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GEOTECHNICAL DESIGN REPORT
US ROUTE 1 BRIDGE NO. 5804
OVER INTERSTATE 295
YARMOUTH, MAINE

November 2024
09.0026144.00

Prepared for:
Hoyle Tanner
Yarmouth, Maine

Prepared by:
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VIA EMAIL

November 21, 2024
File No. 09.0026144.00

Mr. Sean James
Hoyle Tanner
106 Lafayette Street, Suite 2D
Yarmouth, Maine 04096

Re: Geotechnical Design Report
Replacement of US Route 1 Bridge No. 5804 over Interstate 295
MaineDOT WIN 22382.00
Yarmouth, Maine

Dear Mr. James:

We are pleased to provide this Geotechnical Design Report, which includes geotechnical design recommendations for the replacement of US Route 1 Bridge No. 5804 in Yarmouth, Maine. Our work was completed in accordance with the Agreement for On-Call Services dated July 23, 2020 between GZA and Hoyle Tanner, and the Task Order, dated April 24, 2024, which incorporates GZA's Proposal No. 09.P000066.22, dated January 3, 2022, as well as associated contract modifications, and the *Limitations* Included in **Appendix A** of this report.

GZA is providing geotechnical engineering services as a Subconsultant to Hoyle Tanner, who is under contract with MaineDOT for design of the proposed bridge.

It has been a pleasure serving Hoyle Tanner on this phase of the project, and we look forward to our continued work with you through project completion. If you have any questions regarding the report, or if we can provide further assistance, please do not hesitate to contact the undersigned.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Blaine M. Cardali, P.E.
Senior Project Manager

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Consultant Reviewer

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Attachment: Geotechnical Design Report

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1.0 INTRODUCTION

This report presents the results of the geotechnical evaluation by GZA GeoEnvironmental, Inc. (GZA) for the replacement of US Route 1 Bridge No. 5804 in Yarmouth, Maine. Our services were provided in accordance with the Agreement for On-Call Services dated July 23, 2020 between GZA and Hoyle Tanner, and the Task Order, dated January 20, 2022, which incorporates GZA's proposal No. 09.P000066.22, dated January 3, 2022, as well as associated contract modifications, and the *Limitations* Included in **Appendix A** of this report. Hoyle Tanner is serving as the bridge designer for MaineDOT.

1.1 BACKGROUND

The project includes replacement of the US Route 1 Bridge No. 5804 over Interstate 295 in Yarmouth, Maine. The existing bridge was constructed in 1958 and spans east-to-west, carrying Route 1 over Interstate 295 (I- 295), as shown in **Figure 1**. It is a 242-foot-long, four-span, bridge with continuous steel beams and a concrete deck. The bridge consists of a 41-foot-wide concrete deck supported by concrete stub abutments on steel H-piles and multi-column concrete piers on steel H-piles.

A full bridge replacement is proposed to include sidewalks and wider shoulders to accommodate pedestrians and cyclists across this bridge at the request of Town of Yarmouth officials.

The proposed replacement consists of a new two-span bridge constructed approximately 75 to 105 feet west of the existing bridge. The new bridge includes a 10-foot-wide multi-use pathway. The approximate length of the new bridge is 280 feet with a single wall pier located in the median of I-295 and span lengths of 160 and 120 feet. The new abutments are proposed to be designed with integral abutment substructures supported on driven H-piles. Mechanically stabilized earth (MSE) walls are planned to support the approach embankments adjacent to the bridge and in front of the abutments, and the piles will extend through the reinforced earth. The pier is proposed to be supported on driven, end-bearing H-piles. The proposed finish grade is approximately 4.5 feet higher than the existing bridge resulting in new approach embankments up to 26 feet in height. The approach embankment at the south (Abutment 1) approach is completely offset from the existing approach embankment, and the north (Abutment 2) approach will be built partially over the existing embankment slope.

The project also includes realignment of Route 1 to facilitate the bridge offset. The realignment extends approximately 1,200 feet south and 800 feet north of the replacement bridge. Modifications are required at the I-295 Northbound and Southbound ramps as well as the Tyler Drive intersection. Several new light poles that are 40 feet in height are also proposed near the reconfigured intersections.

1.2 OBJECTIVES AND SCOPE OF SERVICES

The objectives of our work were to evaluate subsurface conditions and to provide geotechnical design recommendations for the proposed bridge and approach modifications. To meet these objectives, GZA completed the following Scope of Services:

- Conducted site visits to observe surficial conditions and reviewed mapped surficial and bedrock geology of the site;

- Reviewed existing subsurface data;
- Coordinated and observed subsurface explorations in three phases, consisting of five (5) bridge borings, eleven (11) highway borings including five (5) for lighting structures, and nine (9) seismic piezocone penetration tests (sCPTs), to evaluate subsurface conditions;
- Conducted a laboratory testing program to evaluate engineering and index properties of the site soils;
- Conducted geotechnical engineering analyses for soil properties; stability and settlement of raised and widened embankments; frost susceptibility; AASHTO LRFD load and resistance factors associated with geotechnical design elements; axial resistance of pile foundations; lateral pile design considerations; pile drivability; MSE wall design considerations; lateral earth pressures on abutments and seismic design considerations;
- Developed geotechnical engineering recommendations including foundation design recommendations for driven piles; lateral earth pressures; seismic design parameters; embankment settlement mitigation; MSE wall bearing resistance; geotechnical construction considerations; and
- Prepared this report summarizing our findings and design recommendations.

2.0 SUBSURFACE EXPLORATIONS

2.1 HISTORIC BORINGS

In 1957, MaineDOT conducted five test borings, designated Y1-1 through Y1-5, to explore subsurface conditions at each proposed bridge substructure. Test borings were drilled to depths ranging from 22 to 47 feet below ground surface (bgs). All five borings encountered silt/clay and sand layers and were terminated in bedrock. The borings encountered bedrock at approximately El. 77 to El. 103, and 5 to 6 feet of core was recovered from each location.

In 2005, MaineDOT conducted thirteen test borings for the preliminary design phase of the Exit 15 Interchange Improvements project, located in the vicinity of the proposed bridge. Four of these borings, designated HB-YA-105 through -107, and -112, were drilled within the current project limits. Test borings were drilled to depths ranging from 3 to 20 feet bgs.

In 2011, MaineDOT and Haley & Aldrich, Inc. conducted 70 supplemental test borings for the final design of the Exit 15 Interchange Improvements project. Seven of these borings, designated HB-YA-401 through -404, -507, -508, and -510, were drilled within the current project limits. Test borings were drilled to depths ranging from 7 to 29 feet below ground surface bgs. Fill, Marine Deposits of sand and silty clay, and Glacial Till were encountered in the borings. Probable bedrock was interpreted in four of the seven borings between 7 and 28 feet bgs and was based on casing, splitspoon, or roller bit refusal. Bedrock was not cored.

The boring location plan and boring data from the 1959 As-Built Plans and the boring location plans and logs from the 2005 to 2011 borings are included in **Appendix B**.

2.2 RECENT BORINGS

GZA completed a test boring program in 2022 consisting of eight (8) test borings, including three (3) bridge borings designated as BB-YR1-101 through BB-YR1-103 and five (5) highway borings designated as HB-YR1-101 through HB-YR1-105. GZA completed a supplemental test boring program in spring 2024 consisting of three (3) test borings, including two (2) bridge borings designated as BB-YR1-201 and BB-YR1-202 and one (1) highway boring designated as HB-YR1-201. GZA completed another test boring exploration program in August 2024 consisting of seven (7) highway test borings, designated as HB-YR1-301 through HB-YR1-307.

Borings were drilled using 3- and 4-inch casing, and drive- or spin-and-wash drilling techniques, as noted on the boring logs. Standard penetration testing (SPT) and split spoon sampling were performed continuously in the upper portion of some borings and generally at 5-foot typical intervals using a 24-inch-long, 1-3/8-inch inside diameter sampler. The borings were generally backfilled with ¾-inch crushed stone and/or soil cuttings and topped with asphalt cold patch in roadway areas. GZA personnel monitored the drilling work and prepared logs of each boring that are included in **Appendix C**. Additional details of each program are described below.

Field vane shear tests were taken in pairs at approximately 5- to 10-foot typical intervals within the silt and clay layers. Field vane shear tests were conducted with Geonor 55x110 mm or 65x130 mm rectangular vanes using procedures and rods in accordance with MaineDOT guidelines. Vane types used for each test are documented on the logs. Peak and residual torque values were measured and correlated to undrained shear strength values using the MaineDOT correlation charts. A total of four (4) thin-walled tube samples were taken from the borings and submitted by GZA for laboratory consolidation and shear strength testing.

The as-drilled boring locations and elevations were surveyed by MaineDOT and provided to GZA and are shown on the logs in **Appendix C** and in **Figure 2.** Elevations referenced in this report are in feet and refer to North American Vertical Datum of 1988 (NAVD 88).

2.2.1 Preliminary Borings

Borings BB-YR1-101 through -103 and HB-YR1-101 through -105 were drilled between February 21 and April 11, 2022 by New England Boring Contractors (NEBC). The borings were drilled using a track-mounted Mobile B-53 drill rig and were drilled to depths of approximately 2 to 61 feet and terminated 0 to approximately 13.9 feet into bedrock. The SPTs were conducted using automatic hammer NEBC No. D28, which had a rated hammer efficiency factor at the time of drilling of 0.92.

2.2.2 Supplemental Borings

Borings BB-YR1-201 and -202 and HB-YR1-201 were drilled between April 26 and 30, 2024 by Seaboard Drilling, LLC (Seaboard). The -200 series borings were drilled using a track-mounted Mobile B-50 drill rig and were drilled to depths of approximately 9 to 46 feet and terminated 0 to approximately 14 feet into bedrock. The -200 series SPTs were conducted using automatic hammer Seaboard No. 367, which had a rated hammer efficiency factor at the time of drilling of 1.066.

Borings HB-YR1-301 through -307 were drilled between August 22 and 26, 2024 by Seaboard Drilling, LLC (Seaboard). The -300 series borings were drilled using a track-mounted Mobile B-48 drill rig and were drilled

to depths of approximately 12 to 37 feet and terminated 0 to approximately 5.5 feet into bedrock. The -300 series SPTs were conducted using automatic hammer Seaboard No. 202102, which had a rated hammer efficiency factor at the time of drilling of 0.985.

2.3 SEISMIC CONE PENETRATION TESTING

GZA retained Seaboard to complete nine (9) sCPTs, designated CPT-YR1-201 through CPT-YR1-208, and CPT-YR1-207A between April 25 and 29, 2024. The as-completed sCPT locations and elevations were surveyed by MaineDOT and provided to GZA as shown on **Figure 2**.

The CPTs were performed in accordance with ASTM D5778. All CPTs were advanced using a Diedrich D-50 track-mounted rig providing a reaction for advancement of a Vertek digital cone. The sCPTs were advanced to refusal at depths ranging from approximately 8 to 28 feet. Parameters obtained include cone resistance (qc), sleeve friction (fs), and piezocone pore pressure (u_2). Dissipation tests were conducted at CPT-YR1-204, -207, -207A, and -208. Downhole shear wave velocity measurements were also taken at approximately 1-meter intervals using a surface impact source and a geophone near the cone to calculate shear wave velocity (V_s) at each test depth, except for CPT-YR1-203 and CPT-YR1-207A.

The data report submitted to GZA by Seaboard dated May 10, 2024 containing the raw CPT results is included in **Appendix D**. Seaboard also provided GZA with Excel files containing the raw data collected from the CPTs for use in our engineering evaluations.

GZA utilized the analytical software *CPetIT* by Geologismiki to develop reports of correlated soil types and engineering properties based on the raw data provided by Seaboard. These reports are included in **Appendix D**.

3.0 LABORATORY TESTING

GZA retained two laboratories to complete a soil laboratory testing program, including Thielsch Engineering of Cranston, Rhode Island, to assess the gradation and index properties of the soil, and Soil Metrics of Cape Elizabeth, Maine to assess shear strength and compressibility of cohesive soils. The testing program included:

- Seventeen (17) gradation analyses;
- Fifteen (15) MaineDOT Frost Classifications;
- Thirty-six (36) Unified Soil Classification System (USCS) assessments;
- Twenty-seven (27) moisture content tests;
- Nineteen (19) Atterberg limits analyses;
- Four (4) incremental consolidation tests;
- Four (4) hydrometer tests; and
- One (1) Direct Simple Shear test.

Results of the testing are included in **Appendix E**.

4.0 SUBSURFACE CONDITIONS

4.1 SURFICIAL AND BEDROCK GEOLOGY

Based on available surficial geologic mapping[1] and the results of the subsurface explorations, the surficial units at the site are Marine Clay and Marine Sand of the Presumpscot Formation, which consists of a stratified mixture of sand, silt and clay deposited by glacial melt. Thin drift areas and glacial till are mapped southeast of the bridge and described as less than ten feet of a poorly sorted mixture of gravel, sand, silt and clay over bedrock.

Bedrock in the vicinity of the site is mapped[2] as undifferentiated rock of the Vassalboro Group of Silurian age. The bedrock is characterized as fine to medium grained plagioclase-quartz-biotite granofels and gneiss with light-colored granitic sills.

4.2 SUBSURFACE PROFILE

Up to six soil units were encountered in the test borings and CPTs overlying bedrock: Fill, Relic Topsoil, Marine Clay Crust, Marine Clay, Marine Sand, and Glacial Till. The thicknesses and generalized descriptions of the soil units are presented in the following table in descending order from existing ground surface. Soil descriptions are based on GZA borings and CPTs. Detailed descriptions and interpretations of the materials encountered at specific locations are provided in the boring logs and CPTs in **Appendices C and D**. An interpretive subsurface profile was developed representing generalized stratification along the proposed bridge alignment and is presented on **Figure 3**. The strata thicknesses and elevations are summarized for each boring and CPT in **Table 1**.

GENERALIZED SUBSURFACE CONDITIONS		
Subsurface Unit	**Approximate Encountered Thickness (ft)**	**Generalized Description**
Fill	1.8 to 11.5	Varies from: Brown, loose to dense, fine to coarse SAND, trace Silt to Silty, to: Sandy GRAVEL. (USCS: GP-GM, SM) *Encountered in borings BB-YR1-101, -102, and HB-YR1-201, and -301 through-307.*
Relic Topsoil	3.1	Black, soft, Organic SILT and wood. *Encountered only in boring HB-YR1-306*
Marine Clay Crust	3 to 10	Grey, medium stiff to hard, Silty CLAY, trace fine Sand. (USCS: CL) MaineDOT Frost Classification: III *Encountered in borings BB-YR1-101, -102, -103, -201, -202, and HB-YR1-103, -104, -105, -303, -304, -305, and -306, and all CPTs except CPT-YR1-203.*
Marine Clay	2 to 14.5	Grey-blue, soft to medium stiff, Silty CLAY, trace to little fine Sand. (USCS: CL, ML) MaineDOT Frost Classification: III *Encountered in borings BB-YR1-101, -102, -103, -201, -202, and HB-YR1-104, and CPT-205, -207, -207A and -208.*

[1]Retelle, Michael J., 1999. Surficial geology of the Yarmouth quadrangle, Maine: Maine Geological Survey, Open-File Map 99-105, scale 1:24,000.

[2]West, David P., Jr., and Hussey, Arthur M., 2018, Bedrock Geology of the Yarmouth quadrangle, Maine: Maine Geological Survey, Department of Conservation, Open-File No. 18-10, scale 1:24,000.

GENERALIZED SUBSURFACE CONDITIONS		
Subsurface Unit	**Approximate Encountered Thickness (ft)**	**Generalized Description**
Marine Sand	1.3 to 30.5	Grey, loose to very dense, fine to coarse SAND, trace to some Gravel, little to some Silt. (USCS: SM, SP-SM) MaineDOT Frost Classification: I-II *Encountered in all borings and CPTs except HB-YR1-102, -104, -201, -301, and -303.*
Glacial Till	2.8 to 17.5	Varies from: Grey, very dense, silty SAND, trace to little Gravel, to: Hard, Clayey SILT, some Sand, some Gravel. (USCS: ML, SM) *Encountered in borings BB-YR1-101, -103, -202, and HB-YR1-303, -306, and -307.*
Top of Bedrock Elevation	Encountered Top of Rock:	Abutment 1: Approximate El. 87 to 94 Center Pier: Approximate El. 84 Abutment 2: Approximate El. 64 to 80

4.2.1 Bedrock

Bedrock was cored in borings BB-YR1-101, -102, -103, -201 -202, and HB-YR1-301, and -302. Bedrock in borings BB-YR1-101, -103, -201, and HB-YR1-301 and -303 was described as hard, fresh to moderately weathered, aphanitic, grey, SCHIST. Joints are close to moderately spaced, low to high angle, planar to stepped, smooth to rough, fresh to discolored, and tight to open. Bedrock in borings BB-YR1-102 and -202 was described as very hard to hard, fresh to weathered, fine to coarse grained, white to grey, GRANITE. Joints are very close to widely spaced, horizontal to high angle, planar to undulating, smooth, fresh to decomposed, partially open to open. Secondary joints are close to moderately spaced, low angle, planar, smooth, decomposed, partially open to open. The Rock Quality Designation (RQD) in the core runs ranged from 18 to 97 percent.

4.2.2 Groundwater

The water level was measured in the completed borings after drilling at depths of 1.8 to 16.1 feet below existing grade, corresponding approximately to El. 110.5 to El. 125.8. Water levels measured in the borings were likely influenced by the addition of drill water during rotary wash drilling. The groundwater level was interpreted from the CPTs to be at depths of 1.0 to 2.7 feet at the south (Abutment 1) approach, corresponding approximately to El. 119.5 to El. 124.9. The CPT measurements are considered more representative of in-situ groundwater conditions but were only taken at the south approach.

Fluctuations in groundwater levels will occur due to variations in season, precipitation, and construction activity in the area. Consequently, water levels during and after construction are likely to vary from those encountered in the borings and CPTs at the time the observations were made.

5.0 ENGINEERING EVALUATIONS

5.1 GENERAL

GZA conducted geotechnical engineering evaluations in accordance with *2020 AASHTO LRFD Bridge Design Specifications, 9th Edition* (herein designated as AASHTO LRFD) and the *MaineDOT Bridge Design Guide, 2003 Edition*, with updates through 2018 (MaineDOT BDG). The sections that follow describe the evaluations and the geotechnical basis for each element. Supporting calculations are included in **Appendix F**.

5.2 APPROACH EMBANKMENTS

The new bridge will be constructed approximately 75 to 105 feet to the west of the existing bridge and widened approximately 10 feet to accommodate a multi-use pathway. New fills of up 22 feet at Abutment 1 and up to 26 feet at Abutment 2 are proposed for the new approaches.

MSE retaining walls will be constructed to support the approach embankments. Each approach will have a 73- to 80-foot-long MSE wall that is parallel to and approximately 3 feet in front of the integral abutment backwall. The MSE walls will extend from concrete leveling pads up to the bottom of the abutment backwalls, corresponding to El. 114.5 to El. 131.5 at Abutment 1 and El. 111.5 to 130.5 at Abutment 2, respectively. Therefore, maximum reinforced soil heights in front of the abutments will be on the order of 17 to 19 feet. MSE return walls will also be constructed on both sides of each approach embankment. The return walls adjacent to the abutments will be taller in order to retain the full approach embankment height, with a maximum height of approximately 30 feet. Typical embankment side slopes are proposed with an inclination of 2 horizontal to 1 vertical (2H:1V) on the west (left) side of the embankments and between 8H:1V and 20H:1V on the east (right) side.

5.2.1 Embankment Performance Criteria

We understand that the settlement criteria that have been adopted by MaineDOT for this project include a maximum of 2 inches of pavement settlement within 100 feet of the abutment in the first 5 years post-construction (after final paving), and an additional 2 inches between 5 and 20 years (total 4 inches in the first 20 years).

The basis for acceptable global stability for embankments is specified in AASHTO LRFD Article 11.6.3.7 and utilizes a resistance factor of 0.75 (corresponding to a safety factor of 1.3) where the geotechnical parameters and subsurface stratigraphy are well defined.

Pseudostatic analyses were also conducted to evaluate the likelihood of significant slope movement following the design seismic event.

5.2.2 Soil Profile and Properties

The design soil profiles used in our evaluations included new engineered fill overlying ultra-lightweight foamed glass aggregate (ULFGA), existing fill, marine clay crust, marine clay, marine sand, glacial till and bedrock. The strength and compressibility properties of the marine clay deposit are key to the performance of the embankments. Development of the design parameters for this deposit is described below.

5.2.2.1 Strength

GZA developed marine clay shear strength profiles using the results of field vane shear testing, direct simple shear testing and correlation to CPT cone resistance measurements. CPT measurements were used to estimate the shear strength based on the corrected cone resistance, q_t, and a cone factor, N_{kt}, of 17, which was selected based on correlation between the CPT data and adjacent field vane test results. The individual undrained shear strength, S_u, data points/profiles and interpreted design values are plotted versus elevation on **Figure 4**. The primary profiles (bold black for Abutment 1 and bold blue for Abutment 2) were developed based on borings BB-YR1-101 and -201, -202 and CPT-YR1-205, -207, and -208.

Friction angles for granular soil strata were developed using correlations between corrected SPT N-values and friction angle.

Based on the subsurface data and laboratory and in-situ testing results, and our experience with similar deposits in the area, GZA interpreted the strength properties as follows:

DESIGN SOIL PROFILES – ABUTMENTS					
Soil Unit	**Total Unit Weight (pcf)**	**South Approach/ Abutment 1**		**North Approach/ Abutment 2**	
		Effective Friction Angle (deg) / Undrained Shear Strength (psf)	**Estimated Thickness[1] (feet)**	**Effective Friction Angle (deg) / Undrained Shear Strength (psf)**	**Estimated Thickness[1] (feet)**
Proposed Fill (Common Borrow, Sand, Gravel)	125	32	15 - 16	32	19 – 25
Proposed Lightweight Fill	20	40	6	--	--
MSE Fill	128	34	20	34	21
Existing Fill	125	32	0 - 2	--	--
Marine Clay (crust)	120	S_u = 1,250 psf	8 - 10	S_u = 1,250 psf	2 - 7
Marine Clay (stiff)	118	--	--	S_u = 1,000 psf	2
Marine Clay (medium stiff)	118	S_u = 575 psf	9 - 14	--	--
Marine Sand	120	32	4 - 9	32	9 - 31
Glacial Till	130	38	0 - 6	38	12 - 18
Depth to Bedrock below Existing Grade	--	27 - 34		40 - 52	

Note:
1. Estimated thicknesses of fill strata are measured from existing ground surface.

5.2.2.2 Compressibility

Four one-dimensional consolidation tests were completed on samples taken at the site behind each proposed abutment, at distances of about 30 feet or more from existing embankments. The maximum past pressure results from the consolidation tests were compared to values derived using CPT correlations to develop overconsolidation ratio (OCR) profiles. The equation developed by Kulhawy and Mayne (1990) utilizes the normalized tip resistance of the CPT and a constant k value with a typical value of 0.33 for clay. Hardison and Landon (2015) found a variety of k values representing different Presumpscot Formation clay sites in Maine,

ranging from 0.20 to 0.43. GZA evaluated the correlation factor based on maximum past pressure and OCR at the elevations of the consolidation tests and found a k of 0.3 was representative for the site, which is within the range of past research. These calculated OCR were used to develop maximum past pressure with elevation profiles at each CPT which are plotted on **Figure 4**.

We interpreted the combined results to show that the marine clay crust is highly overconsolidated and will remain completely in recompression under the proposed raise in grade. The underlying marine clay has a relatively uniform maximum past pressure of approximately 3,000 psf and is moderately overconsolidated under the current effective stress. Without settlement mitigation, the final effective stress would be approximately 200 to 600 psf greater than the maximum past pressure at Abutment 1 and about 400 to 500 psf greater at Abutment 2. The marine clay thickness is only 2 feet beneath Abutment 2 and as much as 14 feet at Abutment 1. Therefore, the increased compressibility experienced when the clay becomes normally consolidated has a greater impact at Abutment 1 than Abutment 2.

Based on the laboratory and in-situ testing results and our experience with similar Presumpscot clay deposits in the area, GZA interpreted the index and compressibility properties as follows:

Soil Properties for Settlement Analyses		
Material Property	**Soil Layers**	
	Marine Clay Crust	**Marine Clay**
Modified Recompression Ratio (RR)	0.016	0.016
Modified Compression Ratio (CR)	0.16	0.16
Consolidation Coefficient (Cv)	0.25 ft^2/day	0.25 ft^2/day
Secondary Compression Coefficient (Cαe)	0.001	0.0055
Unit Weight	120 pcf	118 pcf

Considering the granular materials above and below the marine clay and crust, GZA considered the clay to have double drainage.

5.2.3 Settlement Modelling

GZA modeled the consolidation settlement using Settle3™, starting with a pre-construction ground surface at El. 122 to approximate the existing ground surface behind the abutments. The existing and proposed embankments were modelled as embankment fills above EL. 122, based on the surveyed plan sections provided by Hoyle Tanner.

Subsurface stratification and soil properties were developed and utilized as previously described. Each boring and CPT was entered at its actual location to develop a rigorous three-dimensional model of the clay stratification. The preconsolidation profile shown on **Figure 4** was utilized as the initial condition for the model.

The design intent is to limit post-construction settlement to 2 inches in the first 5 years and an additional 2 inches between 5 and 20 years. GZA understands that the construction phasing of the proposed embankment will require new fill approximately to the top of the MSE wall elevation in advance of pile installation, abutment construction, and subsequent completion of the embankment. Therefore, the lower

MSE fill will be placed at least several months prior to final paving. GZA assumes that fills will be placed up to at least El. 129 well before construction and corresponding consolidation will be in recompression and occur rapidly during construction. Therefore, GZA has excluded the consolidation caused by these initial fills from the post-construction settlement estimates. GZA developed the three-dimensional model for analysis of future settlement using proposed grading supplied by Hoyle Tanner.

GZA evaluated three alternatives including no-mitigation (base analysis), rigid inclusion supported embankments, and lightweight fill mitigation. The alternatives are described in more detail in the following section.

5.2.3.1 Settlement Mitigation Alternatives

No Mitigation

GZA evaluated a base model where recompression is completed for fill placed up to the bottom of pile cap level, then filling is completed to design grade without lightweight materials. The results indicate an estimated maximum total settlement (combined primary and secondary settlement for filling above the MSE level) of 2.9 inches within five years and an additional 1.3 inches of settlement between 5- and 20-years post construction at the Abutment 1 approach, which exceed the settlement criteria and therefore warrant mitigation.

The estimated maximum settlement at the Abutment 2 approach is 1 inch in the first five years and an additional 0.3 inches between 5- and 20-years post construction, which meets the project criteria. Therefore, mitigation is not necessary at the Abutment 2 approach.

Abutment 1 Mitigation

GZA evaluated using a 6-foot thickness of ULFGA material instead of full weight fill beneath the roadway section within 100 feet of Abutment 1 to limit stress increase and associated settlement. The 6-foot thickness of the approximately 20 pcf ULFGA material extended approximately 40 to 65 feet behind the abutment, then tapered to zero approximately 100 feet behind the abutment. Based on our Settle3™ analyses, we predict post-construction settlements of approximately 1.8 inches in the first five years and an additional 0.5 to 0.8 inches between 5 and 20 years within the limits of the roadway, which meet the settlement criteria provided by MaineDOT. Therefore, the proposed configuration of lightweight fill is a suitable alternative for settlement mitigation at Abutment 1.

Without mitigation, we estimate up to approximately 5 inches of post-construction settlement during the 75- year life of the bridge. Rigid inclusions could be used to reduce post construction settlement at Abutment 1, and based on typical outcomes documented in the literature, may be able to limit post-construction settlement to 1 inch or less. However, the cost of rigid inclusions is anticipated to be much greater than the premium cost for using the quantity of ULFGA recommended for this project. Therefore, partial replacement using ULFGA material in place of embankment fill is the preferred alternative.

The calculations included in **Appendix F** provide additional details and plotted results of the settlement analyses.

5.2.4 Embankment Slope Stability

GZA evaluated the stability of both approaches at critical cross-sections near the proposed abutments and in the longitudinal direction beneath each abutment. The assumed stratigraphy, soil properties and grading are shown on the output figures for each analysis in **Appendix F**.

Evaluations were conducted using the computer analytical software Slope/W 2022 (Slope/W), developed by Geo-Slope International, based on the Morgenstern-Price method. Sections were evaluated with either the grid and radius or entry exit methods to identify the slip surface with the lowest factor of safety. A 250-psf surcharge load was also included within the limits of the proposed travelway. Slope/W output figures showing the minimum factor of safety for each analysis are presented in **Appendix F.** Additional details of the analyses and results are presented below. The strength profiles presented in **Section 5.2.2** were used for these analyses.

5.2.4.1 Longitudinal Profiles

Static Analysis

The analyzed profiles considered the interpreted typical subsurface conditions along the project baseline, including the proposed presence of the MSE walls and ULFGA at Abutment 1. The beneficial reinforcing effect of the proposed HP 14x89 piles supporting the abutments was included in the Slope/W model. The Brom's method was used to calculate the available resistance from the piles, which is based on the stiffness of the embedded pile and the strength of the soil. Seven HP14x89 piles were modeled beneath each abutment, corresponding to a center-to-center spacing of approximately 10 feet, oriented for strong-axis bending. Brom's method pile resistance calculations are presented in **Appendix F**. The calculated lateral pile resistance was entered in Slope/W using a resistance value per pile and the design pile spacing.

The results indicate a minimum factor of safety of approximately 1.3 for the Abutment 1 and Abutment 2 profiles without considering the beneficial reinforcing effect of the piles and approximately 1.6 including the piles. Therefore, the global stability is acceptable in the longitudinal direction. We note that calculated safety factors do not consider the beneficial effects of the MSE reinforcement.

Seismic Analysis

A pseudostatic analysis was conducted at Abutment 2 including earthquake loading based on the Newmark method by incorporating a horizontal seismic coefficient, k_h, defined as half of the maximum peak ground acceleration at the ground surface (0.07 g). This value is justified by the likely development of some degree of deformation of the overall soil mass above the slip surface, in accordance with AASHTO LRFD Article 11.6.5.2.2. For this analysis, the stability is evaluated for the slip surface that is shown to have the lowest safety factor in the static analysis. The calculated pseudostatic factor of safety against rotational failure is predicted to be approximately 1.2 for the critical slip surface beneath Abutment 2 approach, which corresponds to the lowest static factor of safety for the project. Since the calculated safety factor is greater than 1, significant slope deformations are not considered likely.

5.2.4.2 Transverse Sections

Static Analysis

A Slope/W model was developed for the proposed travelway with a 250-psf traffic surcharge pressure placed over the travel lanes and side slopes generally of 2H:1V. Three cross-sections were selected for analysis, consisting of the highest embankment in proximity to each abutment and one section at 112+25, which is located beyond the limits of the lightweight fill and the MSE wall at the Abutment 1 approach. The evaluations are summarized as follows:

- *Sta. 112+25, Abutment 1 Approach:* 18-foot embankment height above existing grade, right to left analysis only.
- *Sta. 113+25, Abutment 1 Approach:* 22-foot embankment height above existing grade, right to left analysis only. Proposed ULFGA and MSE section included in model.
- *Sta. 116+75, Abutment 2 Approach:* 24- to 25-foot embankment height above existing grade, right to left and left to right analyses. Proposed MSE wall included in model.

The results are summarized in the table below.

SUMMARY OF GLOBAL STABILITY EVALUATION	
Analysis Case	**Minimum Factor of Safety (Static)**
Sta. 112+25, Right to Left	2.2
Sta. 113+25, Right to Left	1.7
Sta. 116+75, Left to Right	2.0
Sta. 116+75, Right to Left	2.1

The results show that the calculated resistance to rotational failure is acceptable for all planned embankment sections.

5.3 SEISMIC DESIGN CONSIDERATIONS

The subsurface profile for seismic design includes the approach fills (including backfill behind abutments), marine clay, marine sand, and glacial till overlying bedrock. Seismic site class was determined in general accordance with AASHTO LRFD Table C3.10.3.1, considering the weighted-average N_{60} values in the borings, which ranged from 10 to 28 bpf, and V_s in sCPT-207 and -208, which ranged from 1,054 to 1,113 feet per second (fps).

The lower-velocity clay soils were thickest beneath the Abutment 1 approach, which would result in a lower average V_s for the soil profile. However, the soil profile is only 28 to 35 feet thick at this location, measured below existing grades. The boring evaluations at the Abutment 1 approach indicated marginal average N_{60} values of 14 and 16 for borings BB-YR1-101 and BB-YR1-201, respectively, including assuming N=100 in the bedrock within the upper 100 feet. When analyzing the average V_s in the two CPTs adjacent to these borings, we included a layer with V_s of 1,500 fps to represent the very dense soil and/or rock in the remaining 100 feet below the CPT profiles, which is lower than the 2,500-fps value typically utilized for “soft” bedrock, which

yielded average V_s of about 1,050 to 1,110 fps. Site Class D is defined as an average V_s between 600 and 1,200 feet per second. Based on the shear wave velocity criterion, the bridge can be assigned to Site Class D.

The available subsurface data indicates that the natural materials encountered at the site are sufficiently cohesive or dense that the liquefaction potential is low.

5.4 EVALUATION OF FOUNDATIONS

5.4.1 Foundation Type Assessment

Driven H-piles are the preferred foundation type for the proposed integral abutments and central pier. Probable bedrock was encountered at EL. 87 to 94 at Abutment 1, EL. 64 to 80 at Abutment 2, and EL. 84 at the central pier. Assuming the piles meet refusal at the encountered rock elevations, the corresponding pile lengths are approximately 37 to 44 feet at Abutment 1, 50 to 66 feet at Abutment 2, and 28 feet at the central pier.

5.4.2 Pile Design Considerations

Based on our experience with similar soils, we anticipate that the proposed H-piles will be driven to refusal on or near the top of rock to achieve the required axial geotechnical resistance. The abutment piles will be driven either prior to placement of or in empty permanent casings extending through the MSE backfill, with pile embedment starting below approximately El. 115 to El. 112. The pier piles will be driven in a cofferdam with a similar bottom elevation. The software package APILE by Ensoft was used to evaluate the skin friction acting on the piles during driving. At Abutment 1 and the pier, the soil profile below these levels will consist primarily of stiff to medium stiff marine clay that is sensitive and will lose most of its strength temporarily during pile driving, underlain by medium dense fine sand which will also have limited friction resistance during driving. For these subsurface profiles, the estimated friction resistance during driving from APILE is on the order of 5 to 10 percent of the required nominal resistance. At Abutment 2, the total soil profile is thicker, the clay thickness is less than 10 feet, and the dense soil at the bottom of the profile is thicker. For the Abutment 2 profile, the estimated friction resistance during driving from APILE is on the order of 70 percent of the required nominal resistance. We assumed a reduced shear strength, 50 percent of the design S_u values, in the clay during driving to consider temporary strength loss at the soil-pile interface.

Since the piles will gain support largely in end bearing, there is no reduction for group interaction in axial compression. Axial tensile geotechnical (uplift) resistance was not evaluated because the structural loads provided by Hoyle Tanner do not include uplift loading on the piles.

By utilizing steel H-piles for support of the abutments and pier, total and differential settlement will be limited to elastic compression of the piles and should be less than ½ inch. Additional settlement on the order of ½ inch or less may occur over time due to downdrag loading.

5.4.3 Load and Resistance Factors

Piles should be designed for the controlling nominal resistance of the piles. In GZA's experience with piles gaining a significant portion of their geotechnical resistance in very dense soil or on bedrock which are verified using dynamic pile analysis methods, the drivability resistance generally controls the geotechnical and

nominal pile resistance. For this condition, the piles will be driven to a nominal resistance calculated by dividing the maximum factored pile load (Strength load case) by a resistance factor of 0.65, per AASHTO LRFD Table 10.5.5.2.3-1. Resistance factors for service and extreme limit state design should be taken as 1.0. A load factor of 1.0 is recommended for downdrag loads for strength limit state design based on local practice.

Structural resistance of the piles should be checked at the strength limit state considering a resistance factor ϕ_c=0.50, per AASHTO LRFD Article 10.7.3.2.3 for hard driving condition. Since the piles will be subject to lateral loading, the piles should also be checked for resistance to combined axial compression and flexure per AASHTO LRFD Articles 6.9.2.2 and 6.15.2. Per AASHTO LRFD Article 6.5.4.2, the axial resistance factor ϕ_{cc}=0.75 and the flexural resistance factor ϕ_f=1.0 should be applied to the combined axial and flexural resistance of the pile in the interaction equation (AASHTO LRFD Eq. 6.9.2.2-1).

AASHTO LRFD load factors should be applied to horizontal earth pressure (EH), vertical earth pressure (EV), earth surcharge (ES), live load surcharge (LS) loads, and components and attachments (DC) loads using the load factors for permanent loads (γ_p) provided in AASHTO LRFD Table 3.4.1-2 for strength limit state foundation design.

5.4.4 Pile Type

The abutments are planned to be supported on ASTM A572, Grade 50 (fy=50 kips per square inch [ksi]) steel HP14x89 piles, oriented for strong-axis bending parallel to the bridge beams. Each abutment will include seven piles. The central pier will be supported by 21 HP14x89 piles, comprised of three rows of seven plumb piles, oriented with the strong axis parallel to the length of the pier, which is skewed approximately 55 degrees from the longitudinal axis of the bridge. The piles will be spaced 3 feet on-center longitudinally and 9.5 feet on-center transversely.

5.4.5 Downdrag

As discussed previously, the proposed settlement mitigation scheme will not mitigate all of the settlement over the 75-year design life of the bridge relative to the abutment piles. We estimate up to 3.1 and 1.5 inches of settlement may occur at Abutments 1 and 2, respectively, during that time. Therefore, the piles should be designed to resist downdrag loading. Based on the subsurface stratification and estimated settlement, we estimate unfactored downdrag loads of approximately 60 kips and 41 kips on piles at Abutments 1 and 2, respectively. Considering the limited filling at the central pier, downdrag is not anticipated on the pier piles.

Side friction contributing to downdrag load was estimated using the β-method in accordance with NAVFAC DM 7.2-211, and as recommended by Sandford et al, "Bitumen Coatings Reduce Downdrag on Piles for Route 1 Interchange Bridges." Assumed beta values ranging from 0.23 to 0.35 and are presented in **Appendix F**. The factored downdrag resistance including a load factor of 1.0 was added to the maximum factored structural load provided by Hoyle Tanner.

5.4.6 Pile Loads

Hoyle Tanner provided a maximum factored axial load for Abutment 1 piles of 356 kips per pile for the strength condition, and the factored downdrag load is 60 kips. Therefore, piles should be installed to a nominal axial

resistance of at least 641 kips, calculated by dividing the maximum factored axial load of 416 kips by a geotechnical resistance factor of 0.65.

Hoyle Tanner provided a maximum factored axial load for Abutment 2 piles of 288 kips per pile for the strength condition, and the factored downdrag load is 41 kips. Therefore, piles should be installed to a nominal axial resistance of at least 506 kips, calculated by dividing the maximum factored axial load of 329 kips by a geotechnical resistance factor of 0.65.

The maximum factored axial load for the pier piles was developed from GZA's pile group evaluations presented in **Section 5.4.7**. The maximum factored axial load for the strength condition is 388 kips. Therefore, piles should be installed to a nominal axial resistance of at least 597 kips, calculated by dividing the maximum factored axial load of 388 kips by a geotechnical resistance factor of 0.65.

The resistance factor assumes that dynamic pile testing with signal matching analysis will be conducted on one pile per substructure during construction in accordance with AASHTO LRFD requirements to assess nominal geotechnical pile resistance.

5.4.7 Lateral Pile Analysis

Abutments

GZA conducted lateral pile analyses for integral abutments using LPile 2022® (LPile). Hoyle Tanner provide a maximum thermal deflection of 1.5 inches and a factored axial load of 356 kips. Downdrag was not included in the axial load as it will act below the pile head and will not contribute to the maximum pile stress. We assumed a fixed-head condition (zero rotation) and imposed the estimated thermal deflection at the pile head. The ground surface was assumed at the bottom-of-abutment/top-of-pile for thermal contraction. The analysis used ASTM A572 Grade 50, HP 14x89 piles aligned for strong-axis bending aligned with the bridge beams. GZA's lateral pile analysis for the integral abutments was conducted in accordance with Section 5.4.2.4 of the MaineDOT BDG and the recommendations included in the "Integral Abutment Bridge Design Guidelines" by the Vermont Department of Transportation (VTrans).

GZA evaluated the soil profiles tabulated below based on the soil conditions encountered in the test borings and laboratory testing results. Considering a thicker layer of soft clay combined with higher axial loads and deflection, Abutment 1 was selected for the LPILE analyses. The piles will be placed within a permanent casing within the MSE backfill and filled with Underdrain backfill material. The densification effect of the pile deflection on the infill gravel within the pipe was considered. The upper 11 feet of infill gravel within the corrugated pipe was assumed to be densified by cyclic lateral pile movement.

L-PILE® INPUT PARAMETERS Abutment 1, Pile Length Approx. 37 ft						
Stratum	**Soil Model**	**Top of Layer Elevation (ft- NAVD 88)**	**Layer Thickness (ft)**	**k (pci) / E50**	**ϕ' (deg)/ Su (psf)**	**γ_t, γ_e (pcf)**
Pea Stone (Densified Upper Casing)	Reese Sand	131	8	258	40	130
Pea Stone (Densified Lower Casing)	Reese Sand	123	3	143	35	122
Pea Stone (Loose Dump)**	Reese Sand	120	5	45	31	52.6
Marine Clay Crust	Stiff Clay w/o Free Water	115	3	0.007	1250	57.6
Marine Clay	Soft Clay	112	9	0.008	575	55.6
Marine Sand	Reese Sand	103	9	55	32	57.6
Top of Rock	--	94	--	--	--	--

Notes:
1. Soil strata were modelled after boring BB-YR1-201.
2. ** indicates the top of layer is the approximate ground water elevation based on the boring logs and/or CPTs.
3. pci = pounds per cubic inch, deg = degrees, psf = pounds per square foot, γ_t = total unit weight (used above anticipated groundwater level), γ_e = effective unit weight (used below anticipated groundwater), pcf = pounds per square foot.

The initial analysis considered pile head boundary conditions including a thermal deflection of 1.5 inches and a fixed-head condition (zero slope condition). The initial lateral pile analysis resulted in a combined axial and bending stress of 63.4 ksi, which is beyond the elastic range of the pile. Therefore, GZA conducted a plastic hinge analysis.

The plastic moment resistance of the pile was calculated using the comparison of factored axial pile load and resistance, unbraced lengths, and effective length factors resulting from the initial LPile analysis. The structural capacity of the pile was checked to determine if a plastic hinge was formed for the specified displacement and specified axial thrust load under combined flexure based on the provisions of Article 6 of AASHTO LRFD and as per the recommendations of Section 5.4.2.4 of the MaineDOT BDG. This involves comparing the ratios of nominal and maximum factored axial load and moment in the pile using the interaction equation presented in AASHTO LRFD 6.9.2.2. This calculation indicates that the combined stress resulting from an axial load of 356 kips and calculated pile head moment of 499 ft-kip results in formation of a plastic hinge.

The hinge allows the pile head to rotate with a constant moment (i.e., the plastic moment). The pile head transforms from a fixed connection to a pinned connection, thereby changing the effective length and design end condition parameter (K-value) of the top segment for stability checks in accordance with AASHTO LRFD Table C4.6.2.5-1. The structural resistance of the top segment of the pile is enhanced since the plastic hinge condition is anticipated to occur.

Since the resulting moment from the initial LPile iteration exceeded the calculated plastic hinge moment, a second LPile analysis was performed using the original specified pile head displacement and the calculated plastic moment. This change results in a reduction of the axial buckling resistance of the upper segment of the pile (Segment 1) where the plastic hinge occurs.

The results of the second analysis indicate that the axial structural resistance including bending is adequate, and the demand ratio for combined bending is less than 1.0 in Segment 2. Therefore, with the exception of the plastic hinge location within the upper 1 foot of the pile below the abutment, the pile remains within the elastic range over the remainder of its length and is stable against buckling. The results also indicate that the nominal structural resistance in Segment 1 is adequate to support the design loads. Therefore, the proposed HP14x89 pile type and strong-axis configuration is suitable for support of the integral abutment deformation and axial loads. The integral abutment pile calculations are included in **Appendix F**.

Central Pier

GZA conducted lateral pile group analyses using FB-MultiPier v6.1.0 (FBP) to evaluate the pier piles. We developed design subsurface profiles for use in FBP that included new fill, marine clay crust, marine clay, marine sand, and bedrock. The soil profile and recommended design properties are summarized in the following table, and pier cap geometry, pile sizes, and load combinations provided by Hoyle Tanner are presented in **Appendix F**. Load combinations were provided for multiple strength and service cases, and Hoyle Tanner recommended using the largest factored loads for axial and moments applied to the bottom of column from different Strength load combinations.

FB-MULTIPIER INPUT PARAMETERS Central Pier						
Stratum	**Soil Model**	**Top of Layer Elevation (ft- NAVD 88)**	**Layer Thickness (ft)**	**k (pci) / E50**	**ϕ' (deg)/ Su (psf)**	**γ_e (pcf)**
Fill	Reese Sand	119	5	83	32	125
Marine Clay Crust	Stiff Clay w/o Free Water	114	3	E_{50} = 0.007	1,250 psf	120
Marine Clay Crust**	Stiff Clay w/o Free Water	111	6	E_{50} = 0.007	1,250 psf	57.6
Marine Clay	Soft Clay	105	14	E_{50} = 0.008	575 psf	55.6
Marine Sand	Reese Sand	91	7	55	32	57.6
Top of Rock	--	84	--	--	--	--

Notes:
1. Soil strata were modelled after boring BB-YR1-102.
2. ** indicates the top of layer is the approximate ground water elevation based on the boring logs.
3. Recommended modulus and unit weight values assume groundwater level at El. 111.
4. pci = pounds per cubic inch, deg = degrees, psf = pounds per square foot,
5. γ_e = effective unit weight (used below anticipated groundwater), pcf = pounds per square foot.
6. Top of pile/Bottom of pile cap at EL. 112, Fill soils modeled from bottom of cap to EL. 119.

GZA conducted analyses for the pier using pile group and cap configurations and pile cap loading provided by Hoyle Tanner. The pier piles will consist of three rows of seven plumb piles (21 total) ASTM A572, Grade 50 (fy=50 ksi) HP14x89 steel H-piles.

The pile stresses and loads from the FBP results indicate a maximum pile demand-capacity ratio of 0.47 for the piles and a maximum factored axial pile load of 388 kips. Considering the demand-capacity ratios are significantly less than 1.0, the piles are judged to remain within an acceptable total stress range. Maximum pile cap movement is predicted to be approximately 0.20 inches vertically (down), 0.02 inches laterally (in the longitudinal direction), and negligible laterally (in the transverse direction). The results show that piles will not be in tension under the applied loads. A required nominal pile resistance of 597 kips is calculated by dividing the maximum factored axial load by the driven pile resistance factor for the strength condition of 0.65. The results indicate that the pier piles are capable of achieving fixity and remaining elastic under the proposed loads.

5.4.8 Design-Phase Pile Drivability Analysis

GZA completed wave equation analyses to assess the drivability of the HP 14x89 Abutment 1, Abutment 2, and pier piles with nominal geotechnical resistances of 641, 506 and 597 kips, respectively. The goal of the analysis was to evaluate the range of rated energy necessary to install the piles to a nominal resistance without exceeding the allowable driving stress.

The analyzed pile lengths were selected assuming that the piles would be driven to the top of rock elevations encountered at the substructures. Analyses for the abutment and pier piles were completed based on a typical pile hammer, a Pileco D30-32 diesel hammer with a ram weight of 6,610 pounds and a maximum rated energy of approximately 70,066 foot-pounds (ft-lbs). The analysis was based on the hammer operating on fuel setting 4, which limits the ram stroke to 7.5 feet and the rated energy to 49,575 ft-lbs. The results are summarized below.

DESIGN-PHASE WAVE EQUATION ANALYSIS RESULTS				
Pile Location and Type	**Embedded Pile Length**	**Required Nominal Geotechnical Resistance (kips)**	**Max Driving Stress (ksi)**	**Final Penetration Resistance (blows per inch)**
Abutment 1 HP 14x89	23 feet	641	45	98
Abutment 2 HP 14x89	46 feet	506	27	7
Pier HP 14x89	28 feet	597	41	9

It has been our practical experience that the wave equation analysis is slightly conservative in estimating driving stresses, and that larger nominal resistances can often be achieved in the field without over stressing. Therefore, since the driving stresses are either less than or are approximately equal to the limiting driving stress of 45 ksi for ASTM A572 steel (50 ksi yield stress), and the calculated penetration resistances are within the MaineDOT preferred range of 6 to 15 blows per inch, the analyzed hammer system type and rated energy are judged acceptable to install the piles to the required nominal resistances noted. These results are

presented to assess drivability of an assumed, typical pile hammer system. Construction-phase drivability analyses should be conducted for all hammer(s) proposed by the contractor, based on the details of their proposed driving system.

5.4.9 Mechanically Stabilized Earth Walls

The plans indicate that the embankments will be supported by MSE walls. Based on the bearing elevations shown on the plans, we estimate that the MSE will bear on existing Marine Clay.

Performance of the MSE walls is anticipated to be controlled primarily by global stability considerations, which have been shown to be acceptable. For bearing resistance at strength limit state, we assumed the clay would achieve a drained condition, which based on the clay thicknesses for this project, is anticipated to occur within about 2 years of completion of construction. The marine clay was assumed to have a drained friction angle of 30 degrees based on literature correlating drained friction angle to plasticity index and laboratory testing completed on past projects in similar clay soils. Strength bearing resistance values were developed using the theoretical method (Munfakh et al., 2001), as referenced in AASHTO LRFD Articles 10.6.3.1.1 and 10.6.3.1.2. Service bearing resistance is related to the settlement of the MSE wall under design loads, which was discussed previously.

Nominal and factored bearing resistance values were evaluated for a range of effective footing widths. Recommended bearing resistance values are presented in **Section 6.5.**

The resistance against sliding should be evaluated in accordance with AASHTO LRFD Article 10.6.3.4 using ϕ_s' equal to δ, equal to 17 degrees, which was selected based on the clay bearing soil using AASHTO Table C3.11.5.3-1. Nominal sliding resistance for MSE walls bearing on soil utilizes a resistance factor of 1.0 for the strength condition. Therefore, the recommended factored sliding resistance coefficient for the MSE bearing surface is 0.31. Passive resistance should be neglected for evaluation of sliding and overturning.

5.4.10 Lateral Earth Pressures

Thermal expansion of the bridge will cause the backwalls of the integral abutment to move toward the backfill, which will result in earth pressures ranging from at-rest to passive earth pressure. The material properties will be controlled by the backfill material, which is proposed to consist of BDG Type 4 soil.

Hoyle Tanner provided the estimated thermal expansion of 1.22 inches for use in abutment design. The abutment height is approximately 12.6 feet resulting in a calculated abutment rotation of 0.0081 feet/foot. GZA recommends using the MassDOT methodology for development of earth pressure for this rotation. Design lateral earth pressure calculations using the MassDOT methodology are presented in **Appendix E**, and recommendations are provided in **Section 6.3** of this report.

AASHTO LRFD Commentary C3.10.9.1 specifies that bridges in Seismic Zone 1 are not required to include acceleration-augmented (earthquake-induced) soil pressures for design.

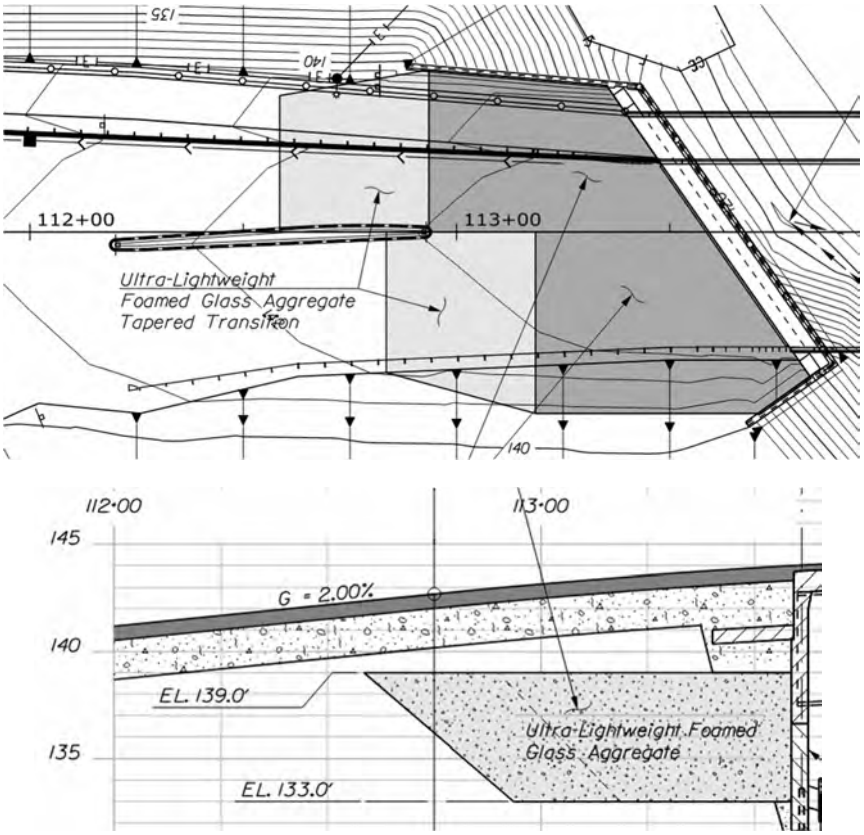
5.4.11 Frost Protection

Fill soils are anticipated to be present at the abutments and embankments, either as existing fill or imported backfill. Based on the MaineDOT BDG, Section 5.2.1, the Freezing Index for the site is 1,285, and with low-moisture content (10-20 percent) soils, the estimated depth of frost penetration is approximately 5.8 feet at the roadway approaches and the integral abutments. However, integral abutments are not required to be founded at the design frost depth per the BDG.
The soils in the vicinity of the pier pile cap and the embedment zone of the MSE wall will consist of marine clay and new fill soils and will be very close to the groundwater level, and therefore are anticipated to have a moisture content of around 20 percent. Therefore, the frost depth at the pier and for the embedded portions of the MSE wall is approximately 4.5 feet.

6.0 RECOMMENDATIONS

6.1 EMBANKMENT DESIGN AND SETTLEMENT MITIGATION

The use of ULFGA is recommended within the Abutment 1 approach embankment to mitigate excessive consolidation settlement under new embankment fills. The ULFGA area should be 6 feet thick from the back of the abutment to Sta. 112+94 (Left) and Sta. 113+60 (Right), then taper to zero in the next 35 feet. The top of the ULFGA should be flat at El. 139 (minimum 1 foot below the new pavement section). The limits of the ULFGA consistent with GZA's settlement evaluations and predictions are shown in the following figures.



Recommended ULFGA Limits, Plan View (Top) and Profile View at Baseline (Bottom)

The thicknesses recommended above should be considered the minimum within the offsets listed, including irregularities in the cross-sections around guardrails and underdrains.

The ULFGA should be completely encapsulated with non-woven separation geotextile (MaineDOT Standard Specification 722.04). Material strength and testing requirements and installation of the ULFGA should be completed in accordance with *Special Provision Section 203, Excavation and Embankment (Ultra-Lightweight Foamed Glass Aggregate)*.

Embankment side slopes should be designed with MaineDOT-typical slope angles of 2H:1V or flatter. Slopes should be provided with loam and seed for permanent erosion protection.

6.2 SEISMIC DESIGN

The peak ground acceleration coefficient, short- and long-period spectral acceleration coefficients were interpolated from the AASHTO LRFD design guide maps (3.10.2.1-1 through -21 as appropriate). Based on the site coordinates, the recommended AASHTO LRFD Response Spectra (Site Class D) for a 7 percent probability of exceedance in 75 years are summarized for the site are as follows:

SITE CLASS D SEISMIC DESIGN PARAMETERS	
Parameter	**Design Value**
Fpga	1.6
Fa	1.6
Fv	2.4
As (Period = 0.0 sec)	0.14 g
SDs (Period = 0.2 sec)	0.28 g
SD1 (Period = 1.0 sec)	0.11 g

6.3 ABUTMENT AND WINGWALL DESIGN

- Backfill between new abutments and wingwalls and a 2H:1V plane extending up from the bottom of the abutment to the pavement subgrade should consist of MaineDOT 703.19 Granular Borrow for Underwater Backfill, MaineDOT BDG Type 4 soil, except in areas where ULFGA is proposed. Passive earth pressure will be highest where Granular Borrow is used. Recommended soil properties for backfill material are as follows:
  - Internal Friction Angle of Soil (Type 4) = 32°;
  - Soil Total Unit Weight (Type 4) = 125 pcf; and
  - Coefficient of Passive Earth Pressure, K_p = 4.9.
- Live load surcharge should be applied as a uniform lateral surcharge pressure using the equivalent fill height (H_{eq}) values developed in accordance with AASHTO LRFD Section 3.11.6.4, based on the abutment/wingwall height and distance from the wall backface to the edge of traffic. A minimum H_{eq} of 2 feet is recommended.
- Foundation drainage should be provided in accordance with Section 5.4.1.9 of the MaineDOT BDG. We recommend the use of French drains on the uphill side of abutments and wing walls to prevent buildup

of differential hydrostatic pressure. The drains should be sloped to drain by gravity and should outlet through a series of 4-inch-diameter weep holes, spaced approximately 10 feet center-to-center. Alternatively, prefabricated drainage geocomposite material can be placed against the uphill side of abutments, after holes have been created through the backing material at the weep hole locations.

6.4 PILE DESIGN

6.4.1 Abutments

- The proposed abutments may be supported on HP 14x89 ASTM A572, Grade 50 steel (50 ksi yield stress) H-piles. Piles should be driven to the required nominal resistance, anticipated to be developed through a combination of side friction and end-bearing on or near the bedrock surface. The piles will be installed within permanent 30-inch-diameter casings that will act as sleeves to facilitate construction of the MSE wall around the pile locations.
- The Abutment 1 piles should be driven to a nominal resistance of 641 kips, calculated by dividing the maximum factored pile load of 416 kips (356 kips Strength I plus 60 kips downdrag) by a resistance factor of 0.65.
- The Abutment 2 piles should be driven to a nominal resistance of 506 kips, calculated by dividing the maximum factored pile load of 329 kips (288 kips Strength I plus 41 kips downdrag) by a resistance factor of 0.65.
- The piles should be oriented for strong-axis bending with respect to the bridge beam alignment.
- Preliminary wave equation analyses indicate that the abutment piles could be driven to the required nominal resistance using a diesel hammer with a rated energy of about 70,066 ft-lbs for the anticipated 38- to 70-foot-long, ASTM A572 Grade 50 HP14x89 piles without exceeding the allowable driving stress of 45 ksi (0.9Fy for 50 ksi steel), and with a final penetration resistance within the MaineDOT range of 6 to 15 blows per inch.
- The annular space between permanent casings and abutment piles should be backfilled with MaineDOT Underdrain Backfill material (Type C), in accordance with MaineDOT 703.22. The backfill should be placed after the piles have been installed.

6.4.2 Pier

- The proposed pier substructure may be supported on HP 14x89 ASTM A572, Grade 50 steel (50 ksi yield stress) H-piles. Piles should be driven to the required nominal resistance, anticipated to be developed through a combination of side friction and end-bearing on or near the bedrock surface.
- The pier piles should be driven to a nominal resistance of 597 kips, calculated by dividing the maximum factored pile load of 388 kips (Strength I) by a resistance factor of 0.65.
- The pier piles should be oriented for strong-axis bending consistent with the lateral pile analyses presented herein.
- Preliminary wave equation analyses indicate that the pier piles can be driven to the required nominal resistance using a diesel hammer with a rated energy of about 70,066 ft-lbs for the anticipated 28-foot-long, ASTM A572 Grade 50 HP14x89 piles without exceeding the allowable driving stress of 45 ksi (0.9Fy

for 50 ksi steel), and with a final penetration resistance within the MaineDOT range of 6 to 15 blows per inch.

6.4.3 General Pile Recommendations

- The pile tip elevations used in the drawings should correspond to the bedrock elevations encountered in the borings (approximately El. 87 to El. 94 at Abutment 1, approximately El. 84 at Pier 1, and approximately El. 65 to El. 80 at Abutment 2). We recommend that pile lengths correspond to the deepest rock anticipated at each substructure at a minimum. A provision is recommended in the drawings for extra pile length to account for variability in the top-of-rock surface and the potential for piles to penetrate a short distance into the bedrock.
- To limit pile damage during driving, cast steel pile points should be provided in accordance with *MaineDOT Standard Specification Section 501.10 – Pile Tips.*
- Pile installation should be controlled using wave equation analysis and field logging of the pile installation with final penetration resistance based on dynamic pile testing with signal matching analysis.
- We recommend that one pile at each abutment and one pier pile be dynamically tested at the end of initial drive to assess driving stress and establish the penetration resistance criteria to achieve the required nominal resistance for the production piles. The plans should also require a restrike test on each test pile.
- Piles may be installed through the marine clay stratum by vibratory methods. Vibratory installation should be terminated when an increase in resistance is detected, and the pile should be monitored dynamically throughout the remainder of the driving.
- Piles shall be spliced in accordance with MaineDOT Section 501.047. Considering the predicted formation of a plastic hinge at the base of the abutment, splices should not be allowed within 15 feet of the bottom of the abutment.
- Integral abutment piles should be checked by the structural engineer for resistance to combined axial compression and flexure per AASHTO LRFD Articles 6.9.2.2 and 6.15.2. Per AASHTO LRFD Article 6.5.4.2, the axial resistance factor ϕ_{cc}=0.7 and the flexural resistance factor ϕ_f=1.0 should be applied to the combined axial and flexural resistance of the pile in the interaction equation (AASHTO LRFD Eq. 6.9.2.2-1).
- Approach slabs should be constructed at each abutment to smooth the transition from the approach embankment to the bridge. The slabs should be positively connected to the backwalls.

6.5 MSE WALL DESIGN

- We recommend nominal and factored (strength limit state) bearing resistances of 7.5 and 4.9 ksf, respectively, based on an effective footing width no less than 12 feet, which is likely to be the minimum effective width for the planned MSE walls. For service limit state design, a bearing resistance of 4.0 ksf is considered suitable based on the result of our settlement and global stability evaluations. The MSE wall designer should check the effective footing widths in their design against these bearing resistance values.
- MSE wall design should be in accordance with the requirements of Standard Specification 677 (Mechanically Stabilized Earth Retaining Wall), Section 11.10 of LRFD and Section 5.6.5.4 of the BDG.

- MSE walls will be founded on marine clay soils. The recommended bearing resistances are contingent upon proper subgrade preparation as described in **Section 7.1**.
- The base resistance against sliding for the MSE wall backfill bearing on clay should be evaluated in accordance with AASHTO Article 10.6.3.4 using $\phi_s' = \delta = 17$ degrees. Nominal sliding resistance is equal to the vertical force multiplied by the sliding resistance coefficient (tan δ), which is equal to 0.31. The factored sliding resistance is also 0.31 for MSE walls for the strength condition.
- Passive resistance on the embedded portions of walls should be neglected when evaluating sliding and overturning.
- A minimum reinforcement length of 0.7 times the height of the wall should be provided.
- Fill in the reinforcement zone should be specified as Gravel Borrow (MaineDOT Item 703.20), except where crushed stone is required beneath the abutment footing. The fill in the reinforcement zone should meet the electrochemical and plasticity requirements in Standard Specification Section 677.048.
- A minimum uniform vertical surcharge load of 250 pounds per square foot should be applied on the roadway surface above the wall. Lateral surcharge resulting from this load should be calculated and documented by the wall designer.

7.0 CONSTRUCTION CONSIDERATIONS

This section provides guidance regarding quality control during pile installation, excavation, dewatering, and foundation subgrade preparation and protection. These items are discussed in the paragraphs that follow.

7.1 MSE WALL SUBGRADE PREPARATION

The MSE walls for this project will be supported on medium stiff marine clay. The marine clay will be very easily disturbed under construction traffic. It will likely be saturated when exposed, and proofrolling or recompaction will not be feasible. Therefore, careful subgrade preparation will be essential to limit potential for overexcavation of disturbed clay.

Clay subgrade surfaces should be prepared with a smooth-edged bucket. To limit disturbance potential, we recommend that a minimum of 12 inches of gravel fill be placed over the prepared subgrade as soon as practical after it is prepared, and prior to any construction equipment traffic. If the subgrade becomes disturbed, any disturbed material should be excavated and replaced with gravel fill.

7.2 PILE INSTALLATION SEQUENCE AND CONTROL

The recommendations presented herein, specifically relative to pile drivability, assume that the soil surrounding the piles, up to the bottom of pile cap level, will be in place at the time of installation. Therefore, a feasible sequence for pile installation and MSE wall construction following excavation to MSE wall bearing level is as follows:

1. Support the minimum 30-inch inside diameter permanent casings at the required locations with the top of casing at the proposed elevation of pile installation;

2. Construct the MSE wall up to the required grade;
3. Install piles to the required penetration criteria;
4. Place backfill material inside permanent casings; and
5. Construct abutment.

Alternatively, the piles could be installed immediately after excavation to the bearing level, and then the casings could be placed and centered over the driven piles while the MSE wall is constructed, resulting in a sequence of 3-1-2-4-5 for the steps above. The recommendations presented herein are valid for either sequence.

Placement of the fill after driving is intended to limit densification of the infill material that would make pile driving more difficult. Under no circumstance should pile driving occur through the MSE backfill without permanent casings.

We recommend that the H-pile installation be controlled using wave equation analysis of the contractor's proposed driving system, field logging of the pile installation, and determination of final penetration resistance based on dynamic pile testing with signal matching analysis. As previously noted, the piles should be driven to a nominal resistance calculated by dividing the maximum factored pile load by a resistance factor of 0.65, per AASHTO LRFD Table 10.5.5.2.3-1.

AASHTO LRFD Table 10.5.5.2.3-1 requires that at least one load test with signal matching be performed per substructure in conjunction with the resistance factor of 0.65. We recommend that one PDA test with Signal Matching be completed at each abutment and at a pier pile, including a restrike test at least 24 hours after initial drive for each tested pile, resulting in a total of three PDA tests.

7.3 EXCAVATION, TEMPORARY LATERAL SUPPORT AND DEWATERING

An approximately 7-foot-deep internally braced sheet pile cofferdam will likely be required for construction of the pier in the I-295 median. Otherwise, we anticipate that the required excavations could be made as sloped open cuts, although it may be desirable to use temporary sheet piles to limit the extent of overexcavation for MSE return walls adjacent to the existing approach embankments.

Temporary dewatering may be necessary to control groundwater inflow in excavations. Although measured water levels are above the bottom of MSE wall elevation, we anticipate that the rate of groundwater flow will be relatively slow from the clay, so water inflow will be more controlled by perched water in overlying fill or surface water or runoff. It is anticipated that water encountered in excavations can be handled by open pumping from sumps installed at the bottoms of excavations. Sumps should be fitted with geotextile or sand filters to prevent loss of subgrade fines during pumping. Dewatering discharge should be managed in accordance with the contractor's Stormwater Prevention Plan and MaineDOT Best Management Practices.

7.4 REUSE OF ON-SITE MATERIALS

The excavated material for the MSE walls will likely be marine clay crust, which does not meet MaineDOT specifications for Granular Borrow and/or Granular Borrow Backfill, and would not be suitable for use as structural backfill.

7.5 ULTRA-LIGHT WEIGHT FILL PLACEMENT

Based on our experience, the ULFGA material can be handled and placed similarly to granular borrow, but a unique aspect that affects construction is that densification must take place in a controlled fashion with careful attention to avoid crushing of the particles. This involves utilization of vibratory plate compaction equipment to place and compact the material in lifts and avoiding direct traffic on the material with heavy construction equipment, including delivery trucks. We recommend that GZA provide submittal review and field engineering to observe and provide input into material-specific aspects of construction sequencing, placement methodology, compaction equipment and compaction procedures.

We recommend that a nonwoven geotextile fabric be placed as a separator between the ULFGA and all other differing materials above, below or adjacent to the material. This will involve a combination of placing the geotextile along prepared subgrade surfaces, wrapping it around the edges of placed ULFGA, and wrapping it around irregularities in the surface as required due to the presence of underdrain piping, catch basins, and guardrails posts.

Equipment travel on placed ULFGA should be strictly prohibited. Construction equipment other than for placement and compaction of ULFGA should not operate on the exposed ULFGA surface until a minimum 12-inch layer of granular cover material is placed over the ULFGA. The cover material should be placed and compacted within 48 hours of placing and compacting the final lift(s) of ULFGA in an area. Until that time, operation of construction equipment directly on the ULFGA shall be limited to light-duty equipment with rubber tires. Placement and compaction procedures should be developed and observed to minimize tracking over the placed material. The contractor should be required to submit a proposed plan for protecting exposed ULFGA.

The ULFGA should be tested, transported, placed and compacted in accordance with the project-specific Special Provision 203.

TABLES

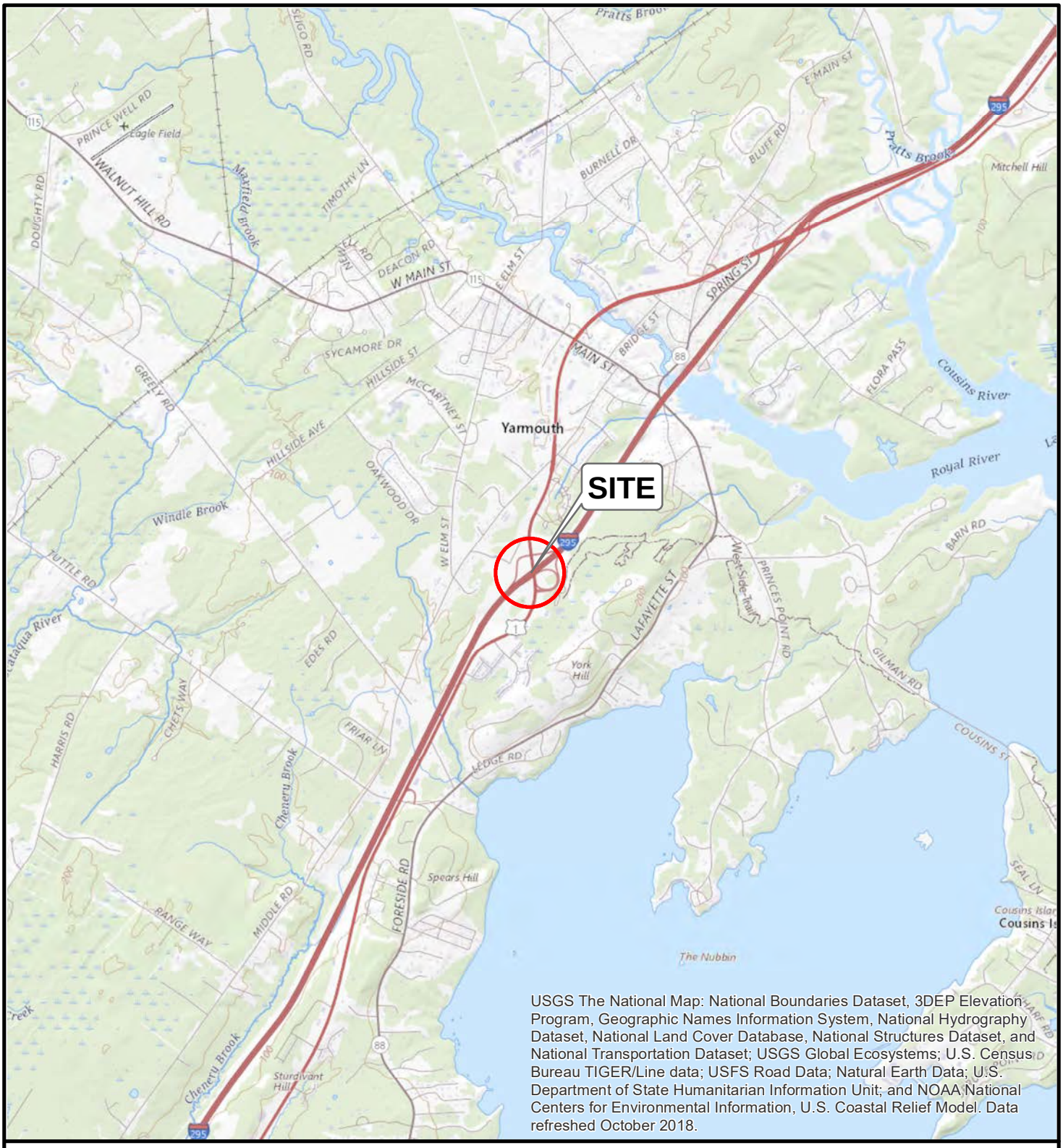
TABLE 1
Summary of Subsurface Explorations
US Route 1 over I-295 Bridge No. 5804 Replacement
Yarmouth, Maine
GZA job#: 09.0026144.00

Exploration Type	Exploration Boring ID	Station	Offset (ft)	Left/ Right	Northing	Easting	Ground Surface El. (ft)	Top of Stratum Elevation								Stratum Thickness							Depth to Bedrock (ft)	Top of Rock Elevation (ft)	Bottom of Exploration Depth (ft)	Bottom of Exploration El. (ft)	Groundwater	
								Topsoil	Fill	Relic Topsoil	Marine Clay (Crust)	Marine Clay	Marine Sand	Glacial Till	Bedrock	Topsoil	Fill	Relic Topsoil	Marine Clay (Crust)	Marine Clay	Marine Sand	Glacial Till					El. (ft)	Depth (ft)
Bridge Borings	BB-YR1-101	113+64.7	15.2	R	346633.6	1032949.0	122.0	NE	122.0	NE	120.2	112.0	98.2	93.8	87.8	NE	1.8	NE	8.2	13.8	4.4	6.0	34.2	87.8	48.1	73.9	119.3	2.7
	BB-YR1-102	115+35.8	11.6	R	346804.4	1032937.5	118.4	118.4	118.0	NE	114.4	105.4	90.9	NE	83.5	0.4	3.6	NE	9.0	14.5	7.4	NE	34.9	83.5	45.6	72.8	110.5	7.9
	BB-YR1-103	116+37.8	21.2	R	346906.8	1032942.4	115.9	115.9	NE	NE	115.5	109.9	107.9	77.4	64.6	0.4	NE	NE	5.6	2.0	30.5	12.8	51.3	64.6	61.3	54.6	112.2	3.7
	BB-YR1-201	113+26.8	32.8	L	346593.6	1032902.7	121.6	NE	NE	NE	121.6	111.6	102.6	NE	93.9	NE	NE	NE	10.0	9.0	8.7	NE	27.7	93.9	42.0	79.6	119.8	1.8
	BB-YR1-202	116+15.1	38.0	L	346881.4	1032884.4	119.3	119.3	NE	NE	118.5	111.3	107.2	97.3	79.8	0.8	NE	NE	7.2	4.1	9.9	17.5	39.5	79.8	46.0	73.3	111.9	7.4
Highway Borings	HB-YR1-101	107+29.1	24.4	L	346002.2	1032923.2	133.5	133.5	NE	NE	NE	NE	132.5	NE	127.9	1.0	NE	NE	NE	NE	4.6	NE	5.6	127.9	5.6	127.9	--	NE
	HB-YR1-102	108+66.0	28.8	L	346134.1	1032927.6	137.6	137.6	NE	NE	NE	NE	NE	NE	137.1	0.5	NE	NE	NE	NE	NE	NE	0.5	137.1	2.1	135.5	--	NE
	HB-YR1-103	110+13.5	10.2	R	346282.6	1032960.0	128.4	128.4	NE	NE	127.8	NE	124.4	NE	123.1	0.6	NE	NE	3.4	NE	1.3	NE	5.3	123.1	6.9	121.5	125.8	2.6
	HB-YR1-104	111+94.3	15.5	R	346463.4	1032957.0	125.1	125.1	NE	NE	124.7	117.1	NE	NE	112.8	0.4	NE	NE	7.6	4.3	NE	NE	12.3	112.8	12.8	112.3	121.9	3.2
	HB-YR1-105	118+02.5	12.4	L	347069.7	1032901.4	119.8	119.8	NE	NE	119.4	NE	111.8	NE	NE	0.4	NE	NE	7.6	NE	>19	NE	NE	NE	27.0	92.8	112.8	7.0
	HB-YR1-201	110+99.7	21.9	L	346367.2	1032924.0	128.2	NE	128.2	NE	NE	NE	NE	NE	119.0	NE	9.2	NE	NE	NE	NE	NE	9.2	119.0	9.2	119.0	122.7	5.5
	HB-YR1-301	109+62.9	59.7	R	346234.2	1033011.8	133.3	NE	133.3	NE	NE	NE	NE	NE	125.8	NE	7.5	NE	NE	NE	NE	NE	7.5	125.8	12.5	120.8	--	--
	HB-YR1-302	111+41.0	153.1	R	346416.5	1033096.9	137.4	NE	137.4	NE	NE	NE	127.4	NE	119.4	NE	10.0	NE	NE	NE	8.0	NE	18.0	119.4	23.5	113.9	122.4	15.0
	HB-YR1-303	111+27.1	57.5	R	346398.4	1033002.0	127.9	NE	127.9	NE	122.9	NE	NE	117.9	NE	NE	5.0	NE	5.0	NE	NE	7.3	NE	NE	17.3	110.6	119.9	8.0
	HB-YR1-304	117+09.4	78.8	L	346973.6	1032839.3	119.7	119.7	118.7	NE	114.7	NE	104.7	NE	NE	1.0	4.0	NE	10.0	NE	>2	NE	NE	NE	17.0	102.7	111.8	7.9
	HB-YR1-305	117+90.0	84.2	L	347053.9	1032830.3	127.4	127.4	126.5	NE	122.4	NE	112.4	NE	NE	0.9	4.1	NE	10.0	NE	4.0	NE	NE	NE	19.0	108.4	120.1	7.3
	HB-YR1-306	120+10.2	112.6	R	347282.9	1033016.8	130.1	130.1	129.7	118.2	115.1	NE	111.2	98.2	NE	0.4	11.5	2.0	5.0	NE	13.0	>4	NE	NE	37.0	93.1	118.9	11.2
	HB-YR1-307	120+18.0	56.9	L	347283.0	1032847.1	130.3	NE	130.3	NE	NE	NE	122.3	112.3	--	NE	8.0	NE	NE	NE	10.0	>2.8	NE	NE	20.8	109.5	114.2	16.1
Cone Penetration Tests	CPT-YR1-201	111+41.2	48.7	R	346411.9	1032992.6	126.9	126.9	NE	NE	124.9	NE	118.9	--	--	2.0	NE	NE	6.0	NE	5.1	--	--	--	13.1	113.8	124.9	2.0
	CPT-YR1-202	112+04.6	37.7	L	346471.3	1032903.4	123.8	123.8	NE	NE	121.8	NE	118.8	--	--	2.0	NE	NE	3.0	NE	3.3	--	--	--	8.3	115.5	122.3	1.5
	CPT-YR1-203	112+35.7	48.1	R	346506.3	1032987.7	125.2	125.2	NE	NE	NE	NE	124.4	--	--	0.8	NE	NE	NE	NE	1.1	--	--	--	1.9	123.3	124.2	1.0
	CPT-YR1-204	112+52.5	3.8	L	346520.7	1032935.1	123.4	123.4	NE	NE	121.4	NE	113.4	--	--	2.0	NE	NE	8.0	NE	7.0	--	--	--	17.1	106.3	121.4	2.0
	CPT-YR1-205	113+03.2	81.1	L	346567.8	1032855.5	121.5	121.5	NE	NE	120.0	113.5	105.5	--	--	1.5	NE	NE	6.5	8.0	5.3	--	--	--	21.3	100.2	119.5	2.0
	CPT-YR1-206	112+89.9	32.5	R	346559.6	1032969.6	123.3	NE	NE	NE	123.3	NE	117.8	--	--	NE	NE	NE	5.5	NE	2.5	--	--	--	8.0	115.3	120.6	2.7
	CPT-YR1-207	113+22.6	44.9	L	346588.8	1032890.9	121.6	121.6	NE	NE	120.1	114.6	108.1	--	--	1.5	NE	NE	5.5	6.5	2.0	--	--	--	14.5	107.1	120.1	1.5
	CPT-YR1-207A	113+24.1	49.5	L	346590.1	1032886.2	121.2	121.2	NE	NE	119.2	113.2	105.7	--	--	2.0	NE	NE	6.0	7.5	1.3	--	--	--	16.8	104.4	119.7	1.5
	CPT-YR1-208	113+59.8	11.0	R	346628.5	1032945.0	121.9	121.9	NE	NE	119.9	112.9	99.9	--	--	2.0	NE	NE	7.0	13.0	6.1	--	--	--	28.1	93.8	120.4	1.5

El. = Elevation, NE = Not Encountered, NM = Not Measured, NP = Not Penetrated, > = Boring Terminated in Stratum

Notes:
1. Refer to the boring logs in Appendix B for additional information.
2. Project elevation datum is North American Vertical Datum (NAVD 88), unless noted otherwise.
3. As-drilled locations were surveyed by MaineDOT and provided to GZA.
4. Stratum depths, thickness and elevations are rounded to the nearest 0.1 foot as interpreted on the boring logs, but this does not represent the precision of the data.

FIGURES



USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed October 2018.

USGS QUADRANGLE LOCATION

N
W E
S

SOURCE : THIS MAP CONTAINS THE ESRI ARCGIS ONLINE USA TOPOGRAPHIC MAP SERVICE, PUBLISHED DECEMBER 12, 2009 BY ESRI ARCIMS SERVICES AND UPDATED AS NEEDED. THIS SERVICE USES UNIFORM NATIONALLY RECOGNIZED DATUM AND CARTOGRAPHY STANDARDS AND A VARIETY OF AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS. THIS MAP ALSO CONTAINS THE ESRI ARCGIS ONLINE USA COUNTIES WHICH PROVIDES DETAILED BOUNDARIES THAT ARE CONSISTENT WITH THE TRACT, BLOCK GROUP, AND STATE DATA SETS AND ARE EFFECTIVE AT REGIONAL AND STATE LEVELS.

0 1,000 2,000 4,000 6,000

SCALE IN FEET

Data Supplied by : esri USGS science for a changing world

PROJ. MGR.: BMC
DESIGNED BY: LCN
REVIEWED BY: ARB
OPERATOR: LCN

DATE: 05-04-2022

LOCUS PLAN

ROUTE 1 BRIDGE OVER INTERSTATE 295
YARMOUTH, ME

JOB NO.
09.0026144.00

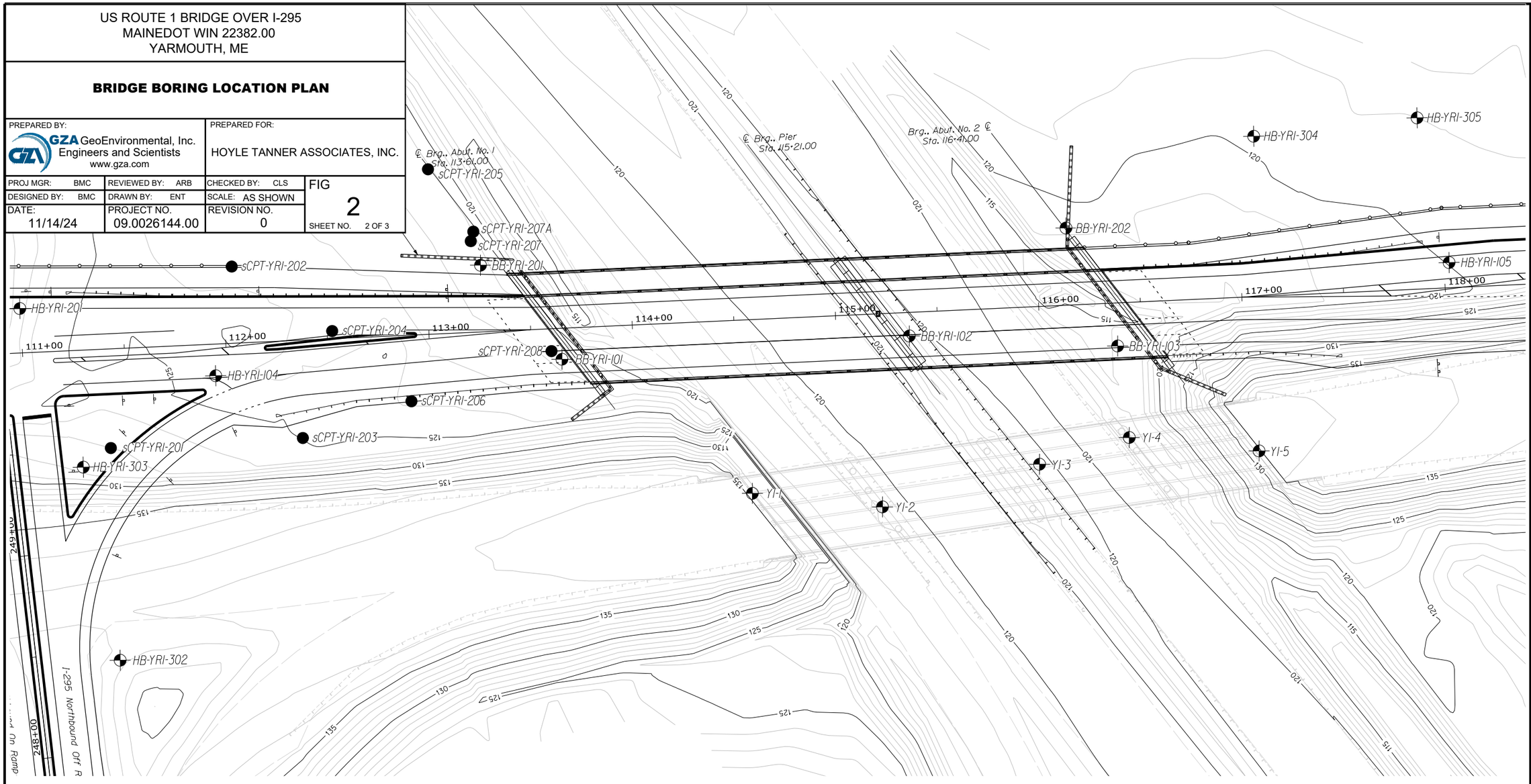
FIGURE NO.
1

© 2022 - GZA GeoEnvironmental, Inc. \\GZAPort1\Jobs\09 Jobs\00026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Figures\GIS\09.0026144.00-Figure 1- Locus Plan.mxd, 5/4/2022, 3:02:19 PM, Luis.Navarrete

US ROUTE 1 BRIDGE OVER I-295
MAINEDOT WIN 22382.00
YARMOUTH, ME

BRIDGE BORING LOCATION PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		HOYLE TANNER ASSOCIATES, INC.	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG 2
DESIGNED BY: BMC	DRAWN BY: ENT	SCALE: AS SHOWN	
DATE: 11/14/24	PROJECT NO. 09.0026144.00	REVISION NO. 0	SHEET NO. 2 OF 3



NOTES

1) Base map developed from electronic files (Alignments.dgn, Bridge.dgn, 3DTopo_071222.dgn, and Contours.dgn) provided by Hoyle, Tanner & Associates on June 17, 2024.

2) The as-drilled locations of the BB-YRI-100 and -200 bridge borings, HB-YRI-100, -200 and -300 series highway borings, and sCPT-YRI-200 series Seismic Cone Penetration Tests were surveyed and provided by MaineDOT in an electronic file (Borings_090324.dgn).

BORING LOCATION PLAN LEGEND

- BB-YRI-103, HB-YRI-105 — Locations and designations of BB- and HB-YRI-100 series borings performed by New England Boring Contractors of Hermon, Maine between February 21 and April 11, 2022.
- BB-YRI-202, HB-YRI-201 — Locations and designations of BB- and HB-YRI-200 series borings performed by Seaboard Drilling, LLC of Bangor, Maine between April 26 and 30, 2024.
- sCPT-YRI-208 — Locations and designations of sCPT-YRI-200 series seismic cone penetration tests performed by Seaboard Drilling, LLC of Bangor, Maine on April 25 and 29, 2024.
- HB-YRI-305 — Locations and designations of HB-YRI-300 series borings performed by Seaboard Drilling, LLC of Bangor, Maine between August, 22 and 26, 2024.
- YI-5 — Approximate locations and designations of YI series borings performed by the Maine State Highway Commission in April, 1957.

PLAN

25 0 25 50
Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00
BRIDGE NO. 5804

BRIDGE PLANS

		BY	DATE
PROJ. MANAGER	M. WIGHT		
DESIGN-DETAILED	E. TOME	B. CARDALI	09/2024
CHECKED-REVIEWED	A. BLASSELL	------	09/2024
DESIGN2-DETAILED2	------	------	------
DESIGN3-DETAILED3	------	------	------
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

SIGNATURE

P.E. NUMBER

DATE

RELOC. RTE. 1 BRIDGE
I-295
CUMBERLAND COUNTY
YARMOUTH

BORING LOCATION PLAN

SHEET NUMBER
13
OF 121

Filename: ...\1 - BLP\BLP - 09.23.24.dgn Division: HIGHWAY Username: common Date:11/21/2024

NOTES

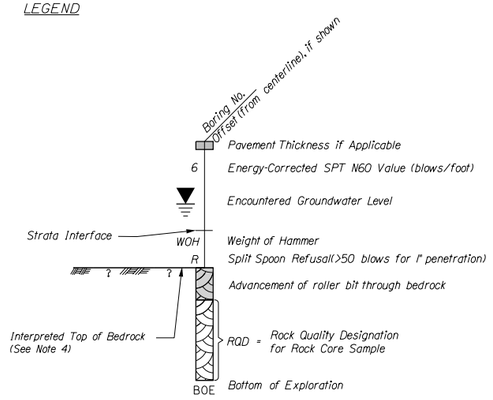
1) Base map developed from electronic files provided by HTA on June 17, 2024 (Profile.dgn)

2) The as-drilled boring locations were surveyed by a MaineDOT survey crew and provided to GZA in an electronic file (Borings.dgn).

3) BB, HB and CPT-YRI-200 series bridge borings were performed by Seaboard Drilling of Bangor Maine, and observed by GZA personnel between April 26 and April 30, 2024

4) 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 rock transitions may vary and are probably more erratic. Boring data are shown for borings drilled off alignment, but interpreted strata are based on the borings drilled closest to the project baseline. For more specific information refer to the exploration logs.

LEGEND

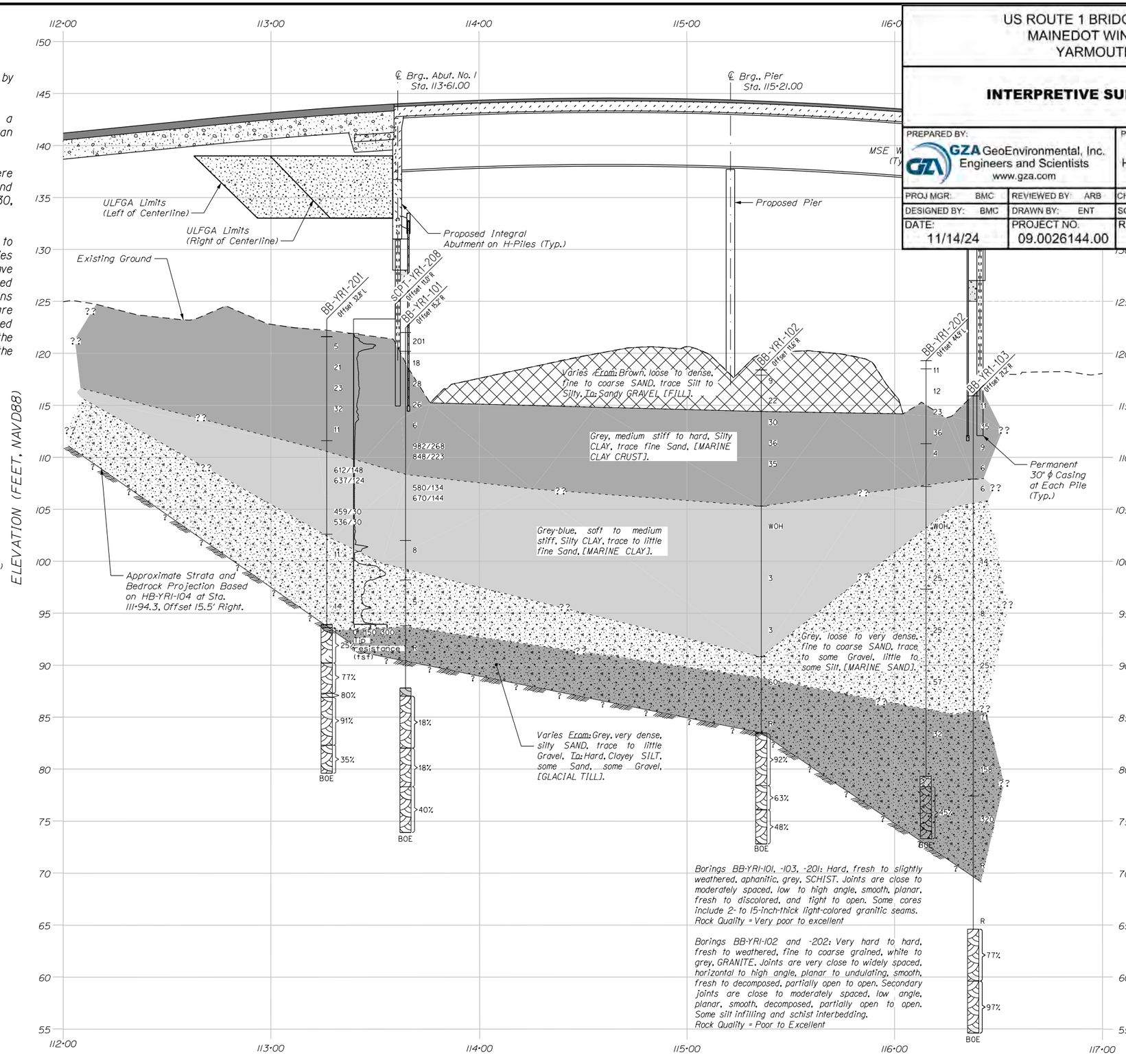


SCALE

Horiz. 25 0 25 50

Vert. 5 0 5 10

Scale in Feet



US ROUTE 1 BRIDGE OVER I-295
MAINEDOT WIN 22382.00
YARMOUTH, ME

INTERPRETIVE SUBSURFACE PROFILE

PREPARED BY:	PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com	HOYLE TANNER ASSOCIATES, INC.	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS
DESIGNED BY: BMC	DRAWN BY: ENT	SCALE: AS SHOWN
DATE: 11/14/24	PROJECT NO. 09.0026144.00	REVISION NO. 0

FIG 3
SHEET NO. 3 OF 3

	BY	DATE
PROJ. MANAGER	M. WOHT	
DESIGN-DETAILED	E. TOME	09/2024
CHECKED-REVIEWED	A. BLANSDELL	
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1	B. CARDALI	09/2024
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

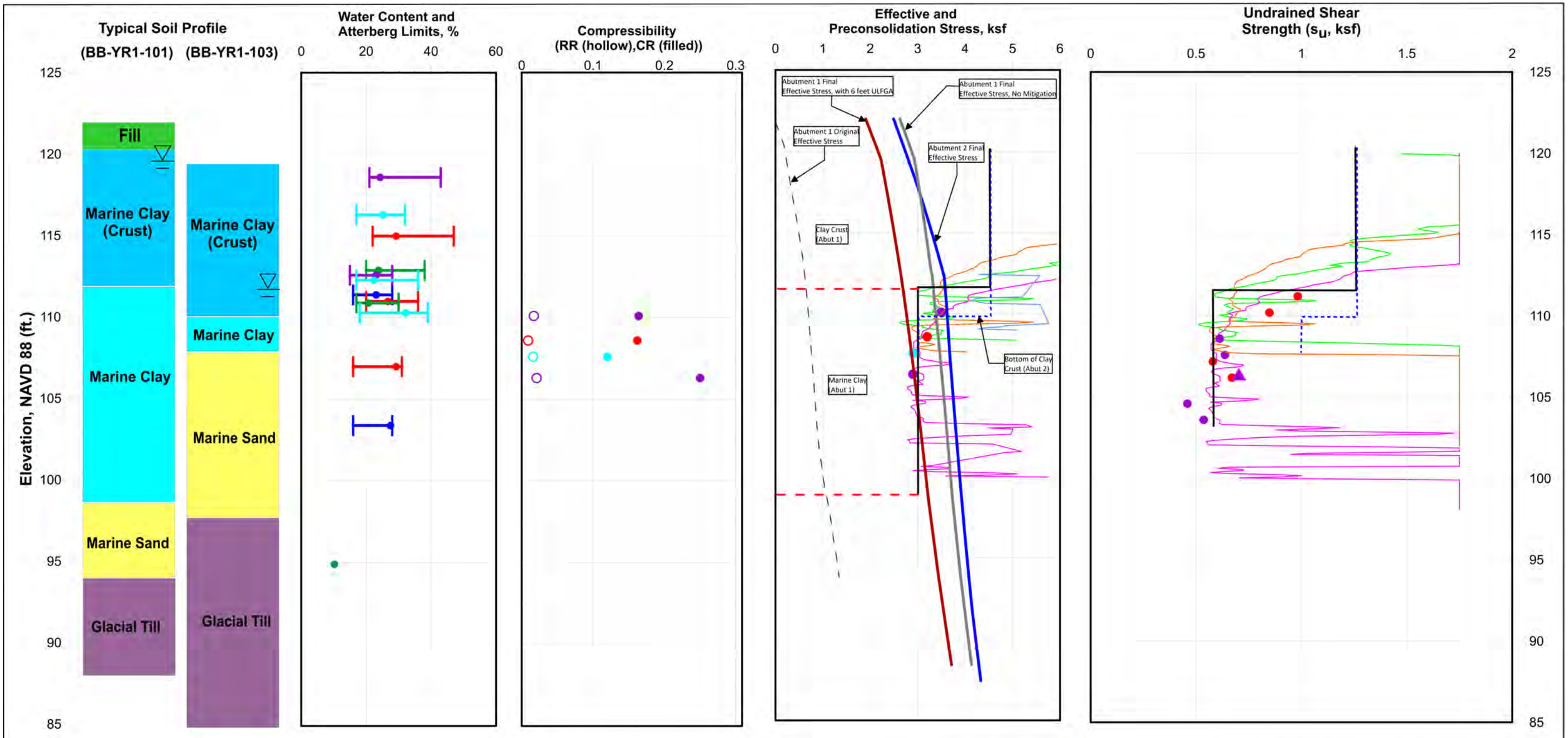
RELOC. RTE. 1 BRIDGE OVER I-295
YARMOUTH CUMBERLAND COUNTY

INTERPRETIVE SUBSURFACE PROFILE

PREPARED BY: GZA

SHEET NUMBER 14 OF 121

Filename: ...\2 - ISP\ISP - 09.19.24.dgn Division: HIGHWAY Username: common Date:11/21/2024



NOTES:

1. DATA BASED ON TEST BORINGS BB-YR1-101, -102, AND -103. THE -101 SERIES BORINGS WERE PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF HERMON, MAINE BETWEEN FEBRUARY 21 AND APRIL 11, 2022. THE -200 SERIES BORINGS WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE BETWEEN APRIL 26 and 30, 2014. ALL BORINGS WERE OBSERVED AND LOGGED BY GZA PERSONNEL.
2. SCPT EXPLORATIONS (SCPT-YR1-101 THROUGH -108, AND SCPT-YR1-107A) WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE ON APRIL 25 AND 29, 2024.
3. TYPICAL SOIL PROFILES BASED ON BORING BB-YR1-101 (ABUTMENT 1) AND BB-YR1-202 (ABUTMENT 2).
4. WATER CONTENTS BASED ON LABORATORY TESTS PERFORMED ON SAMPLES TAKEN FROM RECENT BORINGS.
5. PRECONSOLIDATION PRESSURE CALCULATED FROM CONSOLIDATION TESTS AND ESTIMATED FROM SCPT DATA ASSUMING A K=0.30
6. CORRELATED UNDRAINED SHEAR STRENGTH FROM CPT DATA IS BASED ON N_{KT} = 17.
7. IN LEGEND, FV=UNDRAINED SHEAR STRENGTH FROM IN-SITU FIELD VANE, CONSOL=LAB DATA FROM CONSOLIDATION TEST, DSS=LAB DATA FROM DIRECT SIMPLE SHEAR TEST.

LEGEND

- BB-YR1-101 (FV, Consol)
- BB-YR1-102
- BB-YR1-103
- BB-YR1-201 (FV, Consol)
- BB-YR1-202 (Consol)
- sCPT-YR1-204
- sCPT-YR1-205 (Nkt 17)
- sCPT-YR1-207 (Nkt 17)
- sCPT-YR1-208 (Nkt 17)
- Design Profile Abutment 1
- Design Profile Abutment 2
- BB-YR1-201 DSS (4.5 ksf)

Plastic Limit, PL — Water Content, Wn — Liquid Limit, LL

UNLESS SPECIFICALLY STATED BY WRITTEN AGREEMENT, THIS DRAWING IS THE SOLE PROPERTY OF GZA GEOENVIRONMENTAL, INC. (GZA). THE INFORMATION DEPICTED ON THIS DRAWING IS SOLELY FOR USE BY GZA'S CLIENT OR THE CLIENT'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY THE CLIENT OR OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA.

YARMOUTH ROUTE 1 BRIDGE REPLACEMENT
YARMOUTH, ME

IN-SITU SOIL CONDITIONS VS. ELEVATION
Abutment 1 & 2 Approaches

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers & Scientists
www.gza.com

PREPARED FOR:
MAINE DEPARTMENT OF TRANSPORTATION

PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIGURE 4
DESIGNED BY: BMC	DRAWN BY: ENT	SCALE: N/A	
DATE: 11/21/2024	PROJECT NUMBER: 09.0026144.00	REVISION NUMBER: 0	

APPENDIX A – LIMITATIONS

GEOTECHNICAL LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the contract documents, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions.

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

Subsurface Conditions

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

6. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

7. Water level readings have been made in test holes (as described in this Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to

temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

8. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

9. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

10. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

11. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

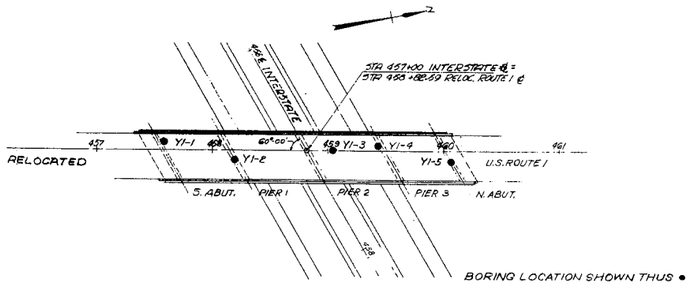
Additional Services

12. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

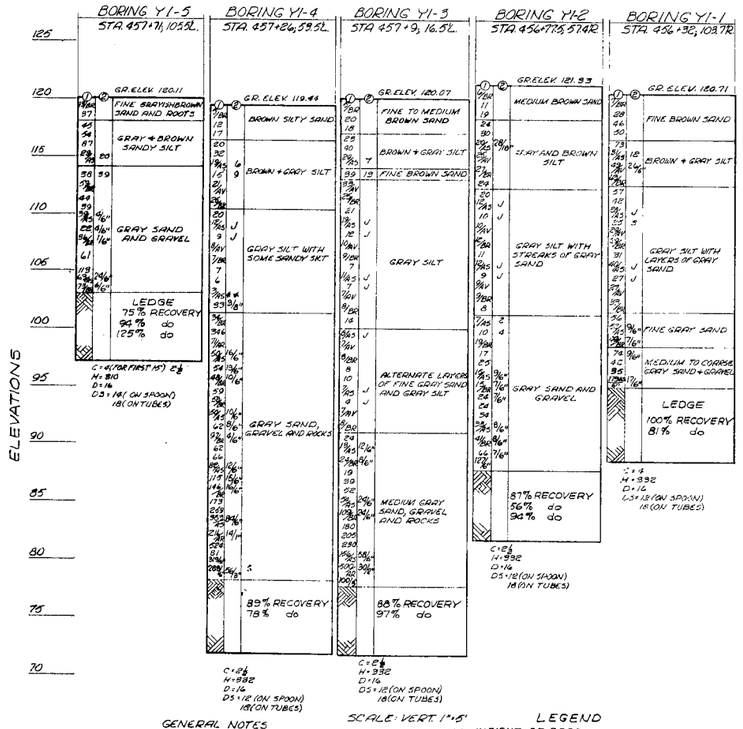
APPENDIX B - HISTORIC BORING LOGS

B.R.R. REGION	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
1	MAINE	I-095-4(6)	38	103

YARMOUTH



BORING LOCATION PLAN
SCALE 1" = 50'



SCALE: VERT. 1" = 5'

GENERAL NOTES

1. BORINGS WERE MADE BY THE MAINE STATE HIGHWAY COMMISSION APRIL 1957.
2. FIGURES IN COLUMN ① = BLOWS PER FOOT ON CASING. FIGURES IN COLUMN ② = BLOWS PER FOOT ON SAMPLER ROD. EXCEPT AS NOTED
3. ELEVATIONS ARE REFERRED TO MEAN SEA LEVEL.

LEGEND

##: WEIGHT OF RODS
AS: CASING WAS DRIVEN AFTER SAMPLING
C: DIAMETER OF CASING IN INCHES
H: WEIGHT OF HAMMER IN POUNDS
D: DROP ON CASING IN INCHES
AR: CASING WAS DRIVEN WASHING AHEAD OF CASING
BR:
AV:
DS: DROP ON SAMPLER ROD IN INCHES
J: SAMPLER DRIVEN BY STATIC LOAD NOT EXCEEDING ½ TON

DES.	
DR.	CEG.
TR.	
CHK.	R.F.C.
APPR.	H.J.W.

Brodie Blue Print-300-4-57

STATE HIGHWAY COMMISSION
AUGUSTA, MAINE

PORTLAND - YARMOUTH INTERSTATE

RELOCATED ROUTE 1 OVER INTERSTATE

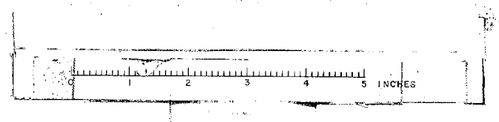
BORING DATA

SHEET NO. 38 OF 103 | SCALE: AS NOTED

FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.

Qm-14
56

M-1092



Locations Plans and Borings Logs
from "Geotechnical Design Report
for Interstate 295 and US Route 1
Exit 15 Interchange Improvements"
Dated November 30, 2012 by Haley
& Aldrich, Inc.

Filename:
Division: HIGHWAY
Username: COMMON
Date:2/21/2011

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

IM-295-1108(600)E EXIT 15
CM-1794(000)X PARK & RIDE LOT

PIN 11086.00 EXIT 15 HIGHWAY PLANS
PIN 17490.00 PARK & RIDE LOT

SIGNATURE
P.E. NUMBER
DATE

	DATE	BY
PROJ. MANAGER		
DESIGN-DETAILED		
CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

YARMOUTH
I-295 EXIT 15

PLANS

SHEET NUMBER
25
OF 226

CURVE DATA
PI = 448+93.79
Δ = 62° - 59' - 59" Lt.
R = 1145.92'
L = 1260.00'
T = 702.22'
E = 198.05'

CURVE DATA
PI = 127+15.40
Δ = 83° - 50' - 21" Rt.
R = 237.00'
L = 346.80'
T = 12.79'
E = 81.51'

CURVE DATA
PI = 201+74.43
Δ = 13°32'10.3" Rt.
R = 182.00'
L = 43.00'
T = 21.60'
E = 1.28'

CURVE DATA
PI = 202+39.48
Δ = 50°46'05.0" Rt.
R = 92.00'
L = 81.52'
T = 43.65'
E = 9.83'

CURVE DATA
PI = 202+94.03
Δ = 10°28'31.1" Rt.
R = 182.00'
L = 33.27'
T = 16.68'
E = 0.76'

FOR CONTINUATION SEE SHEET NO. 24

FOR CONTINUATION SEE SHEET NO. 26

FOR CONTINUATION SEE SHEET NO. 35

FOR CONTINUATION SEE SHEET NO. 36

WIDGERY THOMAS TO STATE OF MAINE DATED: 5/14/69 BOOK 3086, PAGE 173

SEE S.H.C. 3-193 (EE - RESTRICTED TO SCENIC USE)

TBM 185

TBM 184

TBM 183

T 542

T 541

T 540

F 606

F 607

ROUTE 1

NB OFF AUX. RAMP

NB ON RAMP

NB OFF BASELINE

NB OFF AUXILIARY BASELINE

456+92.28, 20.00 LT

457+51.99, 14.51 LT

454+23.51, 16.00 RT

455+82.01, 16.00 RT

452+15.44, 38.32 RT

457+75.41, 26.00 RT

125+94.35, 19.26 RT

203+10.62, 2.00 RT

2.00 RT

LIMIT OF MILL AND OVERLAY, STA. 453+70

MILL AND OVERLAY AREA FROM EXISTING ETW LT TO EXISTING ETW OF INSIDE LANE RT

128+47.50, 4.00 RT

124+83.67, 8.00 RT

GRADE GRASS AREA DOWNWARD FROM EOP TO CB. 4:1 MAX
RESET SIGNS.
6" LOAM AND SEED

350 FLARED TERMINAL

REMOVE CB

REMOVE HMA AND PLACE 2" LOAM AND SEED (TYP)

REMOVE HMA AND PLACE 2" LOAM AND SEED (TYP)

PAVEMENT GRADING BREAK LINE:
RADIUS=252'
PAVEMENT CROSS SLOPE NORTH OF LINE CONTROLLED BY NB OFF BASELINE:
PAVEMENT CROSS SLOPE SOUTH OF LINE CONTROLLED BY NB OFF AUXILIARY BASELINE

TYLER TECHNOLOGIES, INC.
COLE HAAN - LESSEE
TA = 61.7± AC.(SURVEY)
PP 4

LOT PLANS THIS AREA
"SURVEY FOR COLE-HAAN"
BY LAND USE CONSULTANTS
PLAN BOOK 193, PAGE 245
"COLE HAAN SITE PLAN WITH LOT
DIVISION AND ACCESS R.O.W."
PLAN BOOK 208, PAGE 314

SEE SEWER & WATER EASE. PLAN PLAN BOOK 193, PAGE 245

EXISTING SLOPE EASEMENT LIMITS

6IN X 6IN GRANITE CUMBERLAND AND CHEBEAQUE TECHNOLOGIES PARK

HB-YA-401

HB-YA-39

HB-YA-38

HB-YA-37

HB-YA-36

HB-YA-35

HB-YA-34

HB-YA-33

HB-YA-32

HB-YA-202

HB-YA-203

HB-YA-201

CB6 12" RCP

CB7 12" RCP

CB8

CB9

DMH1

DMH2

12" RCP

24IN CMP

12IN RCP

6IN SCH 40 PVC

POB 200+00.00

POB 150+00.00

PC 201+52.83

PC 201+95.83

PCC 202+77.35

PT 203+10.62

PT 200+79.70

PC 124+83.67

PT 124+25.07

PT 128+47.50

PC 113+81.25

TYPE B UD

TYPE C UD

EXISTING C.O.A.

EXISTING SLOPE EASEMENT LIMITS

EXISTING R.O.W.

EXISTING CL

CLL

PFO

ETW

EOP

KEEP RIGHT - NO U TURN

STOP

DO NOT ENTER

YIELD / DO NOT ENTER

ONE WAY

WRONG WAY

YELLOW REFLECTOR

RED REFLECTOR

DIAMOND REFLECTOR

U TURN W/REFLECTOR

NO LEFT TURN

CUMBERLAND

YARMOUTH

SERVICES

18" OPT. III

15" OPT. III

4IN WIDE

4IN WHITE

4IN YELLOW

6" LOAM AND SEED

NORTH TO 115

W/ COVER

NET 1.5%

NET 1.6%

0.9%

1.2%

2%

6%

Filename:
Division: HIGHWAY
Username: COMMON
Date:2/21/2011

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

IM-295-1108(600)E EXIT 15
CM-1794(000)X PARK & RIDE LOT

PIN 11086.00 EXIT 15
PIN 17490.00 PARK & RIDE LOT

HIGHWAY PLANS

	DATE	BY
PROJ. MANAGER		
DESIGN-DETAILED		
CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

YARMOUTH
I-295 EXIT 15

PLANS

SHEET NUMBER

26

OF 226

FOR CONTINUATION SEE SHEET NO. 31

FOR CONTINUATION SEE SHEET NO. 40

FOR CONTINUATION SEE SHEET NO. 27

FOR CONTINUATION SEE SHEET NO. 25

SB ON RAMP

I-295 SB

I-295 NB

NB OFF RAMP

ROUTE 1

HB-YA-103

HB-YA-104

HB-YA-105

HB-YA-106

HB-YA-402

HB-YA-403

HB-YA-504

WIDGERY THOMAS
TO
STATE OF MAINE
DATED: 5/14/69
BOOK 3086, PAGE 173

SEE S.H.C. 3-198
(FEE - RESTRICTED TO SCENIC USE)

100' BUFFER

LEVEL SPREADER
SEE DRAINAGE
DETAILS SHEET

PT 517+08.05

PT 522+37.48

EXISTING C.O.A.

EXISTING SLOPE EASEMENT LIMITS

6IN X 6IN GRANITE: 9IN AG

6IN X 6IN GRANITE: 16IN AG

6IN X 6IN GRANITE: 20IN AG

6IN X 6IN GRANITE: 12IN AG & LEANING

6IN X 6IN GRANITE: 6IN AG & LEANING

RETAINING WALL NO LEFT TURN

REMOVE 250' OF EXIST GUARDRAIL

RED REFLECTOR

SAWCUT

N53°57'30"E

GUARDRAIL BRIDGE TRANSITION TYPE 2 TYPICAL ALL 4 CORNERS
459+95.88,
14.51 LT

TIE PROPOSED GUARDRAIL INTO EXISTING GUARDRAIL

QUADGUARD IMPACT ATTENUATOR

112+55.30,
30.30 LT

112+55.30,
18.00 LT

460+19.34,
26.00 RT

MILL AND OVERLAY ENTIRE WIDTH OF BRIDGE PAVEMENT

LOW VOLUME TERMINAL END

GREEN REFLECTOR

TYPE B UD

CB

24IN RCP

12IN CONCRETE

24IN WIDE

6IN CMP UD

6IN CMP: UNDER DRAIN

24IN X 24IN CONCRETE ELL

TBM 172

TBM 173

TBM 152

TBM 154

T 532

T 531

11+4 (HISTORIC)

11+5 (HISTORIC)

11+2 (HISTORIC)

11+1 (HISTORIC)

5001
5002
5003
5004

5C01
5C02
5C03
5C04
5C05
5C06
5C07
5C08
5C09
5C10
5C11

514+00
515+00
516+00
517+00
452+00
453+00
454+00
455+00
456+00
457+00
458+00
459+00
109+00
110+00
111+00
112+00
113+00
114+00
115+00
461+00
608
506
523
PI 111+33.73
PI 111+53.72

Filename:
Division: HIGHWAY
Username: COMMON
Date:2/21/2011

FOR CONTINUATION SEE SHEET NO. 31

FOR CONTINUATION SEE SHEET NO. 28

FOR CONTINUATION SEE SHEET NO. 26

FOR CONTINUATION SEE SHEET NO. 36

HB-YA-511

HB-YA-508

HB-YA-404

HB-YA-106

HB-YA-107

HB-YA-502

HB-YA-503

HB-YA-301

HB-YA-304

522+00

523+00

524+00

525+00

526+00

527+00

528+00

529+00

530+00

531+00

532+00

533+00

534+00

535+00

536+00

537+00

538+00

539+00

540+00

541+00

542+00

543+00

544+00

545+00

546+00

547+00

548+00

549+00

550+00

551+00

552+00

553+00

554+00

555+00

556+00

557+00

558+00

559+00

560+00

561+00

Filename:
Division: HIGHWAY
Username: COMMON
Date:2/21/2011

ST. LAWRENCE AND ATLANTIC RAILROAD CO

MAINTENANCE FACILITY

RAILROAD CROSSING

REVERSE DIRECTION AHEAD

STOP AHEAD

MOOT MAINTENANCE LOT

HIGH VOLTAGE POWER LINES

FOR CONTINUATION SEE SHEET NO. 28

FOR CONTINUATION SEE SHEET NO. 32

FOR CONTINUATION SEE SHEET NO. 27

FOR CONTINUATION SEE SHEET NO. 22

SEE S.H.C. 3-193

SEE S.H.C. 3-193
(FEE - RESTRICTED TO SCENIC USE)

SB ON RAMP

RIGHT TURN

NORTH BIO-RETENTION CELL, SEE DRAINAGE DETAILS SHEET

WATER QUALITY DITCH SOUTH
SEE DRAINAGE DETAILS SHEET

WATER QUALITY DITCH NORTH
SEE DRAINAGE DETAILS SHEET

SCREENING FENCE

EASEMENT

LIMITS

100' BUFFER

LEVEL SPREADER
SEE DRAINAGE DETAILS SHEET

WIDGERY THOMAS
TO
STATE OF MAINE
DATED: 5/14/69
BOOK 3086, PAGE 173

TE OF EMILY S. RAND
RT S. O'DONNELL
JANE O'DONNELL HACKER
ERSONAL REPRESENTATIVES

L.1

CURVE DATA
PI = 617+41.39
Δ = 26° - 15' - 23" Lt.
R = 164.00'
L = 75.15'
T = 38.25'
E = 4.40'

CURVE DATA
PI = 619+61.83
Δ = 47° - 32' - 57" Rt.
R = 287.00'
L = 238.18'
T = 126.43'
E = 26.61'

CURVE DATA
PI = 621+98.58
Δ = 74° - 37' - 43" Lt.
R = 164.00'
L = 213.61'
T = 125.00'
E = 42.21'

CURVE DATA
PI = 515+63.91
Δ = 41° - 38' - 31" Lt.
R = 416.00'
L = 302.34'
T = 158.20'
E = 29.06'

CURVE DATA
PI = 521+00.29
Δ = 82° - 09' -57" Rt.
R = 244.00'
L = 349.91'
T = 212.73'
E = 79.71'

PC 618+27.14
PT 617+70.00
PC 616+94.84
PT 517+08.05
PC 518+87.56
PRC 620+65.33
PT 522+37.48

HB-YA-602
HB-YA-603
HB-YA-604
HB-YA-605
HB-YA-606
HB-YA-607
HB-YA-504
HB-YA-505
HB-YA-506
HB-YA-506B
HB-YA-507
HB-YA-508
HB-YA-511
HB-YA-105
HB-YA-106
HB-YA-107

CB3

8" UNDERDRAIN

REBAR W/ ALUMINUM CAP IN AG

4IN X 4IN GRANITE IN AG

SAAT-0.46

SAAB 0.46 SAA17

P.L. SAAB EASEMENT

SOUTH / NORTH

EX. SAAB

-49

-00

-49.58 44.62' RT
R=15.00'
-64.57 30.00' RT
R=50.00'
-75.01 16.00' RT
-24.99 67.27' RT
R=10.00'
-33.27 16.00' LT
-43.25 25.34' LT
-80.19 9.35' LT
R=4.00'
-84.17 4.00' LT
-25.35 8.00' LT
R=180.00'
-97.48 18.00' RT
R=90.00'

611+00 610+00 609+00 608+00 607+00 606+00 605+00
616+00 617+00 618+00 619+00 620+00 621+00 622+00
516+00 517+00 518+00 519+00 520+00 521+00 522+00 523+00

12' 14' 4' 10' 8'

T 536

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

IM-295-1108(600)E EXIT 15
CM-1794(000)X PARK & RIDE LOT

PIN 11086.00 EXIT 15 HIGHWAY PLANS
PIN 17490.00 PARK & RIDE LOT

	DATE	BY
PROJ. MANAGER		
DESIGN-DETAILED		
CHECKED-REVIEWED		
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE
P.E. NUMBER
DATE

YARMOUTH
I-295 EXIT 15

PLANS

SHEET NUMBER
31
OF 226

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 North On/Off-Ramp
I-295 South On-Ramp
Location: Yarmouth, Maine

Boring No.: HB-YA-105
PIN: 11086.00

Driller:	Northern Test Boring	**Elevation (ft.)**		**Auger ID/OD:**	2-1/2" 6-3/4"
Operator:	Mike/Nick	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 (Track)	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/19/08; 08:30-09:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	159+07, CL	**Casing ID/OD:**	N/A	**Water Level*:**	None observed
Hammer Efficiency Factor:	0.77	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 Information: 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	24/20	0.00 - 2.00	1/1/4/5	5	6	HSA	-0.20		TOP SOIL, (Sod). 0.20	G#207217 A-4, CL-ML WC=23.2%
										Brown, moist, loose, fine SAND, little silt.	
5								-4.90		4.90 **Bottom of Exploration at 4.90 feet below ground surface.** REFUSAL	
10											
15											
20											
25											

Remarks:

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: I-295 North On/Off-Ramp
I-295 South On-Ramp
Location: Yarmouth, Maine

Boring No.: HB-YA-106
PIN: 11086.00

Driller:	Northern Test Boring	**Elevation (ft.)**		**Auger ID/OD:**	2-1/2" 6-3/4"
Operator:	Mike/Nick	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 (Track)	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/19/08; 09:30-10:30	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	161+00, 5.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None observed
Hammer Efficiency Factor:	0.77	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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	24/16	0.00 - 2.00	1/1/4/7	5	6	HSA	-0.20		TOP SOIL, (Sod). 0.20	
										Brown, moist, loose, fine SAND, trace silt.	
								-4.50		4.50	
5	2D	24/20	5.00 - 7.00	8/9/12/15	21	27				Olive, moist, very stiff, Clayey SILT, little fine sand.	G#207218 A-4, CL WC=20.1% LL=28 PL=19 PI=9
								-9.50		9.50	
10	3D	24/20	10.00 - 12.00	9/33/46/30	79	101				Brown, moist, very dense, fine to coarse SAND, trace gravel.	
								-13.00		13.00	
15	4D	24/22	15.00 - 17.00	15/16/17/17	33	42				Grey, moist, dense, fine to medium SAND, trace silt.	
								-19.50		19.50	
20										**Bottom of Exploration at 19.50 feet below ground surface.** REFUSAL	
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: I-295 North On/Off-Ramp
I-295 South On-Ramp
Location: Yarmouth, Maine

Boring No.: HB-YA-107
PIN: 11086.00

Driller:	Northern Test Boring	**Elevation (ft.)**		**Auger ID/OD:**	2-1/2" 6-3/4"
Operator:	Mike/Nick	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 (Track)	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/19/08; 10:30-11:30	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	163+00, 5.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	+0.9-0.0' ags.
Hammer Efficiency Factor:	0.77	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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	0.00 - 2.00	1/1/3/6	4	5	HSA			0.9' of Water/Ice above groud level. Olive-brown, wet, soft, Clayey SILT, little fine sand, roots.	#207219 A-4, CL-ML WC=22.8% LL=22 PL=17 PI=5
	2D	24/18	4.10 - 6.10	6/9/13/16	22	28		-4.60		4.60	
5										Brown, moist, medium dense, fine SAND, some silt.	
								-8.10		8.10	
	3D	8.4/8.4	9.10 - 9.80	5/30(2.4")	---			-9.80		Brown, wet, dense, fine to coarse SAND, some gravel, trace silt. 9.80	
10										**Bottom of Exploration at 9.80 feet below ground surface.** REFUSAL	
15											
20											
25											

Remarks:

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* 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: I-295 North On/Off-Ramp
I-295 South On-Ramp
Location: Yarmouth, Maine

Boring No.: HB-YA-112
PIN: 11086.00

Driller:	Northern Test Boring	**Elevation (ft.)**		**Auger ID/OD:**	2-1/2" 6-3/4"
Operator:	Mike/Nick	**Datum:**	NAVD 88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 (Track)	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/24/08; 07:30-08:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+00, 5.0 Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.77	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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 Information: 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					---		HSA	-0.30		TOPSOIL. 0.30	
	A1		2.00 - 3.90							Brown, moist, fine to coarse SAND, little gravel, trace silt.	
								-3.90		3.90	
5										**Bottom of Exploration at 3.90 feet below ground surface.** REFUSAL	
10											
15											
20											
25											

Remarks:

A=Auger Sample

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-401
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	134.9	**Auger ID/OD:**	2.5 in. I.D.
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	CME 45 Truck	**Hammer Wt./Fall:**	140/30 SS
Date Start/Finish:	01/03/11-01/03/11	**Drilling Method:**	HSA to 10.4 ft	**Core Barrel:**	--
Boring Location:	STA. 452+00, 15' LT.	**Casing ID/OD:**	--	**Water Level*:**	5.6 ft
Hammer Efficiency Factor: 0.6		**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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							HSA	134.0		-BITUMINOUS CONCRETE- 0.9	
	1D	24/14	1.0 - 3.0	17/12/6/5	18	18				Brown, dry, medium dense, fine to medium SAND, little coarse sand, little gravel -FILL-(SW)	
	2D	24/14	3.0 - 5.0	4/3/2/9	5	5				Light brown, moist to wet, loose, fine SAND, little medium sand -FILL-(SP)	
5	3D	24/19	5.0 - 7.0	8/7/9/10	16	16		129.4		Dark gray, wet, medium dense, fine to medium SAND, little coarse sand with organics, trace silt -FILL-(SW) 5.5	
										Brown to gray, moist to wet, medium dense, fine SAND, some silt, mottled -MARINE DEPOSIT-(SM)	
								126.4		8.5	
										Gravel and clay encountered from 8.5 to 9 ft	
10	4D	0/0	10.0 - 10.0	50(0")				124.5		Note: Auger refusal on probable top of bedrock at 10.4 ft. 10.4	
										Bottom of Exploration at 10.4 feet below ground surface.	
15											
20											
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-402
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	139.7	**Auger ID/OD:**	2.5 in. I.D.
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	CME 45 Truck	**Hammer Wt./Fall:**	140/30 SS - 300/24 NW
Date Start/Finish:	01/04/11-01/04/11	**Drilling Method:**	HSA to 5 ft, NW Drive to 14 ft	**Core Barrel:**	--
Boring Location:	STA. 457+49, CL.	**Casing ID/OD:**	NW - 3.0 in. I.D.	**Water Level*:**	11.3 ft
Hammer Efficiency Factor: 0.6		**Hammer Type:**	Automatic ☐ Hydraulic ☐ Rope & Cathead ☒		

Definitions:
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MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_V = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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								139.3		-BITUMINOUS CONCRETE- 0.4	
	1D	24/14	1.0 - 3.0	20/20/20/30	40	40	HSA			Brown, dry, dense, fine to coarse SAND, some gravel, trace silt -FILL-(SP-SM)	G#11721a A-1-b, SP-SM WC=0.9%
	2D	24/4	3.0 - 5.0	30/18/15/28	33	33				Brown, dry, dense, fine to coarse SAND, some gravel, trace silt -FILL-(SP-SM)	
5	3D	24/18	5.0 - 7.0	15/13/13/13	26	26	19			Brown to rust-brown, dry, medium dense, silty fine SAND, little medium sand and gravel, contains rootlets -FILL-(SM)	G#11721b A-4, SM WC=9.5%
							30				
	4D	24/17	7.0 - 9.0	9/8/12/26	20	20	27			Brown to rust-brown, dry, medium dense, silty fine SAND, little medium sand and gravel, contains rootlets -FILL-(SM)	
							59				
	5D	24/10	9.5 - 11.5	12/13/12/13	25	25	41			Note: Encountered cobble at 9.0 ft. Brown, wet, medium dense, fine to medium SAND, some gravel, trace coarse sand, little silt -FILL-(SM)	G#11721c A-1-b, SM WC=9.2%
10							26				
	6D	24/5	11.5 - 13.5	9/8/11/19	19	19	26			Brown, wet, medium dense, fine to medium SAND, some gravel, trace coarse sand, little silt -FILL-(SM)	
							28				
							18				
	7D	24/14	14.0 - 16.0	10/5/9/11	14	14				Gray, wet, stiff, silty CLAY, some fine sand, trace medium to coarse sand, trace gravel, slightly mottled, contains rootlets -FILL-(CL)	G#11721d A-4(1), CL WC=15.0% LL=23, PL=15 PI=8
15											
	8D	24/15	16.0 - 18.0	11/8/17/20	25	25				Gray to brown, moist, medium dense, fine SAND, some silt and gravel, little medium sand, trace coarse sand, well bonded -FILL-(SM)	G#11721e A-2-4, SM WC=9.5%
								121.7		18.0	
	9D	24/14	18.0 - 20.0	8/5/10/5	15	15				Gray to brown, wet, medium dense, fine SAND, little medium to coarse sand, little silt, trace gravel, organics -MARINE DEPOSIT-(SP)	
								120.2		19.5	
20	10D	24/24	20.0 - 22.0	6/7/10/13	17	17				Thin (1 in.) layer of organics with wood fragments in bottom of split spoon Gray, wet, very stiff, silty CLAY, mottled, with rootlets -MARINE DEPOSIT-(CL)	
								117.7		22.0	
										Bottom of Exploration at 22.0 feet below ground surface.	
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-403
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	136.9	**Auger ID/OD:**	2.5 in. I.D.
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	CME 45 Truck	**Hammer Wt./Fall:**	140/30 SS
Date Start/Finish:	01/03/11-01/03/11	**Drilling Method:**	HSA to 11.0 ft	**Core Barrel:**	--
Boring Location:	STA. 461+00, 10' RT.	**Casing ID/OD:**	--	**Water Level*:**	Dry
Hammer Efficiency Factor:	0.6	**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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							HSA	136.3		-BITUMINOUS CONCRETE- 0.6	
	1D	24/14	1.0 - 3.0	34/29/23/17	52	52				Brown, dry to damp, very dense, fine to coarse SAND, some gravel -FILL-(SW)	
	2D	24/17	3.0 - 5.0	9/13/14/28	27	27				Brown, dry to damp, medium dense, fine SAND, little medium to coarse sand, little gravel, trace silt, well bonded -FILL-(SW)	
5	3D	24/16	5.0 - 7.0	13/15/15/12	30	30				Light brown, dry to damp, medium dense, fine to medium SAND -FILL-(SP)	
	4D	24/18	7.0 - 9.0	14/13/9/11	22	22				Brown, dry to damp, medium dense, fine to medium SAND, little coarse sand, little gravel -FILL-(SW)	
	5D	24/18	9.0 - 11.0	6/6/13/14	19	19				Gray, moist, very stiff, silty CLAY, mottled, blocky (CL)	
10										Gray, moist, very stiff, silty CLAY, little fine to medium sand, trace coarse sand, contains 1 to 2 in. sand layers -FILL-(CL)	
								125.9		11.0	
										Bottom of Exploration at 11.0 feet below ground surface.	
15											
20											
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-404
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	129.2	**Auger ID/OD:**	--
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	CME 45 Truck	**Hammer Wt./Fall:**	140/30 SS
Date Start/Finish:	01/04/11-01/04/11	**Drilling Method:**	HSA to 11.0 ft	**Core Barrel:**	--
Boring Location:	STA. 465+00, 13' LT.	**Casing ID/OD:**	--	**Water Level*:**	Dry
Hammer Efficiency Factor: 0.6		**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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							HSA	128.8		-BITUMINOUS CONCRETE- 0.4	
	1D	24/19	1.0 - 3.0	18/15/15/15	30	30				Dark brown, dry to damp, medium dense, fine to medium SAND, little coarse sand and gravel -FILL-(SW)	
	2D	24/17	3.0 - 5.0	10/18/18/32	36	36				Brown, dry to damp, medium dense, fine SAND, little coarse sand, trace gravel, trace medium sand -FILL-(SP)	
5	3D	24/16	5.0 - 7.0	13/50/17/11	67	67				Gray-brown, dry to damp, dense, fine SAND, some silt, trace medium to coarse sand, contains layers of silty gray to brown sand, slightly mottled, clay layers -FILL-(SP-SM)	
	4D	24/6	7.0 - 9.0	5/4/5/10	9	9				Gray-brown, damp to moist, very dense, fine SAND, little gravel, little coarse sand, trace medium sand, trace silt, contains brick fragments -FILL-(SP)	
										Gray, wet, loose, fine SAND, little silt and gravel, trace coarse to medium sand -FILL-(SP)	
	5D	24/24	9.0 - 11.0	8/8/7/10	15	15		120.2		9.0	
10										Gray-brown, wet, stiff, sandy SILT, slightly mottled, frequent brown fine sand seams -MARINE DEPOSIT-(ML)	
								118.2		11.0	
										Bottom of Exploration at 11.0 feet below ground surface.	
15											
20											
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-507
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	120.7	**Auger ID/OD:**	--
Operator:	T. Schaefer	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	Mobile B53 Bombardier	**Hammer Wt./Fall:**	140/30 SS, 300/14 NW
Date Start/Finish:	1/25/11-1/25/11	**Drilling Method:**	NW to 28.3 ft	**Core Barrel:**	--
Boring Location:	STA. 523+32, 52' RT.	**Casing ID/OD:**	NW 3.0 in. I.D.	**Water Level*:**	--
Hammer Efficiency Factor: 0.6		**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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	0.0 - 2.0	1/WOH/1/2			Auger	120.6		-TOPSOIL- 0.1 Olive-brown, wet, very loose, silty fine SAND, trace medium sand, little organic silt, strong organic odor, wood fragments and rootlets (SM)	
	2D	24/16	2.0 - 4.0	4/5/9/11	14	14				Olive-brown, wet, stiff, silty CLAY, trace fine sand, mottled with fine sand seams and pockets of fine sand -MARINE DEPOSIT-(CL)	G#11722c A-6(10), CL WC=20.4% LL=29, PL=17 PI=12
5	3D	24/22	5.0 - 7.0	6/9/12/17	19	19				Olive-brown, wet, very stiff, silty CLAY, little fine sand seams, slightly mottled -MARINE DEPOSITS-(CL)	G#11722d A-4(6), CL WC=20.9% LL=27, PL=18 PI=9
10	4D	24/24	10.0 - 12.0	5/5/7/8	12	12				Olive-brown, moist, stiff, silty CLAY, little fine sand, trace medium to coarse sand, trace organic silt, horizontal and vertical fine sand seams, some seams composed of coarser sand, occasional blocky texture -MARINE DEPOSIT-(CL)	G#11722e A-4(6), CL WC=23.9% LL=26, PL=17 PI=9
15	5D	24/11	15.0 - 17.0	15/15/17/17	32	32	38	105.7		Brown, wet, dense, medium SAND, some fine sand, little coarse sand, little gravel and silt, contains decomposed bedrock -GLACIAL TILL-(SW)	
							42				
							55				
							72				
							75				
20	6D	24/20	20.0 - 22.0	25/13/11/14	24	24	33			Gray grading to brown, wet, medium dense, fine to medium SAND, little gravel and coarse sand, trace silt -GLACIAL TILL-(SW)	
							52				
							82				
							69				
25							30				

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-507
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	120.7	**Auger ID/OD:**	--
Operator:	T. Schaefer	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	Mobile B53 Bombardier	**Hammer Wt./Fall:**	140/30 SS, 300/14 NW
Date Start/Finish:	1/25/11-1/25/11	**Drilling Method:**	NW to 28.3 ft	**Core Barrel:**	--
Boring Location:	STA. 523+32, 52' RT.	**Casing ID/OD:**	NW 3.0 in. I.D.	**Water Level*:**	--
Hammer Efficiency Factor: 0.6		**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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	7D	24/14	25.0 - 27.0	11/17/15/23	32	32	36	95.7			
							30			Gray, moist to wet, hard SILT, some gravel, some fine sand, trace coarse sand, bonded -GLACIAL TILL-(ML)	
							38				
							50(4")	92.4		Note: Casing refusal on probable top of bedrock at 28.3 ft.	
										25.0 — 28.3 — **Bottom of Exploration at 28.3 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-508
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	121.7	**Auger ID/OD:**	SSA 4.0 in. O.D.
Operator:	T. Schaefer	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	Mobile B53 Bombardier	**Hammer Wt./Fall:**	140/30 SS
Date Start/Finish:	1/25/11-1/25/11	**Drilling Method:**	SSA to 6.9 ft	**Core Barrel:**	--
Boring Location:	STA. 522+81, 60' LT.	**Casing ID/OD:**	--	**Water Level*:**	--
Hammer Efficiency Factor: 0.6		**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 = Insitu Vane Shear Test
MV = Unsuccessful Insitu 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 = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Sample Information

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	24/14	0.0 - 2.0	1/2/4/5	6	6	SSA	121.5		-TOPSOIL- 0.2	
										Gray-brown, moist, loose, silty SAND grading to sandy SILT, trace medium sand, mottled, contains rootlets -MARINE DEPOSIT-(SM/ML)	
	2D	24/24	2.0 - 4.0	4/4/5/6	9	9				Gray-brown, moist to wet, SILT, some fine to coarse sand, trace medium sand, occasional vertical seams of fine sand, pockets of clay, mottled -MARINE DEPOSIT-(ML)	G#11723a A-4, ML WC=22.2%
5	3D	20/19	5.0 - 6.7	4/8/8/50(2")	16	16				Gray-brown, wet, medium dense, fine sandy SILT, trace medium to coarse sand and gravel, silt content increases with depth -MARINE DEPOSIT-(ML)	G#11723b A-4, ML WC=23.1%
								115.0		6.7	
								114.8		-WEATHERED BEDROCK- Note: Auger refusal on probable top of bedrock at 6.9 ft. 6.9	
10										**Bottom of Exploration at 6.9 feet below ground surface.**	
15											
20											
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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Boring No.: HB-YA-508

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295/U.S. Route 1 Interchange Improvements
Location: Yarmouth, Maine

Boring No.: HB-YA-510
PIN: 11086.00

Driller:	Maine Test Borings	**Elevation (ft.)**	120.9	**Auger ID/OD:**	NW 3.0 in. I.D.
Operator:	T. Schaefer	**Datum:**	NAVD 88	**Sampler:**	Split Spoon 1.375 in. I.D.
Logged By:	M. Foley	**Rig Type:**	Mobile B53 Bombardier	**Hammer Wt./Fall:**	140/30 SS, 300/14 NW
Date Start/Finish:	1/26/11-1/26/11	**Drilling Method:**	NW Drive to 12.7 ft	**Core Barrel:**	--
Boring Location:	STA. 523+03, 3' LT.	**Casing ID/OD:**	--	**Water Level*:**	--
Hammer Efficiency Factor: 0.6		**Hammer Type:**	Automatic ☐ Hydraulic ☐ Rope & Cathead ☒		

Definitions:
D = Split Spoon Sample
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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_V = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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	24/8	0.0 - 2.0	1/1/1/2	2	2	SSA	120.7		-TOPSOIL- 0.2	
										Olive-gray, moist to wet, very soft, clayey SILT, little fine sand, trace medium sand, contains rootlets, slightly mottled -MARINE DEPOSIT-(ML)	
	2D	24/16	2.0 - 4.0	2/5/7/7	12	12				Olive-gray, moist to wet, stiff, silty CLAY, trace brown fine sand, slightly blocky texture -MARINE DEPOSIT-(CL)	G#11723c A-6(9), CL WC=22.8% LL=29, PL=18 PI=18
	3D	24/24	4.0 - 6.0	3/3/5/9	8	8				Olive-gray to brown, moist, medium stiff, SILT and silty CLAY, slightly mottled, little fine sand -MARINE DEPOSIT-(CL-ML)	G#11723d A-4(4), CL-ML WC=23.2% LL=25, PL=18 PI=7
5								114.9		6.0	
	4D	24/24	6.0 - 8.0	5/7/7/10	14	14	19			Gray-brown, wet, medium dense, silty fine SAND, with fine to coarse sand seams and layers -MARINE DEPOSIT-(SM)	
							29				
							35				
							20				
10	5D	14/13	10.0 - 11.2	15/16/50(2")				110.6		Gray, wet, hard, sandy SILT (ML) 10.3	
								109.7		Brown, wet, dense, well graded SAND, some gravel, weak to moderately bonded -GLACIAL TILL-(SW) 11.2	
								108.2		-WEATHERED BEDROCK- Note: Weathered rock in spoon tip and observed in wash water. Roller cone refusal on probable top of bedrock at 12.7 ft. 12.7	
										Bottom of Exploration at 12.7 feet below ground surface.	
15											
20											
25											

Remarks:

1. As-drilled coordinates of test borings determined by MaineDOT and provded in NAD83 Maine 2000 West Zone Coordinate System. As-drilled coordinates related to Station and Offset information by FST.
2. Hammer consisted of rope and cathead and safety hammer.

