: 52

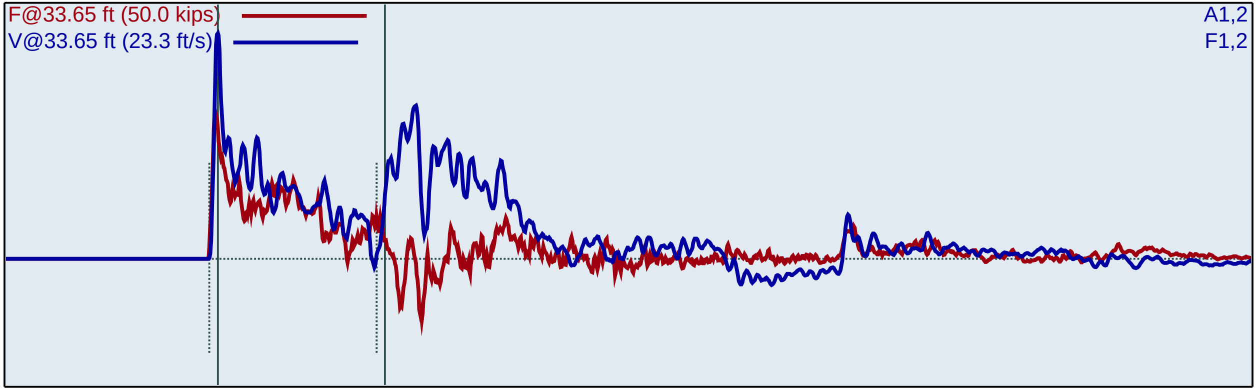
CME-550X (SN 292103)
A. Jennings
B-4

23.5 to 25.0
Test date: 1/21/2019

AR: 1.20 in^2
LE: 33.65 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.50 - 30.00 ft], displaying BN: 9



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	DFN	CSX	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	in	ksi	ft-lb	%
1	28.57	7	1.9	28.2	20.9	1.85	0.86	23.5	305.4	87.2
2	28.64	7	51.0	29.2	21.1	1.67	0.86	24.3	310.6	88.8
3	28.71	7	50.6	27.9	20.4	1.06	0.86	23.2	314.3	89.8
4	28.79	7	50.9	27.6	20.6	1.03	0.86	23.0	309.5	88.4
5	28.86	7	50.5	28.5	20.3	1.16	0.86	23.8	309.4	88.4
6	28.93	7	50.6	27.5	19.8	1.09	0.86	22.9	303.9	86.8
7	29.00	7	50.4	28.7	19.8	0.96	0.86	23.9	310.9	88.8
8	29.07	7	50.6	30.1	20.6	0.88	0.86	25.0	315.0	90.0
9	29.14	7	50.5	28.2	20.6	0.86	0.86	23.5	320.3	91.5
10	29.21	7	50.3	27.7	20.1	0.86	0.86	23.1	312.4	89.3
11	29.29	7	50.5	28.9	20.5	0.86	0.86	24.1	311.9	89.1
12	29.36	7	50.5	28.1	21.0	0.86	0.86	23.4	313.6	89.6
13	29.43	7	50.8	27.7	20.9	0.86	0.86	23.1	311.4	89.0
14	29.50	7	50.4	28.9	21.7	0.87	0.86	24.0	315.1	90.0
15	29.53	17	50.8	28.5	21.7	0.65	0.35	23.8	314.6	89.9
16	29.56	17	50.6	28.2	21.8	0.61	0.35	23.5	317.5	90.7
17	29.59	17	50.3	27.9	21.3	0.58	0.35	23.2	317.8	90.8
18	29.62	17	50.7	28.6	22.4	0.52	0.35	23.8	315.6	90.2
19	29.65	17	50.4	26.5	21.3	0.49	0.35	22.0	323.1	92.3
20	29.68	17	50.2	29.1	22.8	0.47	0.35	24.2	322.9	92.3
21	29.71	17	50.4	26.9	22.0	0.45	0.35	22.4	321.5	91.9
22	29.74	17	50.7	26.5	21.4	0.44	0.35	22.1	324.0	92.6
23	29.76	17	50.8	26.3	21.9	0.43	0.35	22.0	315.4	90.1
24	29.79	17	50.5	26.3	22.0	0.45	0.35	21.9	320.8	91.7
25	29.82	17	50.5	26.2	21.9	0.44	0.35	21.8	326.1	93.2
26	29.85	17	50.4	25.8	21.5	0.44	0.35	21.5	325.6	93.0
27	29.88	17	50.6	27.4	22.4	0.42	0.35	22.9	316.3	90.4

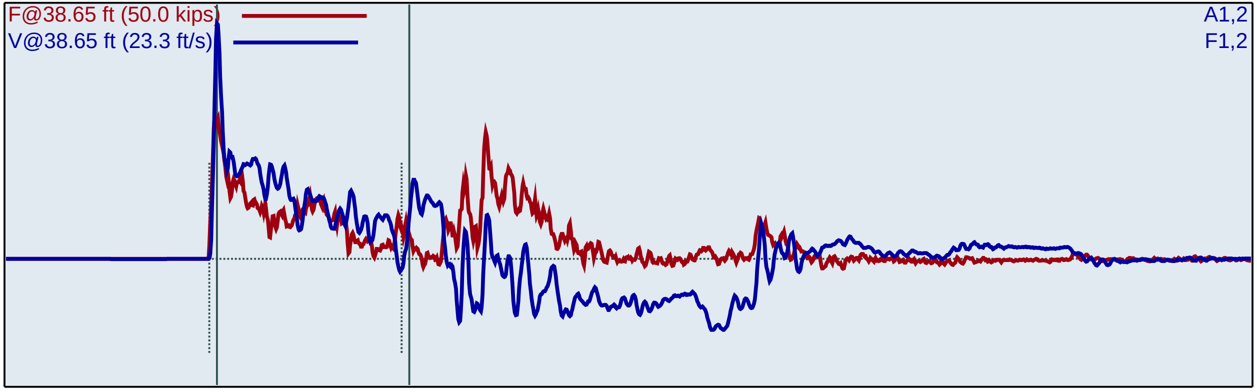
28	29.91	17	50.3	27.6	22.0	0.43	0.35	23.0	324.2	92.6
29	29.94	17	50.7	28.4	23.4	0.43	0.35	23.6	324.6	92.7
30	29.97	17	50.4	28.1	22.9	0.44	0.35	23.4	327.9	93.7
31	30.00	17	50.3	30.9	22.7	0.45	0.35	25.7	331.4	94.7
		Average	50.5	27.9	21.7	0.59	0.50	23.2	319.5	91.3
		Std Dev	0.2	1.2	0.8	0.18	0.23	1.0	5.5	1.6
		Maximum	50.8	30.9	23.4	0.88	0.86	25.7	331.4	94.7
		Minimum	50.2	25.8	20.1	0.42	0.35	21.5	311.4	89.0

N-value: 24

CME-550X (SN 292103) 23.5 to 25.0
A. Jennings Test date: 1/21/2019
B-4

AR: 1.20 in^2 SP: 0.492 k/ft3
LE: 38.65 ft EM: 30000 ksi
WS: 16807.9 ft/s

Depth: (33.50 - 35.00 ft], displaying BN: 31



F1 : [203 AWJ-1] 212.63 PDICAL (1) FF1
F2 : [203 AWJ-2] 212.32 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	DFN	CSX	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	in	ksi	ft-lb	%
1	33.58	6	1.9	30.0	21.5	1.73	1.00	25.0	314.5	89.9
2	33.67	6	51.1	29.7	21.2	1.44	1.00	24.7	315.7	90.2
3	33.75	6	50.6	29.9	21.2	1.29	1.00	24.9	312.0	89.1
4	33.83	6	50.8	29.5	19.4	1.23	1.00	24.6	316.7	90.5
5	33.92	6	50.7	31.4	20.4	1.25	1.00	26.2	326.1	93.2
6	34.00	6	50.5	30.6	20.4	1.14	1.00	25.5	325.3	92.9
7	34.06	9	50.6	29.5	19.7	0.87	0.67	24.6	309.8	88.5
8	34.11	9	50.8	29.0	19.6	0.85	0.67	24.1	307.0	87.7
9	34.17	9	50.5	30.2	20.1	0.85	0.67	25.2	317.1	90.6
10	34.22	9	50.6	31.8	20.3	0.84	0.67	26.5	318.4	91.0
11	34.28	9	50.7	28.8	19.6	0.85	0.67	24.0	313.6	89.6
12	34.33	9	50.5	29.0	19.8	0.82	0.67	24.2	318.7	91.0
13	34.39	9	50.4	29.7	20.0	0.68	0.67	24.7	326.7	93.3
14	34.44	9	50.5	29.4	20.2	0.67	0.67	24.5	315.1	90.0
15	34.50	9	50.7	29.3	19.8	0.67	0.67	24.4	312.0	89.2
16	34.51	0	50.5	28.8	20.5	0.44	0.06	24.0	317.4	90.7
17	34.51	0	50.8	29.5	20.1	0.42	0.06	24.6	320.6	91.6
18	34.52	0	50.2	30.7	21.0	0.41	0.06	25.6	322.7	92.2
19	34.52	0	50.1	28.0	21.1	0.40	0.06	23.3	319.8	91.4
20	34.53	0	50.4	30.7	21.3	0.40	0.06	25.6	327.1	93.5
21	34.53	0	50.4	30.0	21.7	0.39	0.06	25.0	326.4	93.3
22	34.54	0	50.3	29.4	21.4	0.39	0.06	24.5	327.9	93.7
23	34.54	0	50.4	27.4	19.9	0.38	0.06	22.8	315.9	90.3
24	34.55	0	50.2	26.4	21.0	0.37	0.06	22.0	308.7	88.2
25	34.55	0	50.4	27.1	20.3	0.37	0.06	22.6	311.3	89.0
26	34.56	0	50.3	27.6	21.7	0.37	0.06	23.0	313.0	89.4
27	34.56	0	50.3	27.1	21.1	0.37	0.06	22.6	317.3	90.7

28	34.57	0	50.4	27.6	21.4	0.38	0.06	23.0	316.5	90.4
29	34.57	0	50.5	30.1	21.7	0.38	0.06	25.1	323.9	92.5
30	34.58	0	50.3	27.2	21.2	0.37	0.06	22.6	310.6	88.8
31	34.58	0	50.1	27.6	21.5	0.38	0.06	23.0	320.1	91.5
32	34.59	0	50.4	27.6	21.1	0.38	0.06	23.0	323.6	92.4
33	34.59	0	50.3	30.2	21.3	0.37	0.06	25.1	318.8	91.1
34	34.60	0	50.2	29.9	22.4	0.39	0.06	25.0	333.5	95.3
35	34.60	0	50.4	27.9	21.4	0.38	0.06	23.3	321.0	91.7
36	34.61	0	50.4	28.3	21.5	0.37	0.06	23.6	322.7	92.2
37	34.61	0	50.1	30.4	21.8	0.37	0.06	25.4	328.0	93.7
38	34.62	0	50.5	29.5	19.8	0.38	0.06	24.6	320.6	91.6
39	34.62	0	50.3	27.4	21.2	0.36	0.06	22.9	319.3	91.2
40	34.63	0	50.3	29.0	20.3	0.35	0.06	24.1	316.0	90.3
41	34.63	0	50.4	29.2	20.8	0.36	0.06	24.3	321.7	91.9
42	34.64	0	50.3	27.6	21.2	0.36	0.06	23.0	317.2	90.6
43	34.64	0	50.3	28.9	20.9	0.36	0.06	24.1	323.2	92.4
44	34.65	0	50.1	27.6	21.0	0.35	0.06	23.0	316.8	90.5
45	34.65	0	50.5	28.4	20.8	0.35	0.06	23.7	321.3	91.8
46	34.66	0	50.3	27.5	21.3	0.35	0.06	22.9	317.7	90.8
47	34.66	0	50.3	27.9	21.7	0.38	0.06	23.3	336.8	96.2
48	34.67	0	50.2	27.7	20.7	0.37	0.06	23.1	332.2	94.9
49	34.67	0	50.4	28.8	20.8	0.36	0.06	24.0	325.7	93.0
50	34.68	0	50.3	27.8	21.1	0.35	0.06	23.2	318.8	91.1
51	34.68	0	50.3	29.2	20.6	0.34	0.06	24.3	321.1	91.8
52	34.69	0	50.3	29.5	21.9	0.35	0.06	24.6	322.2	92.1
53	34.69	0	50.4	28.2	20.4	0.35	0.06	23.5	317.7	90.8
54	34.70	0	50.4	26.9	21.1	0.35	0.06	22.5	320.4	91.5
55	34.70	0	50.3	26.4	21.5	0.36	0.06	22.0	324.5	92.7
56	34.71	0	50.1	29.6	22.2	0.35	0.06	24.7	318.7	91.1
57	34.71	0	50.3	27.3	21.2	0.35	0.06	22.7	316.7	90.5
58	34.72	0	50.2	28.1	22.3	0.36	0.06	23.4	332.3	94.9
59	34.72	0	50.3	27.1	21.4	0.35	0.06	22.6	325.4	93.0
60	34.73	0	50.2	28.1	20.9	0.35	0.06	23.5	318.2	90.9
61	34.73	0	50.3	27.4	21.8	0.35	0.06	22.8	322.8	92.2
62	34.74	0	50.3	27.2	21.4	0.35	0.06	22.7	317.9	90.8
63	34.74	0	50.3	25.1	22.3	0.35	0.06	20.9	322.4	92.1
64	34.75	0	50.1	25.9	22.5	0.36	0.06	21.6	327.3	93.5
65	34.75	0	50.3	25.3	21.2	0.35	0.06	21.1	317.7	90.8
		Average	50.4	28.4	21.0	0.43	0.15	23.7	320.3	91.5
		Std Dev	0.2	1.4	0.7	0.16	0.22	1.1	6.0	1.7
		Maximum	50.8	31.8	22.5	0.87	0.67	26.5	336.8	96.2
		Minimum	50.1	25.1	19.6	0.34	0.06	20.9	307.0	87.7

N-value: 50 / 3"

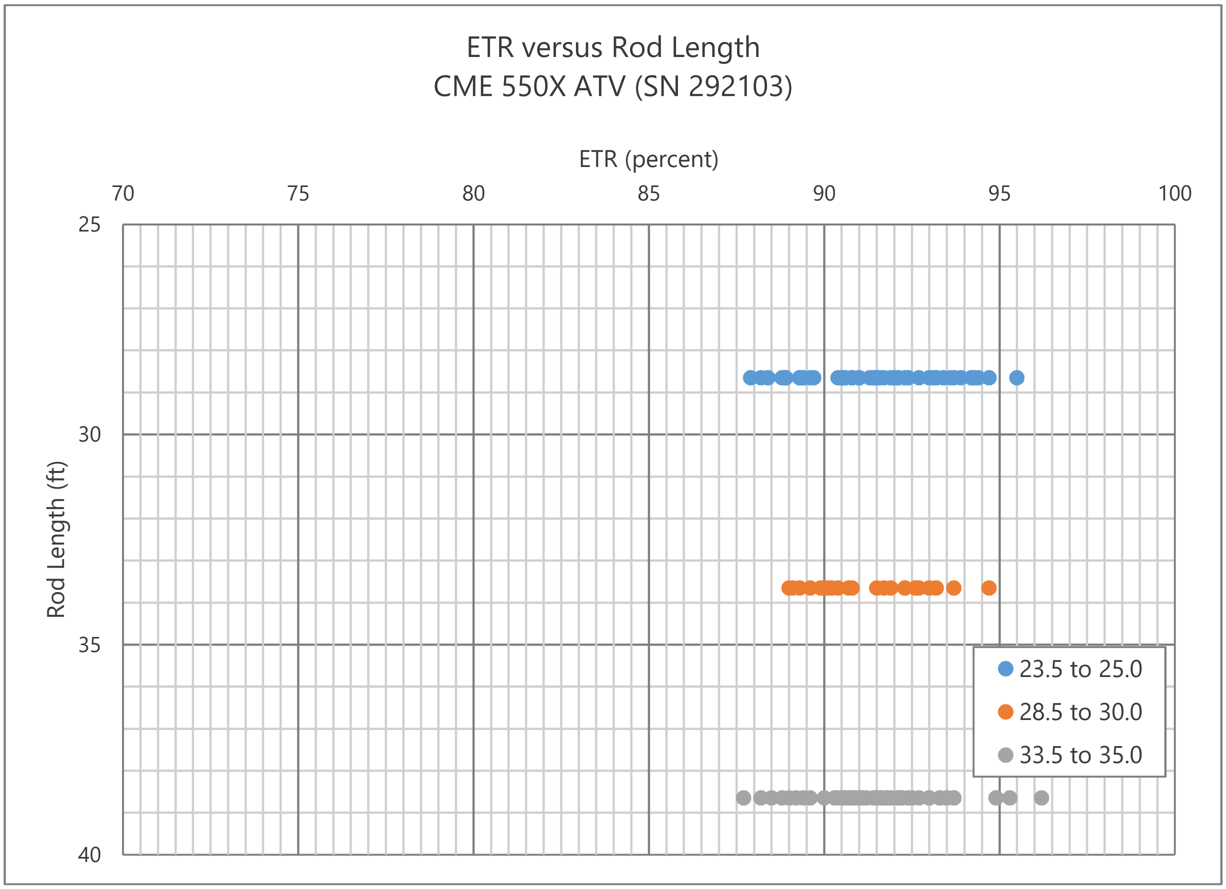
Summary of SPT Test Results

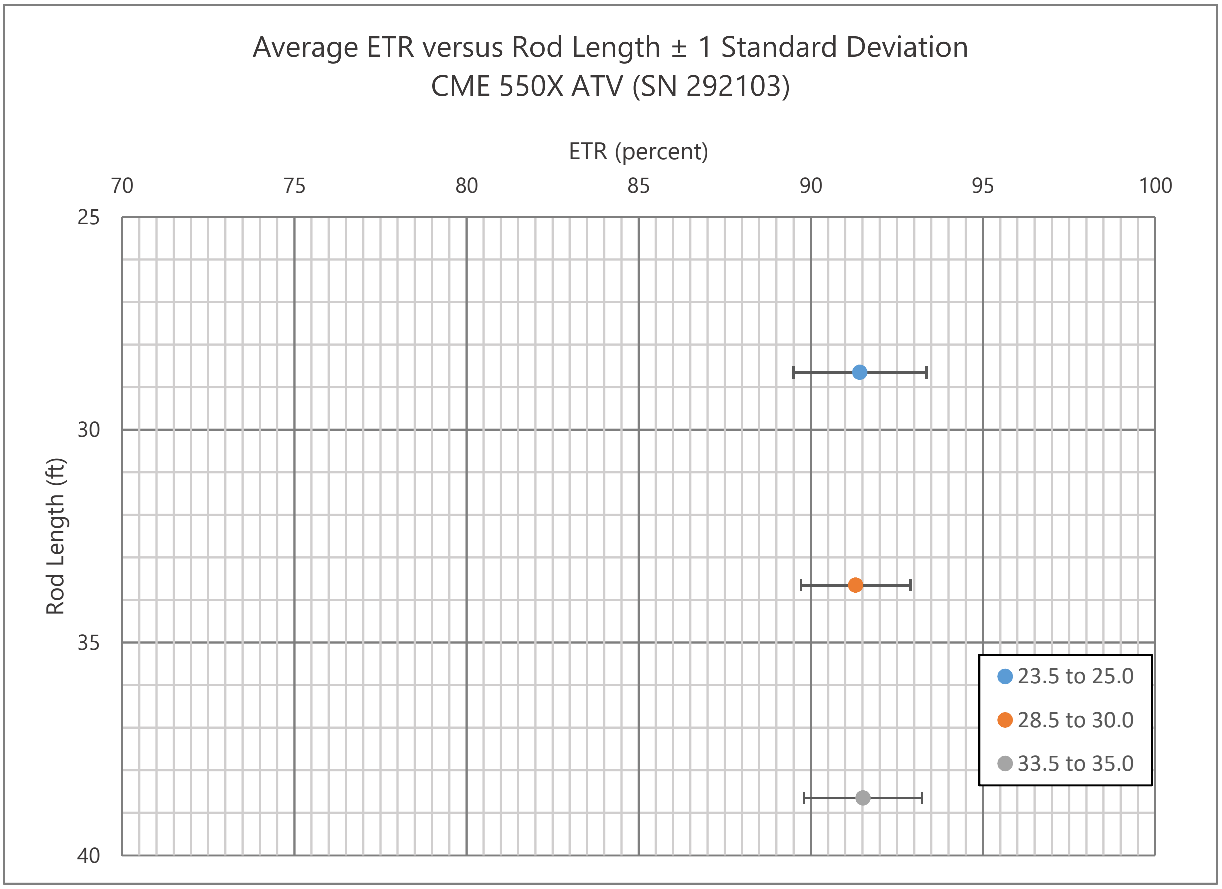
Project: CME-550X (SN 292103), Test Date: 1/21/2019

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average DFN in	Average CSX ksi	Average EFV ft-lb	Average ETR %
28.65	23.50	25.00	**8-15-37**	**52**	**79**	50.2	27.9	21.4	0.41	0.23	23.2	320.0	91.4
33.65	28.50	30.00	**7-7-17**	**24**	**36**	50.5	27.9	21.7	0.59	0.50	23.2	319.5	91.3
38.65	33.50	35.00	**6-9-50/3"**	**50/3"**	**50/3"**	50.4	28.4	21.0	0.43	0.15	23.7	320.3	91.5
					Overall Average Values:	50.3	28.1	21.3	0.45	0.24	23.4	320.0	91.4
					Standard Deviation:	0.2	1.4	0.8	0.15	0.22	1.2	6.2	1.8
					Overall Maximum Value:	50.8	31.8	23.4	0.88	0.86	26.5	336.8	96.2
					Overall Minimum Value:	49.8	25.1	19.6	0.34	0.06	20.9	307.0	87.7


ETR versus Rod Length
CME 550X ATV (SN 292103)
ETR (percent)
70
75
80
85
90
95
100
Rod Length (ft)
25
30
35
40
23.5 to 25.0
28.5 to 30.0
33.5 to 35.0


Average ETR versus Rod Length ± 1 Standard Deviation
CME 550X ATV (SN 292103)
ETR (percent)
70
75
80
85
90
95
100
Rod Length (ft)
25
30
35
40
23.5 to 25.0
28.5 to 30.0
33.5 to 35.0

SPT Energy Evaluation Form

Project: SPT ENERGY TESTING

Project No.: 1280-18-098 P110

Boring No.: B-1 (Testing Boring)

Date: 1/21/2019

Weather: Sunny 33°

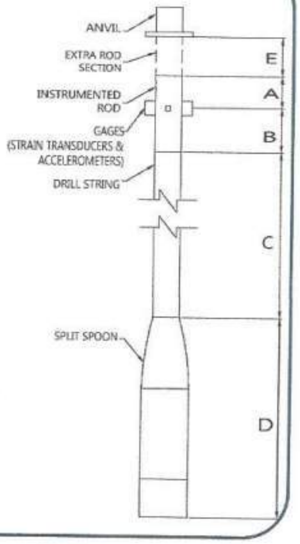
Drill Rod Type: AWJ

On-site Personnel

Drilling Company: S&ME, INC.
Rig Operator: MIKE BORNASH
Engr/Geologist:
Client Rep.:
Analyzer Oper.: ADAM JENNINGS

Rod Info

(A + E) Impact Surface to Gages Length: 1.2 ft
(B) Instr. Rod Length below Gages: .8 ft
(A) + (B) Instr. Rod Length: 2.0 ft
(D) Spoon Length: 2.85 ft
(E) Rod Length Above Instr. Rod (if applicable): N/A ft
Instr. Rod S/N: 203AWJ
Instr. Rod Outside Dia.: 1.75 in.
Instr. Rod Area: 1.20 in²
PDA Make/Model: PID/PAX
PDA Serial No.: 3733L
Calib. Pulse Test (y/n): Y



Rig/Hammer Info

Drill Rig Make/Model: CME 550X
Carrier Type: ATV
Rig Serial No.: 292103
Hammer Type/Model: AUTO CME
Hammer Serial No.: 292103
Hammer Drop System:
Lubrication Condition:
Manufacturer Recommended Operation Rate (bpm): 50-55
Typical Drop Height (in.): 30
Typical Hammer Weight (lbs): 140
Anvil Dimension (in.): 12
Drilling Method: 3¼ HSA w/ AWJ RODS

Gage Info

Gage		Serial No.	Calibration No.
Accel.	A3	K10181	356
	A4	K10182	358
Strain	F3	203AWJ-1	212.63
	F4	203AAWJ-2	212.32

Date of Test	Test Depth Increment (ft to ft)	Test Time Start / Stop (military)	Length of Drill String (ft) *(C)*	(LE) Length below Gages (ft) *(B) + (C) + (D)*	Avg. Meas. Hammer Rate (BPM)	SPT Blow Counts				Drop Height in Tolerance (y/n)	
						6"	12"	18"	N-Value		
12/19/2018	23.5 - 25.0					7	15	37	52	Y	SA SI
12/19/2018	28.5 - 30.0					5	7	17	24	Y	SA SI
12/19/2018	33.5 - 35.0					5	9	50/3		Y	SA SI
12/19/2018											SI SA
12/19/2018											WR
12/19/2018											WR

Notes:

NOTE: (1) Note any unusual hammer operating conditions that affect the hammer performance, or changes in operating conditions (e.g. veritcality, weather, or lubrication between trials). (2) Note any changes in rod diameter along drill string and record locations of short rod sections.

Prepared By (print/signature)

Date

PROJECT:

Western Gwinnett Bikeway
Peachtree Industrial Boulevard | Duluth, Georgia
S&ME Project No. 1280-18-098

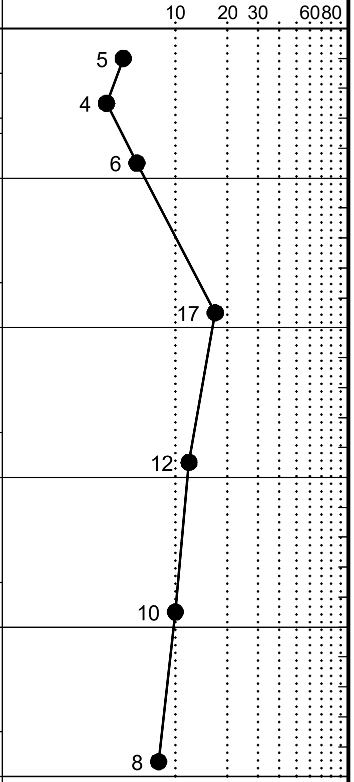
BORING LOG RW10-03

CLIENT: **Pond & Company**	ELEVATION: **911.0 ft**
DATE DRILLED: **1/14/19 - 1/14/19**	BORING DEPTH: **25.0 ft**
DRILL RIG: **D-50**	WATER LEVEL: **Dry ATD**
DRILLER: **S&ME, Inc.**	CAVE-IN DEPTH: **Not measured**
HAMMER TYPE: **Automatic**	LOGGED BY: **AL**
SAMPLING METHOD: **Split Spoon**	
DRILLING METHOD: **3¼" Hollow Stem Auger**	

NOTES:

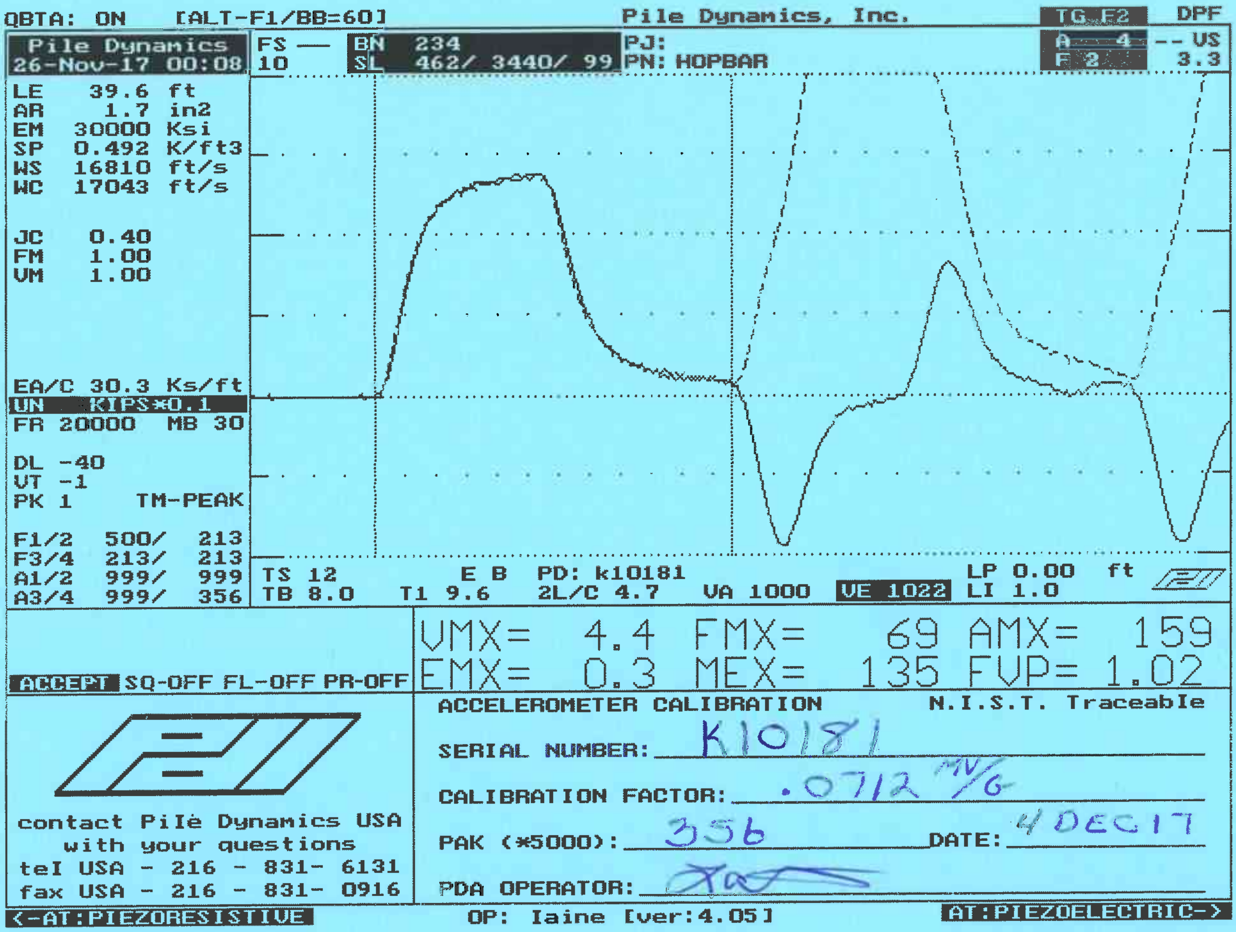
STATION: **258+50** OFFSET:

DEPTH (feet)	ELEV. ( )	GRAPHIC LOG	MATERIAL DESCRIPTION	TESTS	SAMPLE DATA	BLOWS	STANDARD PENETRATION TEST DATA (blows/ft)
	910	▨	**ALLUVIUM: SANDY CLAY (CL)** - soft to firm, brown, moist		1 2	1-2-3 2-2-2	5 4
5		▨	**ALLUVIUM: CLAYEY SAND (SC)** - loose, brown and tan, moist		3	2-3-3	6
10	905	▨	**ALLUVIUM: SANDY CLAY (CL)** - very stiff, gray, tan, and red, moist		4	4-7-10	17
15 20 25	900 895 890	▨	**RESIDUUM: SILTY SAND (SM)** - loose to medium dense, tan and gray, fine to medium grained, moist, w/ rock fragments		5 6 7	7-6-6 3-4-6 3-5-3	12 10 8
			Boring terminated at 25 feet				



NOTES:

1. *THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.*
2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*
5. *SOIL DESCRIPTIONS BASED ON SAMPLES OBTAINED.*



```
QBTA: ON    [ALT-F1/BB=60]                Pile Dynamics, Inc.           TG F2   DPF
Pile Dynamics     FS ——   BN  234              PJ:                     A    4 -- VS
26-Nov-17 00:08   10      SL  462/ 3440/ 99    PN: HOPBAR              F 2      3.3
LE     39.6  ft
AR      1.7  in2
EM   30000  Ksi
SP   0.492  K/ft3
WS   16810  ft/s
WC   17043  ft/s

JC     0.40
FM     1.00
VM     1.00

EA/C 30.3 Ks/ft
UN    KIPS*0.1
FR 20000   MB 30

DL -40
VT -1
PK 1      TM-PEAK

F1/2   500/   213
F3/4   213/   213
A1/2   999/   999   TS 12         E B   PD: k10181            LP 0.00   ft
A3/4   999/   356   TB 8.0   T1 9.6     2L/C 4.7   VA 1000 VE 1022  LI 1.0
                                     VMX=  4.4  FMX=   69  AMX=  159
ACCEPT SQ-OFF FL-OFF PR-OFF          EMX=  0.3  MEX=  135  FVP= 1.02
```

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: K10181

CALIBRATION FACTOR: .0712 mV/G

PAK (*5000): 356 DATE: 4DEC17

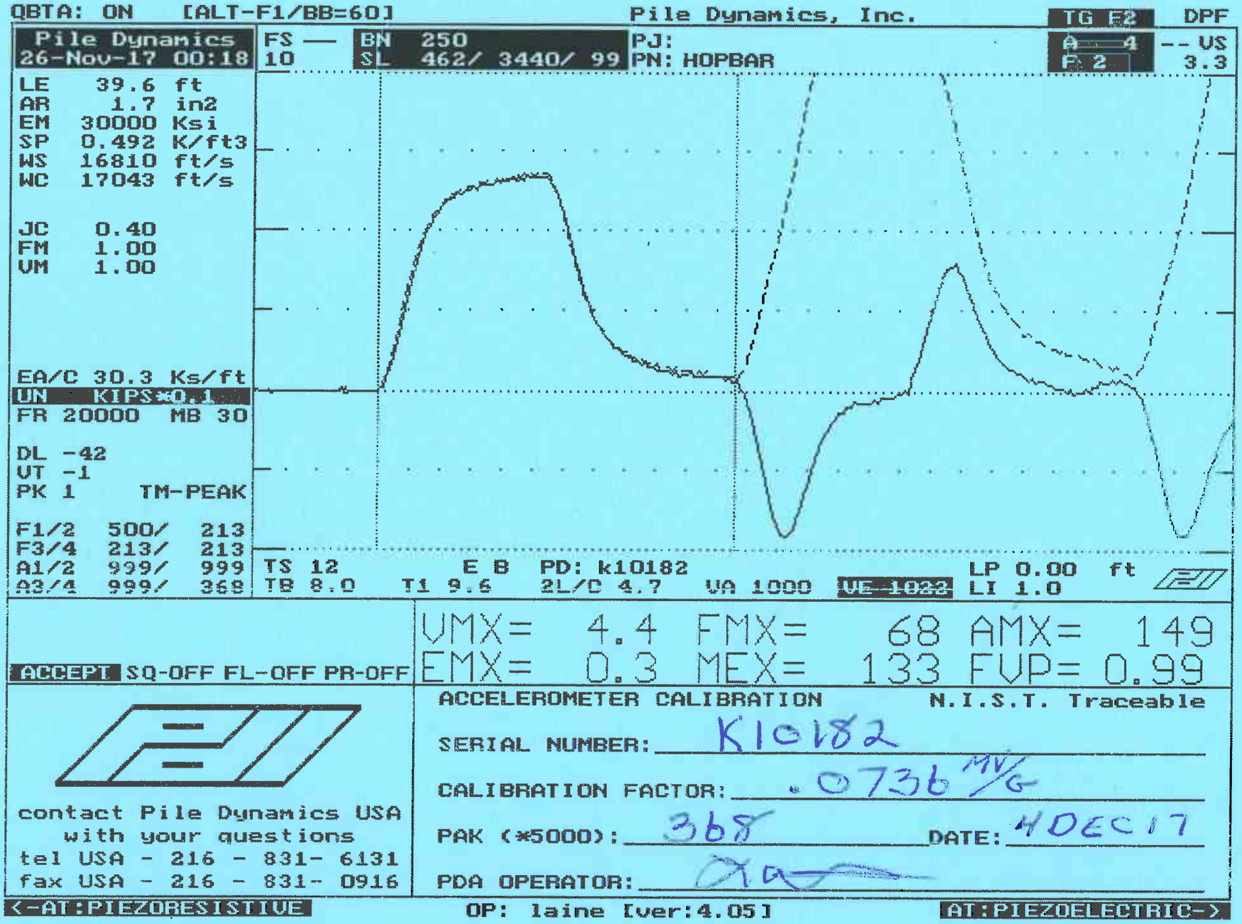
PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE OP: Iaine [ver:4.05] AT:PIEZOELECTRIC->

Smart Sensor

Smart Chip Programmed By Z.M.W. **on** 4DEC17 **CRC Value** 6AD7



```
QBTA: ON   [ALT-F1/BB=60]                 Pile Dynamics, Inc.          TG E2   DPF
 Pile Dynamics       FS ——  BN  250              PJ:                   A —— 4  -- VS
26-Nov-17 00:18      10     SL  462/ 3440/ 99    PN: HOPBAR            F: 2       3.3
LE    39.6  ft
AR     1.7  in2
EM  30000  Ksi
SP  0.492  K/ft3
WS  16810  ft/s
WC  17043  ft/s

JC    0.40
FM    1.00
VM    1.00

EA/C 30.3  Ks/ft
VN    KIPS*0.1
FR 20000    MB 30

DL  -42
VT  -1
PK  1      TM-PEAK

F1/2   500/    213
F3/4   213/    213
A1/2   999/    999   TS 12          E B   PD: k10182                  LP 0.00   ft
A3/4   999/    368   TB 8.0    T1 9.6     2L/C 4.7    VA 1000   VE 1022  LI 1.0

                                   VMX=   4.4   FMX=     68  AMX=   149
ACCEPT SQ-OFF FL-OFF PR-OFF        EMX=   0.3   MEX=    133  FVP= 0.99
```

