GEOTECHNICAL ENGINEERING REPORT

Salmon Falls Bridge over Saco River
WIN 023643.00
Hollis-Buxton, Maine

CHA Project Number: 90330.000

July 2025

Prepared for:
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IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE STAMP OF A LICENSED PROFESSIONAL IS ALTERED, THE ALTERING ENGINEER SHALL STAMP THE DOCUMENT AND INCLUDE THE NOTATION "ALTERED BY" FOLLOWED BY THEIR SIGNATURE, THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

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LIST OF ACRONYMS & ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ASTM	ASTM International
AOS	Apparent Opening Size
BDG	Bridge Design Guide
BGS	Below the Ground Surface
CHA	CHA Consulting, Inc.
FHWA	Federal Highway Administration
FJC	Flush Joint Casing
HSA	Hollow Stem Auger
MaineDOT	Maine Department of Transportation
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride
RQD	Rock Quality Designation
QA	Quality Assurance
QC	Quality Control
SSA	Solid Stem Auger
SPT	Standard Penetration Test
USGS	United States Geological Survey
WOH	Weight of Hammer
WOR	Weight of Rods
FPS	Feet per Second
KSF	Kips per Square Foot
KSI	Kips per Square Inch
PCI	Pounds per Cubic Inch
PCF	Pounds per Cubic Foot
PSI	Pounds per Square Inch

1.0 INTRODUCTION

CHA was retained by MaineDOT to perform geotechnical engineering services for the proposed replacement of the Salmon Falls Bridge over Saco River (Bridge 3708) in Hollis-Buxton, Maine. The project site is shown on *Figure 1- Location Map*.

The primary objectives of the geotechnical services were to explore the subsurface conditions at the project site, provide geotechnical recommendations for the design of the proposed replacement of the Salmon Falls Bridge, and to prepare a report documenting these items.

2.0 SITE AND PROJECT DESCRIPTION

The Salmon Falls Bridge carries U.S. 202 over Saco River in Hollis-Buxton, Maine.

The existing bridge is an approximately 199-foot long three-span structure with reinforced mass concrete abutments and piers supported on bedrock based on record plans. The existing bridge was built in 1948 and the superstructure consists of three simple spans of painted rolled steel beams.

The proposed replacement structure is a 215-foot long, single span bridge with semi-integral abutments on a vertical profile and horizontal alignment similar to the existing. The proposed bridge will have two 11-foot-wide travel lanes and an overall width of 35.3 feet. A portion of the existing abutments and wingwalls are proposed to remain in place and be used as cofferdams. The Headwater Elevation (Q100) of Saco River is El. 128.6 feet. The hydraulics at the bridge are influenced by the operation of the Skeleton Dam downstream. The currently proposed bridge information is summarized below in Table 2.1-1.

Table 2.1-1. Proposed Bridge Information

Abutment Location	Centerline of Bearings	Bottom of Footing El. (feet)
Abutment 1	STA 103+99	124.75
Abutment 2	STA 106+14	124.75

The roadway will be closed during construction and traffic detoured around the site. An excavation support system will not be required.

3.0 SUBSURFACE EXPLORATION AND TESTING

3.1 Subsurface Exploration

CHA conducted a subsurface exploration from August 5 to August 8, 2024. The exploration included 4 borings designated as BB-HBSR-101 through BB-HBSR-104. The borings extended to depths of 28 to 32 feet BGS, respectively. The boring locations are shown on *Figure 2 – Boring Location Plan*.

Seaboard Drilling, LLC of Bangor, Maine was retained by CHA to advance the borings. The as-drilled boring locations were located by field tie measurements to existing features by CHA. Ground surface elevations at the boring locations were estimated by interpolating between contours on the site survey. The locations and elevations should be considered accurate only to the degree implied by the method used to determine them.

The borings were advanced with a rubber track ATV mounted Mobile B48 drill rig using SSA with an inside diameter of 2.25 inches and FJC with an inside diameter of 4 inches. SPT and split barrel sampling was generally performed at standard 5-foot intervals.

Sampling was performed in general accordance with ASTM Standard D-1586 "Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils." The split barrel samples were advanced using an automatic 140 (+/-) pound trip hammer falling 30 (+/-) inches. "Blow counts" are recorded on the boring logs and indicate the penetration resistance for a 6-inch advancement of the split soon. The barrel is initially driven 6 inches to seat the sampler in undisturbed material. The number of blows required to drive the sampler the next 12 inches is taken as the SPT resistance or N-value. This value is indicative of the in-place density or consistency of the soil. The final 6-inch increment that the sampler is driven is not included in the determination of the N-value. Sample refusal is defined as a greater resistance than 50 blows per 6 inches of penetration. The calibration report, dated within 12 months prior to drilling, for the rig and hammer system used was obtained from the driller and N-values were corrected to N_{60} values. The calibration report is included in Appendix E.

An NX size core barrel was used to advance the boring after drilling refusal and obtain 1.875-inch outer diameter core samples in all four borings in general conformance with ASTM Standard D2113 "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation." The RQD value for bedrock samples was then determined in the field for each core sample in general conformance with ASTM Standard D6032 "Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core." RQD is defined as the sum of the length of core pieces 4 inches and longer, divided by the length of the core run, expressed as a percentage. Fractures within the core sample that are deemed to be the result of the drilling process are ignored when computing the RQD. The RQD values provide an indication of the relative degree of jointing or fracturing of the bedrock. Photographs of the rock cores are included in Appendix A.

A CHA geotechnical engineer observed the subsurface exploration to verify that proper drilling methods were used, describe soil and rock samples, and prepare field logs documenting the sampling, testing, and subsurface conditions.

Boreholes were backfilled with soil cuttings upon completion and supplemented with gravel where necessary, then topped with cold patch.

3.2 Laboratory Testing

CHA subcontracted GeoTesting Express of Acton, Massachusetts to perform the following laboratory testing on select soil and rock samples collected during the subsurface exploration.

- Moisture Content – ASTM D2216
- Sieve Analysis – ASTM D6913
- Uniaxial Compressive Strength of Rock – ASTM D7012C

4.0 SUBSURFACE CONDITIONS

The subsurface conditions at the site are summarized below based on a review of published geologic maps and the results of the borings and laboratory testing performed for this project.

4.1 Regional Geology

According to the *Surficial Geology of the Bar Mills Quadrangle, Maine* the surficial soil at the site is mapped as laminated to massive, gray to green-gray silt and clay of the Presumpscot Formation.

According to the *Bedrock Geologic Map of Maine,* the bedrock at the site is mapped as calcareous sandstone of the Vassalboro formation.

4.2 Subsurface Stratigraphy

Subsurface conditions encountered in the borings are detailed and described on the boring logs included in Appendix B. Soil descriptions were updated with the results of the laboratory testing as applicable and the laboratory test results are included in Appendix C. General subsurface conditions are described below in order of increasing depth BGS.

<u>Asphalt Pavement</u> – Asphalt pavement was encountered at the ground surface in all four borings ranging in thickness from 4 to 6 inches.

<u>Fill</u> – Existing fill described as fine to coarse sand with varying amounts of gravel, and silt was encountered below the asphalt in all borings. The fill extended to depths of 18 to 20.5 feet. The fill was brown and visually described as damp or wet. N_{60}-values ranged from 7 to split spoon refusal indicating a loose to very dense density.

<u>Glacial Till</u> – Glacial till described as fine to coarse gravel with fine to coarse sand, clayey silt, and organics was encountered below the fill in boring BB-HBSR-102. The glacial till extended to a depth of 22 feet. The sand was brown and visually described as wet. SPT sampling was attempted resulting in split spoon refusal indicating a very dense density.

<u>Calcareous Sandstone</u> – Calcareous sandstone bedrock was encountered below the fill in borings BB-HBSR-101, BB-HBSR-103, and BB-HBSR-104, and below the glacial till in boring BB-HBSR-102. The calcareous sandstone was slightly metamorphosed and described as gray, fine to coarse-grained, medium hard, very slightly to slightly weathered, with close fracture spacing. The RQD of the recovered samples ranged from 38 to 82 percent, indicating poor to good rock quality.

Table 4.2-1 summarizes top of bedrock elevations encountered in the borings at the proposed abutment locations.

Table 4.2-1. Top of Bedrock Elevations

Boring	Proposed Substructure	Station	Depth to Bedrock (feet)	Elevation of Bedrock Surface (feet)
BB-HBSR-101	Abutment 1	103+93.1	20.5	126
BB-HBSR-102	Abutment 1	103+93.1	22.0	124.5
BB-HBSR-103	Abutment 2	106+20	18.0	129.4
BB-HBSR-104	Abutment 2	106+20	18.5	128.9

4.3 Groundwater Conditions

Groundwater measurements were obtained in the boreholes during drilling operations as indicated on the boring logs included in Appendix B.

The boreholes were only open for a short duration and water was added during the borehole drilling therefore the measurements obtained may not accurately represent the groundwater level. Seasonal factors such as temperature and precipitation affect groundwater levels. For this reason, long-term groundwater levels may differ from those described in this report.

5.0 GEOTECHNICAL RECOMMENDATIONS

The following sections outline geotechnical design recommendations for the proposed project based on the subsurface conditions encountered within the borings. Related calculations are included in Appendix D.

5.1 Spread Footings, Abutments, and Wingwalls

Support the abutments and wingwalls on cast-in-place concrete spread footings founded on competent bedrock or Class A concrete subfootings founded on competent bedrock. Abutments, wingwalls, and their foundations and other supporting elements should be evaluated, proportioned, and designed by the appropriate methods in the applicable sections of the AASHTO LRFD Bridge Design Specifications and the MaineDOT BDG.

Abutments and walls on spread footings should be designed to resist overturning which results from lateral and eccentric vertical loads. The eccentricity should be evaluated in accordance with the MaineDOT BDG. The location of the resultant of the reaction forces at the strength limit state, based on factored loads, shall be within the middle nine-tenths of the footing width or length for footings on rock.

The foundation bearing areas should be approximately level. Bedrock slopes that exceed 4H:1V should be step-serrated or suitably benched to create level steps or a completely level subgrade. For bedrock slopes between 4H:1V and 6H:1V consider dowels into bedrock to control sliding potential. The bedrock surface shall be cleaned of all weathered bedrock, fractured material, loose soil, and/or ponded water prior to placement of the footing concrete or subfooting concrete. Smooth bedrock should be roughened or serrated prior to placing concrete to enhance sliding stability. Abutment and wingwall spread footings bearing on the competent bedrock at this project site do not require additional embedment for frost or scour protection.

Design the footings for a maximum service limit state bearing resistance of 40 ksf and a maximum strength limit state bearing resistance of 145 ksf, based on a RMR value of 52 and an average unconfined compressive strength of 2,888 ksf. The strength limit state bearing resistance includes a resistance factor of 0.45. Settlement of the abutments and wingwalls should be less than 0.5-inch at service limit if designed in accordance with the recommendations in this report. A nominal coefficient of friction of 0.60 at the bedrock-concrete interface and a resistance factor of 0.80 is recommended for checking sliding.

The proposed abutments and wingwalls should be backfilled with granular borrow for underwater backfill. This backfill should extend a minimum of 10 feet laterally from the back face of the walls and 1 foot laterally from the back face of the footings. The semi-integral abutments should be designed for active earth pressure over the rigid abutment height using a Rankine active earth pressure coefficient, K_a, of 0.307 and a uniform pressure distribution due to the height of the soil behind the superstructure backwall. The superstructure backwall should be designed for full passive pressure using a passive earth pressure coefficient, K_p, of 8.38. The wingwall active earth pressure coefficients were calculated using Coulomb based on wingwall geometry information available at time of report and are summarized in Table 5.1-1. The abutments and wingwalls should be designed for other surcharge loads as applicable. The recommended backfill properties for granular borrow for underwater backfill (Soil Type 4) are summarized below.

- Soil total unit weight = 125 pcf
- Internal angle of friction, ϕ = 32°
- Friction angle between fill and wall, δ = 24°

Table 5.1-1. Coulomb Active Earth Pressure Coefficients for Wingwalls

Location	K_a
Northwest WW	0.309
Northeast WW	0.294
Southwest WW	0.285
Southeast WW	0.287

5.2 Seismic

Site class D is recommended for seismic design of the bridge. Seismic design parameters were developed in accordance with AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020 as referenced by the MaineDOT BDG. The values are based on site class D for a seven percent probability of exceedance in 75 years. Table 5.2-1 summarizes the seismic design parameters.

Table 5.2-1. Seismic Design Parameters

Parameter	Design Value
F_{pga}	1.6
F_a	1.6
F_v	2.4
A_s	0.149
S_{DS}	0.296
S_{D1}	0.108

Therefore, the site is designated as Seismic Zone 1.

5.3 Frost Penetration Depth

According to the MaineDOT BDG, the design freezing index at the site is approximately 1300 degree-days. An assumed water content of 10% in the coarse-grained soil was selected based on laboratory test results. A frost penetration depth of 6.5 feet BGS is recommended for the site based on these parameters. Spread footings founded on bedrock require no minimum embedment depth due to frost.

5.4 Control of Water

The current plan for the replacing the bridge is to use portions of the existing abutments and wingwalls as cofferdams. Groundwater level observations made during the subsurface were affected by the drilling process, but it is likely that groundwater will be encountered over the bedrock surface in the foundation excavations. Appropriate items should be included in the contract to ensure that foundation excavations are dewatered so that all foundations are constructed in the dry.

5.5 Embankment Design Considerations

Embankment slopes uphill of the new wingwalls with inclinations of 2H:1V or flatter should be provided with loam and seed for permanent erosion protection. Riprap slope protection should be used in these uphill areas where slopes will be steeper than 2H:1V. Riprap slope protection should be used downhill of the new wingwalls for erosion protection. Riprap slope protection should consist of a 3-foot thick layer of plain riprap underlain by a 1-foot thick layer of bedding material.

The on-site soils generally do not meet MaineDOT requirements for Granular Borrow Material for Underwater Backfill or Gravel Borrow, but may meet requirements for Common Borrow, and/or Granular Borrow Material for Embankment Construction. The suitability of on-site soil for re-use as fill should be evaluated based on bulk sampling and laboratory testing of the material.

6.0 EXCAVATIONS

All excavations should be performed in accordance with OSHA standards and other applicable State and Federal regulations. In areas where sufficient sloping of excavation is not possible, the excavation should be shored, sheeted, and braced. All temporary excavation support systems should be designed by a Professional Engineer licensed in the State of Maine.

7.0 OBSERVATION DURING CONSTRUCTION

A qualified geotechnical engineer should carefully inspect all final bearing surfaces for foundations to ascertain that bedrock subgrades have been properly prepared. The materials used as fill should be tested by a qualified soils laboratory to verify they meet the specified gradations and to determine their optimum moisture content and maximum dry density for compaction. In-place density tests should be performed to verify that compaction methods and equipment achieve the required densities.

8.0 CLOSURE

The geotechnical recommendations presented in this report are based, in part, on project and subsurface information available at the time this report was prepared and in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. Some variation of subsurface conditions may occur between locations explored that may not become evident until construction. Depending on the nature and extent of the variations, it may be necessary to re-evaluate the recommendations presented in this report.

This report has been prepared solely for design purposes and shall not be incorporated by reference or other means in the Contract Documents. If this report is included in the Contract Documents, it shall be for information only. Specifications shall take precedence.

9.0 REFERENCES

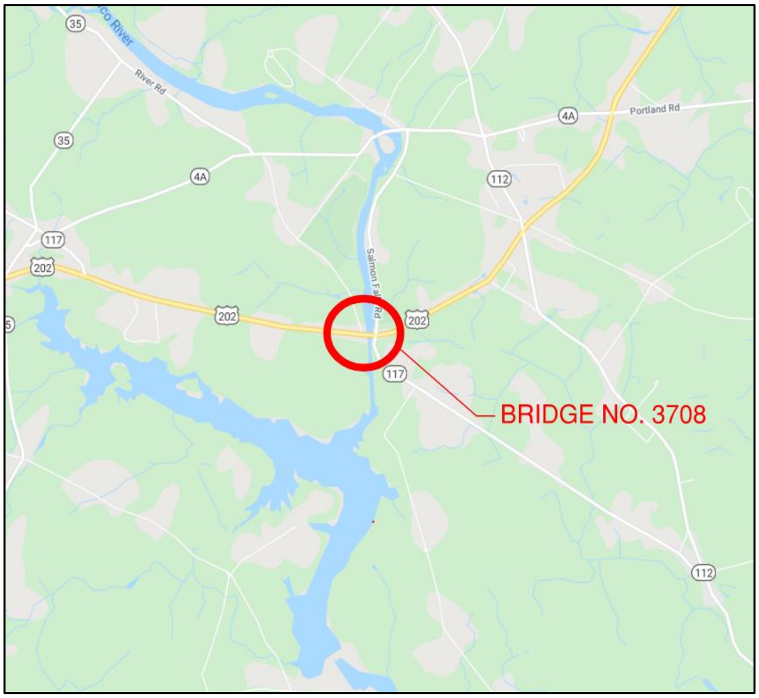
Hunter, L.E., et.al. *Surficial Geology of the Bar Mills Quadrangle, Maine*. Maine Geological Survey, 1999.

Osberg, Philip H., Hussey II, Arthur M., Boone, Gary M. et. al. *Bedrock Geologic Map of Maine*. Maine Geological Survey,1985.

FIGURES

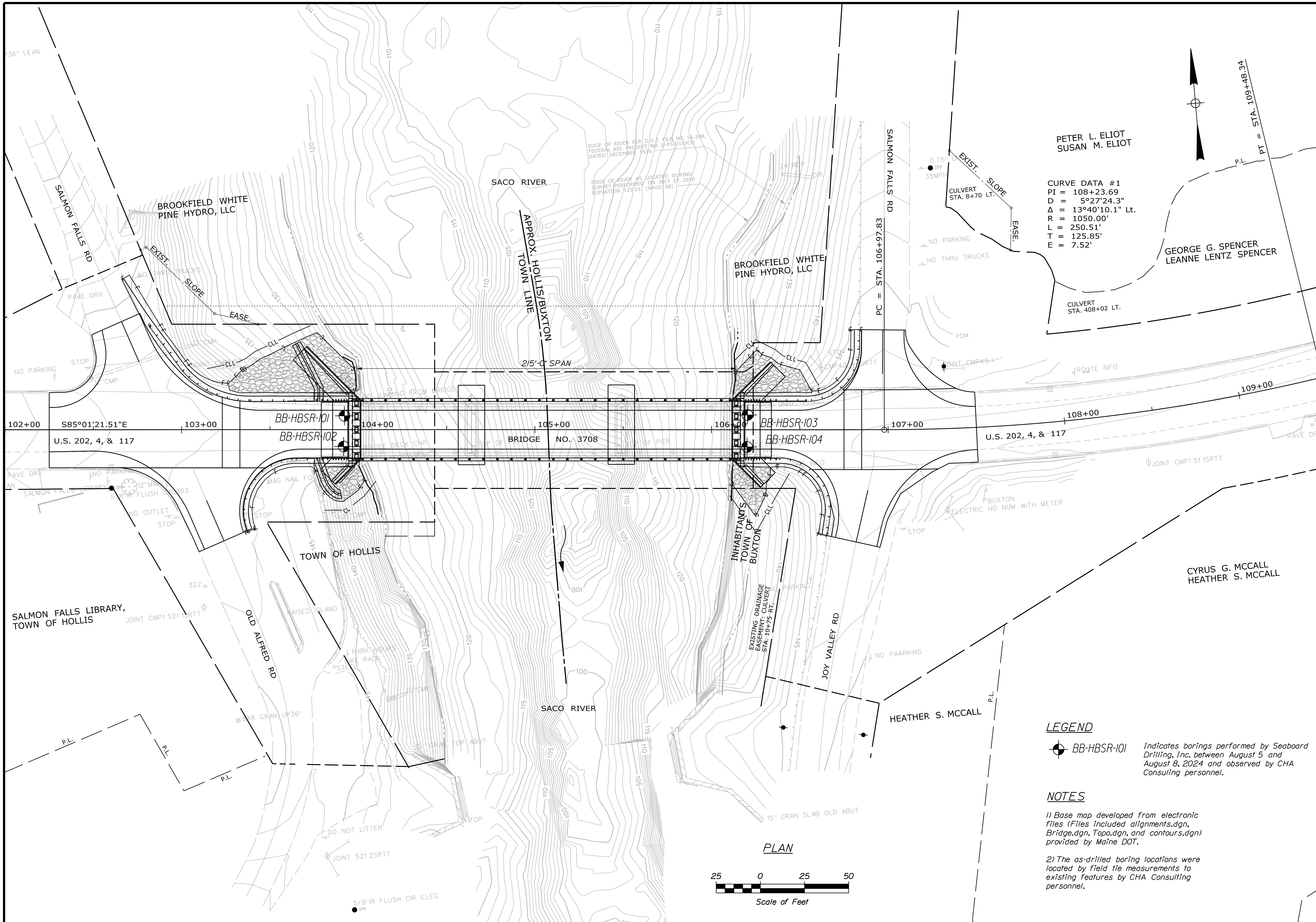
FIGURE 1, LOCATION MAP

Hollis Buxton, Salmon Falls Bridge #3708
U.S. 202, 4 & 117 over Saco River



Latitude: 43° 35' 47.3" N, Longitude: 70° 33' 14.2" W
Images are from Google Maps

Filename: ...\MSTA\005_Boring Plan.dgn   Division: HIGHWAY   Username: 1619   Date:7/10/2025



LEGEND

BB-HBSR-101 — Indicates borings performed by Seaboard Drilling, Inc. between August 5 and August 8, 2024 and observed by CHA Consuling personnel.

NOTES

1) Base map developed from electronic files (Files included alignments.dgn, Bridge.dgn, Topo.dgn, and contours.dgn) provided by Maine DOT.

2) The as-drilled boring locations were located by field tie measurements to existing features by CHA Consulting personnel.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2364300

WIN 23643.00

BRIDGE NO. 3708   BRIDGE PLANS

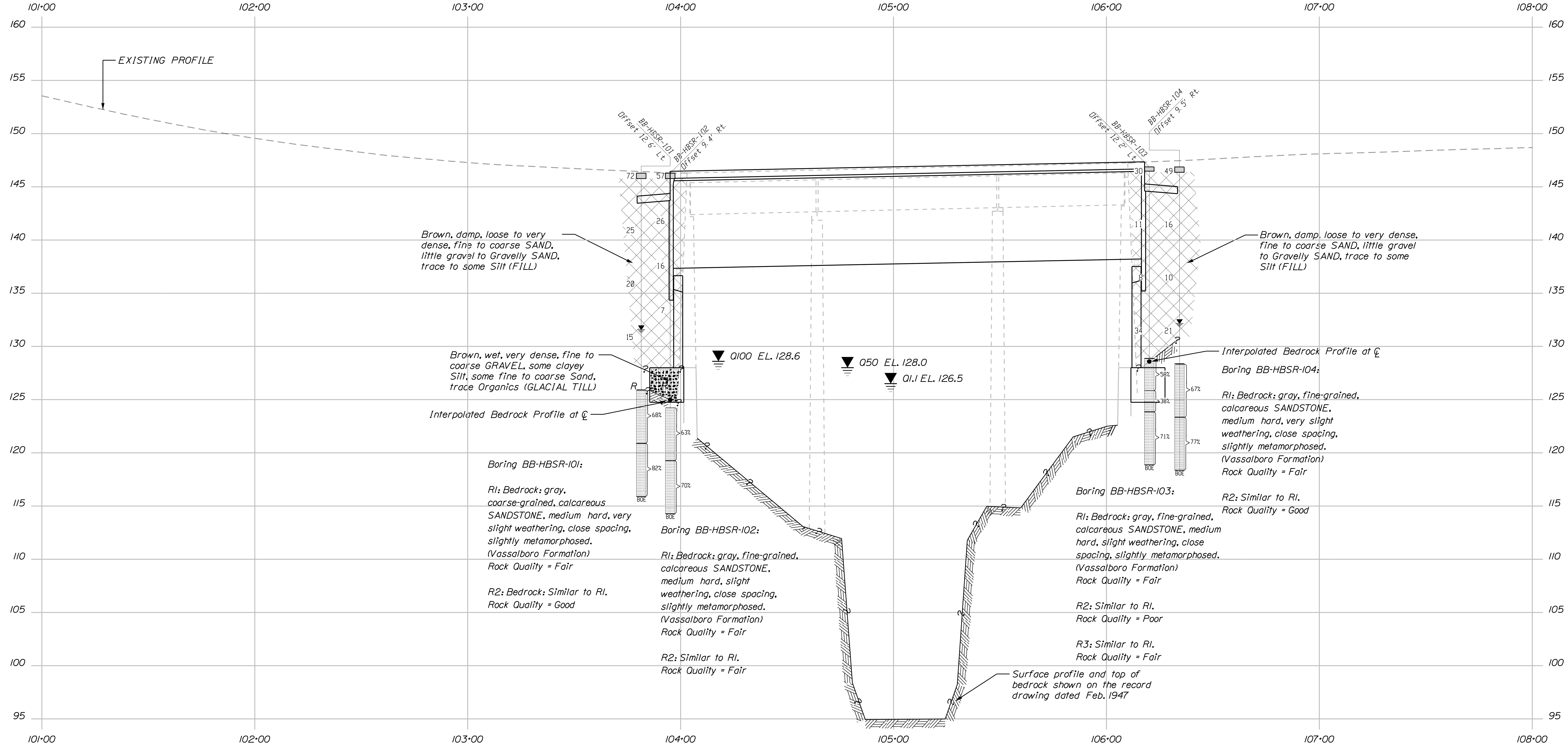
	BY	DATE
PROJ. MANAGER	D. Eaton	
DESIGN-DETAILED	P. Lusitani	N. Zukerman Nov. 2024
CHECKED-REVIEWED	C. Wall	J. Parrelli Jan. 2024
DESIGN2-DETAILED2	R. Howe	P. Pare Nov. 2024
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE   P.E. NUMBER   DATE

SALMON FALLS BRIDGE
SACO RIVER
HOLLIS-BUXTON   YORK COUNTY

BORING LOCATION PLAN

SHEET NUMBER
5
OF 56

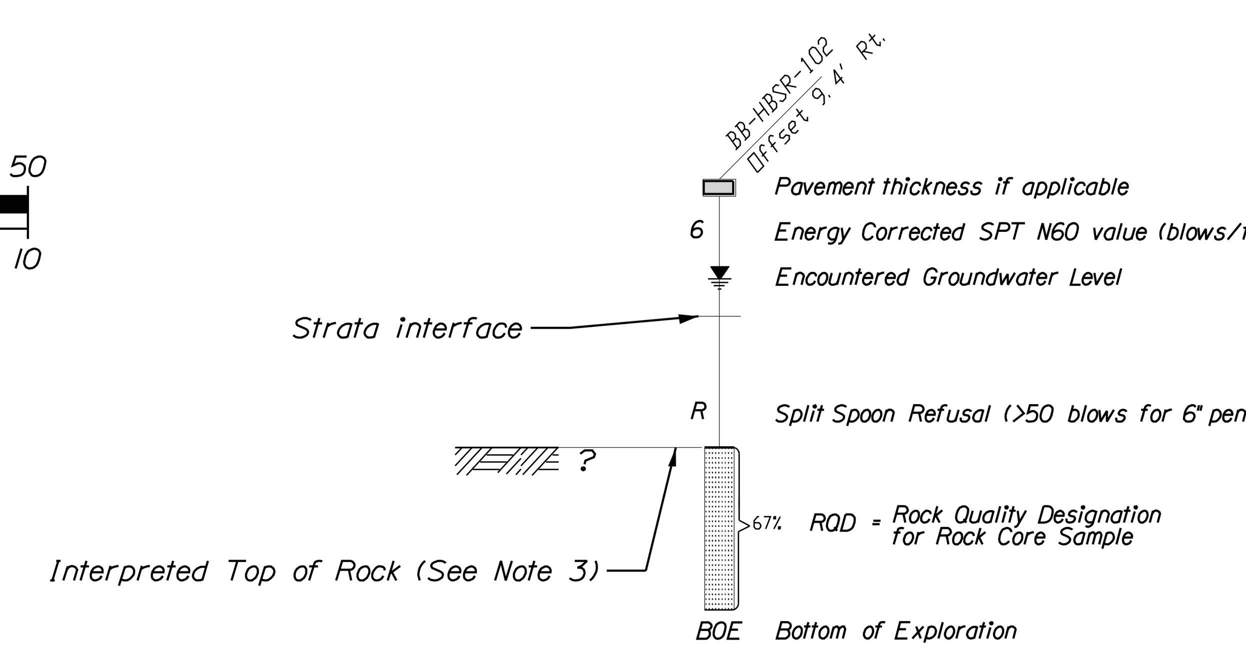


PROFILE

Horiz. 25 0 25 50

Vert. 5 0 5 10

Scale of Feet



NOTES:

1) Base map developed from electronic files provided by Maine DOT.

2) BB-HBSR-100 series bridge borings were performed by Seaboard Drilling, Inc. and observed by CHA Consulting personnel between August 5 and August 8, 2024.

3) This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information, refer to the boring logs.

Filename: ...\006_Boring Interpretive.dgn Division: HIGHWAY Username: 1619 Date:7/10/2025

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN
PIN

HIGHWAY PLANS / BRIDGE PLANS

PROJ. MANAGER	$PROJMANAGER$	
DESIGN-DETAILED	$designer1$	$detailer1$	$projdate1$
CHECKED-REVIEWED	$designer2$	$detailer2$	$projdate2$
DESIGN2-DETAILED3	$designer3$	$detailer3$	$projdate3$
REVISIONS 1		$revdate1$
REVISIONS 2	$revision3$	$revdate2$
REVISIONS 3	$revision4$	$revdate3$
REVISIONS 4		$revdate4$
FIELD CHANGES	$fieldchange$	$fielddate$

BY DATE SIGNATURE P.E. NUMBER DATE

INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER

6

OF

Filename: ...\MSTA\007_Boring Logs.dgn Division: HIGHWAY Username: 1619 Date:7/10/2025

Maine Department of Transportation — Soil/Rock Exploration Log — US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge	Location: Hollis, ME	Boring No.: BB-HBSR-101	WIN: 23643.00
Driller: Seaboard Drilling, Inc.	Elevation (ft.): 146.5	Auger ID/OD: 2.25"	
Operator: M. Bussey	Datum: NAVD88	Sampler: Standard Split Spoon	
Logged By: C. Hourigan	Rig Type: Mobile B-48	Hammer Wt./Fall: 140#/30"	
Date Start/Finish: Aug. 5 & Aug. 6, 2024	Drilling Method: Flush-Joint Casing	Core Barrel: NX	
Boring Location: 103+93.1, 8.6 Lt.	Casing ID/OD: 4"	Water Level*: 14.7 ft. bgs	
Hammer Efficiency Factor: 0.985	Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person; S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.50 - 2.50	22-24-20-21	44	72	SSA	146.0	6" Asphalt Pavement (0.5) Brown, damp, very dense, fine to coarse Gravelly SAND, little silt. (Fill)	A-1-a, SP-SM WC=2.5%
5	2D	24/18	5.00 - 7.00	8-8-7-6	15	25			Becomes medium dense, grades to little gravel. (Fill)	
10	3D	24/11	10.00 - 12.00	6-6-6-7	12	20	41		Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt. (Fill)	A-1-b, SM WC=7.2%
							46			
							53			
							57			
							43			
15	4D	24/7	15.00 - 17.00	8-5-4-2	9	15	22		Similar to 3D. (Fill)	
							19			
							22			
							27			
							23		No recovery.	
20	5D R1	6/0 60/60	20.00 - 20.50 20.50 - 25.50	50/6" RQD = 68%	R		32/6" NX	126.0	(20.5) Top of bedrock at Elev.: 126'. R1: Bedrock: gray, coarse-grained, calcareous SANDSTONE, medium hard, very slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 20.5-21.5 ft (2:54) 21.5-22.5 ft (2:54) 22.5-23.5 ft (2:52) 23.5-24.5 ft (2:23) 24.5-25.5 ft (3:40) 100% Recovery	qp = 2,529 ksf
25	R2	60/56	25.50 - 30.50	RQD = 82%					R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Good. R2: Core Times (min:sec) 25.5-26.5 ft (4:46) 26.5-27.5 ft (3:44) 27.5-28.5 ft (2:25) 28.5-29.5 ft (3:50) 29.5-30.5 ft (3:52) 100% Recovery	
30								116.0	(30.5) Bottom of Exploration at 30.5 feet below ground surface.	

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 20.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1 Boring No.: BB-HBSR-101

Maine Department of Transportation — Soil/Rock Exploration Log — US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge	Location: Hollis, ME	Boring No.: BB-HBSR-102	WIN: 23643.00
Driller: Seaboard Drilling, Inc.	Elevation (ft.): 146.5	Auger ID/OD: 2.25"	
Operator: M. Bussey	Datum: NAVD88	Sampler: Standard Split Spoon	
Logged By: C. Hourigan	Rig Type: Mobile B-48	Hammer Wt./Fall: 140#/30"	
Date Start/Finish: Aug. 5 & Aug. 5, 2024	Drilling Method: Flush-Joint Casing	Core Barrel: NX	
Boring Location: 103+93.1, 9.0 Rt.	Casing ID/OD: 4"	Water Level*: 7.0 ft. bgs	
Hammer Efficiency Factor: 0.985	Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person; S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/15	0.50 - 2.50	24-21-14-15	35	57	SSA	146.0	6" Asphalt Pavement (0.5) Brown, damp, very dense, fine to coarse SAND, little silt, little gravel. (Fill)	
5	2D	24/12	5.00 - 7.00	8-10-6-5	16	26			Becomes medium dense, grades to some gravel. (Fill)	
10	3D	24/13	10.00 - 12.00	6-5-5-6	10	16			Brown, damp, medium dense, fine to coarse SAND, some silt, some gravel. (Fill)	A-1-b, SM WC=4.7%
15	4D	24/15	15.00 - 17.00	4-2-2-2	4	7	18		Brown, damp, loose, fine to coarse Gravelly SAND, some silt. (Fill)	
							26			
							38			
							45	128.0	(18.5)	
							55			
20	5D	6/4	20.00 - 20.50	50/6"	R		79		Brown, wet, very dense, fine to coarse GRAVEL, some clayey silt, some fine to coarse sand, trace organics. (Glacial Till)	A-2-4, GM WC=4.2%
							66	124.5	(22.0)	
	R1	60/57	22.00 - 27.00	RQD = 63%			NX		Top of bedrock at Elev.: 124.5'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 22-23 ft (2:48) 23-24 ft (2:28) 24-25 ft (2:51) 25-26 ft (3:09) 26-27 ft (3:37) 95% Recovery	qp = 2,735 ksf
25	R2	60/63	27.00 - 32.00	RQD = 70%					R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Fair. R2: Core Times (min:sec) 27-28 ft (5:02) 28-29 ft (3:27) 29-30 ft (2:44) 30-31 ft (3:26) 31-32 ft (3:28) 105% Recovery	
30								114.5	(32.0) Bottom of Exploration at 32.0 feet below ground surface.	

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 22 feet.
3. Recovered remainder of R1 sample in R2 core run.
4. Water at 7.0 feet upon completion of exploration.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1 Boring No.: BB-HBSR-102

Maine Department of Transportation — Soil/Rock Exploration Log — US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge	Location: Hollis, ME	Boring No.: BB-HBSR-103	WIN: 23643.00
Driller: Seaboard Drilling, Inc.	Elevation (ft.): 147.4	Auger ID/OD: 2.25"	
Operator: M. Bussey	Datum: NAVD88	Sampler: Standard Split Spoon	
Logged By: C. Hourigan	Rig Type: Mobile B-48	Hammer Wt./Fall: 140#/30"	
Date Start/Finish: Aug. 6 & Aug. 7, 2024	Drilling Method: Flush-Joint Casing	Core Barrel: NX	
Boring Location: 106+20.0, 9.0 Lt.	Casing ID/OD: 4"	Water Level*: 8.8 ft. bgs	
Hammer Efficiency Factor: 0.985	Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person; S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/11	0.50 - 2.50	17-10-8-10	18	30	SSA	146.9	4" Asphalt Pavement (0.5) Brown, damp, medium dense, fine to coarse Gravelly SAND, trace silt. (Fill)	A-1-a, SP-SM WC=1.9%
5	2D	24/12	5.00 - 7.00	3-3-4-5	7	11			Grades to little silt. (Fill)	
10	3D	24/11	10.00 - 12.00	3-3-2-2	5	8			Brown, damp, loose, fine to coarse Gravelly SAND, trace silt. (Fill)	A-1-b, SP-SM WC=2.8%
15	4D	24/7	15.00 - 17.00	17-12-9-5	21	34	24		Becomes dense. (Fill)	
							29			
							36	129.4	(18.0)	
		36/36	18.00 - 21.00	RQD = 58%			NX		Top of bedrock at Elev.: 129.4'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 18-19 ft (4:13) 19-20 ft (5:30) 20-21 ft (4:30) 100% Recovery	qp = 3,054 ksf
20		24/12	21.00 - 23.00	RQD = 38%					R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Poor. R2: Core Times (min:sec) 21-22 ft (1:09) 22-23 ft (1:44) 50% Recovery	
		60/68	23.00 - 28.00	RQD = 71%					R3: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Fair. R3: Core Times (min:sec) 23-24 ft (2:11) 24-25 ft (1:52) 25-26 ft (1:41) 26-27 ft (1:27) 27-28 ft (1:34) 113% Recovery	
25								119.4	(28.0) Bottom of Exploration at 28.0 feet below ground surface.	