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

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APPENDIX C - TEST 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

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):

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

*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))

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

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-101

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	122.0	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/22/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 113+64.7, 15.2' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	2.7'
Hammer Efficiency Factor:	0.92	**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	22/18	0.0 - 1.8	9-50-81-50/2"	131	201	SSA			Brown, dry, fine to coarse SAND, little gravel, (Fill). Bottom 8" is white rock - probable cobble.	
							RC				
								120.2		1.8	
	2D	24/14	2.0 - 4.0	12-5-7-10	12	18				Grey, moist, very stiff, CLAY, trace fine sand, (Marine Clay Crust). PP(tsf) = 3.5, 3.0, 3.0	
	3D	24/24	4.0 - 6.0	7-8-10-12	18	28				Grey, dry, hard, CLAY, (Marine Clay Crust). PP(tsf) = 3.5, 4.0, 4.5	
5											
	4D	24/24	6.0 - 8.0	10-8-9-7	17	26				Grey, moist, very stiff, Silty CLAY, (Marine Clay Crust). PP(tsf) = 4.0, 2.5, 3.0	A-7-6, CL LL=47 PL=22 PI=25 WC=29.2
	5D	24/24	8.0 - 10.0	2-2-2-2	4	6				Grey, moist, medium stiff to stiff, CLAY, (Marine Clay Crust). Approximately 1"-2" thick sand seam at 9.0'. PP(tsf) = 0.5, 0.75, 1.0	
10								112.0		10.0	
	6D	24/24	10.0 - 12.0	Push thru vane						Grey, wet, medium stiff, Silty CLAY, (Marine Clay). 55x110mm vane raw torque readings: V1: 22/6 in-lbs V2: 19/5 in-lbs Grey, wet, Silty CLAY, trace fine Sand, (Marine Clay).	A-6, CL LL=36 PL=20 PI=16 WC=26.7
	V1		~~10.6 - 11.0~~	S_u=982/268 psf							
	V2		11.6 - 12.0	S_u=848/223 psf							
	1U	24/21	12.0 - 14.0		--						
	7D	24/24	14.0 - 16.0	Push thru vane	--					Grey, wet, medium stiff, Silty CLAY, (Marine Clay). 55x110mm vane raw torque readings: V3: 13/3 ft-lbs V4: 15/3 ft lbs	
	V3		~~14.6 - 15.0~~	S_u=580/134 psf							
15	V4		15.6 - 16.0	S_u=670/144 psf							
20	8D	24/18	20.0 - 22.0	WOR-2-3-2	5	8				Grey, wet, medium stiff to stiff, Silty CLAY, little fine sand, (Marine Clay). Advanced vane to 20.6', could not shear. Drove splitspoon through vane interval.	G#S-842 A-4(0)
	MV1		~~20.6 - 20.6~~								
								98.2		23.8	
25										Roller bit advancement and wash return indicate coarse sand at 23.8', probable top of marine sand.	

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346633.6N, 1032949.0E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-101

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	122.0	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/22/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 113+64.7, 15.2' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	2.7'
Hammer Efficiency Factor: 0.92		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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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)
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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	9D	24/16	25.0 - 27.0	4-2-1-1	3	5				Grey, wet, loose, fine to medium SAND, little silt, little gravel, (Marine Sand). Increased roller cone resistance and gravel in wash at 28.2'.	
								93.8		28.2	
30	10D	8/4	30.0 - 30.7	20-52/2"	R					Grey, wet, very hard, Clayey SILT, some sand, some gravel, (Glacial Till).	G#S-843 A-4(2), ML
								87.8		34.2	
35	R1	60/30	35.0 - 40.0	RQD = 18%			NX			Increased roller bit resistance at 34.2', probable top of rock. Advanced roller bit to 35.0' and set up to core. R1: Hard, slightly weathered, aphanitic, grey, SCHIST, with 5" white granite seam. Primary joints are moderately spaced, high angle, planar, smooth, fresh, tight. Secondary joints are close to moderately spaced, low angle, planar, smooth, discolored to fresh, tight to open. Rock Quality = Very Poor Recovery = 50% Rock Core Times (min:sec): 35.0-36.0' (1:55), 36.0-37.0' (1:32), 37.0-38.0' (1:51), 38.0-39.0' (1:23), 39.0-40.0' (1:29)	
40	R2	44/27	40.0 - 43.7	RQD = 18%						R2: Hard, slightly weathered, aphanitic, grey, SCHIST. Primary joints are closely spaced, low angle, planar, smooth, discolored, partially open to open. Secondary joints are closely spaced, high angle to vertical, planar, smooth, discolored, partially open. Rock Quality = Very Poor Recovery = 61% Rock Core Times (min:sec): 40.0-41.0' (1:51), 41.0-42.0' (1:22), 42.0-43.0' (1:42), 43.0-43.7' (2:44)	
	R3	53/38	43.7 - 48.1	RQD = 40%						R3: Hard, fresh, aphanitic, grey, SCHIST. Primary joints are close to moderately spaced, low angle, planar, smooth, fresh, tight. Secondary joints are moderately spaced, high angle to vertical, planar, smooth, discolored, tight to partially open. Rock Quality = Poor Recovery = 100% Rock Core Times (min:sec): 43.7-44.0' (0:39), 44.0-45.0' (2:01), 45.0-46.0' (1:54), 46.0-47.0' (2:09), 47.0-48.1' (1:44)	
45								73.9		48.1	
50										**Bottom of Exploration at 48.1 feet below ground surface.**	

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-102

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	118.4	**Auger ID/OD:**	4.25" OD
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4/11/22-4/11/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 115+35.8, 11.6' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.9'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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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
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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	24/10	0.0 - 2.0	3-3-3-4	6	9	SSA	118.0		Top 5": Topsoil.	
										0.4	
										Bottom 5": Brown, dry, loose, fine to coarse SAND, (Fill).	
	2D	24/3	2.0 - 4.0	4-7-8-10	15	22				Brown, dry, medium dense, fine to coarse SAND, (Fill).	
								114.4		4.0	
	3D	24/24	4.0 - 6.0	10-10-11-10	21	30				Grey, moist, very stiff, Silty CLAY, (Marine Clay Crust).	
5											
	4D	24/24	6.0 - 8.0	9-13-12-11	25	36				Grey, moist, hard, Silty CLAY, 2" sand seam at 7.2', (Marine Clay Crust).	LL=28 PL=16 PI=12 WC=23.1
	5D	24/24	8.0 - 10.0	6-11-13-10	24	35				Grey, moist, hard, Silty CLAY, (Marine Clay Crust).	
10							SPIN				
							73				
							97				
							85	105.4		13.0	
	6D	24/24	14.0 - 16.0	WOH-WOH-WOH-WOH	--		RC			Grey, wet, Silty CLAY, trace fine sand, (Marine Clay).	LL=28 PL=16 PI=12 WC=27.5
15											
	MV1 7D	24/13	19.0 - 21.0	1-1-1-1	2	3				MV1: Could not advance vane at 19.0'. Grey, wet, Silty CLAY, trace fine sand, (Marine Clay).	
20											
	MV2									MV2: Could not advance vane at 24.0'. Grey, wet, Silty CLAY, fine sand in top 4", (Marine Clay).	
25	8D	24/24	24.0 - 26.0	1-1-1-WOH	2	3					

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.863.
2. Water level measured immediately after removal of casing.
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346804.4N, 1032937.5E).
5. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-102

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	118.4	**Auger ID/OD:**	4.25" OD
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4/11/22-4/11/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 115+35.8, 11.6' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.9'
Hammer Efficiency Factor: 0.863		**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
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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)
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N-uncorrected = Raw Field SPT N-value
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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.
								90.9		27.5 Probable transition between Marine Clay and Marine Sand at 27.5' bgs based on increased rollerbit resistance and wash return.	
30	9D	24/16	29.0 - 31.0	16-22-20-19	42	60				Grey, wet, very dense, fine to medium SAND, some silt, trace gravel, (Marine Sand).	G#22-S-1265
35	10D	11/5	34.0 - 34.9	24-57/5"	--		NX	83.5		Grey, wet, very dense, fine SAND and weathered rock. Top 3" is black rock, then 1.5" fine white sand, then 0.5" white weathered rock. Probable top of bedrock at 34.9'. 34.9 Advanced roller bit to 35.0' and set up to core.	
	R1	60/60	35.0 - 40.0	RQD = 92%						R1: Hard, fresh to weathered, coarse to very coarse grained, white and grey, GRANITE. Joints are close to widely spaced, high angle, planar, smooth, fresh to decomposed, partially open, bottom 15" is weathered. Recovery = 100% Rock Quality = Excellent Rock Core Times (min:sec): 35.0-36.0' (3:36), 36.0-37.0' (2:56), 37.0-38.0' (2:42), 38.0-39.0' (3:05), 39.0-40.0' (2:27)	
40	R2	28/28	40.0 - 42.3	RQD = 63%						R2: Hard, weathered, coarse grained to very coarse grained, grey and white, GRANITE. Primary joints are close to moderately spaced, high angle, planar, smooth, decomposed, partially open to open. Secondary joints are close to moderately spaced, low angle, planar, smooth, decomposed, partially open to open. Recovery = 100% Rock Quality = Fair Rock Core Times (min:sec): 40.0-41.0' (1:40), 41.0-42.0' (2:31), 42.0-42.3' (1:11)	
	R3	40/32	42.3 - 45.6	RQD = 48%				74.4		R3: Top 19": Hard, weathered, coarse grained to very coarse grained, grey and white, GRANITE. Joints are closely spaced, high angle, planar, smooth, decomposed, open.	
45								72.8		44.0 R3: Bottom 13": Hard, fresh, aphanitic, grey, SCHIST. One joint is moderately dipping, planar, smooth, fresh, partially open. Recovery = 80% Rock Quality = Poor Rock Core Times (min:sec): 42.3-43.0' (1:50), 43.0-44.0' (3:26), 44.0-45.0' (3:08), 45.0-45.6' (0:50)	
50										45.6 **Bottom of Exploration at 45.6 feet below ground surface.**	

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.863.
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Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-103

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	115.9	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/23/22-2/24/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 116+37.8, 21.2' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	3.7'
Hammer Efficiency Factor:	0.92	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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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	24/19	0.0 - 2.0	1-2-5-6	7	11	SSA	115.5		Grey, wet, medium stiff, CLAY, (Topsoil). Organics in top 5". 0.4	
	2D	24/24	2.0 - 4.0	8-10-13-12	23	35				Grey, wet, very stiff, Silty CLAY, trace fine sand (Marine Clay Crust). PP(tsf) = 2.5, 2.25	A-6, CL LL=38 PL=20 PI=18 WC=23.8
	3D	24/24	4.0 - 6.0	2-2-4-3	6	9				Grey, wet, very stiff to stiff, Silty CLAY, (Marine Clay Crust). PP(tsf) = 2.0, 2.25	A-6, CL LL=30 PL=17 PI=13 WC=20.7
5	4D	24/24	6.0 - 8.0	3-2-2-2	4	6				Grey, wet, stiff to medium stiff, Sandy CLAY, (Marine Clay Crust). PP(tsf) = 0.25	
	5D	24/10	8.0 - 10.0	WOH-1-3-3	4	6		107.9		8.0 Grey, wet, loose, fine to medium SAND, little silt, trace gravel, (Marine Sand). MV1: Could not advance vane at 8.0'.	
10											
15	6D	24/8	15.0 - 17.0	3-5-4-5	9	14	22			Grey, wet, medium dense, fine to coarse SAND, trace silt, (Marine Sand).	
							15			Coarse sand and gravel in wash return.	
							16				
							10				
							13				
20	7D	24/8	20.0 - 22.0	4-4-1-1	5	8	15			Grey, wet, loose, fine to medium SAND, little silt, little gravel, (Marine Sand).	G#S-846 A-2-4(0), SM WC=10.2
							16			Coarse sand and gravel in wash return.	
							36				
							55				
25							32				

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346906.8N, 1032942.4E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-103

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	115.9	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/23/22-2/24/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 116+37.8, 21.2' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	3.7'
Hammer Efficiency Factor: 0.92		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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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	8D	24/8	25.0 - 27.0	10-9-7-12	16	25	55			Grey, wet, medium dense, fine to coarse SAND, little gravel, trace silt, (Marine Sand).	
							43				
							49				
							51				
							27				
30	9D	24/16	30.0 - 32.0	5-18-28-32	46	71	44			Grey, wet, very dense, fine to coarse SAND, some gravel, trace silt, (Marine Sand).	
							75			Casing resistance at 33.8'; advanced roller cone to 35.0', probable cobble.	
							148				
							495				
							RC				
35	10D	24/22	35.0 - 37.0	31-58-45-81	103	158	162			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Marine Sand).	G#S-847 A-1-b, SM WC=7.5
							264				
							272				
							291	77.4		38.5	
							267				
40	11D	19/15	40.0 - 41.6	27-73-136-53/1"	209	320	RC			Grey, wet, very dense, fine to medium Silty SAND, (Glacial Till).	
45	12D	6/6	45.0 - 45.5	83/6"	--					Grey, wet, very dense, fine to coarse Silty SAND, trace gravel, (Glacial Till).	
50											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-103

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	115.9	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/23/22-2/24/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 116+37.8, 21.2' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	3.7'
Hammer Efficiency Factor: 0.92		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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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.
50	13D	14/14	50.0 - 51.2	34-147-36/2"						Grey, wet, very dense, Silty SAND, trace gravel, (Glacial Till).	G#S-848 A-4(0), SM
	R1	60/52	51.3 - 56.3	RQD = 77%			NX	64.6		Increased roller cone resistance at 51.3', probable bedrock. Set up to core at 51.3'.	
										51.3	
										R1: Hard, fresh, aphanitic, grey, SCHIST with 7"-15"-thick white, granite seams. Joints are close to moderately spaced, low angle, planar, smooth, fresh, tight to open. One high angle joint, planar, smooth, fresh, tight. Rock Quality = Good Recovery = 87% Rock Core Times (min:sec): 51.3-52.3' (2:31), 52.3-53.3' (1:57), 53.3-54.3' (2:01), 54.3-55.3' (2:08), 55.3-56.3' (2:42)	
55											
	R2	60/60	56.3 - 61.3	RQD = 97%						R2: Hard, fresh, aphanitic, grey, SCHIST, with 2.0'-2.5'-thick, white granite seams. Joints are close to moderately spaced, low angle, planar, smooth, fresh, tight to partially open. Rock Quality = Excellent Recovery = 100% Rock Core Times (min:sec): 56.3-57.3' (2:16), 57.3-58.3' (1:52), 58.3-59.3' (1:53), 59.3-60.3' (1:42), 60.3-61.3' (1:26)	
60								54.6		61.3	
										Bottom of Exploration at 61.3 feet below ground surface.	
65											
70											
75											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-201

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	121.6	**Auger ID/OD:**	4"/4.5"
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	Mobile B-50	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4-26-24 / 4-26-24	**Drilling Method:**	SSA, Drive & Wash	**Core Barrel:**	NQ
Boring Location:	Sta. 113+26.8, 32.8' Lt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	1.8'
Hammer Efficiency Factor:	1.066	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
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N-uncorrected = Raw Field SPT N-value
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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
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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	24/18	0.0 - 2.0	1-1-2-1	3	5	SSA			Grey, wet, Clayey SILT, with fine to coarse sand seams, (Marine Clay Crust). PP = 1.0, 1.5 tsf	
	2D	24/18	2.0 - 4.0	3-4-8-12	12	21				Grey to brown, wet, very stiff, Silty CLAY, with occasional sand seams and marbling, (Marine Clay Crust). PP = 2.5, 2.75, 2.5 tsf	G#24-S-1968 LL=43 PL=21 PI=22 WC=24.3
5	3D	24/21	4.0 - 6.0	3-5-8-10	13	23				Grey, wet, very stiff, Silty CLAY, with marbling, (Marine Clay Crust). PP=3.5, 3.5, 3.5 tsf	
	4D	24/19	6.0 - 8.0	8-9-9-1	18	32				Grey-grey/blue, wet, very stiff, Silty CLAY, (Marine Clay Crust). PP=2.5, 1.5, 0.25 tsf	
	5D	24/19	8.0 - 10.0	5-4-2-2	6	11				Grey, wet, stiff, CLAY & SILT, (Marine Clay Crust).	G#24-S-1969 LL=28 PL=15 PI=13 WC=23.0
10	U1	24/21	10.0 - 12.0					111.6		10.0 Grey-blue, wet, medium stiff, Silty CLAY, trace fine sand, (Marine Clay).	
	V1		12.6 - 13.2	S_u=612/148 psf						65x130 mm vane raw torque readings: V1: 22.3/5.4 ft-lbs V2: 23.2/4.5 ft-lbs	
	V2		13.6 - 14.2	S_u=637/124 psf							
15	U2	24/21	14.0 - 16.0				PUSH			Grey-blue, wet, medium stiff, Silty CLAY, trace fine sand, (Marine Clay).	
	V3		16.6 - 17.2	S_u=459/30 psf						V3: 16.7/1.1 ft-lbs V4: 19.5/1.1 ft-lbs	
	V4		17.6 - 18.2	S_u=536/30 psf							
	G1									G1: Grey, wet, soft to medium stiff, SILT, little sand, trace clay, (Marine Clay).	
								102.6		19.0	
20	6D	24/12	20.0 - 22.0	2-3-3-4	6	11	28			Grey, wet, medium dense, fine to medium SAND, little fine gravel, little silt, (Marine Sand).	G#24-S-1970 A-2-4(0), SP-SM
							26				
							27				
							28				
25							29				

Remarks:

1. Fine grained soil descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
2. Automatic hammer Seaboard SN 367 with an energy transfer ratio = 1.066.
3. Water level measured immediately after removal of casing.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346593.6N, 1032902.7E).
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-201

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	121.6	**Auger ID/OD:**	4"/4.5"
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	Mobile B-50	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4-26-24 / 4-26-24	**Drilling Method:**	SSA, Drive & Wash	**Core Barrel:**	NQ
Boring Location:	Sta. 113+26.8, 32.8' Lt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	1.8'
Hammer Efficiency Factor: 1.066		**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 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
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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	7D	24/13	25.0 - 27.0	2-2-6-6	8	14	21			Grey, wet, medium dense, fine to medium SAND, little silt, trace gravel, (Marine Sand).	
							25				
							39/0"	93.9		27.7	
	R1	44/35	28.0 - 31.7	RQD = 25%			NQ			Casing refusal at 27.7', probable top of rock. Advanced to 28.0' and set up to core. R1: Very hard, slightly weathered, fine grained to aphanitic, grey, SCHIST. Primary joints are close, horizontal to low angle, planar, smooth, fresh to discolored, tight. Secondary joints are randomly vertical, stepped, rough, discolored, tight to open, with silt pit infilling. Rock Quality: Very Poor Recovery: 79% Rock Core Times (min:sec): 28.0-29.0' (5:34), 29.0-30.0' (2:34), 30.0-31.0' (2:43), 31.0-31.7' (2:22)	
30											
	R2	35/33	31.7 - 34.6	RQD = 77%						R2: Very hard, slightly weathered, fine grained to aphanitic, grey, SCHIST. Joints are close to moderately spaced, low angle, undulating to stepped, smooth to rough, fresh, tight, with sand, silt, clay and gravel, filled cavity foam from 31.7' 32.7', and silt infilling. Rock Quality: Good Recovery: 94% Rock Core Times (min:sec): 31.7-32.7' (1:37), 32.7-33.7' (2:07), 33.7-34.6' (2:04)	
	R3	5/4	34.7 - 35.1	RQD = 80%						R3: Very hard, slightly weathered, fine grained to aphanitic, grey, SCHIST. Joints are close, horizontal, planar, smooth, fresh, open, with silt infilling. Rock Quality: Good Recovery: 80% Rock Core Times (min:sec): 34.7-35.0' (1:01)	
35	R4	56/54	35.0 - 39.7	RQD = 91%						R4: Very hard, fresh, fine grained to aphanitic, grey, SCHIST. Joints are moderately spaced, low angle, planar, smooth, fresh, tight, with pit silt and sand infilling. Rock Quality: Excellent Recovery: 96% Rock Core Times (min:sec): 35.0-36.0' (1:54), 36.0-37.0' (2:05), 37.0-38.0' (2:35), 38.0-39.0' (2:25), 39.0-39.8' (1:45)	
	R5	28/28	39.8 - 42.1	RQD = 35%				79.6		R5: Very hard, slightly weathered, fine grained to aphanitic, grey, SCHIST. Joints are very close to close, low to high angle, planar to undulating, smooth, fresh to discolored, tight to open, with silt infilling. Rock Quality: Poor Recovery: 100% Rock Core Times (min:sec): 39.8-40.8' (1:53), 40.8-42.0' (3:41)	
40										42.0 **Bottom of Exploration at 42.0 feet below ground surface.**	
45											
50											

Remarks:

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3. Water level measured immediately after removal of casing.
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-202

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	119.3	**Auger ID/OD:**	4"/4.5"
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	Mobile B-50	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4-29-24 / 4-30-24	**Drilling Method:**	SSA, Drive & Wash	**Core Barrel:**	NQ
Boring Location:	Sta. 116+15.1, 38.0' Lt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.4'
Hammer Efficiency Factor:	1.066	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
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S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
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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)
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LL = Liquid Limit
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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	24/17	0.0 - 2.0	1-1-5-6	6	11	SSA	118.5		1D (0'-0.8'): Brown to black, moist, loose, silty fine to medum SAND, with roots and organic silt, (Forest Mat).	
										0.8	
										1D (0.8'-1.4'): Grey, moist, loose, silty fine to medium SAND, (Marine Clay Crust).	
	2D	24/22	2.0 - 4.0	5-3-4-6	7	12				2D (2.0'-2.8'): Grey, moist, loose, silty fine to medium SAND, (Marine Clay Crust).	G#24-S-1971 LL=32 PL=17 PI=15 WC=25.3
										2D (2.8'-3.9'): Grey, moist, stiff, CLAY & SILT, with marbling, (Marine Clay). PP = 1.5, 1.5, 2.2 tsf	
	3D	24/24	4.0 - 6.0	4-4-9-10	13	23				Grey, moist, very stiff, Silty CLAY, with marbling, (Marine Clay Crust). PP=1.5, 2.5, 3.0, 3.5 tsf	
5											
	4D	24/10	6.0 - 8.0	7-9-11-9	20	36				Grey to olive, moist, very stiff to hard, CLAY & SILT, with decreasing marbling, (Marine Clay Crust). PP=2.0, 2.0, 2.0 tsf	G#24-S-1972 LL=36 PL=17 PI=19 WC=22.4
	5D	24/24	8.0 - 10.0	2-1-1-2	2	4				Grey, wet, medium stiff, Silty CLAY, (Marine Clay). PP=0.5, 0.5, 0.5 tsf	G#24-S-1973 LL=39 PL=18 PI=21 WC=32.2
10								109.3		10.0	
	U1	24/18	10.0 - 12.0								
								107.2		MV1: Unable to penetrate, probable sand seams.	
	MV1	24/24	12.0 - 12.1	Push Thru Vane	--					12.1	
	6D		12.1 - 14.1				6			6D: Grey, wet, Sandy SILT, trace clay, with sand seams, (Marine Sand).	
15	7D	24/23	15.0 - 17.0	WOH-WOH-WOH-2	R		10			7D (15.0'-16.7'): Grey, wet, very soft, SILT & CLAY, some fine sand, (Marine Sand).	G#24-S-1974 A-4(0), ML
							23			7D (16.7'-16.9'): Grey, wet, fine to coarse SAND, (Marine Sand).	
							15				
							16				
							26				
20	8D	24/14	20.0 - 22.0	10-7-7-8	14	25	14			Grey, wet, medium dense, gravelly fine to coarse SAND, little silt, (Marine Sand).	
							11				
							45	97.3		22.0	
							73				
25							65				

Remarks:

1. Fine grained soil descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
2. Automatic hammer Seaboard SN 367 with an energy transfer ratio = 1.066.
3. Water level measured immediately after removal of casing.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346881.4N, 1032884.4E).
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-202

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	119.3	**Auger ID/OD:**	4"/4.5"
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	Mobile B-50	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4-29-24 / 4-30-24	**Drilling Method:**	SSA, Drive & Wash	**Core Barrel:**	NQ
Boring Location:	Sta. 116+15.1, 38.0' Lt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.4'
Hammer Efficiency Factor:	1.066	**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	9D	24/15	25.0 - 27.0	7-8-6-8	14	25	20			Grey, wet, medium dense, Silty fine to medium SAND, trace gravel, (Glacial Till).	
							30				
							63				
							90				
							86				
30	10D	24/14	30.0 - 32.0	21-16-16-13	32	57	93			Grey, wet, very dense, fine to medium SAND, some clayey silt, little gravel, (Glacial Till).	G#24-S-1975 A-2-4(0), SM
							80				
							64				
							74				
							73				
35	11D	24/20	35.0 - 37.0	6-6-12-25	18	32	52			Grey, wet, dense, Silty fine to coarse SAND, some gravel, (Glacial Till).	
							50				
							84				
							105				
							63/6"	79.8		39.5	
40	12D	0/0	40.0 - 40.0	25/0"	R		RC NQ			Casing refusal at 39.5', probable top of rock; advanced roller cone to 40.0'. Splitspoon refusal at 40.0'. Advanced roller cone to 41.0' and set up to core. R1: Very hard, slightly weathered, fine to medium grained, white, GRANITE. Joints are very close to close, horizontal to low angle, undulating, smooth, fresh to discolored, open, with silt infilling and schist interbedding. Rock Quality: Poor Recovery: 93% Rock Core Times (min:sec): 41.0-42.0' (3:26), 42.0-43.0' (3:18), 43.0-44.0' (3:30), 44.0-45.0' (2:44) Boring terminated at 46.0', core barrel broke.	
	R1	60/56	41.0 - 46.0	RQD = 45%							
45								73.3		46.0	
										Bottom of Exploration at 46.0 feet below ground surface.	
50											

Remarks:

1. Fine grained soil descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
2. Automatic hammer Seaboard SN 367 with an energy transfer ratio = 1.066.
3. Water level measured immediately after removal of casing.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346881.4N, 1032884.4E).
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-101

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	133.5	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/21/22	**Drilling Method:**	SSA	**Core Barrel:**	--
Boring Location:	Sta. 107+29.1, 24.4' Lt	**Casing ID/OD:**	--	**Water Level*:**	Not Encountered
Hammer Efficiency Factor: 0.92		**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	0.0 - 2.0	6-3-2-2	5	8	SSA	132.5		Brown, dry, loose, fine to coarse SAND, little gravel, with wood fragments, (Topsoil). 1.0	
	2D	24/18	2.0 - 4.0	4-4-5-8	9	14				Brown, moist, medium dense, Silty SAND, trace gravel, (Marine Sand).	G#S-830 A-4, SM WC-22.7
	3D	17/13	4.0 - 5.4	6-14-47/5"	R					Brown, moist, fine to medium SAND, trace gravel, (Marine Sand). White rock fragments in bottom 1". Boring terminated upon auger refusal at 5.6'.	
5								127.9		5.6 **Bottom of Exploration at 5.6 feet below ground surface.**	
10											
15											
20											
25											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346002.2N, 1032923.2E).

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-102

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	132 (est.)	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/21/22	**Drilling Method:**	SSA	**Core Barrel:**	--
Boring Location:	Sta. 108+66.0, 28.8' Lt	**Casing ID/OD:**	--	**Water Level*:**	Not Encountered
Hammer Efficiency Factor: 0.92		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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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	22/11	0.0 - 1.8	3-1-3-52/4"	4	6		131.5		Top 6": Brown, moist, loose, Sandy GRAVEL, little silt, some organics.	G#S-831
										0.5	A-1-b, GP-GM
								129.9		Bottom 5": White/grey weathered rock. Boring terminated upon auger refusal at 2.1'.	WC-21.1
										2.1	
										Bottom of Exploration at 2.1 feet below ground surface.	
5											
10											
15											
20											
25											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. Elevations were estimated by interpolating between contours on the plans.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346134.1N, 1032927.6E).

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* 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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-103

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	128.4	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/21/22	**Drilling Method:**	SSA	**Core Barrel:**	--
Boring Location:	Sta. 110+13.5, 10.2' Rt	**Casing ID/OD:**	--	**Water Level*:**	2.6'
Hammer Efficiency Factor:	0.92	**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	24/14	0.0 - 2.0	2-1-1-3	2	3	SSA	127.8		Top 7": Dark brown, wet, organics, some plant matter, (Topsoil).	
										0.6	
										Bottom 7": Grey, moist, CLAY, (Marine Clay Crust). PP(tsf) = 0.25	
	2D	24/23	2.0 - 4.0	3-6-6-8	12	18				Grey, moist, very stiff, Silty CLAY, (Marine Clay Crust). PP(tsf) = 1.5, 2.5	A-6, CL LL=32 PL=17 PI=15 WC=20.5
								124.4		4.0	
	3D	24/20	4.0 - 6.0	1-4-10-59	14	21				Top 15": Grey, wet, medium dense, Silty SAND, trace gravel, (Marine Sand).	G#S-833 A-4(0), SM WC=19.1
5								123.1		5.3	
										Bottom 5": Weathered/fractured Rock. Advanced auger to refusal at 6.9'.	
								121.5		6.9	
										Bottom of Exploration at 6.9 feet below ground surface.	
10											
15											
20											
25											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346282.6N, 1032960.0E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-104

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	125.1	**Auger ID/OD:**	6.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/21/22-2/21/22	**Drilling Method:**	HSA	**Core Barrel:**	--
Boring Location:	Sta. 111+94.3, 15.5' Rt	**Casing ID/OD:**	--	**Water Level*:**	3.2'
Hammer Efficiency Factor:	0.92	**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	0.0 - 2.0	4-1-1-2	2	3	HSA	124.7		Top 5": Brown, moist, organic material, (Topsoil).	
										0.4	
										Bottom 10": Grey, moist, CLAY, (Marine Clay Crust). PP(tsf) = 2.5, 3.0	
	2D	24/24	2.0 - 4.0	4-5-7-11	12	18				Grey, moist, very stiff, Silty CLAY, (Marine Clay Crust). PP(tsf) = 4.25	A-7-6, CL LL=45 PL=22 PI=23 WC=27.4
	3D	24/24	4.0 - 6.0	2-3-5-8	8	12				Grey, wet, stiff, CLAY, (Marine Clay Crust). PP(tsf) = 1.5, 1.25, 1.75	
5	4D	24/24	6.0 - 8.0	7-8-12-9	20	31				4D (Top 20"): Grey, wet, very stiff, CLAY, (Marine Clay Crust). PP(tsf) = 3.75, 2.5, 2.75	
								117.4		7.7	
	5D	24/24	8.0 - 10.0	5-4-2-6	6	9		117.1		4D (Bottom 4"): Grey, wet, fine Clayey SAND, (Sand Seam).	G#S-835 A-4(0), ML WC=26.0
										8.0 Grey, wet, medium stiff to stiff, Silty CLAY, trace fine sand, trace gravel, (Marine Clay).	
10											
								112.8		12.3	
								112.3		Auger encountered increased resistance at 12.3'. Probable top of weathered/fractured rock. Advanced auger to refusal at 12.8'.	
										12.8 **Bottom of Exploration at 12.8 feet below ground surface.**	
15											
20											
25											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measurd immediately after completion of drilling.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346463.4N, 1032957.0E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-105

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	119.8	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/24/22-2/24/22	**Drilling Method:**	SSA	**Core Barrel:**	--
Boring Location:	Sta. 118+02.5, 12.4' Lt	**Casing ID/OD:**	--	**Water Level*:**	7.0'
Hammer Efficiency Factor:	0.92	**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	24/11	0.0 - 2.0	2-1-1-1	2	3	SSA	119.4		Brown, moist, very loose, fine to medium SAND, with organics in top 5", (Topsoil).	
										0.4	
	2D	24/22	2.0 - 4.0	5-6-5-6	11	17				Grey, wet, very stiff, Silty CLAY, some fine sand, (Marine Clay Crust).	G#S-836 A-6, ML WC=21.4
	3D	24/24	4.0 - 6.0	4-6-9-13	15	23				Grey, wet, very stiff to hard, Silty CLAY, (Marine Clay Crust). PP(tsf) = 3.75, 4.25	
5	4D	24/24	6.0 - 8.0	10-13-17-16	30	46				Grey, wet, very stiff to hard, Silty CLAY, (Marine Clay Crust). PP(tsf) = 3.5, 4.5, 4.0	A-6, CL LL=35 PL=18 PI=17
	5D	24/24	8.0 - 10.0	4-4-3-3	7	11		111.8		8.0	WC=21.6
										Grey, wet, medium dense, fine SAND, Silty Clay in bottom 5" of spoon, (Marine Sand).	
10							HSA				
15	6D	24/14	15.0 - 17.0	3-2-5-6	7	11				Grey, wet, medium dense, fine Silty SAND, (Marine Sand).	
20	7D	24/22	20.0 - 22.0	5-4-6-7	10	15				Brown, wet, medium dense, fine to medium SAND, little silt, (Marine Sand).	G#S-838 A-1-4(0), SM WC=18.0
25											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (347069.7N, 1032901.4E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-105

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	119.8	**Auger ID/OD:**	4.25" OD
Operator:	Mike Porter	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	2/24/22-2/24/22	**Drilling Method:**	SSA	**Core Barrel:**	--
Boring Location:	Sta. 118+02.5, 12.4' Lt	**Casing ID/OD:**	--	**Water Level*:**	7.0'
Hammer Efficiency Factor: 0.92		**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 Information: 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	8D	24/20	25.0 - 27.0	17-24-26-23	50	77		92.8		Grey and brown, wet, dense, fine to coarse SAND, trace Silt, (Marine Sand).	
										27.0	
										Bottom of Exploration at 27.0 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.92.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (347069.7N, 1032901.4E).
4. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
5. "PP" indicates pocket penetrometer readings were taken, which correspond to approximate unconfined compressive strength in tons per square foot. These values are equivalent to undrained shear strength in kips per square foot.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-201

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	128.2	**Auger ID/OD:**	4"/4.5"
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	Mobile B-50	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4-29-24 / 4-29-24	**Drilling Method:**	SSA, Drive & Wash	**Core Barrel:**	--
Boring Location:	Sta. 110+99.7, 21.9' Lt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	5.5'
Hammer Efficiency Factor:	1.066	**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	24/8	0.0 - 2.0	1-1-1-2	2	4	SSA			Brown-red, moist, loose, Silty SAND, with organics, (Fill).	
	2D	24/19	2.0 - 4.0	6-6-6-6	12	21				2D (2.0'-2.4'): Brown-red, moist, Silty SAND, with organics, (Fill). 2D (2.4'-3.6'): Light brown to brown, moist, medium dense, fine to coarse SAND, some silt, trace gravel, (Fill).	G#24-S-1976 A-2-4(0), SM
5	3D	24/17	5.0 - 7.0	9-8-8-10	16	28				Light brown to olive, wet, medium dense, fine to medium SAND, some silt, trace gravel, with fine to coarse sand seams, (Fill).	G#24-S-1977 A-2-4(0), SM
								119.0		Auger refusal at 9.2'. 9.2 **Bottom of Exploration at 9.2 feet below ground surface.**	
10											
15											
20											
25											

Remarks:

1. Automatic hammer Seaboard SN 367 with an energy transfer ratio = 1.066.
2. Water level measured immediately after removal of casing.
3. As-drilled boring locations were surveyed by MaineDOT in the field (346367.2N, 1032924.0E).

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-301

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	133.3	**Auger ID/OD:**	4.0/4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/26/24-8/26/24	**Drilling Method:**	HSA/Drive-and-Wash	**Core Barrel:**	NX
Boring Location:	Sta. 109+62.9, 59.7' Rt	**Casing ID/OD:**	4.0/4.25"	**Water Level*:**	Not Observed
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	0.0 - 2.0	2-8-8-12	16	26	HSA			Brown, moist, medium dense, Gravelly fine to coarse SAND, (Fill).	
										2 to 7.5 ft increaing auger resistance, possible cobbles.	
5	2D	24/3	5.0 - 7.0	5-11-29-28	40	66				Brown, moist, dense, Sandy GRAVEL, (Fill).	
	R1	60/17	7.5 - 12.5	RQD = 71%			NX	125.8		7.5 — Auger refusal at 7.5' on probable top of rock. Set up to core at 7.5'. R1: Hard, moderately weathered, fine to medium grained, gray, SCHIST, with interbedded Granite. Joints are close to moderately spaced, low angle, stepped, rough, discolored, open, with sand and mineral infilling. Recovery = 28% Rock Quality = Fair Rock Core Times (min:sec): 7.5-8.5' (2:26), 8.5-9.5' (2:29), 9.5-10.5' (2:40), 10.5-11.5' (1:57), 11.5-12.5' (2:11)	
10								120.8		12.5 — **Bottom of Exploration at 12.5 feet below ground surface.**	
15											
20											
25											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (346234.2N, 1033011.8E).

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-302

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	137.4	**Auger ID/OD:**	4.0/4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/26/24-8/26/24	**Drilling Method:**	HSA/Drive-and-Wash	**Core Barrel:**	NX
Boring Location:	Sta. 111+41.0, 153.1' Rt	**Casing ID/OD:**	4.0/4.25"	**Water Level*:**	15.0'
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
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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	0.0 - 2.0	2-6-10-7	16	26	HSA			Brown, moist, medium dense, Gravelly fine to coarse SAND, (Fill).	
5	2D	24/12	5.0 - 7.0	24-11-33-15	44	72				Grey, moist, dense, Gravelly fine to coarse SAND, (Fill).	
10	3D	24/20	10.0 - 12.0	4-8-12-11	20	33		127.4		10.0 Grey, moist, medium dense, Gravelly fine to medium SAND, trace silt, (Marine Sand).	
15	4D	24/17	15.0 - 17.0	11-13-12-30	25	41				Grey, wet, medium dense, fine to medium SAND, little gravel, little silt, (Marine Sand). Auger refusal at 18.0', probable top of rock.	
	R1	60/60	18.0 - 23.0	RQD = 58%			NX	119.4		18.0 Advanced roller bit to 18.5' and set up to core. R1: Hard, moderately weathered, fine to medium grained, grey, SCHIST, with interbedded Granite. Joints are very close to moderately spaced, moderately to high angle, undulating, smooth to rough, discolored to fresh, open, with silt infilling. Recovery = 100% Rock Quality = Fair Rock Core Times (min:sec): 18.5-19.5' (2:55), 19.5-20.5' (2:30), 20.5-21.5' (2:09), 21.5-22.5' (2:05), 22.5-23.5' (2:05)	
20								113.9		23.5 **Bottom of Exploration at 23.5 feet below ground surface.**	
25											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (346416.5N, 1033096.9E).

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-303

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	127.9	**Auger ID/OD:**	4.0/4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/23/24-8/24/24	**Drilling Method:**	HSA	**Core Barrel:**	--
Boring Location:	Sta. 111+27.1, 57.5' Rt	**Casing ID/OD:**	--	**Water Level*:**	8.0'
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
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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	24/18	0.0 - 2.0	5-21-24-22	45	74	HSA			Grey, moist, dense, Gravelly SAND, (Fill).	
5	2D	24/24	5.0 - 7.0	4-5-7-9	12	20		122.9		5.0 Grey, moist, very stiff, Silty CLAY, occastional sand partings, (Marine Clay Crust). PP = 3.5, 3.5, 2.5 tsf	
10	3D	24/6	10.0 - 12.0	14-7-8-12	15	25		117.9		10.0 Grey, wet, medium dense, Sandy GRAVEL, little silt, (Glacial Till).	
15	4D	24/1	15.0 - 17.0	50/4"						Grey, wet, dense to very dense, Sandy GRAVEL, (Glacial Till).	
								110.6		17.3 **Bottom of Exploration at 17.3 feet below ground surface.**	
20											
25											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (346398.4N, 1033002.0E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-304

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	119.7	**Auger ID/OD:**	1.0/2.0"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/22/24-8/22/24	**Drilling Method:**	HSA	**Core Barrel:**	--
Boring Location:	Sta. 117+09.4, 78.8' Lt	**Casing ID/OD:**	--	**Water Level*:**	7.9'
Hammer Efficiency Factor:	0.985	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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U = Thin Wall Tube Sample
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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	24/18	0.0 - 2.0	1-2-7-6	9	15	HSA	118.7		1D (Top 12"): Brown, moist, loose, silty fine SAND, with organics, (Topsoil).	
										1.0	
										1D (Bottom 6"): Grey, moist, medium dense, fine to medium SAND, some silt, (Fill).	
5	2D	24/24	5.0 - 7.0	3-6-7-8	13	21		114.7		5.0	
										Grey, moist, hard to very stiff, Silty CLAY, with occasional sand partings and marbling, (Marine Clay Crust). PP = 5.0, 5.0, 3.0 tsf	
	3D	24/24	7.0 - 9.0	7-7-7-8	14	23				Grey, wet, stiff, Silty CLAY, (Marine Clay Crust). PP = 2.0, 2.0, 1.5 tsf	
	4D	24/24	9.0 - 11.0	2-1-3-2	4	7				Grey, wet, medium stiff to soft, Silty CLAY, (Marine Clay Crust). PP = 2.0, 1.0, 0.5 tsf	
10	5D	24/24	11.0 - 13.0	3-3-3-3	6	10				Grey, wet, medium stiff to soft, Silty CLAY, some fine Sand, (Marine Clay Crust). PP = 0.0, 0.0, 0.0 tsf	
	6D	24/24	13.0 - 15.0	WOH-WOH-WOH-2						Grey, wet, medium stiff to soft, Silty CLAY, some fine Sand, (Marine Clay Crust). PP = 0.0, 0.0, 0.0 tsf	
15	7D	24/24	15.0 - 17.0	WOH-1-1-3	2	3		104.7		15.0	
										7D (Top 12"): Grey, wet, loose, SAND, (Marine Sand).	
										7D (Bottom 12"): Brown, wet, loose, fine to medium, SAND, (Marine Sand).	
								102.7		17.0	
20										**Bottom of Exploration at 17.0 feet below ground surface.**	
25											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (346973.6N, 1032839.3E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-305

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	127.4	**Auger ID/OD:**	4.0/4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/22/24-8/22/24	**Drilling Method:**	HSA	**Core Barrel:**	--
Boring Location:	Sta. 117+90.0, 84.2' Lt	**Casing ID/OD:**	--	**Water Level*:**	7.3'
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	24/19	0.0 - 2.0	1-12-4-8	16	26	HSA	126.5		1D (Top 11"): Dark brown, moist, loose, Sandy SILT, with organics, (Topsoil).	
										0.9	
										1D (Bottom 8"): Tan, moist, medium dense, fine to medium SAND, little silt, (Fill).	
5	2D	24/24	5.0 - 7.0	4-8-13-15	21	34		122.4		5.0	
										Grey, moist, hard, Silty CLAY, with frequent sand seams and marbling, (Marine Clay Crust). PP = 5.0, 4.0, 4.0 tsf	
	3D	24/24	7.0 - 9.0	6-7-7-8	14	23				Grey, wet, stiff, Silty CLAY, with frequent sand partings, (Marine Clay Crust). PP = 2.0, 2.5, 3.0 tsf	
	4D	24/24	9.0 - 11.0	1-2-1-2	3	5				Grey, wet, soft, Silty CLAY, (Marine Clay Crust). PP = 0.5, 0.5, 0.5 tsf	
10	5D	24/24	11.0 - 13.0	2-3-4-4	7	11				Grey, wet, medium stiff, Silty CLAY, with frequent sand partings, (Marine Clay Crust). PP = 1.0, 1.5, 1.0 tsf	
	6D	24/15	13.0 - 15.0	3-4-5-6	9	15				Grey, wet, medium stiff, Silty CLAY, (Marine Clay Crust).	
15	7D	24/8	15.0 - 17.0	2-5-5-3	10	16		112.4		15.0	
										Grey, wet, medium dense, Silty SAND (Marine Sand).	
	8D	24/24	17.0 - 19.0	WOH-2-3-4	5	8				8D (Top 23"): Grey, wet, loose, Silty SAND, (Marine Sand).	
								108.4		8D (Bottom 1"): Brown, wet, loose, fine to medium SAND, (Marine Sand).	
20										19.0	
										Bottom of Exploration at 19.0 feet below ground surface.	
25											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (347053.9N, 1032830.3E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-306

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	130.1	**Auger ID/OD:**	4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/23/24-8/23/24	**Drilling Method:**	SSA/Drive & Wash	**Core Barrel:**	--
Boring Location:	Sta. 120+10.2, 112.6' Rt	**Casing ID/OD:**	4.0/4.5"	**Water Level*:**	11.2'
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	24/9	0.4 - 2.4	13-18-18-12	36	59	SSA	129.7		Top 5": Hot Mix Asphalt (0.4) Brown, moist, dense, Gravelly fine to coarse SAND, (Fill).	
5	2D	24/15	5.0 - 7.0	4-5-6-6	11	18				Grey, moist, hard, Silty CLAY, with frequent sand partings, gravel and sand from 6.2'-6.5',(Fill).	
10	3D	24/24	10.0 - 12.0	1-2-1-1	3	5	PUSH			3D (Top 23"): Grey, moist to wet, loose, Silty fine SAND, (Fill).	
							56	118.2		(11.9) 3D (Bottom 1"): Black, wet, soft, wood and organic silts, (Relic Topsoil).	
							76				
15	4D	24/24	15.0 - 17.0	4-4-5-8	9	15	81 28	115.1		At 14.0' casing and drill advancement slowed by wood. (15.0) Grey, wet, very stiff, Silty CLAY, with frequent sand partings/seams, (Marine Clay Crust). PP = 3.0, 2.5, 1.0 tsf	
							26				
							29				
							27				
							31				
20	5D	24/24	20.0 - 22.0	5-1-3-3	4	7	40	110.1		(20.0) Grey, wet, stiff, Silty SAND, with frequent clay partings/seams, (Marine Sand).	
							43				
							41				
							42				
25							39				

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (347282.9N, 1033016.8E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-306

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	130.1	**Auger ID/OD:**	4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/23/24-8/23/24	**Drilling Method:**	SSA/Drive & Wash	**Core Barrel:**	--
Boring Location:	Sta. 120+10.2, 112.6' Rt	**Casing ID/OD:**	4.0/4.5"	**Water Level*:**	11.2'
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	6D	24/0	25.0 - 27.0	12-17-16-12	33	54	53			No recovery.	
							41				
							54				
							56				
							40				
30	7D	24/9	30.0 - 32.0	3-1-1-5	2	3	44			Grey, wet, loose, Silty fine to coarse SAND, (Marine Sand).	
							53			Increased roller bit resistance and gravel fragments in wash return at 33 feet, indicating probable transition to glacial till.	
							60				
							68	97.1		33.0	
							69				
35	8D	25/10	35.0 - 37.1	14-29-24-15	53	87	77			Grey, wet, very dense, Gravelly fine to coarse SAND, (Glacial Till).	
								93.1		37.0	
										Bottom of Exploration at 37.0 feet below ground surface.	
40											
45											
50											

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (347282.9N, 1033016.8E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: HB-YR1-307

WIN: 22382.00

Driller:	Seaboard Drilling	**Elevation (ft.)**	130.3	**Auger ID/OD:**	4.0/4.5"
Operator:	M. Busses	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	J. Cozens	**Rig Type:**	B-48 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/22/24-8/22/24	**Drilling Method:**	HSA	**Core Barrel:**	--
Boring Location:	Sta. 120+18.0, 56.9' Rt	**Casing ID/OD:**	--	**Water Level*:**	16.1'
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	24/9	0.0 - 2.0	8-10-12-13	22	36	HSA			Brown, moist, medium dense, Gravelly fine to coarse SAND, (Fill).	
5	2D	24/7	5.0 - 7.0	5-4-7-1	11	18				Dark grey, moist, medium dense, Sandy GRAVEL, trace silt, (Fill).	
								122.3		8.0	
10	3D	24/0	10.0 - 12.0	4-7-9-12	16	26				No recovery.	
15	4D	24/18	15.0 - 17.0	9-6-10-16	16	26				Grey, wet, medium dense, Silty SAND, (Marine Sand).	
								112.3		18.0	
20	5D	9./9	20.0 - 20.8	15-50/4"						Grey, wet, dense, Gravelly SAND, little Silt, (Glacial Till).	
								109.5		20.8	
25										**Bottom of Exploration at 20.8 feet below ground surface.**	

Remarks:

1. Automatic hammer Seaboard Drilling # SN 202102 with energy transfer ratio = 0.985.
2. As-drilled boring locations were surveyed by MaineDOT in the field (347283.0N, 1032847.1E).
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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 D - SEISMIC CONE PENETRATION TEST REPORTS

SEABOARD DRILLING

www.seaboarddrilling.com

S-24-0202

May 10, 2024

GZA GeoEnvironmental, Inc.
Attention: Blaine Cardali, P.E.
707 Sable Oaks Drive, Suite 150
Portland, ME 04106

Subject: CPT Exploration Findings
Relocate U.S. Route 1 Bridge over I-295
U.S. Route 1
Yarmouth, Maine

Dear Blaine:

In accordance with our Subcontract Agreement, dated April 23, 2024, we completed test boring and seismic piezocone penetration testing (CPT) explorations for the replacement of the U.S Route 1 bridge over I-295 in Yarmouth. The test borings were observed and logged by GZA personnel. This report summarizes and provides data relative to the CPT explorations.

CPT EXPLORATION PROGRAM

Nine CPT explorations (CPT-YR1-201 through CPT-YR1-208, and CPT-YR1-207A) were advanced on April 25 and 29, 2024 adjacent to previously drilled test boring locations. The exploration locations were selected and pre-marked at the site by GZA personnel. The CPTs were advanced using a Diedrich D-50 track mounted drill rig utilizing Vertek piezocone equipment. The CPT exploration program included the following:

- Nine CPT explorations advanced to depths ranging from 1.9 to 28.1 feet below the existing ground surface.
- Shear wave velocity testing was performed at rod break intervals throughout advancement of the CPTs, except for CPT-YR1-203 and CPT-YR1-107A.
- A total of five porewater dissipation tests were performed in the CPT explorations at depths selected by GZA personnel.

The CPT explorations were performed in accordance with ASTM D5778. Shear wave velocity testing was performed in accordance with ASTM D7400.

SUBSURFACE CONDITIONS

The following is a summary of subsurface findings in each of the CPT explorations.

CPT-YR1-201		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-3.0	Types 4, 6, & 8	Layered silty clay to clay, sandy silt to clayey silt, sand to silty sand
3.0-7.7	Type 6	Sandy silt to clayey silt
7.7-13.1*	Type 8	Sand to silty sand

*push refusal

CPT-YR1-202		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-3.4	Types 3 & 4	Clays
3.4-8.3*	Type 6	Sandy silt to clayey silt with silt and sand layers

*push refusal

CPT-YR1-203		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-1.9*	Types 8, 9 & 10	Topsoil over sand and gravel

*push refusal

CPT-YR1-204		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-8.2	Types 5 & 6	Clayey silt to silty clay and sandy silt to clayey silt
8.2-17.1*	Types 5, 6, 7, & 8	Layered sands, silts, and clays

*push refusal

CPT-YR1-205		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-9.1	Types 5 & 6	Clayey silt to silty clay and sandy silt to clayey silt
9.1-15.5	Type 1	Sensitive fine grained
15.5-21.3*	Type 8	Sand to silty sand

*push refusal

CPT-YR1-206		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-2.1	Types 3 & 4	Clays
2.1-5.3	Types 6 & 7	Sandy silt to clayey silt and silty sand to sandy silt
5.3-8.0*	Types 8 & 9	Sands

*push refusal

CPT-YR1-207		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-9.1	Types 5 & 6	Clayey silt to silty clay and sandy silt to clayey silt
9.1-13.2	Type 1	Sensitive fine grained
13.2-14.5*	Types 9 & 10	Sands

*push refusal

CPT-YR1-207A		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-9.2	Types 5 & 6	Clayey silt to silty clay and sandy silt to clayey silt
9.2-15.3	Type 1	Sensitive fine grained
15.3-16.8*	Types 8 & 9	Sands

*push refusal

CPT-YR1-208		
Depth (feet)	**Predominant Soil Type**	**Soil Description**
0-10.2	Types 5 & 6	Clayey silt to silty clay and sandy silt to clayey silt
10.2-19.9	Type 1	Sensitive fine grained
19.9-28.1*	Types 8 & 9	Sands

*push refusal

Soil behavior type profiling is based on normalized cone penetration resistance, Robertson 1986. Detailed soil type behavior is presented on the attached logs.

SEISMIC SHEAR WAVE VELOCITY TESTING

Shear wave velocity testing was performed in each of the CPT explorations at rod break intervals, except for CPT-YR1-203 and CPT-YR1-207A. Results are presented on the logs. Waterfall plots showing shear wave velocity details are attached. A summary of the results is presented below:

SHEAR WAVE VELOCITY TEST SUMMARY							
CPT-YR1-201		CPT-YR1-202		CPT-YR1-204		CPT-YR1-205	
Depth (ft)	Seismic Velocity (ft/s)	Depth (ft)	Seismic Velocity (ft/s)	Depth (ft)	Seismic Velocity (ft/s)	Depth (ft)	Seismic Velocity (ft/s)
2.2	633	2.1	915	2.2	327	2.2	782
5.5	539			5.4	812	5.5	843
8.2	575			8.7	492	8.7	471
11.3	4334			11.9	633	12.0	460
				15.2	491	15.2	528
						18.5	505
Average:	1520			Average:	551	Average:	598

CPT-YR1-206		CPT-YR1-207		CPT-YR1-208	
Depth (ft)	Seismic Velocity (ft/s)	Depth (ft)	Seismic Velocity (ft/s)	Depth (ft)	Seismic Velocity (ft/s)
1.8	618	2.2	358	2.0	665
5.0	389	5.2	563	5.2	733
		8.4	427	8.4	505
		11.6	481	11.6	513
				15.0	513
				18.1	567
				21.4	616
				24.6	713
Average:	504	Average:	457	Average:	603

DISSIPATION TESTING

Five dissipation tests were performed in the explorations. Plots of the dissipation tests are attached. A summary of the results is presented below:

DISSIPATION TEST SUMMARY					
Location	**Depth (ft)**	**U_0 (psi)**	**U_{100} (psi)**	**U_{50} (psi)**	**T_{50} (sec)**
CPT-YR1-204	15.2	8.1	5.7	6.9	23.8
CPT-YR1-207	12.5	34.4	4.8	19.6	38.6
CPT-YR1-207A	8.1	72.2	2.9	37.6	605.6
CPT-YR1-208	8.0	17.9	2.6	10.2	57.1
	16.0	50.3	6.1	28.2	720.9

CLOSURE

It has been a pleasure to be of assistance to you on this project. Please let us know if you have any questions.

Sincerely,

Seaboard Drilling, LLC

Kevin J. Hanscom
Driller

SEISMIC CONE PENETRATION TEST PLOTS

CPT-YR1-201

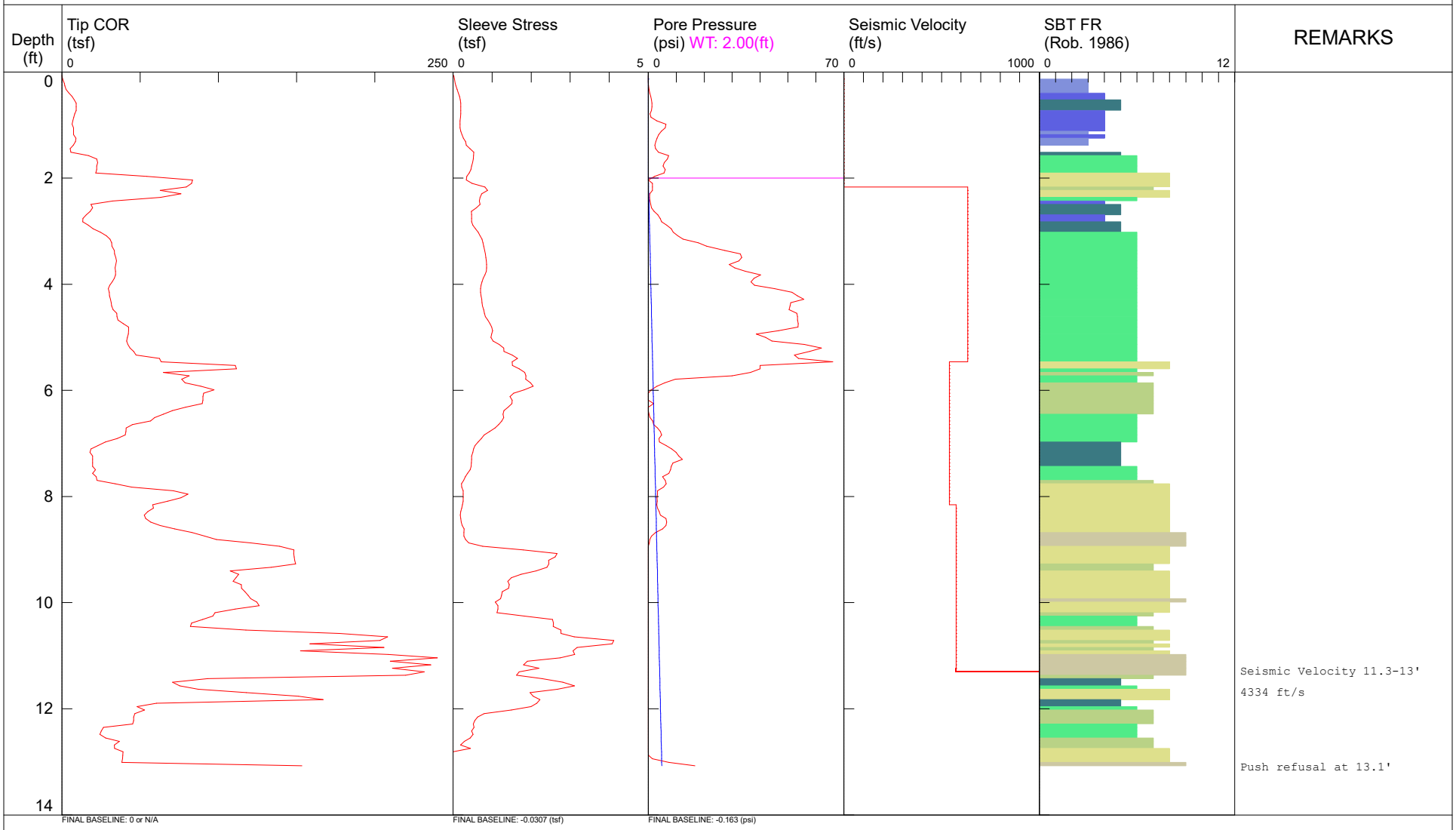
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-201.DAT

TEST ID: CPT-YR1-201
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 13.074 ft



REMARKS

Seismic Velocity 11.3-13'
4334 ft/s

Push refusal at 13.1'

PROBE ID: 4644.163XX

1 Sensitive fine grained
2 Organic material
3 Clays
4 Silty clay to clay
5 Clayey silt to silty clay
6 Sandy silt to clayey silt
7 Silty sand to sandy silt
8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-202

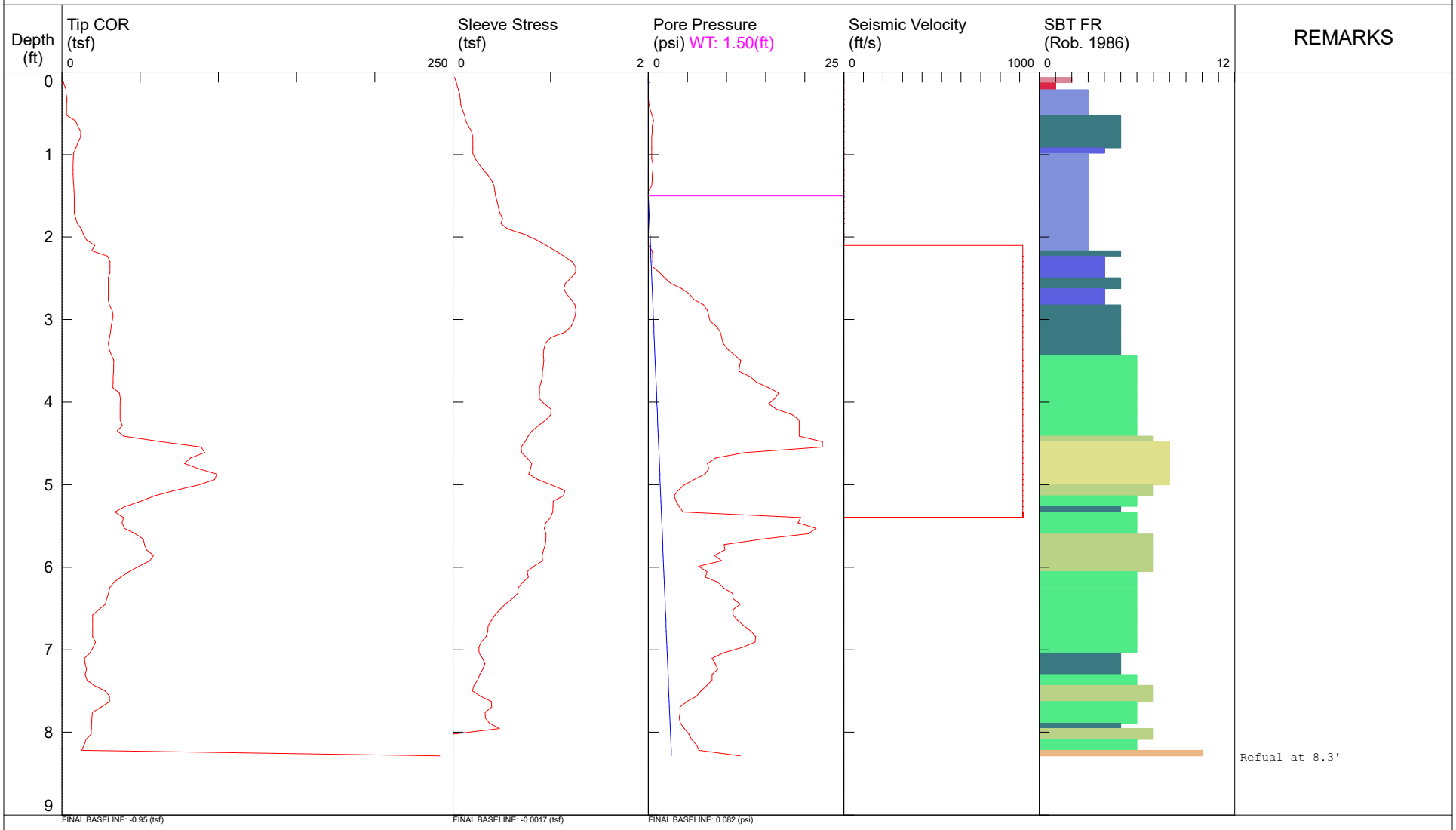
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-202.DAT

TEST ID: CPT-YR1-202
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 8.284 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-203

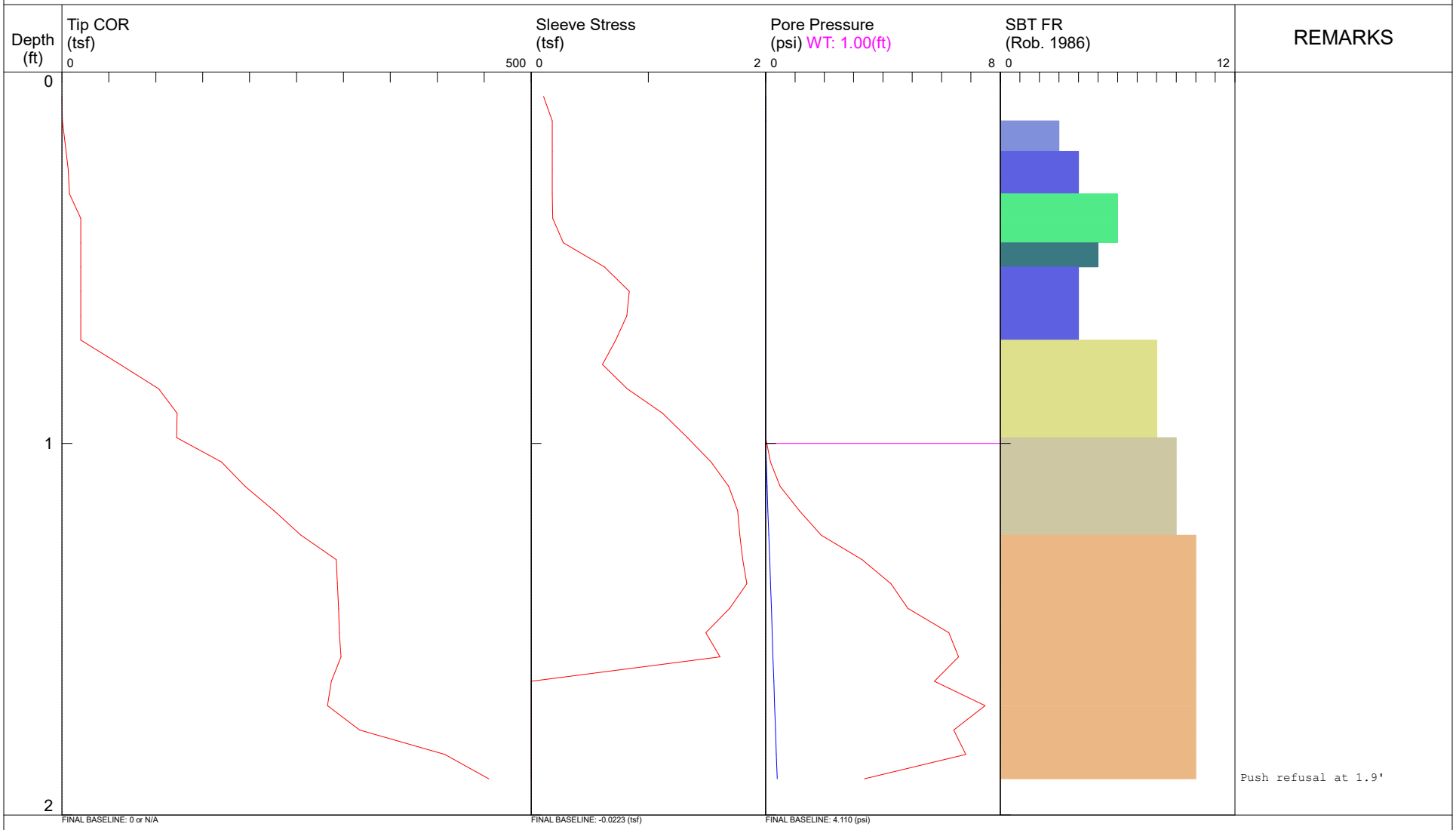
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-203.DAT

TEST ID: CPT-YR1-203
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 1.903 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-204

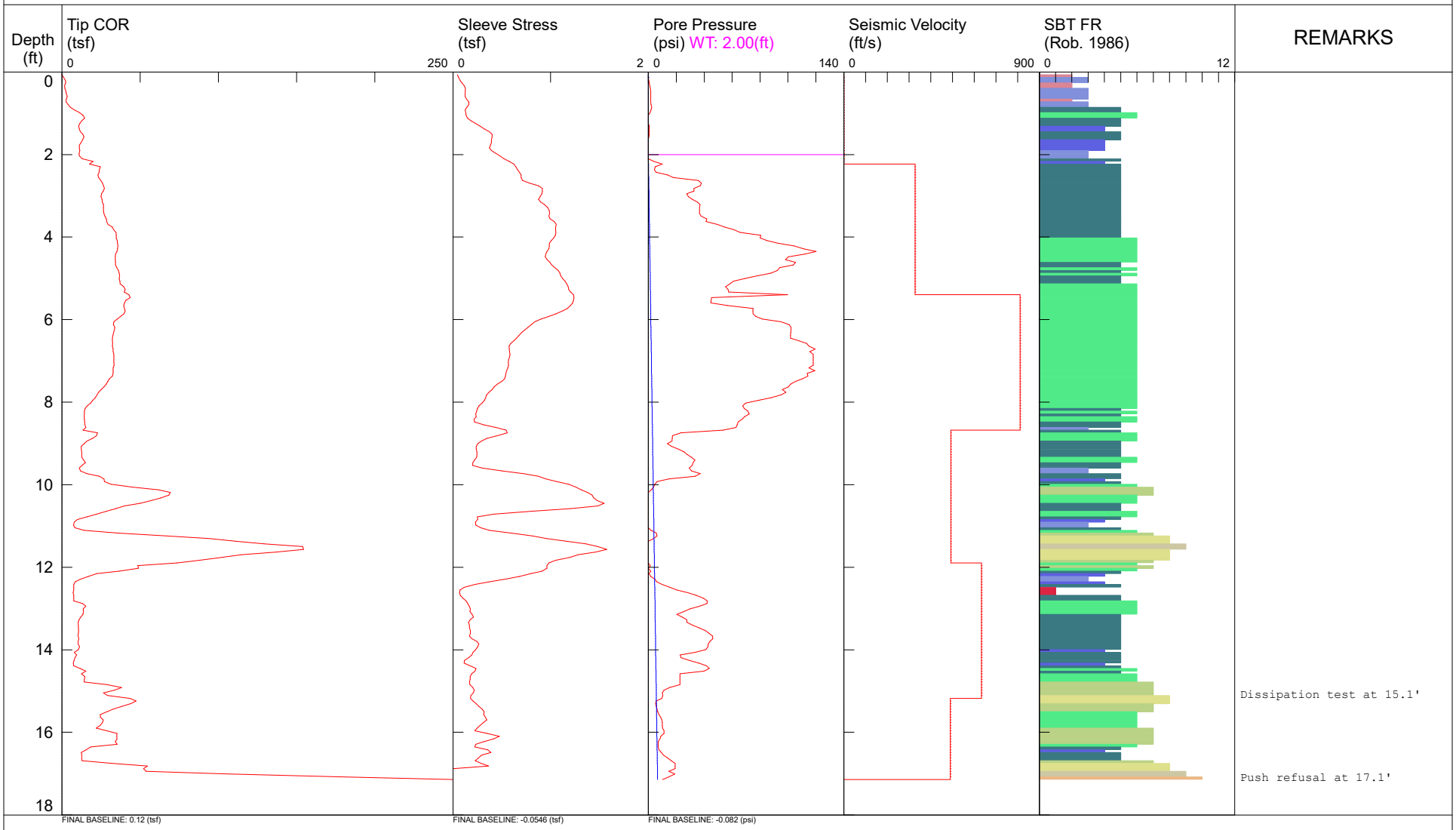
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-204.DAT

TEST ID: CPT-YR1-204
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 17.142 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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3 Clays
4 Silty clay to clay
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6 Sandy silt to clayey silt
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8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-205

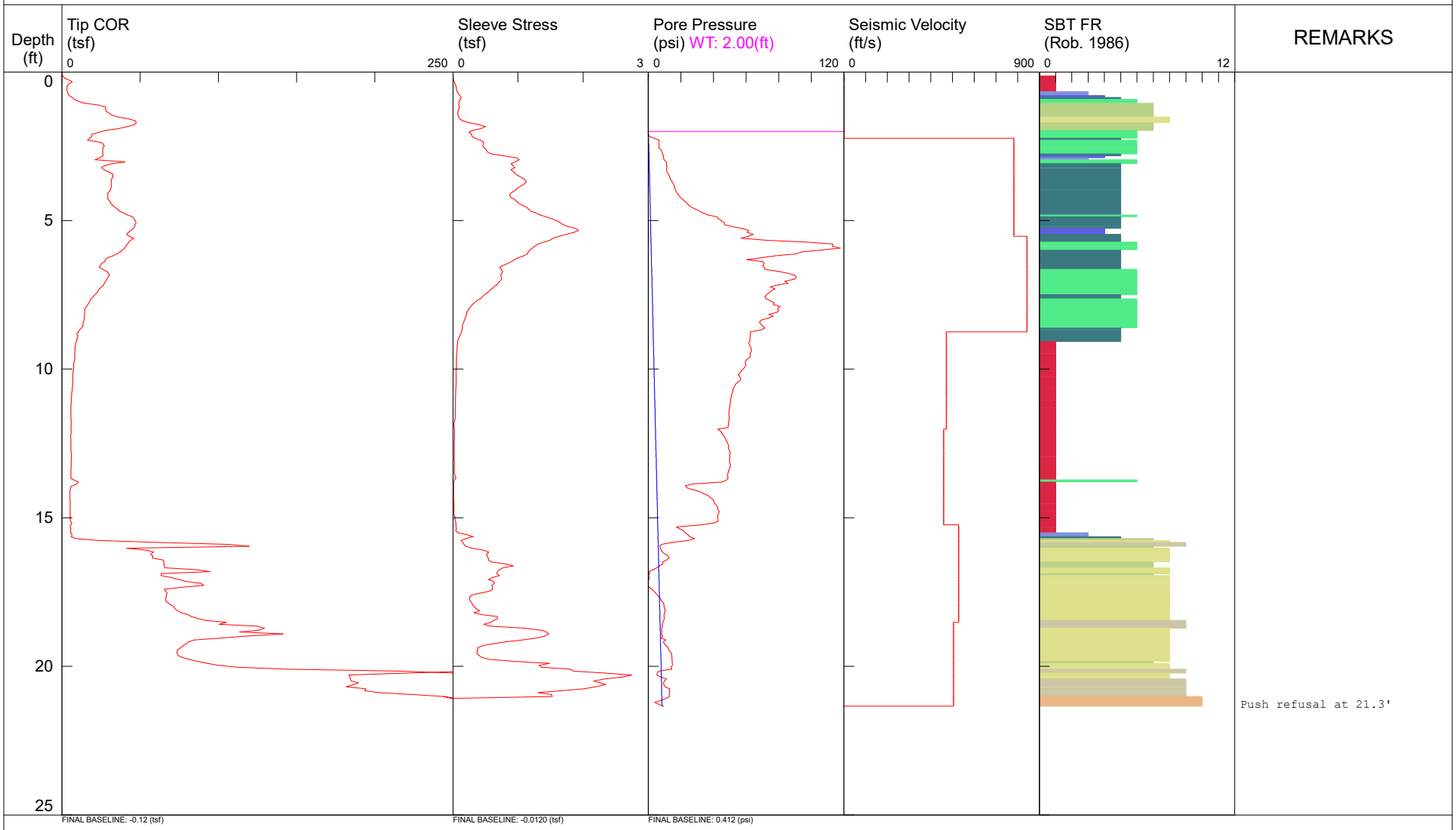
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-205.DAT

TEST ID: CPT-YR1-205
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 21.342 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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8 sand to silty sand
9 Sand
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11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-206

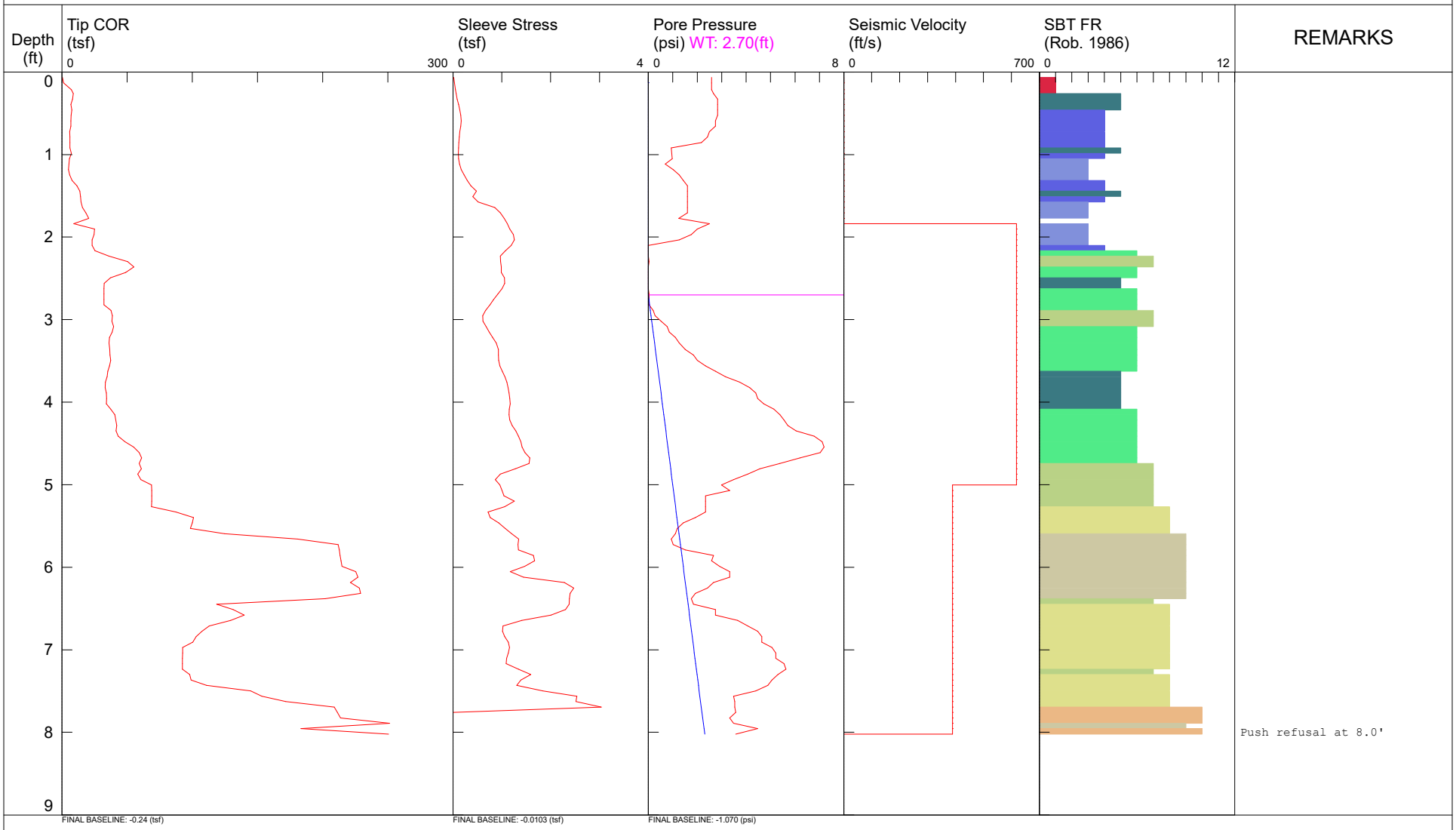
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-206.DAT

TEST ID: CPT-YR1-206
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 8.022 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-207

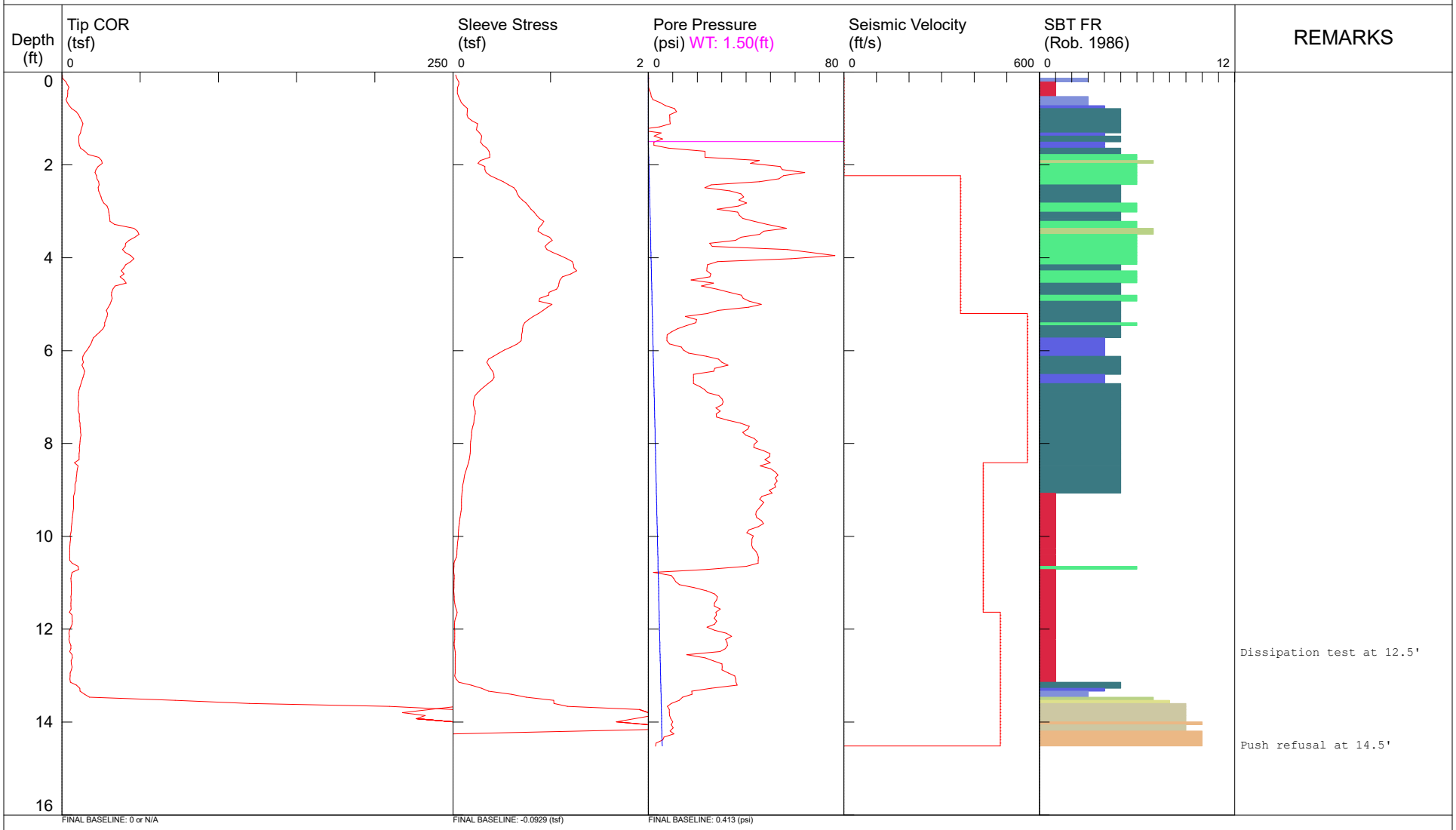
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-207.DAT

TEST ID: CPT-YR1-207
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 14.518 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-207A

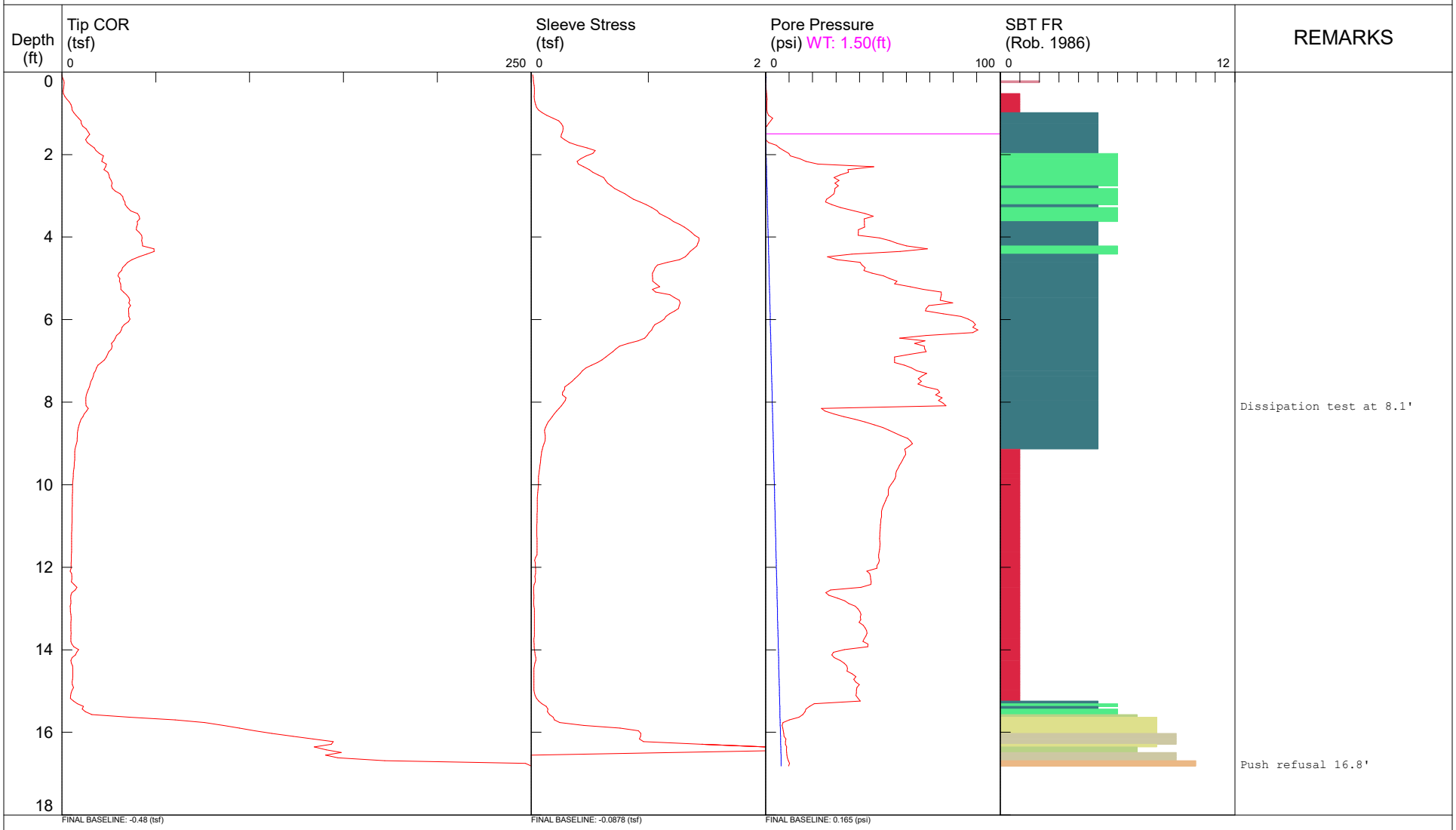
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-207A.DAT

TEST ID: CPT-YR1-207A
TEST DATE: Thu 25/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 16.814 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT-YR1-208

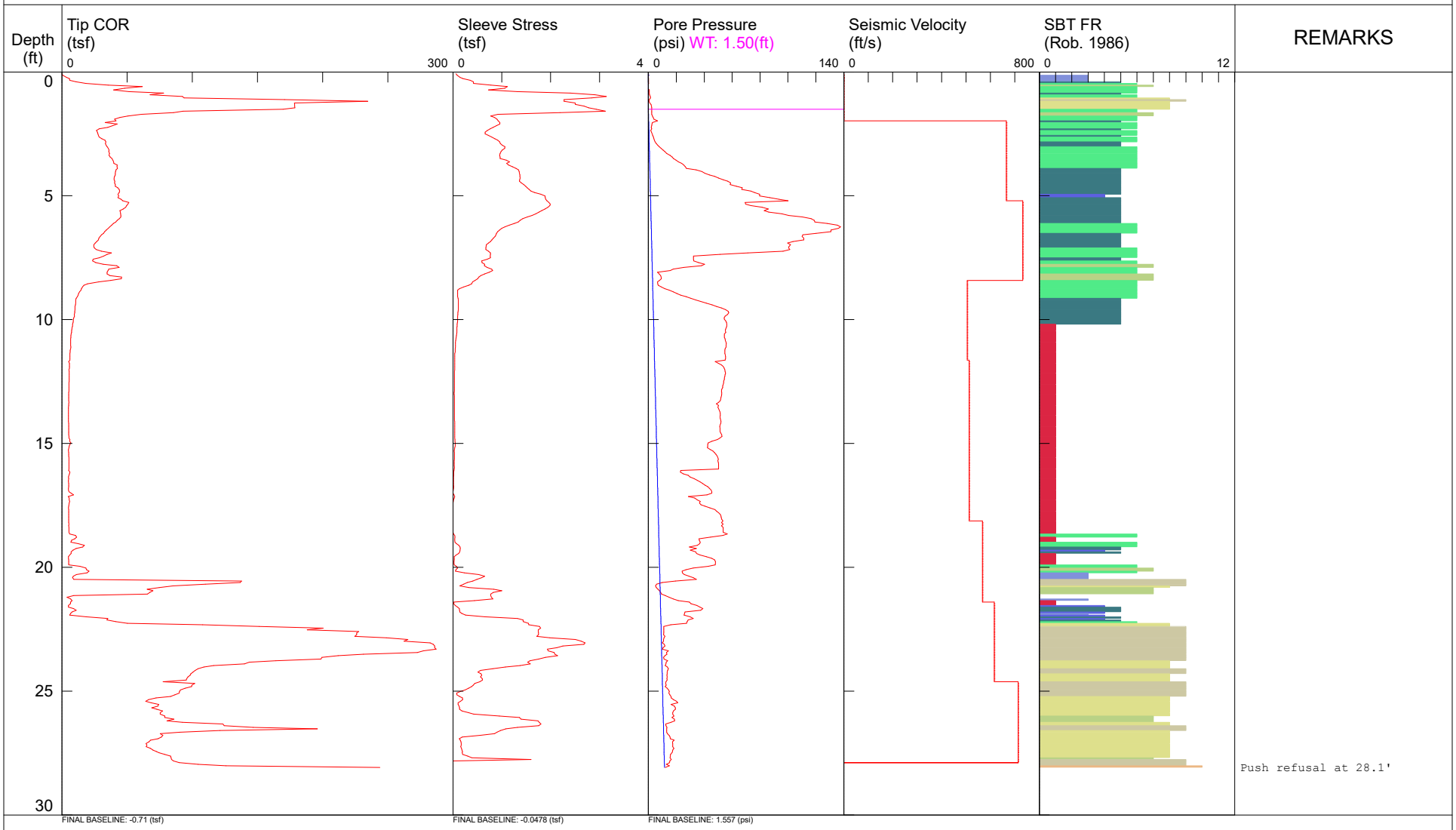
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-208.DAT

TEST ID: CPT-YR1-208
TEST DATE: Mon 29/Apr/2024
GROUND SURFACE ELEV.: 000 +/-
TOTAL DEPTH: 28.084 ft



PROBE ID: 4644.163XX

1 Sensitive fine grained
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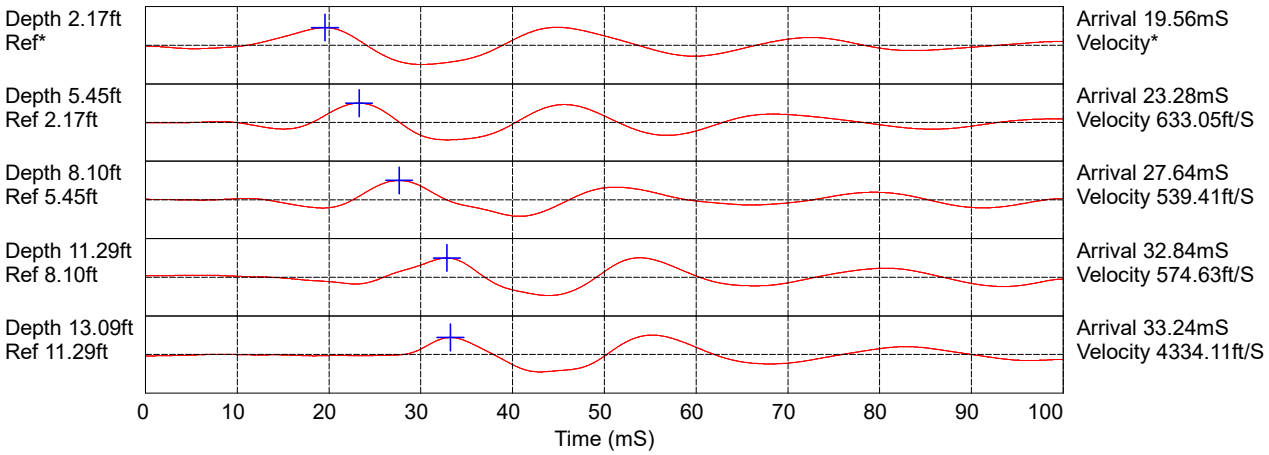
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

SEISMIC CONE PENETRATION TEST SHEAR WAVE (Vs) TRACES

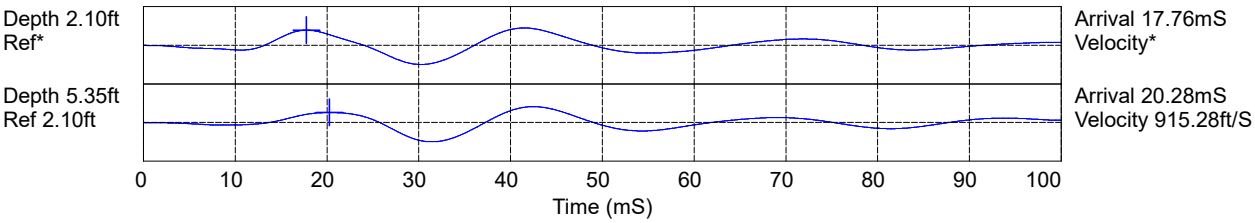
FILENAME: CPT-YR1-201 Final.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

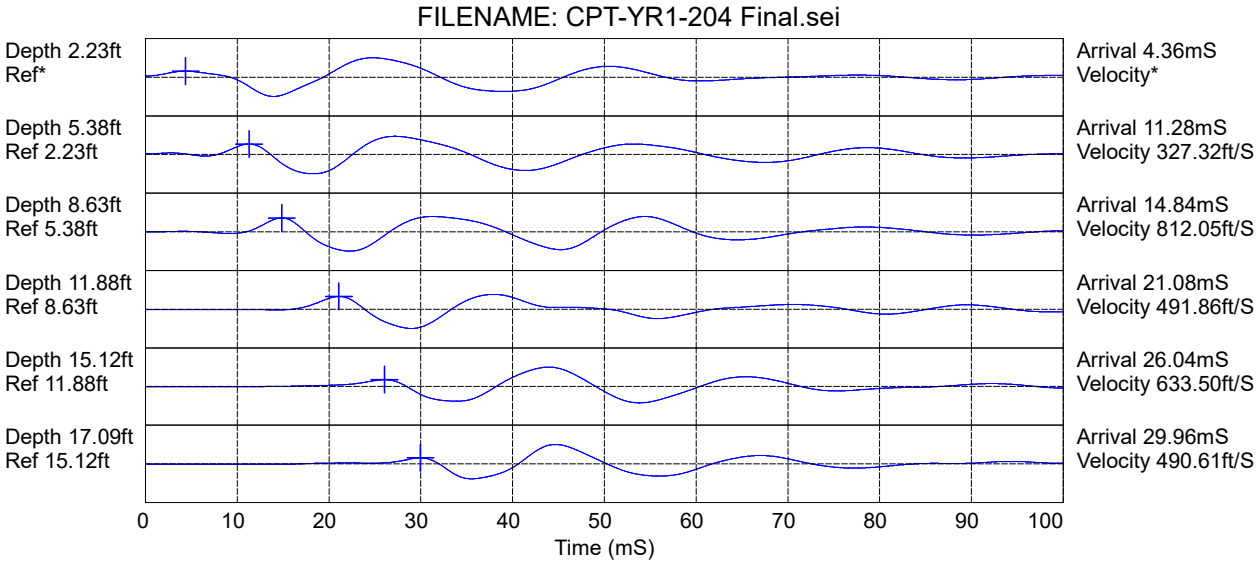
FILENAME: CPT-YR1-201 Final.sei

FILENAME: CPT-YR1-202 Final.SEI.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

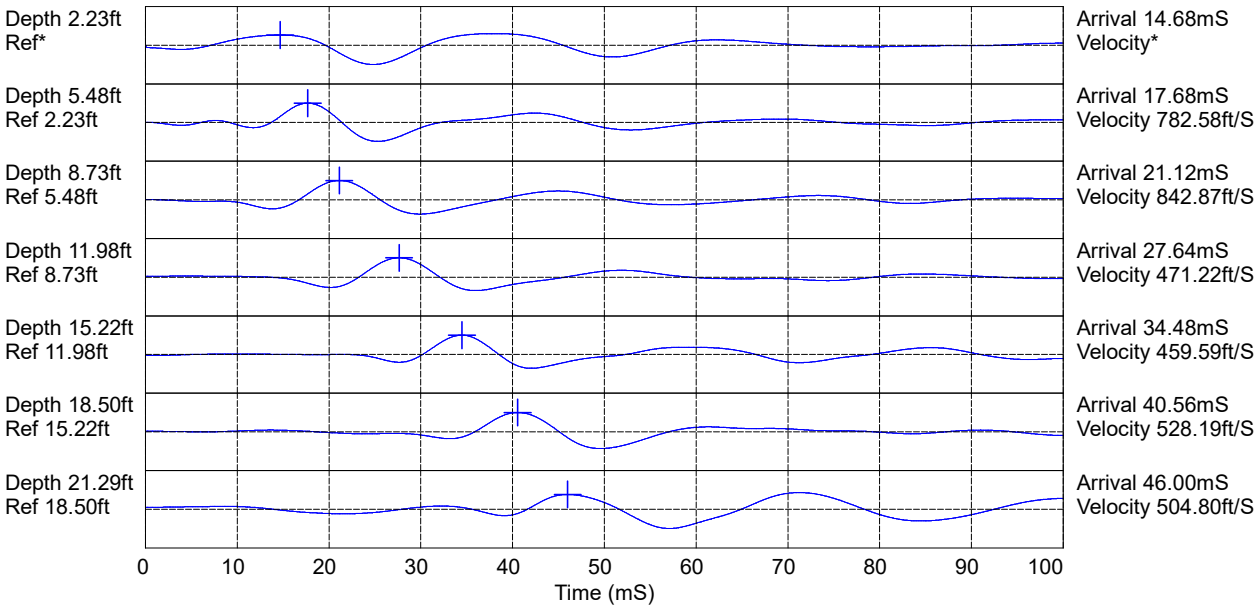
FILENAME: CPT-YR1-202 Final.SEI.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

FILENAME: CPT-YR1-204 Final.sei

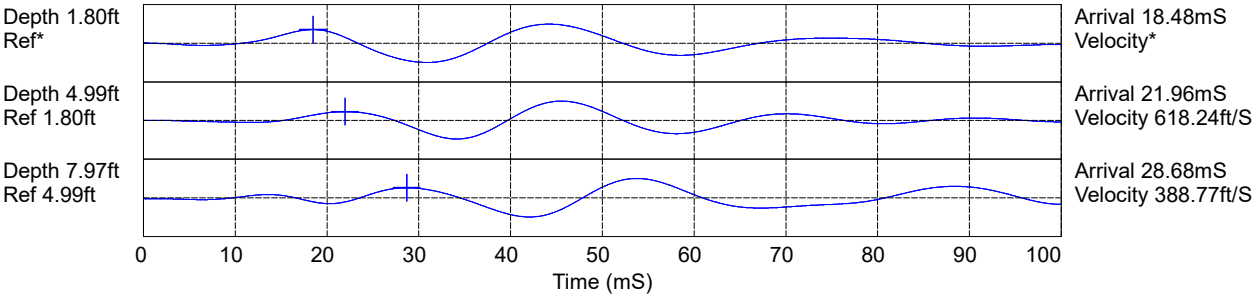
FILENAME: CPT-YR1-205 Final.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

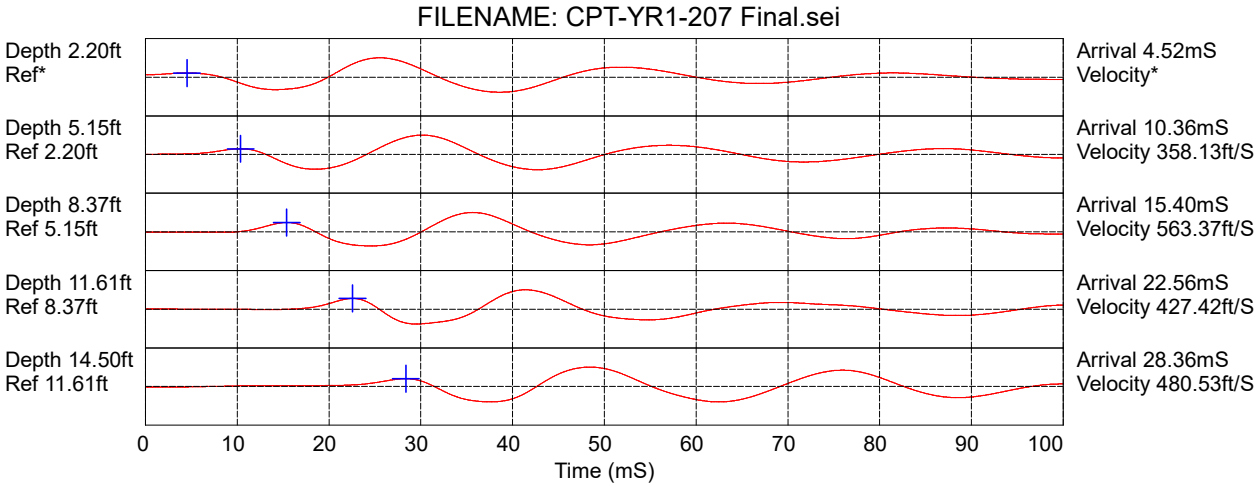
FILENAME: CPT-YR1-205 Final.sei

FILENAME: CPT-YR1-206 Final.sei



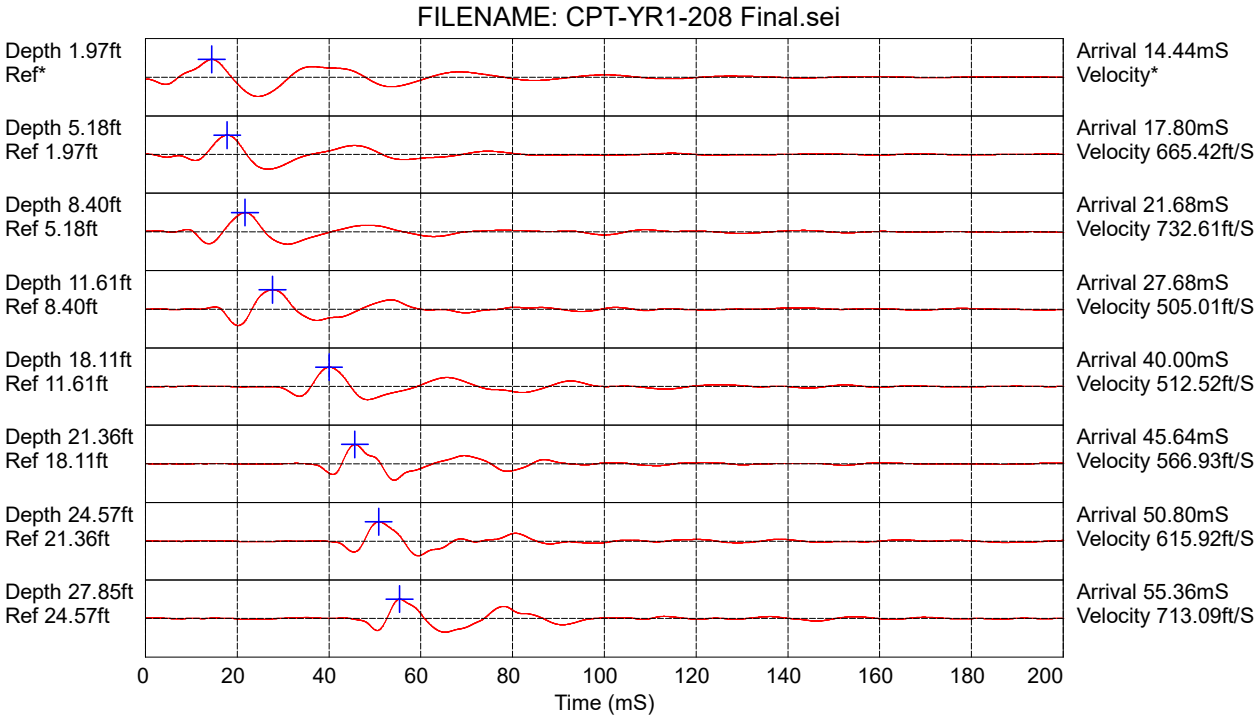
Hammer to Rod String Distance (ft): 3.51
* = Not Determined

FILENAME: CPT-YR1-206 Final.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

FILENAME: CPT-YR1-207 Final.sei



Hammer to Rod String Distance (ft): 3.51
* = Not Determined

FILENAME: CPT-YR1-208 Final.sei

PORE PRESSURE DISSIPATION PLOTS

DISSIPATION

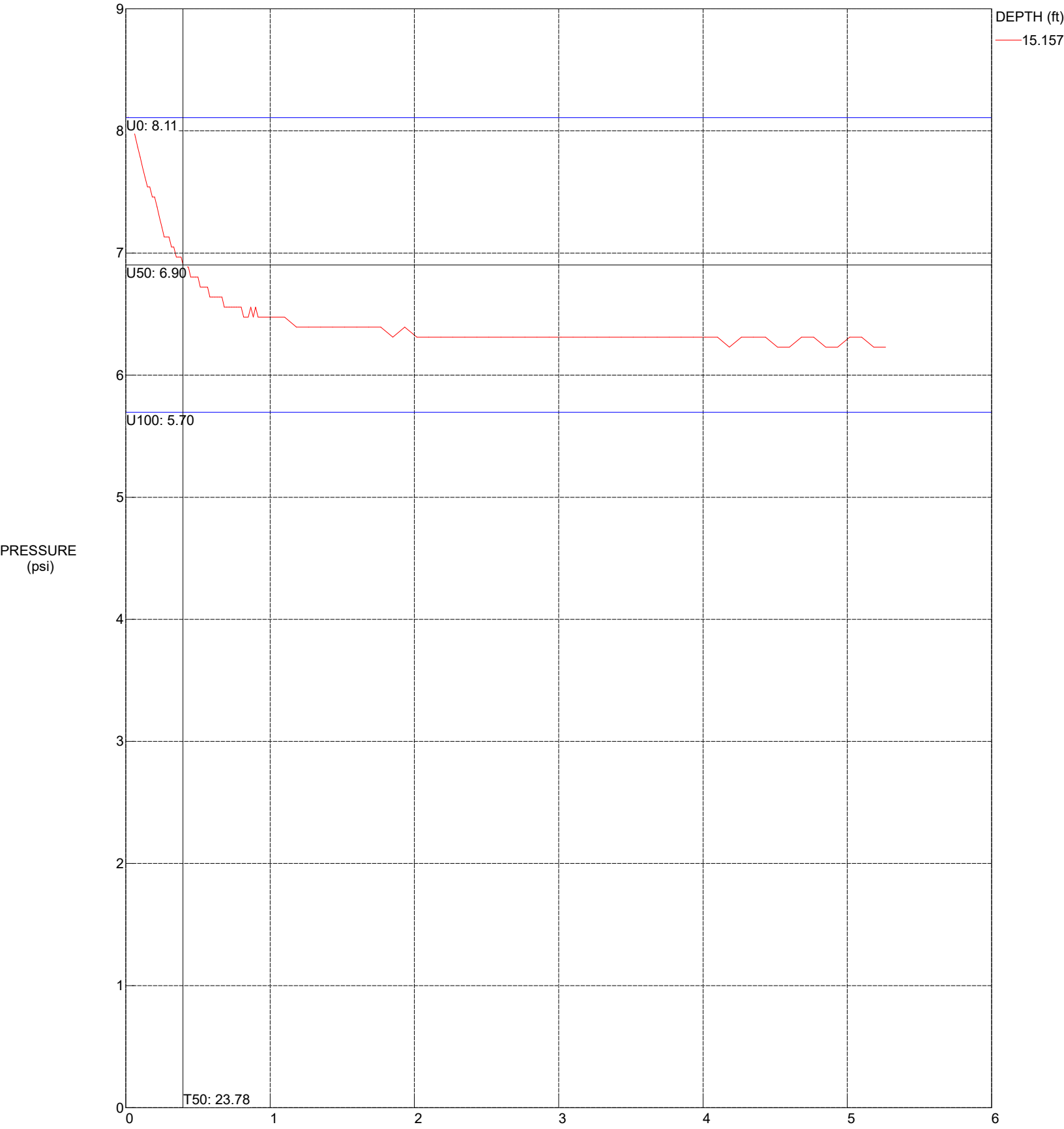
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-204.DIS

TEST ID: CPT-YR1-204
TEST DATE: Thu 25/Apr/2024



MAXIMUM PRESSURE = 8.114 (psi)
TIME: (MINUTES)
HYDROSTATIC PRESSURE = 5.704 (psi), WATER TABLE: 2.00 ft
PROBE ID: 4644.163XX

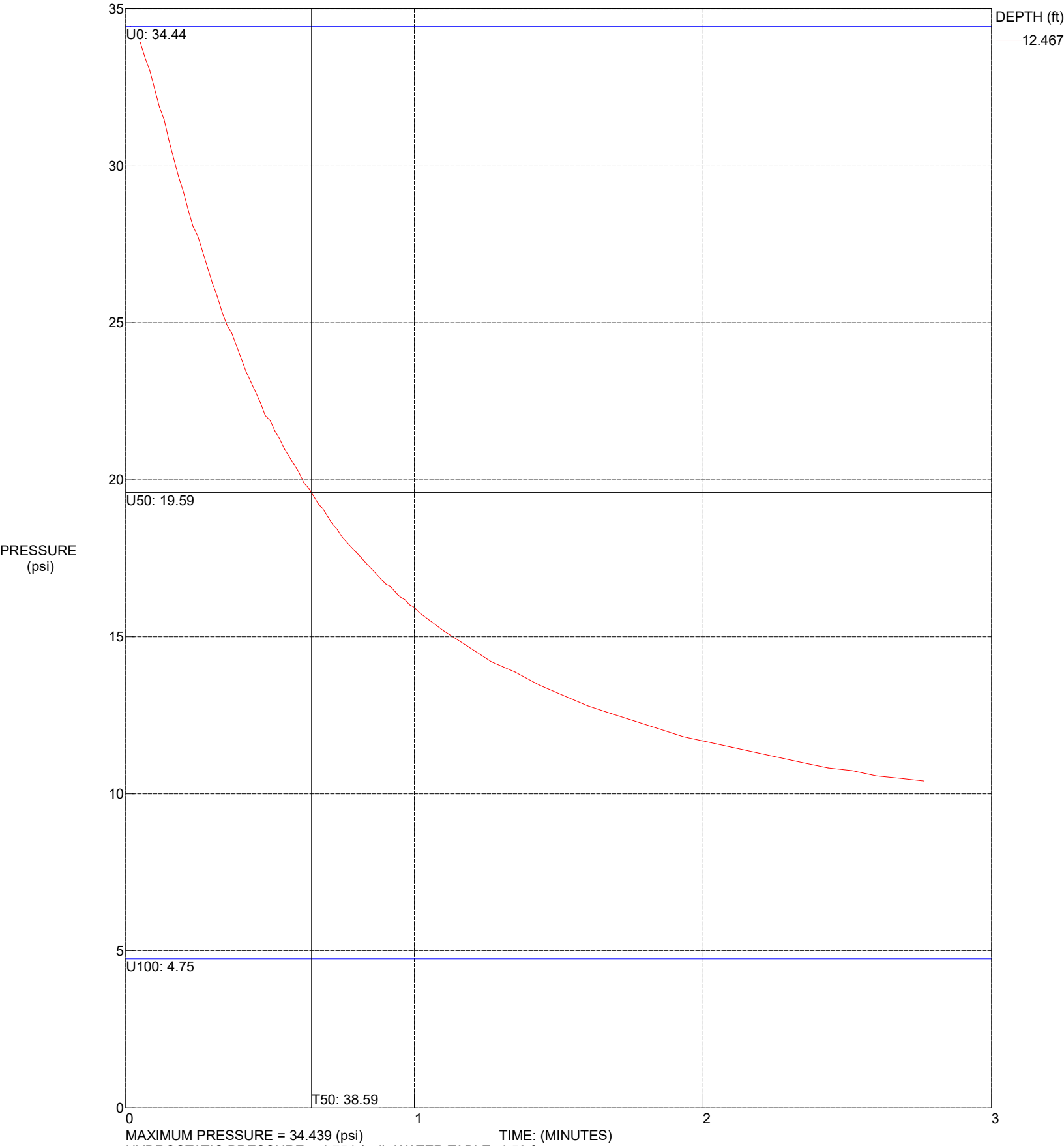
DISSIPATION

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-207.DIS

TEST ID: CPT-YR1-207
TEST DATE: Thu 25/Apr/2024



MAXIMUM PRESSURE = 34.439 (psi)
TIME: (MINUTES)
HYDROSTATIC PRESSURE = 4.754 (psi), WATER TABLE: 1.50 ft
PROBE ID: 4644.163XX

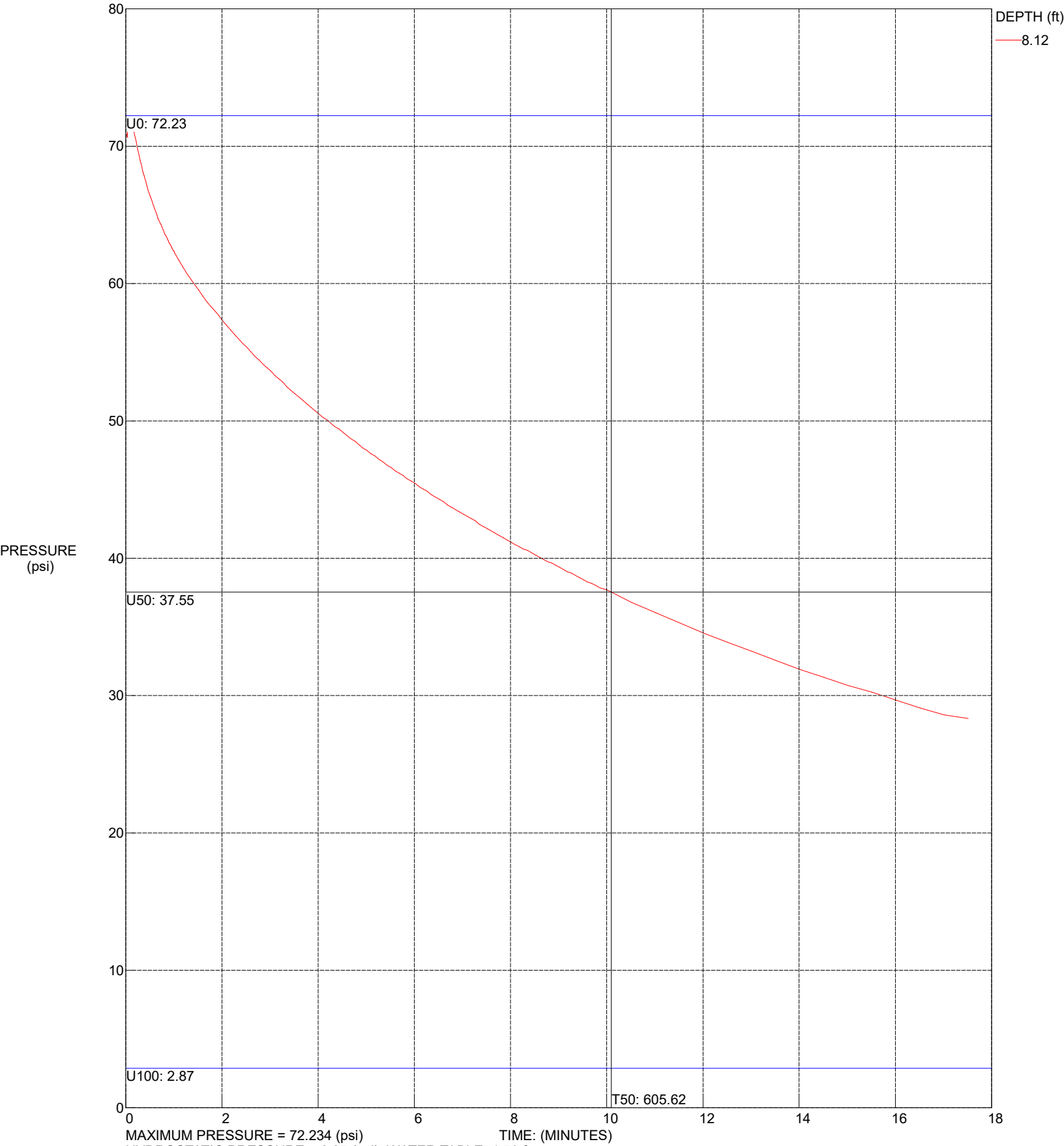
DISSIPATION

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-207A.DIS

TEST ID: CPT-YR1-207A
TEST DATE: Thu 25/Apr/2024



MAXIMUM PRESSURE = 72.234 (psi)
TIME: (MINUTES)
HYDROSTATIC PRESSURE = 2.87 (psi), WATER TABLE: 1.50 ft
PROBE ID: 4644.163XX

DISSIPATION

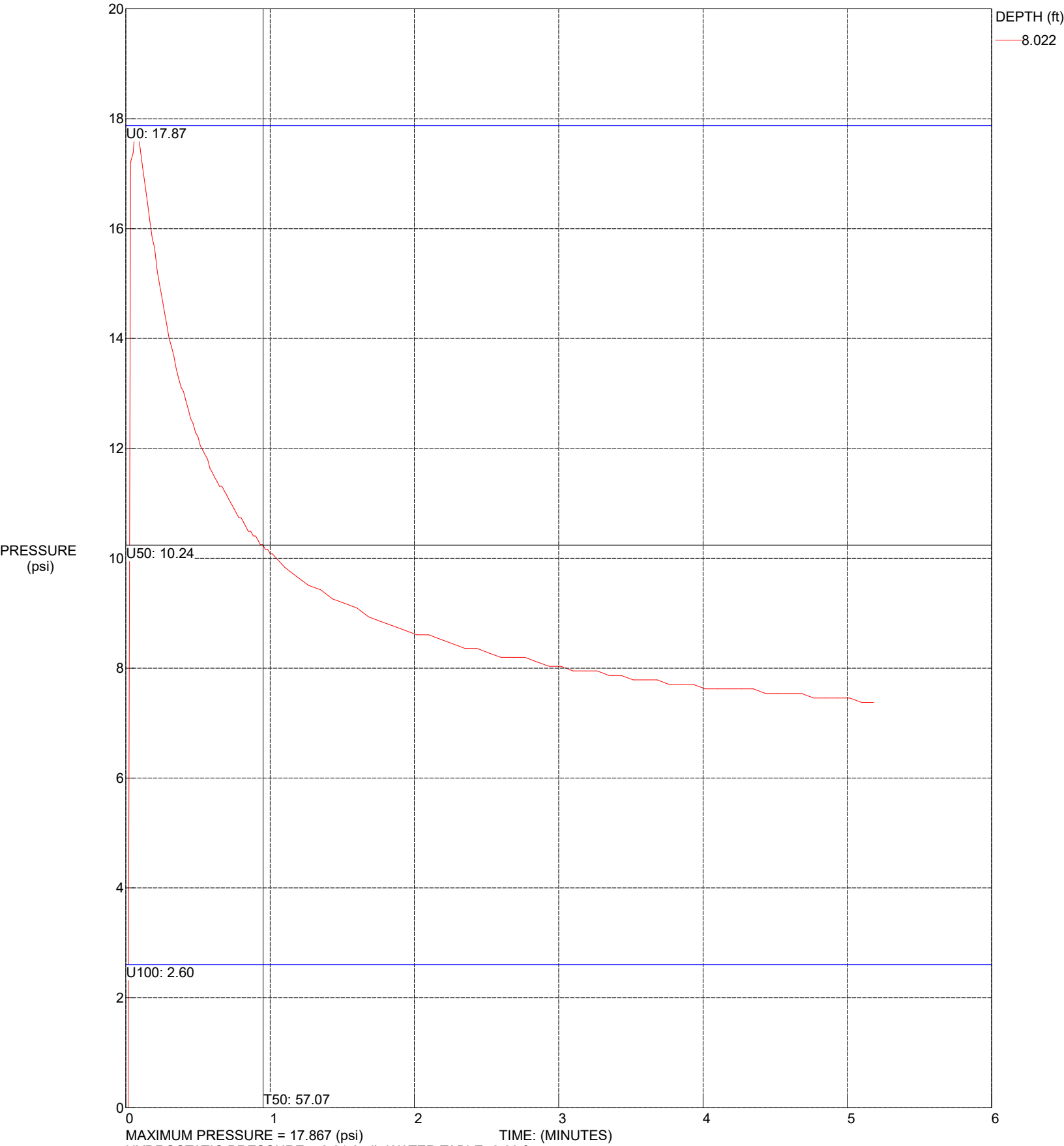
SEABOARD DRILLING

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-208.DIS

TEST ID: CPT-YR1-208
TEST DATE: Mon 29/Apr/2024



MAXIMUM PRESSURE = 17.867 (psi)
TIME: (MINUTES)
HYDROSTATIC PRESSURE = 2.61 (psi), WATER TABLE: 2.00 ft
PROBE ID: 4644.163XX

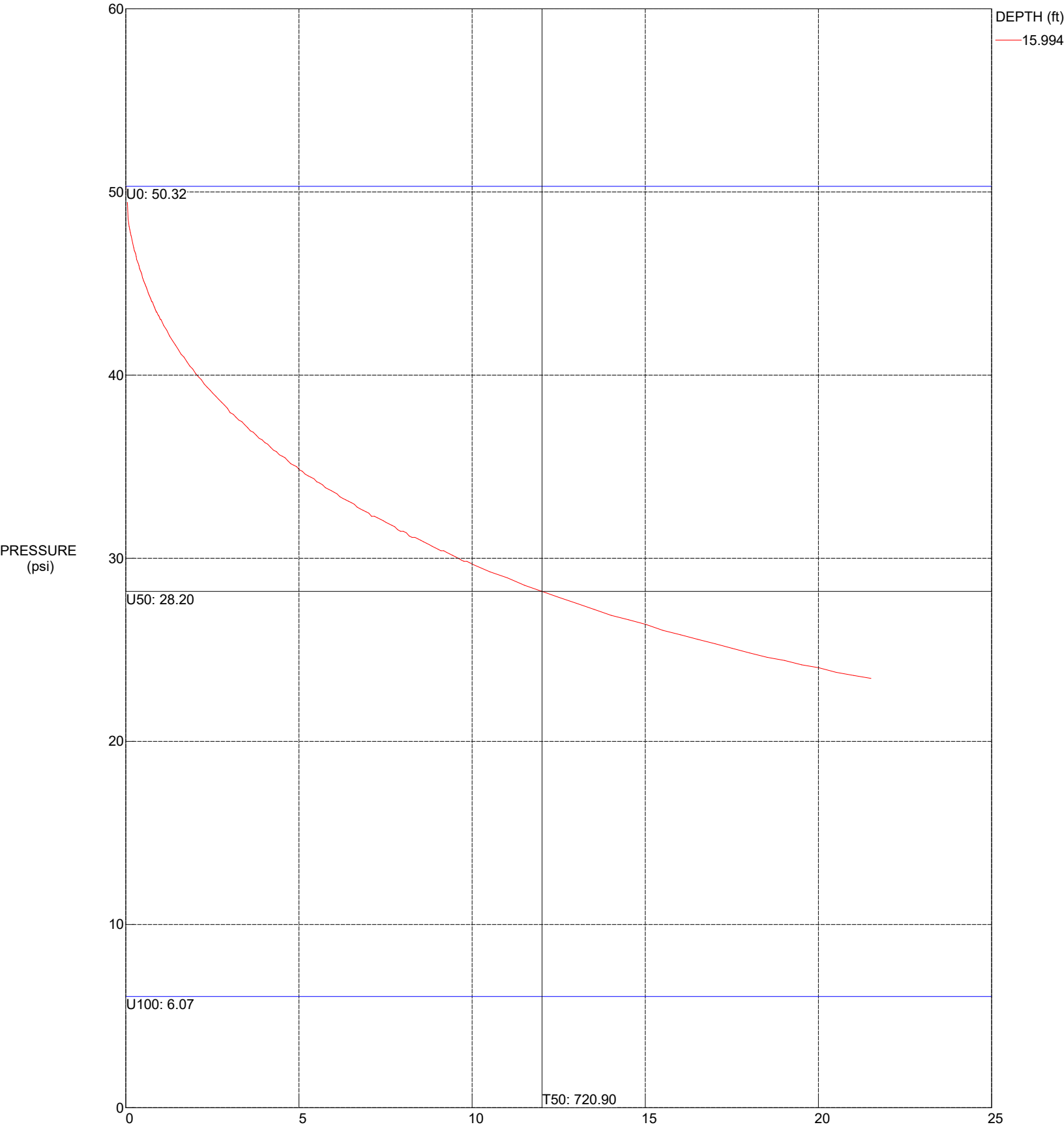
DISSIPATION

COMPANY: Seaboard Drilling
PROJECT: Relocate U.S. Route 1 Bridge over I-295
SITE: U.S. Route 1
LOCATION: Yarmouth, ME
CLIENT: GZA GeoEnvironmental, Inc.