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: K10182

CALIBRATION FACTOR: .0736 mV/G

PAK (*5000): 368 DATE: 4DEC17

PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE   OP: laine [ver:4.05]   AT:PIEZOELECTRIC->

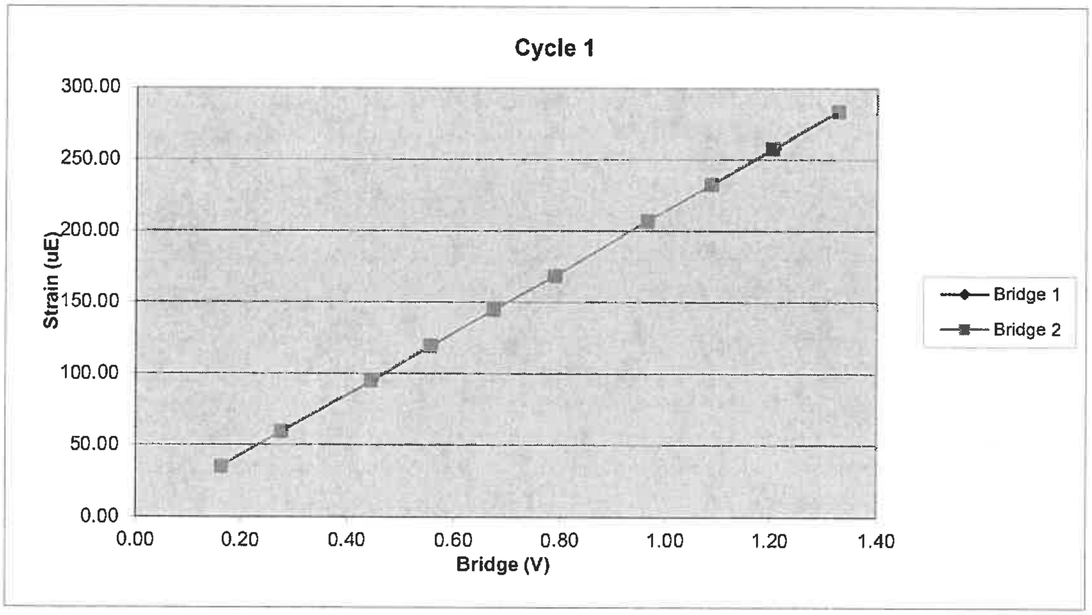
Smart Sensor

Smart Chip Programmed By J.M.W. **on** 4DEC17 **CRC Value** 1798

203AWJ		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1238.45	35.09	0.16	0.16
3	2101.82	59.39	0.28	0.28
4	3386.54	94.77	0.44	0.44
5	4235.08	119.35	0.56	0.56
6	5136.73	144.58	0.67	0.67
7	6021.00	168.91	0.79	0.79
8	7359.61	207.34	0.97	0.97
9	8298.94	232.84	1.09	1.09
10	9187.31	257.76	1.21	1.20
11	10120.00	284.12	1.33	1.33

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7630.77**	**Force Calibration (lb/V)**	**7630.97**
Offset	-7.83	Offset	-3.17
Correlation	1.000000	Correlation	0.999999
Strain Calibration (µE/V)	**213.97**	**Strain Calibration (µE/V)**	**213.98**
Offset	0.12	Offset	0.25
Correlation	0.999992	Correlation	0.999995

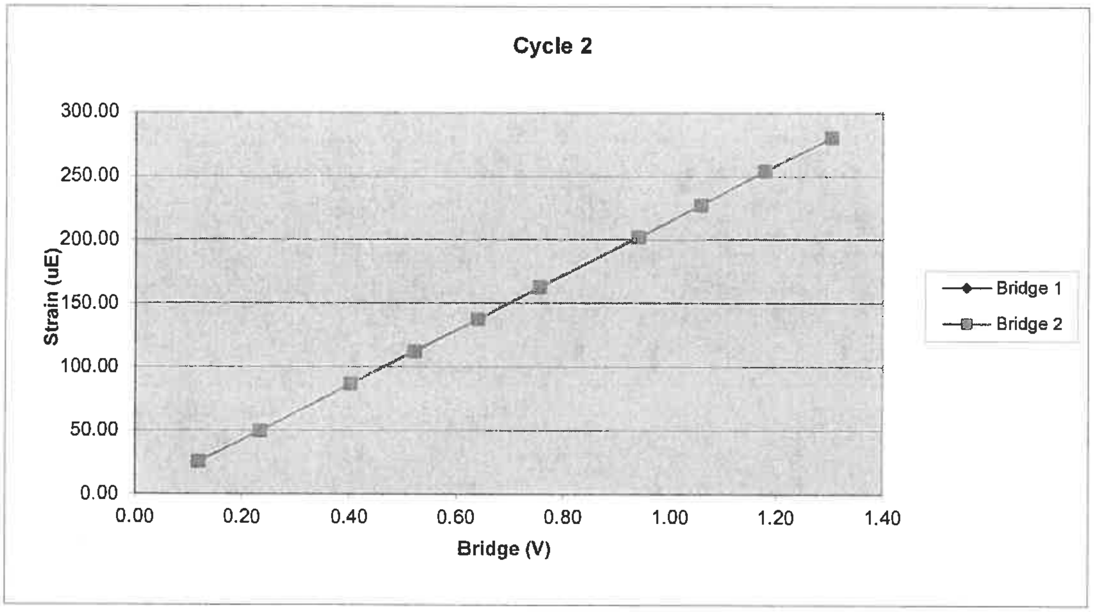
Force Strain Calibration	
EA (Kips)	**35662.28**
Offset	-12.17
Correlation	0.999993



203AWJ		Cycle 2		
Sample	**Force (lb)**	**Strain (μE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	883.29	25.21	0.12	0.12
3	1765.61	49.65	0.23	0.23
4	3049.75	86.59	0.40	0.40
5	3958.42	112.20	0.52	0.52
6	4857.33	137.43	0.64	0.64
7	5743.75	162.78	0.76	0.76
8	7145.42	202.15	0.94	0.94
9	8044.14	227.44	1.06	1.06
10	8969.22	253.99	1.18	1.18
11	9924.95	280.34	1.30	1.30

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7617.86**	**Force Calibration (lb/V)**	**7627.07**
Offset	**-11.91**	Offset	**-18.36**
Correlation	**0.999998**	Correlation	**1.000000**
Strain Calibration (μE/V)	**215.30**	**Strain Calibration (μE/V)**	**215.56**
Offset	**-0.14**	Offset	**-0.33**
Correlation	**0.999995**	Correlation	**0.999996**

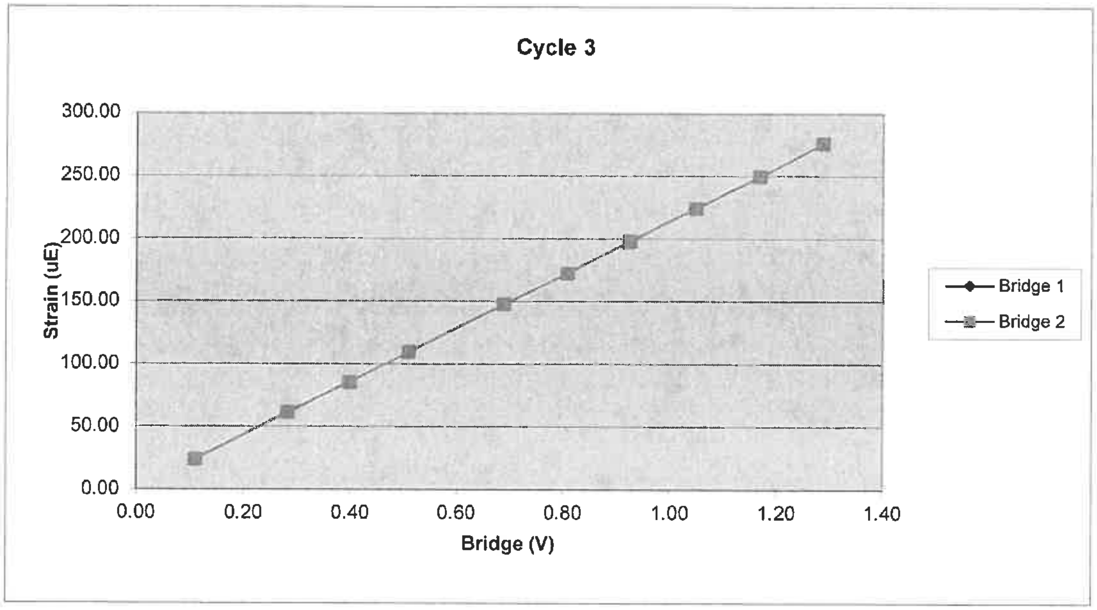
Force Strain Calibration	
EA (Kips)	**35381.61**
Offset	**-6.76**
Correlation	**0.999996**



203AWJ		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	843.85	23.93	0.11	0.11
3	2145.36	61.00	0.28	0.28
4	3029.63	85.25	0.40	0.40
5	3880.71	109.47	0.51	0.51
6	5241.19	147.71	0.69	0.69
7	6147.33	172.47	0.81	0.81
8	7034.72	198.06	0.92	0.92
9	7979.71	224.33	1.05	1.05
10	8906.15	249.58	1.17	1.17
11	9817.56	275.86	1.29	1.29

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7623.93**	**Force Calibration (lb/V)**	**7629.88**
Offset	**-3.49**	Offset	**-9.59**
Correlation	**0.999999**	Correlation	**0.999999**
Strain Calibration (µE/V)	**213.65**	**Strain Calibration (µE/V)**	**213.81**
Offset	**0.47**	Offset	**0.30**
Correlation	**0.999992**	Correlation	**0.999991**

Force Strain Calibration	
EA (Kips)	**35684.19**
Offset	**-20.08**
Correlation	**0.999992**



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

Calibration Factors	**203AWJ**		
Bridge 1 (µE/V)	**214.31**	**Bridge 2 (µE/V)**	**214.45**
EA Factor (Kips)	**35576.02**	**Area (in^2)**	**1.19**

Calibrated by: David
Calibrated Date: 2/26/2019

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

S&ME- Diedrich D-50 Track (SN 382)

Report of SPT Energy Measurements
S&ME Diedrich D-50 Track (Serial No. 382)
Spartanburg, South Carolina
S&ME Project No. 6235-17-020

PREPARED FOR:

North Carolina Department of Transportation
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699

PREPARED BY:

S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273

March 6, 2019

March 6, 2019

North Carolina Department of Transportation
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699

Attention: Dr. Shunyi (Chris) Chen, Ph.D., P.E.

Cc: Ms. Cheryl A. Youngblood, L.G.

Reference: **Report of SPT Energy Measurements**
S&ME Diedrich D-50 Track (Serial No. 382)
Spartanburg, South Carolina
S&ME Project No. 6235-17-020
NC PE Firm License No. F-0176

Dear Dr. Chen:

We have completed the Standard Penetration Test (SPT) energy measurements on the automatic hammer used with our Diedrich D-50 track-mounted drill rig (Serial No. 382). This service was performed by Mr. Joseph Williamson, P.E. of our firm on February 15, 2019, in general accordance with ASTM D4633 and the most recent revision of the North Carolina Department of Transportation (NCDOT) Geotechnical Engineering Unit's requirements. Review of the data quality and analyses was performed by Mr. Gregory Canivan, P.E. of our firm. Copies of the Certificates of Proficiency issued by Pile Dynamics based on the Dynamic Measurement and Analysis Proficiency Test for Mr. Williamson and Mr. Canivan are included in the Appendix. The testing procedures, equipment used during testing, and detailed results are presented in this report.

1.0 Dynamic Testing Methodology

Testing was performed using a model PAX (Serial No. 3733L) Pile Driving Analyzer^{TM} (PDA) manufactured by Pile Dynamics, Inc. The PDA was used to record and interpret data from two piezoresistive accelerometers (Serial Nos. K10181 and K10182) bolted to a 2.65-foot long BW drill rod (Serial No. 102) internally instrumented with two strain transducers. Calibration sheets for the accelerometers and the instrumented rod are included in the Appendix. The instrumented BW drill rod has a cross-sectional area of 1.82 square inches and an outside diameter of approximately 2.125 inches. Therefore, we calculate the inside diameter to be approximately 1.5 inches at the gauge location. The accelerometers and strain gauges, which are diametrically opposed near the middle of the instrumented rod, monitor acceleration and strain for each hammer blow. The analyzer converts the data to velocities and forces and computes the maximum transferred hammer energies with the "EFV" method described in ASTM D4633. Preliminary results are recorded and displayed in real time for each blow.

2.0 Testing and Observations

S&ME personnel were on site February 15, 2019, to observe and perform high-strain dynamic testing during SPT sampling on the Diedrich D-50 track-mounted drill rig operated by Justin Millwood of S&ME. The measurements were taken during drilling and sampling of a test hole at S&ME's office in Spartanburg, South Carolina. SPT energy measurements were recorded during seven sampling intervals at depths of approximately 28.2, 33.2, 38.2, 43.2, 48.2, 53.2, and 58.2 ft below the ground surface. The 33.2, 38.2, and 43.2-ft sample intervals did not meet the NCDOT blow count requirements and were not included in the data analysis. The information presented in the tables below summarizes the equipment and tooling used during the SPT energy measurements.

Table 2-1: Drill Rig Information

Manufacturer	Diedrich
Model	D-50
Serial Number	382
Operator	J. Millwood
Carrier	Track

Table 2-2: Hammer Information

Model / Type	Diedrich / Auto
Serial Number	382
Anvil Height (inches)	N/A – Anvil Built into Casing of Auto Hammer
Anvil Diameter (inches)	N/A – Anvil Built into Casing of Auto Hammer
Typical Drop Height (inches)	30
Typical Ram Weight (pounds)	140
Ram Serial Number	N/A

Table 2-3: Drilling and Instrumented Rod Information

Drill Rod Type	BW
OD (inches)	2.125
ID (inches)	1.5
Cross-Sectional Area (in^2)	1.82
Typical Lengths (feet)	5
Instrumented Rod Type	BW (Serial No. 102)
OD (inches)	2.125
ID (inches)	1.5
Cross-Sectional Area (in^2)	1.82
Total Instrumented Rod Length (feet)	2.65
Length Below Gages (feet)	1.4
Split-Spoon Length (feet)	2.95

3.0 Dynamic Testing Results

The total rod length from the instrumentation to the tip of the split-spoon sampler was determined by adding 4.35 ft to the drill rod length at each sample depth. The SPT Energy Measurement Data Summary tables in the Appendix present the test data from every hammer blow at each sampling interval, along with representative force and velocity traces for each test interval. Per ASTM D4633, only the blows from the final foot of each sample interval (i.e. the blows that determine the N-value) are considered when computing the average measurement values of each test interval.

The reported blow counts obtained by the drill rig personnel, a summary of the test data, and average computed hammer energy and transfer ratio values are provided in Table 3-1. Based on the test data, the automatic hammer on the Diedrich D-50 operated at an average rate of about 42 blows per minute (bpm) during dynamic testing. The measured average transferred hammer energy (EFV) of the four sample intervals tested ranged from 337 to 347 ft-lbs, which corresponds to Energy Transfer Ratio (ETR) values of 96.4 to 99.1%, respectively. Plots and tables of the following are also included in the Appendix and present the test data with depth for each test interval:

- Penetration vs. BLC[1]
- Penetration vs. FMX[2]
- Penetration vs. EFV[3]
- Penetration vs. CSX[4]
- Penetration vs. VMX[5]
- Penetration vs. ETR[6]
- ETR vs. Rod Length
- Average ETR vs. Rod Length

Table 3-1: Summary of Dynamic Testing Results

Data Set ID	Sample Depth (ft)	Drill Rod Length (ft)	Instrumentation to Sampler Tip Length (ft)	Blows per 6" Increment / N-value	Soil Sample Description (Piedmont Residual)	Avg. BPM	Avg. EFV (ft-lbs)	Avg. ETR (%)
1	28.2 – 29.7	29.0	33.35	1-3-5 / 8	SILTY SAND	41.8	338	96.5
2	48.2 – 49.7	49.0	53.35	3-4-4 / 8	SILTY SAND	41.6	337	96.4
3	53.2 – 54.7	54.0	58.35	6-8-10 / 18	SILTY SAND	41.2	340	97.3
4	58.2 – 59.7	59.0	63.35	20-21-24 / 45	SILTY SAND	41.7	347	99.1
					Overall Average	**41.6**	**343**	**98.1**

The overall average transferred hammer energy for the automatic hammer on the Diedrich D-50 track-mounted drill rig was 343 foot-pounds, with an average ETR of 98.1%.

---

[1] BLC - Blow Count per 6-in. increment
[2] FMX - Maximum Compressive Force
[3] EFV – Maximum Transferred Energy
[4] CSX – Maximum Compressive Stress
[5] VMX – Maximum Velocity
[6] ETR – Energy Transfer Ratio – Ratio of Calculated Energy to Theoretical Energy of 140 lb hammer falling 30 inches

4.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report were based on the applicable standards of our profession in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

5.0 Closing

S&ME appreciates the opportunity to provide this report to the North Carolina Department of Transportation, Geotechnical Engineering Unit. Please let us know if you have any questions concerning this report.

Sincerely,

S&ME, Inc.

Joseph Will

Joseph R. Williamson, P.E.
Project Engineer
N.C. Registration No. 042168

DocuSigned by:
Greg Canivan
8C4BAC9729DB487...

SEAL
028593
GREGORY J. CANIVAN

Gregory J. Canivan, P.E.
Technical Principal
N.C. Registration No. 028593

Appendices:

- Appendix I - Certificates of Proficiency
- Appendix II - Instrumented Rod and Accelerometer Calibration Sheets
- Appendix III - Diedrich D-50 Track (SN 382) SPT Energy Measurements Summary Plots and Tables
- Appendix IV - SPT Energy Evaluation Form (Field Log)

Appendices

Appendix I

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Joseph Williamson
S&ME

has on October 31, 2017 achieved the rank of

INTERMEDIATE

on the **Dynamic Measurement and Analysis Proficiency Test**.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that Individuals at the Intermediate level seek Advanced, Master or Expert levels through additional study within four years of the date of this document.**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate. This certificate can be verified at www.PDAproficiencytest.com.

Steven A. Hall
Steven A. Hall, Executive Director
Pile Driving Contractors Association

Garland Likins
Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 2426

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Greg Canivan
S&ME Inc.

has on October 8, 2014 achieved the rank of

MASTER

on the **Dynamic Measurement and Analysis Proficiency Test**.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that individuals at the Master level seek to attain Expert level through additional study within five years of the date of this document**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate. This certificate can be verified at www.PDAproficiencytest.com.

Steven A. Hall

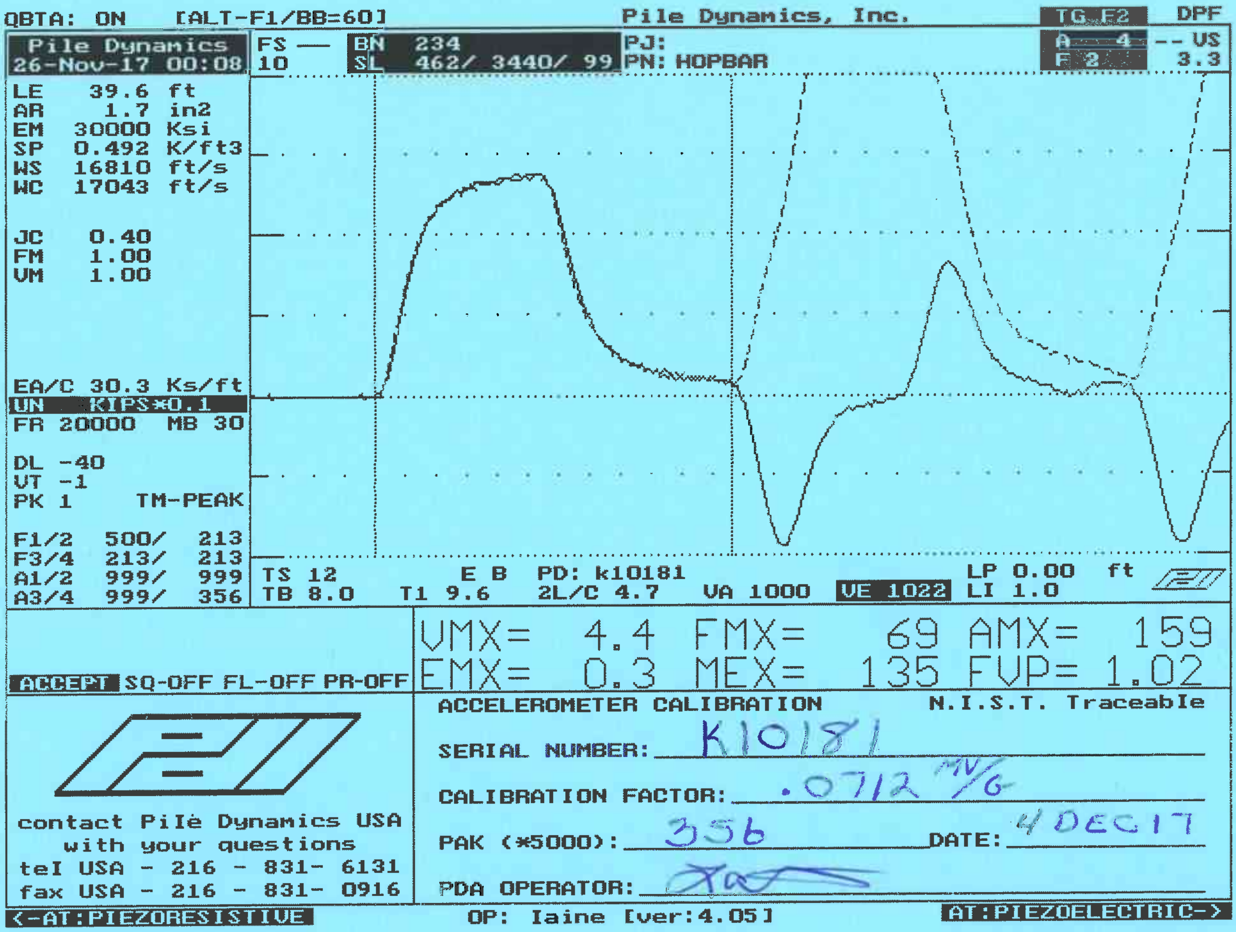
Steven A. Hall, Executive Director
Pile Driving Contractors Association

Garland Likins

Garland Likins, President
Pile Dynamics, Inc

No. 721

Appendix II



```
QBTA: ON    [ALT-F1/BB=60]                Pile Dynamics, Inc.          TG F2    DPF
Pile Dynamics    FS —   BN  234                PJ:                       A    4  -- VS
26-Nov-17 00:08  10     SL  462/ 3440/ 99      PN: HOPBAR                F 2        3.3
LE     39.6  ft
AR      1.7  in2
EM    30000  Ksi
SP    0.492  K/ft3
WS    16810  ft/s
WC    17043  ft/s

JC     0.40
FM     1.00
VM     1.00

EA/C 30.3 Ks/ft
UN    KIPS*0.1
FR 20000    MB 30

DL -40
VT -1
PK 1       TM-PEAK

F1/2   500/   213
F3/4   213/   213
A1/2   999/   999  TS 12         E B    PD: k10181                     LP 0.00   ft
A3/4   999/   356  TB 8.0    T1 9.6     2L/C 4.7     VA 1000  VE 1022   LI 1.0
                               VMX=  4.4  FMX=    69  AMX=   159
ACCEPT SQ-OFF FL-OFF PR-OFF    EMX=  0.3  MEX=   135  FVP= 1.02
                               ACCELEROMETER CALIBRATION      N.I.S.T. Traceable

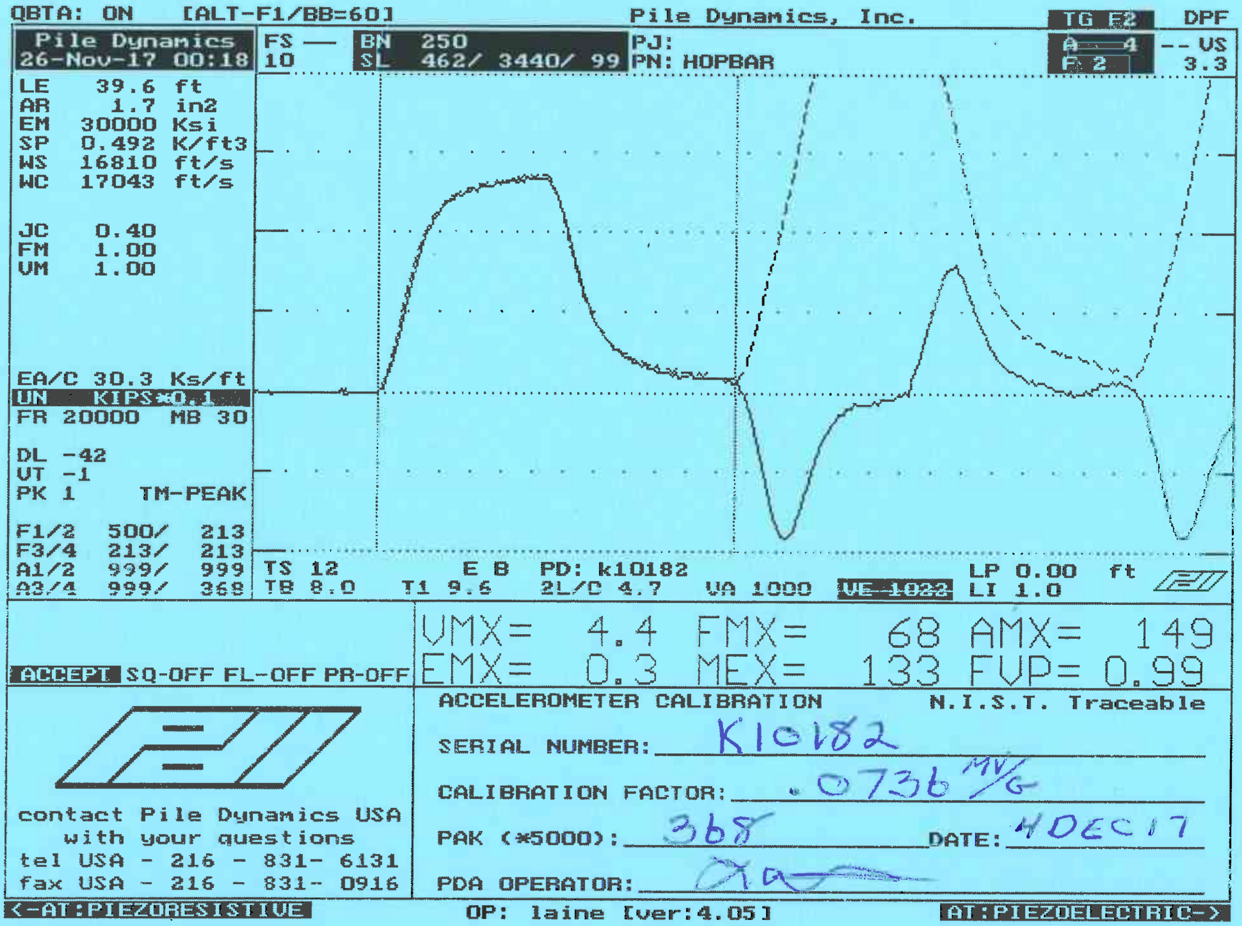
                               SERIAL NUMBER: K10181

                               CALIBRATION FACTOR: .0712 mV/G

                               PAK (*5000): 356          DATE: 4 DEC 17
contact Pile Dynamics USA
  with your questions          PDA OPERATOR:
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916
<-AT:PIEZORESISTIVE              OP: laine [ver:4.05]        AT:PIEZOELECTRIC->
```

Smart Sensor

Smart Chip Programmed By Z.M.W. **on** 4 DEC 17 **CRC Value** 6AD7



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QBTA: ON   [ALT-F1/BB=60]                 Pile Dynamics, Inc.          TG F2   DPF
 Pile Dynamics     FS ——  BN  250           PJ:                        A —— 4  -- VS
26-Nov-17 00:18    10     SL  462/ 3440/ 99 PN: HOPBAR                 F: 2      3.3
LE    39.6 ft
AR     1.7 in2
EM  30000 Ksi
SP  0.492 K/ft3
WS  16810 ft/s
WC  17043 ft/s

JC    0.40
FM    1.00
VM    1.00

EA/C 30.3 Ks/ft
VN   KIPS*0.1
FR 20000   MB 30

DL -42
VT -1
PK 1      TM-PEAK

F1/2   500/   213
F3/4   213/   213
A1/2   999/   999  TS 12        E B  PD: k10182                      LP 0.00  ft
A3/4   999/   368  TB 8.0   T1 9.6   2L/C 4.7   VA 1000   VE 1022   LI 1.0