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 18 feet.
3. Core barrel jam at 21 feet. Replace barrel bit.
4. Recovered remainder of R2 sample in R3 core run.
5. Water at 8.8 feet upon completion of exploration.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1 Boring No.: BB-HBSR-103

Maine Department of Transportation — Soil/Rock Exploration Log — US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge	Location: Hollis, ME	Boring No.: BB-HBSR-104	WIN: 23643.00
Driller: Seaboard Drilling, Inc.	Elevation (ft.): 147.4	Auger ID/OD: 2.25"	
Operator: M. Bussey	Datum: NAVD88	Sampler: Standard Split Spoon	
Logged By: C. Hourigan	Rig Type: Mobile B-48	Hammer Wt./Fall: 140#/30"	
Date Start/Finish: Aug. 8 & Aug. 8, 2024	Drilling Method: Flush-Joint Casing	Core Barrel: NX	
Boring Location: 106+20.0, 8.6 Rt.	Casing ID/OD: 4"	Water Level*: 14.7 ft. bgs	
Hammer Efficiency Factor: 0.985	Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions: D = Split Spoon Sample; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MU = Unsuccessful Thin Wall Tube Sample Attempt; V = Field Vane Shear Test, PP = Pocket Penetrometer; MV = Unsuccessful Field Vane Shear Test Attempt; R = Rock Core Sample; SSA = Solid Stem Auger; HSA = Hollow Stem Auger; RC = Roller Cone; WOH = Weight of 140lb. Hammer; WOR/C = Weight of Rods or Casing; WO1P = Weight of One Person; S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf); $S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf); q_p = Unconfined Compressive Strength (ksf); N-uncorrected = Raw Field SPT N-value; Hammer Efficiency Factor = Rig Specific Annual Calibration Value; N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency; N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected; T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; G = Grain Size Analysis; C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.50 - 2.50	21-15-15-16	30	49	SSA	146.9	5" Asphalt Pavement (0.5) Brown, damp, dense, fine to coarse SAND, some gravel, trace silt. (Fill)	
5	2D	24/14	5.00 - 7.00	5-6-4-3	10	16			Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt. (Fill)	A-1-b, SM WC=3.3%
10	3D	24/14	10.00 - 12.00	3-3-3-4	6	10	44		Becomes loose, grades to little gravel. (Fill)	
							48			
							50			
							46			
							44			
15	4D	24/4	15.00 - 17.00	13-7-6-4	13	21	43		Brown, damp, medium dense, fine to coarse Gravelly SAND, trace silt. (Fill)	A-1-b, SW-SM WC=10.6%
							31			
							38			
	R1	60/60	18.50 - 23.50	RQD = 67%			43 NX	128.9	(18.5) Top of bedrock at Elev.: 128.9'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, very slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 18.5-19.5 ft (2:43) 19.5-20.5 ft (1:49) 20.5-21.5 ft (1:44) 21.5-22.5 ft (1:57) 22.5-23.5 ft (2:42) 100% Recovery	qp = 3,234 ksf
20	R2	60/60	23.50 - 28.50	RQD = 77%					R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Good. R2: Core Times (min:sec) 23.5-24.5 ft (3:22) 24.5-25.5 ft (4:21) 25.5-26.5 ft (2:46) 26.5-27.5 ft (3:55) 27.5-28.5 ft (3:22) 100% Recovery	
25								118.9	(28.5) Bottom of Exploration at 28.5 feet below ground surface.	

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 18.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 1 Boring No.: BB-HBSR-104

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2364300

BRIDGE PLANS

WIN 23643.00

BRIDGE NO. 3708

		BY	DATE
PROJ. MANAGER	D. Eaton		
DESIGN-DETAILED	P. Lusitani	N. Zukerman	Nov. 2024
CHECKED-REVIEWED	C. Wall	J. Parrelli	Jan. 2025
DESIGN2-DETAILED2	R. Howe	P. Pare	Nov. 2024
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

SALMON FALLS BRIDGE
SACO RIVER
HOLLIS-BUXTON YORK COUNTY

BORING LOGS

SHEET NUMBER 7 OF 56

APPENDIX A

Bedrock Core Photographs

MaineDOT Hollis-Buxton Bridge

Carries US-202 over Saco River

Hollis, ME

Rock Core Photographs

Boring No.	Run	Depth (ft)	Recovery (in.)	Recovery (%)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-HBSR-102	R1	22 - 27	57	95	38	63	SANDSTONE	1
BB-HBSR-102	R2	27 - 32	63	105	42	70	SANDSTONE	1,2
BB-HBSR-101	R1	20.5 – 25.5	60	100	41	68	SANDSTONE	3
BB-HBSR-101	R2	25.5 – 30.5	56	93	49	82	SANDSTONE	4

Notes:

1. Box row corresponds to the core box section in which the rock core sample is contained.
2. Top photo is dry, bottom photo is wet.

MaineDOT Hollis-Buxton Bridge

Carries US-202 over Saco River

Hollis, ME

Rock Core Photographs

Boring No.	Run	Depth (ft)	Recovery (in.)	Recovery (%)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-HBSR-103	R1	18 - 21	36	100	21	58	SANDSTONE	1
BB-HBSR-103	R2	21 - 23	12	50	9	38	SANDSTONE	1
BB-HBSR-103	R3	23 - 28	68	113	48	71	SANDSTONE	1,2
BB-HBSR-104	R1	18.5 – 23.5	60	100	40	67	SANDSTONE	3
BB-HBSR-104	R2	23.5 – 28.5	60	100	46	77	SANDSTONE	4

Notes:

1. Box row corresponds to the core box section in which the rock core sample is contained.
2. Top photo is dry, bottom photo is wet.

APPENDIX B

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, Gravelly sands, little or no fines
			SP	Poorly-graded sands, Gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, Silty or Clayey fine sands, or Clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, Gravelly clays, Sandy clays, Silty clays, lean clays.
			OL	Organic silts and organic Silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations (in this order, if applicable):

Color (Munsell color chart)
Moisture (dry, damp, moist, wet)
Density/Consistency (from above right hand side)
Texture (fine, medium, coarse, etc.)
Name (Sand, Silty Sand, Clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc.,)
Cementation (weak, moderate, or strong)
Geologic Origin (till, marine clay, alluvium, etc.)
Groundwater level

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

MODIFIED BURMISTER SYSTEM

Descriptive Term	Portion of Total (%)
trace	0 - 10
little	11 - 20
some	21 - 35
adjective (e.g. Sandy, Clayey)	36 - 50

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) Silty or Clayey gravels; and (3) Silty, Clayey or Gravelly sands. Density is rated according to standard penetration resistance (N-value).

Density of Cohesionless Soils	Standard Penetration Resistance N_{60}-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) Gravelly, Sandy or Silty clays; and (3) Clayey silts. Consistency is rated according to undrained shear strength as indicated.

Consistency of Cohesive soils	SPT N_{60}-Value (blows per foot)	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD\ (\%) = \frac{\text{sum of the lengths of intact pieces of core* > 4 inches}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Rock Quality Based on RQD

Rock Quality	RQD (%)
Very Poor	≤25
Poor	26 - 50
Fair	51 - 75
Good	76 - 90
Excellent	91 - 100

Desired Rock Observations (in this order, if applicable):

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Rock Type (granite, schist, sandstone, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.)
- -spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet)
- -tightness (tight, open, or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock quality (very poor, poor, etc.)
ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

Sample Container Labeling Requirements:

WIN	Blow Counts
Bridge Name / Town	Sample Recovery
Boring Number	Date
Sample Number	Personnel Initials
Sample Depth	

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge
Location: Hollis, ME

Boring No.: BB-HBSR-101
WIN: 23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	146.5	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 5 & Aug. 6, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	103+93.1, 8.6 Lt.	**Casing ID/OD:**	4"	**Water Level*:**	14.7 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.50 - 2.50	22-24-20-21	44	72	SSA	146.0		6" Asphalt Pavement 0.5 Brown, damp, very dense, fine to coarse Gravelly SAND, little silt. (Fill)	A-1-a, SP-SM WC=2.5%
5	2D	24/18	5.00 - 7.00	8-8-7-6	15	25				Becomes medium dense, grades to little gravel. (Fill)	
10	3D	24/11	10.00 - 12.00	6-6-6-7	12	20	41			Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt. (Fill)	A-1-b, SM WC=7.2%
							46				
							53				
							57				
							43				
15	4D	24/7	15.00 - 17.00	8-5-4-2	9	15	22			Similar to 3D. (Fill)	
							19				
							22				
							27				
							23				
20	5D	6/0	20.00 - 20.50	50/6"	R		32/6"	126.0		No recovery. 20.5	
	R1	60/60	20.50 - 25.50	RQD = 68%			NX			Top of bedrock at Elev.: 126'. R1: Bedrock: gray, coarse-grained, calcareous SANDSTONE, medium hard, very slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 20.5-21.5 ft (2:54) 21.5-22.5 ft (2:54)	qp = 2,529 ksf
25											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 20.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge
Location: Hollis, ME

Boring No.: BB-HBSR-101
WIN: 23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	146.5	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 5 & Aug. 6, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	103+93.1, 8.6 Lt.	**Casing ID/OD:**	4"	**Water Level*:**	14.7 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	R2	60/56	25.50 - 30.50	RQD = 82%						22.5-23.5 ft (2:52) 23.5-24.5 ft (2:23) 24.5-25.5 ft (3:40) 100% Recovery R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Good. R2: Core Times (min:sec) 25.5-26.5 ft (4:46) 26.5-27.5 ft (3:44) 27.5-28.5 ft (2:25) 28.5-29.5 ft (3:50) 29.5-30.5 ft (3:52) 100% Recovery	
30								116.0		30.5	
										Bottom of Exploration at 30.5 feet below ground surface.	
35											
40											
45											
50											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 20.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge
Location: Hollis, ME

Boring No.: BB-HBSR-102
WIN: 23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	146.5	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 5 & Aug. 5, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	103+93.1, 9.0 Rt.	**Casing ID/OD:**	4"	**Water Level*:**	7.0 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/15	0.50 - 2.50	24-21-14-15	35	57	SSA	146.0		6" Asphalt Pavement (0.5) Brown, damp, very dense, fine to coarse SAND, little silt, little gravel. (Fill)	
5	2D	24/12	5.00 - 7.00	8-10-6-5	16	26				Becomes medium dense, grades to some gravel. (Fill)	
10	3D	24/13	10.00 - 12.00	6-5-5-6	10	16				Brown, damp, medium dense, fine to coarse SAND, some silt, some gravel. (Fill)	A-1-b, SM WC=4.7%
15	4D	24/15	15.00 - 17.00	4-2-2-2	4	7	18			Brown, damp, loose, fine to coarse Gravelly SAND, some silt. (Fill)	
							26				
							38				
							45	128.0		18.5	
							55				
20	5D	6/4	20.00 - 20.50	50/6"	R		79			Brown, wet, very dense, fine to coarse GRAVEL, some clayey silt, some fine to coarse sand, trace organics. (Glacial Till)	A-2-4, GM WC=4.2%
							66	124.5		22.0	
	R1	60/57	22.00 - 27.00	RQD = 63%			NX			Top of bedrock at Elev.: 124.5'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec)	qp = 2,735 ksf
25											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 22 feet.
3. Recovered remainder of R1 sample in R2 core run.
4. Water at 7.0 feet upon completion of exploration.
5. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge				**Boring No.:**	BB-HBSR-102
Location: Hollis, ME				**WIN:**	23643.00
Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	146.5	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 5 & Aug. 5, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	103+93.1, 9.0 Rt.	**Casing ID/OD:**	4"	**Water Level*:**	7.0 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										22-23 ft (2:48) 23-24 ft (2:28) 24-25 ft (2:51) 25-26 ft (3:09) 26-27 ft (3:37) 95% Recovery	
	R2	60/63	27.00 - 32.00	RQD = 70%						R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Fair. R2: Core Times (min:sec) 27-28 ft (5:02) 28-29 ft (3:27) 29-30 ft (2:44) 30-31 ft (3:26) 31-32 ft (3:28) 105% Recovery	
30											
								114.5		32.0	
										Bottom of Exploration at 32.0 feet below ground surface.	
35											
40											
45											
50											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 22 feet.
3. Recovered remainder of R1 sample in R2 core run.
4. Water at 7.0 feet upon completion of exploration.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge		**Boring No.:**	BB-HBSR-103
Location: Hollis, ME		**WIN:**	23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	147.4	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 6 & Aug. 7, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	106+20.0, 9.0 Lt.	**Casing ID/OD:**	4"	**Water Level*:**	8.8 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/11	0.50 - 2.50	17-10-8-10	18	30	SSA	146.9		4" Asphalt Pavement 0.5	A-1-a, SP-SM WC=1.9%
										Brown, damp, medium dense, fine to coarse Gravelly SAND, trace silt. (Fill)	
5	2D	24/12	5.00 - 7.00	3-3-4-5	7	11				Grades to little silt. (Fill)	
10	3D	24/11	10.00 - 12.00	3-3-2-2	5	8				Brown, damp, loose, fine to coarse Gravelly SAND, trace silt. (Fill)	A-1-b, SP-SM WC=2.8%
15	4D	24/7	15.00 - 17.00	17-12-9-5	21	34	24			Becomes dense. (Fill)	
							29				
							36				
		36/36	18.00 - 21.00	RQD = 58%			NX	129.4		18.0 Top of bedrock at Elev.: 129.4'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 18-19 ft (4:13) 19-20 ft (5:30) 20-21 ft (4:30) 100% Recovery	qp = 3,054 ksf
20											
		24/12	21.00 - 23.00	RQD = 38%						R2: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Poor. R2: Core Times (min:sec)	
		60/68	23.00 - 28.00	RQD = 71%							
25											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 18 feet.
3. Core barrel jam at 21 feet. Replace barrel bit.
4. Recovered remainder of R2 sample in R3 core run.
5. Water at 8.8 feet upon completion of exploration.
6. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge
Location: Hollis, ME

Boring No.: BB-HBSR-103
WIN: 23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	147.4	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 6 & Aug. 7, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	106+20.0, 9.0 Lt.	**Casing ID/OD:**	4"	**Water Level*:**	8.8 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										21-22 ft (1:09) 22-23 ft (1:44) 50% Recovery R3: Bedrock: Similar to R1. [Vassalboro Formation] Rock Quality: Fair.	
								119.4		R3: Core Times (min:sec) 23-24 ft (2:11) 24-25 ft (1:52) 25-26 ft (1:41) 26-27 ft (1:27) 27-28 ft (1:34) 113% Recovery	
30										28.0	
										Bottom of Exploration at 28.0 feet below ground surface.	
35											
40											
45											
50											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 15 feet of soil. No water observed in borehole at 15 feet (prior to introducing water).
2. Roller bit refusal at 18 feet.
3. Core barrel jam at 21 feet. Replace barrel bit.
4. Recovered remainder of R2 sample in R3 core run.
5. Water at 8.8 feet upon completion of exploration.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge
Location: Hollis, ME

Boring No.: BB-HBSR-104
WIN: 23643.00

Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	147.4	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 8 & Aug. 8, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	106+20.0, 8.6 Rt.	**Casing ID/OD:**	4"	**Water Level*:**	14.7 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.50 - 2.50	21-15-15-16	30	49	SSA	146.9		5" Asphalt Pavement 0.5 Brown, damp, dense, fine to coarse SAND, some gravel, trace silt. (Fill)	
5	2D	24/14	5.00 - 7.00	5-6-4-3	10	16				Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt. (Fill)	A-1-b, SM WC=3.3%
10	3D	24/14	10.00 - 12.00	3-3-3-4	6	10	44			Becomes loose, grades to little gravel. (Fill)	
							48				
							50				
							46				
							44				
15	4D	24/4	15.00 - 17.00	13-7-6-4	13	21	43			Brown, damp, medium dense, fine to coarse Gravelly SAND, trace silt. (Fill)	A-1-b, SW-SM WC=10.6%
							31				
							38				
	R1	60/60	18.50 - 23.50	RQD = 67%			43 NX	128.9		18.5 Top of bedrock at Elev.: 128.9'. R1: Bedrock: gray, fine-grained, calcareous SANDSTONE, medium hard, very slight weathering, close spacing, slightly metamorphosed. [Vassalboro Formation] Rock Quality: Fair. R1: Core Times (min:sec) 18.5-19.5 ft (2:43) 19.5-20.5 ft (1:49) 20.5-21.5 ft (1:44) 21.5-22.5 ft (1:57) 22.5-23.5 ft (2:42) 100% Recovery	qp = 3,234 ksf
20											
	R2	60/60	23.50 - 28.50	RQD = 77%						R2: Bedrock: Similar to R1.	
25											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 18.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Hollis-Buxton Bridge		**Location:** Hollis, ME		**Boring No.:** BB-HBSR-104	**WIN:** 23643.00
Driller:	Seaboard Drilling, Inc.	**Elevation (ft.)**	147.4	**Auger ID/OD:**	2.25"
Operator:	M. Bussey	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Hourigan	**Rig Type:**	Mobile B-48	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	Aug. 8 & Aug. 8, 2024	**Drilling Method:**	Flush-Joint Casing	**Core Barrel:**	NX
Boring Location:	106+20.0, 8.6 Rt.	**Casing ID/OD:**	4"	**Water Level*:**	14.7 ft. bgs
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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MU = Unsuccessful Thin Wall Tube Sample Attempt
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SSA = Solid Stem Auger
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WOH = Weight of 140 lb. Hammer
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S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25								118.9		[Vassalboro Formation] Rock Quality: Good. R2: Core Times (min:sec) 23.5-24.5 ft (3:22) 24.5-25.5 ft (4:21) 25.5-26.5 ft (2:46) 26.5-27.5 ft (3:55) 27.5-28.5 ft (3:22) 100% Recovery 28.5	
										Bottom of Exploration at 28.5 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

1. Use 2.25" SSA to advance borehole through asphalt and initial 10 feet of soil. No water observed in borehole at 10 feet (prior to introducing water).
2. Roller bit refusal at 18.5 feet.
3. Water at 14.7 feet upon completion of exploration.
4. The borehole was backfilled with soil cuttings and topped with coldpatch upon completion.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

APPENDIX C

Laboratory Test Results

Client:	CHA Companies, Inc.				
Project:	Hollis-Buxton Bridge				
Location:	---			Project No:	GTX-319779
Boring ID:	---	Sample Type:	---	Tested By:	ajl
Sample ID:	---	Test Date:	09/13/24	Checked By:	ank
Depth :	---	Test Id:	785320		

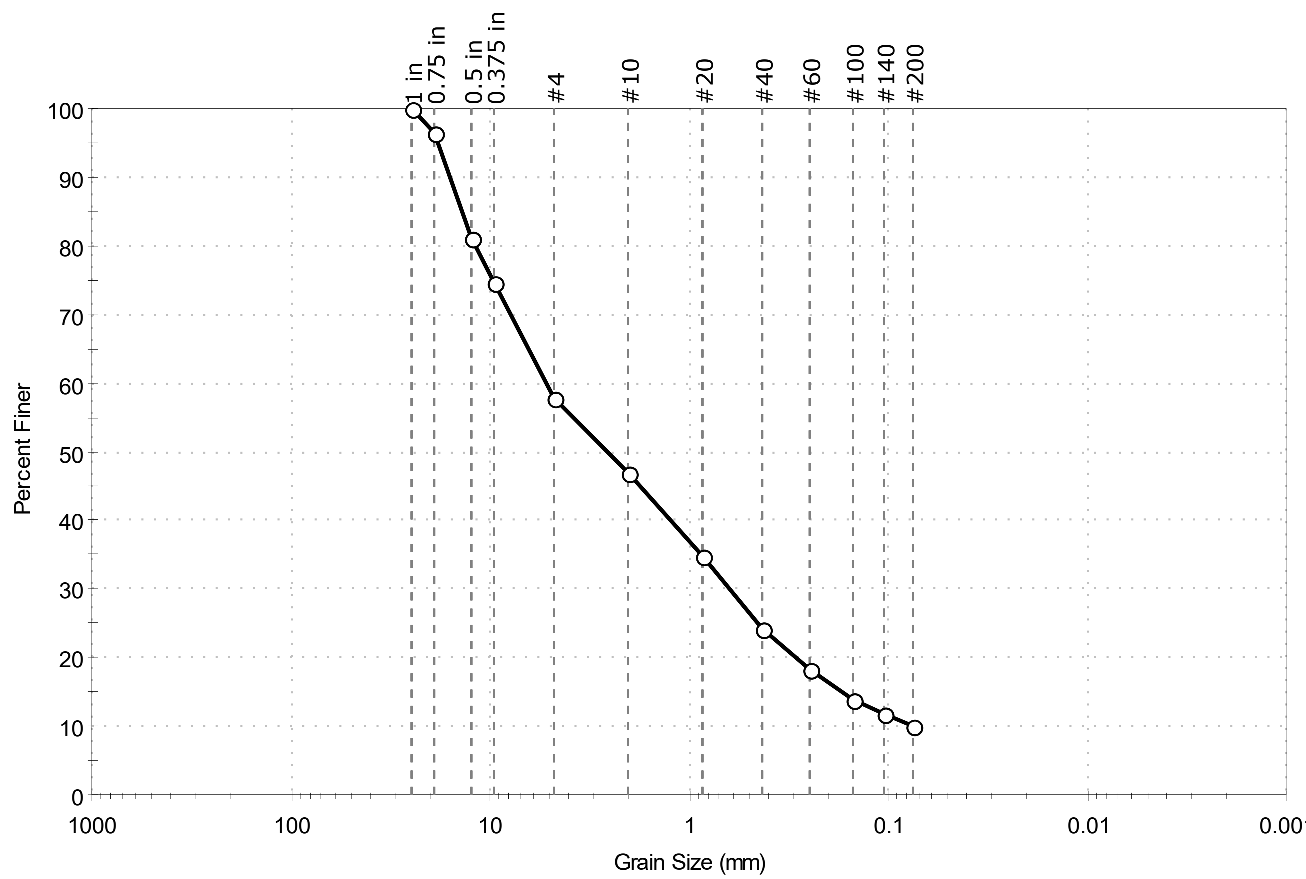
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BB-HBSR-101	1D	0.5-2.5'	Moist, light brown sand with silt and gravel	2.5
BB-HBSR-101	3D	10-12'	Moist, brown silty sand with gravel	7.2
BB-HBSR-102	3D	10-12'	Moist, brown silty sand with gravel	4.7
BB-HBSR-102	5D	20-20.5'	Moist, brownish gray silty gravel with sand	4.2
BB-HBSR-103	1D	0.3-2.3'	Moist, light brown sand with silt and gravel	1.9
BB-HBSR-103	3D	10-12'	Moist, brown sand with silt and gravel	2.8
BB-HBSR-104	2D	5-7'	Mpoist, light brown sand with silt and gravel	3.3
BB-HBSR-104	4D	15-17'	Moist, dark brown sand with silt and gravel	10.6

Notes: Temperature of Drying : 110º Celsius

Client:	CHA Companies, Inc.		
Project:	Hollis-Buxton Bridge		
Location:	---	Project No:	GTX-319779
Boring ID: BB-HBSR-101	Sample Type: Bag	Tested By:	ajl
Sample ID: 1D	Test Date: 09/16/24	Checked By:	ank
Depth : 0.5-2.5'	Test Id: 785305		
Test Comment:	---		
Visual Description:	Moist, light brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	42.1	47.7	10.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	96		
0.5 in	12.50	81		
0.375 in	9.50	75		
#4	4.75	58		
#10	2.00	47		
#20	0.85	35		
#40	0.42	24		
#60	0.25	18		
#100	0.15	14		
#140	0.11	12		
#200	0.075	10		

Coefficients

D_{85} =13.9239 mm D_{30} =0.6196 mm
D_{60} =5.1912 mm D_{15} =0.1704 mm
D_{50} =2.5500 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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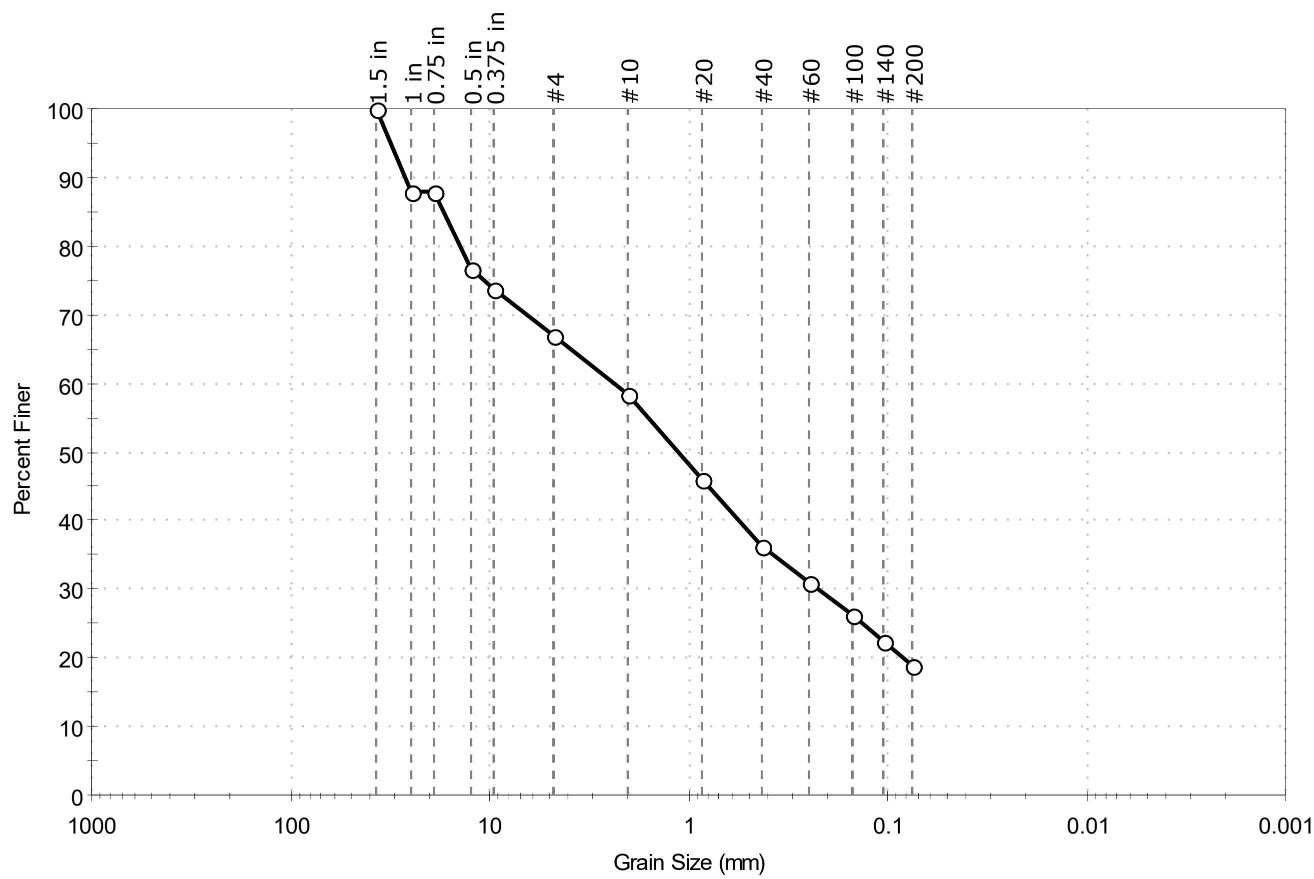
Client:	CHA Companies, Inc.		
Project:	Hollis-Buxton Bridge		
Location:	---	Project No:	GTX-319779
Boring ID: BB-HBSR-101	Sample Type: Bag	Tested By:	ajl
Sample ID: 3D	Test Date: 09/16/24	Checked By:	ank
Depth : 10-12'	Test Id: 785306		
Test Comment:	---		
Visual Description:	Moist, brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	33.2	47.8	19.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	88		
0.75 in	19.00	88		
0.5 in	12.50	77		
0.375 in	9.50	74		
#4	4.75	67		
#10	2.00	58		
#20	0.85	46		
#40	0.42	36		
#60	0.25	31		
#100	0.15	26		
#140	0.11	22		
#200	0.075	19		

Coefficients

D_{85} =17.0939 mm D_{30} =0.2271 mm
D_{60} =2.3569 mm D_{15} =N/A
D_{50} =1.1237 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM   N/A

AASHTO   Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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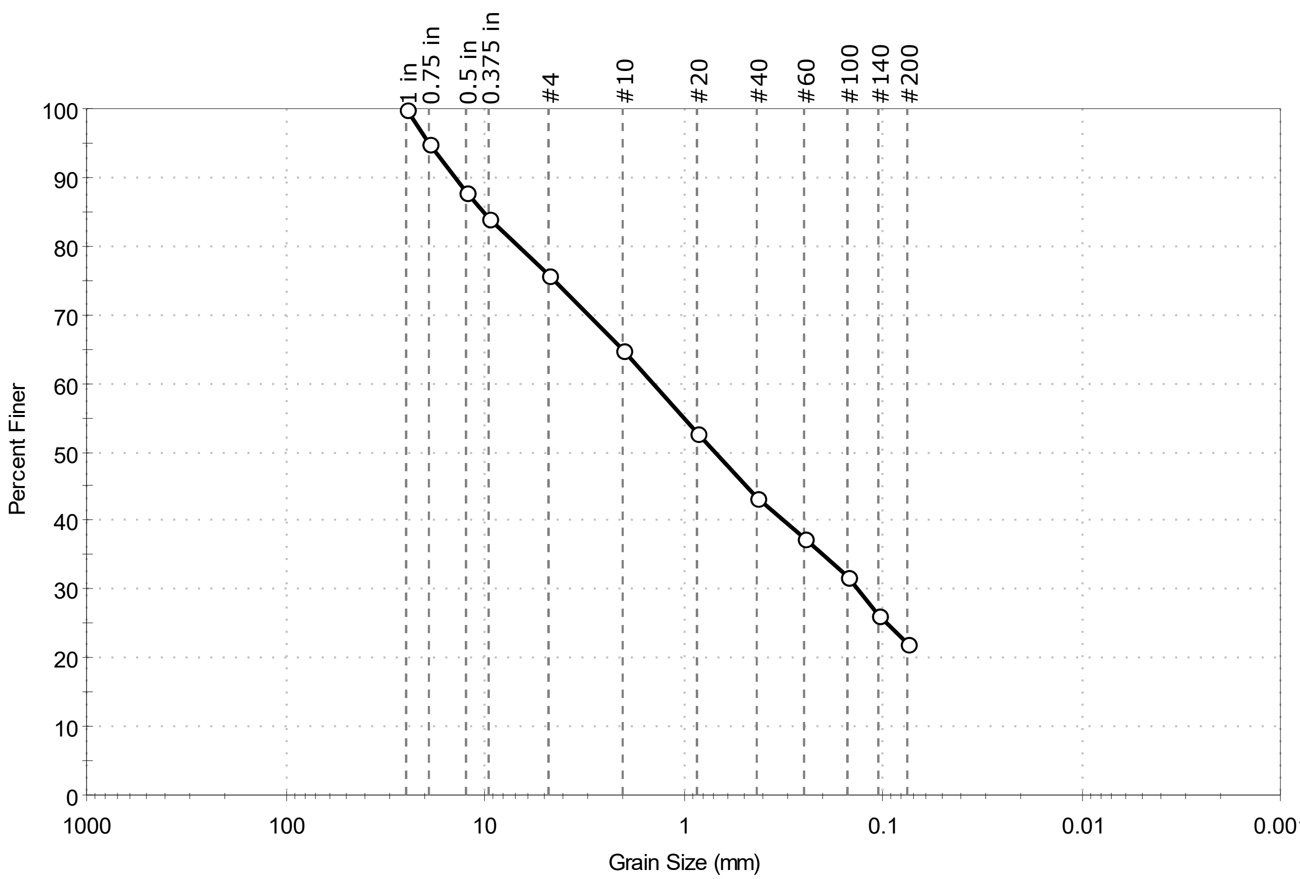
Client: CHA Companies, Inc.			
Project: Hollis-Buxton Bridge			
Location: ---		Project No:	GTX-319779
Boring ID: BB-HBSR-102	Sample Type: Bag	Tested By:	ajl
Sample ID: 3D	Test Date: 09/16/24	Checked By:	ank
Depth : 10-12'	Test Id: 785307		

Test Comment: ---
Visual Description: Moist, brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	24.3	53.5	22.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	95		
0.5 in	12.50	88		
0.375 in	9.50	84		
#4	4.75	76		
#10	2.00	65		
#20	0.85	53		
#40	0.42	43		
#60	0.25	38		
#100	0.15	32		
#140	0.11	26		
#200	0.075	22		

Coefficients

D_{85} =10.1192 mm | D_{30} =0.1337 mm
D_{60} =1.4131 mm | D_{15} =N/A
D_{50} =0.6928 mm | D_{10} =N/A
C_u =N/A | C_c =N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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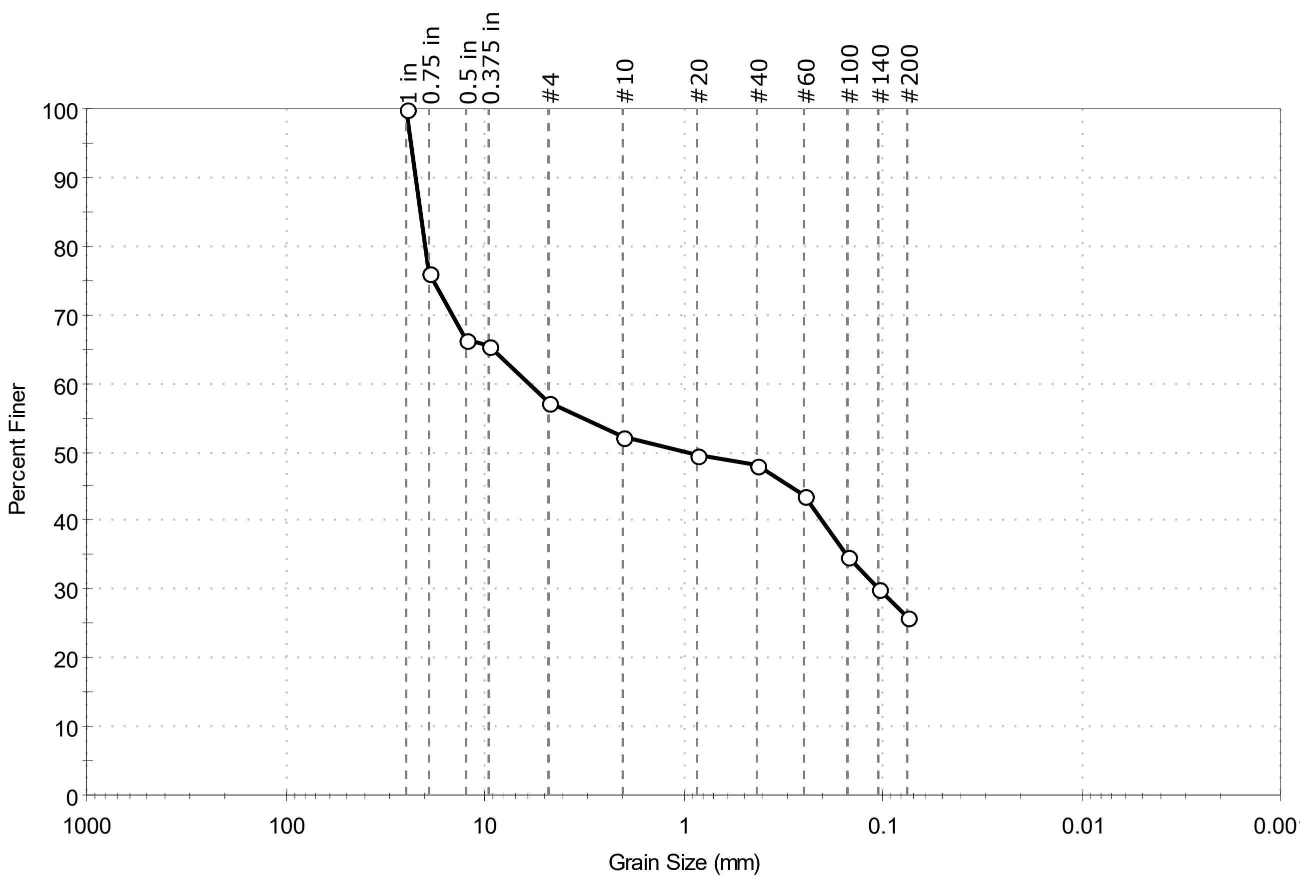
Client:	CHA Companies, Inc.		
Project:	Hollis-Buxton Bridge		
Location:	---	Project No:	GTX-319779
Boring ID: BB-HBSR-102	Sample Type: Bag	Tested By:	ajl
Sample ID: 5D	Test Date: 09/16/24	Checked By:	ank
Depth : 20-20.5'	Test Id: 785308		

Test Comment: ---

Visual Description: Moist, brownish gray silty gravel with sand

Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	42.9	31.2	25.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	76		
0.5 in	12.50	66		
0.375 in	9.50	65		
#4	4.75	57		
#10	2.00	52		
#20	0.85	50		
#40	0.42	48		
#60	0.25	44		
#100	0.15	35		
#140	0.11	30		
#200	0.075	26		