OPERATOR: Kevin Hanscom

FILENAME: CPT-YR1-208.DIS

TEST ID: CPT-YR1-208
TEST DATE: Mon 29/Apr/2024

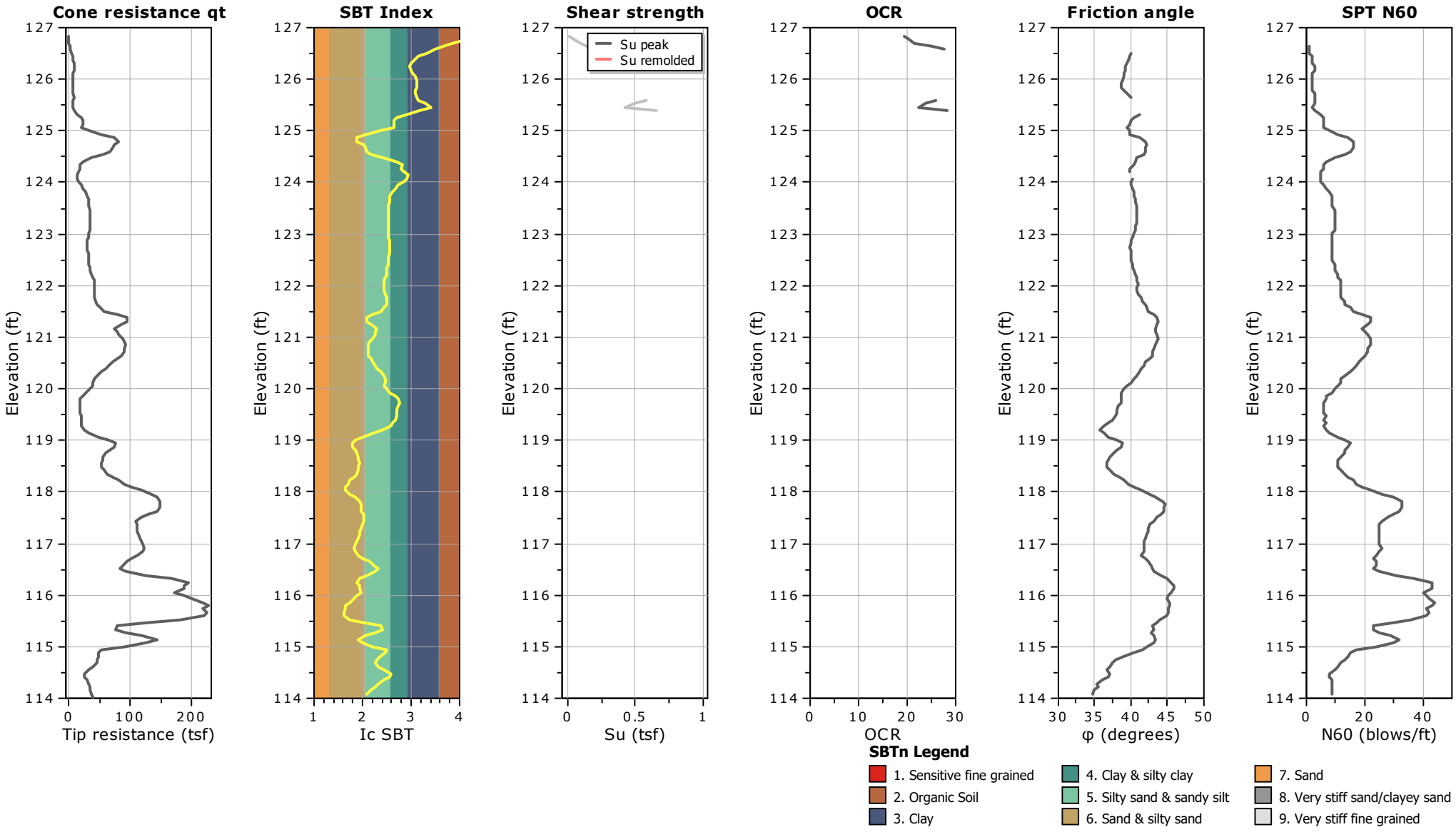


MAXIMUM PRESSURE = 50.323 (psi)
HYDROSTATIC PRESSURE = 6.066 (psi), WATER TABLE: 2.00 ft
PROBE ID: 4644.163XX

GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-201 Data
Total depth: 13.07 ft, Date: 6/19/2024
Surface Elevation: 126.90 ft
Coords: X:1032949.00, Y:346633.60
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

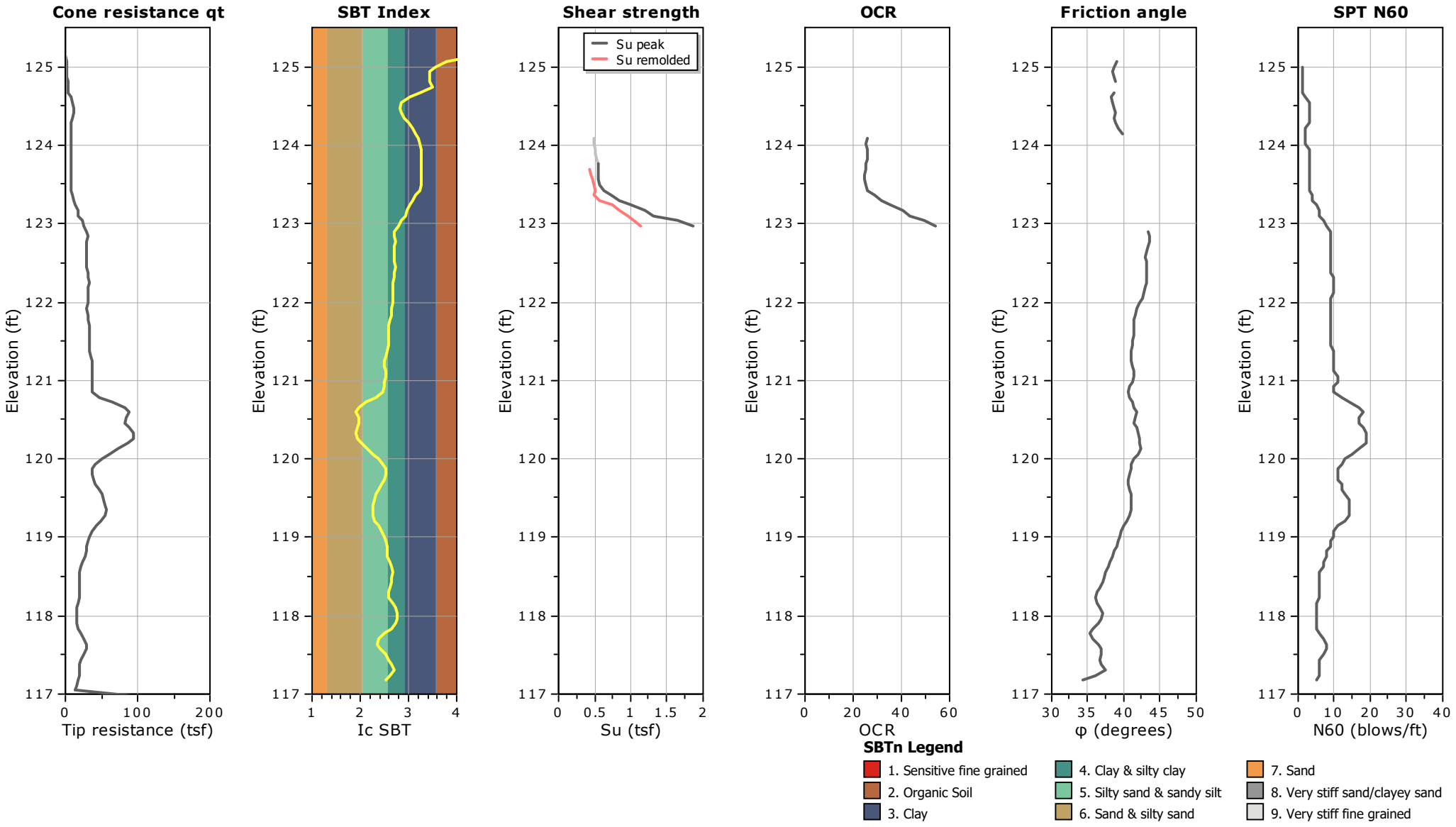
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-202 Data
Total depth: 8.28 ft, Date: 6/19/2024
Surface Elevation: 125.20 ft
Coords: X:1032903.40, Y:346471.30
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

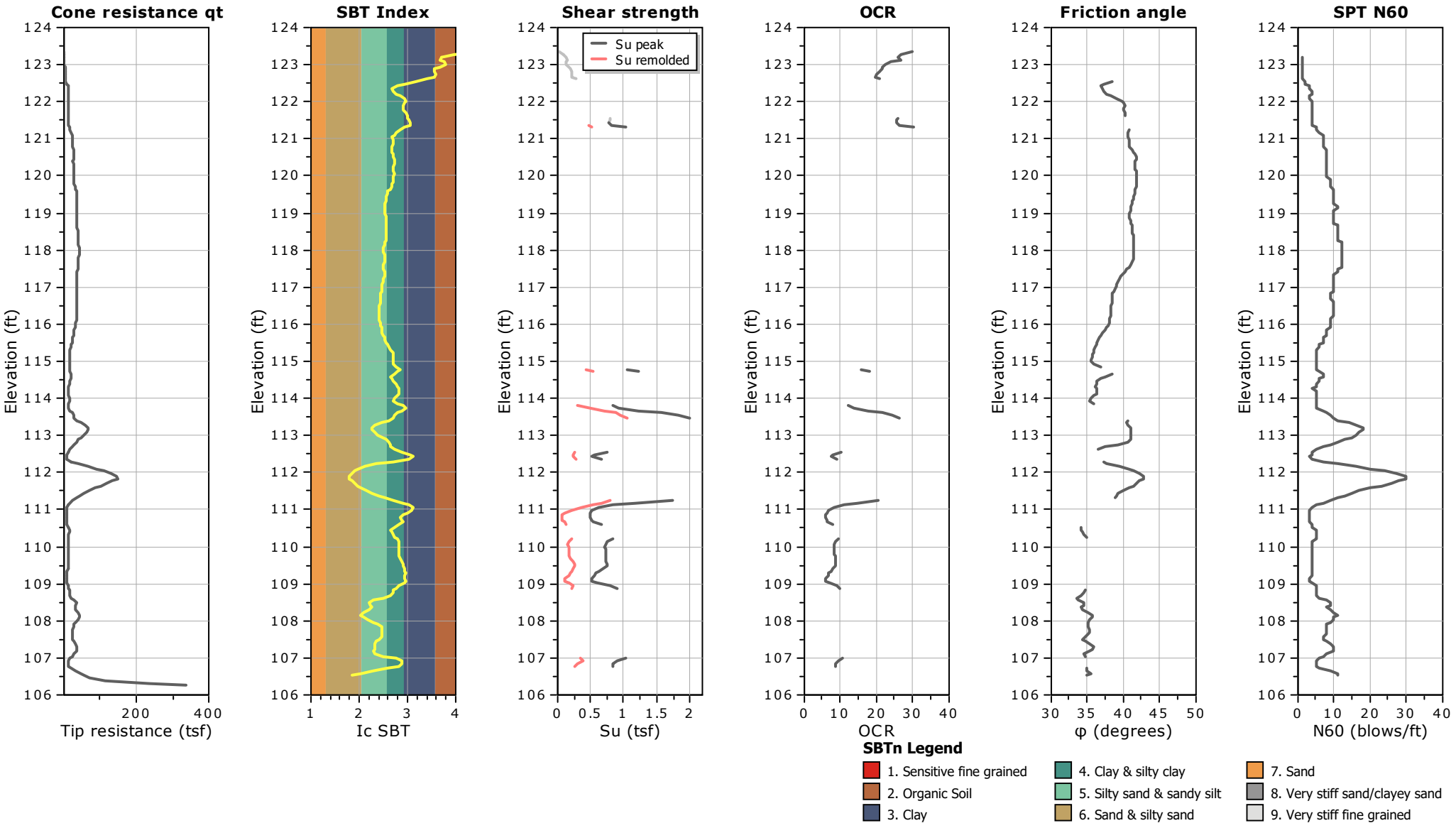
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-204 Data
Total depth: 17.14 ft, Date: 6/19/2024
Surface Elevation: 123.40 ft
Coords: X:1032935.10, Y:346520.70
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

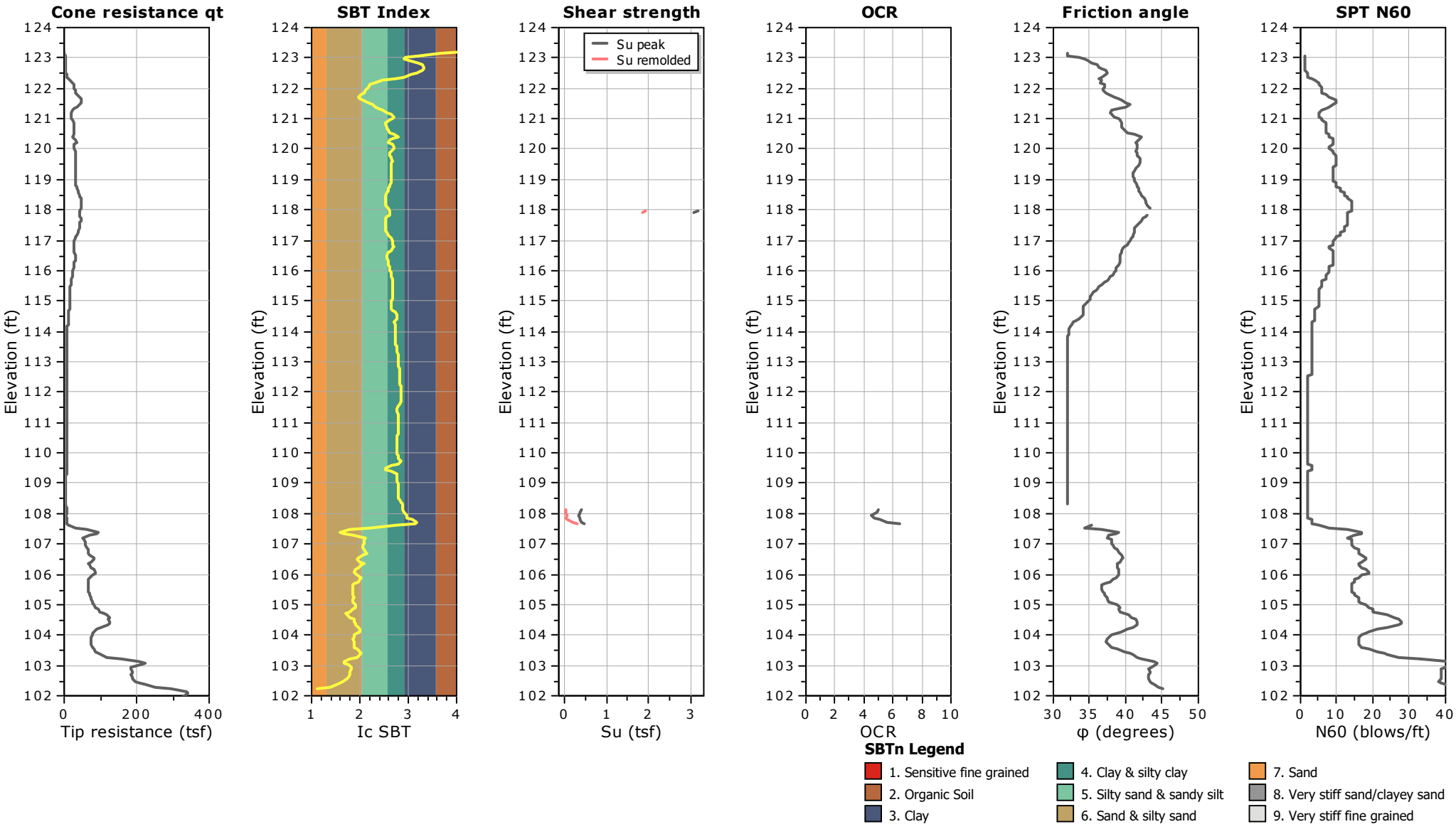
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-205 Data
Total depth: 21.34 ft, Date: 6/19/2024
Surface Elevation: 123.30 ft
Coords: X:1032855.50, Y:346567.80
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

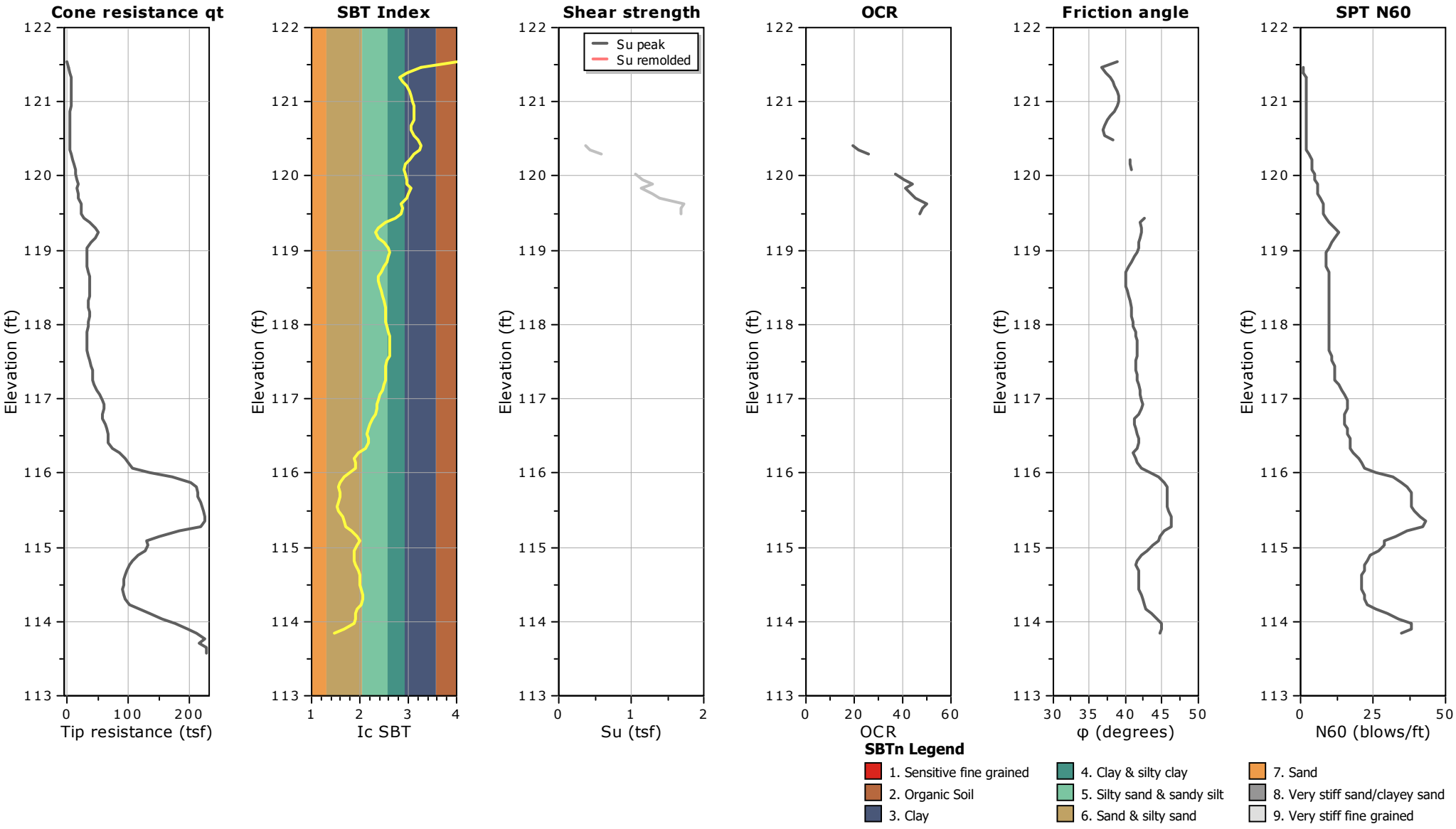
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-206 Data
Total depth: 8.02 ft, Date: 6/19/2024
Surface Elevation: 121.60 ft
Coords: X:1032969.60, Y:346559.60
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

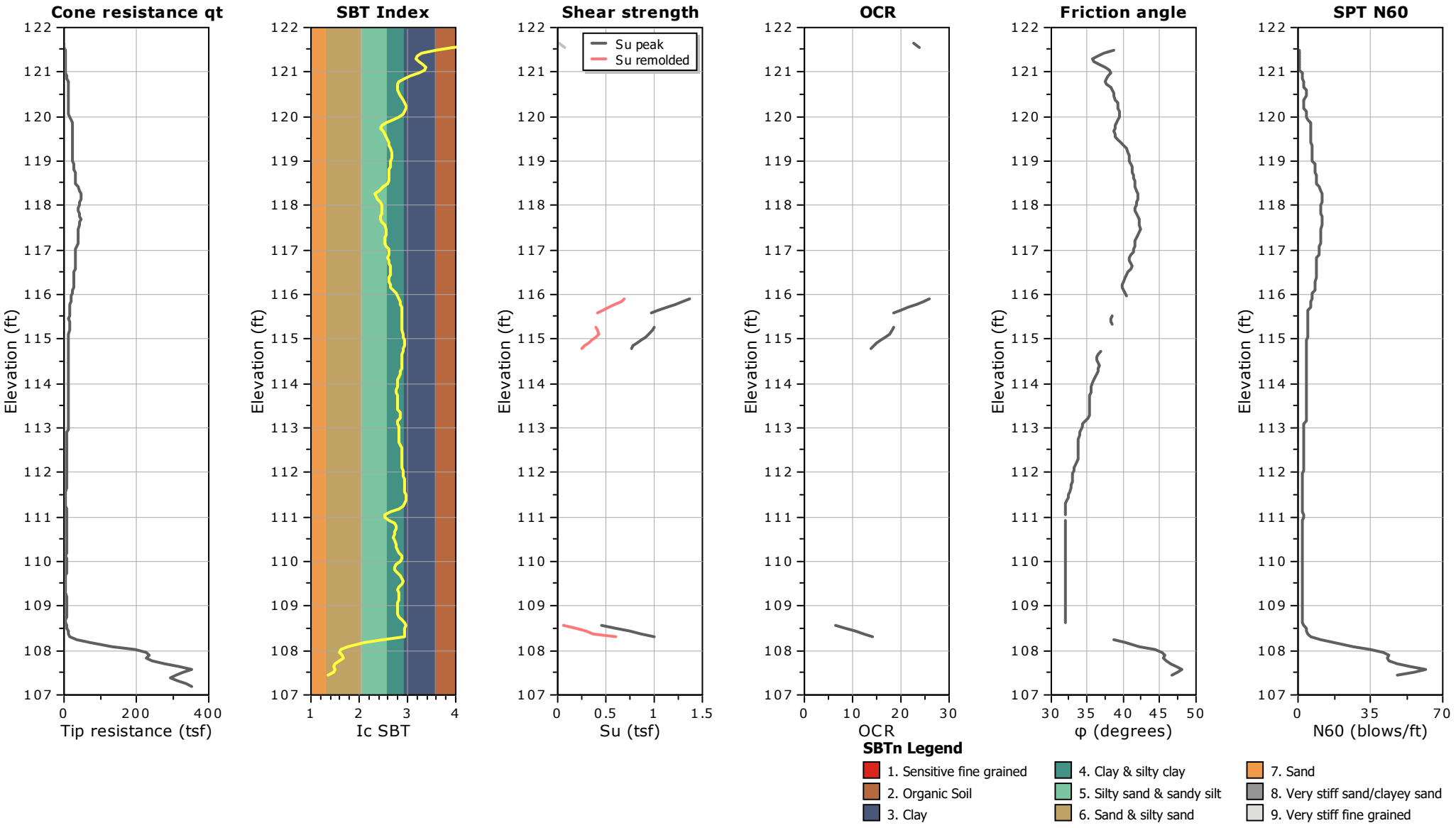
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-207 Data
Total depth: 14.52 ft, Date: 6/19/2024
Surface Elevation: 121.70 ft
Coords: X:1032890.90, Y:346588.80
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

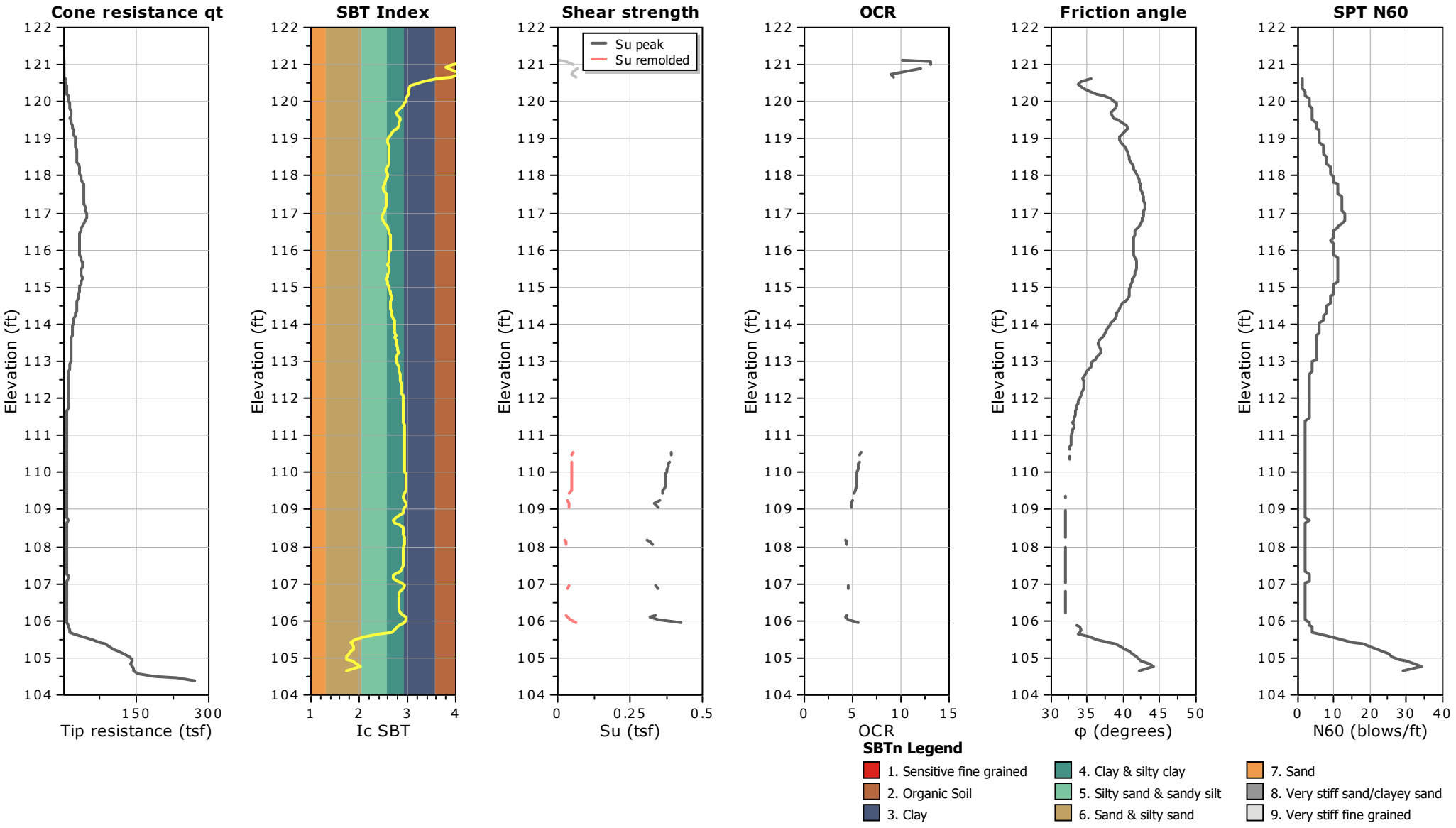
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-207A Data
Total depth: 16.81 ft, Date: 6/19/2024
Surface Elevation: 121.20 ft
Coords: X:1032886.20, Y:346590.10
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

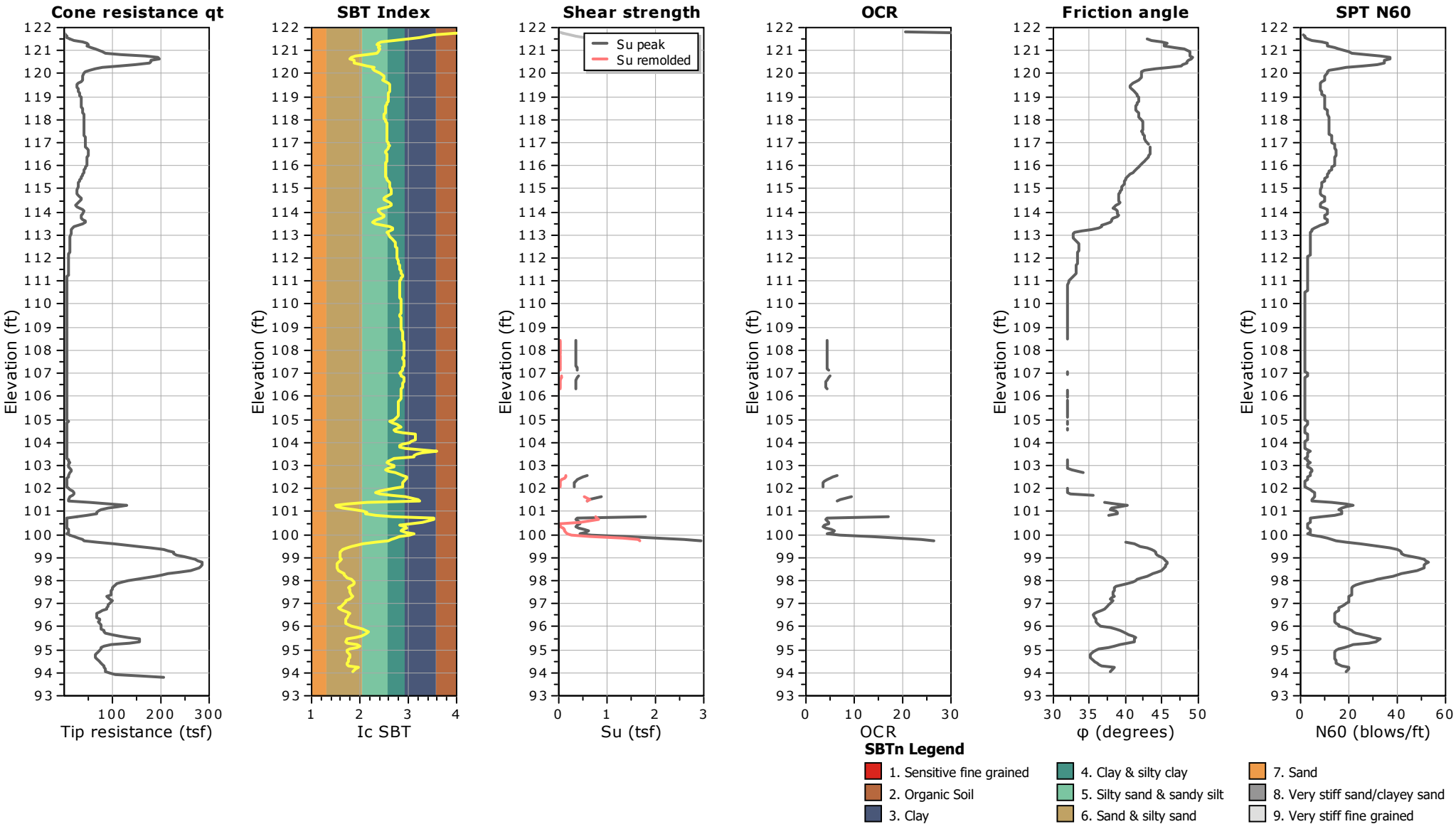
Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



GZA GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, Maine

CPT: CPT-YR1-208 Data
Total depth: 28.08 ft, Date: 6/19/2024
Surface Elevation: 121.90 ft
Coords: X:1032945.00, Y:346628.50
Cone Type: Vertek
Cone Operator: Seaboard Drilling, LLC

Project: US Route 1 Bridge No. 5804 over I-295 Replacement, WIN 22382.00 (GZA File No. 09.0026144.00)
Location: Yarmouth, ME



APPENDIX E - LABORATORY TEST RESULTS

THIELSCH ENGINEERING

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
GZA GeoEnvironmental
South Portland, ME
PM: B. Cardali
Assigned By: B. Cardali
Collected By: Erin Tombaugh

Project Information:
Rt l Bridge No. 5804 Replacement, MEDOT WIN 22382.00
Yarmouth, ME
GZA Project Number: 09.0026144.00
Summary Page: 1 of 2
Report Date: 03.25.22

LABORATORY TESTING DATA SHEET, Report No.: 7421-C-121

Boring No.	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Moisture Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Moisture Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D854			D1557						
HB-YR1-101	2D	2-4	22-S-830	24.3			2.6	62.0	35.4											Olive Silty SAND, trace fine Gravel
HB-YR1-102	1D	0-1.9	22-S-831	21.1			50.6	37.8	11.6											Brown Sandy GRAVEL, little Silt
HB-YR1-103	2D	2-4	22-S-832	20.5	32	17														Brown CLAY & SILT
HB-YR1-103	3D	4-6	22-S-833	45.5			2.4	55.6	42.0											Olive Silty SAND, trace fine Gravel
HB-YR1-104	2D	2-4	22-S-834	27.4	45	22														Olive Silty ClAY
HB-YR1-104	5D	8-10	22-S-835	26.0			0.6	9.6	89.8											Olive SILT & CLAY, trace fine Sand, trace fine Gravel
HB-YR1-105	2D	2-4	22-S-836	21.4			0.0	31.4	68.6											Olive SILT & CLAY, some fine Sand
HB-YR1-105	4D	6-8	22-S-837	21.6	35	18														Olive-Gray CLAY & SILT
HB-YR1-105	7D	25-27	22-S-838	18.0			0.0	81.3	18.7											Olive-Brown f-m SAND, little Silt

Date Received: *03.07.22*

Reviewed By:

Date Reviewed: *03.25.22*

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THIELSCH ENGINEERING
195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
GZA GeoEnvironmental
South Portland, ME
PM: B. Cardali
Assigned By: B. Cardali
Collected By: Erin Tombaugh

Project Information:
Rt l Bridge No. 5804 Replacement, MEDOT WIN 22382.00
Yarmouth, ME
GZA Project Number: 09.0026144.00
Summary Page: 2 of 2
Report Date: 03.25.22

LABORATORY TESTING DATA SHEET, Report No.: 7421-C-121

Boring No.	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Moisture Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Moisture Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D854			D1557						
BB-YR1-101	4D	6-8	22-S-839	29.2	47	22														Olive Silty CLAY
BB-YR1-101	6D	10-12	22-S-840	26.7	36	20														Olive CLAY & SILT
BB-YR1-101	7D	14-16	22-S-841	29.2	31	16														Gray CLAY & SILT
BB-YR1-101	8D	20-22	22-S-842				0.0	13.1	86.9											Olive-Gray SILT & CLAY, little fine Sand
BB-YR1-101	10D	30-30.7	22-S-843				21.9	25.9	52.2											Olive-Gray SILT & CLAY, some f-c Sand, some f-c Gravel
BB-YR1-103	2D	2-4	22-S-844	23.8	38	20														Olive-Gray CLAY & SILT
BB-YR1-103	3D	4-6	22-S-845	20.7	30	17														Gray CLAY & SILT
BB-YR1-103	7D	20-22	22-S-846	10.2			16.4	65.6	18.0											Light Gray f-m SAND, little Silt, little f-c Gravel
BB-YR1-103	10D	35-37	22-S-847	7.5			26.6	51.9	21.5											Gray f-c SAND, some f-c Gravel, some Silt
BB-YR1-103	13D	50-51.2	22-S-848				8.2	56.1	35.7											Dark Gray Silty SAND, trace fine Gravel

Date Received: *03.07.22*

Reviewed By:

Date Reviewed: *03.25.22*

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THIELSCH ENGINEERING

State of Maine - Department of Transportation
Laboratory Testing Summary Sheet

US Route 1 Bridge Replacement #5804
Town(s): Yarmouth, ME

MDOT Project Number: WIN22382.00

GZA Project Number: 09.0026144.00

Boring & Sample Identification Number	Station (Feet)	Sample No.	Depth (Feet)	Lab Number	Organic %	W.C.	L.L.	P.L.	Classification		
									Unified	AASHTO	Frost
HB-YR1-101		2D	2-4	S-830		22.7			SM	A-4	
HB-YR1-102		1D	0-1.9	S-831		21.1			GP-GM	A-1-b	I
HB-YR1-103		2D	2-4	S-832		20.5	32	17	CL	A-6	III
HB-YR1-103		3D	4-6	S-833		19.1			SM	A-4(0)	
HB-YR1-104		2D	2-4	S-834		27.4	45	22	CL	A-7-6	III
HB-YR1-104		5D	8-10	S-835		26.0			ML	A-4(0)	III
HB-YR1-105		2D	2-4	S-836		21.4			ML	A-6	
HB-YR1-105		4D	6-8	S-837		21.6	35	18	CL	A-6	III
HB-YR1-105		7D	25-27	S-838		18.0			SM	A-2-4(0)	II
BB-YR1-101		4D	6-8	S-839		29.2	47	22	CL	A-7-6	III
BB-YR1-101		6D	10-12	S-840		26.7	36	20	CL	A-6	III
BB-YR1-101		7D	14-16	S-841		29.2	31	16	CL	A-6	III
BB-YR1-101		8D	20-22	S-842					ML	A-4(0)	III
BB-YR1-101		10D	30-30.7	S-843					ML	A-4(2)	
BB-YR1-102		4D	6-8	S-1263		23.1	28	12			
BB-YR1-102		6D	14-16	S-1264		27.5	28	12			
BB-YR1-102		9D	29-31	S-1265					SM	A-2-4(0)	I
BB-YR1-103		2D	2-4	S-844		23.8	38	20	CL	A-6	III
BB-YR1-103		3D	4-6	S-845		20.7	30	17	CL	A-6	III
BB-YR1-103		7D	20-22	S-846		10.2			SM	A-2-4(0)	II
BB-YR1-103		10D	35-37	S-847		7.5			SM	A-1-b	II
BB-YR1-103		13D	50-51.2	S-848					SM	A-4(0)	

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MDOT and Corps of Engineers Classification Systems.

GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-19 and/or ASTM D 6913-17

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-19

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-17E1

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-17e1

Particle Size Distribution Report

ASTM D6913 & D1140

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.6	2.7	7.2	52.1	35.4	

Test Results (ASTM D6913 & D1140)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3/4"	100.0			
1/2"	98.0			
3/8"	98.0			
#4	97.4			
#10	94.7			
#20	91.3			
#40	87.5			
#60	82.3			
#100	75.2			
#200	35.4			

* (no specification provided)

Material Description

Olive Silty SAND, trace fine Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.6444 D_{85}= 0.3198 D_{60}= 0.1111
D_{50}= 0.0948 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4

Test Remarks

Sample visually classified as non-plastic.

Source of Sample: HB Depth: 2-4'
Sample Number: HB-YR1-101 / 2D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

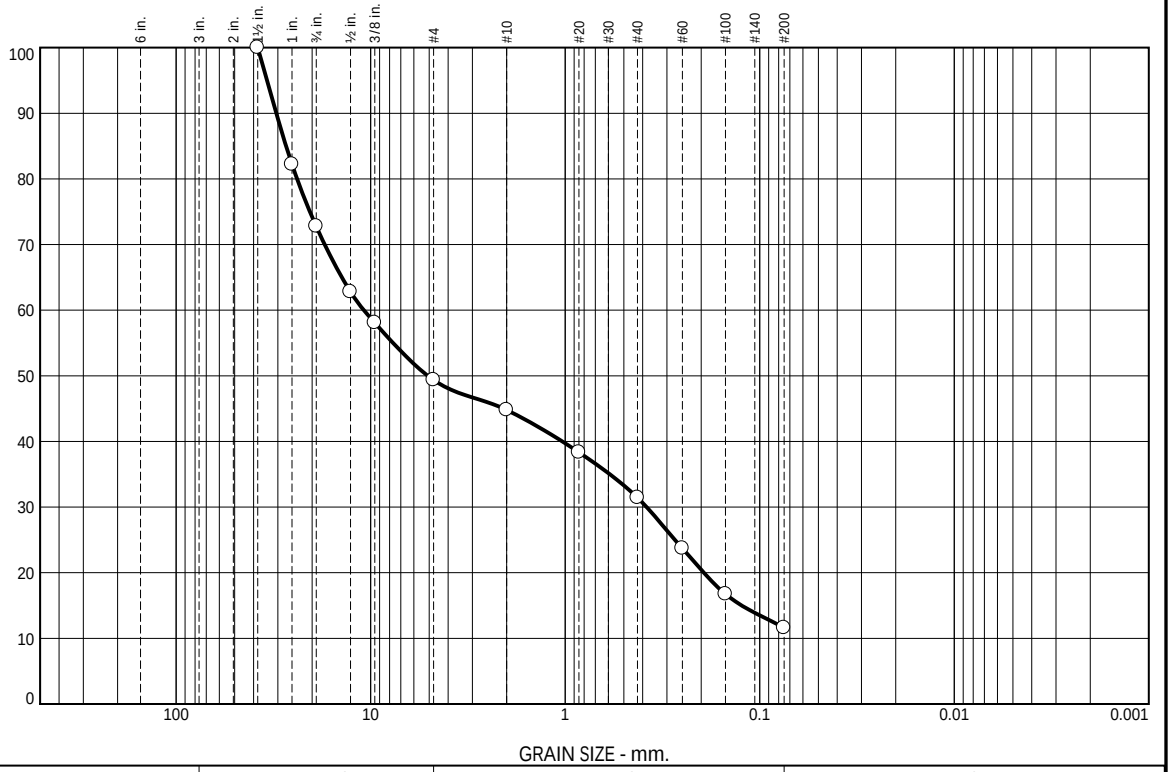
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-830

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

ASTM D6913 & D1140



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	27.2	23.4	4.6	13.4	19.8	11.6	

Test Results (ASTM D6913 & D1140)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1 1/2"	100.0			
1"	82.2			
3/4"	72.8			
1/2"	62.8			
3/8"	58.1			
#4	49.4			
#10	44.8			
#20	38.3			
#40	31.4			
#60	23.7			
#100	16.7			
#200	11.6			

* (no specification provided)

Material Description

Brown Sandy GRAVEL, little Silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 30.5388 D_{85}= 27.2227 D_{60}= 10.8537
D_{50}= 5.0847 D_{30}= 0.3812 D_{15}= 0.1239
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-b

Test Remarks

Source of Sample: HB Depth: 0-1.9'
Sample Number: HB-YR1-102 / 1D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

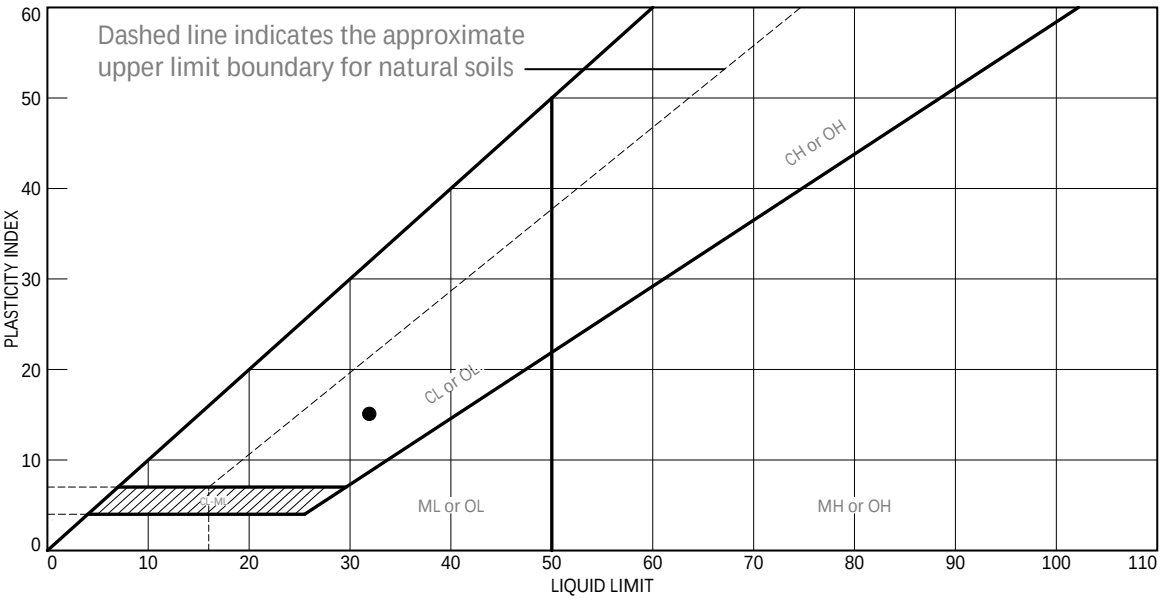
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-831

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown CLAY & SILT	32	17	15			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: HB Depth: 2-4'

Sample Number: HB-YR1-103 / 2D

Thielsch Engineering Inc.

Cranston, RI

Remarks:

Figure 22-L-832

Tested By: AV Checked By:

Particle Size Distribution Report

ASTM D6913 & D1140

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	1.3	6.2	48.1	42.0	

Test Results (ASTM D6913 & D1140)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1/2"	100.0			
3/8"	98.9			
#4	97.6			
#10	96.3			
#20	94.3			
#40	90.1			
#60	82.6			
#100	69.2			
#200	42.0			

* (no specification provided)

Material Description

Olive Silty SAND, trace fine Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4221 D_{85}= 0.2844 D_{60}= 0.1166
D_{50}= 0.0913 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/4"

Source of Sample: HB Depth: 4-6'
Sample Number: HB-YR1-103 / 3D Sample Date:

Thielsch Engineering Inc.
Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-833

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

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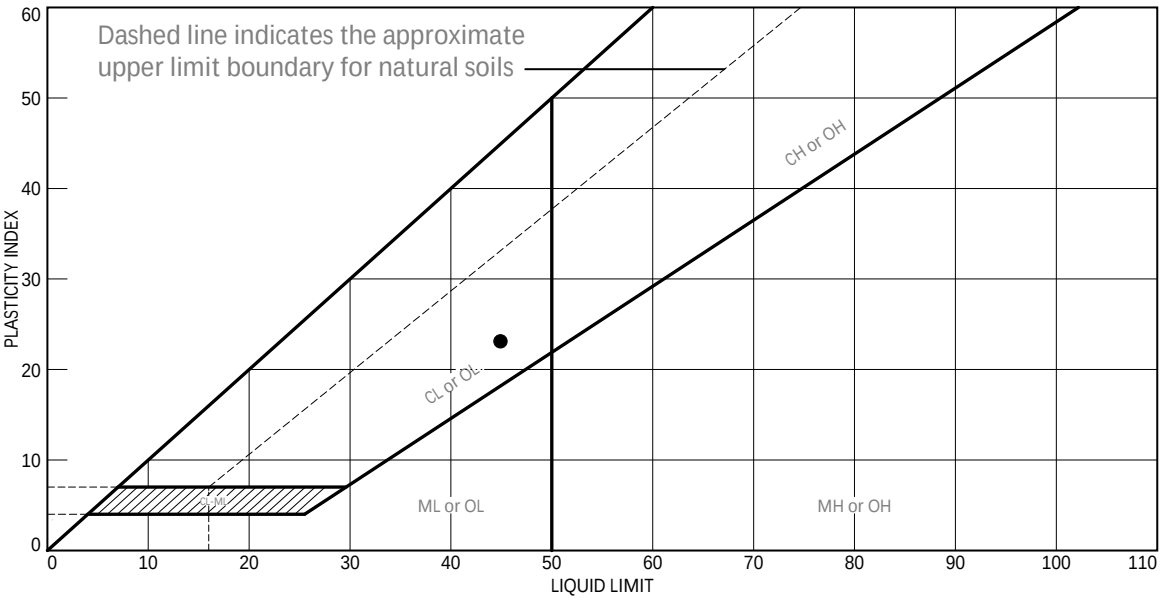
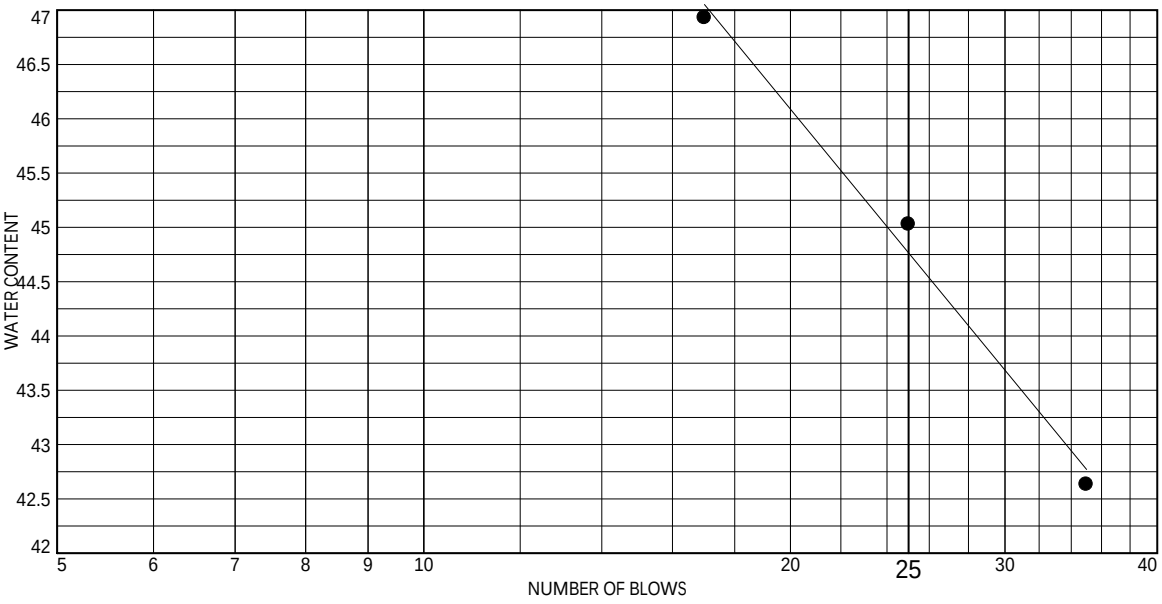
LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive Silty CLAY	45	22	23			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: HB Depth: 2-4'

Sample Number: HB-YR1-104 / 2D

Thielsch Engineering Inc.

Cranston, RI

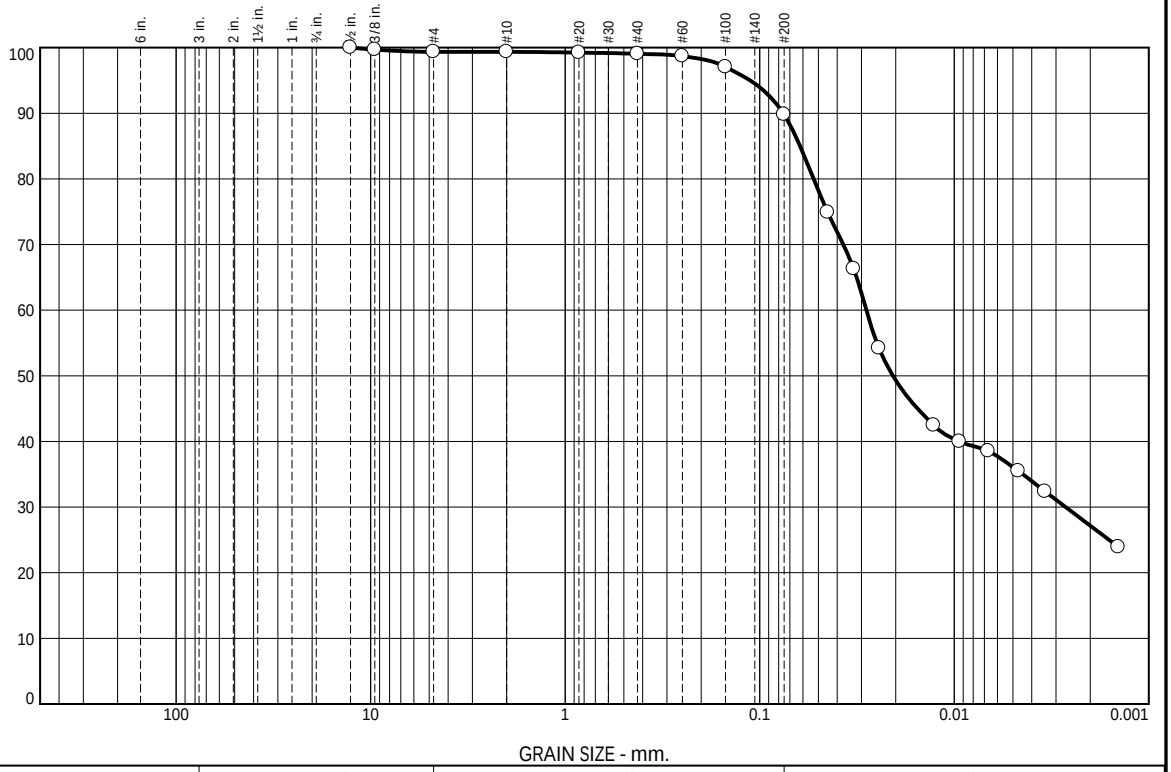
Remarks:

Figure 22-L-834

Tested By: SL Checked By:

Particle Size Distribution Report

ASTM D6913 & D1140, ASTM D7928



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	0.0	0.3	9.3	62.6	27.2

Test Results (ASTM D6913 & D1140, ASTM D7928)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1/2"	100.0			
3/8"	99.7			
#4	99.4			
#10	99.4			100.0
#20	99.2			99.9
#40	99.1			99.7
#60	98.7			99.3
#100	97.1			97.7
#200	89.8			90.4
0.0448 mm.	74.9			
0.0329 mm.	66.3			
0.0244 mm.	54.2			
0.0128 mm.	42.5			
0.0094 mm.	40.0			
0.0067 mm.	38.5			
0.0047 mm.	35.5			
0.0034 mm.	32.4			
0.0014 mm.	23.9			

* (no specification provided)

Material Description

Olive SILT & CLAY, trace fine Sand, trace fine Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0758 D_{85}= 0.0620 D_{60}= 0.0283
D_{50}= 0.0207 D_{30}= 0.0027 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Source of Sample: HB Depth: 8-10'
Sample Number: HB-YR1-104 / 5D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-835

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

ASTM D6913

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	0.5	30.7	68.6	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
#4	100.0			
#10	99.8			
#20	99.6			
#40	99.3			
#60	98.4			
#100	92.7			
#200	68.6			

* (no specification provided)

Material Description

Olive SILT & CLAY, some fine Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1355 D_{85}= 0.1162 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(5)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Source of Sample: HB Depth: 2-4'
Sample Number: HB-YR1-105 / 2D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-836

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

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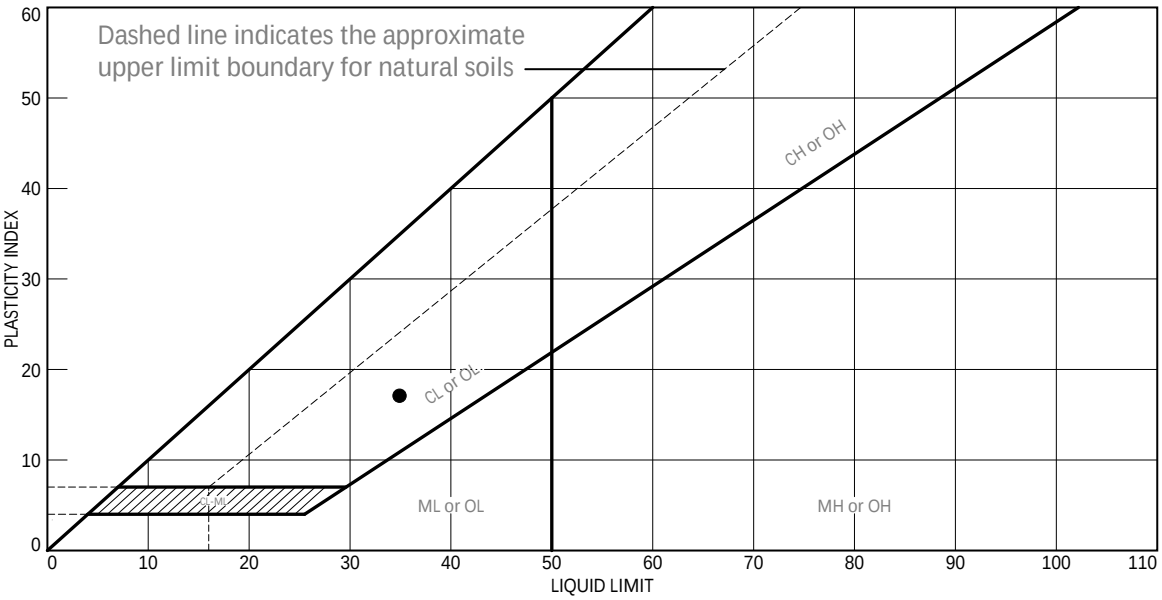
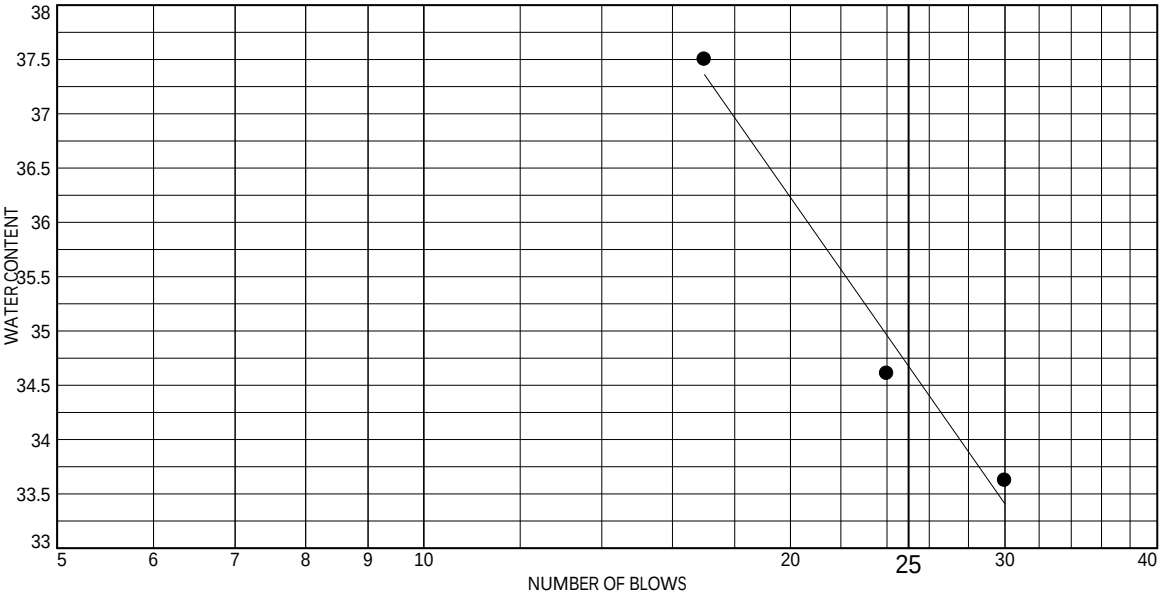
LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive-Gray CLAY & SILT	35	18	17			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: HB Depth: 6-8'

Sample Number: HB-YR1-105 / 4D

Thielsch Engineering Inc.

Cranston, RI

Remarks:

Figure 22-L-837

Tested By: SL Checked By:

Particle Size Distribution Report

ASTM D6913

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	17.6	63.5	18.7	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
#4	100.0			
#10	99.8			
#20	98.7			
#40	82.2			
#60	45.7			
#100	30.4			
#200	18.7			

* (no specification provided)

Material Description

Olive-Brown f-m SAND, little Silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.5185 D_{85}= 0.4532 D_{60}= 0.3093
D_{50}= 0.2695 D_{30}= 0.1474 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Source of Sample: HB Depth: 25-27'
Sample Number: HB-YR1-105 / 7D Sample Date:

Thielsch Engineering Inc.
Cranston, RI

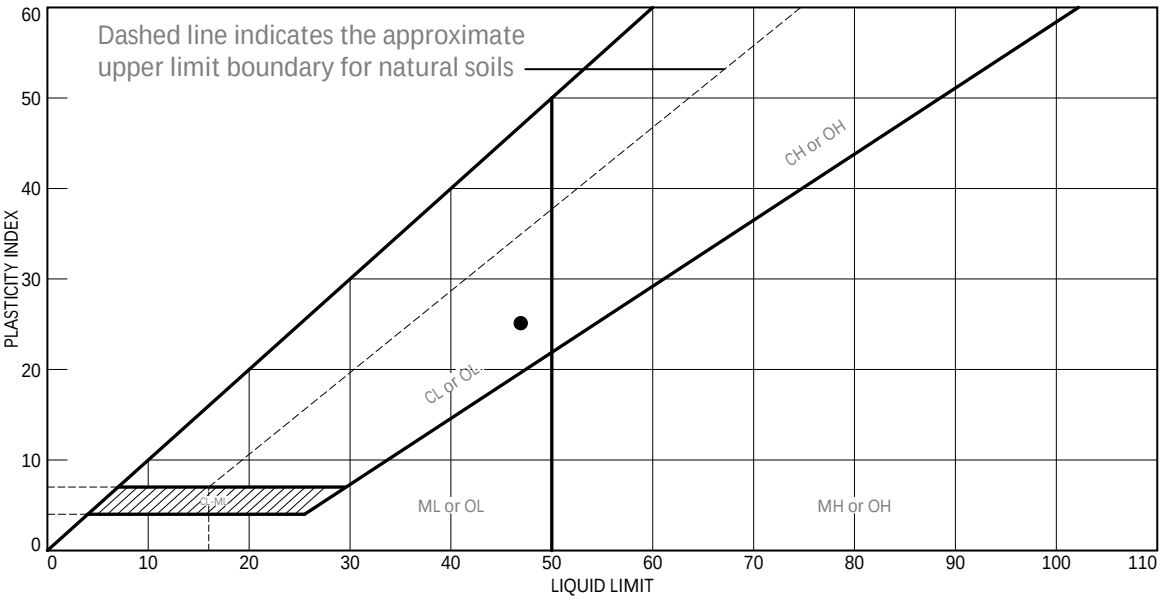
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-838

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive Silty CLAY	47	22	25			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 6-8'

Sample Number: BB-YR1-101 / 4D

Thielsch Engineering Inc.

Cranston, RI

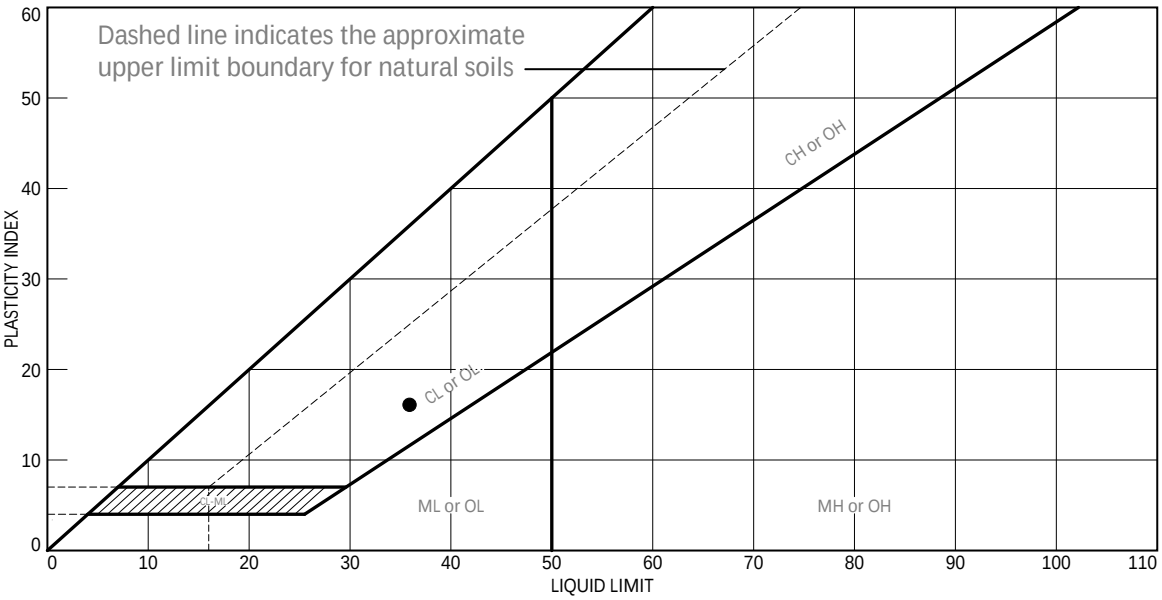
Remarks:

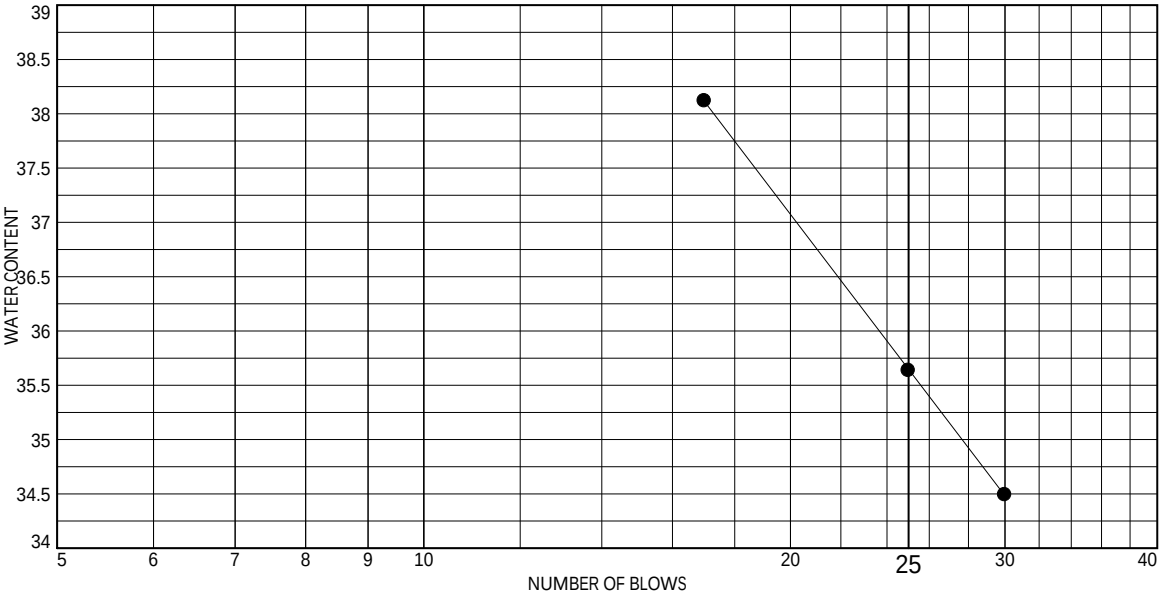
Figure 22-L-839

Tested By: SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive CLAY & SILT	36	20	16			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 10-12'

Sample Number: BB-YR1-101 / 6D

Thielsch Engineering Inc.

Cranston, RI

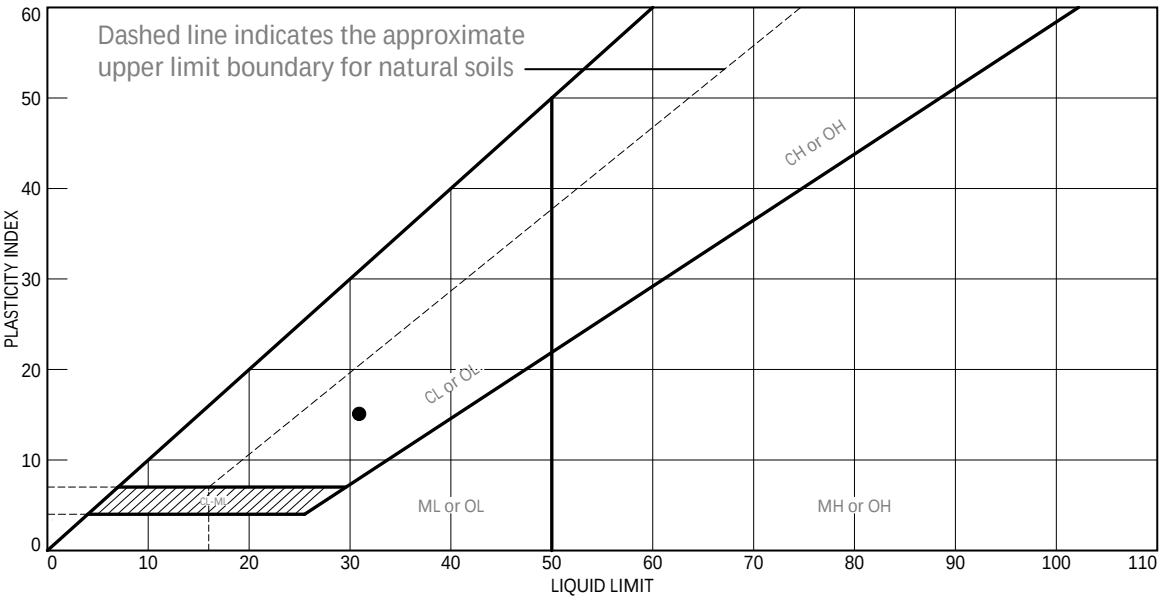
Remarks:

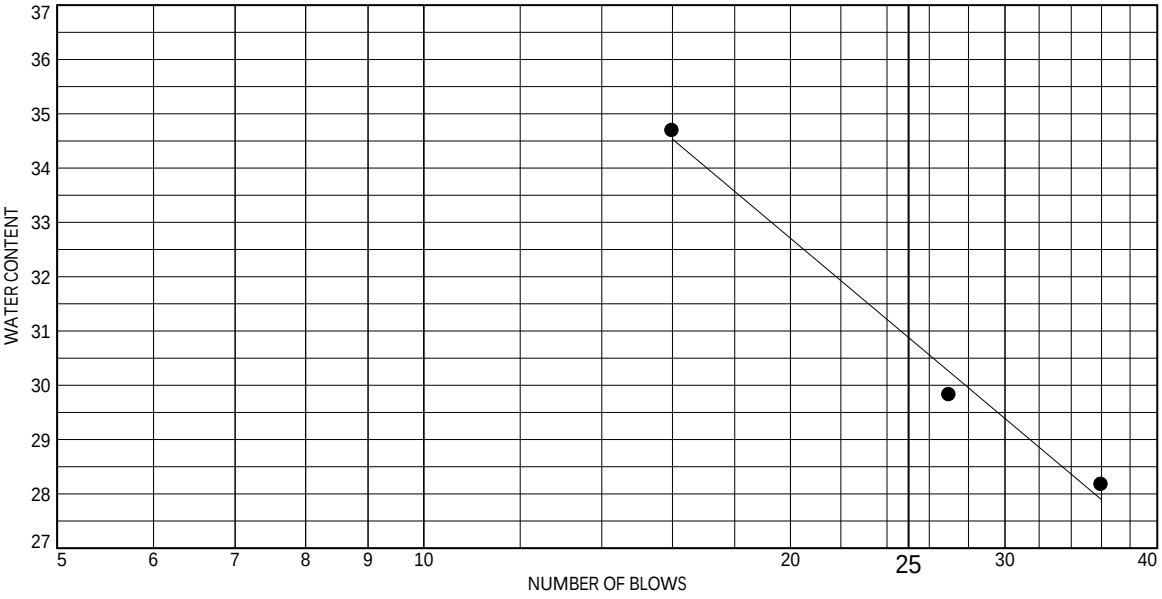
Figure 22-L-840

Tested By: SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray CLAY & SILT	31	16	15			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 14-15'

Sample Number: BB-YR1-101 / 6D

Thielsch Engineering Inc.

Cranston, RI

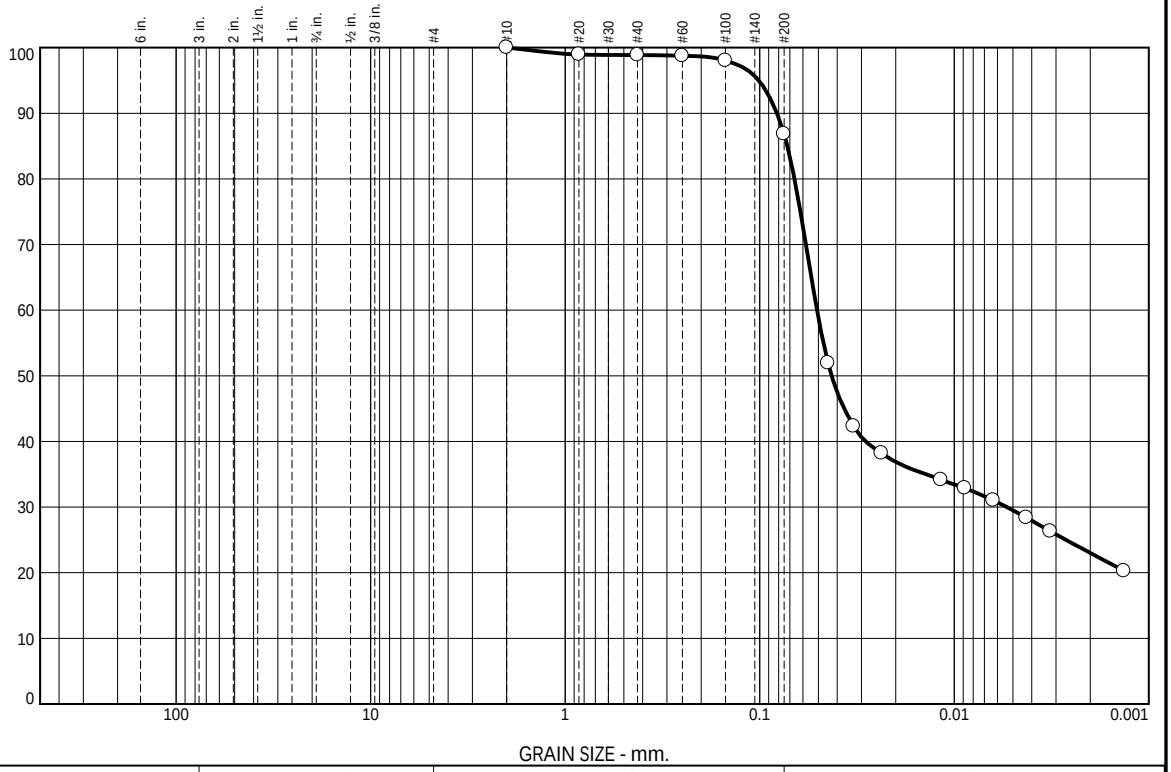
Remarks:

Figure 22-L-841

Tested By: SL Checked By:

Particle Size Distribution Report

ASTM D6913 and ASTM D7928



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.1	12.0	63.9	23.0

Test Results (ASTM D6913 and ASTM D7928)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
#10	100.0			
#20	99.0			
#40	98.9			
#60	98.7			
#100	98.0			
#200	86.9			
0.0446 mm.	51.9			
0.0329 mm.	42.3			
0.0237 mm.	38.2			
0.0117 mm.	34.1			
0.0088 mm.	32.9			
0.0063 mm.	31.0			
0.0043 mm.	28.4			
0.0032 mm.	26.3			
0.0013 mm.	20.3			

* (no specification provided)

Material Description

Olive-Gray SILT & CLAY, little fine Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.0816 D_{85}= 0.0721 D_{60}= 0.0508
D_{50}= 0.0427 D_{30}= 0.0054 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Source of Sample: BB Depth: 20-22'
Sample Number: BB-YR1-101 / 8D Sample Date:

Thielsch Engineering Inc.
Cranston, RI

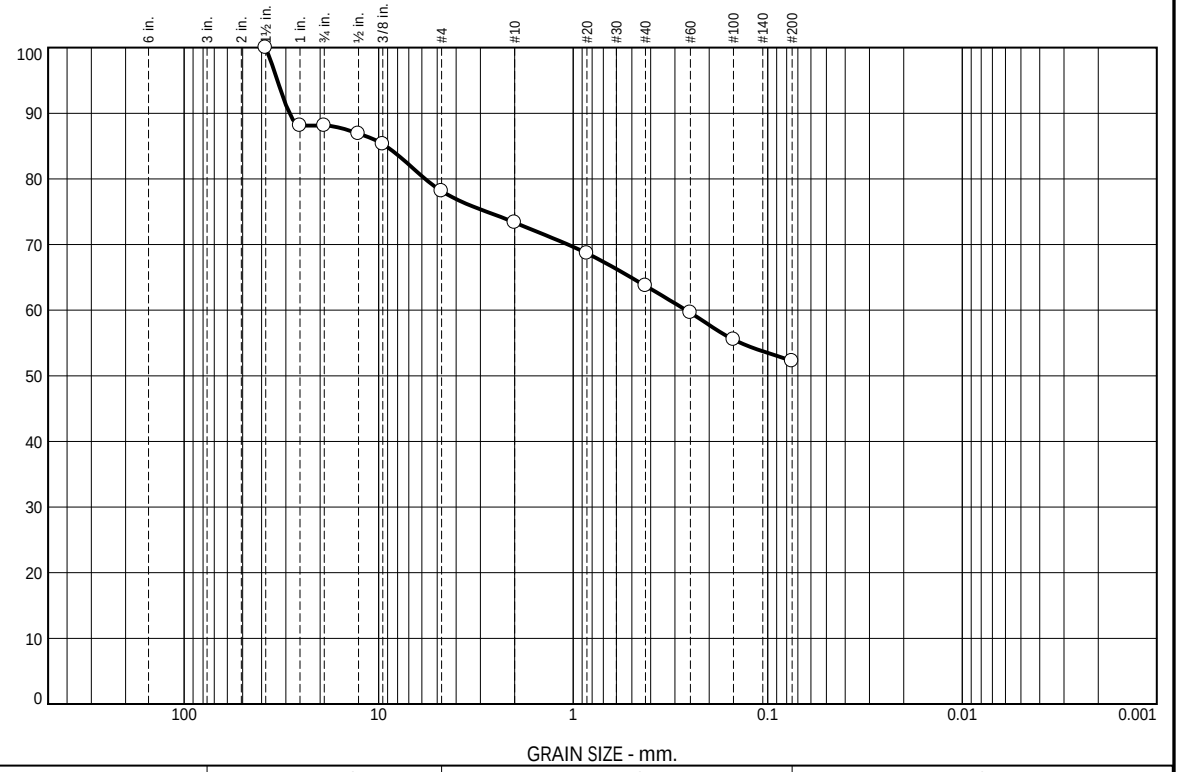
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-842

Tested By: JF / SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.9	10.0	4.7	9.7	11.5	52.2	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1 1/2"	100.0			
1"	88.1			
3/4"	88.1			
1/2"	86.9			
3/8"	85.3			
#4	78.1			
#10	73.4			
#20	68.7			
#40	63.7			
#60	59.6			
#100	55.5			
#200	52.2			

* (no specification provided)

Material Description

Olive-Gray SILT & CLAY, some f-c Sand, some f-c Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 28.7502 D_{85}= 9.1722 D_{60}= 0.2629
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(2)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Source of Sample: BB Depth: 30-30.7'
Sample Number: BB-YR1-101 / 10D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-843

Tested By: SF Checked By:

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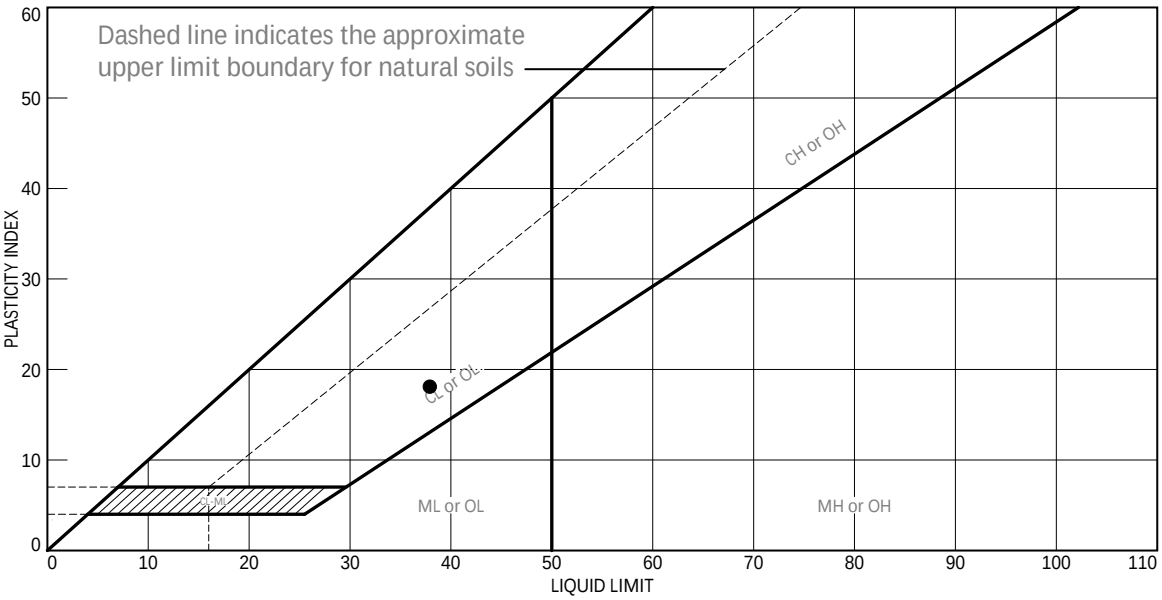
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive-Gray CLAY & SILT	38	20	18			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 2-4'

Sample Number: BB-YR1-103 / 2D

Thielsch Engineering Inc.

Cranston, RI

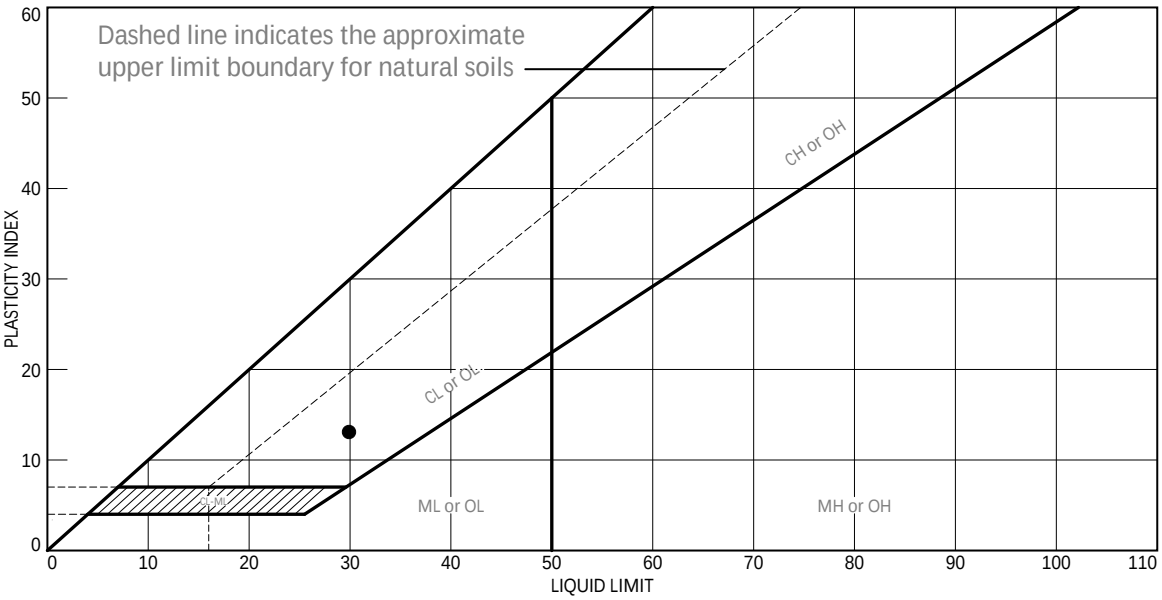
Remarks:

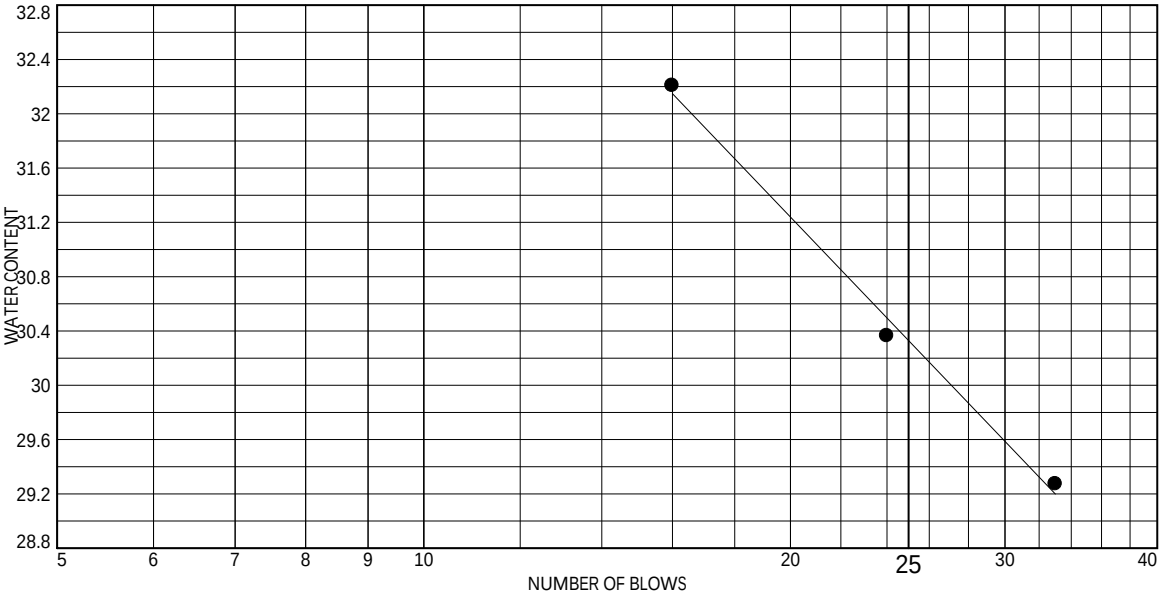
Figure 22-L-844

Tested By: SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray CLAY & SILT	30	17	13			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 4-6'

Sample Number: BB-YR1-103 / 3D

Thielsch Engineering Inc.

Cranston, RI

Remarks:

Figure 22-L-845

Tested By: SL Checked By:

Particle Size Distribution Report

ASTM D6913

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.4	6.0	6.3	25.7	33.6	18.0	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1"	100.0			
3/4"	89.6			
1/2"	89.6			
3/8"	89.6			
#4	83.6			
#10	77.3			
#20	66.0			
#40	51.6			
#60	38.5			
#100	26.3			
#200	18.0			

* (no specification provided)

Material Description

Light Gray f-m SAND, little Silt, little f-c Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 19.8616 D_{85}= 5.4878 D_{60}= 0.6202
D_{50}= 0.3961 D_{30}= 0.1786 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Source of Sample: BB Depth: 20-22'
Sample Number: BB-YR1-103 / 7D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

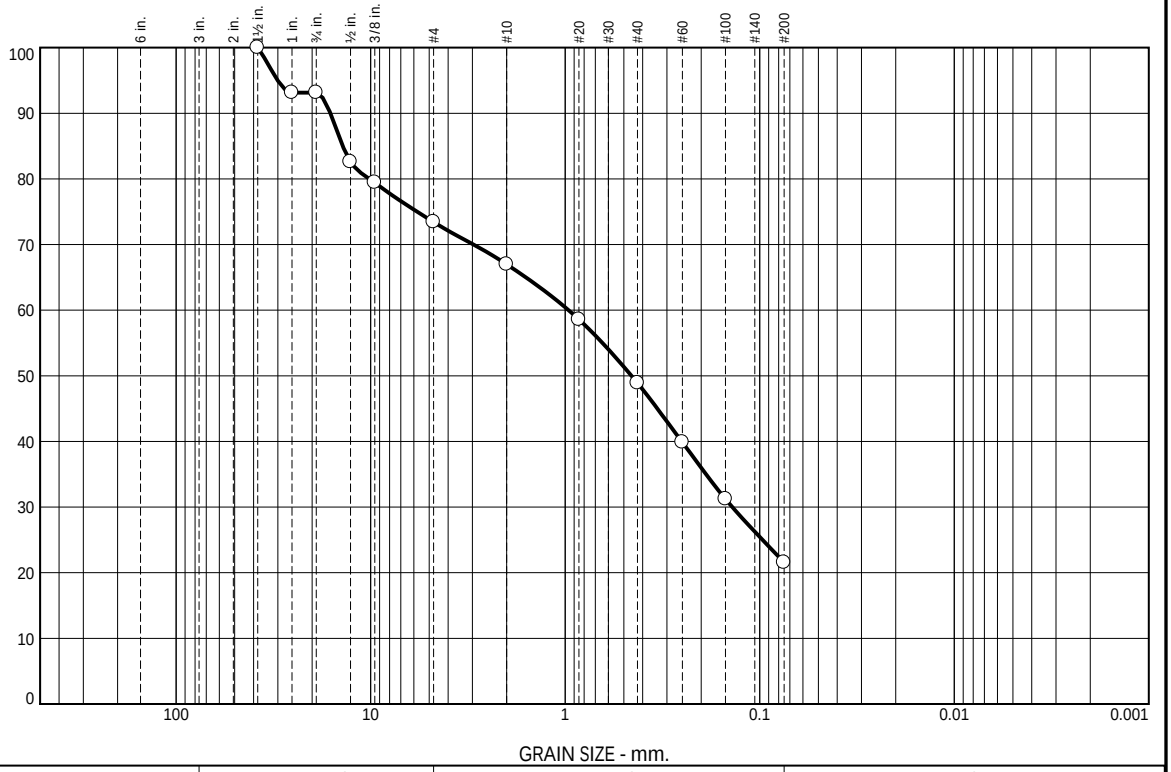
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-846

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	19.7	6.4	18.1	27.4	21.5	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1 1/2"	100.0			
1"	93.1			
3/4"	93.1			
1/2"	82.6			
3/8"	79.4			
#4	73.4			
#10	67.0			
#20	58.6			
#40	48.9			
#60	39.9			
#100	31.2			
#200	21.5			

* (no specification provided)

Material Description

Gray f-c SAND, some f-c Gravel, some Silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 16.1249 D_{85}= 13.9262 D_{60}= 0.9618
D_{50}= 0.4565 D_{30}= 0.1384 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Test Remarks

Source of Sample: BB Depth: 35-37'
Sample Number: BB-YR1-103 / 10D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

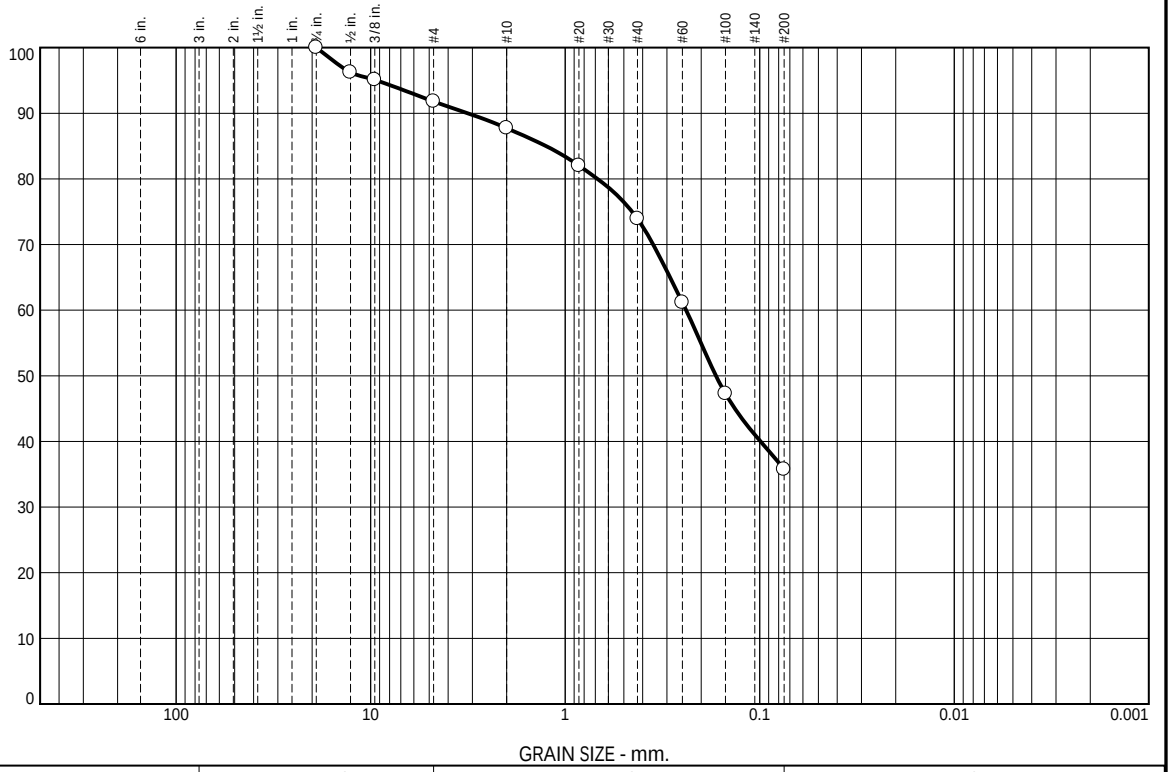
Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-847

Tested By: SL / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.2	4.1	13.8	38.2	35.7	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3/4"	100.0			
1/2"	96.2			
3/8"	95.1			
#4	91.8			
#10	87.7			
#20	82.0			
#40	73.9			
#60	61.2			
#100	47.3			
#200	35.7			

* (no specification provided)

Material Description

Dark Gray Silty SAND, trace fine Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 3.1762 D_{85}= 1.2542 D_{60}= 0.2391
D_{50}= 0.1679 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Test Remarks

Source of Sample: BB Depth: 50-51.2'
Sample Number: BB-YR1-103 / 13D Sample Date:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-848

Tested By: SF / JF Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

THIELSCH ENGINEERING
195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
GZA GeoEnvironmental
South Portland, ME
PM: B. Cardali
Assigned By: B. Cardali
Collected By: Emma Tombaugh

Project Information:
Rt 1 Bridge 5804 Replacement, MEDOT WIN 22382.00
Yarmouth, ME
GZA Project Number: 09.0026144.00
Summary Page: 1 of 1
Report Date: 04.22.22

LABORATORY TESTING DATA SHEET, Report No.: 7422-D-141

Boring No.	Sample No.	Depth (ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Moisture Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	pH	Dry unit wt. (pcf)	Test Moisture Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D4792			D1557						
BB-YR1-102	4D	6-8	22-S-1263	23.1	28	16														Olive Gray CLAY & SILT
BB-YR1-102	6D	14-16	22-S-1264	27.5	28	16														Gray CLAY & SILT
BB-YR1-102	9D	29-31	22-S-1265				7.5	69.2	23.3											Gray f-m SAND, some Silt, trace fine Gravel

Date Received: *04.15.22*

Reviewed By:

Date Reviewed: *04.25.22*

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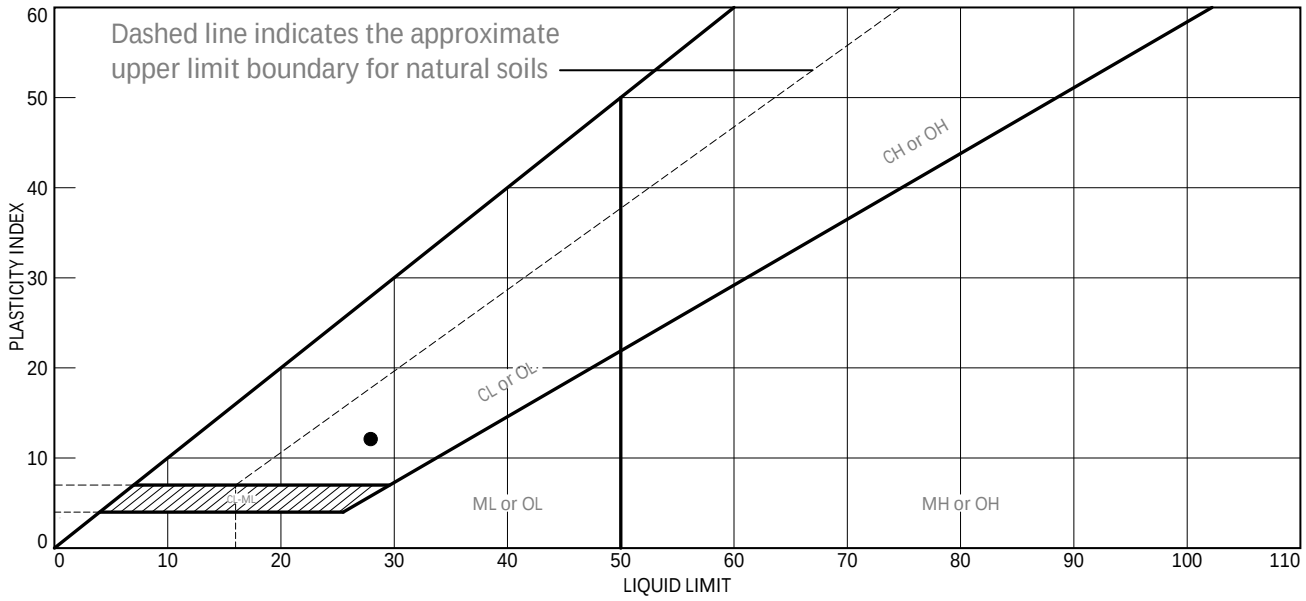
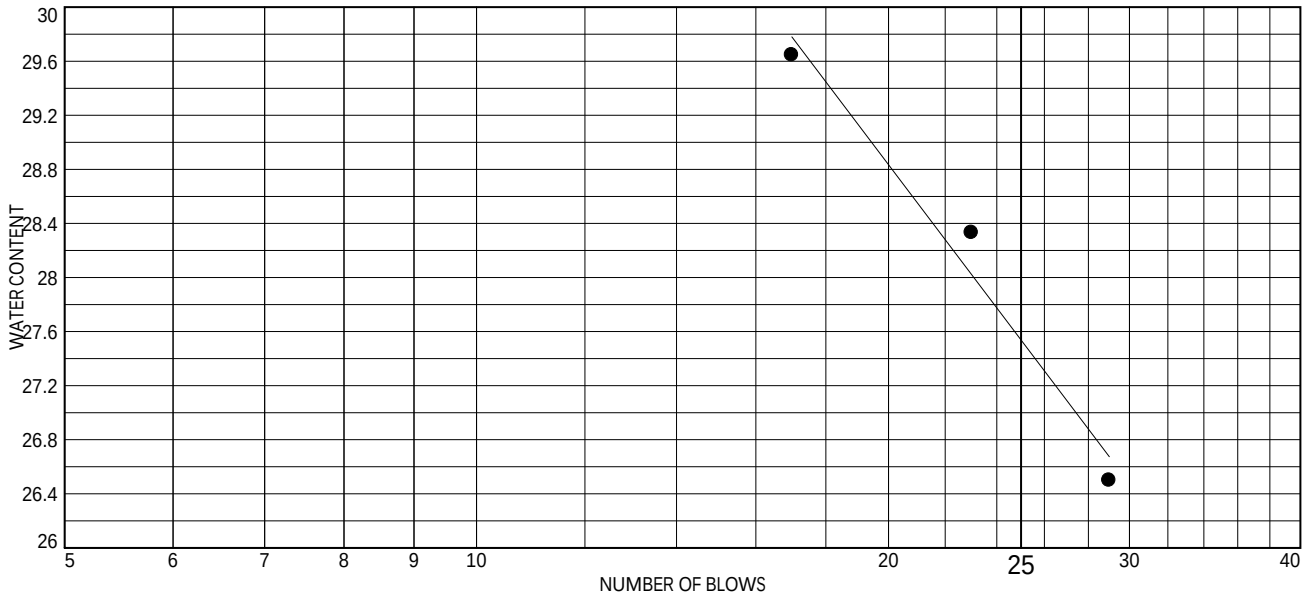
LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive Gray CLAY & SILT	28	16	12			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 6-8'

Sample Number: BB-YR1-102 / 4D

Thielsch Engineering Inc.

Cranston, RI

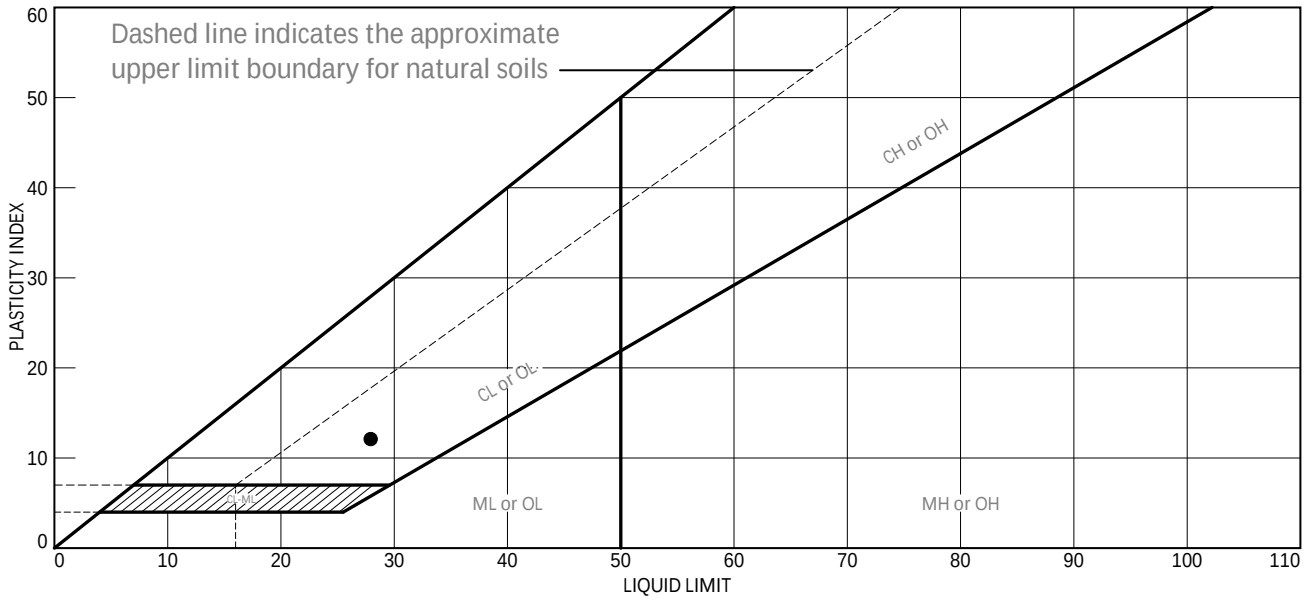
Remarks:

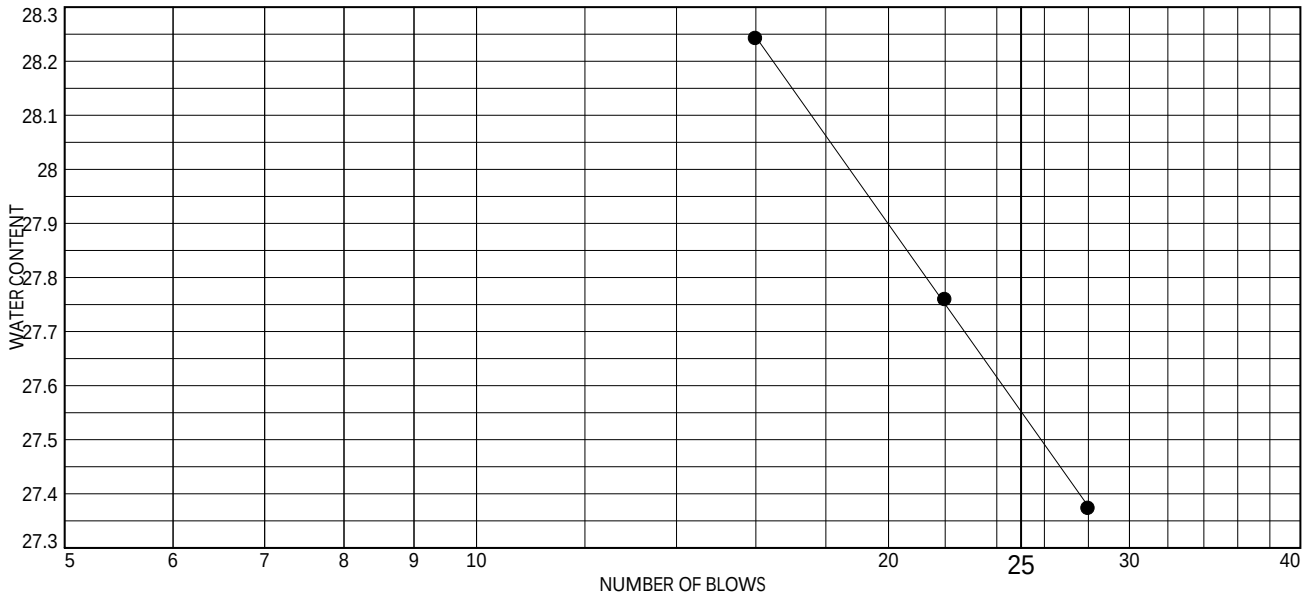
Figure 22-L-1263

Tested By: SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray CLAY & SILT	28	16	12			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: Rt 1 Bridge No. 5804 Replacement

MEDOT WIN 22382.00

Source of Sample: BB Depth: 14-16'

Sample Number: BB-YR1-102 / 6D

Thielsch Engineering Inc.

Cranston, RI

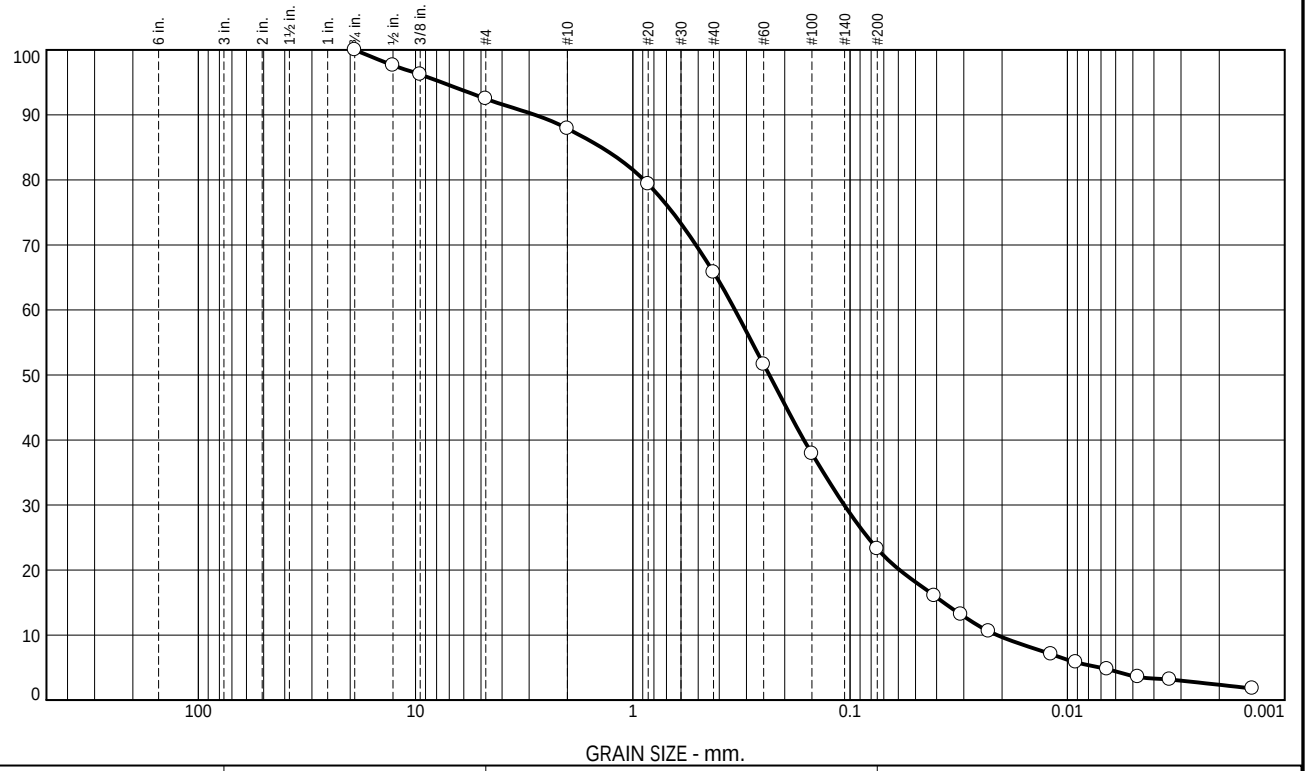
Remarks:

Figure 22-L-1264

Tested By: SL Checked By:

Particle Size Distribution Report

ASTM D6913 and ASTM D7928



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.5	4.6	22.1	42.5	20.9	2.4

Test Results (ASTM D6913 and ASTM D7928)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3/4"	100.0			
1/2"	97.6			
3/8"	96.2			
#4	92.5			
#10	87.9			95.0
#20	79.4			85.8
#40	65.8			71.2
#60	51.6			55.8
#100	37.9			41.0
#200	23.3			25.2
0.0409 mm.	16.1			
0.0309 mm.	13.2			
0.0230 mm.	10.6			
0.0119 mm.	7.1			
0.0091 mm.	5.8			
0.0066 mm.	4.8			
0.0047 mm.	3.6			
0.0034 mm.	3.2			
0.0014 mm.	1.8			

* (no specification provided)

Material Description

Gray f-m SAND, some Silt, trace fine Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 2.8215 D_{85}= 1.3952 D_{60}= 0.3387
D_{50}= 0.2355 D_{30}= 0.1064 D_{15}= 0.0371
D_{10}= 0.0211 C_u= 16.08 C_c= 1.59

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Source of Sample: BB Depth: 29-31'
Sample Number: BB-YR1-102 / 9D Sample Date: 04.20.22

Thielsch Engineering Inc.
Cranston, RI

Client: GZA GeoEnvironmental
Project: Rt 1 Bridge No. 5804 Replacement
MEDOT WIN 22382.00
Project No: 09.0026144.00 Figure 22-S-1265

Tested By: FR / SL Checked By:

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Thielsch
DIVISION OF THE RISE GROUP

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
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cts.thielsch.com
Let's Build a Solid Foundation

Client Information:	
GZA GeoEnvironmental	
S. Portland, ME	
Project Manager:	John Cozens
Assigned By:	John Cozens
Collected By:	GZA

Project Information:	
US Rt 1, Yarmouth Bridge No. 5804	
Bridge #5804 over I-295	
Project Number:	09.0026144.00
Summary Page:	1 of 1
Report Date:	5/31/2024

LABORATORY TESTING DATA SHEET, Report No.: 7424-E-211

Material Source	Sample ID	Depth (ft)	Laboratory No.	Identification Tests										Proctor / CBR / Permeability Tests							Laboratory Log and Soil Description
				As Rcvd Moisture Content %	LL %	PL %	OD LL	Gravel %	Sand %	Fines %	Org. %	pH	g_d MAX (pcf) W_{opt} (%)	g_d MAX (pcf) W_{opt} (%) (Corr.)	Dry unit wt. (pcf)	Test Moisture Content %	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318			C136			D2974	D4792	D1557								
BB-YR1-201	2D	2-4	24-S-1968	24.3	43	21															Brown Silty CLAY
BB-YR1-201	5D	8-10	24-S-1969	23.0	28	15															Olive CLAY & SILT
BB-YR1-201	6D	20-22	24-S-1970					14.6	74.3	11.1											Grey f-m SAND, little fine Gravel, little Silt
BB-YR1-202	2D	2-4	24-S-1971	25.3	32	17															Brown CLAY & SILT
BB-YR1-202	4D	6-8	24-S-1972	22.4	36	17															Olive CLAY & SILT
BB-YR1-202	5D	8-10	24-S-1973	32.2	39	18															Grey Silty CLAY
BB-YR1-202	7D-A	15-17	24-S-1974					0.0	28.2	71.8											Grey SILT & CLAY, some fine Sand
BB-YR1-202	10D	30-32	24-S-1975					14.8	54.6	30.6											Grey f-m SAND, some Clayey SILT, little f-c
HB-YR1-201	2D	2-4	24-S-1976					3.5	66.2	30.3											Brown f-c SAND, some Silt, trace fine Gravel
HB-YR1-201	3D	5-7	24-S-1977					2.1	68.4	29.5											Olive f-m SAND, some Silt, trace fine Gravel

Date Received: **5/22/2024**

Reviewed By:

Date Reviewed: **5/31/2024**

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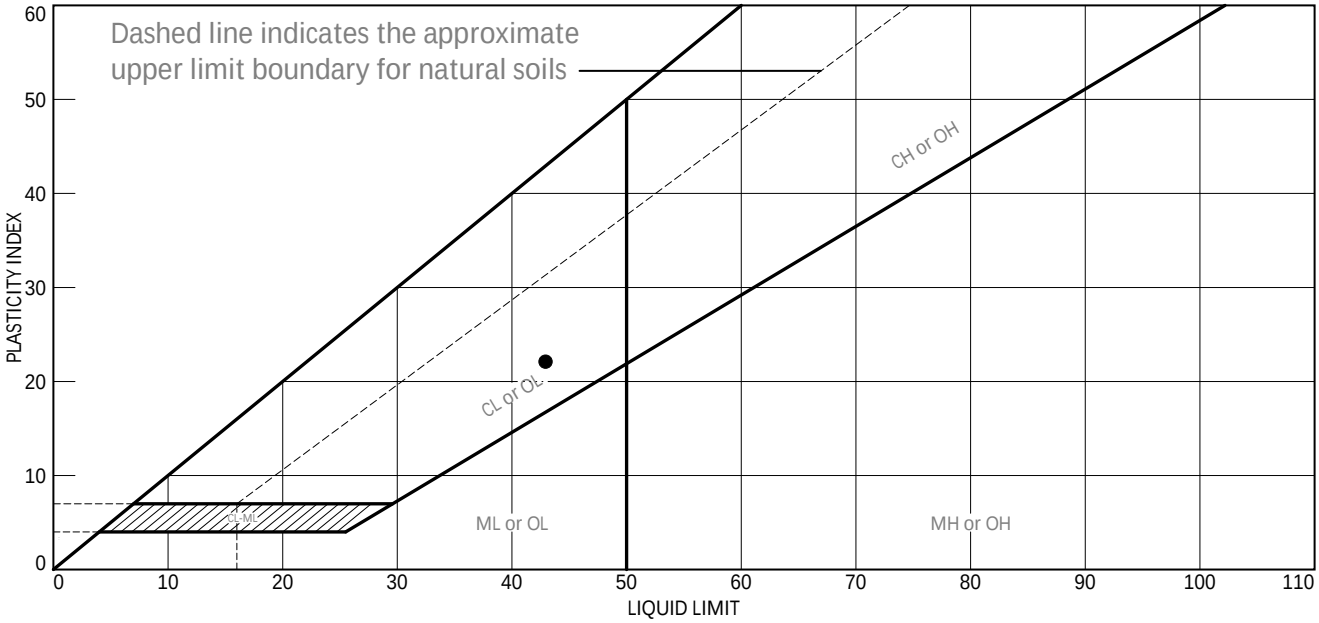
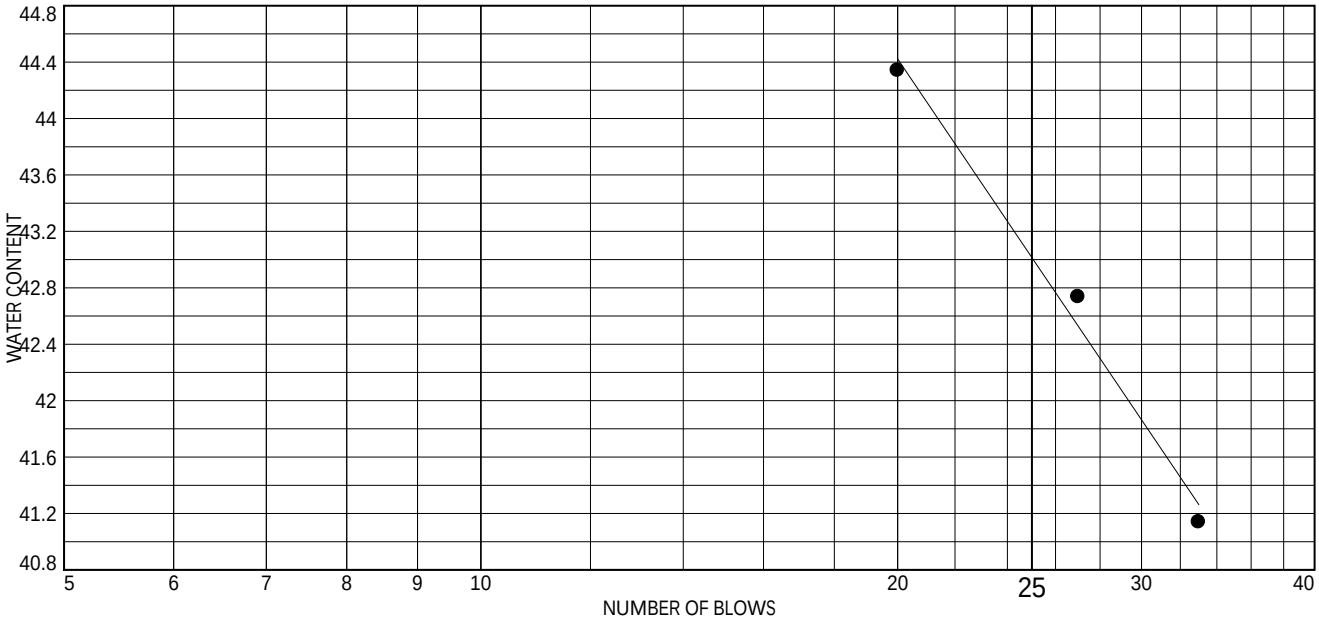
LIQUID AND PLASTIC LIMITS TEST REPORT





MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
● Brown Silty CLAY	43	21	22			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: U.S. Rt 1, Yarmouth Bridge No. 5804

Bridge #5804 over I-295

Source of Sample: BB-YR1-201 Depth: 2-4'

Sample Number: 2D

Thielsch Engineering Inc.

Cranston, RI

Remarks:

Fig. 24-L-1968

Tested By: SL Checked By: Rebecca Roth

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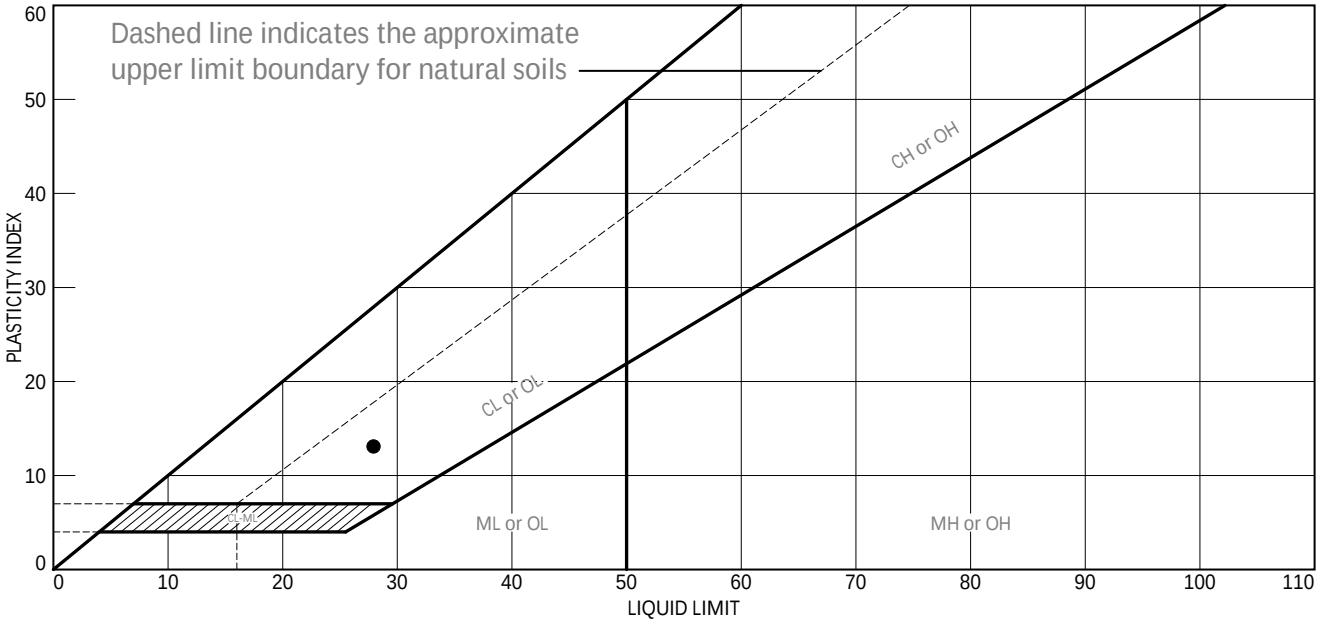
LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
● Olive CLAY & SILT	28	15	13			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: U.S. Rt 1, Yarmouth Bridge No. 5804

Bridge #5804 over I-295

Source of Sample: BB-YR1-201 Depth: 8-10'

Sample Number: 5D

Thielsch Engineering Inc.

Cranston, RI

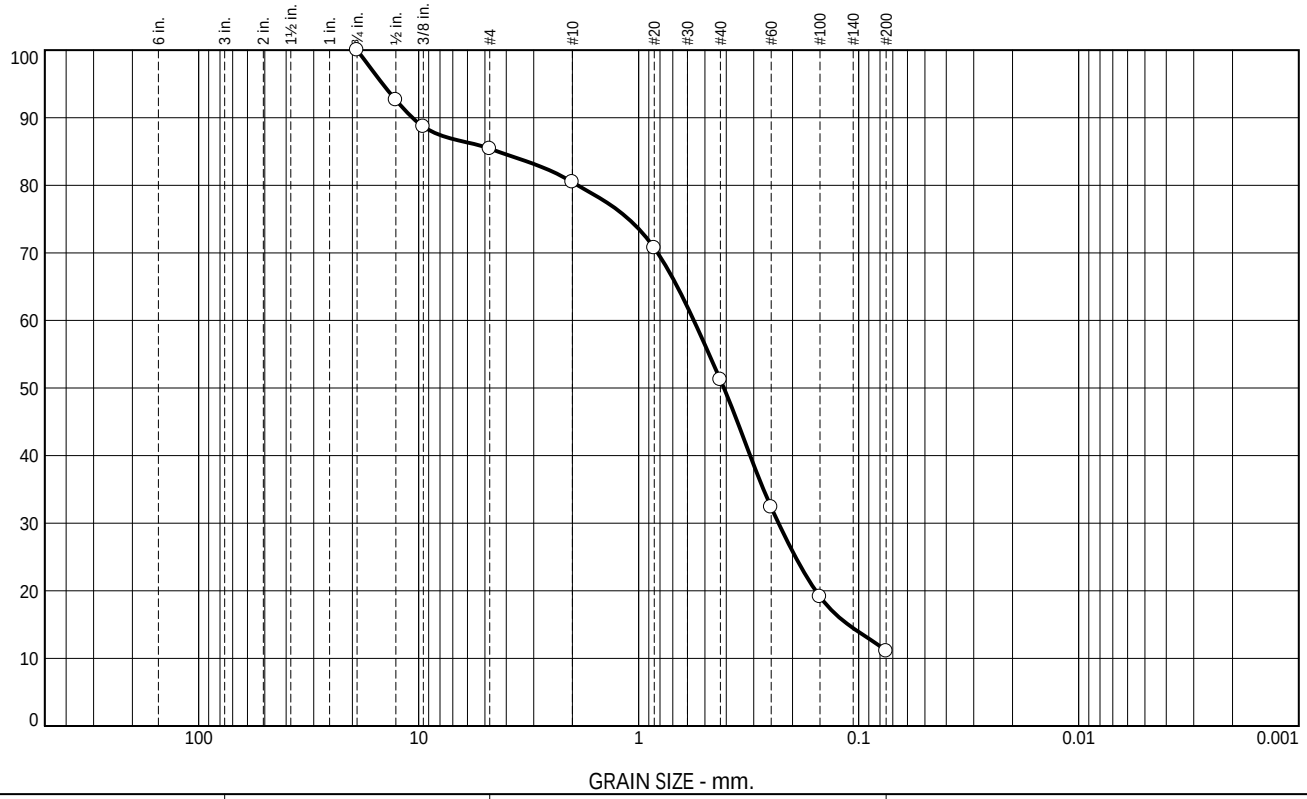
Remarks:

Fig. 24-L-1969

Tested By: SL Checked By: Rebecca Roth

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.6	4.9	29.3	40.1	11.1	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3/4"	100.0			
1/2"	92.6			
3/8"	88.7			
#4	85.4			
#10	80.5			
#20	70.7			
#40	51.2			
#60	32.4			
#100	19.1			
#200	11.1			

* (no specification provided)

Material Description

Grey f-m SAND, little fine Gravel, little Silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 10.6802 D_{85}= 4.3769 D_{60}= 0.5617
D_{50}= 0.4095 D_{30}= 0.2312 D_{15}= 0.1116
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-2-4(0)

Test Remarks

Source of Sample: BB-YR1-201 Depth: 20-22'
Sample Number: 6D Sample Date: 05.30.21

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: U.S. Rt 1, Yarmouth Bridge No. 5804
Bridge #5804 over I-295
Project No: 09.0026144.00 Fig. 24-S-1970

Tested By: MCS Checked By: Rebecca Roth

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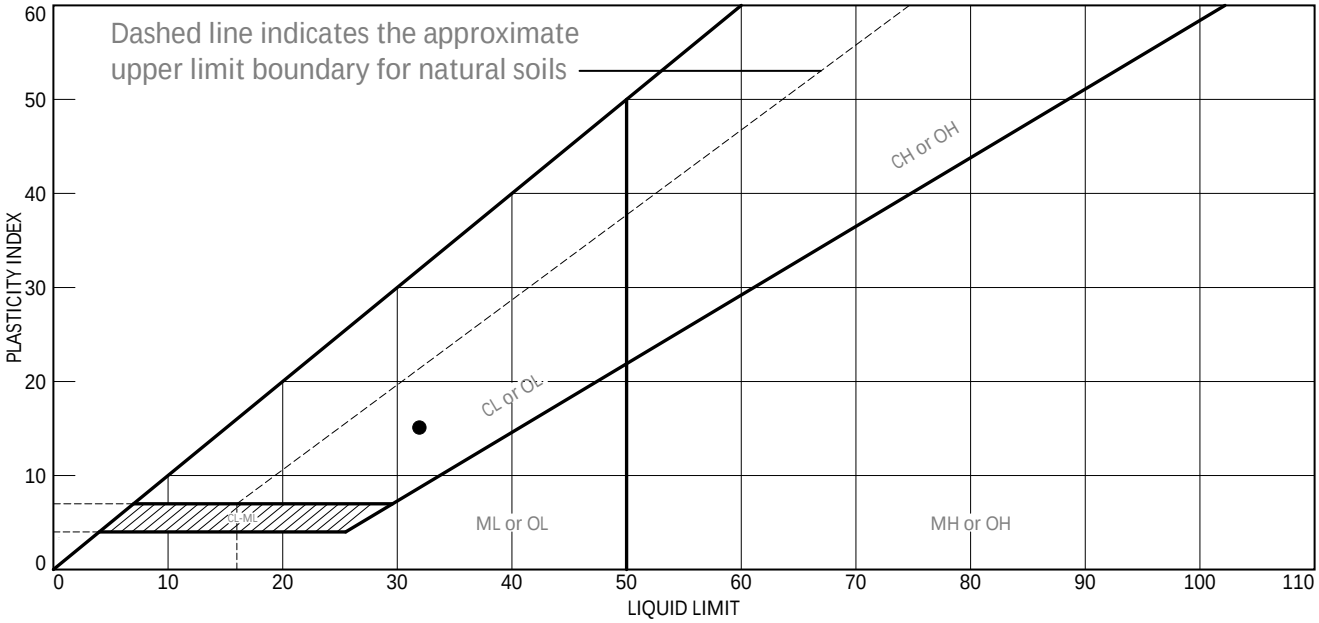
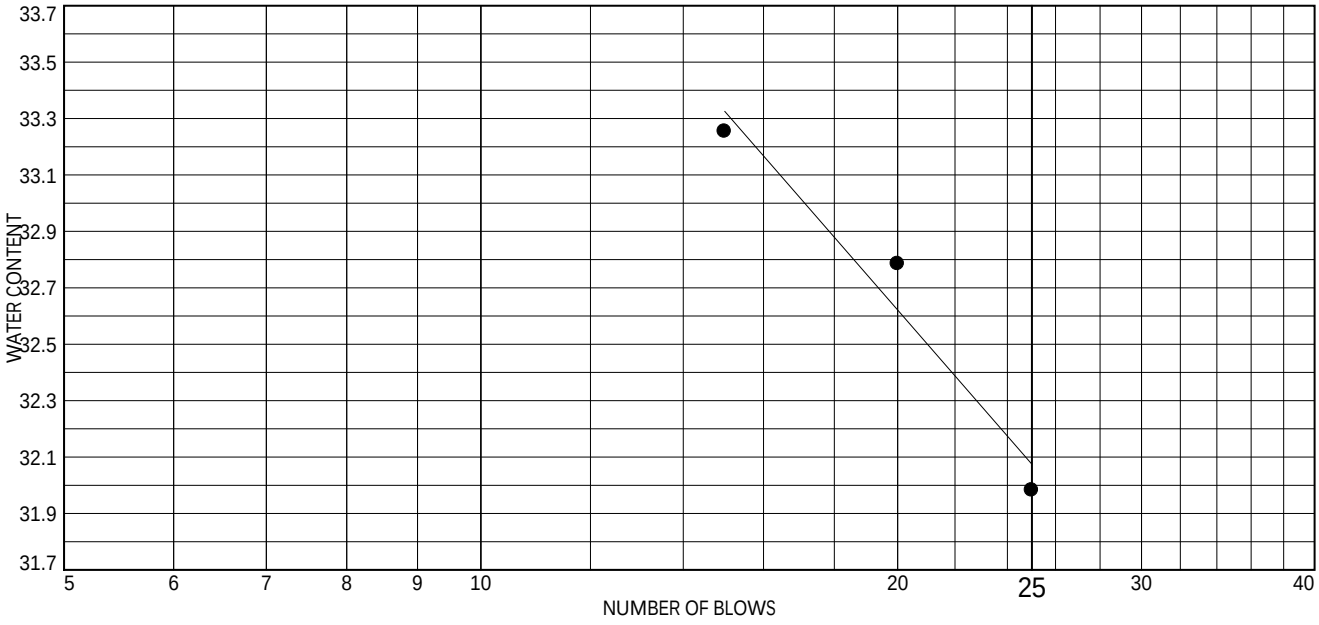
LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown CLAY & SILT	32	17	15			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: U.S. Rt 1, Yarmouth Bridge No. 5804

Bridge #5804 over I-295

Source of Sample: BB-YR1-202 Depth: 2-4'

Sample Number: 2D

Thielsch Engineering Inc.

Cranston, RI

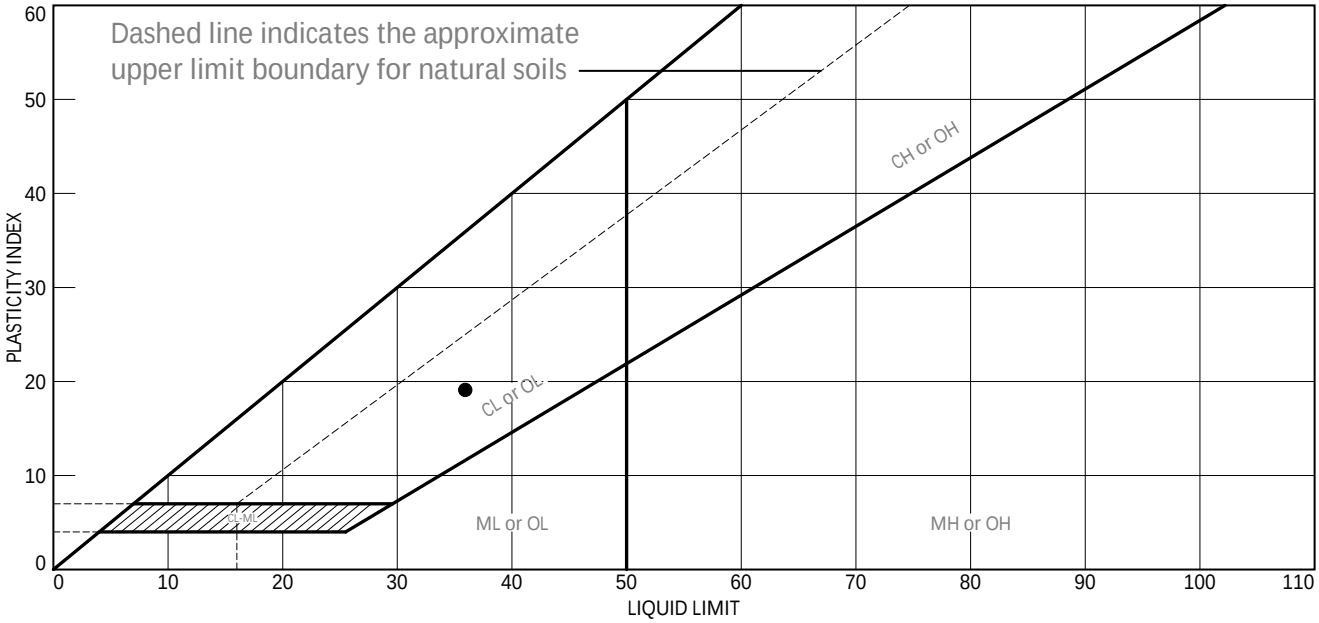
Remarks:

Fig. 24-L-1971

Tested By: RB Checked By: Rebecca Roth

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive CLAY & SILT	36	17	19			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: U.S. Rt 1, Yarmouth Bridge No. 5804

Bridge #5804 over I-295

Source of Sample: BB-YR1-202 Depth: 6-8'

Sample Number: 4D

Thielsch Engineering Inc.

Cranston, RI

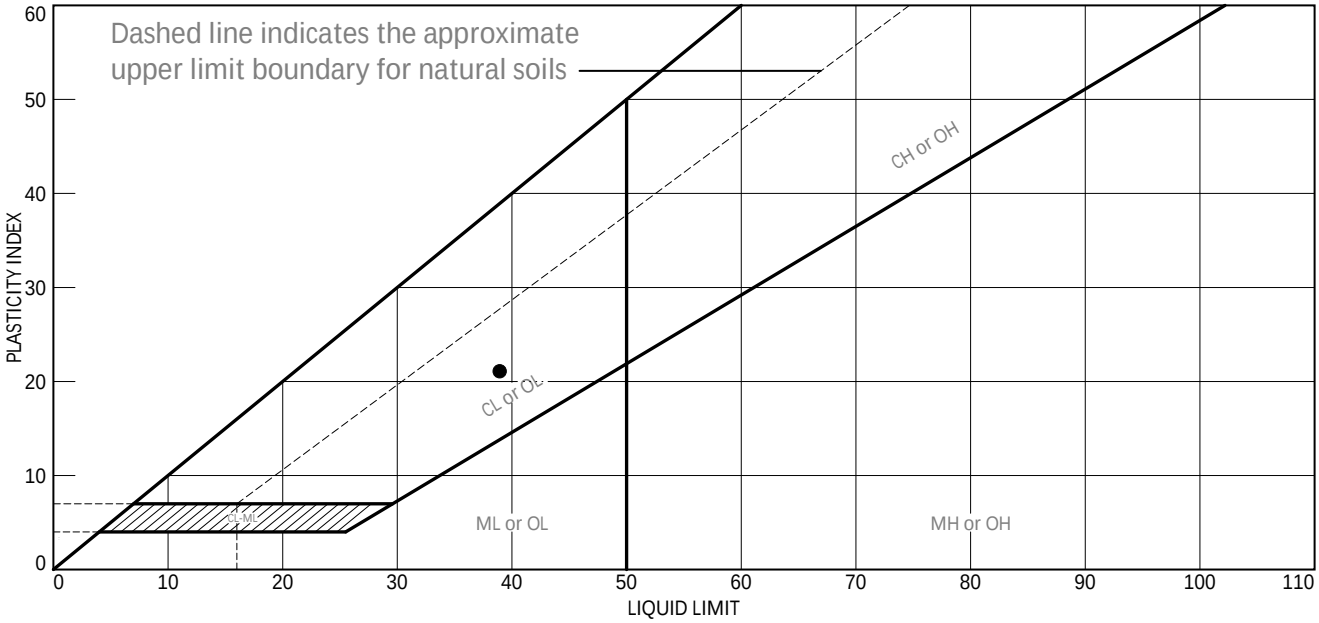
Remarks:

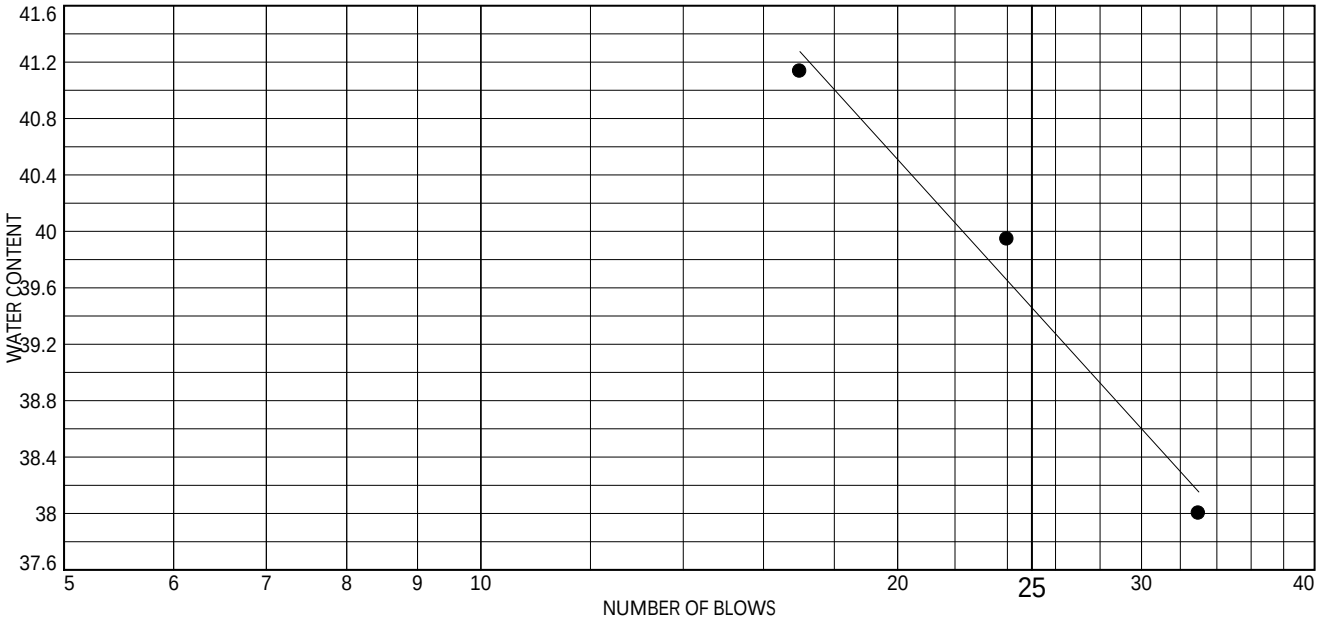
Fig. 24-L-1972

Tested By: SL Checked By: Rebecca Roth

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Grey Silty CLAY	39	18	21			

Project No. 09.0026144.00 Client: GZA GeoEnvironmental

Project: U.S. Rt 1, Yarmouth Bridge No. 5804

Bridge #5804 over I-295

Source of Sample: BB-YR1-202 Depth: 8-10'

Sample Number: 5D

Thielsch Engineering Inc.

Cranston, RI

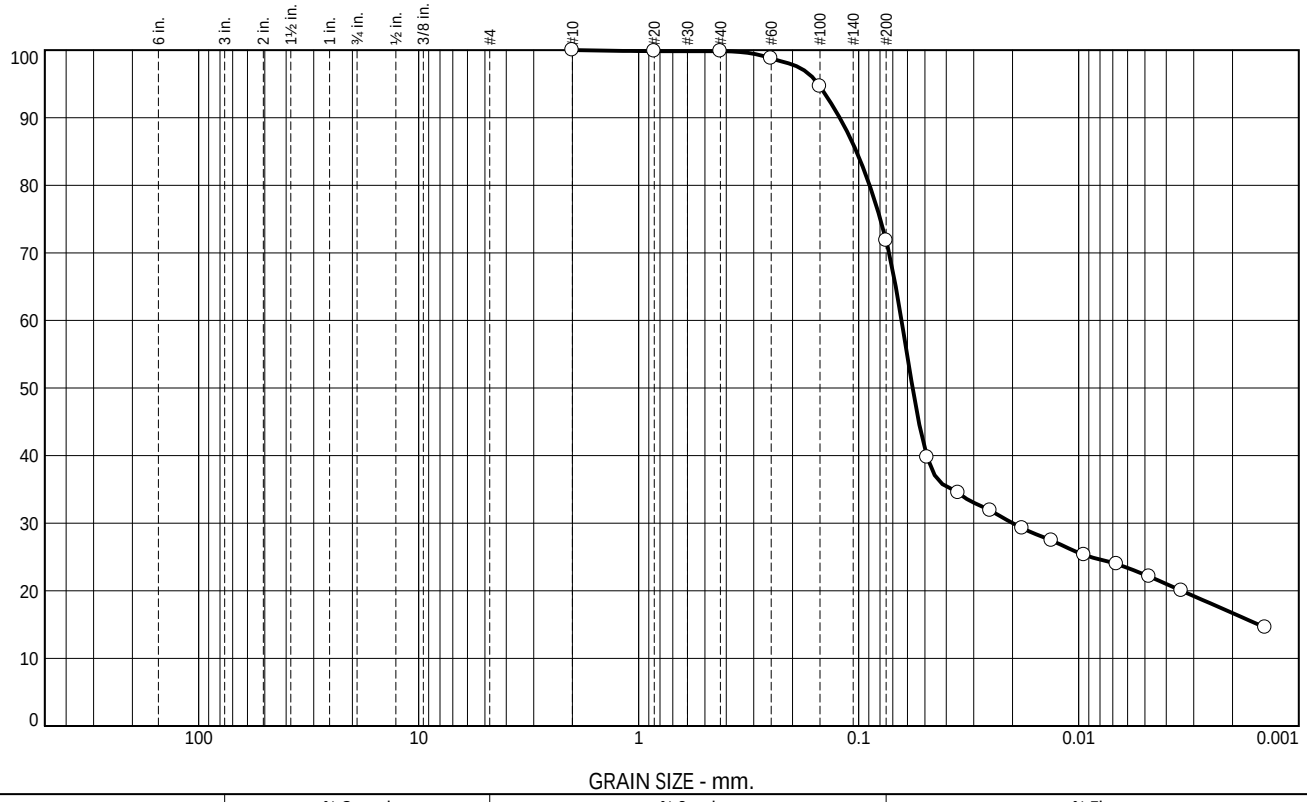
Remarks:

Fig. 24-L-1973

Tested By: RB Checked By: Rebecca Roth

Particle Size Distribution Report

ASTM D6913 and D7928



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	28.0	55.1	16.7

Test Results (ASTM D6913 and D7928)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
#10	100.0			
#20	99.8			
#40	99.8			
#60	98.8			
#100	94.6			
#200	71.8			
0.0488 mm.	39.7			
0.0353 mm.	34.5			
0.0252 mm.	31.9			
0.0180 mm.	29.3			
0.0133 mm.	27.4			
0.0095 mm.	25.3			
0.0067 mm.	24.0			
0.0048 mm.	22.1			
0.0034 mm.	20.0			
0.0014 mm.	14.6			

* (no specification provided)

Material Description

Grey SILT & CLAY, some fine Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1220 D_{85}= 0.1024 D_{60}= 0.0639
D_{50}= 0.0569 D_{30}= 0.0200 D_{15}= 0.0015
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/8".
Sample received with standing water.

Source of Sample: BB-YR1-202 Depth: 15-17'
Sample Number 6D Sample Date: 05.30.24

Thielsch Engineering Inc.
Cranston, RI

Client: GZA GeoEnvironmental
Project: U.S. Rt 1, Yarmouth Bridge No. 5804
Bridge #5804 over I-295
Project No: 09.0026144.00 Fig. 24-S-1974

Tested By: MCS / RB Checked By: Rebecca Roth

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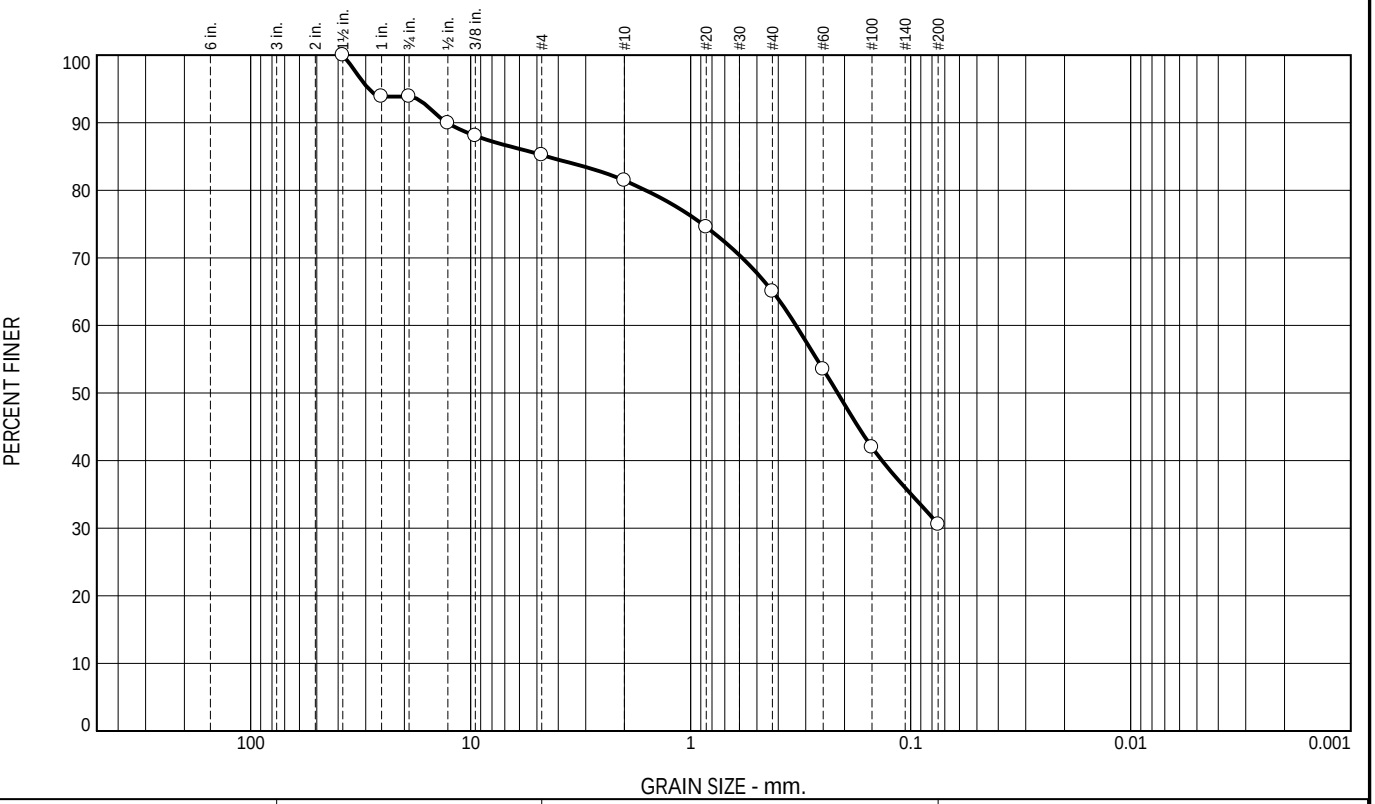
Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.1	8.7	3.8	16.4	34.4	30.6	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1 1/2"	100.0			
1"	93.9			
3/4"	93.9			
1/2"	89.9			
3/8"	88.1			
#4	85.2			
#10	81.4			
#20	74.6			
#40	65.0			
#60	53.5			
#100	42.0			
#200	30.6			

* (no specification provided)

Material Description

Grey f-m SAND, some Clayey SILT, little f-c Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 12.8177 D_{85}= 4.5042 D_{60}= 0.3322
D_{50}= 0.2146 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Sample visually classified as plastic. Sample rolled to 1/4"

Source of Sample: BB-YR1-202 Depth: 30-32'
Sample Number: 9D Sample Date: 05.30.24

Thielsch Engineering Inc.
Cranston, RI

Client: GZA GeoEnvironmental
Project: U.S. Rt 1, Yarmouth Bridge No. 5804
Bridge #5804 over I-295
Project No: 09.0026144.00 Fig. 24-S-1975

Tested By: MCS Checked By: Rebecca Roth

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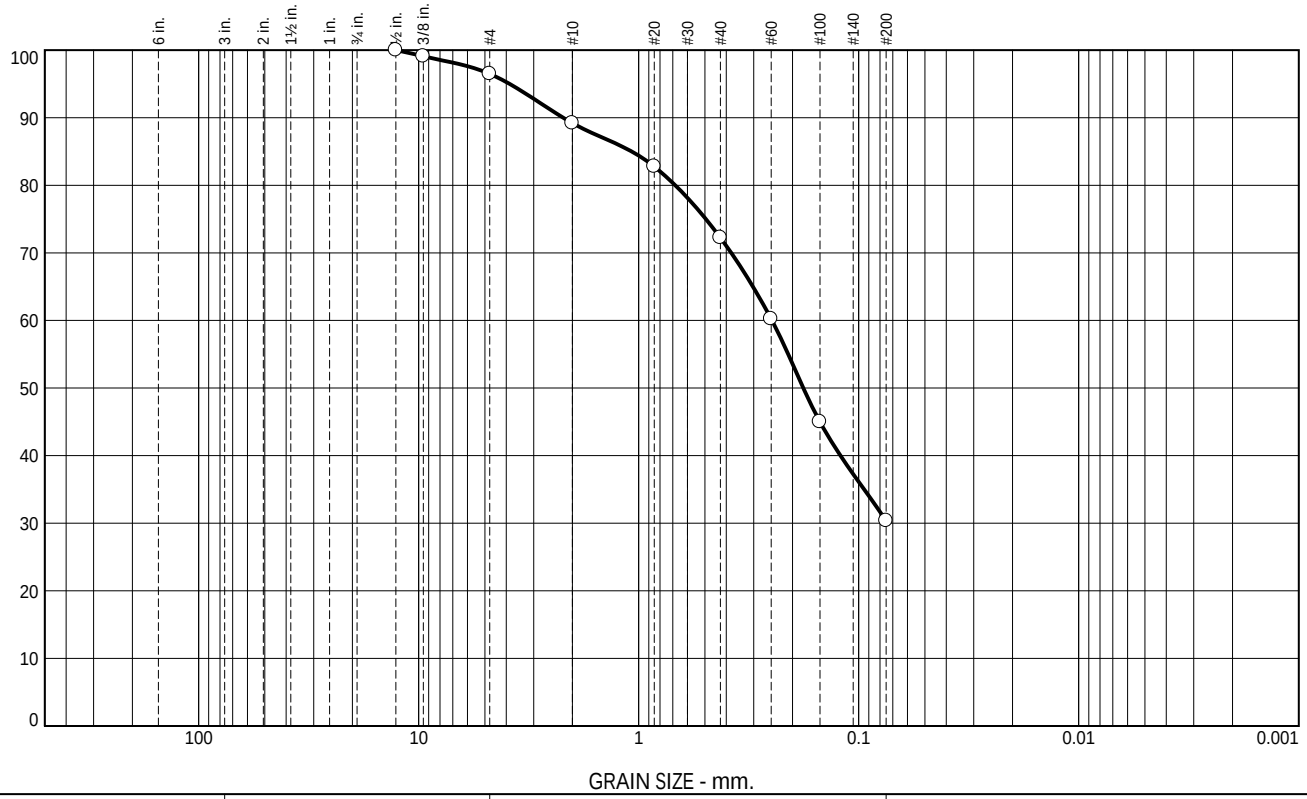
Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.5	7.3	17.0	41.9	30.3	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1/2"	100.0			
3/8"	99.1			
#4	96.5			
#10	89.2			
#20	82.8			
#40	72.2			
#60	60.2			
#100	45.0			
#200	30.3			

* (no specification provided)

Material Description

Brown f-c SAND, some Silt, trace fine Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 2.2039 D_{85}= 1.0763 D_{60}= 0.2477
D_{50}= 0.1785 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Sample visually classified as non-plastic.