                                 VMX=  4.4  FMX=    68 AMX=  149
ACCEPT SQ-OFF FL-OFF PR-OFF      EMX=  0.3  MEX=   133 FVP= 0.99
```

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

ACCELEROMETER CALIBRATION   N.I.S.T. Traceable

SERIAL NUMBER: K10182

CALIBRATION FACTOR: .0736 mV/G

PAK (*5000): 368   DATE: 4DEC17

PDA OPERATOR:

<-AT:PIEZORESISTIVE   OP: laine [ver:4.05]   AT:PIEZOELECTRIC->

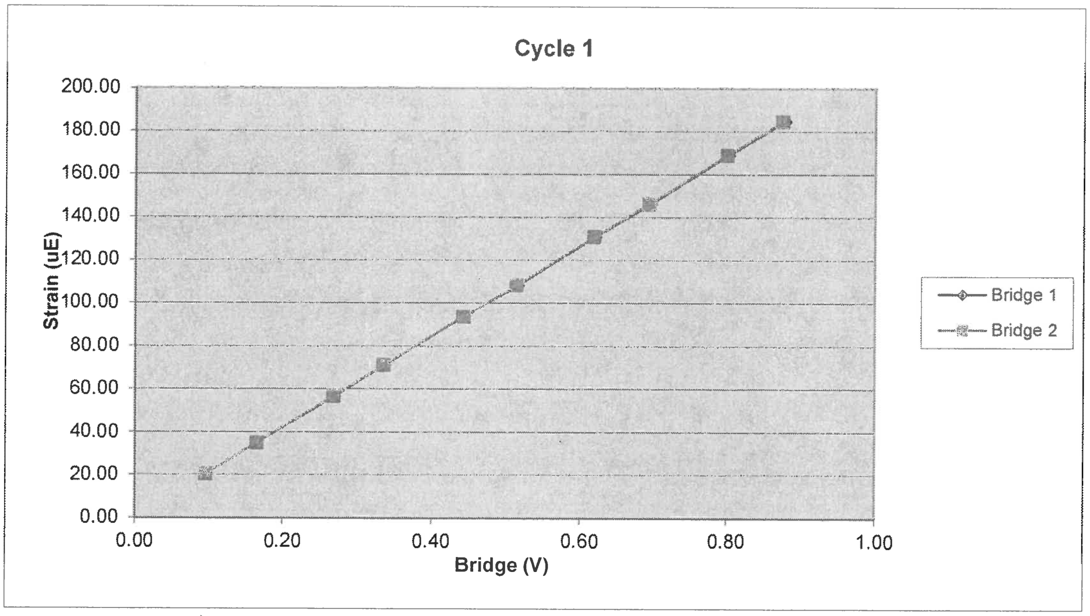
Smart Sensor

Smart Chip Programmed By J.M.W. **on** 4DEC17 **CRC Value** 1798

102BW		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1095.24	20.23	0.10	0.10
3	1886.37	34.92	0.16	0.16
4	3088.81	56.56	0.27	0.27
5	3858.71	71.04	0.34	0.34
6	5085.34	93.60	0.44	0.44
7	5908.54	108.17	0.51	0.51
8	7119.44	130.81	0.62	0.62
9	7983.55	146.15	0.69	0.69
10	9219.63	168.88	0.80	0.80
11	10084.73	184.60	0.88	0.87

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**11500.87**	**Force Calibration (lb/V)**	**11534.91**
Offset	-2.16	Offset	-7.27
Correlation	0.999999	Correlation	0.999999
Strain Calibration (µE/V)	**210.25**	**Strain Calibration (µE/V)**	**210.88**
Offset	0.30	Offset	0.21
Correlation	0.999993	Correlation	0.999995

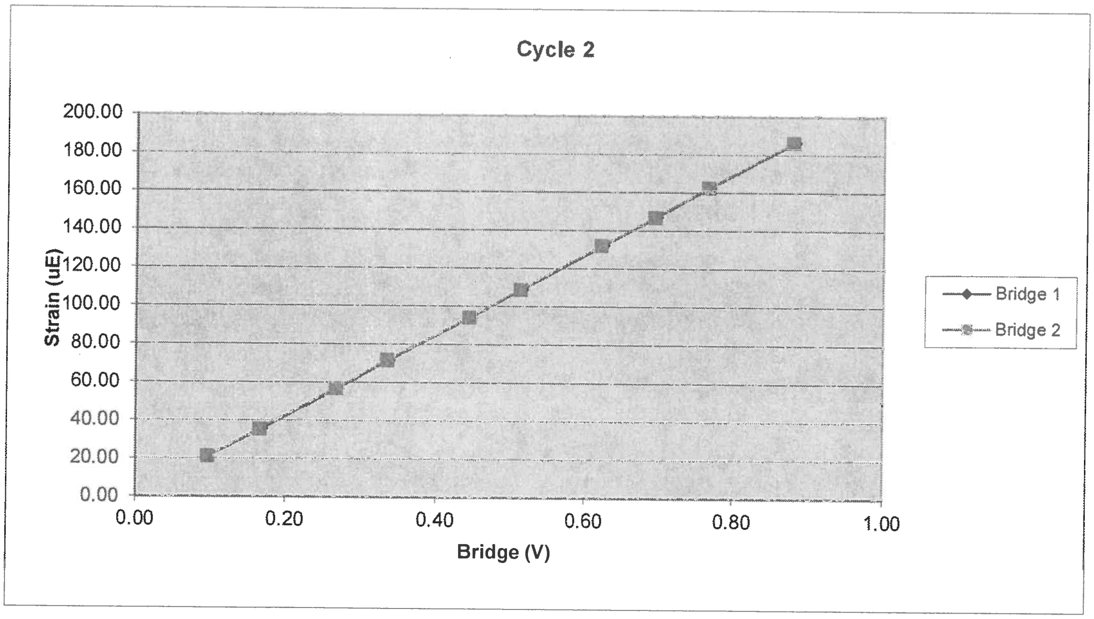
Force Strain Calibration	
EA (Kips)	**54698.97**
Offset	-18.70
Correlation	0.999994



102BW		Cycle 2		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1120.61	20.82	0.10	0.10
3	1926.89	35.33	0.17	0.17
4	3094.72	56.55	0.27	0.27
5	3888.41	71.48	0.34	0.33
6	5144.16	93.89	0.44	0.44
7	5940.80	108.73	0.51	0.51
8	7193.60	131.98	0.62	0.62
9	8040.99	146.97	0.70	0.69
10	8848.65	162.51	0.77	0.77
11	10165.37	186.33	0.88	0.88

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**11552.98**	**Force Calibration (lb/V)**	**11555.35**
Offset	**-0.36**	Offset	**15.25**
Correlation	**0.999997**	Correlation	**0.999998**
Strain Calibration (µE/V)	**211.64**	**Strain Calibration (µE/V)**	**211.68**
Offset	**0.03**	Offset	**0.31**
Correlation	**0.999993**	Correlation	**0.999993**

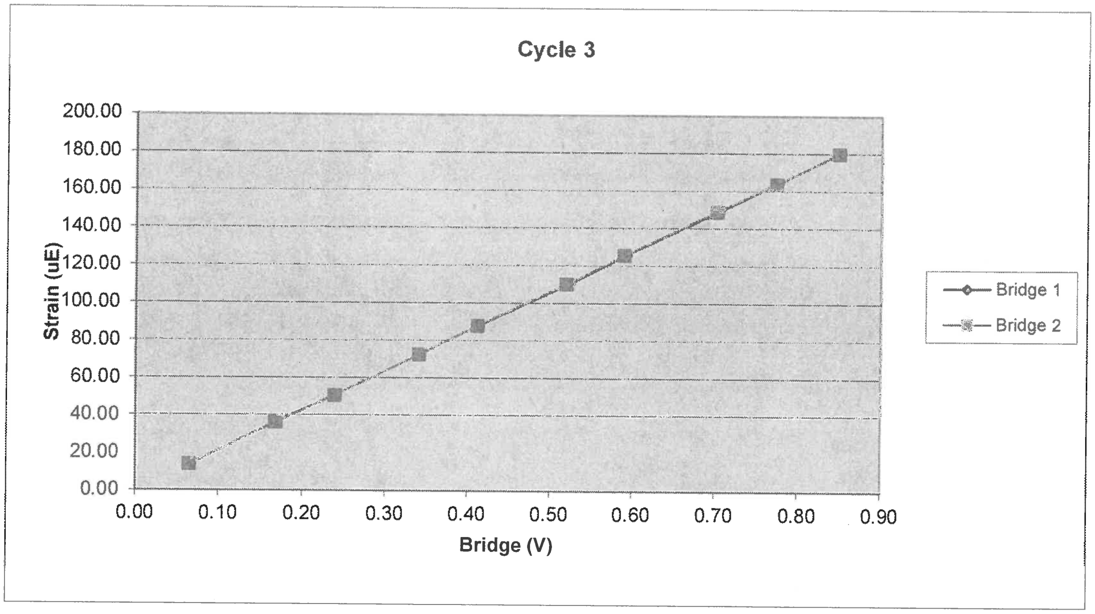
Force Strain Calibration	
EA (Kips)	**54586.80**
Offset	**-1.83**
Correlation	**0.999989**



102BW		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	728.19	13.83	0.07	0.06
3	1910.96	36.06	0.17	0.17
4	2721.96	50.60	0.24	0.24
5	3901.78	72.41	0.34	0.34
6	4724.79	87.76	0.41	0.41
7	5973.85	110.13	0.52	0.52
8	6776.59	125.45	0.59	0.59
9	8061.64	148.89	0.70	0.70
10	8899.20	163.80	0.77	0.77
11	9736.37	179.68	0.85	0.85

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**11507.00**	**Force Calibration (lb/V)**	**11517.03**
Offset	**-19.88**	Offset	**-19.40**
Correlation	**0.999996**	Correlation	**0.999997**
Strain Calibration (µE/V)	**211.37**	**Strain Calibration (µE/V)**	**211.56**
Offset	**0.34**	Offset	**0.35**
Correlation	**0.999987**	Correlation	**0.999992**

Force Strain Calibration	
EA (Kips)	**54438.54**
Offset	**-38.30**
Correlation	**0.999990**



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

Calibration Factors	**102BW**		
Bridge 1 (µE/V)	**211.09**	**Bridge 2 (µE/V)**	**211.37**
EA Factor (Kips)	**54574.77**	**Area (in^2)**	**1.82**

Calibrated by: David Bu
Calibrated Date: 6/1/2018

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

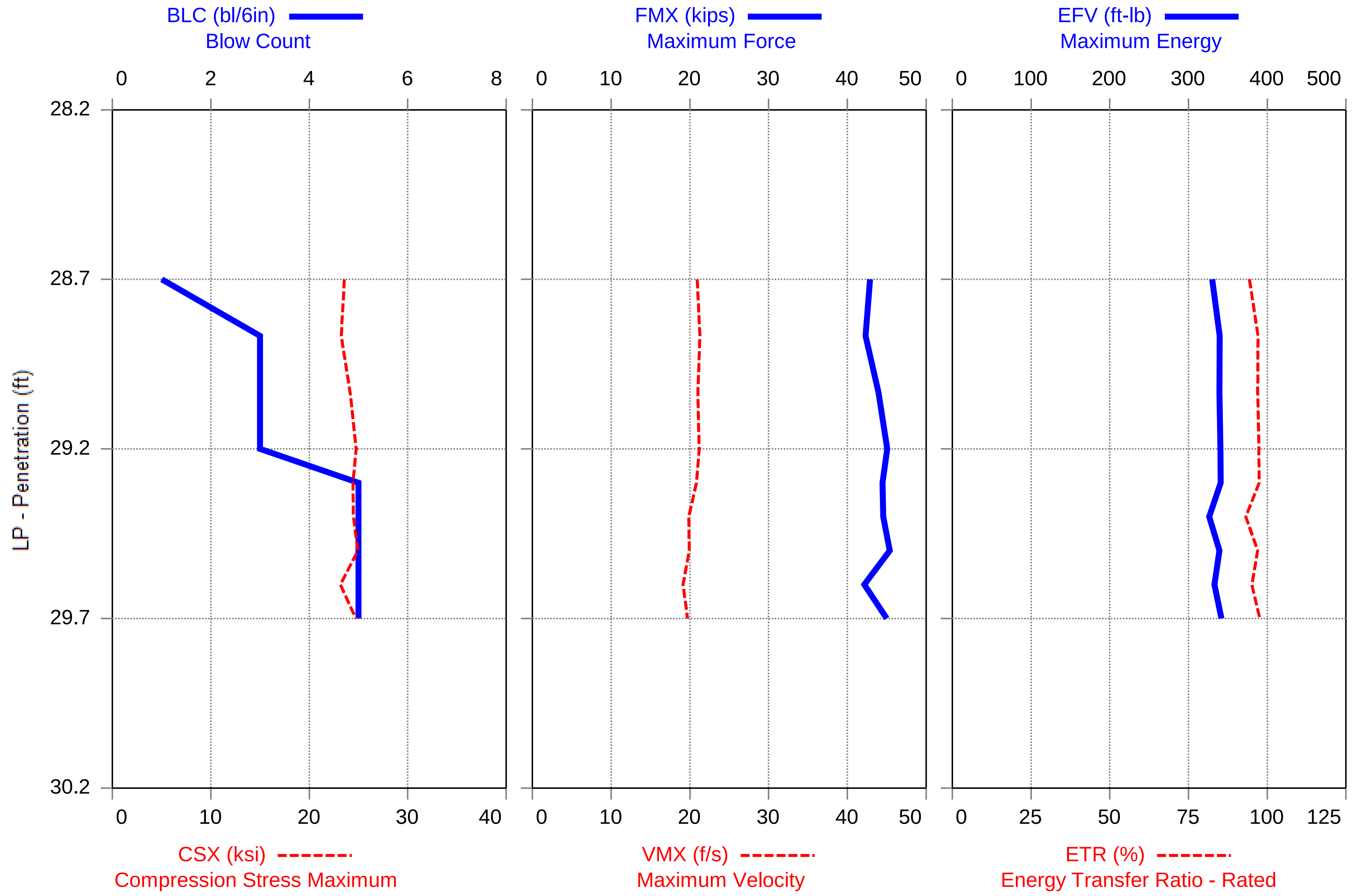
Traceable to N.I.S.T.

Appendix III

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 17-February-2019 **Test started: 15-February-2019**

DIEDRICH D-50 SN382 - 28.2-29.7 FEET



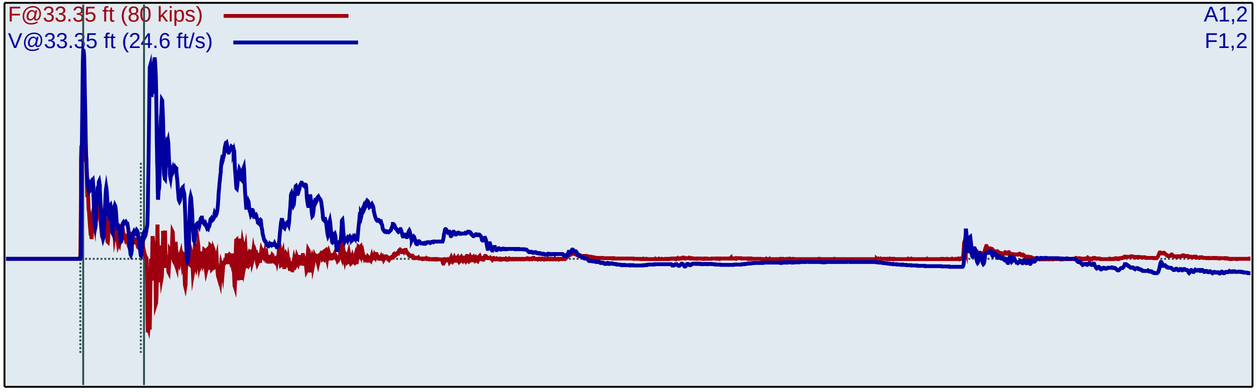
DIEDRICH D-50 SN382
JRW
TEST HOLE 2

28.2-29.7 FEET
Test date: 2/15/2019

AR: 1.82 in^2
LE: 33.35 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.20 - 29.70 ft], displaying BN: 7



F1 : [102 BW-1] 211.09 PDICAL (1) FF1
F2 : [102 BW-2] 211.37 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	28.70	1	1.9	43	20.9	6.00	23.6	6.00	330	94.3
2	28.87	3	42.1	42	21.3	2.46	23.2	2.00	340	97.1
3	29.03	3	42.1	44	21.0	2.34	24.1	2.00	339	97.0
4	29.20	3	41.7	45	21.2	2.00	24.8	2.00	341	97.3
5	29.30	5	41.8	44	20.8	1.67	24.4	1.20	341	97.4
6	29.40	5	42.2	45	19.9	1.53	24.5	1.20	326	93.2
7	29.50	5	41.5	45	19.9	1.47	24.9	1.20	339	97.0
8	29.60	5	41.8	42	19.1	1.42	23.2	1.20	333	95.1
9	29.70	5	41.5	45	19.7	1.37	24.7	1.20	342	97.6
		Average	41.8	44	20.4	1.78	24.2	1.50	338	96.5
		Std Dev	0.3	1	0.8	0.40	0.6	0.39	5	1.4
		Maximum	42.2	45	21.3	2.46	24.9	2.00	342	97.6
		Minimum	41.5	42	19.1	1.37	23.2	1.20	326	93.2

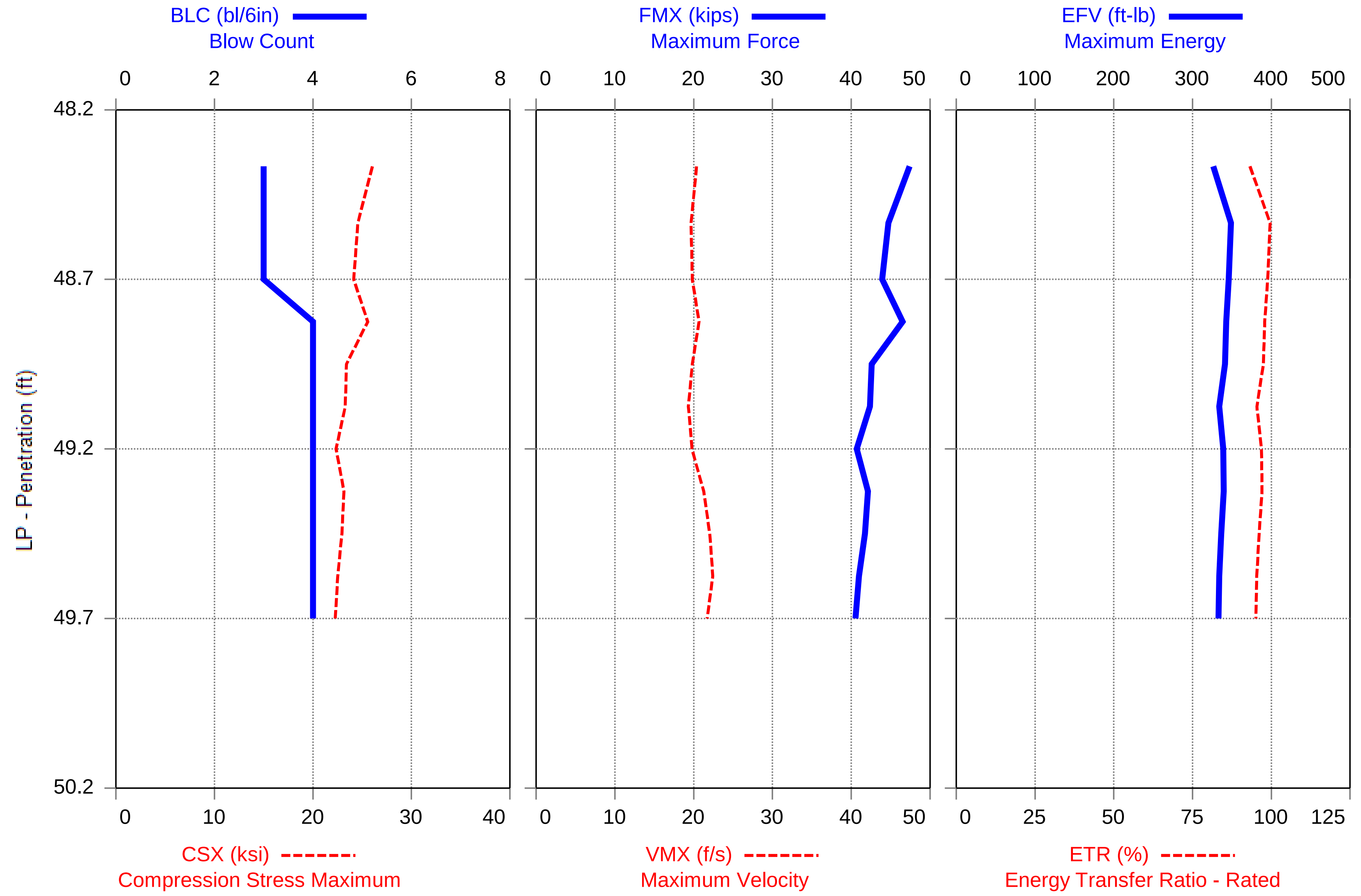
N-value: 8

Sample Interval Time: 11.46 seconds.

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 17-February-2019 **Test started: 15-February-2019**

DIEDRICH D-50 SN382 - 48.2-49.7 FEET



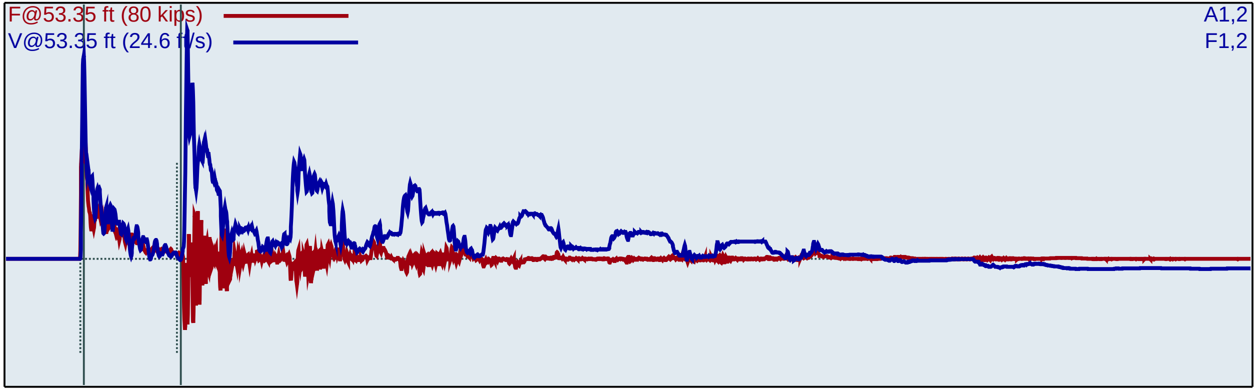
DIEDRICH D-50 SN382
JRW
TEST HOLE 2

48.2-49.7 FEET
Test date: 2/15/2019

AR: 1.82 in^2
LE: 53.35 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (48.20 - 49.70 ft], displaying BN: 9



F1 : [102 BW-1] 211.09 PDICAL (1) FF1
F2 : [102 BW-2] 211.37 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	48.37	3	1.9	47	20.4	2.02	26.0	2.00	326	93.2
2	48.53	3	41.5	45	19.7	2.07	24.6	2.00	349	99.6
3	48.70	3	41.6	44	19.8	2.10	24.1	2.00	346	98.8
4	48.83	4	41.7	47	20.7	1.81	25.6	1.50	343	97.9
5	48.95	4	41.6	43	19.8	1.78	23.4	1.50	341	97.5
6	49.08	4	41.7	42	19.3	1.67	23.3	1.50	334	95.4
7	49.20	4	41.8	41	19.8	1.57	22.4	1.50	339	96.9
8	49.33	4	41.4	42	21.3	1.66	23.1	1.50	340	97.0
9	49.45	4	41.9	42	22.0	1.69	22.9	1.50	336	96.1
10	49.58	4	41.5	41	22.4	1.55	22.5	1.50	334	95.4
11	49.70	4	40.9	41	21.7	1.50	22.3	1.50	333	95.1
		Average	41.6	42	20.9	1.66	23.2	1.50	337	96.4
		Std Dev	0.3	2	1.1	0.10	1.0	0.00	3	1.0
		Maximum	41.9	47	22.4	1.81	25.6	1.50	343	97.9
		Minimum	40.9	41	19.3	1.50	22.3	1.50	333	95.1

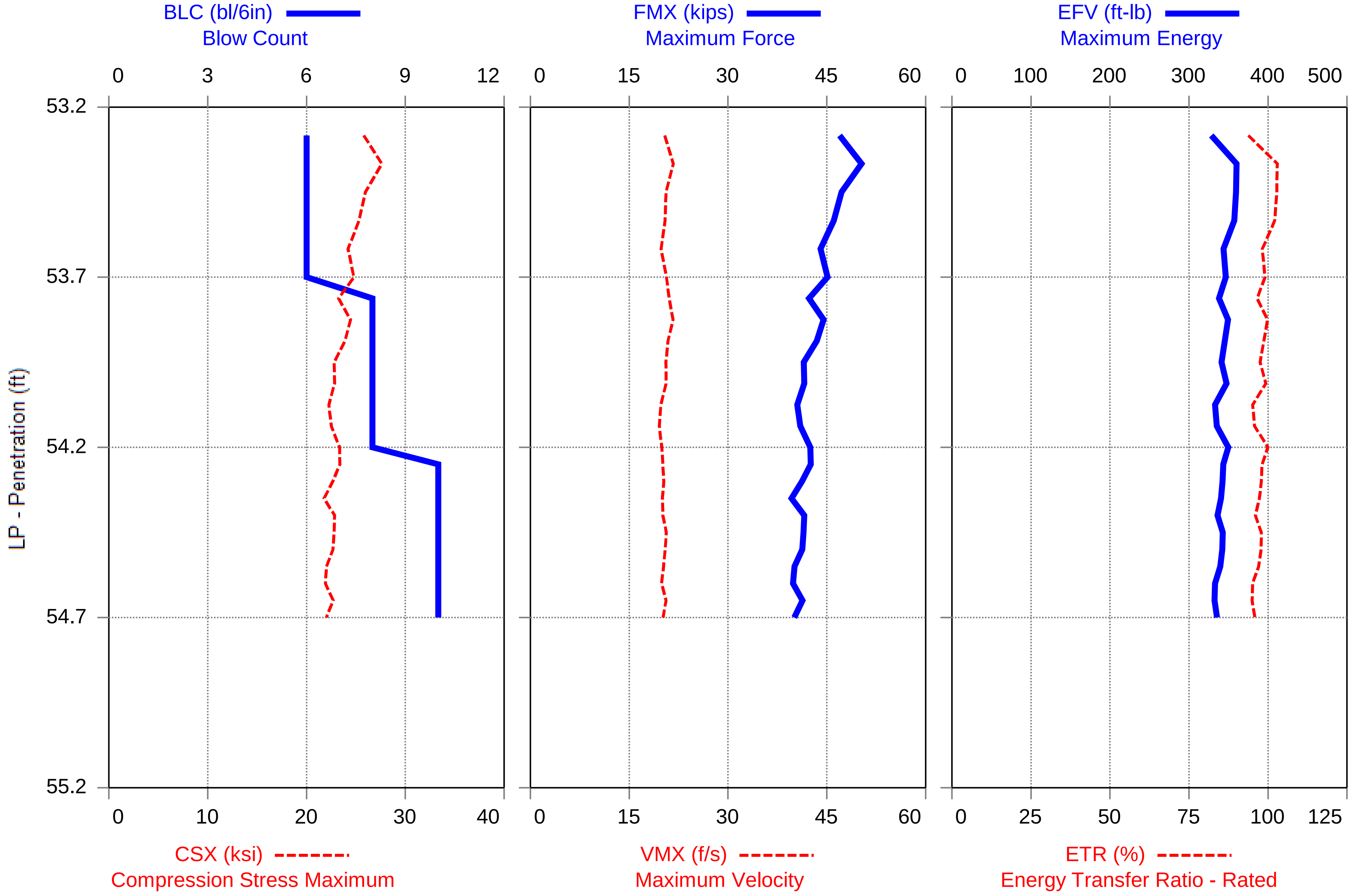
N-value: 8

Sample Interval Time: 14.42 seconds.

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 17-February-2019 **Test started: 15-February-2019**

DIEDRICH D-50 SN382 - 53.2-54.7 FEET



Pile Dynamics, Inc.
SPT Analyzer Results

PDA-S Ver. 2018.30 - Printed: 2/17/2019

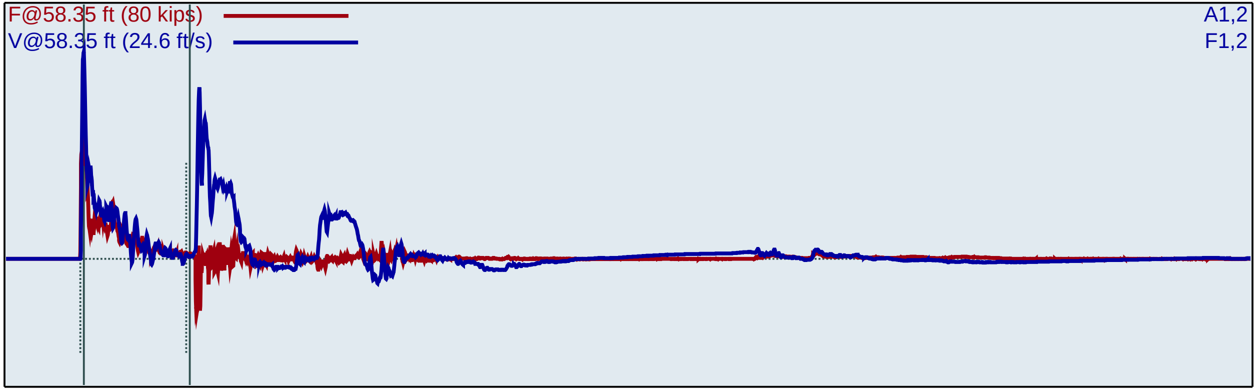
DIEDRICH D-50 SN382
JRW
TEST HOLE 2

53.2-54.7 FEET
Test date: 2/15/2019

AR: 1.82 in^2
LE: 58.35 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (53.20 - 54.70 ft], displaying BN: 22



F1 : [102 BW-1] 211.09 PDICAL (1) FF1
F2 : [102 BW-2] 211.37 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	53.28	6	1.9	47	20.4	1.32	25.8	1.00	328	93.7
2	53.37	6	41.5	50	21.7	1.31	27.6	1.00	360	102.9
3	53.45	6	41.4	47	20.6	1.30	26.0	1.00	360	102.8
4	53.53	6	41.2	46	20.4	1.25	25.3	1.00	357	102.1
5	53.62	6	42.0	44	19.8	1.17	24.2	1.00	344	98.2
6	53.70	6	41.7	45	20.6	1.14	24.8	1.00	347	99.0
7	53.76	8	41.9	42	21.1	1.01	23.2	0.75	338	96.6
8	53.83	8	41.4	45	21.7	1.01	24.5	0.75	350	99.9
9	53.89	8	41.7	43	20.9	0.96	23.9	0.75	345	98.7
10	53.95	8	41.5	41	20.6	0.92	22.8	0.75	341	97.5
11	54.01	8	41.3	42	20.6	0.94	22.8	0.75	348	99.3
12	54.08	8	41.4	41	19.8	0.76	22.3	0.75	333	95.1
13	54.14	8	41.6	41	19.6	0.77	22.5	0.75	335	95.8
14	54.20	8	40.8	42	19.9	0.83	23.3	0.75	350	100.0
15	54.25	10	41.3	43	20.1	0.75	23.4	0.60	343	98.1
16	54.30	10	40.7	41	20.3	0.73	22.7	0.60	343	97.9
17	54.35	10	41.2	40	20.0	0.73	21.8	0.60	340	97.3
18	54.40	10	41.0	42	20.1	0.72	22.8	0.60	336	96.0
19	54.45	10	40.6	41	20.6	0.67	22.8	0.60	343	97.9
20	54.50	10	41.1	41	20.4	0.71	22.7	0.60	342	97.8
21	54.55	10	40.8	40	20.2	0.69	22.0	0.60	340	97.0
22	54.60	10	40.7	40	19.9	0.64	21.9	0.60	333	95.1
23	54.65	10	41.0	41	20.6	0.64	22.7	0.60	332	95.0
24	54.70	10	40.8	40	20.1	0.62	22.0	0.60	336	95.9

Average	41.2	41	20.4	0.78	22.8	0.67	340	97.3
Std Dev	0.4	1	0.5	0.13	0.7	0.07	5	1.5
Maximum	41.9	45	21.7	1.01	24.5	0.75	350	100.0
Minimum	40.6	40	19.6	0.62	21.8	0.60	332	95.0

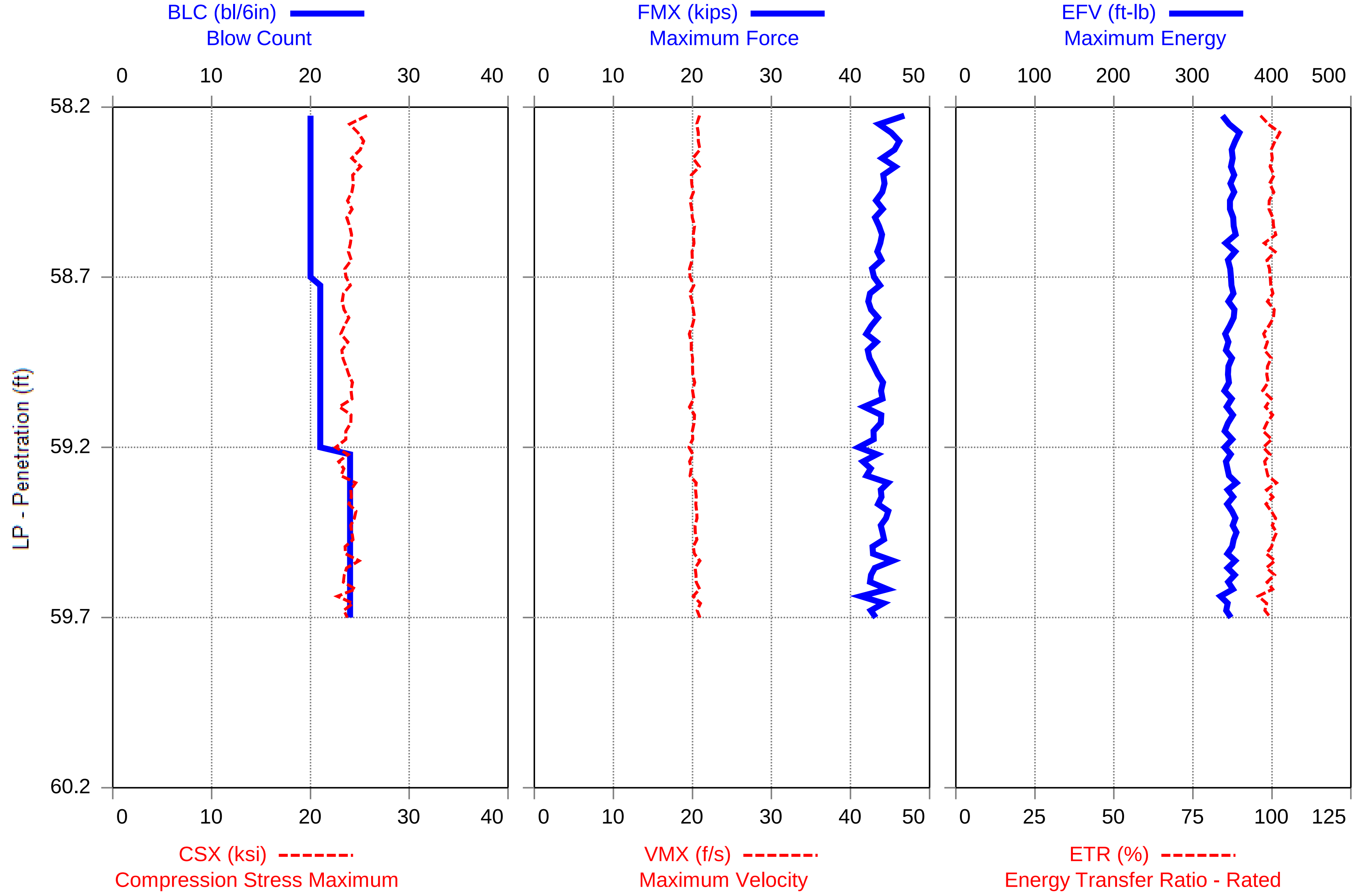
N-value: 18

Sample Interval Time: 33.41 seconds.

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 17-February-2019 **Test started: 15-February-2019**

DIEDRICH D-50 SN382 - 58.2-59.7 FEET



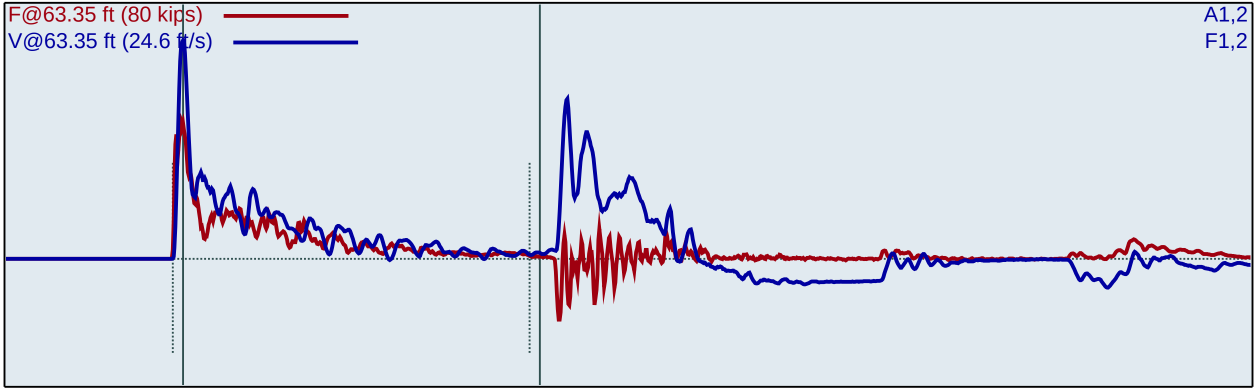
DIEDRICH D-50 SN382
JRW
TEST HOLE 2

58.2-59.7 FEET
Test date: 2/15/2019

AR: 1.82 in^2
LE: 63.35 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (58.20 - 59.70 ft], displaying BN: 63



F1 : [102 BW-1] 211.09 PDICAL (1) FF1
F2 : [102 BW-2] 211.37 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
1	58.23	20	1.9	47	20.9	0.65	25.7	0.30	337	96.4
2	58.25	20	41.2	44	20.5	0.57	24.0	0.30	346	98.8
3	58.28	20	41.1	45	20.7	0.58	24.8	0.30	359	102.5
4	58.30	20	42.4	46	20.7	0.52	25.4	0.30	353	101.0
5	58.33	20	42.0	46	21.0	0.50	25.0	0.30	349	99.8
6	58.35	20	41.7	44	20.1	0.51	24.2	0.30	350	100.1
7	58.38	20	41.9	46	20.9	0.52	25.1	0.30	348	99.5
8	58.40	20	41.2	44	19.8	0.50	24.3	0.30	352	100.7
9	58.43	20	41.9	44	19.9	0.52	24.4	0.30	347	99.3
10	58.45	20	41.2	44	20.1	0.50	24.2	0.30	352	100.6
11	58.48	20	42.1	43	19.7	0.50	23.7	0.30	347	99.1
12	58.50	20	41.9	44	19.9	0.51	24.2	0.30	347	99.1
13	58.53	20	41.4	43	20.0	0.50	23.7	0.30	351	100.3
14	58.55	20	41.8	44	20.3	0.49	24.0	0.30	352	100.5
15	58.58	20	41.5	44	20.1	0.52	24.2	0.30	354	101.2
16	58.60	20	41.9	44	20.2	0.50	24.0	0.30	342	97.6
17	58.63	20	41.1	43	20.0	0.53	23.8	0.30	354	101.0
18	58.65	20	41.8	44	20.0	0.50	24.1	0.30	344	98.4
19	58.68	20	41.0	43	19.6	0.52	23.5	0.30	347	99.2
20	58.70	20	41.5	43	19.7	0.51	23.6	0.30	348	99.4
21	58.72	21	41.4	44	20.2	0.52	24.0	0.29	349	99.6
22	58.75	21	41.1	42	19.7	0.51	23.3	0.29	351	100.3
23	58.77	21	41.4	42	20.0	0.51	23.2	0.29	345	98.6
24	58.80	21	40.6	43	20.1	0.51	23.4	0.29	352	100.7
25	58.82	21	41.3	43	20.3	0.52	23.9	0.29	352	100.5
26	58.84	21	41.0	43	20.0	0.51	23.4	0.29	347	99.0
27	58.87	21	41.5	42	19.6	0.51	23.1	0.29	341	97.4

28	58.89	21	41.1	43	19.8	0.51	23.8	0.29	345	98.6
29	58.91	21	41.2	42	19.9	0.51	23.2	0.29	342	97.6
30	58.94	21	41.2	42	20.0	0.51	23.3	0.29	349	99.8
31	58.96	21	41.5	43	20.0	0.49	23.6	0.29	345	98.6
32	58.99	21	41.7	43	20.0	0.49	23.9	0.29	344	98.4
33	59.01	21	41.2	44	20.3	0.50	24.2	0.29	346	98.8
34	59.03	21	41.6	44	20.0	0.49	24.1	0.29	340	97.1
35	59.06	21	41.5	44	20.2	0.50	24.2	0.29	349	99.8
36	59.08	21	41.8	42	19.6	0.49	22.9	0.29	343	97.9
37	59.10	21	41.6	44	20.3	0.50	24.1	0.29	351	100.2
38	59.13	21	42.0	44	20.2	0.50	24.1	0.29	344	98.4
39	59.15	21	41.8	43	20.0	0.50	23.6	0.29	340	97.2
40	59.18	21	41.8	43	20.0	0.51	23.6	0.29	350	99.9
41	59.20	21	41.5	41	19.5	0.49	22.5	0.29	340	97.2
42	59.22	24	41.9	43	20.1	0.50	23.8	0.25	348	99.4
43	59.24	24	42.0	42	19.6	0.48	22.8	0.25	342	97.7
44	59.26	24	41.7	43	19.8	0.47	23.4	0.25	344	98.2
45	59.28	24	41.8	42	19.7	0.47	23.1	0.25	345	98.7
46	59.30	24	41.9	45	20.5	0.47	24.6	0.25	355	101.4
47	59.33	24	42.0	44	20.4	0.45	24.1	0.25	344	98.3
48	59.35	24	41.9	44	20.5	0.46	24.1	0.25	351	100.3
49	59.37	24	41.8	43	20.4	0.47	23.9	0.25	343	98.1
50	59.39	24	42.0	45	20.5	0.48	24.6	0.25	349	99.8
51	59.41	24	41.5	44	20.6	0.47	24.4	0.25	354	101.1
52	59.43	24	42.3	44	20.3	0.47	24.1	0.25	350	100.1
53	59.45	24	42.0	44	20.4	0.48	24.2	0.25	355	101.4
54	59.47	24	42.0	44	20.6	0.48	24.3	0.25	352	100.5
55	59.49	24	41.9	43	20.1	0.47	23.5	0.25	350	99.9
56	59.51	24	41.9	43	20.2	0.47	23.5	0.25	344	98.2
57	59.53	24	42.2	45	20.9	0.49	24.9	0.25	353	101.0
58	59.55	24	41.9	43	20.4	0.47	23.7	0.25	344	98.3
59	59.58	24	42.0	43	20.4	0.49	23.4	0.25	353	100.8
60	59.60	24	42.0	42	20.5	0.47	23.3	0.25	345	98.4
61	59.62	24	42.2	45	20.9	0.49	24.6	0.25	351	100.2
62	59.64	24	42.2	41	20.1	0.47	22.7	0.25	335	95.6
63	59.66	24	41.8	44	21.0	0.48	24.3	0.25	344	98.3
64	59.68	24	42.2	43	20.6	0.48	23.4	0.25	342	97.7
65	59.70	24	41.9	43	20.9	0.48	23.7	0.25	348	99.5
		Average	41.7	43	20.2	0.49	23.7	0.27	347	99.1
		Std Dev	0.4	1	0.4	0.02	0.5	0.02	5	1.3
		Maximum	42.3	45	21.0	0.52	24.9	0.29	355	101.4
		Minimum	40.6	41	19.5	0.45	22.5	0.25	335	95.6

N-value: 45

Sample Interval Time: 91.98 seconds.

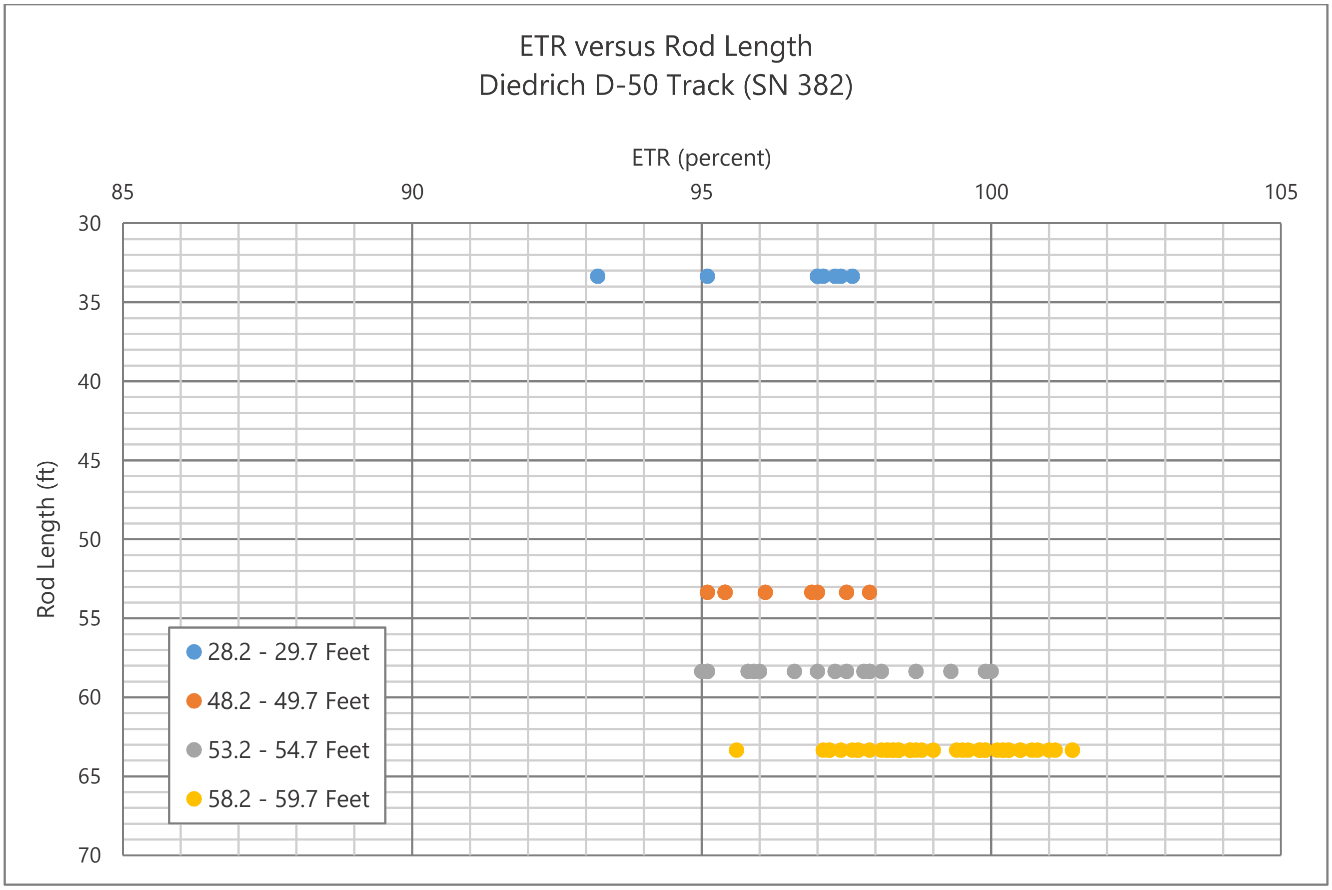
Summary of SPT Test Results

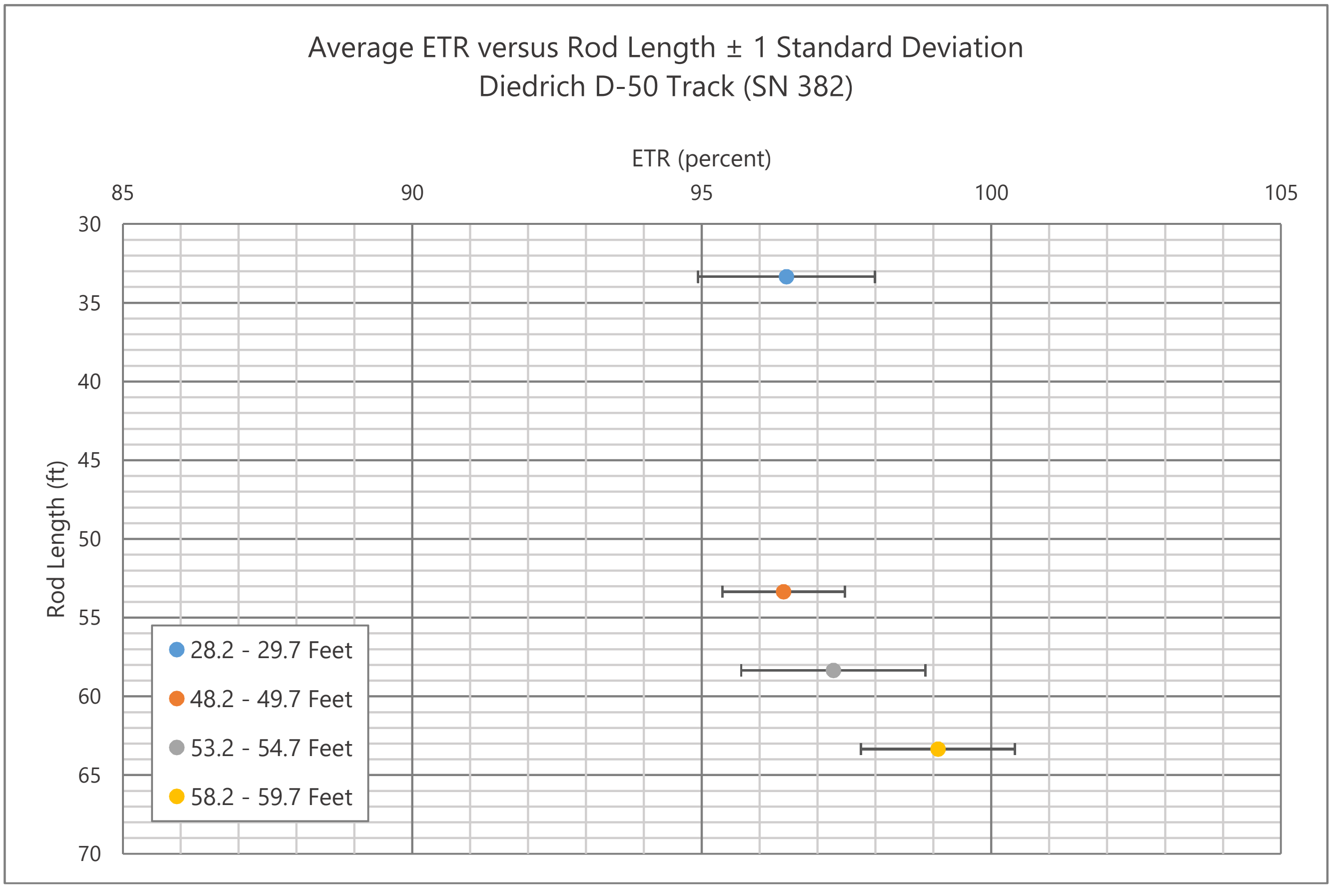
Project: DIEDRICH D-50 SN382, Test Date: 2/15/2019

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average CSX ksi	Average DFN in	Average EFV ft-lb	Average ETR %
33.35	28.20	29.70	**1-3-5**	**8**	**13**	41.8	44	20.4	1.78	24.2	1.50	338	96.5
53.35	48.20	49.70	**3-4-4**	**8**	**13**	41.6	42	20.9	1.66	23.2	1.50	337	96.4
58.35	53.20	54.70	**6-8-10**	**18**	**29**	41.2	41	20.4	0.78	22.8	0.67	340	97.3
63.35	58.20	59.70	**20-21-24**	**45**	**73**	41.7	43	20.2	0.49	23.7	0.27	347	99.1
					Overall Average Values:	41.6	43	20.3	0.81	23.5	0.61	343	98.1
					Standard Deviation:	0.4	1	0.6	0.50	0.8	0.49	6	1.8
					Overall Maximum Value:	42.3	47	22.4	2.46	25.6	2.00	355	101.4
					Overall Minimum Value:	40.6	40	19.1	0.45	21.8	0.25	326	93.2


ETR versus Rod Length
Diedrich D-50 Track (SN 382)
ETR (percent)
85
90
95
100
105
Rod Length (ft)
30
35
40
45
50
55
60
65
70
28.2 - 29.7 Feet
48.2 - 49.7 Feet
53.2 - 54.7 Feet
58.2 - 59.7 Feet


Average ETR versus Rod Length ± 1 Standard Deviation
Diedrich D-50 Track (SN 382)
ETR (percent)
85
90
95
100
105
Rod Length (ft)
30
35
40
45
50
55
60
65
70
28.2 - 29.7 Feet
48.2 - 49.7 Feet
53.2 - 54.7 Feet
58.2 - 59.7 Feet

Appendix IV

SPT Energy Evaluation Form

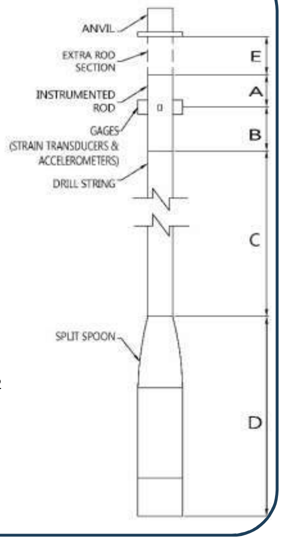
Project: SPT ENERGY TESTING
Project No.: 6235-17-020
Boring No.: TEST HOLE
Date: 2/15/2019
Weather: CLEAR / 60s
Drill Rod Type: 5' LONG BWJ

On-site Personnel

Drilling Company: S&ME, INC.
Rig Operator: J. MILLWOOD
Engr/Geologist: N/A
Client Rep.: N/A
Analyzer Oper.: J. WILLIAMSON

Rod Info

(A + E) Impact Surface to Gages Length: 1.6 ft
(B) Instr. Rod Length below Gages: 1.4 ft
(A) + (B) Instr. Rod Length: 2.65 ft
(D) Spoon Length: 2.95 ft
(E) Rod Length Above Instr. Rod (if applicable): 0.4 ft
Instr. Rod S/N: 102BW
Instr. Rod Outside Dia.: 2.125 in.
Instr. Rod Area: 1.82 in^2
PDA Make/Model: PDI/PAX
PDA Serial No.: 3733L
Calib. Pulse Test (y/n): Y



Rig/Hammer Info

Drill Rig Make/Model: DIEDRICH D-50
Carrier Type: TRACK
Rig Serial No.: 382
Hammer Type/Model: DIEDRICH D-50
Hammer Serial No.: 382
Hammer Drop System: AUTOMATIC
Lubrication Condition: PER MANUFACTURER
Manufacturer Recommended Operation Rate (bpm): 50
Typical Drop Height (in.): 30
Typical Hammer Weight (lbs): 140
Anvil Dimension (in.): N/A - BUILT IN
Drilling Method: MUD ROTARY - 2-15/16" TRICONE

Gage Info

Gage		Serial No.	Calibration No.
Accel.	A3	K10181	356
	A4	K10182	368
Strain	F3	102BW-1	211.09
	F4	102BW-2	211.37

Date of Test	Test Depth Increment (ft to ft)	Test Time Start / Stop (military)	Length of Drill String (ft) ***(C)***	(LE) Length below Gages (ft) ***(B) + (C) + (D)***	Avg. Meas. Hammer Rate (BPM)	SPT Blow Counts				Drop Height in Tolerance (y/n)	
						6"	12"	18"	N-Value		
2/15/2019	28.2 - 29.7	14:57	29.0	33.35	42	1	3	5	8	Y	SI SA
2/15/2019	33.2 - 34.7	15;02	34.0	38.35	42	1	2	4	6	Y	SI SA
2/15/2019	38.2 - 39.7	15:07	39.0	43.35	42	1	2	2	4	Y	SI SA
2/15/2019	43.2 - 44.7	15:14	44.0	48.35	42	3	3	4	7	Y	SI SA
2/15/2019	48.2 - 49.7	15;23	49.0	53.35	42	3	4	4	8	Y	SI SA
2/15/2019	53.2 - 54.7	15:30	54.0	58.35	41	6	8	10	18	Y	SI SA
2/15/2019	58.2 - 59.7	15:43	59.0	63.35	42	20	21	24	45	Y	SI SA

Notes:

NOTE: (1) Note any unusual hammer operating conditions that affect the hammer performance, or changes in operating conditions (e.g. veritcality, weather, or lubrication between trials). (2) Note any changes in rod diameter along drill string and record locations of short rod sections.

Joseph Will

Prepared By (print/signature)

2/15/2019
Date

Betts- CME 75 (SN 164447)

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April 18, 2019

Subject: **Dynamic Testing Report**
SPT Hammer Energy Measurement- CME-75 (S/N 164447)
156 N Johnson Street
Newborn, Georgia 30056
UES Project 0950.1900024.0000

UES has completed the high strain dynamic (i.e. PDA) testing for the Soil Test Boring drill rig designated CME-75 in use at the above referenced project. Dynamic monitoring was conducted during performance of a soil test boring in order to determine energy transferred by the Standard Penetration Test hammer to the drill rods during split spoon sampling. The dynamic testing was conducted using the Pile Driving Analyzer^{TM} (PDA) Model 8G, which records, digitizes, and processes the force and acceleration signals. The dynamic testing was carried out in accordance with ASTM D4945 *Standard Test Method for High Strain Dynamic Testing of Piles and* ASTM D4633 *Standard Test Method for Energy Measurement for Dynamic Penetrometers.*