Coefficients

D_{85} =21.0418 mm | D_{30} =0.1049 mm

D_{60} =6.0376 mm | D_{15} =N/A

D_{50} =0.9484 mm | D_{10} =N/A

C_u =N/A | C_c =N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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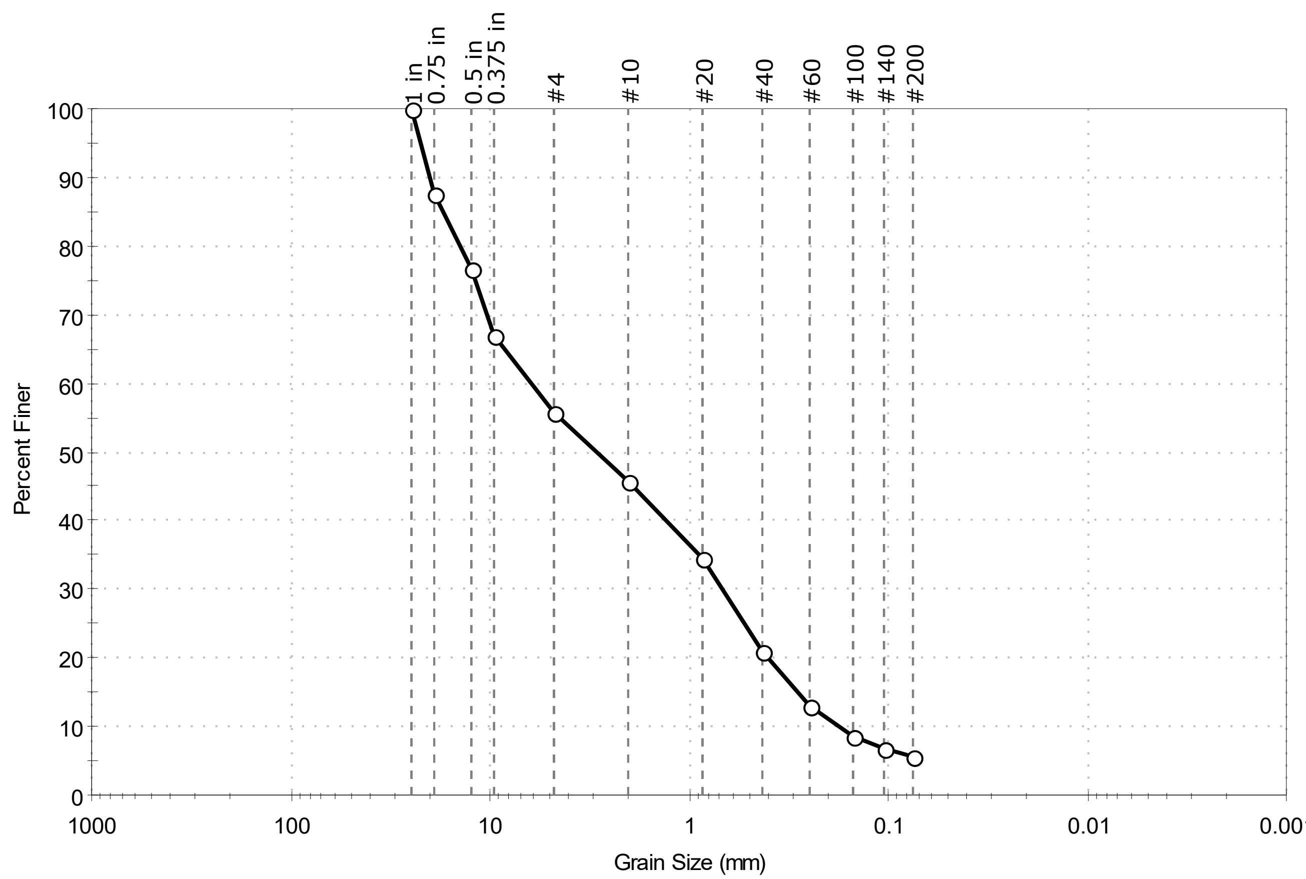
Client:	CHA Companies, Inc.		
Project:	Hollis-Buxton Bridge		
Location:	---	Project No:	GTX-319779
Boring ID:	BB-HBSR-103	Sample Type: Bag	Tested By: ajl
Sample ID:	1D	Test Date: 09/16/24	Checked By: ank
Depth :	0.3-2.3'	Test Id: 785309	
Test Comment:	---		
Visual Description:	Moist, light brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	44.4	50.0	5.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	88		
0.5 in	12.50	77		
0.375 in	9.50	67		
#4	4.75	56		
#10	2.00	46		
#20	0.85	34		
#40	0.42	21		
#60	0.25	13		
#100	0.15	8		
#140	0.11	7		
#200	0.075	5.6		

Coefficients

D_{85} =17.2066 mm — D_{30} =0.6788 mm

D_{60} =6.2027 mm — D_{15} =0.2880 mm

D_{50} =2.9126 mm — D_{10} =0.1790 mm

C_u =34.652 — C_c =0.415

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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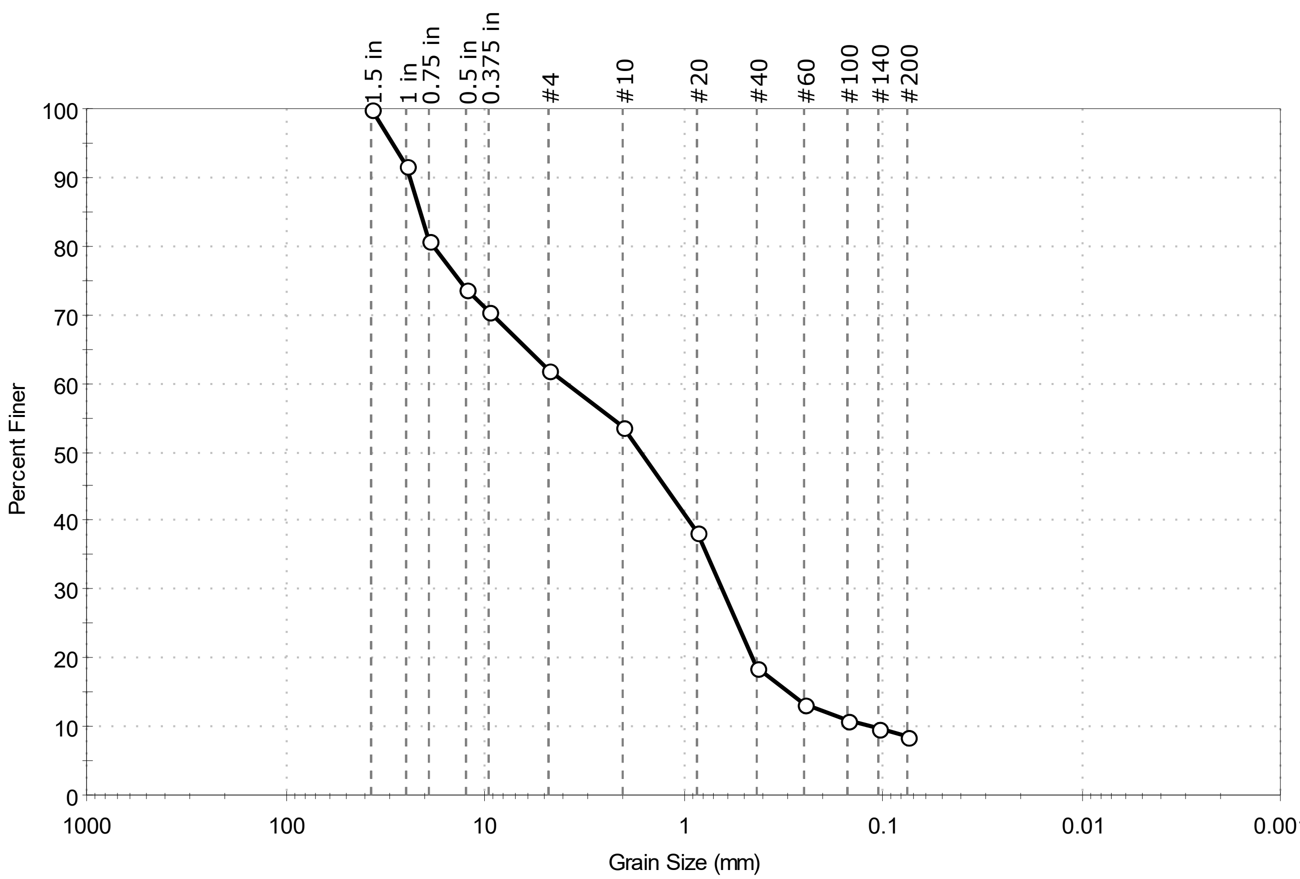
Client:	CHA Companies, Inc.		
Project:	Hollis-Buxton Bridge		
Location:	---	Project No:	GTX-319779
Boring ID: BB-HBSR-103	Sample Type: Bag	Tested By:	ajl
Sample ID: 3D	Test Date: 09/16/24	Checked By:	ank
Depth : 10-12'	Test Id: 785310		

Test Comment: ---
Visual Description: Moist, brown sand with silt and gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	37.9	53.6	8.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	92		
0.75 in	19.00	81		
0.5 in	12.50	74		
0.375 in	9.50	70		
#4	4.75	62		
#10	2.00	54		
#20	0.85	38		
#40	0.42	19		
#60	0.25	13		
#100	0.15	11		
#140	0.11	10		
#200	0.075	8.5		

Coefficients

D_{85} =21.1041 mm D_{30} =0.6330 mm
D_{60} =3.8518 mm D_{15} =0.2966 mm
D_{50} =1.6267 mm D_{10} =0.1141 mm
C_u =33.758 C_c =0.912

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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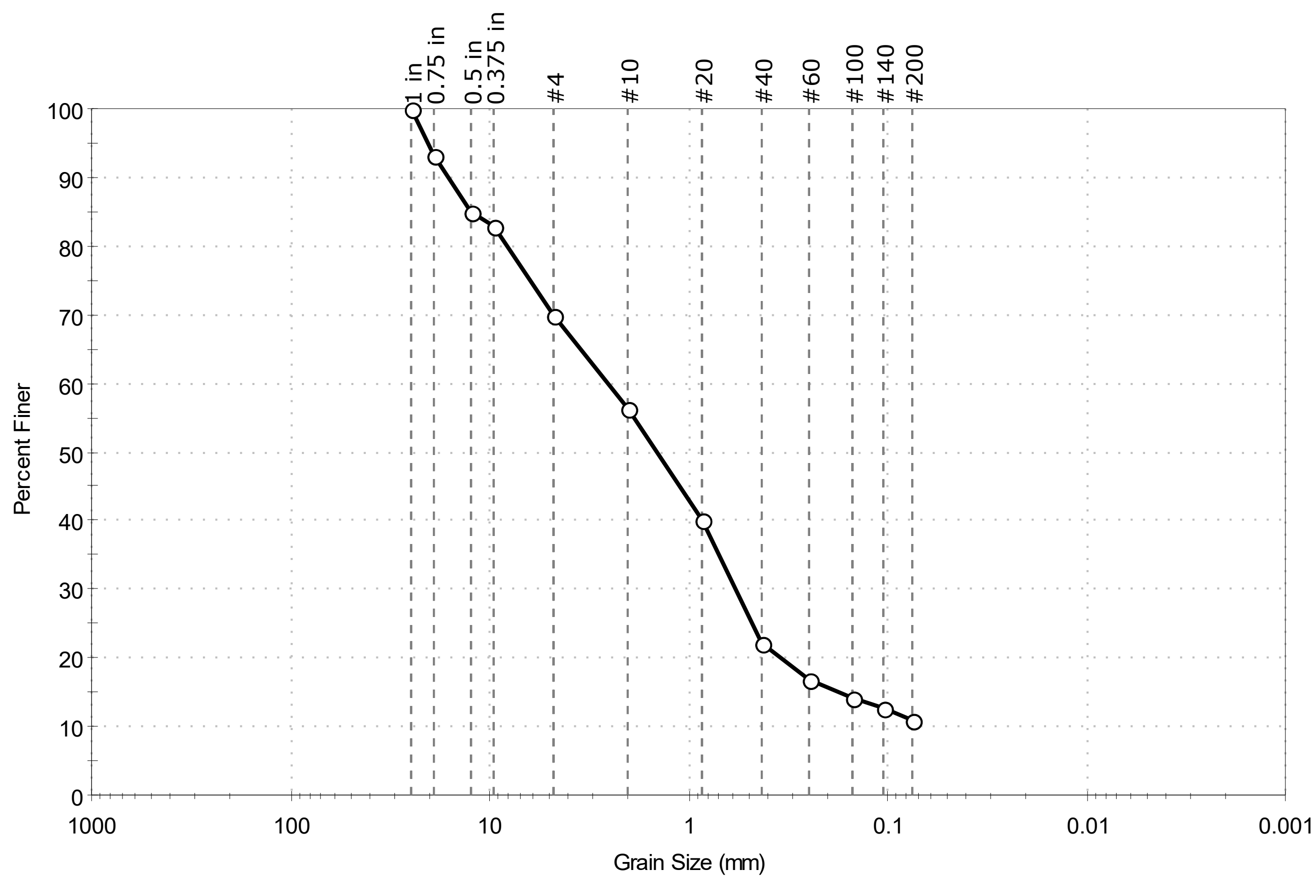
Client:	CHA Companies, Inc.			
Project:	Hollis-Buxton Bridge			
Location:	---		Project No:	GTX-319779
Boring ID:	BB-HBSR-104	Sample Type: Bag	Tested By:	ajl
Sample ID:	2D	Test Date: 09/16/24	Checked By:	ank
Depth :	5-7'	Test Id: 785311		

Test Comment: ---
Visual Description: Mpoist, light brown sand with silt and gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	29.9	59.0	11.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	93		
0.5 in	12.50	85		
0.375 in	9.50	83		
#4	4.75	70		
#10	2.00	56		
#20	0.85	40		
#40	0.42	22		
#60	0.25	17		
#100	0.15	14		
#140	0.11	13		
#200	0.075	11		

Coefficients

D_{85} =12.4375 mm D_{30} =0.5731 mm
D_{60} =2.5077 mm D_{15} =0.1728 mm
D_{50} =1.4246 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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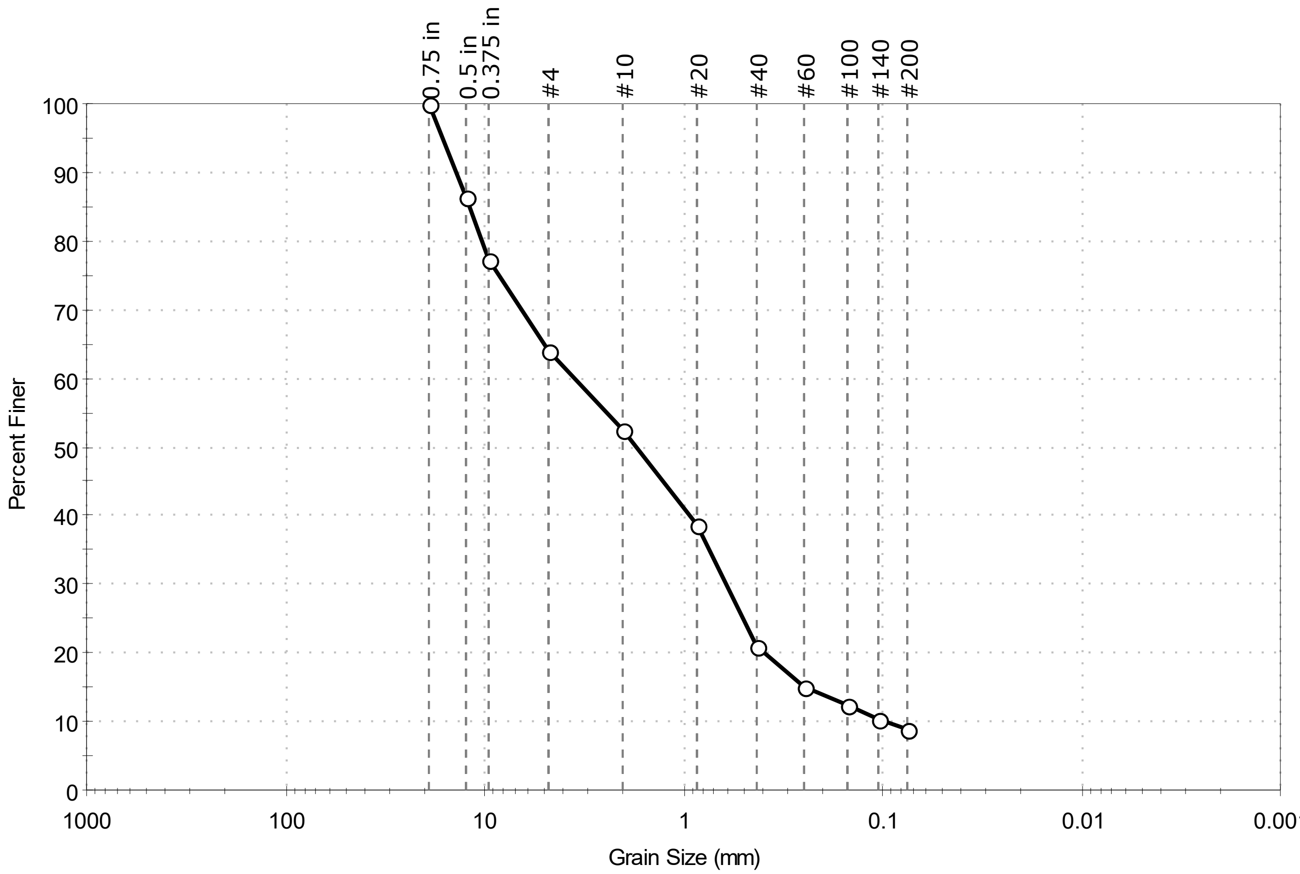
Client:	CHA Companies, Inc.				
Project:	Hollis-Buxton Bridge				
Location:	---			Project No:	GTX-319779
Boring ID:	BB-HBSR-104	Sample Type:	Bag	Tested By:	ajl
Sample ID:	4D	Test Date:	09/16/24	Checked By:	ank
Depth :	15-17'	Test Id:	785312		

Test Comment: ---
Visual Description: Moist, dark brown sand with silt and gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	36.0	55.3	8.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	86		
0.375 in	9.50	77		
#4	4.75	64		
#10	2.00	53		
#20	0.85	39		
#40	0.42	21		
#60	0.25	15		
#100	0.15	12		
#140	0.11	10		
#200	0.075	8.7		

Coefficients

D_{85} =11.9889 mm
D_{30} =0.6079 mm
D_{60} =3.5057 mm
D_{15} =0.2463 mm
D_{50} =1.7054 mm
D_{10} =0.0969 mm
C_u =36.179
C_c =1.088

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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GeoTesting EXPRESS
A Sercel Business

Client: CHA Companies, Inc.			
Project: Hollis-Buxton Bridge			
Location: ---		Project No: GTX-319779	
Boring ID: ---	Sample Type: ---	Tested By: gp	
Sample ID: ---	Test Date: 09/25/24	Checked By: smd	
Depth : ---	Test Id: 785326		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
BB-HBSR-101	R-1	23.81-24.19 ft	170	17560	2	No	1,*
BB-HBSR-102	R-1	22.40-22.78 ft	170	18995	1	No	1,*
BB-HBSR-103	R-1	19.33-19.70 ft	170	21208	1	No	1,*
BB-HBSR-104	R-1	21.96-22.34 ft	170	22459	1	No	1,*

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.

All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.

The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.

Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure (See attached photographs)

1: Best effort end preparation. See Tolerance report for details.
2: The as-received core did not meet the ASTM side straightness tolerance due to irregularities in the sample as cored.
3: Specimen L/D < 2.
4: The as-received core did not meet the ASTM minimum diameter tolerance of 1.875 inches.
5: Specimen diameter is less than 10 times maximum particle size.
6: Specimen diameter is less than 6 times maximum particle size.

*Because the indicated tested specimens did not meet the ASTM D4543 standard tolerances, the results reported here may differ from those for a test specimen within tolerances.

GeoTesting EXPRESS
A Sercel Business

Client:	CHA Companies, Inc.	Test Date:	9/25/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-101		
Sample ID:	R-1		
Depth (ft):	23.81-24.19		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.41	4.40	4.41		
Specimen Diameter, in:	1.98	1.98	1.98		
Specimen Mass, g:	606.07				
Bulk Density, lb/ft^3	170	**Minimum Diameter Tolerence Met?**		**YES**	
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**		**YES**	

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

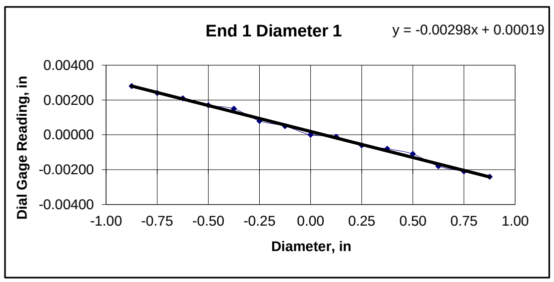
END FLATNESS AND PARALLELISM (Procedure FP1)

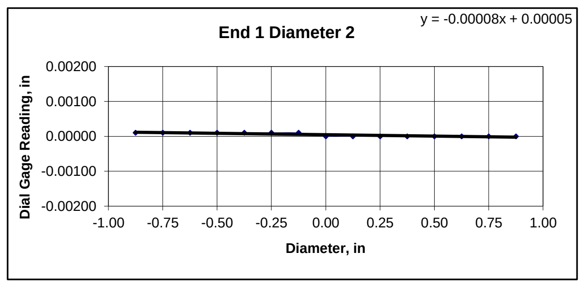
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00280	0.00240	0.00210	0.00170	0.00150	0.00080	0.00050	0.00000	-0.00010	-0.00060	-0.00080	-0.00110	-0.00180	-0.00210	-0.00240
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

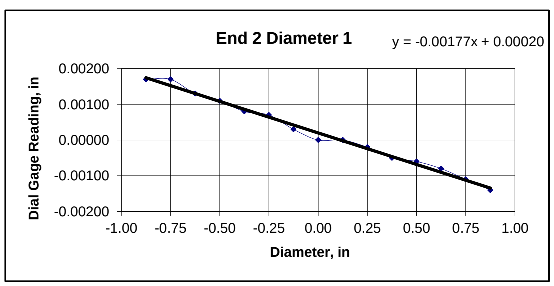
Difference between max and min readings, in:
0° = 0.00520 90° = 0.00010

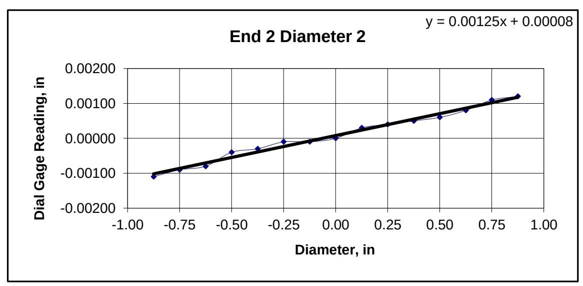
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00170	0.00170	0.00130	0.00110	0.00080	0.00070	0.00030	0.00000	0.00000	-0.00020	-0.00050	-0.00060	-0.00080	-0.00110	-0.00140
Diameter 2, in (rotated 90°)	-0.00110	-0.00090	-0.00080	-0.00040	-0.00030	-0.00010	-0.00010	0.00000	0.00030	0.00040	0.00050	0.00060	0.00080	0.00110	0.00120

Difference between max and min readings, in:
0° = 0.0031 90° = 0.0023
Maximum difference must be < 0.0020 in. Difference = ± 0.00260
Flatness Tolerance Met? **NO**









DIAMETER 1

End 1:		
	Slope of Best Fit Line	0.00298
	Angle of Best Fit Line:	0.17090
End 2:		
	Slope of Best Fit Line	0.00177
	Angle of Best Fit Line:	0.10117
Maximum Angular Difference:		0.06974

Parallelism Tolerance Met? **NO**
Spherically Seated

DIAMETER 2

End 1:		
	Slope of Best Fit Line	0.00008
	Angle of Best Fit Line:	0.00458
End 2:		
	Slope of Best Fit Line	0.00125
	Angle of Best Fit Line:	0.07187
Maximum Angular Difference:		0.06728

Parallelism Tolerance Met? **NO**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00520	1.980	0.00263	0.150	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00310	1.980	0.00157	0.090	YES
Diameter 2, in (rotated 90°)	0.00230	1.980	0.00116	0.067	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	CHA Companies, Inc.	Test Date:	9/25/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-101	Reliable dial gauge measurements could not be performed on this rock type. Tolerance measurements were performed using a machinist straightedge and feeler gauges to ASTM specifications.	
Sample ID:	R-1		
Depth (ft):	23.81-24.19		
Visual Description:	See photographs		

BEST EFFORT END FLATNESS TOLERANCES OF ROCK CORE SPECIMENS TO ASTM D4543

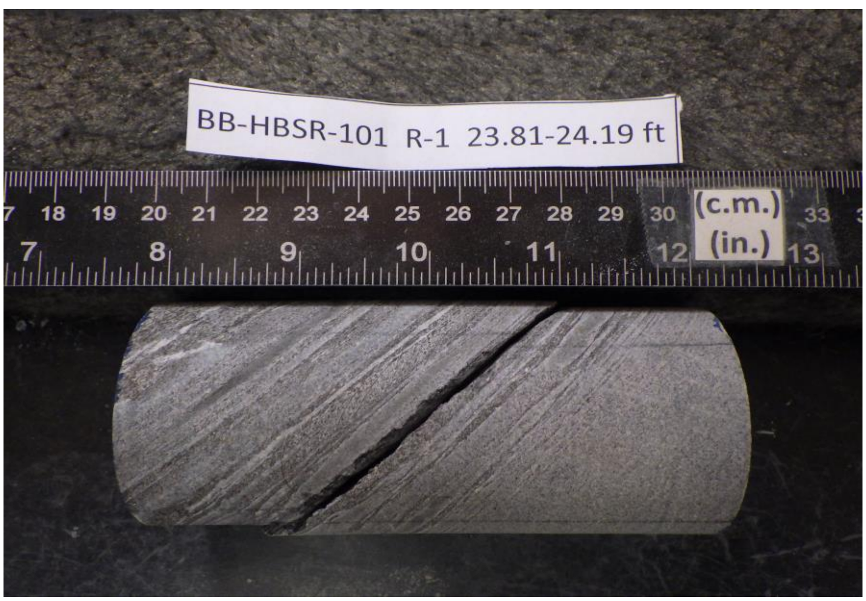
END FLATNESS

END 1		
Diameter 1	Is the maximum gap $\leq \pm0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm0.001$ in.?	YES
END 2		
Diameter 1	Is the maximum gap $\leq \pm0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm0.001$ in.?	YES

End Flatness Tolerance Met? YES

Client:	CHA Companies, Inc.
Project Name:	Hollis-Buxton Bridge
Project Location:	---
GTX #:	319779
Test Date:	9/26/2024
Tested By:	gp
Checked By:	smd
Boring ID:	BB-HBSR-101
Sample ID:	R-1
Depth, ft:	23.81-24.19

After cutting and grinding



After break

Client:	CHA Companies, Inc.	Test Date:	9/24/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-102		
Sample ID:	R-1		
Depth (ft):	22.40-22.78		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.35	4.33	4.34		
Specimen Diameter, in:	1.98	1.99	1.99		
Specimen Mass, g:	601.42				
Bulk Density, lb/ft^3	170	**Minimum Diameter Tolerence Met?**		**YES**	
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**		**YES**	

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

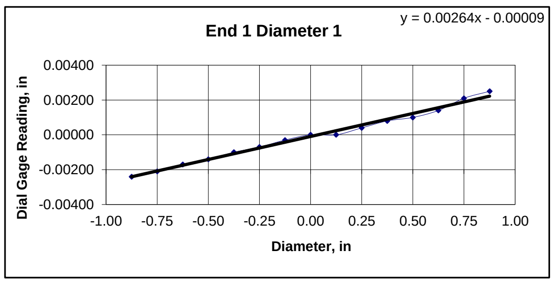
END FLATNESS AND PARALLELISM (Procedure FP1)

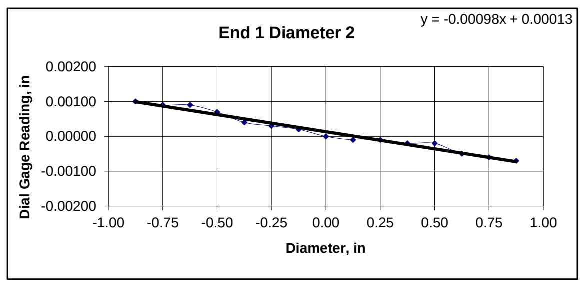
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00240	-0.00210	-0.00170	-0.00140	-0.00100	-0.00070	-0.00030	0.00000	0.00000	0.00040	0.00080	0.00100	0.00140	0.00210	0.00250
Diameter 2, in (rotated 90°)	0.00100	0.00090	0.00090	0.00070	0.00040	0.00030	0.00020	0.00000	-0.00010	-0.00010	-0.00020	-0.00020	-0.00050	-0.00060	-0.00070

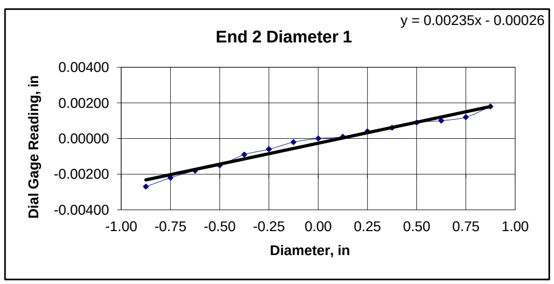
Difference between max and min readings, in:
0° = 0.00490 90° = 0.00170

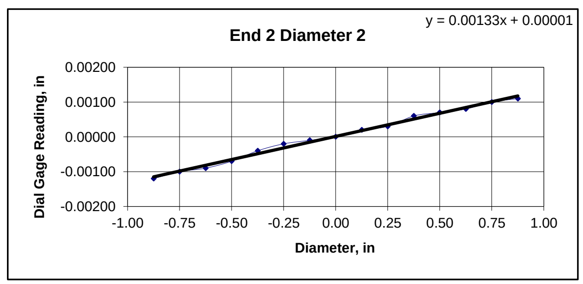
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00270	-0.00220	-0.00180	-0.00150	-0.00090	-0.00060	-0.00020	0.00000	0.00010	0.00040	0.00060	0.00090	0.00100	0.00120	0.00180
Diameter 2, in (rotated 90°)	-0.00120	-0.00100	-0.00090	-0.00070	-0.00040	-0.00020	-0.00010	0.00000	0.00020	0.00030	0.00060	0.00070	0.00080	0.00100	0.00110

Difference between max and min readings, in:
0° = 0.0045 90° = 0.0023
Maximum difference must be < 0.0020 in. Difference = ± 0.00245
Flatness Tolerance Met? **NO**









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00264
	Angle of Best Fit Line:	0.15142
End 2:	Slope of Best Fit Line	0.00235
	Angle of Best Fit Line:	0.13473
Maximum Angular Difference:		0.01670

Parallelism Tolerance Met? **NO**
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00098
	Angle of Best Fit Line:	0.05631
End 2:	Slope of Best Fit Line	0.00133
	Angle of Best Fit Line:	0.07612
Maximum Angular Difference:		0.01981

Parallelism Tolerance Met? **NO**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00490	1.985	0.00247	0.141	YES
Diameter 2, in (rotated 90°)	0.00170	1.985	0.00086	0.049	YES
END 2					
Diameter 1, in	0.00450	1.985	0.00227	0.130	YES
Diameter 2, in (rotated 90°)	0.00230	1.985	0.00116	0.066	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	CHA Companies, Inc.	Test Date:	9/24/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-102	Reliable dial gauge measurements could not be performed on this rock type. Tolerance measurements were performed using a machinist straightedge and feeler gauges to ASTM specifications.	
Sample ID:	R-1		
Depth (ft):	22.40-22.78		
Visual Description:	See photographs		

BEST EFFORT END FLATNESS TOLERANCES OF ROCK CORE SPECIMENS TO ASTM D4543

END FLATNESS

END 1

Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm 0.001$ in.?	YES

END 2

Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm 0.001$ in.?	YES

End Flatness Tolerance Met? YES

Client:	CHA Companies, Inc.
Project Name:	Hollis-Buxton Bridge
Project Location:	---
GTX #:	319779
Test Date:	9/25/2024
Tested By:	gp
Checked By:	smd
Boring ID:	BB-HBSR-102
Sample ID:	R-1
Depth, ft:	22.40-22.78

After cutting and grinding

After break

Client:	CHA Companies, Inc.	Test Date:	9/25/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-103		
Sample ID:	R-1		
Depth (ft):	19.33-19.70		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.27	4.27	4.27		
Specimen Diameter, in:	1.99	1.99	1.99		
Specimen Mass, g:	592.36				
Bulk Density, lb/ft^3	170			**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.1			**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00280	-0.00240	-0.00200	-0.00150	-0.00110	-0.00070	0.00000	0.00000	0.00030	0.00060	0.00090	0.00130	0.00170	0.00230	0.00260
Diameter 2, in (rotated 90°)	-0.00320	-0.00260	-0.00200	-0.00170	-0.00100	-0.00060	-0.00020	0.00000	0.00050	0.00090	0.00130	0.00180	0.00220	0.00290	0.00330

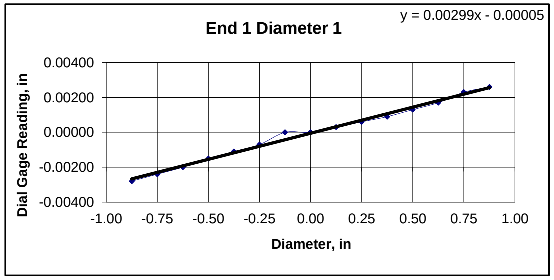
Difference between max and min readings, in:
0° = 0.00540 90° = 0.00650

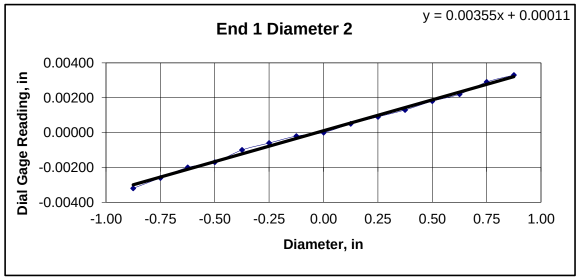
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00310	-0.00260	-0.00230	-0.00160	-0.00080	-0.00060	-0.00020	0.00000	0.00060	0.00120	0.00150	0.00210	0.00260	0.00310	0.00360
Diameter 2, in (rotated 90°)	0.00280	0.00240	0.00220	0.00160	0.00140	0.00080	0.00030	0.00000	-0.00050	-0.00070	-0.00120	-0.00150	-0.00190	-0.00220	-0.00270

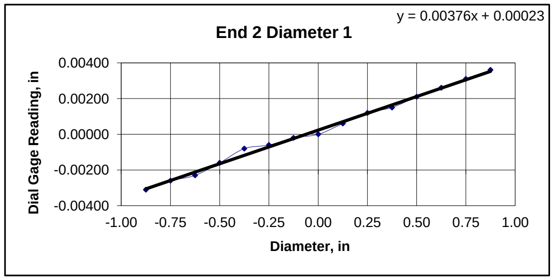
Difference between max and min readings, in:
0° = 0.0067 90° = 0.0055

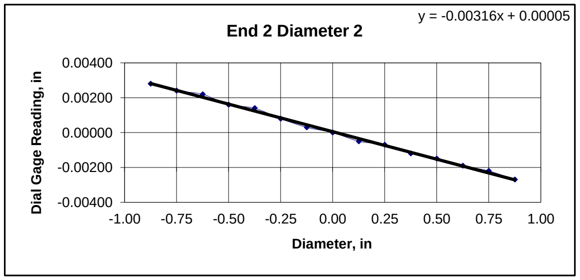
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00335

Flatness Tolerance Met? **NO**









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00299
	Angle of Best Fit Line:	0.17123
End 2:	Slope of Best Fit Line	0.00376
	Angle of Best Fit Line:	0.21559
Maximum Angular Difference:		0.04436

Parallelism Tolerance Met? **NO**
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00355
	Angle of Best Fit Line:	0.20315
End 2:	Slope of Best Fit Line	0.00316
	Angle of Best Fit Line:	0.18105
Maximum Angular Difference:		0.02210

Parallelism Tolerance Met? **NO**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00540	1.990	0.00271	0.155	YES
Diameter 2, in (rotated 90°)	0.00650	1.990	0.00327	0.187	YES
END 2					
Diameter 1, in	0.00670	1.990	0.00337	0.193	YES
Diameter 2, in (rotated 90°)	0.00550	1.990	0.00276	0.158	YES

Maximum angle of departure must be $\leq$ 0.25°

Perpendicularity Tolerance Met? **YES**

Client:	CHA Companies, Inc.	Test Date:	9/25/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-103	Reliable dial gauge measurements could not be performed on this rock type. Tolerance measurements were performed using a machinist straightedge and feeler gauges to ASTM specifications.	
Sample ID:	R-1		
Depth (ft):	19.33-19.70		
Visual Description:	See photographs		

BEST EFFORT END FLATNESS TOLERANCES OF ROCK CORE SPECIMENS TO ASTM D4543

END FLATNESS

END 1

Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90^{o})	Is the maximum gap $\leq \pm 0.001$ in.?	YES

END 2

Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90^{o})	Is the maximum gap $\leq \pm 0.001$ in.?	YES