Source of Sample: HB-YR1-201 Depth: 2-4'
Sample Number: 2D Sample Date: 05.30.24

Thielsch Engineering Inc.
Cranston, RI

Client: GZA GeoEnvironmental
Project: U.S. Rt 1, Yarmouth Bridge No. 5804
Bridge #5804 over I-295
Project No: 09.0026144.00 Fig. 24-S-1976

Tested By: MCS Checked By: Rebecca Roth

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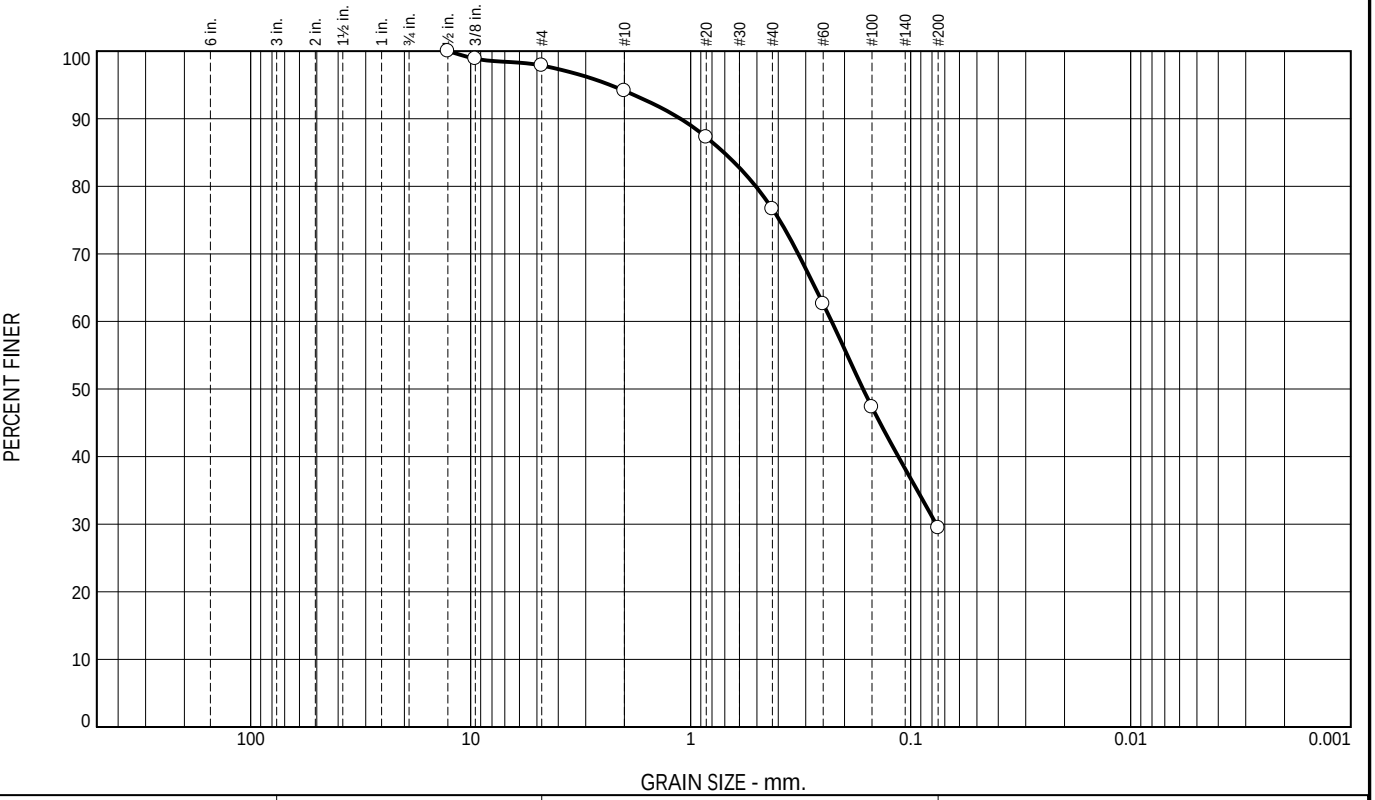
Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	3.8	17.4	47.2	29.5	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1/2"	100.0			
3/8"	98.9			
#4	97.9			
#10	94.1			
#20	87.3			
#40	76.7			
#60	62.6			
#100	47.3			
#200	29.5			

* (no specification provided)

Material Description

Olive f-m SAND, some Silt, trace fine Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 1.1138 D_{85}= 0.7066 D_{60}= 0.2285
D_{50}= 0.1646 D_{30}= 0.0766 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Test Remarks

Source of Sample: HB-YR1-201 Depth: 5-7'
Sample Number: 3D Sample Date: 05.30.24

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental
Project: U.S. Rt 1, Yarmouth Bridge No. 5804
Bridge #5804 over I-295
Project No: 09.0026144.00 Fig. 24-S-1977

Tested By: MCS Checked By: Rebecca Roth

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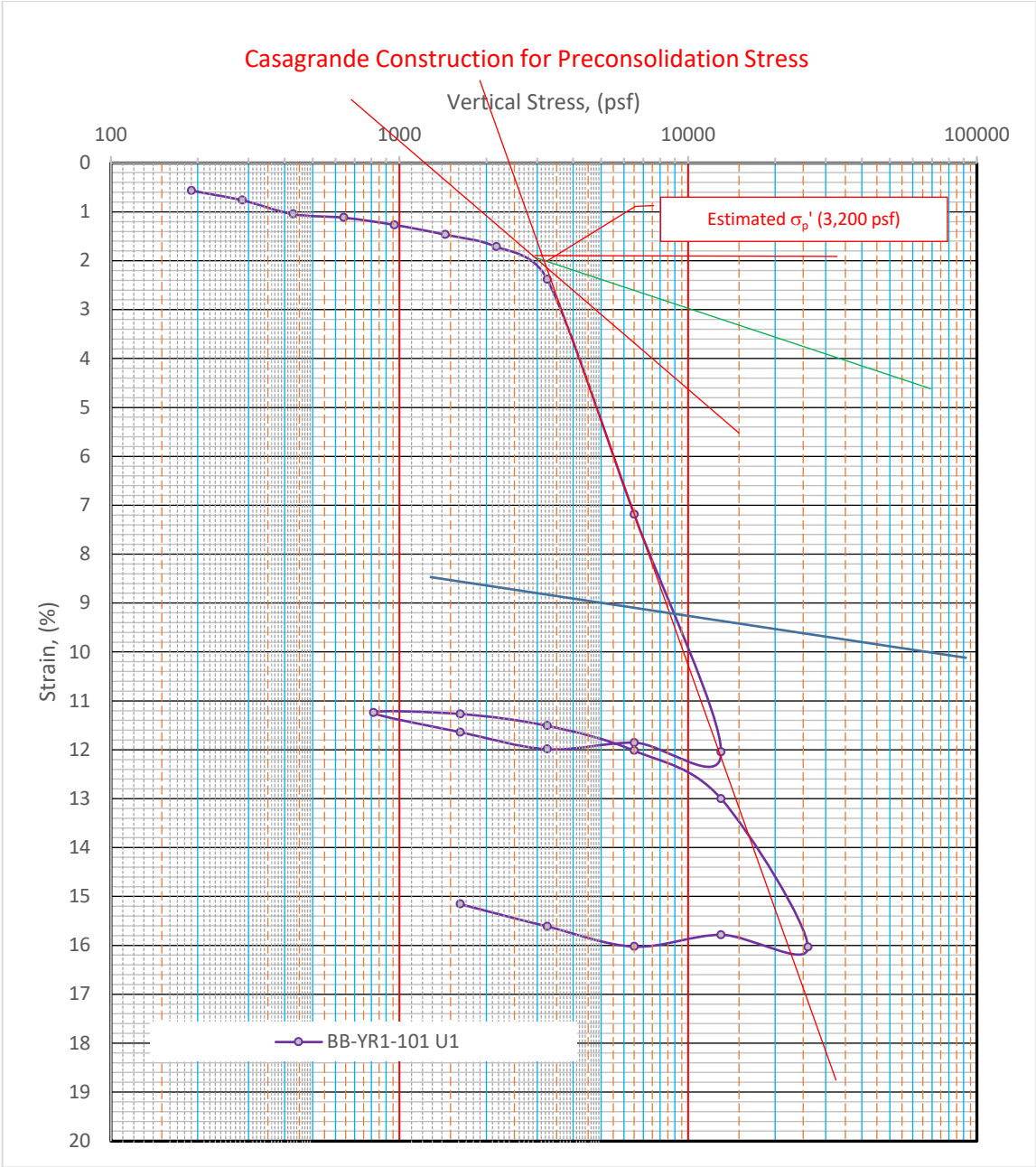
Consolidation Test Data
Summary Report

Project Name:	Yarmouth Route 1 Bridge
Project Number:	166-23
Project Location:	Yarmouth, ME
Client:	GZA
Sample Description:	Gray Silty Clay
Preparation:	Trimmed Shelby Tube

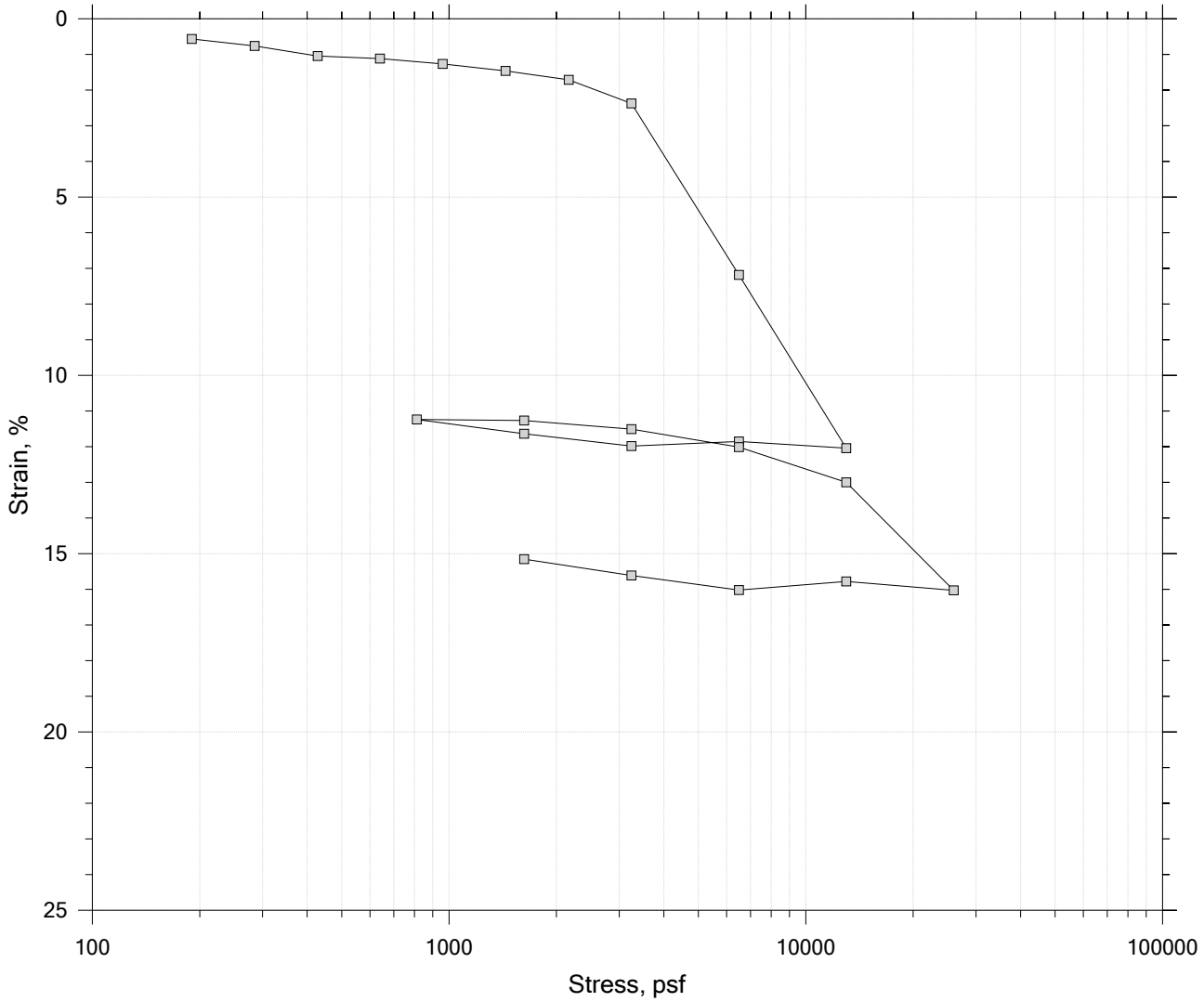
Lab Test No:	ICON 68-367
Boring No.	BB-YR1-101
Sample No:	U1
Boring Elevation (ft).	NA
Sample Depth (ft):	12-14
Test Specimen Depth (Ft):	13.42
Test Specimen Elevation:	NA
Water Content (%):	30.74
Dry Unit Weight (pcf):	93.3
Wet Unit Weight (pcf):	122.0
Saturation Before (%):	96.7
Saturation After (%):	100
Void Ratio Before:	0.9
Void Ratio After:	0.62
Overburden Pressure (psf):	--
Max Previous stress (psf):	3,200
Max Prev. stress (Work) (psf):	3,100
OCR:	--
Compression Index (C_{CE}):	0.162
Recompression Index (C_{RE}):	0.009
Liquid Limit:	NA
Plastic Limit:	NA
Plasticity Index:	NA
Liquidity Index:	NA
Specific Gravity (implied)	2.85
Vane Shear test on Tube at 13.6 ft	527 psf
Tested By:	sjr
Date Tested:	3/18/2021
Checked By:	sjr



Soil Metrics LLC Geotechnical Engineering

One-Dimensional Consolidation by ASTM D2435 - Method B

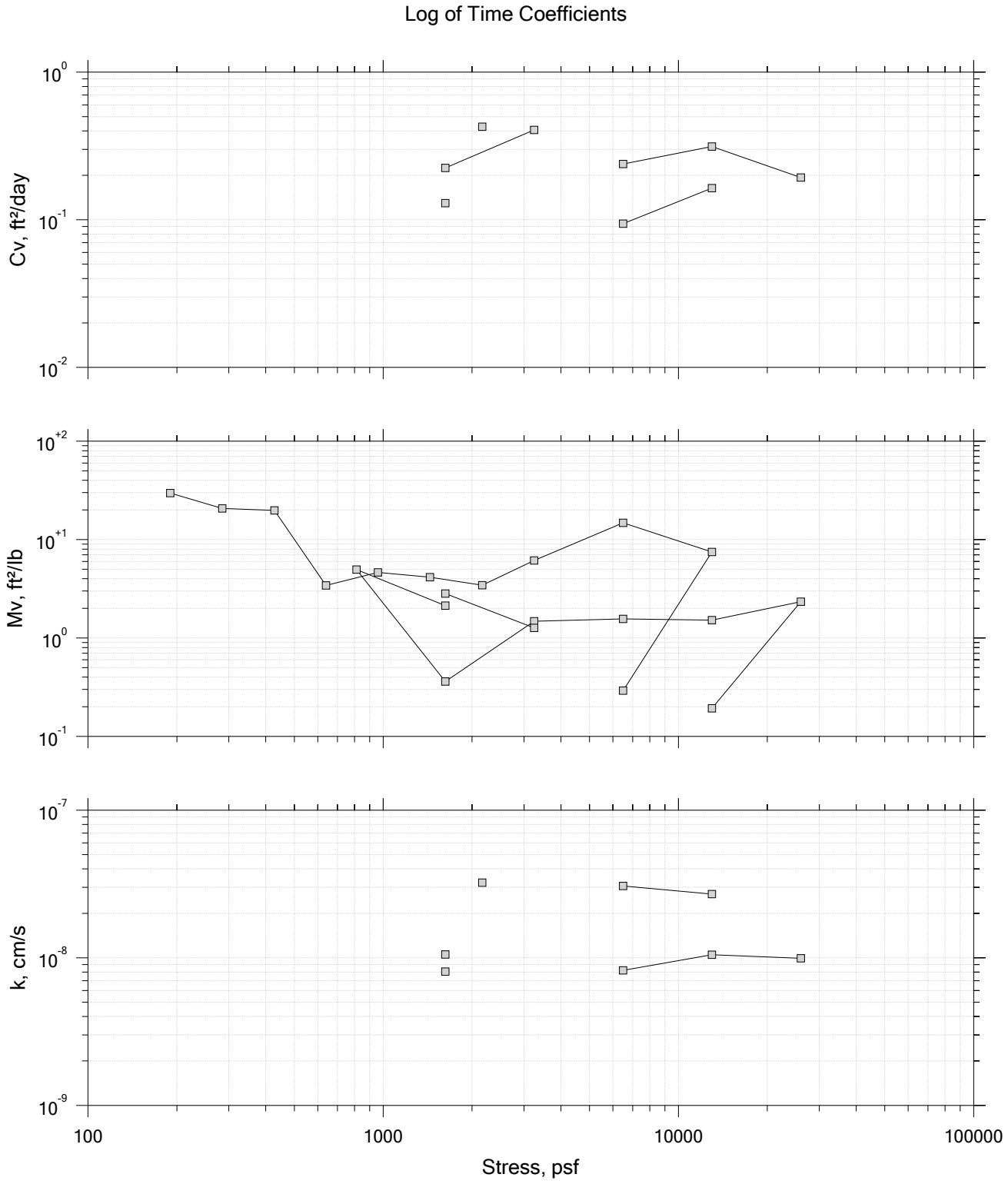
Summary Report



				Before Test	After Test
Current Vertical Effective Stress, psf: 0				Water Content, %	30.74	21.69
Preconsolidation Stress, psf: 3282				Dry Unit Weight, pcf	93.325	109.9
Compression Ratio: 0				Saturation, %	96.73	100.00
Specimen Diameter, in: 2.5		Specimen Height, in: 1.001		Void Ratio	0.90	0.62
LL: 0	PL: 0	PI: 0	GS: 2.85			

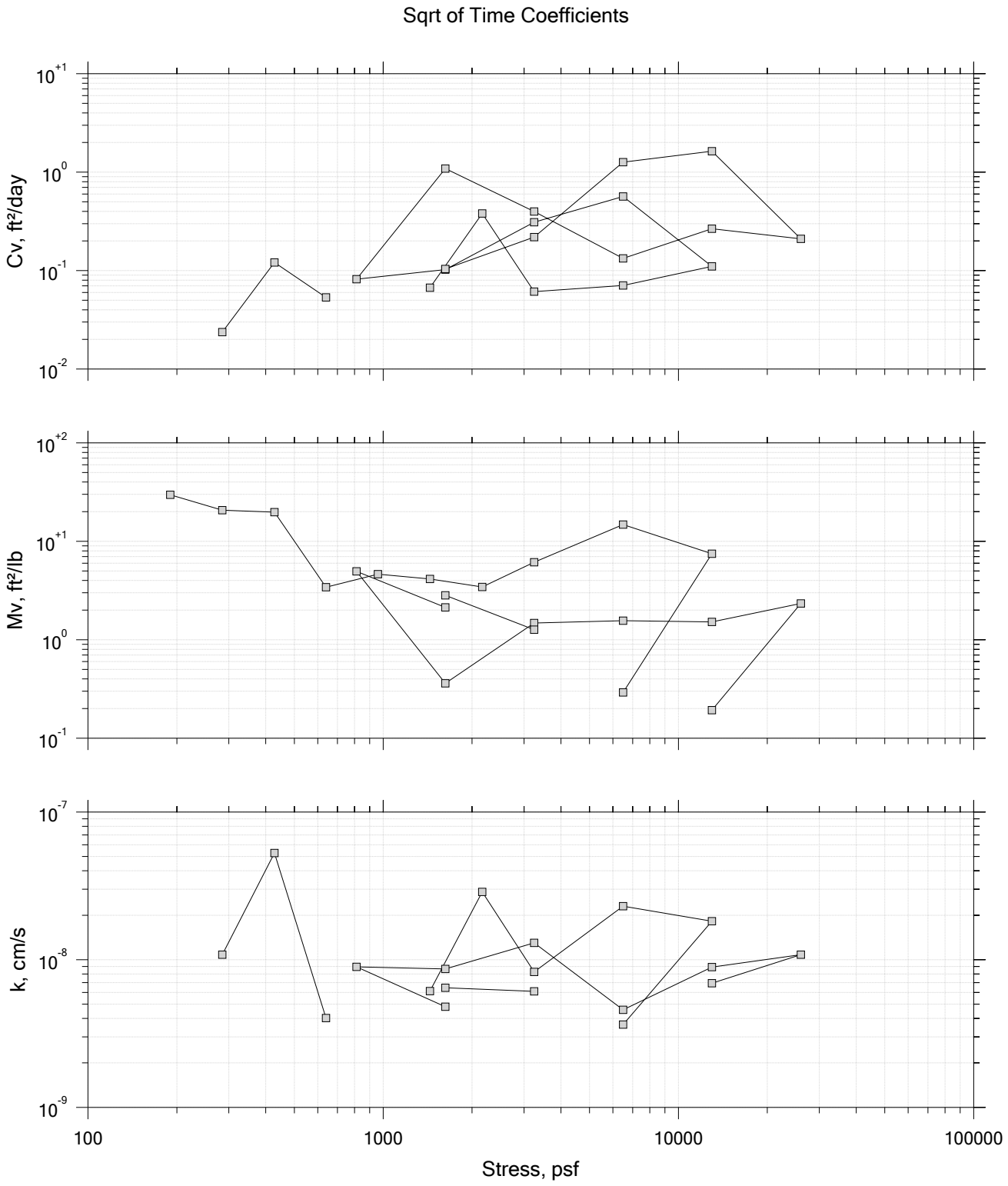
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		
	Displacement at End of Primary		

One-Dimensional Consolidation by ASTM D2435 - Method B



Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

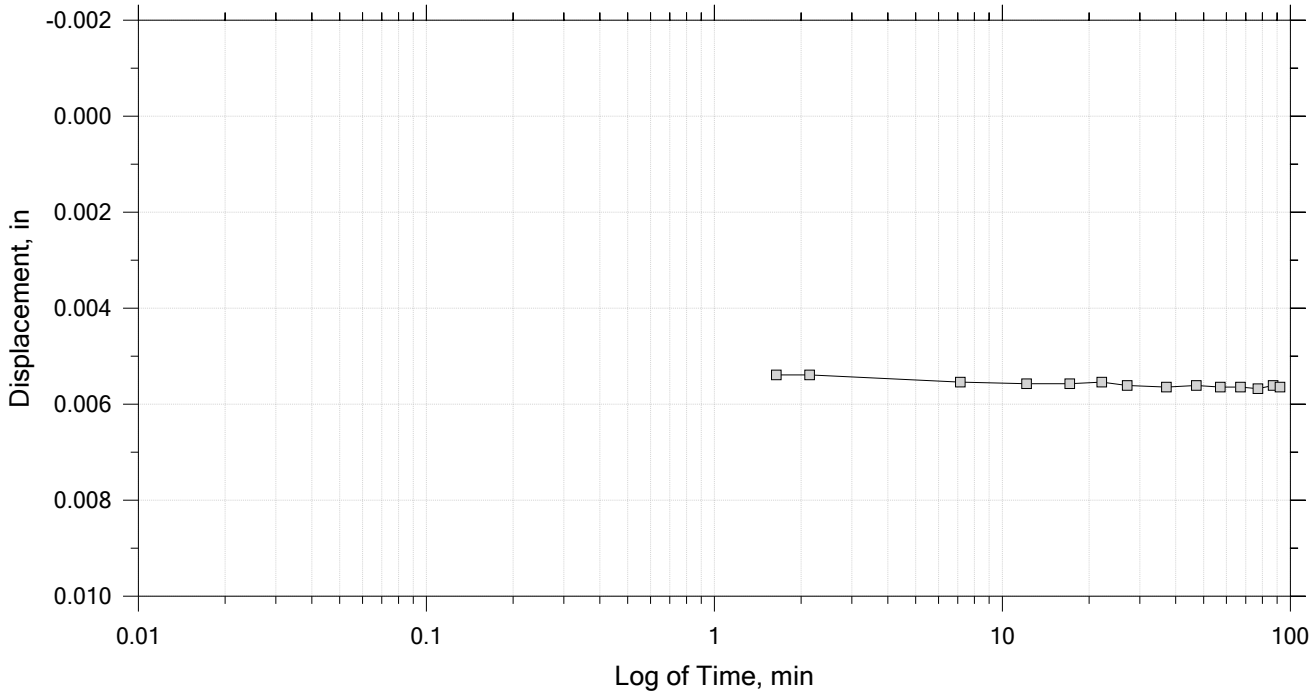
One-Dimensional Consolidation by ASTM D2435 - Method B

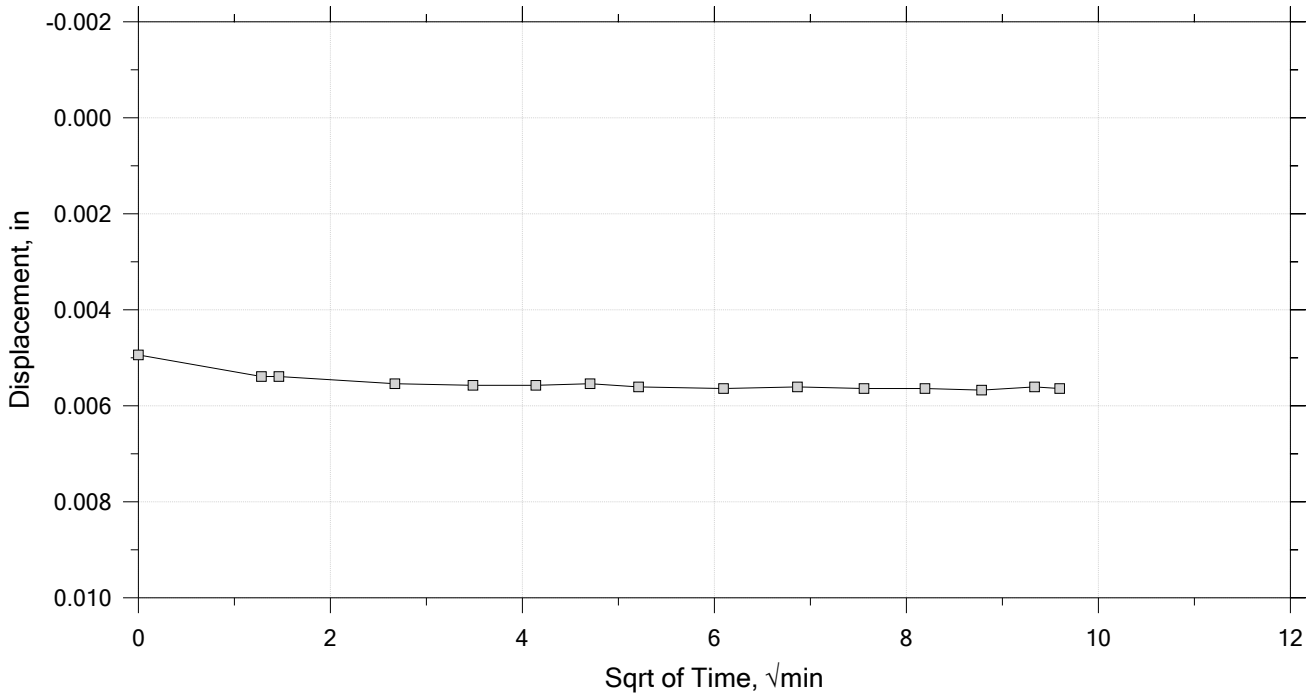


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 23
Constant Load Step
Stress: 190 psf

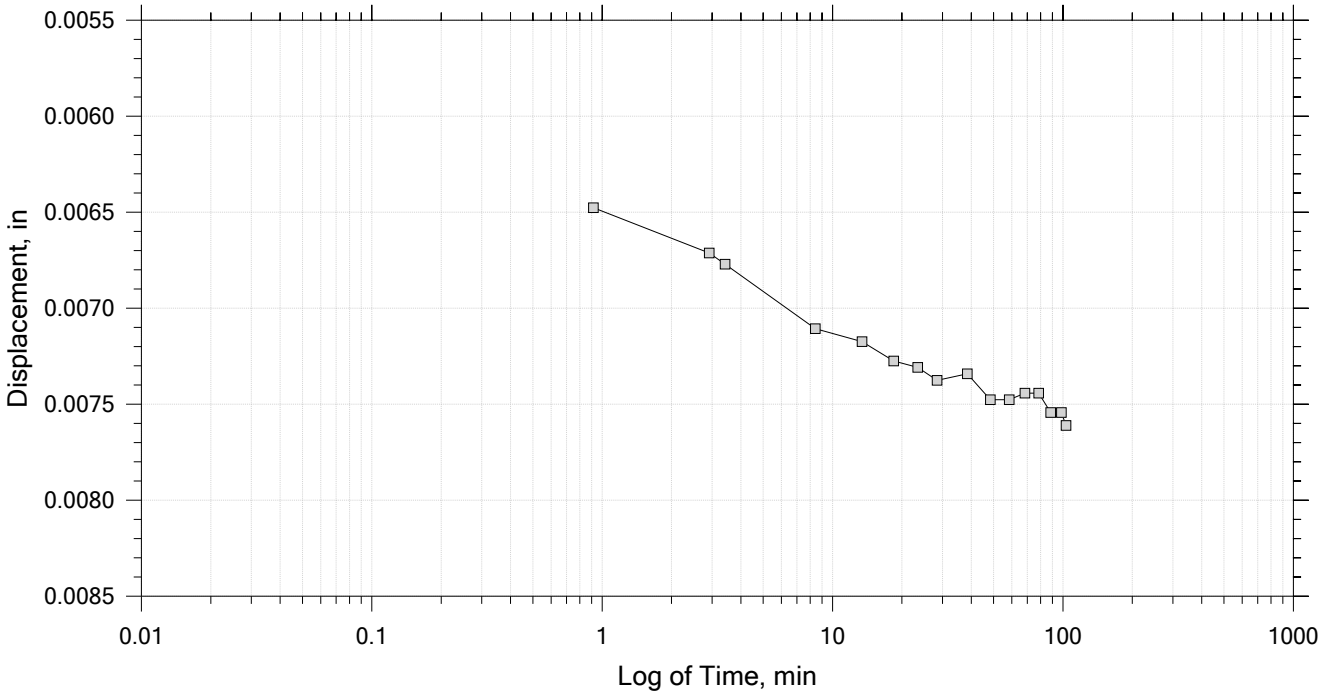


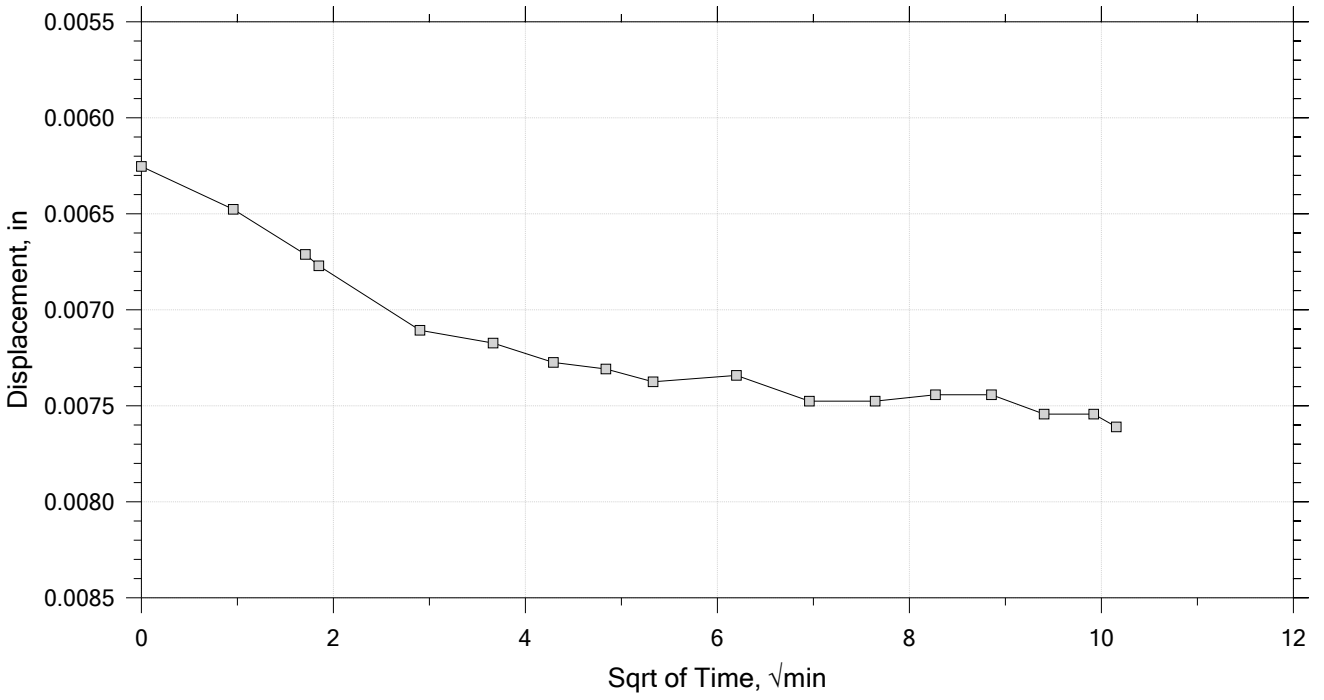


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 23
Constant Load Step
Stress: 285 psf

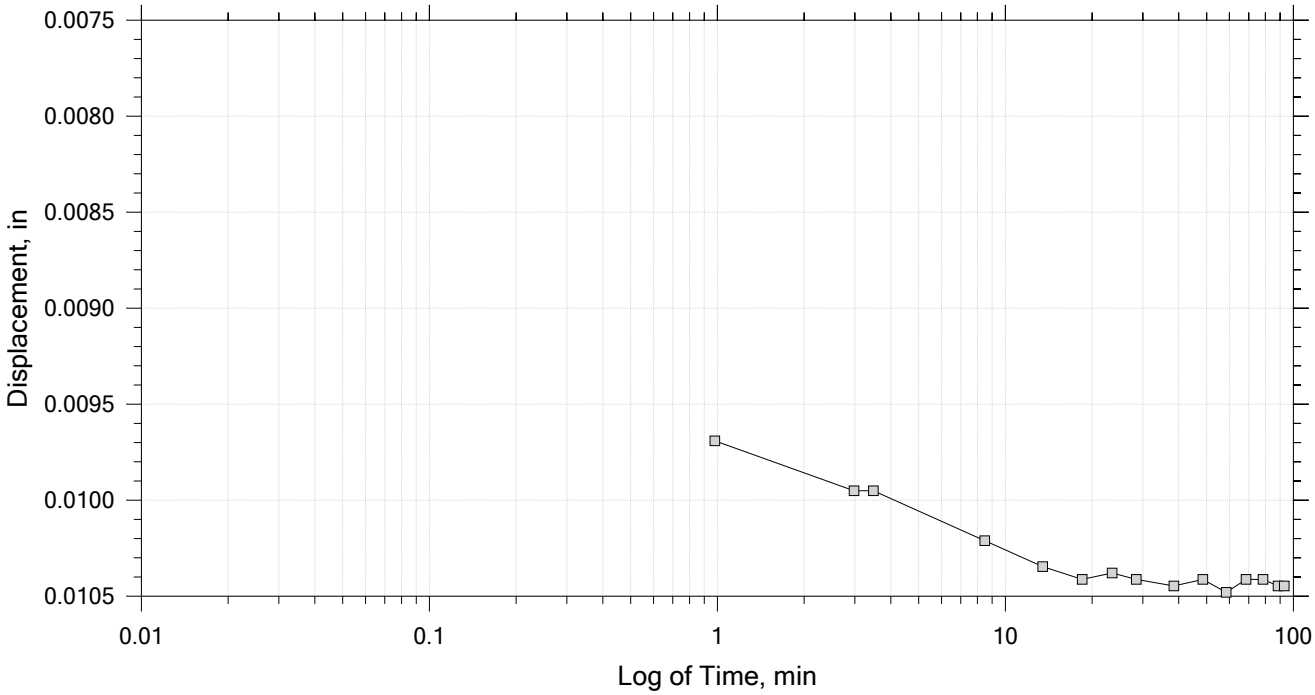


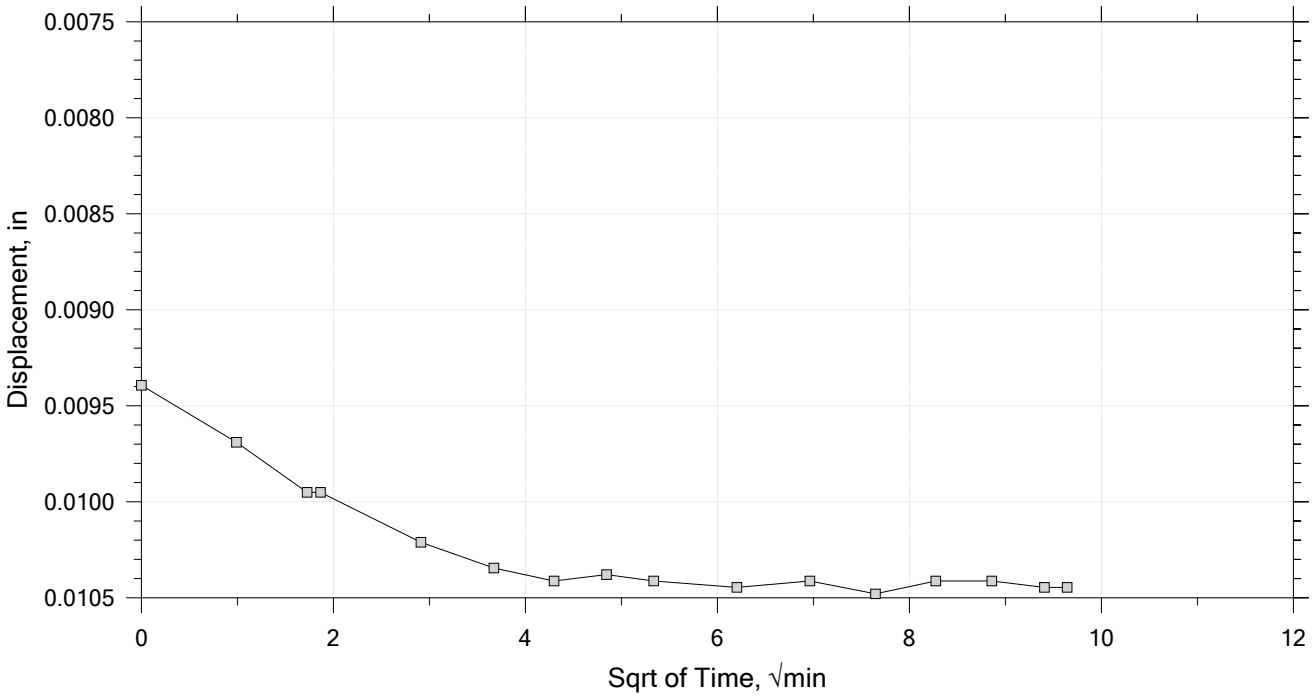


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 23
Constant Load Step
Stress: 428 psf

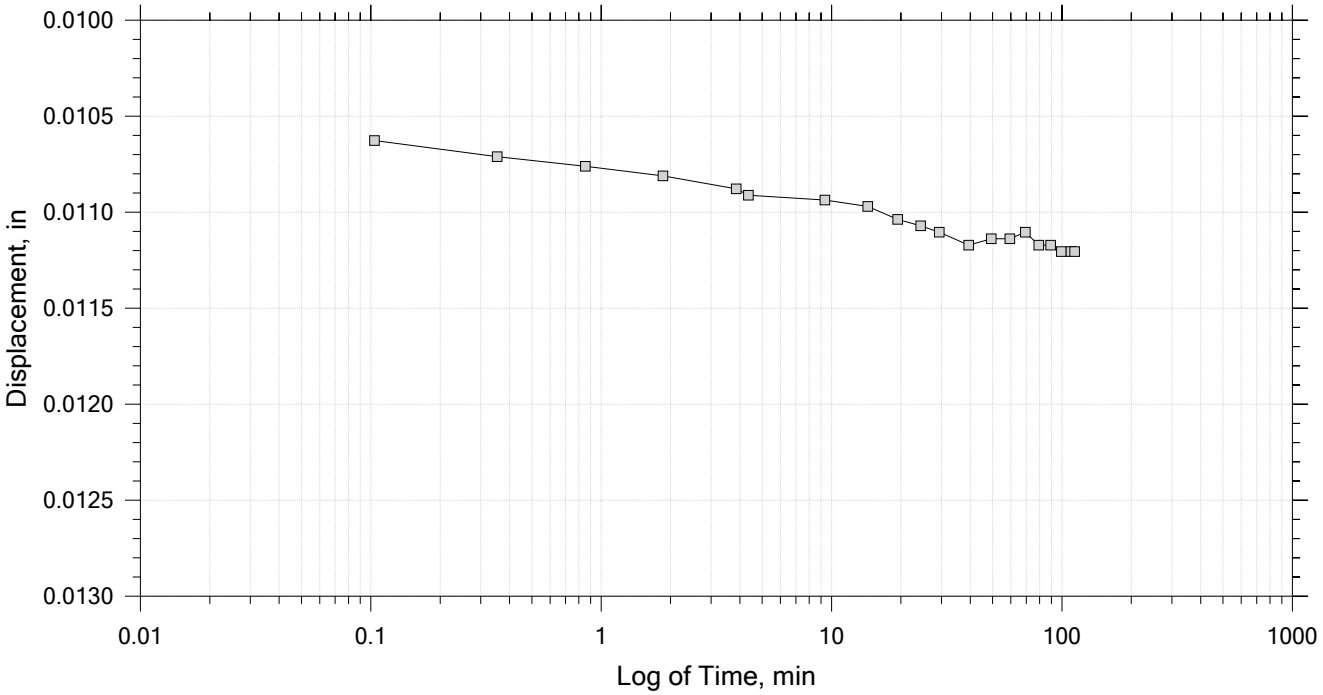


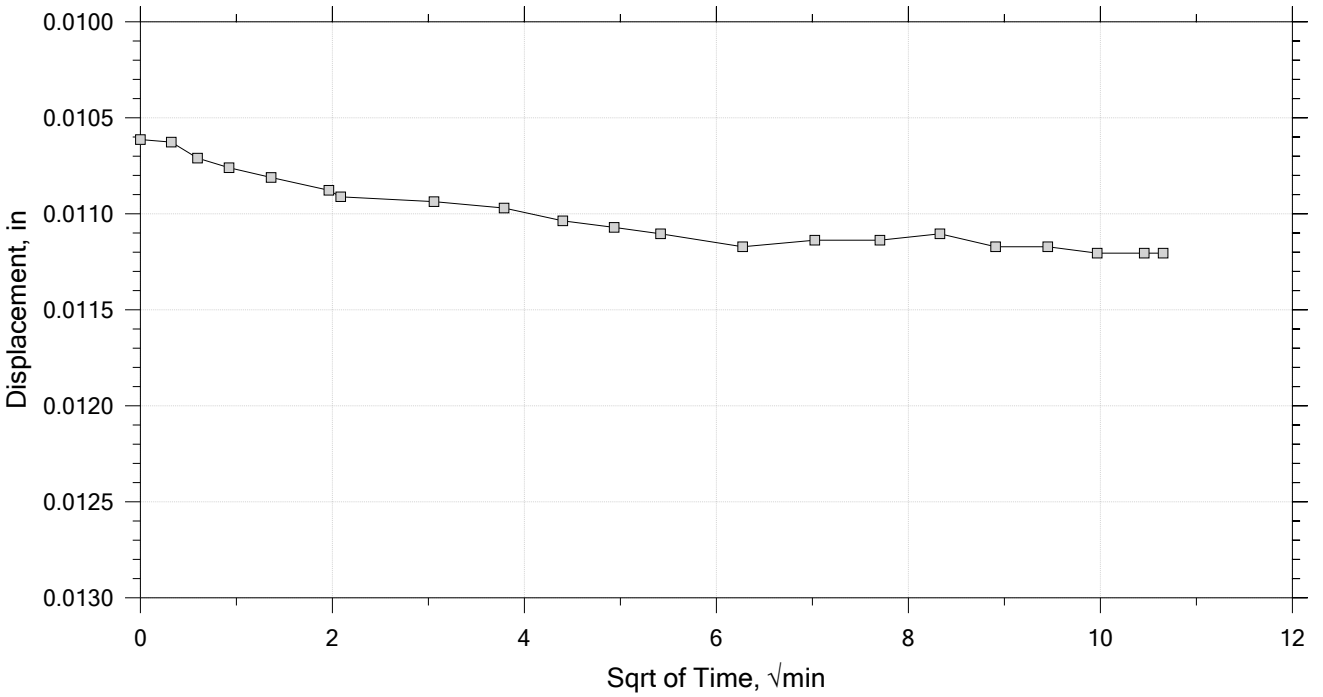


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 23
Constant Load Step
Stress: 640 psf

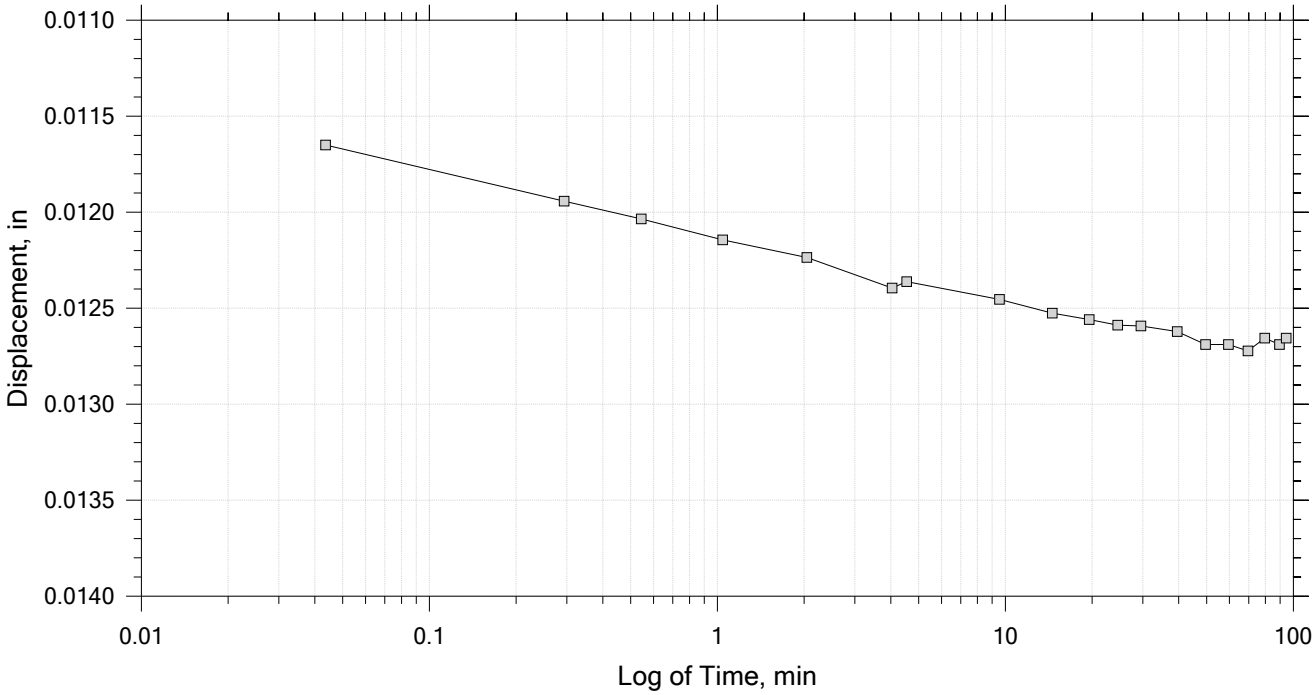


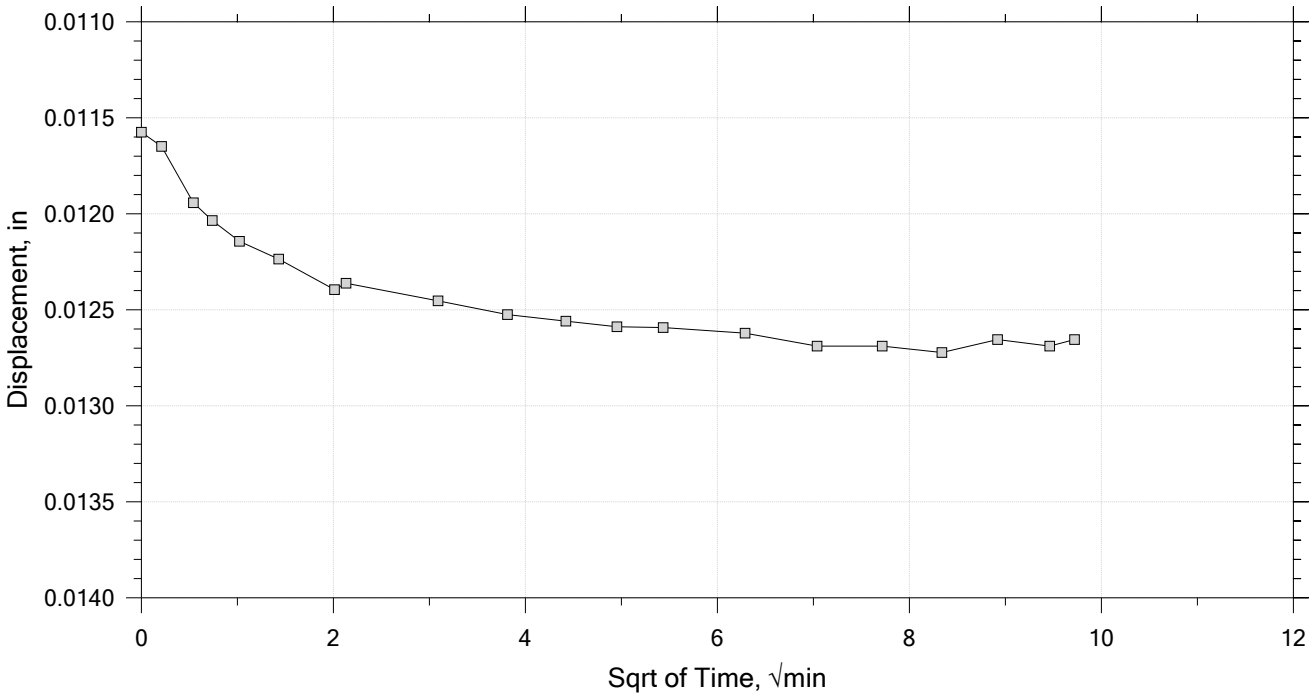


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 23
Constant Load Step
Stress: 960 psf





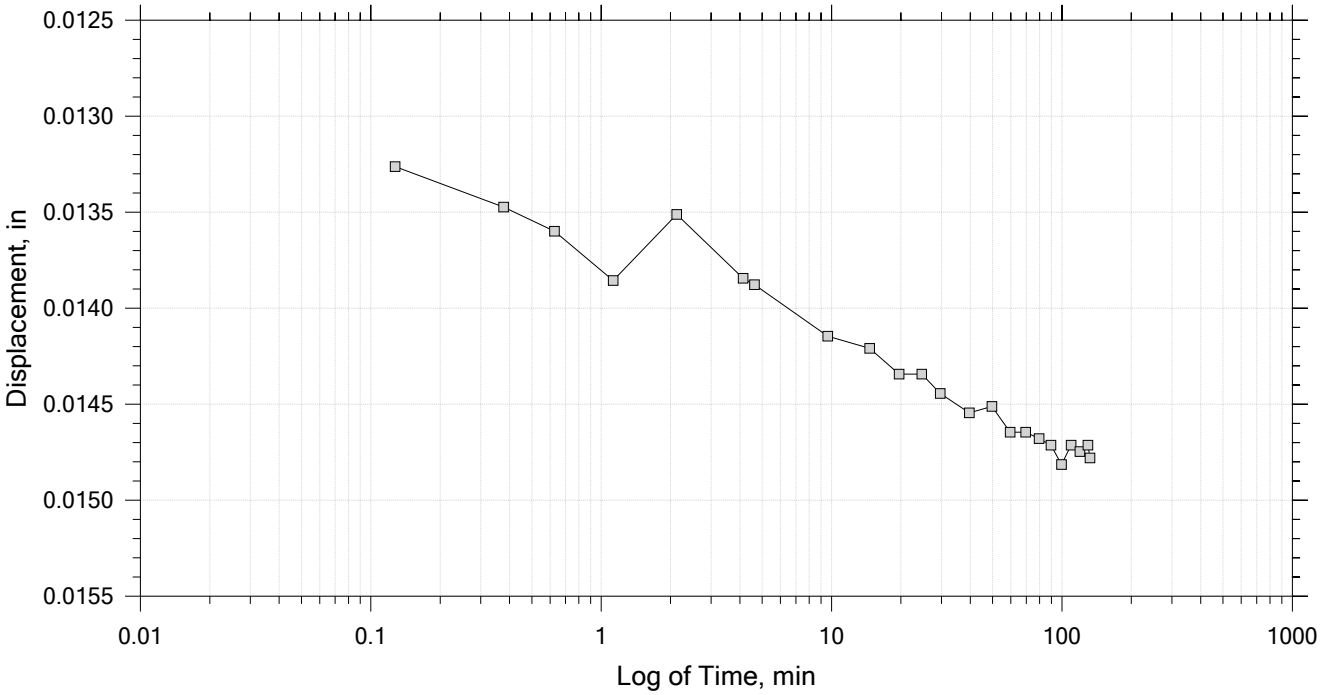
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

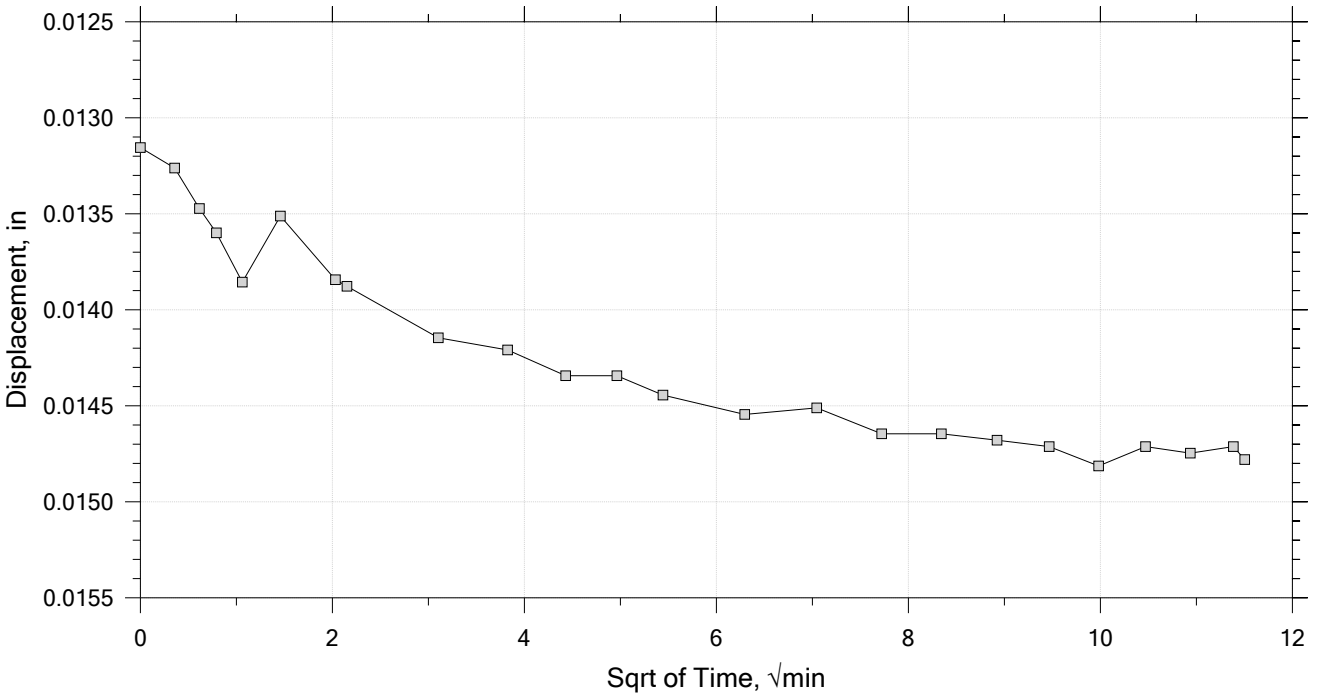
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 23

Constant Load Step

Stress: 1.44e+03 psf

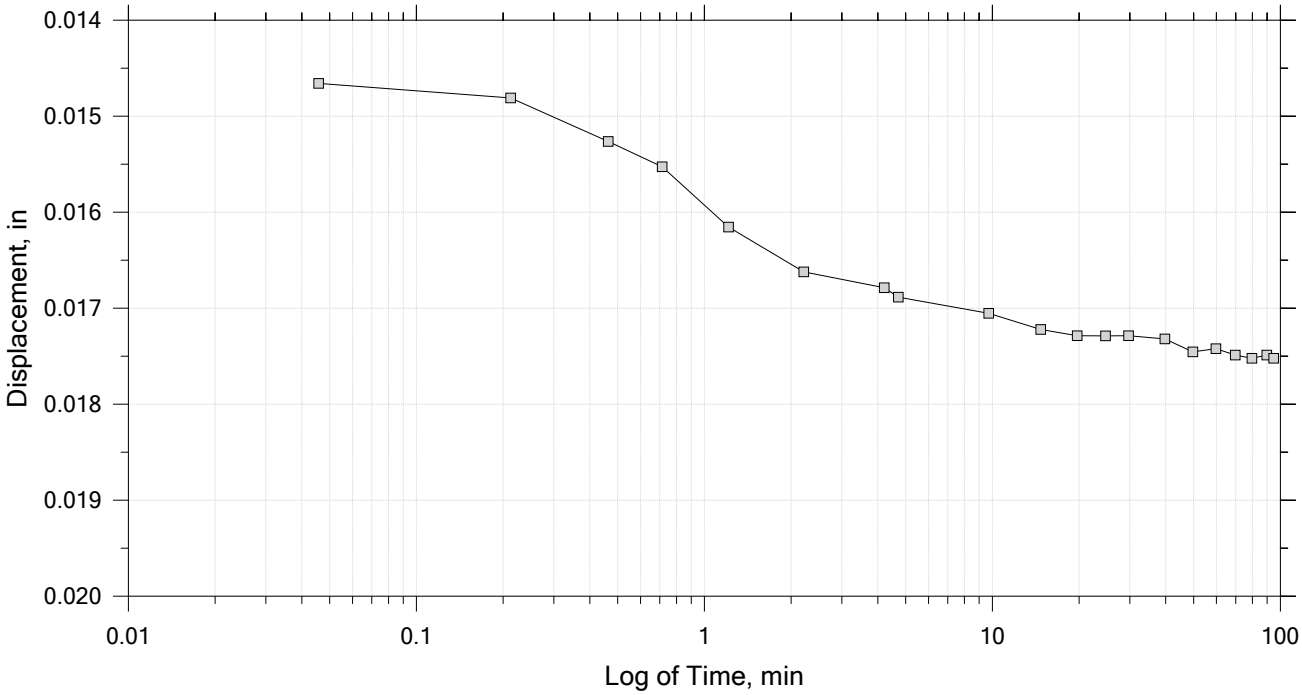


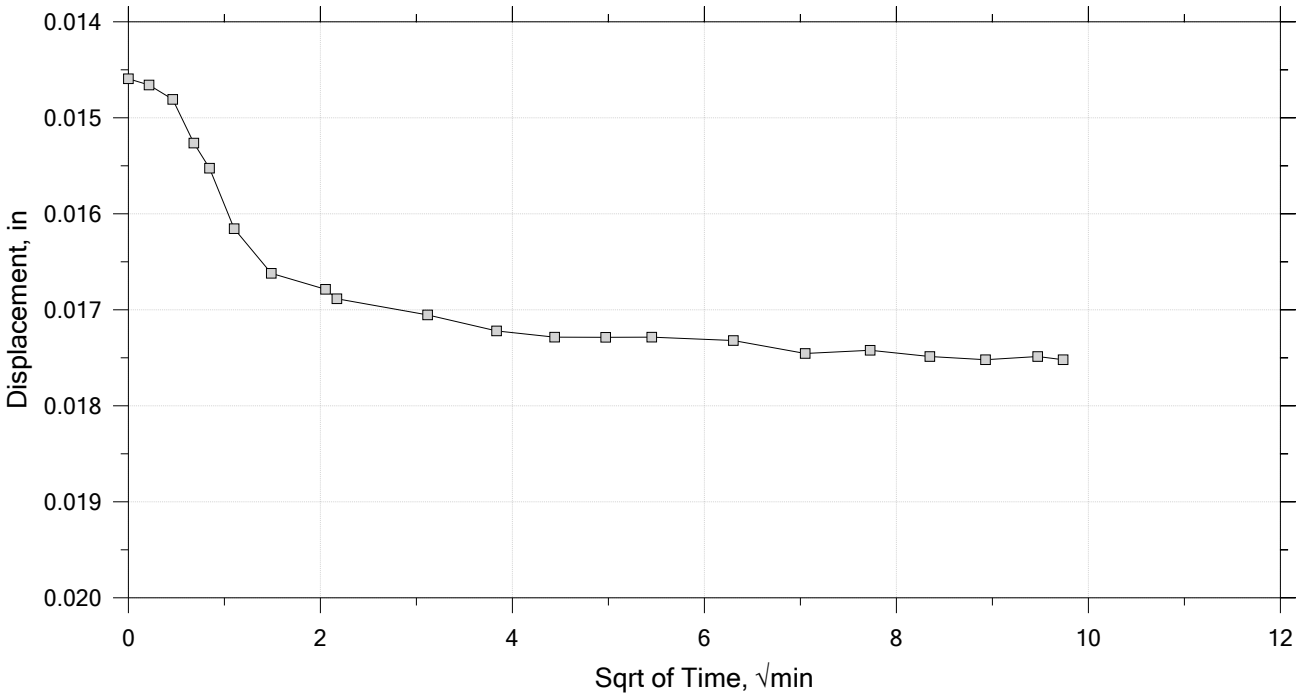


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 23
Constant Load Step
Stress: 2.16e+03 psf

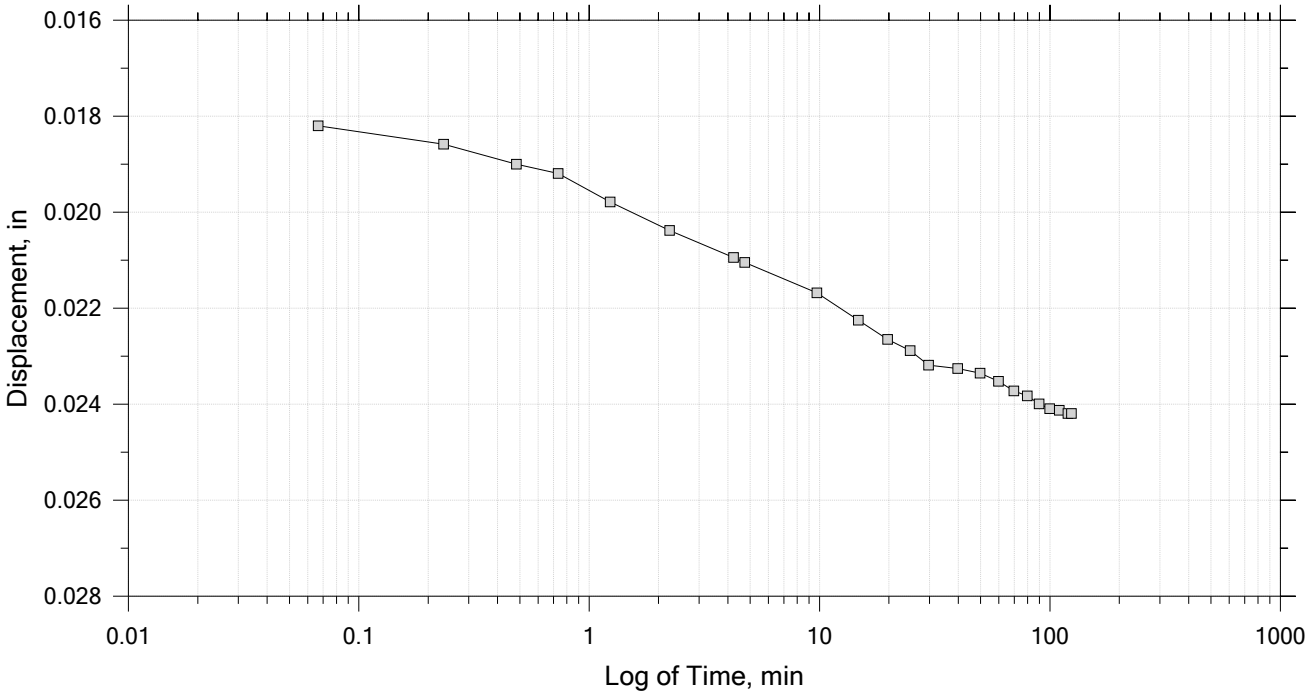


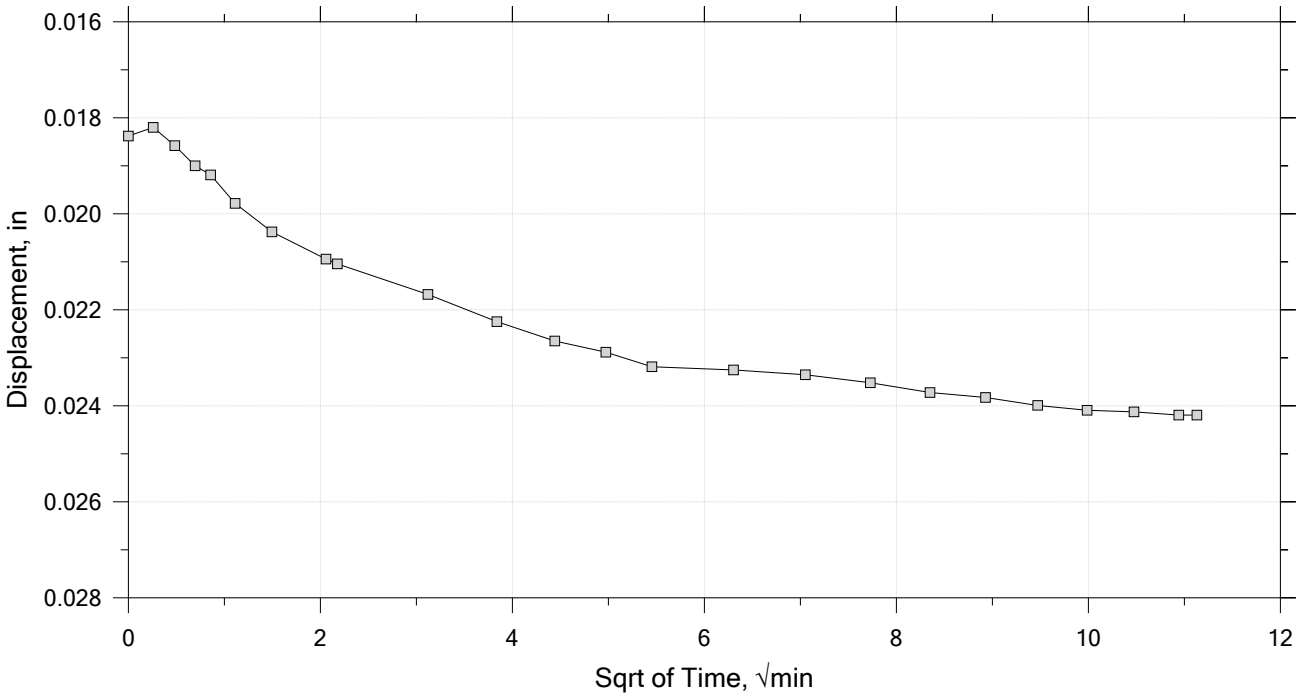


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 23
Constant Load Step
Stress: 3.25e+03 psf





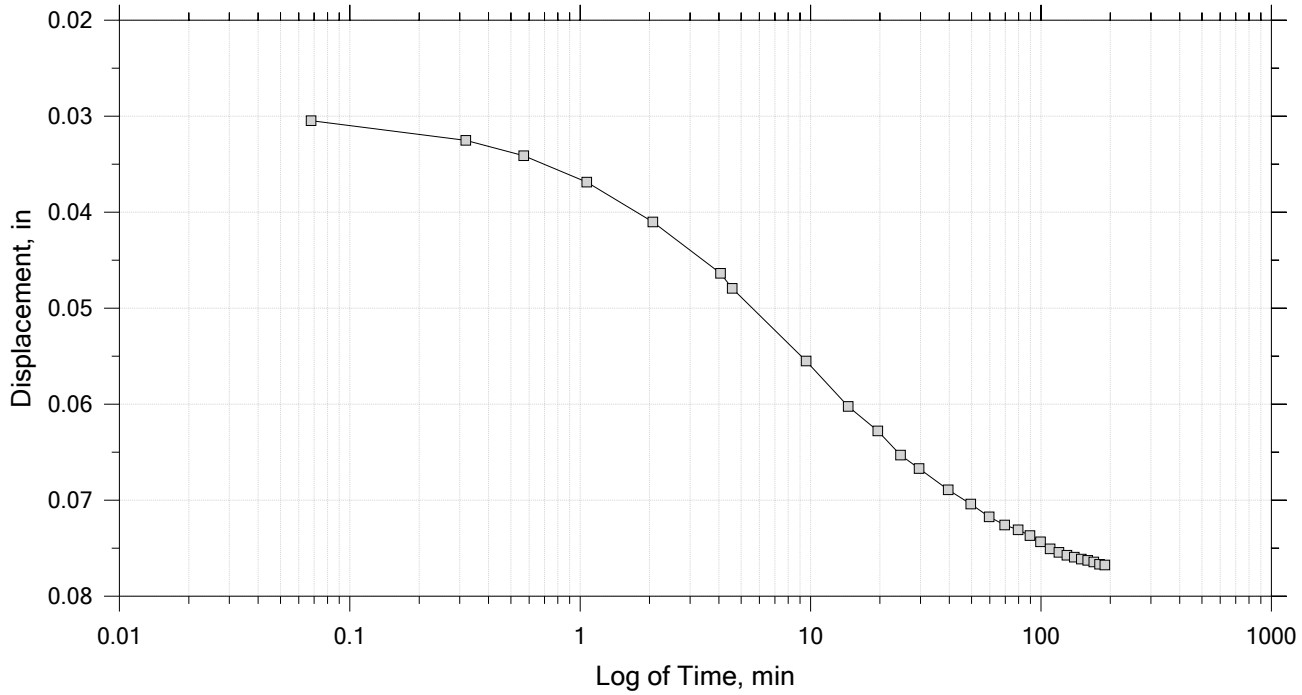
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

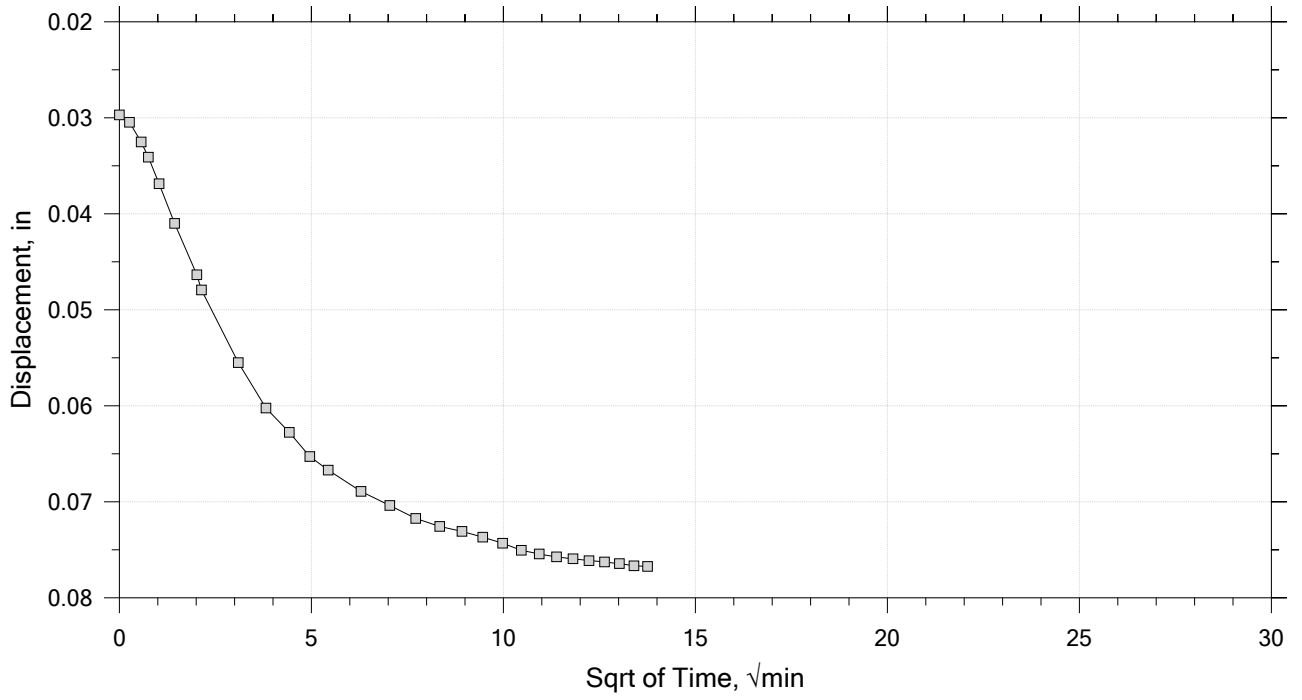
One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 23

Constant Load Step

Stress: 6.49e+03 psf

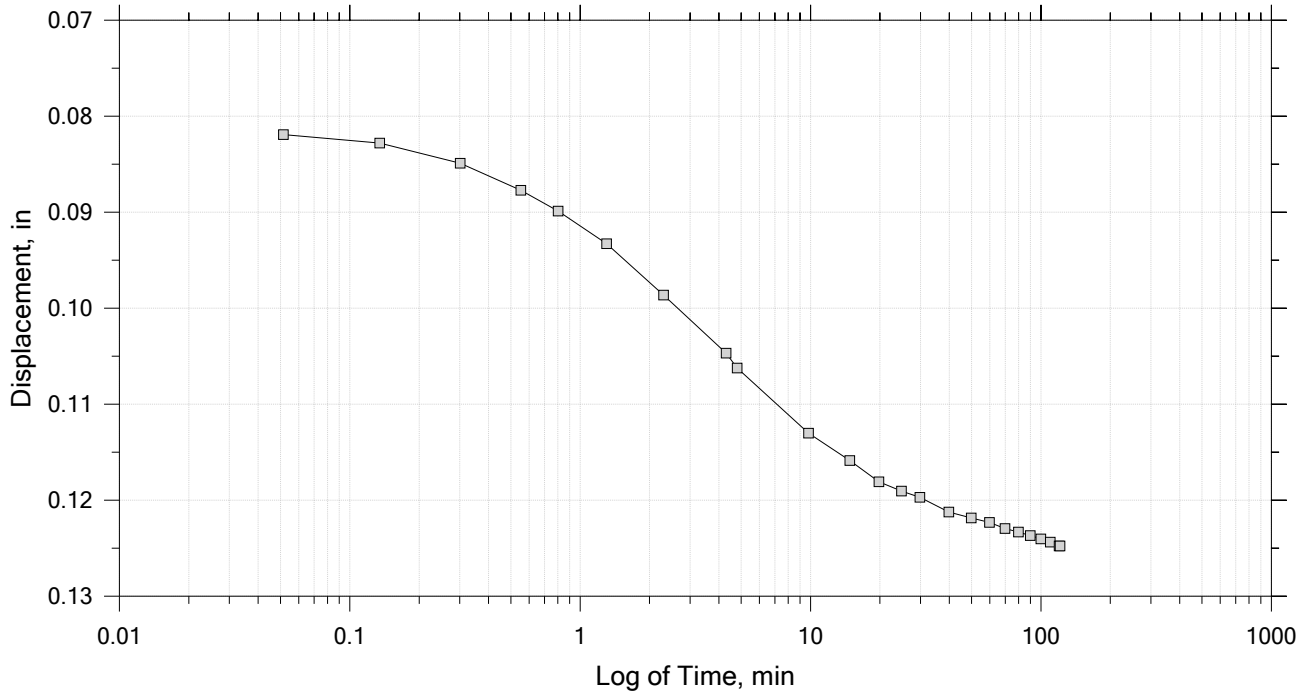


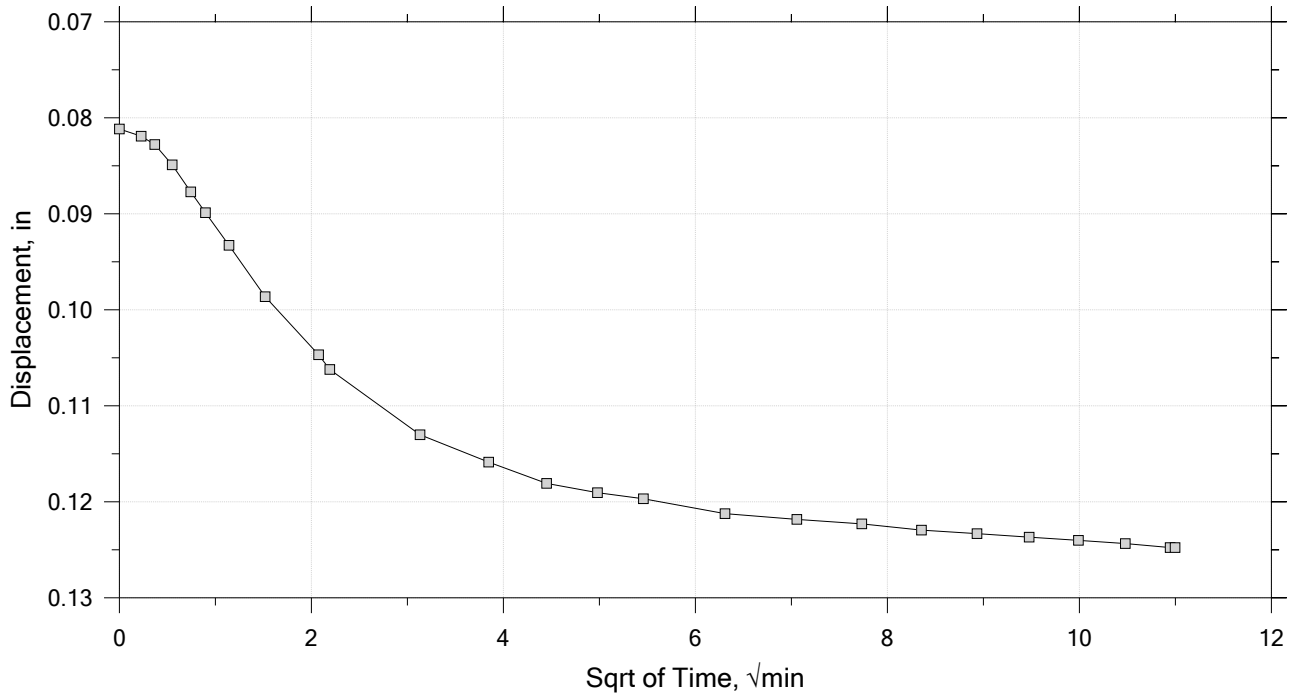


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 23
Constant Load Step
Stress: 1.3e+04 psf

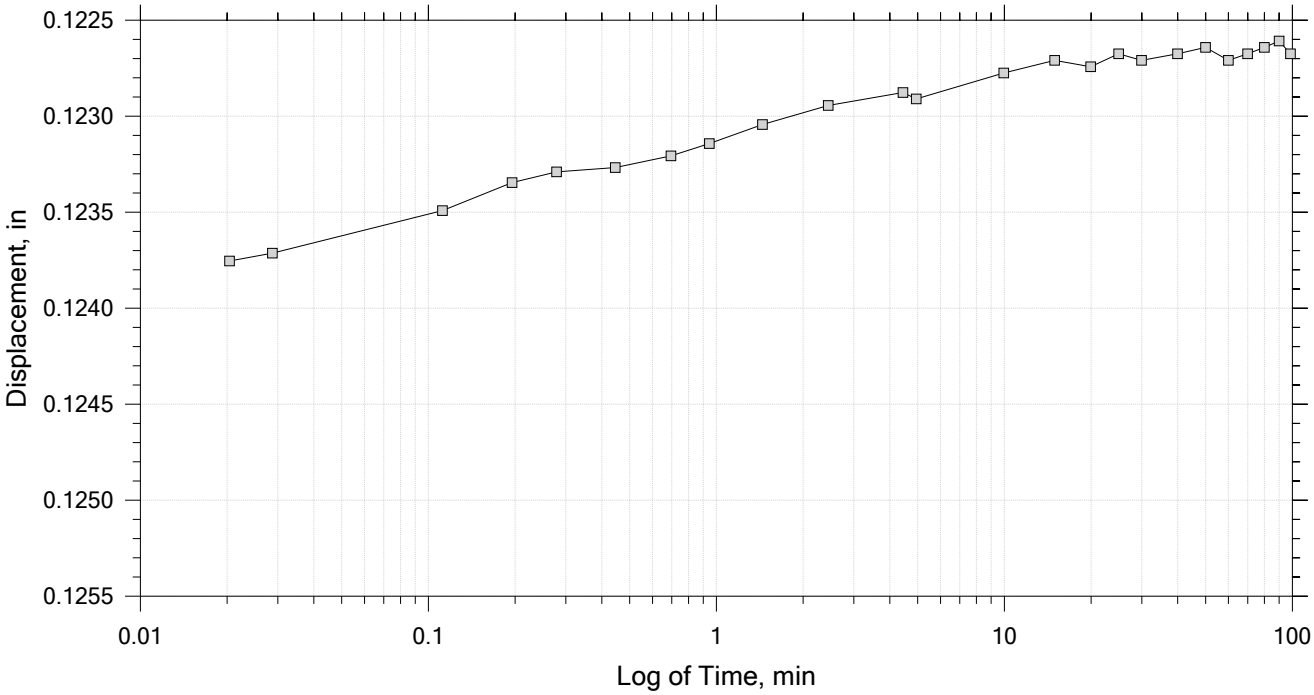


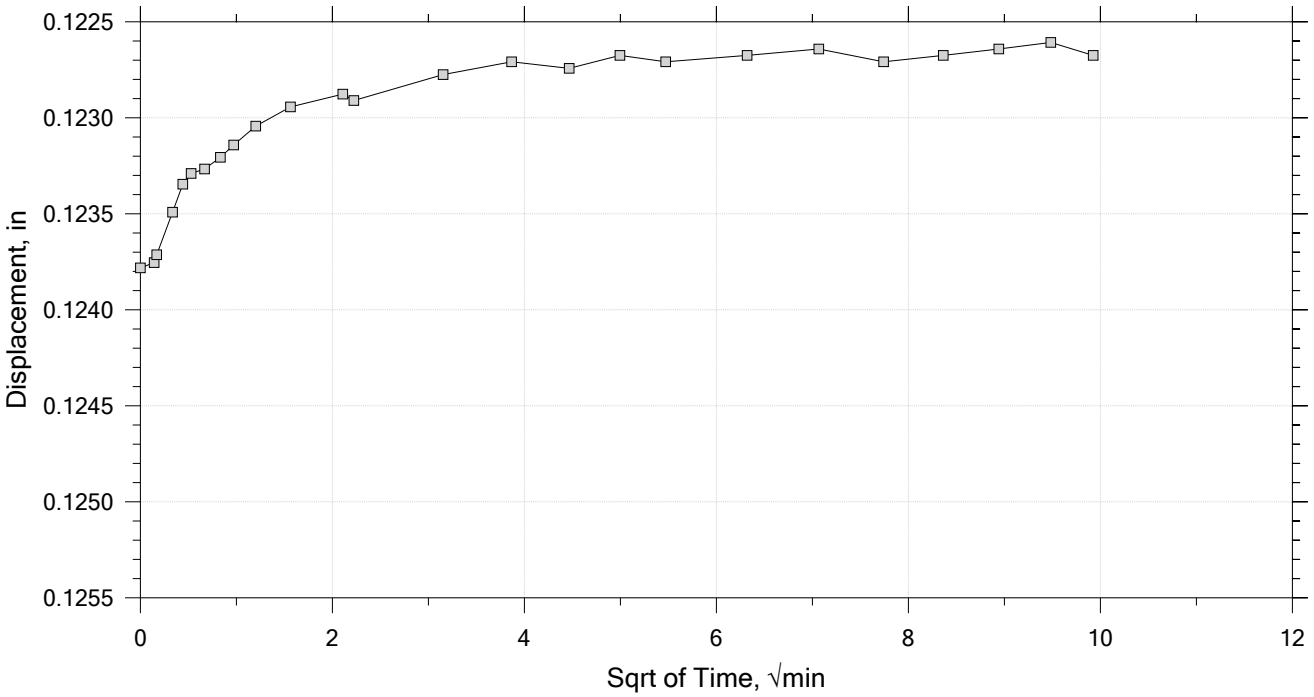


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 23
Constant Load Step
Stress: 6.49e+03 psf

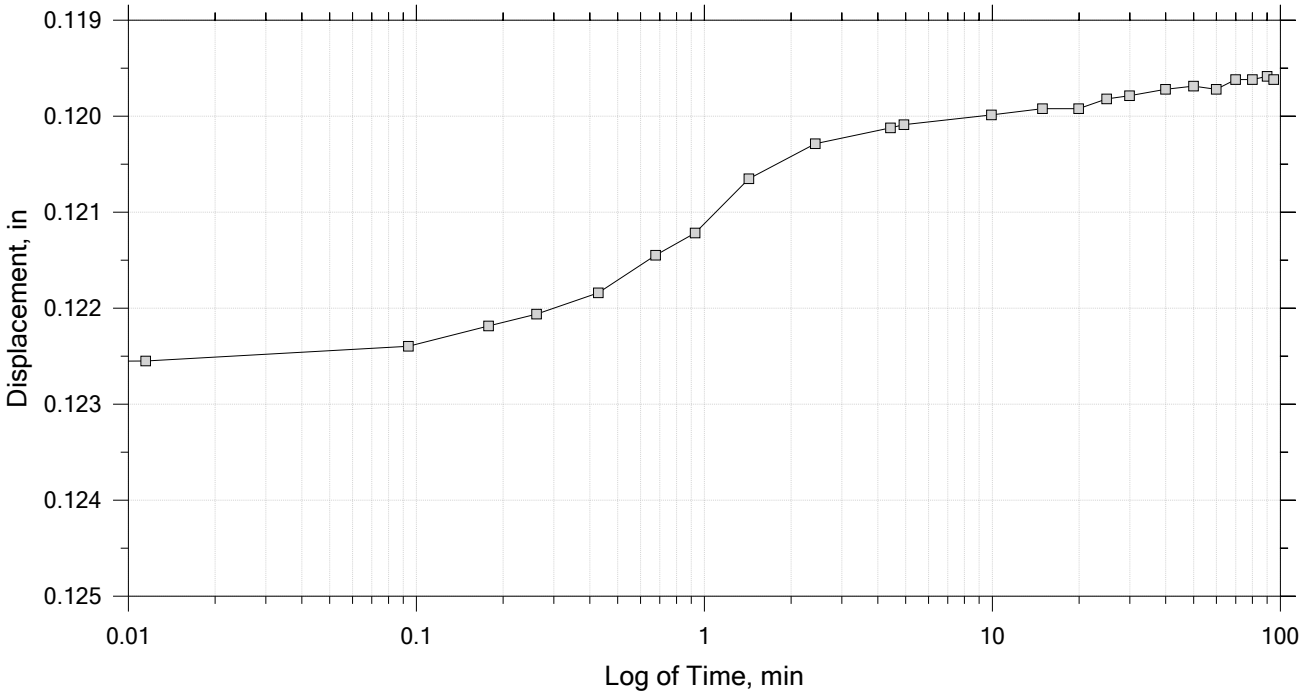


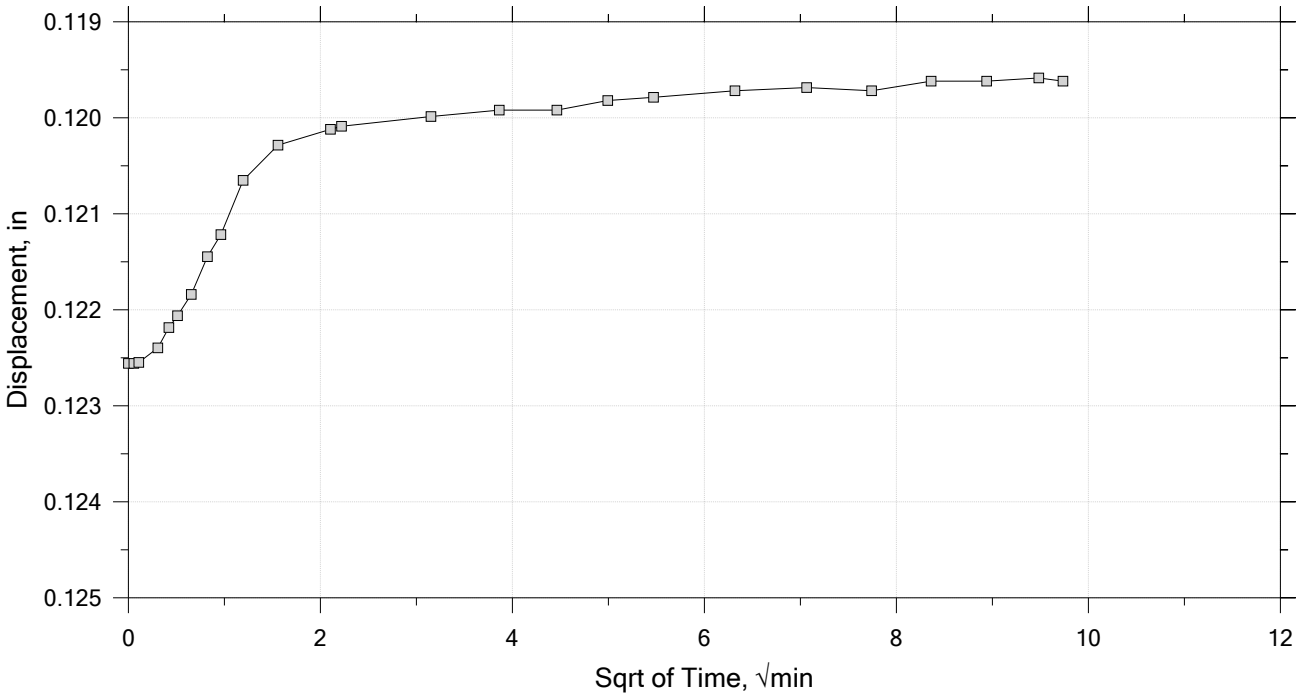


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 23
Constant Load Step
Stress: 3.25e+03 psf

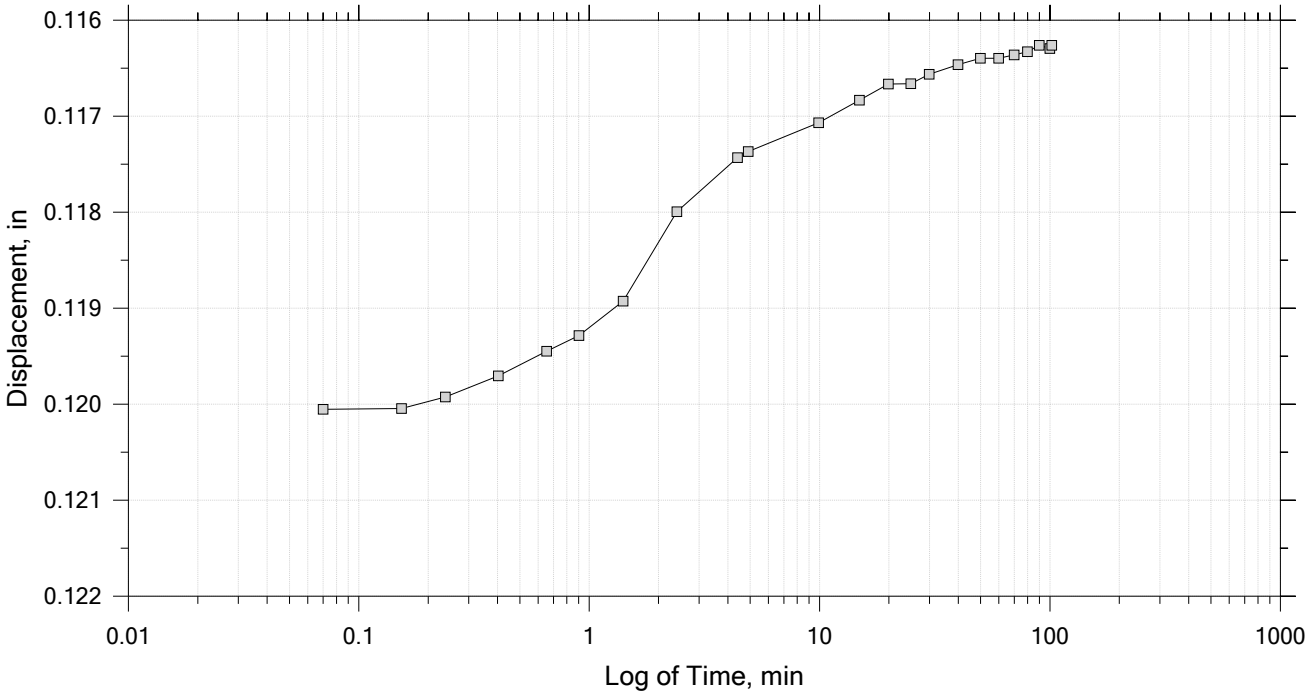


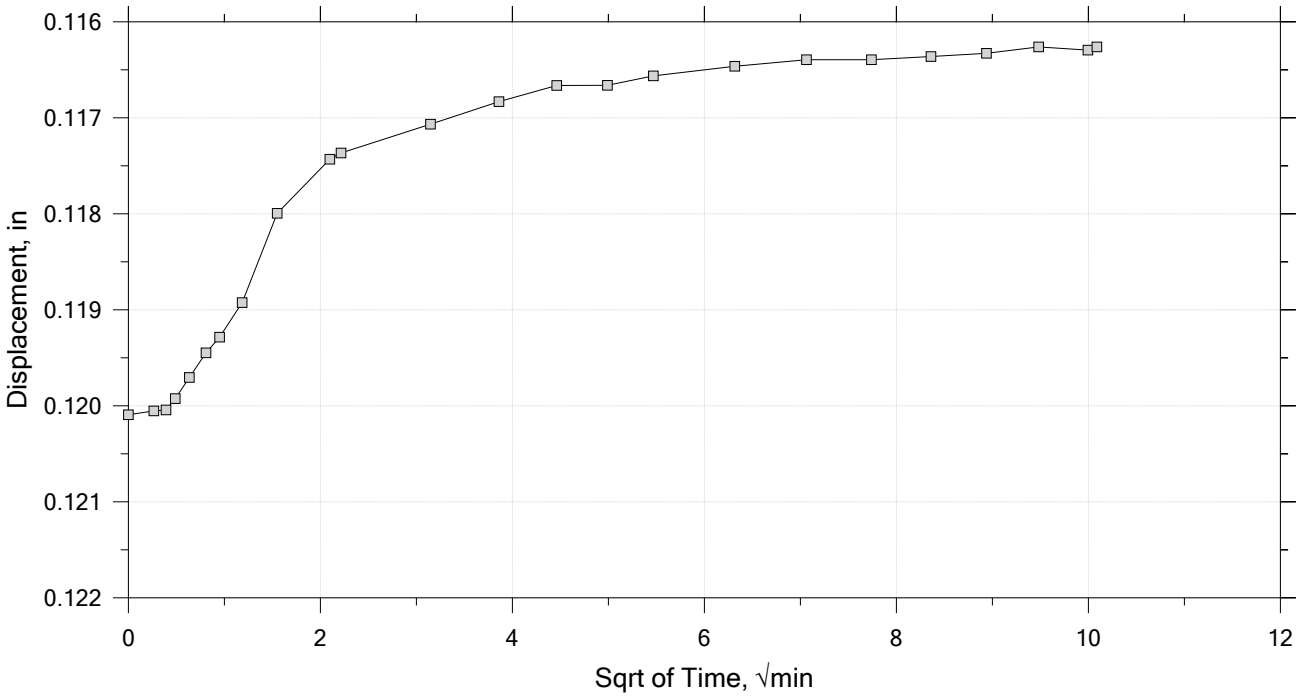


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 23
Constant Load Step
Stress: 1.62e+03 psf

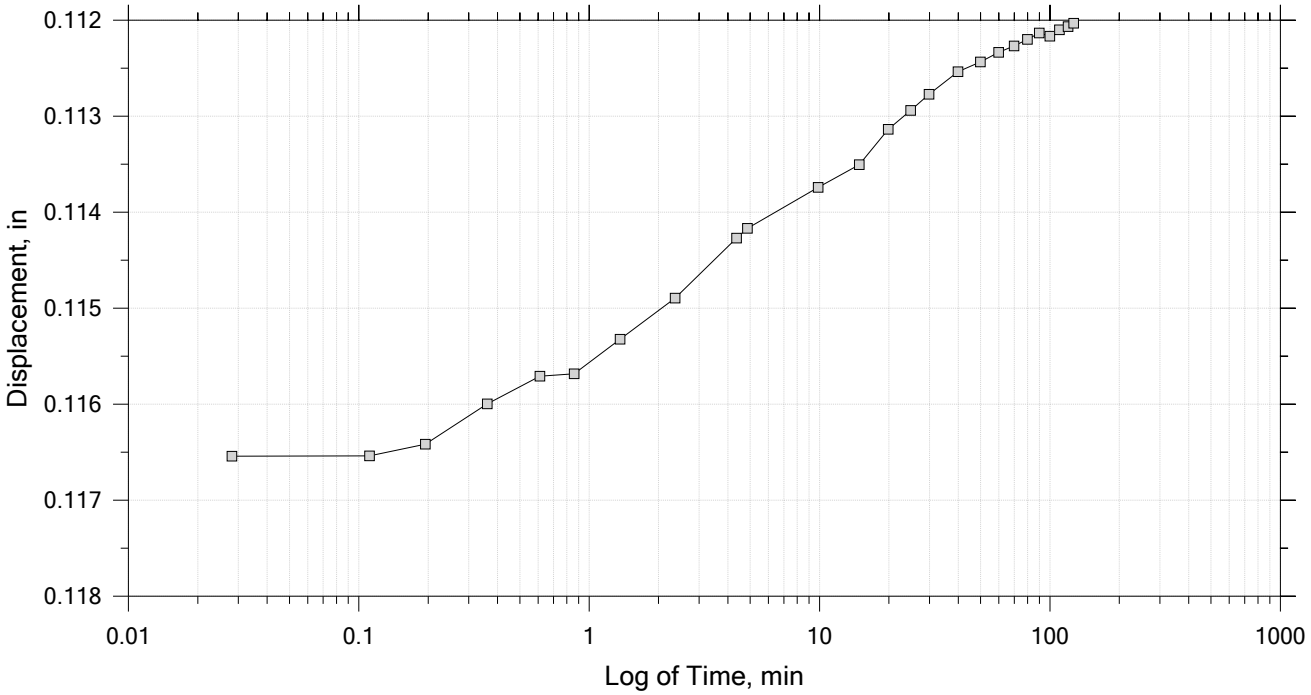


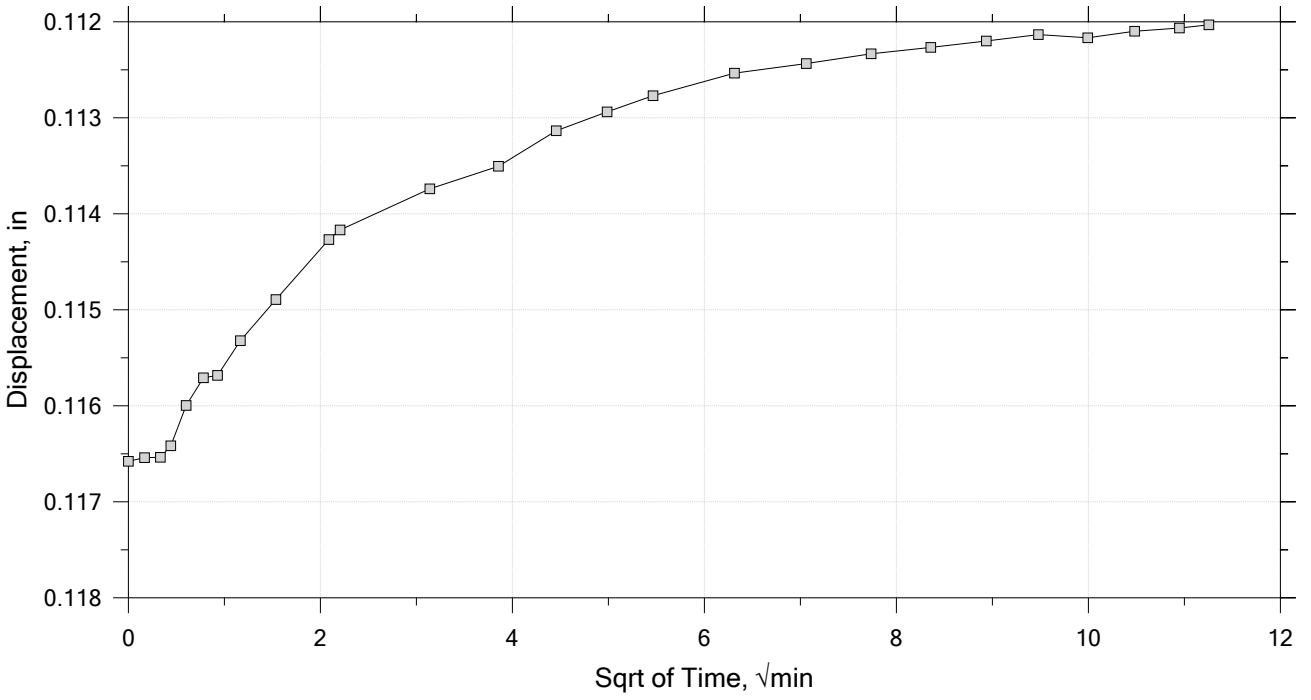


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 23
Constant Load Step
Stress: 812 psf

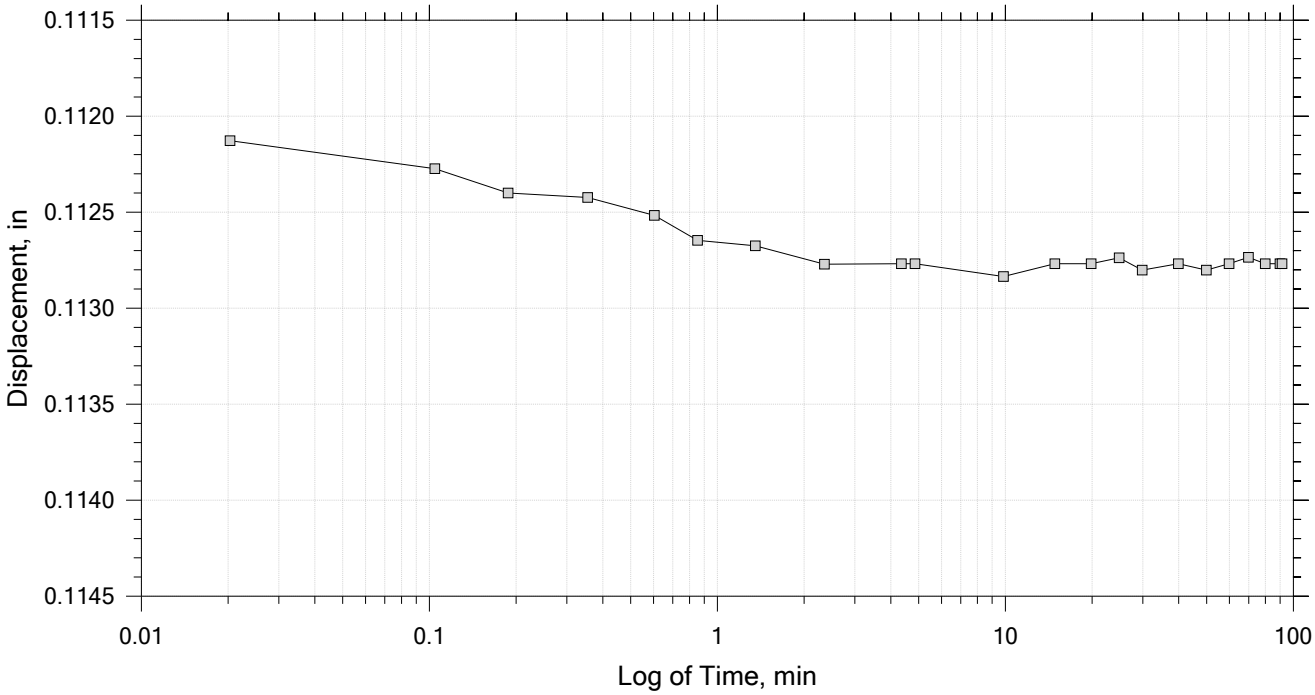


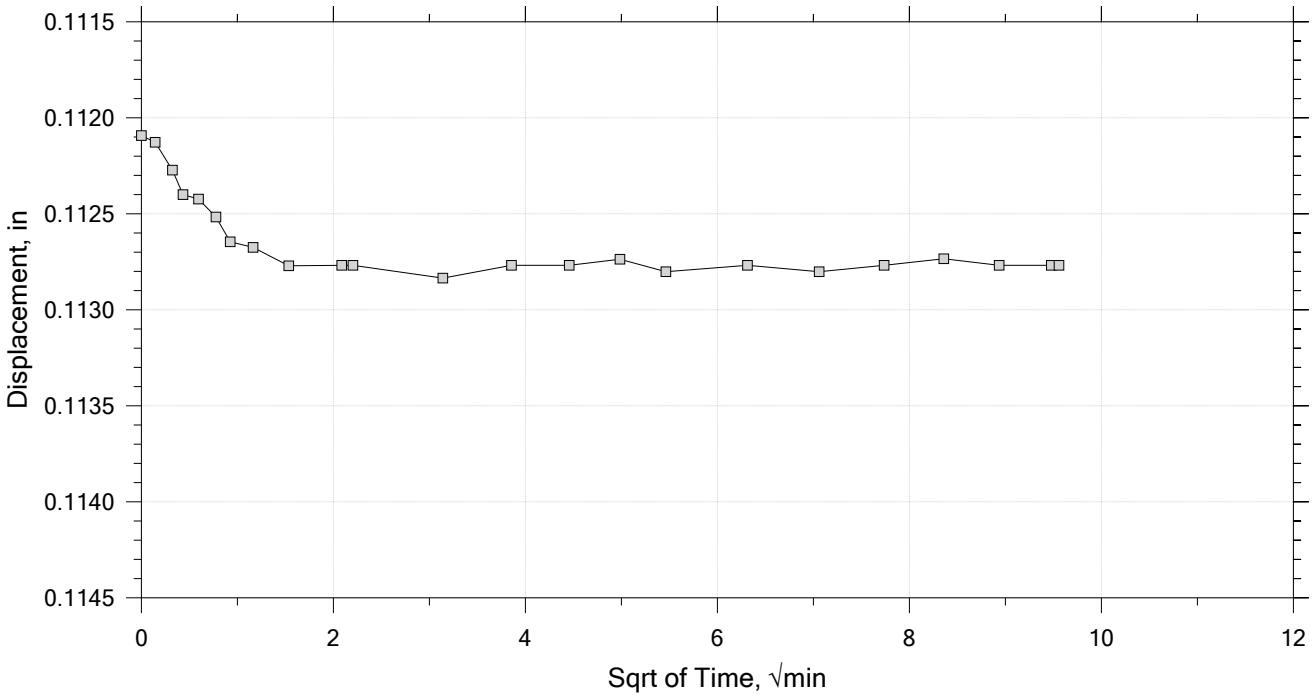


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 23
Constant Load Step
Stress: 1.62e+03 psf

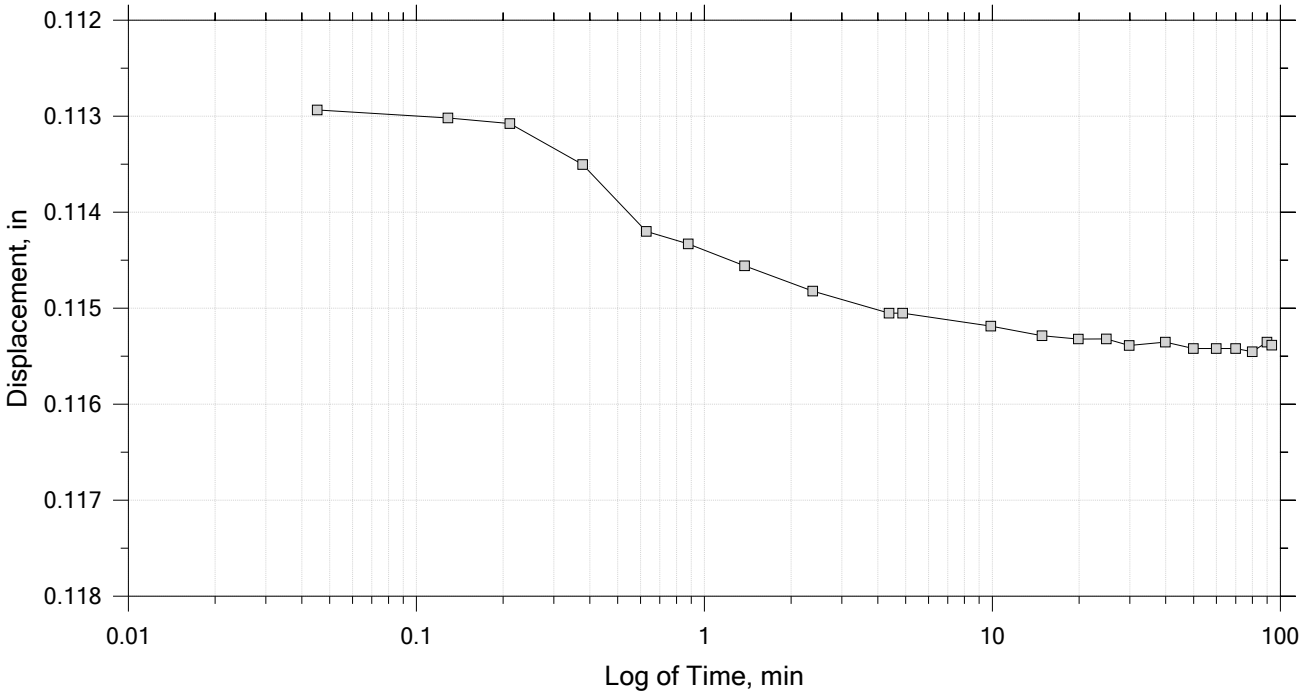


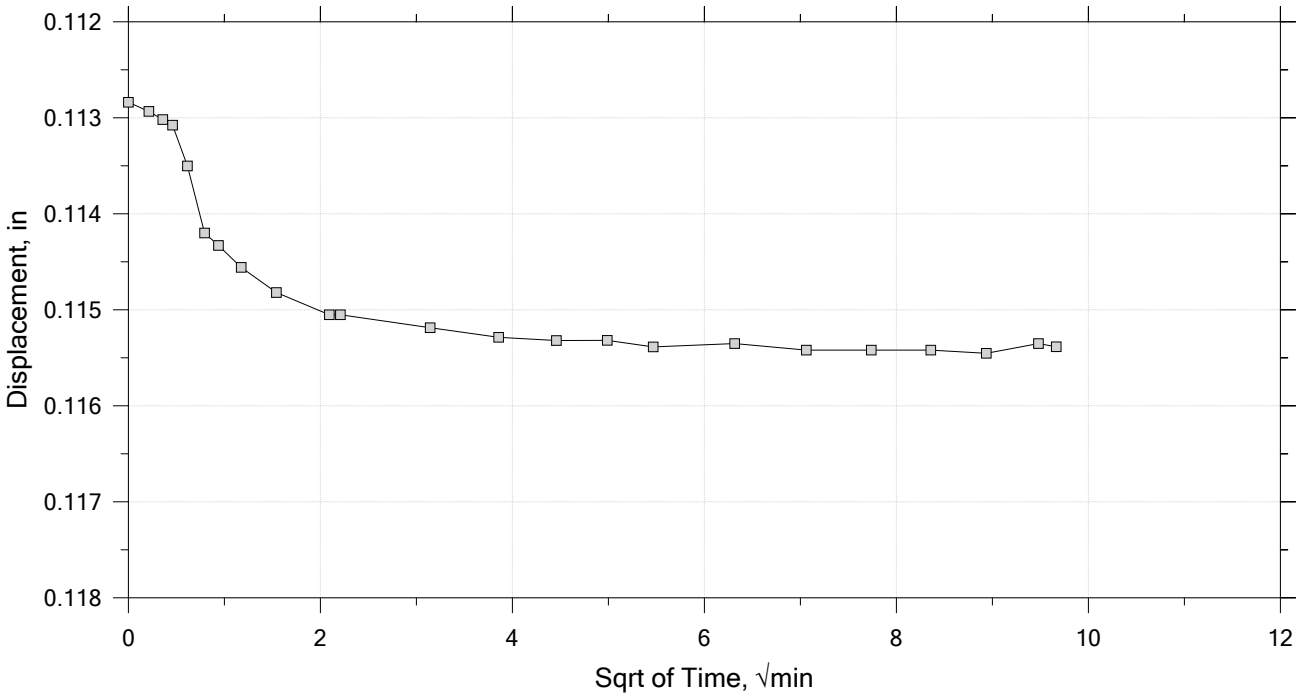


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 23
Constant Load Step
Stress: 3.25e+03 psf

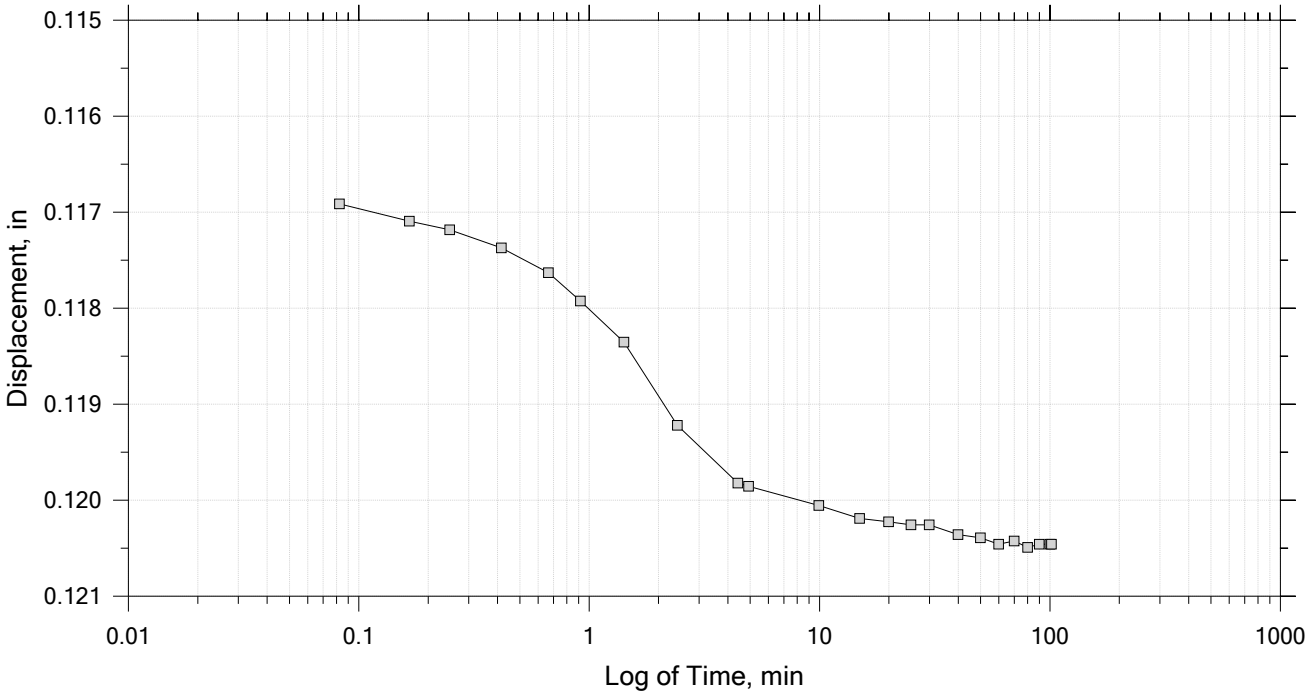


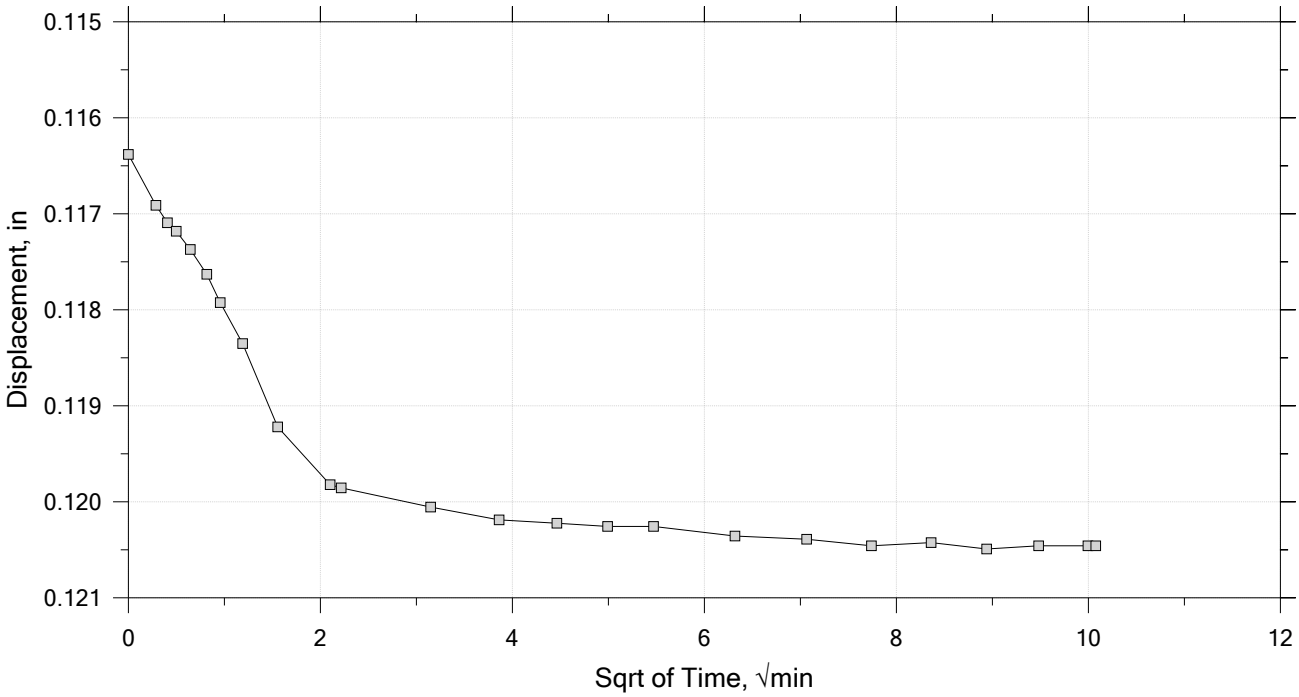


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 17 of 23
Constant Load Step
Stress: 6.49e+03 psf

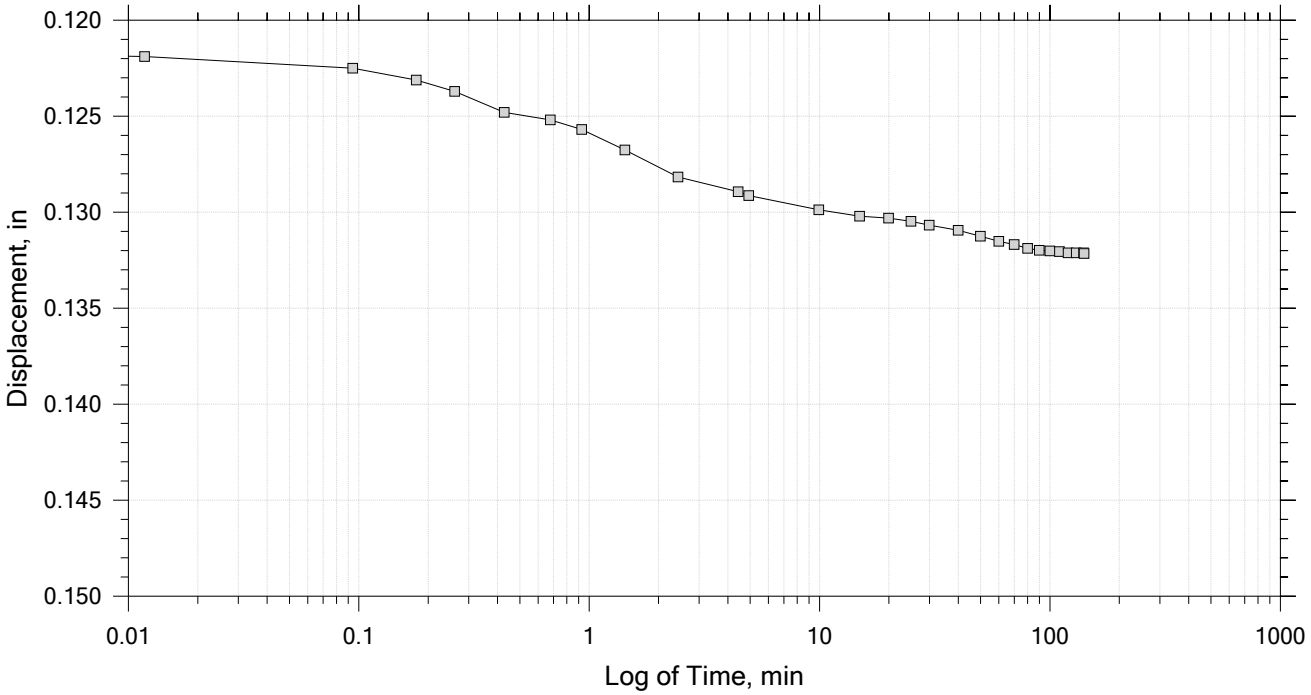


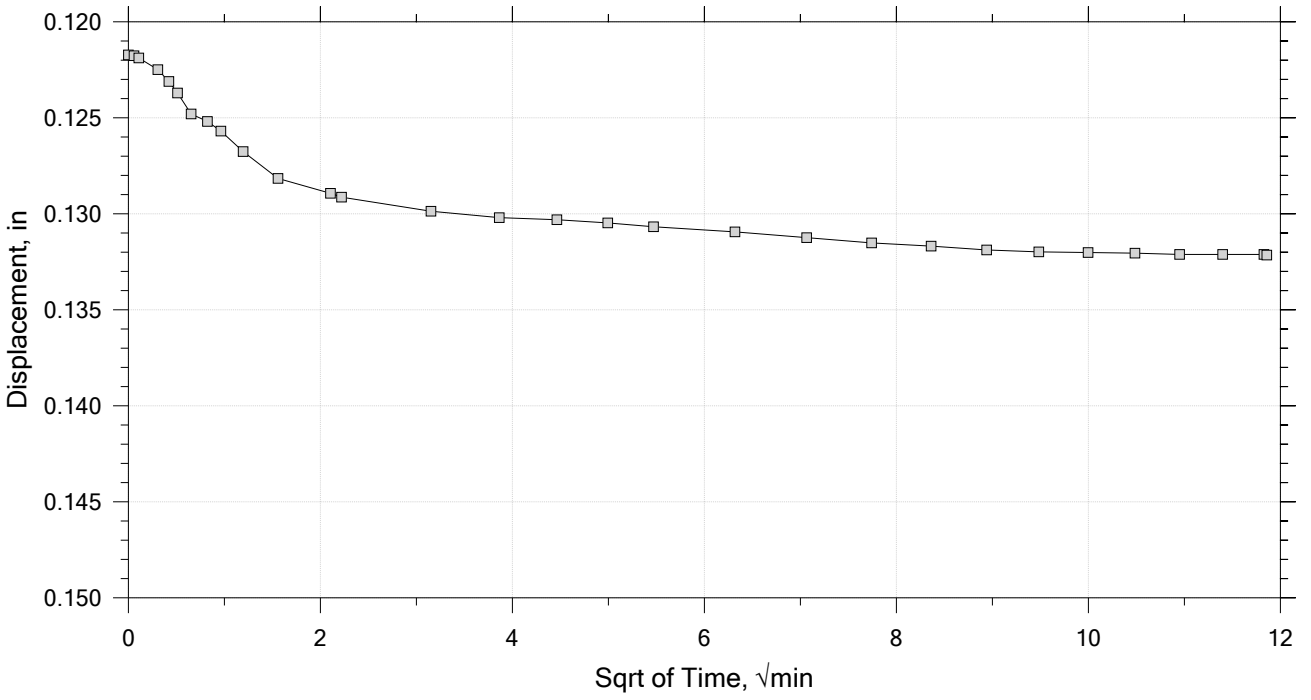


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 18 of 23
Constant Load Step
Stress: 1.3e+04 psf

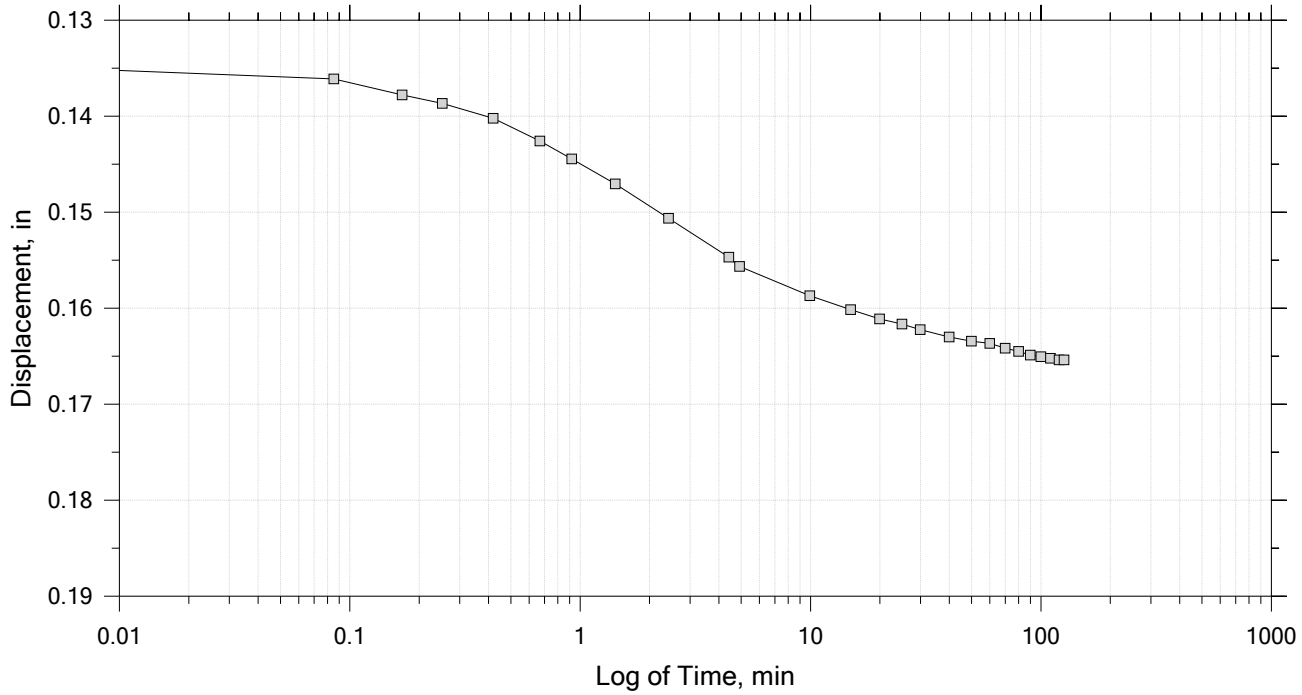


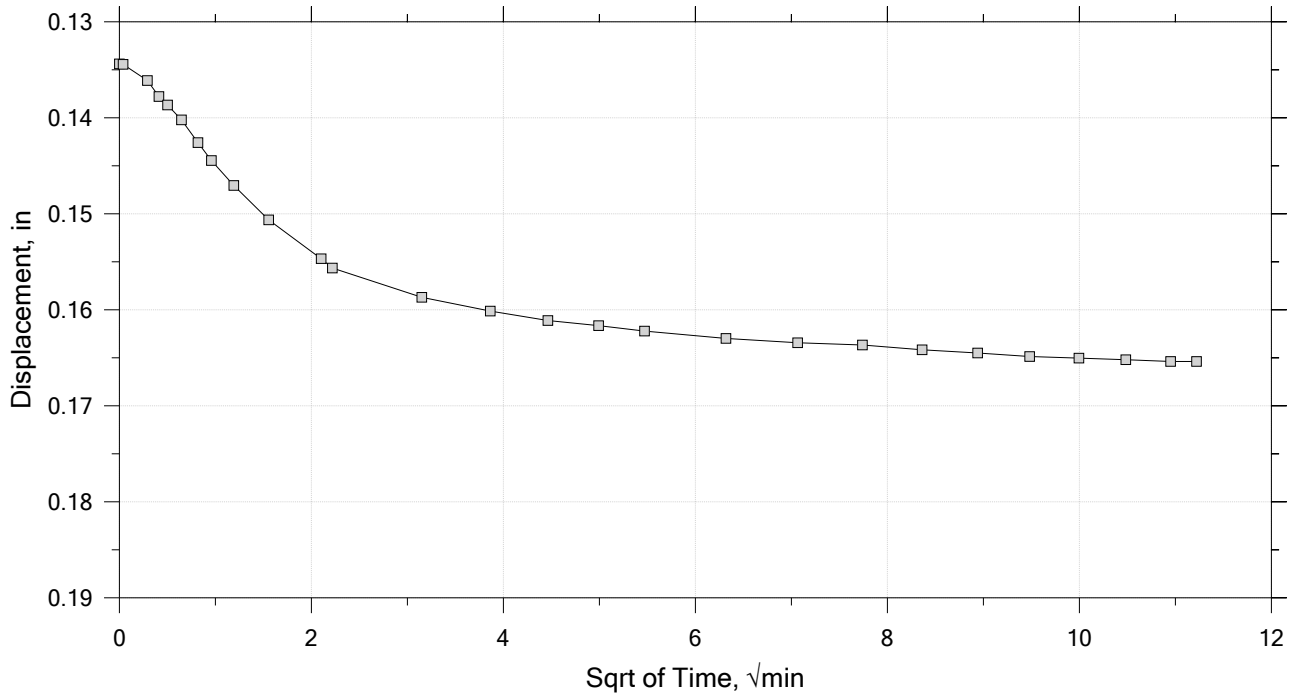


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 19 of 23
Constant Load Step
Stress: 2.6e+04 psf

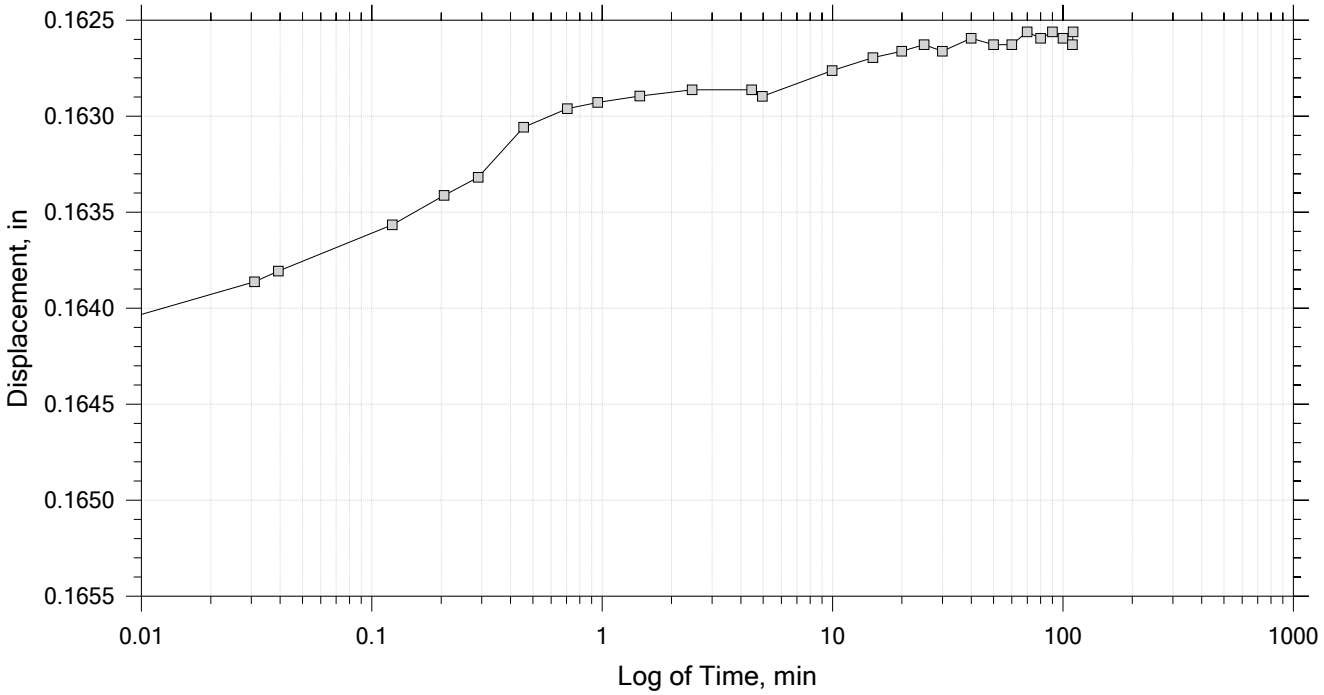


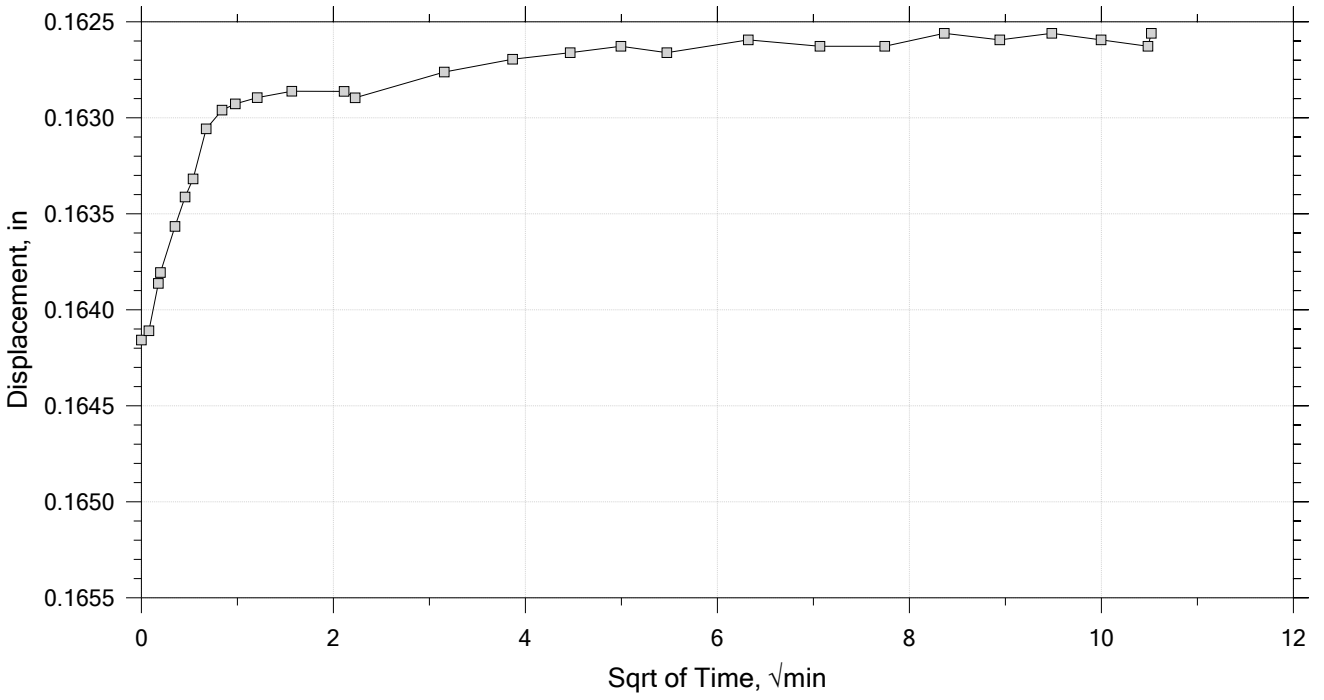


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 20 of 23
Constant Load Step
Stress: 1.3e+04 psf