PROJECT DESCRIPTION

Overview

The SPT hammer calibration testing was performed on site at the property located at 156 N Johnson Street in Newborn, Georgia. The SPT hammer calibration testing was performed at five (5) depths during sampling of an SPT Test Boring on April 12, 2019. The SPT hammer calibration testing was performed the following sampling depths; 33.5 to 35.0 feet (Sample 1), 38.5 to 40.0 feet (Sample 2), 43.5 to 45.0 feet (Sample 3), 48.5 to 50.0 feet (Sample 4), and 53.5 to 55.0 feet (Sample 5).

SPT Testing Overview

Numerous technical publications exist regarding the Standard Penetration Test (SPT). Of these publications, ASTM D1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* is considered to be the industry standard. This standard was last approved in January, 1999. In addition, U.S. Army Corp of Engineers Engineering Technical Letter (ETL) 1110-1-138 (dated March, 1988) is also a commonly used standard reference.

The Standard Penetration Test (SPT) consists of a drive weight assembly (i.e. hammer and anvil), split spoon sampler, and drill rods. The drive weight system consists of a 140 lb hammer raised by a number of mechanical means. The split spoon sampler is placed at the end of the drill rods in a borehole. The 140 lb hammer is raised 30 inches and then dropped to impact the drill rods. This procedure is repeated until the sampler has penetrated 18 inches into the underlying soil. The number of blows required to advance the split spoon sampler 12 inches is recorded as the “N” value for the test. Typically, the test is performed every 2 ½ ft for the upper 10 ft of a boring and then at 5 ft intervals thereafter. The standard dimensions of the split spoon sampler are shown in Figure 1, while a typical SPT setup is presented in Figure 2.

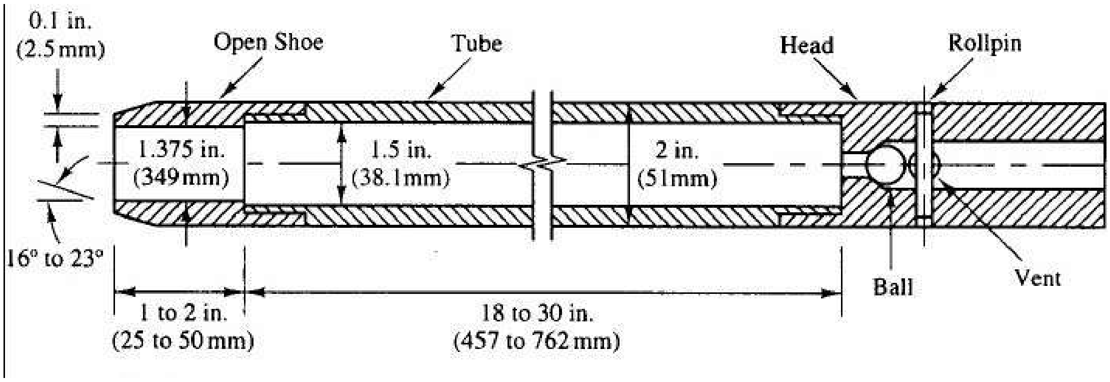


Figure 1. Split Spoon Sampler (after Rogers, 2004, adapted from ASTM D1586).

There are three (3) types of SPT hammers currently used in drilling practice today: the donut hammer, the automatic hammer, and the safety hammer. In addition, there are three (3) main types of hammer lifting mechanisms: cathead-rope system, spooling wench, or chain driven systems. Drill rods vary from AW (1 ¾ in O.D.) to NW (2 5/8 in O.D.), with drill rod lengths varying between 2 ft to 10 ft increments. Methods for advancing boreholes for the SPT test include mud rotary drilling, hollow stem augers, and water drilling with steel casing.

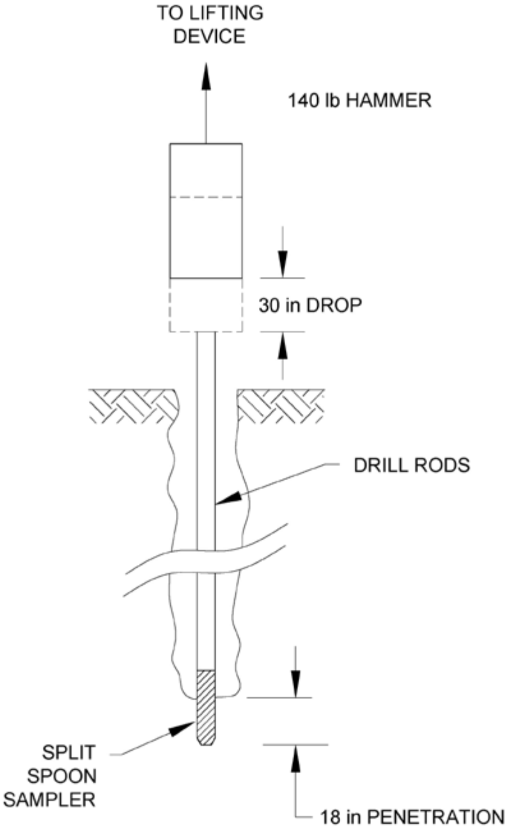


Figure 2. Typical SPT Setup.

SPT Energy Measurements

A number of factors can influence the SPT test and the subsequent N value. These include but are not limited to the following:

- Hammer
- Hammer Lifting System
- Operator Field Procedures
- Drill Rod Diameter and Length
- Borehole Drilling Method and Size
- Spilt Spoon Sampler

A graphical representation of various SPT system variables is provided in Figure 3.

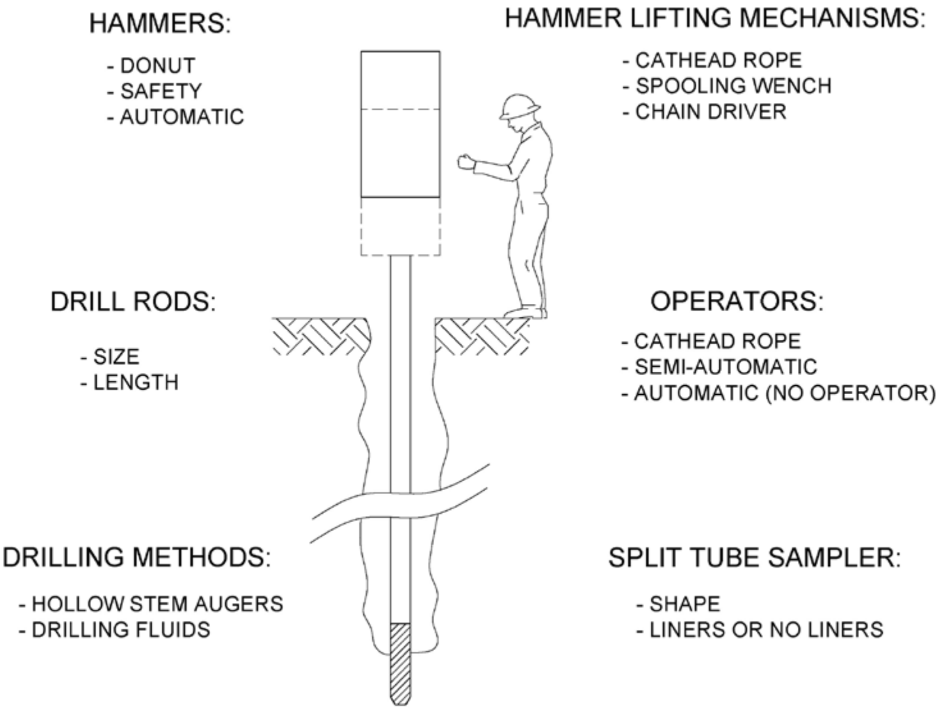


Figure 3. SPT Testing System Variables (after Lamb, 1997).

In order to account for these system variables, standardized SPT corrections have been developed. The corrected blow count is referred to as the N_{60} value. The N_{60} value is derived from the assumed efficiency of the original SPT (Mohr) hammer (Rogers, 2004). The following equation defines N_{60} values:

$$N_{60} = C_{60}C_bC_sC_rN$$

Where:
N_{60} = SPT N Value corrected for field procedures and apparatus
C_{60} = Hammer Efficiency Correction
C_b = Borehole Diameter Correction
C_s = Sample Barrel Correction
C_r = Rod Length Correction
N = Raw SPT value
In addition, the N value is influenced by the overburden pressure. Laio and Whitman (1986) proposed the following overburden correction for N_{60}, termed $(N_1)_{60}$:

$$(N_1)_{60} = N_{60}\frac{\sqrt{2000\,psf}}{\sigma'_v}$$

Where:
σ'_v = Effective vertical overburden stress

The hammer efficiency correction (C_{60}) is based on the Energy Transfer Efficiency (ER_i) and the 60% of the theoretical transferred hammer energy of 350 ft-lbs (i.e. 140 lbs multiplied by a 30 inch drop). The following equations show the derivation of C_{60}:

$$ER_i = \frac{E_i}{E_{th}}$$

Where:
ER_i = Energy Transfer Efficiency
E_i = Measured Transferred Energy
E_{th} = Theoretical Transferred Energy (i.e. 350 ft-lb)

and

$$C_{60} = \frac{ER_i}{60\%}$$

For liquefaction analysis using SPT N values, transferred energy measurements are required to determine $(N_1)_{60}$. The methods for determining the normalized penetration resistance for liquefaction potential are presented in ASTM D6066 *Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential.*

Transferred (i.e. delivered) energy measurements of SPT testing (i.e. the energy delivered by the hammer to the drill rods) are commonly taken in engineering practice through the use of several types of instruments. The most common of these is the Pile Driving Analyzer (PDA), developed and marketed by Pile Dynamics Inc. of Cleveland, Ohio. The PDA is a computer fitted with a data acquisition and a signal conditioning system and is typically used to conduct high strain dynamic load testing of driven piles, which is analogous to the SPT test. Strain gages and accelerometers which are connected to the PDA are attached to the pile or drill rods (for SPT testing). During pile driving or SPT testing, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The PDA saves selected hammer blows containing this information to disk and determines the compressive stresses, displacement, and energy at the point of measurement (pile top). The maximum transferred energy (EMX) is derived from the dynamic measurements using the following equation:

$$EMX = \int_{b}^{a} F(t)V(t)dt$$

Where:
a = Time Energy Transfer Begins
b = Time Energy Transfer End
F = Force
V = Velocity
t = Time

Refer to Abou-matar and Goble (1997) for additional details of SPT energy measurements using the PDA. Literature regarding the PDA is provided in the Appendix.

SPT Rig/Hammer System

The tested drill rig is designated CME-75 and is manufactured by Central Mine Equipment, Inc. The drill rig was parked on existing grade in a grassy area for this project. We understand that the drill rig was built on October 29, 1984 and is identified with Serial Number 164447. The CME-75 drill rig is fitted with an automatically operated hammer system. The drill rig and SPT hammer were operated by Mr. Chris Golden.

The method of drilling for the rig during testing was hollow stem auger (HSA), with Standard Penetration Testing being performed with AWJ drill rods. AWJ drill rod sections have nominal outside diameter of 1-5/8 inches and wall thickness of 3/16 inches. The instrumented sub-assembly (i.e. where gauges were attached) consisted of a two feet long section of AWJ rod that was threaded into the top drill rod at each testing interval.

Dynamic Load Test Instrumentation

The dynamic pile testing instrumentation consisted of a 2-feet long AWJ instrumented drill rod which is fitted with two strain gauges by Pile Dynamic Inc., in addition two (2) accelerometer transducers are attached a distance of approximately 1 foot below the top (i.e. in the center) of a two feet long instrumented AWJ drill rod. One strain gauge and one accelerometer are on opposite faces of the sub-assembly to minimize the effects of uneven hammer impact and rod bending.

A Model 8G Pile Driving Analyzer™ (PDA), manufactured by Pile Dynamics Inc., was used to collect the instrumentation data. The PDA is a computer fitted with a data acquisition and a signal conditioning system. During driving, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The sampling frequency used during the SPT Energy Measurement Testing was 20,000 hertz (20 kHz). The PDA saves selected hammer blows containing this information to disk and determines the energy at the point of measurement.

DYNAMIC TESTING RESULTS

Hammer Performance

The transferred energy monitored during the sampling is summarized in Table 1. Note that the values are those recorded during the second and third 6-inch sampling interval at each depth. Hammer Efficiency is based on measured transferred energy divided by the energy generated with a 140 pound hammer dropping 30 inches (0.35 kip-ft).

Table 1. CME-75 Rig SPT Energy Measurement Summary

SPT 1 Sample Depth (feet)	**SPT Blow Count (Per 6 inch)**	**Hammer Efficiency (%)**			
		Min	Max	**Average**	Standard Deviation
33.5 to 35.0	3-4-4	73.70	75.96	75.02	0.71
38.5 to 40.0	5-12-14	70.58	74.11	72.25	0.92
43.5 to 45.0	5-12-21	70.22	74.76	71.98	1.13
48.5 to 50.0	8-12-25	71.29	74.62	72.84	0.80
53.5 to 55.0	20-22-29	70.49	74.32	72.31	0.78
OVERALL[1]:		71.26	74.75	**72.88**	0.87

The following figure shows the SPT rig tested.

Figure 1: SPT drill rig.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the SPT hammer on the drill rig designated CME-75 is operating within a normal range for a semi-automatic SPT hammer.

UES appreciates the opportunity to provide this report. This report is for the sole use of this project and should not be relied upon otherwise. Should the project change significantly, we can review and modify our recommendations as needed. If you have questions concerning the contents herein, please contact us.

Sincerely,

UNIVERSAL ENGINEERING SCIENCES, INC.
Universal Florida Certificate of Authorization No. 549

Joshua C. Adams
Deep Foundation Engineer
HSDPT Certified – Master Level

Adam G Kirk

ADAM G. KIRK
No. 74552

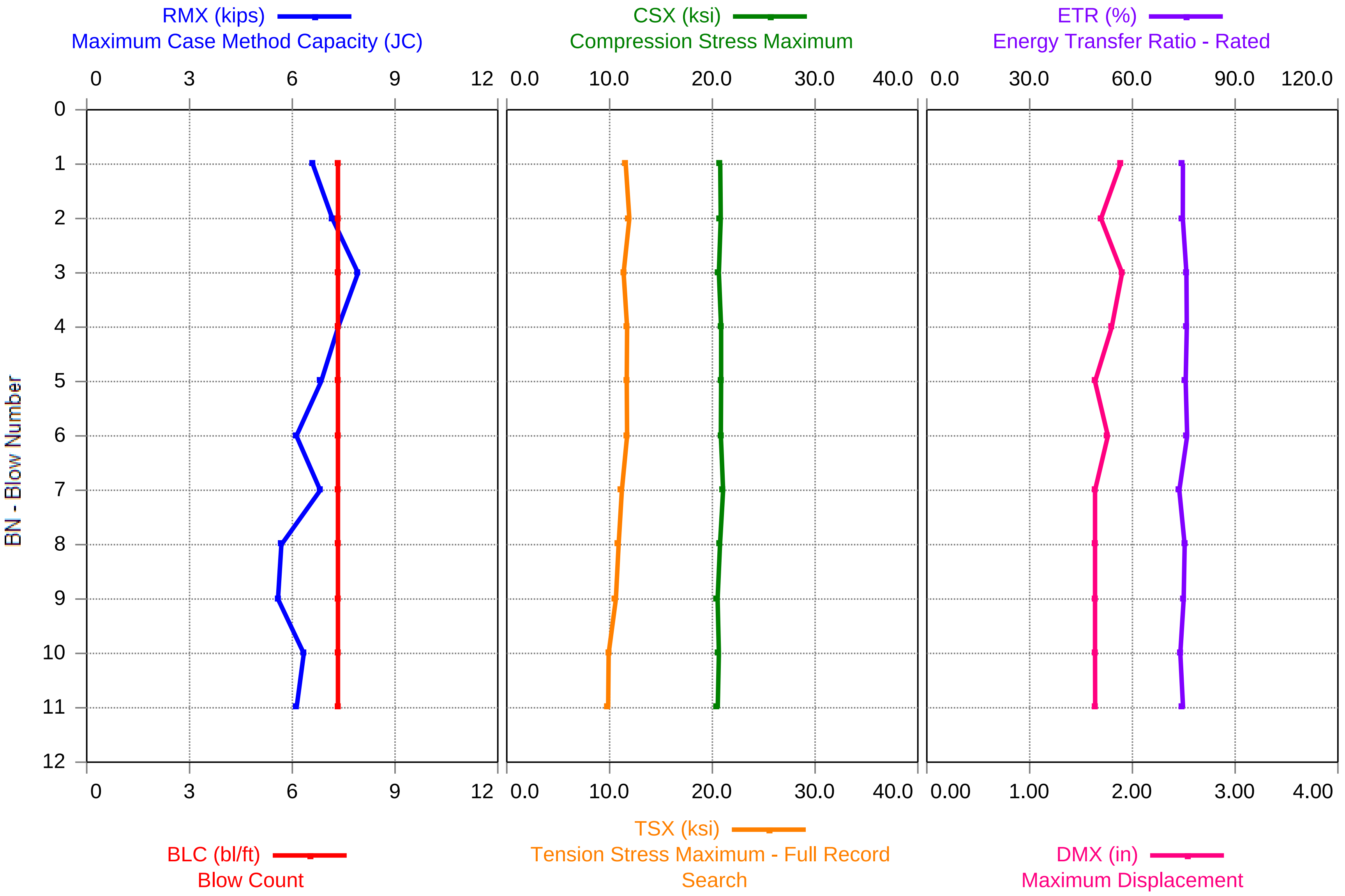
Adam G. Kirk, P.E.
Senior Engineer
Florida P.E. Number 74552
Date: 4-18-18

Attachments: PDA Data Output (PDIPLOT Graphs and Tables)

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019 Test started: 12-April-2019

Georgia SPT - SPT 2 Sample1



Case Method & iCAP® Results PDIPLOT2 2017.2.58.3 - Printed 18-April-2019

Georgia SPT - SPT 2 Sample1 Rod of area 1.18 square inches on CME 75

OP: NVT Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³

LE: 44.00 ft EM: 30,000 ksi

WS: 16,807.9 f/s JC: 0.60

RMX:	Maximum Case Method Capacity (JC)	CSB:	Compression Stress at Bottom of Pile
CSX:	Compression Stress Maximum	DMX:	Maximum Displacement
TSX:	Tension Stress Maximum - Full Record Search	SFR:	Skin Friction (Crude Damping Correction)
STK:	Hammer Stroke	ETR:	Energy Transfer Ratio - Rated
CSI:	Compression Stress Maximum - Individual Sensor		

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	33.64	7	6.6	20.8	11.6	0.00	20.8	15.0	1.88	3	74.72
2	33.77	7	7.2	20.8	11.9	0.00	21.0	14.5	1.69	4	74.72
3	33.91	7	7.9	20.6	11.4	0.00	21.1	15.1	1.90	4	75.75
4	34.05	7	7.3	20.8	11.7	0.00	21.1	14.6	1.80	4	75.86
5	34.18	7	6.8	20.9	11.7	0.00	21.1	14.6	1.64	3	75.54
6	34.32	7	6.1	20.8	11.7	0.00	21.1	15.0	1.76	2	75.96
7	34.45	7	6.8	21.0	11.2	0.00	21.3	15.3	1.64	3	73.70
8	34.59	7	5.7	20.7	10.9	0.00	21.0	14.7	1.64	2	75.25
9	34.73	7	5.6	20.5	10.6	0.00	20.8	14.6	1.64	2	74.95
10	34.86	7	6.3	20.6	9.9	0.00	20.9	14.4	1.64	3	73.99
11	35.00	7	6.1	20.5	9.9	0.00	20.8	14.6	1.64	3	74.78
		Average	6.6	20.7	11.1	**	21.0	14.8	1.71	3	75.02
		Std. Dev.	0.7	0.2	0.7	**	0.1	0.3	0.10	1	0.71
		Maximum	7.9	21.0	11.9	**	21.3	15.3	1.90	4	75.96
		Minimum	5.6	20.5	9.9	**	20.8	14.4	1.64	2	73.70

Total number of blows analyzed: 11

BL# Sensors

1-11 F1: [357AWJ1] 212.0 (1.02); F4: [357AWJ2] 211.2 (1.02); A2: [55385] 915.0 (0.98);
A3: [50148] 1065.0 (0.98)

BL# Comments

11 End of Set 1. n=10

Time Summary

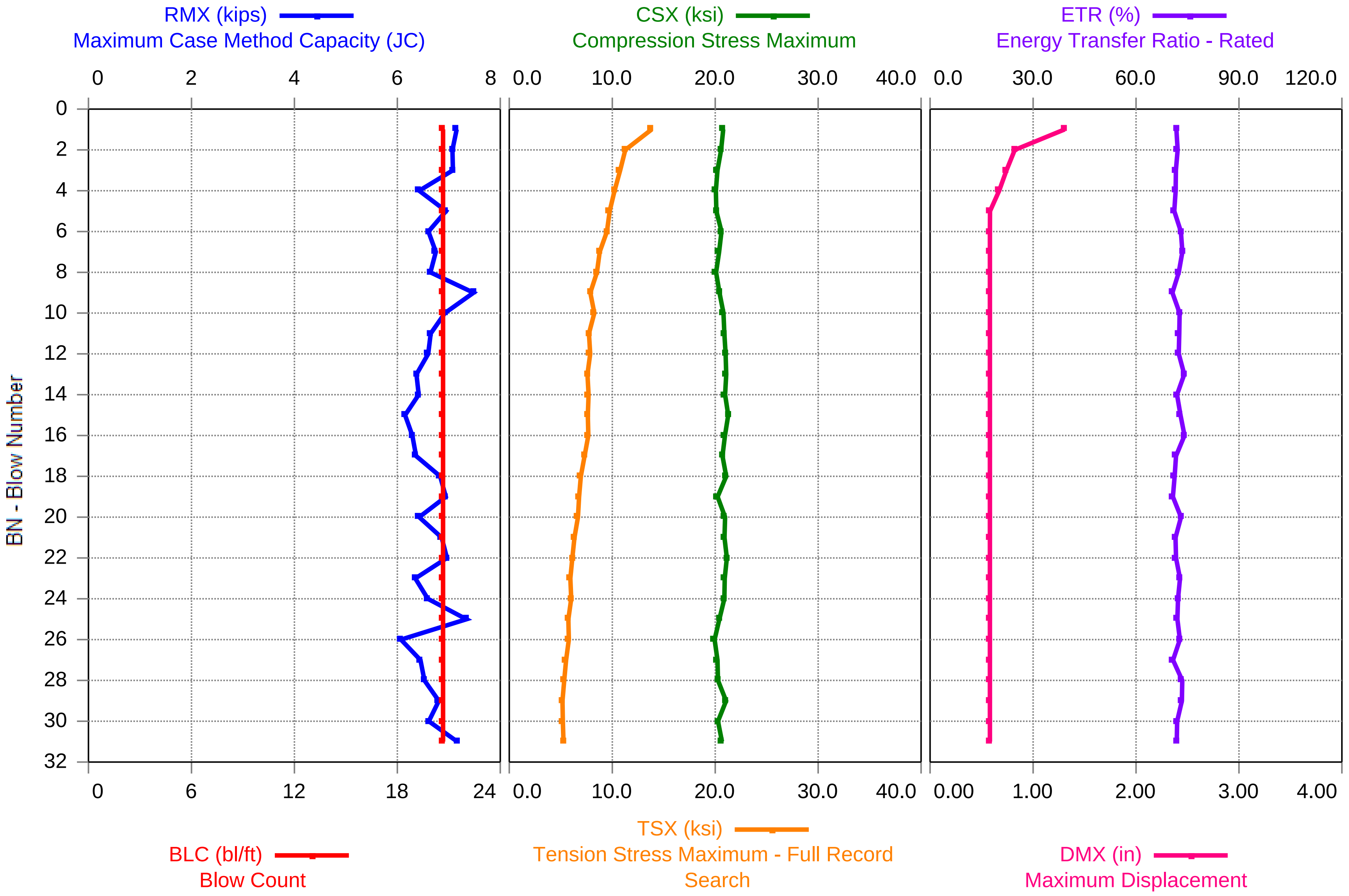
Drive 13 seconds 1:46 PM - 1:46 PM BN 1 - 11

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 2 Sample 2



Georgia SPT - SPT 2 Sample 2
Rod of area 1.18 square inches on CME 75
OP: NVT
Date: 12-April-2019

AR: 1.18 in^2
LE: 50.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth	BLC	RMX	CSX	TSX	STK	CSI	CSB	DMX	SFR	ETR
	ft	bl/ft	kips	ksi	ksi	ft	ksi	ksi	in	kips	(%)
1	38.55	21	7.2	20.8	13.8	0.00	20.9	15.4	1.31	3	71.76
2	38.60	21	7.1	20.6	11.3	0.00	20.6	14.9	0.82	3	72.14
3	38.65	21	7.1	20.2	10.8	0.00	20.5	14.7	0.74	3	71.63
4	38.69	21	6.4	20.1	10.2	0.00	20.3	14.2	0.67	3	71.53
5	38.74	21	6.9	20.1	9.8	0.00	20.3	14.5	0.58	3	71.16
6	38.79	21	6.6	20.6	9.5	0.00	20.9	14.4	0.58	3	73.06
7	38.84	21	6.7	20.4	8.8	0.00	20.4	14.7	0.58	3	73.52
8	38.89	21	6.6	20.1	8.5	0.00	20.1	13.9	0.58	3	72.45
9	38.94	21	7.5	20.4	7.9	0.00	20.4	14.3	0.58	3	70.58
10	38.98	21	6.9	20.8	8.3	0.00	21.0	14.9	0.58	3	72.72
11	39.03	21	6.6	20.9	7.7	0.00	21.0	14.7	0.58	3	72.58
12	39.08	21	6.6	21.0	7.9	0.00	21.2	14.8	0.58	3	72.44
13	39.13	21	6.4	21.1	7.6	0.00	21.1	14.7	0.58	3	74.07
14	39.18	21	6.4	21.0	7.7	0.00	21.2	14.4	0.58	3	71.92
15	39.23	21	6.1	21.3	7.6	0.00	21.3	14.8	0.58	3	72.94
16	39.27	21	6.3	20.9	7.7	0.00	21.2	15.0	0.58	2	74.11
17	39.32	21	6.4	20.7	7.3	0.00	20.8	14.4	0.58	3	71.63
18	39.37	21	6.8	21.1	6.9	0.00	21.1	15.2	0.58	3	71.24
19	39.42	21	6.9	20.2	6.8	0.00	20.4	14.9	0.58	3	70.74
20	39.47	21	6.4	21.0	6.7	0.00	21.0	15.1	0.58	3	73.12
21	39.52	21	6.9	20.9	6.3	0.00	21.0	15.2	0.58	3	71.50
22	39.56	21	7.0	21.1	6.1	0.00	21.3	15.1	0.58	3	71.65
23	39.61	21	6.3	20.9	5.9	0.00	21.0	15.0	0.58	3	72.81
24	39.66	21	6.6	20.9	6.0	0.00	21.0	15.0	0.58	3	72.22
25	39.71	21	7.3	20.4	5.7	0.00	20.7	14.9	0.58	3	72.04
26	39.76	21	6.1	19.9	5.8	0.00	20.0	14.2	0.58	2	72.76
27	39.81	21	6.4	20.2	5.5	0.00	20.5	14.8	0.58	3	70.77
28	39.85	21	6.5	20.3	5.3	0.00	20.5	14.7	0.58	3	73.48
29	39.90	21	6.8	21.1	5.2	0.00	21.3	15.2	0.58	3	73.35
30	39.95	21	6.6	20.3	5.2	0.00	20.6	14.3	0.58	3	71.99
31	40.00	21	7.2	20.7	5.3	0.00	20.9	15.1	0.58	3	71.85
		Average	6.7	20.6	7.6	**	20.8	14.8	0.62	3	72.25
		Std. Dev.	0.3	0.4	2.0	**	0.4	0.4	0.14	0	0.92
		Maximum	7.5	21.3	13.8	**	21.3	15.4	1.31	3	74.11
		Minimum	6.1	19.9	5.2	**	20.0	13.9	0.58	2	70.58

Total number of blows analyzed: 31

BL#	Sensors
1-31	F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

Georgia SPT - SPT 2 Sample 2 Rod of area 1.18 square inches on CME 75
OP: NVT Date: 12-April-2019

BL#	Comments
31	end of set 2. N=28

Time Summary

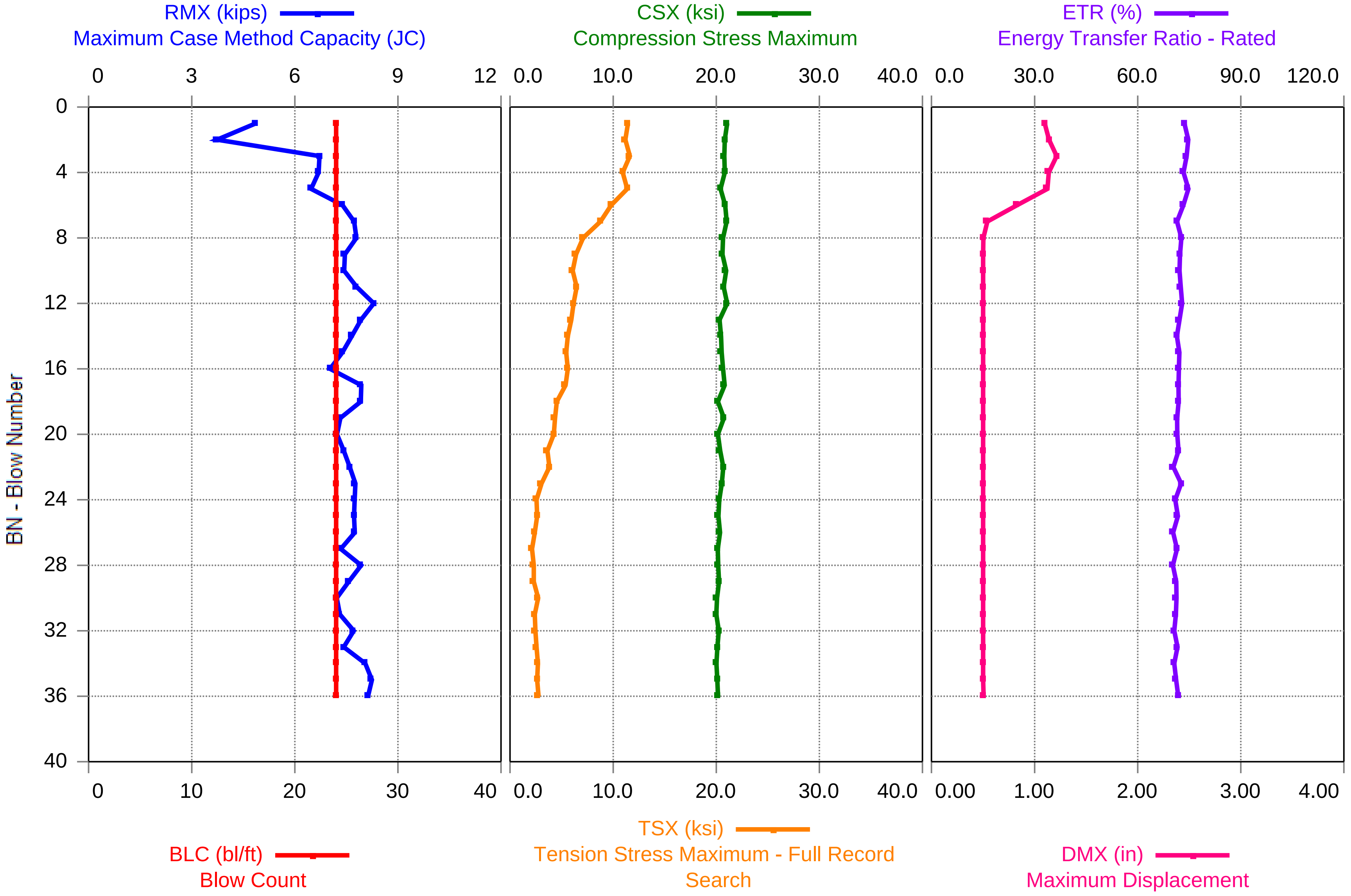
Drive 41 seconds 1:56 PM - 1:56 PM BN 1 - 31

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 2 Sample 3



Georgia SPT - SPT 2 Sample 3
Rod of area 1.18 square inches on CME 75
OP: NVT
Date: 12-April-2019

AR: 1.18 in²
LE: 55.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	43.54	24	4.9	21.1	11.4	0.00	21.6	13.3	1.10	3	73.56
2	43.58	24	3.7	20.8	11.2	0.00	21.3	12.7	1.14	2	74.69
3	43.63	24	6.7	20.8	11.6	0.00	21.2	14.4	1.21	3	74.22
4	43.67	24	6.7	20.8	10.9	0.00	21.4	13.9	1.14	4	73.33
5	43.71	24	6.5	20.4	11.4	0.00	20.9	13.8	1.12	3	74.76
6	43.75	24	7.4	20.9	9.8	0.00	21.5	14.5	0.83	4	73.27
7	43.79	24	7.7	21.0	8.8	0.00	21.6	14.4	0.54	4	71.45
8	43.83	24	7.8	20.7	7.1	0.00	21.3	14.5	0.50	4	72.71
9	43.88	24	7.5	20.6	6.4	0.00	21.2	14.7	0.50	3	72.31
10	43.92	24	7.4	21.0	6.1	0.00	21.6	14.8	0.50	3	72.14
11	43.96	24	7.8	20.7	6.5	0.00	21.4	14.8	0.50	4	72.51
12	44.00	24	8.3	21.1	6.2	0.00	21.9	15.1	0.50	4	72.92
13	44.04	24	7.9	20.3	5.9	0.00	20.8	14.8	0.50	4	72.14
14	44.08	24	7.7	20.5	5.6	0.00	21.2	14.6	0.50	4	71.40
15	44.13	24	7.4	20.5	5.4	0.00	21.3	14.9	0.50	3	72.12
16	44.17	24	7.0	20.7	5.6	0.00	21.4	14.6	0.50	3	71.96
17	44.21	24	7.9	20.8	5.4	0.00	21.5	15.1	0.50	4	71.86
18	44.25	24	7.9	20.2	4.5	0.00	20.7	14.4	0.50	4	71.91
19	44.29	24	7.3	20.7	4.4	0.00	21.5	14.2	0.50	4	71.45
20	44.33	24	7.2	20.2	4.2	0.00	20.7	14.2	0.50	3	71.52
21	44.38	24	7.4	20.4	3.6	0.00	21.1	14.4	0.50	4	71.86
22	44.42	24	7.6	20.7	3.8	0.00	21.3	14.4	0.50	4	70.36
23	44.46	24	7.8	20.5	3.0	0.00	21.4	14.7	0.50	4	72.62
24	44.50	24	7.7	20.3	2.6	0.00	20.9	14.1	0.50	4	70.92
25	44.54	24	7.7	20.2	2.6	0.00	20.8	13.9	0.50	4	71.70
26	44.58	24	7.7	20.4	2.4	0.00	21.1	14.3	0.50	4	70.31
27	44.63	24	7.3	20.1	2.1	0.00	20.8	14.0	0.50	4	71.44
28	44.67	24	7.9	20.2	2.3	0.00	20.7	14.0	0.50	4	70.22
29	44.71	24	7.6	20.3	2.3	0.00	20.9	14.2	0.50	4	71.23
30	44.75	24	7.2	20.1	2.7	0.00	20.7	14.1	0.50	4	71.27
31	44.79	24	7.3	20.0	2.4	0.00	20.6	13.8	0.50	4	71.10
32	44.83	24	7.7	20.2	2.5	0.00	20.8	14.3	0.50	4	70.64
33	44.88	24	7.4	20.1	2.6	0.00	20.7	13.8	0.50	4	71.58
34	44.92	24	8.0	20.0	2.7	0.00	20.5	14.0	0.50	4	70.62
35	44.96	24	8.2	20.1	2.6	0.00	20.7	14.2	0.50	4	71.18
36	45.00	24	8.1	20.2	2.8	0.00	20.6	14.3	0.51	4	71.80
		Average	7.4	20.5	5.3	**	21.1	14.3	0.60	4	71.98