End Flatness Tolerance Met? YES

Client:	CHA Companies, Inc.
Project Name:	Hollis-Buxton Bridge
Project Location:	---
GTX #:	319779
Test Date:	9/26/2024
Tested By:	gp
Checked By:	smd
Boring ID:	BB-HBSR-103
Sample ID:	R-1
Depth, ft:	19.33-19.70

After cutting and grinding

After break

Client:	CHA Companies, Inc.	Test Date:	9/24/2024
Project Name:	Hollis-Buxton Bridge	Tested By:	cml
Project Location:	---	Checked By:	smd
GTX #:	319779		
Boring ID:	BB-HBSR-104		
Sample ID:	R-1		
Depth (ft):	21.96-22.34		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.36	4.36	4.36		
Specimen Diameter, in:	1.97	1.98	1.98		
Specimen Mass, g:	598.35				
Bulk Density, lb/ft^3	170			**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2			**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:

Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00050	-0.00040	-0.00040	-0.00040	-0.00040	-0.00040	-0.00040	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00180	0.00160	0.00140	0.00120	0.00080	0.00050	0.00020	0.00000	-0.00010	-0.00030	-0.00060	-0.00090	-0.00110	-0.00150	-0.00190

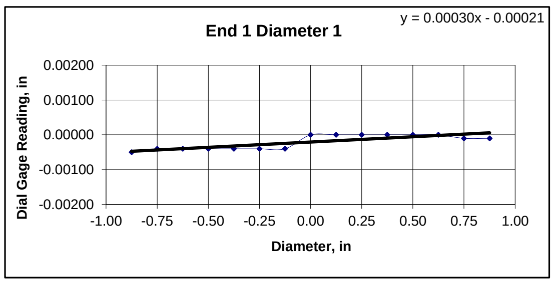
Difference between max and min readings, in:
0° = 0.00050 90° = 0.00370

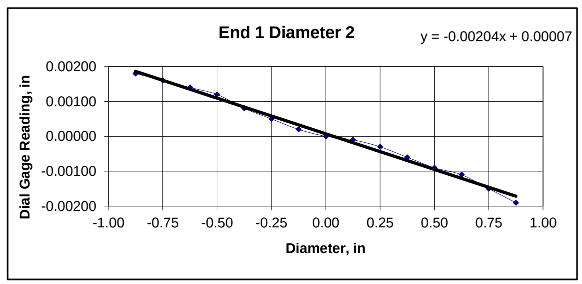
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000	-0.00010	-0.00010	-0.00010	-0.00020
Diameter 2, in (rotated 90°)	-0.00260	-0.00180	-0.00170	-0.00140	-0.00110	-0.00060	-0.00040	0.00000	0.00030	0.00070	0.00100	0.00110	0.00140	0.00190	0.00220

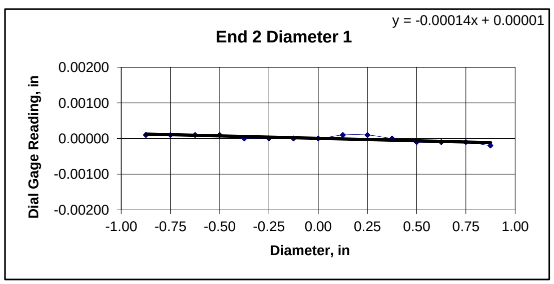
Difference between max and min readings, in:
0° = 0.0003 90° = 0.0048

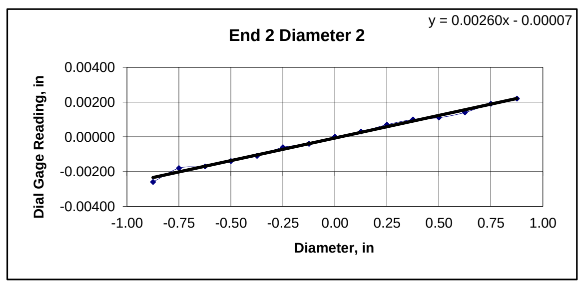
Maximum difference must be < 0.0020 in. Difference = ± 0.00240

Flatness Tolerance Met? **NO**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00030
Angle of Best Fit Line: 0.01735

End 2:
Slope of Best Fit Line 0.00014
Angle of Best Fit Line: 0.00786

Maximum Angular Difference: 0.00949

Parallelism Tolerance Met? **NO**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00204
Angle of Best Fit Line: 0.11705

End 2:
Slope of Best Fit Line 0.00260
Angle of Best Fit Line: 0.14880

Maximum Angular Difference: 0.03176

Parallelism Tolerance Met? **NO**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00050	1.975	0.00025	0.015	YES
Diameter 2, in (rotated 90°)	0.00370	1.975	0.00187	0.107	YES
END 2					
Diameter 1, in	0.00030	1.975	0.00015	0.009	YES
Diameter 2, in (rotated 90°)	0.00480	1.975	0.00243	0.139	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? **YES**

Client:	CHA Companies, Inc.		Test Date:	9/24/2024
Project Name:	Hollis-Buxton Bridge		Tested By:	cml
Project Location:	---		Checked By:	smd
GTX #:	319779			
Boring ID:	BB-HBSR-104		Reliable dial gauge measurements could not be performed on this rock type. Tolerance measurements were performed using a machinist straightedge and feeler gauges to ASTM specifications.	
Sample ID:	R-1			
Depth (ft):	21.96-22.34			
Visual Description:	See photographs			

BEST EFFORT END FLATNESS TOLERANCES OF ROCK CORE SPECIMENS TO ASTM D4543

END FLATNESS		
END 1		
Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm 0.001$ in.?	YES
END 2		
Diameter 1	Is the maximum gap $\leq \pm 0.001$ in.?	YES
Diameter 2 (rotated 90°)	Is the maximum gap $\leq \pm 0.001$ in.?	YES

End Flatness Tolerance Met? YES

Client:	CHA Companies, Inc.
Project Name:	Hollis-Buxton Bridge
Project Location:	---
GTX #:	319779
Test Date:	9/25/2024
Tested By:	gp
Checked By:	smd
Boring ID:	BB-HBSR-104
Sample ID:	R-1
Depth, ft:	21.96-22.34

After cutting and grinding

After break

APPENDIX D

Calculations

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
CHECKED BY:	CWS	SHEET #: 1	OF	4
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	10/1/2024	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Abutment and Wingwall Geotechnical Foundation Design Parameters	

References | Calculations | Notes

Problem Statement:

Determine the coefficient of friction, and the service and strength limit bearing resistances for the replacement bridge abutments and wingwalls. The new substructures will be designed to bear on the bedrock or on concrete sub-footings bearing on the bedrock.

Data Sources:

1) Boring logs and laboratory test results

References:

1) AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020 (AASHTO)

2) MaineDOT Bridge Design Guide with 2018 Updates (BDG)

3) *FHWA-IF-02-034. Geotechnical Engineering Circular 5: Evaluation of Soil and Rock Properties.* United States Department of Transportation Federal Higway Administration. 2002.
Referenced by AASHTO as "Sabatini et al. (2002)" and herein.

4) *EPRI EL-5918. Analysis and Design of Foundations Socketed into Rock*. Empire State Electric Engineering Research Corporation and Electric Power Research Institute. 1988.
Referenced by AASHTO as "Carter & Kulhawy (1988)" and herein.

5) *NCHRP Report 651. LRFD Design and Construction of Shallow Foundations for Highway Bridges*. National Academies of Science, Engineering, and Medicine. 2010. (NCHRP)

6) Wyllie, D.C. (1999) *Foundations on Rock: Engineering Practice, Second Edition.* CRC Press. (Wyllie (1999))

7) Hoek, E. and Brown, E.T. (1988) *The Hoek-Borwn Failure Criterion - A 1988 Update. Proceedings of the 15th Canadian Rock Mechanics Symposium.* Toronto: Civil Engineering Dept., University of Toronto. (Hoek & Brown (1988))

Determine Coefficient of Sliding:

Coefficient of Friction = 0.60

Use value for mass concrete on clean gravel based on MaineDOT comments, see Attachment 1.

CHA

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
		SHEET #: 2	OF	4
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	10/1/2024	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Abutment and Wingwall Geotechnical Foundation Design Parameters	

References	Calculations	Notes

Determine Service Limit Bearing Resistance:

Service Limit Bearing Resistance = 40 ksf

Use presumptive value for footings on sound sandstone, see Attachment 2.

Determine Strength Limit Bearing Resistance:

Calculate strength limit bearing resistance using the Semi-Empirical Procedure referenced by AASHTO, see Attachment 3, modified based on MaineDOT comments.

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
		SHEET #: 3	OF	4
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	10/1/2024	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Abutment and Wingwall Geotechnical Foundation Design Parameters	

References | Calculations | Notes

Semi-Empircal Procedure for Bearing Resistance of Rock

NHCRP

Per MaineDOT, use equation 82b to calculate q_{ult} equal to the nominal bearing resistance.

Eq. 82b is a modified version of Eq. 3-6 provided in Carter & Kulhawy (1988) shown as Eq. 82a in NHCRP. See excerpt below.

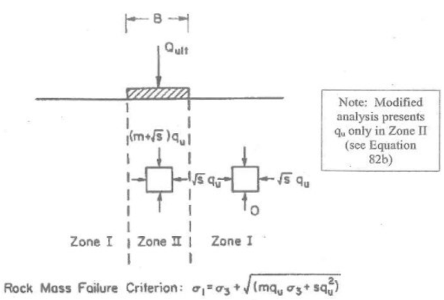


Figure 39. Lower bound solution for bearing capacity (Carter and Kulhawy, 1988).

across the interface must be maintained and therefore the bearing capacity of the strip footing may be evaluated from Equation 81 (with $\sigma_3 = s^{0.5}q_u$) as

$$q_{ult} = \left(m + \sqrt{s}\right)q_u \qquad (82a)$$

In an errata to Carter and Kulhawy (1988), Equation (82a) was modified to the following:

$$q_{ult} = \left(\sqrt{s} + \left(m\sqrt{s} + s\right)^{0.5}\right)q_u \qquad (82b)$$

Excerpt from Wyllie (2009):

The allowable bearing pressure q_a is related to the rock mass strength by the factor of safety FS and the correction factor C_{f1}:

$$q_a = \frac{C_{f1}\,s^{1/2}\sigma_{u(r)}\left[1 + \left(ms^{-1/2} + 1\right)^{1/2}\right]}{FS} \qquad (5.4)$$

Table 5.4 Correction factors for foundation shapes (L = length, B = width)

Foundation shape	C_{f1}	C_{f2}
Strip ($L/B > 6$)	1.0	1.0
Rectangular		
$L/B = 2$	1.12	0.9
$L/B = 5$	1.05	0.95
Square	1.25	0.85
Circular	1.2	0.7

Inputs:

Parameter	**Symbol**	**Value**	**Unit**	
Avg. Unconf. Comp. Strength	q_u	2888	ksf	Based on lab results, Average q_u = 20,056 psi or 2,888 ksf
	m	0.486		See sheet below.
	s	0.00034		See sheet below.

Outputs:

Nominal Bearing Resistance	q_n	331	ksf	NCHRP Eq-82b, see excerpt top left.

Per MaineDOT, check nominal bearing resistance with Eq 5.4 from Wyllie (2009), assuming FS = 1:

	C_{f1}	1		Wyllie (2009) Table 5.4, for strip footing, see excerpt top right.
Nominal Bearing Resistance	q_n	331	ksf	Wyllie (2009) Eq 5.4, see excerpt top right.

Nominal Bearing Resistance matches; proceed.

$q_R = \varphi_b\, q_n$ AASHTO Eq 10.6.3.1.1-1

Bearing Resistance Factor	φ_b	0.45		AASHTO Table 10.5.5.2.2-1
Factored Bearing Resistance	q_R	**149**	**ksf**	

Rock Mass Rating (RMR) Calculation and Input Parameters for Non-Linear Shear Strength Evaluation of Rock

Sabatini et al. (2002) - Table 40 See Attachment 4.

A. Classification Parameters and Their Ratings

Parameter No.	Description	Project Data	Appropriate Value Range		Relative Rating Value
1	Strength of Intact Rock	Unconfined Compressive Strength	2,089 - 4,177 ksf (100 - 200 MPA)	Uniaxial Compressive Strength	12
2	Drill Core RQD		50% to 75%		13
3	Spacing of Joints		2 inches - 1 foot (50 - 300 mm)		10
4	Condition of Joints		Slightly Rough Surfaces, Separation <0.05 in (1 mm), hard joint wall		20
5	Groundwater Conditions	General Conditions	Moderate pressure		4

B. Rating Adjustment for Joint Orientation

Structure Type	Strike and Dip Orientation of Joints	Rating Value
Foundation	Fair	-7

C. Rock Mass Classes Determined from Total Ratings

Parameter	Value
RMR Rating	52
Class No.	3
Description	Fair Rock

Carter & Kulhawy (1988) - Table 3-1 See Attachment 5.

Select m_i for intact rock from Attachment 5. Calculate m and s values using equations 18 and 19 from Hoek & Brown (1988).

Parameter	Value	Description
Rock Type	C	Arenaceous rocks with strong crystals and poor cleavage (sandstone, quartzite)
mi	15	Intact Rock Samples for Rock Type C

Hoek & Brown (1988) See excerpt to right.

m	**0.486**	Hoek & Brown (1988) Eq-18
s	**0.00034**	Hoek & Brown (1988) Eq-19

Excerpt from Hoek & Brown (1988):

Disturbed rock masses :

$$\frac{m}{m_i} = \exp\left(\frac{\text{RMR} - 100}{14}\right) \quad (18)$$

$$s = \exp\left(\frac{\text{RMR} - 100}{6}\right) \quad (19)$$

Undisturbed or interlocking rock masses:

$$\frac{m}{m_i} = \exp\left(\frac{\text{RMR} - 100}{28}\right) \quad (20)$$

$$s = \exp\left(\frac{\text{RMR} - 100}{9}\right) \quad (21)$$

where

m and s are the rock mass constants and m_i is the value of m for the *intact* rock.

ATTACHMENT 1 - AASHTO LRFD BDS, 9th Ed, 2020

Table C3.11.5.3-1—Friction Angle for Dissimilar Materials (U.S. Department of the Navy, 1982a)

Interface Materials	Friction Angle, δ (degrees)	Coefficient of Friction, tan δ (dim.)
Mass concrete on the following foundation materials:		
• Clean sound rock	35	0.70
• Clean gravel, gravel-sand mixtures, coarse sand	29 to 31	0.55 to 0.60
• Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	24 to 29	0.45 to 0.55
• Clean fine sand, silty or clayey fine to medium sand	19 to 24	0.34 to 0.
• Fine sandy silt, nonplastic silt	17 to 19	0.31 to 0.
• Very stiff and hard residual or preconsolidated clay	22 to 26	0.40 to 0.
• Medium stiff and stiff clay and silty clay	17 to 19	0.31 to 0.
Masonry on foundation materials has same friction factors.		
Steel sheet piles against the following soils:		
• Clean gravel, gravel-sand mixtures, well-graded rock fill with spalls	22	0.40
• Clean sand, silty sand-gravel mixture, single-size hard rock fill	17	0.31
• Silty sand, gravel or sand mixed with silt or clay	14	0.25
• Fine sandy silt, nonplastic silt	11	0.19
Formed or precast concrete or concrete sheet piling against the following soils:		
• Clean gravel, gravel-sand mixture, well-graded rock fill with spalls	22 to 26	0.40 to 0.49
• Clean sand, silty sand-gravel mixture, single-size hard rock fill	17 to 22	0.31 to 0.40
• Silty sand, gravel or sand mixed with silt or clay	17	0.31
• Fine sandy silt, nonplastic silt	14	0.25
Various structural materials:		
• Masonry on masonry, igneous and metamorphic rocks:		
○ dressed soft rock on dressed soft rock	35	0.70
○ dressed hard rock on dressed soft rock	33	0.65
○ dressed hard rock on dressed hard rock	29	0.55
• Masonry on wood in direction of cross grain	26	0.49
• Steel on steel at sheet pile interlocks	17	0.31

Select 0.60 based on MaineDOT comments.

3.11.5.4—Passive Lateral Earth Pressure Coefficient, k_p

For noncohesive soils, values of the coefficient of passive lateral earth pressure may be taken from Figure 3.11.5.4-1 for the case of a sloping or vertical wall with a horizontal backfill or from Figure 3.11.5.4-2 for the case of a vertical wall and sloping backfill. For conditions that deviate from those described in Figures 3.11.5.4-1 and 3.11.5.4-2, the passive pressure may be calculated by using a trial procedure based on wedge theory, e.g., see Terzaghi et al. (1996). When wedge theory is used, the limiting value of the wall friction angle should not be taken larger than one-half the angle of internal friction, ϕ_f.

For cohesive soils, passive pressures may be estimated by:

C3.11.5.4

The movement required to mobilize passive pressure is approximately 10.0 times as large as the movement needed to induce earth pressure to the active values. The movement required to mobilize full passive pressure in loose sand is approximately five percent of the height of the face on which the passive pressure acts. For dense sand, the movement required to mobilize full passive pressure is smaller than five percent of the height of the face on which the passive pressure acts, and five percent represents a conservative estimate of the movement required to mobilize the full passive pressure. For poorly compacted cohesive soils, the movement required to mobilize full passive pressure is larger than five percent of the height of the face on which the pressure acts.

Table C10.6.2.5.1-1—Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982)

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf) Ordinary Range	Bearing Resistance (ksf) Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120–200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60–80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30–50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16–24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16–24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16–24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense Medium dense to dense Loose	12–20 8–14 4–12	14 10 6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense Medium dense to dense Loose	8–12 4–8 2–6	8 6 3
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense Medium dense to dense Loose	6–12 2–6 1–2	8 4 1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard Medium stiff to stiff Soft	4–8 2–6 1–2	6 3 1

Bedrock on-site is described as sandstone.

10.6.2.5.2—Semiempirical Procedures for Bearing Resistance

Bearing resistance on rock shall be determined using empirical correlation to the Geomechanic Rock Mass Rating System, RMR. Local experience should be considered in the use of these semi-empirical procedures.

If the recommended value of presumptive bearing resistance exceeds either the unconfined compressive strength of the rock or the nominal resistance of the concrete, the presumptive bearing resistance shall be taken as the lesser of the unconfined compressive strength of the rock or the nominal resistance of the concrete. The nominal resistance of concrete shall be taken as $0.3 f'_c$.

project site for which the subsurface conditions, e.g., stratification, geologic history, and properties, are relatively uniform.

10.6.3.2—Bearing Resistance of Rock

10.6.3.2.1—General

The methods used for design of footings on rock shall consider the presence, orientation, and condition of discontinuities, weathering profiles, and other similar profiles as they apply at a particular site.

For footings on competent rock, reliance on simple and direct analyses based on uniaxial compressive rock strengths and *RQD* may be applicable. For footings on less competent rock, more detailed investigations and analyses shall be performed to account for the effects of weathering and the presence and condition of discontinuities.

The designer shall judge the competency of a rock mass by taking into consideration both the nature of the intact rock and the orientation and condition of discontinuities of the overall rock mass. Where engineering judgment does not verify the presence of competent rock, the competency of the rock mass should be verified using the procedures for RMR rating.

C10.6.3.2.1

The design of spread footings bearing on rock is frequently controlled by either overall stability, e.g., the orientation and conditions of discontinuities, or load eccentricity considerations. The designer should verify adequate overall stability and size the footing based on eccentricity requirements at the strength limit state before checking nominal bearing resistance at both the service and strength limit states.

The design procedures for foundations in rock have been developed using the RMR, rock mass rating system. Classification of the rock mass should be according to the RMR system. For additional information on the RMR system, see Sabatini et al. (2002).

10.6.3.2.2—Semiempirical Procedures

The nominal bearing resistance of rock should be determined using empirical correlation with the Geomechanics RMR system. Local experience shall be considered in the use of these semi-empirical procedures.

The factored bearing stress of the foundation shall not be taken to be greater than the factored compressive resistance of the footing concrete.

C10.6.3.2.2

The bearing resistance of jointed or broken rock may be estimated using the semi-empirical procedure developed by Carter and Kulhawy (1988). This procedure is based on the unconfined compressive strength of the intact rock core sample. Depending on rock mass quality measured in terms of RMR system, the nominal bearing resistance of a rock mass varies from a small fraction to six times the unconfined compressive strength of intact rock core samples.

10.6.3.2.3—Analytic Method

The nominal bearing resistance of foundations on rock shall be determined using established rock mechanics principles based on the rock mass strength parameters. The influence of discontinuities on the failure mode shall also be considered.

C10.6.3.2.3

Depending upon the relative spacing of joints and rock layering, bearing capacity failures for foundations on rock may take several forms. Except for the case of a rock mass with closed joints, the failure modes are different from those in soil. Procedures for estimating bearing resistance for each of the failure modes can be found in Kulhawy and Goodman (1987), Goodman (1989), and Sowers (1979).

10.6.3.2.4—Load Test

Where appropriate, load tests may be performed to determine the nominal bearing resistance of foundations on rock.

10.6.3.3—Eccentric Load Limitations

The eccentricity of loading at the strength limit state, evaluated based on factored loads shall not exceed:

C10.6.3.3

A comprehensive parametric study was conducted for cantilevered retaining walls of various heights and soil

ATTACHMENT 4 - Sabatini et al. (2002)

Table 40. CSIR classification of jointed rock mass.

A. CLASSIFICATION PARAMETERS AND THEIR RATINGS

	PARAMETER		RANGES OF VALUES						
1	Strength of intact rock material	Point load strength index	>8 MPa	4 to 8 Mpa	2 to 4 MPa	1 to 2 MPa	For this low range – uniaxial compressive test is preferred		
		Uniaxial compressive strength	>200 MPa	100 to 200 MPa (2089-4177ksf)	50 to 100 MPa	25 to 50 MPa	10 to 25 MPa	3 to 10 MPa	1 to 3 MPa
	Relative Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% to 100%	75% to 90%	50% to 75%	25% to 50%	<25%		
	Relative Rating		20	17	13	8	3		
3	Spacing of joints		>3 m	1 to 3m	0.3 to 1 m	(2in. - 1ft) 50 to 300 mm	<50mm		
	Relative Rating		30	25	20	10	5		
4	Condition of joints		Very rough surfaces Not continuous No separation Hard joint wall rock	Slightly rough surfaces Separation <1mm Hard joint wall rock	Slightly rough surfaces Separation <1mm Soft joint wall rock	Slickensided surfaces or Gouge <5 mm thick or Joints open 1 to 5 mm Continuous joints	Soft gouge >5 mm thick or Joints open >5 mm Continuous joints		
	Relative Rating		25	20	12	6	0		
5	Ground water	Inflow per 10 m tunnel length	None		<25 liters/min	25 to 125 liters/min	>125 liters/min		
		Ratio= joint water pressure/major principal stress	OR 0		OR 0.0 to 0.2	OR 0.2 to 0.5	OR >0.5		
		General Conditions	OR Completely Dry		OR Moist only (interstitial water)	OR Water under moderate pressure	OR Severe water problems		
	Relative Rating		10		7	4	0		

B. RATING ADJUSTMENT FOR JOINT ORIENTATIONS

Strike and dip orientations of joints		Very favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Ratings	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

C. ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS

RMR Rating	100 to 81	80 to 61	60 to 41	40 to 21	<20
Class No.	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

ATTACHMENT 5 - Carter & Kulhawy (1988)

Table 3-1

APPROXIMATE CORRELATION BETWEEN ROCK MASS QUALITY AND STRENGTH CONSTANTS

m_i for Rock Type C

Rock Mass Quality	Approximate Joint Spacing	CSIR Rating	NGI Rating	S Value	m Value as Function of Rock Type A	B	C	D	E
Excellent	> 3 m (10 ft) intact	100	500	1	7	10	15	17	25
Very good	1-3 m interlocking	85	100	0.1	3.5	5	7.5	8.5	12.5
Good	1-3 m slightly weathered	65	10	0.004	0.7	1	1.5	1.7	2.5
Fair	0.3-1 m moderately weathered	44	1	10^{-4}	0.14	0.2	0.3	0.34	0.5
Poor	30-500 mm weathered with gouge	23	0.1	10^{-5}	0.04	0.05	0.08	0.09	0.13
Very poor	< 50 mm (2 in) heavily weathered	3	0.01	0	0.007	0.01	0.015	0.017	0.025

Rock Types:
A - Carbonate rocks with well-developed crystal cleavage (dolostone, limestone, marble)
B - Lithified argillaceous rocks (mudstone, siltstone, shale, slate)
C - Arenaceous rocks with strong crystals and poor cleavage (sandstone, quartzite)
D - Fine-grained igneous crystalline rocks (andesite, dolerite, diabase, rhyolite)
E - Coarse-grained igneous and metamorphic crystalline rocks (amphibolite, gabbro, gneiss, granite, norite, quartzdiorite)

Source: Hoek (11), p. 215.

the rock mass, and selecting an appropriate category is easier if either the CSIR (12) or NGI (13) classification data are available. The values in this table should only be used as general guidelines, and they do not replace the need for testing or other means of assessing the strength parameters more reliably.

In another study of the bearing capacity of jointed rock, a plasticity solution was obtained which incorporates the discontinuities in the rock mass (14).

CHA

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT	90330	PHASE	7000
		ORG			
CHECKED BY:	CWS	SHEET #:	1	OF	2
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/18/2025		
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Lateral Earth Pressure Coefficients		

References	Calculations	Notes

Problem Statement:

Determine the earth pressure coefficients at the bridge abutments, backwalls, and wingwalls.

Data Sources:

1) Boring logs and laboratory test results

2) Design information from CHA Structural Group

References:

1) AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020 (AASHTO)

2) MaineDOT Bridge Design Guide with 2018 Updates (BDG)

From CHA Structural Group:

Based on geometry of wingwalls, use Coulomb Active Earth Pressure.

Wingwall modified backfill slopes, β^*, based on BDG Fig 3-2:

NW	9.16
NE	5.52
SW	3.19
SE	3.70

Determine Seismic Design Parameters

Summary:

Abutments:

Rankine K_a 0.307

Backwalls:

Coulomb K_p 8.38

Wingwalls:

Location	Coulomb K_a
NW	0.309
NE	0.294
SW	0.285
SE	0.287

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT	PHASE	ORG
		90330	7000	
		SHEET #: 2	OF	2
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/18/2025	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Lateral Earth Pressures	

References	Calculations	Notes

Recommended backfill properties for granular borrow for underwater backfill are as follows:

Internal Friction Angle, ø	=	32	degrees
Friction angle between fill and wall, δ	=	24	degrees

Abutment Active Earth Pressure Coefficient (Rankine)

Assume a horizontal backfill surface where β = 0 deg

$$K_a = tan^2\left(45 - \frac{\emptyset}{2}\right)$$

K_a = 0.307

Backwall Passive Earth Pressure Coefficient (Coulomb)

Assume horizontal backfill surface where β = 0 deg and that the slope of backwall, α, is 90 degrees from horizontal

$$K_p = \frac{\sin(\alpha - \emptyset)^2}{sin\alpha^2 * \sin(\alpha + \delta) * \left(1 - \sqrt{\frac{\sin(\emptyset + \delta) * \sin(\emptyset + \beta)}{\sin(\alpha + \delta) * \sin(\alpha + \beta)}}\right)^2}$$

K_p = 8.38

Wingwall Active Earth Pressure (Coulomb)

Assume slope of backwall, α, is 90 degrees from horizontal

$$K_a = \frac{\sin(\alpha + \emptyset)^2}{sin\alpha^2 * \sin(\alpha - \delta) * \left(1 + \sqrt{\frac{\sin(\emptyset + \delta) * \sin(\emptyset - \beta)}{\sin(\alpha - \delta) * \sin(\alpha + \beta)}}\right)^2}$$

Wingwall	β*	K_a
NW	9.16	**0.309**
NE	5.52	**0.294**
SW	3.19	**0.285**
SE	3.70	**0.287**

SITE CLASS FOR SEISMIC DESIGN

Reference: AASHTO LRFD Bridge Design Specifications, 9th Edition

PROJECT NAME:	Salmon Falls Bridge		=Input
CHA Project No.:	90330.0000		=Output
DATE:	1/15/2024		

Boring - BB-HBSR-101

Depth (feet)	d_i Values	N_i Values	d_i/N_i
1.5	3.75	44	0.09
6	4.75	15	0.32
11	5	12	0.42
16	5	9	0.56
20.25	2	100	0.02
20.5	79.5	100	0.80
Total =	100	N (bar)=	46
		Site Class =	D

Boring - BB-HBSR-102

Depth (feet)	d_i Values	N_i Values	d_i/N_i
1.5	3.75	35	0.11
6	4.75	16	0.30
11	5	10	0.50
16	5	4	1.25
20.25	3.5	100	0.04
22	78	100	0.78
Total =	100	N (bar)=	34
		Site Class =	D

Site Class Definition (Table 3.10.3.1-1)	
Site Class	Average Properties 100' Below Footing Elevation Standard Penetration Resistance (N (bar))
C	N (bar)> 50
D	15<= N (bar)<= 50
E	N (bar)<15

Notes:

3) Refer to the Reference sheet tab for additional parameters that govern site classes.

Table C3.10.3.1-1:

$$\overline{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

Symbol Definitions

d_i= Effective Depth

N_i = Standard Penetration Resistance

SITE CLASS FOR SEISMIC DESIGN

Reference: AASHTO LRFD Bridge Design Specifications, 9th Edition

PROJECT NAME: Salmon Falls Bridge
CHA Project No.: 90330.0000
DATE: 1/15/2024

(Yellow) =Input
(Red) =Output

Boring - BB-HBSR-103

Depth (feet)	d_i Values	N_i Values	d_i/N_i
1.5	3.75	18	0.21
6	4.75	7	0.68
11	5	5	1.00
16	4.5	21	0.21
18	82	100	0.82
Total =	100	N (bar)=	34
		Site Class =	D

Boring - BB-HBSR-104

Depth (feet)	d_i Values	N_i Values	d_i/N_i
1.5	3.75	30	0.13
6	4.75	10	0.48
11	5	6	0.83
16	5	13	0.38
18.5	81.5	100	0.82
Total =	100	N (bar)=	38
		Site Class =	D

Site Class Definition (Table 3.10.3.1-1)	
Site Class	**Average Properties 100' Below Footing Elevation**
	Standard Penetration Resistance (N (bar))
C	N (bar)> 50
D	15<= N (bar)<= 50
E	N (bar)<15

Notes:

3) Refer to the Reference sheet tab for additional parameters that govern site classes.

Table C3.10.3.1-1:

$$\overline{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

Symbol Definitions

$d_{i=}$ Effective Depth
N_i = Standard Penetration Resistance

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:	
CHECKED BY:	CWS	SHEET #:	1	OF	5
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/10/2025		
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Seismic Design Parameters		

References	Calculations	Notes

Problem Statement:

Determine the following seismic design parameters based on Site Class D: F_{pga}, F_a, F_v, A_S, S_{DS}, S_{D1}, and Seismic Zone. Per MaineDOT Bridge Design Guide Section 5.2.5, seismic analysis of bridges and foundations shall be performed in accordance with the LRFD Specifications or the AASHTO Guide Specifications for LRFD Seismic Design.

Data Sources:

1) Boring logs and laboratory test results

References:

1) AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020 (AASHTO)

2) MaineDOT Bridge Design Guide with 2018 Updates (BDG)

Determine Seismic Design Parameters

Summary:

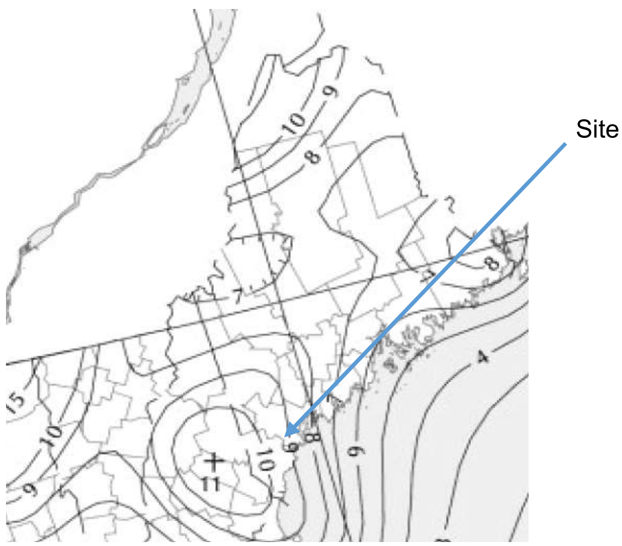
F_{PGA}	1.6
F_a	1.6
F_v	2.4
A_S	0.149
S_{DS}	0.296
S_{D1}	0.108
Seismic Zone 1	

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
		SHEET #: 2	OF	5
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/10/2025	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Seismic Design Parameters	

References	Calculations	Notes

PGA= 0.093



AASHTO Fig. 3.10.2.1-1

F_{PGA} = 1.6

Table 3.10.3.2-1—Values of Site Factor, F_{pga}, at Zero-Period on Acceleration Spectrum

Site Class	Peak Ground Acceleration Coefficient (*PGA*)[1]				
	PGA < 0.10	*PGA* = 0.20	*PGA* = 0.30	*PGA* = 0.40	*PGA* > 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F[2]	*	*	*	*	*

Notes:

[1]Use straight-line interpolation for intermediate values of *PGA*.

[2]Site-specific geotechnical investigation and dynamic site response analysis should be performed for all sites in Site Class F.

AASHTO

$A_S = F_{pga} * PGA$ **A_S = 0.149**

AASHTO Eq. 3.10.4.2-2

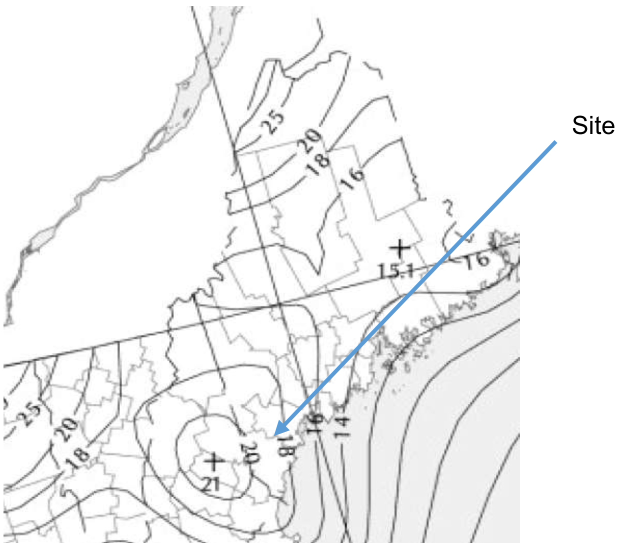
CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
		SHEET #: 3	OF 5	
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE: 7/10/2025		
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT: Seismic Design Parameters		

References	Calculations	Notes

S_S = 0.185

AASHTO Fig. 3.10.2.1-2



F_a = 1.6

AASHTO

Table 3.10.3.2-2—Values of Site Factor, F_a, for Short-Period Range of Acceleration Spectrum

Site Class	Spectral Acceleration Coefficient at Period 0.2 sec (S_S)[1]				
	$S_S <$ 0.25	$S_S =$ 0.50	$S_S =$ 0.75	$S_S =$ 1.00	$S_S >$ 1.25
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F[2]	*	*	*	*	*

Notes:

[1]Use straight-line interpolation for intermediate values of S_s.

[2]Site-specific geotechnical investigation and dynamic site response analysis should be performed for all sites in Site Class F.

$S_{DS} = F_a * S_S$ **S_{DS} = 0.296**

AASHTO Eq. 3.10.4.2-3

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT	PHASE	ORG	
		90330	7000		
		SHEET #:	4	OF	5
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/10/2025		
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Seismic Design Parameters		

References	Calculations	Notes

$S_1 =$ 0.045

AASHTO Fig. 3.10.2.1-3

$F_v =$ 2.4

AASHTO

Table 3.10.3.2-3—Values of Site Factor, F_v, for Long-Period Range of Acceleration Spectrum

Site Class	Spectral Acceleration Coefficient at Period 1.0 sec (S_1)[1]				
	$S_1 <$ 0.1	$S_1 =$ 0.2	$S_1 =$ 0.3	$S_1 =$ 0.4	$S_1 >$ 0.5
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F[2]	*	*	*	*	*

Notes:

[1]Use straight-line interpolation for intermediate values of S_1.

[2]Site-specific geotechnical investigation and dynamic site response analysis should be performed for all sites in Site Class F.

$S_{D1} = F_v * S_1$ **$S_{D1} =$ 0.108**

AASHTO Eq. 3.10.4.2-6

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
		SHEET #: 5	OF 5	
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE: 7/10/2025		
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT: Seismic Design Parameters		

References	Calculations	Notes

Seismic Zone = 1

AASHTO

Table 3.10.6-1—Seismic Zones

Acceleration Coefficient, S_{D1}	Seismic Zone
$S_{D1} \leq 0.15$	1
$0.15 < S_{D1} \leq 0.30$	2
$0.30 < S_{D1} \leq 0.50$	3
$0.50 < S_{D1}$	4

CHA COMPUTATION

COMPLETED BY:	M. Horan	PROJECT: 90330	PHASE: 7000	ORG:
CHECKED BY:	CWS	SHEET #: 1	OF	1
PROJECT NAME:	Salmon Falls Bridge over Saco River	DATE:	7/10/2025	
PROJECT LOCATION:	Hollis-Buxton, ME	SUBJECT:	Frost Depth	

References	Calculations	Notes

Problem Statement:

Determine the frost depth at the site per MaineDOT Bridge Design Guide Section 5.2.1.