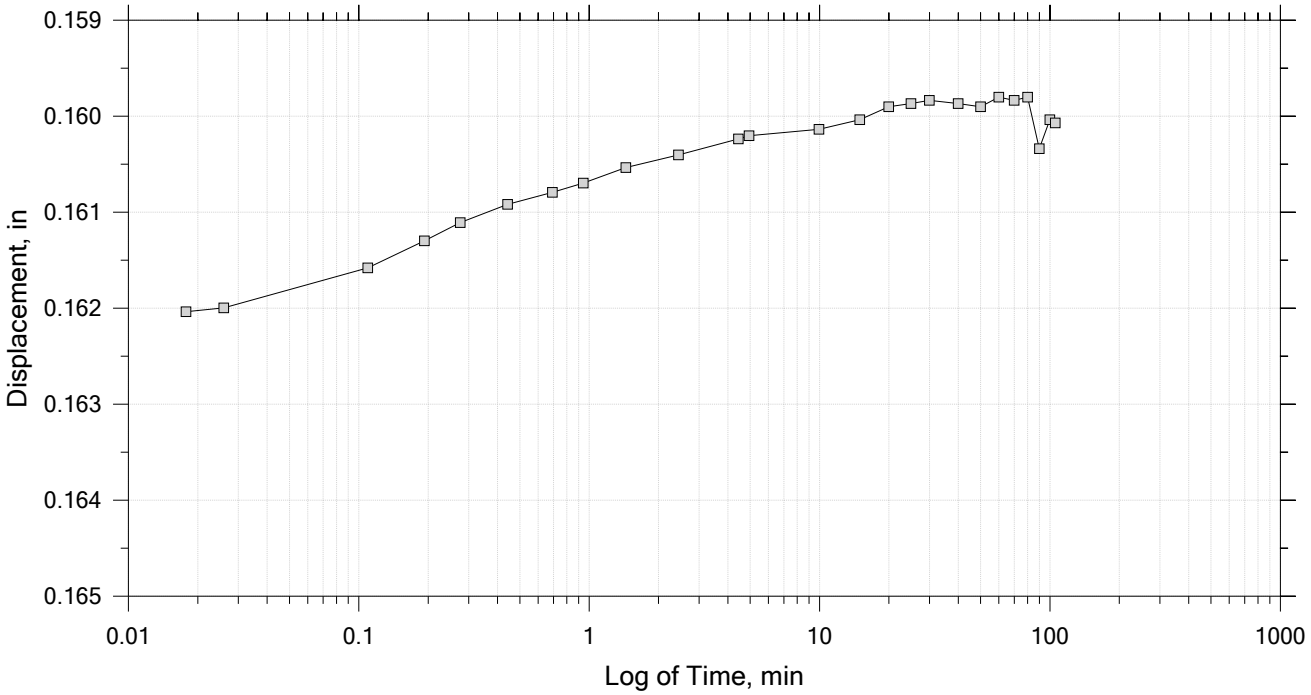


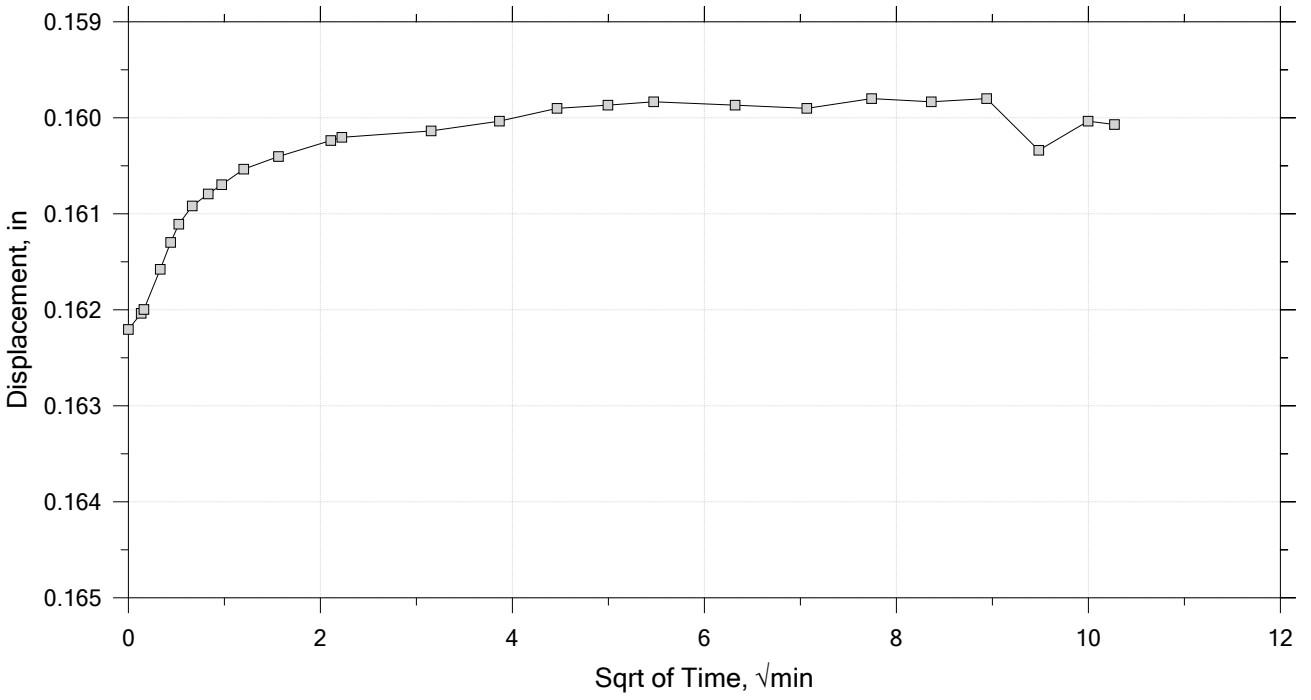


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 21 of 23
Constant Load Step
Stress: 6.49e+03 psf

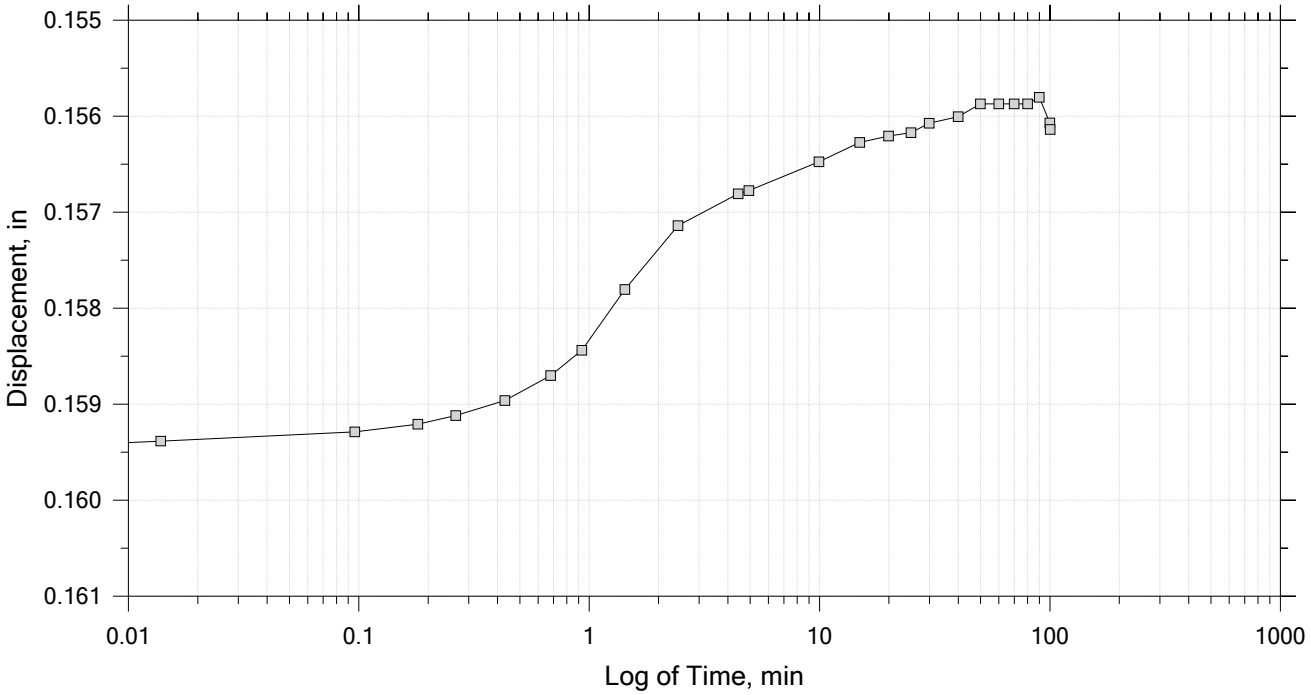


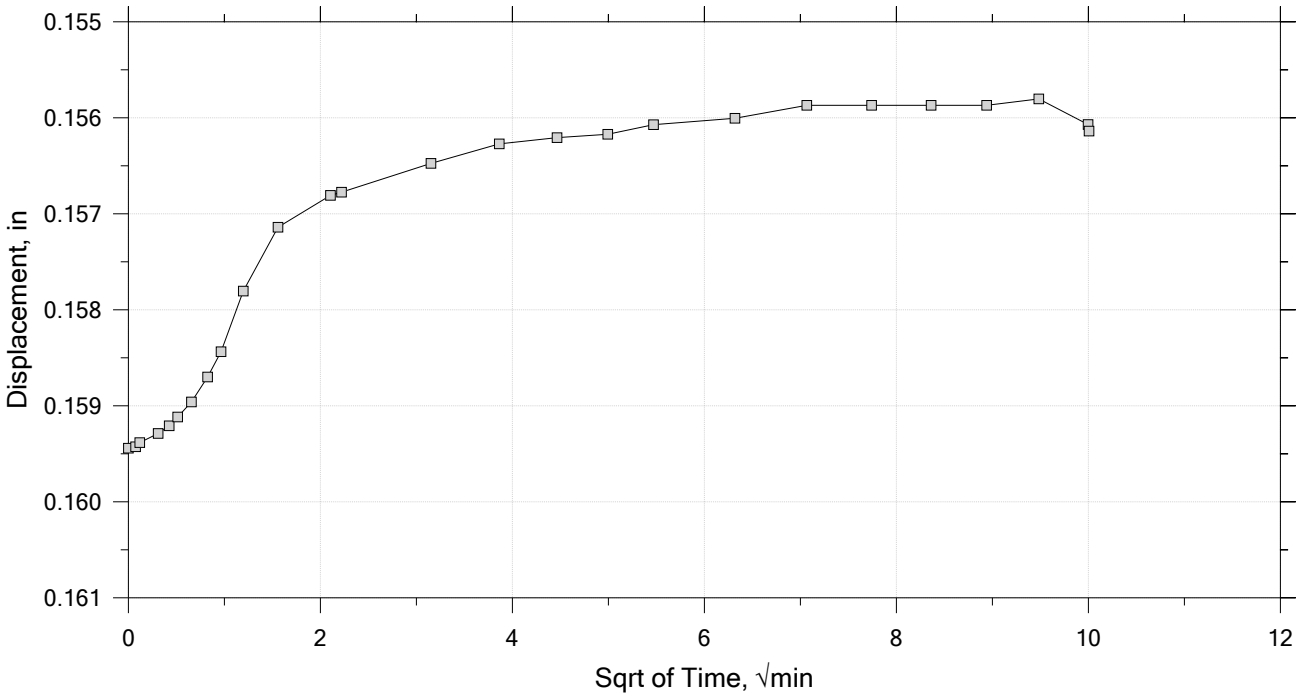


Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 22 of 23
Constant Load Step
Stress: 3.25e+03 psf

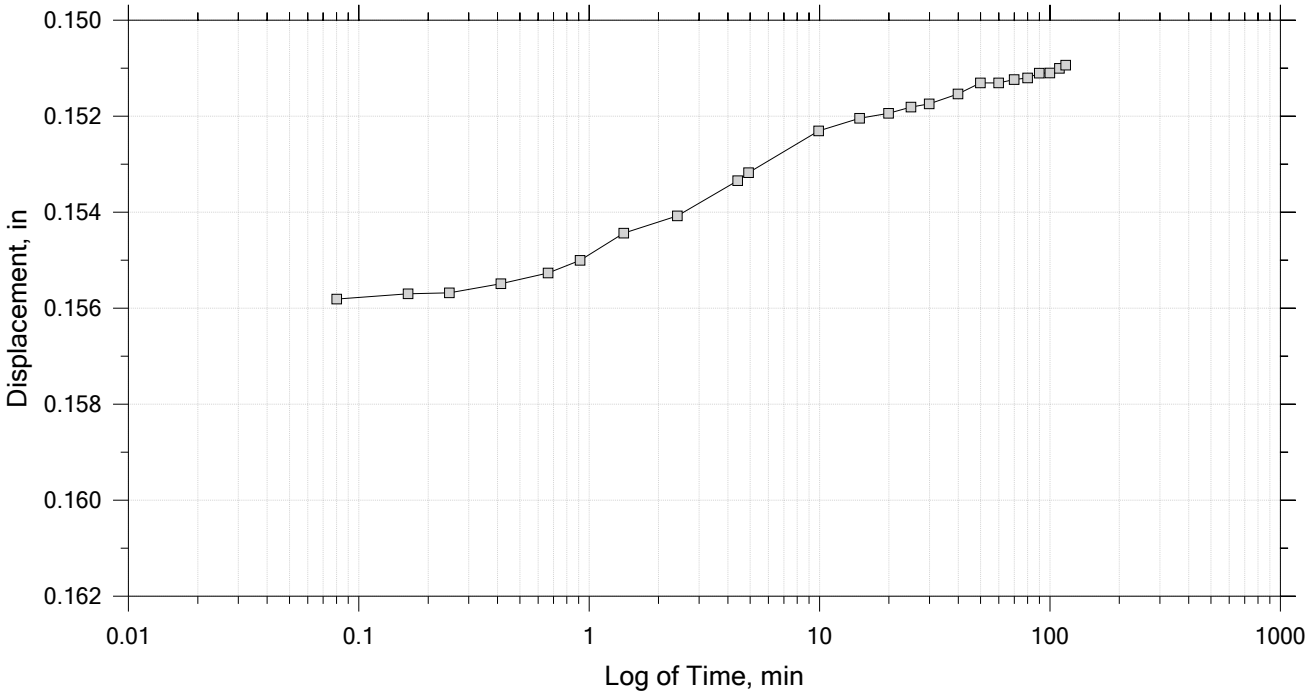


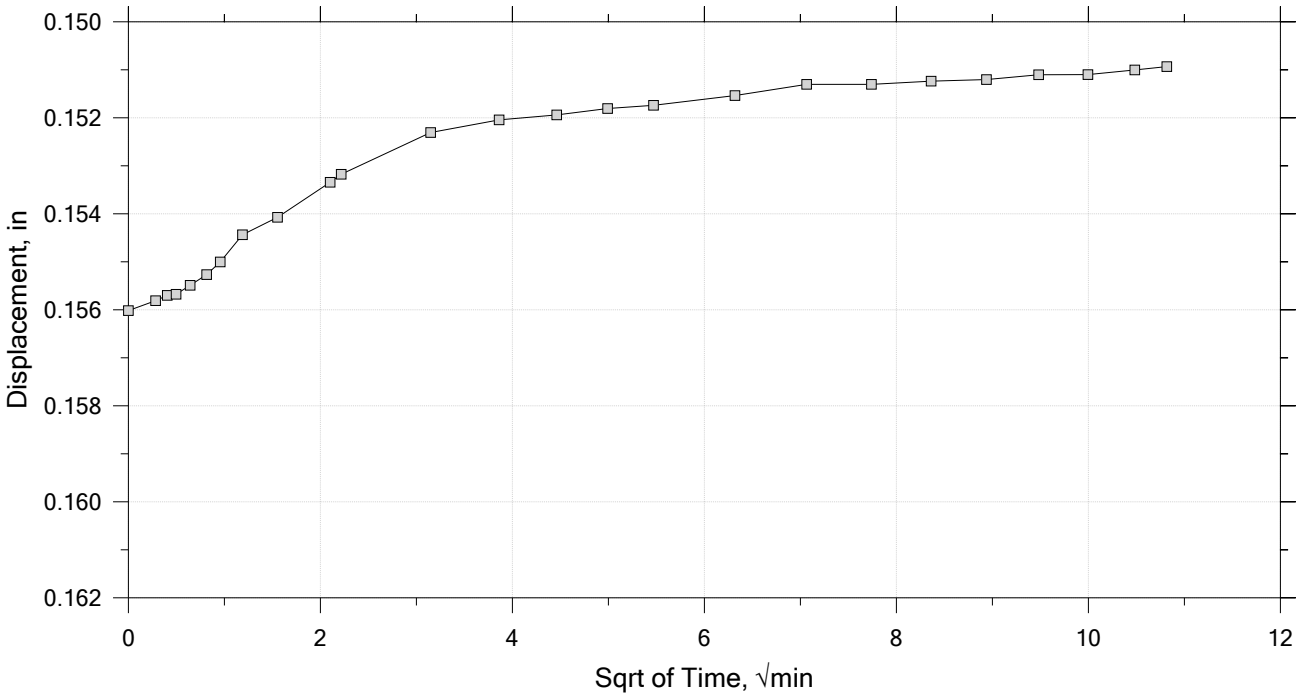


Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 23 of 23
Constant Load Step
Stress: 1.62e+03 psf





Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter, in: 2.50	Specific Gravity: 2.85 (Implied)	Liquid Limit: 0
Specimen Height, in: 1.00	Initial Void Ratio: 0.905	Plastic Limit: 0
Final Height, in: 0.85	Final Void Ratio: 0.618	Plasticity Index: 0

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	218	---	"ring"	313
Mass Container, gm	36.95	109.52	109.52	60.85
Mass Container + Wet Soil, gm	147.25	266.89	256	207.17
Mass Container + Dry Soil, gm	122.76	229.89	229.89	181.09
Mass Dry Soil, gm	85.81	120.37	120.37	120.24
Water Content, %	28.54	30.74	21.69	21.69
Void Ratio	---	0.90	0.62	---
Degree of Saturation, %	---	96.73	100.00	---
Dry Unit Weight, pcf	---	93.325	109.9	---

Preconsolidation Stress, psf	3282
Compression Ratio	0
Rebound Ratio	0
Compression Index	0
Rebound Index	0

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
Test Number: ICONP-68-381	Preparation: wet	Elevation: --
Description: Gray Silty Clay. .		
Remarks:		

One-Dimensional Consolidation by ASTM D2435 - Method B

Log of Time Coefficients

Step	Applied Stress psf	EOP Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/day	Mv ft²/lb	k cm/s	Ca %
1	190.	0.005642	0.894	0.564	0.000	0.00e+00	2.97e+01	0.00e+00	0.00e+00
2	285.	0.007611	0.890	0.760	0.000	0.00e+00	2.07e+01	0.00e+00	0.00e+00
3	428.	0.01045	0.885	1.04	0.000	0.00e+00	1.98e+01	0.00e+00	0.00e+00
4	640.	0.01117	0.884	1.12	0.000	0.00e+00	3.42e+00	0.00e+00	0.00e+00
5	960.	0.01266	0.881	1.26	0.000	0.00e+00	4.63e+00	0.00e+00	0.00e+00
6	1.44e+03	0.01465	0.877	1.46	0.000	0.00e+00	4.14e+00	0.00e+00	0.00e+00
7	2.16e+03	0.01714	0.872	1.71	1.120	4.27e-01	3.44e+00	3.23e-08	0.00e+00
8	3.25e+03	0.02378	0.860	2.38	0.000	0.00e+00	6.13e+00	0.00e+00	0.00e+00
9	6.49e+03	0.07188	0.768	7.18	4.757	9.41e-02	1.48e+01	3.07e-08	0.00e+00
10	1.30e+04	0.1205	0.675	12.0	2.461	1.64e-01	7.49e+00	2.70e-08	0.00e+00
11	6.49e+03	0.1187	0.679	11.9	0.000	0.00e+00	2.92e-01	0.00e+00	0.00e+00
12	3.25e+03	0.1200	0.677	12.0	0.943	4.06e-01	-4.03e-01	-3.60e-09	0.00e+00
13	1.62e+03	0.1165	0.683	11.6	1.711	2.24e-01	2.13e+00	1.05e-08	0.00e+00
14	812.	0.1125	0.691	11.2	0.000	0.00e+00	4.96e+00	0.00e+00	0.00e+00
15	1.62e+03	0.1128	0.690	11.3	0.000	0.00e+00	3.61e-01	0.00e+00	0.00e+00
16	3.25e+03	0.1152	0.686	11.5	0.000	0.00e+00	1.48e+00	0.00e+00	0.00e+00
17	6.49e+03	0.1203	0.676	12.0	1.609	2.39e-01	1.56e+00	8.23e-09	0.00e+00
18	1.30e+04	0.1301	0.657	13.0	1.205	3.14e-01	1.52e+00	1.05e-08	0.00e+00
19	2.60e+04	0.1605	0.600	16.0	1.868	1.93e-01	2.33e+00	9.93e-09	0.00e+00
20	1.30e+04	0.1580	0.604	15.8	0.000	0.00e+00	1.93e-01	0.00e+00	0.00e+00
21	6.49e+03	0.1604	0.600	16.0	0.000	0.00e+00	-3.72e-01	-0.00e+00	0.00e+00
22	3.25e+03	0.1563	0.608	15.6	0.000	0.00e+00	1.27e+00	0.00e+00	0.00e+00
23	1.62e+03	0.1517	0.616	15.2	2.725	1.30e-01	2.82e+00	8.06e-09	0.00e+00

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		
	Displacement at End of Primary		

One-Dimensional Consolidation by ASTM D2435 - Method B

Sqrt of Time Coefficients

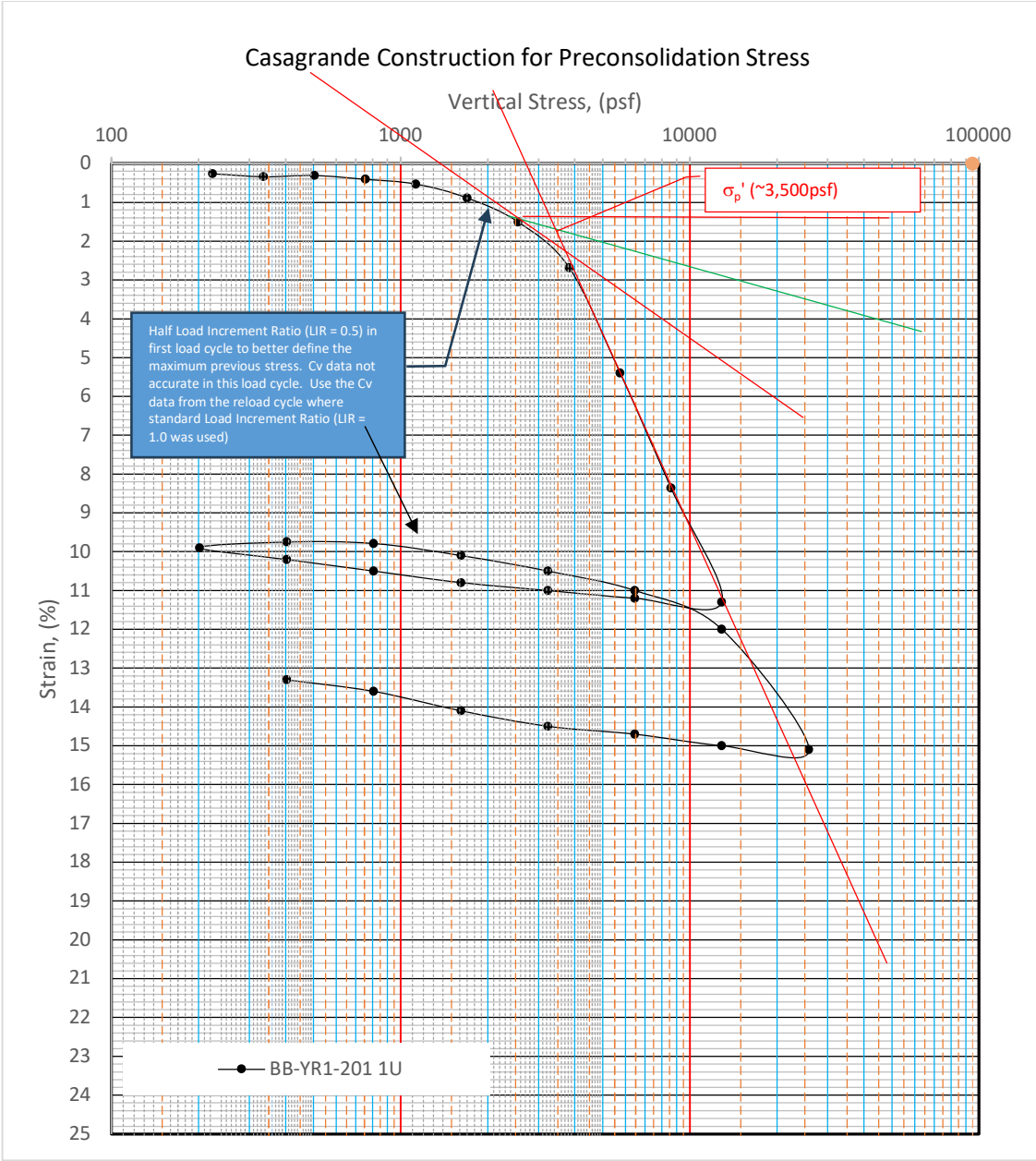
Step	Applied Stress psf	EOP Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/day	Mv ft²/lb	k cm/s
1	190.	0.005642	0.894	0.564	0.000	0.00e+00	2.97e+01	0.00e+00
2	285.	0.007611	0.890	0.760	88.415	2.37e-02	2.07e+01	1.08e-08
3	428.	0.01045	0.885	1.04	17.233	1.21e-01	1.98e+01	5.28e-08
4	640.	0.01117	0.884	1.12	38.897	5.34e-02	3.42e+00	4.03e-09
5	960.	0.01266	0.881	1.26	0.000	0.00e+00	4.63e+00	0.00e+00
6	1.44e+03	0.01465	0.877	1.46	30.777	6.72e-02	4.14e+00	6.13e-09
7	2.16e+03	0.01714	0.872	1.71	5.404	3.81e-01	3.44e+00	2.88e-08
8	3.25e+03	0.02378	0.860	2.38	33.294	6.12e-02	6.13e+00	8.27e-09
9	6.49e+03	0.07188	0.768	7.18	27.248	7.07e-02	1.48e+01	2.30e-08
10	1.30e+04	0.1205	0.675	12.0	15.705	1.11e-01	7.49e+00	1.82e-08
11	6.49e+03	0.1187	0.679	11.9	2.913	5.65e-01	2.92e-01	3.63e-09
12	3.25e+03	0.1200	0.677	12.0	5.318	3.10e-01	-4.03e-01	-2.75e-09
13	1.62e+03	0.1165	0.683	11.6	16.142	1.02e-01	2.13e+00	4.80e-09
14	812.	0.1125	0.691	11.2	20.339	8.19e-02	4.96e+00	8.94e-09
15	1.62e+03	0.1128	0.690	11.3	1.537	1.09e+00	3.61e-01	8.65e-09
16	3.25e+03	0.1152	0.686	11.5	4.186	3.99e-01	1.48e+00	1.30e-08
17	6.49e+03	0.1203	0.676	12.0	12.443	1.33e-01	1.56e+00	4.58e-09
18	1.30e+04	0.1301	0.657	13.0	6.106	2.66e-01	1.52e+00	8.91e-09
19	2.60e+04	0.1605	0.600	16.0	7.374	2.11e-01	2.33e+00	1.08e-08
20	1.30e+04	0.1580	0.604	15.8	0.920	1.63e+00	1.93e-01	6.92e-09
21	6.49e+03	0.1604	0.600	16.0	1.188	1.26e+00	-3.72e-01	-1.04e-08
22	3.25e+03	0.1563	0.608	15.6	6.876	2.19e-01	1.27e+00	6.11e-09
23	1.62e+03	0.1517	0.616	15.2	14.655	1.04e-01	2.82e+00	6.45e-09

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: So Portland, ME	Project Number: 166-25
	Boring Number: BB-YR1-101	Tester: sjr	Checker: sjr
	Sample Number: U1	Test Date: 3/18/22	Depth: 13.42
	Test Number: ICONP-68-381	Preparation: wet	Elevation: --
	Description: Gray Silty Clay. .		
	Remarks:		
	Displacement at End of Primary		

Consolidation Test Data
Summary Report

Project Name:	Yarmouth Rt 1 Bridge
Project Number:	166-35
Project Location:	Yarmouth, Maine
Client:	GZA - PN: 09.0026144.00
Sample Description:	Gray Silty Clay (CL)
Preparation:	Trimmed Shelby Tube

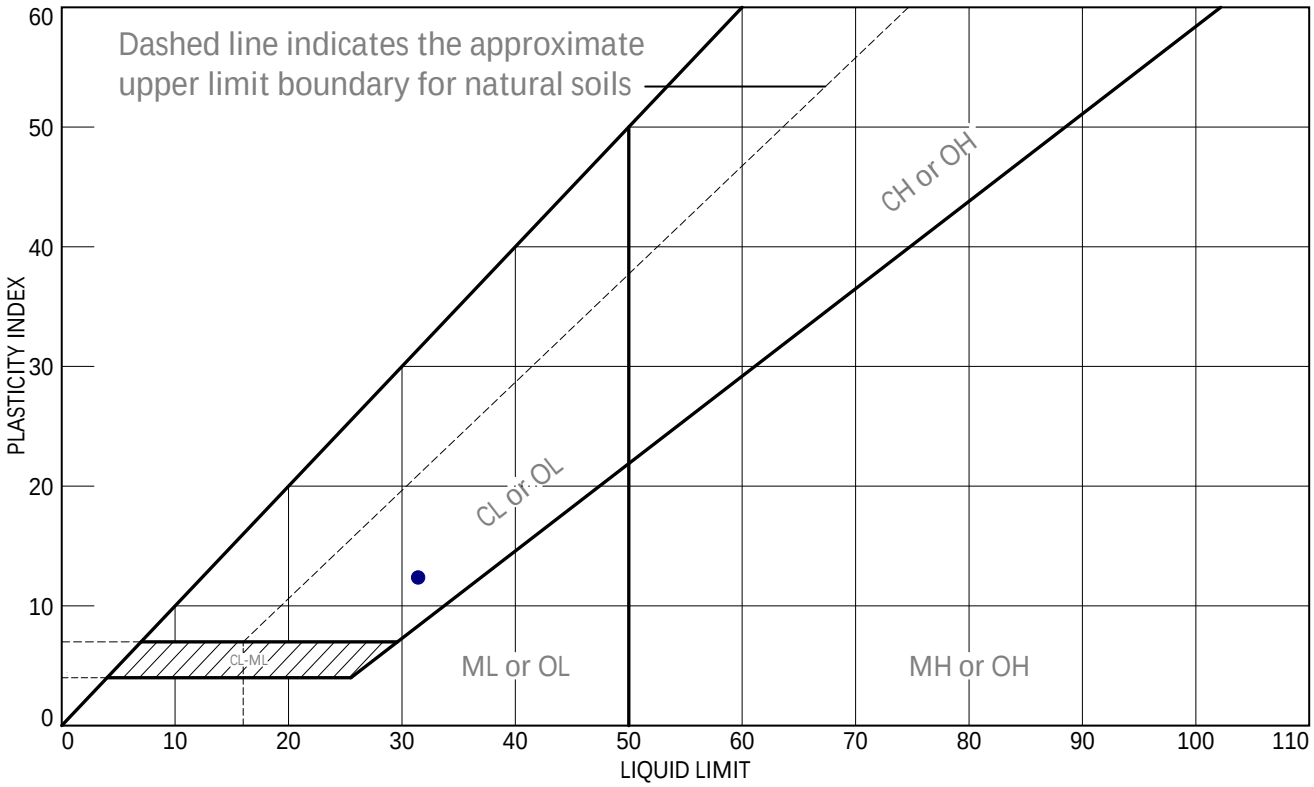
Lab Test No:	ICON 68-423			
Boring No.	BB-YR1-201			
Sample No:	1U			
Boring Elevation (ft).	--			
Sample Depth (ft):	10-12			
Test Specimen Depth (Ft):	11.48			
Test Specimen Elevation:	---			
Water Content (%):	31.0			
Dry Unit Weight (pcf):	93.2			
Wet Unit Weight (pcf):	122.1			
Saturation Before (%):	98.9			
Saturation After (%):	100			
Void Ratio Before:	0.88			
Void Ratio After:	0.63			
Overburden Pressure (psf):	--			
Max Previous stress (psf):	3,500			
Max Prev. stress (Work) (psf):	3,300			
OCR:	--			
Compression Index (C_{CE}):	0.164			
Recompression Index (C_{RE}):	0.017	from re-load curve		
Liquid Limit:	31.5			
Plastic Limit:	19.2			
Plasticity Index:	12.3			
Liquidity Index:	1.0			
Lab Vane Su at 11.65 ft. (psf)	606			
Tested By:	sjr			
Date Tested:	5/22/2024			
Checked By:	sjr			



Note 1: The calculations for the Max Previous Stress, the Compression Index and the Recompression Index are provided for the convienience of the Specifier. The Specifier should make their own independent assessment of Maximum Previous stress, Cce and Cre for use in any engineering analyses.

Soil Metrics LLC Geotechnical Engineering

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-YR1-201	1U	10-12		19.2	31.5	12.3		CL

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GZA

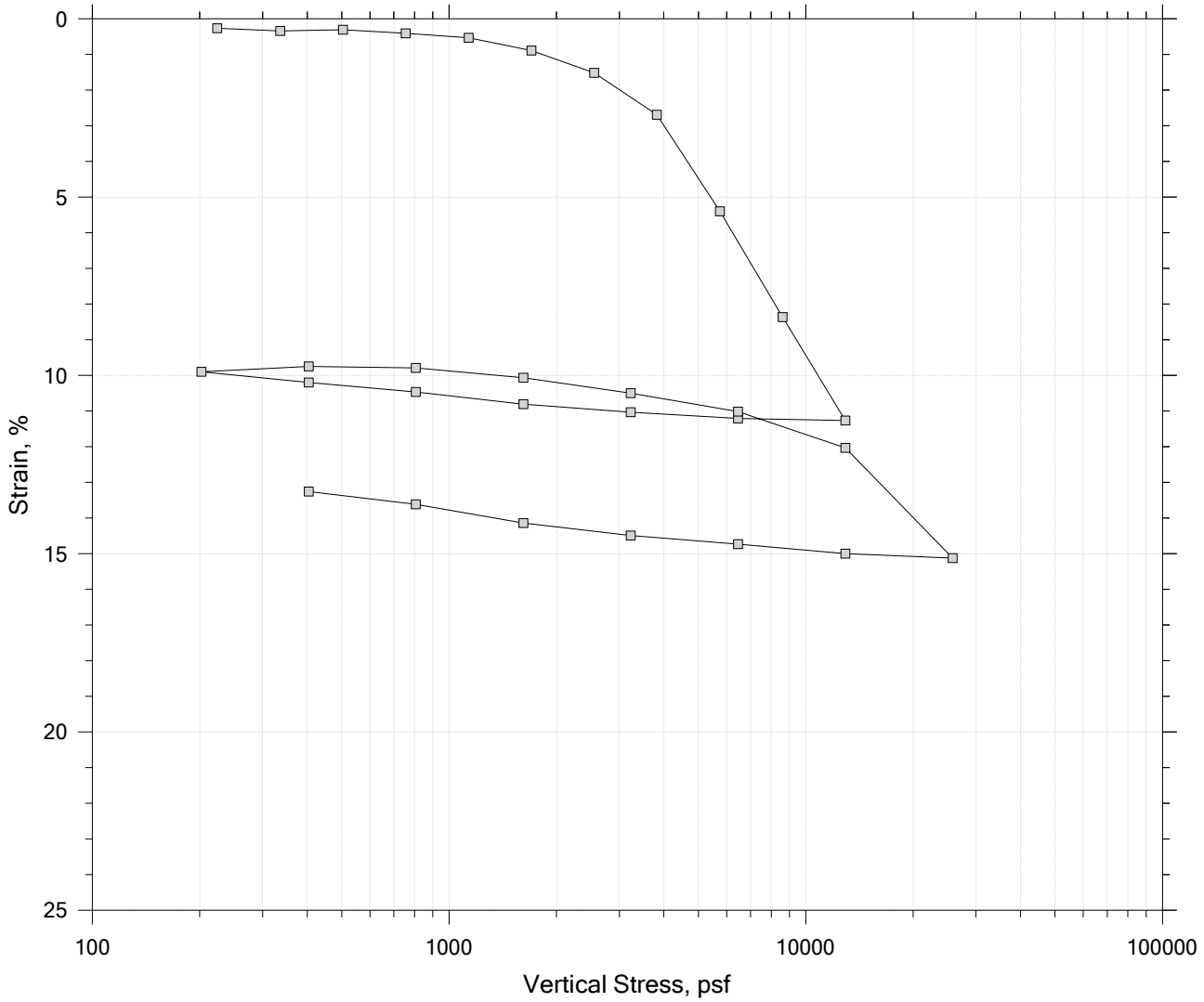
Project: Yarmouth Route 1 Bridge

Project No.: GZA PN 09.0026144.00 Figure

Tested By: sjr Checked By: sjr

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



					Before Test	After Test
Current Vertical Effective Stress: 0 psf				Water Content, %	30.98	22.45
Preconsolidation Stress: 0 psf				Dry Unit Weight, pcf	93.195	107.44
Compression Ratio: 0				Saturation, %	98.91	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	0.88	0.63
LL: 32	PL: 19	PI: 12	GS: 2.80			

Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Implied Specific Gravity: 2.80	Liquid Limit: 32
Initial Height: 1.00 in	Initial Void Ratio: 0.878	Plastic Limit: 19
Final Height: 0.87 in	Final Void Ratio: 0.629	Plasticity Index: 12

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	209	RING	"ring"	302
Mass Container, gm	36.67	109.53	109.53	60.04
Mass Container + Wet Soil, gm	177.49	266.82	256.57	206.94
Mass Container + Dry Soil, gm	145.97	229.61	229.61	180.01
Mass Dry Soil, gm	109.3	120.08	120.08	119.97
Water Content, %	28.84	30.98	22.45	22.45
Void Ratio	---	0.88	0.63	---
Degree of Saturation, %	---	98.91	100.00	---
Dry Unit Weight, pcf	---	93.195	107.44	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

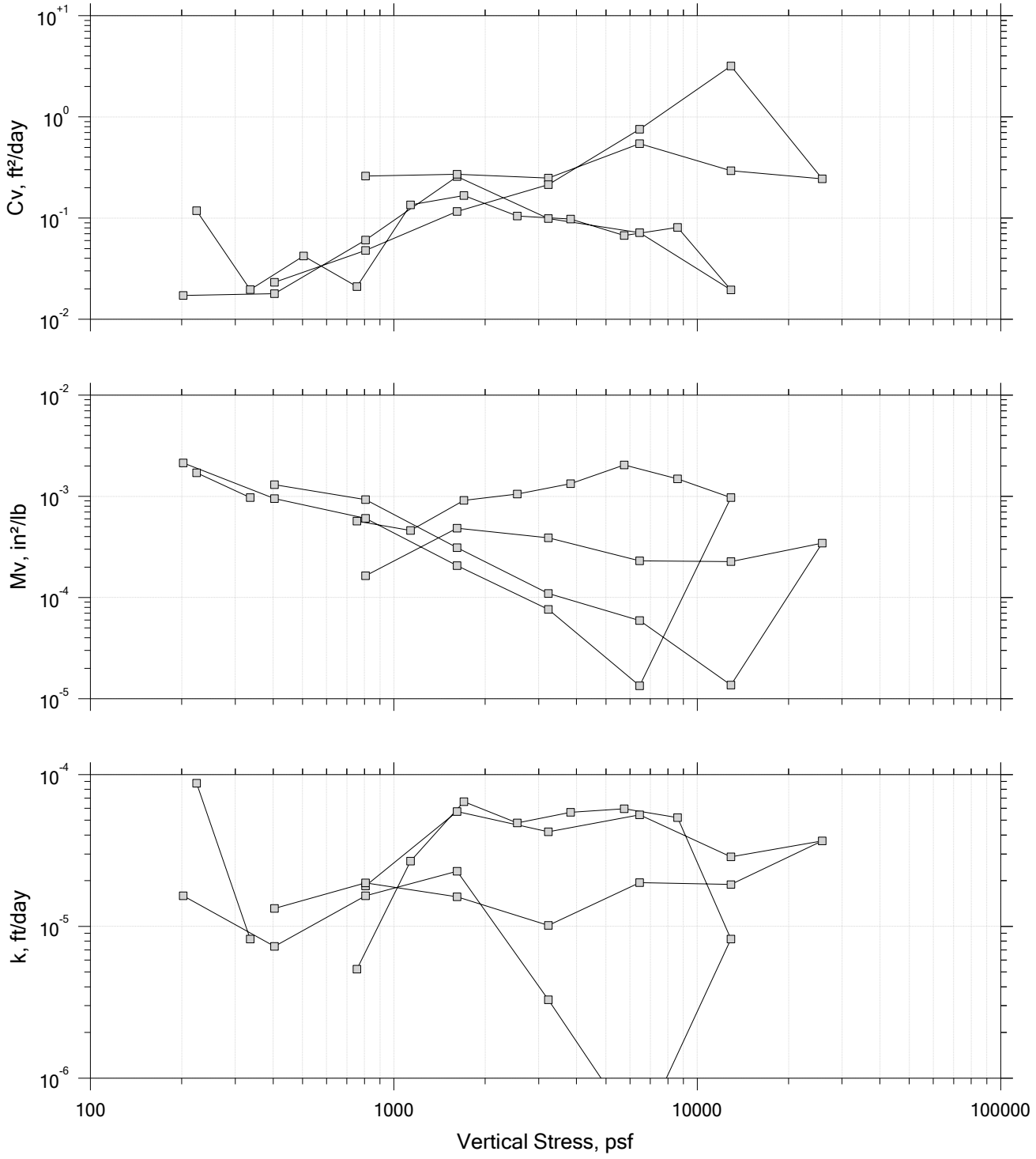
Square Root of Time Coefficients

Step	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/day	Mv 1/psf	k ft/day
1	224.	0.002656	0.873	0.266	17.841	1.19e-01	1.19e-05	8.77e-05
2	336.	0.003411	0.872	0.341	107.499	1.96e-02	6.74e-06	8.25e-06
3	504.	0.003096	0.873	0.310	49.765	4.23e-02	-1.88e-06	-4.96e-06
4	756.	0.004094	0.871	0.409	99.802	2.11e-02	3.96e-06	5.22e-06
5	1.13e+03	0.005302	0.868	0.530	15.550	1.35e-01	3.20e-06	2.69e-05
6	1.70e+03	0.008904	0.862	0.890	12.508	1.67e-01	6.35e-06	6.63e-05
7	2.55e+03	0.01514	0.850	1.51	19.739	1.05e-01	7.33e-06	4.80e-05
8	3.83e+03	0.02692	0.828	2.69	20.815	9.76e-02	9.24e-06	5.63e-05
9	5.74e+03	0.05402	0.777	5.40	28.953	6.74e-02	1.42e-05	5.96e-05
10	8.61e+03	0.08363	0.721	8.36	22.747	8.08e-02	1.03e-05	5.21e-05
11	1.29e+04	0.1127	0.667	11.3	88.107	1.96e-02	6.74e-06	8.24e-06
12	6.46e+03	0.1121	0.668	11.2	23.262	7.18e-02	9.31e-08	4.17e-07
13	3.23e+03	0.1104	0.671	11.0	16.881	9.92e-02	5.30e-07	3.28e-06
14	1.62e+03	0.1080	0.675	10.8	6.519	2.58e-01	1.43e-06	2.31e-05
15	807.	0.1047	0.682	10.5	27.872	6.07e-02	4.20e-06	1.59e-05
16	404.	0.1020	0.687	10.2	95.066	1.79e-02	6.59e-06	7.38e-06
17	202.	0.09900	0.692	9.90	99.916	1.72e-02	1.48e-05	1.59e-05
18	404.	0.09746	0.695	9.75	0.000	0.00e+00	-7.59e-06	-0.00e+00
19	807.	0.09792	0.695	9.79	6.644	2.60e-01	1.14e-06	1.85e-05
20	1.62e+03	0.1006	0.689	10.1	6.340	2.71e-01	3.36e-06	5.70e-05
21	3.23e+03	0.1050	0.681	10.5	6.866	2.49e-01	2.71e-06	4.20e-05
22	6.46e+03	0.1102	0.671	11.0	3.106	5.44e-01	1.60e-06	5.43e-05
23	1.29e+04	0.1203	0.652	12.0	5.662	2.93e-01	1.57e-06	2.87e-05
24	2.58e+04	0.1512	0.594	15.1	6.479	2.44e-01	2.39e-06	3.65e-05
25	1.29e+04	0.1500	0.597	15.0	0.480	3.19e+00	9.47e-08	1.89e-05
26	6.46e+03	0.1473	0.602	14.7	2.037	7.54e-01	4.12e-07	1.94e-05
27	3.23e+03	0.1449	0.606	14.5	7.236	2.14e-01	7.61e-07	1.02e-05
28	1.62e+03	0.1414	0.613	14.1	13.410	1.16e-01	2.16e-06	1.57e-05
29	807.	0.1362	0.623	13.6	32.741	4.80e-02	6.45e-06	1.93e-05
30	404.	0.1325	0.629	13.3	68.342	2.32e-02	9.04e-06	1.31e-05

Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

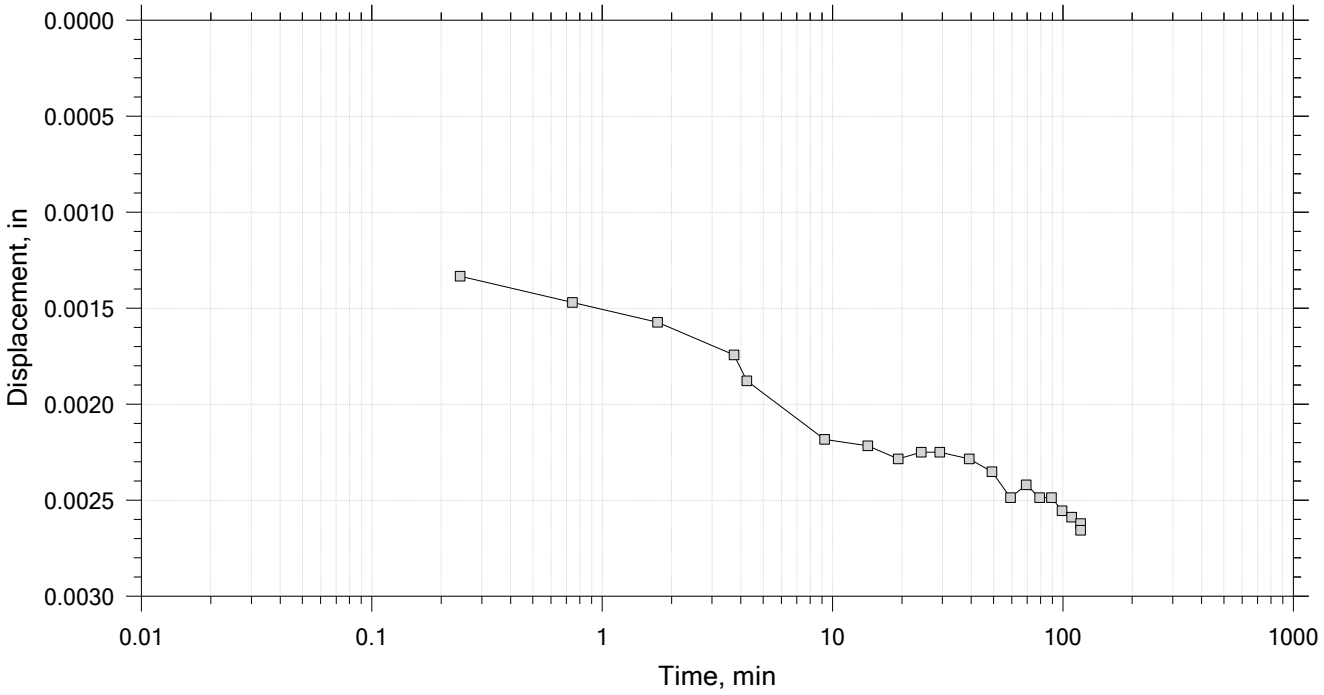
Square Root of Time Coefficients

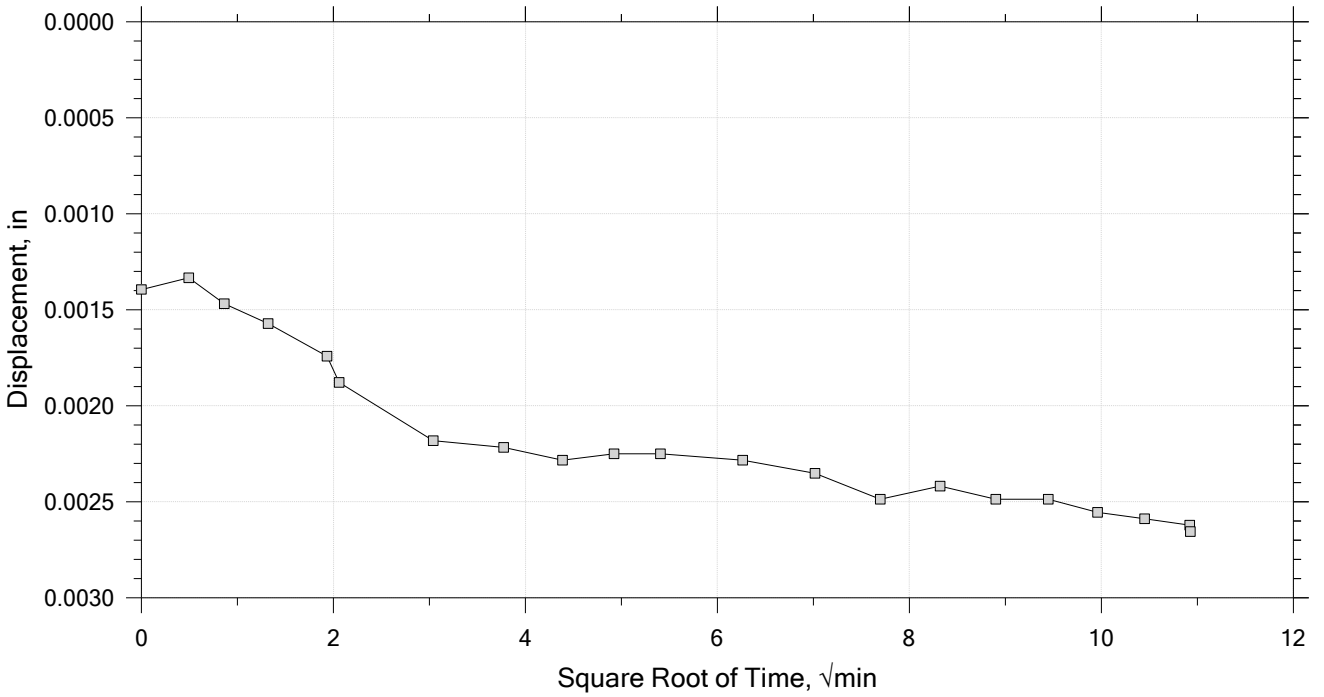


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 30
Constant Load Step
Stress: 224 psf

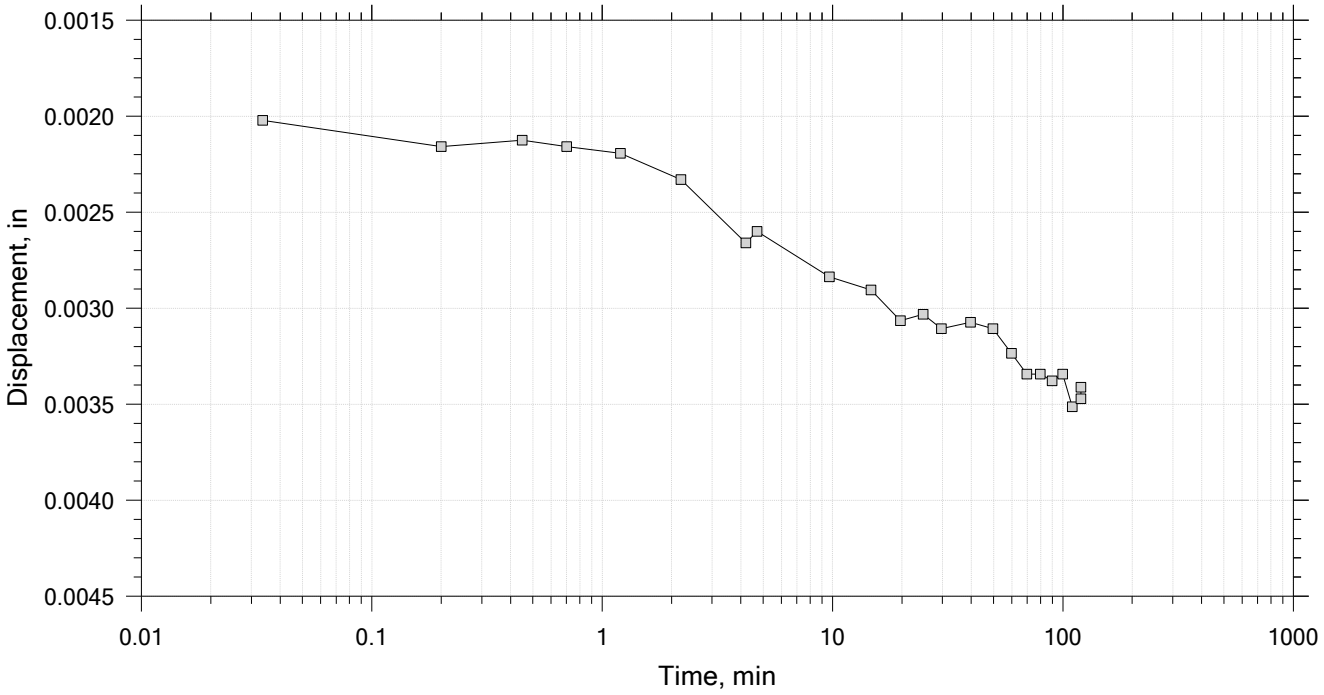


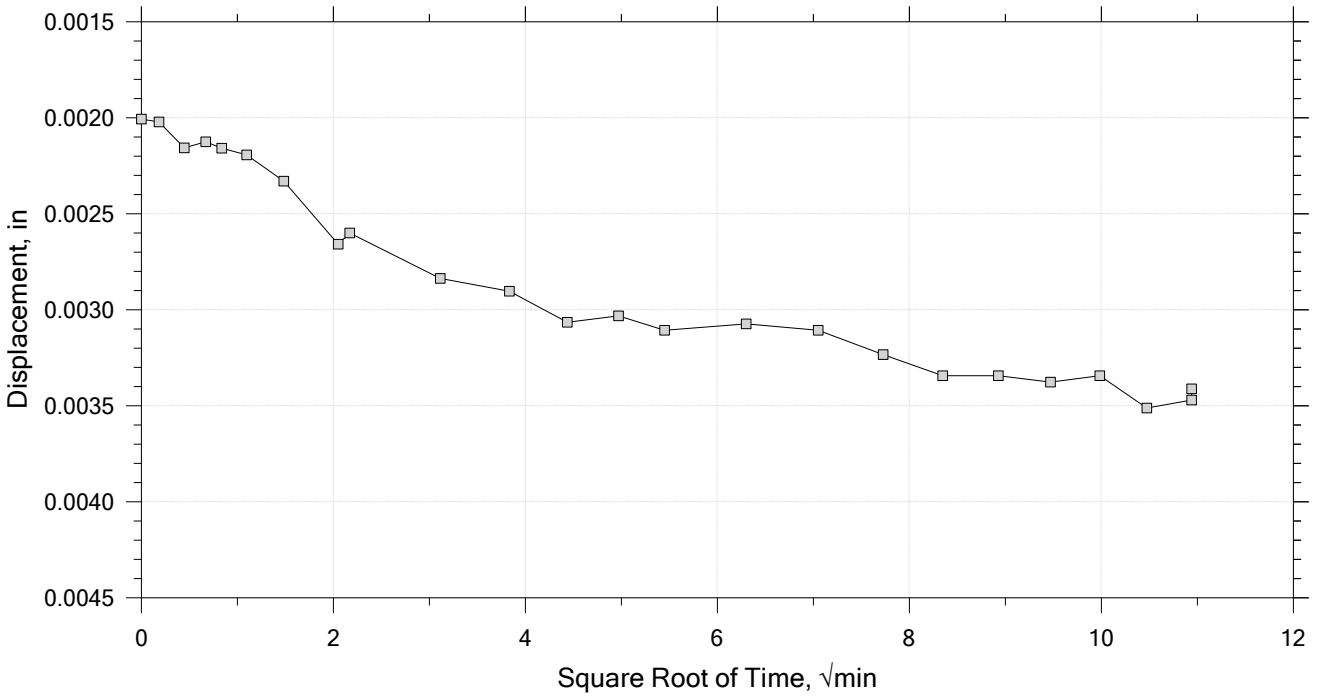


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 30
Constant Load Step
Stress: 336 psf

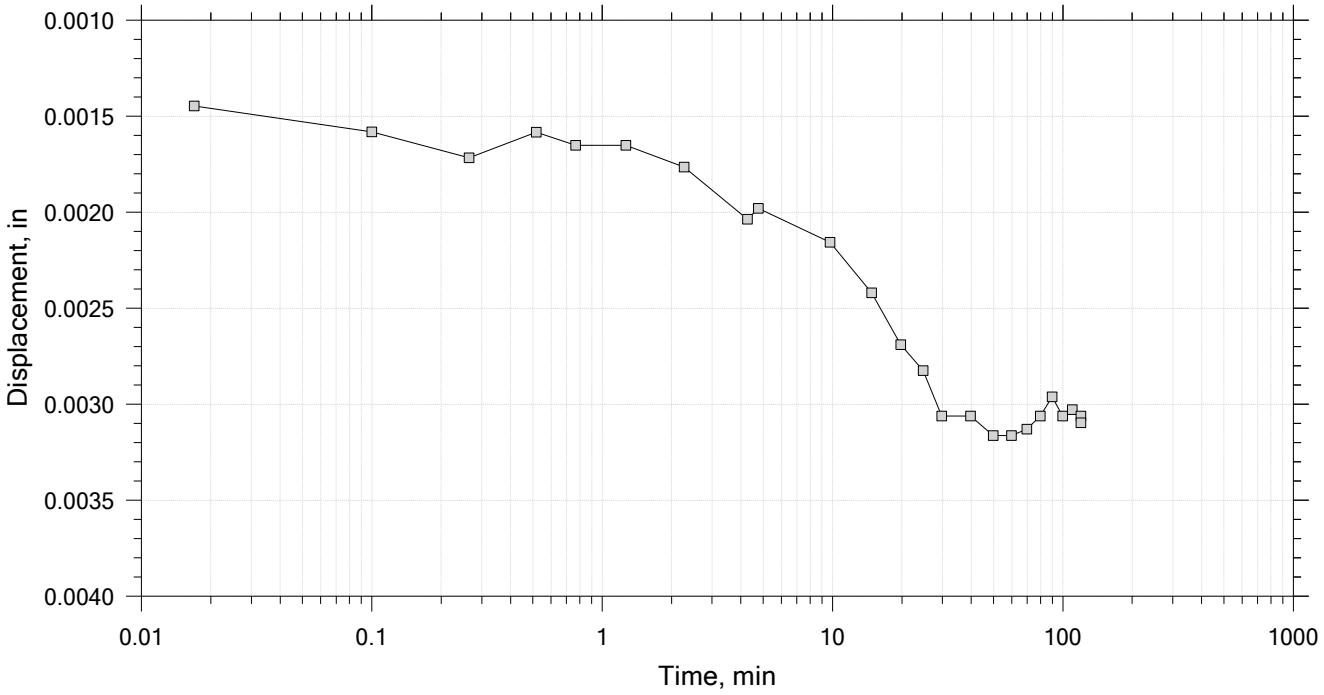


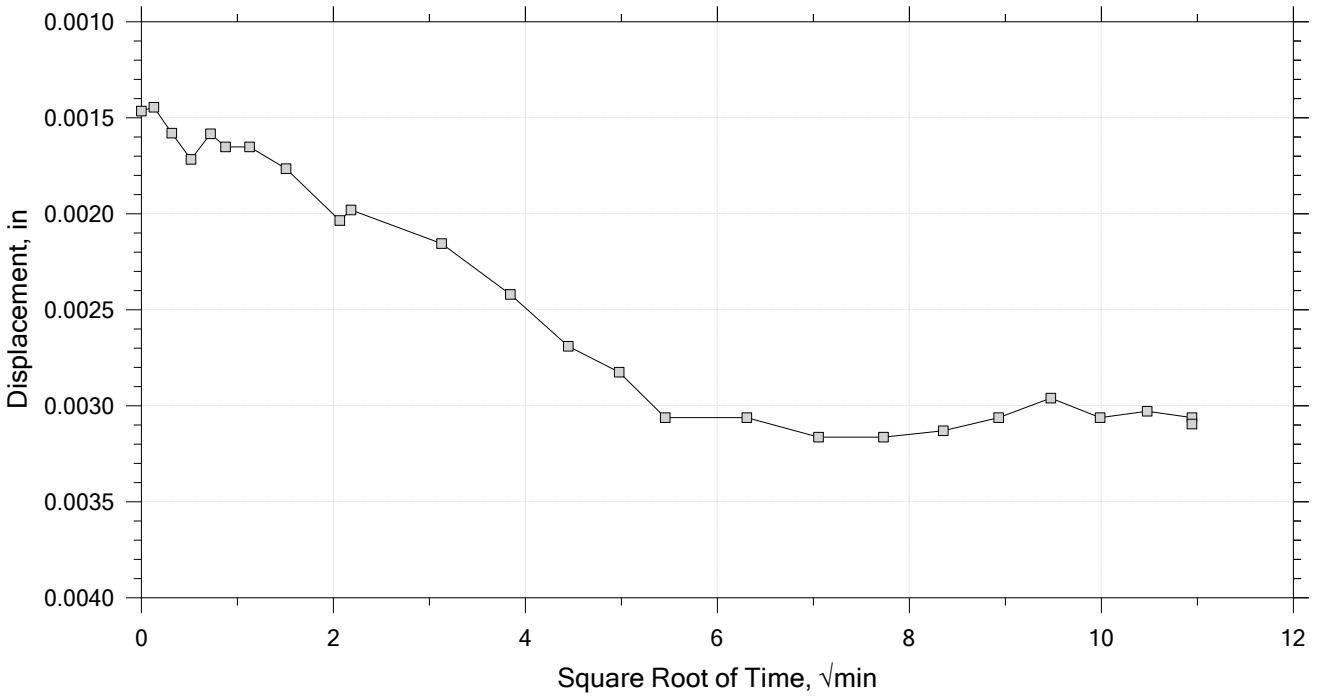


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 30
Constant Load Step
Stress: 504 psf

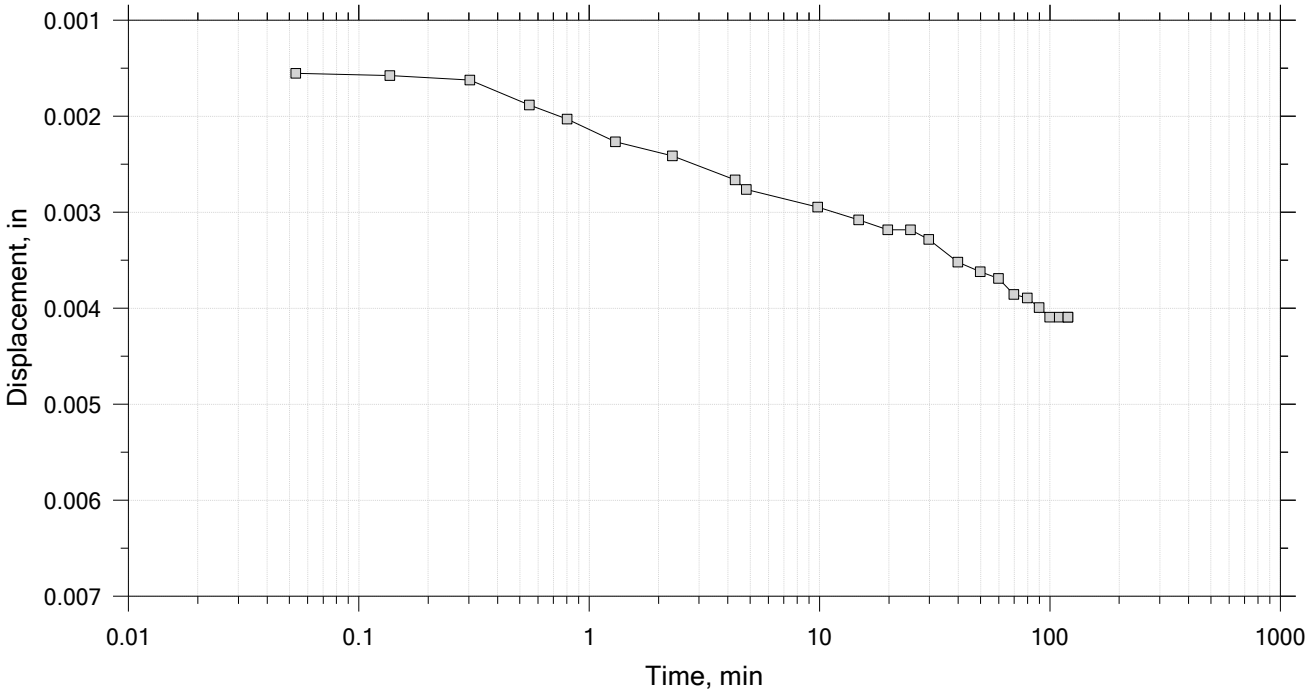


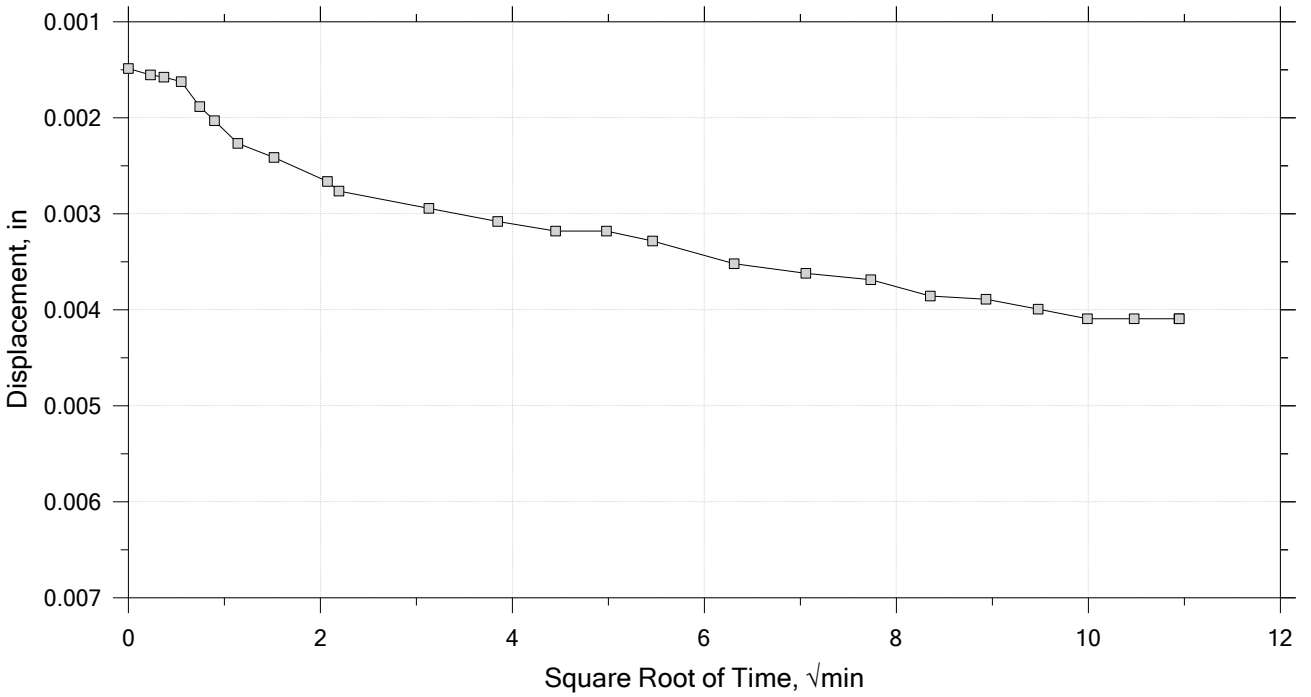


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 30
Constant Load Step
Stress: 756 psf

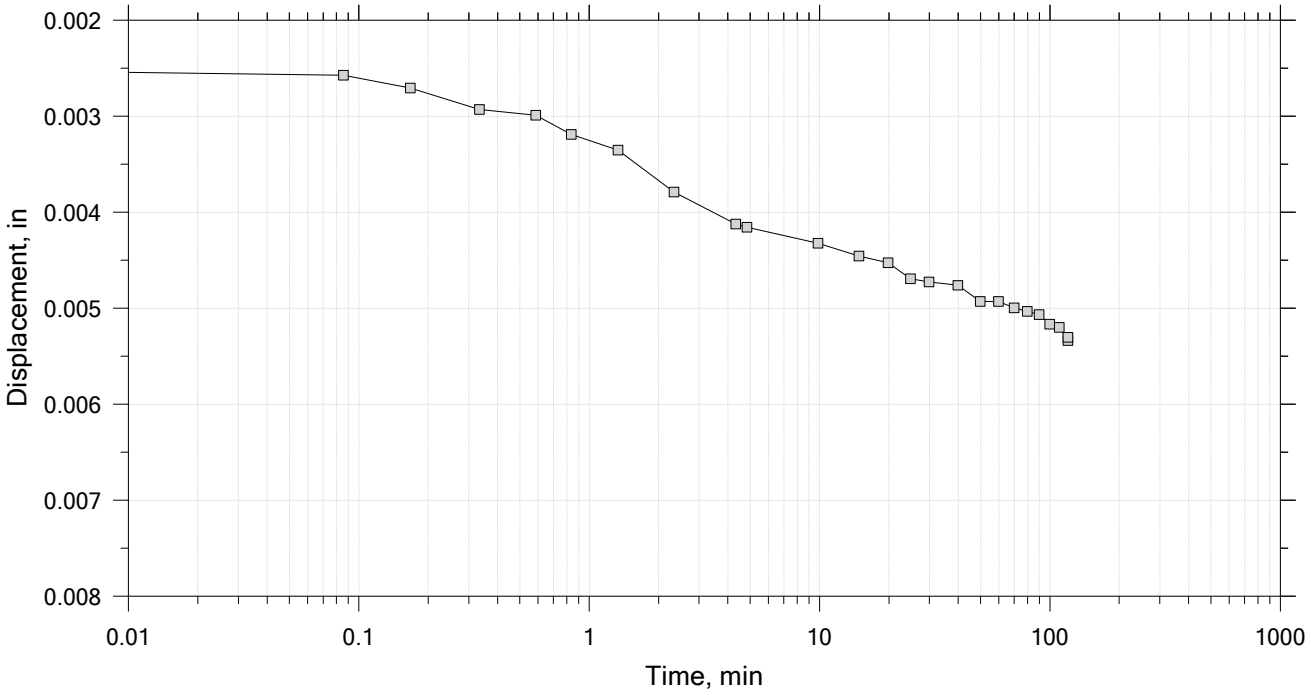


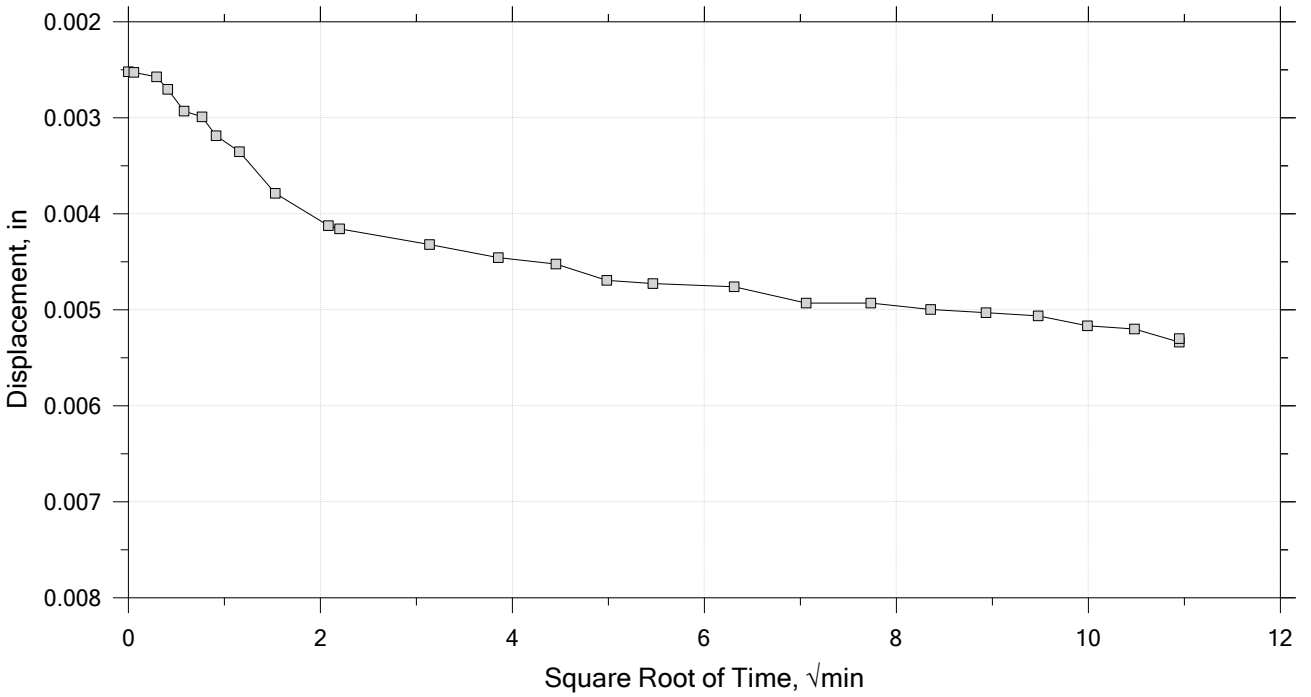


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 30
Constant Load Step
Stress: 1.13e+03 psf

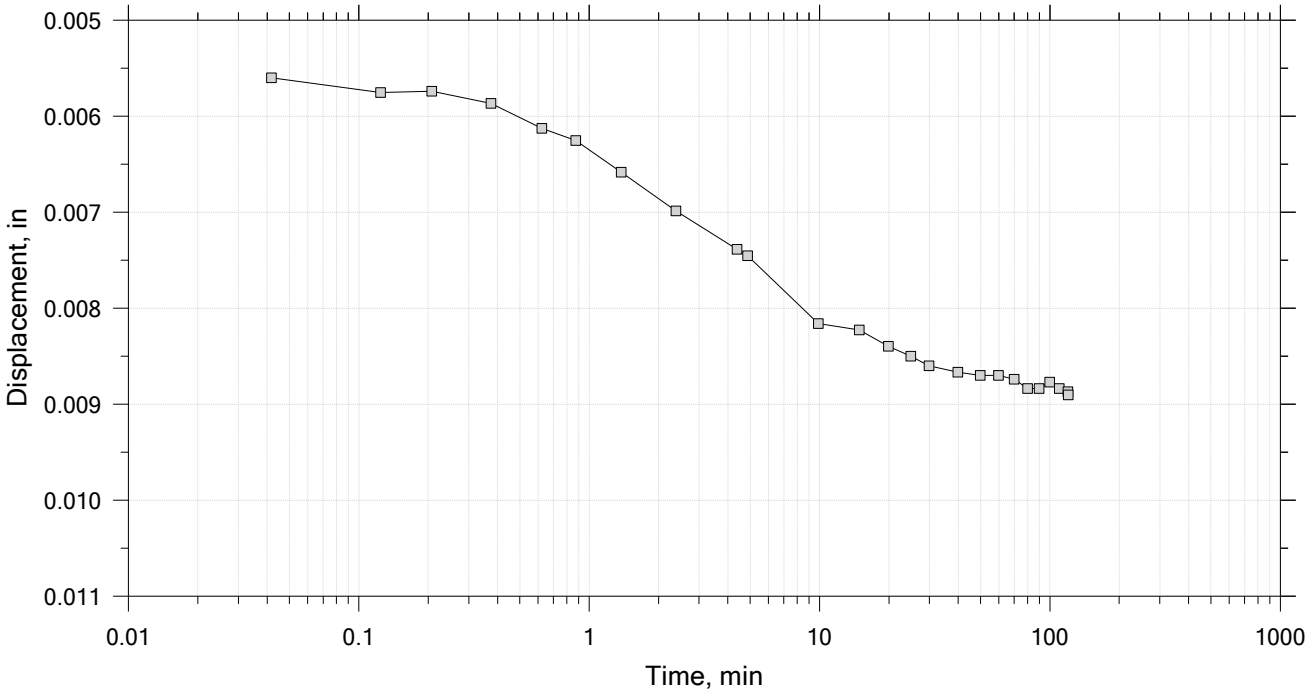


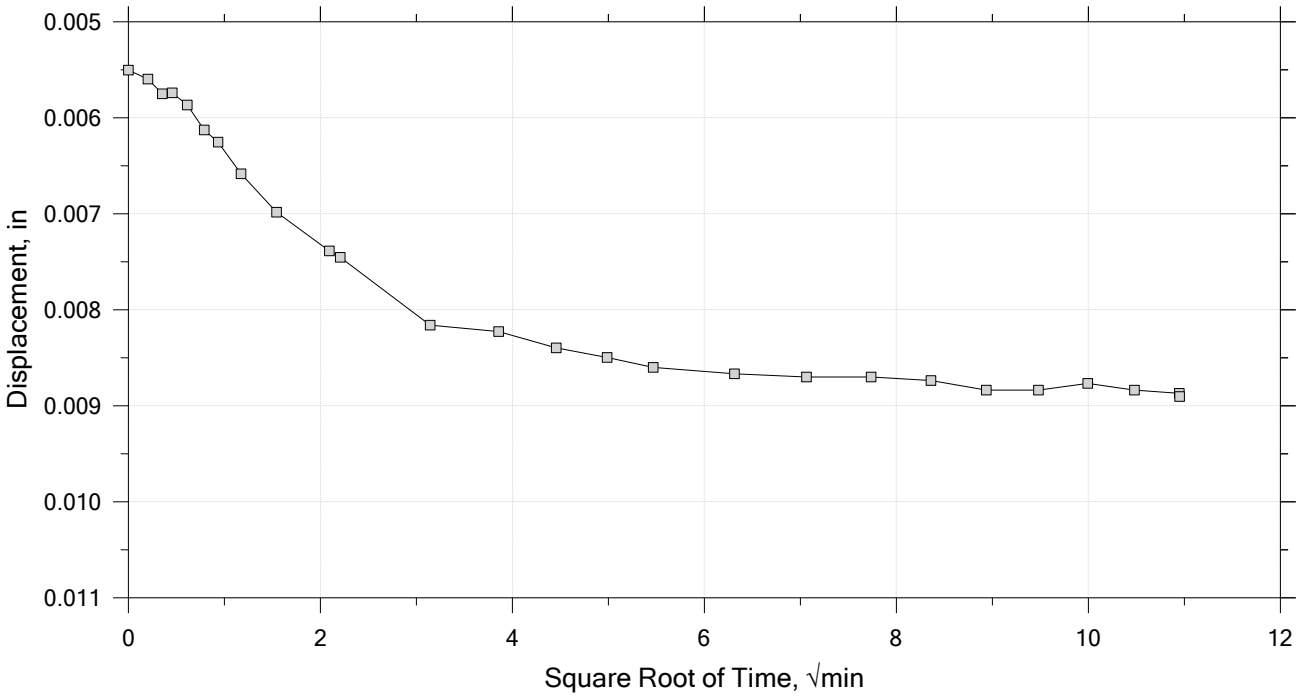


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 30
Constant Load Step
Stress: 1.7e+03 psf

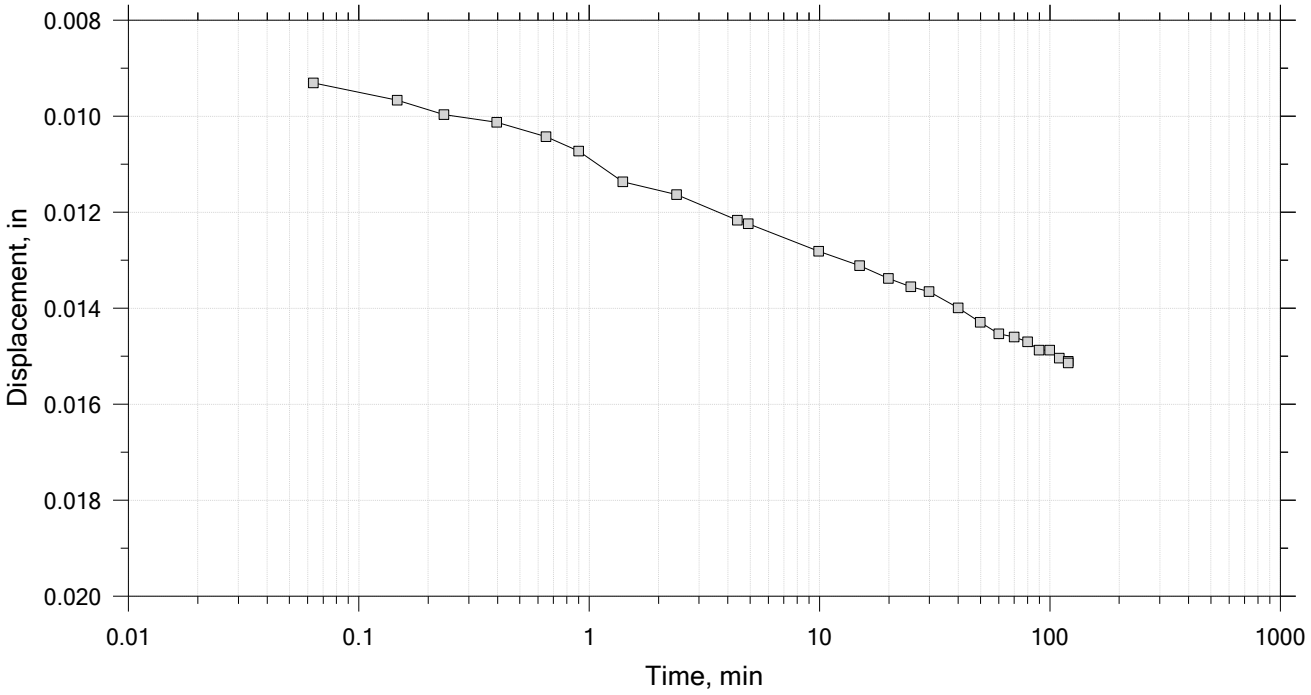


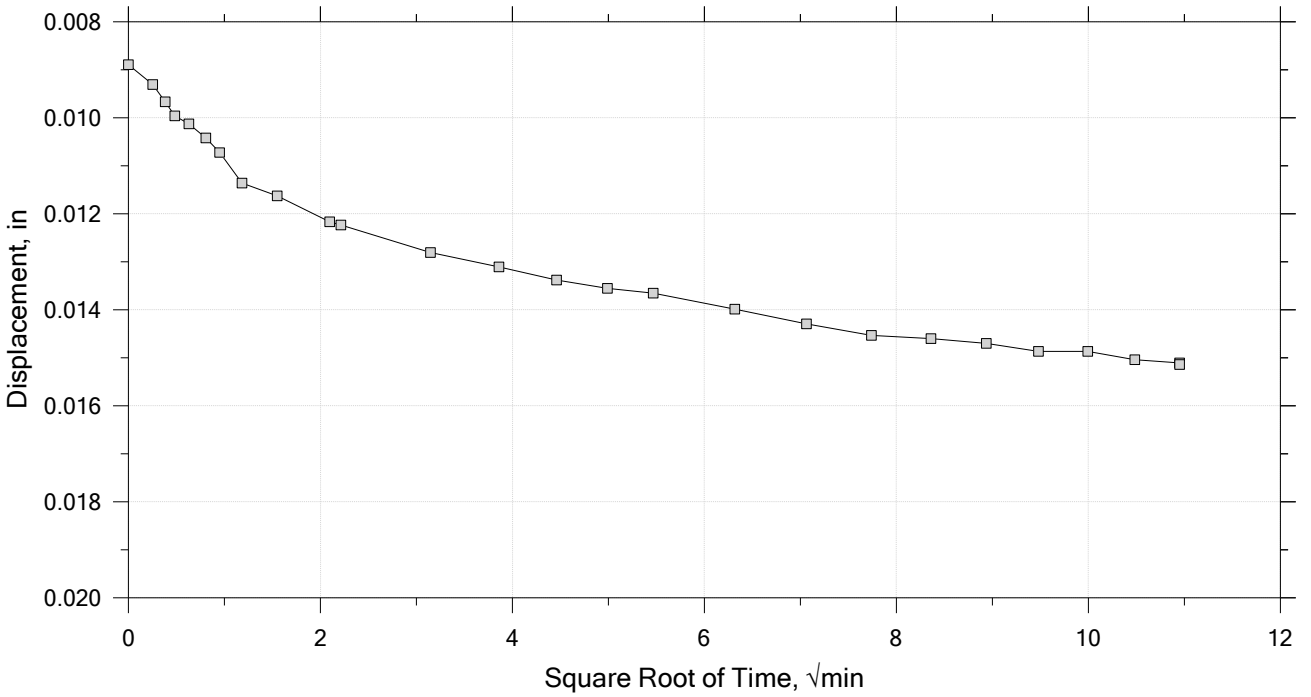


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 30
Constant Load Step
Stress: 2.55e+03 psf

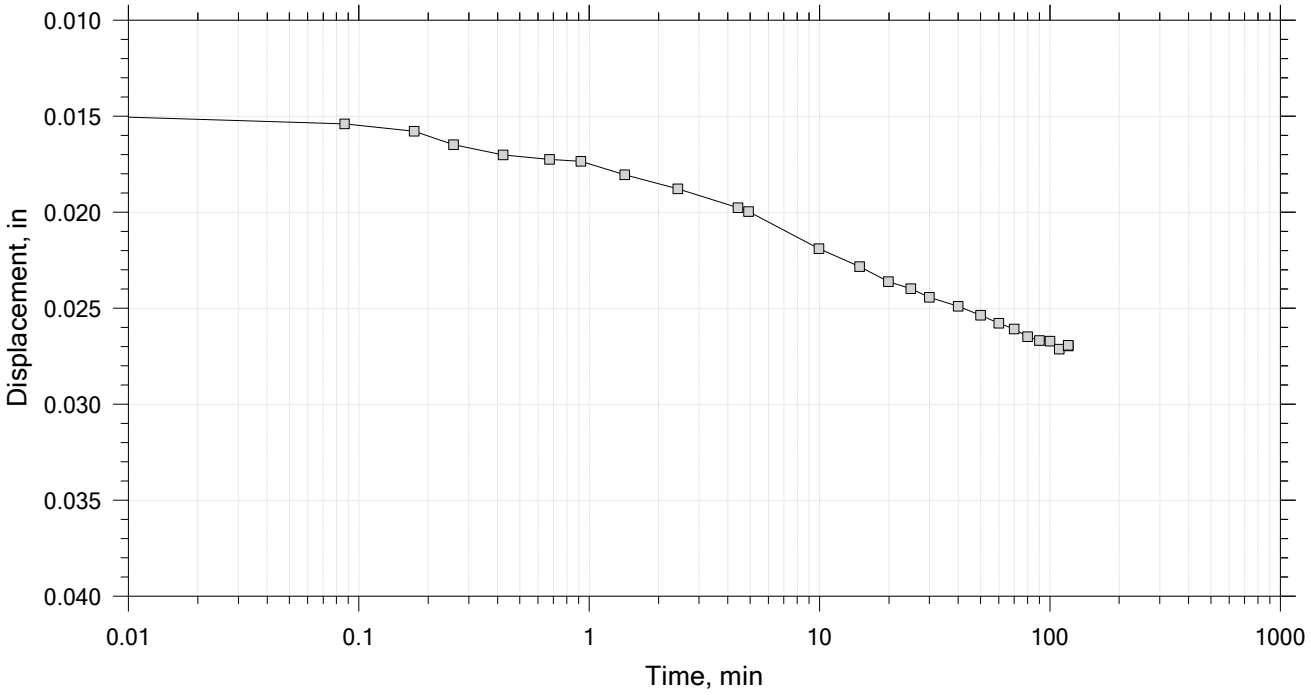


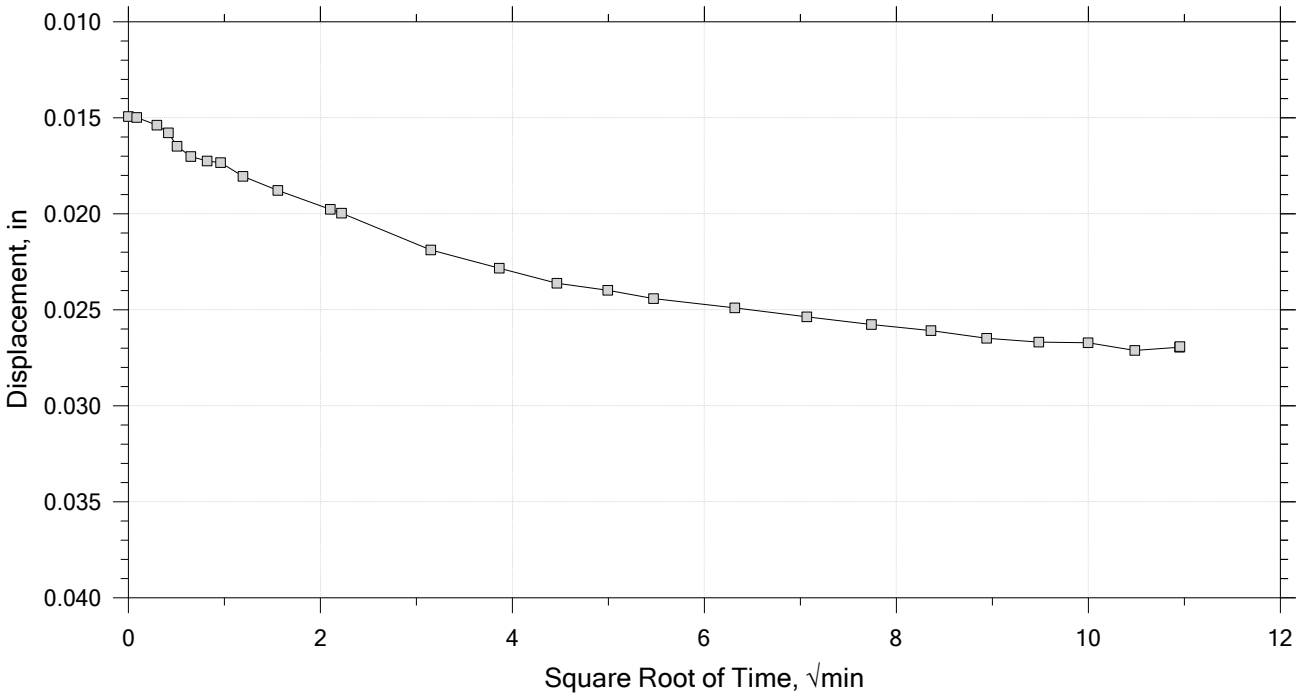


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 30
Constant Load Step
Stress: 3.83e+03 psf

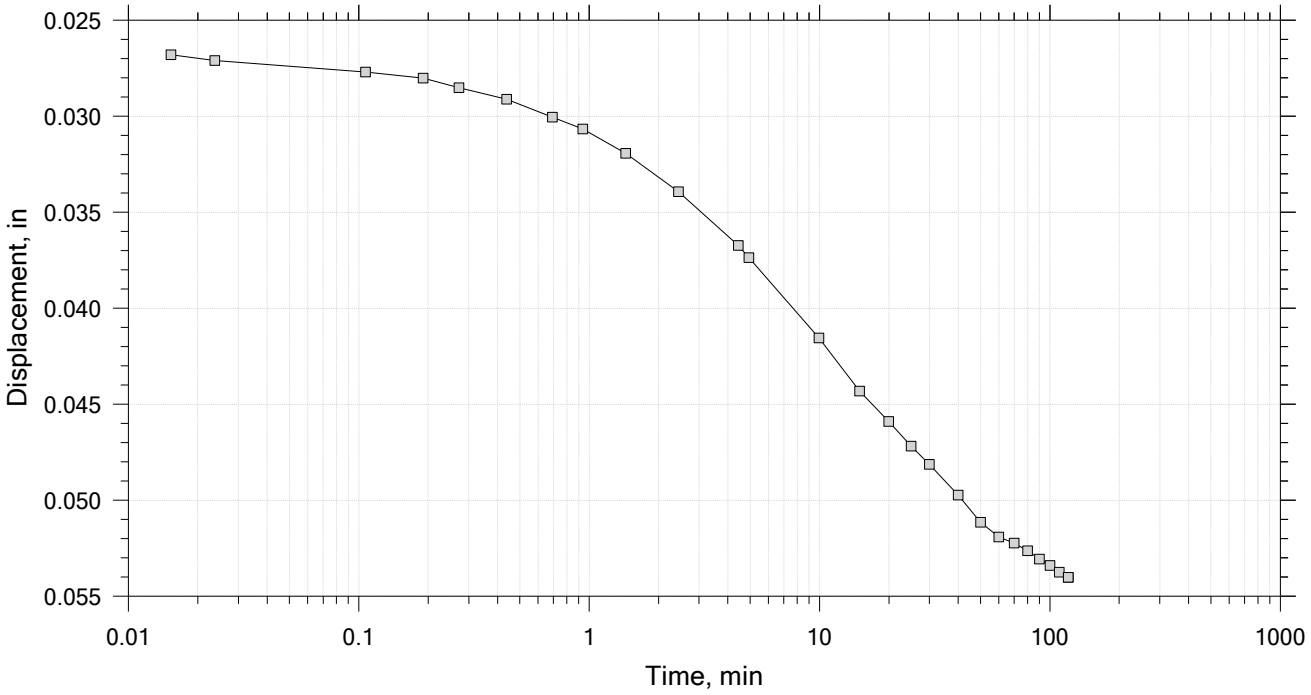


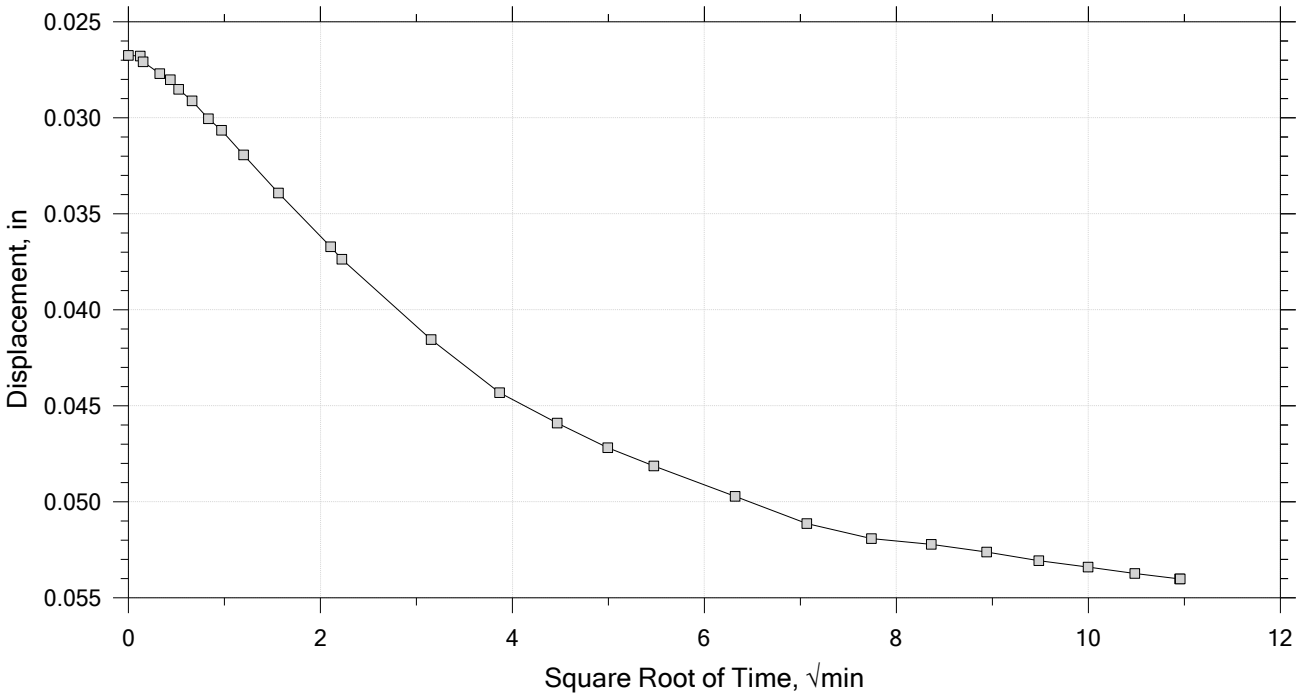


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 30
Constant Load Step
Stress: 5.74e+03 psf

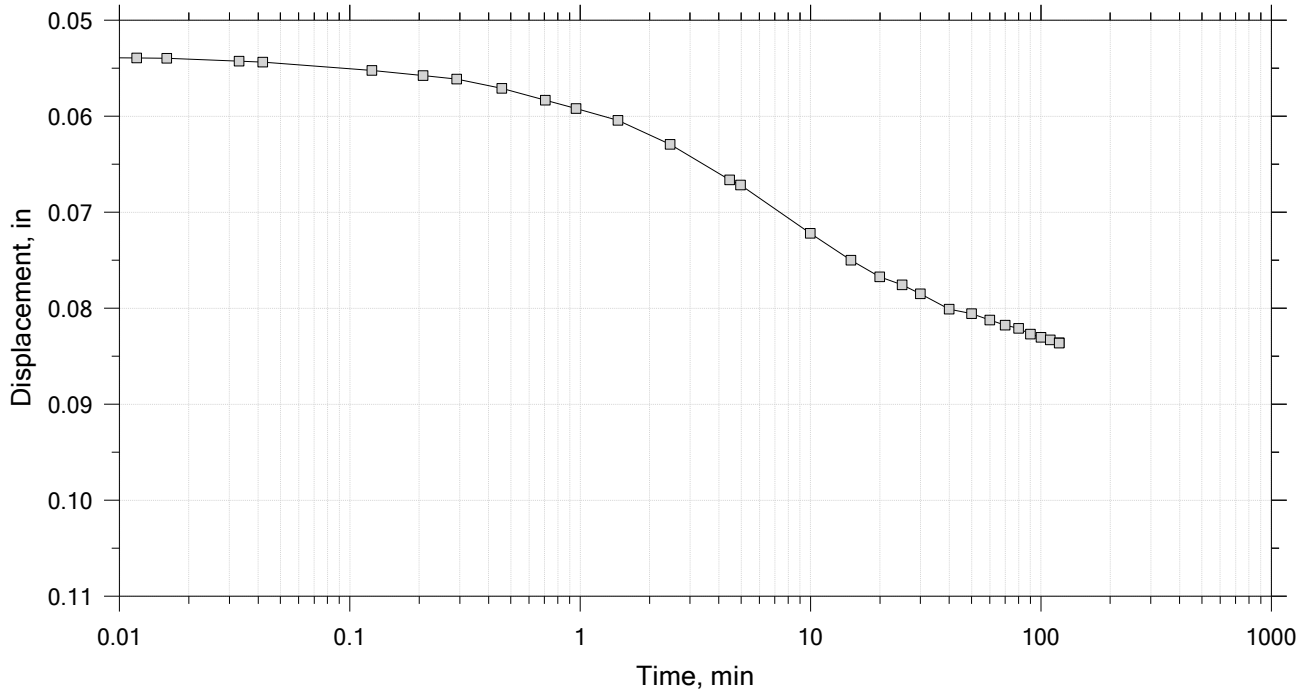


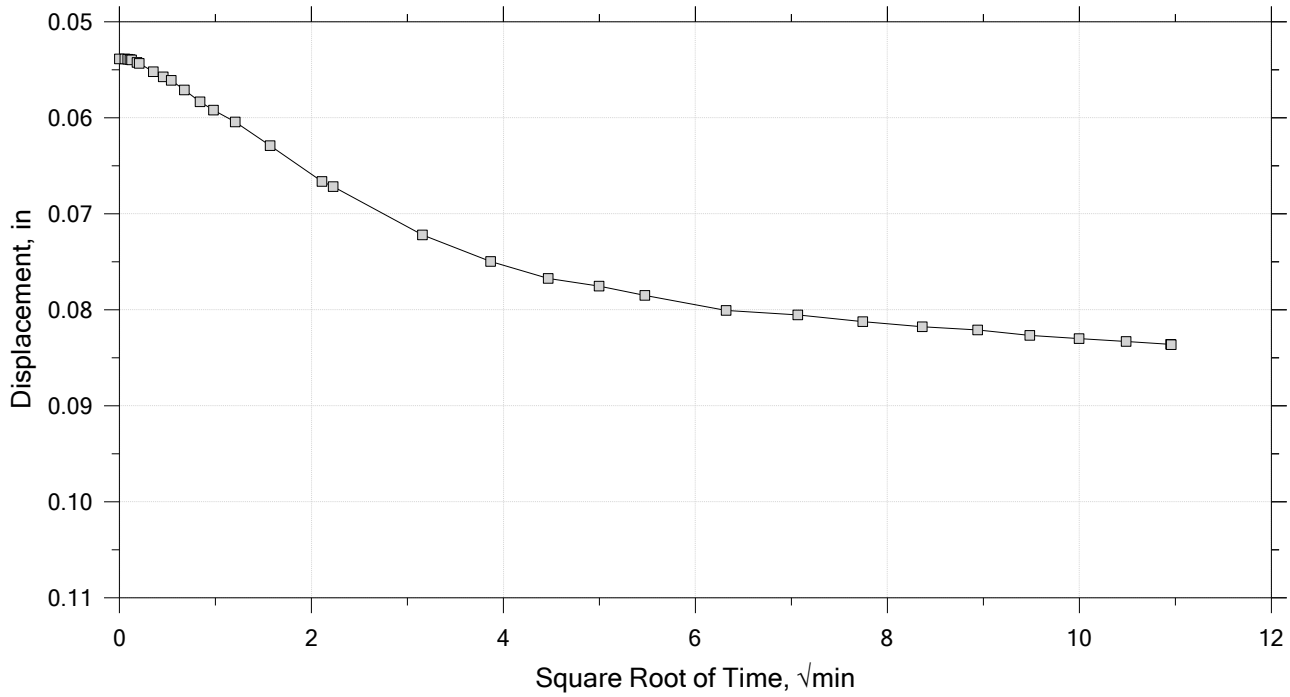


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 30
Constant Load Step
Stress: 8.61e+03 psf

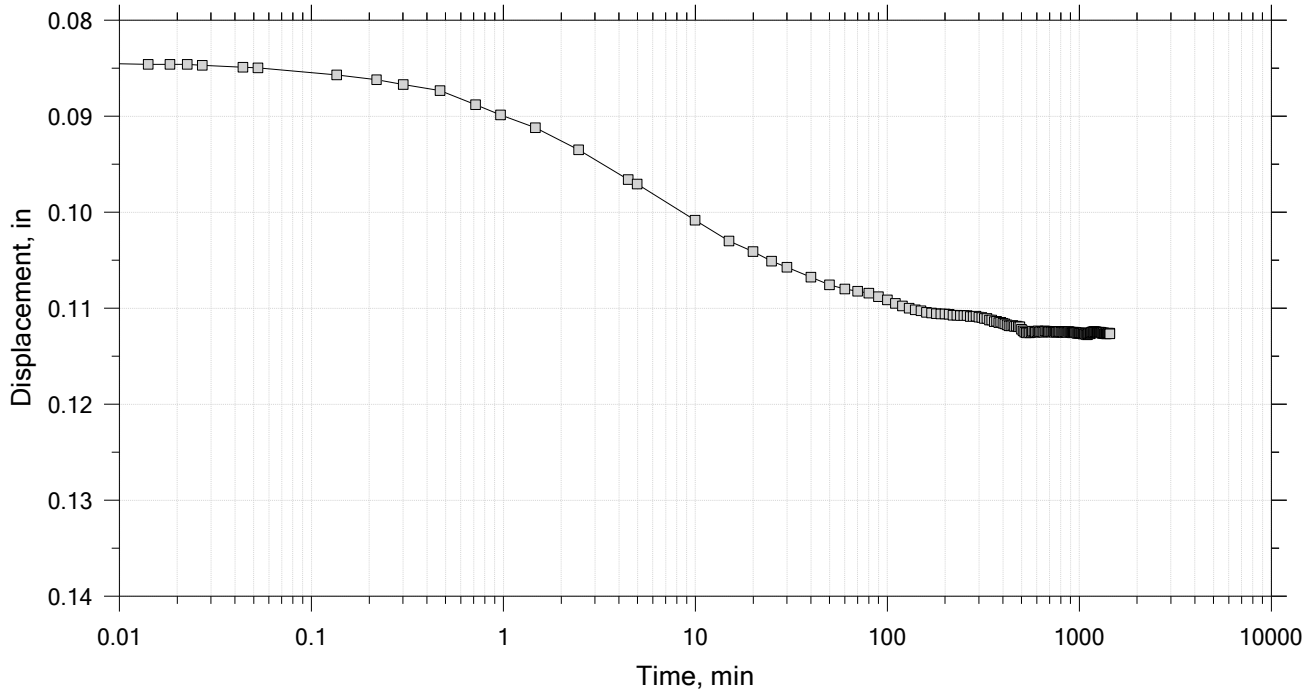


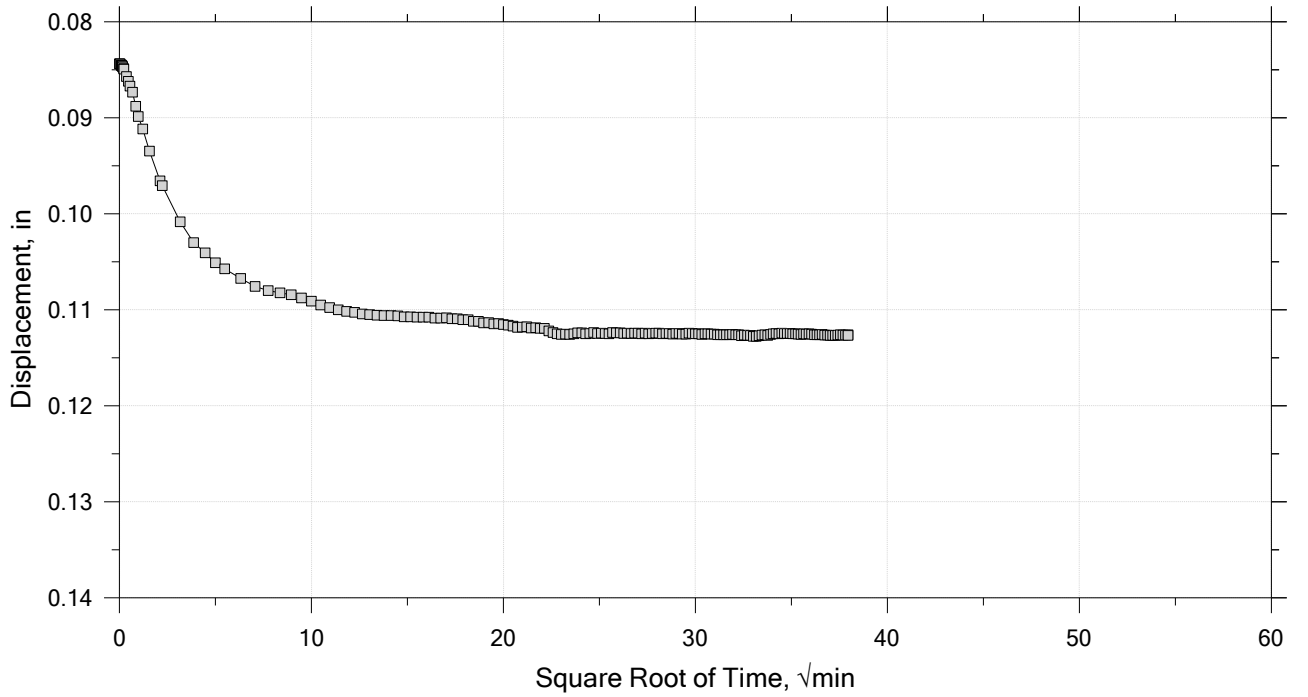


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 30
Constant Load Step
Stress: 1.29e+04 psf

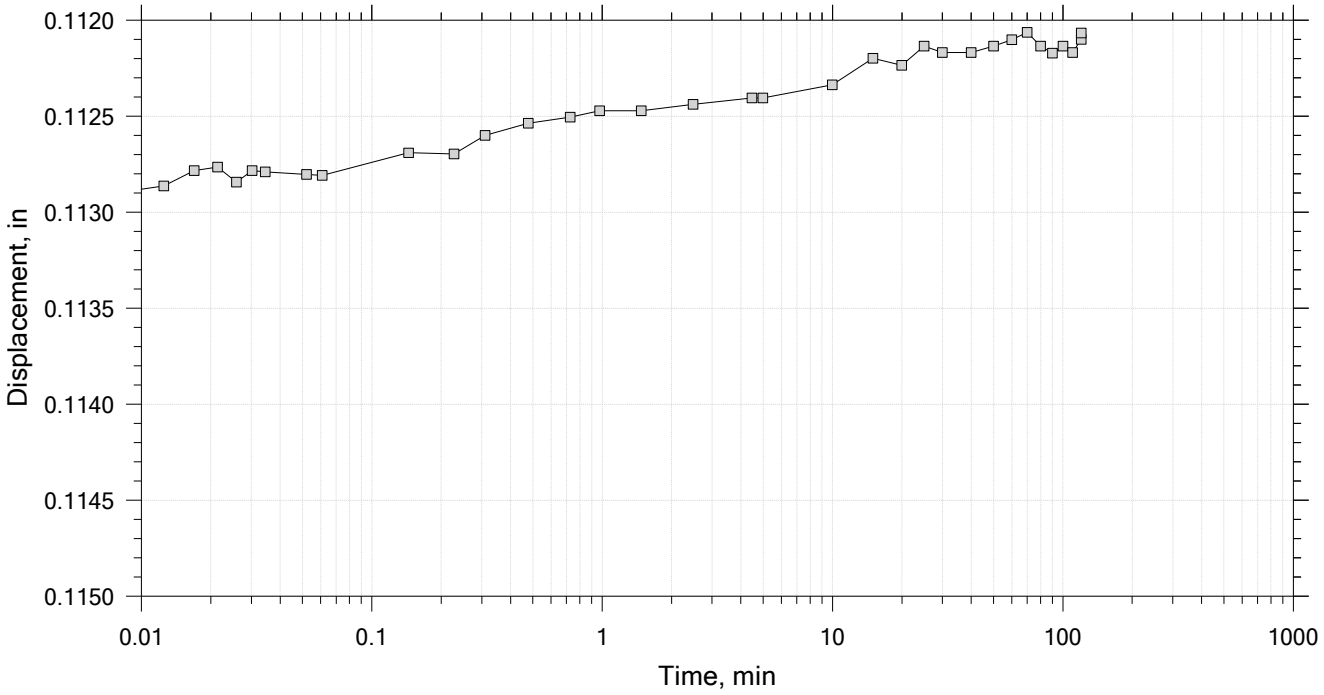


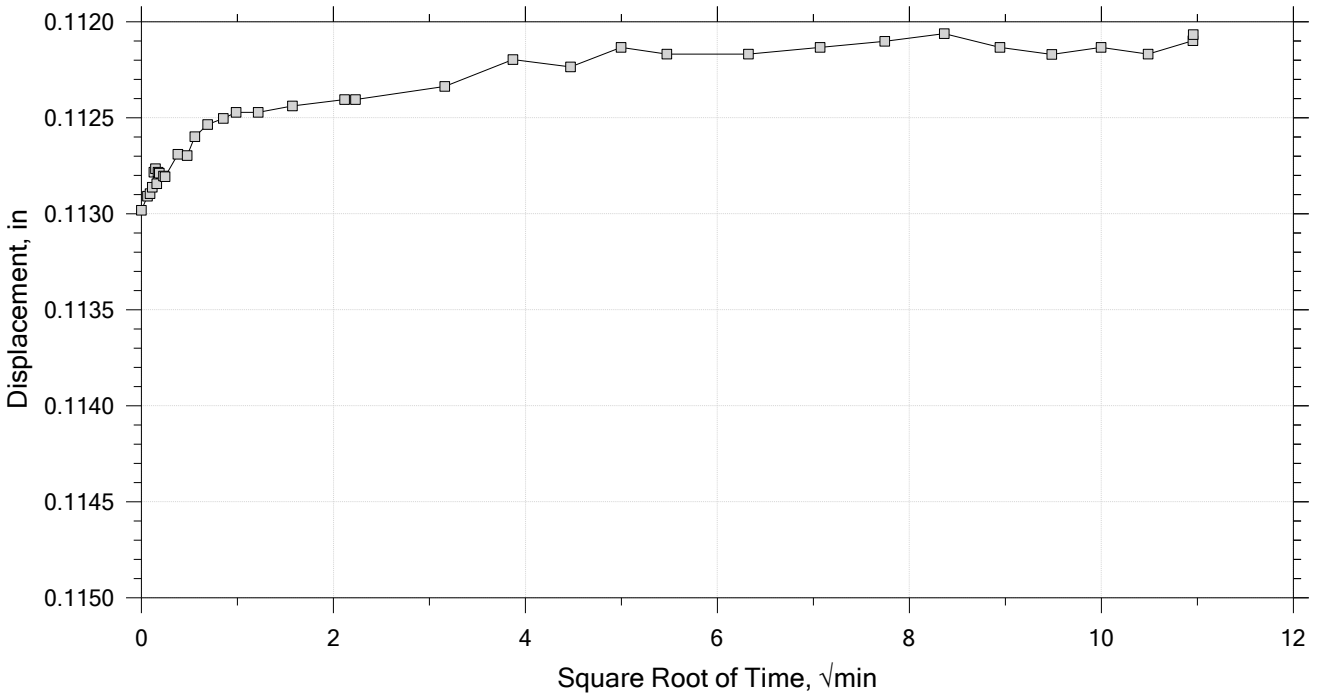


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 30
Constant Load Step
Stress: 6.46e+03 psf

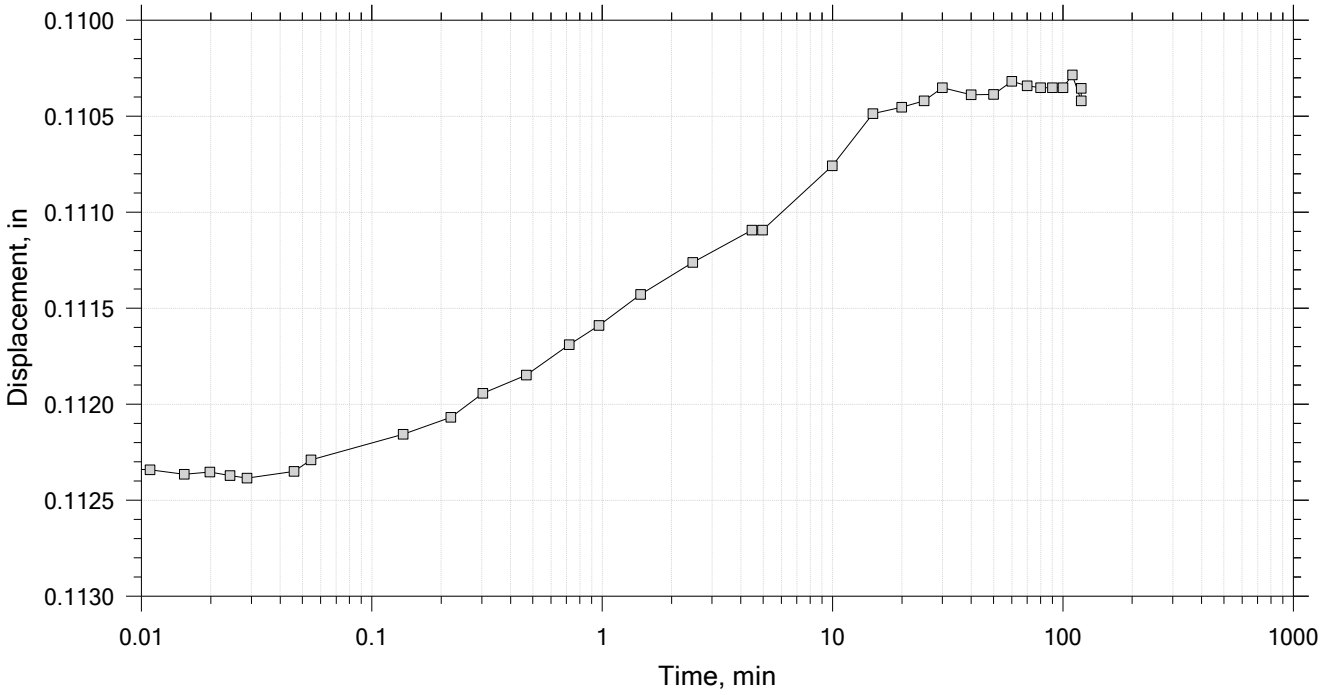


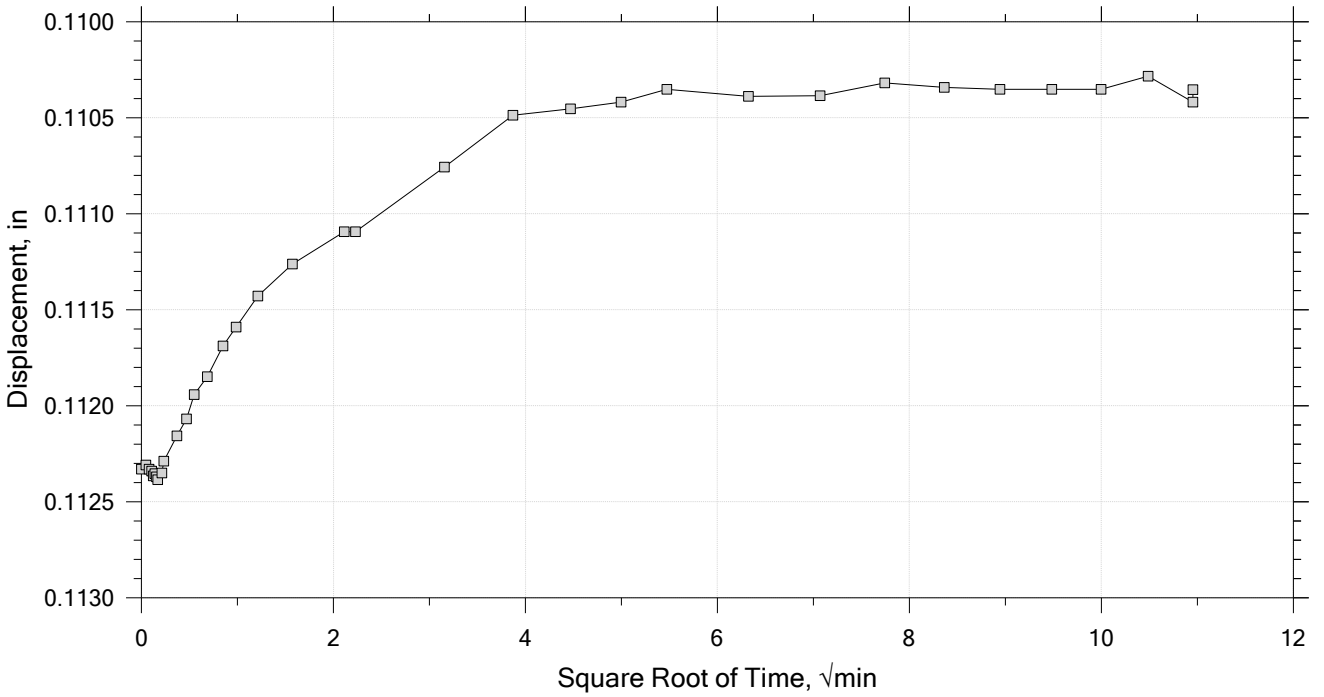


Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
Test No.: 68-423	Sample Type: wet	Elevation: --
Description:		
Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 30
Constant Load Step
Stress: 3.23e+03 psf

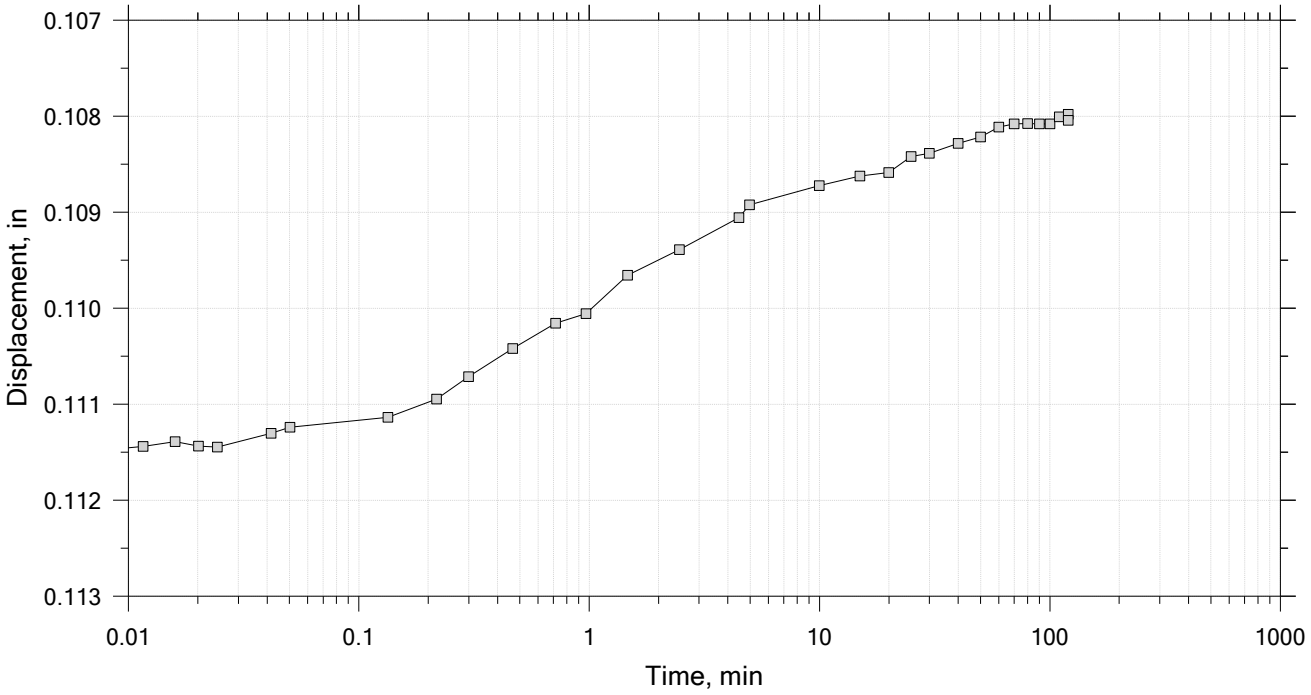


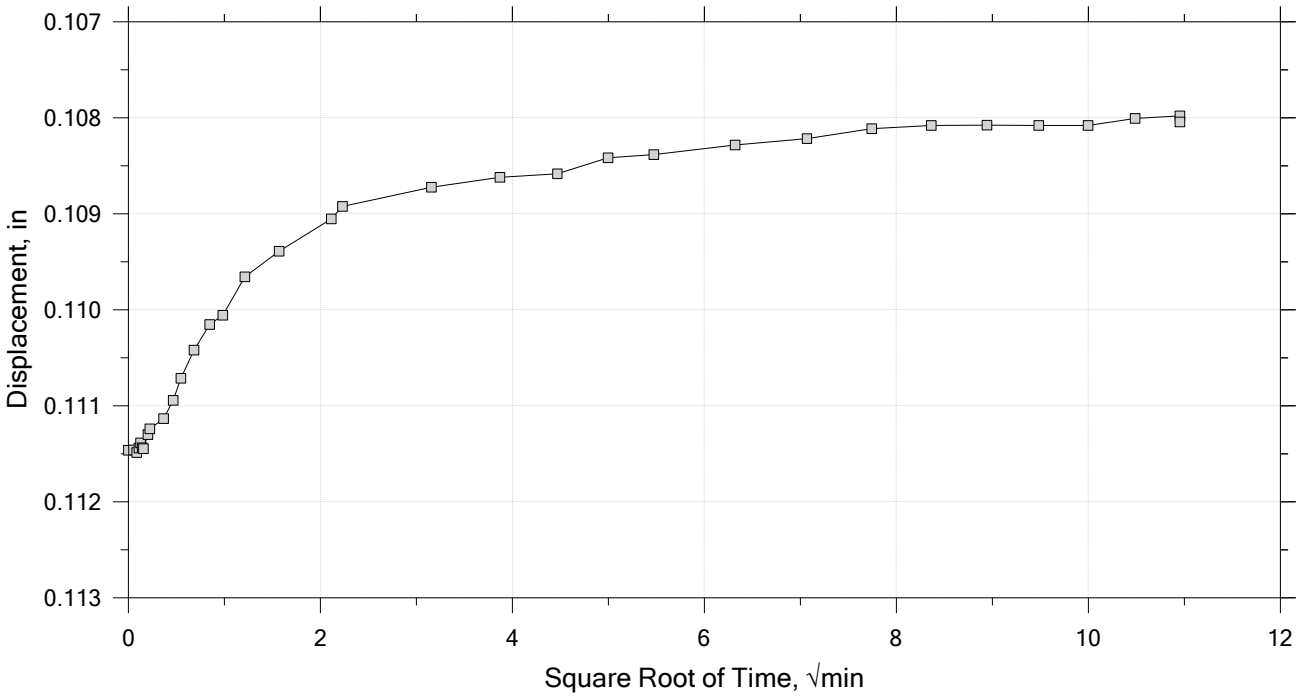


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 30
Constant Load Step
Stress: 1.62e+03 psf

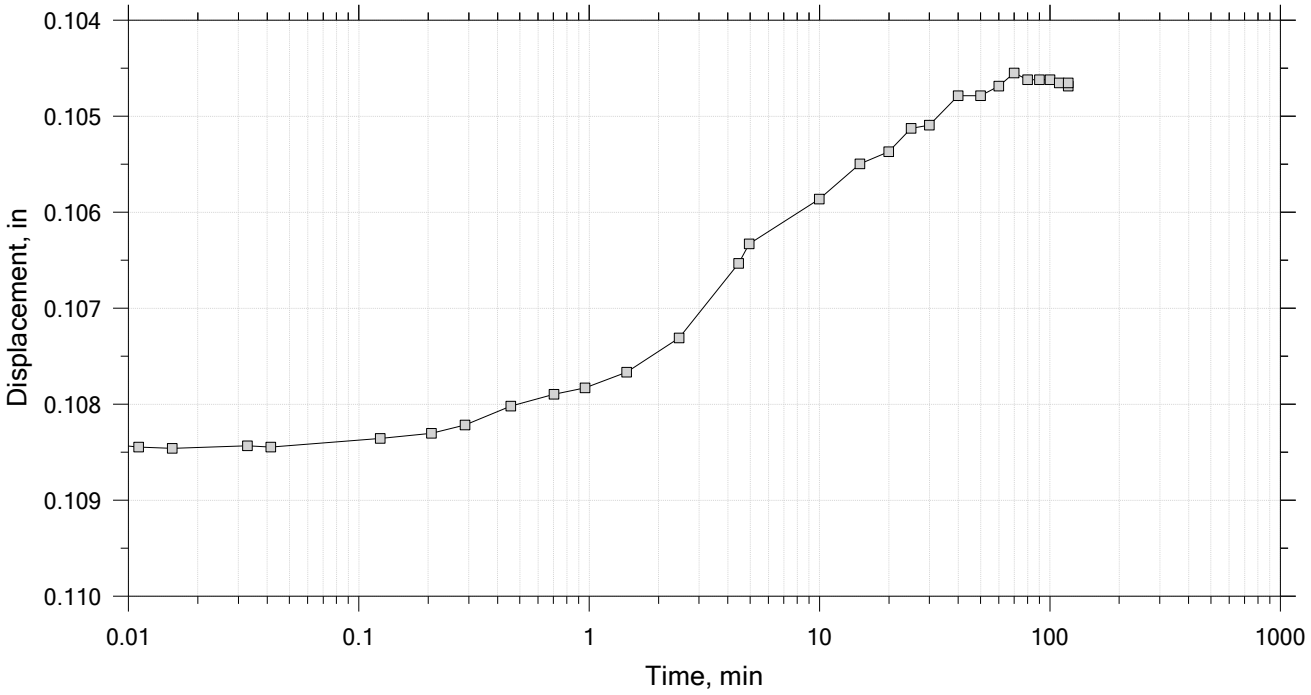


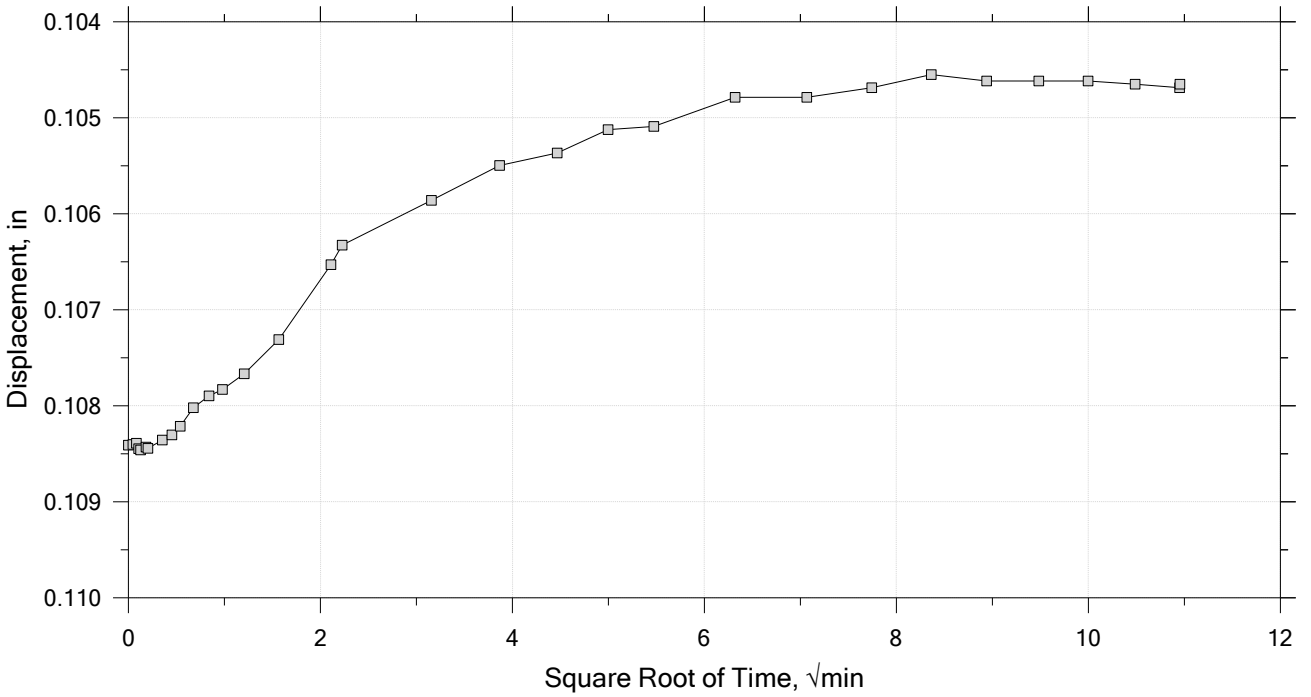


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 30
Constant Load Step
Stress: 807 psf

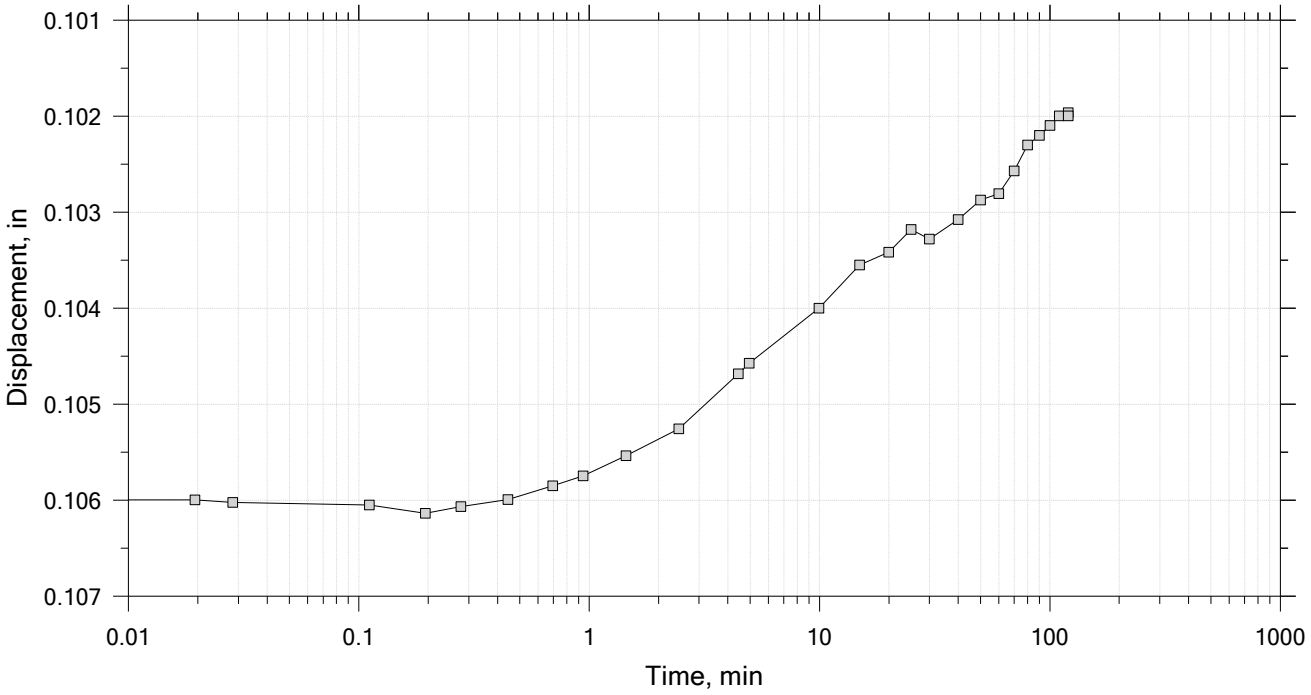


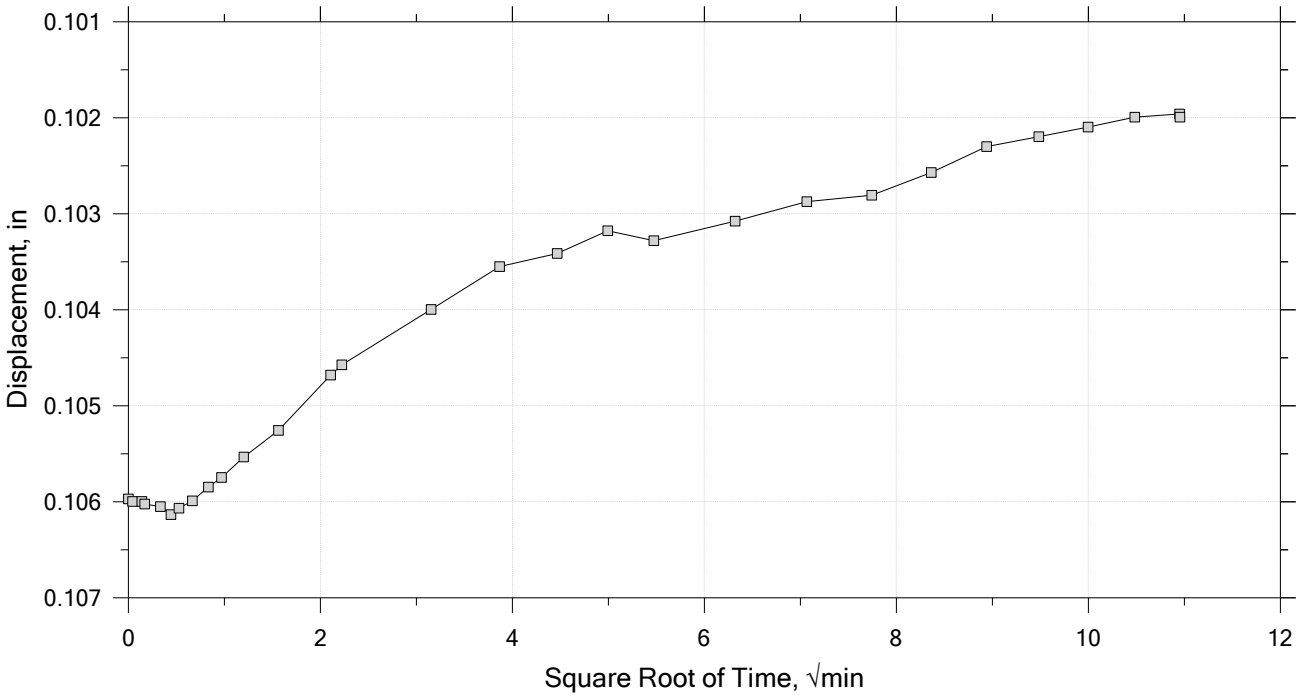


Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
Test No.: 68-423	Sample Type: wet	Elevation: --
Description:		
Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 30
Constant Load Step
Stress: 404 psf