		Std. Dev.	0.9	0.3	3.1	**	0.4	0.5	0.23	0	1.13
		Maximum	8.3	21.1	11.6	**	21.9	15.1	1.21	4	74.76
		Minimum	3.7	20.0	2.1	**	20.5	12.7	0.50	2	70.22

Total number of blows analyzed: 36

Georgia SPT - SPT 2 Sample 3
OP: NVT
Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL#	Sensors
1-36	F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

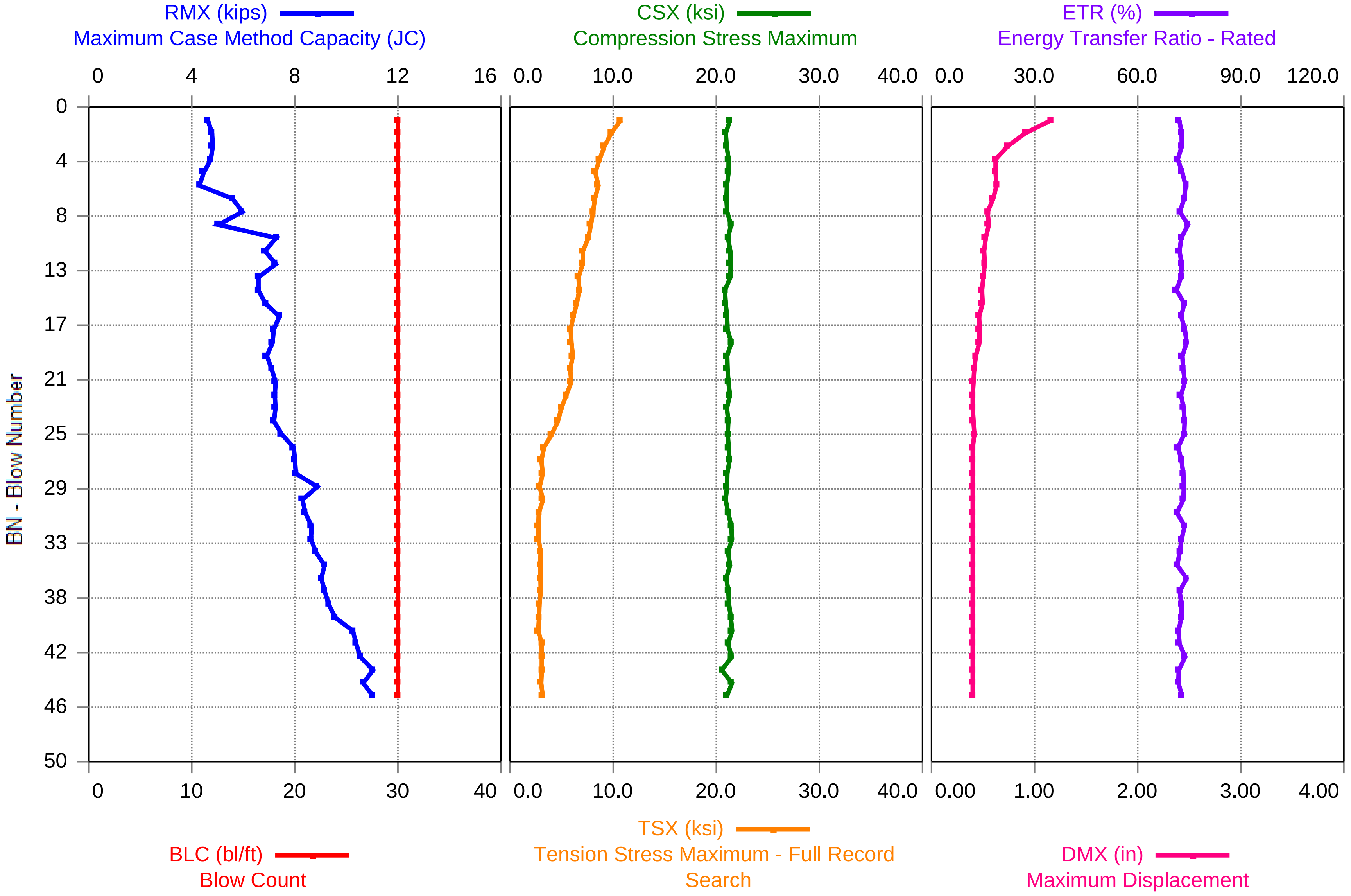
BL#	Comments
36	End of Set 3. n=33

Time Summary

Drive 49 seconds 2:14 PM - 2:14 PM BN 1 - 36

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results
Printed: 18-April-2019
Test started: 12-April-2019

Georgia SPT - SPT 2 Sample 4



Georgia SPT - SPT 2 Sample 4
Rod of area 1.18 square inches on CME 75
OP: NVT
Date: 12-April-2019

AR: 1.18 in^2
LE: 55.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	48.53	30	4.6	21.3	10.7	0.00	21.5	15.0	1.17	1	72.09
2	48.57	30	4.8	20.9	9.8	0.00	21.1	13.1	0.91	2	72.78
3	48.60	30	4.8	21.0	9.2	0.00	21.0	13.8	0.74	2	72.83
4	48.63	30	4.7	21.2	8.7	0.00	21.2	14.1	0.62	2	71.63
5	48.67	30	4.5	21.2	8.3	0.00	21.2	14.6	0.62	1	72.96
6	48.70	30	4.3	21.0	8.6	0.00	21.1	14.3	0.63	2	73.93
7	48.73	30	5.6	21.0	8.2	0.00	21.0	15.0	0.60	2	73.49
8	48.77	30	6.0	21.1	8.0	0.00	21.1	15.2	0.54	2	72.26
9	48.80	30	5.0	21.4	7.8	0.00	21.5	14.4	0.56	2	74.62
10	48.83	30	7.3	21.1	7.6	0.00	21.2	15.6	0.53	3	72.65
11	48.87	30	6.8	21.4	7.1	0.00	21.4	15.6	0.51	3	72.17
12	48.90	30	7.3	21.4	7.0	0.00	21.5	15.8	0.52	3	72.82
13	48.93	30	6.6	21.4	6.6	0.00	21.5	15.5	0.50	2	72.61
14	48.97	30	6.6	20.8	6.7	0.00	20.9	15.4	0.49	2	71.29
15	49.00	30	6.9	20.9	6.5	0.00	21.0	15.8	0.50	2	73.55
16	49.03	30	7.4	21.0	6.1	0.00	21.1	15.7	0.46	3	72.67
17	49.07	30	7.2	21.1	5.9	0.00	21.2	15.9	0.47	3	73.71
18	49.10	30	7.1	21.5	6.0	0.00	21.7	15.8	0.46	3	74.24
19	49.13	30	6.9	21.1	6.1	0.00	21.1	15.3	0.43	2	73.00
20	49.17	30	7.1	21.1	5.8	0.00	21.1	15.9	0.41	2	73.21
21	49.20	30	7.3	21.2	5.9	0.00	21.3	16.0	0.41	2	73.71
22	49.23	30	7.2	21.3	5.5	0.00	21.5	15.9	0.40	2	72.58
23	49.27	30	7.2	21.0	5.0	0.00	21.1	15.9	0.40	2	73.35
24	49.30	30	7.2	21.2	4.6	0.00	21.2	16.1	0.41	2	73.66
25	49.33	30	7.5	21.1	4.0	0.00	21.1	15.8	0.42	3	73.49
26	49.37	30	8.0	21.2	3.3	0.00	21.4	14.8	0.40	3	71.73
27	49.40	30	8.0	21.3	3.0	0.00	21.4	15.8	0.40	3	72.73
28	49.43	30	8.0	21.1	3.2	0.00	21.1	15.8	0.40	3	73.24
29	49.47	30	8.9	21.0	2.9	0.00	21.1	16.0	0.40	3	73.44
30	49.50	30	8.3	20.9	3.2	0.00	21.0	15.8	0.40	3	73.26
31	49.53	30	8.4	21.2	2.8	0.00	21.2	15.5	0.40	3	71.45
32	49.57	30	8.7	21.5	2.8	0.00	21.7	15.7	0.40	3	73.66
33	49.60	30	8.6	21.5	2.8	0.00	21.8	16.2	0.40	3	72.79
34	49.63	30	8.8	21.1	3.0	0.00	21.3	15.8	0.40	3	72.19
35	49.67	30	9.2	21.3	2.9	0.00	21.6	15.2	0.40	4	71.50
36	49.70	30	9.0	21.0	3.0	0.00	21.2	15.9	0.40	3	74.18
37	49.73	30	9.2	21.2	3.0	0.00	21.2	15.7	0.40	3	72.21
38	49.77	30	9.3	21.2	2.9	0.00	21.4	15.9	0.40	4	72.74
39	49.80	30	9.6	21.4	2.8	0.00	21.6	15.9	0.40	4	72.69
40	49.83	30	10.3	21.5	2.7	0.00	21.8	15.9	0.40	4	71.86
41	49.87	30	10.4	21.1	3.1	0.00	21.3	16.2	0.40	4	72.14
42	49.90	30	10.5	21.5	3.1	0.00	21.7	15.8	0.40	4	73.82
43	49.93	30	11.0	20.5	3.1	0.00	20.6	15.9	0.40	4	71.92
44	49.97	30	10.7	21.5	3.0	0.00	21.6	16.4	0.40	4	71.82
45	50.00	30	11.0	21.0	3.2	0.00	21.1	15.8	0.40	4	72.92

Georgia SPT - SPT 2 Sample 4
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
		Average	7.6	21.2	5.2	**	21.3	15.5	0.48	3	72.84
		Std. Dev.	1.8	0.2	2.3	**	0.3	0.7	0.15	1	0.80
		Maximum	11.0	21.5	10.7	**	21.8	16.4	1.17	4	74.62
		Minimum	4.3	20.5	2.7	**	20.6	13.1	0.40	1	71.29

Total number of blows analyzed: 45

BL# Sensors

1-45 F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

BL# Comments

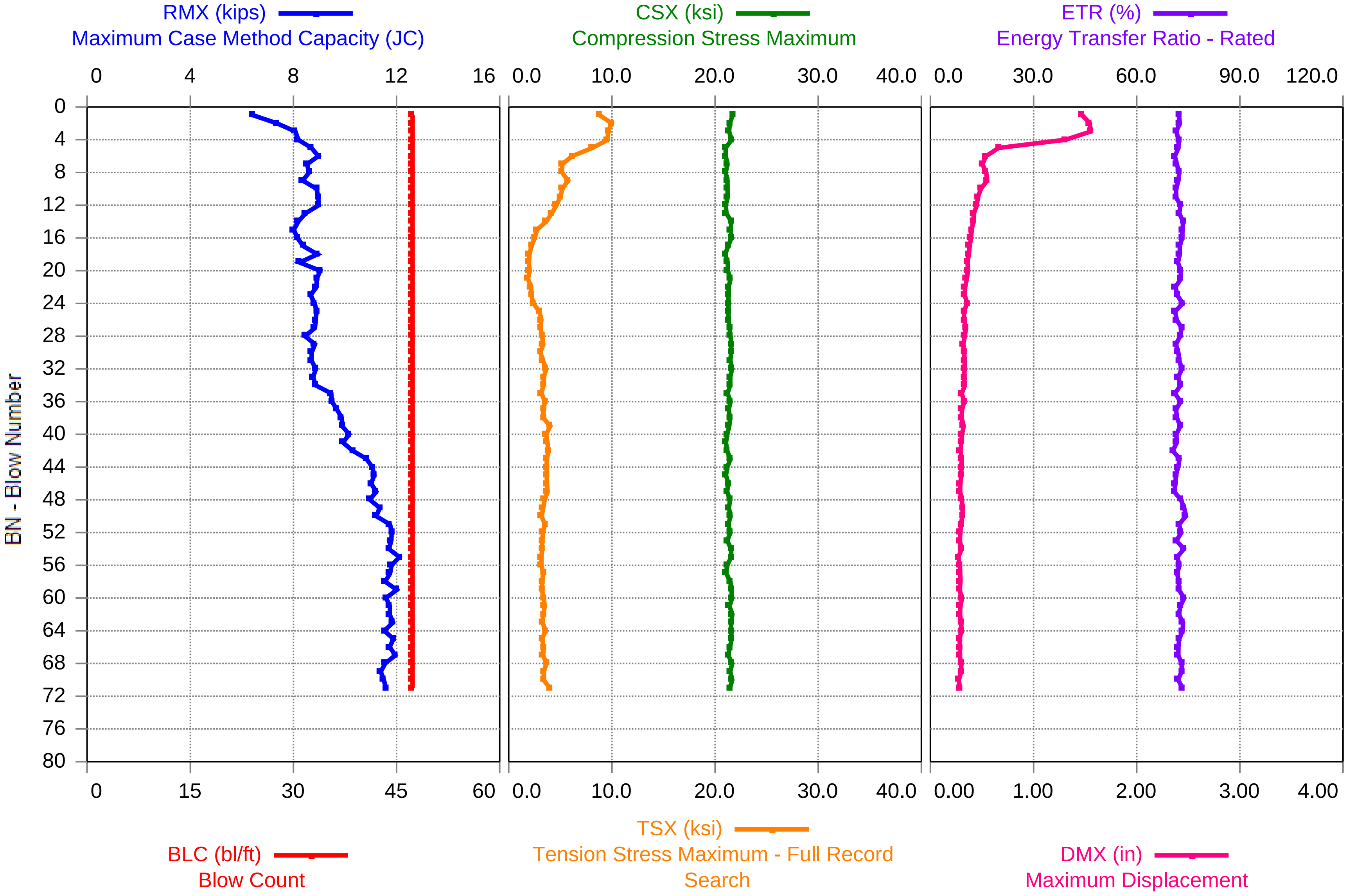
45 end of set 4. n=39

Time Summary

Drive 1 minute 2 seconds 2:27 PM - 2:28 PM BN 1 - 45

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results
Printed: 18-April-2019
Test started: 12-April-2019

Georgia SPT - SPT 2 Sample 5



Georgia SPT - SPT 2 Sample 5
Rod of area 1.18 square inches on CME 75
OP: NVT
Date: 12-April-2019

AR: 1.18 in^2
LE: 60.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	53.52	47	6.4	21.7	8.8	0.00	21.8	17.7	1.47	1	72.27
2	53.54	47	7.4	21.4	10.0	0.00	21.5	15.4	1.55	3	72.51
3	53.56	47	8.1	21.4	9.6	0.00	21.4	15.5	1.55	4	71.52
4	53.58	47	8.2	21.6	9.6	0.00	21.6	16.4	1.31	3	72.20
5	53.61	47	8.7	21.0	8.1	0.00	21.2	15.8	0.66	4	72.13
6	53.63	47	9.0	21.0	6.1	0.00	21.2	16.1	0.54	3	71.12
7	53.65	47	8.5	21.2	5.2	0.00	21.3	16.4	0.50	3	71.64
8	53.67	47	8.6	21.0	5.2	0.00	21.2	16.6	0.54	3	72.37
9	53.69	47	8.4	21.2	5.7	0.00	21.4	16.1	0.55	3	72.11
10	53.71	47	8.9	21.2	5.2	0.00	21.3	16.7	0.49	3	71.46
11	53.73	47	9.0	21.2	5.0	0.00	21.5	16.8	0.46	3	71.39
12	53.75	47	9.0	21.0	4.6	0.00	21.2	16.7	0.45	3	72.71
13	53.77	47	8.5	21.1	4.2	0.00	21.2	16.0	0.42	3	72.38
14	53.80	47	8.2	21.6	3.6	0.00	21.6	16.8	0.42	3	73.49
15	53.82	47	8.0	21.5	2.7	0.00	21.6	16.6	0.40	3	73.30
16	53.84	47	8.2	21.6	2.5	0.00	21.6	16.6	0.39	3	73.22
17	53.86	47	8.4	21.3	2.2	0.00	21.3	16.0	0.38	3	72.54
18	53.88	47	8.9	21.0	2.0	0.00	21.1	16.8	0.37	3	72.52
19	53.90	47	8.2	21.2	2.0	0.00	21.3	16.6	0.36	3	71.99
20	53.92	47	9.0	21.2	2.0	0.00	21.5	16.7	0.36	3	72.82
21	53.94	47	8.9	21.5	1.9	0.00	21.7	16.7	0.35	3	72.80
22	53.96	47	8.9	21.3	2.2	0.00	21.6	16.5	0.34	3	71.30
23	53.99	47	8.7	21.3	2.2	0.00	21.4	16.5	0.33	3	71.79
24	54.01	47	8.8	21.3	2.4	0.00	21.4	16.4	0.36	3	73.37
25	54.03	47	8.9	21.3	3.0	0.00	21.4	16.8	0.32	3	71.17
26	54.05	47	8.9	21.3	3.2	0.00	21.5	16.6	0.33	3	71.61
27	54.07	47	8.8	21.4	3.1	0.00	21.4	17.5	0.35	2	73.06
28	54.09	47	8.5	21.5	3.2	0.00	21.5	16.7	0.33	3	72.63
29	54.11	47	8.8	21.6	3.3	0.00	21.7	16.8	0.32	3	71.40
30	54.13	47	8.7	21.6	3.1	0.00	21.8	16.6	0.33	3	72.10
31	54.15	47	8.7	21.5	3.3	0.00	21.7	16.9	0.33	3	72.38
32	54.18	47	8.9	21.7	3.6	0.00	21.8	17.1	0.33	3	73.15
33	54.20	47	8.8	21.5	3.4	0.00	21.6	17.1	0.33	3	72.04
34	54.22	47	8.9	21.5	3.3	0.00	21.6	16.8	0.33	3	72.75
35	54.24	47	9.5	21.2	3.2	0.00	21.5	16.8	0.30	3	71.13
36	54.26	47	9.5	21.5	3.5	0.00	21.6	17.0	0.33	3	72.73
37	54.28	47	9.7	21.3	3.4	0.00	21.5	16.8	0.31	3	71.44
38	54.30	47	9.9	21.5	3.4	0.00	21.7	16.4	0.30	4	71.71
39	54.32	47	9.9	21.4	4.0	0.00	21.4	17.0	0.32	3	72.68
40	54.35	47	10.2	21.2	3.6	0.00	21.3	16.6	0.31	4	71.51
41	54.37	47	9.9	21.1	3.7	0.00	21.2	16.6	0.30	4	71.63
42	54.39	47	10.3	21.2	3.8	0.00	21.3	16.5	0.29	4	70.49
43	54.41	47	10.8	21.5	3.7	0.00	21.7	16.6	0.30	4	72.44
44	54.43	47	11.1	21.2	3.7	0.00	21.2	16.5	0.30	4	72.04
45	54.45	47	11.1	21.1	3.7	0.00	21.2	16.6	0.30	4	71.36

Georgia SPT - SPT 2 Sample 5 Rod of area 1.18 square inches on CME 75
OP: NVT Date: 12-April-2019

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
46	54.47	47	11.0	21.3	3.7	0.00	21.5	16.5	0.29	4	71.27
47	54.49	47	11.2	21.2	3.8	0.00	21.3	16.3	0.29	4	70.87
48	54.51	47	11.0	21.5	3.5	0.00	21.6	16.6	0.30	4	72.83
49	54.54	47	11.4	21.3	3.3	0.00	21.4	16.7	0.31	4	73.80
50	54.56	47	11.2	21.5	3.2	0.00	21.7	16.9	0.31	4	74.32
51	54.58	47	11.7	21.3	3.5	0.00	21.3	16.3	0.30	4	72.31
52	54.60	47	11.8	21.5	3.3	0.00	21.7	16.5	0.29	5	72.94
53	54.62	47	11.8	21.2	3.2	0.00	21.3	16.7	0.28	4	71.57
54	54.64	47	11.7	21.6	3.2	0.00	21.6	16.3	0.30	5	73.68
55	54.66	47	12.1	21.6	3.2	0.00	21.6	16.2	0.27	5	71.81
56	54.68	47	11.8	21.2	3.2	0.00	21.3	16.5	0.29	5	72.43
57	54.70	47	11.7	21.1	3.4	0.00	21.2	16.6	0.29	4	71.75
58	54.73	47	11.6	21.5	3.2	0.00	21.7	16.3	0.29	5	72.23
59	54.75	47	12.0	21.6	3.2	0.00	21.7	16.1	0.28	5	72.28
60	54.77	47	11.6	21.6	3.4	0.00	21.7	16.4	0.31	5	73.76
61	54.79	47	11.7	21.4	3.5	0.00	21.5	15.7	0.29	5	72.69
62	54.81	47	11.7	21.7	3.4	0.00	21.7	16.8	0.29	4	72.24
63	54.83	47	11.9	21.5	3.3	0.00	21.6	15.9	0.30	5	73.48
64	54.85	47	11.5	21.6	3.6	0.00	21.6	15.8	0.30	5	73.37
65	54.87	47	11.9	21.6	3.2	0.00	21.7	16.5	0.28	5	72.35
66	54.89	47	11.7	21.4	3.4	0.00	21.5	16.4	0.29	5	72.12
67	54.92	47	12.0	21.3	3.3	0.00	21.3	16.5	0.28	5	72.10
68	54.94	47	11.6	21.7	3.6	0.00	21.8	16.7	0.30	5	73.06
69	54.96	47	11.4	21.5	3.4	0.00	21.5	16.6	0.30	5	73.07
70	54.98	47	11.5	21.7	3.4	0.00	21.8	16.4	0.28	5	72.03
71	55.00	47	11.6	21.4	4.0	0.00	21.5	16.1	0.28	5	73.35
		Average	9.9	21.4	3.9	**	21.5	16.5	0.41	4	72.31
		Std. Dev.	1.5	0.2	1.7	**	0.2	0.4	0.27	1	0.78
		Maximum	12.1	21.7	10.0	**	21.8	17.7	1.55	5	74.32
		Minimum	6.4	21.0	1.9	**	21.1	15.4	0.27	1	70.49

Total number of blows analyzed: 71

BL#	Sensors
1-71	F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

BL#	Comments
71	end of set 5. n=51

Time Summary

Drive 1 minute 41 seconds 2:42 PM - 2:43 PM BN 1 - 71

Betts- CME 55 (SN 54005)

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Betts Environmental
361 Airport Square
Adel, Georgia 31620

April 18, 2019

Subject: **Dynamic Testing Report**
SPT Hammer Energy Measurement- CME-55 (S/N 54005)
156 N Johnson Street
Newborn, Georgia 30056
UES Project 0950.1900024.0000

UES has completed the high strain dynamic (i.e. PDA) testing for the Soil Test Boring drill rig designated CME-55 in use at the above referenced project. Dynamic monitoring was conducted during performance of a soil test boring in order to determine energy transferred by the Standard Penetration Test hammer to the drill rods during split spoon sampling. The dynamic testing was conducted using the Pile Driving Analyzer^{TM} (PDA) Model 8G, which records, digitizes, and processes the force and acceleration signals. The dynamic testing was carried out in accordance with ASTM D4945 *Standard Test Method for High Strain Dynamic Testing of Piles and* ASTM D4633 *Standard Test Method for Energy Measurement for Dynamic Penetrometers.*

PROJECT DESCRIPTION

Overview

The SPT hammer calibration testing was performed on site at the property located at 156 N Johnson Street in Newborn, Georgia. The SPT hammer calibration testing was performed at seven (7) depths during sampling of an SPT Test Boring on April 12, 2019. The SPT hammer calibration testing was performed the following sampling depths; 6.5 to 8.0 feet (Sample 1), 12.0 to 13.5 feet (Sample 2), 18.5 to 20.0 feet (Sample 3), 23.5 to 25.0 feet (Sample 4), 33.5 to 35.0 feet (Sample 5), 38.5 to 40.0 feet (Sample 6), and 43.5 to 45.0 feet (Sample 7).

SPT Testing Overview

Numerous technical publications exist regarding the Standard Penetration Test (SPT). Of these publications, ASTM D1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* is considered to be the industry standard. This standard was last approved in January, 1999. In addition, U.S. Army Corp of Engineers Engineering Technical Letter (ETL) 1110-1-138 (dated March, 1988) is also a commonly used standard reference.

The Standard Penetration Test (SPT) consists of a drive weight assembly (i.e. hammer and anvil), split spoon sampler, and drill rods. The drive weight system consists of a 140 lb hammer raised by a number of mechanical means. The split spoon sampler is placed at the end of the drill rods in a borehole. The 140 lb hammer is raised 30 inches and then dropped to impact the drill rods. This procedure is repeated until the sampler has penetrated 18 inches into the underlying soil. The number of blows required to advance the split spoon sampler 12 inches is recorded as the “N” value for the test. Typically, the test is performed every 2 ½ ft for the upper 10 ft of a boring and then at 5 ft intervals thereafter. The standard dimensions of the split spoon sampler are shown in Figure 1, while a typical SPT setup is presented in Figure 2.

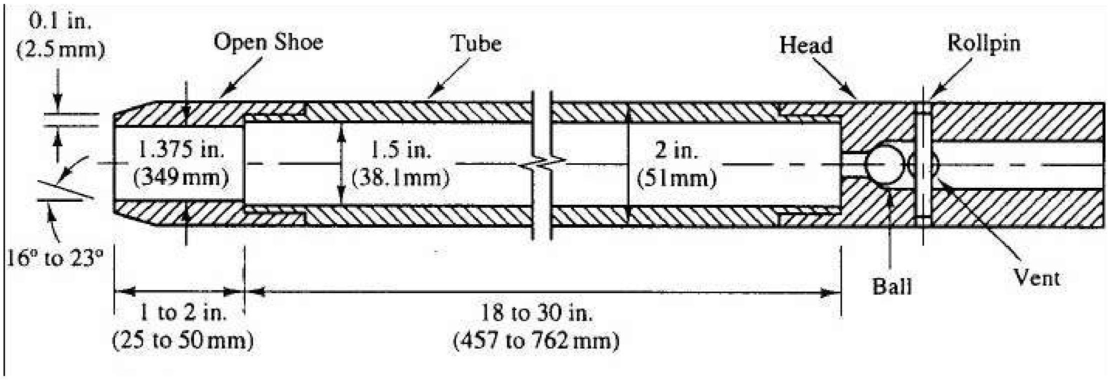


Figure 1. Split Spoon Sampler (after Rogers, 2004, adapted from ASTM D1586).

There are three (3) types of SPT hammers currently used in drilling practice today: the donut hammer, the automatic hammer, and the safety hammer. In addition, there are three (3) main types of hammer lifting mechanisms: cathead-rope system, spooling wench, or chain driven systems. Drill rods vary from AW (1 ¾ in O.D.) to NW (2 5/8 in O.D.), with drill rod lengths varying between 2 ft to 10 ft increments. Methods for advancing boreholes for the SPT test include mud rotary drilling, hollow stem augers, and water drilling with steel casing.

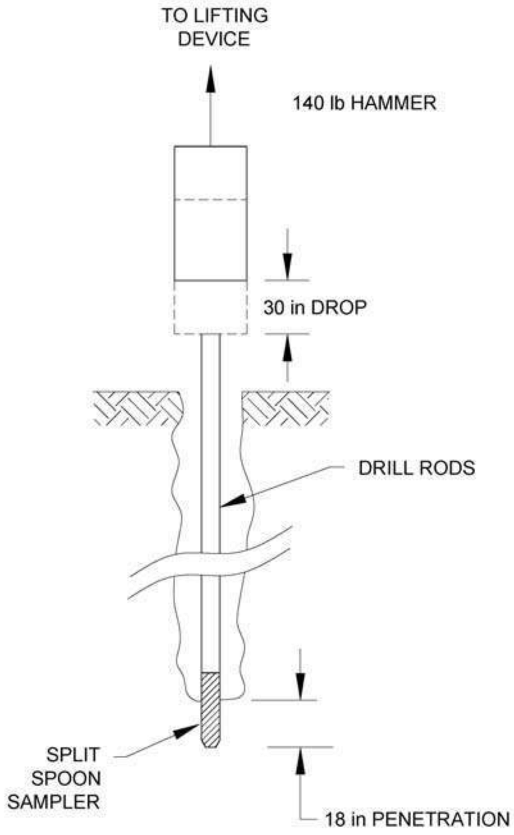


Figure 2. Typical SPT Setup.

SPT Energy Measurements

A number of factors can influence the SPT test and the subsequent N value. These include but are not limited to the following:

- Hammer
- Hammer Lifting System
- Operator Field Procedures
- Drill Rod Diameter and Length
- Borehole Drilling Method and Size
- Spilt Spoon Sampler

A graphical representation of various SPT system variables is provided in Figure 3.

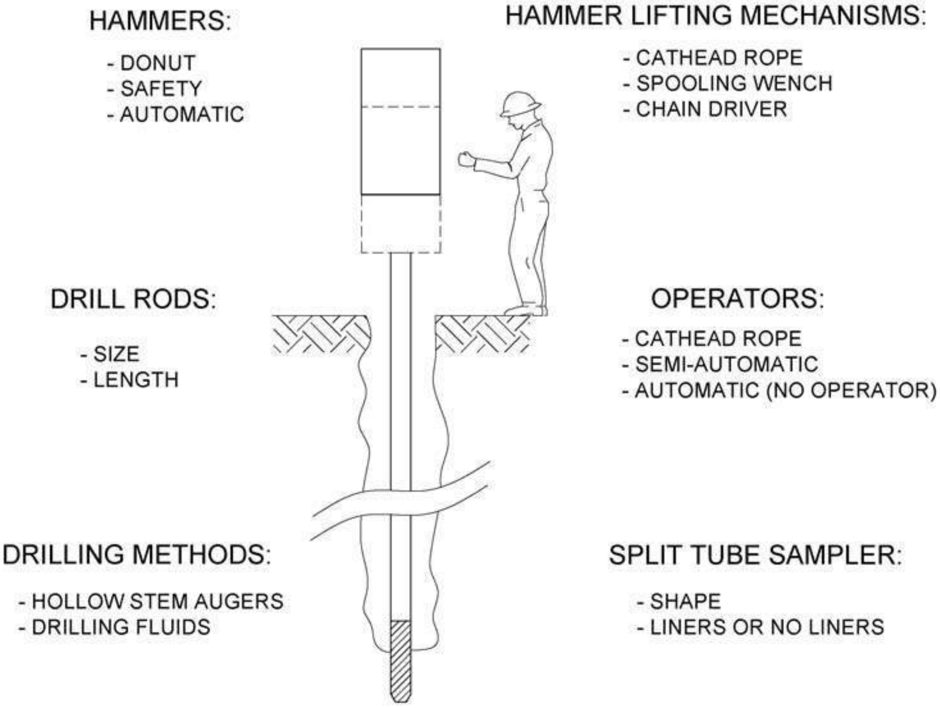


Figure 3. SPT Testing System Variables (after Lamb, 1997).

In order to account for these system variables, standardized SPT corrections have been developed. The corrected blow count is referred to as the N_{60} value. The N_{60} value is derived from the assumed efficiency of the original SPT (Mohr) hammer (Rogers, 2004). The following equation defines N_{60} values:

$$N_{60} = C_{60}C_bC_sC_rN$$

Where:
N_{60} = SPT N Value corrected for field procedures and apparatus
C_{60} = Hammer Efficiency Correction
C_b = Borehole Diameter Correction
C_s = Sample Barrel Correction
C_r = Rod Length Correction
N = Raw SPT value

In addition, the N value is influenced by the overburden pressure. Laio and Whitman (1986) proposed the following overburden correction for N_{60}, termed $(N_1)_{60}$:

$$(N_1)_{60} = N_{60}\frac{\sqrt{2000\,psf}}{\sigma'_v}$$

Where:
σ'_v = Effective vertical overburden stress

The hammer efficiency correction (C_{60}) is based on the Energy Transfer Efficiency (ER_i) and the 60% of the theoretical transferred hammer energy of 350 ft-lbs (i.e. 140 lbs multiplied by a 30 inch drop). The following equations show the derivation of C_{60}:

$$ER_i = \frac{E_i}{E_{th}}$$

Where:
ER_i = Energy Transfer Efficiency
E_i = Measured Transferred Energy
E_{th} = Theoretical Transferred Energy (i.e. 350 ft-lb)

and

$$C_{60} = \frac{ER_i}{60\%}$$

For liquefaction analysis using SPT N values, transferred energy measurements are required to determine $(N_1)_{60}$. The methods for determining the normalized penetration resistance for liquefaction potential are presented in ASTM D6066 *Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential.*

Transferred (i.e. delivered) energy measurements of SPT testing (i.e. the energy delivered by the hammer to the drill rods) are commonly taken in engineering practice through the use of several types of instruments. The most common of these is the Pile Driving Analyzer (PDA), developed and marketed by Pile Dynamics Inc. of Cleveland, Ohio. The PDA is a computer fitted with a data acquisition and a signal conditioning system and is typically used to conduct high strain dynamic load testing of driven piles, which is analogous to the SPT test. Strain gages and accelerometers which are connected to the PDA are attached to the pile or drill rods (for SPT testing). During pile driving or SPT testing, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The PDA saves selected hammer blows containing this information to disk and determines the compressive stresses, displacement, and energy at the point of measurement (pile top). The maximum transferred energy (EMX) is derived from the dynamic measurements using the following equation:

$$EMX = \int_{b}^{a} F(t)V(t)dt$$

Where:
a = Time Energy Transfer Begins
b = Time Energy Transfer End
F = Force
V = Velocity
t = Time

Refer to Abou-matar and Goble (1997) for additional details of SPT energy measurements using the PDA. Literature regarding the PDA is provided in the Appendix.

SPT Rig/Hammer System

The tested drill rig is designated CME-55 and is manufactured by Central Mine Equipment, Inc. The drill rig was parked on existing grade in a grassy area for this project. We understand that the drill rig was built on July 29, 1970 and is identified with Serial Number 54005. The CME-55 drill rig is fitted with an automatically operated hammer system. The drill rig and SPT hammer were operated by Mr. Chris Golden.

The method of drilling for the rig during testing was hollow stem auger (HSA), with Standard Penetration Testing being performed with AWJ drill rods. AWJ drill rod sections have nominal outside diameter of 1-5/8 inches and wall thickness of 3/16 inches. The instrumented sub-assembly (i.e. where gauges were attached) consisted of a two feet long section of AWJ rod that was threaded into the top drill rod at each testing interval.