Data Sources:

1) Boring logs and laboratory test results

References:

1) MaineDOT Bridge Design Guide with 2018 Updates (BDG)

Determine Frost Depth

Laboratory test results indicated that the site soils were primarily coarse grained (sand as the major constituent). Moisture content tests indicate that moisture content within the borings were generally below 10%.

From Attachment 1, the site location has a design freezing index of 1300.

Table 5-1 Depth of Frost Penetration

BDG

Design Freezing Index	Frost Penetration (in)					
	Coarse Grained			Fine Grained		
	w=10%	w=20%	w=30%	w=10%	w=20%	w=30%
1000	66.3	55.0	47.5	47.1	40.7	36.9
1100	69.8	57.8	49.8	49.6	42.7	38.7
1200	73.1	60.4	52.0	51.9	44.7	40.5
1300	76.3	63.0	54.3	54.2	46.6	42.2
1400	79.2	65.5	56.4	56.3	48.5	43.9
1500	82.1	67.9	58.4	58.3	50.2	45.4
1600	84.8	70.2	60.3	60.2	51.9	46.9
1700	87.5	72.4	62.2	62.2	53.5	48.4
1800	90.1	74.5	64.0	64.0	55.1	49.8
1900	92.6	76.6	65.7	65.8	56.7	51.1
2000	95.1	78.7	67.5	67.6	58.2	52.5
2100	97.6	80.7	69.2	69.3	59.7	53.8
2200	100.0	82.6	70.8	71.0	61.1	55.1
2300	102.3	84.5	72.4	72.7	62.5	56.4
2400	104.6	86.4	74.0	74.3	63.9	57.6
2500	106.9	88.2	75.6	75.9	65.2	58.8
2600	109.1	89.9	77.1	77.5	66.5	60.0

Therefore, the frost penetration depth is 76.3 inches or 6.36 feet. **Use 6.5 feet.**

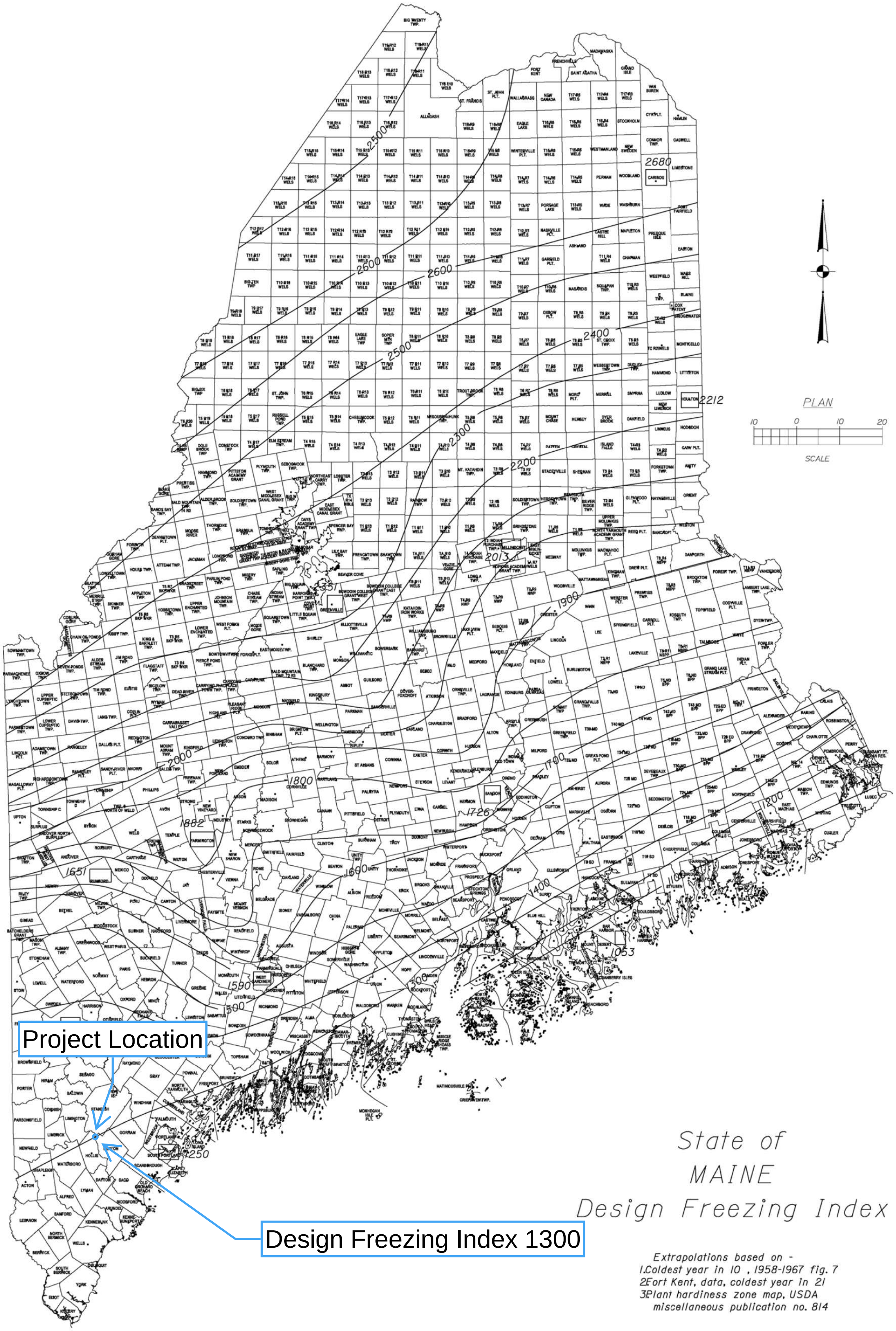


Figure 5-1 Maine Design Freezing Index Map

APPENDIX E

Automatic Hammer Calibration Report

November 10, 2023

Mr. Eric Baron
S.W. Cole Explorations, LLC
37 Liberty Drive
Bangor, ME 04401

Re: SPT Energy Calibration
Gorham, MA

GRL Job No. 2023PA00074

Mr. Baron

This report summarizes the results from the Standard Penetration Test (SPT) energy measurements performed for the Acker AD2 (SN 0877506), Diedrich D-50 (SN 362), Diedrich D-50 (SN 367), and Mobile B-48 (SN 202102) drill rigs. The field work associated with the energy measurements summarized in this report was performed on November 3, 2023.

The purpose in collecting the SPT energy measurements was to compute the energy transfer to the drill rods and the energy transfer ratio for the SPT hammers. To meet this objective, a model 8G Pile Driving Analyzer (PDA) was used to acquire and process the dynamic test data. Additional information regarding the testing equipment and analytical procedures is provided in Appendix A.

The energy measurements were performed in general accordance with the procedures set forth in ASTM D4633-16, Standard Test Method for Energy Measurements for Dynamic Penetrometers. This ASTM standard suggests that the SPT N value fall between 10 and 50 blows per foot to limit the effect of extra potential energy due to the set per blow.

Test Sequence

An instrumented NW drill rod with a J adaptor was used to acquire energy measurements during four or five SPT sampling events for the four drill rigs. This 2.375-foot-long instrumented section was placed between the SPT hammer and the top of the drill string. The measurement location on the instrumented NWJ rod section added an additional 9-inches to the reported rod length. The rod length also included the 3.25-, 3.3-, 3.3-, and 3.0-foot-long split-barrel sampler/adapter attached to the bottom of the Acker AD2 (SN 0877506), Diedrich D-50 (SN 362), Diedrich D-50 (SN 367), and Mobile B-48 (SN 202102) drill rods, respectively.

For the Acker AD2 (SN 0877506), five sampling events were monitored in a single borehole (BH1) between sampling depths of 25.0 to 36.5 feet. For the Diedrich D-50 (SN 362), five sampling events were monitored in a single borehole (BH1) between sampling depths of 25.0 to 43.5 feet. For the Diedrich D-50 (SN 367), four sampling events were monitored in a single borehole (BH1) between sampling depths of 25.0 to 41.5 feet. For the Mobile B-48 (SN 202102), five sampling events were monitored in a single borehole (BH1) between sampling depths of 25.0 to 34.5 feet.

For each SPT sampling event, the SPT split-spoon sampler was driven 18 inches while blows were recorded for each of the three 6-in increments. The SPT N value for each sampling event was then calculated as the number of blows for the second and third sampling increments. The N values for all sampling events for all four rigs were within the ASTM D4633 suggested range of 10 to 50. Including the instrumented section, drill rods, split spoon and adapter, the instrumented lengths ranged from 29.05 to 46.05 feet for the four rigs.

Energy Transfer Measurements

Strain and acceleration measurements were made on the instrumented NWJ drill rod. The strain and acceleration signals were conditioned and converted to force and velocities by an 8G model Pile Driving Analyzer. The PDA interprets the measured dynamic data according to the Case Method equations. Force and velocity records were viewed graphically on the PDA screen during data acquisition to assess data quality and were then digitally stored.

The maximum energy transferred to the rod (EFV) was calculated by integrating both the force and velocity records over time as follows:

$$EFV = \int F(t)V(t)dt$$

Where: $F(t)$ = the force at time t
$V(t)$ = the velocity at time t

The energy transfer ratio is computed by dividing the maximum transferred energy by the theoretical SPT hammer energy of 350 ft-lbs (computed from the product of the hammer weight, assumed to be 140 lbs, and the fall height, assumed to be 2.5 ft). The SPT N values can then be corrected for a nominal 60% transfer efficiency, N_{60}, as follows:

$$N_{60} = (e_m / 60)\, N_m$$

Where: e_m = the measured energy transfer ratio (ETR)
N_m = the measured SPT N value

Conclusions

Appendix B presents the average transferred energies and the energy transfer ratios for each sampling event calculated using the *EFV* equation. Average values of the hammer operating rate (BPM), maximum impact force (FMX), and maximum velocity (VMX) are also included along with the maximum, minimum, and standard deviation for each sampling event. The overall energy transfer ratios for all four or five sampling events weighted by N-value are presented in Table 1 below for corresponding drill rigs Acker AD2 (SN 0877506), Diedrich D-50 (SN 362), Diedrich D-50 (SN 367), and Mobile B-48 (SN 202102). All four or five sampling events were within the ASTM D4633 suggested N-Value range of 10 to 50 for all four rigs.

Table 1. Summary of Average Energy Transfer and Energy Transfer Ratio

Drill Rig (Serial Number)	*Average Energy Transfer (ft-lbs)*	*Energy Transfer Ratio (%)*
Acker AD2 (SN: 0877506)	337	96.6
Diedrich D-50 (SN: 362)	381	108.7
Diedrich D-50 (SN: 367)	373	106.6
Mobile B-48 (SN: 202102)	345	98.5

We appreciate the opportunity to be of assistance to you. Please do not hesitate to contact us if you have any questions regarding this report, or if we may be of further service.

Sincerely,
GRL Engineers, Inc.

Stephanie Gomez

Alex Ryberg, P.E.

STATE OF MAINE
ALEX
RYBERG
No. 16630
LICENSED
PROFESSIONAL ENGINEER

APPENDIX A
AN INTRODUCTION INTO SPT DYNAMIC PILE TESTING

1. BACKGROUND

The Standard Penetration Test is frequently conducted as an in-situ assessment of soil strength. This test requires that a 140 lb weight is dropped 30 inches onto a drive rod at whose bottom a sampler is usually installed. The sampler is driven for 18 inches; the number of blows required for the last 12 inches of driving is the so-called N-value. The N-value may be used as a strength indicator for foundation design or as a means of assessing the liquefaction potential of soils.

Obviously, the SPT hammer efficiency is an important consideration when using the N-values for design purposes. Measurements have indicated that the energy in the drive rod is sometimes only 30% and and may reach 90% of the potential or rated energy of the SPT hammer (E-rated = 0.35 kip-ft or 0.475 kJ). The type of hammer used to drive the rod is the main reason for these variations. On the average, the energy in the drive rod is 60% of the standard rated energy.

Because of the variability of energy, methods based on N-values are considered unreliable. However, measurements during SPT testing using the Case Method can be done on a routine basis and these measurements yield the transferred energy values. With measured energy, EMX, known, an adjustment of the measured N-value, N_m, can be made as follows.

$$N_{60} = N_m \, [E_m \, / \, (0.6 E_r \,)] \qquad (1)$$

Thus, if the measured energy value is equal to the normally expected transferred energy of 60% of E-rated then the adjusted and measured N-values are identical. On the other hand, if the measured energy is only 30% then the adjusted blow count will be reduced by 50%.

2. DYNAMIC TESTING AND ANALYSIS METHODS APPLIED TO SPT

The Case Method of dynamic pile testing, named after the Case Institute of Technology where it was developed between 1964 and 1975, requires that a substantial ram mass (e.g. a pile driving hammer) impacts the pile top such that the pile undergoes at least a small permanent set. Thus, the method is also referred to as a “High Strain Method”. The Case Method requires dynamic measurements on the pile or shaft under the ram impact and then a calculation of various quantities. Conveniently, for SPT applications, the measurements and analyses are done by a single piece of equipment: the SPT Analyzer. The Pile Driving Analyzer® (PDA) is also suitable to perform these measurements and data processing.

A related analysis method is the “Wave Equation Analysis” which calculates a relationship between bearing capacity, pile stresses, transferred energy and field blow count. The GRLWEAP™ program performs this analysis and provides a complete set of helpful information and input data. This program can be used very effectively to simulate the SPT driving process.

3. MEASUREMENTS

GRL uses equipment manufactured by Pile Dynamics, Inc. The system includes either an SPT-Analyzer™ (SPTA) or a Pile Driving Analyzer® (PDA), an instrumented rod section and two accelerometers. SPT energy testing is very closely related to and borrows procedures from dynamic pile testing. Those interested in the basis of the SPT energy testing method may obtain extensive literature on dynamic pile testing from GRL Engineers, Inc.

3.1 SPT Analyzer or Pile Driving Analyzer

The basis for the results calculated by the SPTA or PDA are strain and acceleration measured in an instrumented rod section. These signals are converted to rod top force, F(t), and rod top velocity, v(t). The SPTA or PDA conditions, calibrates and displays these signals and immediately computes average pile force and velocity thereby eliminating bending effects. The product of these two measurements is then integrated over time which yields the energy transferred to the instrumented section as a function of time (see Section 4.1).

For convenience and accuracy, strain measurements are usually taken on an instrumented section of SPT drive rod. Ideally, the section properties of the instrumented rod and those of the drive rod are the same, however, using subs, other sections can also be utilized.

For the instrumented section, PDI provides a force calibration in such a way that the output of the instrumented rod is directly calculated without the need for an accurate elastic modulus or cross sectional area of the rod section.

The acceleration measurements are often demanding in the SPT environment, because of high frequency and high acceleration motion components. An experienced measurement engineer, therefore, has to evaluate the quality of this data before final conclusions are drawn from the numerical results calculated by SPTA or PDA.

SPTA or PDA records are taken while the standard N-value is acquired in the conventional manner. This then allows a direct correlation between N-value and average transferred energy.

3.2 HPA

The SPT hammer's ram velocity may be directly obtained using radar technology in the Hammer Performance Analyzer™. The impact velocity results can be automatically processed with a PC or recorded on a strip chart. HPA measurements yield a hammer kinetic energy, but not the energy transferred to the drive rod.

4 RECORD EVALUATION BY SPTA OR PDA

4.1 HAMMER PERFORMANCE

The PDA calculates the energy transferred to the pile top from:

$$E(t) = \int_0^t F(\tau)v(\tau)\, d\tau \qquad (2)$$

The maximum of the E(t) curve is often called **ENTHRU or EMX;** it is the most important quantity for an overall evaluation of the performance of a hammer and driving system. **EMX** allows for a classification of the hammer's performance when presented as, e_T, the rated transfer efficiency, also called energy transfer ratio (**ETR**) or global efficiency.

$$e_T = EMX/E_R \qquad (3)$$

where E_R is the hammer manufacturer's rated energy value or 0.35 kip-ft (0.475 kJ) in the case of the SPT hammer.

Often in the SPT literature one finds also reference to the EF2 energy. This evaluation is based on assumed proportionality between force and velocity (see also Section 5):

$$v(t) = F(t) / Z \qquad (4)$$

where Z = EA/c is the pile impedance, E is the elastic modulus, A is the cross sectional area and c is the speed of the stress wave in the pile material..

Combining equations 2 and 4 leads to

$$EF(t) = \int_0^t F(\tau)^2 / Z\, d\tau \qquad (5)$$

The EF2 transferred energy value is the EF-value at the time t = 2L/c, where L is the drive rod length and c is the stress wave speed in steel (16,800 ft/s or 5,124 m/s). Since the force is easier to measure than both force and velocity, Equation 5 is preferred by some test engineers. However, the EF method is fraught with errors and certain correction factors have to be applied to make it approximately correct. Among the error sources are the following:

- Proportionality is often violated prior to time 2L/c. The proportionality between force and velocity in a downward traveling wave only holds if the wave does not encounter a disturbance prior to reflecting off the pile toe. Such disturbances include a change in cross sectional area, an open or loose splice or joint, or resistance along the shaft.

- Using only one force measurement precludes a data quality check based on the proportionality between force and velocity. Thus, a force measurement that is for some reason in error may not be detectable, which will lead to errors in the EF2 value. Data quality checks will be discussed further in Section 5.

The use if EF2 is therefore not recommended but it is often included in result presentations for the sake of completeness.

4.2 STRESSES

During SPT monitoring, it is also of interest to monitor compressive stresses at both the top of the drive rod and at its bottom.

At the pile top (location of sensors) the maximum compression stress averaged over the rod's cross section, **CSX**, is directly obtained from the measurements. Note that this stress value refers to the instrumented section. If the rod has a different cross sectional area then the stress in the rod will be different from CSX.

The SPTA or PDA can also calculate, in an approximate manner, the force at the rod bottom, **CFB**. To obtain the corresponding stress, this force value should be divided by the appropriate cross sectional area, e.g. by the rod area just above the sampler or by the sampler area itself. Of course, non-uniform stress components as they might occur at the sampler tip due to a sloping rock are not considered in this calculation.

5. DATA QUALITY CHECKS

Quality data is the first and foremost requirement for accurate dynamic testing results. It is therefore important that the measurement engineer performing SPTA or PDA tests has the experience necessary to recognize measurement problems and take appropriate corrective action should problems develop. Fortunately, dynamic pile testing allows for certain data quality checks because two independent measurements are taken that have to conform to the so-called proportionality relationship.

As long as there is only a wave traveling in one direction, as is the case during impact when only a downward traveling wave exists in the rod, force and velocity measured at its top are proportional

$$F = v Z \qquad (5)$$

where Z is again the pile impedance, Z = EA/c. This relationship can also be expressed in terms of stress

$$\sigma = F/A = v\ (E/c) \qquad (6)$$

or strain

$$\epsilon = \sigma/E = v / c \qquad (7)$$

This means that the early portion of strain times wave speed must be equal to the velocity unless the proportionality is affected by high friction near the pile top or by a pile cross sectional change not far below the sensors. Checking the proportionality is an excellent means of assuring meaningful measurements but is only truly meaningful for perfectly uniform rods. Open or loose splices, for example, will lead to a non-proportionality. For SPT rods it is fortunate that usually no soil resistance acts along the shaft and for that reason, proportionality can exist until the stress wave returns from sampler top or rod bottom unless connectors are not sufficiently tightened or have a significant mass.

Velocity data quality can also be checked by looking at the final displacement, DFN, which is calculated from the acceleration by double integration. If the calculated final displacement is much higher or lower than indicated by the N-value, the accelerometer attachment may be loose or the sensor may be faulty. If major drift in the velocity is observed, the EMX value may be in error, even though proportionality from impact to time 2L/c exists. In this case, it may be useful to evaluate the energy transferred to the drill rod at time 2L/c, which is calculated by the PDA or SPTA as the E2E quantity.

Appendix B

SPT Results

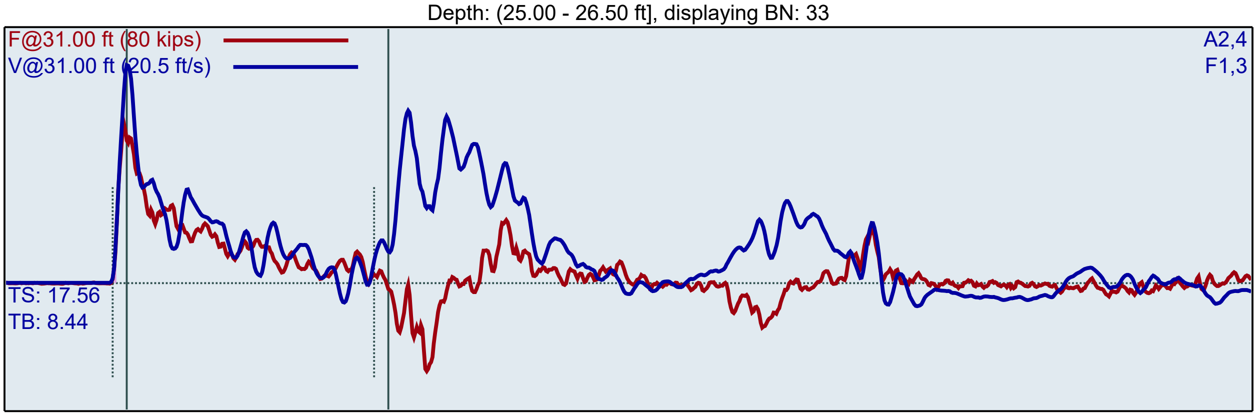
ACKER AD2 SN0877506
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 31.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 33



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
1	11	25.05	25.05	49	16.9	3693	1.14	1.9	342	97.7
2	11	25.09	25.09	48	16.9	3548	1.08	52.0	343	98.1
3	11	25.14	25.14	47	16.0	3171	0.97	52.2	333	95.0
4	11	25.18	25.18	47	16.1	3185	1.01	52.4	330	94.3
5	11	25.23	25.23	48	16.3	3221	0.75	52.4	335	95.7
6	11	25.27	25.27	47	16.5	3263	0.96	52.4	341	97.5
7	11	25.32	25.32	47	16.1	3144	0.96	52.3	335	95.7
8	11	25.36	25.36	48	17.0	3479	0.86	52.3	343	98.0
9	11	25.41	25.41	48	16.4	3234	0.92	52.4	343	98.0
10	11	25.45	25.45	47	16.3	3191	0.75	52.4	335	95.6
11	11	25.50	25.50	51	17.5	3946	0.75	52.4	347	99.2
12	14	25.54	25.54	46	16.4	3180	1.02	52.2	339	96.8
13	14	25.57	25.57	47	16.7	3272	0.69	52.2	337	96.4
14	14	25.61	25.61	49	17.1	3567	0.73	52.4	344	98.2
15	14	25.64	25.64	46	16.4	3143	0.91	52.3	337	96.3
16	14	25.68	25.68	48	16.9	3293	0.74	52.4	340	97.1
17	14	25.71	25.71	46	16.3	3186	0.79	52.3	336	96.1
18	14	25.75	25.75	47	16.6	3176	0.92	52.4	342	97.6
19	14	25.79	25.79	47	16.1	3124	0.61	52.3	329	93.9
20	14	25.82	25.82	46	16.0	3139	0.68	52.3	328	93.8
21	14	25.86	25.86	46	16.4	3181	0.87	52.3	336	95.9
22	14	25.89	25.89	47	16.9	3460	0.68	52.5	336	96.0
23	14	25.93	25.93	47	16.6	3146	0.78	52.3	337	96.2
24	14	25.96	25.96	46	16.4	3086	0.69	52.5	333	95.1
25	14	26.00	26.00	46	15.9	3113	0.68	52.3	326	93.2
26	16	26.03	26.03	46	16.1	3150	0.67	52.5	327	93.5
27	16	26.06	26.06	48	17.1	3568	0.85	52.3	342	97.7

28	16	26.09	26.09	47	16.2	3208	0.70	52.2	332	94.9
29	16	26.13	26.13	46	16.4	3167	0.74	52.4	333	95.3
30	16	26.16	26.16	50	17.5	3903	0.62	52.4	348	99.5
31	16	26.19	26.19	49	17.3	3800	0.72	52.3	344	98.3
32	16	26.22	26.22	46	16.1	3117	0.66	52.5	329	94.1
33	16	26.25	26.25	50	17.4	3941	0.74	52.3	344	98.3
34	16	26.28	26.28	49	17.3	3881	0.62	52.4	342	97.8
35	16	26.31	26.31	48	17.2	3524	0.74	52.3	347	99.1
36	16	26.34	26.34	51	17.8	4266	0.79	52.5	352	100.7
37	16	26.38	26.38	48	17.0	3517	0.59	52.2	340	97.1
38	16	26.41	26.41	49	17.7	4079	0.71	52.4	347	99.1
39	16	26.44	26.44	51	17.8	4137	0.65	52.2	352	100.7
40	16	26.47	26.47	46	16.3	3130	0.73	52.5	331	94.6
41	16	26.50	26.50	46	16.7	3177	0.66	52.4	336	96.1
		Average	26.03	48	16.8	3421	0.73	52.3	338	96.6
		Std Dev	0.29	2	0.6	356	0.10	0.1	7	2.0
		Maximum	26.50	51	17.8	4266	1.02	52.5	352	100.7
		Minimum	25.54	46	15.9	3086	0.59	52.2	326	93.2

N-value: 30

Sample Interval Time: 45.86 seconds.

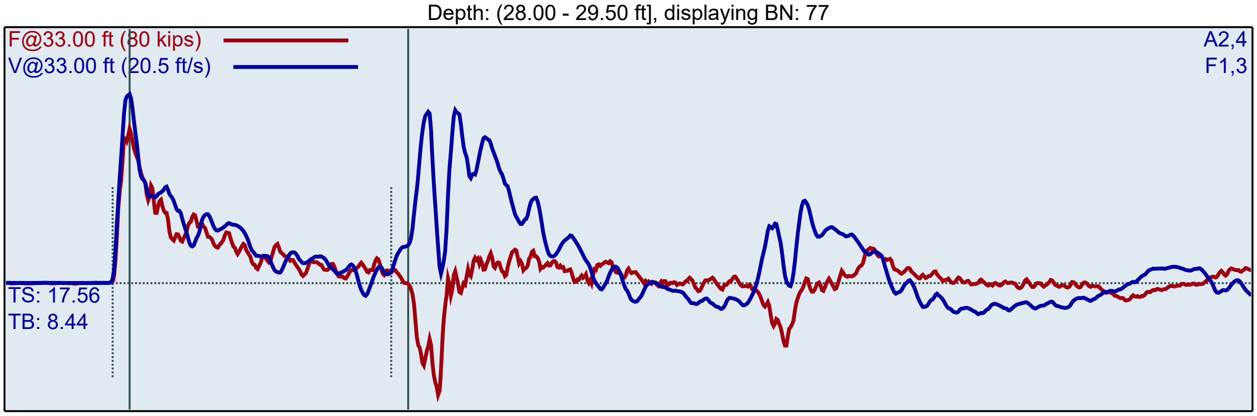
ACKER AD2 SN0877506
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 33.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.00 - 29.50 ft], displaying BN: 77



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	LP ft	FMX kips	VMX ft/s	AMX g's	DMX in	BPM bpm	EFV ft-lb	ETR %
42	10	28.05	28.05	51	19.5	3623	1.24	1.9	350	99.9
43	10	28.10	28.10	54	19.3	4146	1.09	52.6	357	102.0
44	10	28.15	28.15	51	18.3	3565	0.91	53.0	345	98.7
45	10	28.20	28.20	54	17.8	4403	0.83	52.8	353	100.9
46	10	28.25	28.25	54	17.7	4456	0.85	52.8	357	102.0
47	10	28.30	28.30	51	17.0	3841	0.82	53.0	349	99.6
48	10	28.35	28.35	48	15.5	3108	0.66	52.9	328	93.8
49	10	28.40	28.40	47	16.2	3482	0.61	52.8	327	93.5
50	10	28.45	28.45	52	16.7	4257	0.87	53.0	351	100.2
51	10	28.50	28.50	50	15.6	3566	0.73	52.8	340	97.1
52	16	28.53	28.53	47	14.8	3302	0.56	53.1	327	93.4
53	16	28.56	28.56	48	16.3	3794	0.74	52.9	336	95.9
54	16	28.59	28.59	49	15.9	3736	0.73	53.0	342	97.8
55	16	28.63	28.63	48	15.4	3318	0.63	52.9	331	94.6
56	16	28.66	28.66	51	16.6	4141	0.73	53.0	352	100.5
57	16	28.69	28.69	51	15.6	3764	0.65	52.9	339	96.9
58	16	28.72	28.72	47	14.7	3421	0.52	53.1	333	95.1
59	16	28.75	28.75	53	16.7	4336	0.53	52.9	355	101.3
60	16	28.78	28.78	53	16.6	4298	0.59	53.0	353	100.8
61	16	28.81	28.81	47	14.7	3547	0.65	52.8	338	96.4
62	16	28.84	28.84	52	15.8	3604	0.65	53.1	343	98.0
63	16	28.88	28.88	48	14.7	3180	0.60	53.0	329	94.1
64	16	28.91	28.91	52	16.5	4046	0.52	52.9	350	99.9
65	16	28.94	28.94	49	15.1	3848	0.46	53.0	335	95.7
66	16	28.97	28.97	51	15.4	4319	0.48	52.8	335	95.8
67	16	29.00	29.00	48	14.7	3629	0.45	53.0	324	92.7
68	19	29.03	29.03	49	15.1	4043	0.47	52.8	336	96.1
69	19	29.05	29.05	51	15.4	4411	0.44	53.1	337	96.2
70	19	29.08	29.08	49	15.3	4093	0.46	52.8	336	96.1
71	19	29.11	29.11	50	15.2	3888	0.43	53.0	333	95.0
72	19	29.13	29.13	50	15.6	4466	0.48	52.9	342	97.6

73	19	29.16	29.16	47	14.9	4260	0.48	52.9	336	96.1
74	19	29.18	29.18	47	15.0	4070	0.61	53.1	333	95.3
75	19	29.21	29.21	46	14.8	4001	0.44	52.8	327	93.5
76	19	29.24	29.24	49	15.9	4279	0.47	53.0	339	96.8
77	19	29.26	29.26	48	15.1	4232	0.52	53.0	334	95.6
78	19	29.29	29.29	47	15.2	3914	0.56	53.0	337	96.4
79	19	29.32	29.32	49	15.4	4015	0.42	52.9	333	95.2
80	19	29.34	29.34	54	16.7	4574	0.51	53.0	355	101.5
81	19	29.37	29.37	49	15.0	4420	0.40	53.1	331	94.4
82	19	29.39	29.39	50	16.3	4125	0.51	52.9	350	100.0
83	19	29.42	29.42	48	15.2	4517	0.51	53.0	335	95.7
84	19	29.45	29.45	52	16.4	4371	0.41	52.8	346	98.9
85	19	29.47	29.47	48	15.1	4242	0.63	53.1	338	96.6
86	19	29.50	29.50	51	16.4	4559	0.42	52.9	345	98.6
		Average	29.04	49	15.5	4022	0.53	53.0	338	96.7
		Std Dev	0.29	2	0.7	373	0.09	0.1	8	2.3
		Maximum	29.50	54	16.7	4574	0.74	53.1	355	101.5
		Minimum	28.53	46	14.7	3180	0.40	52.8	324	92.7

N-value: 35

Sample Interval Time: 49.86 seconds.

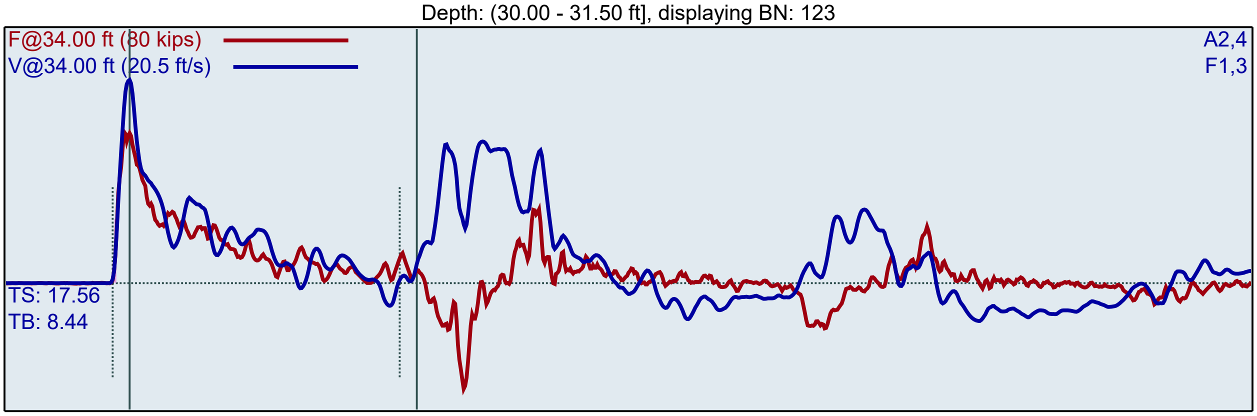
ACKER AD2 SN0877506
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 34.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 123



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	LP ft	FMX kips	VMX ft/s	AMX g's	DMX in	BPM bpm	EFV ft-lb	ETR %
87	12	30.04	30.04	48	16.1	3313	0.80	1.9	330	94.2
88	12	30.08	30.08	45	15.0	3188	0.65	52.7	318	90.9
89	12	30.13	30.13	46	15.0	3230	0.67	52.9	323	92.3
90	12	30.17	30.17	46	15.2	3380	0.58	53.0	324	92.7
91	12	30.21	30.21	47	15.5	3484	0.59	52.8	338	96.5
92	12	30.25	30.25	47	15.5	3506	0.57	53.1	334	95.4
93	12	30.29	30.29	47	15.1	3246	0.57	52.8	327	93.5
94	12	30.33	30.33	46	15.1	3288	0.63	53.0	331	94.5
95	12	30.38	30.38	47	15.3	3245	0.68	52.9	334	95.4
96	12	30.42	30.42	47	15.1	3165	0.50	53.0	328	93.8
97	12	30.46	30.46	47	15.4	3331	0.50	53.1	330	94.4
98	12	30.50	30.50	47	15.6	3468	0.52	52.9	337	96.4
99	15	30.53	30.53	46	15.0	3137	0.48	53.1	326	93.1
100	15	30.57	30.57	47	15.2	3083	0.48	52.9	330	94.3
101	15	30.60	30.60	47	15.5	3284	0.48	53.0	330	94.4
102	15	30.63	30.63	46	14.7	2980	0.47	53.0	321	91.7
103	15	30.67	30.67	45	14.9	3000	0.48	52.9	324	92.5
104	15	30.70	30.70	48	15.7	3513	0.55	53.0	340	97.2
105	15	30.73	30.73	47	15.1	3300	0.46	53.0	324	92.5
106	15	30.77	30.77	45	15.1	3107	0.61	52.9	329	94.0
107	15	30.80	30.80	47	15.4	3355	0.44	53.2	327	93.5
108	15	30.83	30.83	46	15.3	3207	0.46	52.9	328	93.6
109	15	30.87	30.87	47	15.8	3401	0.72	53.0	340	97.1
110	15	30.90	30.90	47	15.8	3539	0.62	53.1	338	96.7
111	15	30.93	30.93	47	15.5	3285	0.45	53.1	328	93.8
112	15	30.97	30.97	47	16.0	3612	0.73	53.0	341	97.3
113	15	31.00	31.00	48	15.9	3516	0.45	52.9	333	95.2
114	20	31.03	31.03	53	17.1	4286	0.57	53.1	352	100.7
115	20	31.05	31.05	47	16.1	3456	0.59	53.1	342	97.6
116	20	31.08	31.08	47	16.1	3537	0.66	53.0	341	97.4
117	20	31.10	31.10	47	16.0	3424	0.42	53.1	332	94.9

118	20	31.13	31.13	47	15.8	3362	0.54	53.0	335	95.7
119	20	31.15	31.15	46	15.8	3329	0.61	53.0	339	96.7
120	20	31.18	31.18	51	16.8	3996	0.45	52.9	346	98.8
121	20	31.20	31.20	47	15.5	3296	0.42	53.1	326	93.2
122	20	31.23	31.23	46	16.4	3406	0.45	53.1	348	99.4
123	20	31.25	31.25	47	16.3	3537	0.41	53.0	335	95.8
124	20	31.28	31.28	47	16.3	3479	0.43	53.0	338	96.5
125	20	31.30	31.30	47	16.2	3473	0.47	53.2	339	97.0
126	20	31.33	31.33	48	16.3	3422	0.45	53.0	338	96.7
127	20	31.35	31.35	47	16.3	3574	0.53	53.0	342	97.8
128	20	31.38	31.38	48	16.3	3521	0.53	53.0	340	97.1
129	20	31.40	31.40	48	16.2	3512	0.39	53.1	333	95.1
130	20	31.43	31.43	47	16.3	3454	0.60	53.1	338	96.5
131	20	31.45	31.45	46	16.1	3327	0.58	52.8	337	96.2
132	20	31.48	31.48	47	16.4	3511	0.49	53.2	339	96.8
133	20	31.50	31.50	47	16.2	3501	0.60	53.1	337	96.3
		Average	31.05	47	15.9	3421	0.52	53.0	335	95.8
		Std Dev	0.28	1	0.5	242	0.09	0.1	7	2.0
		Maximum	31.50	53	17.1	4286	0.73	53.2	352	100.7
		Minimum	30.53	45	14.7	2980	0.39	52.8	321	91.7

N-value: 35

Sample Interval Time: 52.05 seconds.