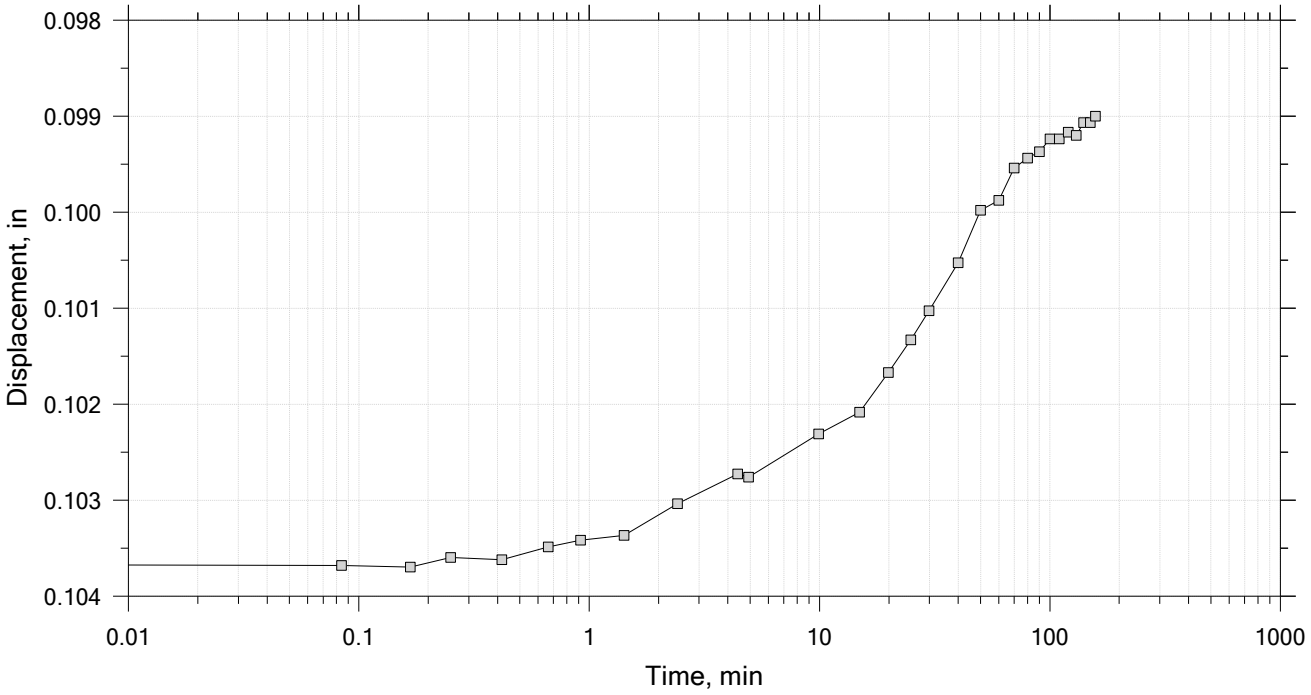


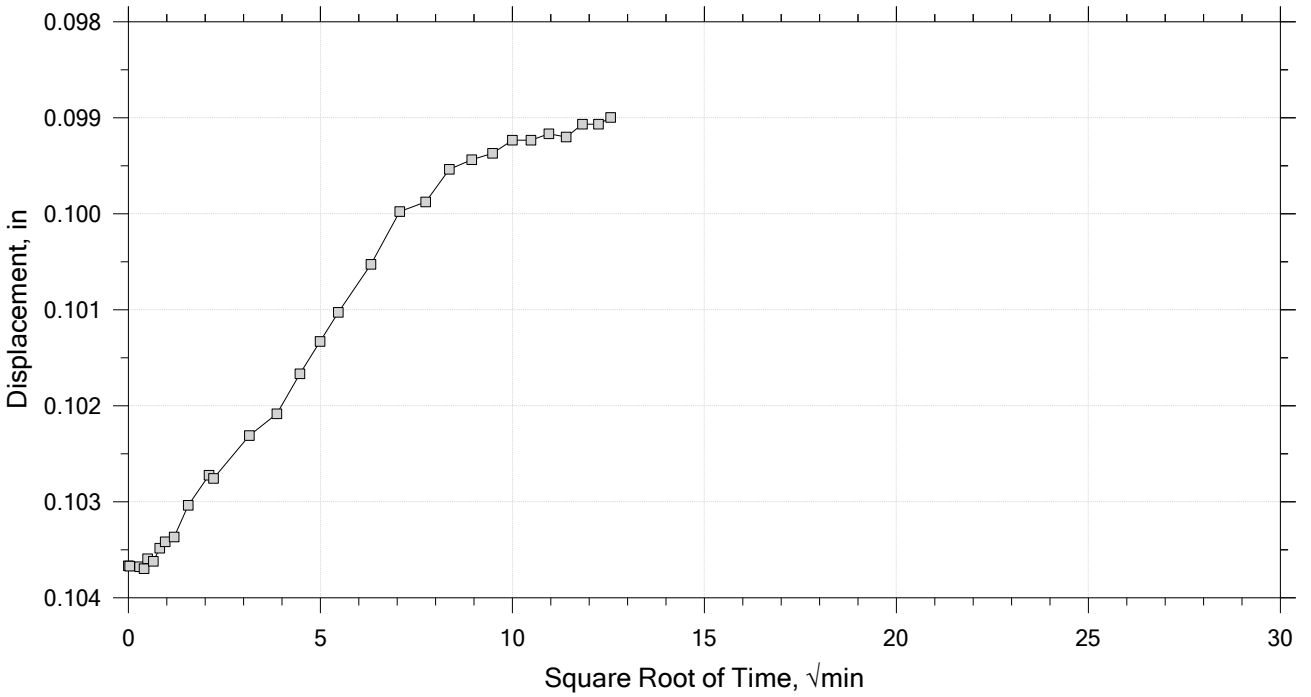


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 17 of 30
Constant Load Step
Stress: 202 psf

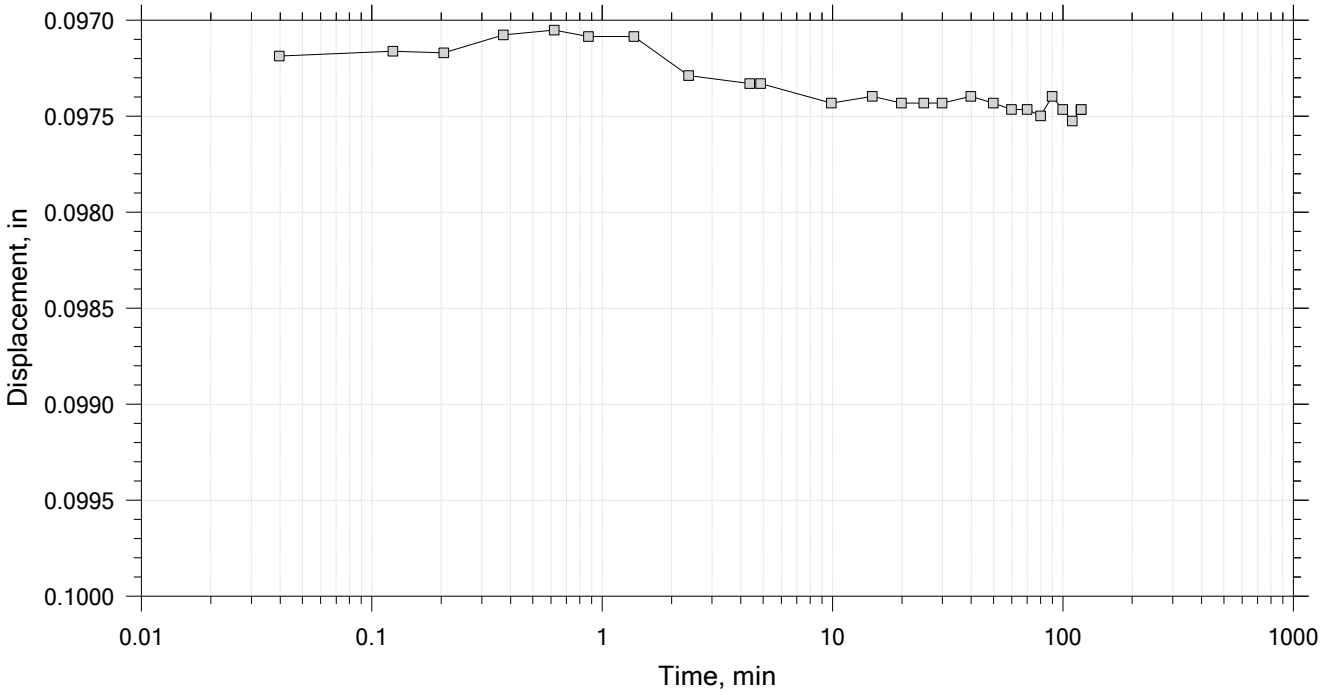


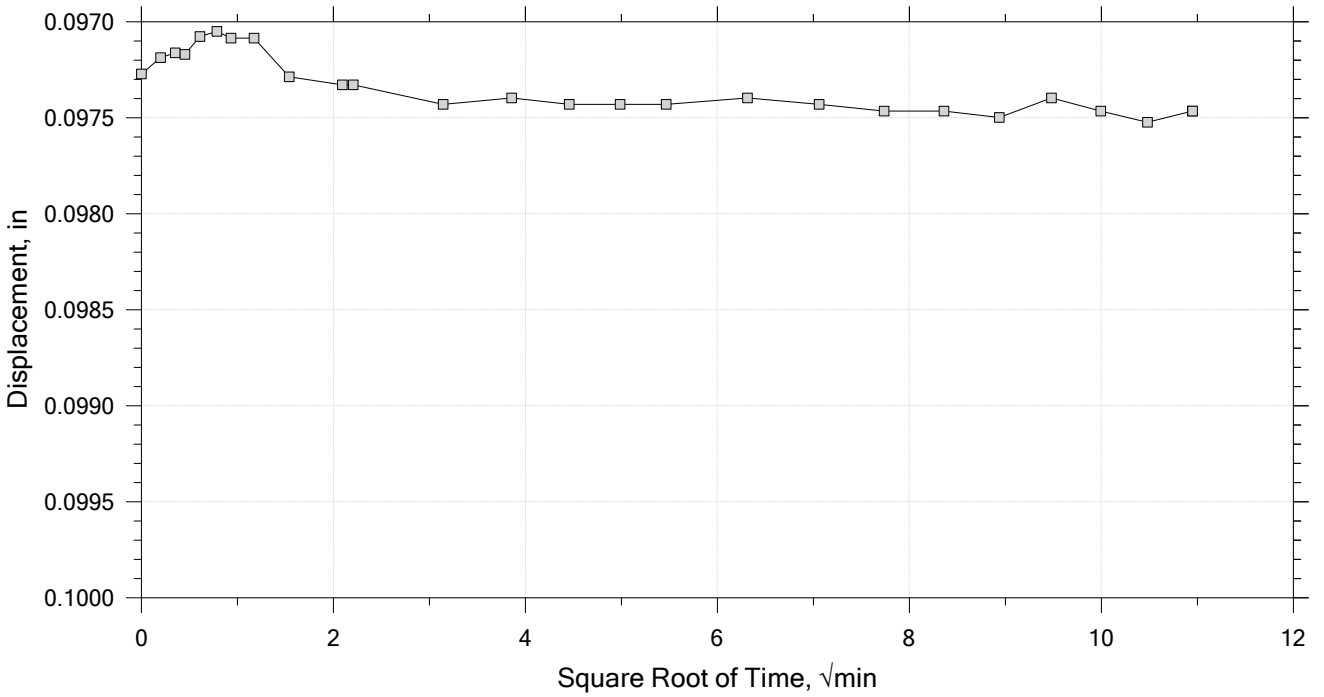


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 18 of 30
Constant Load Step
Stress: 404 psf

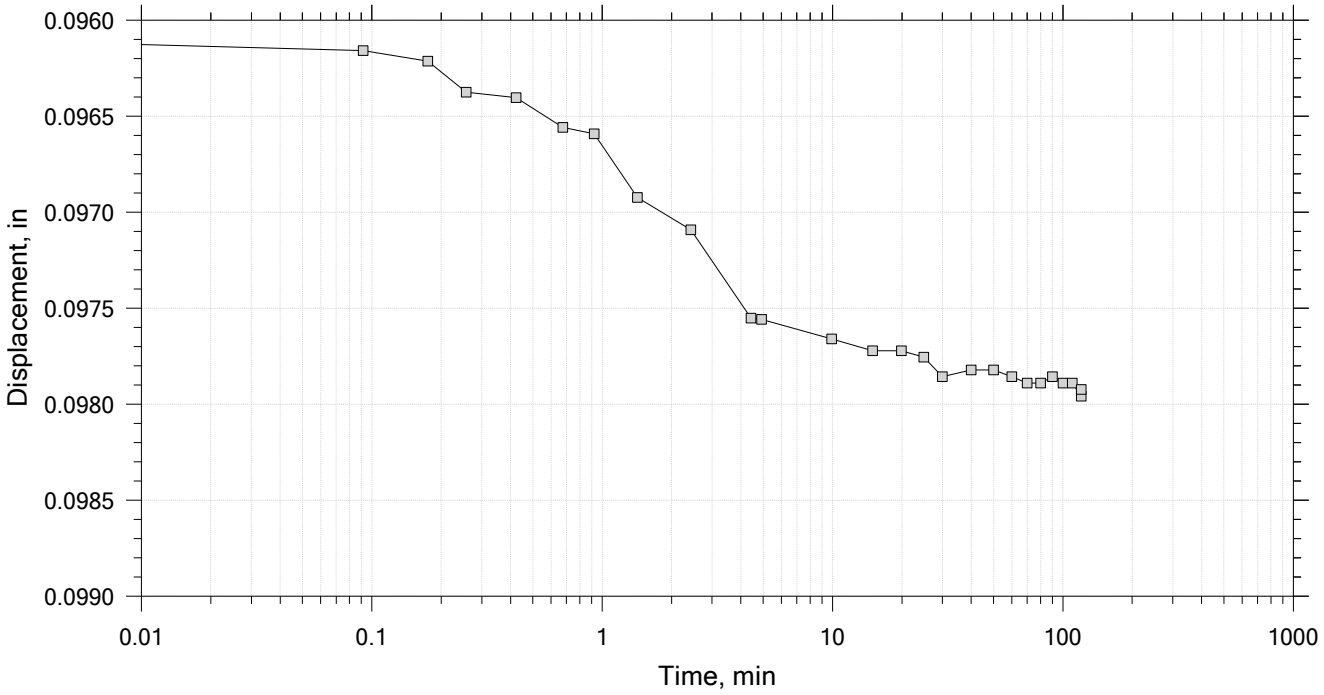


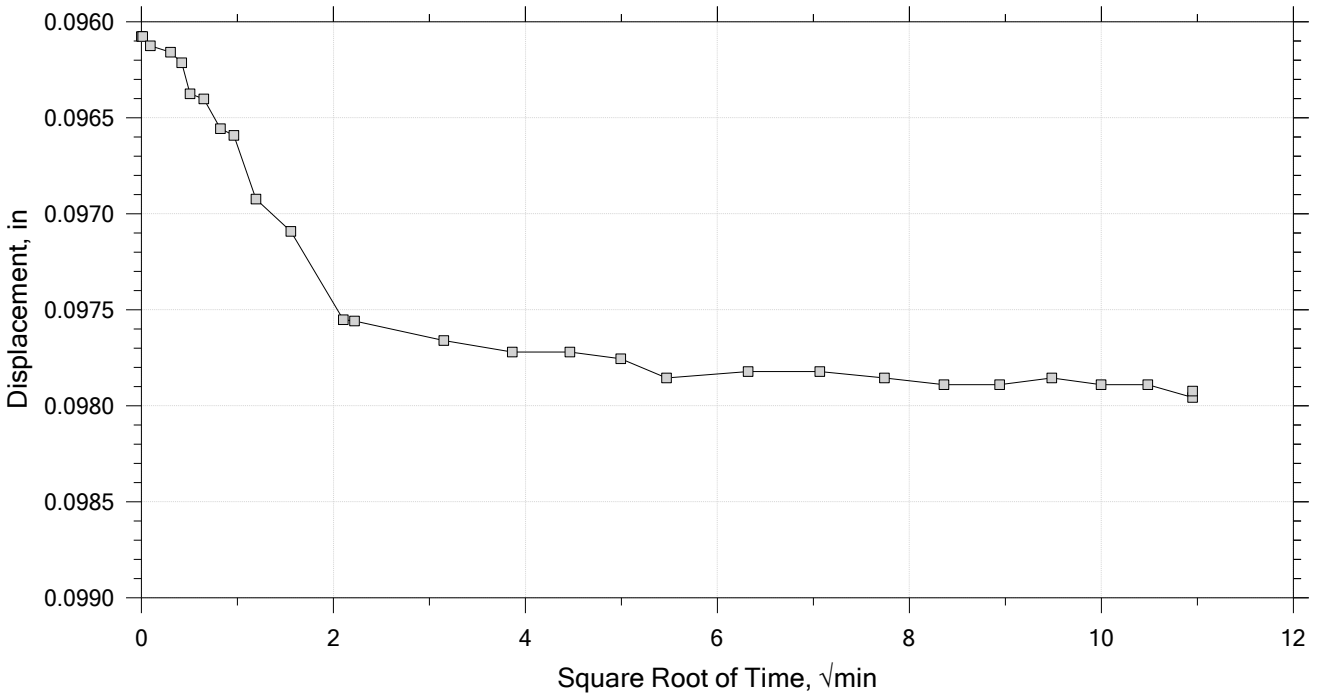


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 19 of 30
Constant Load Step
Stress: 807 psf

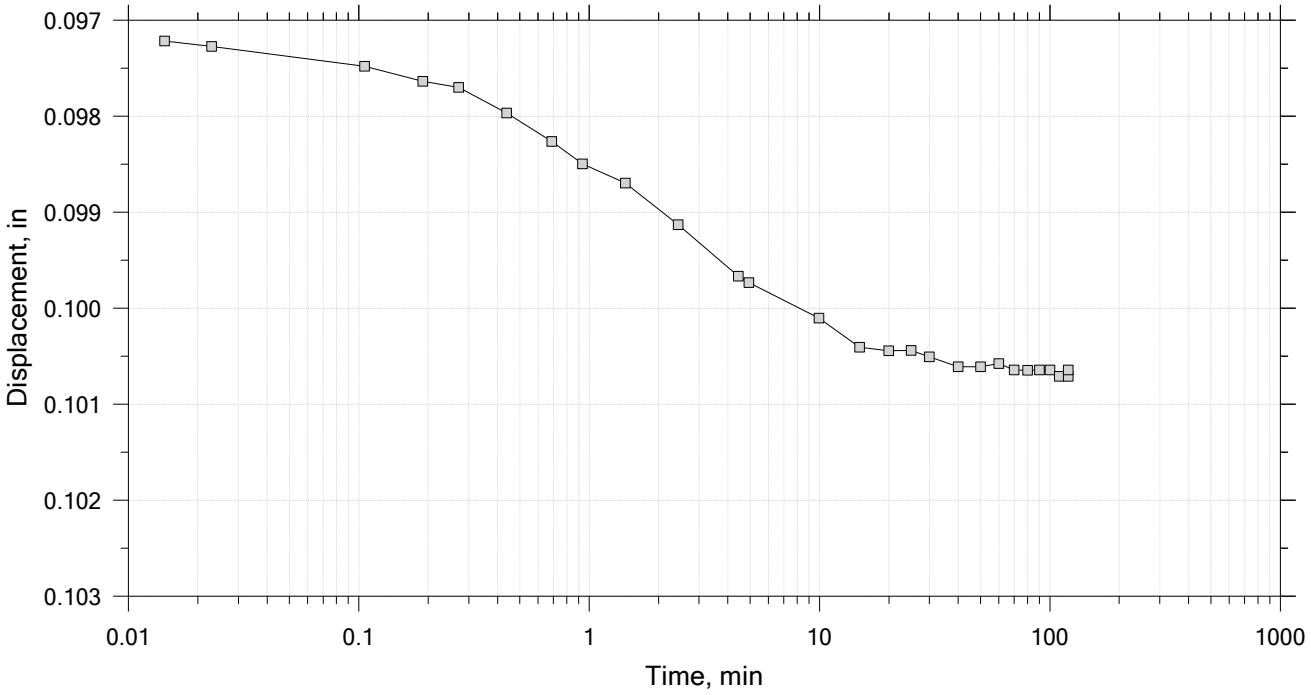


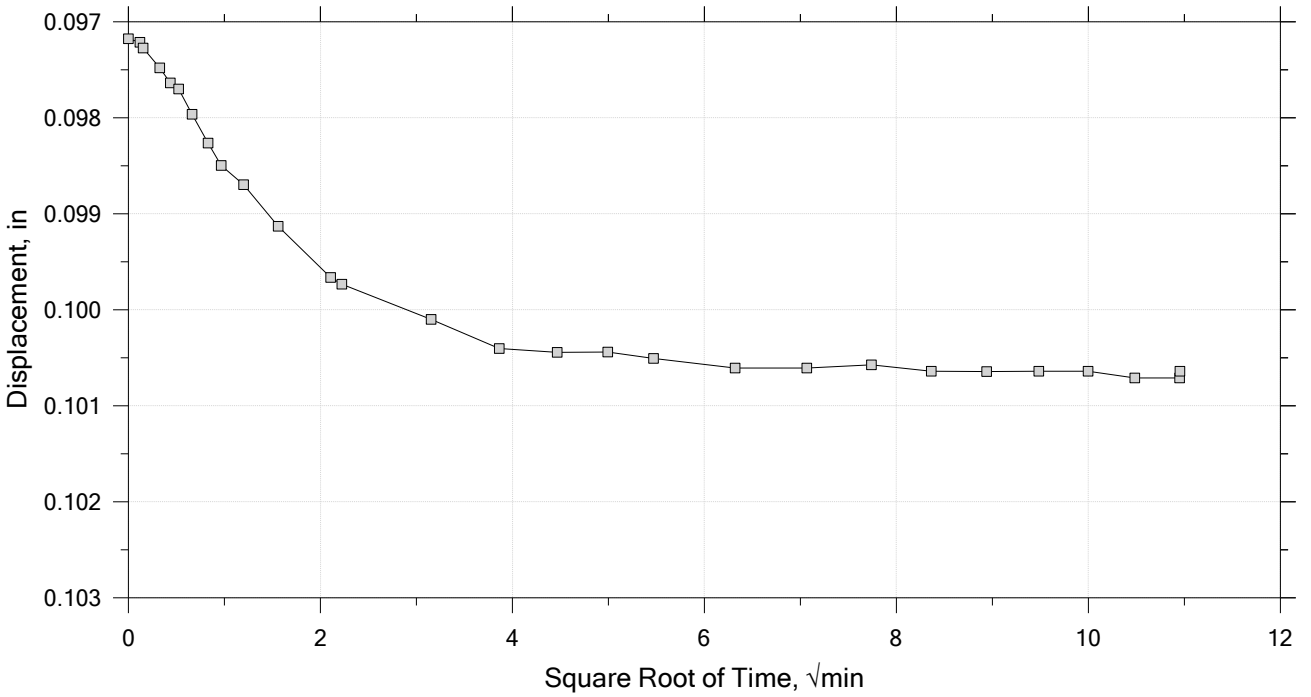


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 20 of 30
Constant Load Step
Stress: 1.62e+03 psf

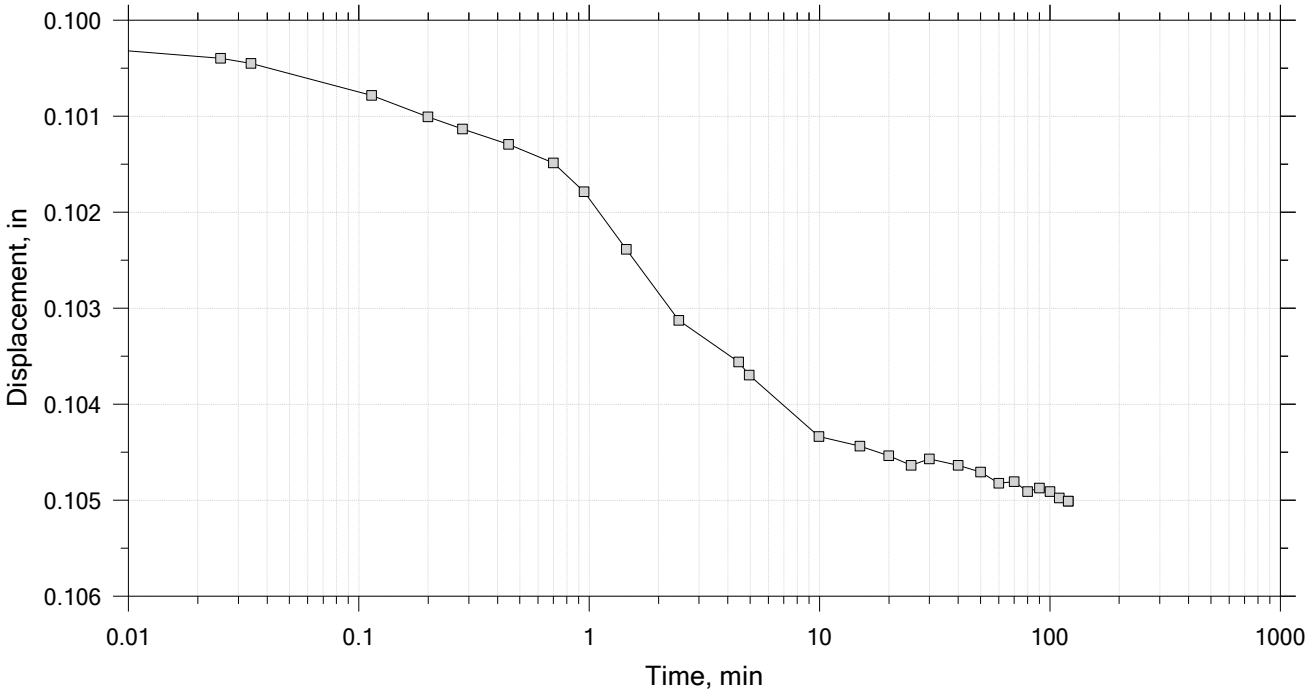


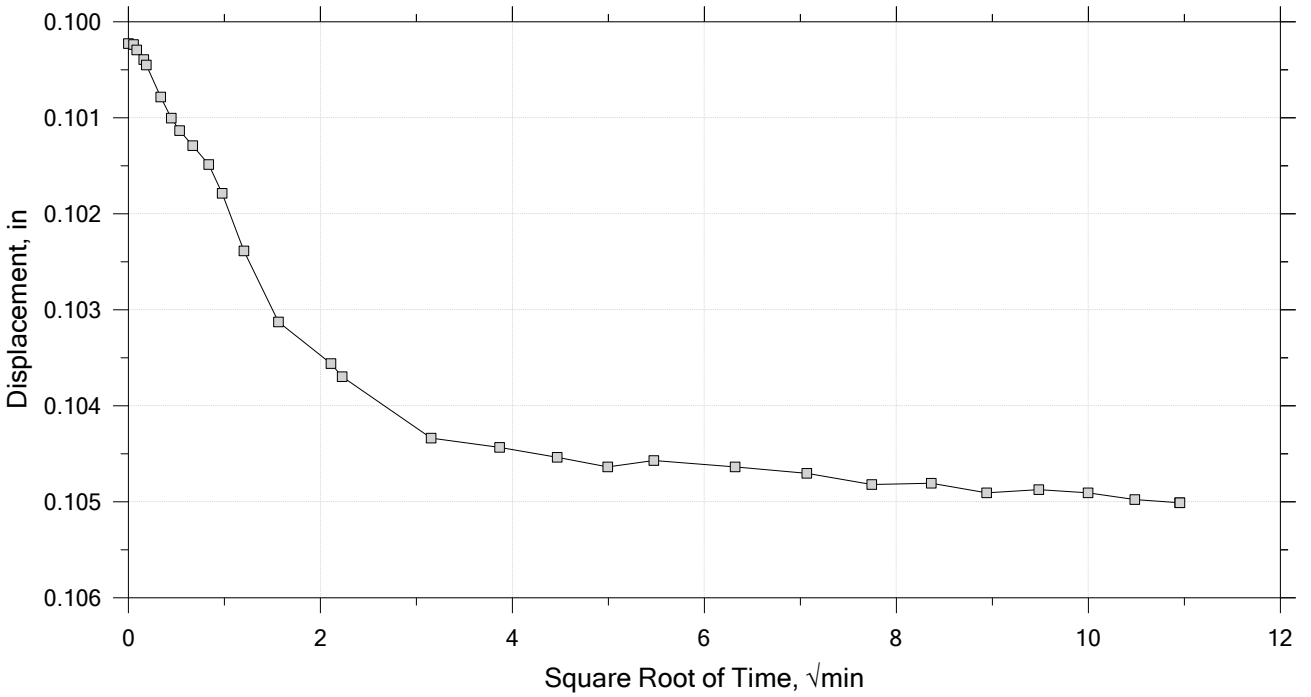


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 21 of 30
Constant Load Step
Stress: 3.23e+03 psf

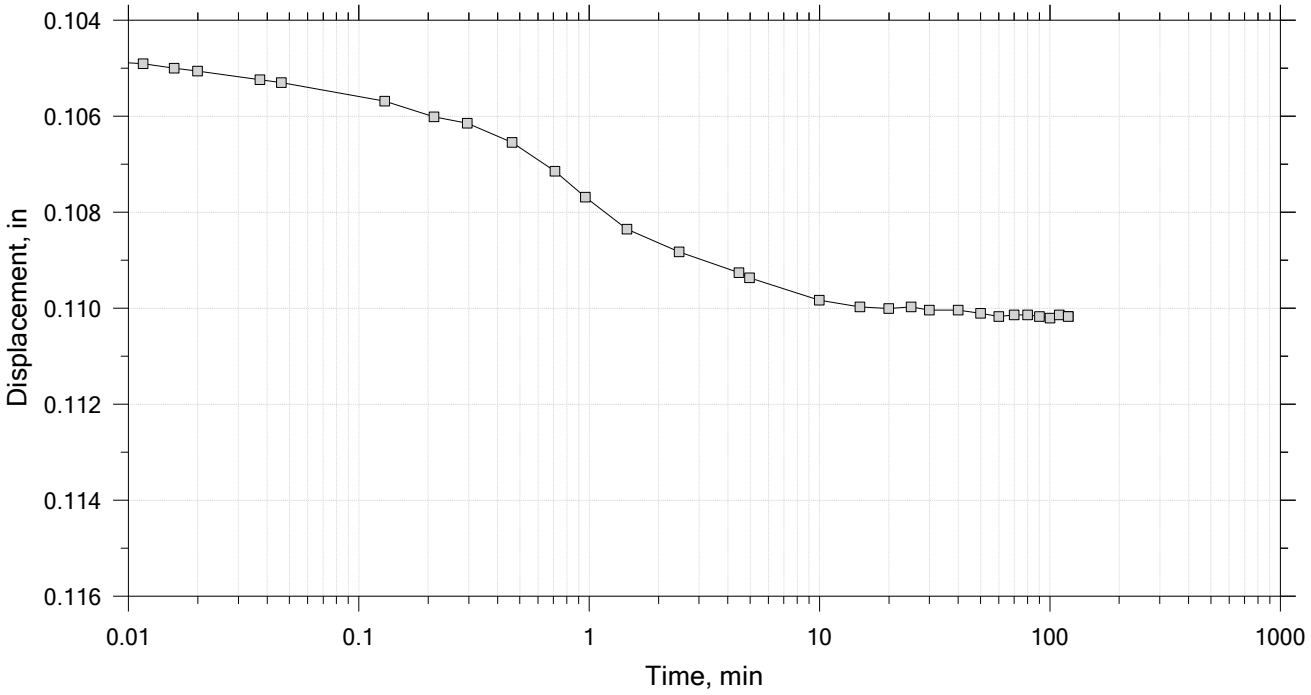


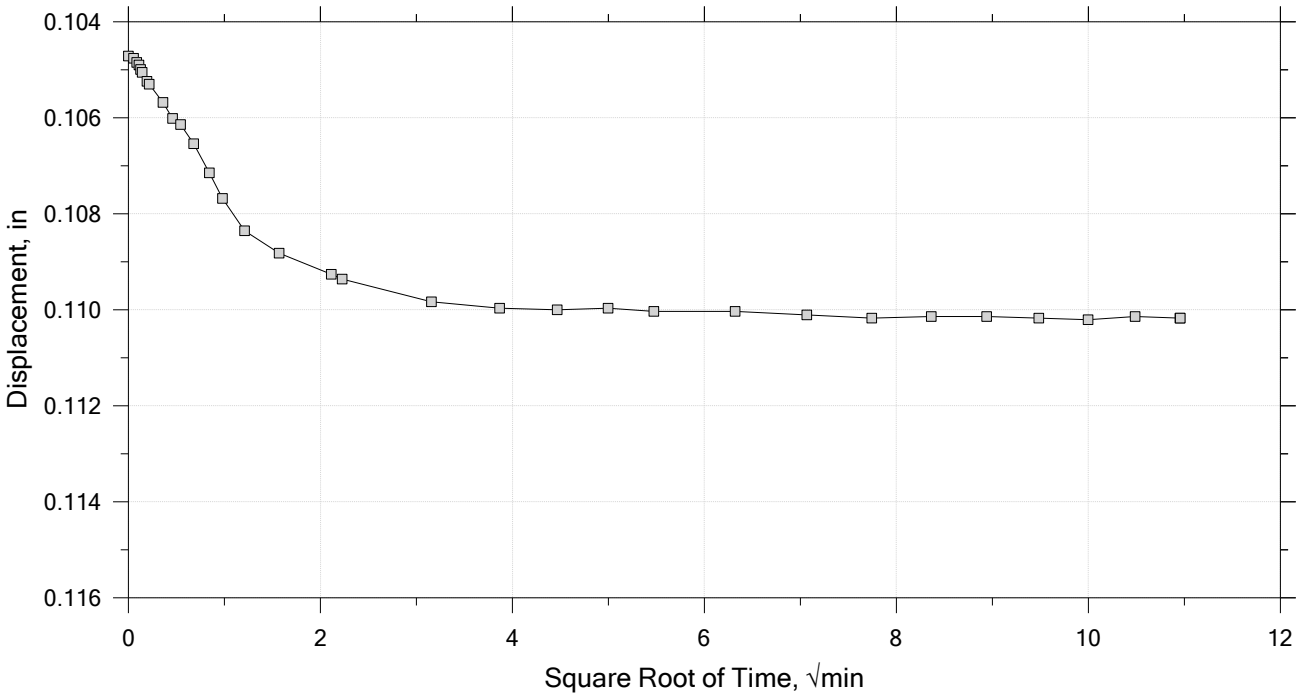


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 22 of 30
Constant Load Step
Stress: 6.46e+03 psf

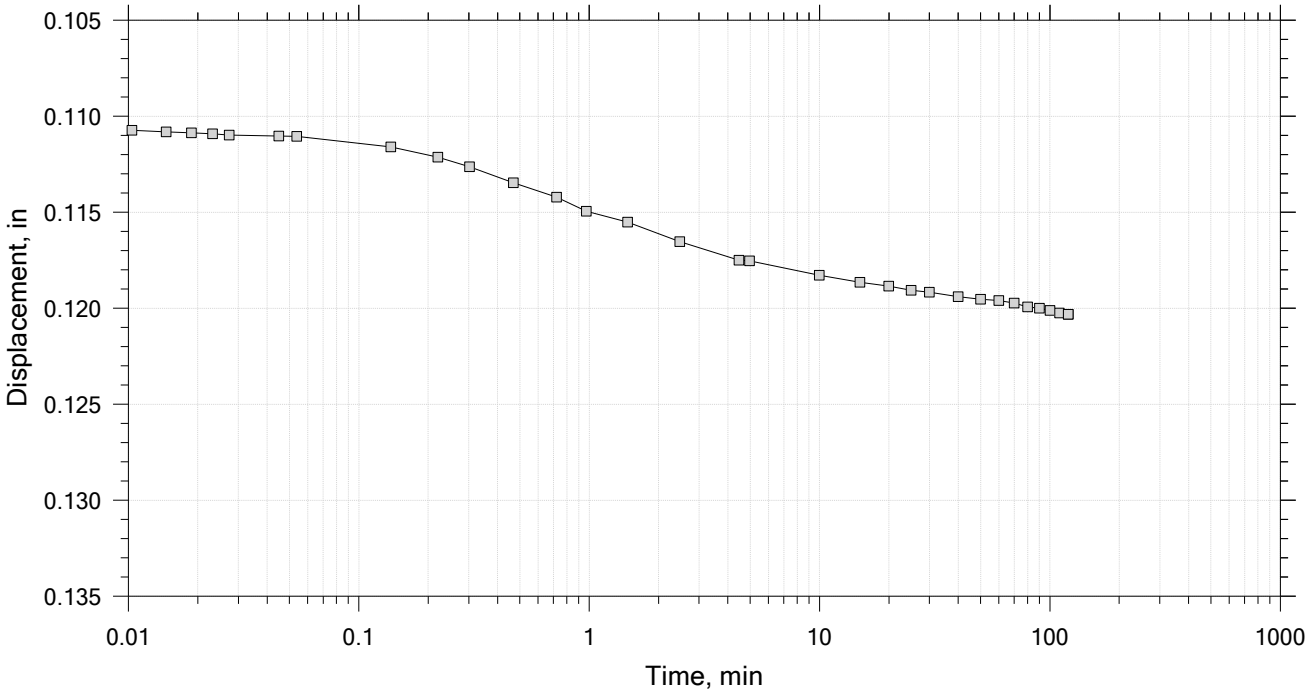


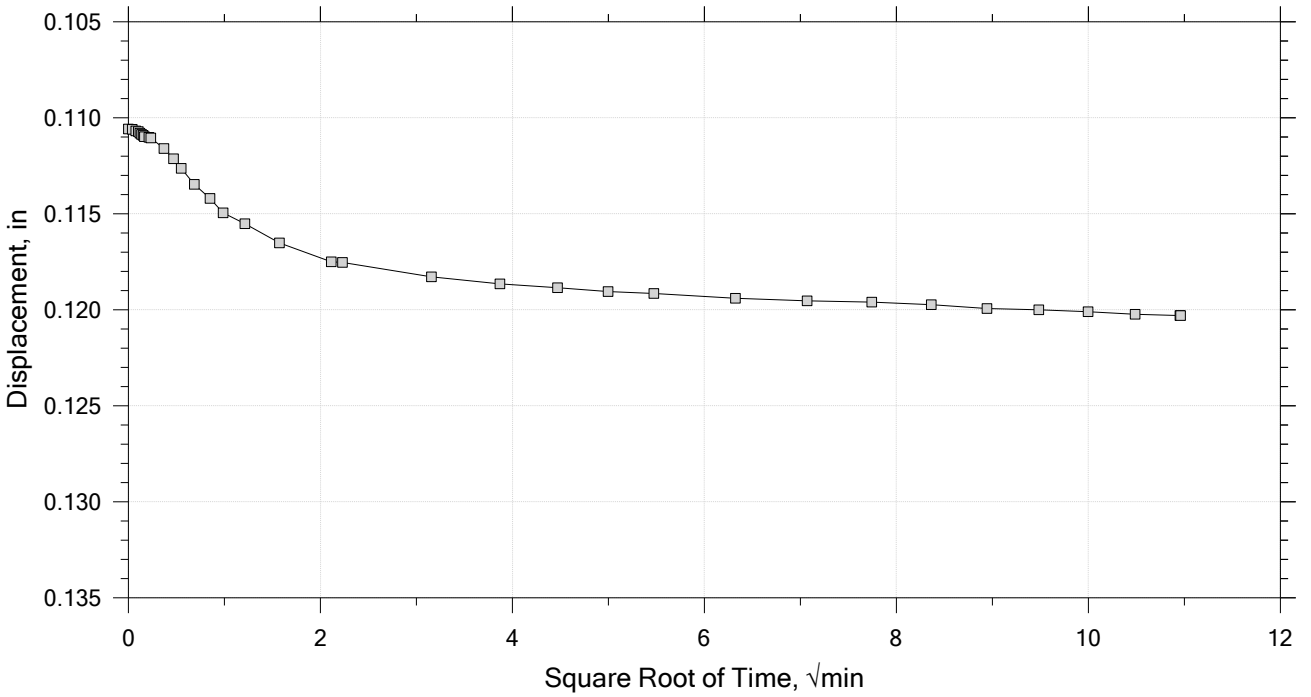


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 23 of 30
Constant Load Step
Stress: 1.29e+04 psf

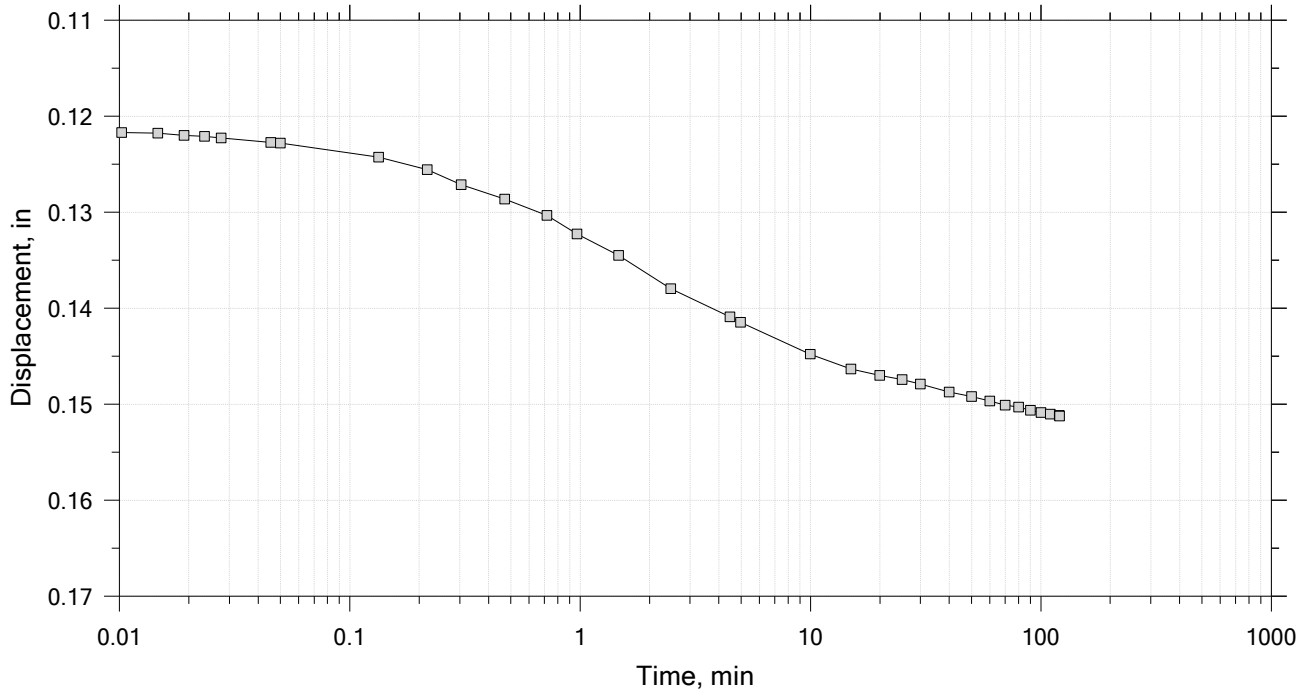


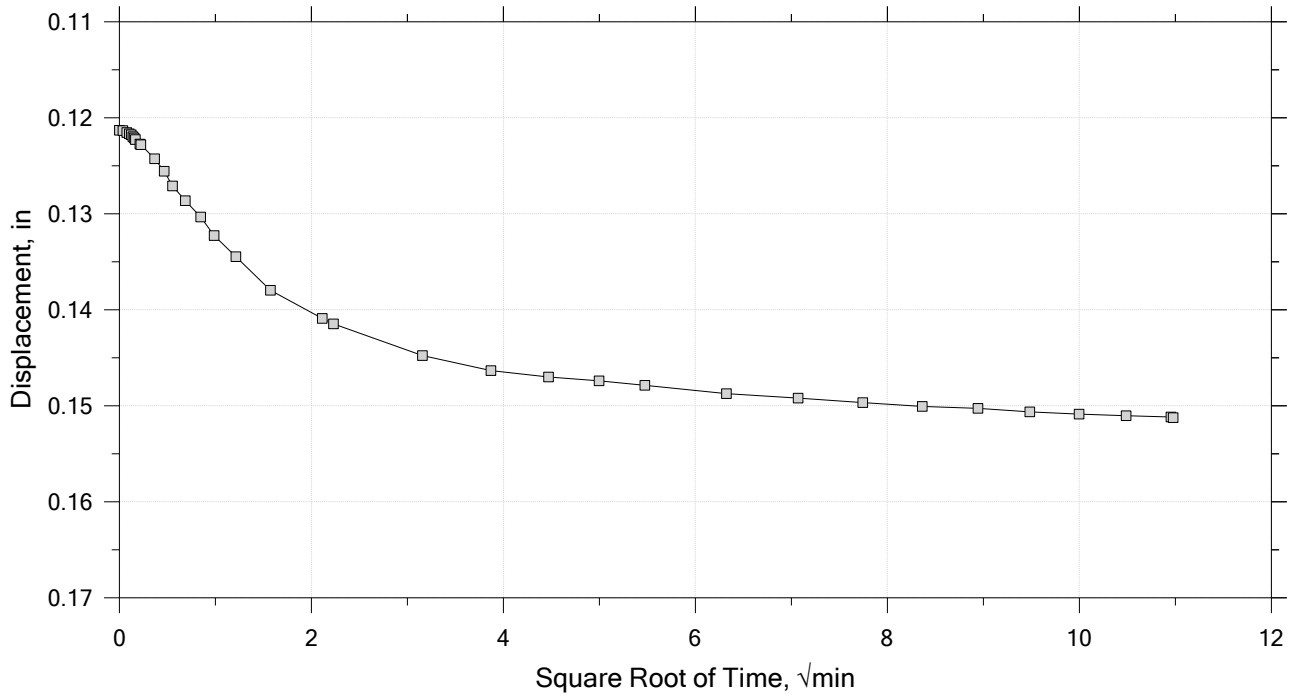


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 24 of 30
Constant Load Step
Stress: 2.58e+04 psf

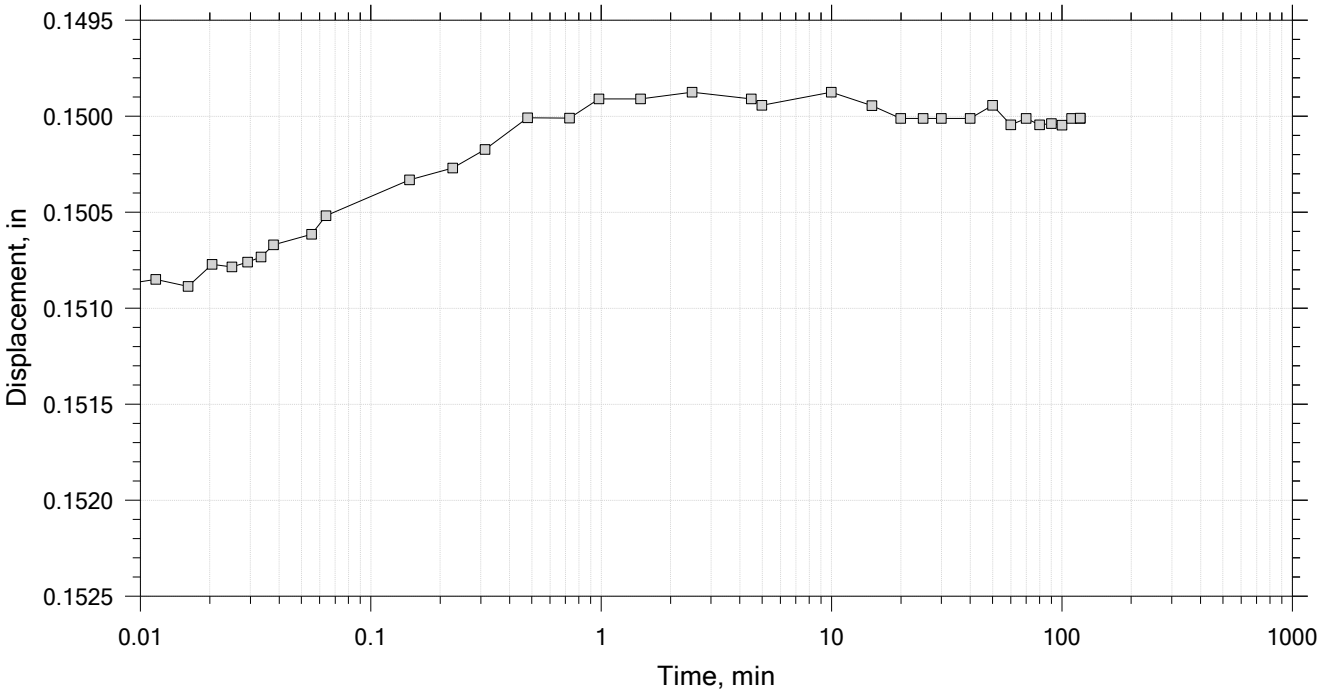


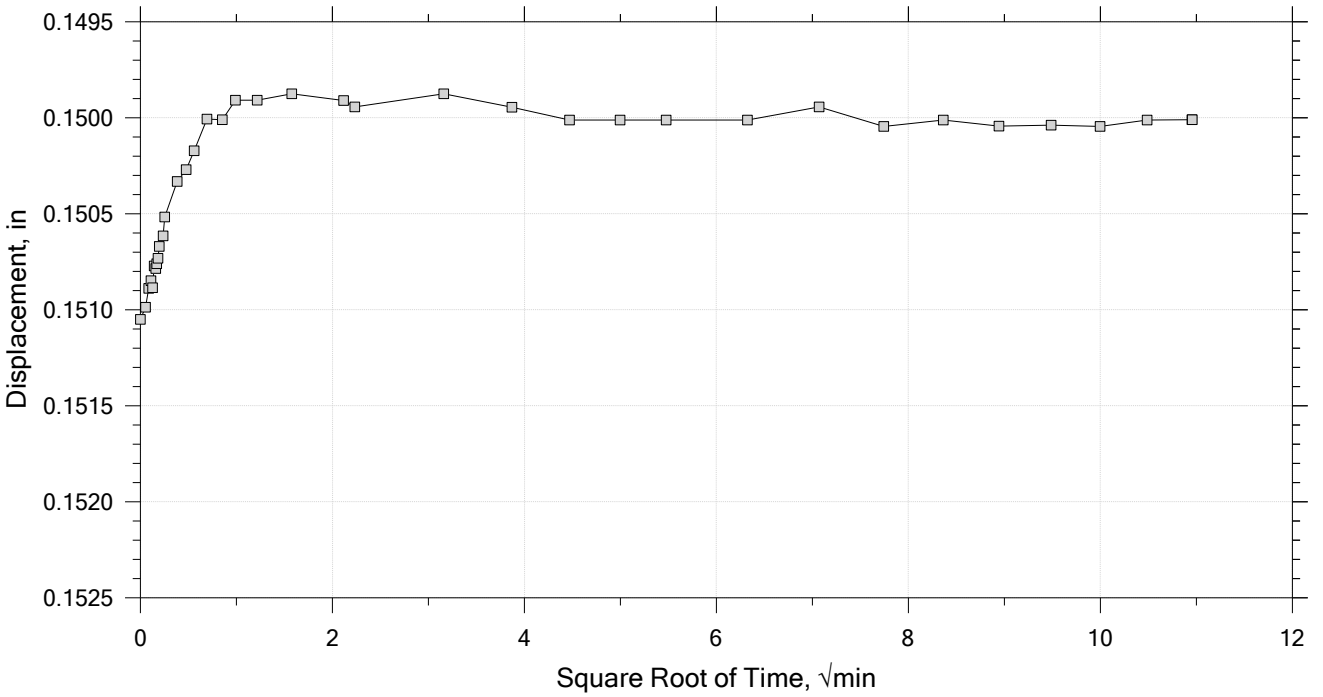


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 25 of 30
Constant Load Step
Stress: 1.29e+04 psf

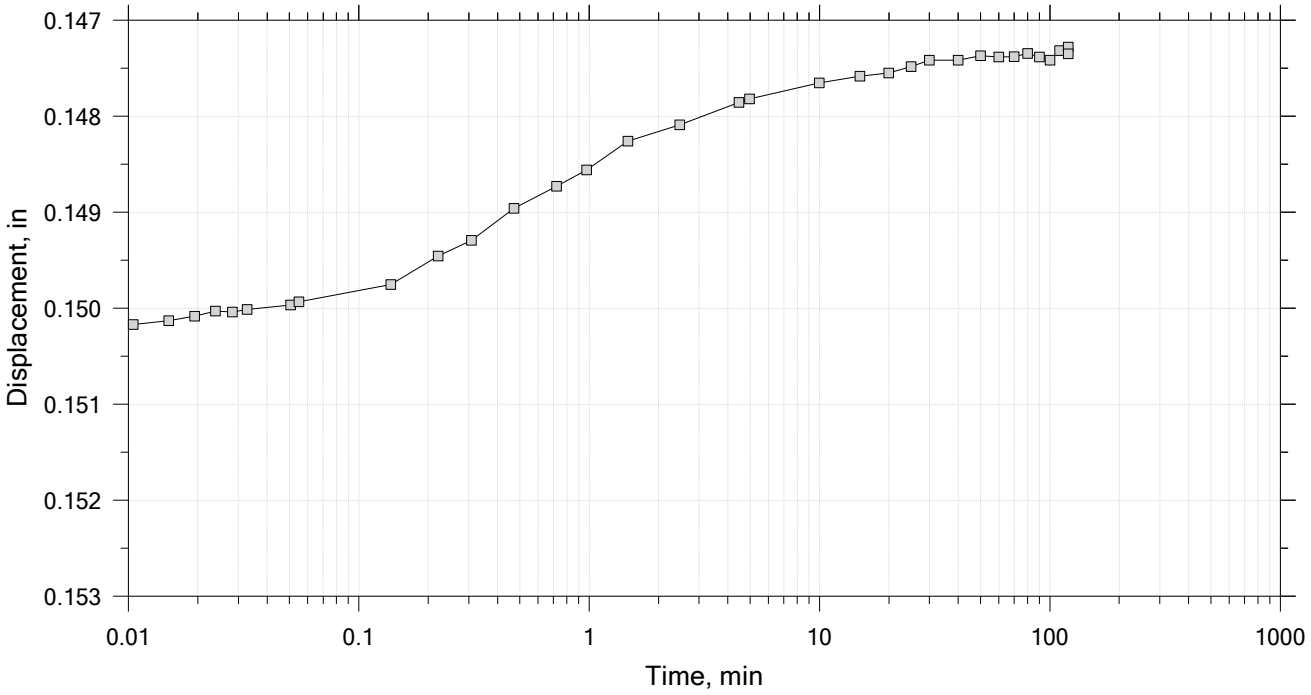


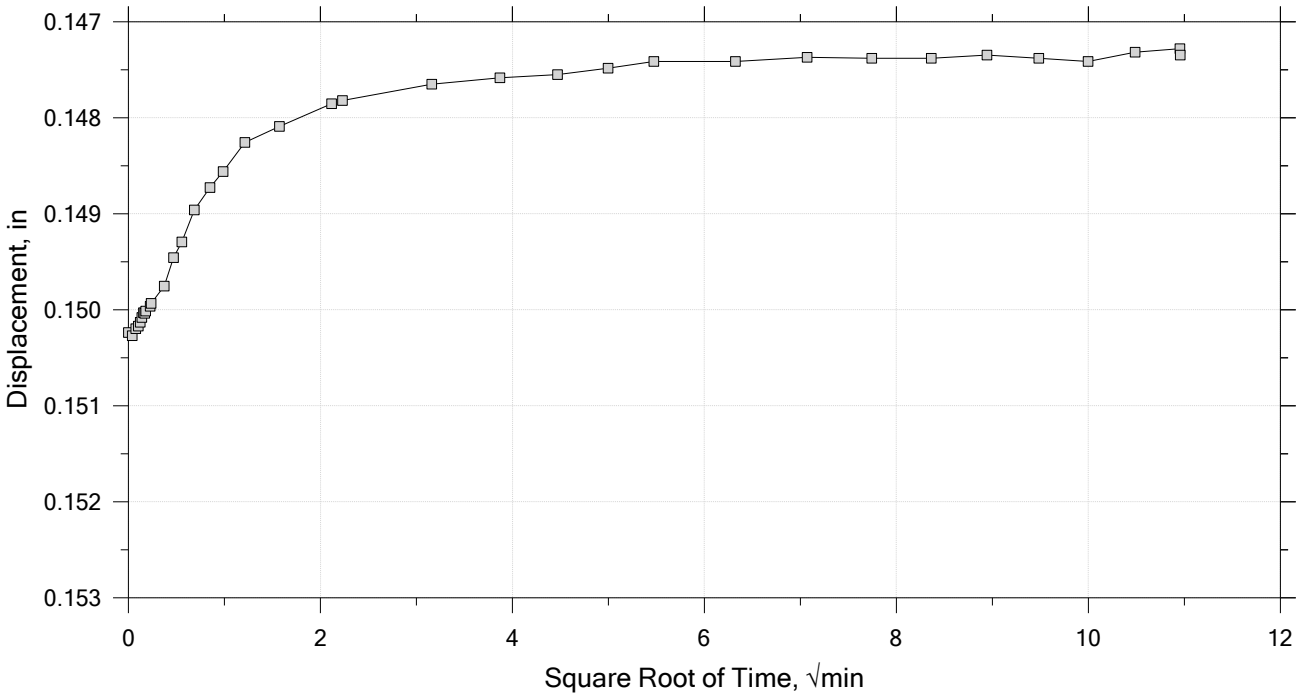


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 26 of 30
Constant Load Step
Stress: 6.46e+03 psf

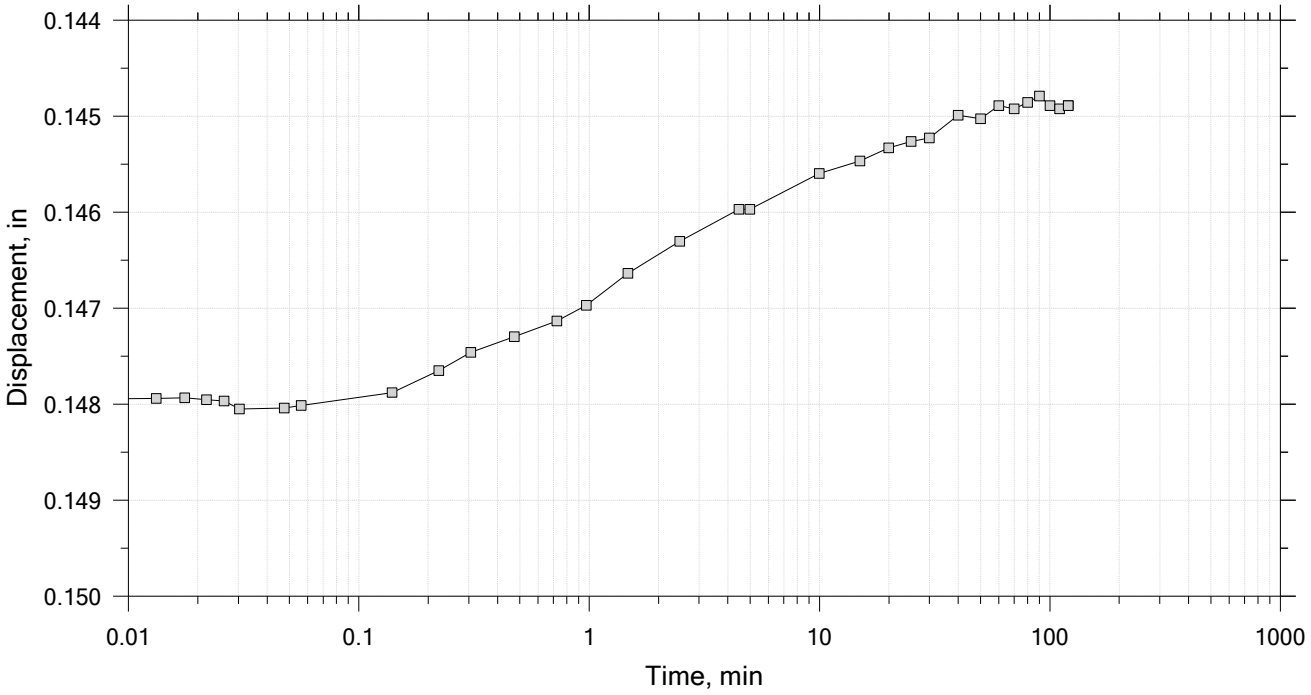


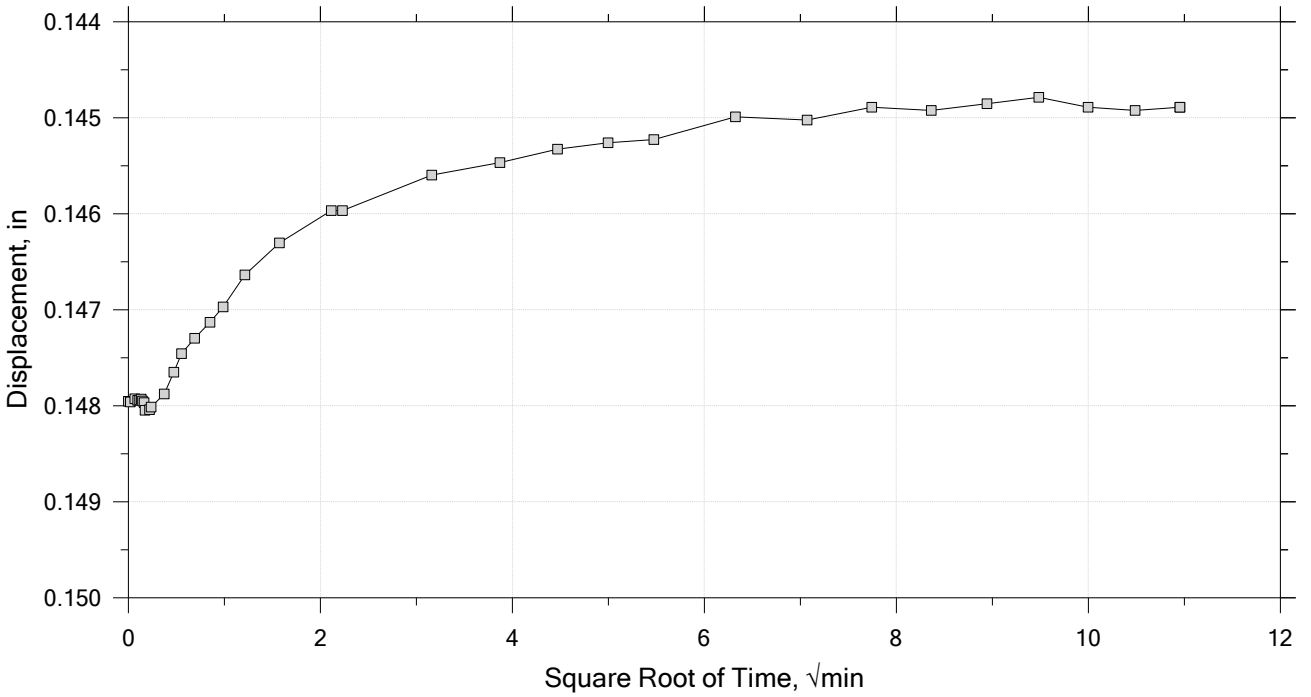


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 27 of 30
Constant Load Step
Stress: 3.23e+03 psf

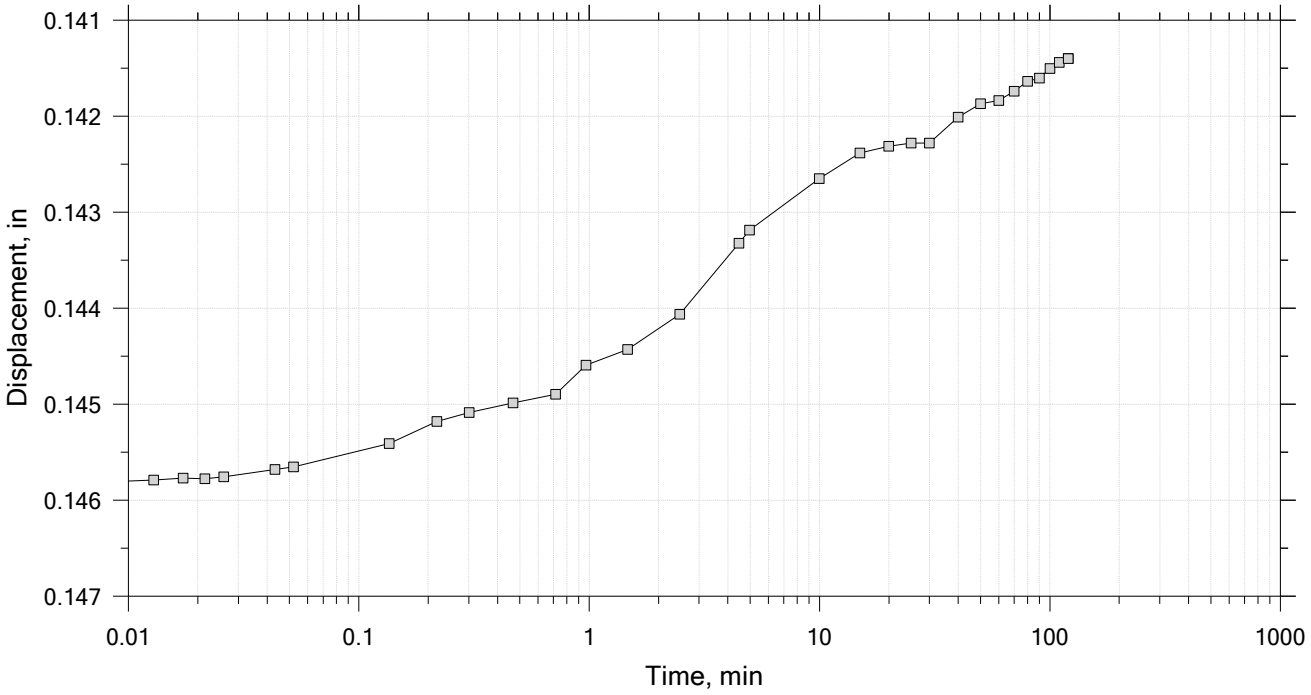


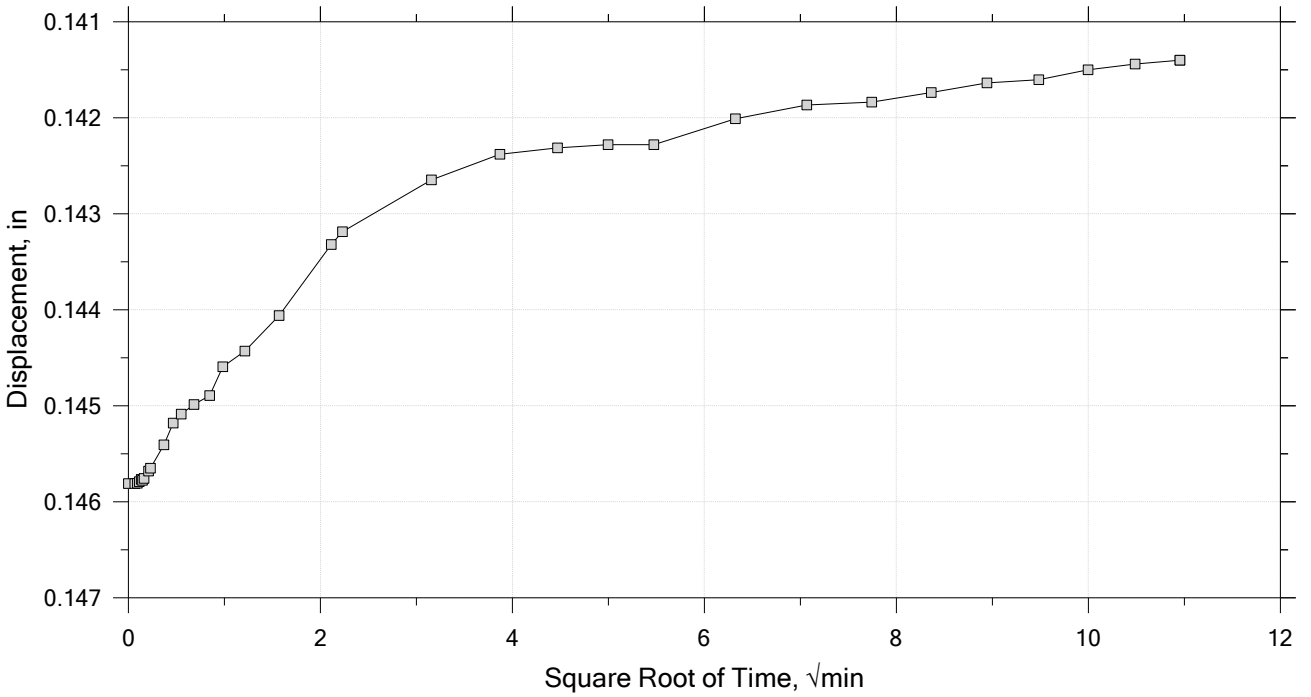


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 28 of 30
Constant Load Step
Stress: 1.62e+03 psf

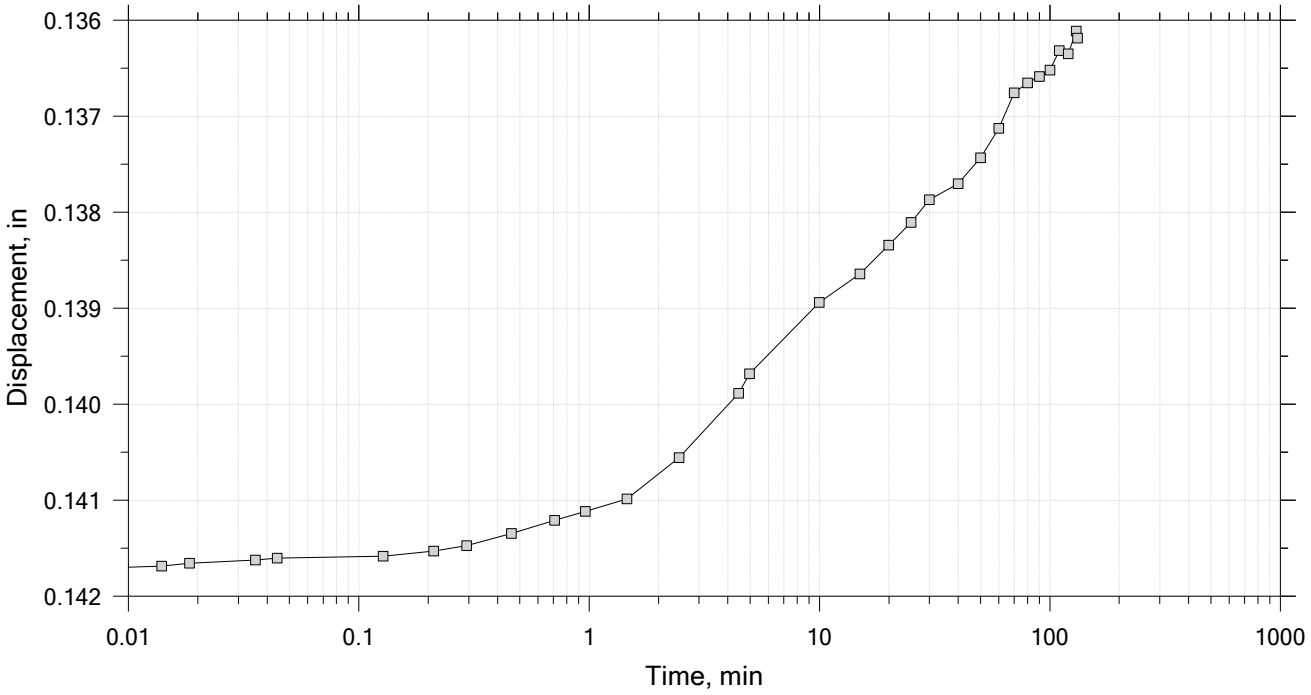


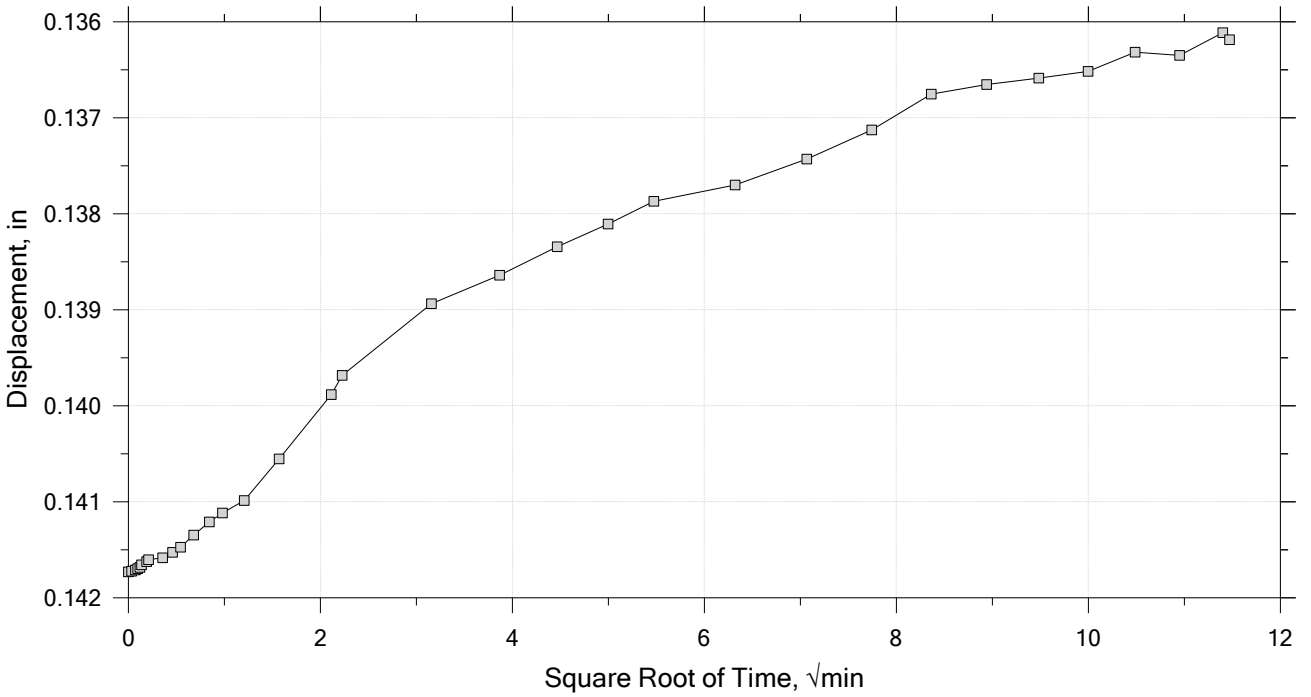


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 29 of 30
Constant Load Step
Stress: 807 psf

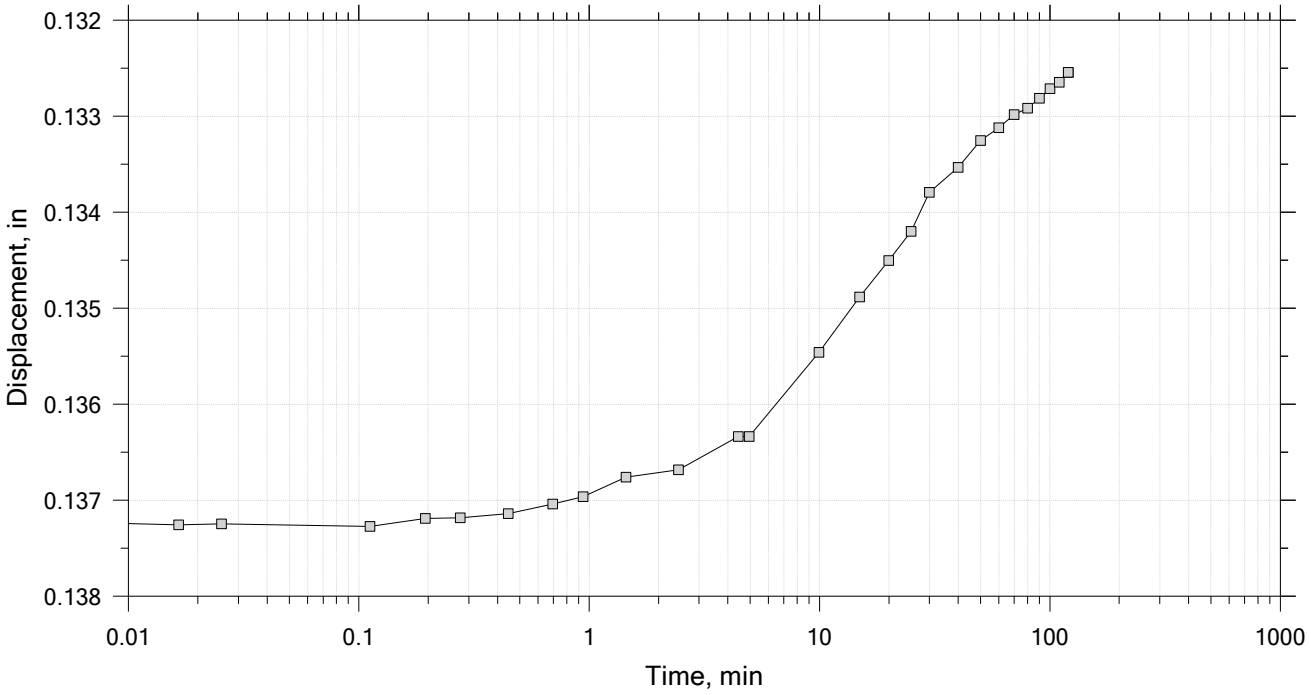


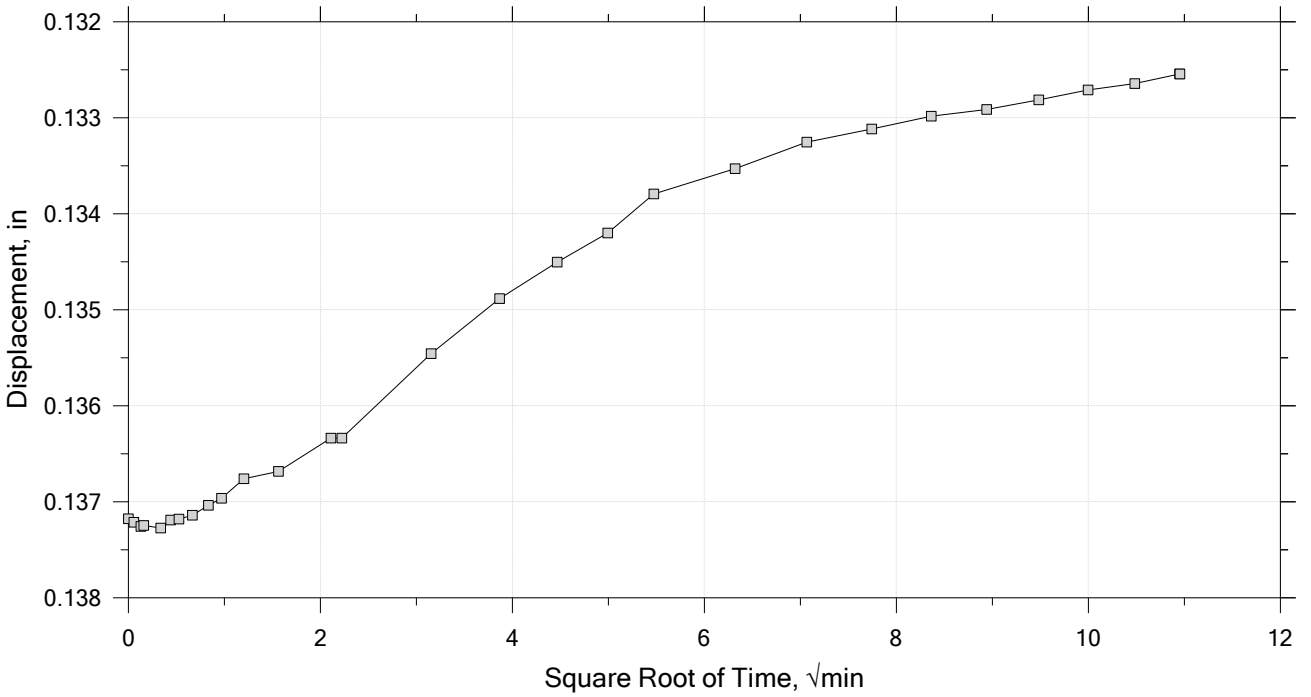


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 30 of 30
Constant Load Step
Stress: 404 psf



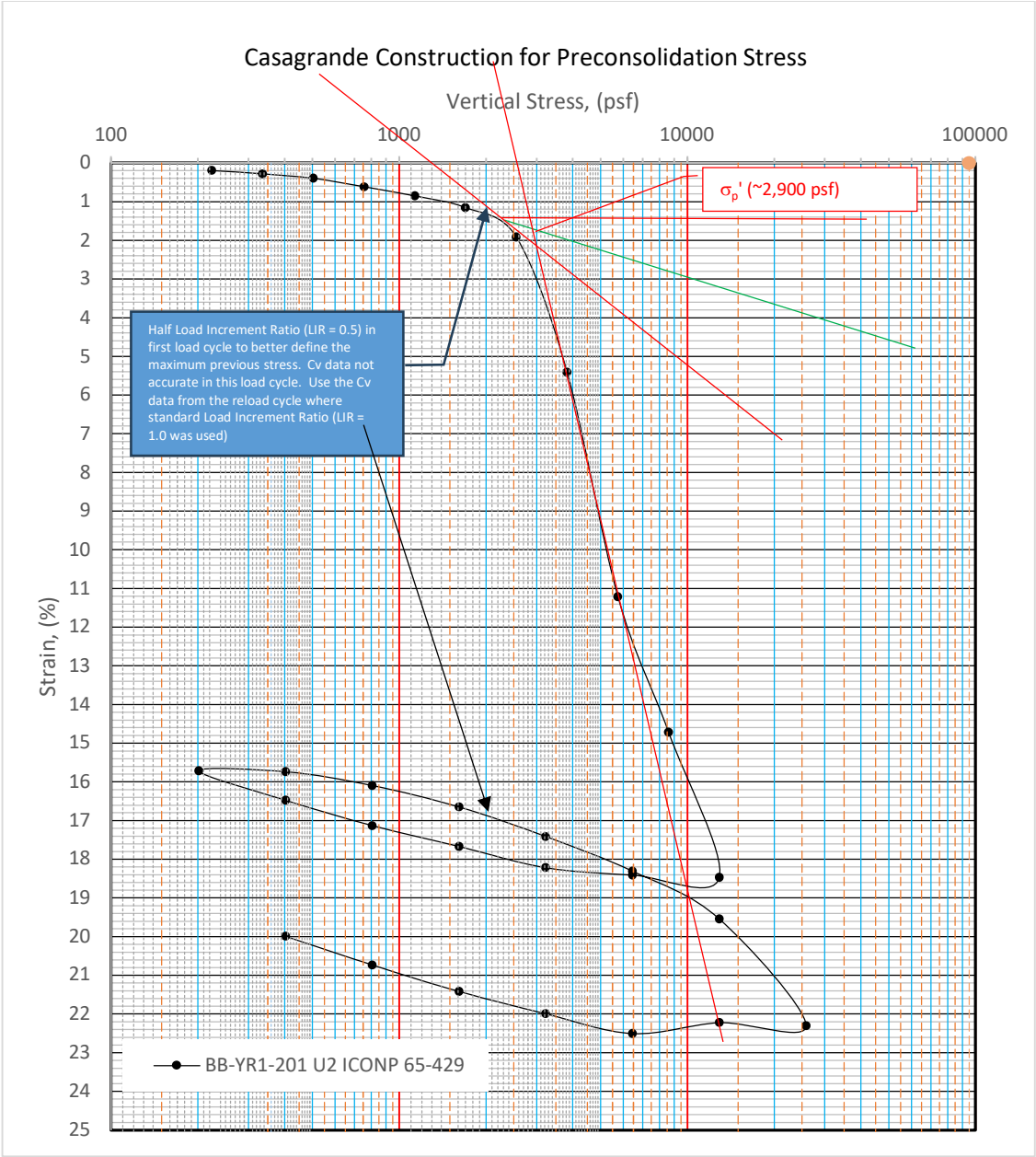


Soil Metrics LLC	Project: Route 1 Bridge	Location: Yarmouth, ME	Project No.: 164-35
	Boring No.: BB-YR1-201	Tested By: sjr	Checked By: sjr
	Sample No.: 1U	Test Date: 5/22/2024	Depth: 11.48
	Test No.: 68-423	Sample Type: wet	Elevation: --
	Description:		
	Remarks: 24 hour load hold on load step 11 for C-alpha		

Consolidation Test Data
Summary Report

Project Name:	Yarmouth Rt 1 Bridge
Project Number:	166-35
Project Location:	Yarmouth, Maine
Client:	GZA - PN: 09.0026144.00
Sample Description:	Gray Silty Clay (CL)
Preparation:	Trimmed Shelby Tube

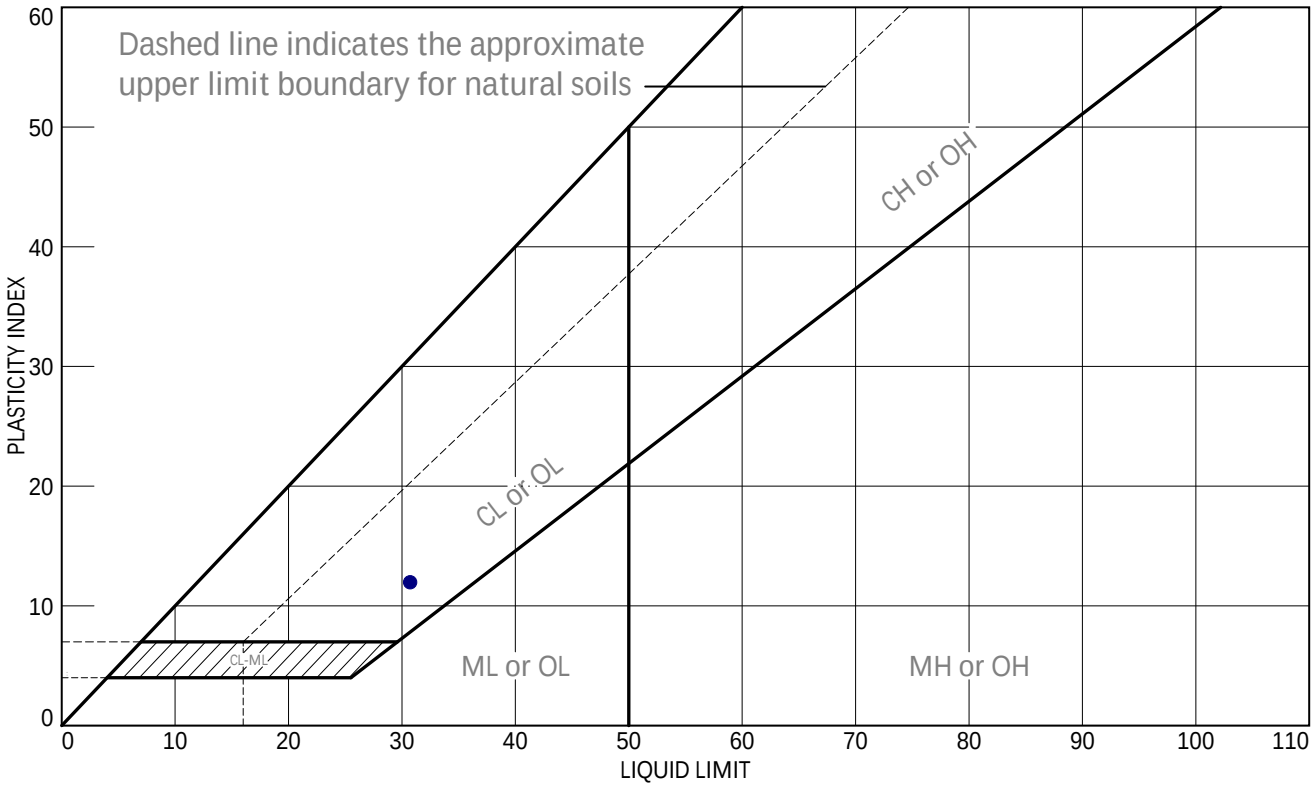
Lab Test No:	ICON 65-429			
Boring No.	BB-YR1-201			
Sample No:	2U			
Boring Elevation (ft).	--			
Sample Depth (ft):	14-16			
Test Specimen Depth (Ft):	15.3			
Test Specimen Elevation:	---			
Water Content (%):	44.4			
Dry Unit Weight (pcf):	77.7			
Wet Unit Weight (pcf):	112.2			
Saturation Before (%):	98.1			
Saturation After (%):	100			
Void Ratio Before:	1.29			
Void Ratio After:	0.83			
Overburden Pressure (psf):	--			
Max Previous stress (psf):	2,900			
Max Prev. stress (Work) (psf):	2,700			
OCR:	--			
Compression Index (C_{CE}):	0.339			
Recompression Index (C_{RE}):	0.028	from re-load curve		
Liquid Limit:	30.8			
Plastic Limit:	18.9			
Plasticity Index:	11.9			
Liquidity Index:	2.1			
Lab Vane Su at 15.17 ft. (psf)	512			
Tested By:	sjr			
Date Tested:	5/22/2024			
Checked By:	sjr			



Note 1: The calculations for the Max Previous Stress, the Compression Index and the Recompression Index are provided for the convienience of the Specifier. The Specifier should make their own independent assessment of Maximum Previous stress, Cce and Cre for use in any engineering analyses.

Soil Metrics LLC Geotechnical Engineering

LIQUID AND PLASTIC LIMITS TEST REPORT



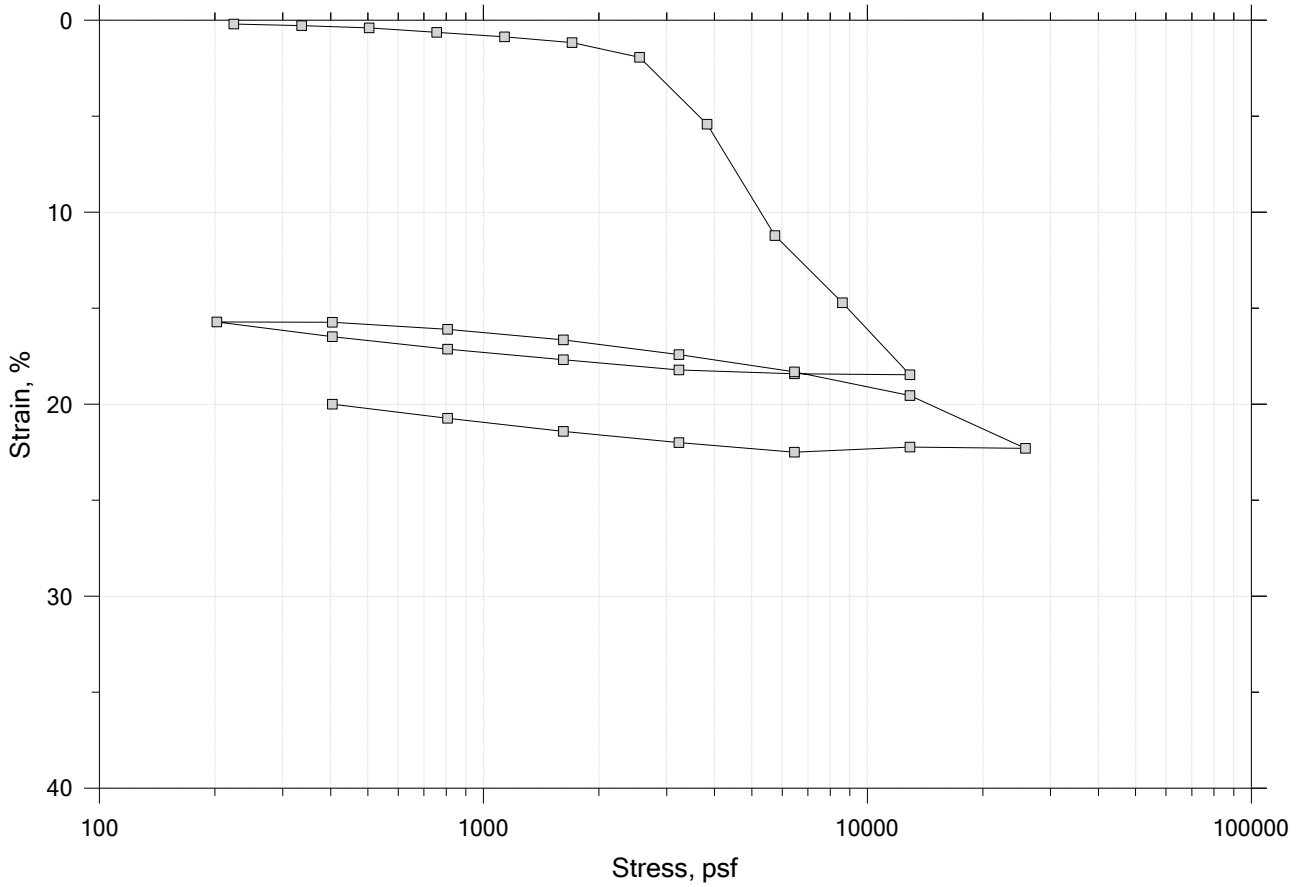
SOIL DATA									
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-YR1-201	2U	14-16		18.9	30.8	11.9		CL

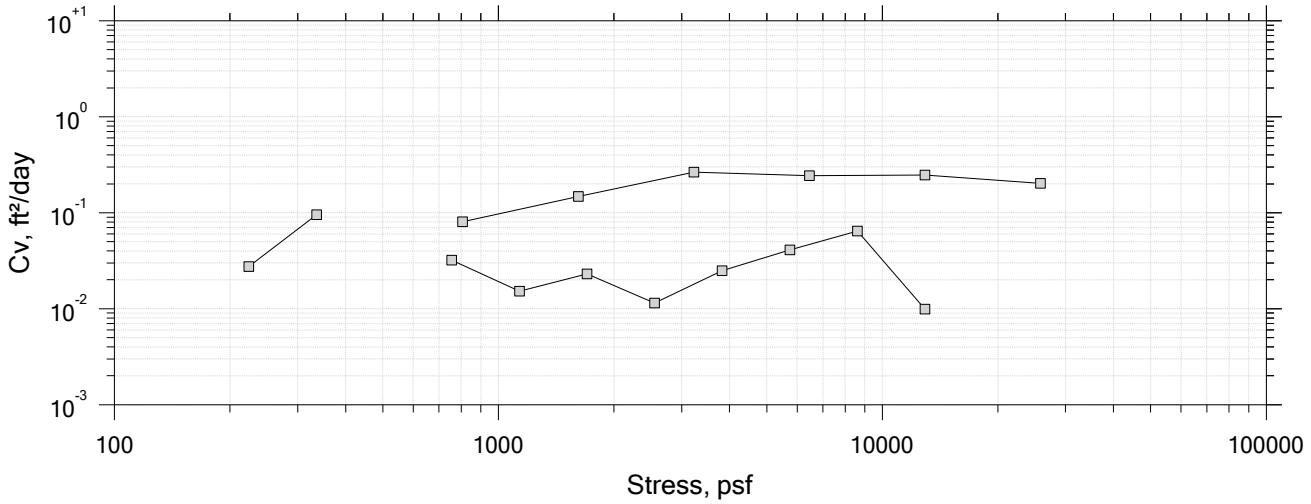
Soil Metrics LLC Cape Elizabeth, Maine	Client: GZA Project: Yarmouth Route 1 Bridge Project No.: GZA PN 09.0026144.00 Figure

Tested By: sjr Checked By: sjr

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		
	Displacement at End of Primary		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter, in: 2.50	Specific Gravity: 2.85 (Implied)	Liquid Limit: 31
Specimen Height, in: 1.00	Initial Void Ratio: 1.29	Plastic Limit: 19
Final Height, in: 0.80	Final Void Ratio: 0.831	Plasticity Index: 12

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	207	---	"ring"	321
Mass Container, gm	36.82	110.25	110.25	60.4
Mass Container + Wet Soil, gm	139.35	254.91	239.71	189.67
Mass Container + Dry Soil, gm	109.7	210.46	210.46	160.46
Mass Dry Soil, gm	72.88	100.21	100.21	100.06
Water Content, %	40.68	44.36	29.19	29.19
Void Ratio	---	1.29	0.83	---
Degree of Saturation, %	---	98.14	100.00	---
Dry Unit Weight, pcf	---	77.707	97.043	---

Preconsolidation Stress, psf	---
Compression Ratio	0
Rebound Ratio	0
Compression Index	0
Rebound Index	0

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

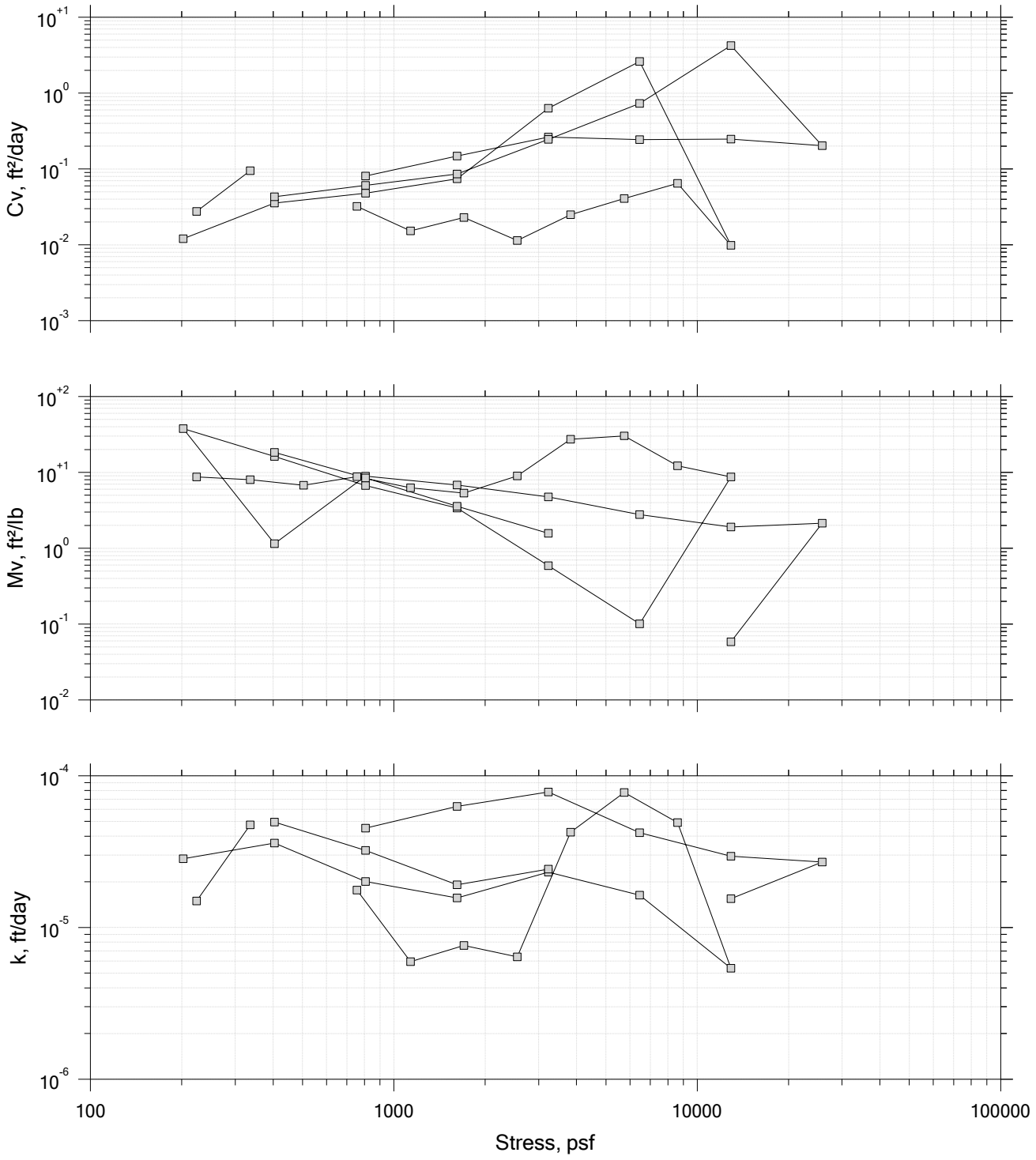
One-Dimensional Consolidation by ASTM D2435 - Method B

Sqrt of Time Coefficients

Step	Applied Stress psf	EOP Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/day	Mv ft²/lb	k ft/day
1	224.	0.001950	1.28	0.195	76.961	2.75e-02	8.71e+00	1.49e-05
2	336.	0.002845	1.28	0.285	22.208	9.50e-02	7.99e+00	4.74e-05
3	504.	0.003982	1.28	0.398	0.000	0.00e+00	6.77e+00	0.00e+00
4	756.	0.006203	1.27	0.620	65.387	3.21e-02	8.81e+00	1.77e-05
5	1.13e+03	0.008566	1.27	0.857	136.754	1.53e-02	6.25e+00	5.96e-06
6	1.70e+03	0.01158	1.26	1.16	90.454	2.30e-02	5.31e+00	7.62e-06
7	2.55e+03	0.01923	1.24	1.92	179.908	1.14e-02	8.99e+00	6.41e-06
8	3.83e+03	0.05409	1.16	5.41	78.948	2.49e-02	2.73e+01	4.25e-05
9	5.74e+03	0.1122	1.03	11.2	43.576	4.09e-02	3.03e+01	7.75e-05
10	8.61e+03	0.1472	0.950	14.7	24.881	6.45e-02	1.22e+01	4.91e-05
11	1.29e+04	0.1847	0.864	18.5	149.144	9.89e-03	8.72e+00	5.39e-06
12	6.46e+03	0.1841	0.865	18.4	0.540	2.61e+00	1.00e-01	1.64e-05
13	3.23e+03	0.1822	0.870	18.2	2.238	6.32e-01	5.88e-01	2.32e-05
14	1.61e+03	0.1767	0.882	17.7	19.221	7.43e-02	3.38e+00	1.57e-05
15	807.	0.1713	0.895	17.1	30.244	4.78e-02	6.72e+00	2.01e-05
16	404.	0.1647	0.910	16.5	41.345	3.55e-02	1.62e+01	3.60e-05
17	202.	0.1571	0.927	15.7	123.824	1.21e-02	3.77e+01	2.84e-05
18	404.	0.1574	0.927	15.7	0.000	0.00e+00	1.15e+00	0.00e+00
19	807.	0.1610	0.918	16.1	18.562	8.07e-02	8.95e+00	4.51e-05
20	1.61e+03	0.1665	0.906	16.6	10.031	1.48e-01	6.81e+00	6.29e-05
21	3.23e+03	0.1741	0.888	17.4	5.532	2.64e-01	4.74e+00	7.81e-05
22	6.46e+03	0.1831	0.868	18.3	5.874	2.44e-01	2.78e+00	4.22e-05
23	1.29e+04	0.1954	0.840	19.5	5.623	2.48e-01	1.91e+00	2.95e-05
24	2.58e+04	0.2230	0.776	22.3	6.554	2.02e-01	2.14e+00	2.70e-05
25	1.29e+04	0.2223	0.778	22.2	0.302	4.24e+00	5.85e-02	1.55e-05
26	6.46e+03	0.2250	0.772	22.5	1.741	7.34e-01	-4.31e-01	-1.98e-05
27	3.23e+03	0.2199	0.783	22.0	5.211	2.46e-01	1.58e+00	2.42e-05
28	1.61e+03	0.2142	0.797	21.4	15.171	8.57e-02	3.57e+00	1.91e-05
29	807.	0.2073	0.812	20.7	21.701	6.09e-02	8.47e+00	3.22e-05
30	404.	0.1999	0.829	20.0	31.165	4.31e-02	1.84e+01	4.96e-05

Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		
	Displacement at End of Primary		

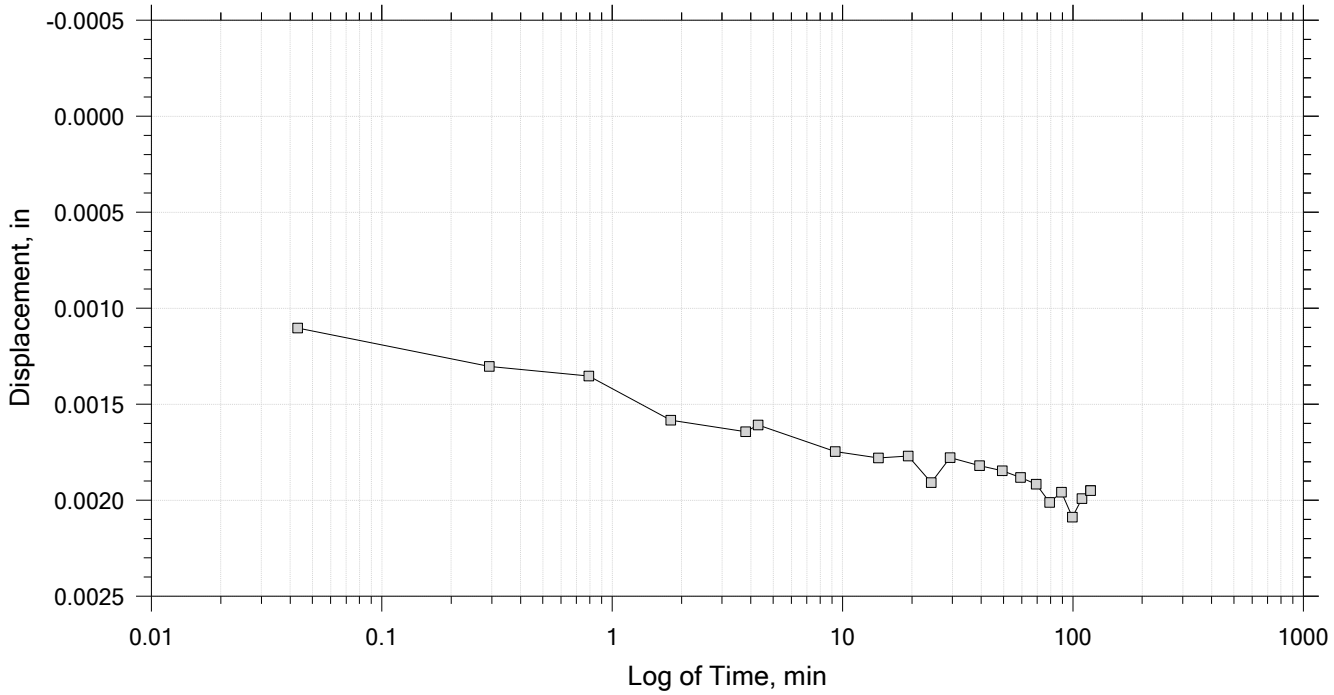
One-Dimensional Consolidation by ASTM D2435 - Method B

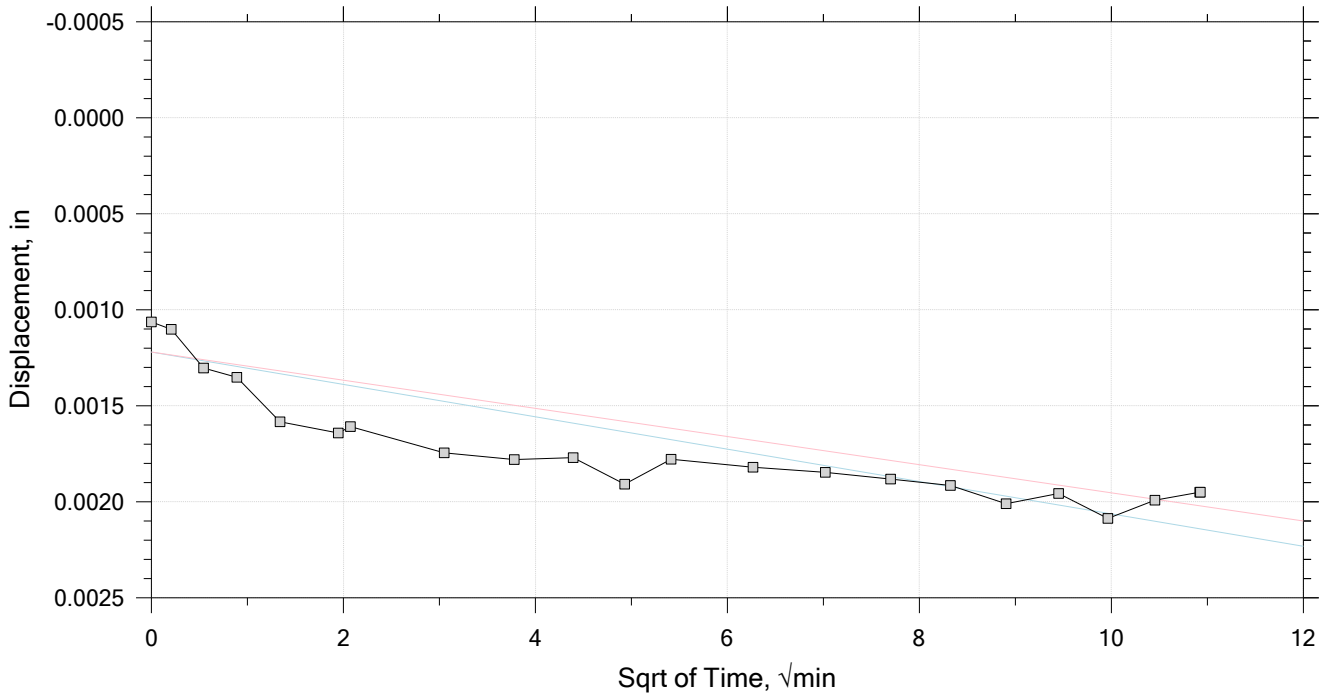


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 30
Constant Load Step
Stress: 224 psf

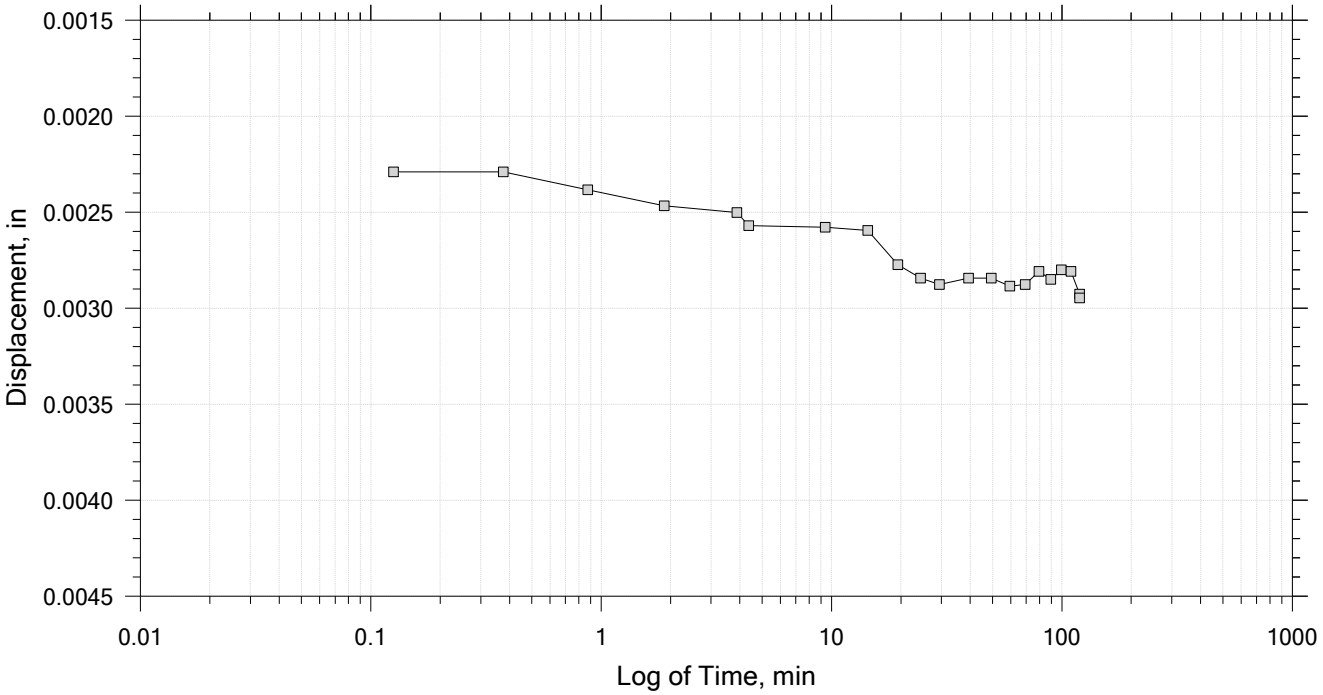


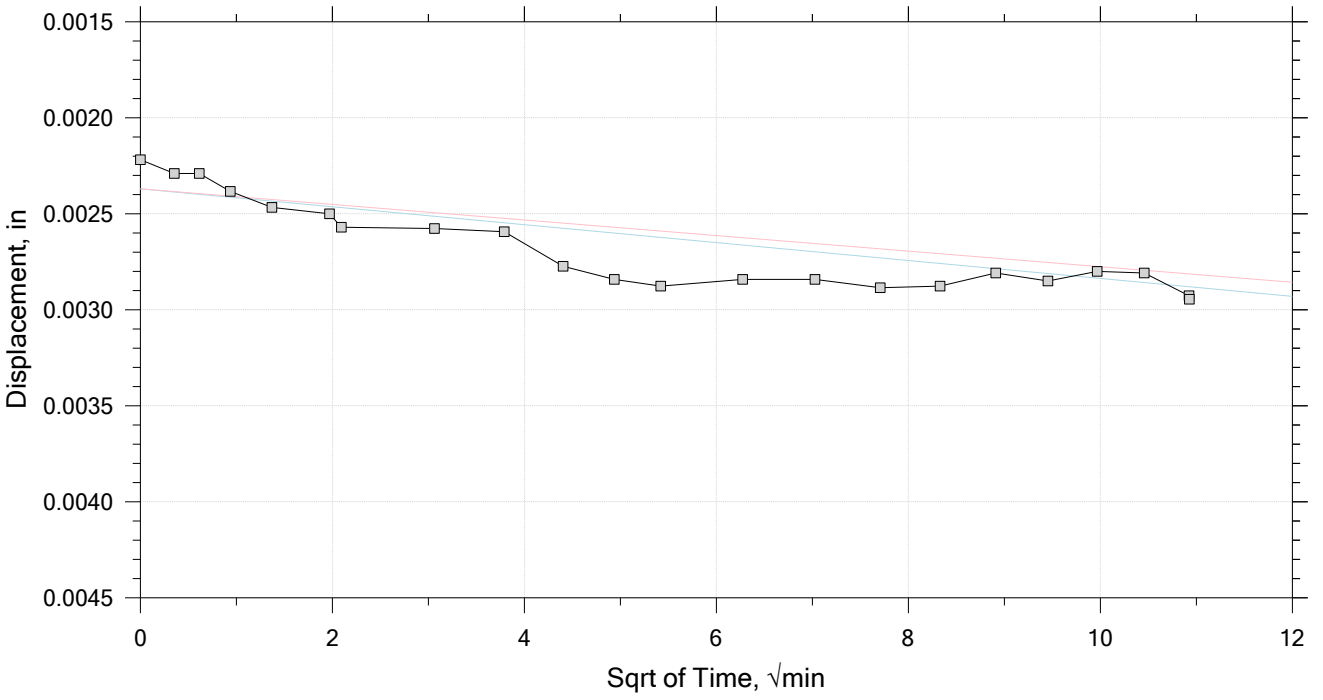


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 30
Constant Load Step
Stress: 336 psf

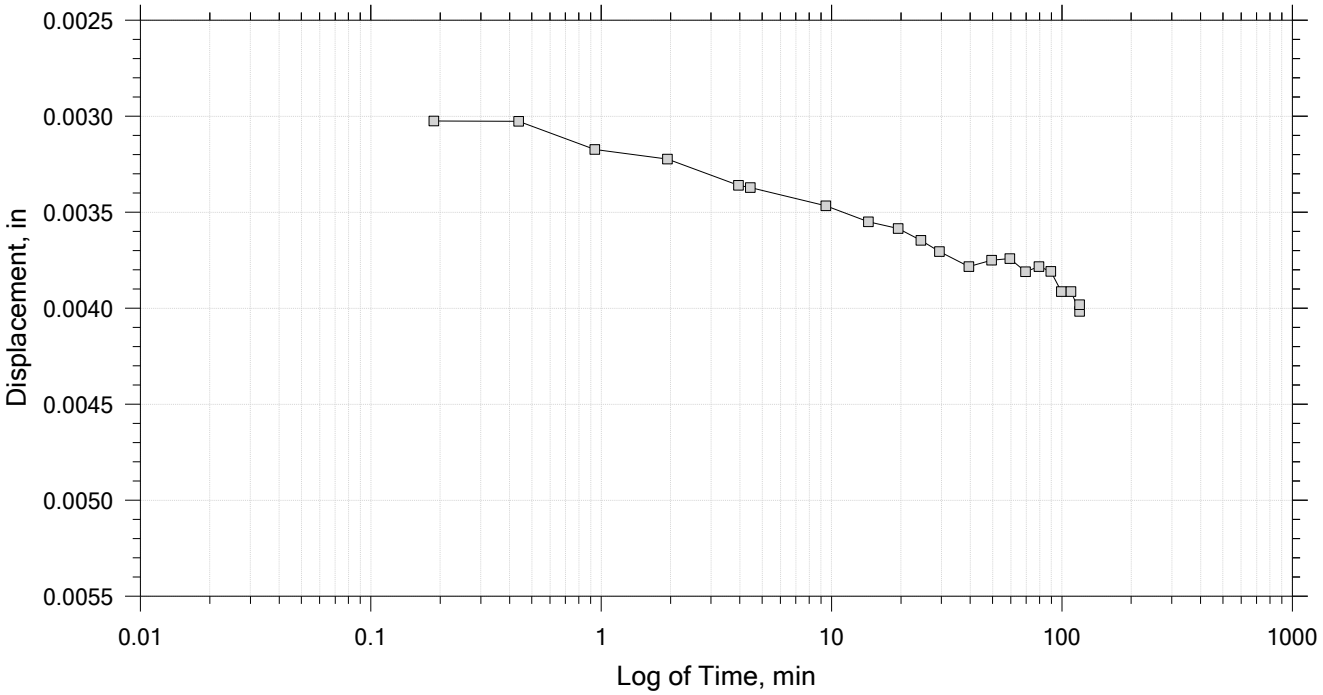


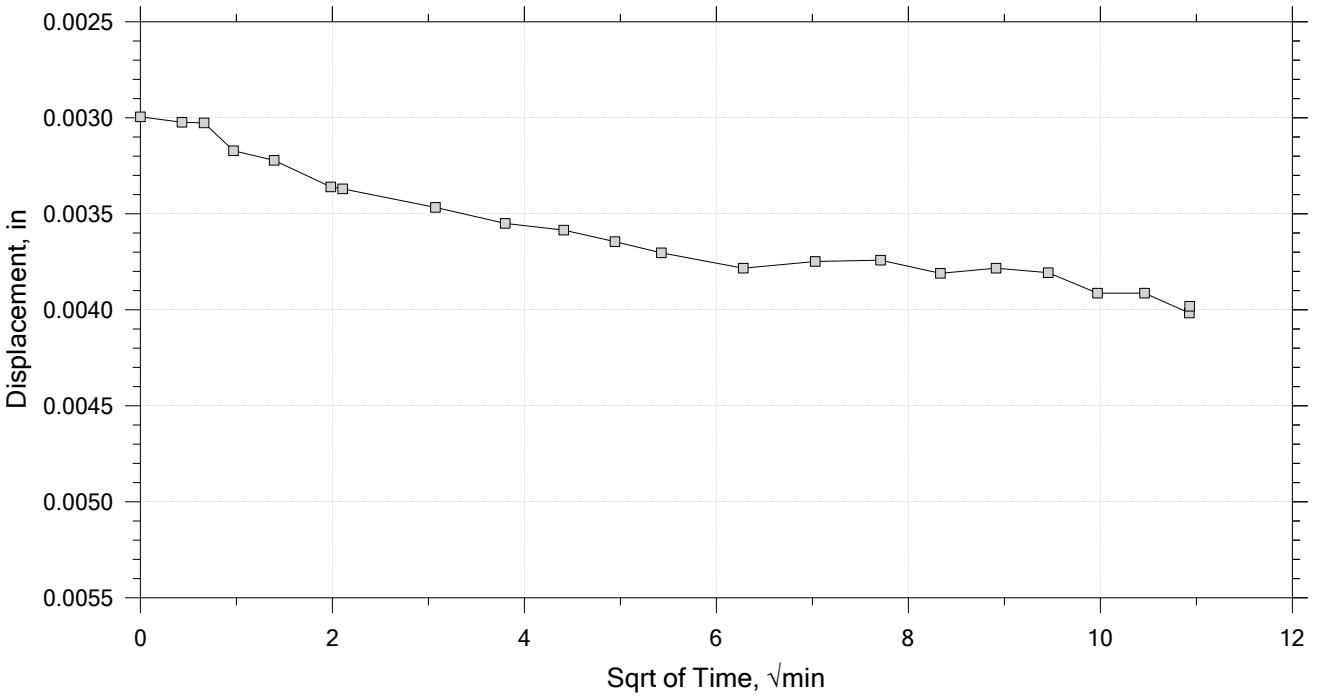


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
Test Number: ICONP 65-429	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 30
Constant Load Step
Stress: 504 psf

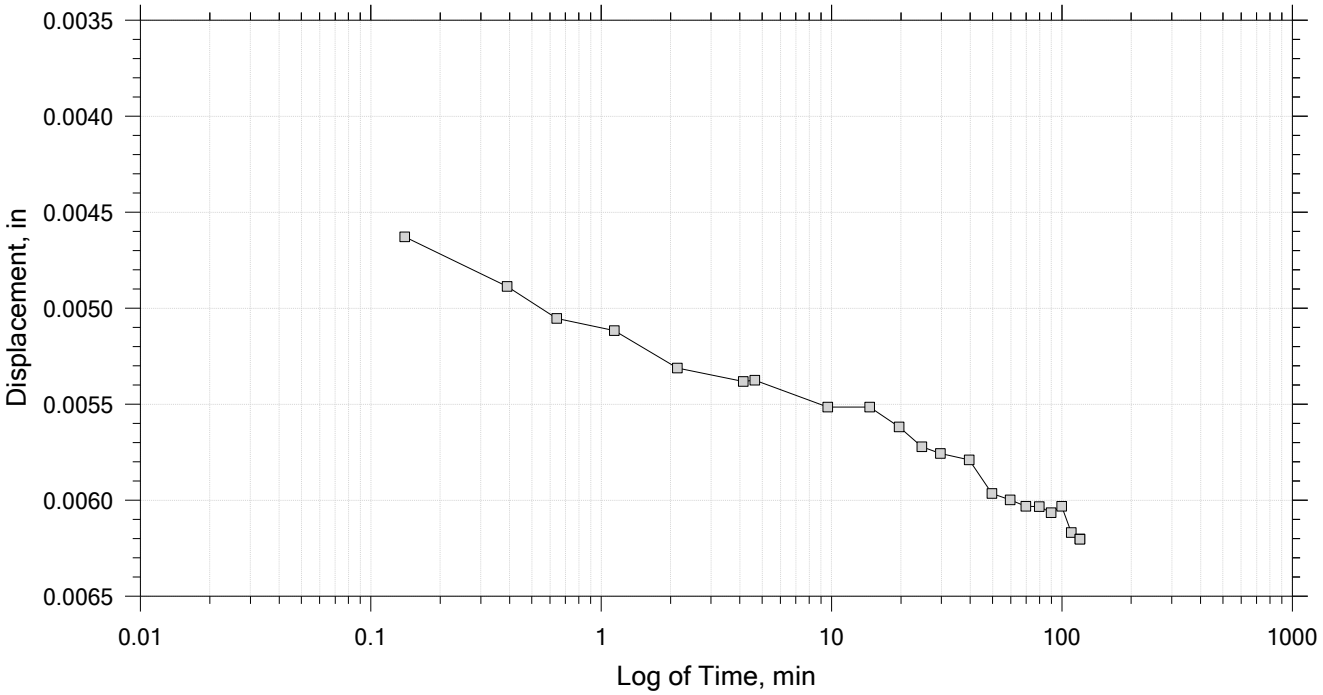


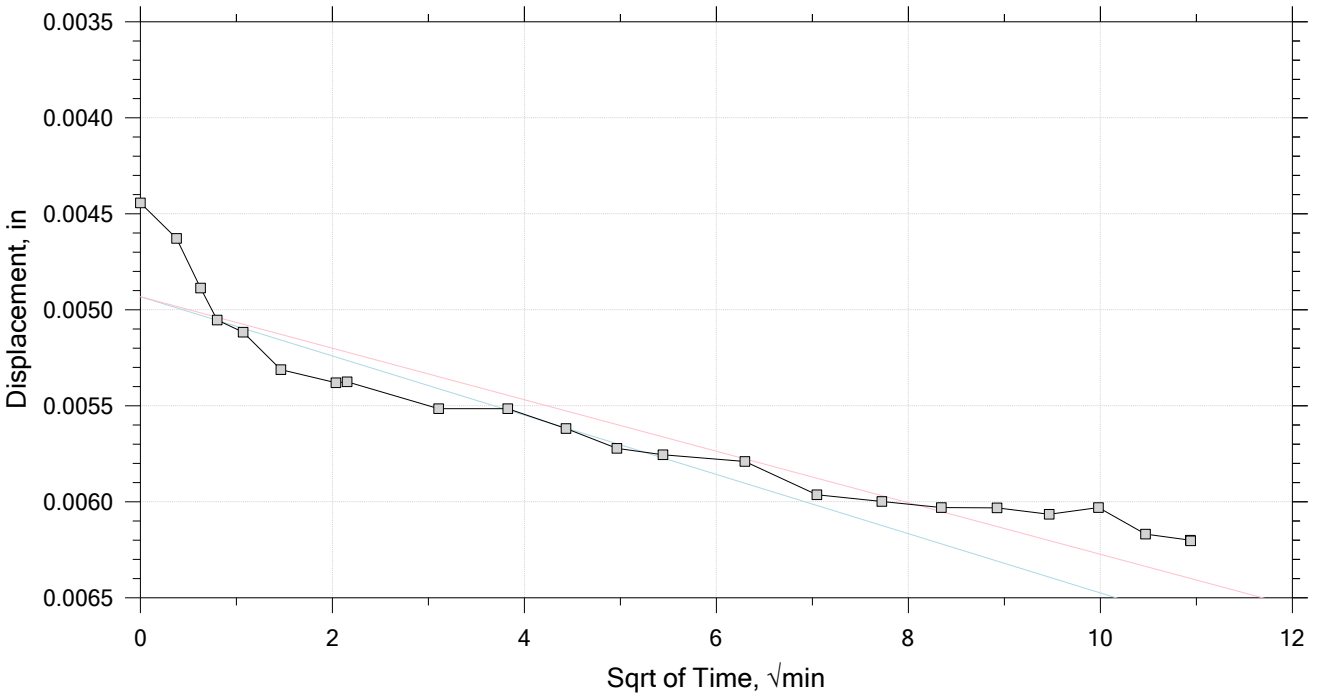


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
Test Number: ICONP 65-429	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 30
Constant Load Step
Stress: 756 psf

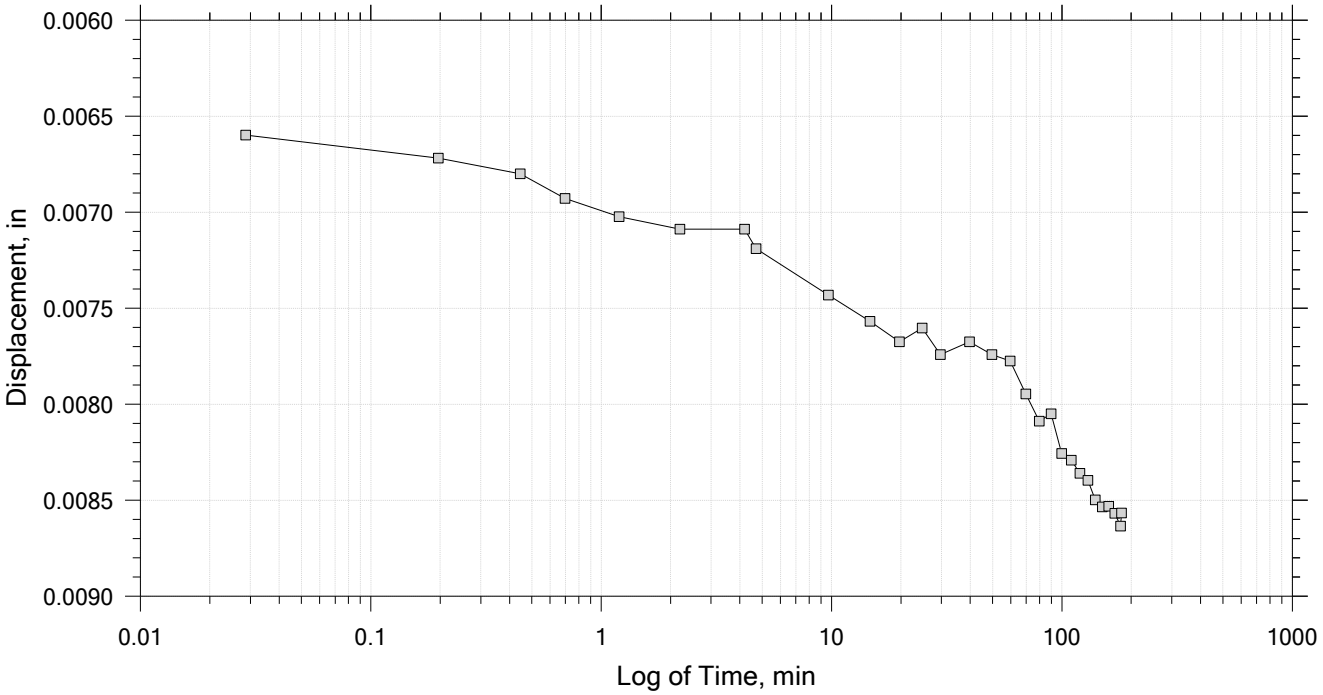


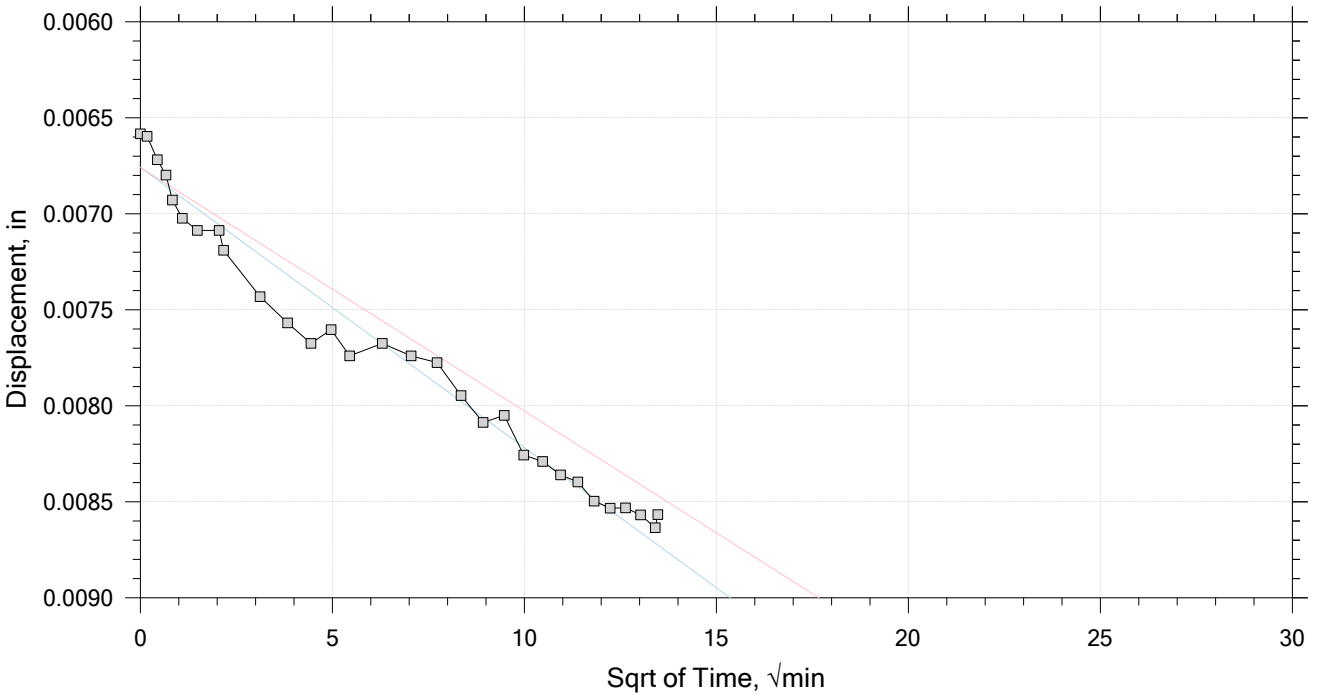


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 30
Constant Load Step
Stress: 1.13e+03 psf

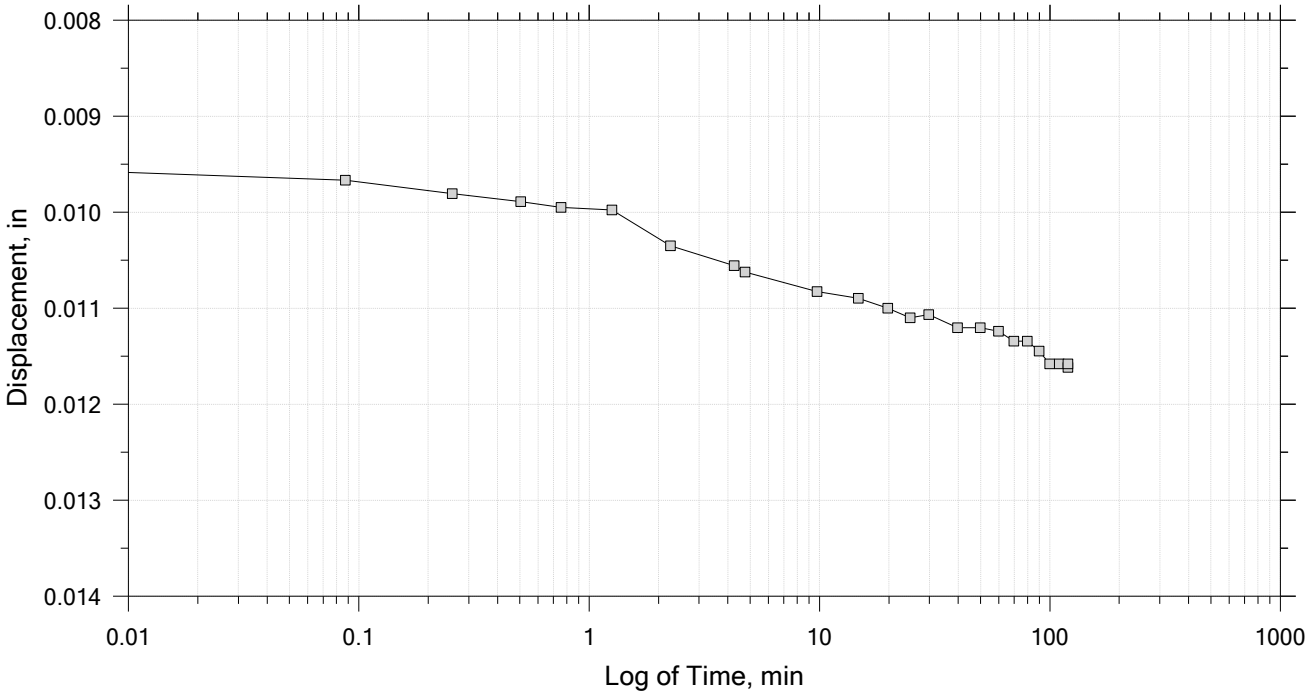


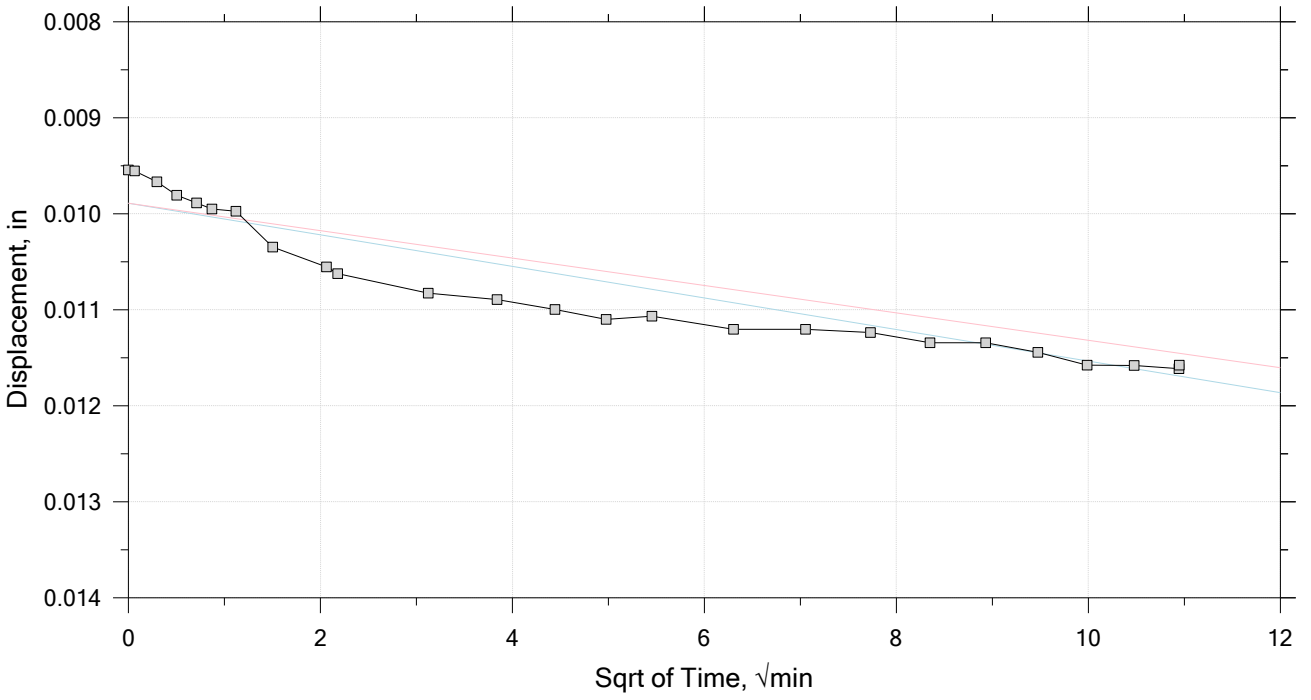


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 30
Constant Load Step
Stress: 1.7e+03 psf