Dynamic Load Test Instrumentation

The dynamic pile testing instrumentation consisted of a 2-feet long AWJ instrumented drill rod which is fitted with two strain gauges by Pile Dynamic Inc., in addition two (2) accelerometer transducers are attached a distance of approximately 1 foot below the top (i.e. in the center) of a two feet long instrumented AWJ drill rod. One strain gauge and one accelerometer are on opposite faces of the sub-assembly to minimize the effects of uneven hammer impact and rod bending.

A Model 8G Pile Driving Analyzer™ (PDA), manufactured by Pile Dynamics Inc., was used to collect the instrumentation data. The PDA is a computer fitted with a data acquisition and a signal conditioning system. During driving, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The sampling frequency used during the SPT Energy Measurement Testing was 20,000 hertz (20 kHz). The PDA saves selected hammer blows containing this information to disk and determines the energy at the point of measurement.

DYNAMIC TESTING RESULTS

Hammer Performance

The transferred energy monitored during the sampling is summarized in Table 1. Note that the values are those recorded during the second and third 6-inch sampling interval at each depth. Hammer Efficiency is based on measured transferred energy divided by the energy generated with a 140 pound hammer dropping 30 inches (0.35 kip-ft).

Table 1. CME-55 Rig SPT Energy Measurement Summary

SPT 1 Sample Depth (feet)	**SPT Blow Count (Per 6 inch)**	**Hammer Efficiency (%)**			
		Min	Max	**Average**	Standard Deviation
6.5 to 8.0	2-4-4	64.65	78.85	73.81	4.71
12.0 to 13.5	4-4-4	50.97	71.61	65.31	4.97
18.5 to 20.0	3-3-6	54.22	83.02	74.03	8.02
23.5 to 25.0	3-3-6	54.95	88.18	81.35	8.64
33.5 to 35.0	12-7-9	49.92	75.68	67.40	5.70
38.5 to 40.0	3-4-8	74.83	87.65	83.22	2.96
43.5 to 45.0	3-6-10	77.94	89.29	84.77	3.10
OVERALL[1]:		61.07	82.04	**75.70**	5.44

The following figure shows the SPT rig tested.

Figure 1: SPT drill rig.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the SPT hammer on the drill rig designated CME-55 is operating within a normal range for a semi-automatic SPT hammer.

UES appreciates the opportunity to provide this report. This report is for the sole use of this project and should not be relied upon otherwise. Should the project change significantly, we can review and modify our recommendations as needed. If you have questions concerning the contents herein, please contact us.

Sincerely,

UNIVERSAL ENGINEERING SCIENCES, INC.
Universal Florida Certificate of Authorization No. 549

Joshua C. Adams
Deep Foundation Engineer
HSDPT Certified – Master Level

Adam G. Kirk

Adam G. Kirk, P.E.
Senior Engineer
Florida P.E. Number 74552
Date: 4-18-19

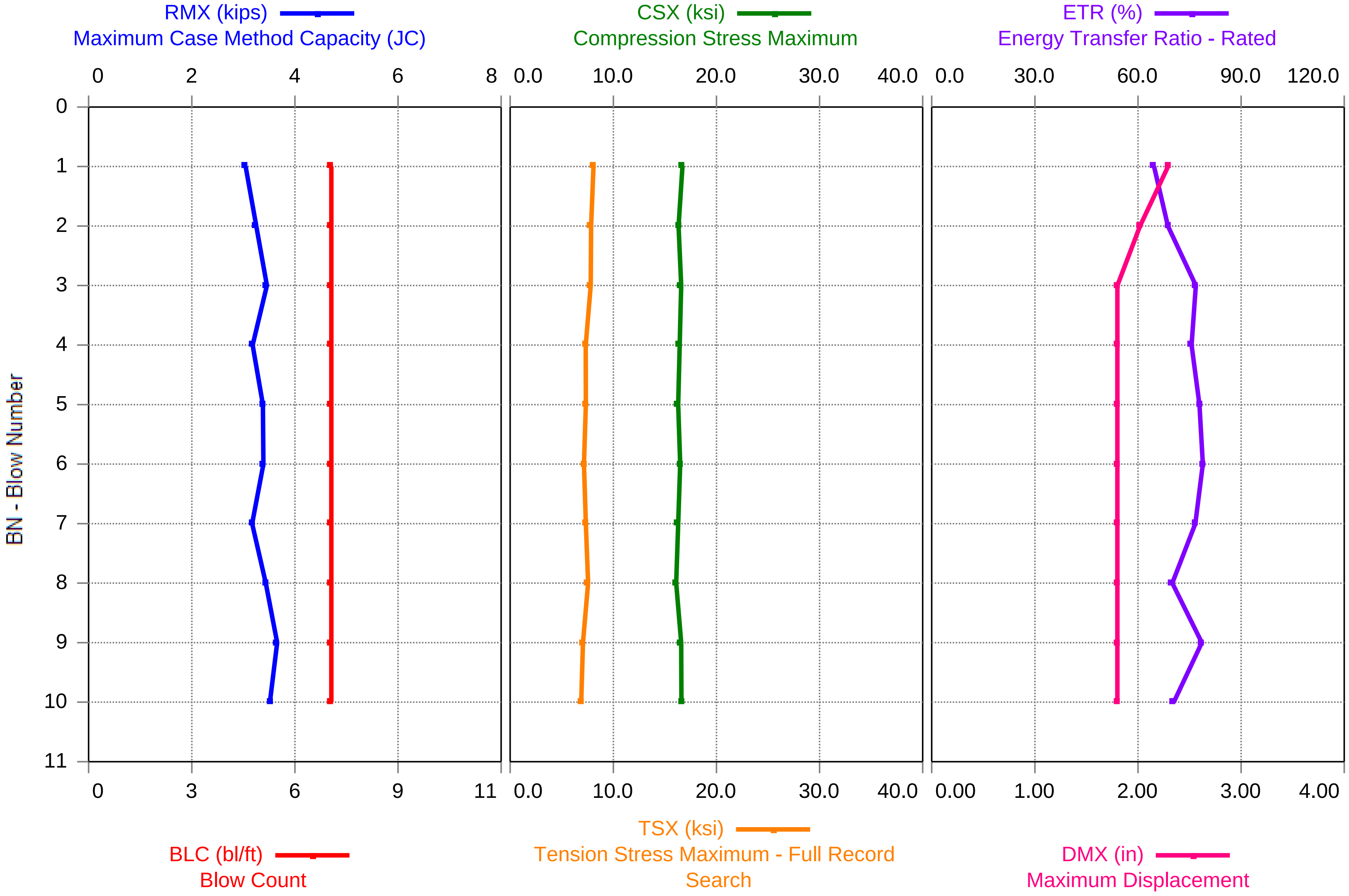
Attachments: PDA Data Output (PDIPLOT Graphs and Tables)

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 1



Georgia SPT - SPT 1 Sample 1 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 13.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	6.65	7	3.0	16.7	8.1	0.00	17.1	2.7	2.29	3	64.65
2	6.80	7	3.3	16.3	7.8	0.00	16.5	2.8	2.02	3	68.71
3	6.95	7	3.5	16.6	7.8	0.00	16.8	3.5	1.80	3	76.83
4	7.10	7	3.2	16.4	7.3	0.00	16.8	3.6	1.80	2	75.57
5	7.25	7	3.4	16.3	7.3	0.00	16.6	4.7	1.80	2	77.88
6	7.40	7	3.4	16.5	7.1	0.00	16.7	3.9	1.80	2	78.85
7	7.55	7	3.2	16.3	7.3	0.00	16.6	4.8	1.80	2	76.68
8	7.70	7	3.4	16.1	7.5	0.00	16.3	3.7	1.80	2	69.96
9	7.85	7	3.7	16.6	7.1	0.00	16.9	4.1	1.80	2	78.57
10	8.00	7	3.5	16.6	6.9	0.00	17.0	4.4	1.80	2	70.40
		Average	3.3	16.4	7.4	**	16.7	3.8	1.87	2	73.81
		Std. Dev.	0.2	0.2	0.4	**	0.2	0.7	0.15	0	4.71
		Maximum	3.7	16.7	8.1	**	17.1	4.8	2.29	3	78.85
		Minimum	3.0	16.1	6.9	**	16.3	2.7	1.80	2	64.65

Total number of blows analyzed: 10

BL# Sensors

1-10 F1: [357AWJ1] 212.0 (1.10); F4: [357AWJ2] 211.2 (1.10); A2: [55385] 915.0 (0.90);
A3: [50148] 1065.0 (0.90)

BL# Comments

10 END of Drive 1

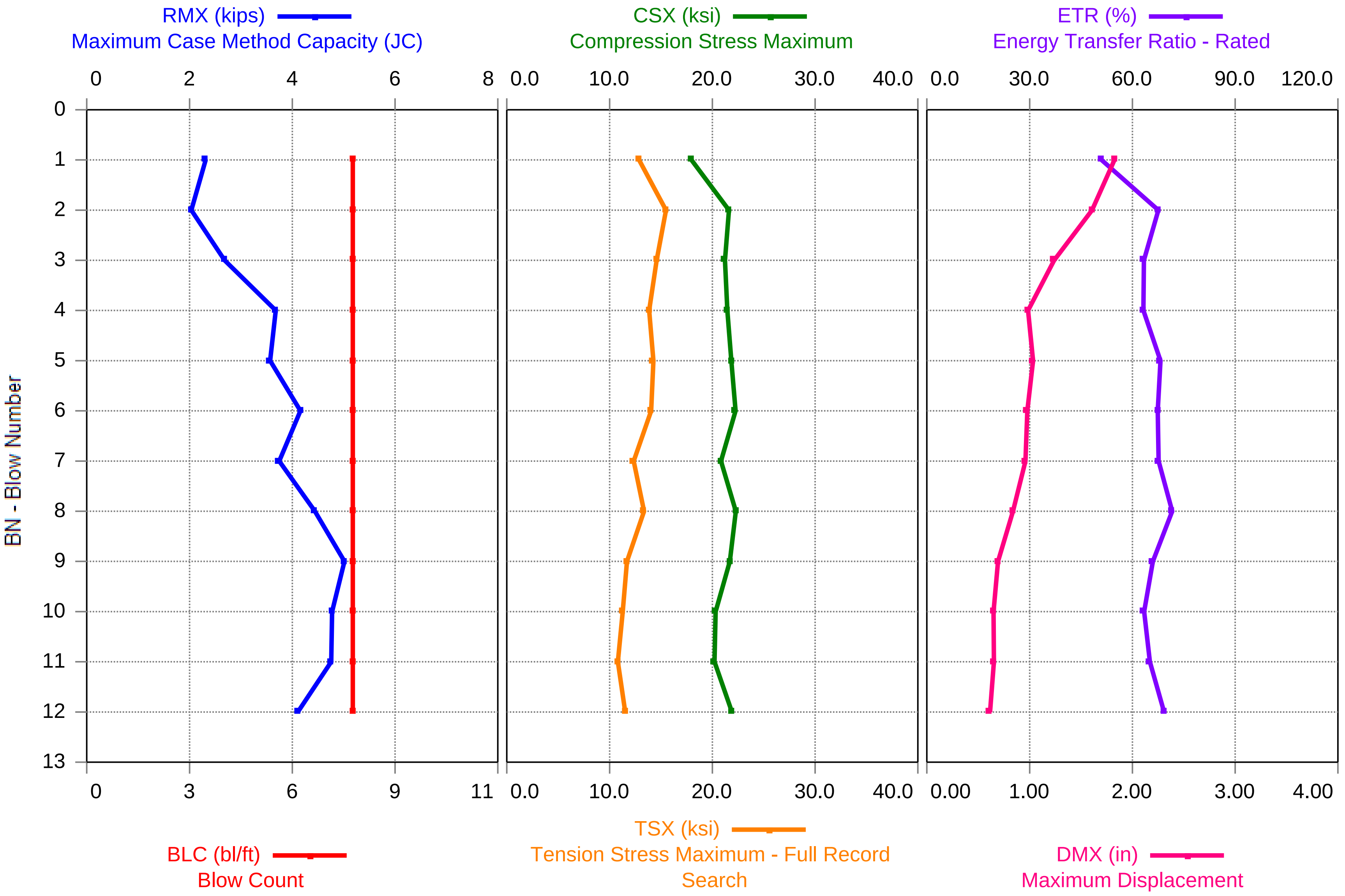
Time Summary

Drive 9 seconds 8:44 AM - 8:44 AM BN 1 - 10

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019 Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 2



Georgia SPT - SPT 1 Sample 2 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

AR: 1.18 in²
LE: 18.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.60

RMX:	Maximum Case Method Capacity (JC)	CSB:	Compression Stress at Bottom of Pile
CSX:	Compression Stress Maximum	DMX:	Maximum Displacement
TSX:	Tension Stress Maximum - Full Record Search	SFR:	Skin Friction (Crude Damping Correction)
STK:	Hammer Stroke	ETR:	Energy Transfer Ratio - Rated
CSI:	Compression Stress Maximum - Individual Sensor		

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	12.00	7	2.3	18.0	12.9	0.00	18.2	9.3	1.83	1	50.97
2	12.14	7	2.0	21.6	15.5	0.00	21.8	9.6	1.61	2	67.57
3	12.27	7	2.7	21.2	14.6	0.00	21.4	10.7	1.24	2	63.34
4	12.41	7	3.7	21.5	13.8	0.00	21.8	11.3	0.98	3	63.19
5	12.55	7	3.6	21.8	14.3	0.00	21.9	9.3	1.03	3	68.21
6	12.68	7	4.2	22.3	14.0	0.00	22.4	11.3	0.98	3	67.40
7	12.82	7	3.7	20.8	12.3	0.00	21.0	10.9	0.96	3	67.64
8	12.95	7	4.4	22.3	13.3	0.00	22.4	10.7	0.84	3	71.61
9	13.09	7	5.0	21.7	11.7	0.00	21.8	11.9	0.69	4	65.98
10	13.23	7	4.8	20.3	11.3	0.00	20.4	11.4	0.65	3	63.42
11	13.36	7	4.8	20.2	10.8	0.00	20.4	11.5	0.65	3	65.11
12	13.50	7	4.1	21.9	11.5	0.00	22.0	10.9	0.62	3	69.25
		Average	3.8	21.1	13.0	**	21.3	10.8	1.01	3	65.31
		Std. Dev.	0.9	1.2	1.4	**	1.1	0.8	0.37	1	4.97
		Maximum	5.0	22.3	15.5	**	22.4	11.9	1.83	4	71.61
		Minimum	2.0	18.0	10.8	**	18.2	9.3	0.62	1	50.97

Total number of blows analyzed: 12

BL#	Sensors
1-12	F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

BL#	Comments
12	END of Set 2

Time Summary

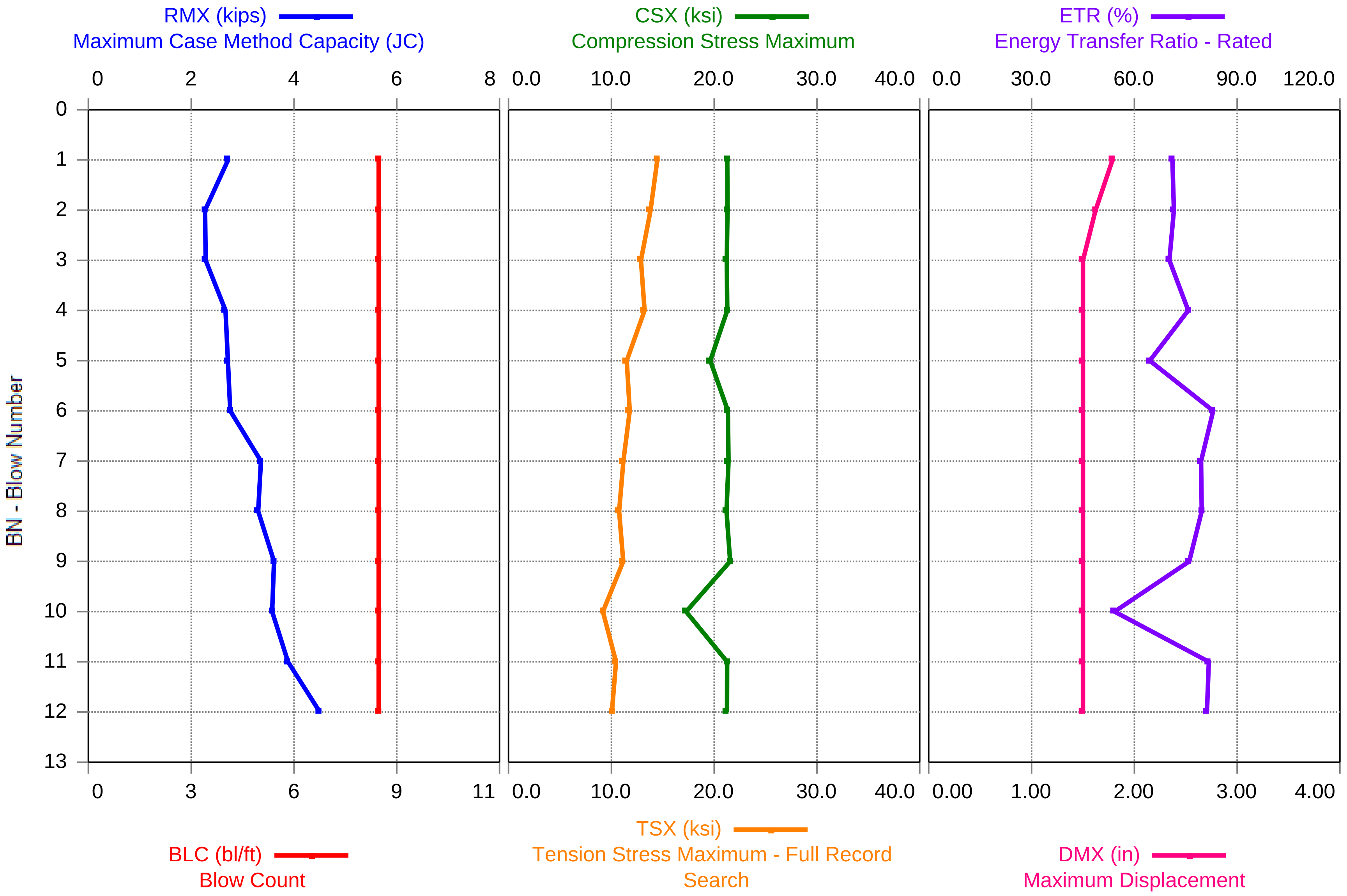
Drive 10 seconds 8:59 AM - 8:59 AM BN 1 - 12

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 3



Georgia SPT - SPT 1 Sample 3
Rod of area 1.18 square inches
OP: NVT
Date: 12-April-2019

AR: 1.18 in^2
LE: 23.50 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	18.63	8	2.7	21.3	14.5	0.00	21.5	6.2	1.79	2	71.09
2	18.75	8	2.3	21.3	13.8	0.00	21.5	8.4	1.62	2	71.56
3	18.88	8	2.3	21.2	12.9	0.00	21.5	6.7	1.50	2	70.22
4	19.00	8	2.7	21.3	13.2	0.00	21.5	8.1	1.50	2	75.72
5	19.13	8	2.7	19.6	11.5	0.00	19.9	8.0	1.50	2	64.52
6	19.25	8	2.8	21.3	11.8	0.00	21.5	9.5	1.50	2	83.02
7	19.38	8	3.4	21.4	11.2	0.00	21.6	9.2	1.50	3	79.49
8	19.50	8	3.3	21.2	10.8	0.00	21.5	8.7	1.50	3	79.66
9	19.63	8	3.6	21.6	11.2	0.00	21.8	10.5	1.50	3	76.00
10	19.75	8	3.6	17.3	9.2	0.00	17.5	8.5	1.50	3	54.22
11	19.88	8	3.9	21.3	10.5	0.00	21.5	10.7	1.50	2	81.74
12	20.00	8	4.5	21.3	10.0	0.00	21.4	10.0	1.50	3	81.18
		Average	3.1	20.8	11.7	**	21.0	8.7	1.53	2	74.03
		Std. Dev.	0.7	1.2	1.5	**	1.2	1.3	0.08	0	8.02
		Maximum	4.5	21.6	14.5	**	21.8	10.7	1.79	3	83.02
		Minimum	2.3	17.3	9.2	**	17.5	6.2	1.50	2	54.22

Total number of blows analyzed: 12

BL#	Sensors
1-12	F1: [357AWJ1] 212.0 (1.11); F4: [357AWJ2] 211.2 (1.11); A2: [55385] 915.0 (0.89); A3: [50148] 1065.0 (0.89)

BL#	Comments
12	end of set 3

Time Summary

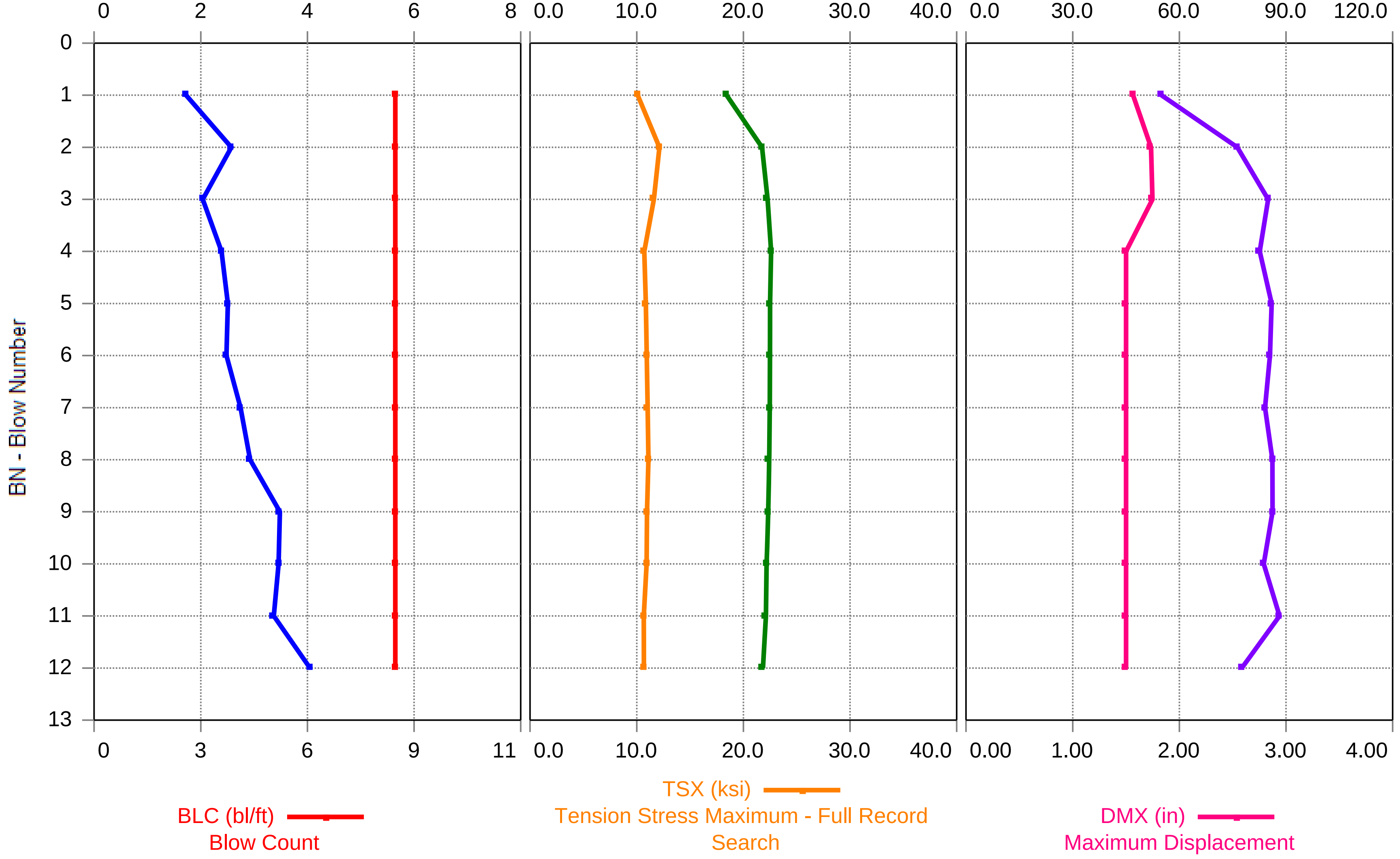
Drive 11 seconds 9:08 AM - 9:09 AM BN 1 - 12

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 4



Georgia SPT - SPT 1 Sample 4
Rod of area 1.18 square inches
OP: NVT
Date: 12-April-2019

AR: 1.18 in^2
LE: 29.00 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft^3
EM: 30,000 ksi
JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	23.63	8	1.7	18.4	10.1	0.00	18.5	11.2	1.57	0	54.95
2	23.75	8	2.6	21.7	12.1	0.00	21.8	10.8	1.73	1	76.30
3	23.88	8	2.0	22.3	11.6	0.00	22.4	9.8	1.75	1	84.95
4	24.00	8	2.4	22.6	10.7	0.00	23.3	8.9	1.50	2	82.61
5	24.13	8	2.5	22.5	10.9	0.00	22.8	8.9	1.50	2	85.97
6	24.25	8	2.5	22.5	10.9	0.00	22.9	10.2	1.50	2	85.49
7	24.38	8	2.7	22.5	11.0	0.00	23.0	10.5	1.50	2	84.11
8	24.50	8	2.9	22.4	11.1	0.00	23.1	9.8	1.50	2	86.16
9	24.63	8	3.5	22.3	11.0	0.00	23.0	9.3	1.50	2	86.22
10	24.75	8	3.5	22.2	10.9	0.00	22.7	11.3	1.50	2	83.75
11	24.88	8	3.4	22.1	10.7	0.00	22.8	10.0	1.50	2	88.18
12	25.00	8	4.0	21.8	10.7	0.00	22.2	10.9	1.50	2	77.55
		Average	2.8	21.9	11.0	**	22.4	10.1	1.55	2	81.35
		Std. Dev.	0.6	1.1	0.5	**	1.2	0.8	0.09	1	8.64
		Maximum	4.0	22.6	12.1	**	23.3	11.3	1.75	2	88.18
		Minimum	1.7	18.4	10.1	**	18.5	8.9	1.50	0	54.95

Total number of blows analyzed: 12

BL#	Sensors
1-12	F1: [357AWJ1] 212.0 (1.15); F4: [357AWJ2] 211.2 (1.15); A2: [55385] 915.0 (0.85); A3: [50148] 1065.0 (0.85)

BL#	Comments
11	end of set 4. N=9

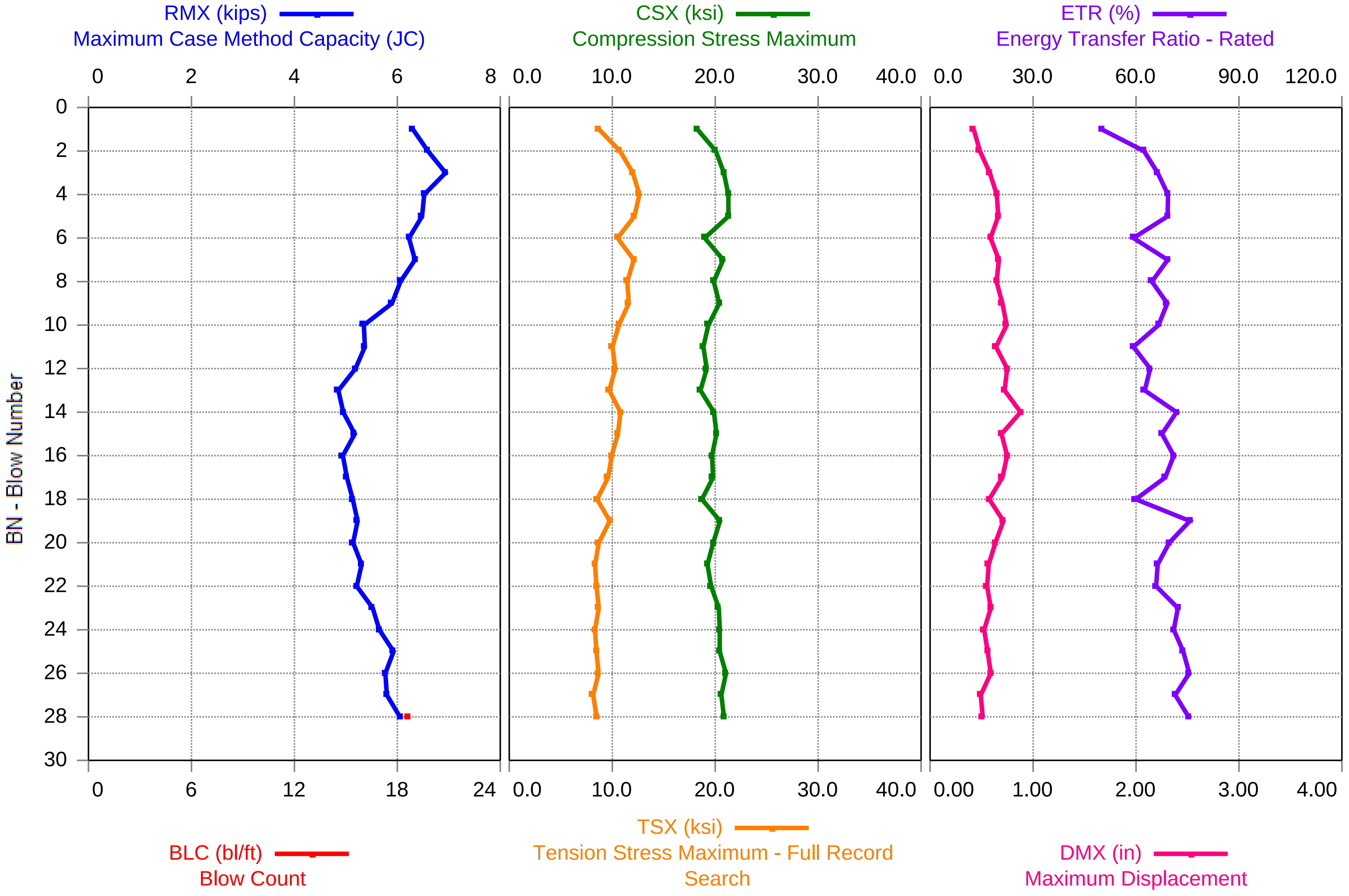
Time Summary

Drive 11 seconds 9:20 AM - 9:20 AM BN 1 - 12

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019 Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 5



Georgia SPT - SPT 1 Sample 5 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 39.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	33.00	0	6.3	18.2	8.7	0.00	18.4	9.1	0.42	3	49.92
2	33.00	0	6.6	20.1	10.8	0.00	20.1	9.4	0.48	4	62.35
3	33.00	0	6.9	20.8	12.0	0.00	20.9	10.6	0.58	4	66.31
4	33.00	0	6.5	21.3	12.6	0.00	21.5	10.9	0.65	4	69.33
5	33.00	0	6.5	21.3	12.1	0.00	21.5	11.3	0.66	3	69.21
6	33.00	0	6.2	19.0	10.5	0.00	19.2	9.4	0.59	3	59.24
7	33.00	0	6.3	20.8	12.1	0.00	21.2	11.5	0.67	3	69.19
8	33.00	0	6.1	19.9	11.5	0.00	20.0	9.9	0.65	4	64.62
9	33.00	0	5.9	20.4	11.6	0.00	20.8	11.1	0.70	3	69.09
10	33.00	0	5.3	19.3	10.6	0.00	19.6	10.8	0.74	2	66.54
11	33.00	0	5.4	18.8	10.0	0.00	19.1	10.5	0.64	3	59.25
12	33.00	0	5.2	19.2	10.3	0.00	19.5	12.6	0.75	2	64.12
13	33.00	0	4.9	18.6	9.7	0.00	18.9	10.2	0.72	3	62.54
14	33.00	0	4.9	19.9	10.8	0.00	20.3	10.9	0.88	3	71.79
15	33.00	0	5.2	20.1	10.6	0.00	20.6	12.7	0.69	2	67.56
16	33.00	0	4.9	19.7	9.9	0.00	20.1	11.0	0.75	3	70.99
17	33.00	0	5.0	19.8	9.6	0.00	20.3	12.4	0.70	2	68.50
18	33.00	0	5.1	18.7	8.5	0.00	19.1	10.8	0.57	3	59.93
19	33.00	0	5.2	20.5	9.8	0.00	20.9	13.1	0.71	2	75.68
20	33.00	0	5.1	19.8	8.7	0.00	20.3	13.3	0.63	2	69.69
21	33.00	0	5.3	19.2	8.3	0.00	19.7	13.0	0.57	2	66.31
22	33.00	0	5.2	19.6	8.5	0.00	20.1	12.4	0.55	2	65.86
23	33.00	0	5.5	20.3	8.7	0.00	20.8	14.1	0.59	2	72.19
24	33.00	0	5.7	20.4	8.3	0.00	20.9	13.9	0.53	2	71.00
25	33.00	0	5.9	20.4	8.5	0.00	21.0	13.4	0.56	2	73.75
26	33.00	0	5.8	21.0	8.7	0.00	21.5	14.7	0.59	2	75.52
27	33.00	0	5.8	20.6	8.2	0.00	21.0	14.4	0.49	2	71.44
28	34.50	19	6.1	20.9	8.5	0.00	21.4	14.1	0.51	2	75.32
		Average	5.7	20.0	9.9	**	20.3	11.9	0.63	3	67.40
		Std. Dev.	0.6	0.8	1.4	**	0.9	1.6	0.10	1	5.70
		Maximum	6.9	21.3	12.6	**	21.5	14.7	0.88	4	75.68
		Minimum	4.9	18.2	8.2	**	18.4	9.1	0.42	2	49.92

Total number of blows analyzed: 28

BL# Sensors

1-28 F1: [357AWJ1] 212.0 (1.12); F2: [357AWJ2] 211.2 (1.12); A1: [55385] 915.0 (0.88);
A2: [50148] 1065.0 (0.88)

BL# Comments

28 ;End of Set 5. N=15

Georgia SPT - SPT 1 Sample 5 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

Time Summary

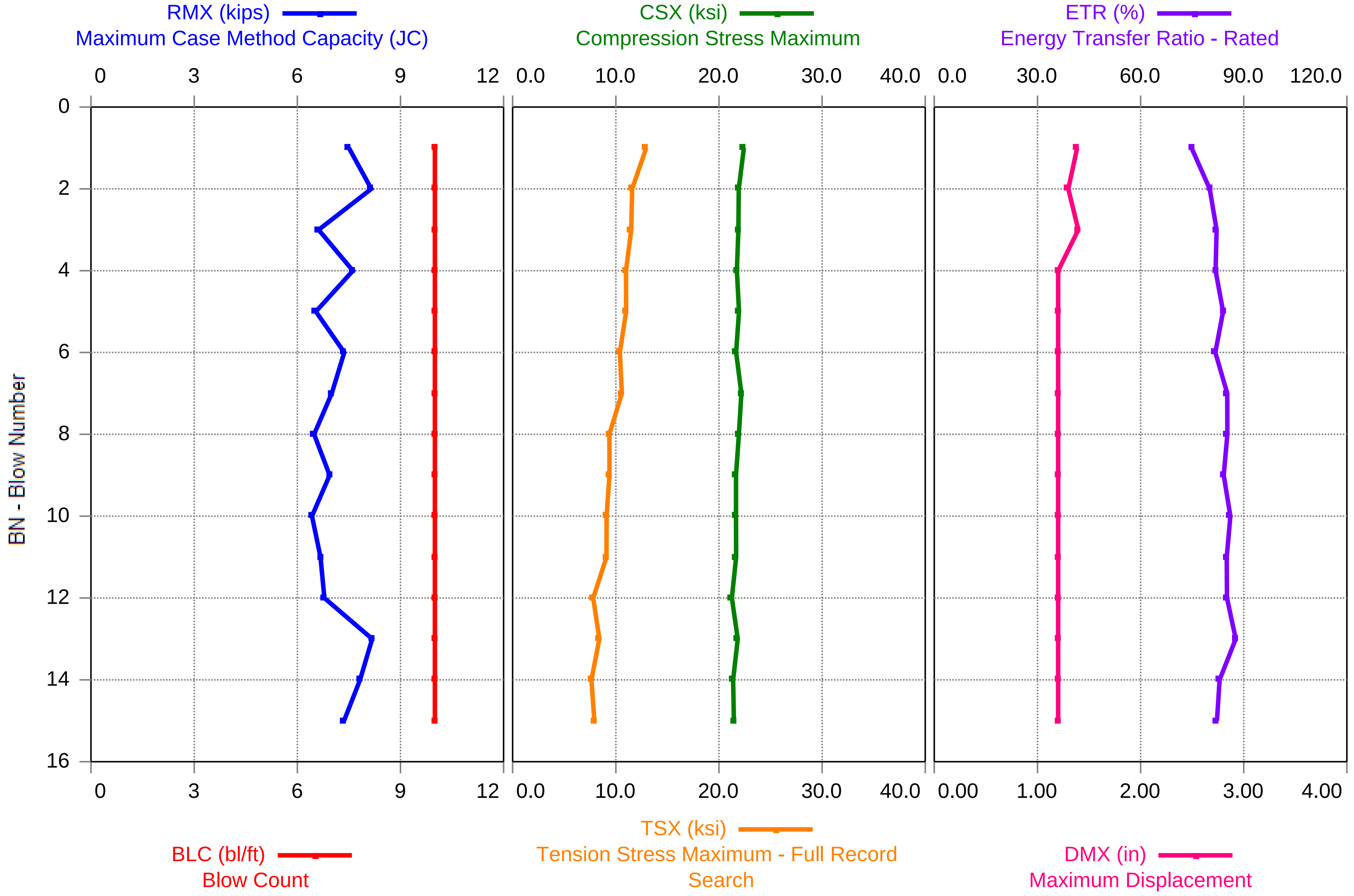
Drive 26 seconds 9:34 AM - 9:34 AM BN 1 - 28

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 6



Georgia SPT - SPT 1 Sample 6 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 44.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	38.60	10	7.5	22.4	13.0	0.00	23.0	15.9	1.38	3	74.83
2	38.70	10	8.2	21.9	11.6	0.00	22.2	15.4	1.30	4	80.08
3	38.80	10	6.6	21.9	11.5	0.00	22.3	16.1	1.40	2	82.09
4	38.90	10	7.6	21.7	11.0	0.00	22.2	15.9	1.20	3	81.82
5	39.00	10	6.5	21.9	11.0	0.00	22.4	15.6	1.20	3	83.98
6	39.10	10	7.4	21.7	10.4	0.00	22.1	15.5	1.20	3	81.72
7	39.20	10	7.0	22.2	10.6	0.00	23.0	15.6	1.20	3	85.20
8	39.30	10	6.5	21.9	9.4	0.00	22.6	15.2	1.20	3	85.23
9	39.40	10	6.9	21.7	9.4	0.00	22.2	15.1	1.20	3	84.18
10	39.50	10	6.4	21.7	9.1	0.00	22.3	15.3	1.20	3	86.11
11	39.60	10	6.7	21.7	9.1	0.00	22.2	15.0	1.20	3	85.05
12	39.70	10	6.8	21.3	7.8	0.00	21.6	15.2	1.20	3	85.13
13	39.80	10	8.2	21.8	8.4	0.00	22.3	16.0	1.20	3	87.65
14	39.90	10	7.8	21.4	7.6	0.00	21.7	15.6	1.20	3	82.98
15	40.00	10	7.4	21.4	7.9	0.00	21.9	16.1	1.20	3	82.20
		Average	7.2	21.8	9.9	**	22.3	15.6	1.23	3	83.22
		Std. Dev.	0.6	0.3	1.5	**	0.4	0.4	0.07	0	2.96
		Maximum	8.2	22.4	13.0	**	23.0	16.1	1.40	4	87.65
		Minimum	6.4	21.3	7.6	**	21.6	15.0	1.20	2	74.83

Total number of blows analyzed: 15

BL#	Sensors
1-15	F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88); A3: [50148] 1065.0 (0.88)

BL#	Comments
14	End of Set 6. N=12

Time Summary

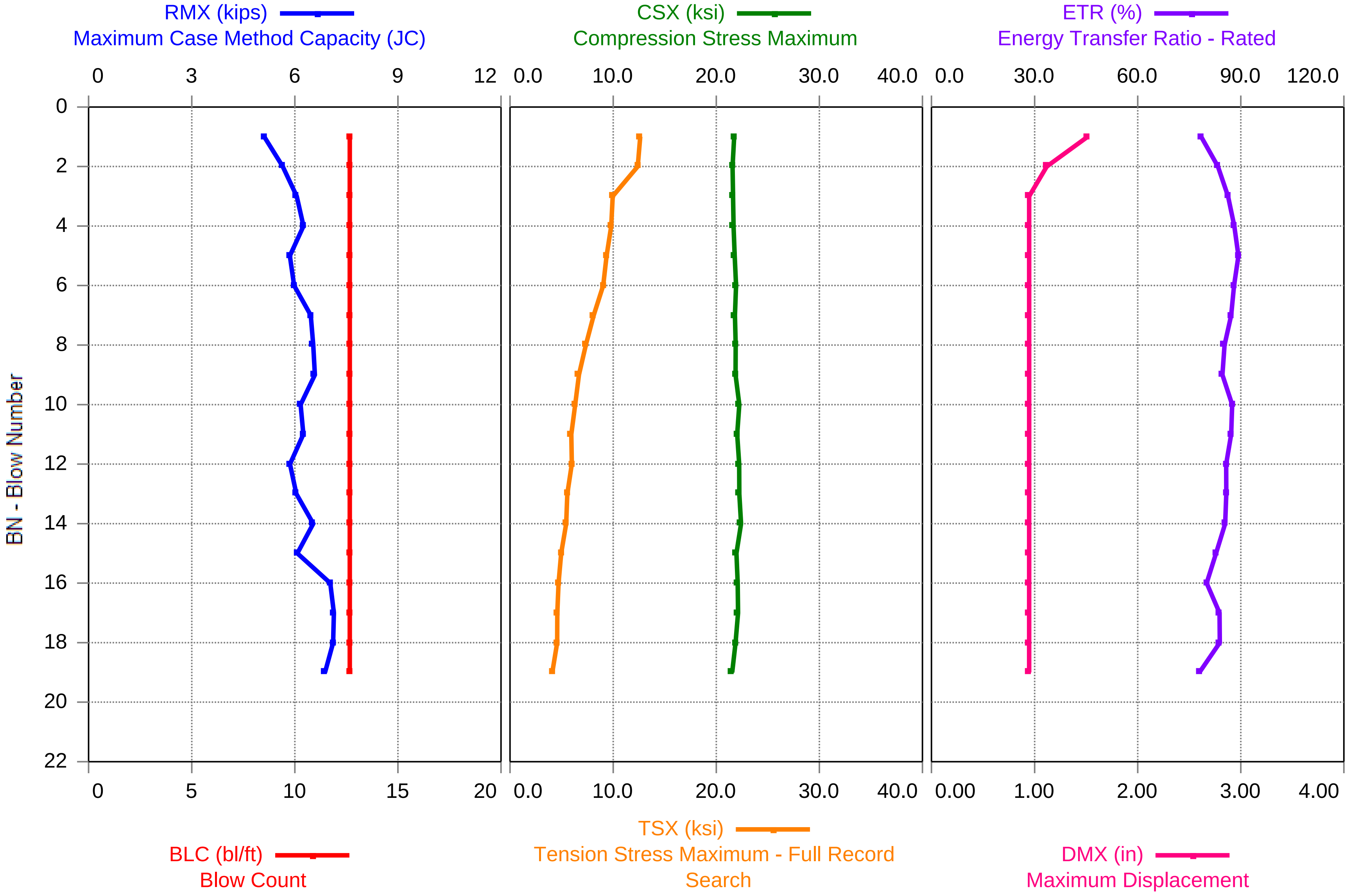
Drive 14 seconds 9:44 AM - 9:44 AM BN 1 - 15

Universal Engineering Sciences, Inc. - PDIPLOT2 Ver 2017.2.58.3 - Case Method & iCAP® Results

Printed: 18-April-2019

Test started: 12-April-2019

Georgia SPT - SPT 1 Sample 7



Georgia SPT - SPT 1 Sample 7 Rod of area 1.18 square inches
OP: NVT Date: 12-April-2019

AR: 1.18 in^2 SP: 0.492 k/ft^3
LE: 50.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC)
CSX: Compression Stress Maximum
TSX: Tension Stress Maximum - Full Record Search
STK: Hammer Stroke
CSI: Compression Stress Maximum - Individual Sensor
CSB: Compression Stress at Bottom of Pile
DMX: Maximum Displacement
SFR: Skin Friction (Crude Damping Correction)
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	43.58	13	5.1	21.7	12.6	0.00	22.2	13.4	1.51	3	78.47
2	43.66	13	5.6	21.6	12.4	0.00	21.8	13.3	1.12	3	83.35
3	43.74	13	6.1	21.6	10.0	0.00	22.0	13.8	0.95	3	86.28
4	43.82	13	6.3	21.7	9.8	0.00	22.1	13.7	0.95	4	88.08
5	43.89	13	5.9	21.8	9.4	0.00	22.1	13.6	0.95	3	89.29
6	43.97	13	6.0	21.9	9.0	0.00	22.2	13.7	0.95	4	88.04
7	44.05	13	6.5	21.8	8.1	0.00	22.3	14.6	0.95	3	87.18
8	44.13	13	6.5	21.9	7.3	0.00	22.2	14.2	0.95	4	85.25
9	44.21	13	6.6	21.9	6.7	0.00	22.2	14.6	0.95	3	84.63
10	44.29	13	6.2	22.2	6.3	0.00	22.5	14.0	0.95	3	87.49
11	44.37	13	6.2	22.0	5.9	0.00	22.1	13.6	0.95	4	87.18
12	44.45	13	5.9	22.2	6.0	0.00	22.5	13.7	0.95	3	85.73
13	44.53	13	6.0	22.2	5.6	0.00	22.6	14.4	0.95	3	85.77
14	44.61	13	6.5	22.4	5.4	0.00	22.9	14.4	0.95	3	85.46
15	44.68	13	6.1	22.0	5.0	0.00	22.3	14.0	0.95	3	82.78
16	44.76	13	7.0	22.1	4.7	0.00	22.5	14.4	0.95	4	80.06
17	44.84	13	7.1	22.1	4.6	0.00	22.5	14.8	0.95	3	83.79
18	44.92	13	7.1	21.9	4.6	0.00	22.1	15.5	0.95	3	83.88
19	45.00	13	6.9	21.5	4.1	0.00	22.0	14.9	0.95	3	77.94
		Average	6.3	21.9	7.2	**	22.3	14.1	0.99	3	84.77
		Std. Dev.	0.5	0.2	2.6	**	0.3	0.6	0.13	0	3.10
		Maximum	7.1	22.4	12.6	**	22.9	15.5	1.51	4	89.29
		Minimum	5.1	21.5	4.1	**	21.8	13.3	0.95	3	77.94

Total number of blows analyzed: 19

BL#	Sensors
1-19	F1: [357AWJ1] 212.0 (1.10); F4: [357AWJ2] 211.2 (1.10); A2: [55385] 915.0 (0.90); A3: [50148] 1065.0 (0.90)

BL#	Comments
19	End of Set 7. N=16

Time Summary

Drive 18 seconds 9:53 AM - 9:54 AM BN 1 - 19

Tri-State- CME 45 (SN 31692402)

Report of SPT Energy Measurements
Tri-State CME 45 Barge Rig
Roswell, Georgia
S&ME Project No. 1280-18-101

PREPARED FOR:

NOVA Engineering and Environmental, LLC
3900 Kennesaw 75 Parkway, Suite 100
Kennesaw, Georgia 30144

PREPARED BY:

S&ME, Inc.
4350 River Green Parkway, Suite 200
Duluth, Georgia 30096

December 19, 2019

December 19, 2019

NOVA Engineering and Environmental, LLC
3900 Kennesaw 75 Parkway, Suite 100
Kennesaw, Georgia 30144

Attention: Mr. Eric Tay, P.E.

Reference: **Report of SPT Energy Measurements**
Tri-State CME 45 Barge Rig
Roswell, Georgia
S&ME Project No. 1280-18-101

Dear Mr. Tay:

S&ME, Inc. (S&ME) completed the Standard Penetration Test (SPT) energy measurements on the automatic hammer mounted on Tri-State Drilling's CME 45 barge-mounted drill rig. This service was performed by Mr. Adam Jennings of S&ME on December 17, 2019, following the field exploration on the State Route 400 Major Mobility Improvement Project (MMIP) in Atlanta, Georgia. SPT energy testing was performed in general accordance with ASTM D4633 and pursuant to S&ME Proposal No. 12-1800360 dated August 27, 2018. The testing procedures, equipment used during testing, and detailed results are presented in this report.

1.0 Dynamic Testing Methodology