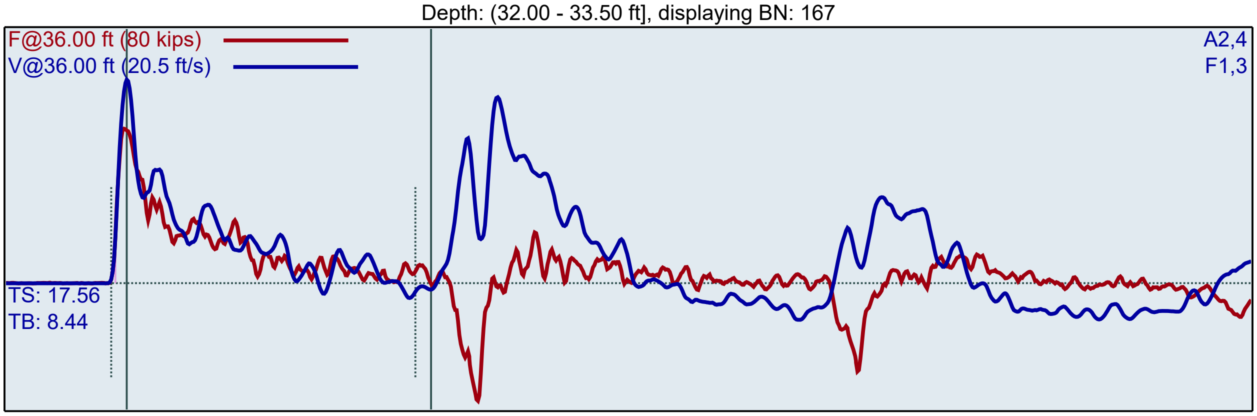
ACKER AD2 SN0877506
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 36.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (32.00 - 33.50 ft], displaying BN: 167



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
134	10	32.05	32.05	45	14.8	2846	0.73	1.9	312	89.0
135	10	32.10	32.10	46	14.8	3086	0.68	52.1	317	90.7
136	10	32.15	32.15	46	14.8	3063	0.66	52.4	323	92.4
137	10	32.20	32.20	46	15.2	3248	0.65	52.2	326	93.2
138	10	32.25	32.25	47	15.7	3445	0.64	52.4	336	96.0
139	10	32.30	32.30	45	14.7	3020	0.66	52.3	321	91.8
140	10	32.35	32.35	48	16.1	3530	0.63	52.4	339	96.9
141	10	32.40	32.40	48	15.5	3372	0.64	52.4	337	96.2
142	10	32.45	32.45	47	15.3	3322	0.65	52.3	334	95.4
143	10	32.50	32.50	47	15.2	3245	0.62	52.4	331	94.5
144	15	32.53	32.53	46	15.1	3238	0.54	52.2	326	93.2
145	15	32.57	32.57	46	14.9	3155	0.53	52.5	324	92.5
146	15	32.60	32.60	48	16.1	3673	0.53	52.4	340	97.1
147	15	32.63	32.63	46	14.9	3093	0.52	52.3	323	92.2
148	15	32.67	32.67	47	15.5	3325	0.51	52.6	331	94.7
149	15	32.70	32.70	46	15.2	3175	0.51	52.2	328	93.8
150	15	32.73	32.73	47	16.5	4074	0.52	52.4	345	98.6
151	15	32.77	32.77	47	15.1	3127	0.48	52.3	325	92.8
152	15	32.80	32.80	46	15.1	3135	0.49	52.6	323	92.3
153	15	32.83	32.83	49	16.7	4243	0.51	52.3	349	99.8
154	15	32.87	32.87	46	15.1	3222	0.48	52.3	327	93.4
155	15	32.90	32.90	47	16.4	3966	0.49	52.4	341	97.4
156	15	32.93	32.93	46	15.3	3199	0.49	52.4	333	95.0
157	15	32.97	32.97	47	15.4	3406	0.48	52.4	332	94.8
158	15	33.00	33.00	47	16.2	3787	0.49	52.3	342	97.8
159	18	33.03	33.03	46	15.1	3260	0.46	52.5	327	93.4
160	18	33.06	33.06	49	16.6	4322	0.47	52.3	341	97.5
161	18	33.08	33.08	47	15.7	3426	0.46	52.4	332	94.8
162	18	33.11	33.11	46	15.0	3211	0.44	52.5	321	91.6
163	18	33.14	33.14	47	15.4	3402	0.46	52.5	330	94.4
164	18	33.17	33.17	50	16.8	4472	0.47	52.4	348	99.4

165	18	33.19	33.19	46	15.0	3168	0.46	52.3	328	93.6
166	18	33.22	33.22	49	16.2	4069	0.44	52.4	339	96.8
167	18	33.25	33.25	48	16.3	3980	0.44	52.3	341	97.3
168	18	33.28	33.28	48	16.1	3878	0.45	52.5	342	97.9
169	18	33.31	33.31	50	16.3	4211	0.45	52.4	343	98.1
170	18	33.33	33.33	48	15.5	3509	0.44	52.5	336	96.0
171	18	33.36	33.36	45	14.5	2966	0.44	52.4	323	92.1
172	18	33.39	33.39	48	15.8	3812	0.43	52.4	337	96.4
173	18	33.42	33.42	47	15.5	3446	0.44	52.4	339	96.9
174	18	33.44	33.44	50	16.0	4052	0.43	52.5	343	98.0
175	18	33.47	33.47	48	15.1	3351	0.43	52.4	333	95.1
176	18	33.50	33.50	48	15.8	3808	0.44	52.4	346	98.9
		Average	33.04	47	15.6	3581	0.47	52.4	334	95.6
		Std Dev	0.29	1	0.6	420	0.03	0.1	8	2.4
		Maximum	33.50	50	16.8	4472	0.54	52.6	349	99.8
		Minimum	32.53	45	14.5	2966	0.43	52.2	321	91.6

N-value: 33

Sample Interval Time: 48.13 seconds.

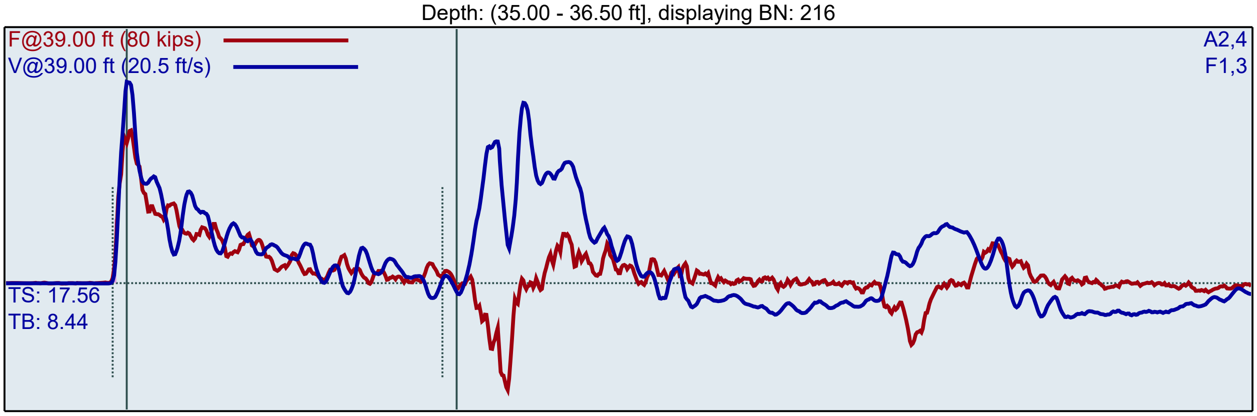
ACKER AD2 SN0877506
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 39.00 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (35.00 - 36.50 ft], displaying BN: 216



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
177	12	35.04	35.04	48	17.0	4190	0.75	1.9	341	97.3
178	12	35.08	35.08	47	15.4	3299	0.84	52.8	335	95.6
179	12	35.13	35.13	47	15.6	3354	0.71	53.1	336	96.1
180	12	35.17	35.17	47	15.6	3400	0.63	53.2	335	95.6
181	12	35.21	35.21	48	16.4	3806	0.61	53.1	343	98.1
182	12	35.25	35.25	48	16.2	3683	0.53	53.1	335	95.8
183	12	35.29	35.29	46	15.6	3329	0.61	53.1	331	94.5
184	12	35.33	35.33	47	15.0	3021	0.79	53.4	325	93.0
185	12	35.38	35.38	47	15.7	3448	0.60	53.1	335	95.7
186	12	35.42	35.42	47	15.2	3186	0.54	53.2	324	92.7
187	12	35.46	35.46	48	16.3	3689	0.50	53.1	341	97.3
188	12	35.50	35.50	47	15.6	3285	0.67	53.2	334	95.4
189	17	35.53	35.53	48	16.8	4227	0.47	53.2	346	98.8
190	17	35.56	35.56	47	15.2	3072	0.90	53.1	333	95.1
191	17	35.59	35.59	47	14.9	3000	0.51	53.2	326	93.1
192	17	35.62	35.62	48	16.1	3501	0.47	53.1	340	97.2
193	17	35.65	35.65	47	15.2	3178	0.50	53.3	330	94.2
194	17	35.68	35.68	47	14.8	2934	0.43	53.2	323	92.3
195	17	35.71	35.71	48	14.9	3044	0.44	53.2	323	92.3
196	17	35.74	35.74	51	17.2	4339	0.55	53.1	349	99.8
197	17	35.76	35.76	50	17.1	4374	0.62	53.0	346	98.9
198	17	35.79	35.79	48	15.3	3176	0.47	53.2	331	94.7
199	17	35.82	35.82	47	15.5	3320	0.45	53.2	333	95.1
200	17	35.85	35.85	47	15.1	3140	0.41	53.2	322	92.1
201	17	35.88	35.88	49	16.8	4061	0.55	53.2	349	99.7
202	17	35.91	35.91	47	15.4	3323	0.55	53.1	332	94.8
203	17	35.94	35.94	47	16.2	3703	0.53	53.1	342	97.7
204	17	35.97	35.97	47	15.1	3307	0.44	53.2	326	93.1
205	17	36.00	36.00	46	15.5	3288	0.44	53.2	334	95.6
206	21	36.02	36.02	48	16.0	3619	0.50	53.2	346	98.9
207	21	36.05	36.05	47	15.6	3370	0.52	53.1	334	95.3

208	21	36.07	36.07	48	16.1	3619	0.46	53.2	343	98.0
209	21	36.10	36.10	47	15.4	3312	0.59	53.1	327	93.4
210	21	36.12	36.12	48	16.7	4122	0.46	53.2	341	97.3
211	21	36.14	36.14	53	17.5	4708	0.46	53.2	354	101.0
212	21	36.17	36.17	47	15.5	3175	0.38	53.1	330	94.3
213	21	36.19	36.19	48	15.8	3510	0.67	53.4	332	94.9
214	21	36.21	36.21	49	16.6	4188	0.49	53.1	348	99.5
215	21	36.24	36.24	47	15.6	3418	0.45	53.2	337	96.3
216	21	36.26	36.26	48	16.1	3867	0.39	53.1	334	95.6
217	21	36.29	36.29	52	17.5	4535	0.41	53.3	356	101.8
218	21	36.31	36.31	51	17.1	4634	0.37	53.1	343	97.9
219	21	36.33	36.33	48	16.0	3640	0.38	53.2	339	96.8
220	21	36.36	36.36	48	16.1	3768	0.40	53.3	345	98.5
221	21	36.38	36.38	48	15.6	3434	0.52	53.2	335	95.8
222	21	36.40	36.40	49	16.6	4192	0.49	53.1	348	99.4
223	21	36.43	36.43	47	15.9	3873	0.38	53.2	343	98.0
224	21	36.45	36.45	49	16.8	4594	0.38	53.2	348	99.4
225	21	36.48	36.48	48	15.4	3221	0.37	53.2	327	93.6
226	21	36.50	36.50	46	15.7	3775	0.48	53.3	339	96.9
		Average	36.04	48	16.0	3673	0.48	53.2	338	96.5
		Std Dev	0.29	2	0.7	506	0.10	0.1	9	2.6
		Maximum	36.50	53	17.5	4708	0.90	53.4	356	101.8
		Minimum	35.53	46	14.8	2934	0.37	53.0	322	92.1

N-value: 38

Sample Interval Time: 55.27 seconds.

Summary of SPT Test Results

Project: ACKER AD2 SN0877506, Test Date: 11/3/2023

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average LP ft	Average FMX kips	Average VMX ft/s	Average AMX g's	Average DMX in	Average BPM bpm	Average EFV ft-lb	Average ETR %
31.00	**11-14-16**	25.00	26.50	**30**	**48**	26.03	48	16.8	3421	0.73	52.3	338	96.6
33.00	**10-16-19**	28.00	29.50	**35**	**56**	29.04	49	15.5	4022	0.53	53.0	338	96.7
34.00	**12-15-20**	30.00	31.50	**35**	**56**	31.05	47	15.9	3421	0.52	53.0	335	95.8
36.00	**10-15-18**	32.00	33.50	**33**	**52**	33.04	47	15.6	3581	0.47	52.4	334	95.6
39.00	**12-17-21**	35.00	36.50	**38**	**60**	36.04	48	16.0	3673	0.48	53.2	338	96.5
					Overall Average Values:	31.25	48	15.9	3631	0.54	52.8	337	96.2
					Standard Deviation:	3.40	2	0.8	450	0.13	0.3	8	2.3
					Overall Maximum Value:	36.50	54	17.8	4708	1.02	53.4	356	101.8
					Overall Minimum Value:	25.54	45	14.5	2934	0.37	52.2	321	91.6

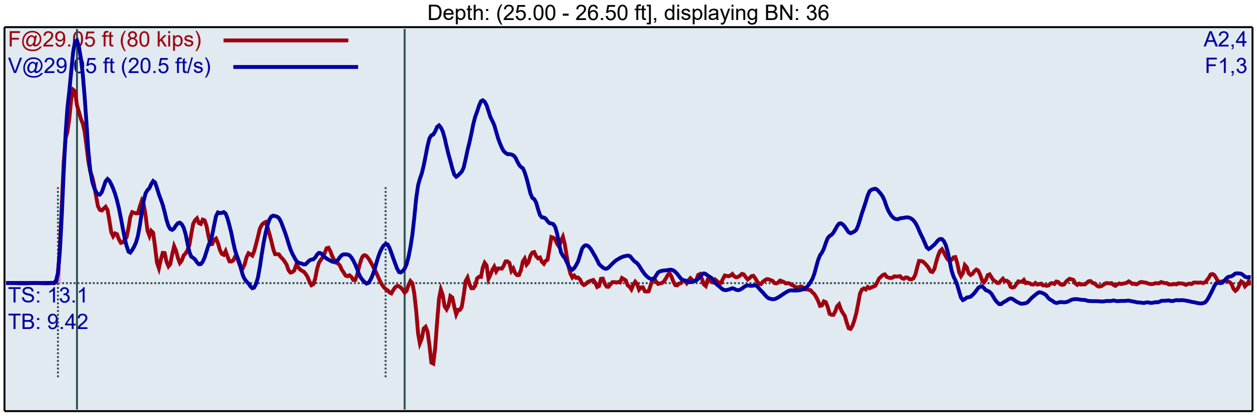
DIEDRICH D50 SN362
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 29.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 36



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration

DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
1	12	25.04	25.04	56	19.6	5348	1.02	1.9	350	99.9
2	12	25.08	25.08	59	20.9	5692	1.06	55.6	385	110.0
3	12	25.13	25.13	61	21.1	5648	0.87	56.6	396	113.2
4	12	25.17	25.17	62	20.2	5766	0.76	57.5	394	112.6
5	12	25.21	25.21	62	20.1	5830	0.72	56.5	396	113.2
6	12	25.25	25.25	63	20.1	5970	0.87	56.6	398	113.8
7	12	25.29	25.29	62	19.8	5550	0.66	56.9	392	111.9
8	12	25.33	25.33	63	19.9	5833	0.72	57.4	390	111.4
9	12	25.38	25.38	62	19.7	5524	0.71	56.2	395	112.8
10	12	25.42	25.42	63	19.8	5813	0.82	57.7	384	109.8
11	12	25.46	25.46	65	20.0	5864	0.61	56.3	397	113.3
12	12	25.50	25.50	64	20.0	6062	0.77	57.0	391	111.7
13	15	25.53	25.53	64	20.0	6055	0.62	56.5	389	111.3
14	15	25.57	25.57	62	19.6	5598	0.56	56.1	383	109.4
15	15	25.60	25.60	64	20.2	6072	0.56	55.8	396	113.1
16	15	25.63	25.63	63	19.8	5620	0.66	56.3	391	111.8
17	15	25.67	25.67	64	20.2	5977	0.60	55.8	398	113.7
18	15	25.70	25.70	62	19.9	5711	0.69	56.0	387	110.6
19	15	25.73	25.73	63	19.9	6098	0.59	56.3	379	108.2
20	15	25.77	25.77	63	19.9	6028	0.58	55.7	382	109.1
21	15	25.80	25.80	63	20.2	5885	0.62	55.0	397	113.3
22	15	25.83	25.83	62	19.8	5870	0.74	56.2	382	109.1
23	15	25.87	25.87	62	19.8	5681	0.69	55.2	383	109.5
24	15	25.90	25.90	63	20.1	6087	0.67	55.7	386	110.3
25	15	25.93	25.93	61	19.3	5418	0.60	55.8	375	107.2
26	15	25.97	25.97	62	19.9	6011	0.70	55.6	381	108.9
27	15	26.00	26.00	63	19.9	5928	0.74	55.3	385	109.9

28	17	26.03	26.03	63	20.0	6017	0.69	55.5	389	111.2
29	17	26.06	26.06	62	19.6	5612	0.60	56.4	378	108.0
30	17	26.09	26.09	63	19.6	5809	0.66	56.2	379	108.2
31	17	26.12	26.12	62	19.7	5690	0.52	55.5	382	109.1
32	17	26.15	26.15	63	19.8	5871	0.56	55.7	385	110.1
33	17	26.18	26.18	64	20.0	5980	0.60	54.9	394	112.4
34	17	26.21	26.21	64	20.0	6083	0.52	56.0	385	110.1
35	17	26.24	26.24	63	19.9	5916	0.56	55.9	381	109.0
36	17	26.26	26.26	60	19.4	5527	0.60	56.0	373	106.5
37	17	26.29	26.29	61	19.5	5547	0.57	55.4	372	106.4
38	17	26.32	26.32	61	19.7	5791	0.57	55.4	376	107.4
39	17	26.35	26.35	61	19.7	5599	0.56	54.5	378	108.1
40	17	26.38	26.38	62	20.2	6058	0.55	55.6	384	109.6
41	17	26.41	26.41	61	20.1	6087	0.55	56.0	384	109.6
42	17	26.44	26.44	60	19.7	5588	0.49	55.2	382	109.2
43	17	26.47	26.47	59	20.0	5768	0.53	55.1	385	110.0
44	17	26.50	26.50	59	19.9	5737	0.46	56.2	379	108.3
		Average	26.03	62	19.9	5835	0.60	55.7	384	109.6
		Std Dev	0.29	1	0.2	199	0.07	0.5	6	1.8
		Maximum	26.50	64	20.2	6098	0.74	56.5	398	113.7
		Minimum	25.53	59	19.3	5418	0.46	54.5	372	106.4

N-value: 32

Sample Interval Time: 46.06 seconds.

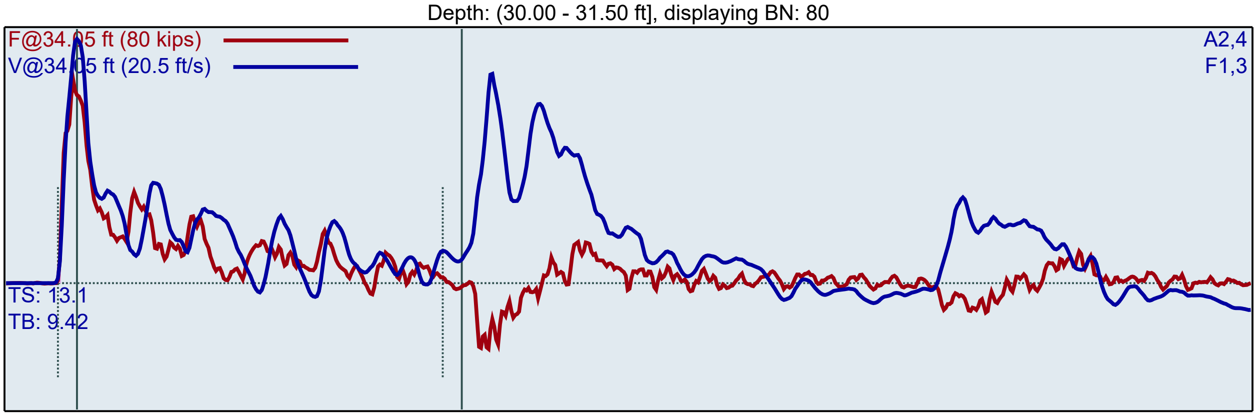
DIEDRICH D50 SN362
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 34.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 80



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
45	12	30.04	30.04	59	20.1	5352	0.86	1.9	383	109.3
46	12	30.08	30.08	62	20.4	5627	0.91	56.2	391	111.7
47	12	30.13	30.13	61	19.6	5354	0.83	56.6	385	110.1
48	12	30.17	30.17	64	20.3	5923	0.70	55.5	400	114.2
49	12	30.21	30.21	62	20.1	5298	0.82	55.7	405	115.8
50	12	30.25	30.25	62	20.1	5455	0.72	56.7	398	113.8
51	12	30.29	30.29	61	19.9	5503	0.64	56.8	393	112.4
52	12	30.33	30.33	62	20.0	5688	0.61	56.0	389	111.0
53	12	30.38	30.38	61	19.7	5444	0.68	55.6	390	111.4
54	12	30.42	30.42	61	19.6	5689	0.70	55.8	390	111.5
55	12	30.46	30.46	63	20.0	6191	0.65	55.7	391	111.8
56	12	30.50	30.50	61	19.8	6058	0.62	56.2	389	111.1
57	15	30.53	30.53	62	19.8	5913	0.54	55.5	386	110.2
58	15	30.57	30.57	61	19.5	5645	0.59	55.8	380	108.5
59	15	30.60	30.60	62	19.7	5758	0.73	56.0	386	110.2
60	15	30.63	30.63	61	19.4	5691	0.66	56.6	379	108.3
61	15	30.67	30.67	60	19.4	5547	0.57	56.7	382	109.3
62	15	30.70	30.70	62	19.9	6320	0.52	54.6	391	111.8
63	15	30.73	30.73	63	20.0	6544	0.52	55.4	392	112.0
64	15	30.77	30.77	64	19.8	6072	0.52	55.5	391	111.6
65	15	30.80	30.80	62	19.6	6097	0.49	56.4	381	108.8
66	15	30.83	30.83	61	19.3	6148	0.48	56.0	374	106.9
67	15	30.87	30.87	62	19.6	5839	0.49	56.1	386	110.4
68	15	30.90	30.90	64	19.8	6440	0.48	55.8	382	109.2
69	15	30.93	30.93	65	19.9	6320	0.52	54.4	399	113.9
70	15	30.97	30.97	63	19.6	6320	0.51	57.1	389	111.1
71	15	31.00	31.00	64	19.7	6029	0.49	55.2	390	111.4
72	18	31.03	31.03	64	19.6	6072	0.45	56.2	386	110.3
73	18	31.06	31.06	63	19.6	6065	0.46	56.6	387	110.5
74	18	31.08	31.08	62	19.5	5429	0.46	55.7	385	109.9
75	18	31.11	31.11	63	19.6	6292	0.44	55.5	384	109.7

76	18	31.14	31.14	64	19.6	5888	0.46	56.1	386	110.2
77	18	31.17	31.17	64	19.6	6041	0.45	56.2	387	110.5
78	18	31.19	31.19	64	19.6	5828	0.53	55.5	391	111.7
79	18	31.22	31.22	64	19.9	6222	0.53	55.2	399	114.1
80	18	31.25	31.25	64	19.5	5727	0.58	56.5	386	110.3
81	18	31.28	31.28	64	19.7	5984	0.55	55.5	393	112.4
82	18	31.31	31.31	63	19.7	6111	0.48	55.8	393	112.3
83	18	31.33	31.33	62	19.3	5549	0.50	55.6	392	112.1
84	18	31.36	31.36	61	19.3	5835	0.46	55.7	383	109.4
85	18	31.39	31.39	64	19.7	5933	0.58	56.0	391	111.8
86	18	31.42	31.42	64	19.6	5848	0.47	55.7	392	111.9
87	18	31.44	31.44	63	19.5	5775	0.62	55.8	391	111.7
88	18	31.47	31.47	65	19.9	6058	0.47	55.2	392	111.9
89	18	31.50	31.50	62	19.4	5583	0.50	55.5	393	112.2
		Average	31.04	63	19.6	5967	0.52	55.8	388	110.8
		Std Dev	0.29	1	0.2	270	0.06	0.6	5	1.5
		Maximum	31.50	65	20.0	6544	0.73	57.1	399	114.1
		Minimum	30.53	60	19.3	5429	0.44	54.4	374	106.9

N-value: 33

Sample Interval Time: 47.28 seconds.

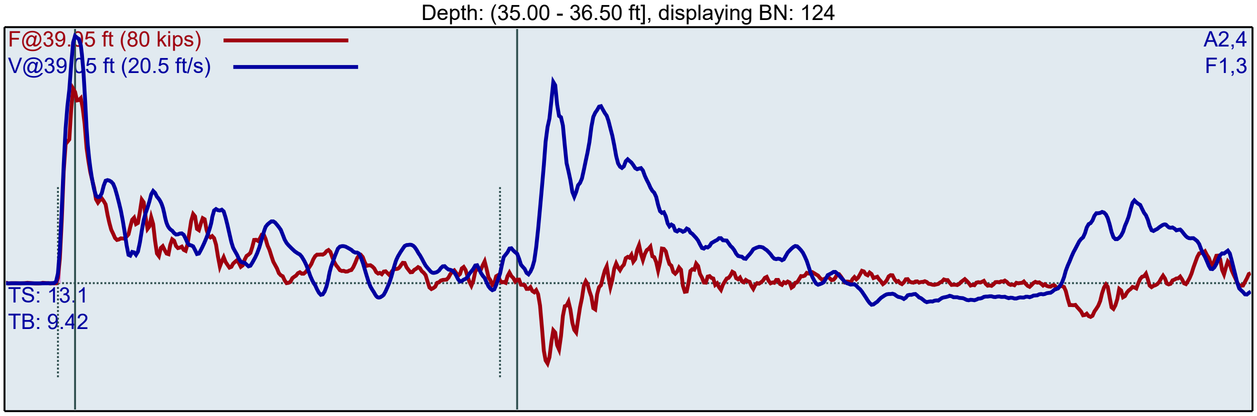
DIEDRICH D50 SN362
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 39.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (35.00 - 36.50 ft], displaying BN: 124



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
90	13	35.04	35.04	58	19.3	5265	0.54	1.9	358	102.2
91	13	35.08	35.08	59	20.1	5657	0.56	55.5	378	108.0
92	13	35.12	35.12	60	20.2	5670	0.59	54.1	394	112.7
93	13	35.15	35.15	62	20.6	5846	0.74	56.2	403	115.3
94	13	35.19	35.19	61	20.2	5641	0.70	57.3	391	111.6
95	13	35.23	35.23	61	20.3	5835	0.74	56.0	390	111.5
96	13	35.27	35.27	59	19.7	5441	0.71	56.0	380	108.7
97	13	35.31	35.31	60	20.4	5322	0.67	55.8	404	115.4
98	13	35.35	35.35	61	20.1	5517	0.57	56.4	392	112.0
99	13	35.38	35.38	62	20.6	5730	0.66	56.1	399	114.1
100	13	35.42	35.42	61	20.4	5501	0.57	55.9	399	114.0
101	13	35.46	35.46	61	20.1	5540	0.55	56.4	384	109.7
102	13	35.50	35.50	62	20.3	5542	0.55	56.4	389	111.1
103	14	35.54	35.54	60	20.2	5397	0.55	56.4	391	111.6
104	14	35.57	35.57	60	20.0	5609	0.53	56.6	379	108.3
105	14	35.61	35.61	63	20.6	5843	0.53	55.6	397	113.5
106	14	35.64	35.64	62	20.1	5714	0.63	57.3	387	110.7
107	14	35.68	35.68	63	20.5	5860	0.58	55.6	398	113.9
108	14	35.71	35.71	62	20.2	5848	0.54	56.4	390	111.3
109	14	35.75	35.75	62	20.3	5920	0.64	56.4	393	112.4
110	14	35.79	35.79	62	20.6	5946	0.54	56.0	398	113.7
111	14	35.82	35.82	61	20.1	5612	0.53	56.0	385	110.1
112	14	35.86	35.86	61	20.1	5639	0.52	56.5	389	111.2
113	14	35.89	35.89	61	20.1	5492	0.52	56.7	386	110.2
114	14	35.93	35.93	60	19.8	5443	0.51	56.3	378	108.0
115	14	35.96	35.96	60	19.7	5290	0.52	55.9	381	108.8
116	14	36.00	36.00	62	20.3	5954	0.53	55.7	392	112.0
117	15	36.03	36.03	62	20.3	5891	0.50	56.2	387	110.5
118	15	36.07	36.07	62	20.2	5965	0.57	56.2	393	112.2
119	15	36.10	36.10	61	20.0	5590	0.50	56.2	385	109.9
120	15	36.13	36.13	63	20.4	5919	0.51	55.5	390	111.6

121	15	36.17	36.17	59	19.5	5118	0.50	55.6	387	110.5
122	15	36.20	36.20	64	20.5	6292	0.50	56.3	395	113.0
123	15	36.23	36.23	63	20.1	6063	0.51	56.7	391	111.6
124	15	36.27	36.27	61	19.8	5471	0.48	55.6	385	110.0
125	15	36.30	36.30	63	20.0	5712	0.49	55.6	391	111.8
126	15	36.33	36.33	60	19.9	5665	0.49	56.4	387	110.6
127	15	36.37	36.37	59	19.3	5144	0.49	56.1	387	110.5
128	15	36.40	36.40	63	20.0	5704	0.50	55.8	396	113.1
129	15	36.43	36.43	62	20.0	5854	0.48	55.6	392	112.0
130	15	36.47	36.47	60	19.4	5418	0.49	56.2	388	110.8
131	15	36.50	36.50	64	20.4	6047	0.48	55.9	393	112.4
		Average	36.03	62	20.1	5704	0.52	56.1	389	111.2
		Std Dev	0.29	1	0.3	276	0.04	0.4	5	1.5
		Maximum	36.50	64	20.6	6292	0.64	57.3	398	113.9
		Minimum	35.54	59	19.3	5118	0.48	55.5	378	108.0

N-value: 29

Sample Interval Time: 43.91 seconds.

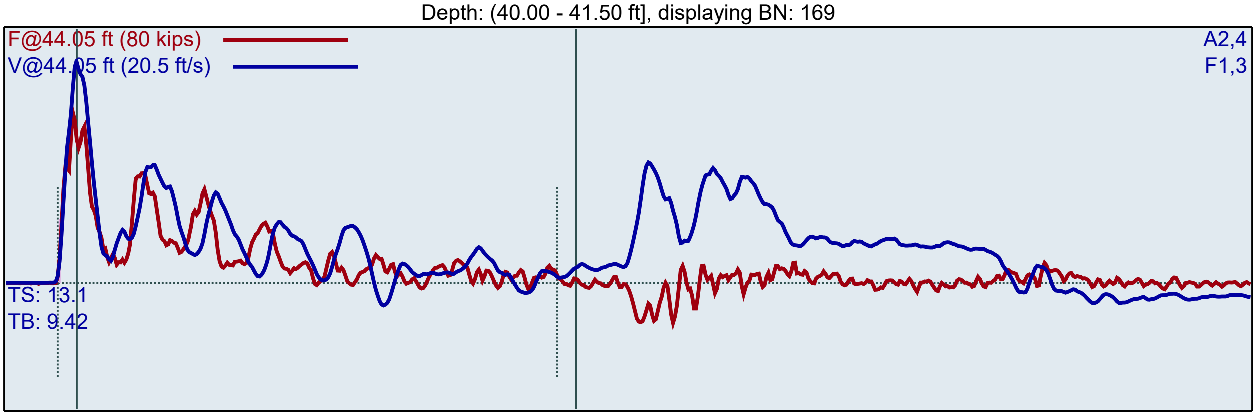
DIEDRICH D50 SN362
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 44.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (40.00 - 41.50 ft], displaying BN: 169



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
132	13	40.04	40.04	48	18.2	4224	0.53	1.9	285	81.4
133	13	40.08	40.08	55	20.8	5154	0.59	55.9	364	103.9
134	13	40.12	40.12	56	21.4	5119	0.58	56.2	377	107.6
135	13	40.15	40.15	57	20.8	5351	0.59	55.6	387	110.4
136	13	40.19	40.19	58	21.8	5365	0.59	56.8	388	110.9
137	13	40.23	40.23	58	21.8	5211	0.58	57.3	383	109.4
138	13	40.27	40.27	61	22.0	5446	0.56	55.7	386	110.4
139	13	40.31	40.31	61	21.6	5376	0.66	56.6	391	111.7
140	13	40.35	40.35	61	21.2	5427	0.55	57.4	382	109.0
141	13	40.38	40.38	62	21.4	5508	0.53	56.4	378	108.1
142	13	40.42	40.42	63	22.0	5648	0.59	56.3	383	109.4
143	13	40.46	40.46	61	21.5	5038	0.53	56.0	381	109.0
144	13	40.50	40.50	64	21.3	5771	0.51	57.1	377	107.7
145	16	40.53	40.53	63	21.3	5602	0.52	57.0	378	108.0
146	16	40.56	40.56	62	21.1	5238	0.62	56.0	367	104.8
147	16	40.59	40.59	61	20.7	5357	0.49	56.9	366	104.5
148	16	40.63	40.63	62	20.7	5384	0.62	57.1	360	102.9
149	16	40.66	40.66	63	21.1	5750	0.48	56.2	373	106.5
150	16	40.69	40.69	61	20.7	5155	0.45	56.4	354	101.2
151	16	40.72	40.72	62	20.3	4859	0.46	56.7	361	103.2
152	16	40.75	40.75	63	20.5	4893	0.46	55.7	367	104.8
153	16	40.78	40.78	64	20.7	5387	0.51	56.6	379	108.2
154	16	40.81	40.81	62	20.9	4715	0.64	56.2	384	109.6
155	16	40.84	40.84	63	20.3	5032	0.53	56.6	371	106.1
156	16	40.88	40.88	62	20.0	5121	0.55	56.6	376	107.4
157	16	40.91	40.91	63	19.7	5112	0.49	56.2	377	107.7
158	16	40.94	40.94	63	20.0	5436	0.46	56.9	368	105.2
159	16	40.97	40.97	64	20.4	5421	0.45	56.5	376	107.5
160	16	41.00	41.00	65	20.6	5292	0.47	55.6	380	108.5
161	17	41.03	41.03	62	20.3	5158	0.44	56.5	370	105.6
162	17	41.06	41.06	64	20.6	5235	0.46	56.6	380	108.5

163	17	41.09	41.09	61	19.7	4996	0.44	56.7	362	103.3
164	17	41.12	41.12	62	20.3	4840	0.61	56.3	370	105.6
165	17	41.15	41.15	60	19.4	4757	0.44	56.1	359	102.5
166	17	41.18	41.18	64	20.7	5454	0.44	55.7	379	108.3
167	17	41.21	41.21	63	20.5	5010	0.49	56.8	370	105.8
168	17	41.24	41.24	62	20.5	5076	0.44	55.7	377	107.6
169	17	41.26	41.26	53	17.6	4157	0.44	56.3	346	98.7
170	17	41.29	41.29	57	19.0	4043	0.42	56.2	349	99.8
171	17	41.32	41.32	62	19.9	4476	0.43	56.0	365	104.4
172	17	41.35	41.35	58	19.2	4233	0.43	56.6	355	101.4
173	17	41.38	41.38	59	19.4	4332	0.43	55.1	371	105.9
174	17	41.41	41.41	57	19.0	4019	0.43	56.3	363	103.8
175	17	41.44	41.44	59	19.4	4054	0.42	56.4	357	102.1
176	17	41.47	41.47	59	19.1	4163	0.42	56.3	357	101.9
177	17	41.50	41.50	63	20.3	5040	0.56	55.5	378	108.0
		Average	41.02	61	20.1	4933	0.48	56.3	368	105.1
		Std Dev	0.29	2	0.8	485	0.06	0.5	10	2.7
		Maximum	41.50	65	21.3	5750	0.64	57.1	384	109.6
		Minimum	40.53	53	17.6	4019	0.42	55.1	346	98.7

N-value: 33

Sample Interval Time: 47.91 seconds.