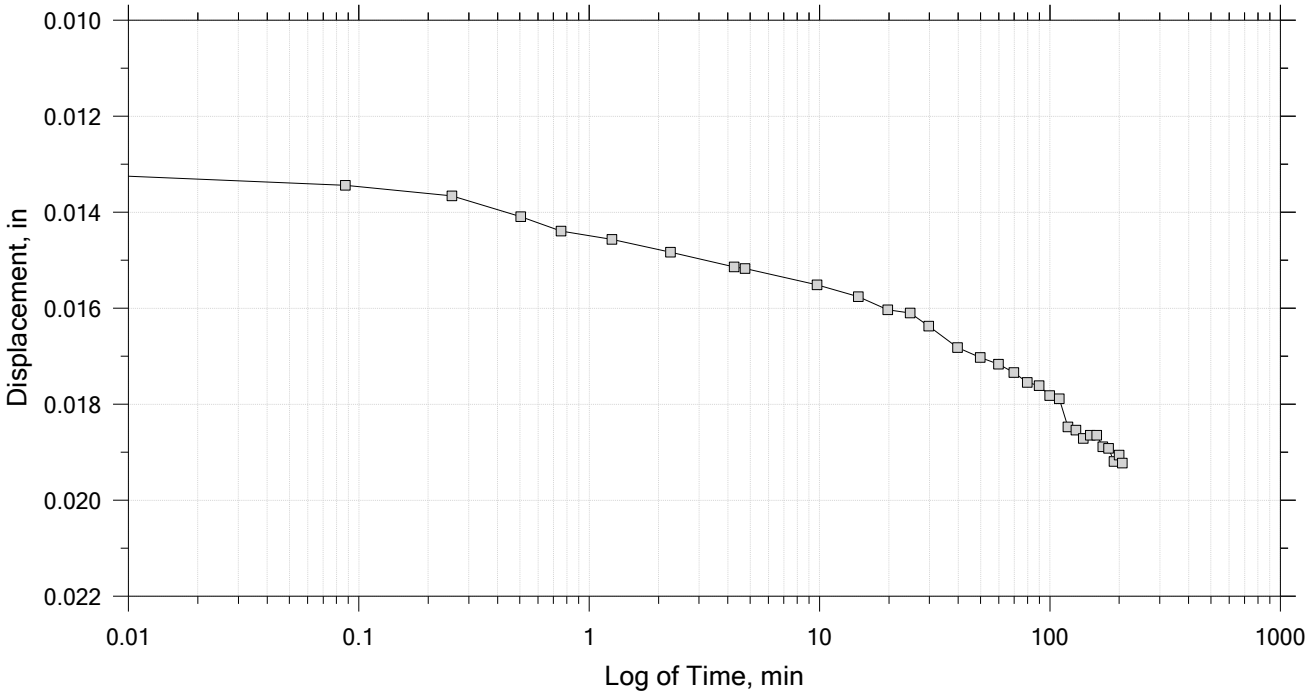


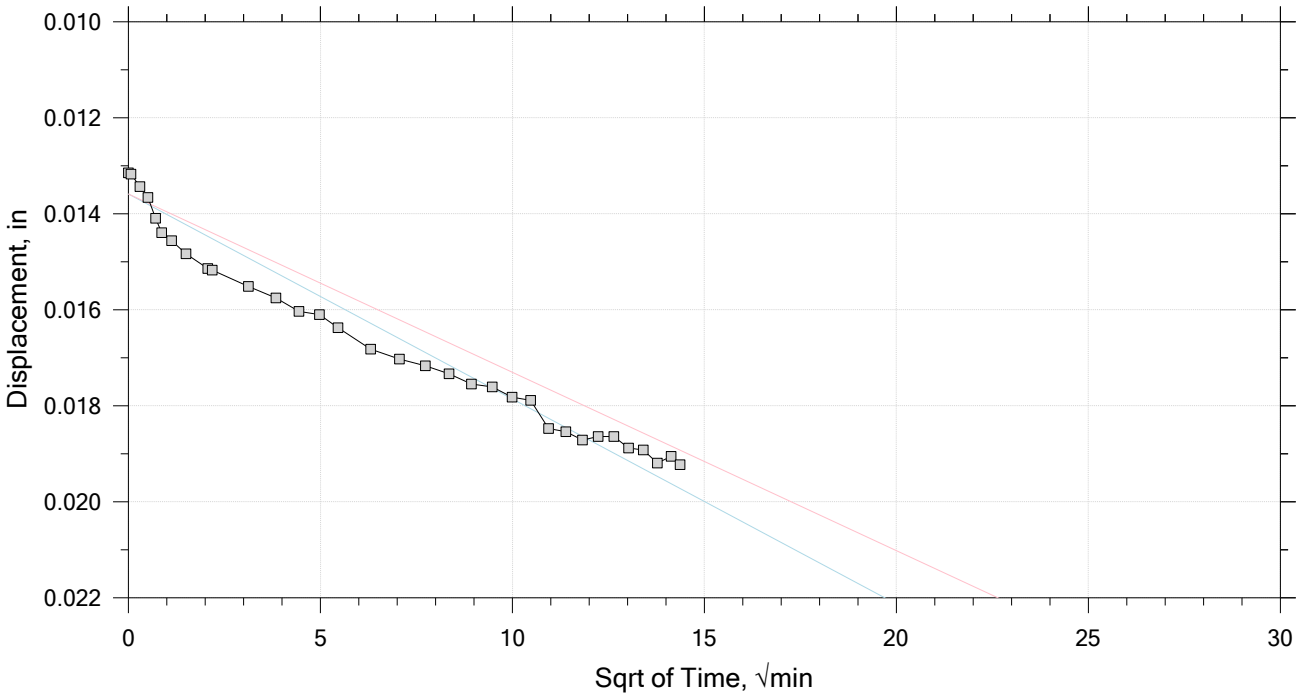


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 30
Constant Load Step
Stress: 2.55e+03 psf

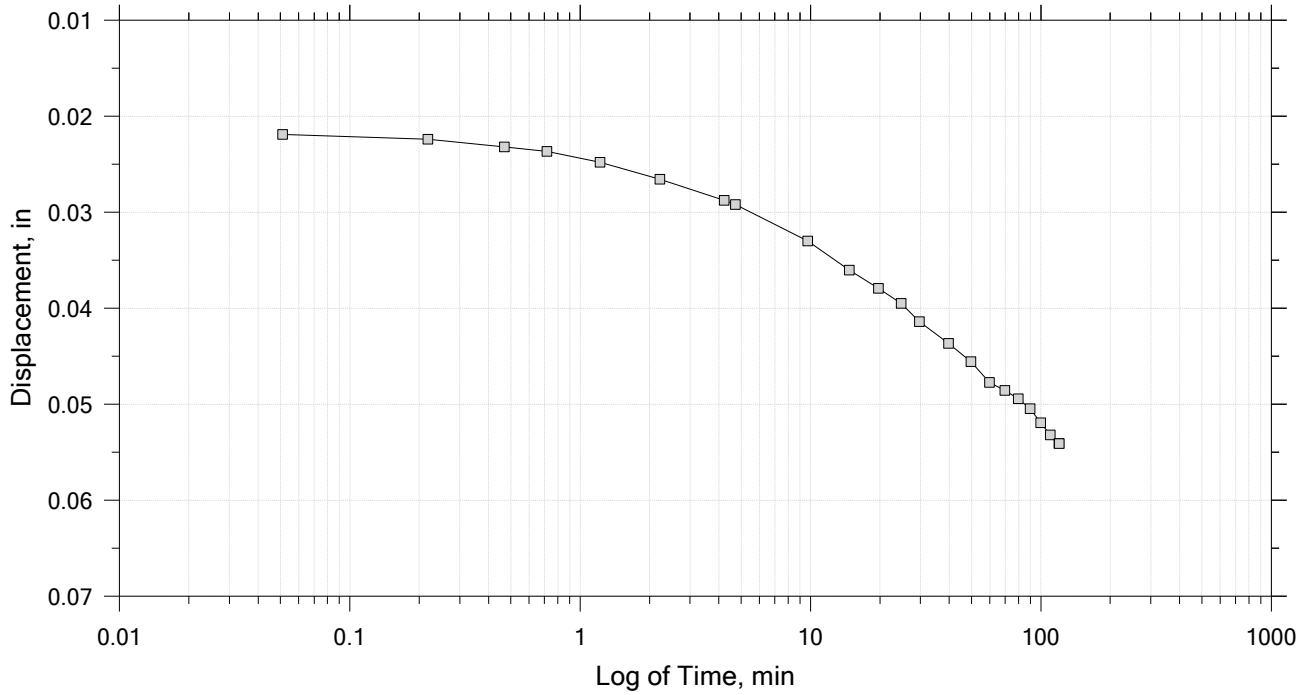


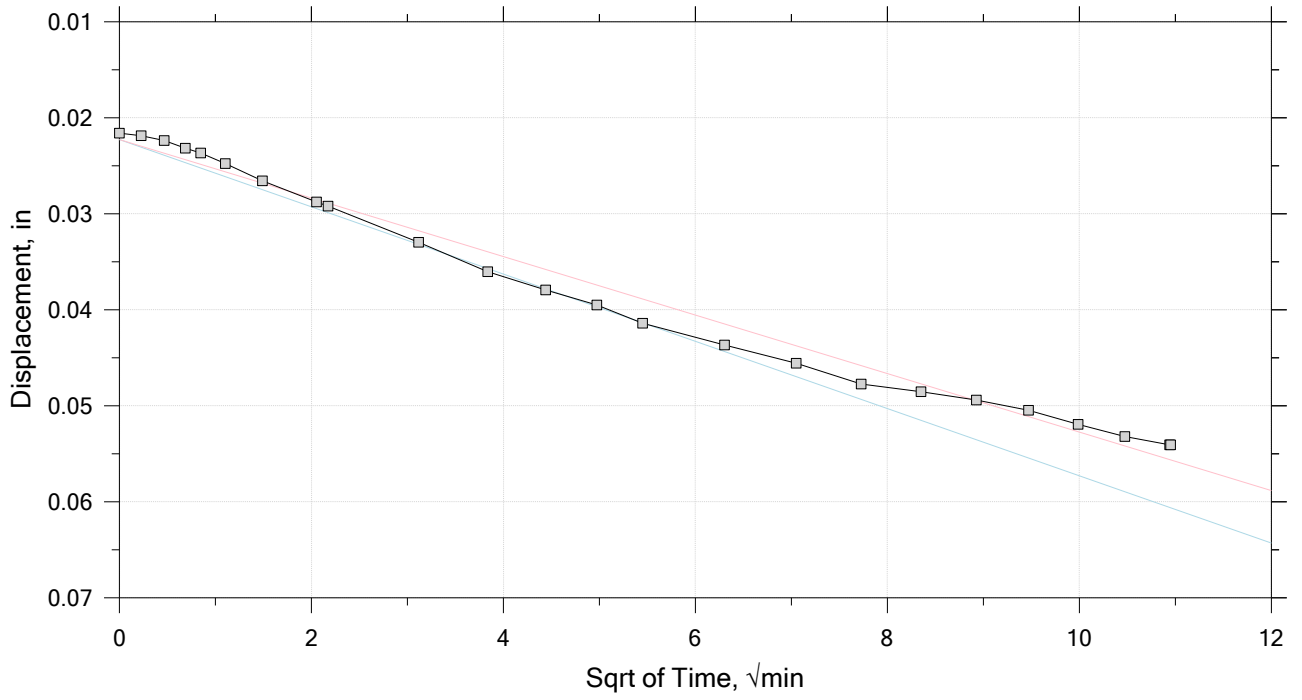


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 30
Constant Load Step
Stress: 3.83e+03 psf

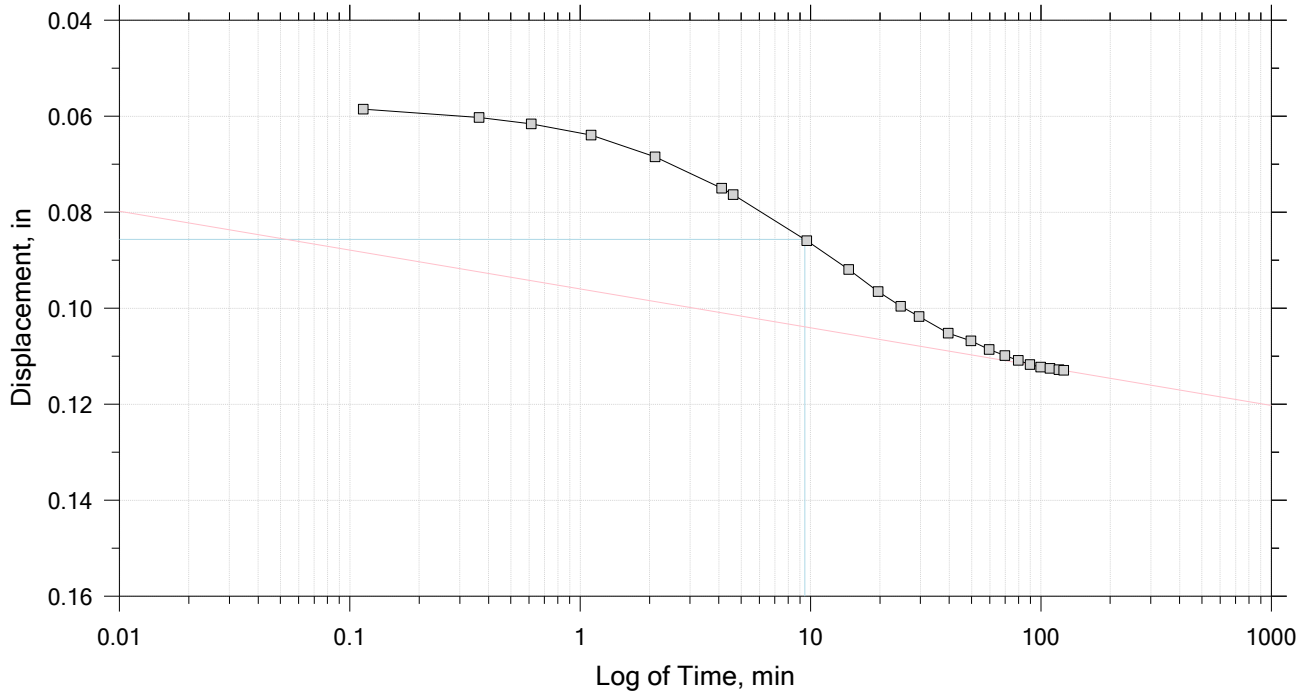


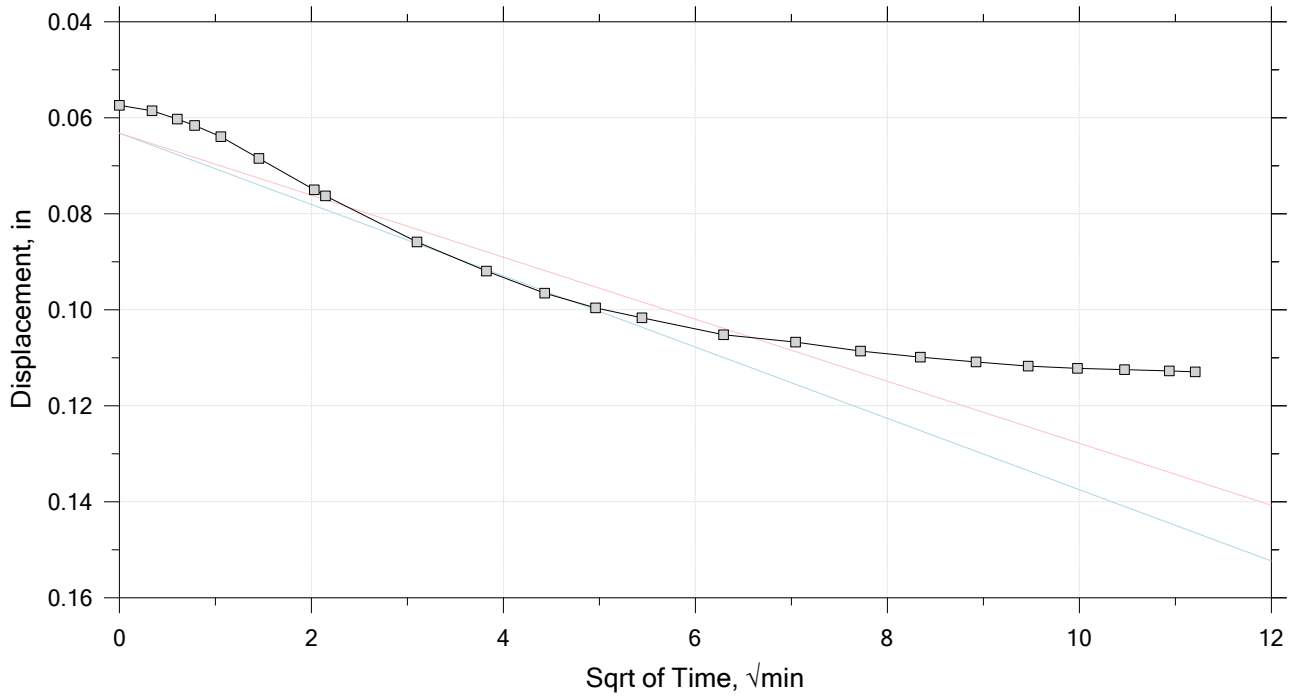


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 30
Constant Load Step
Stress: 5.74e+03 psf

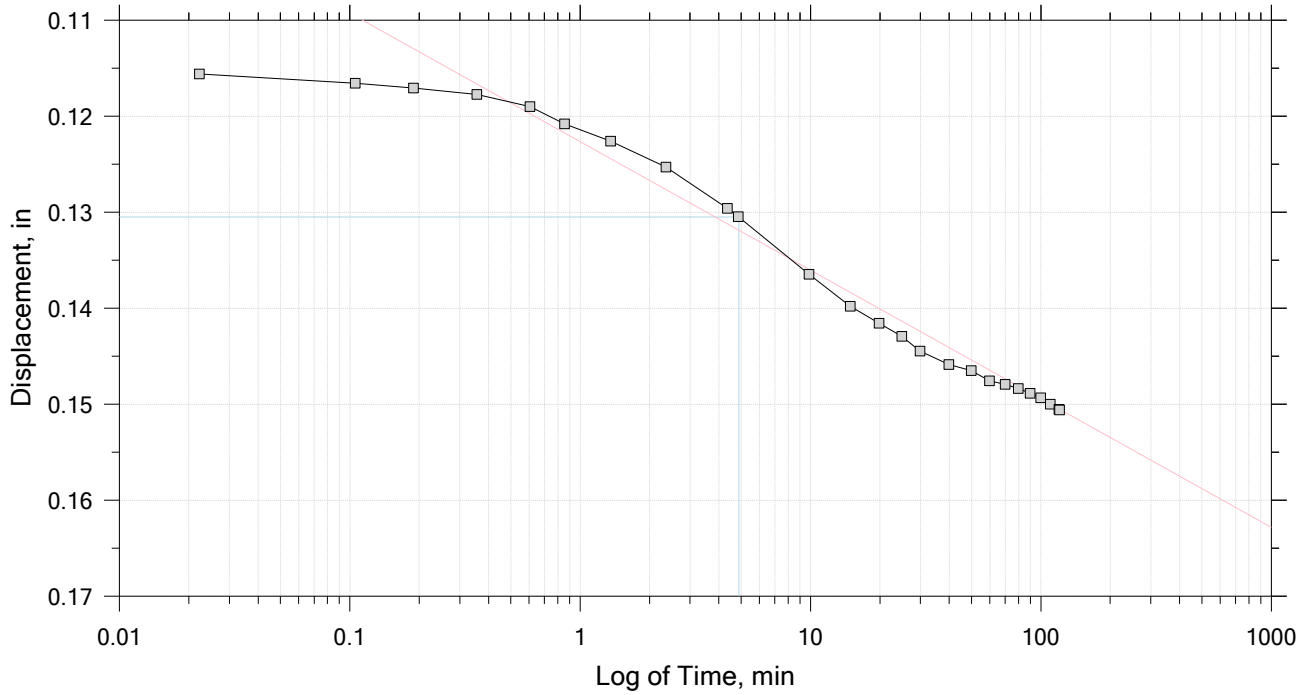


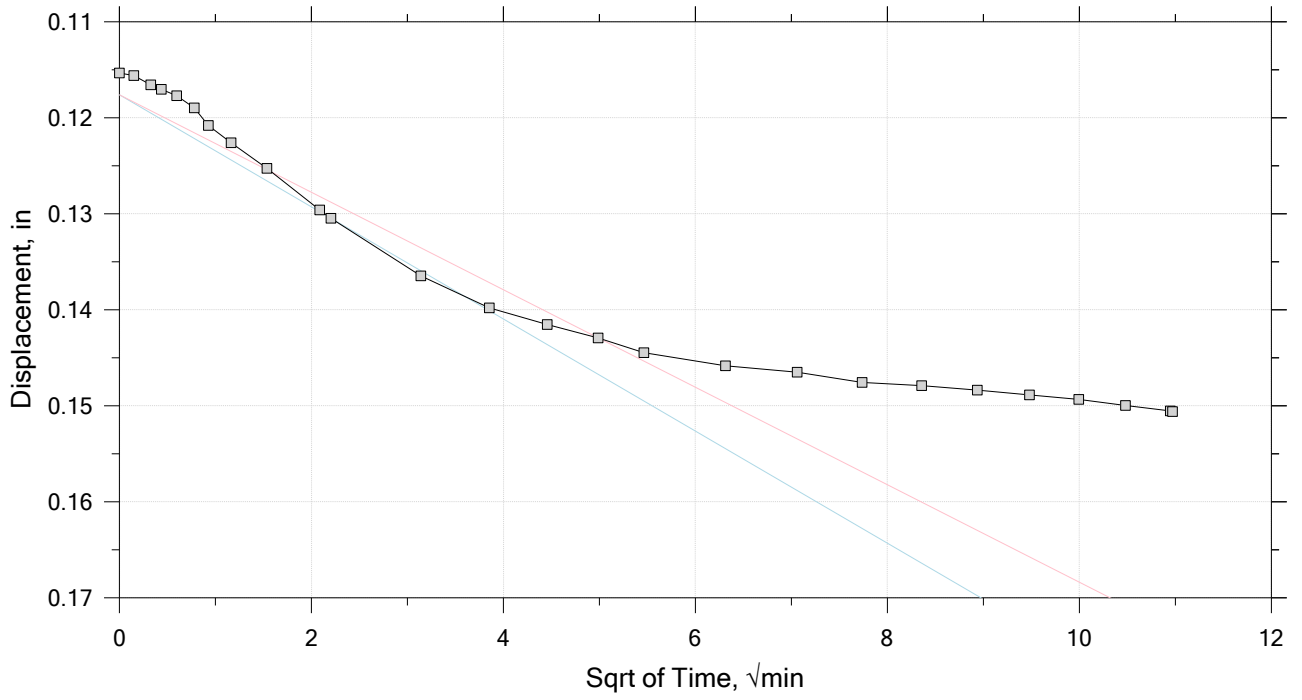


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 30
Constant Load Step
Stress: 8.61e+03 psf

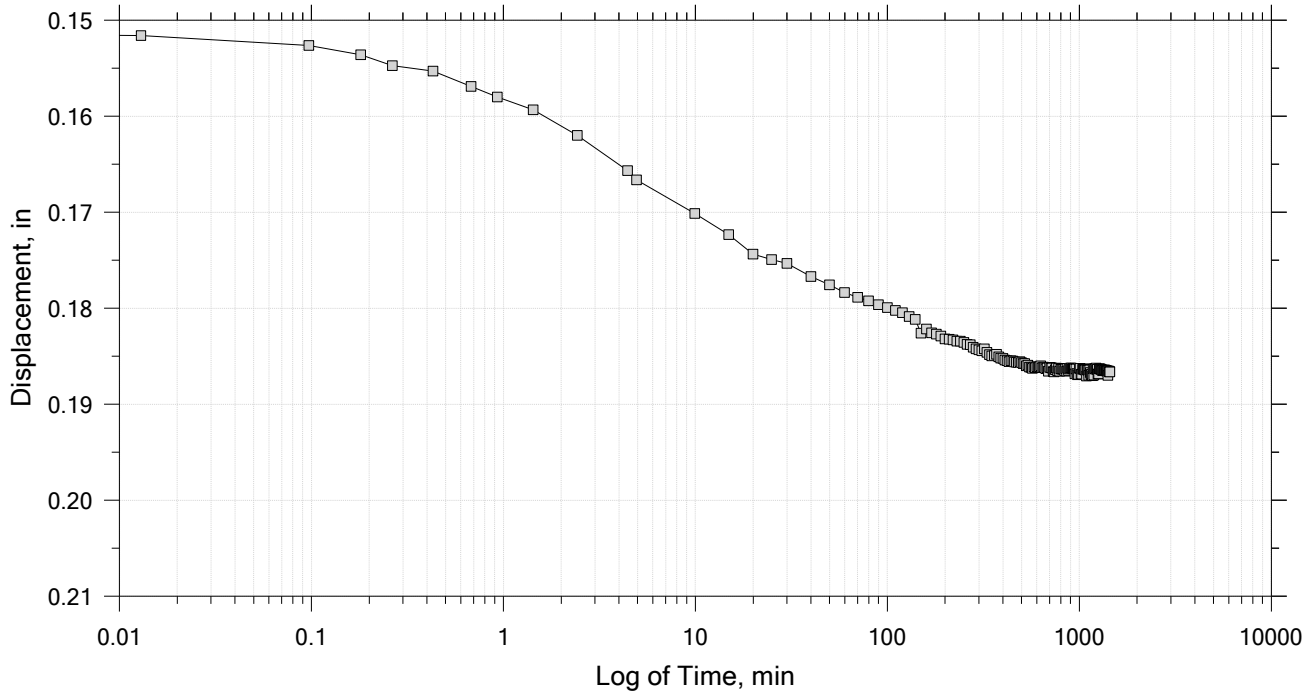


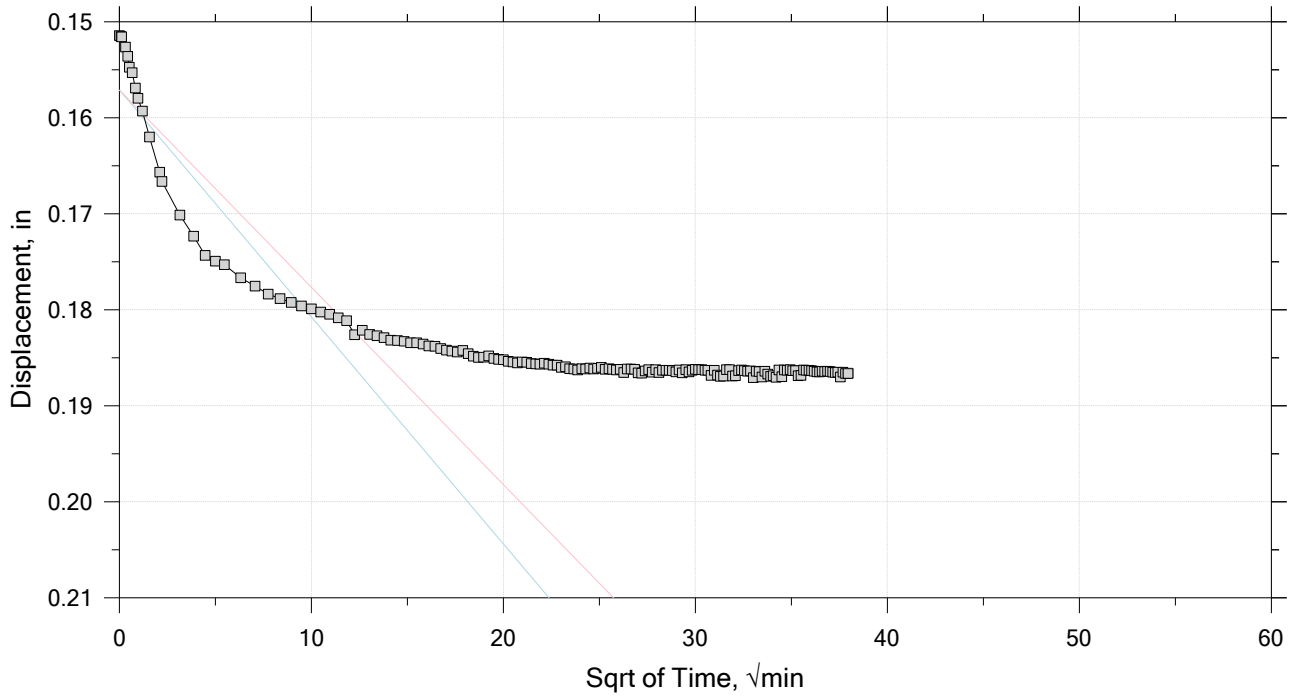


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 30
Constant Load Step
Stress: 1.29e+04 psf

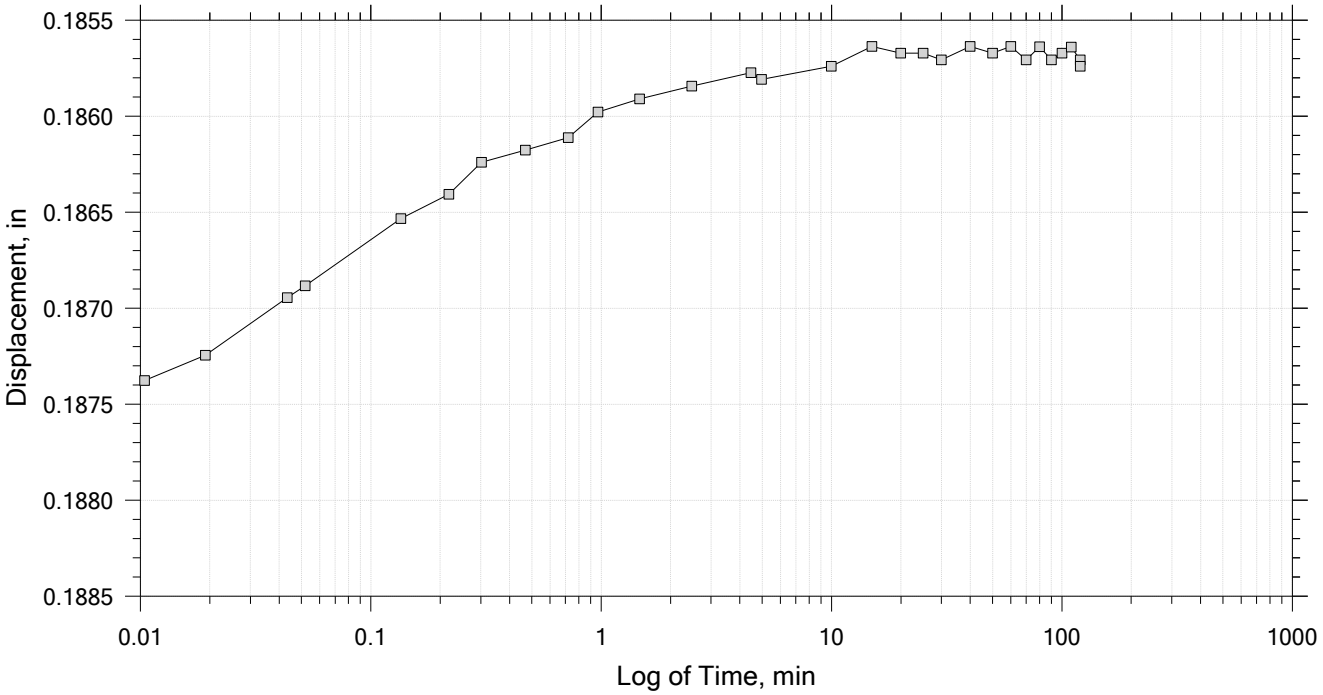


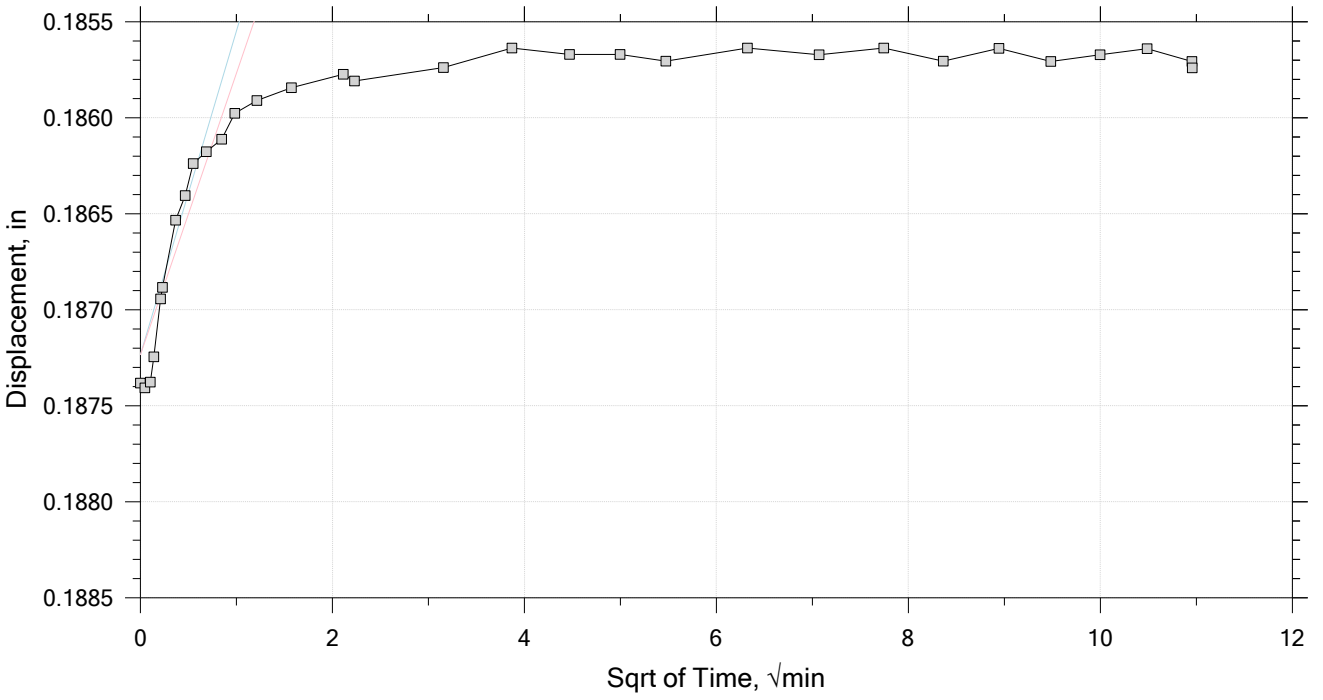


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 30
Constant Load Step
Stress: 6.46e+03 psf

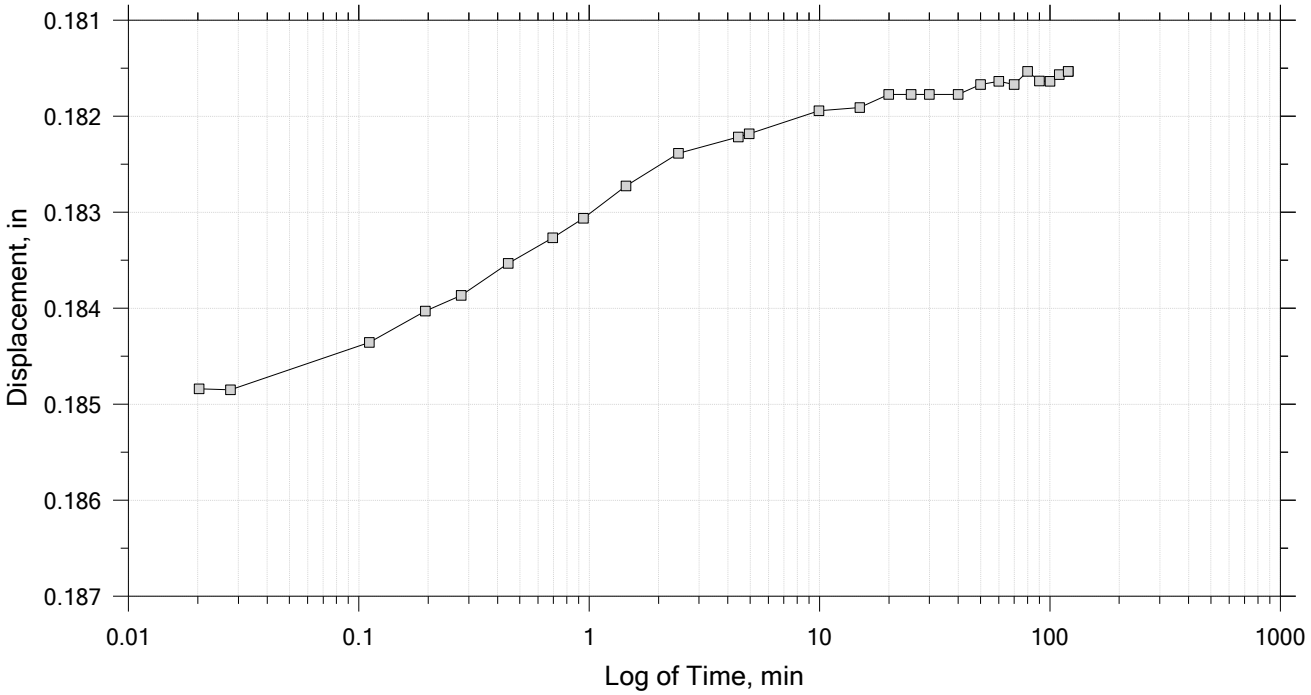


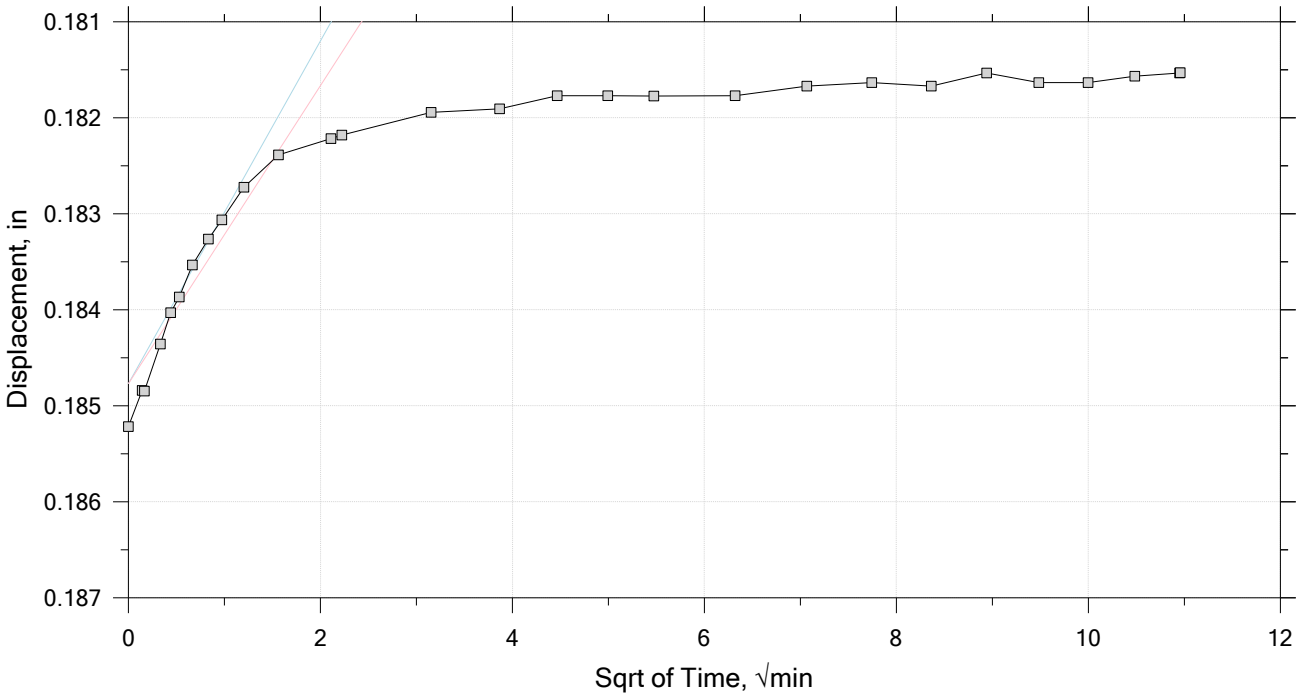


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 30
Constant Load Step
Stress: 3.23e+03 psf

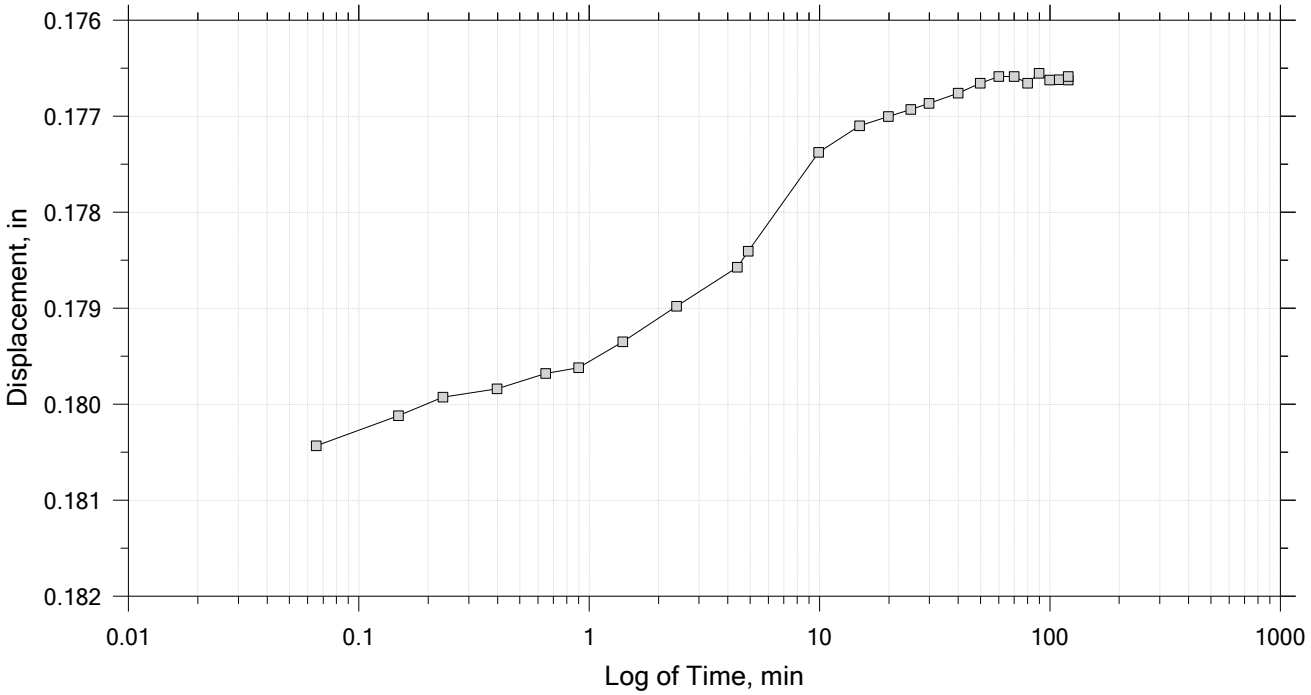


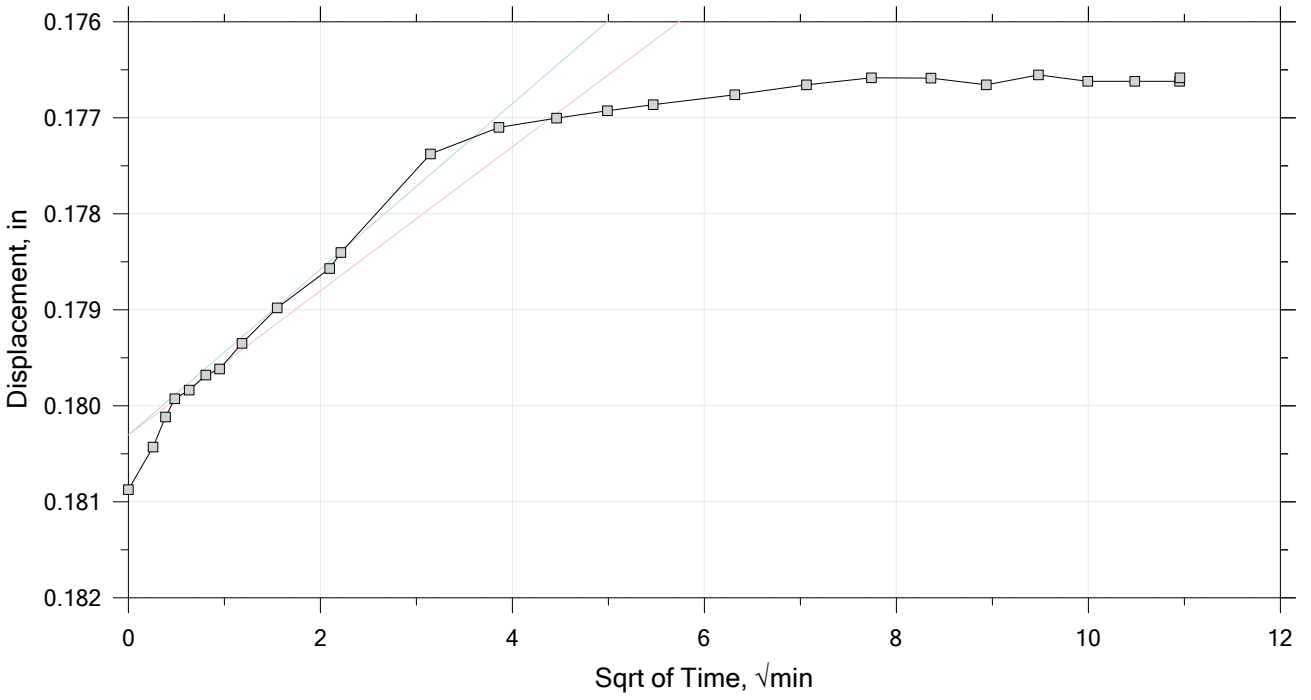


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 30
Constant Load Step
Stress: 1.61e+03 psf

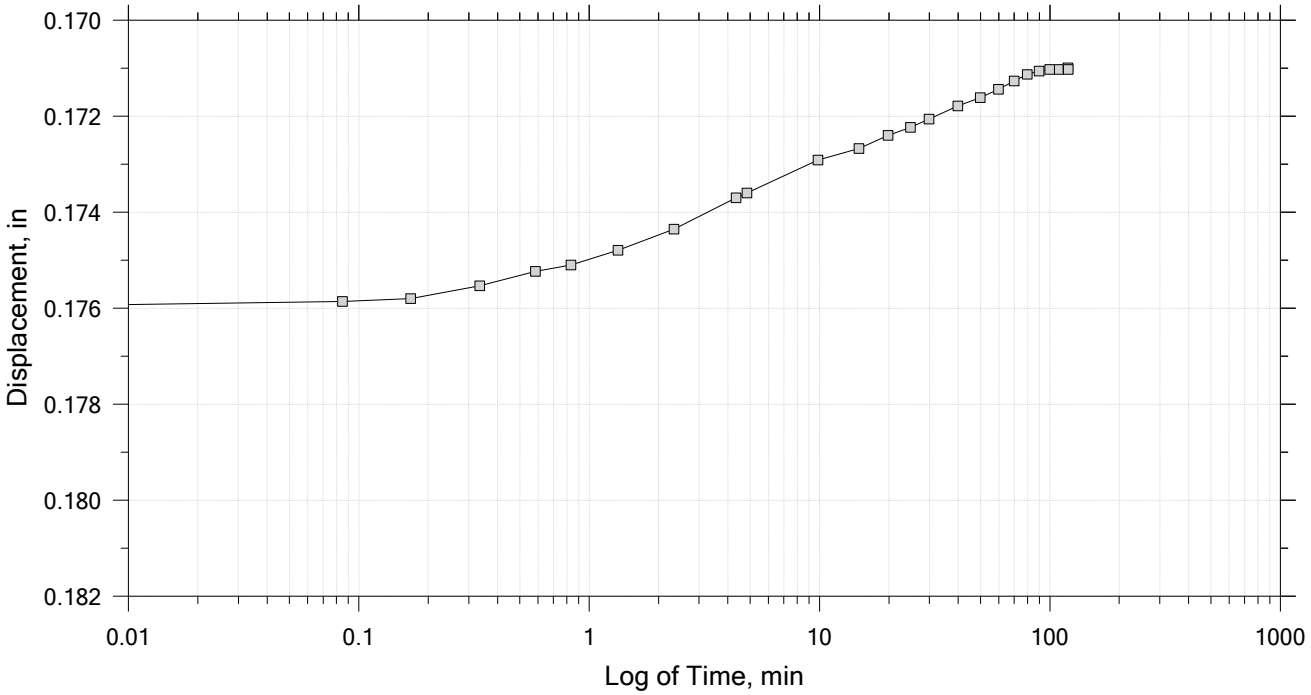


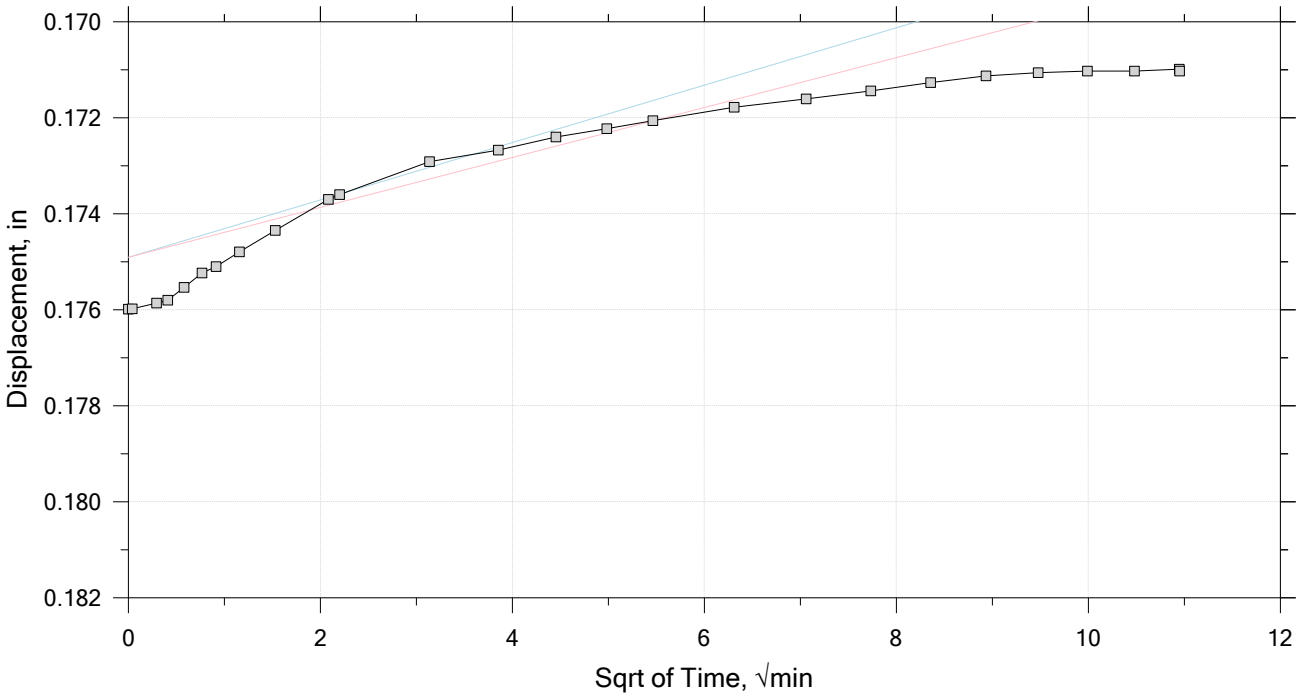


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 30
Constant Load Step
Stress: 807 psf

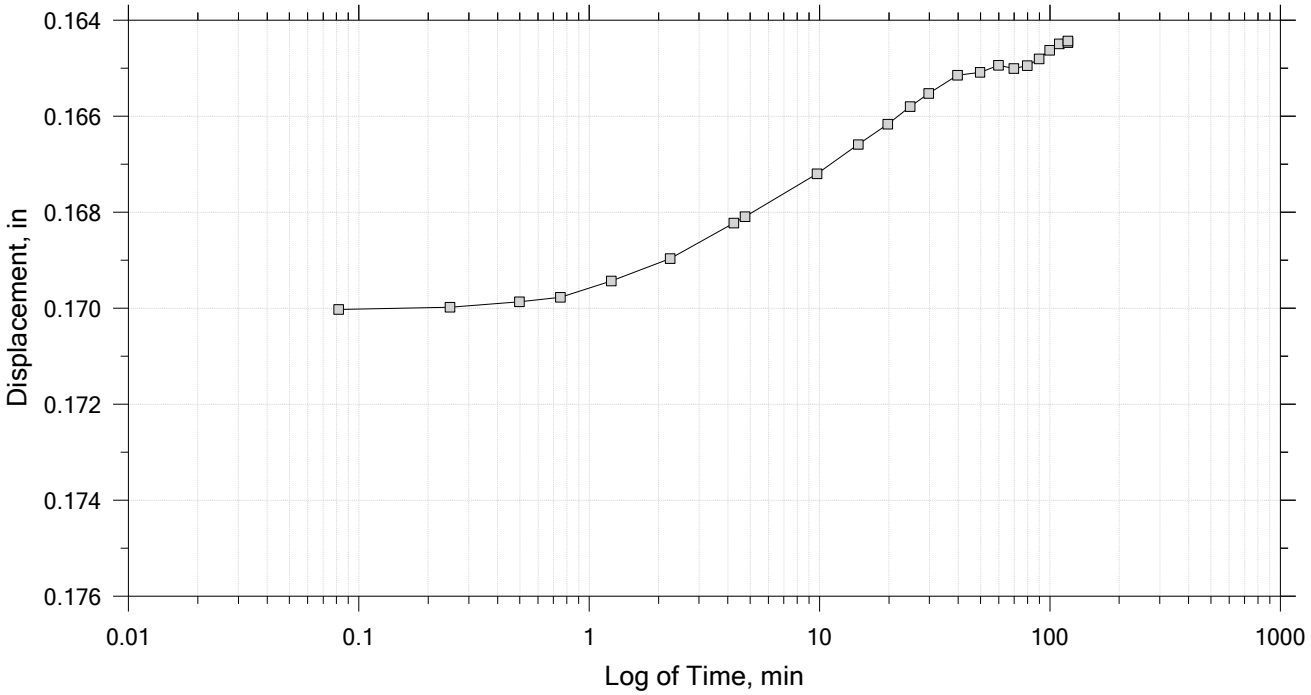


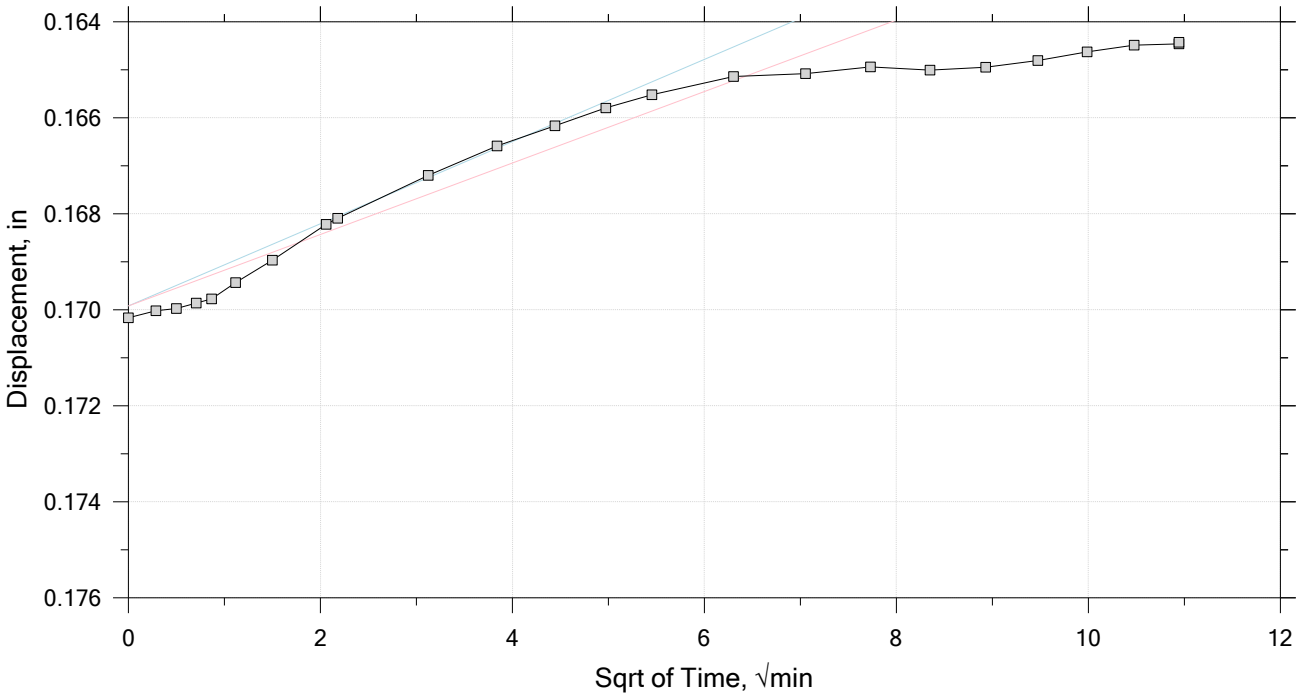


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
Test Number: ICONP 65-429	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 30
Constant Load Step
Stress: 404 psf

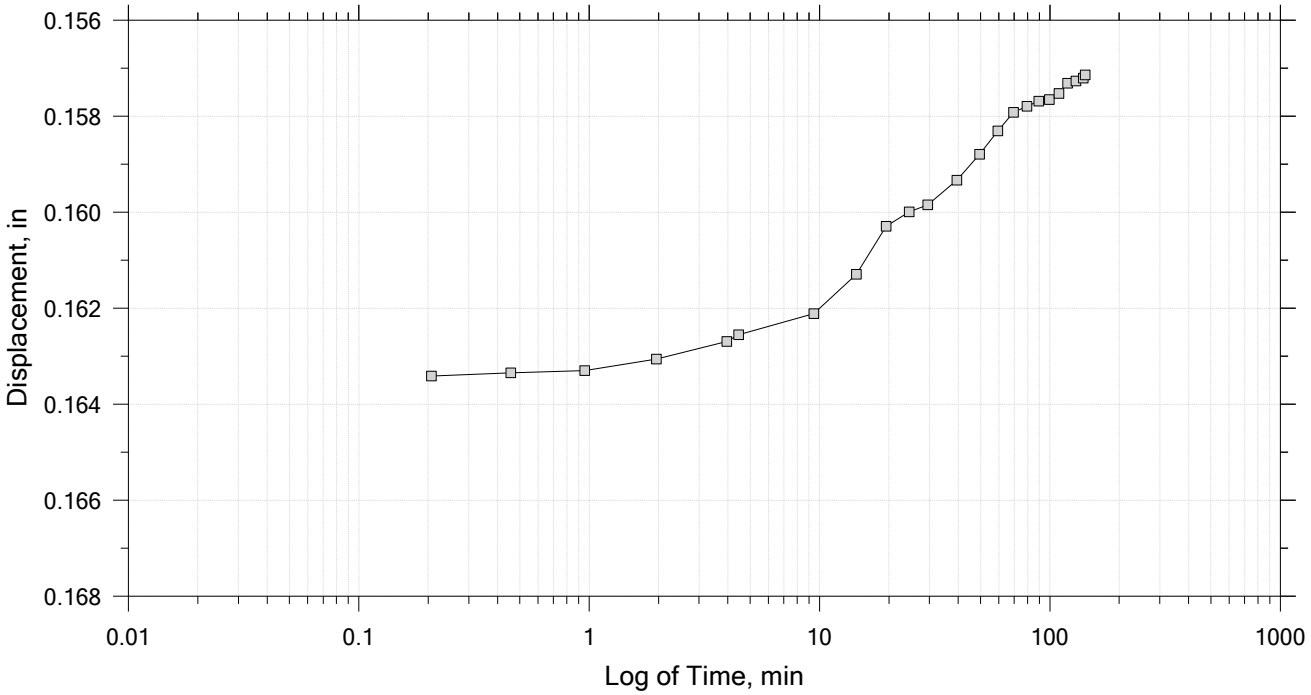


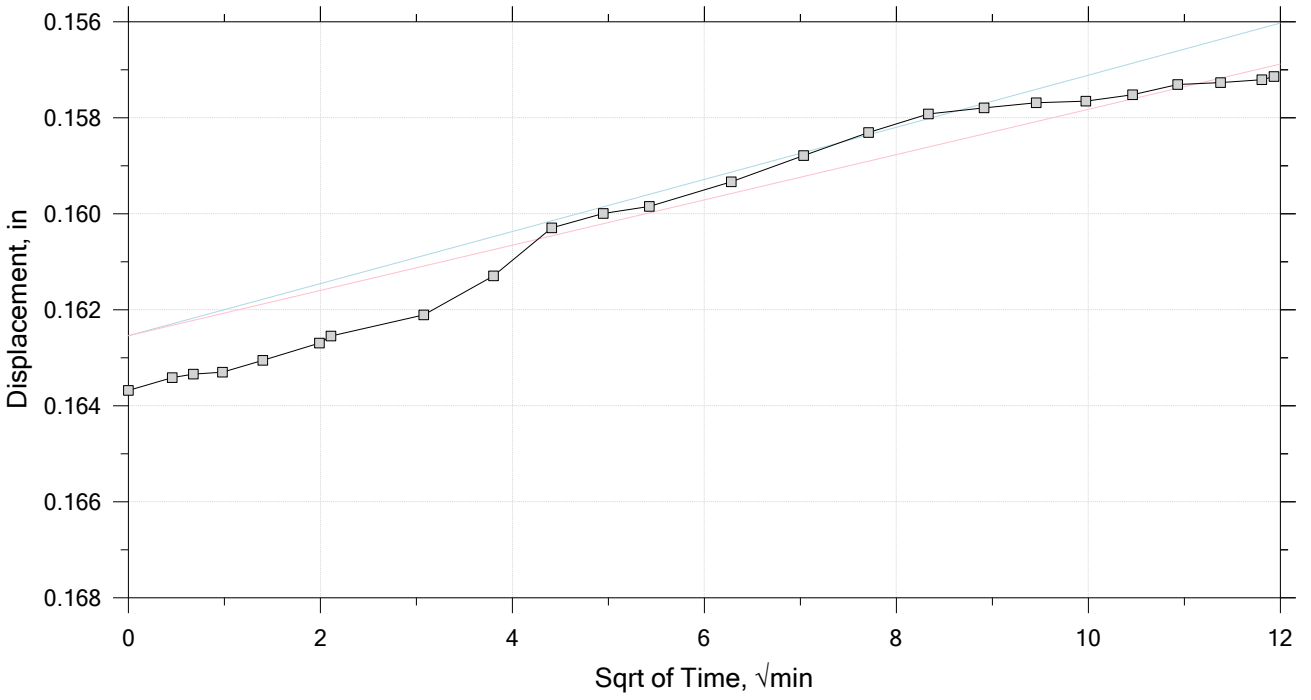


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 17 of 30
Constant Load Step
Stress: 202 psf

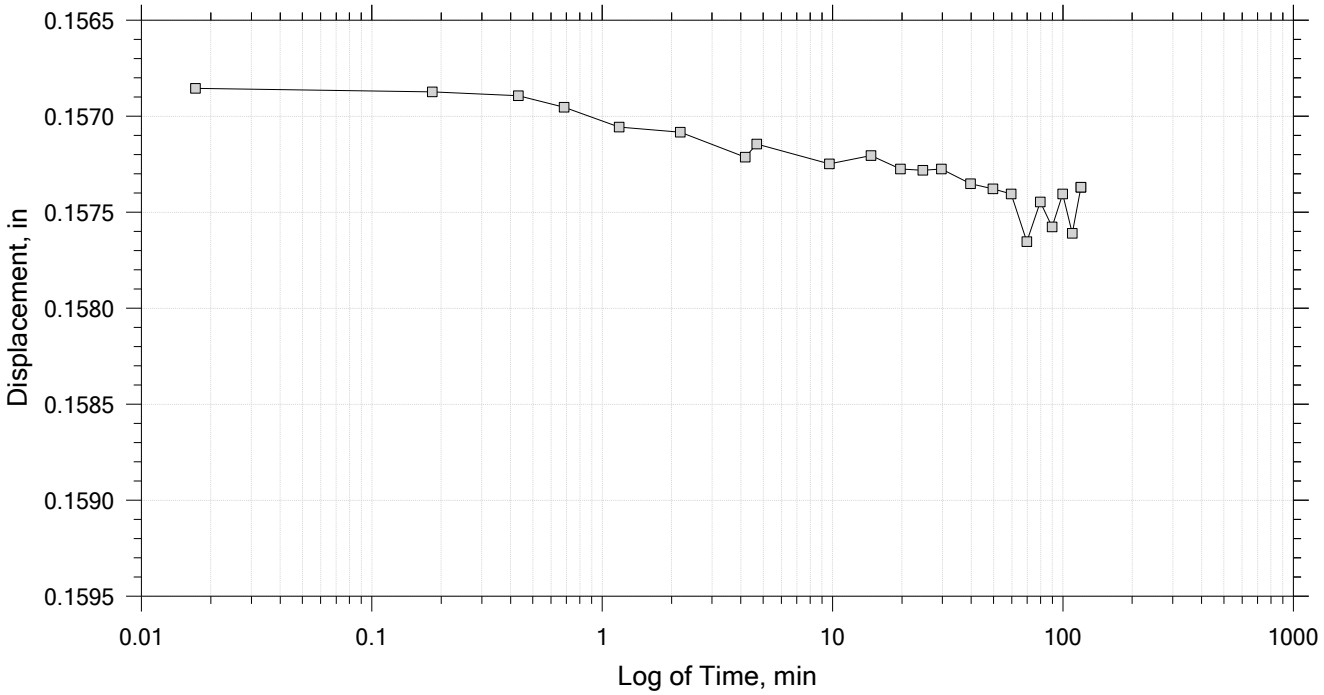


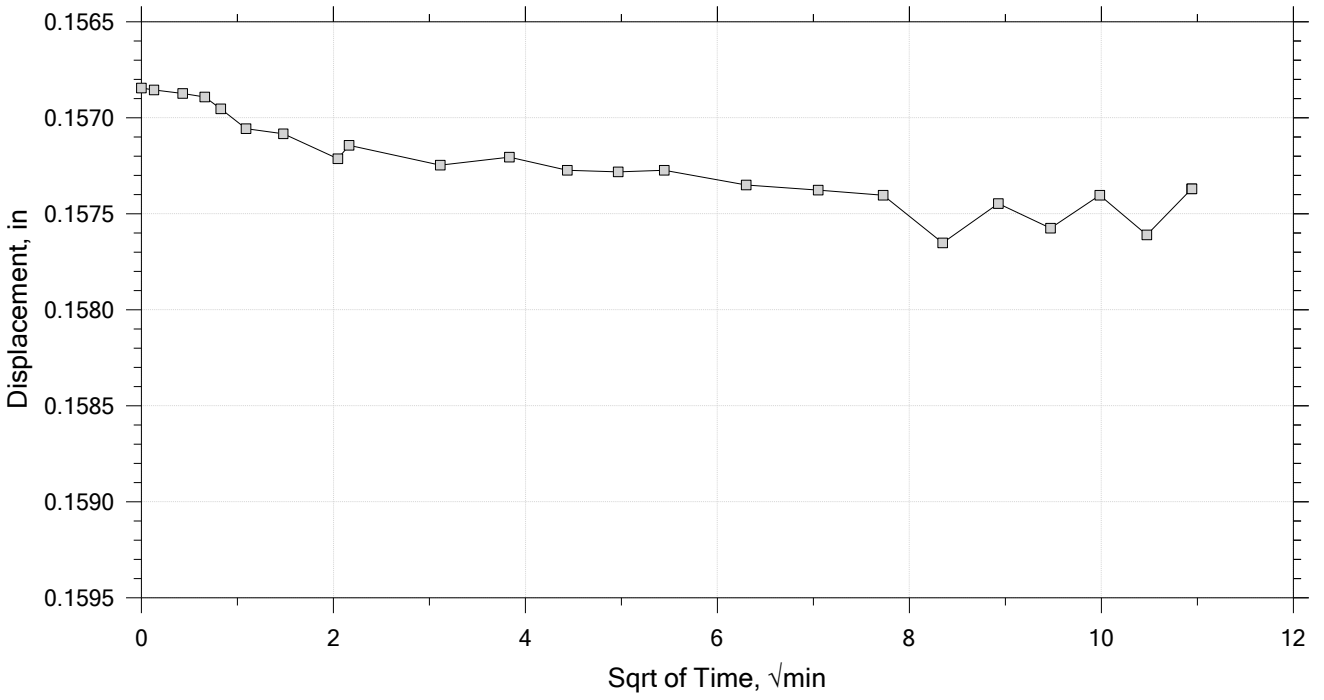


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 18 of 30
Constant Load Step
Stress: 404 psf

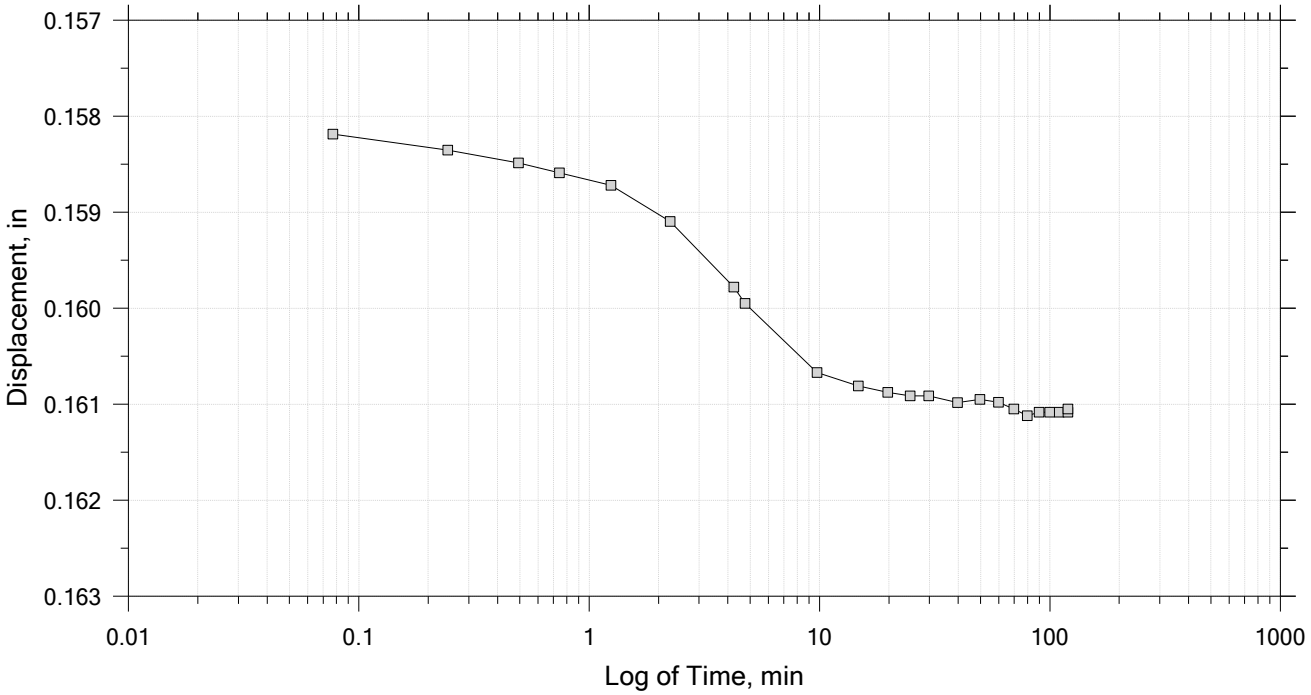


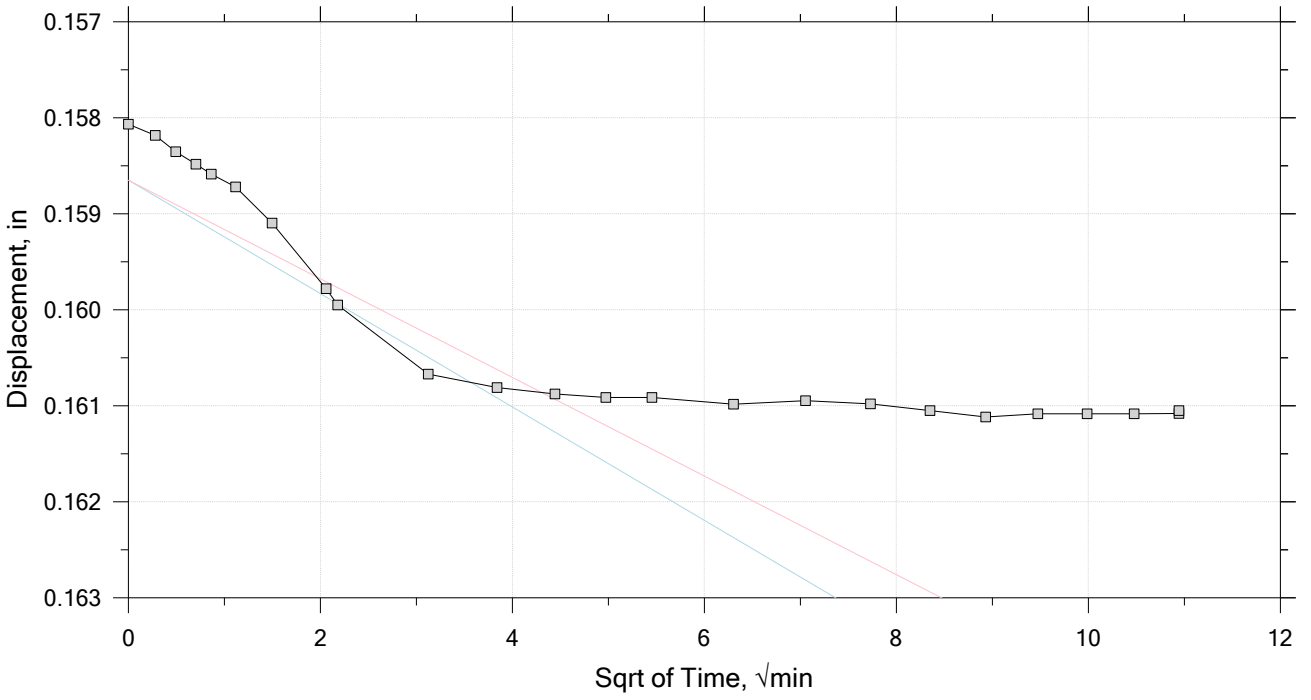


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
Test Number: ICONP 65-429	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 19 of 30
Constant Load Step
Stress: 807 psf

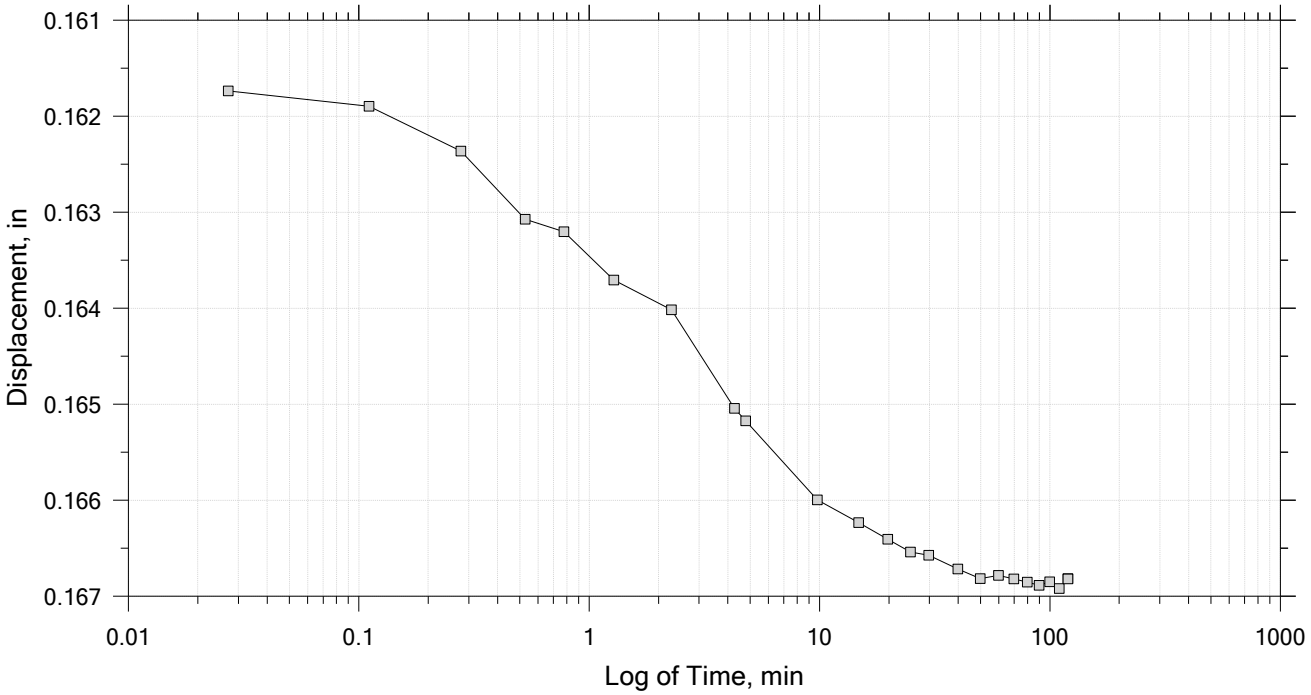


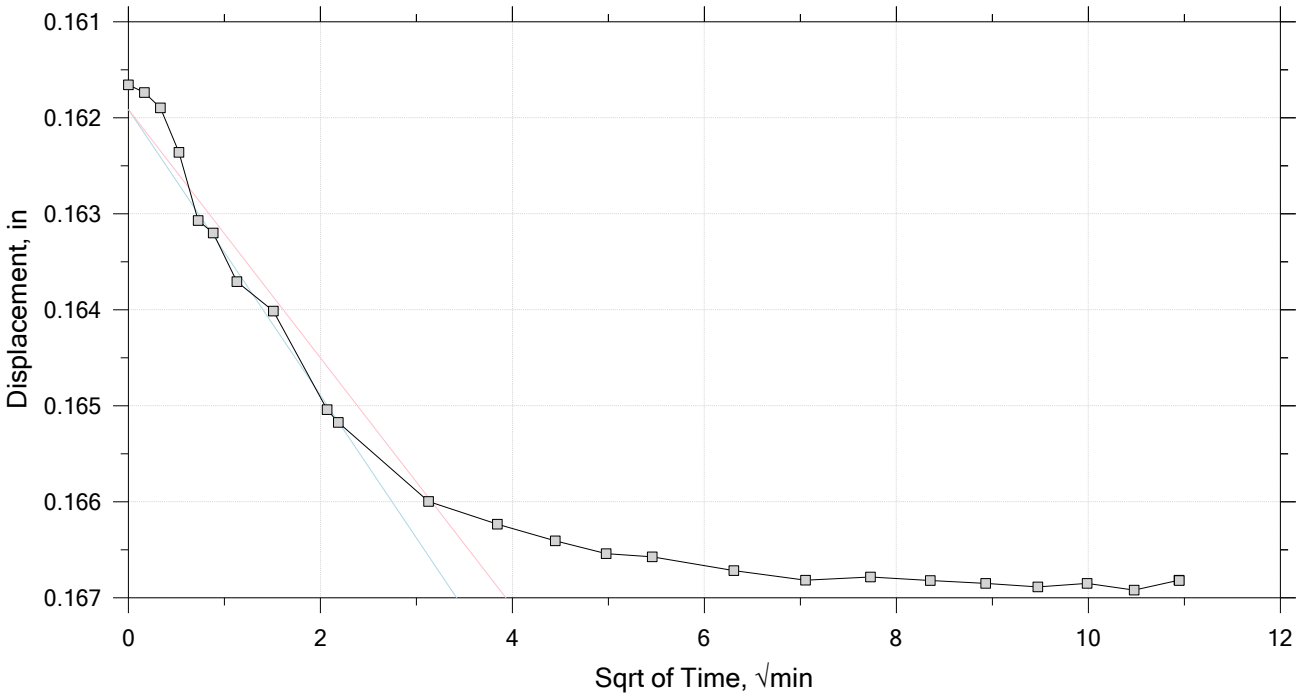


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 20 of 30
Constant Load Step
Stress: 1.61e+03 psf

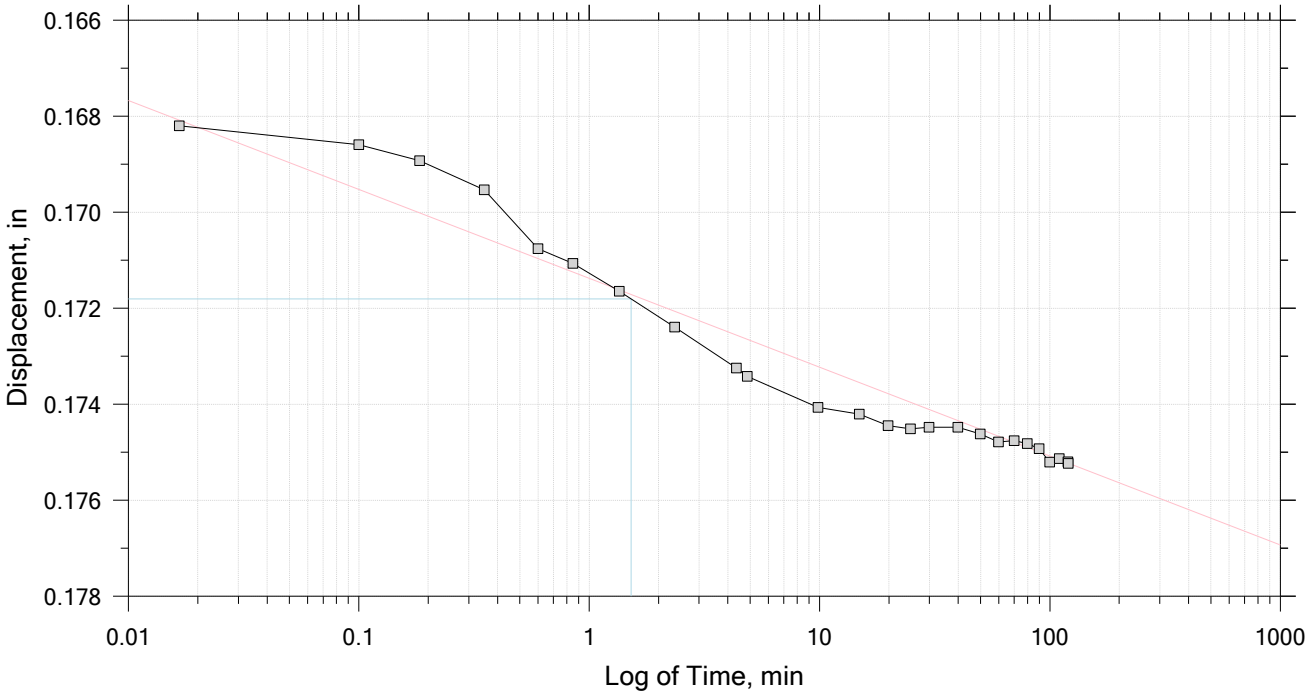


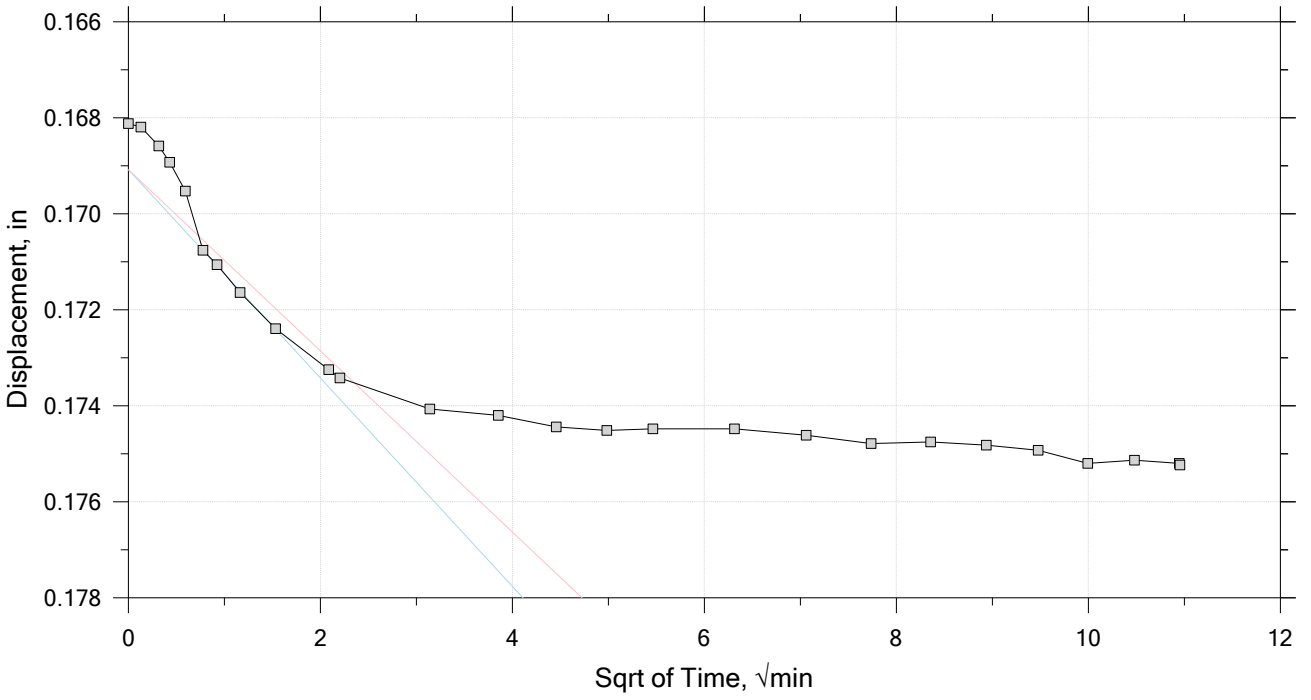


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 21 of 30
Constant Load Step
Stress: 3.23e+03 psf

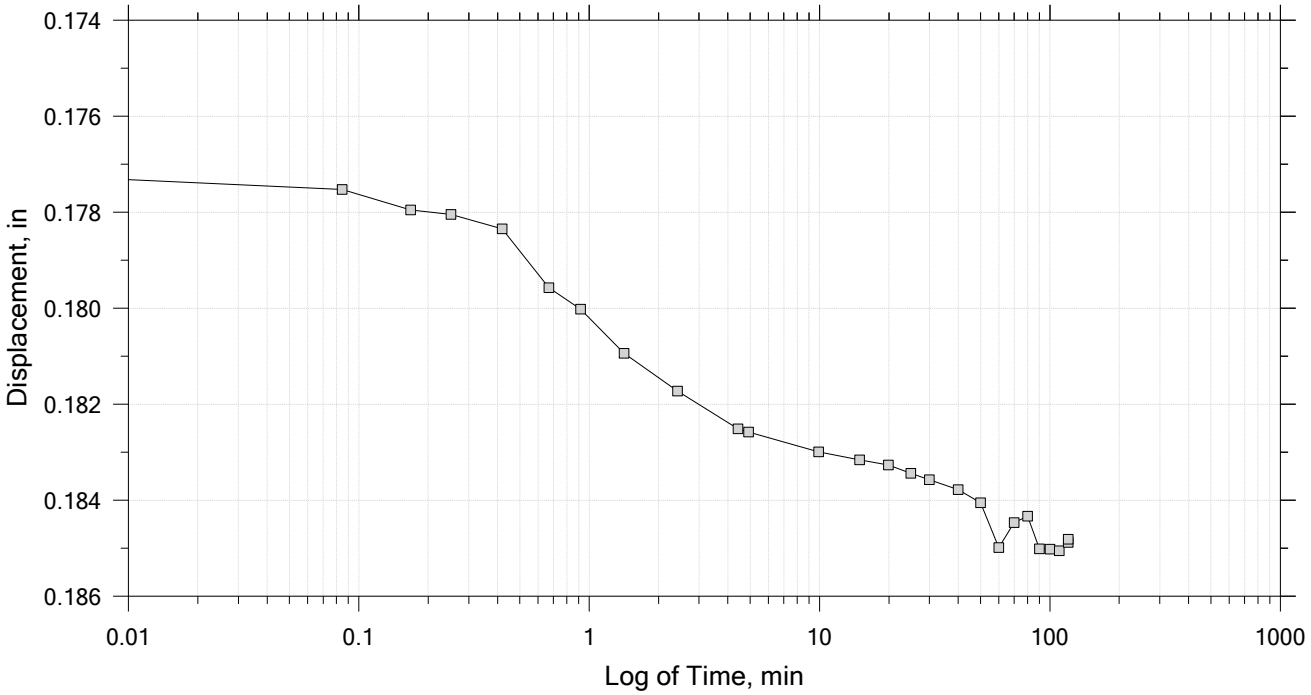


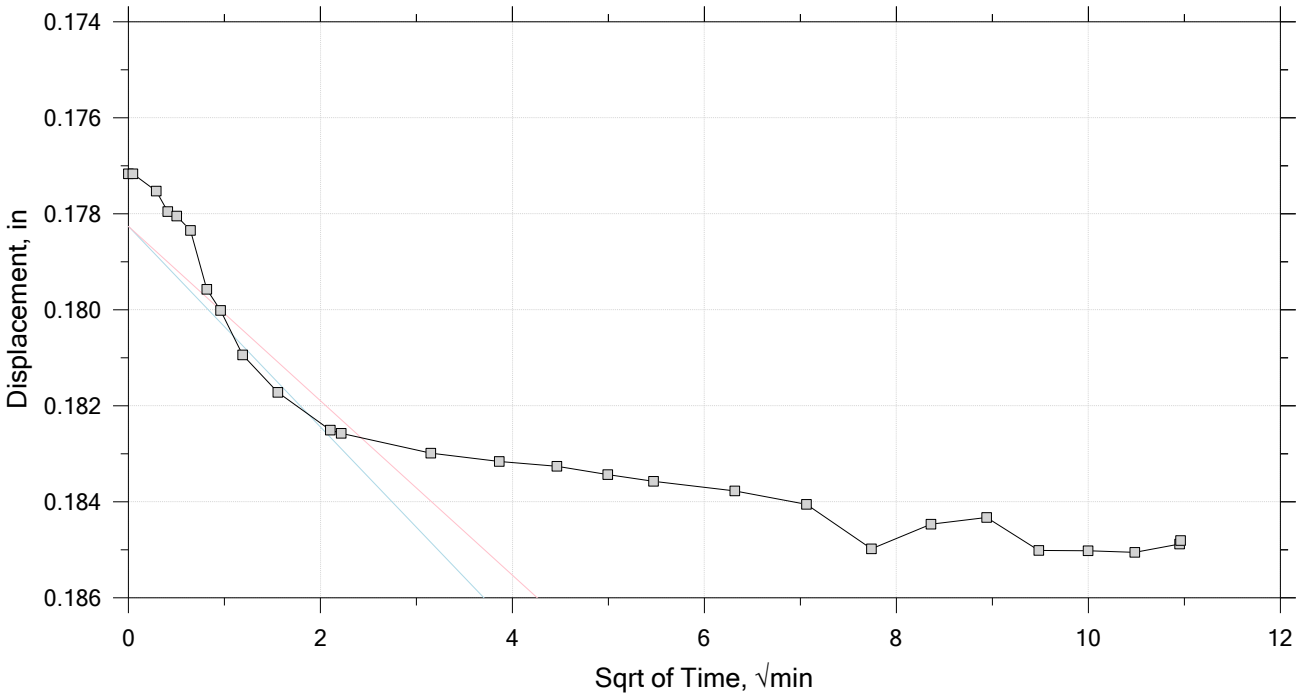


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 22 of 30
Constant Load Step
Stress: 6.46e+03 psf

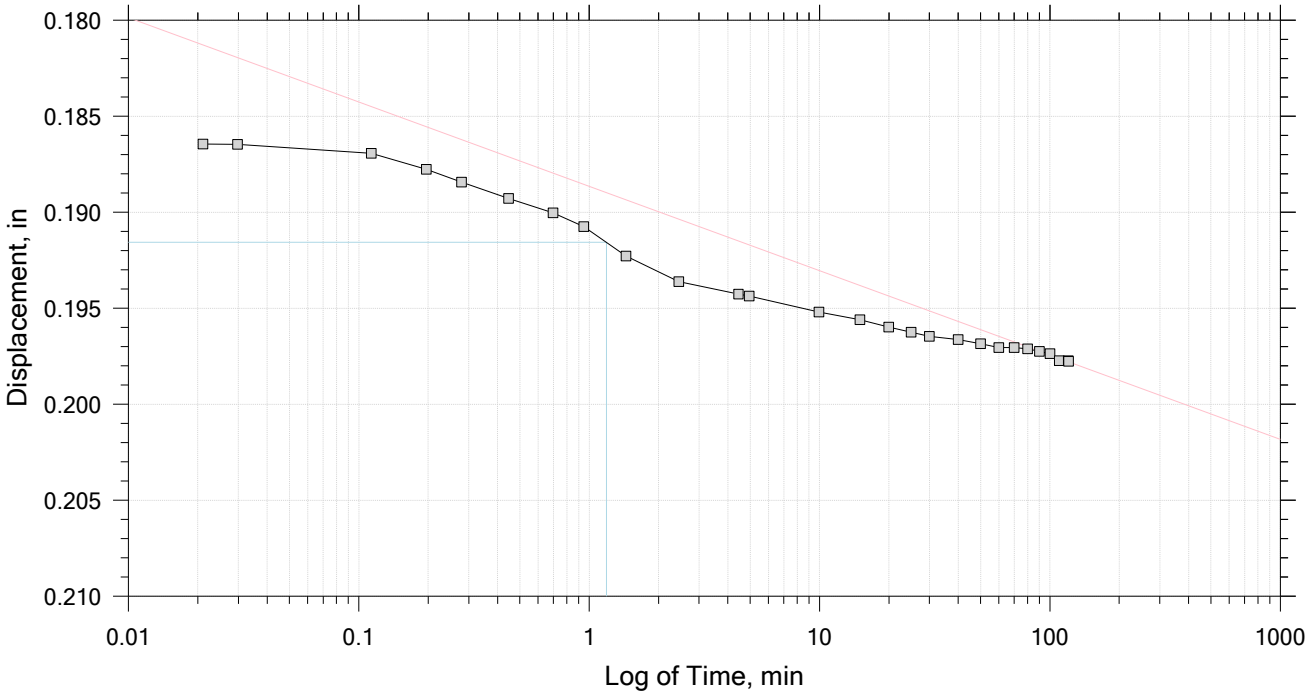


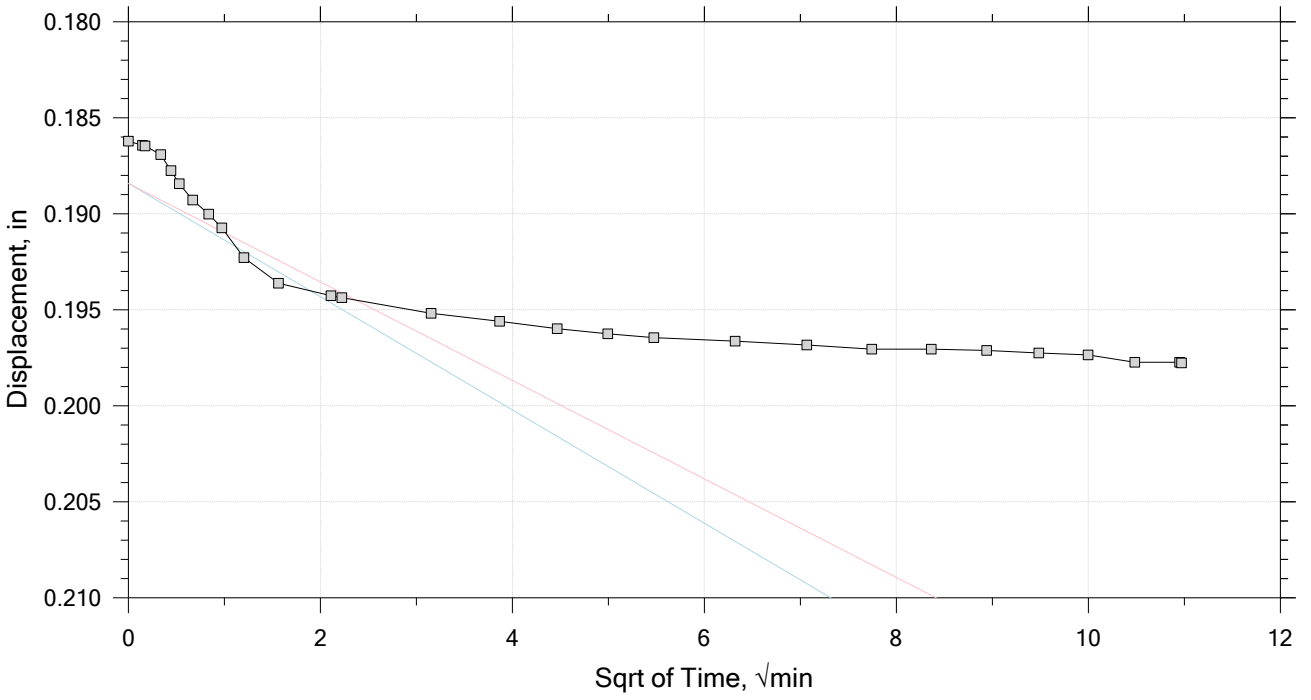


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 23 of 30
Constant Load Step
Stress: 1.29e+04 psf

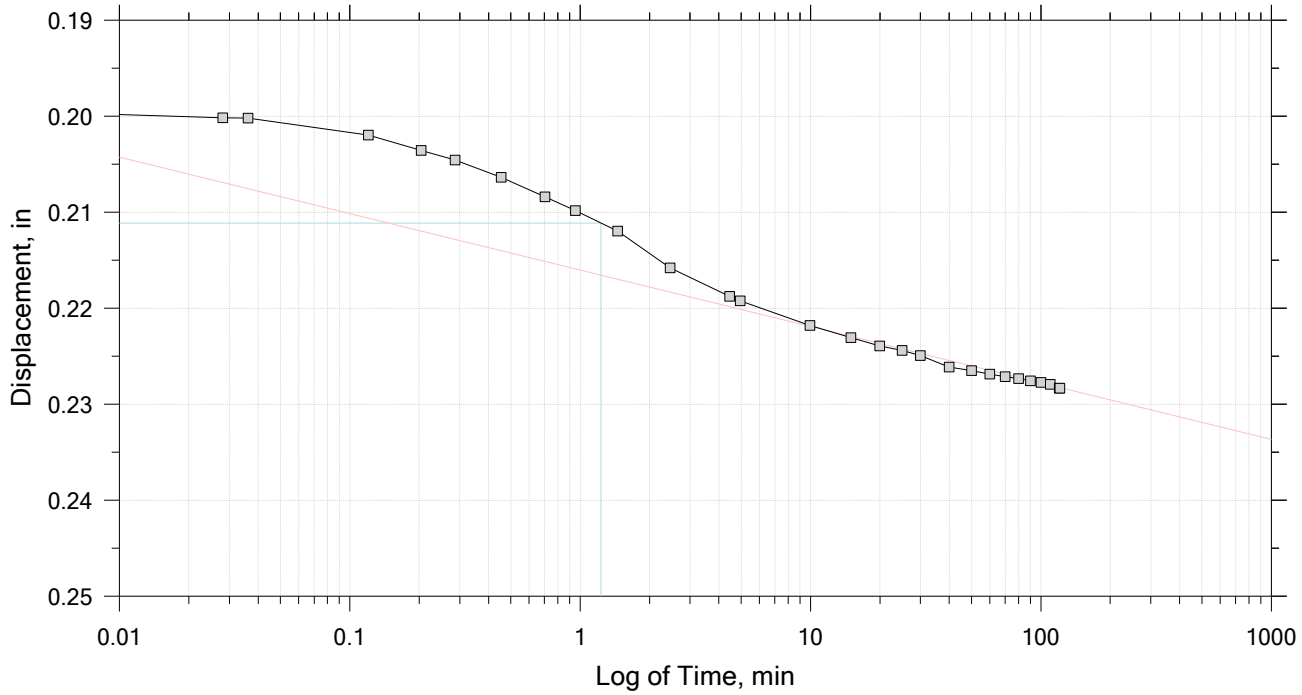


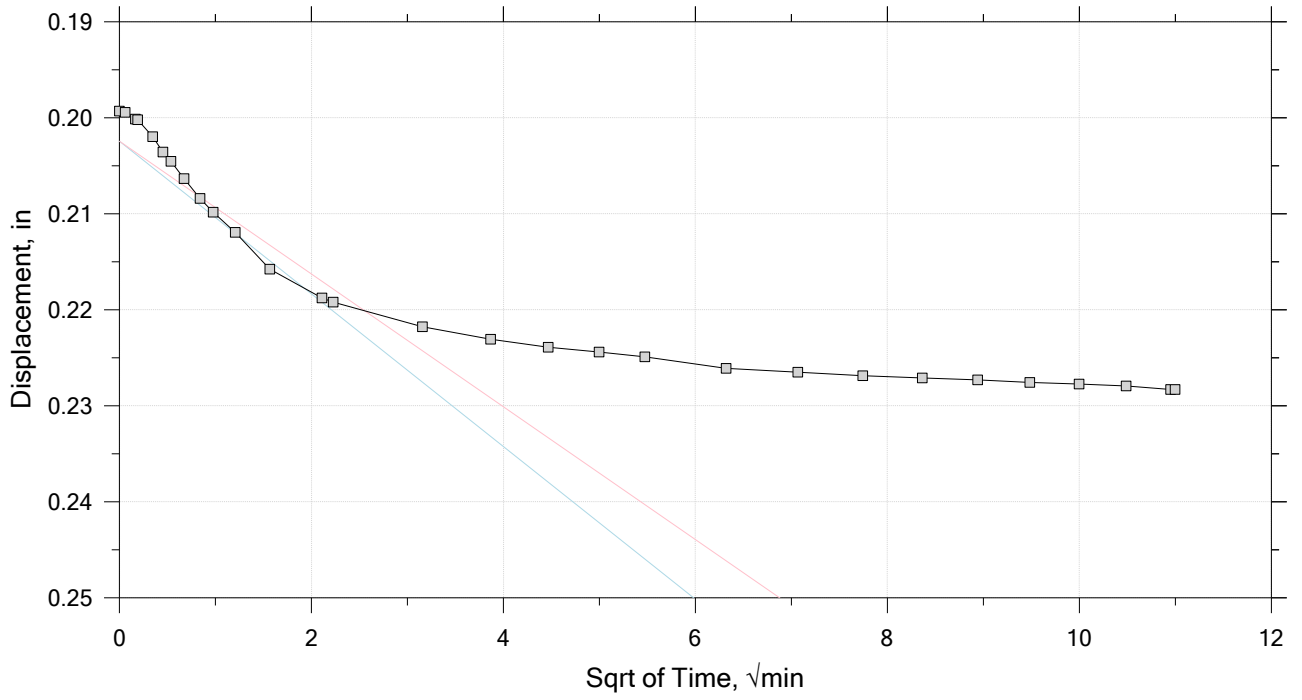


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 24 of 30
Constant Load Step
Stress: 2.58e+04 psf

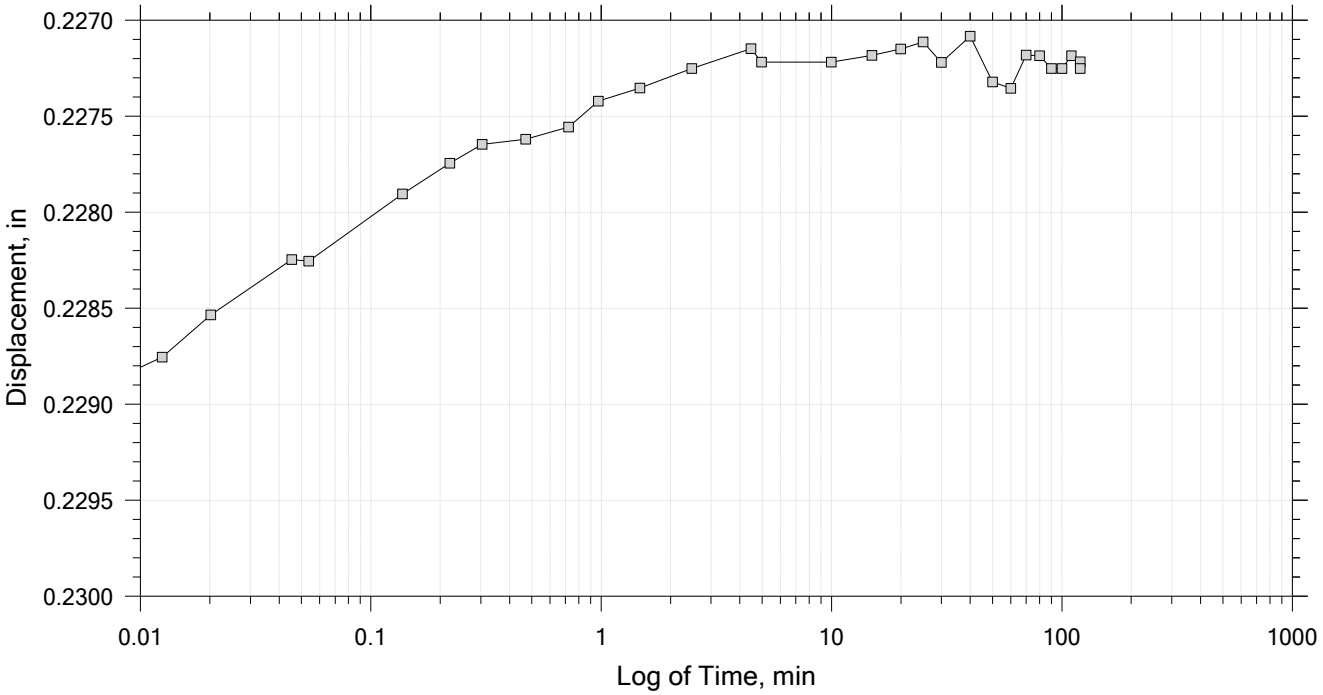


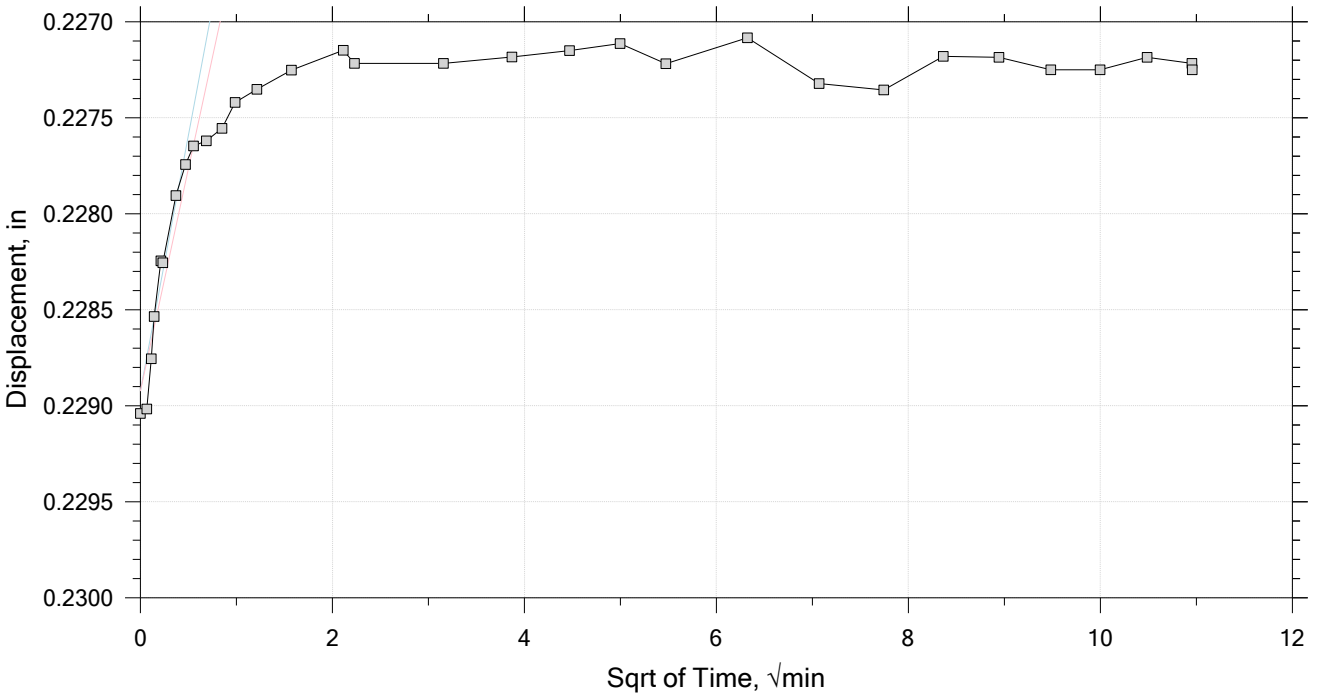


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 25 of 30
Constant Load Step
Stress: 1.29e+04 psf

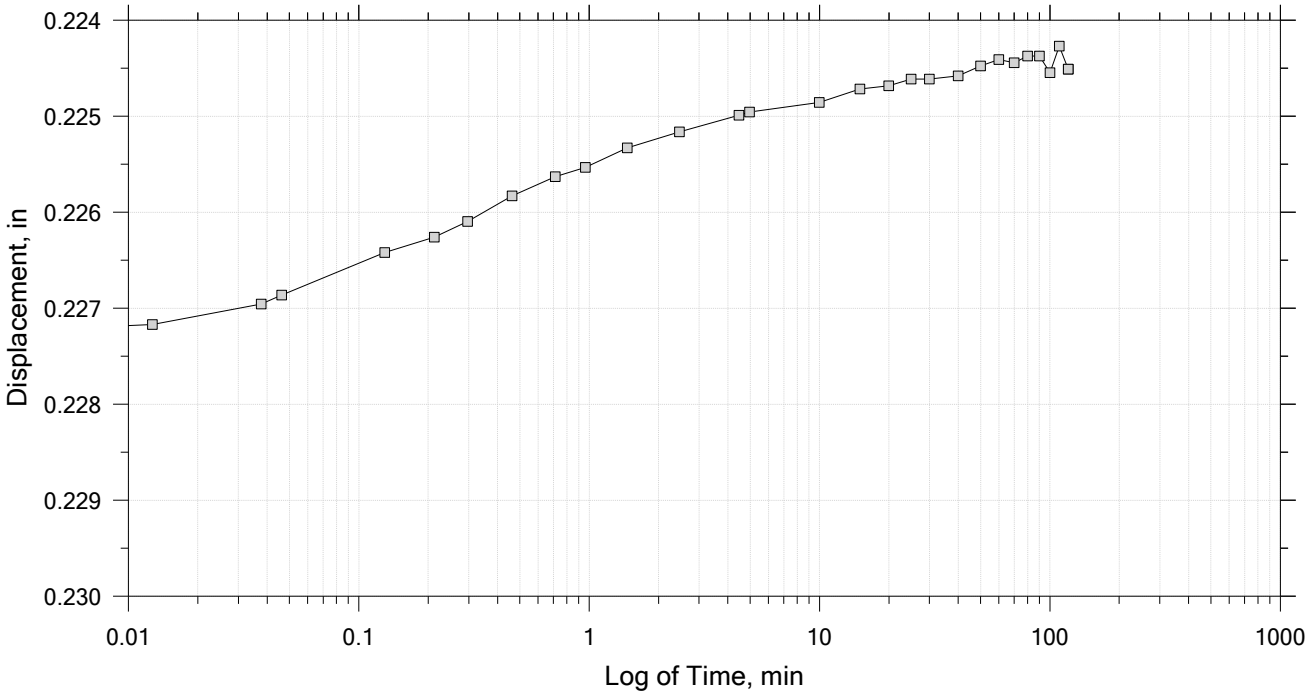


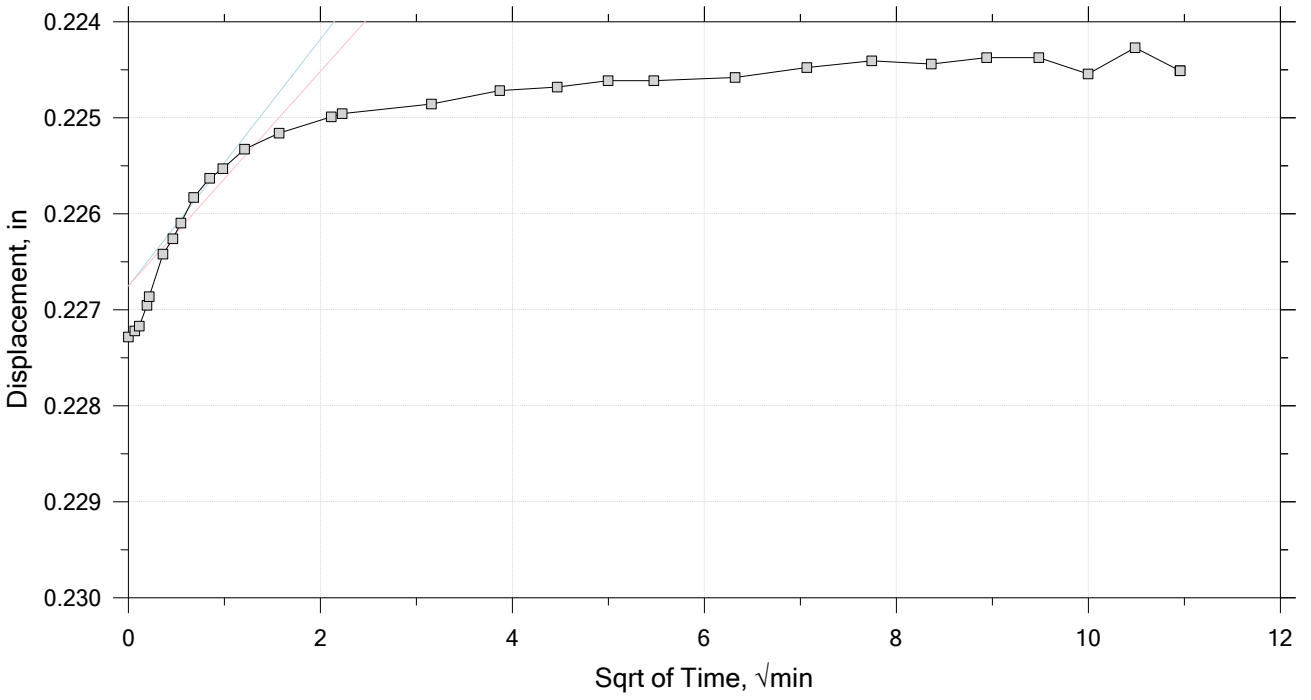


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
Test Number: ICONP 65-429	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 26 of 30
Constant Load Step
Stress: 6.46e+03 psf

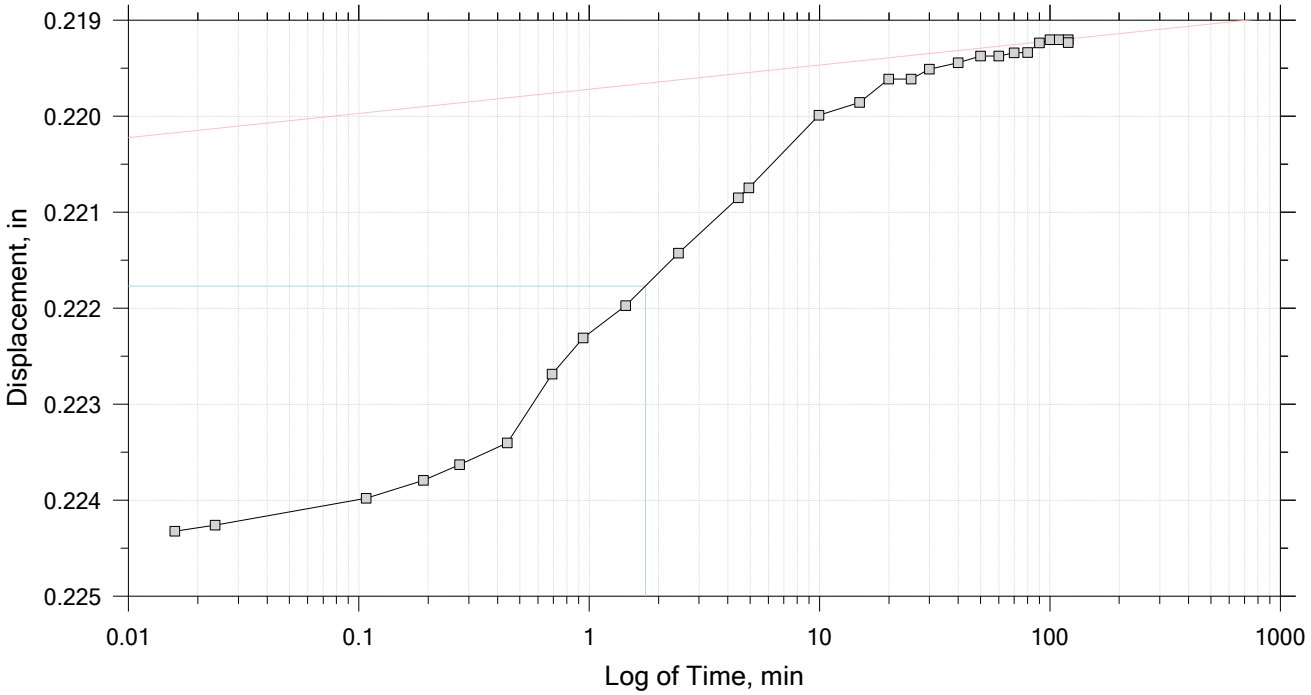


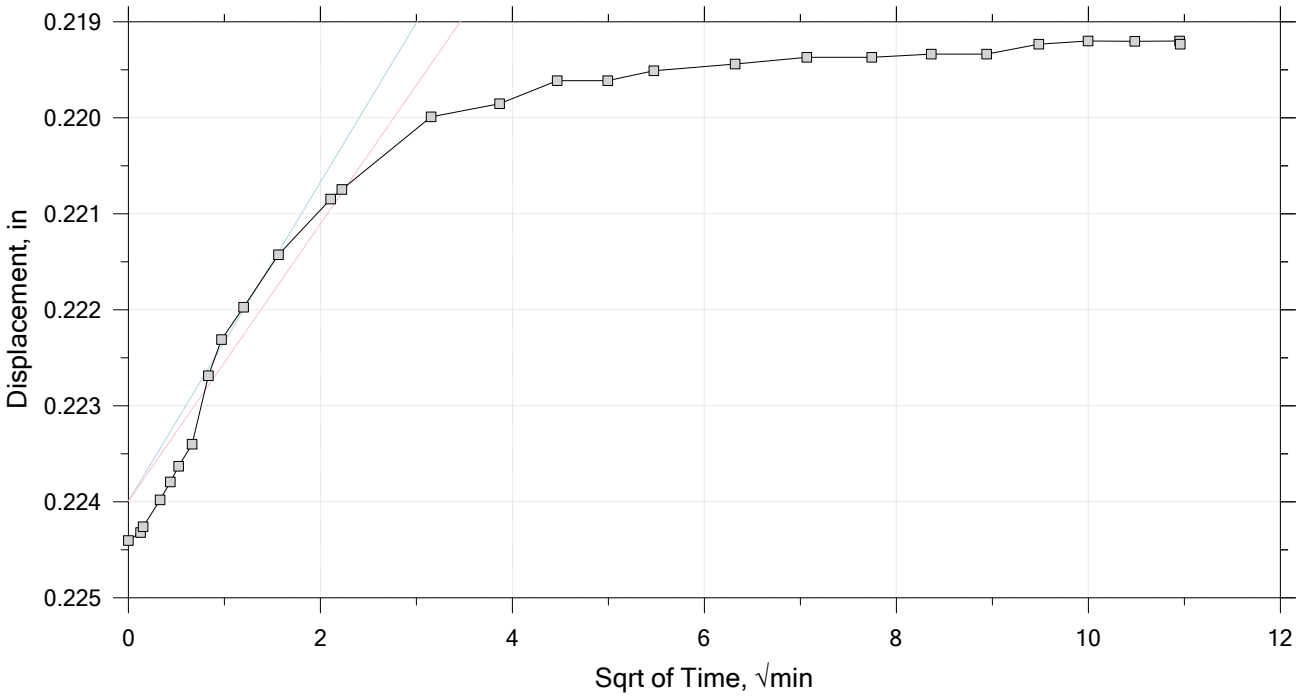


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 27 of 30
Constant Load Step
Stress: 3.23e+03 psf

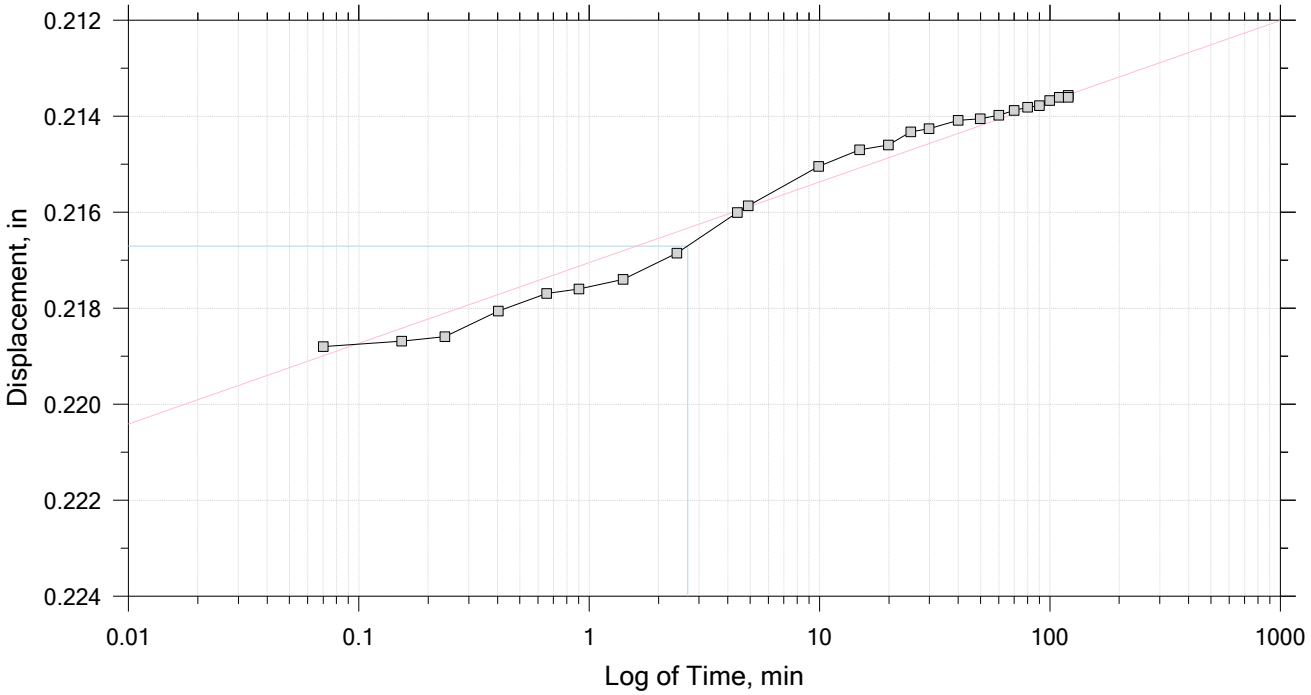


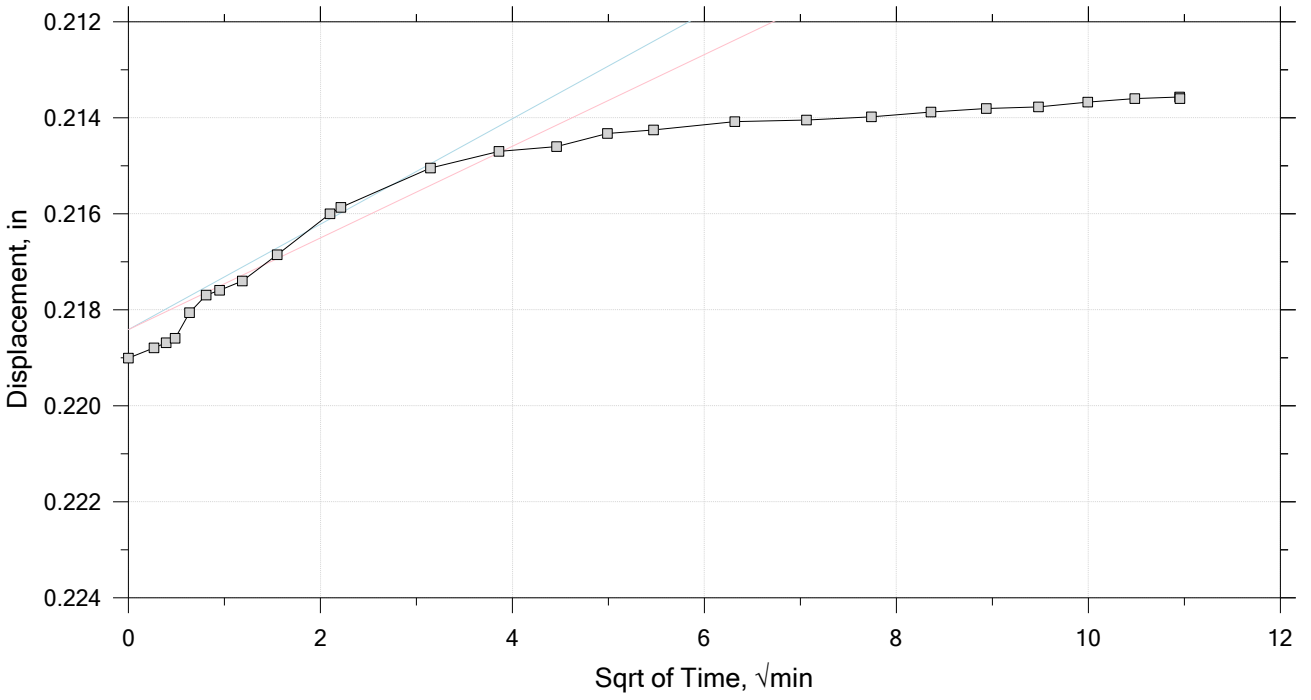


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 28 of 30
Constant Load Step
Stress: 1.61e+03 psf

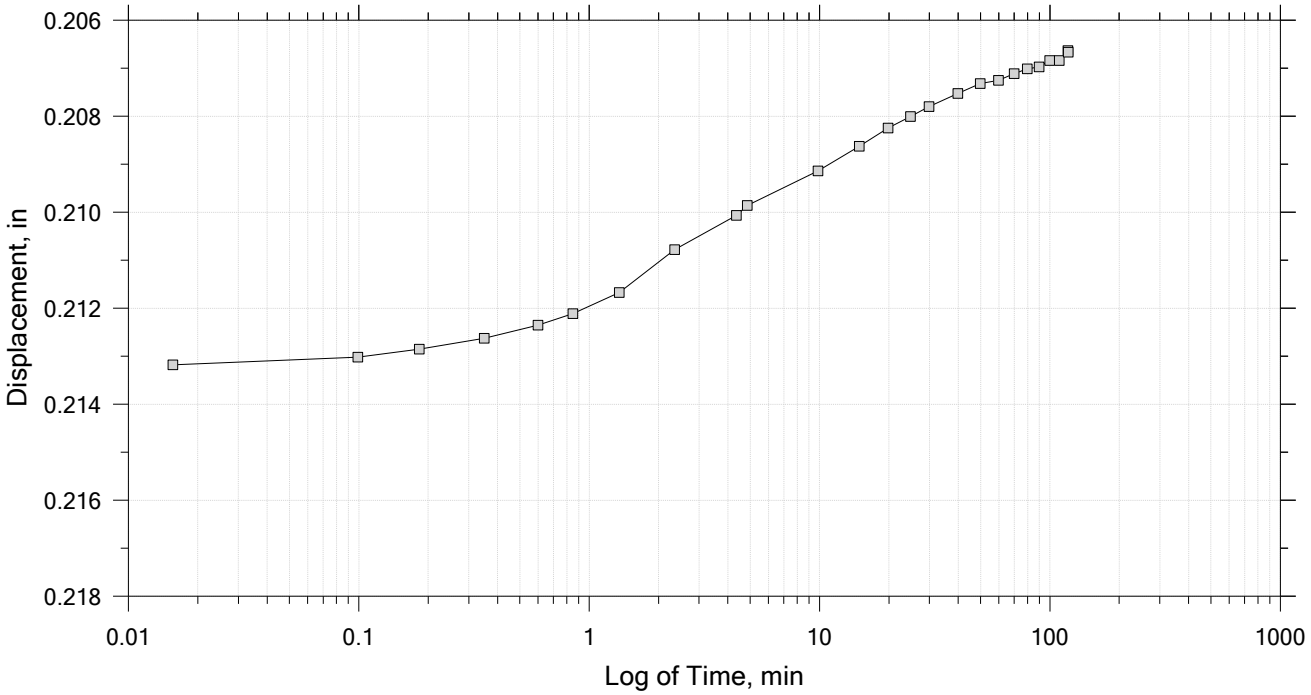


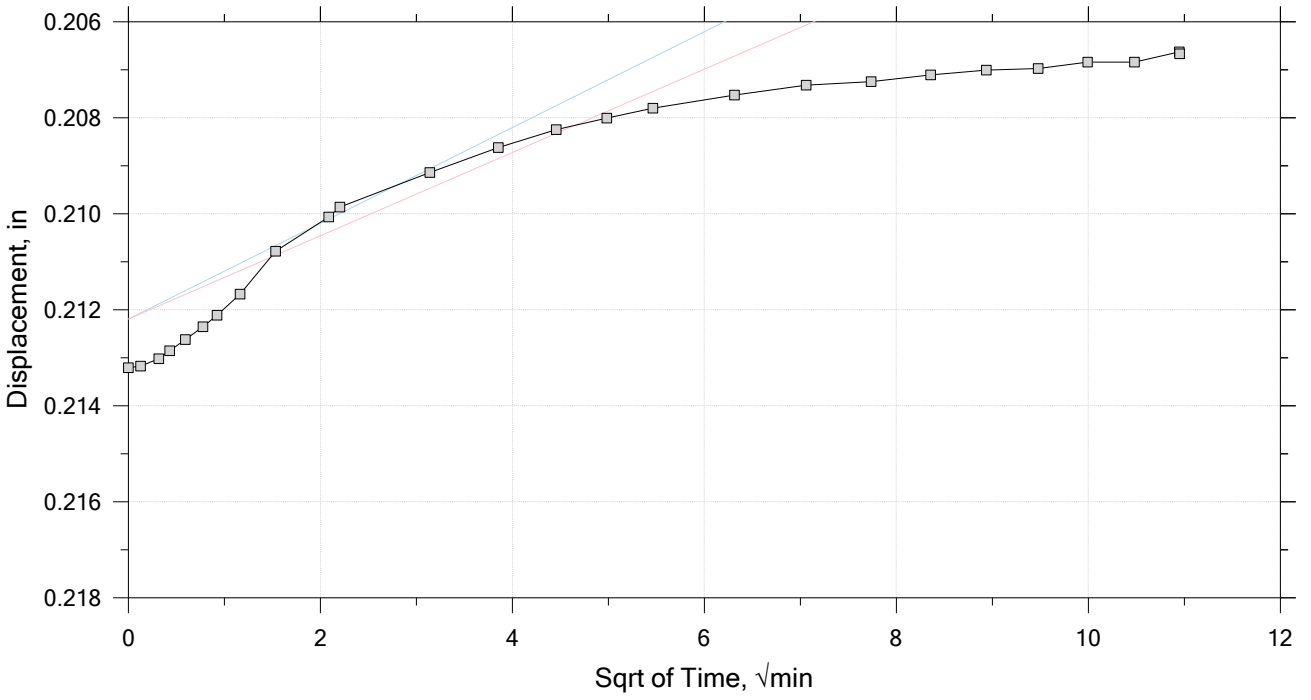


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 29 of 30
Constant Load Step
Stress: 807 psf

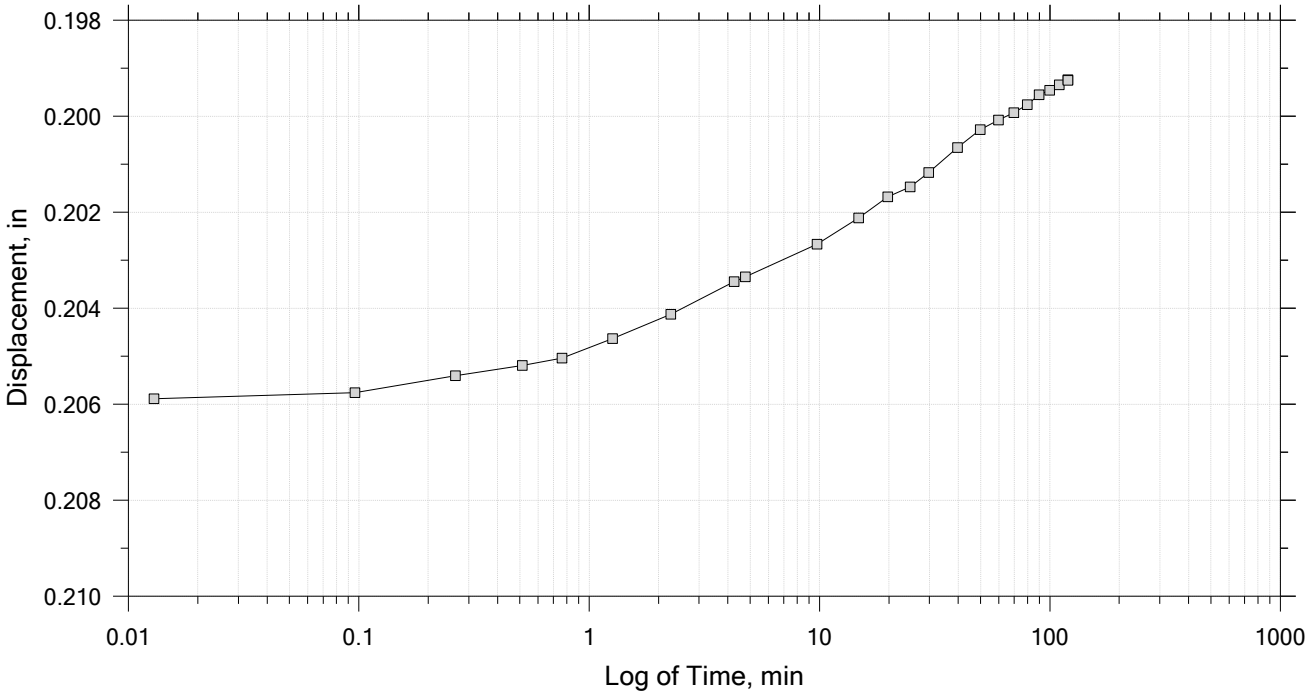


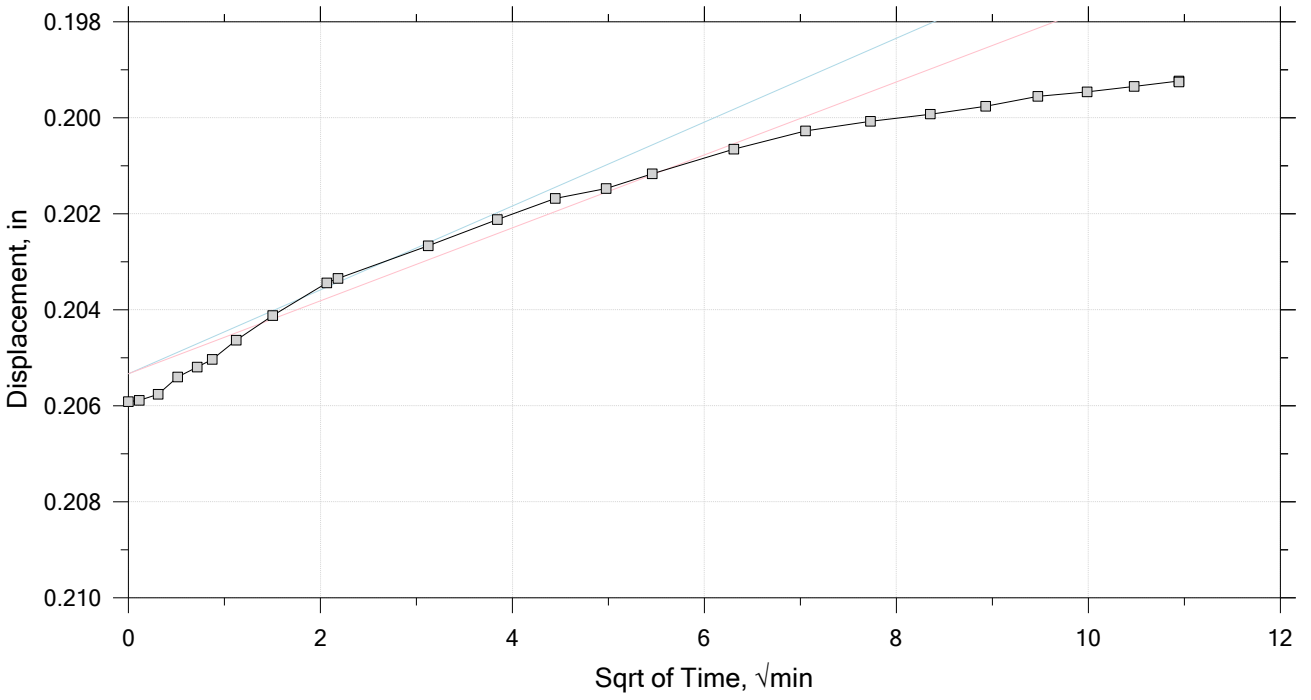


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 30 of 30
Constant Load Step
Stress: 404 psf



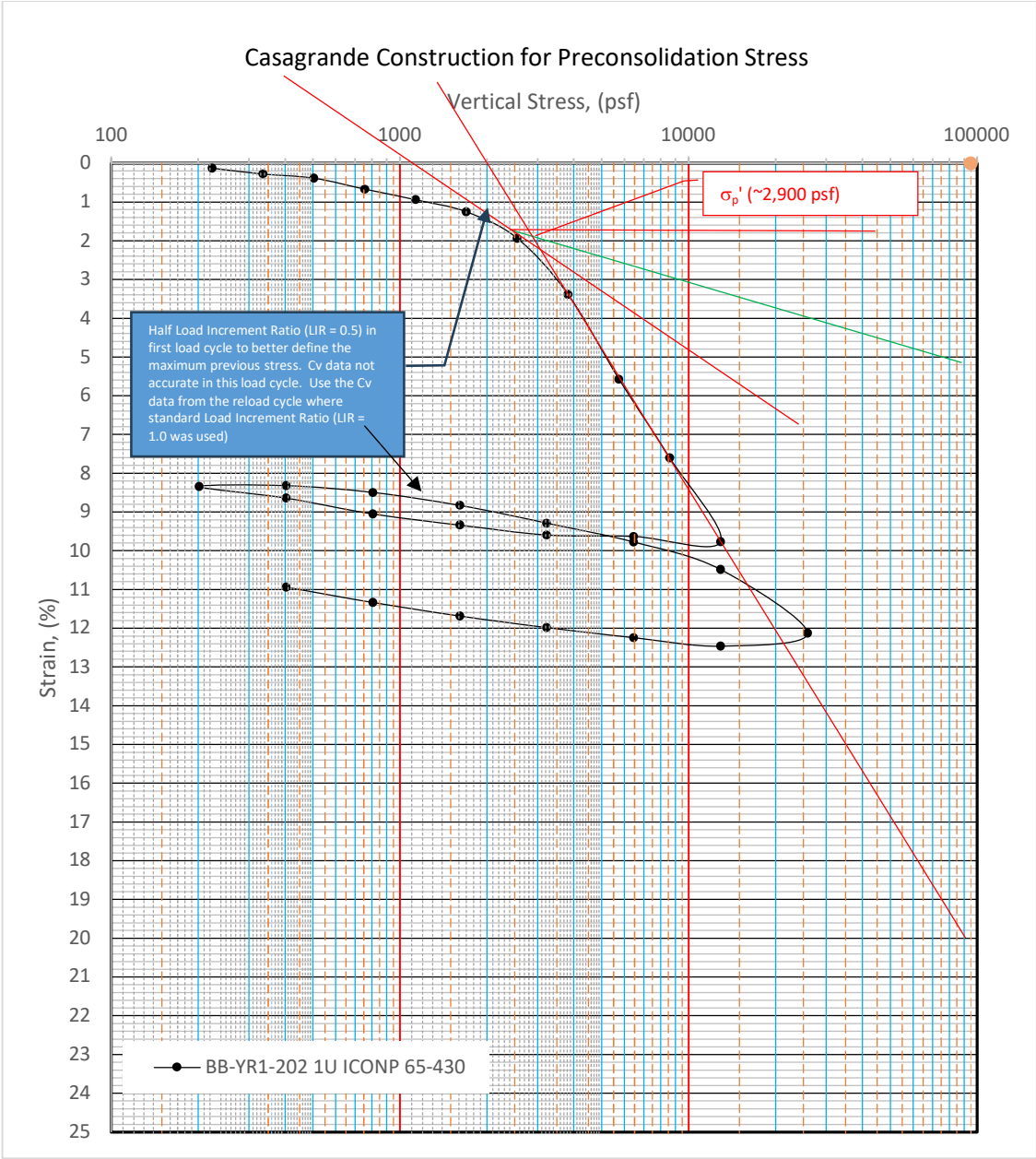


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-201	Tester: sjr	Checker: sjr
	Sample Number: U2	Test Date: 5/22/2024	Depth: 15.3
	Test Number: ICONP 65-429	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

Consolidation Test Data
Summary Report

Project Name:	Yarmouth Rt 1 Bridge
Project Number:	166-35
Project Location:	Yarmouth, Maine
Client:	GZA - PN: 09.0026144.00
Sample Description:	Gray Silty Clay (CL)
Preparation:	Trimmed Shelby Tube

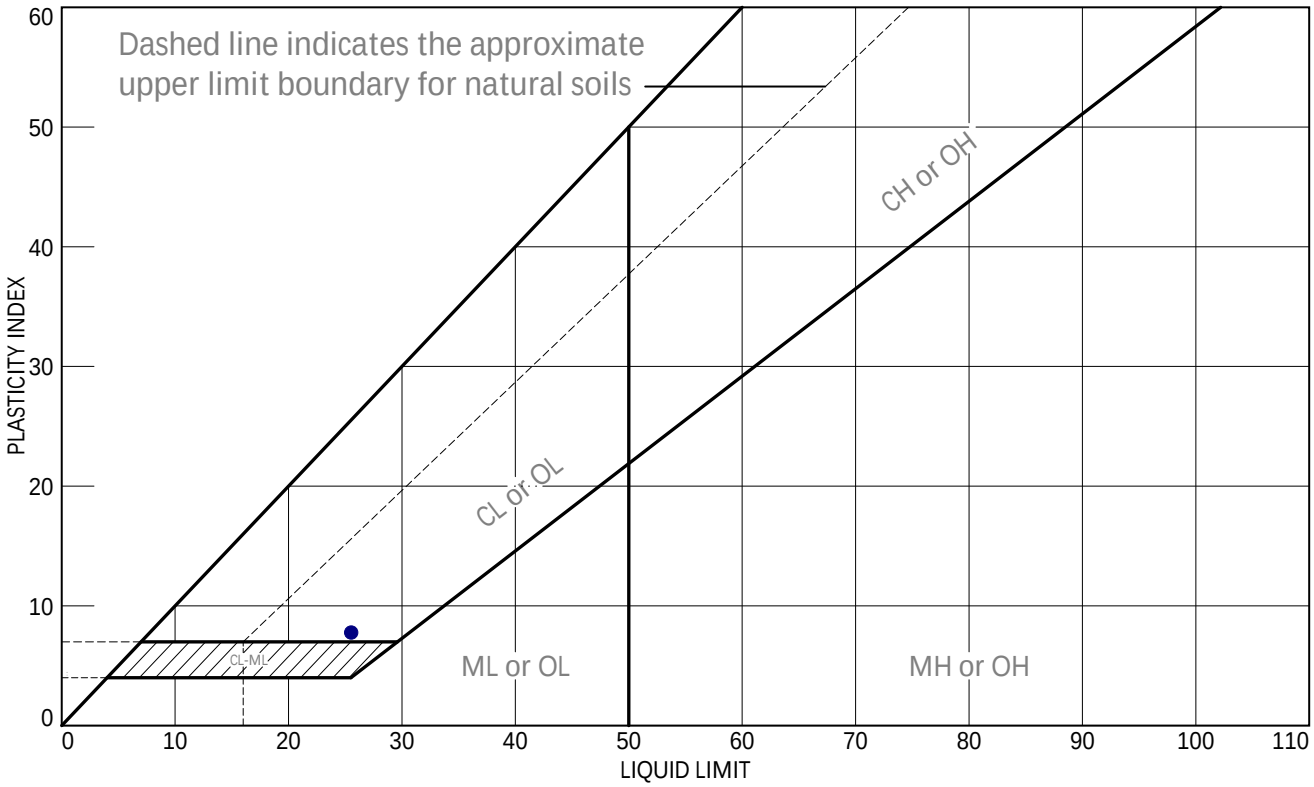
Lab Test No:	ICON 65-430			
Boring No.	BB-YR1-202			
Sample No:	1U			
Boring Elevation (ft).	--			
Sample Depth (ft):	10-12			
Test Specimen Depth (Ft):	11.7			
Test Specimen Elevation:	---			
Water Content (%):	26.3			
Dry Unit Weight (pcf):	99.7			
Wet Unit Weight (pcf):	125.8			
Saturation Before (%):	98.2			
Saturation After (%):	100			
Void Ratio Before:	0.74			
Void Ratio After:	0.55			
Overburden Pressure (psf):	--			
Max Previous stress (psf):	2,900			
Max Prev. stress (Work) (psf):	2,800			
OCR:	--			
Compression Index (C_{CE}):	0.12			
Recompression Index (C_{RE}):	0.016	from re-load curve		
Liquid Limit:	25.6			
Plastic Limit:	17.9			
Plasticity Index:	7.7			
Liquidity Index:	1.1			
Lab Vane Su at 11.85 ft. (psf)	648			
Tested By:	sjr			
Date Tested:	5/26/2024			
Checked By:	sjr			



Note 1: The calculations for the Max Previous Stress, the Compression Index and the Recompression Index are provided for the convienience of the Specifier. The Specifier should make their own independent assessment of Maximum Previous stress, Cce and Cre for use in any engineering analyses.