Testing was performed using a model PAX (Serial No. 3733L) Pile Driving Analyzer^{TM} (PDA) manufactured by Pile Dynamics, Inc. The PDA was used to record and interpret data from two piezoresistive accelerometers (Serial Nos. K10181 and K10182) bolted to an approximately 2-foot long AWJ drill rod (SN203) internally instrumented with two strain transducers. The instrumented AWJ drill rod has a cross-sectional area of 1.19 square inches, an outside diameter of approximately 1.75 inches, and an inside diameter of approximately 1.25 inches at the gauge location. The accelerometers and strain gauges, which are mounted on opposing axes near the middle of the instrumented rod, monitor acceleration and strain for each hammer blow. The analyzer converts the data to velocities and forces and computes the maximum transferred hammer energies with the "EFV" method described in ASTM D4633. Preliminary results are recorded and displayed in real time for each blow. Calibration sheets for the accelerometers and the instrumented rod are included in the Appendix.

2.0 Testing and Observations

On December 17, 2019, we perform high-strain dynamic testing during SPT sampling on the CME 45 barge-mounted drill rig operated by Mr. Sawyer Blevins with Tri-State Drilling. The measurements were taken during drilling of a test hole in Tri-State Drilling's yard in Roswell, Georgia. SPT energy measurements were recorded during three intervals at depths of approximately 28½, 32, and 33½ ft below the top of the barge which was sitting on the ground. The information presented in the tables below summarizes the equipment tested and tooling used during the SPT energy measurements.

Table 2-1: Drill Rig Information

Manufacturer	CME
Model	45
Serial Number	31692402
Operator	S. Blevins
Carrier	Barge
Hammer Type	CME Autohammer

Table 2-2: Instrumented Rod Information

Instrumented Rod Type	AWJ (SN 203)
Average OD (inches)	1.75
Average ID (inches)	1.25
Cross-Sectional Area (in^2)	1.19
Total Instrumented Rod Length (feet)	2.00
Length Below Gages (feet)	0.8
Split-Spoon Length (feet)	2.65

3.0 Dynamic Testing Results

The total rod length from the instrumentation to the tip of the split-spoon sampler was determined by adding 3.4 ft to the required drill rod length at each sample depth. Based on the test data, the automatic hammer on the CME 45 barge-mounted drill rig operated at a rate of about 55 to 56 blows per minute (bpm) during dynamic testing. The measured transferred hammer energy (EFV) of all the individual blows ranged from 278 to 348 ft-lbs, which corresponds to Energy Transfer Ratio (ETR) values of 79.3 to 99.3%, respectively. The SPT Energy Measurement Data Summary tables in the Appendix present the test data from every hammer blow at each sampling interval, along with representative force and velocity traces for each test interval. The reported blow counts, obtained by the drill rig personnel, and a summary of the test data and average computed hammer energy and transfer ratio values are provided in Table 3-1. Plots and tables of the following are also included in the Appendix and present the test data with depth for each test interval:

- Penetration vs. BLC
- Penetration vs. FMX
- Penetration vs. EFV
- Penetration vs. CSX
- Penetration vs. VMX
- Penetration vs. ETR
- Average ETR vs. Rod Length
- ETR vs. Rod Length

Table 3-1: Summary of Dynamic Testing Results

Data Set ID	Sample Depth (ft)	Drill Rod Length (ft)	Instrumentation to Sampler Tip Length (ft)	Blows per 6" Increment / N-value	Soil Sample Description (Coastal Plain)	Avg. BPM	Avg. EFV (ft-lbs)	Avg. ETR (%)
1	28½ - 30	30	33.4	14-5-5 / 10	Sandy Silt	55.7	321	91.8
2	32 - 33½	32	35.4	5-16-23 / 39	Sandy Silt	55.3	333	95.2
3	33½ - 35	35	38.4	50 blows in 3 in.	Sandy Silt/PWR	54.1	329	94
Overall Average						**55.0**	**328**	**93.7**

The average hammer rate, transferred energy, and transfer ratio were calculated for each depth interval. Per ASTM D4633, only the blows from the final foot of each sample interval (i.e. the blows that determine the N-value) were included when computing the average values shown in Table 3-1. The overall average transferred hammer energy for the automatic hammer on the CME 45 barge-mounted drill rig (for all the depth intervals tested) was 328 foot-pounds, with an average ETR of 93.7%.

4.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report were based on the applicable standards of our profession in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

5.0 Closing

We appreciate the opportunity to be of service on this project. Please let us know if you have any questions concerning this report.

Sincerely,

S&ME, Inc.

R. Heath Forbes, P.E. (SC)
Project Engineer
hforbes@smeinc.com

Jeffrey A. Doubrava, P.E.
Vice President / Senior Engineer
jdoubrava@smeinc.com

Appendices:
- Appendix I – Tri-State CME 45 Barge Rig SPT Energy Measurements Summary Plots and Tables
- Appendix II – Instrumented Rod and Accelerometer Calibration Sheets

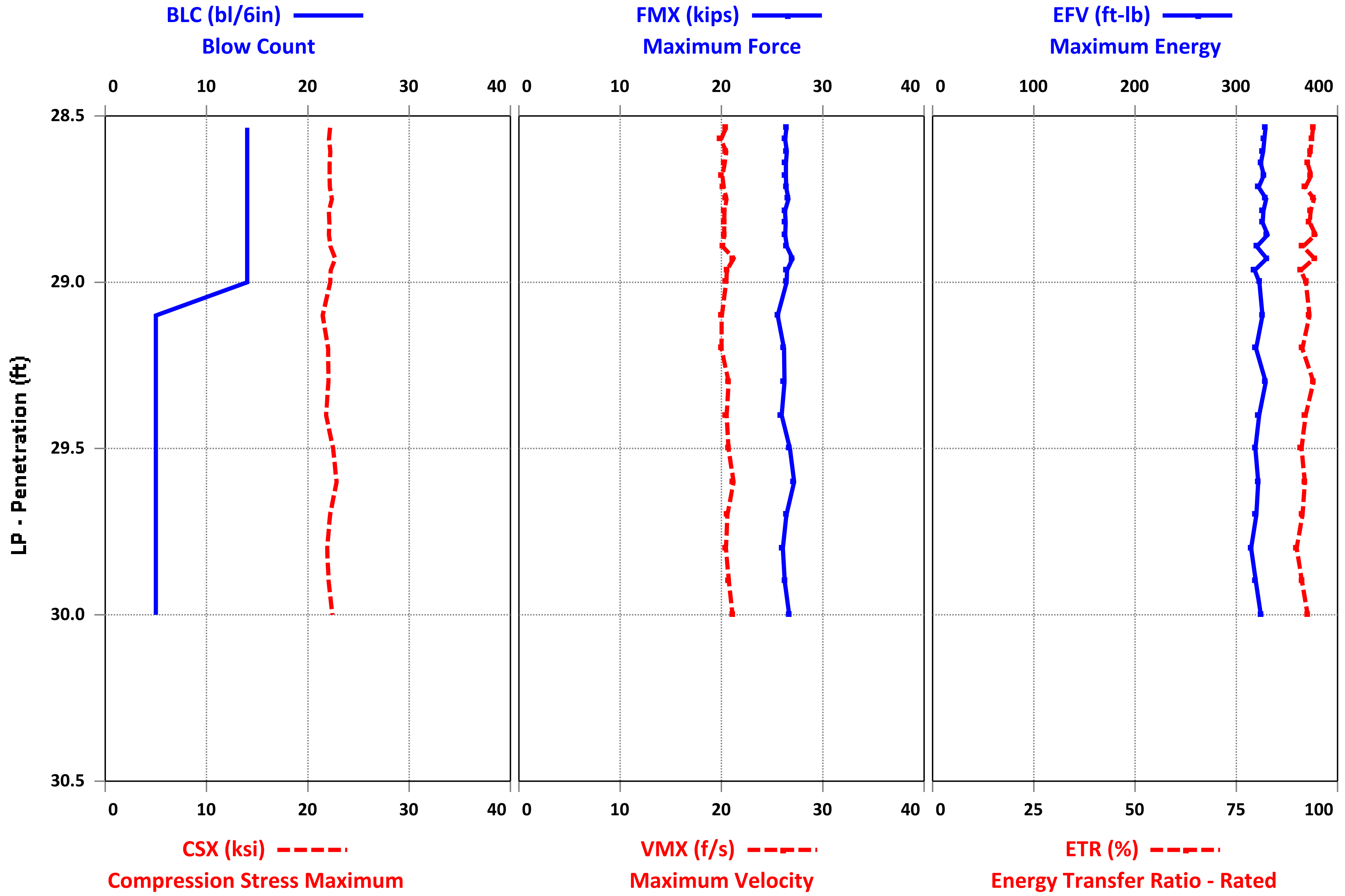
Appendices

Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.5 - Case Method & iCAP® Results

Printed: 19-December-2019

Test started: 17-December-2019

Tri-State CME 45 Barge Rig - 28.5 to 30.0 ft

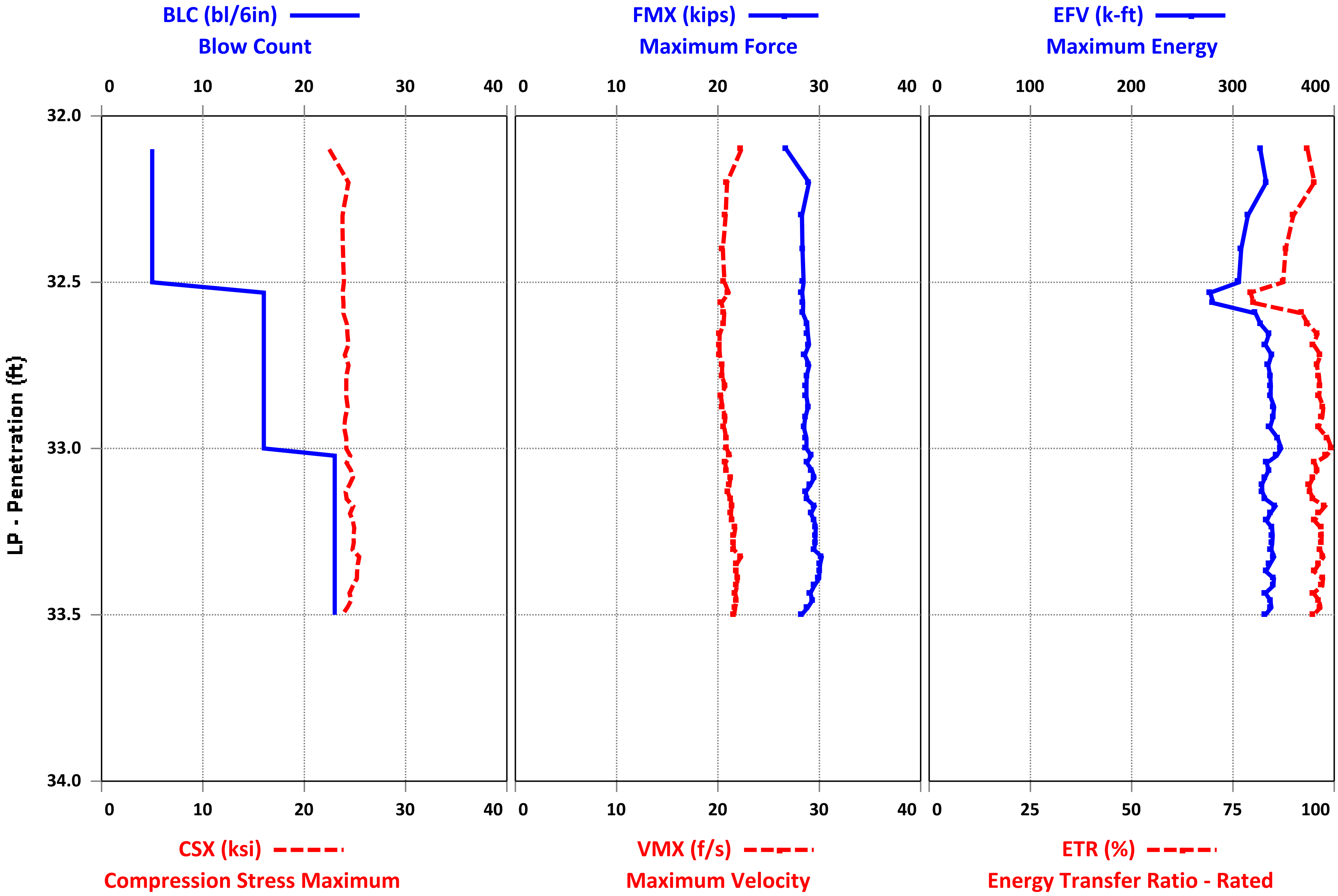


Pile Dynamics, Inc. - PDIPLOT2 Ver 2017.2.58.5 - Case Method & iCAP® Results

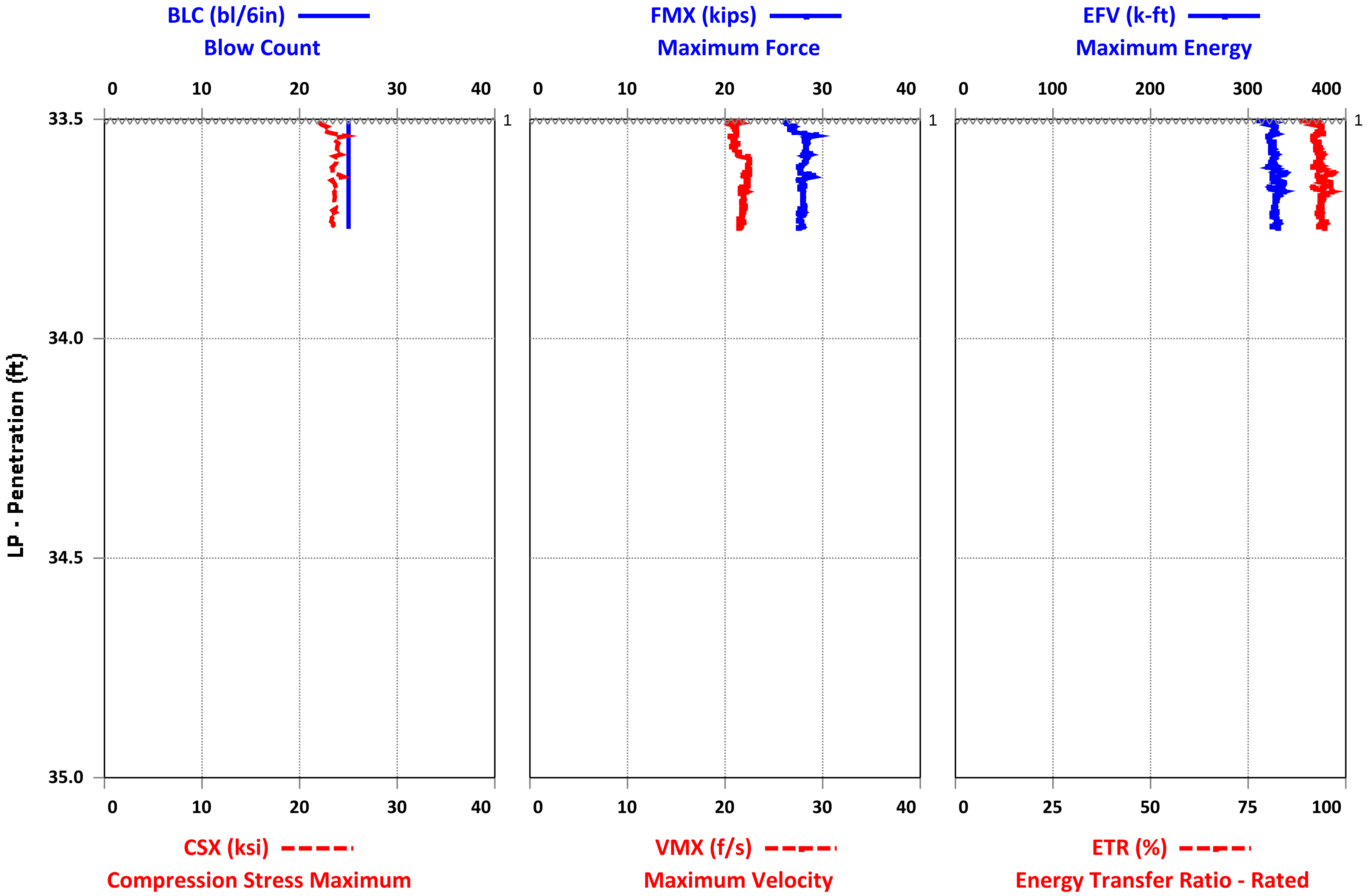
Printed: 19-December-2019

Test started: 17-December-2019

Tri-State CME 45 Barge Rig - 32.0 to 33.5 ft



Tri-State CME 45 Barge Rig - 33.5 to 35.0 ft



1 - Blow count = 50 blows over 3 in.

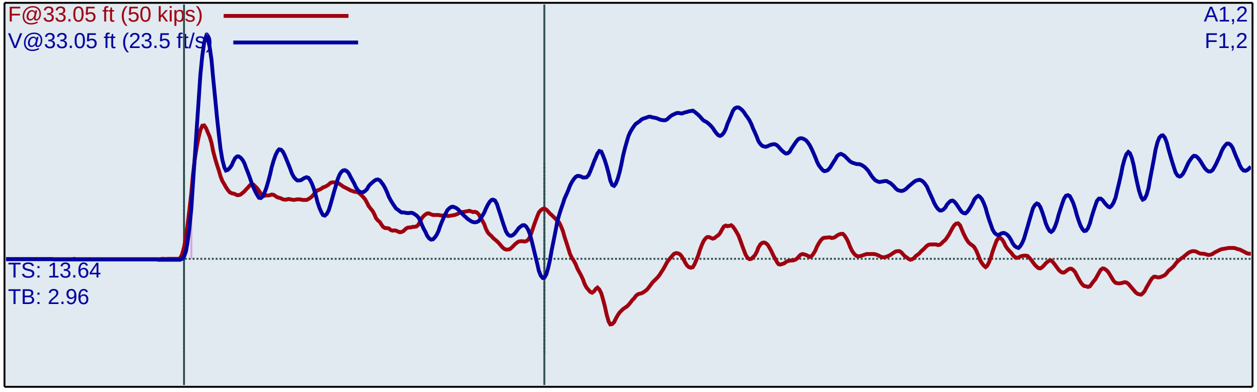
Tri-State CME 45 Barge Rig
JAJ
Test Hole

28.5 to 30.0 ft
Test date: 12/17/2019

AR: 1.19 in^2
LE: 33.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.50 - 30.00 ft], displaying BN: 22



F1 : [203 AWJ-1] 214.31 PDICAL (1) FF6
F2 : [203 AWJ-2] 214.45 PDICAL (1) FF6

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF6
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF6

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP ft	BC /6"	BPM bpm	FMX kips	VMX ft/s	DMX in	DFN in	CSX ksi	EFV ft-lb	ETR %
1	28.54	14	55.9	26	20.4	0.47	0.43	22.2	329	93.9
2	28.57	14	55.9	26	19.9	0.48	0.43	22.1	328	93.6
3	28.61	14	55.6	26	20.5	0.48	0.43	22.2	326	93.2
4	28.64	14	56.3	26	20.3	0.49	0.43	22.1	324	92.6
5	28.68	14	55.6	26	20.1	0.50	0.43	22.1	327	93.5
6	28.71	14	55.5	26	20.2	0.52	0.43	22.2	322	92.0
7	28.75	14	56.0	27	20.5	0.53	0.43	22.4	330	94.2
8	28.79	14	55.9	26	20.3	0.54	0.43	22.1	327	93.3
9	28.82	14	55.8	26	20.3	0.54	0.43	22.1	326	93.2
10	28.86	14	55.7	26	20.3	0.56	0.43	22.1	331	94.5
11	28.89	14	55.7	26	20.1	0.55	0.43	22.2	320	91.4
12	28.93	14	55.8	27	21.2	0.61	0.43	22.7	330	94.2
13	28.96	14	56.0	26	20.5	0.64	0.43	22.3	318	90.9
14	29.00	14	55.8	26	20.5	0.71	0.43	22.2	323	92.2
15	29.10	5	55.8	26	20.0	1.20	1.20	21.5	326	93.1
16	29.20	5	55.8	26	20.0	1.20	1.20	22.0	319	91.3
17	29.30	5	55.6	26	20.7	1.22	1.20	22.0	329	94.0
18	29.40	5	55.2	26	20.5	1.31	1.20	21.8	322	92.1
19	29.50	5	56.1	27	20.7	1.34	1.20	22.5	319	91.1
20	29.60	5	55.9	27	21.2	1.42	1.20	22.8	322	91.9
21	29.70	5	55.8	26	20.6	1.48	1.20	22.2	320	91.3
22	29.80	5	55.8	26	20.4	1.50	1.20	21.9	315	89.9
23	29.90	5	56.0	26	20.7	1.50	1.20	22.0	319	91.2
24	30.00	5	55.2	27	21.1	1.52	1.20	22.4	324	92.6

Average	55.7	26	20.6	1.37	1.20	22.1	321	91.8
Std Dev	0.3	0	0.4	0.12	0.00	0.4	4	1.1
Maximum	56.1	27	21.2	1.52	1.20	22.8	329	94.0
Minimum	55.2	26	20.0	1.20	1.20	21.5	315	89.9
			N-value: 10					

Sample Interval Time: 24.69 seconds.

Summary of SPT Test Results

Project: Tri-State CME 45 Barge Rig, Test Date: 12/17/2019

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average DFN in	Average CSX ksi	Average EFV ft-lb	Average ETR %
33.05	28.50	30.00	**14-5-5**	**10**	**15**	55.7	26	20.6	1.37	1.20	22.1	321	91.8
Overall Average Values:						55.7	26	20.6	1.37	1.20	22.1	321	91.8
Standard Deviation:						0.3	0	0.4	0.12	0.00	0.4	4	1.1
Overall Maximum Value:						56.1	27	21.2	1.52	1.20	22.8	329	94.0
Overall Minimum Value:						55.2	26	20.0	1.20	1.20	21.5	315	89.9

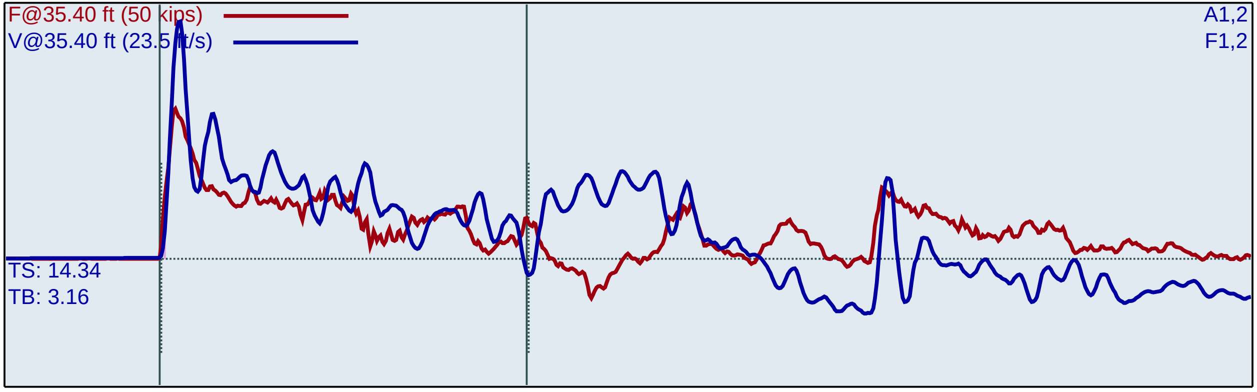
Tri-State CME 45 Barge Rig
JAJ
Test Hole

32.0 to 33.5 ft
Test date: 12/17/2019

AR: 1.19 in^2
LE: 35.40 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (32.00 - 33.50 ft], displaying BN: 42



F1 : [203 AWJ-1] 214.31 PDICAL (1) FF1
F2 : [203 AWJ-2] 214.45 PDICAL (1) FF1

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF1
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	DFN	CSX	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	in	ksi	ft-lb	%
1	32.10	5	1.9	27	22.3	1.27	1.20	22.5	327	93.4
2	32.20	5	20.2	29	20.9	1.32	1.20	24.4	333	95.1
3	32.30	5	59.0	28	20.8	1.26	1.20	23.8	315	89.9
4	32.40	5	55.7	28	20.5	1.26	1.20	23.8	308	88.0
5	32.50	5	55.6	28	20.6	1.31	1.19	23.9	306	87.4
6	32.53	16	55.9	28	21.1	0.93	0.36	23.8	278	79.3
7	32.56	16	55.7	28	20.3	0.94	0.36	23.9	280	80.1
8	32.59	16	55.2	28	20.6	0.59	0.38	23.9	322	92.0
9	32.63	16	55.4	29	20.5	0.48	0.37	24.2	327	93.4
10	32.66	16	55.2	29	20.2	0.43	0.37	24.3	335	95.8
11	32.69	16	55.4	29	20.1	0.44	0.38	24.4	332	94.9
12	32.72	16	55.5	29	20.2	0.43	0.38	24.0	338	96.6
13	32.75	16	55.2	29	20.4	0.44	0.38	24.4	335	95.7
14	32.78	16	55.7	29	20.4	0.44	0.38	24.2	337	96.2
15	32.81	16	55.2	29	20.7	0.45	0.38	24.1	337	96.4
16	32.84	16	55.5	29	20.3	0.44	0.38	24.1	337	96.3
17	32.88	16	55.3	29	20.4	0.44	0.38	24.3	341	97.3
18	32.91	16	55.6	29	20.7	0.43	0.38	24.1	340	97.0
19	32.94	16	55.4	28	20.6	0.44	0.38	23.9	336	96.1
20	32.97	16	55.2	29	20.8	0.43	0.38	24.1	344	98.3
21	33.00	16	55.5	29	20.8	0.43	0.38	24.1	348	99.3
22	33.02	23	55.4	29	21.2	0.43	0.26	24.5	343	98.1
23	33.04	23	55.7	29	20.7	0.41	0.26	24.2	333	95.2
24	33.07	23	55.2	29	20.8	0.41	0.26	24.6	335	95.8
25	33.09	23	55.4	30	21.2	0.42	0.26	24.8	332	94.8
26	33.11	23	55.3	29	21.1	0.42	0.26	24.5	328	93.9
27	33.13	23	55.3	29	21.0	0.43	0.26	24.1	329	94.0

28	33.15	23	55.3	29	21.2	0.42	0.26	24.2	332	94.9
29	33.17	23	55.0	30	21.4	0.42	0.26	24.8	342	97.7
30	33.20	23	55.4	29	21.3	0.42	0.26	24.5	337	96.2
31	33.22	23	55.3	30	21.4	0.43	0.26	24.8	333	95.2
32	33.24	23	55.2	30	21.7	0.43	0.26	24.9	339	96.7
33	33.26	23	55.1	30	21.6	0.44	0.26	24.9	339	96.9
34	33.28	23	55.2	30	21.5	0.43	0.26	24.9	339	96.8
35	33.30	23	55.4	29	21.6	0.42	0.26	24.8	338	96.5
36	33.33	23	54.9	30	22.3	0.42	0.26	25.4	341	97.3
37	33.35	23	55.0	30	21.8	0.42	0.26	25.3	337	96.1
38	33.37	23	55.5	30	21.8	0.43	0.26	25.2	332	95.0
39	33.39	23	55.0	30	21.9	0.44	0.26	25.2	340	97.2
40	33.41	23	55.2	29	21.9	0.44	0.26	24.8	340	97.0
41	33.43	23	54.9	29	21.7	0.44	0.26	24.5	332	94.8
42	33.46	23	55.5	29	21.8	0.45	0.26	24.6	337	96.2
43	33.48	23	54.7	29	21.7	0.44	0.26	24.3	338	96.5
44	33.50	23	54.8	28	21.6	0.45	0.26	23.7	332	94.9
		Average	55.3	29	21.1	0.46	0.31	24.4	333	95.2
		Std Dev	0.3	1	0.6	0.11	0.06	0.4	13	3.9
		Maximum	55.9	30	22.3	0.94	0.38	25.4	348	99.3
		Minimum	54.7	28	20.1	0.41	0.26	23.7	278	79.3

N-value: 39

Sample Interval Time: 48.39 seconds.

Summary of SPT Test Results

Project: Tri-State CME 45 Barge Rig, Test Date: 12/17/2019

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average DFN in	Average CSX ksi	Average EFV ft-lb	Average ETR %
35.40	32.00	33.50	**5-16-23**	**39**	**61**	55.3	29	21.1	0.46	0.31	24.4	333	95.2
					Overall Average Values:	55.3	29	21.1	0.46	0.31	24.4	333	95.2
					Standard Deviation:	0.3	1	0.6	0.11	0.06	0.4	13	3.9
					Overall Maximum Value:	55.9	30	22.3	0.94	0.38	25.4	348	99.3
					Overall Minimum Value:	54.7	28	20.1	0.41	0.26	23.7	278	79.3

SPT Analyzer Results

PDA-S Ver. 2019.30.82 - Printed: 12/19/2019

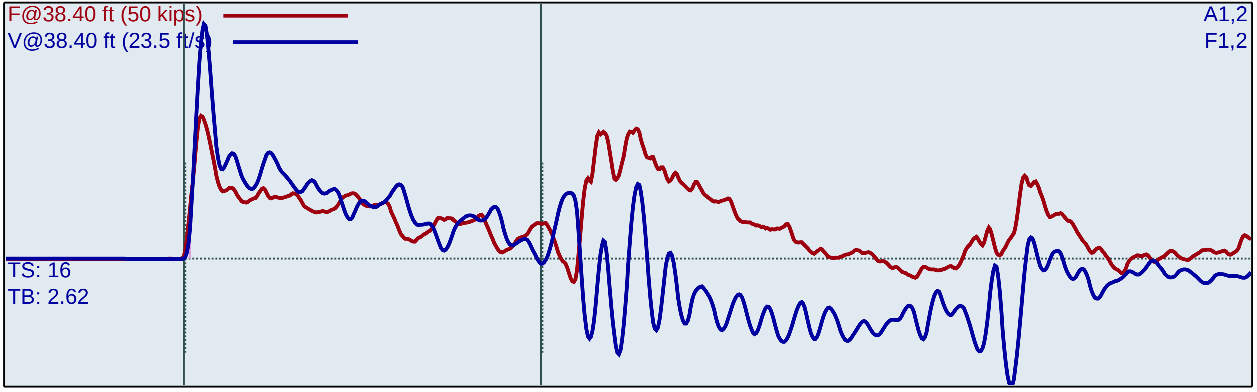
Tri-State CME 45 Barge Rig
JAJ
Test Hole

33.5 to 35.0 ft
Test date: 12/17/2019

AR: 1.19 in^2
LE: 38.40 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

BN: 1 - 59, displaying BN: 57



F1 : [203 AWJ-1] 214.31 PDICAL (1) FF4
F2 : [203 AWJ-2] 214.45 PDICAL (1) FF4

A1 (PR): [K10181] 356 mv/6.4v/5000g (1) VF4
A2 (PR): [K10182] 368 mv/6.4v/5000g (1) VF4

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement

DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	LP	BC	BPM	FMX	VMX	DMX	DFN	CSX	EFV	ETR
	ft	/6"	bpm	kips	ft/s	in	in	ksi	ft-lb	%
1	33.51	0	18.3	26	21.0	1.17	0.10	22.0	312	89.3
2	33.52	0	60.7	26	21.7	0.46	0.10	22.0	327	93.4
3	33.53	0	54.9	26	20.5	0.37	0.10	22.3	320	91.5
4	33.53	0	54.3	27	21.0	0.40	0.10	22.8	329	94.1
5	33.54	0	55.2	27	21.2	0.40	0.10	22.4	329	94.0
6	33.55	0	54.5	27	21.1	0.39	0.10	22.5	328	93.7
7	33.56	0	55.0	27	21.2	0.39	0.10	22.9	325	92.9
8	33.57	0	54.7	28	21.3	0.36	0.10	23.7	331	94.5
9	33.58	0	54.9	29	21.3	0.35	0.10	24.7	326	93.1
10	33.58	0	54.4	28	20.7	0.35	0.10	23.7	322	92.0
11	33.59	0	55.0	28	21.0	0.34	0.10	23.9	322	92.1
12	33.60	0	54.7	28	21.0	0.35	0.10	23.8	323	92.4
13	33.61	0	54.8	29	20.9	0.35	0.10	24.0	327	93.4
14	33.62	0	54.8	28	21.4	0.35	0.10	23.9	327	93.5
15	33.63	0	54.9	28	20.8	0.34	0.10	23.8	324	92.7
16	33.64	0	55.1	28	21.1	0.35	0.10	23.8	328	93.6
17	33.64	0	54.7	28	21.1	0.34	0.10	23.9	324	92.6
18	33.65	0	54.7	28	21.5	0.33	0.10	23.7	325	92.9
19	33.66	0	54.9	29	21.4	0.34	0.10	24.2	330	94.3
20	33.67	0	54.6	28	21.5	0.34	0.10	23.5	328	93.8
21	33.68	0	54.5	28	22.3	0.34	0.10	23.9	331	94.5
22	33.69	0	55.0	28	22.6	0.34	0.10	23.8	328	93.7
23	33.69	0	54.7	28	22.5	0.33	0.10	23.8	329	94.1
24	33.70	0	54.7	28	22.5	0.34	0.10	23.7	326	93.3
25	33.71	0	54.7	28	22.4	0.34	0.10	23.5	331	94.6
26	33.72	0	54.9	28	22.5	0.33	0.10	23.3	324	92.4
27	33.73	0	54.1	28	22.5	0.34	0.10	23.4	333	95.1

28	33.74	0	54.8	28	22.5	0.34	0.10	23.4	329	94.0
29	33.75	0	54.7	28	22.1	0.36	0.10	23.4	340	97.1
30	33.75	0	54.3	29	22.5	0.36	0.10	24.1	338	96.5
31	33.76	0	54.8	29	22.0	0.34	0.10	24.5	327	93.5
32	33.77	0	54.4	28	22.3	0.33	0.10	23.7	328	93.8
33	33.78	0	54.8	28	22.3	0.35	0.10	23.2	332	94.9
34	33.79	0	54.4	28	22.3	0.34	0.10	23.5	330	94.2
35	33.80	0	54.7	28	22.3	0.35	0.10	23.6	337	96.4
36	33.81	0	54.4	28	22.4	0.35	0.10	23.7	337	96.2
37	33.81	0	55.1	28	21.9	0.33	0.10	23.3	324	92.6
38	33.82	0	54.4	28	21.7	0.34	0.10	23.3	327	93.3
39	33.83	0	53.9	28	22.3	0.34	0.10	23.6	338	96.6
40	33.84	0	54.6	28	21.7	0.33	0.10	23.5	333	95.1
41	33.85	0	55.0	28	21.9	0.34	0.10	23.6	333	95.2
42	33.86	0	54.2	28	21.9	0.34	0.10	23.6	330	94.4
43	33.86	0	54.6	28	22.0	0.34	0.10	23.5	331	94.5
44	33.87	0	54.4	28	22.0	0.34	0.10	23.5	330	94.3
45	33.88	0	54.7	28	21.8	0.33	0.10	23.6	330	94.4
46	33.89	0	54.5	28	21.9	0.33	0.10	23.6	329	94.0
47	33.90	0	54.0	28	22.1	0.33	0.10	23.7	330	94.3
48	33.91	0	54.5	28	22.1	0.33	0.10	23.7	329	94.0
49	33.92	0	54.7	28	21.8	0.34	0.10	23.4	331	94.5
50	33.92	0	54.2	28	21.9	0.34	0.10	23.7	330	94.2
51	33.93	0	54.5	28	21.8	0.34	0.10	23.3	327	93.6
52	33.94	0	54.1	28	21.9	0.33	0.10	23.5	330	94.3
53	33.95	0	54.7	28	21.8	0.33	0.10	23.3	327	93.4
54	33.96	0	54.0	28	21.5	0.34	0.10	23.3	332	94.7
55	33.97	0	54.3	28	21.7	0.34	0.10	23.2	330	94.2
56	33.97	0	54.5	28	21.9	0.34	0.10	23.4	334	95.6
57	33.98	0	54.1	28	21.6	0.33	0.10	23.4	330	94.3
58	33.99	0	54.4	28	21.7	0.33	0.10	23.6	328	93.7
59	34.00	0	54.7	28	21.6	0.34	0.10	23.2	332	94.9
		Average	54.1	28	21.7	0.36	0.10	23.5	329	94.0
		Std Dev	4.8	1	0.5	0.11	0.00	0.5	4	1.3
		Maximum	60.7	29	22.6	1.17	0.10	24.7	340	97.1
		Minimum	18.3	26	20.5	0.33	0.10	22.0	312	89.3

N-value: 59

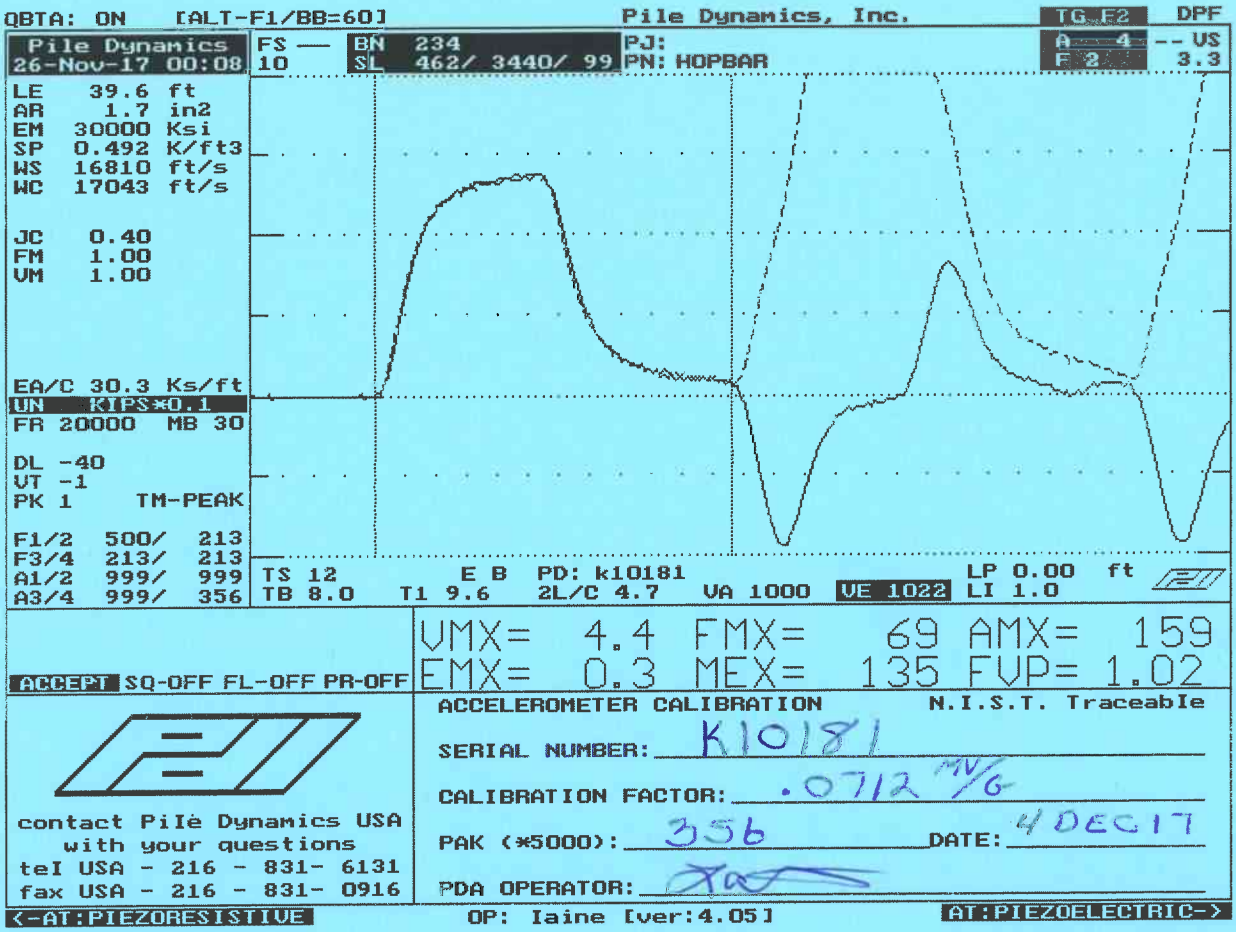
Sample Interval Time: 63.51 seconds.

Summary of SPT Test Results

Project: Tri-State CME 45 Barge Rig, Test Date: 12/17/2019

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
CSX: Compression Stress Maximum
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average DFN in	Average CSX ksi	Average EFV ft-lb	Average ETR %
38.40	0.00	0.00	50 blows over 3 in.			54.1	28	21.7	0.36	0.10	23.5	329	94.0
Overall Average Values:						54.1	28	21.7	0.36	0.10	23.5	329	94.0
Standard Deviation:						4.8	1	0.5	0.11	0.00	0.5	4	1.3
Overall Maximum Value:						60.7	29	22.6	1.17	0.10	24.7	340	97.1
Overall Minimum Value:						18.3	26	20.5	0.33	0.10	22.0	312	89.3



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QBTA: ON    [ALT-F1/BB=60]              Pile Dynamics, Inc.              TG F2   DPF
Pile Dynamics      FS —    BN  234                PJ:                   A    4 -- VS
26-Nov-17 00:08    10      SL  462/ 3440/ 99      PN: HOPBAR            F 2      3.3
LE     39.6 ft
AR      1.7 in2
EM   30000 Ksi
SP   0.492 K/ft3
WS   16810 ft/s
WC   17043 ft/s

JC     0.40
FM     1.00
VM     1.00

EA/C 30.3 Ks/ft
UN     KIPS*0.1
FR 20000    MB 30

DL -40
VT -1
PK 1       TM-PEAK

F1/2   500/   213
F3/4   213/   213
A1/2   999/   999  TS 12         E B   PD: k10181                     LP 0.00   ft
A3/4   999/   356  TB 8.0   T1 9.6     2L/C 4.7    VA 1000   VE 1022  LI 1.0

                        VMX=  4.4  FMX=   69  AMX=  159
ACCEPT SQ-OFF FL-OFF PR-OFF  EMX=  0.3  MEX=  135  FVP= 1.02
```