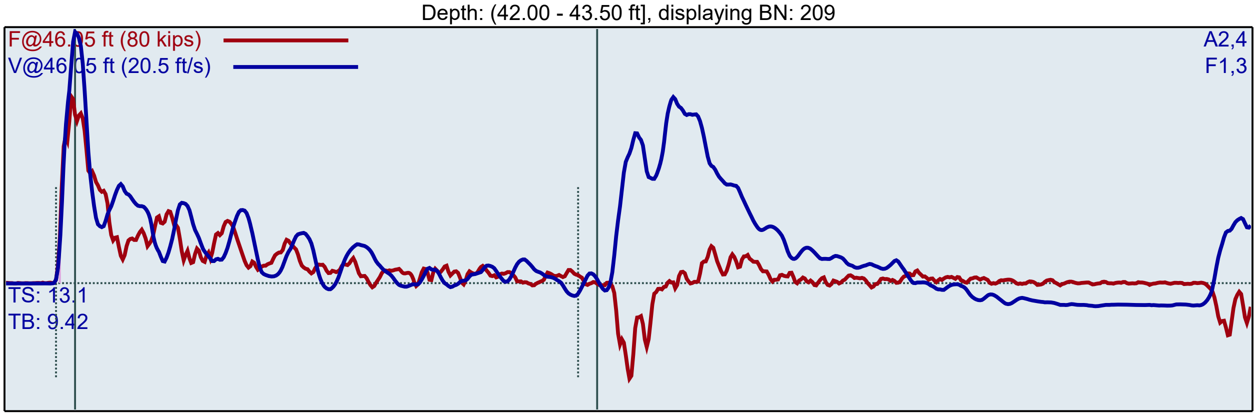
DIEDRICH D50 SN362
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 46.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (42.00 - 43.50 ft], displaying BN: 209



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1
A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
178	11	42.05	42.05	58	19.2	4822	0.74	1.9	371	106.0
179	11	42.09	42.09	55	20.2	4905	0.72	56.2	372	106.4
180	11	42.14	42.14	55	20.1	5082	0.66	56.8	357	102.1
181	11	42.18	42.18	57	20.3	5272	0.62	56.3	367	104.8
182	11	42.23	42.23	58	20.7	5642	0.62	56.3	372	106.2
183	11	42.27	42.27	56	20.2	5083	0.64	56.1	372	106.3
184	11	42.32	42.32	56	20.9	5511	0.59	56.0	379	108.4
185	11	42.36	42.36	57	20.8	5757	0.60	56.7	383	109.4
186	11	42.41	42.41	56	20.6	5423	0.55	55.8	371	105.9
187	11	42.45	42.45	60	20.9	5688	0.59	55.9	379	108.4
188	11	42.50	42.50	59	20.8	5582	0.55	56.4	380	108.5
189	13	42.54	42.54	60	21.0	5806	0.57	55.8	390	111.3
190	13	42.58	42.58	60	20.9	5769	0.52	56.2	379	108.2
191	13	42.62	42.62	59	20.6	5550	0.56	56.2	379	108.4
192	13	42.65	42.65	59	20.1	5666	0.50	56.6	371	105.9
193	13	42.69	42.69	59	20.5	5730	0.50	56.5	372	106.4
194	13	42.73	42.73	59	20.2	5688	0.51	56.3	368	105.1
195	13	42.77	42.77	59	20.2	5472	0.51	56.6	375	107.3
196	13	42.81	42.81	61	20.7	5688	0.49	56.0	382	109.0
197	13	42.85	42.85	60	20.1	5683	0.51	56.8	373	106.7
198	13	42.88	42.88	61	20.6	5828	0.49	55.9	381	108.8
199	13	42.92	42.92	60	20.4	5562	0.47	56.3	375	107.1
200	13	42.96	42.96	58	20.4	5422	0.47	56.7	370	105.7
201	13	43.00	43.00	59	20.3	5572	0.47	56.2	369	105.4
202	15	43.03	43.03	59	20.0	5413	0.47	56.4	365	104.3
203	15	43.07	43.07	61	20.2	5817	0.47	55.7	379	108.2
204	15	43.10	43.10	61	20.5	5689	0.48	55.5	378	107.9
205	15	43.13	43.13	59	20.3	5547	0.44	56.8	369	105.4
206	15	43.17	43.17	60	20.3	5648	0.49	56.7	376	107.4
207	15	43.20	43.20	58	20.4	5315	0.47	56.2	375	107.1
208	15	43.23	43.23	58	20.4	5252	0.46	55.9	372	106.3

209	15	43.27	43.27	58	20.1	5338	0.46	56.8	369	105.3
210	15	43.30	43.30	58	19.6	5368	0.48	55.7	369	105.3
211	15	43.33	43.33	59	20.4	5644	0.45	56.4	367	105.0
212	15	43.37	43.37	61	20.7	5876	0.44	55.4	376	107.5
213	15	43.40	43.40	61	20.3	5688	0.44	56.1	371	106.0
214	15	43.43	43.43	60	20.5	5496	0.47	56.3	368	105.1
215	15	43.47	43.47	60	20.1	5614	0.44	55.4	373	106.7
216	15	43.50	43.50	60	20.6	5462	0.44	56.3	376	107.5
		Average	43.04	60	20.4	5593	0.48	56.2	374	106.8
		Std Dev	0.29	1	0.3	164	0.03	0.4	5	1.5
		Maximum	43.50	61	21.0	5876	0.57	56.8	390	111.3
		Minimum	42.54	58	19.6	5252	0.44	55.4	365	104.3

N-value: 28

Sample Interval Time: 41.66 seconds.

Summary of SPT Test Results

Project: DIEDRICH D50 SN362, Test Date: 11/3/2023

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average LP ft	Average FMX kips	Average VMX ft/s	Average AMX g's	Average DMX in	Average BPM bpm	Average EFV ft-lb	Average ETR %
29.05	**12-15-17**	25.00	26.50	**32**	**57**	26.03	62	19.9	5835	0.60	55.7	384	109.6
34.05	**12-15-18**	30.00	31.50	**33**	**59**	31.04	63	19.6	5967	0.52	55.8	388	110.8
39.05	**13-14-15**	35.00	36.50	**29**	**52**	36.03	62	20.1	5704	0.52	56.1	389	111.2
44.05	**13-16-17**	40.00	41.50	**33**	**59**	41.02	61	20.1	4933	0.48	56.3	368	105.1
46.05	**11-13-15**	42.00	43.50	**28**	**50**	43.04	60	20.4	5593	0.48	56.2	374	106.8
					Overall Average Values:	35.23	62	20.0	5603	0.52	56.0	381	108.7
					Standard Deviation:	6.29	2	0.5	479	0.07	0.5	11	3.1
					Overall Maximum Value:	43.50	65	21.3	6544	0.74	57.3	399	114.1
					Overall Minimum Value:	25.53	53	17.6	4019	0.42	54.4	346	98.7

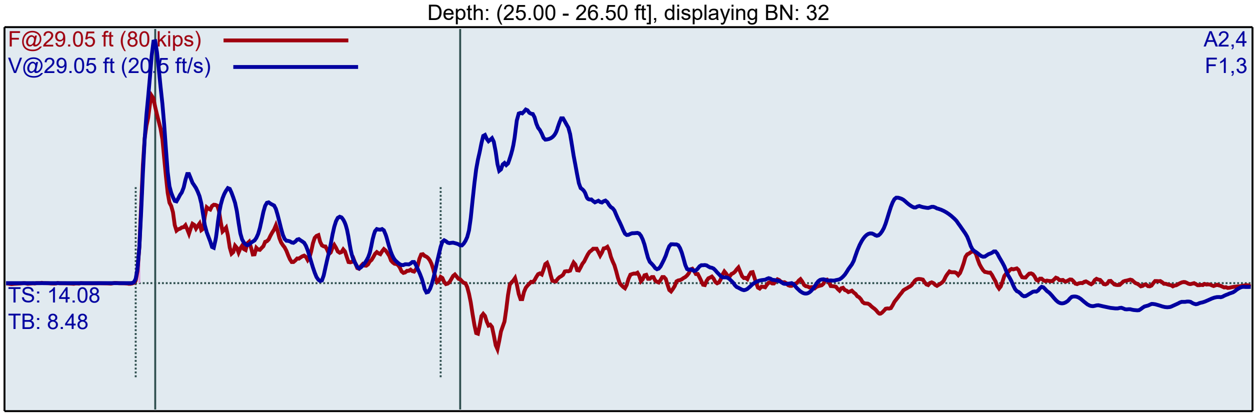
DIEDRICH D50 SN367
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 29.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 32



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration

DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
1	10	25.05	25.05	62	20.0	5240	0.97	1.9	388	110.8
2	10	25.10	25.10	60	19.8	5430	1.05	54.6	371	106.1
3	10	25.15	25.15	60	19.5	5082	0.70	53.4	366	104.7
4	10	25.20	25.20	57	19.4	4664	0.67	52.7	374	106.8
5	10	25.25	25.25	61	20.2	5847	0.72	52.4	390	111.4
6	10	25.30	25.30	60	20.0	5202	0.72	52.7	384	109.8
7	10	25.35	25.35	60	19.7	5316	0.78	52.9	377	107.8
8	10	25.40	25.40	62	20.4	5839	0.75	53.1	389	111.1
9	10	25.45	25.45	64	20.5	5804	0.77	52.4	394	112.5
10	10	25.50	25.50	60	19.9	5156	0.80	53.2	381	108.9
11	13	25.54	25.54	62	20.1	5457	0.67	52.4	380	108.5
12	13	25.58	25.58	63	20.5	5400	0.67	52.6	390	111.4
13	13	25.62	25.62	58	19.3	4801	0.81	53.3	371	106.0
14	13	25.65	25.65	59	19.6	4939	0.58	52.1	370	105.8
15	13	25.69	25.69	60	20.2	5177	0.70	52.5	383	109.3
16	13	25.73	25.73	55	18.8	4515	0.69	52.5	369	105.5
17	13	25.77	25.77	58	19.5	5019	0.93	52.6	378	108.1
18	13	25.81	25.81	59	19.5	4970	0.62	52.4	380	108.5
19	13	25.85	25.85	59	19.9	5026	0.55	52.8	372	106.1
20	13	25.88	25.88	60	20.0	5061	0.58	52.3	388	110.8
21	13	25.92	25.92	57	19.5	4786	0.54	53.7	366	104.6
22	13	25.96	25.96	62	20.6	5733	0.70	51.4	391	111.8
23	13	26.00	26.00	56	19.0	4911	0.62	53.4	359	102.6
24	17	26.03	26.03	58	19.4	5055	0.53	51.5	374	106.8
25	17	26.06	26.06	57	19.3	4980	0.60	53.5	363	103.8
26	17	26.09	26.09	58	19.5	5207	0.53	51.7	371	105.9
27	17	26.12	26.12	58	19.2	4904	0.68	52.3	371	106.0

28	17	26.15	26.15	60	20.0	5343	0.56	52.3	374	106.9
29	17	26.18	26.18	61	20.3	5600	0.57	52.8	378	108.0
30	17	26.21	26.21	58	19.1	4902	0.62	52.0	365	104.3
31	17	26.24	26.24	58	19.9	5317	0.69	53.5	374	106.9
32	17	26.26	26.26	59	19.3	4926	0.75	51.3	374	106.8
33	17	26.29	26.29	61	20.5	5766	0.55	52.2	382	109.1
34	17	26.32	26.32	59	19.3	5112	0.53	53.1	364	104.0
35	17	26.35	26.35	57	18.8	4947	0.48	52.1	357	102.0
36	17	26.38	26.38	60	19.8	5470	0.49	52.0	375	107.0
37	17	26.41	26.41	60	19.8	5535	0.47	53.1	365	104.4
38	17	26.44	26.44	58	19.3	5296	0.46	52.3	357	101.9
39	17	26.47	26.47	60	19.8	5661	0.47	51.8	375	107.0
40	17	26.50	26.50	60	20.1	5511	0.49	52.6	374	107.0
		Average	26.05	59	19.7	5178	0.60	52.5	373	106.6
		Std Dev	0.28	2	0.5	309	0.11	0.6	9	2.5
		Maximum	26.50	63	20.6	5766	0.93	53.7	391	111.8
		Minimum	25.54	55	18.8	4515	0.46	51.3	357	101.9

N-value: 30

Sample Interval Time: 44.49 seconds.

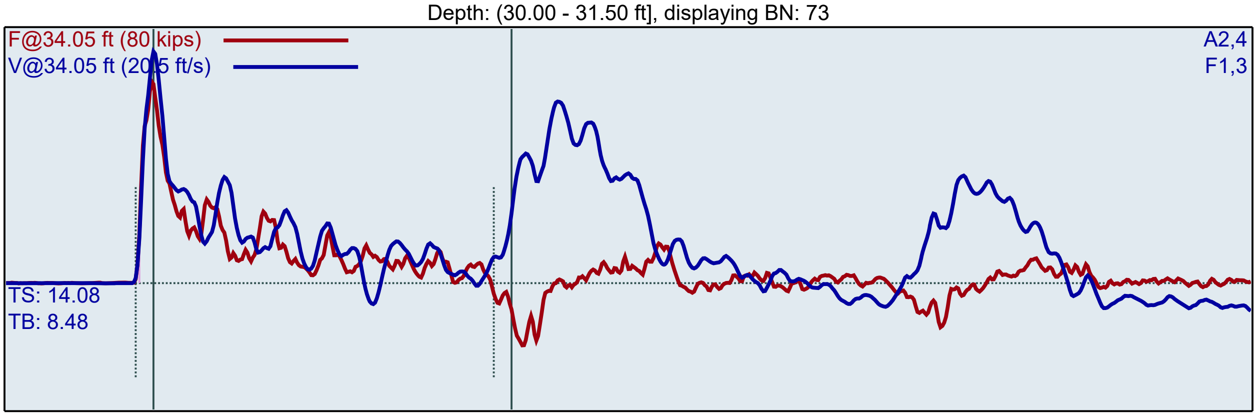
DIEDRICH D50 SN367
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 34.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (30.00 - 31.50 ft], displaying BN: 73



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
41	12	30.04	30.04	64	19.3	5648	1.11	1.9	402	114.8
42	12	30.08	30.08	61	18.8	5300	0.88	54.2	377	107.7
43	12	30.13	30.13	61	18.7	5244	0.87	52.9	376	107.6
44	12	30.17	30.17	62	18.7	5042	0.87	53.8	371	105.9
45	12	30.21	30.21	63	18.8	5314	0.79	51.7	380	108.6
46	12	30.25	30.25	64	19.1	5557	0.78	52.6	382	109.3
47	12	30.29	30.29	62	18.8	5319	0.82	52.9	375	107.0
48	12	30.33	30.33	64	19.2	5414	0.69	51.9	391	111.8
49	12	30.38	30.38	66	19.3	5815	0.77	52.6	391	111.7
50	12	30.42	30.42	64	19.1	5304	0.55	53.2	384	109.7
51	12	30.46	30.46	63	19.0	5289	0.60	51.7	385	109.9
52	12	30.50	30.50	64	19.1	5398	0.71	52.6	385	110.1
53	13	30.54	30.54	63	19.0	5103	0.76	51.8	390	111.5
54	13	30.58	30.58	65	19.4	5615	0.63	53.0	388	110.7
55	13	30.62	30.62	62	18.8	4800	0.85	51.5	391	111.6
56	13	30.65	30.65	63	18.9	5175	0.69	52.1	387	110.6
57	13	30.69	30.69	66	19.4	5633	0.72	51.9	401	114.6
58	13	30.73	30.73	66	19.2	5643	0.74	52.9	387	110.4
59	13	30.77	30.77	62	18.7	5117	0.79	51.9	386	110.4
60	13	30.81	30.81	62	18.6	5305	0.55	52.6	380	108.6
61	13	30.85	30.85	63	19.1	4954	0.67	51.1	397	113.4
62	13	30.88	30.88	64	18.8	5123	0.58	52.8	378	107.9
63	13	30.92	30.92	64	18.8	5203	0.69	52.2	382	109.1
64	13	30.96	30.96	62	18.5	4939	0.75	51.6	381	108.7
65	13	31.00	31.00	62	18.5	5081	0.53	51.6	377	107.6
66	15	31.03	31.03	64	18.9	5430	0.57	52.2	382	109.2
67	15	31.07	31.07	64	18.7	5375	0.61	52.1	390	111.3
68	15	31.10	31.10	62	18.5	5170	0.72	51.4	381	108.9
69	15	31.13	31.13	62	18.4	5181	0.54	52.4	375	107.2
70	15	31.17	31.17	64	19.0	5355	0.53	51.9	382	109.1
71	15	31.20	31.20	61	18.1	5053	0.55	52.1	370	105.6

72	15	31.23	31.23	63	18.8	5379	0.80	52.0	375	107.3
73	15	31.27	31.27	63	18.5	5249	0.51	51.7	372	106.3
74	15	31.30	31.30	64	18.9	5319	0.74	51.6	386	110.3
75	15	31.33	31.33	64	18.9	5272	0.76	52.4	382	109.2
76	15	31.37	31.37	62	18.5	5161	0.57	52.2	371	105.9
77	15	31.40	31.40	63	18.8	5293	0.61	51.5	378	108.1
78	15	31.43	31.43	61	18.3	5023	0.70	52.1	370	105.7
79	15	31.47	31.47	64	18.9	5557	0.50	52.0	375	107.1
80	15	31.50	31.50	64	19.0	5415	0.52	52.1	377	107.7
		Average	31.04	63	18.8	5247	0.65	52.0	382	109.1
		Std Dev	0.29	1	0.3	210	0.10	0.4	8	2.2
		Maximum	31.50	66	19.4	5643	0.85	53.0	401	114.6
		Minimum	30.54	61	18.1	4800	0.50	51.1	370	105.6

N-value: 28

Sample Interval Time: 44.81 seconds.

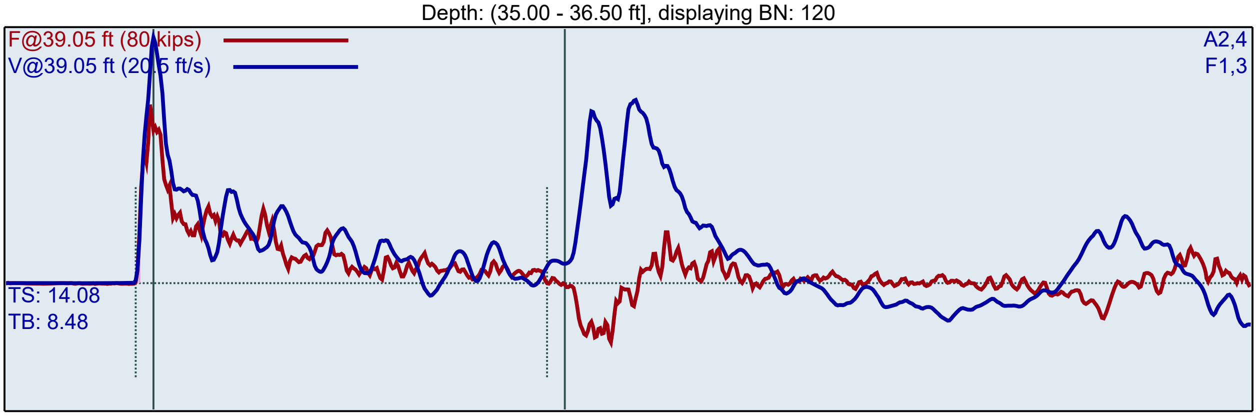
DIEDRICH D50 SN367
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 39.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (35.00 - 36.50 ft], displaying BN: 120



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
81	13	35.04	35.04	61	19.4	5186	1.19	1.9	364	104.1
82	13	35.08	35.08	59	20.8	5365	0.86	51.1	364	103.9
83	13	35.12	35.12	60	20.6	5116	0.74	51.7	360	102.9
84	13	35.15	35.15	63	21.0	5395	0.69	52.2	369	105.3
85	13	35.19	35.19	61	20.8	5141	0.57	52.1	362	103.4
86	13	35.23	35.23	61	20.9	5091	0.64	52.1	365	104.3
87	13	35.27	35.27	62	21.0	5407	0.66	51.6	378	108.1
88	13	35.31	35.31	60	20.4	4848	0.83	52.3	368	105.2
89	13	35.35	35.35	60	20.2	4761	0.55	52.4	356	101.9
90	13	35.38	35.38	60	20.5	5212	0.51	52.5	350	100.1
91	13	35.42	35.42	59	20.5	4985	0.55	51.3	366	104.6
92	13	35.46	35.46	63	21.1	5331	0.56	52.1	374	107.0
93	13	35.50	35.50	58	20.1	5007	0.51	52.4	351	100.3
94	16	35.53	35.53	60	20.5	5047	0.52	51.3	362	103.5
95	16	35.56	35.56	61	20.7	5381	0.51	52.2	367	104.9
96	16	35.59	35.59	60	20.5	5221	0.53	51.5	370	105.6
97	16	35.63	35.63	60	20.6	5184	0.52	52.4	363	103.7
98	16	35.66	35.66	62	20.8	5593	0.50	52.0	360	102.9
99	16	35.69	35.69	57	19.8	4835	0.58	51.8	362	103.5
100	16	35.72	35.72	60	20.4	5560	0.60	51.8	371	106.1
101	16	35.75	35.75	61	20.2	5532	0.49	52.6	359	102.5
102	16	35.78	35.78	61	20.0	5646	0.49	52.0	364	103.9
103	16	35.81	35.81	63	20.7	6093	0.55	51.6	366	104.6
104	16	35.84	35.84	62	20.2	5519	0.49	51.5	363	103.7
105	16	35.88	35.88	58	19.5	5332	0.49	53.0	356	101.7
106	16	35.91	35.91	61	20.1	5462	0.45	51.5	359	102.5
107	16	35.94	35.94	62	20.1	5678	0.46	51.4	363	103.7
108	16	35.97	35.97	58	19.7	5705	0.45	52.0	357	102.1
109	16	36.00	36.00	61	19.5	5285	0.45	52.1	368	105.1
110	21	36.02	36.02	60	19.6	5811	0.42	52.3	356	101.8
111	21	36.05	36.05	60	19.4	5445	0.41	52.0	355	101.5

112	21	36.07	36.07	59	19.6	5359	0.44	51.5	364	103.9
113	21	36.10	36.10	57	19.4	5565	0.41	51.9	356	101.7
114	21	36.12	36.12	58	19.7	5872	0.41	52.2	361	103.0
115	21	36.14	36.14	57	19.6	5408	0.43	51.3	364	103.9
116	21	36.17	36.17	54	19.1	5221	0.41	52.2	350	100.1
117	21	36.19	36.19	57	19.5	5165	0.51	51.6	367	104.8
118	21	36.21	36.21	55	19.5	5352	0.49	52.2	358	102.4
119	21	36.24	36.24	56	19.2	5287	0.53	52.1	353	101.0
120	21	36.26	36.26	56	19.7	5643	0.40	51.5	353	101.0
121	21	36.29	36.29	55	19.2	5023	0.46	51.7	361	103.1
122	21	36.31	36.31	55	19.3	5363	0.47	52.0	357	102.0
123	21	36.33	36.33	53	18.8	4910	0.39	51.6	350	99.9
124	21	36.36	36.36	55	19.7	5510	0.40	51.5	364	104.0
125	21	36.38	36.38	52	18.9	5265	0.38	52.3	346	98.9
126	21	36.40	36.40	54	19.3	5307	0.44	51.3	365	104.2
127	21	36.43	36.43	54	19.3	5272	0.38	52.2	354	101.1
128	21	36.45	36.45	55	19.4	5161	0.39	51.9	356	101.8
129	21	36.48	36.48	53	19.4	5286	0.39	51.9	353	100.8
130	21	36.50	36.50	52	18.8	4709	0.44	51.6	352	100.5
		Average	36.05	58	19.7	5379	0.46	51.9	360	102.7
		Std Dev	0.28	3	0.5	280	0.06	0.4	6	1.7
		Maximum	36.50	63	20.8	6093	0.60	53.0	371	106.1
		Minimum	35.53	52	18.8	4709	0.38	51.3	346	98.9

N-value: 37

Sample Interval Time: 56.62 seconds.

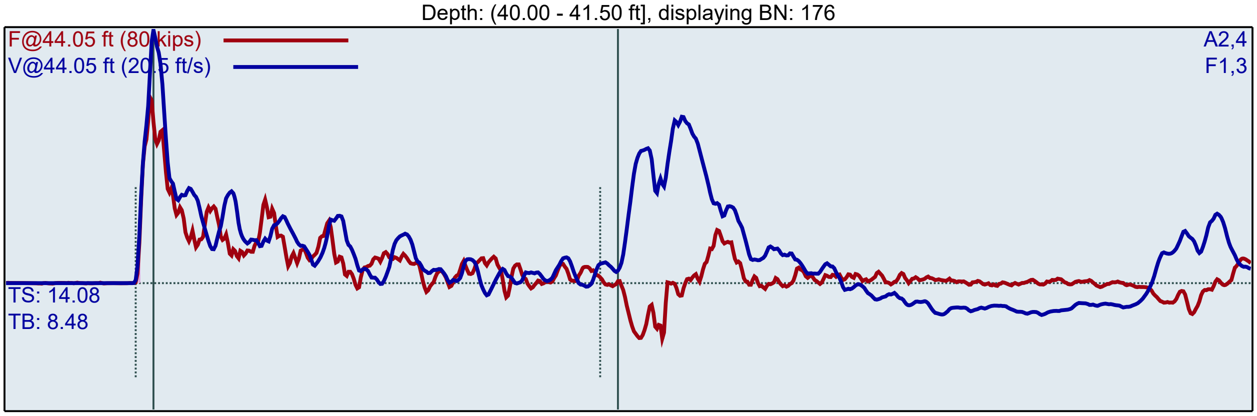
DIEDRICH D50 SN367
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 44.05 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (40.00 - 41.50 ft], displaying BN: 176



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
131	16	40.03	40.03	60	19.7	5458	0.38	1.9	366	104.5
132	16	40.06	40.06	59	20.2	5235	0.43	50.6	373	106.7
133	16	40.09	40.09	62	21.3	5381	0.47	51.5	381	108.8
134	16	40.13	40.13	60	20.5	4873	0.48	52.4	373	106.7
135	16	40.16	40.16	61	20.8	4867	0.50	52.2	376	107.6
136	16	40.19	40.19	62	21.4	4950	0.53	52.1	393	112.2
137	16	40.22	40.22	63	20.9	5040	0.51	52.2	385	110.1
138	16	40.25	40.25	62	21.3	5051	0.51	52.4	383	109.5
139	16	40.28	40.28	63	20.9	5042	0.52	52.2	385	110.1
140	16	40.31	40.31	63	21.4	4933	0.53	51.9	390	111.5
141	16	40.34	40.34	62	20.9	4540	0.50	52.5	376	107.3
142	16	40.38	40.38	63	21.3	4902	0.50	51.9	378	108.1
143	16	40.41	40.41	62	20.8	4544	0.50	52.4	377	107.6
144	16	40.44	40.44	59	20.7	4318	0.49	51.1	387	110.5
145	16	40.47	40.47	60	20.4	4332	0.48	52.6	375	107.1
146	16	40.50	40.50	59	20.8	4282	0.50	51.7	381	108.9
147	18	40.53	40.53	58	20.2	4141	0.50	52.1	375	107.2
148	18	40.56	40.56	58	20.9	4393	0.49	51.9	380	108.6
149	18	40.58	40.58	60	21.0	4448	0.47	52.6	370	105.7
150	18	40.61	40.61	56	20.3	4060	0.48	51.8	366	104.6
151	18	40.64	40.64	59	20.6	4455	0.49	51.7	382	109.2
152	18	40.67	40.67	60	21.2	4590	0.48	51.8	398	113.7
153	18	40.69	40.69	58	20.4	4420	0.45	52.5	371	105.9
154	18	40.72	40.72	58	20.2	4440	0.54	52.7	369	105.4
155	18	40.75	40.75	62	21.3	4778	0.47	51.3	387	110.5
156	18	40.78	40.78	63	21.3	4767	0.55	51.7	397	113.3
157	18	40.81	40.81	57	20.0	4276	0.45	52.2	369	105.4
158	18	40.83	40.83	61	20.5	4903	0.48	52.2	387	110.6
159	18	40.86	40.86	61	20.7	4910	0.49	52.3	378	108.0
160	18	40.89	40.89	57	20.1	4571	0.45	52.1	372	106.4
161	18	40.92	40.92	57	19.9	4265	0.48	51.3	386	110.4

162	18	40.94	40.94	62	21.5	5018	0.46	52.4	402	114.9
163	18	40.97	40.97	59	19.7	4464	0.44	52.7	372	106.2
164	18	41.00	41.00	57	19.7	4476	0.46	51.4	380	108.6
165	24	41.02	41.02	59	20.2	4762	0.46	52.3	378	108.0
166	24	41.04	41.04	60	20.3	4811	0.42	51.9	371	106.1
167	24	41.06	41.06	60	20.8	4983	0.42	52.0	382	109.2
168	24	41.08	41.08	61	20.7	4898	0.41	52.0	385	109.9
169	24	41.10	41.10	60	20.7	4910	0.41	51.9	369	105.5
170	24	41.13	41.13	61	20.3	4646	0.41	51.5	383	109.5
171	24	41.15	41.15	59	20.4	4557	0.38	52.6	359	102.4
172	24	41.17	41.17	59	20.9	4867	0.38	51.2	376	107.5
173	24	41.19	41.19	63	20.8	4669	0.41	51.6	387	110.6
174	24	41.21	41.21	62	20.4	4987	0.39	52.1	380	108.7
175	24	41.23	41.23	61	20.7	5017	0.38	52.0	379	108.3
176	24	41.25	41.25	58	20.2	4922	0.37	52.6	366	104.6
177	24	41.27	41.27	59	20.7	4960	0.38	51.0	387	110.5
178	24	41.29	41.29	60	20.2	4993	0.35	52.3	370	105.6
179	24	41.31	41.31	59	20.5	4754	0.36	51.7	382	109.1
180	24	41.33	41.33	60	20.5	4889	0.36	52.4	387	110.6
181	24	41.35	41.35	57	20.3	4665	0.34	51.7	374	106.8
182	24	41.38	41.38	58	20.4	4738	0.34	51.5	386	110.3
183	24	41.40	41.40	57	20.1	4876	0.42	52.0	375	107.1
184	24	41.42	41.42	60	20.1	4758	0.33	51.5	382	109.2
185	24	41.44	41.44	58	20.3	4764	0.48	51.4	385	110.0
186	24	41.46	41.46	62	20.8	5119	0.34	51.2	400	114.3
187	24	41.48	41.48	59	19.8	4750	0.32	52.3	375	107.2
188	24	41.50	41.50	59	20.4	4791	0.32	51.2	385	109.9
		Average	41.05	59	20.5	4701	0.42	51.9	380	108.5
		Std Dev	0.28	2	0.4	252	0.06	0.5	9	2.7
		Maximum	41.50	63	21.5	5119	0.55	52.7	402	114.9
		Minimum	40.53	56	19.7	4060	0.32	51.0	359	102.4

N-value: 42

Sample Interval Time: 65.83 seconds.

Summary of SPT Test Results

Project: DIEDRICH D50 SN367, Test Date: 11/3/2023

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average LP ft	Average FMX kips	Average VMX ft/s	Average AMX g's	Average DMX in	Average BPM bpm	Average EFV ft-lb	Average ETR %
29.05	**10-13-17**	25.00	26.50	**30**	**53**	26.05	59	19.7	5178	0.60	52.5	373	106.6
34.05	**12-13-15**	30.00	31.50	**28**	**49**	31.04	63	18.8	5247	0.65	52.0	382	109.1
39.05	**13-16-21**	35.00	36.50	**37**	**65**	36.05	58	19.7	5379	0.46	51.9	360	102.7
44.05	**16-18-24**	40.00	41.50	**42**	**74**	41.05	59	20.5	4701	0.42	51.9	380	108.5
					Overall Average Values:	34.37	60	19.8	5100	0.52	52.1	373	106.6
					Standard Deviation:	5.65	3	0.7	382	0.12	0.5	12	3.4
					Overall Maximum Value:	41.50	66	21.5	6093	0.93	53.7	402	114.9
					Overall Minimum Value:	25.54	52	18.1	4060	0.32	51.0	346	98.9

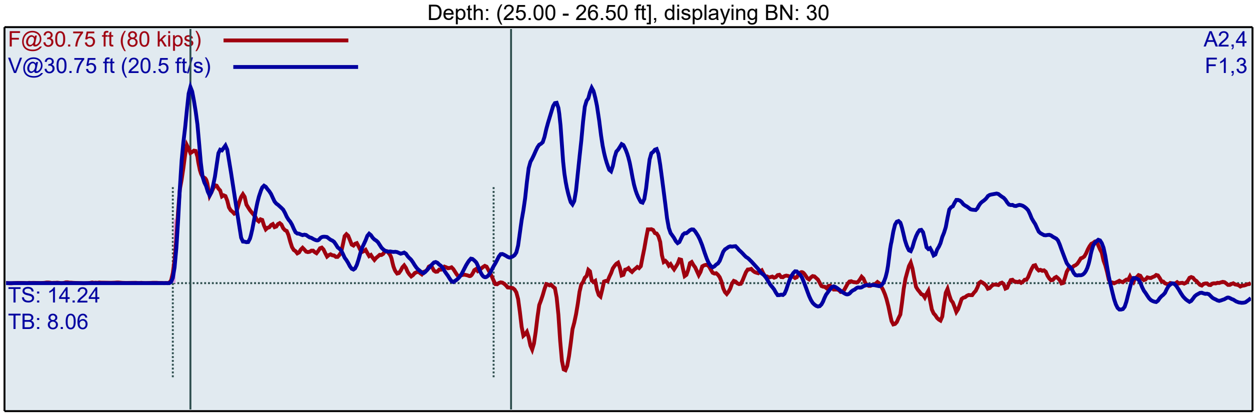
MOBILE B48 SN202102
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 30.75 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (25.00 - 26.50 ft], displaying BN: 30



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration

DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
1	3	25.17	25.17	47	16.3	4692	2.00	1.9	353	101.0
2	3	25.33	25.33	44	17.3	4109	2.00	51.3	359	102.6
3	3	25.50	25.50	44	17.2	3752	2.00	50.9	360	102.7
4	14	25.54	25.54	44	16.7	3366	0.65	51.0	328	93.6
5	14	25.57	25.57	44	15.9	3259	0.60	50.4	326	93.1
6	14	25.61	25.61	44	16.0	3416	0.67	50.6	333	95.0
7	14	25.64	25.64	43	15.9	3407	0.63	50.6	337	96.3
8	14	25.68	25.68	43	16.0	3318	0.58	50.5	327	93.5
9	14	25.71	25.71	43	16.0	3246	0.67	50.3	329	93.9
10	14	25.75	25.75	44	16.1	3356	0.62	50.5	331	94.6
11	14	25.79	25.79	43	15.5	2940	0.65	50.3	319	91.3
12	14	25.82	25.82	44	15.8	3144	0.55	50.5	320	91.4
13	14	25.86	25.86	45	16.1	3770	0.69	50.2	337	96.2
14	14	25.89	25.89	43	15.6	3381	0.63	50.4	330	94.3
15	14	25.93	25.93	43	15.6	3368	0.64	50.3	336	96.0
16	14	25.96	25.96	42	15.5	3152	0.67	50.3	327	93.3
17	14	26.00	26.00	42	15.3	3419	0.60	50.3	326	93.0
18	26	26.02	26.02	43	15.4	3302	0.55	50.3	327	93.3
19	26	26.04	26.04	42	15.0	3157	0.59	50.2	324	92.6
20	26	26.06	26.06	42	15.2	3032	0.63	50.4	319	91.2
21	26	26.08	26.08	41	14.9	3166	0.67	50.3	318	90.7
22	26	26.10	26.10	41	14.8	3055	0.57	50.2	322	91.9
23	26	26.12	26.12	40	14.6	2994	0.54	50.2	320	91.4
24	26	26.13	26.13	41	15.5	3539	0.68	50.3	321	91.8
25	26	26.15	26.15	40	15.2	3219	0.68	50.4	319	91.1
26	26	26.17	26.17	41	14.8	3295	0.62	50.3	323	92.2
27	26	26.19	26.19	42	15.2	3578	0.61	50.1	327	93.4

28	26	26.21	26.21	43	15.4	3572	0.79	50.3	338	96.6
29	26	26.23	26.23	42	15.2	3339	0.54	50.0	330	94.4
30	26	26.25	26.25	43	15.7	4010	0.68	50.3	337	96.3
31	26	26.27	26.27	43	15.6	3733	0.57	50.3	332	94.9
32	26	26.29	26.29	42	15.4	3882	0.72	50.3	336	95.9
33	26	26.31	26.31	41	15.2	3322	0.59	50.0	320	91.6
34	26	26.33	26.33	43	15.1	3434	0.60	50.1	325	93.0
35	26	26.35	26.35	43	15.2	3660	0.65	50.3	331	94.4
36	26	26.37	26.37	43	15.2	3409	0.71	50.0	326	93.2
37	26	26.38	26.38	43	15.3	3721	0.70	50.3	325	92.7
38	26	26.40	26.40	43	15.3	3420	0.73	49.9	326	93.0
39	26	26.42	26.42	42	14.8	3246	0.60	50.3	320	91.4
40	26	26.44	26.44	44	15.0	3381	0.68	50.1	386	110.1
41	26	26.46	26.46	42	15.3	3504	0.63	50.3	329	94.0
42	26	26.48	26.48	42	15.4	3446	0.49	50.2	320	91.6
43	26	26.50	26.50	42	15.4	3279	0.58	50.0	323	92.4
		Average	26.09	43	15.4	3381	0.63	50.3	328	93.8
		Std Dev	0.28	1	0.4	231	0.06	0.2	11	3.1
		Maximum	26.50	45	16.7	4010	0.79	51.0	386	110.1
		Minimum	25.54	40	14.6	2940	0.49	49.9	318	90.7

N-value: 40

Sample Interval Time: 50.06 seconds.