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: K10181

CALIBRATION FACTOR: .0712 mV/G

PAK (*5000): 356 DATE: 4 DEC 17

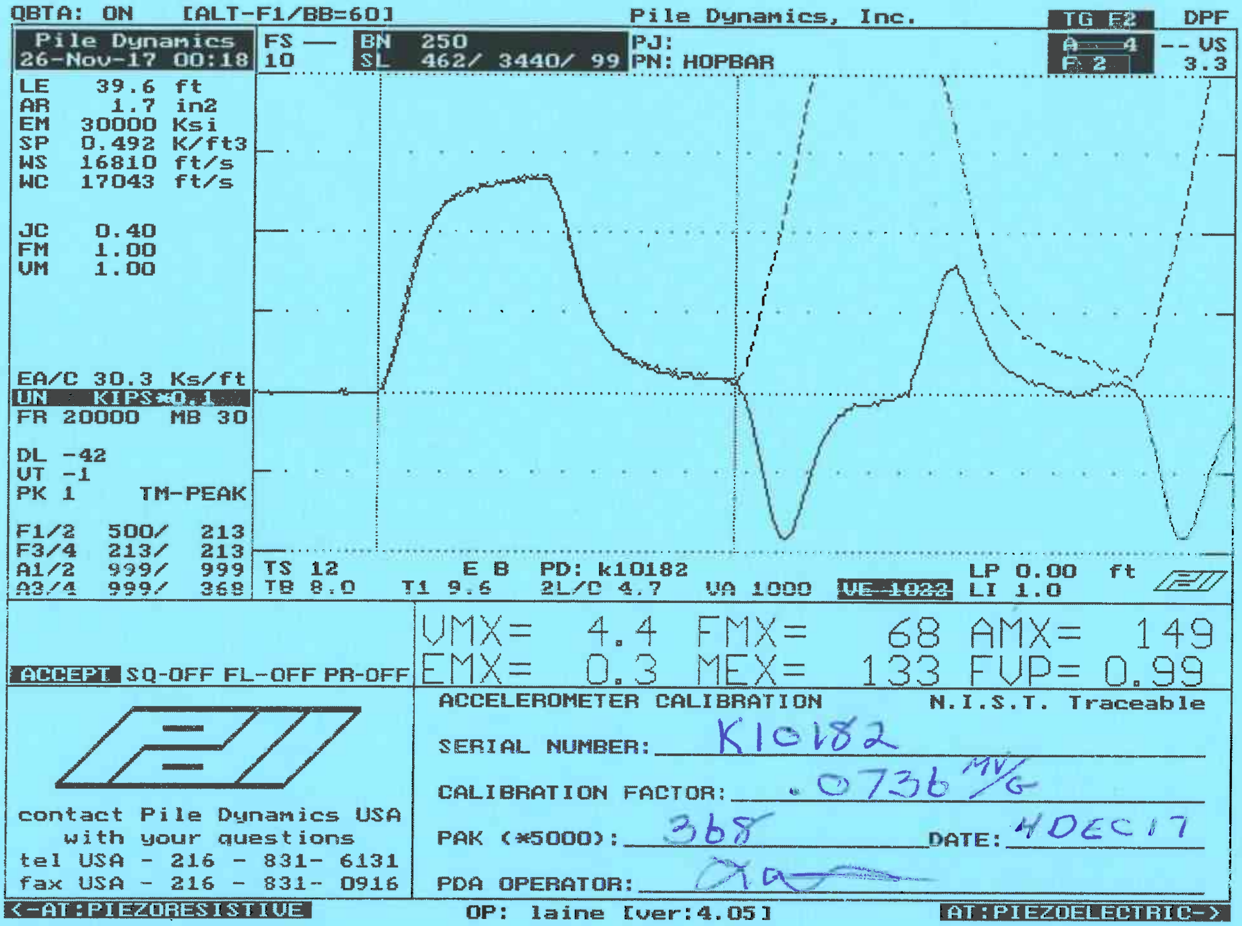
PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE   OP: Iaine [ver:4.05]   AT:PIEZOELECTRIC->

Smart Sensor

Smart Chip Programmed By Z.M.W. **on** 4DEC17 **CRC Value** 6AD7



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QBTA: ON    [ALT-F1/BB=60]                    Pile Dynamics, Inc.                        TG E2   DPF
 Pile Dynamics      FS ——  BN  250           PJ:                                          A——4  -- VS
26-Nov-17 00:18     10     SL  462/ 3440/ 99 PN: HOPBAR                                   F 2     3.3
LE    39.6  ft
AR     1.7  in2
EM   30000  Ksi
SP   0.492  K/ft3
WS   16810  ft/s
WC   17043  ft/s

JC    0.40
FM    1.00
VM    1.00

EA/C 30.3  Ks/ft
UN    KIPS*0.1
FR 20000   MB 30

DL  -42
VT  -1
PK 1     TM-PEAK

F1/2   500/   213
F3/4   213/   213
A1/2   999/   999  TS 12       E B   PD: k10182                   LP 0.00   ft
A3/4   999/   368  TB 8.0  T1 9.6    2L/C 4.7   VA 1000  VE 1022  LI 1.0
                                   VMX=   4.4  FMX=     68  AMX=   149
ACCEPT SQ-OFF FL-OFF PR-OFF        EMX=   0.3  MEX=    133  FVP= 0.99
```

ACCELEROMETER CALIBRATION N.I.S.T. Traceable

SERIAL NUMBER: K10182

CALIBRATION FACTOR: .0736 mV/G

PAK (*5000): 368 DATE: 4DEC17

PDA OPERATOR:

contact Pile Dynamics USA
with your questions
tel USA - 216 - 831- 6131
fax USA - 216 - 831- 0916

<-AT:PIEZORESISTIVE   OP: laine [ver:4.05]   AT:PIEZOELECTRIC->

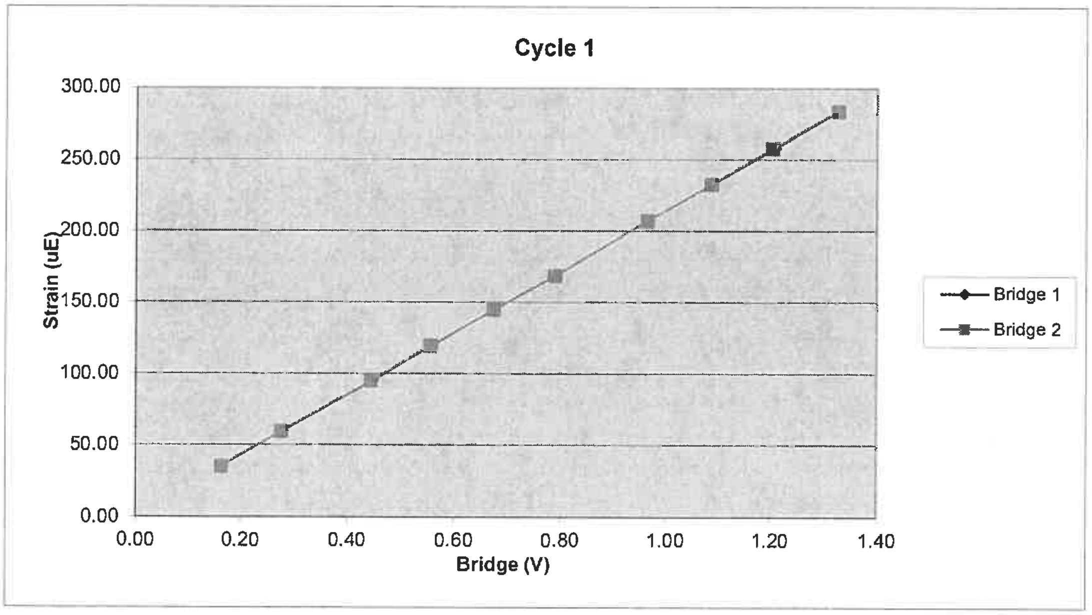
Smart Sensor

Smart Chip Programmed By J.M.W. **on** 4DEC17 **CRC Value** 1798

203AWJ		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1238.45	35.09	0.16	0.16
3	2101.82	59.39	0.28	0.28
4	3386.54	94.77	0.44	0.44
5	4235.08	119.35	0.56	0.56
6	5136.73	144.58	0.67	0.67
7	6021.00	168.91	0.79	0.79
8	7359.61	207.34	0.97	0.97
9	8298.94	232.84	1.09	1.09
10	9187.31	257.76	1.21	1.20
11	10120.00	284.12	1.33	1.33

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7630.77**	**Force Calibration (lb/V)**	**7630.97**
Offset	-7.83	Offset	-3.17
Correlation	1.000000	Correlation	0.999999
Strain Calibration (µE/V)	**213.97**	**Strain Calibration (µE/V)**	**213.98**
Offset	0.12	Offset	0.25
Correlation	0.999992	Correlation	0.999995

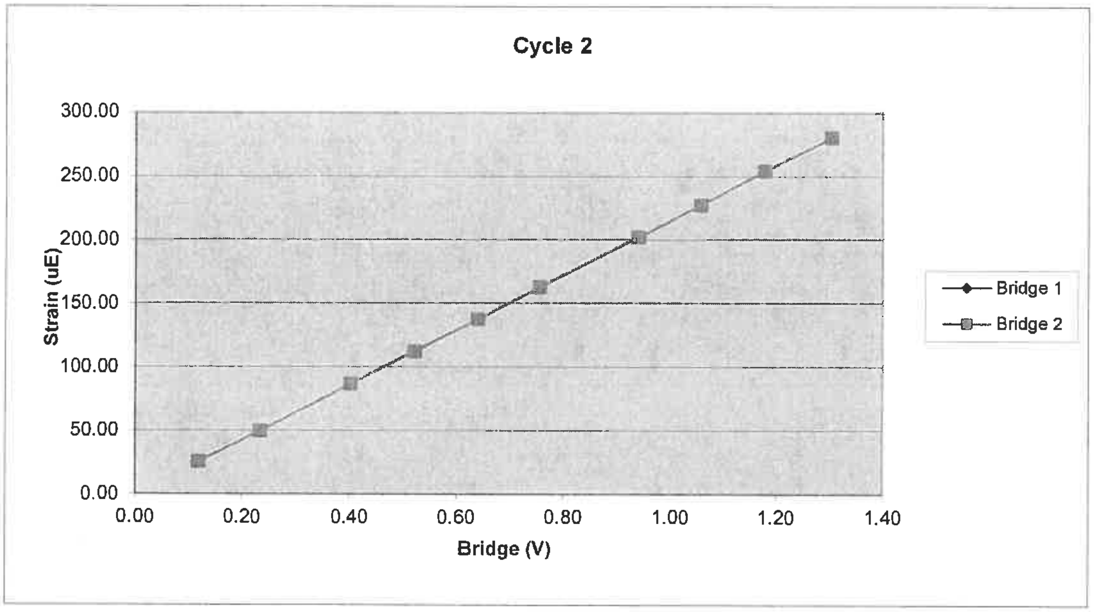
Force Strain Calibration	
EA (Kips)	**35662.28**
Offset	-12.17
Correlation	0.999993



203AWJ		Cycle 2		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	883.29	25.21	0.12	0.12
3	1765.61	49.65	0.23	0.23
4	3049.75	86.59	0.40	0.40
5	3958.42	112.20	0.52	0.52
6	4857.33	137.43	0.64	0.64
7	5743.75	162.78	0.76	0.76
8	7145.42	202.15	0.94	0.94
9	8044.14	227.44	1.06	1.06
10	8969.22	253.99	1.18	1.18
11	9924.95	280.34	1.30	1.30

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7617.86**	**Force Calibration (lb/V)**	**7627.07**
Offset	**-11.91**	Offset	**-18.36**
Correlation	**0.999998**	Correlation	**1.000000**
Strain Calibration (µE/V)	**215.30**	**Strain Calibration (µE/V)**	**215.56**
Offset	**-0.14**	Offset	**-0.33**
Correlation	**0.999995**	Correlation	**0.999996**

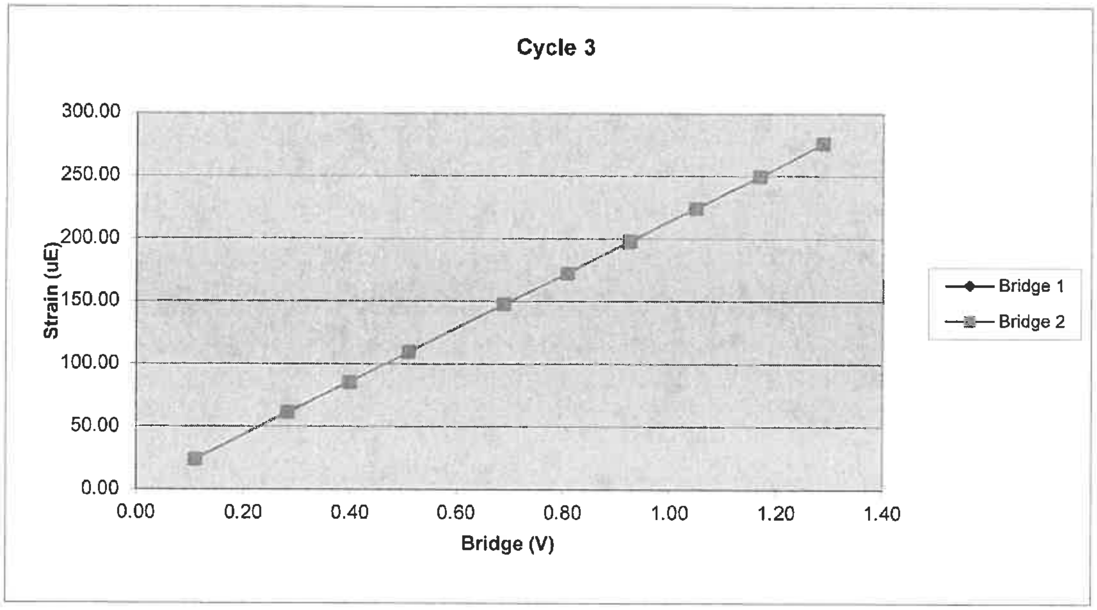
Force Strain Calibration	
EA (Kips)	**35381.61**
Offset	**-6.76**
Correlation	**0.999996**



203AWJ		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	843.85	23.93	0.11	0.11
3	2145.36	61.00	0.28	0.28
4	3029.63	85.25	0.40	0.40
5	3880.71	109.47	0.51	0.51
6	5241.19	147.71	0.69	0.69
7	6147.33	172.47	0.81	0.81
8	7034.72	198.06	0.92	0.92
9	7979.71	224.33	1.05	1.05
10	8906.15	249.58	1.17	1.17
11	9817.56	275.86	1.29	1.29

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7623.93**	**Force Calibration (lb/V)**	**7629.88**
Offset	**-3.49**	Offset	**-9.59**
Correlation	**0.999999**	Correlation	**0.999999**
Strain Calibration (µE/V)	**213.65**	**Strain Calibration (µE/V)**	**213.81**
Offset	**0.47**	Offset	**0.30**
Correlation	**0.999992**	Correlation	**0.999991**

Force Strain Calibration	
EA (Kips)	**35684.19**
Offset	**-20.08**
Correlation	**0.999992**



Bridge Excitation (V)	5
Shunt Resitor (ohm)	60.4k

Calibration Factors	203AWJ		
Bridge 1 (μE/V)	214.31	Bridge 2 (μE/V)	214.45
EA Factor (Kips)	35576.02	Area (in^2)	1.19

Calibrated by: David
Calibrated Date: 2/26/2019

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in 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.

Geotechnical-Engineering 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 given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives 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 this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- 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. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include 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.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering 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 subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
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