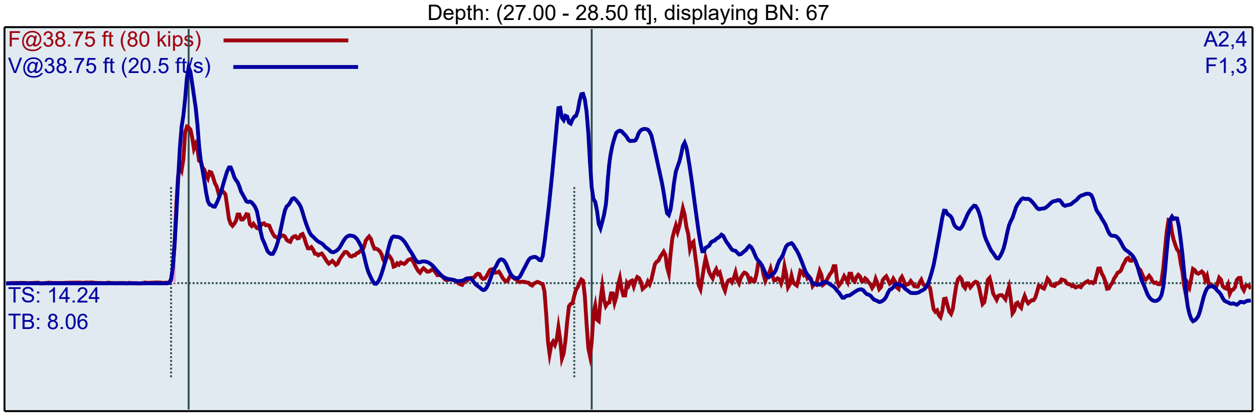
MOBILE B48 SN202102
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 38.75 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (27.00 - 28.50 ft], displaying BN: 67



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	LP ft	FMX kips	VMX ft/s	AMX g's	DMX in	BPM bpm	EFV ft-lb	ETR %
44	7	27.07	27.07	51	18.6	4466	1.46	58.5	364	103.9
45	7	27.14	27.14	49	18.3	4161	1.45	52.8	358	102.3
46	7	27.21	27.21	50	18.0	4699	1.22	52.6	368	105.1
47	7	27.29	27.29	49	17.6	4578	1.06	51.9	342	97.6
48	7	27.36	27.36	49	17.4	4579	0.96	51.9	357	101.9
49	7	27.43	27.43	47	17.2	4000	1.07	51.4	352	100.4
50	7	27.50	27.50	49	18.0	4636	1.11	51.4	363	103.7
51	10	27.55	27.55	48	17.2	4312	1.03	51.5	356	101.6
52	10	27.60	27.60	47	16.8	4102	0.92	51.2	349	99.7
53	10	27.65	27.65	47	17.3	4212	0.98	51.1	355	101.4
54	10	27.70	27.70	47	17.0	3925	0.88	51.3	349	99.7
55	10	27.75	27.75	48	16.9	3743	0.78	51.3	348	99.5
56	10	27.80	27.80	47	16.8	3904	0.96	51.2	351	100.3
57	10	27.85	27.85	49	17.3	4166	0.81	51.0	356	101.7
58	10	27.90	27.90	49	17.4	4194	0.76	51.2	355	101.3
59	10	27.95	27.95	48	17.1	3977	0.74	51.2	351	100.4
60	10	28.00	28.00	49	17.3	3915	0.89	51.1	361	103.2
61	13	28.04	28.04	49	17.1	4072	0.65	51.3	351	100.3
62	13	28.08	28.08	48	17.1	4053	0.62	50.9	355	101.5
63	13	28.12	28.12	50	17.3	4122	0.74	51.0	356	101.7
64	13	28.15	28.15	50	17.6	4219	0.60	51.2	351	100.2
65	13	28.19	28.19	50	17.7	4304	0.61	51.0	358	102.3
66	13	28.23	28.23	49	17.8	4309	0.70	51.1	354	101.1
67	13	28.27	28.27	49	17.3	4354	0.80	51.2	351	100.2
68	13	28.31	28.31	51	17.9	4451	0.91	51.0	366	104.5
69	13	28.35	28.35	51	17.1	4299	0.85	51.2	357	102.1
70	13	28.38	28.38	53	18.1	4590	0.81	50.8	369	105.4
71	13	28.42	28.42	53	18.0	4448	0.64	51.0	367	104.9
72	13	28.46	28.46	52	17.1	4169	1.00	51.0	364	104.0
73	13	28.50	28.50	53	17.4	4351	0.88	51.2	359	102.7

Average	28.05	49	17.3	4182	0.81	51.1	356	101.7
Std Dev	0.28	2	0.4	200	0.13	0.2	6	1.7
Maximum	28.50	53	18.1	4590	1.03	51.5	369	105.4
Minimum	27.55	47	16.8	3743	0.60	50.8	348	99.5

N-value: 23

Sample Interval Time: 33.95 seconds.

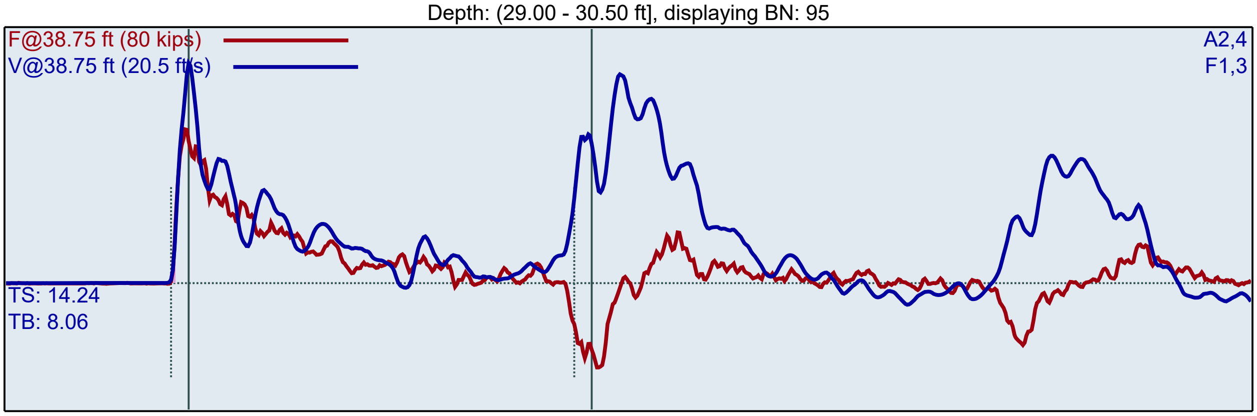
MOBILE B48 SN202102
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 38.75 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (29.00 - 30.50 ft], displaying BN: 95



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	LP ft	FMX kips	VMX ft/s	AMX g's	DMX in	BPM bpm	EFV ft-lb	ETR %
74	7	29.07	29.07	46	18.8	4137	1.41	1.9	362	103.5
75	7	29.14	29.14	47	17.8	4509	1.48	52.9	365	104.3
76	7	29.21	29.21	45	17.2	4010	1.20	52.5	354	101.2
77	7	29.29	29.29	46	17.7	4247	1.10	52.0	361	103.2
78	7	29.36	29.36	47	17.2	4134	0.94	51.7	351	100.2
79	7	29.43	29.43	47	17.7	4429	0.97	51.7	362	103.4
80	7	29.50	29.50	46	17.1	4113	0.88	51.4	349	99.8
81	8	29.56	29.56	47	17.2	4234	0.83	51.3	356	101.8
82	8	29.63	29.63	47	17.6	4562	0.86	51.3	357	102.1
83	8	29.69	29.69	46	16.9	4219	0.95	51.3	349	99.6
84	8	29.75	29.75	48	17.8	4772	0.86	51.4	366	104.6
85	8	29.81	29.81	48	17.4	4453	0.95	51.4	360	102.8
86	8	29.88	29.88	48	17.9	4852	0.79	51.3	363	103.6
87	8	29.94	29.94	48	17.4	4477	0.82	51.3	359	102.7
88	8	30.00	30.00	48	17.7	4724	0.75	51.4	358	102.4
89	13	30.04	30.04	48	17.8	4713	0.76	51.3	359	102.5
90	13	30.08	30.08	48	17.5	4594	0.62	51.2	358	102.3
91	13	30.12	30.12	49	18.3	5206	0.79	51.2	365	104.3
92	13	30.15	30.15	48	17.8	4771	0.69	51.2	359	102.5
93	13	30.19	30.19	47	17.4	4513	0.78	51.3	353	100.7
94	13	30.23	30.23	50	18.3	5298	0.55	51.1	358	102.3
95	13	30.27	30.27	48	17.6	4660	0.61	51.1	352	100.6
96	13	30.31	30.31	47	17.4	4527	0.56	51.2	348	99.5
97	13	30.35	30.35	49	17.8	5096	0.55	51.2	355	101.5
98	13	30.38	30.38	48	17.8	4713	0.67	51.2	358	102.1
99	13	30.42	30.42	50	18.1	5067	0.66	51.3	362	103.5
100	13	30.46	30.46	49	17.4	4726	0.52	51.1	352	100.5
101	13	30.50	30.50	49	17.6	4704	0.52	51.1	352	100.7

Average	30.08	48	17.6	4709	0.72	51.2	357	102.0
Std Dev	0.28	1	0.3	276	0.13	0.1	5	1.4
Maximum	30.50	50	18.3	5298	0.95	51.4	366	104.6
Minimum	29.56	46	16.9	4219	0.52	51.1	348	99.5
			N-value: 21					

Sample Interval Time: 31.52 seconds.

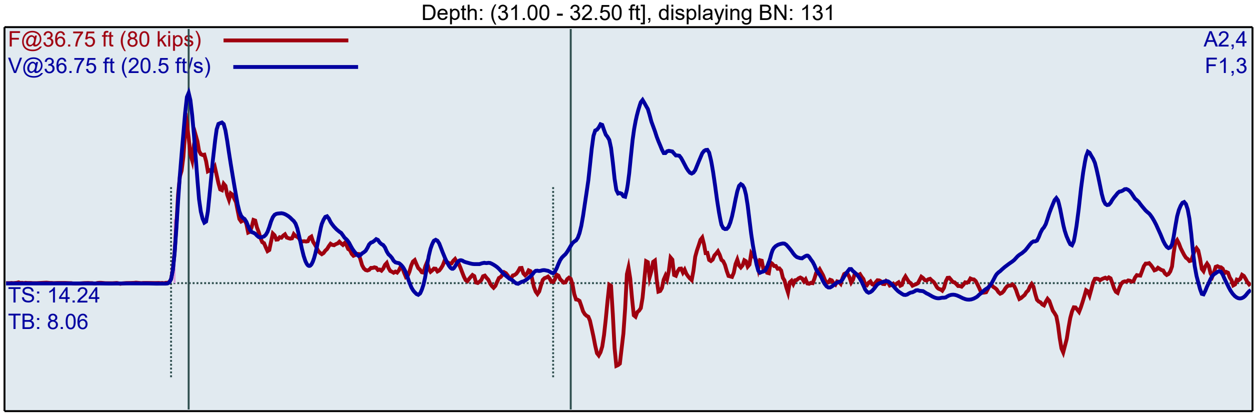
MOBILE B48 SN202102
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 36.75 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (31.00 - 32.50 ft], displaying BN: 131



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1

A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC	LP	LP	FMX	VMX	AMX	DMX	BPM	EFV	ETR
	/6"	ft	ft	kips	ft/s	g's	in	bpm	ft-lb	%
102	11	31.05	31.05	56	18.3	4189	1.23	1.9	365	104.4
103	11	31.09	31.09	54	17.8	4043	0.85	52.8	354	101.3
104	11	31.14	31.14	52	18.5	3893	0.80	52.3	349	99.8
105	11	31.18	31.18	52	18.0	4130	0.71	52.1	354	101.1
106	11	31.23	31.23	51	17.3	3960	0.63	51.7	347	99.2
107	11	31.27	31.27	53	18.0	4161	0.77	51.4	358	102.3
108	11	31.32	31.32	51	18.0	3901	0.57	51.6	345	98.6
109	11	31.36	31.36	53	17.8	4312	0.66	51.3	356	101.7
110	11	31.41	31.41	52	18.0	4123	0.57	51.2	353	100.9
111	11	31.45	31.45	51	17.1	4196	0.65	51.3	360	102.8
112	11	31.50	31.50	50	17.2	4075	0.65	51.3	353	100.8
113	12	31.54	31.54	49	17.7	3865	0.59	51.4	345	98.7
114	12	31.58	31.58	49	17.3	3955	0.65	51.2	353	100.9
115	12	31.63	31.63	49	16.5	3879	0.55	51.2	347	99.1
116	12	31.67	31.67	49	16.0	4010	0.52	51.4	344	98.4
117	12	31.71	31.71	47	17.6	3826	0.70	51.3	348	99.4
118	12	31.75	31.75	48	16.1	4094	0.67	51.1	350	99.9
119	12	31.79	31.79	49	15.5	3891	0.66	51.2	346	98.9
120	12	31.83	31.83	49	15.5	3584	0.75	51.2	341	97.4
121	12	31.88	31.88	49	15.4	3949	0.61	51.2	347	99.1
122	12	31.92	31.92	49	15.3	3742	0.68	51.2	345	98.7
123	12	31.96	31.96	50	15.1	3497	0.85	51.1	339	96.7
124	12	32.00	32.00	50	16.0	3956	0.95	51.3	349	99.8
125	14	32.04	32.04	50	15.4	3671	0.78	51.0	347	99.0
126	14	32.07	32.07	50	15.4	3762	0.69	51.2	344	98.4
127	14	32.11	32.11	49	15.2	3608	0.68	51.2	340	97.0
128	14	32.14	32.14	49	15.5	4126	0.71	51.1	352	100.5
129	14	32.18	32.18	48	15.4	3455	0.60	51.1	340	97.2
130	14	32.21	32.21	49	15.7	3609	0.69	51.2	340	97.2
131	14	32.25	32.25	50	15.2	3493	0.83	51.1	338	96.6
132	14	32.29	32.29	49	15.2	3307	0.75	50.9	337	96.2

133	14	32.32	32.32	49	15.2	3591	0.58	51.2	342	97.7
134	14	32.36	32.36	49	15.1	3378	0.59	51.2	330	94.4
135	14	32.39	32.39	50	15.3	3602	0.68	51.1	343	98.0
136	14	32.43	32.43	49	15.4	3332	0.66	51.2	331	94.5
137	14	32.46	32.46	50	14.9	3330	0.62	51.0	333	95.0
138	14	32.50	32.50	49	15.7	4148	0.60	51.0	352	100.6
		Average	32.04	49	15.7	3718	0.68	51.2	343	98.0
		Std Dev	0.29	1	0.7	253	0.10	0.1	6	1.7
		Maximum	32.50	50	17.7	4148	0.95	51.4	353	100.9
		Minimum	31.54	47	14.9	3307	0.52	50.9	330	94.4

N-value: 26

Sample Interval Time: 42.05 seconds.

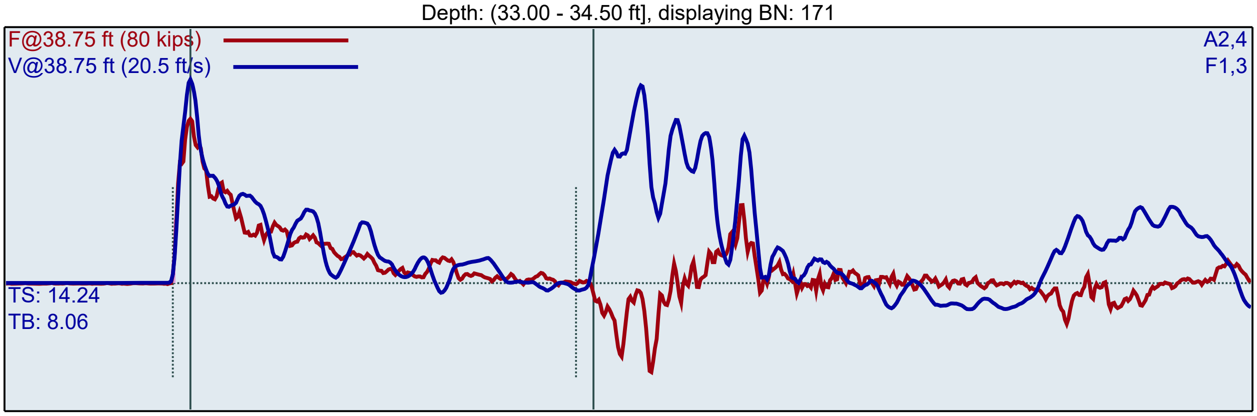
MOBILE B48 SN202102
sgh
BH1

25-26.5
Interval start: 11/3/2023

AR: 2.19 in^2
LE: 38.75 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (33.00 - 34.50 ft], displaying BN: 171



F1 : [229NW1] 226.25 PDICAL (1) FF1
F3 : [229NW2] 226.389 PDICAL (1) FF1
A2 (PR): [K11978] 361.916 mv/6.4v/5000g (1) VF1
A4 (PR): [K11979] 379.201 mv/6.4v/5000g (1) VF1

BL#	BC /6"	LP ft	LP ft	FMX kips	VMX ft/s	AMX g's	DMX in	BPM bpm	EFV ft-lb	ETR %
139	12	33.04	33.04	51	17.7	4128	0.72	1.9	352	100.5
140	12	33.08	33.08	52	18.2	3853	0.75	52.8	349	99.8
141	12	33.13	33.13	52	17.8	4330	0.68	52.3	359	102.5
142	12	33.17	33.17	52	17.1	4022	0.63	51.8	351	100.3
143	12	33.21	33.21	52	16.9	4201	0.60	51.8	352	100.5
144	12	33.25	33.25	51	17.1	3879	0.61	51.4	352	100.6
145	12	33.29	33.29	52	16.8	4282	0.53	51.4	356	101.7
146	12	33.33	33.33	50	16.5	3881	0.52	51.3	349	99.8
147	12	33.38	33.38	51	16.5	3913	0.56	51.4	353	100.9
148	12	33.42	33.42	51	16.3	4048	0.51	51.4	354	101.1
149	12	33.46	33.46	51	15.9	3853	0.50	51.3	347	99.1
150	12	33.50	33.50	52	16.2	3969	0.54	51.1	350	100.1
151	12	33.54	33.54	51	15.9	3866	0.52	51.5	344	98.1
152	12	33.58	33.58	51	16.6	3954	0.56	51.0	354	101.3
153	12	33.63	33.63	51	16.1	3940	0.57	51.4	348	99.5
154	12	33.67	33.67	51	15.9	3805	0.59	51.3	348	99.5
155	12	33.71	33.71	51	16.4	4079	0.57	51.2	357	101.9
156	12	33.75	33.75	52	16.0	3814	0.59	51.0	353	100.8
157	12	33.79	33.79	51	16.0	3954	0.55	51.2	348	99.5
158	12	33.83	33.83	52	16.2	3992	0.53	51.0	354	101.1
159	12	33.88	33.88	53	16.8	4510	0.54	51.4	362	103.3
160	12	33.92	33.92	51	15.9	3908	0.50	51.1	344	98.4
161	12	33.96	33.96	52	16.2	4035	0.52	51.2	351	100.4
162	12	34.00	34.00	52	16.4	4256	0.51	50.9	354	101.1
163	17	34.03	34.03	51	16.2	4117	0.47	51.2	345	98.7
164	17	34.06	34.06	50	15.8	3905	0.47	51.0	344	98.2
165	17	34.09	34.09	51	16.1	4023	0.48	51.1	348	99.4
166	17	34.12	34.12	52	16.2	4068	0.52	51.1	356	101.7
167	17	34.15	34.15	52	16.4	4143	0.48	51.0	351	100.4
168	17	34.18	34.18	52	16.4	4188	0.48	51.2	353	100.8
169	17	34.21	34.21	52	16.7	4437	0.46	51.2	356	101.7

170	17	34.24	34.24	51	16.1	4102	0.47	51.0	350	99.9
171	17	34.26	34.26	51	16.3	4189	0.47	51.1	347	99.2
172	17	34.29	34.29	52	16.2	4273	0.46	51.1	343	98.0
173	17	34.32	34.32	51	16.5	4232	0.65	50.8	352	100.5
174	17	34.35	34.35	51	16.2	4129	0.45	51.0	347	99.0
175	17	34.38	34.38	54	17.0	4637	0.46	51.3	360	102.8
176	17	34.41	34.41	51	16.3	4176	0.45	51.1	350	99.9
177	17	34.44	34.44	53	16.5	4364	0.44	50.8	350	99.9
178	17	34.47	34.47	51	16.3	4314	0.45	51.2	345	98.4
179	17	34.50	34.50	52	16.6	4533	0.45	51.0	349	99.8
		Average	34.06	52	16.3	4136	0.51	51.1	350	100.1
		Std Dev	0.28	1	0.3	213	0.05	0.2	5	1.4
		Maximum	34.50	54	17.0	4637	0.65	51.5	362	103.3
		Minimum	33.54	50	15.8	3805	0.44	50.8	343	98.0

N-value: 29

Sample Interval Time: 46.81 seconds.

Summary of SPT Test Results

Project: MOBILE B48 SN202102, Test Date: 11/3/2023

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
AMX: Maximum Acceleration
DMX: Maximum Displacement
BPM: Blows/Minute
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	Start Depth ft	Final Depth ft	**N Value**	**N60 Value**	Average LP ft	Average FMX kips	Average VMX ft/s	Average AMX g's	Average DMX in	Average BPM bpm	Average EFV ft-lb	Average ETR %
30.75	**3-14-26**	25.00	26.50	**40**	**65**	26.09	43	15.4	3381	0.63	50.3	328	93.8
38.75	**7-10-13**	27.00	28.50	**23**	**37**	28.05	49	17.3	4182	0.81	51.1	356	101.7
38.75	**7-8-13**	29.00	30.50	**21**	**34**	30.08	48	17.6	4709	0.72	51.2	357	102.0
36.75	**11-12-14**	31.00	32.50	**26**	**42**	32.04	49	15.7	3718	0.68	51.2	343	98.0
38.75	**12-12-17**	33.00	34.50	**29**	**47**	34.06	52	16.3	4136	0.51	51.1	350	100.1
					Overall Average Values:	29.79	48	16.3	3935	0.66	50.9	345	98.5
					Standard Deviation:	3.05	4	1.0	511	0.13	0.4	14	3.9
					Overall Maximum Value:	34.50	54	18.3	5298	1.03	51.5	386	110.1
					Overall Minimum Value:	25.54	40	14.6	2940	0.44	49.9	318	90.7

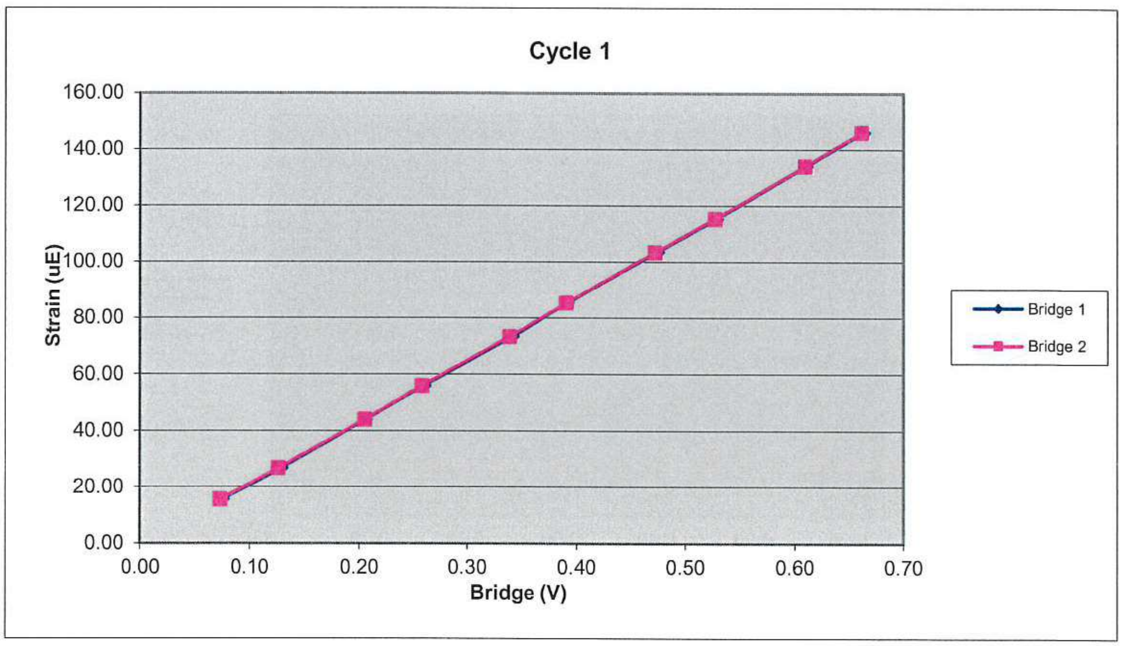
APPENDIX C:

Calibration Sheets

229NW		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1112.02	15.55	0.07	0.07
3	1910.25	26.68	0.13	0.13
4	3060.97	44.03	0.21	0.21
5	3853.65	55.89	0.26	0.26
6	5049.69	73.33	0.34	0.34
7	5819.27	85.30	0.39	0.39
8	7051.76	103.47	0.47	0.47
9	7851.17	115.32	0.53	0.53
10	9086.49	134.04	0.61	0.61
11	9871.47	146.00	0.66	0.66

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**14874.04**	**Force Calibration (lb/V)**	**14857.77**
Offset	-9.17	Offset	22.53
Correlation	0.999998	Correlation	0.999997
Strain Calibration (µE/V)	**221.84**	**Strain Calibration (µE/V)**	**221.60**
Offset	-1.71	Offset	-1.23
Correlation	0.999969	Correlation	0.999973

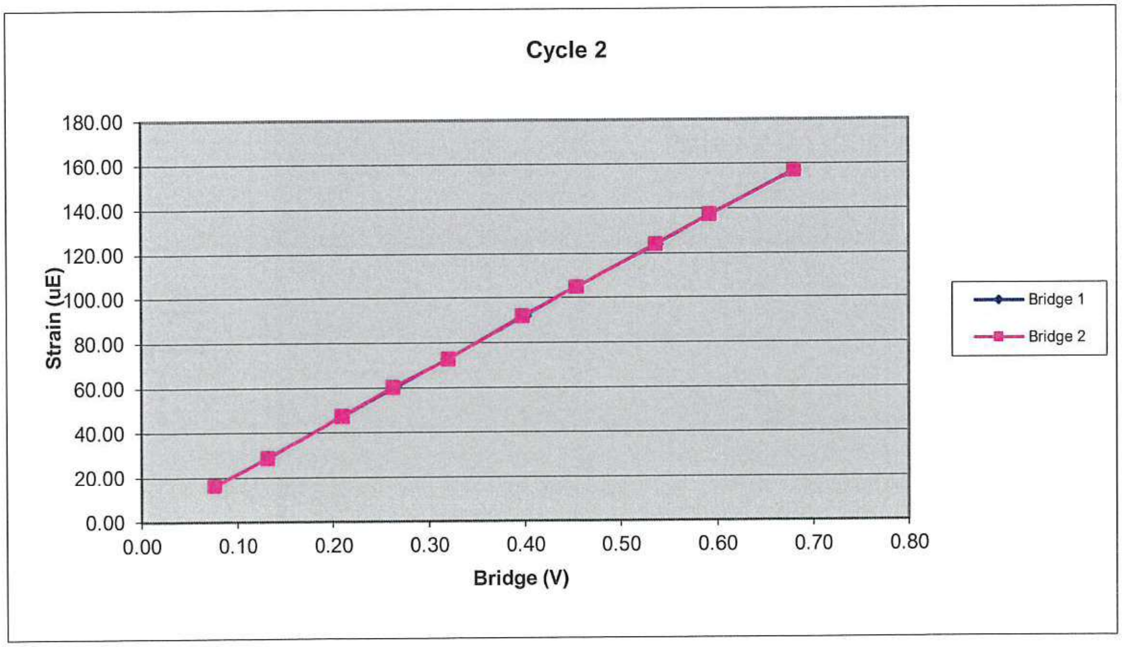
Force Strain Calibration	
EA (Kips)	**67045.14**
Offset	105.54
Correlation	0.999980



229NW		Cycle 2		
Sample	**Force (lb)**	**Strain (μE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1138.82	16.11	0.08	0.08
3	1956.07	28.69	0.13	0.13
4	3125.50	47.35	0.21	0.21
5	3933.19	60.02	0.26	0.26
6	4756.28	72.60	0.32	0.32
7	5937.50	91.65	0.40	0.40
8	6780.19	104.70	0.45	0.45
9	8000.60	123.79	0.54	0.54
10	8829.34	136.95	0.59	0.59
11	10137.77	156.78	0.68	0.68

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**14877.68**	**Force Calibration (lb/V)**	**14888.24**
Offset	**1.07**	Offset	**5.83**
Correlation	**0.999995**	Correlation	**0.999995**
Strain Calibration (μE/V)	**233.28**	**Strain Calibration (μE/V)**	**233.44**
Offset	**-1.72**	Offset	**-1.65**
Correlation	**0.999981**	Correlation	**0.999974**

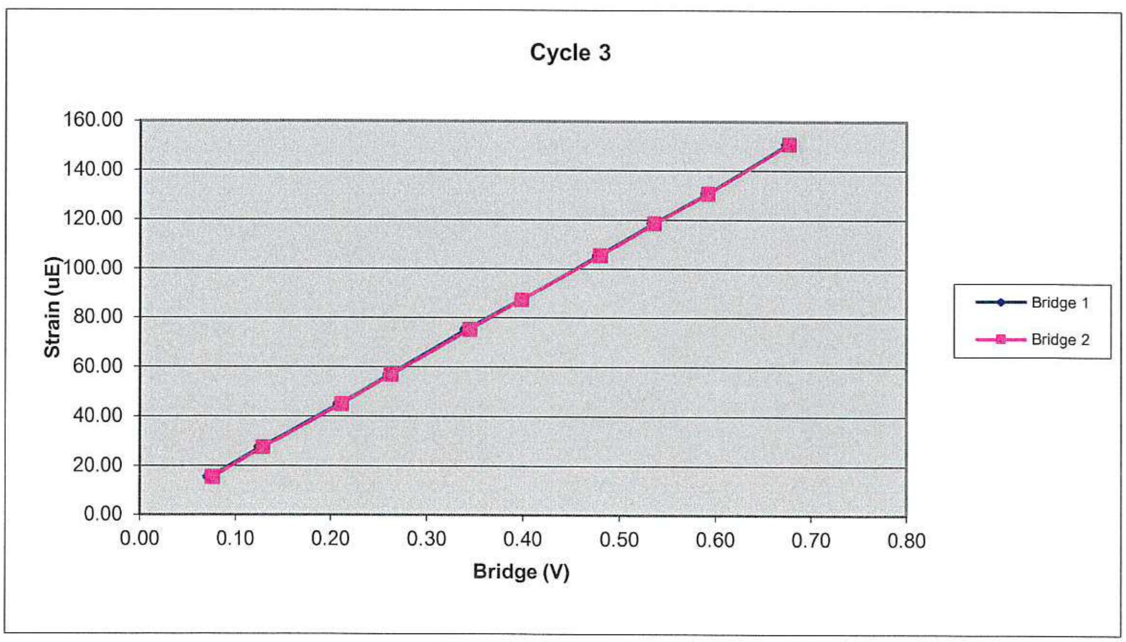
Force Strain Calibration	
EA (Kips)	**63774.45**
Offset	**111.21**
Correlation	**0.999988**



229NW		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1115.52	15.49	0.07	0.08
3	1909.57	27.45	0.13	0.13
4	3130.47	45.10	0.21	0.21
5	3902.09	56.94	0.26	0.26
6	5107.98	75.30	0.34	0.34
7	5934.87	87.37	0.40	0.40
8	7121.46	105.50	0.48	0.48
9	7964.43	118.45	0.54	0.54
10	8810.24	130.58	0.59	0.59
11	10075.29	150.67	0.68	0.68

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**14851.93**	**Force Calibration (lb/V)**	**14885.25**
Offset	**19.69**	Offset	**-16.88**
Correlation	**0.999994**	Correlation	**0.999996**
Strain Calibration (µE/V)	**223.62**	**Strain Calibration (µE/V)**	**224.13**
Offset	**-1.34**	Offset	**-1.89**
Correlation	**0.999956**	Correlation	**0.999973**

Force Strain Calibration	
EA (Kips)	**66410.13**
Offset	**109.03**
Correlation	**0.999970**



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

Calibration Factors	229NW		
Bridge 1 (μE/V)	226.25	Bridge 2 (μE/V)	226.39
EA Factor (Kips)	65743.24	Area (in^2)	2.19

Calibrated by: Sean Boone
Calibrated Date: 5/10/2023

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on FEB 1 1 2021

Serial No:	K11978	**Temperature:**	19.0 °C
Model:	PR	**Humidity:**	29%
Calibrated on:	Channel 4 on 8G 5161 LE		

Ref Acc 1:	63479! 1079 g's/volt	**Cal on:**	22Jan2021
Ref Acc 2:	65538! 1043 g's/volt	**Cal on:**	22Jan2021

Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

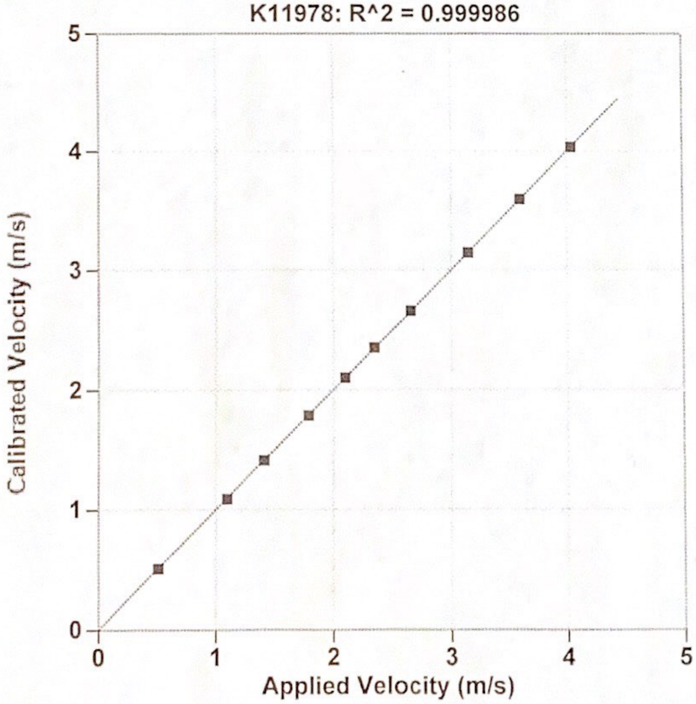
PDA CALIBRATION FACTOR

361.9 mv/5000g
(72.4 µv/g)
R^2: 0.999986 [Chip programmed]

Operator: William Johnson

Signed

K11978: R^2 = 0.999986



Reference Velocity m/s	S/N K11978 Velocity m/s
0.511	0.508
1.096	1.090
1.414	1.411
1.792	1.786
2.100	2.102
2.348	2.352
2.655	2.660
3.144	3.145
3.590	3.592
4.039	4.035

Maximum Acceleration: 884 g's

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on FEB 1 1 2021

Serial No:	K11979	**Temperature:**	19.0 °C
Model:	PR	**Humidity:**	29%
Calibrated on:	Channel 3 on 8G 5161 LE		

Ref Acc 1:	63479! 1079 g's/volt	**Cal on:**	22Jan2021
Ref Acc 2:	65538! 1043 g's/volt	**Cal on:**	22Jan2021

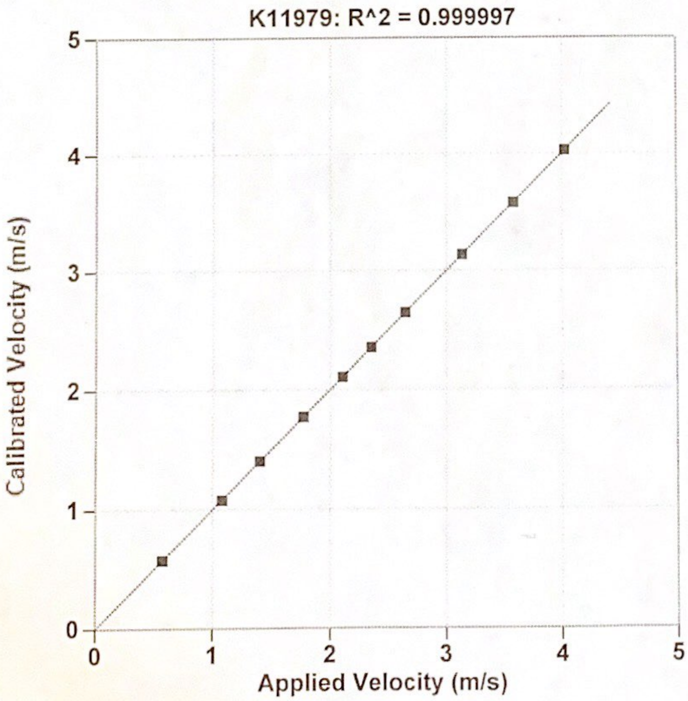
Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).

PDA CALIBRATION FACTOR

346.4 mv/5000g
(69.3 µv/g)
R^2: 0.999997 [Chip programmed]

Operator: William Johnson

Signed



Reference Velocity m/s	S/N K11979 Velocity m/s
0.576	0.576
1.082	1.080
1.403	1.404
1.775	1.771
2.104	2.104
2.353	2.354
2.644	2.642
3.136	3.136
3.579	3.579
4.026	4.028

Maximum Acceleration: 882 g's

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