Soil Metrics LLC Geotechnical Engineering

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-YR1-202	1U	10-12		17.9	25.6	7.7		CL

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GZA

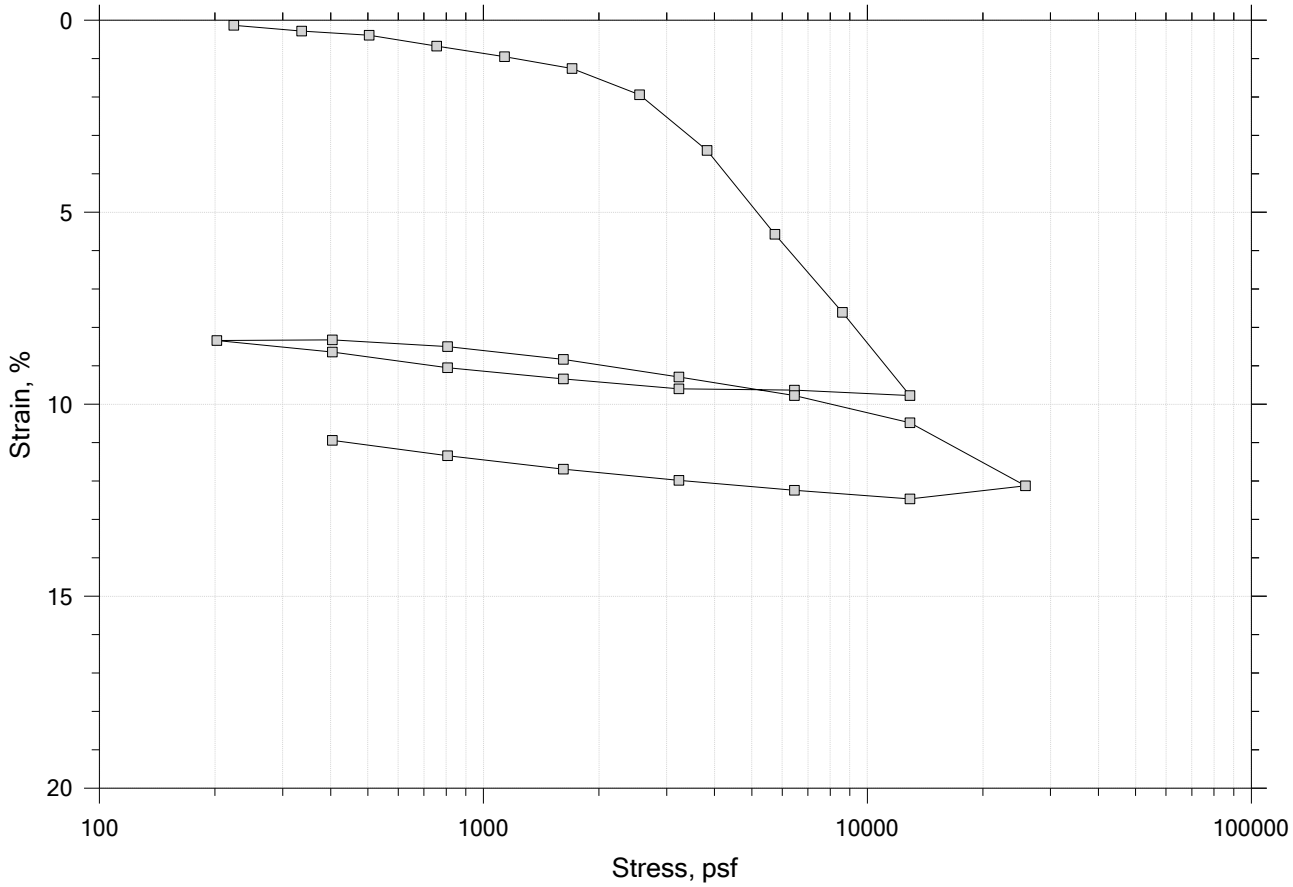
Project: Yarmouth Route 1 Bridge

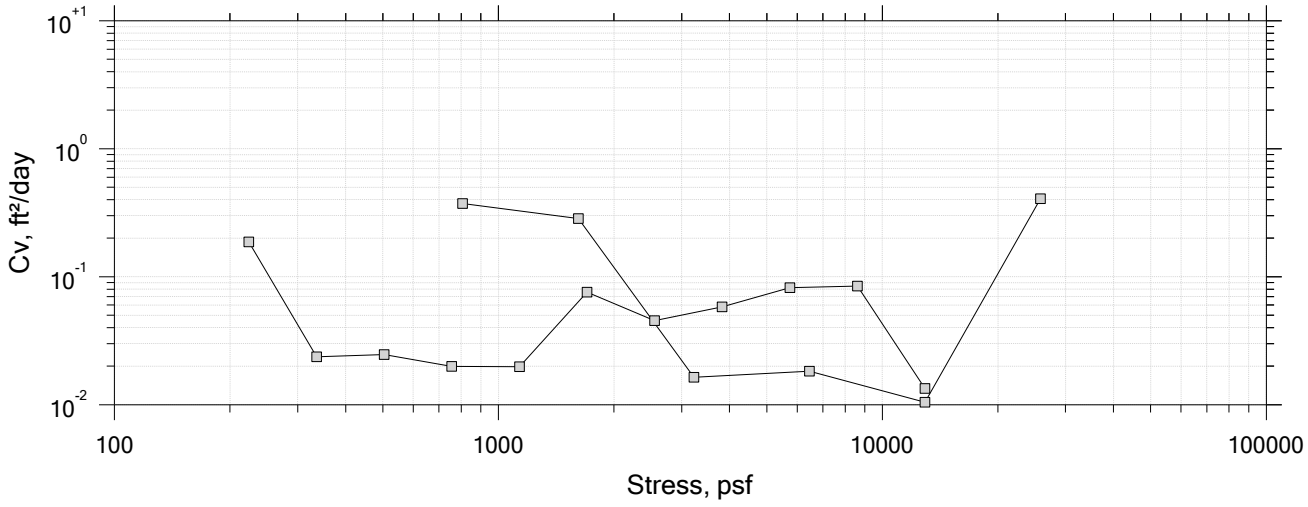
Project No.: GZA PN 09.0026144.00 Figure

Tested By: sjr Checked By: sjr

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report





Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		
	Displacement at End of Primary		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter, in: 2.50	Specific Gravity: 2.79 (Implied)	Liquid Limit: 26
Specimen Height, in: 1.00	Initial Void Ratio: 0.745	Plastic Limit: 18
Final Height, in: 0.89	Final Void Ratio: 0.554	Plasticity Index: 8

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	214	---	"ring"	301
Mass Container, gm	37.02	110.25	110.25	60.57
Mass Container + Wet Soil, gm	192.44	272.49	264.31	214.24
Mass Container + Dry Soil, gm	161.18	238.76	238.76	188.75
Mass Dry Soil, gm	124.16	128.51	128.51	128.18
Water Content, %	25.18	26.25	19.89	19.89
Void Ratio	---	0.74	0.55	---
Degree of Saturation, %	---	98.17	100.00	---
Dry Unit Weight, pcf	---	99.651	111.89	---

Preconsolidation Stress, psf	---
Compression Ratio	0
Rebound Ratio	0
Compression Index	0
Rebound Index	0

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

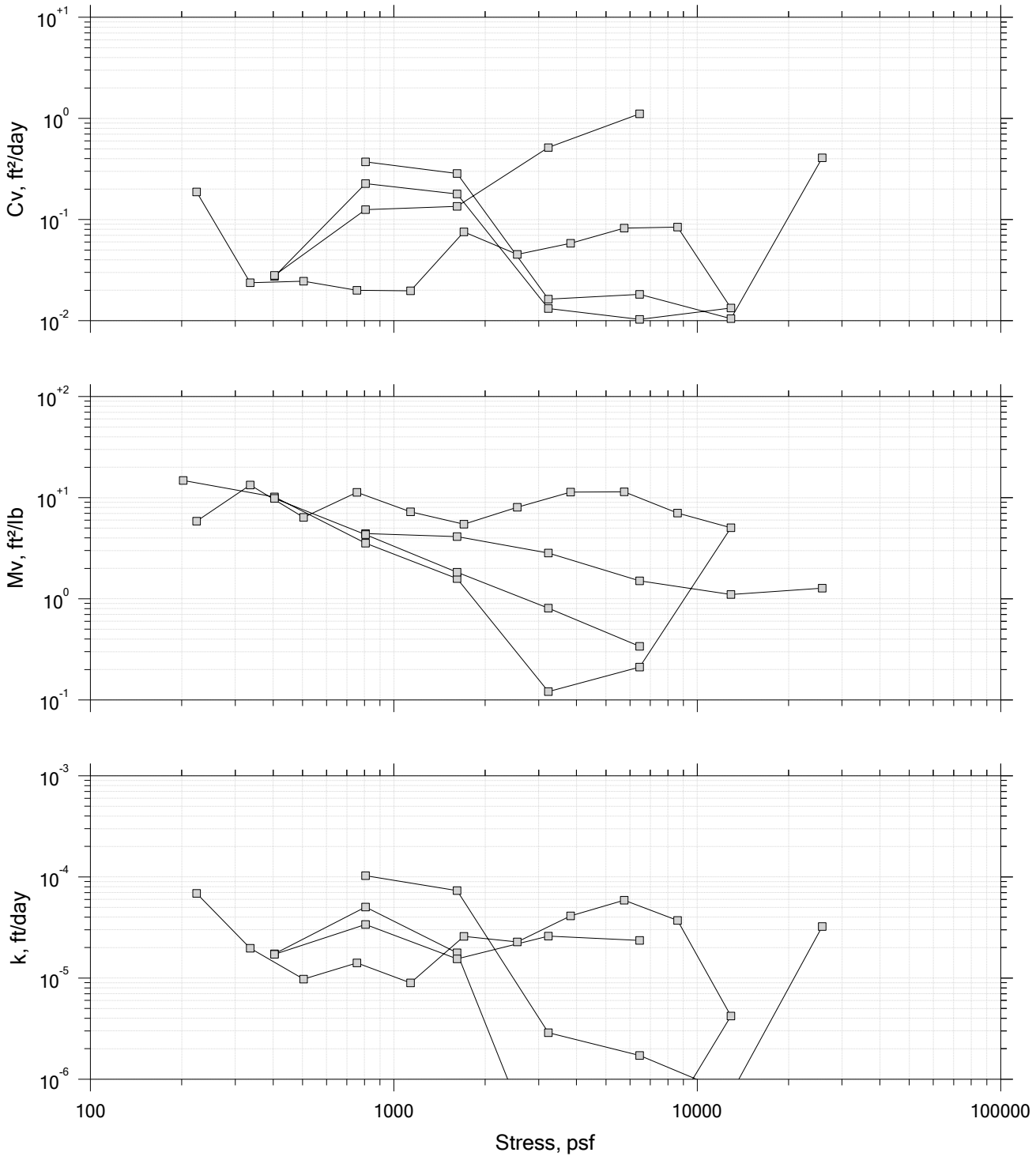
Sqrt of Time Coefficients

Step	Applied Stress psf	EOP Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft²/day	Mv ft²/lb	k ft/day
1	224.	0.001314	0.742	0.131	11.301	1.87e-01	5.87e+00	6.86e-05
2	336.	0.002808	0.740	0.281	89.001	2.37e-02	1.33e+01	1.98e-05
3	504.	0.003879	0.738	0.388	85.638	2.46e-02	6.37e+00	9.78e-06
4	756.	0.006722	0.733	0.672	105.006	2.00e-02	1.13e+01	1.41e-05
5	1.13e+03	0.009461	0.728	0.946	105.420	1.98e-02	7.25e+00	8.95e-06
6	1.70e+03	0.01256	0.723	1.26	27.427	7.56e-02	5.47e+00	2.58e-05
7	2.55e+03	0.01941	0.711	1.94	45.339	4.53e-02	8.05e+00	2.27e-05
8	3.83e+03	0.03387	0.686	3.39	34.483	5.82e-02	1.13e+01	4.12e-05
9	5.74e+03	0.05577	0.647	5.58	23.502	8.23e-02	1.14e+01	5.88e-05
10	8.61e+03	0.07603	0.612	7.60	21.945	8.43e-02	7.06e+00	3.71e-05
11	1.29e+04	0.09770	0.574	9.77	132.247	1.34e-02	5.03e+00	4.20e-06
12	6.46e+03	0.09634	0.577	9.63	168.000	1.03e-02	2.12e-01	1.36e-07
13	3.23e+03	0.09595	0.577	9.59	131.611	1.32e-02	1.21e-01	9.93e-08
14	1.61e+03	0.09339	0.582	9.34	9.686	1.79e-01	1.58e+00	1.78e-05
15	807.	0.09051	0.587	9.05	7.728	2.26e-01	3.56e+00	5.03e-05
16	404.	0.08642	0.594	8.64	64.174	2.74e-02	1.02e+01	1.74e-05
17	202.	0.08343	0.599	8.34	0.000	0.00e+00	1.48e+01	0.00e+00
18	404.	0.08321	0.600	8.32	0.000	0.00e+00	-1.06e+00	-0.00e+00
19	807.	0.08499	0.596	8.50	4.770	3.73e-01	4.42e+00	1.03e-04
20	1.61e+03	0.08832	0.591	8.83	6.207	2.85e-01	4.12e+00	7.33e-05
21	3.23e+03	0.09289	0.583	9.29	107.183	1.64e-02	2.83e+00	2.89e-06
22	6.46e+03	0.09775	0.574	9.77	95.102	1.82e-02	1.51e+00	1.71e-06
23	1.29e+04	0.1049	0.562	10.5	163.343	1.05e-02	1.10e+00	7.21e-07
24	2.58e+04	0.1213	0.533	12.1	4.088	4.08e-01	1.27e+00	3.24e-05
25	1.29e+04	0.1246	0.527	12.5	0.000	0.00e+00	-2.60e-01	-0.00e+00
26	6.46e+03	0.1224	0.531	12.2	1.464	1.11e+00	3.39e-01	2.35e-05
27	3.23e+03	0.1198	0.536	12.0	3.179	5.15e-01	8.09e-01	2.60e-05
28	1.61e+03	0.1169	0.541	11.7	12.218	1.35e-01	1.84e+00	1.55e-05
29	807.	0.1134	0.547	11.3	13.227	1.26e-01	4.33e+00	3.39e-05
30	404.	0.1094	0.554	10.9	59.717	2.80e-02	9.82e+00	1.72e-05

Soil Metrics LLC

Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		
Displacement at End of Primary		

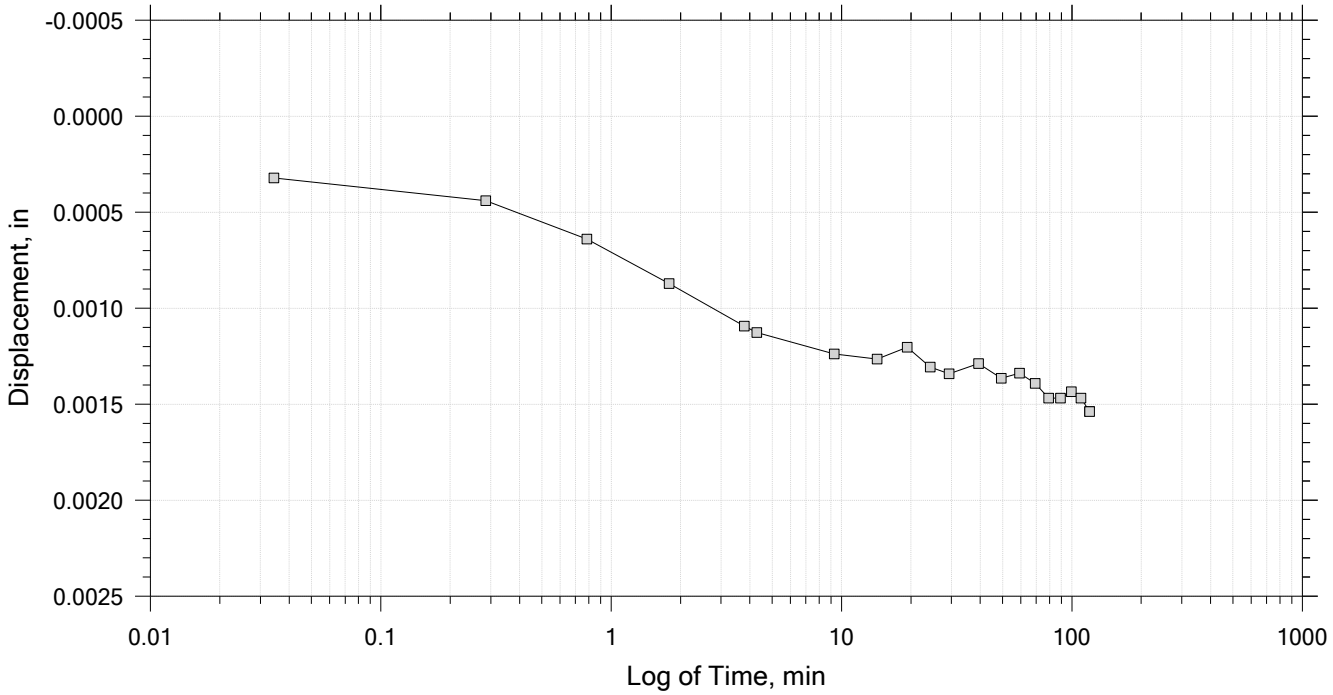
One-Dimensional Consolidation by ASTM D2435 - Method B

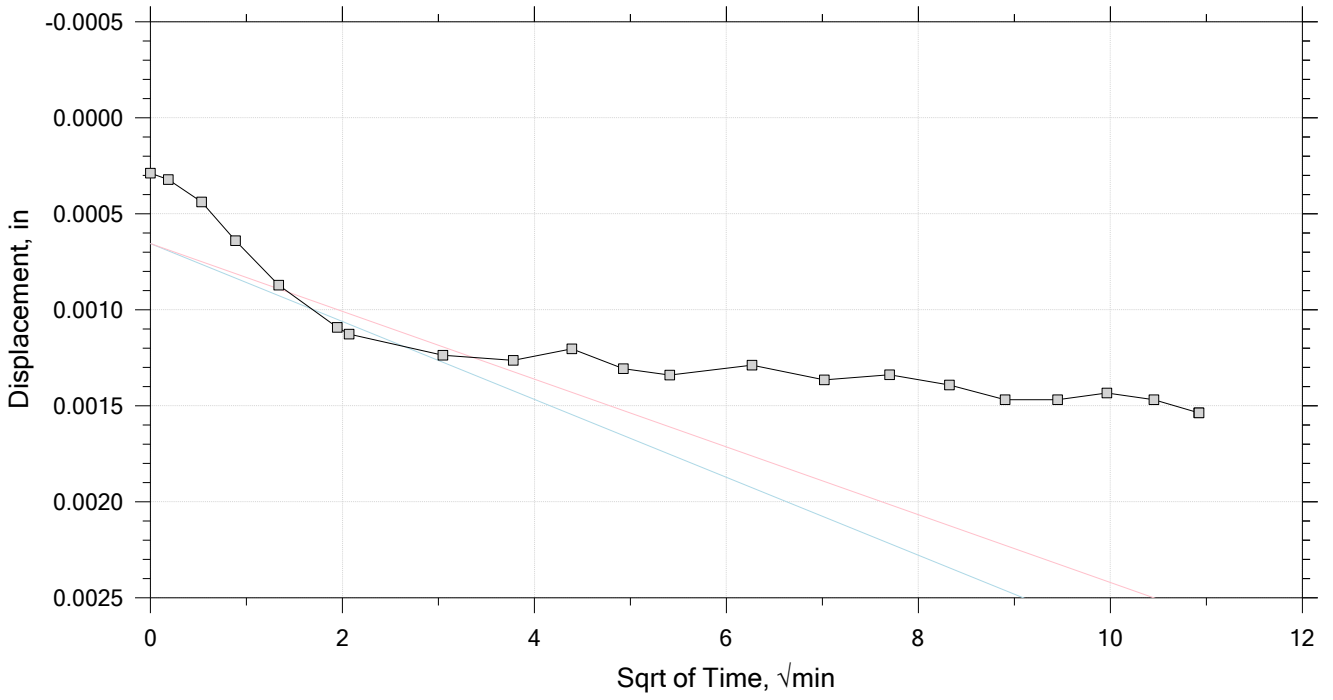


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 1 of 30
Constant Load Step
Stress: 224 psf

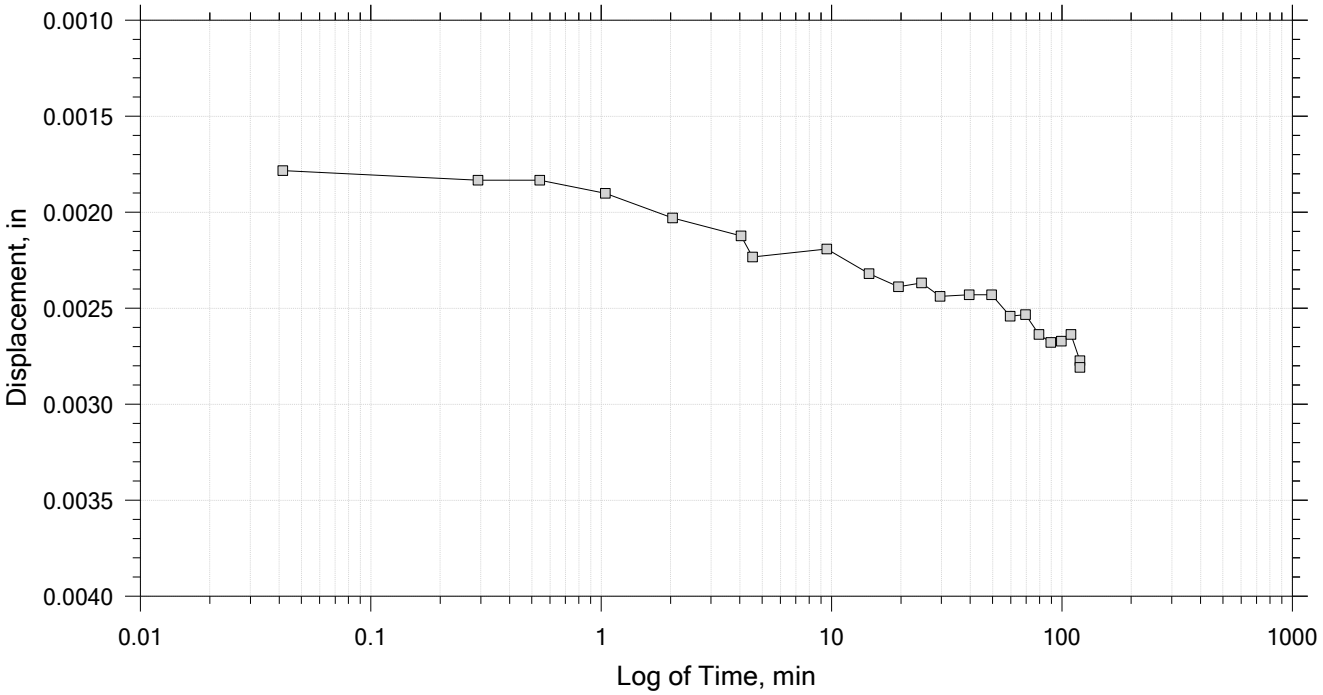


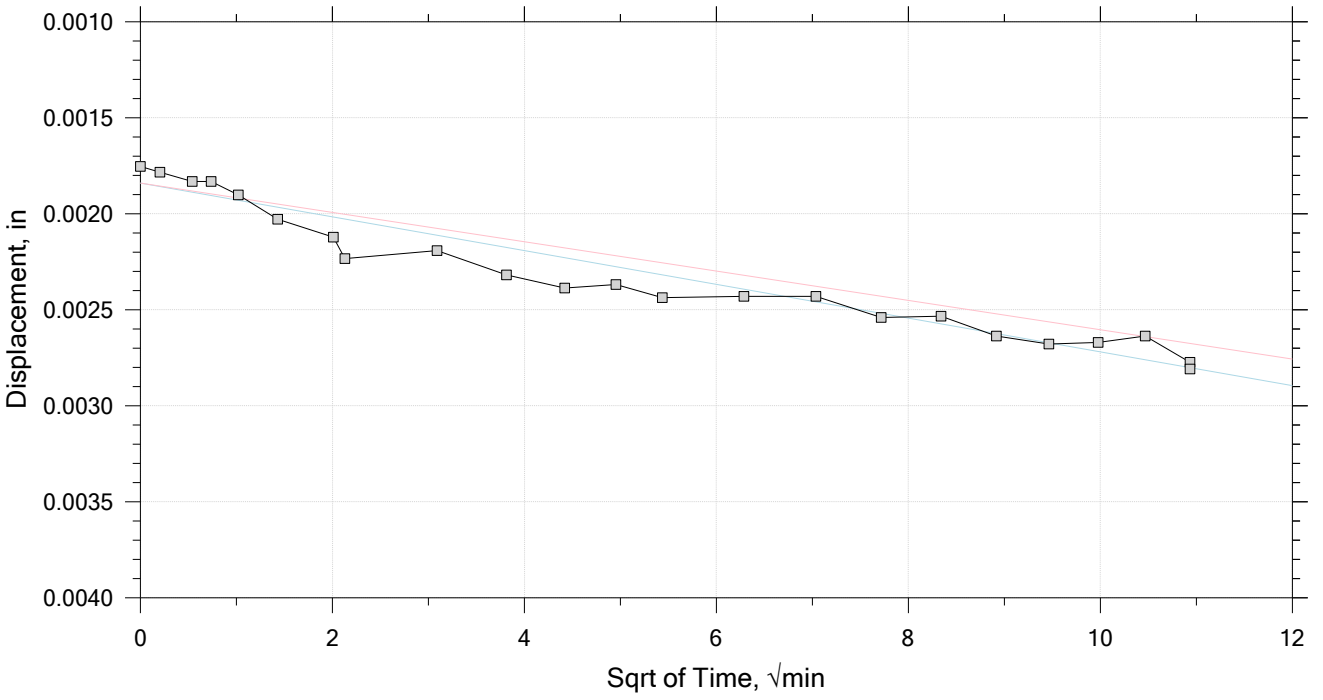


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 2 of 30
Constant Load Step
Stress: 336 psf

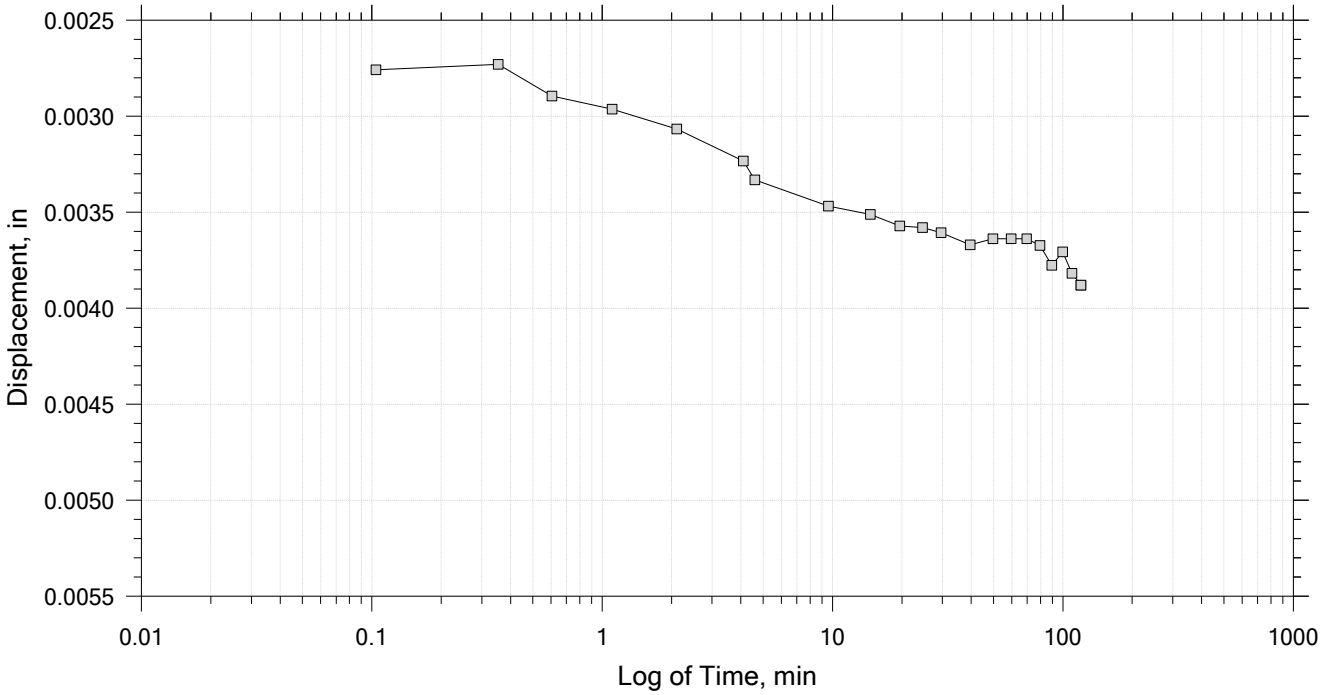


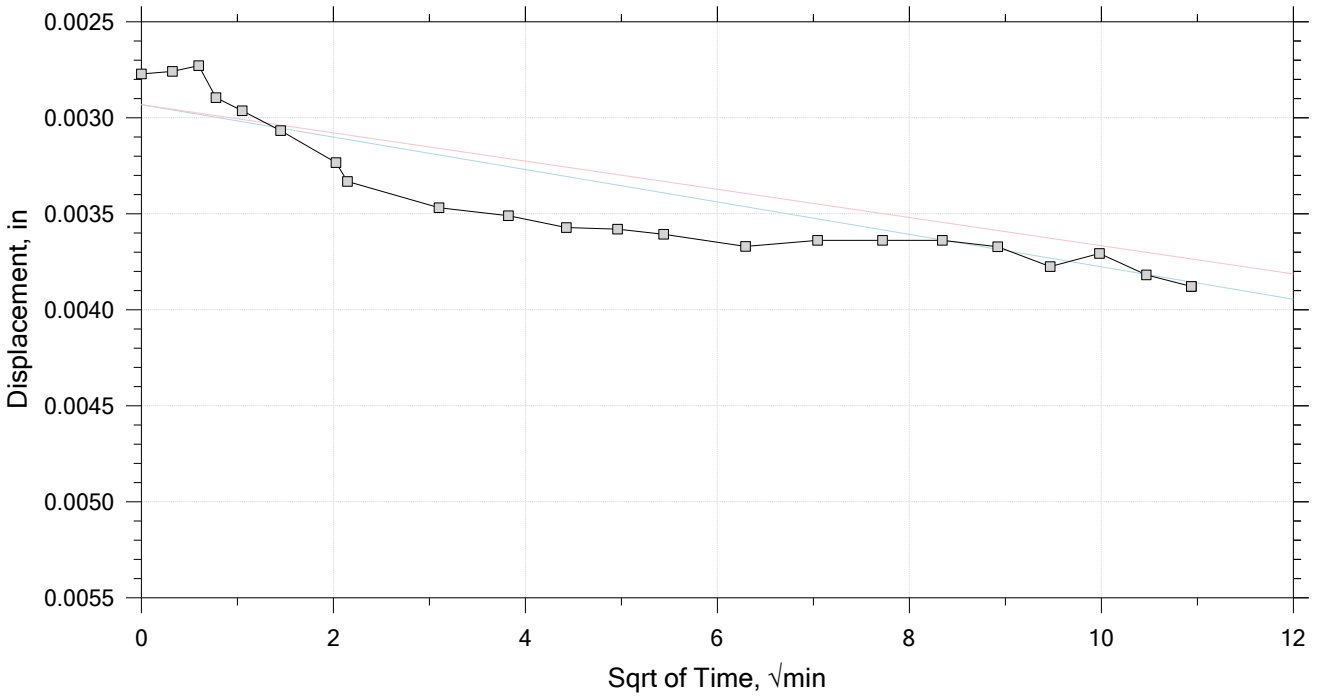


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 3 of 30
Constant Load Step
Stress: 504 psf

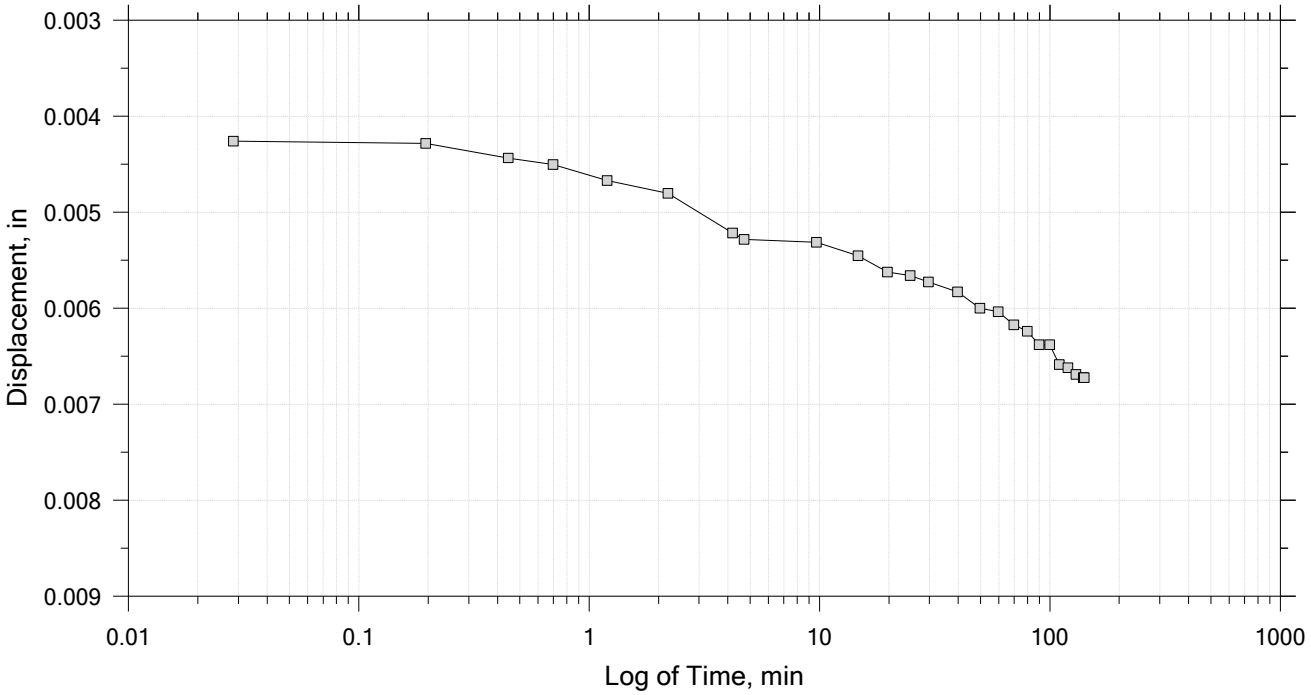


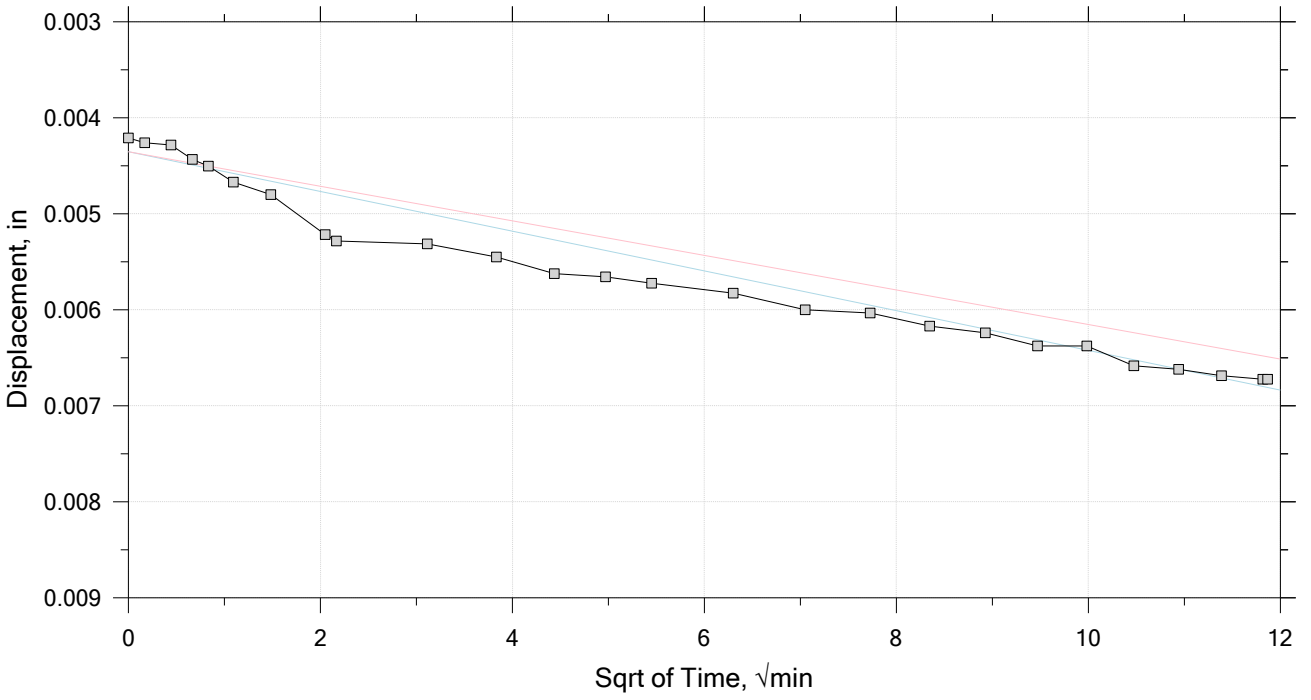


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 30
Constant Load Step
Stress: 756 psf

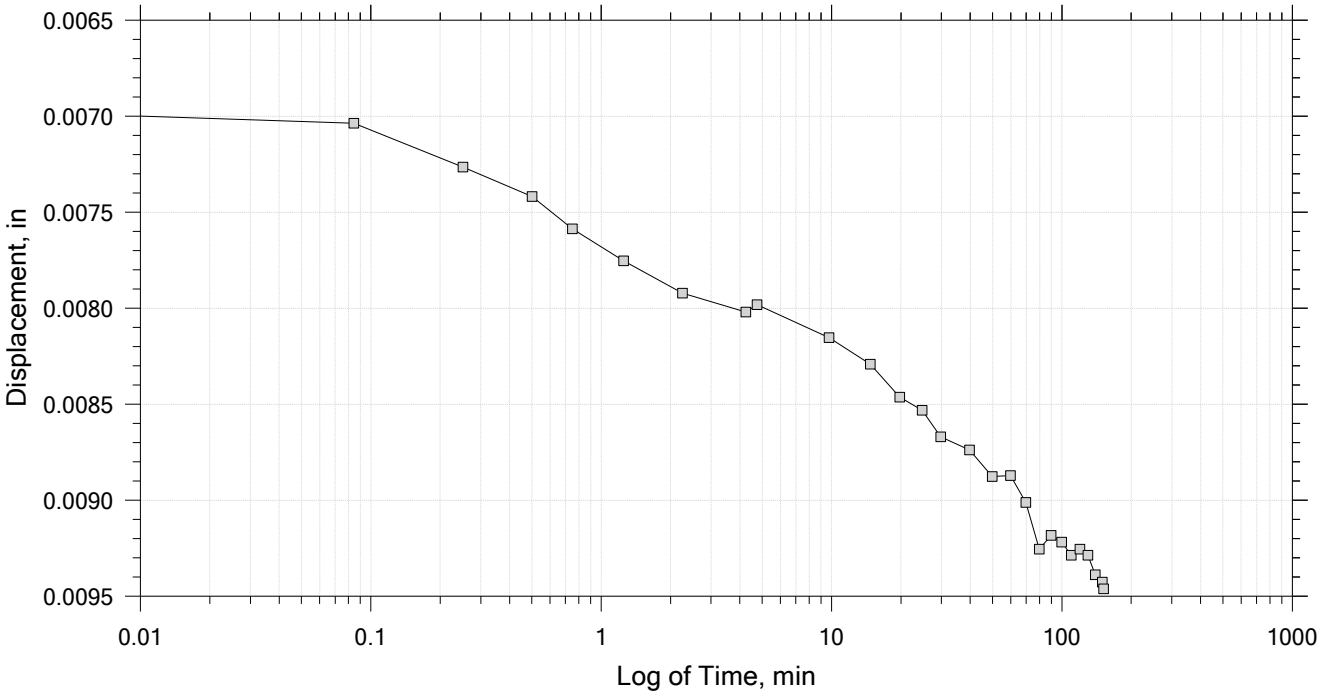


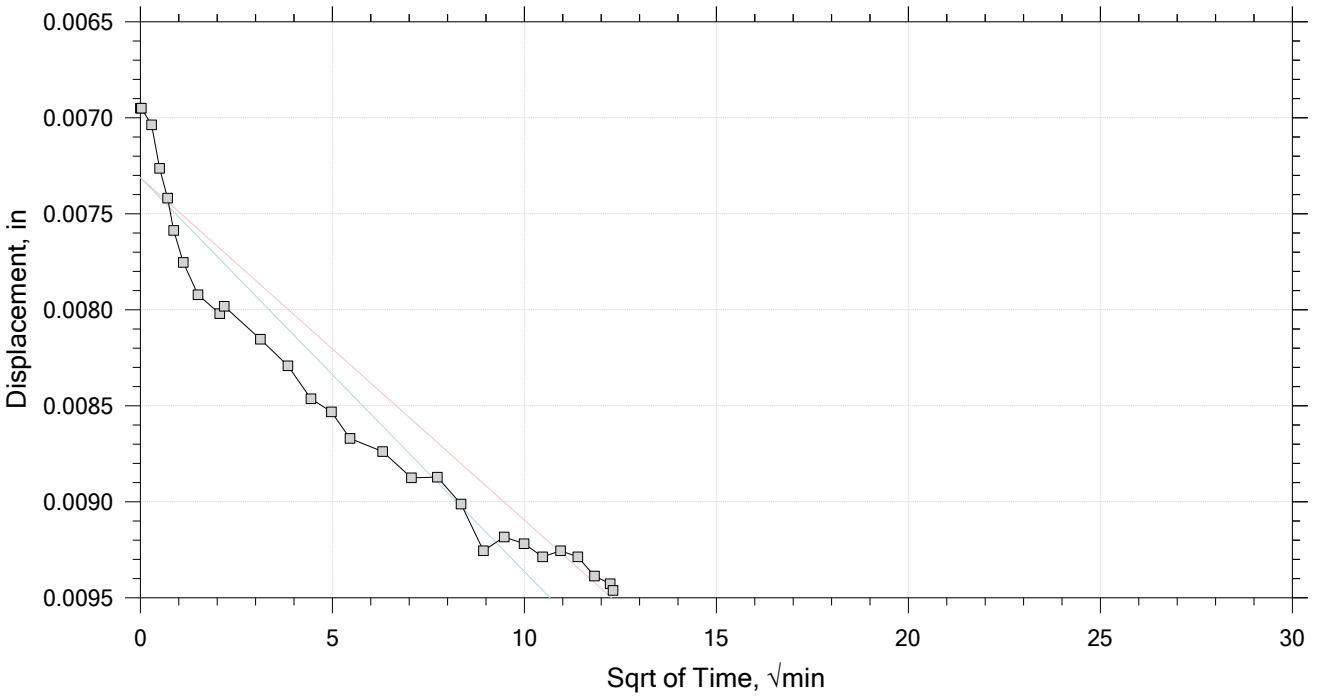


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 30
Constant Load Step
Stress: 1.13e+03 psf

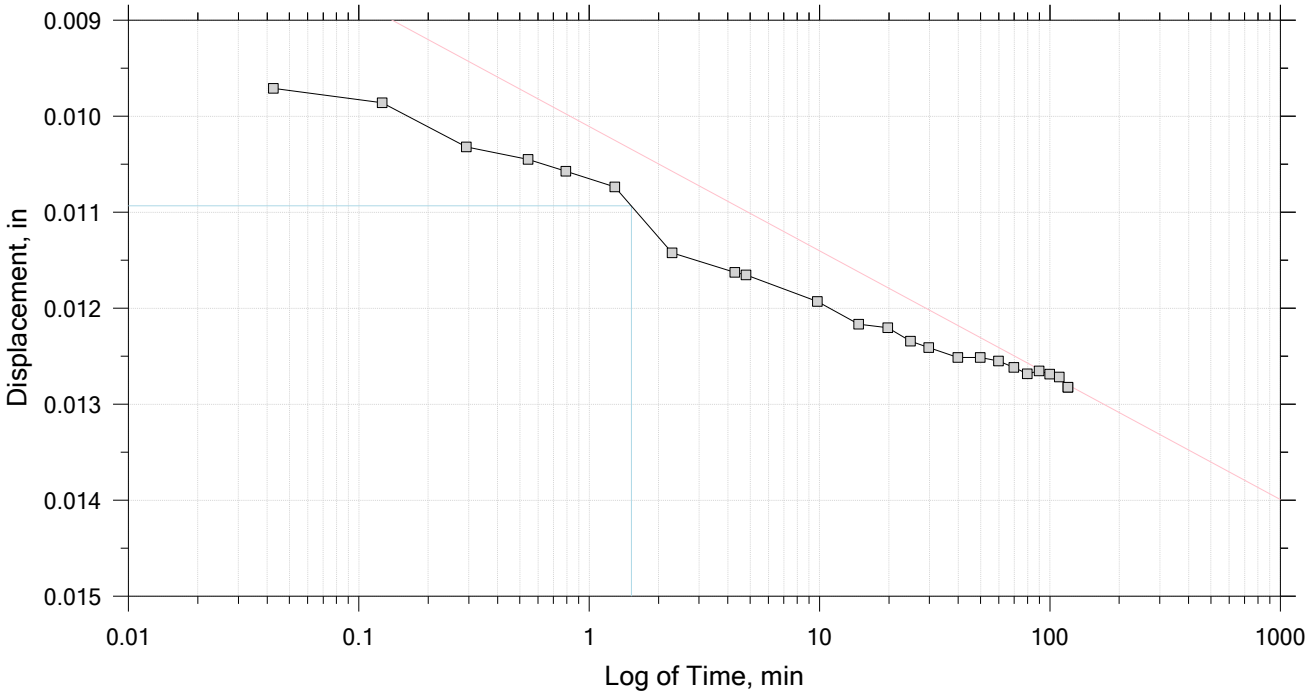


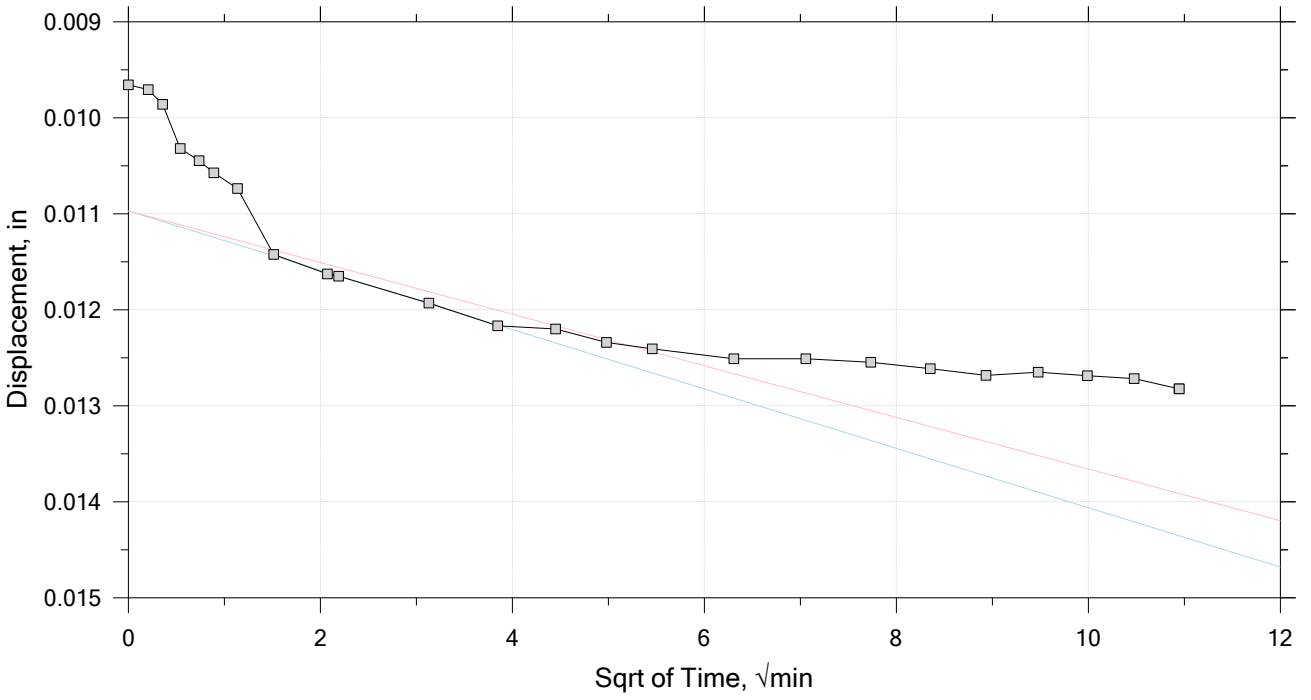


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 30
Constant Load Step
Stress: 1.7e+03 psf

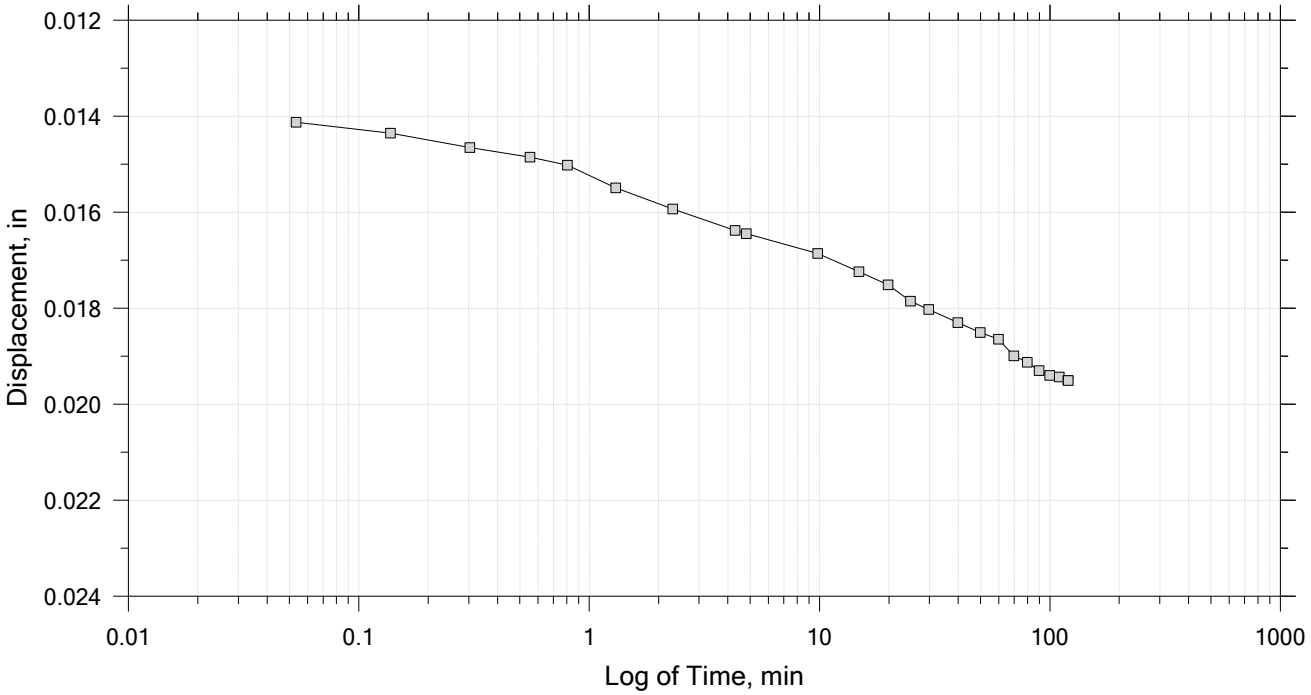


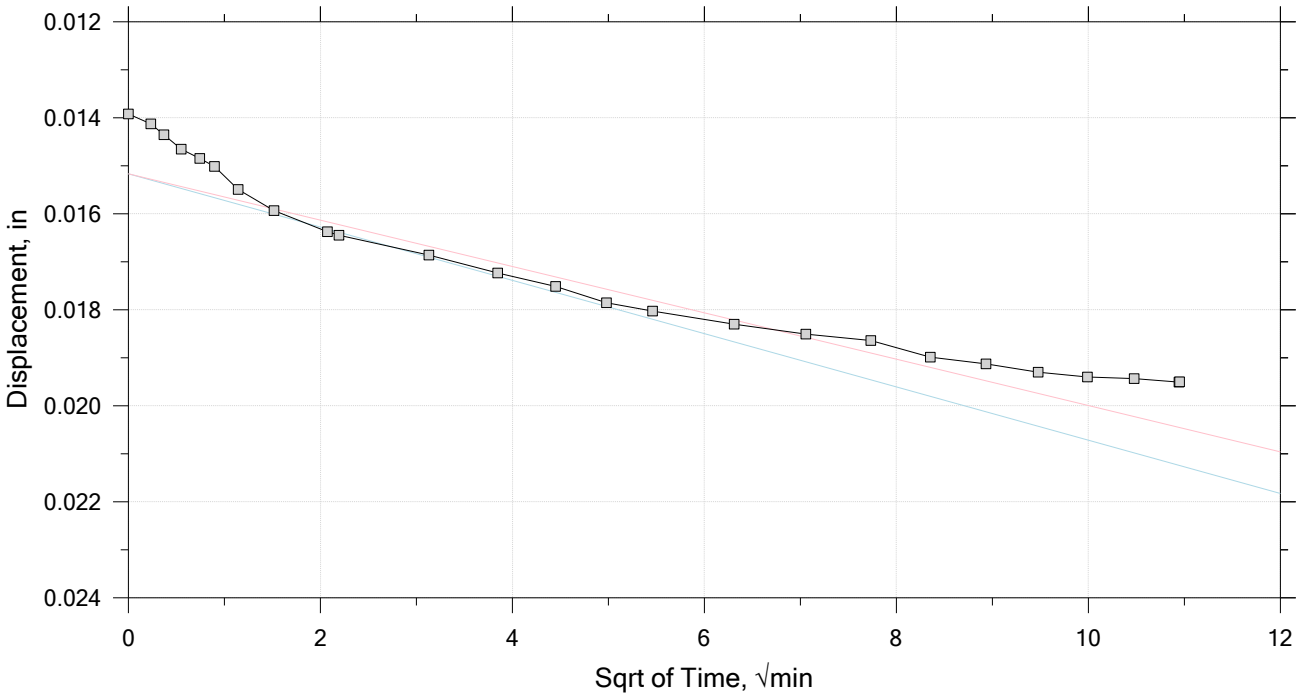


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 30
Constant Load Step
Stress: 2.55e+03 psf

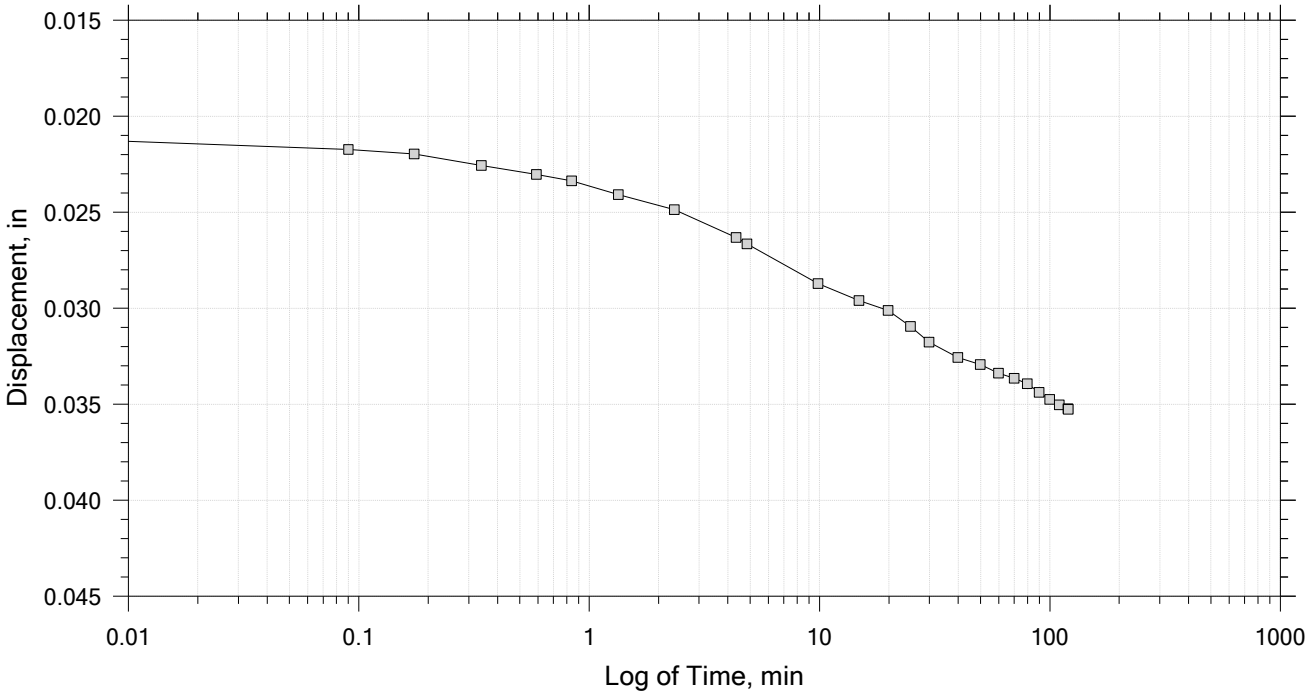


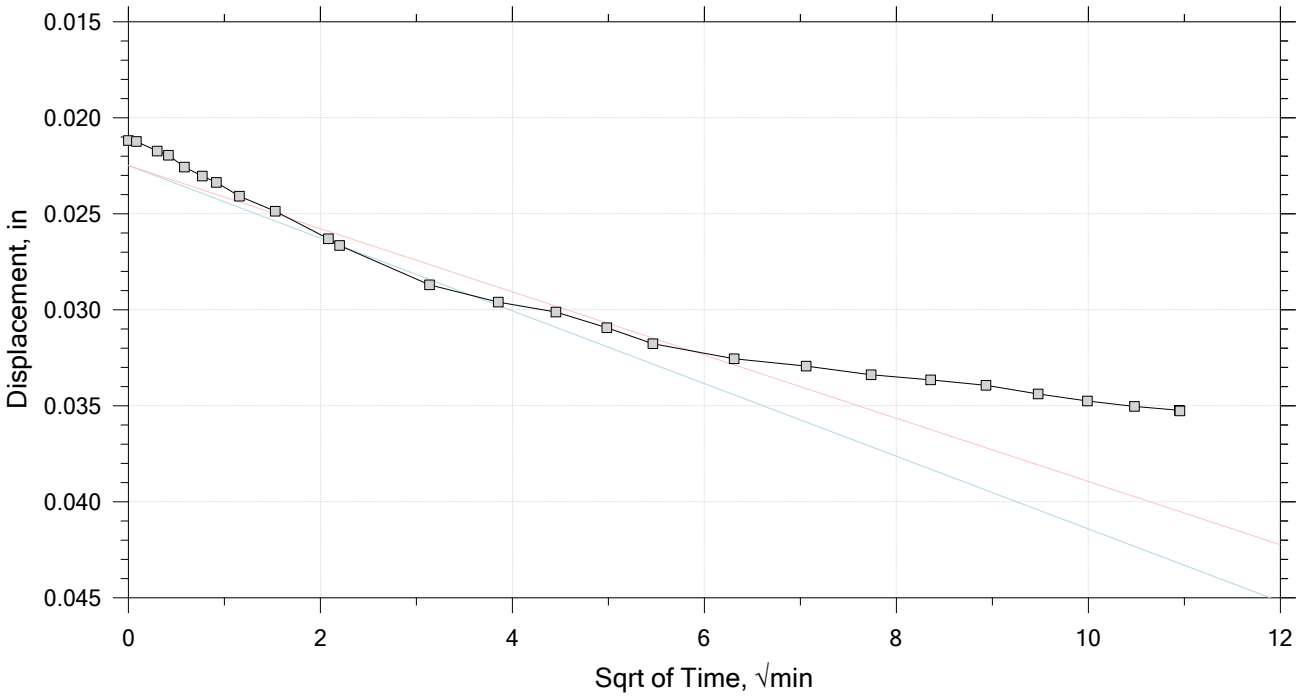


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 30
Constant Load Step
Stress: 3.83e+03 psf

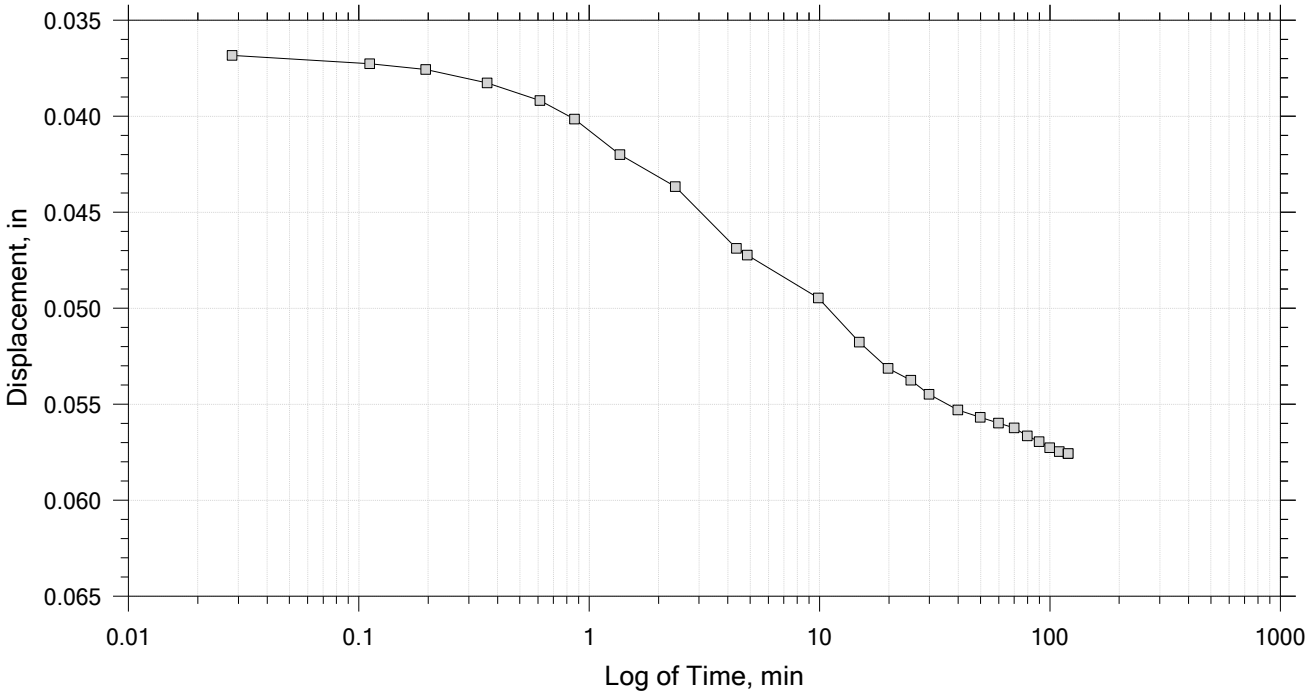


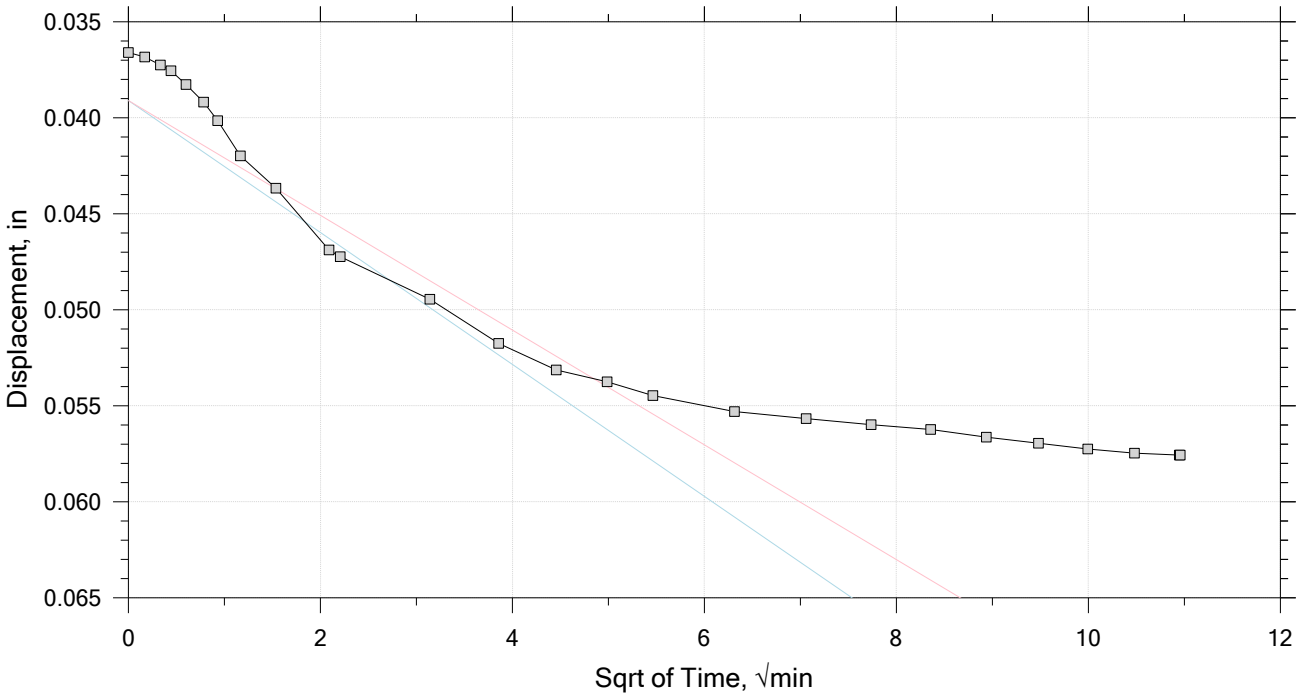


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 30
Constant Load Step
Stress: 5.74e+03 psf

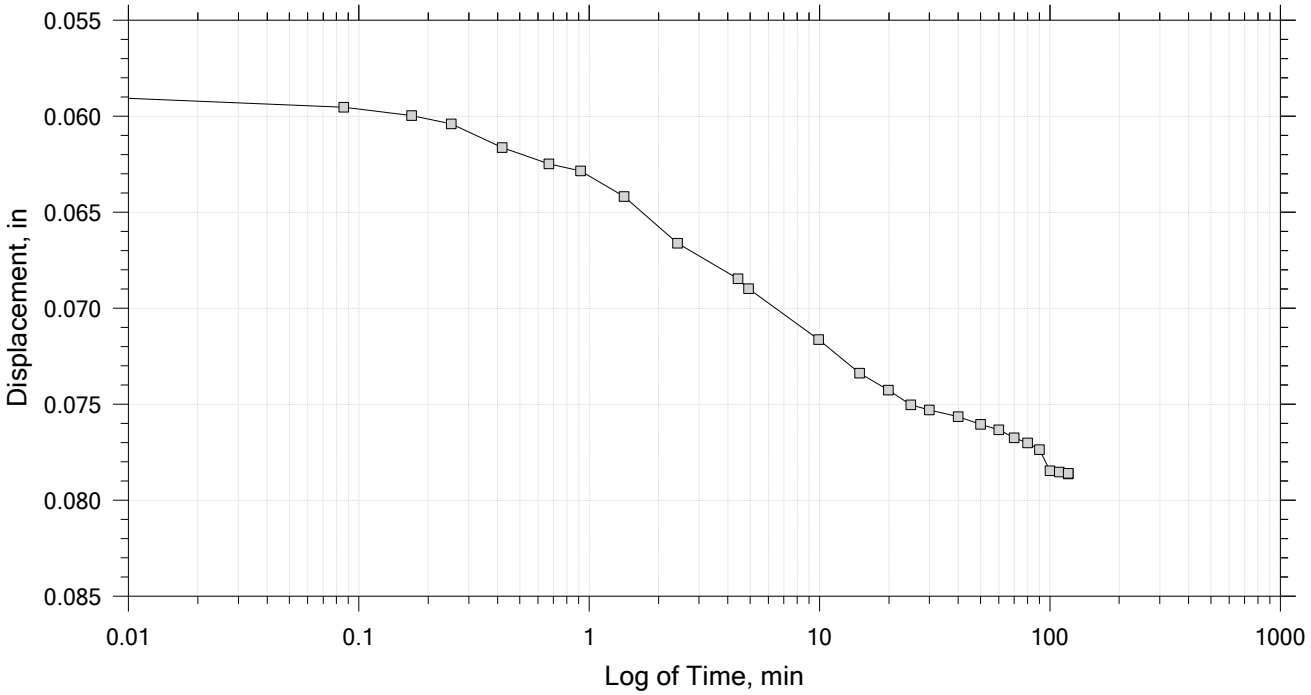


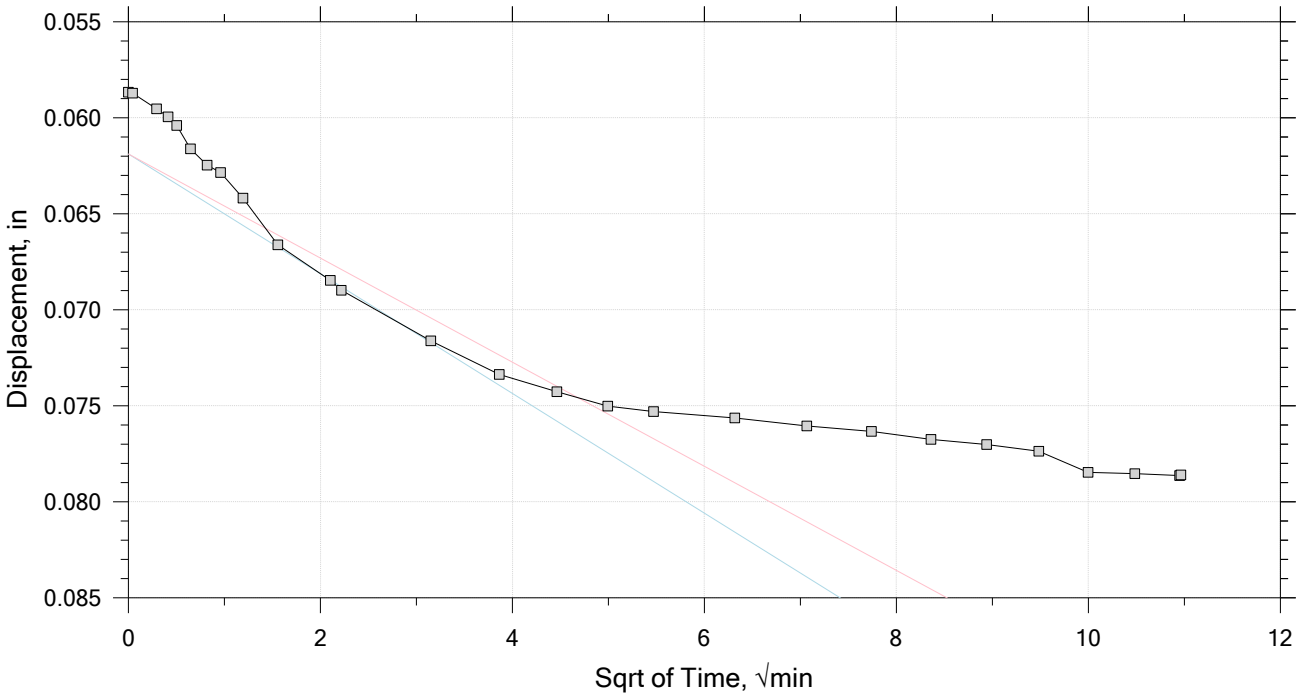


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 30
Constant Load Step
Stress: 8.61e+03 psf

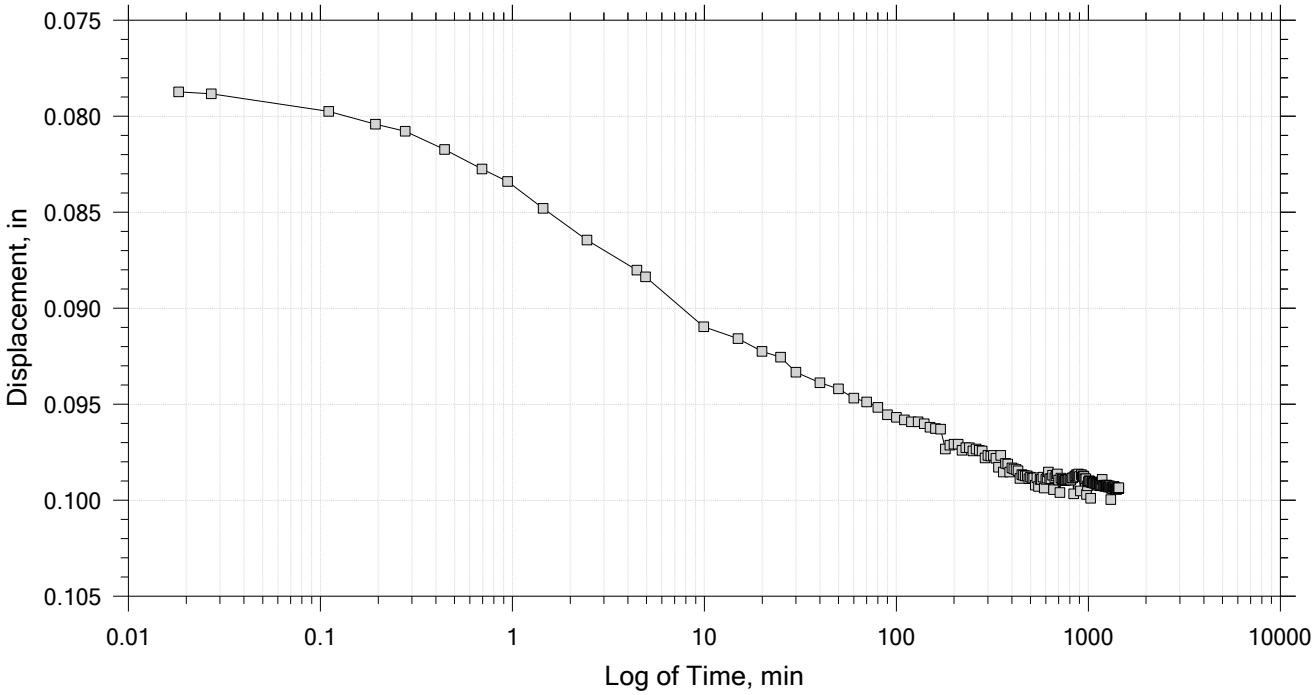


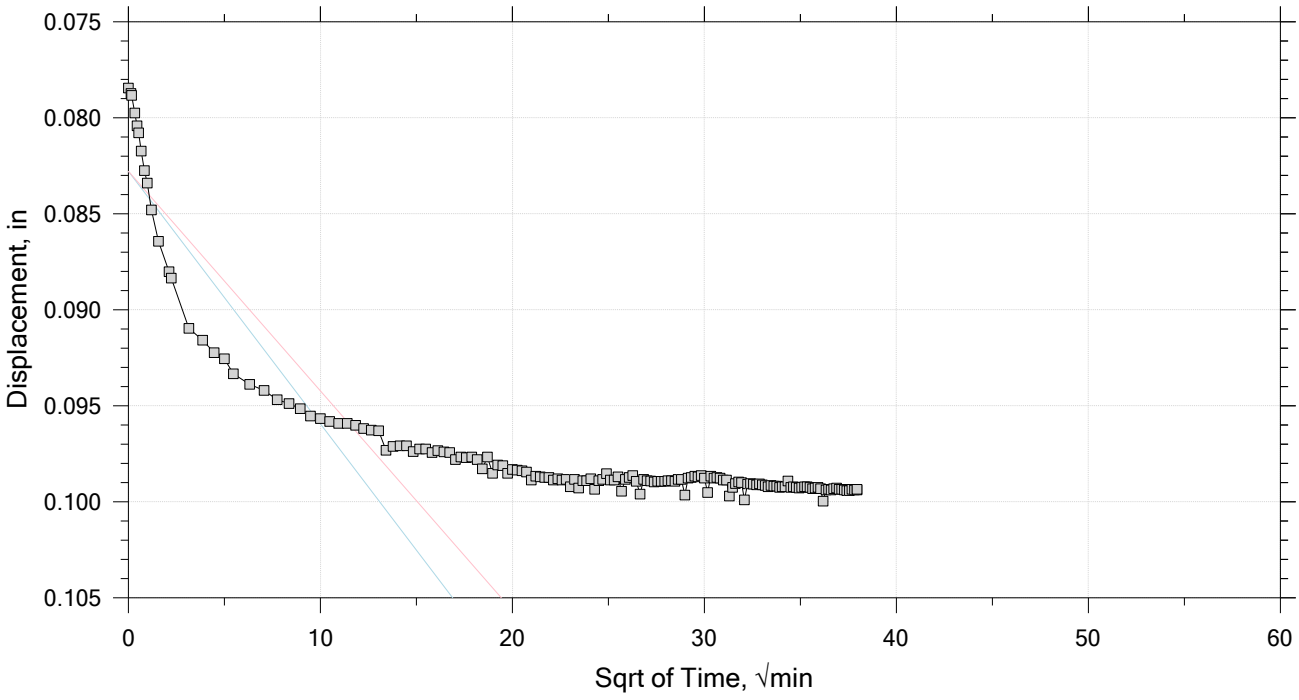


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 30
Constant Load Step
Stress: 1.29e+04 psf

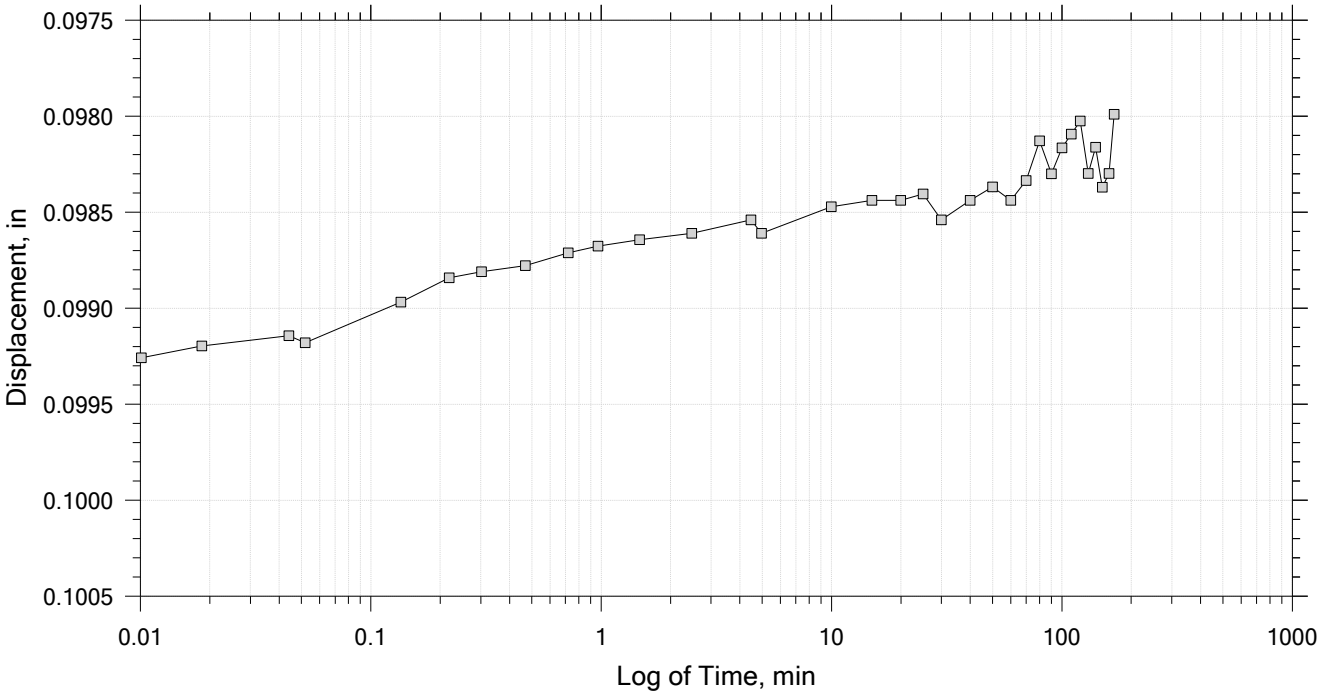


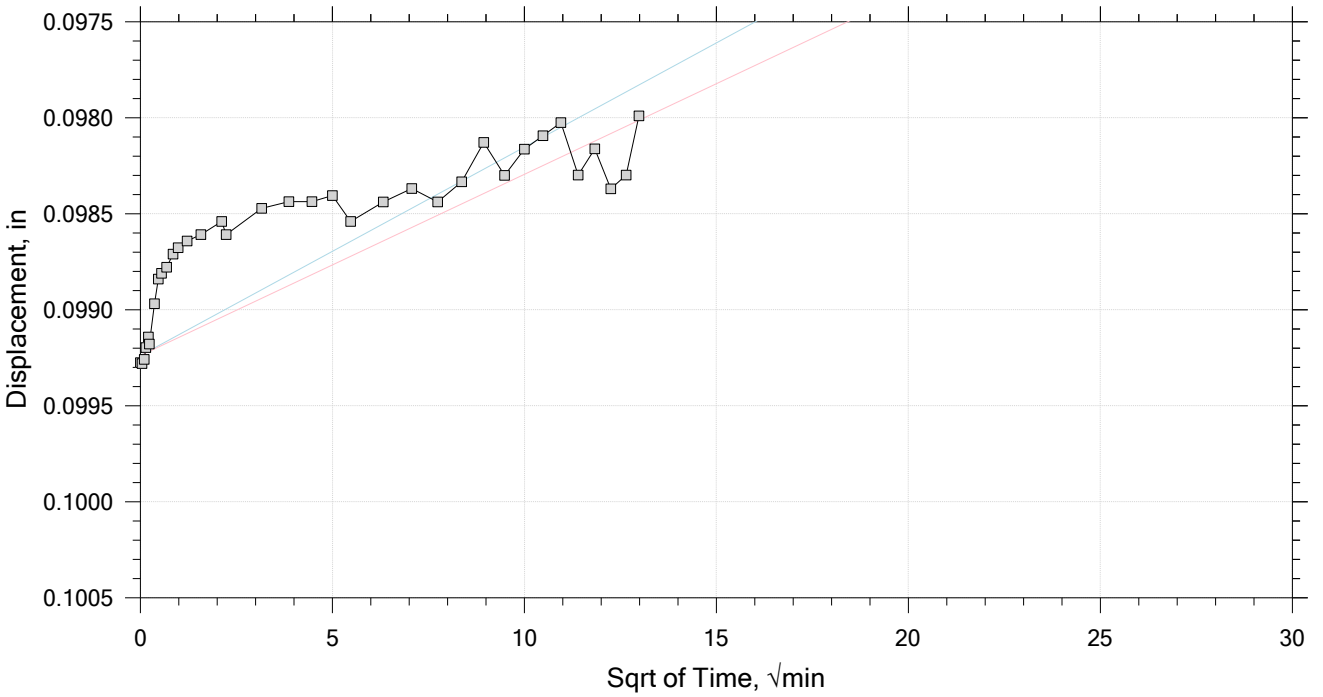


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 30
Constant Load Step
Stress: 6.46e+03 psf

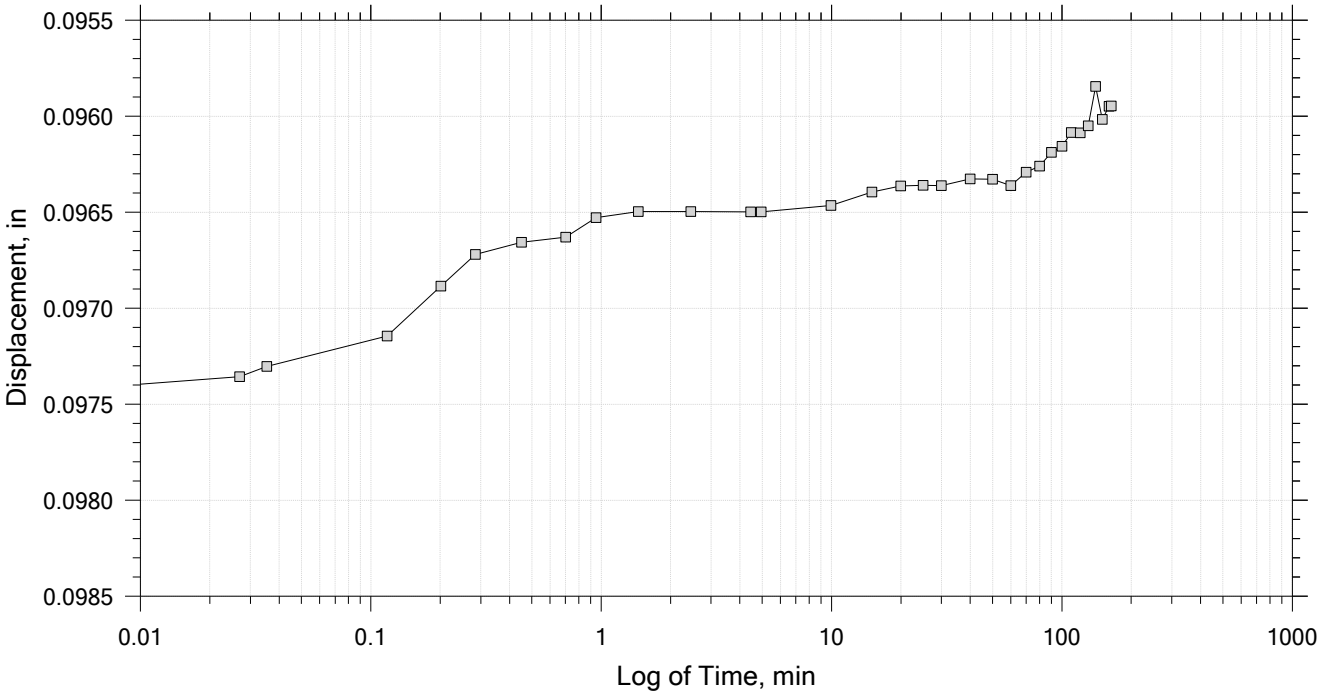


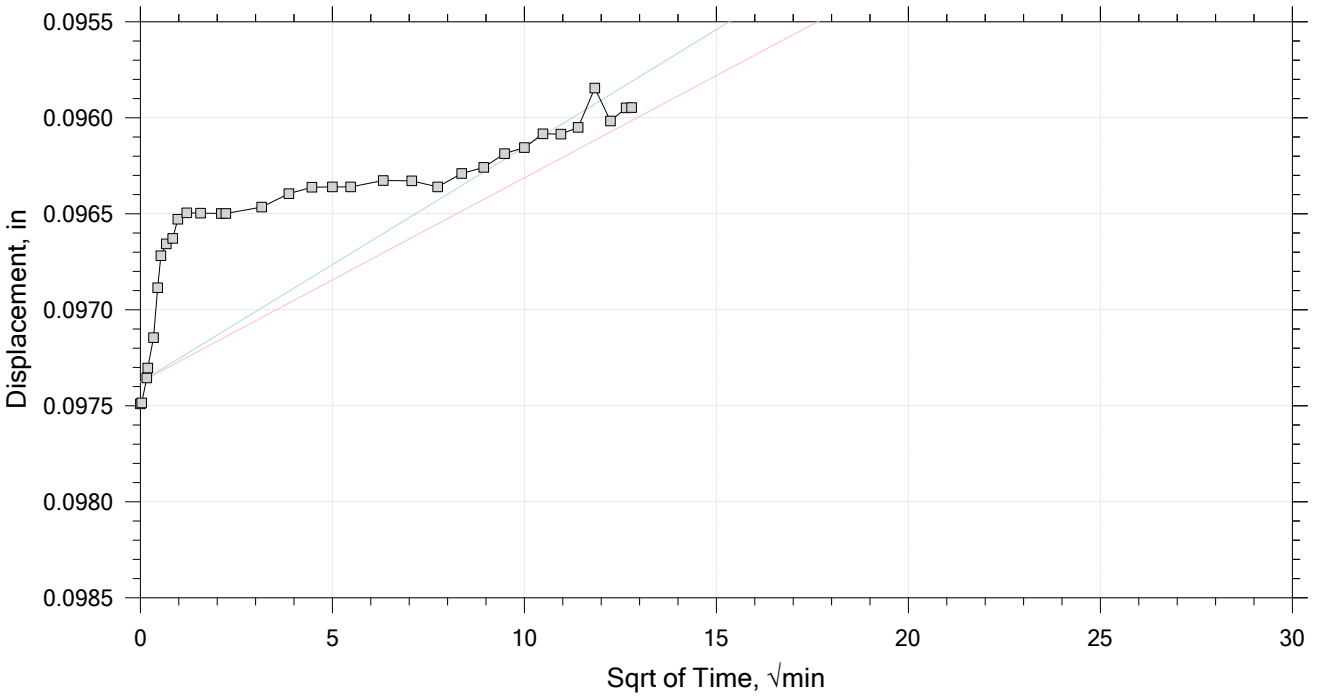


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 30
Constant Load Step
Stress: 3.23e+03 psf

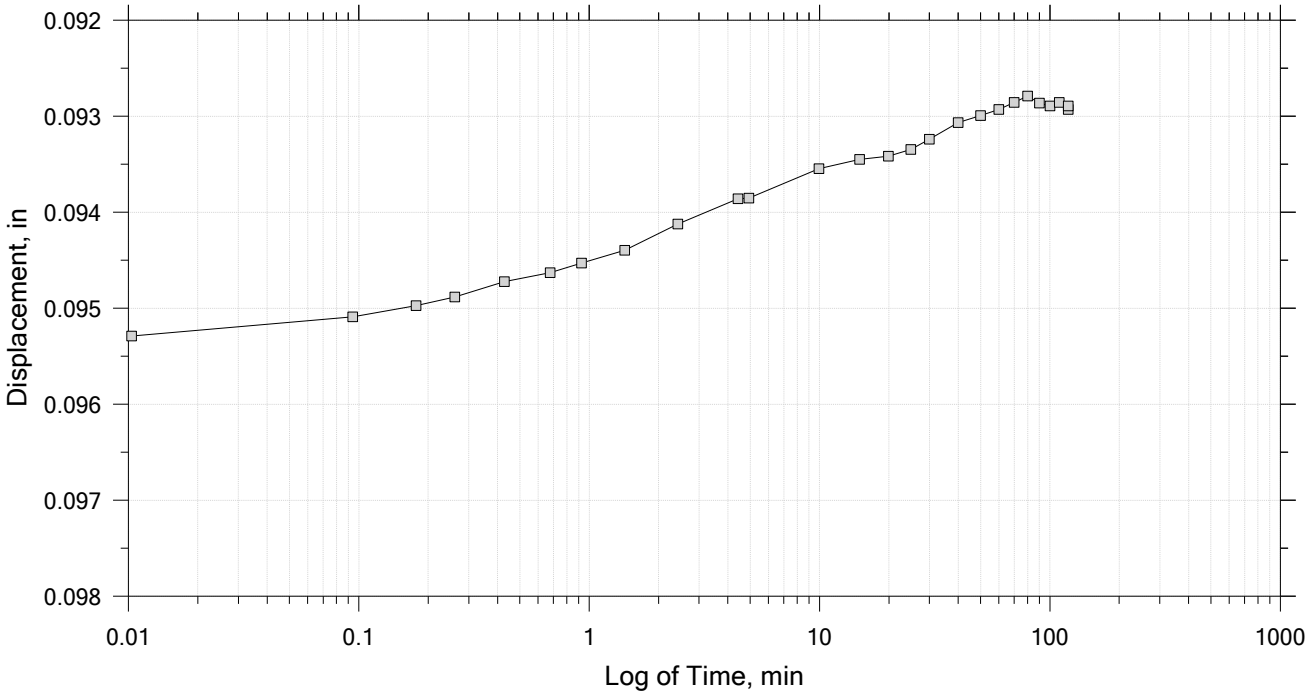


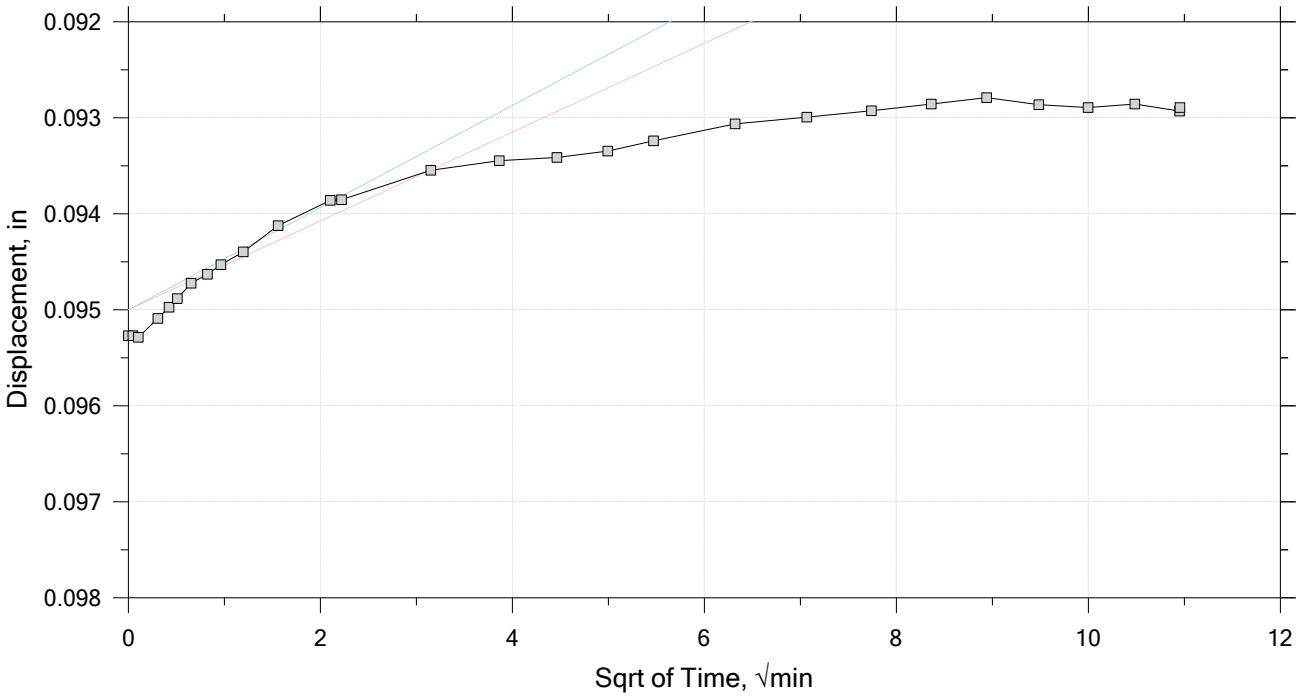


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 30
Constant Load Step
Stress: 1.61e+03 psf

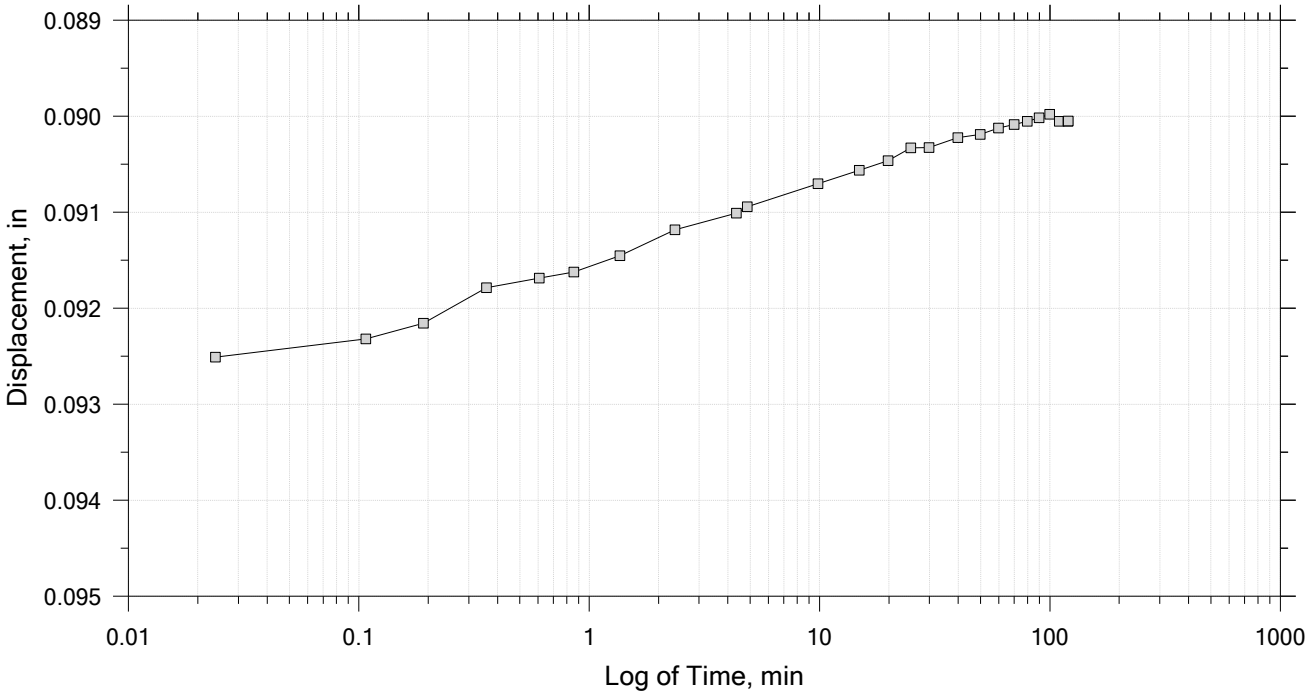


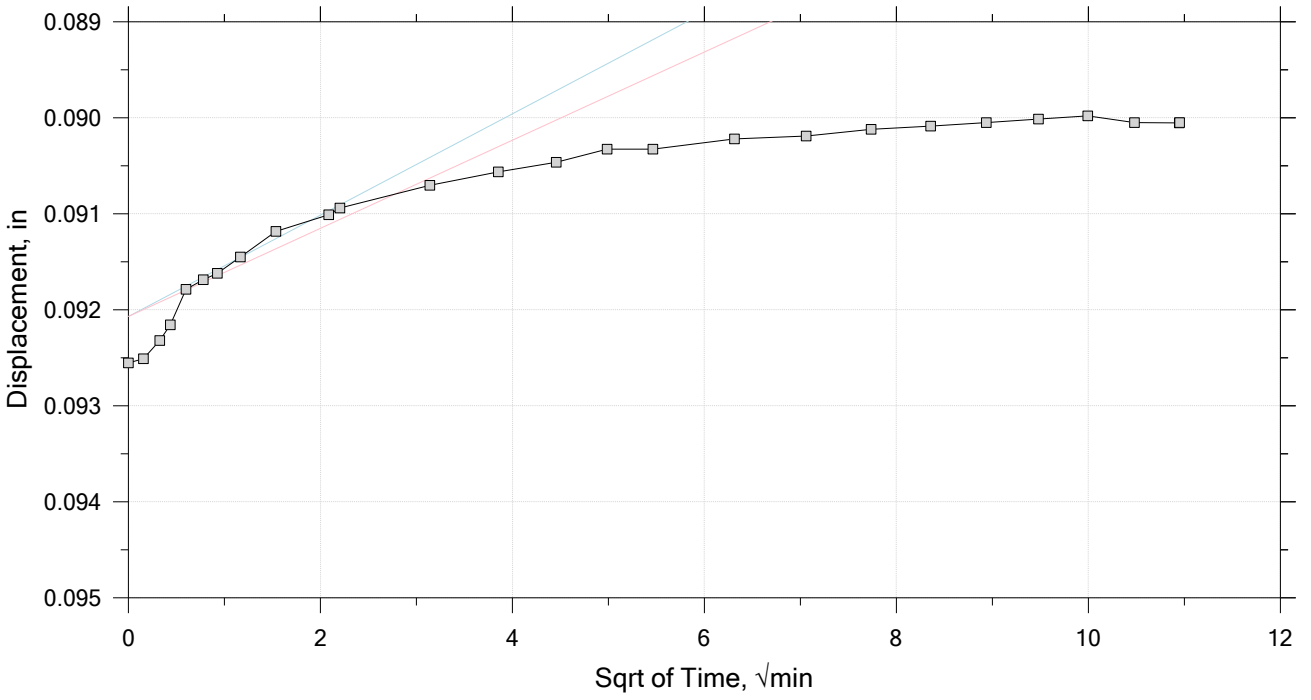


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 30
Constant Load Step
Stress: 807 psf

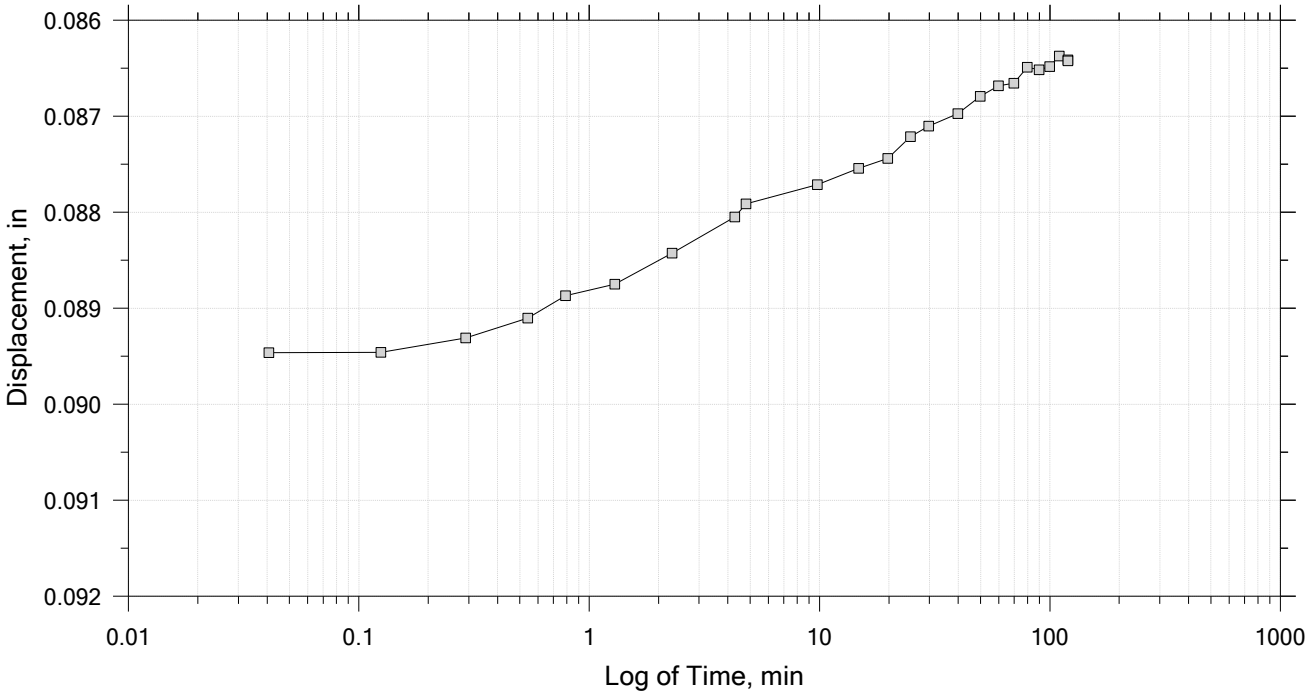


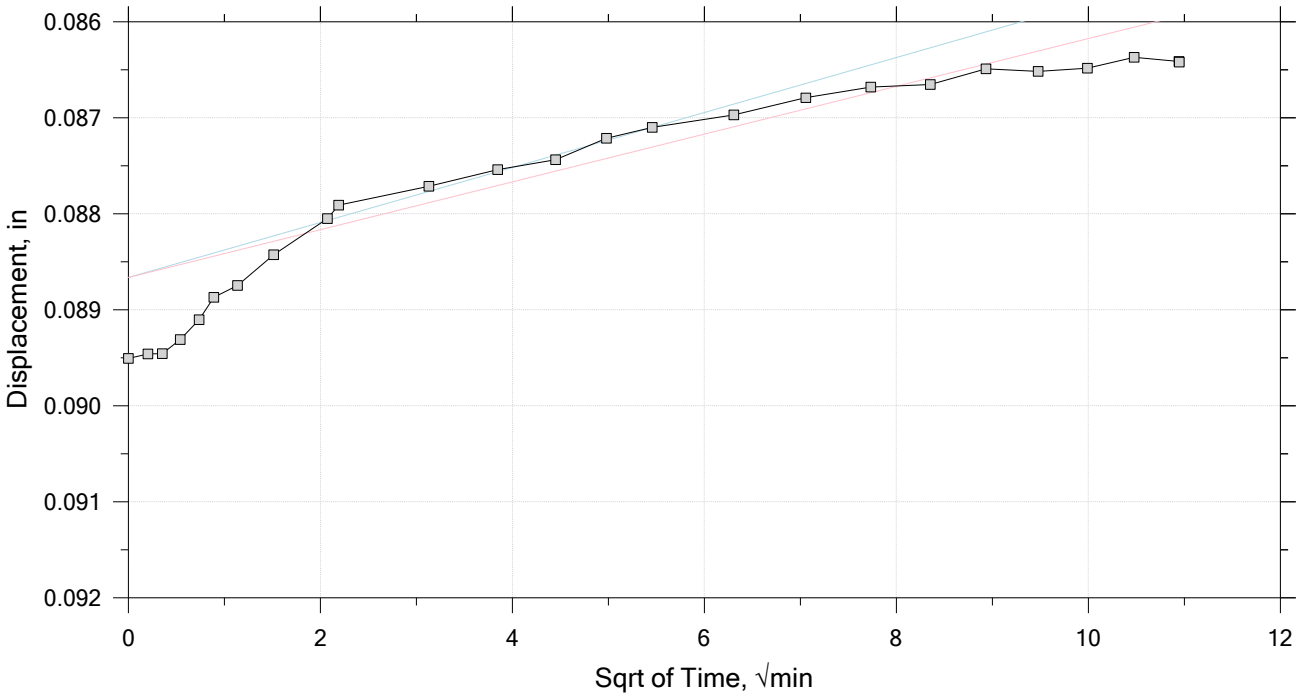


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 30
Constant Load Step
Stress: 404 psf

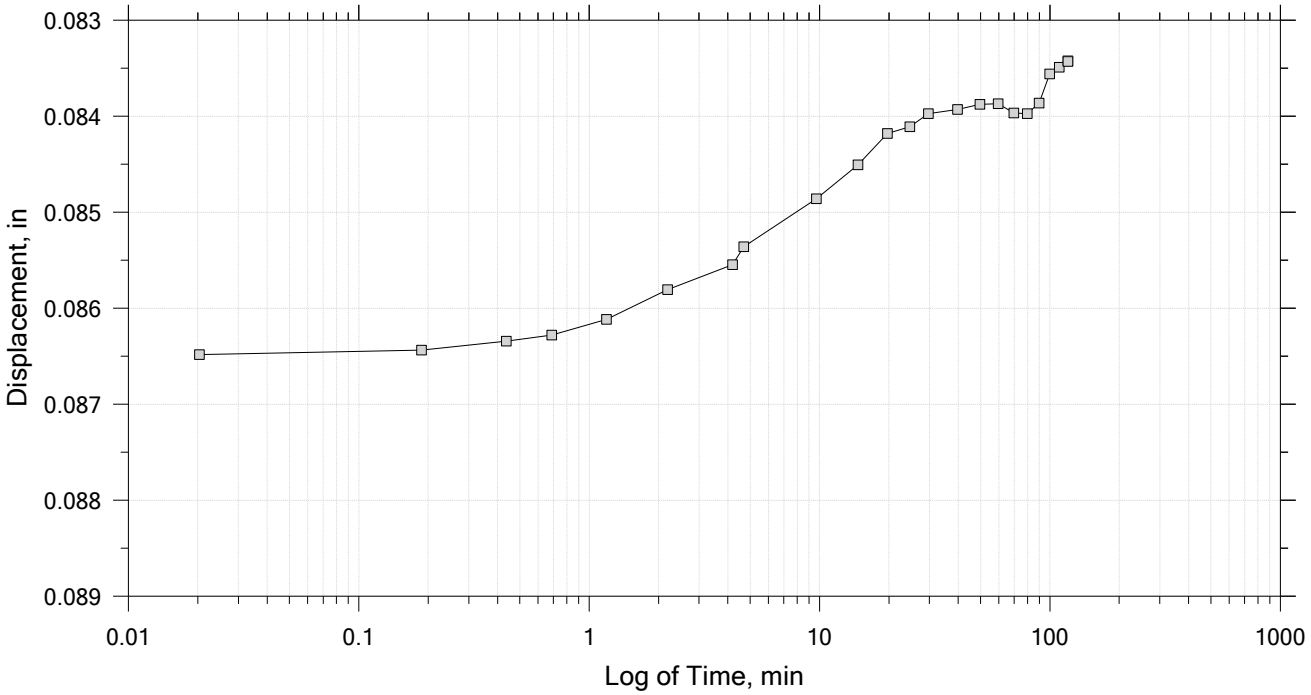


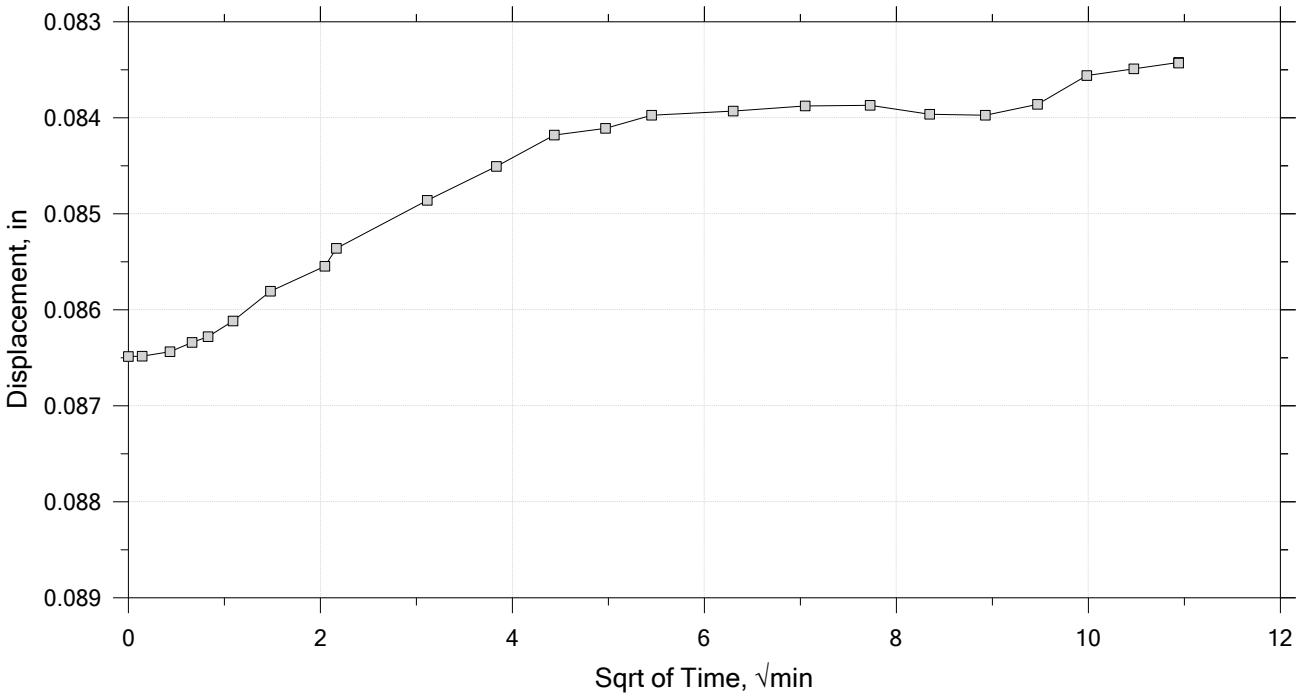


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 17 of 30
Constant Load Step
Stress: 202 psf

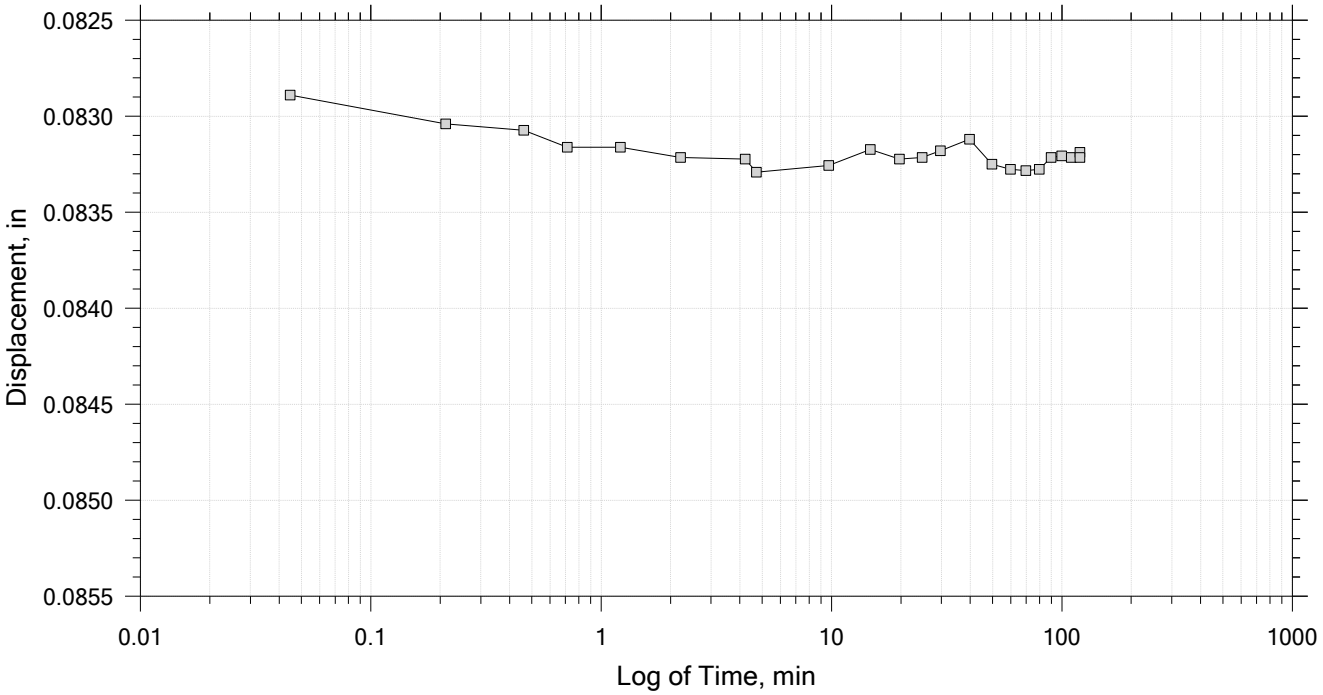


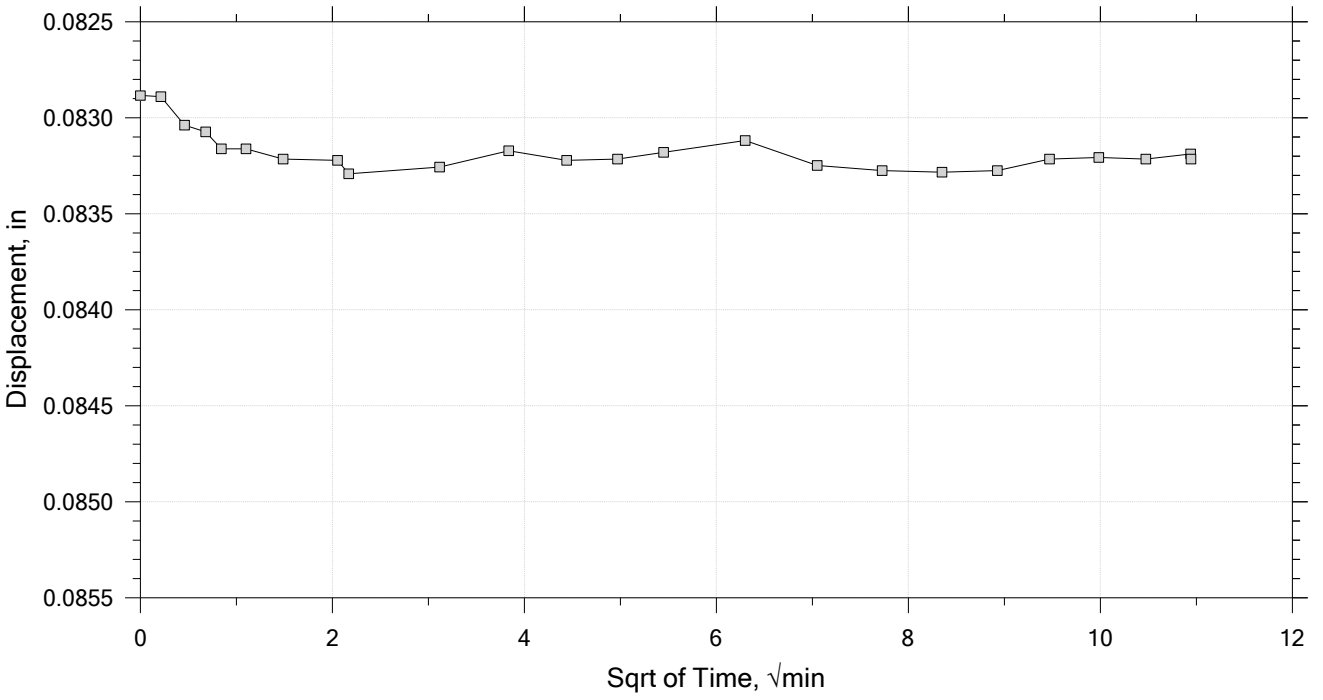


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 18 of 30
Constant Load Step
Stress: 404 psf

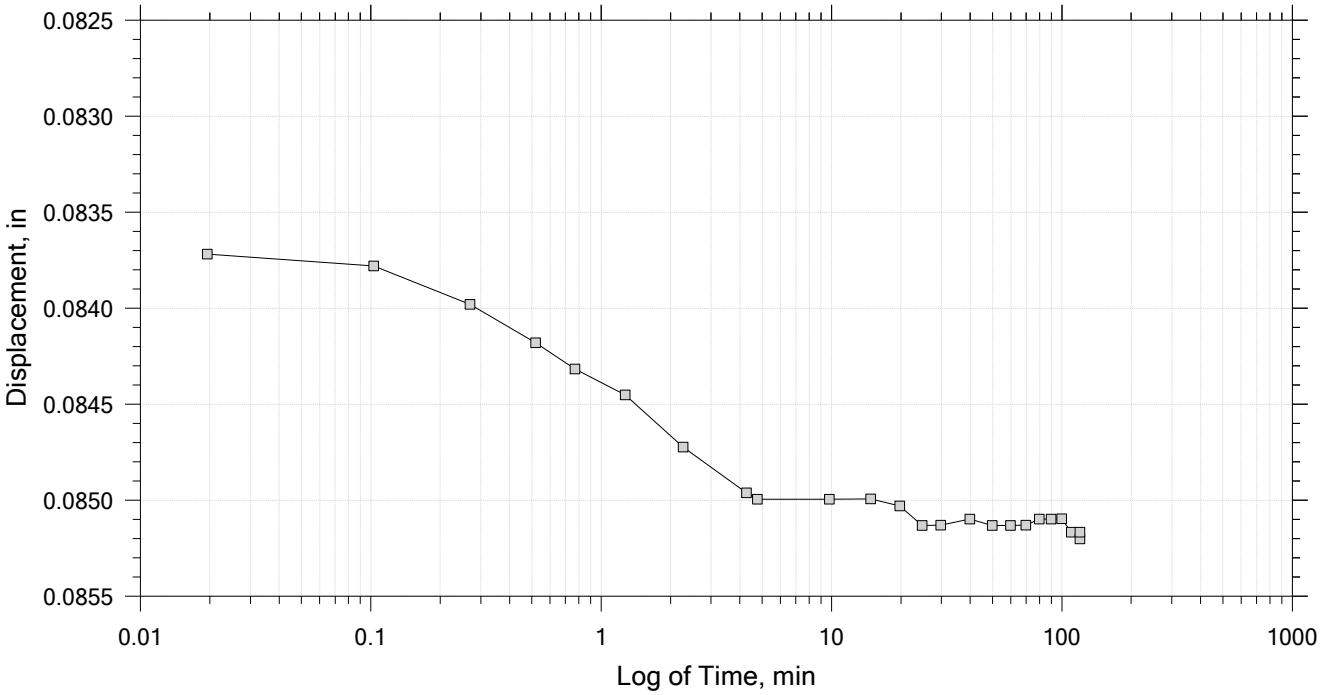


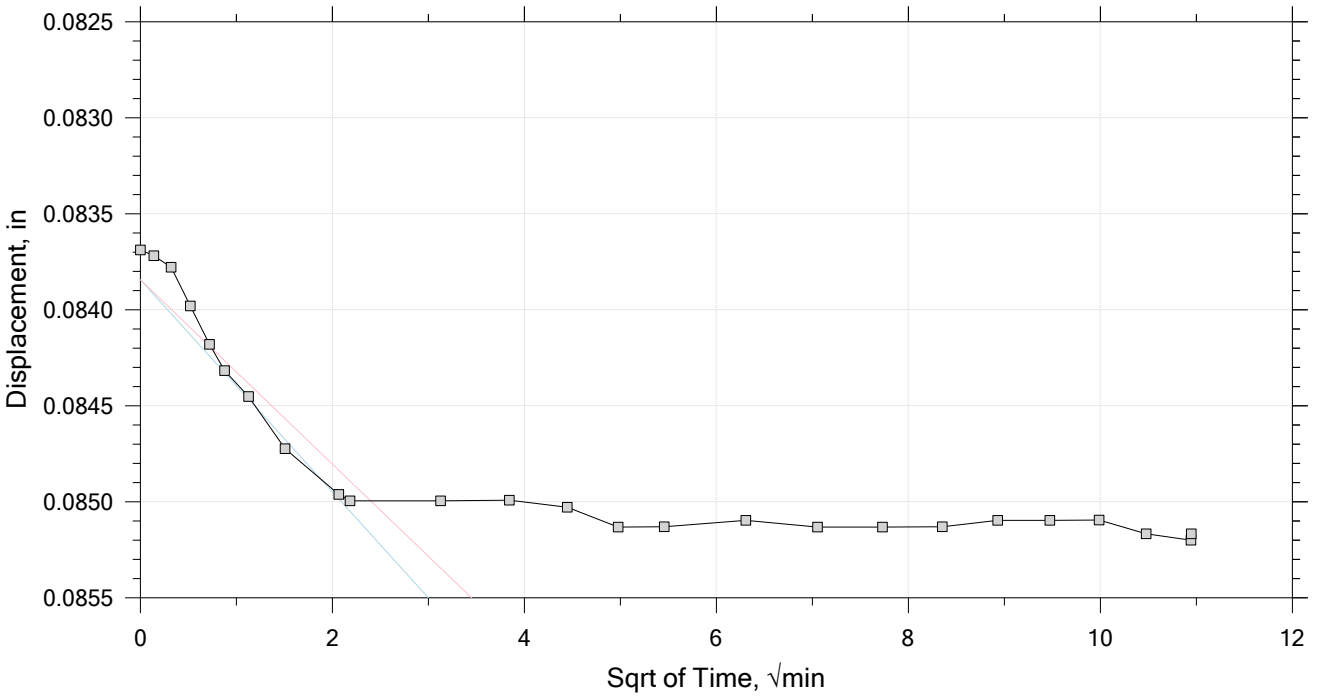


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 19 of 30
Constant Load Step
Stress: 807 psf

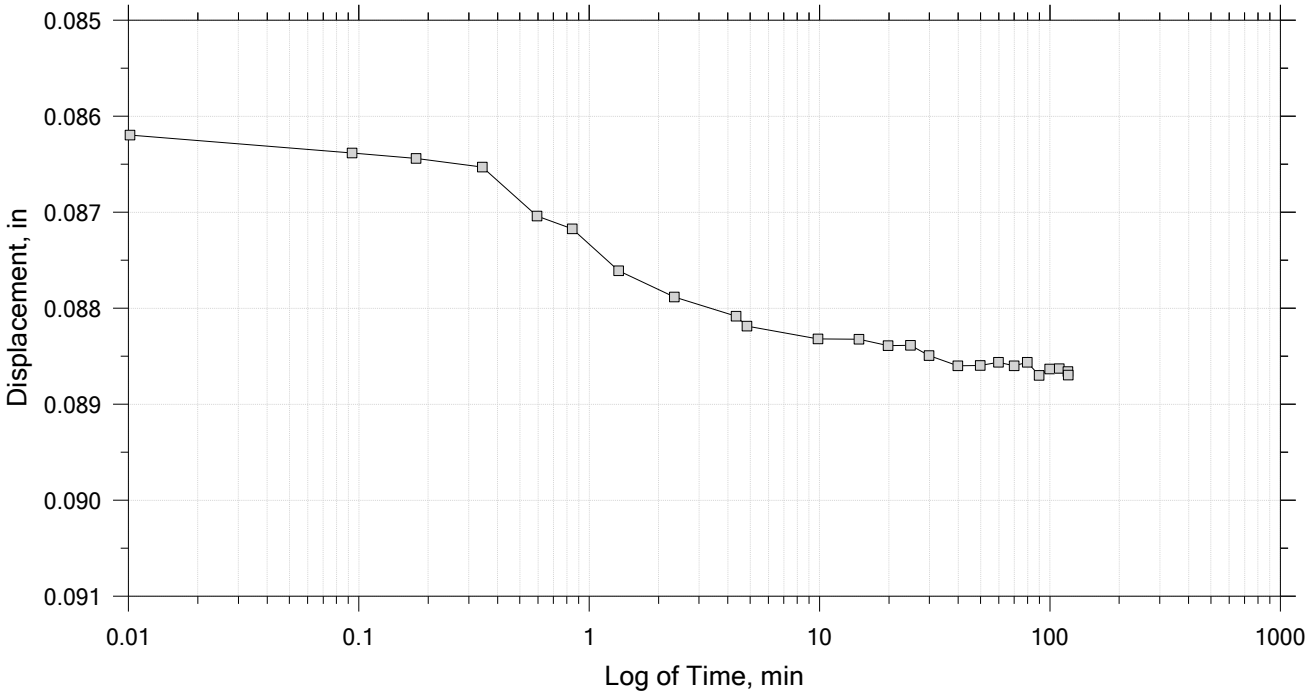


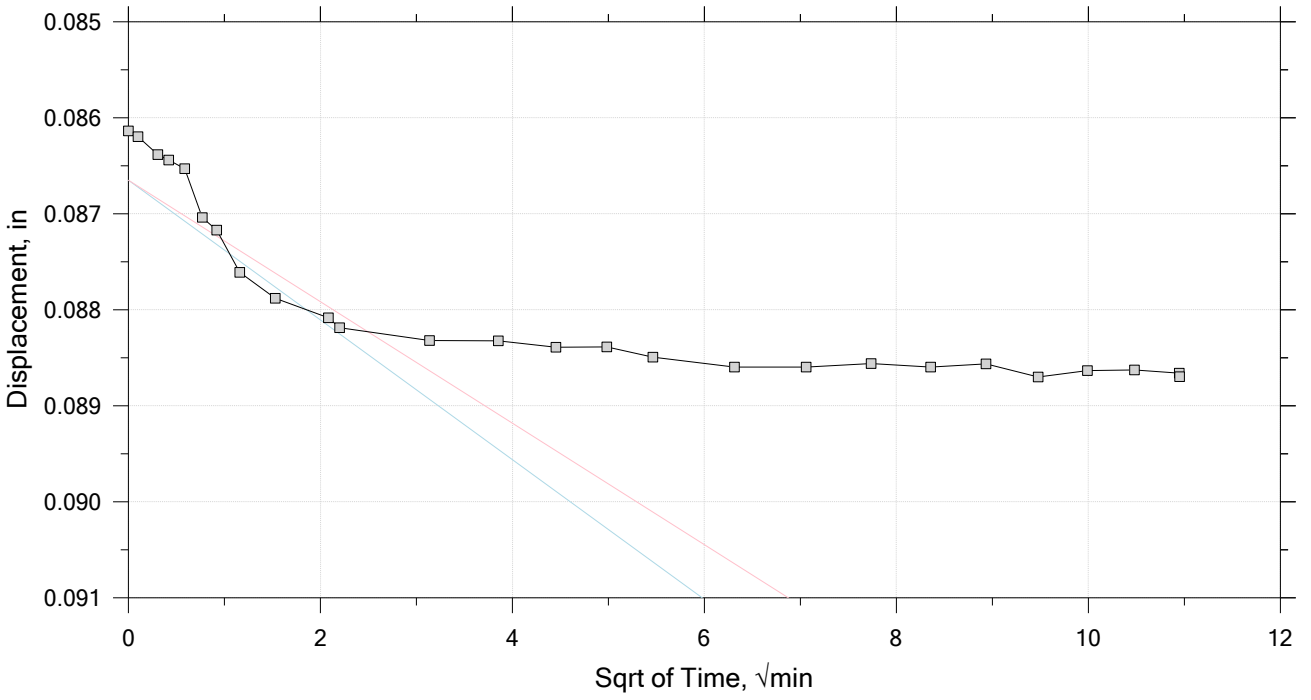


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 20 of 30
Constant Load Step
Stress: 1.61e+03 psf

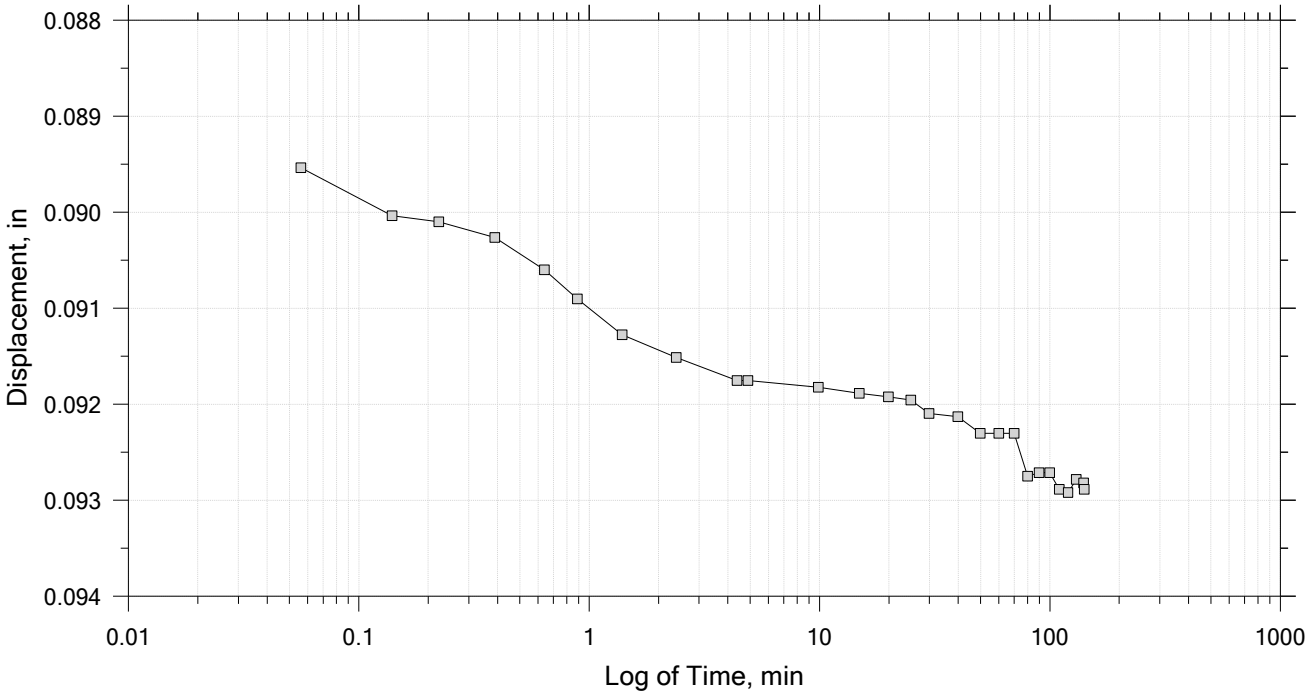


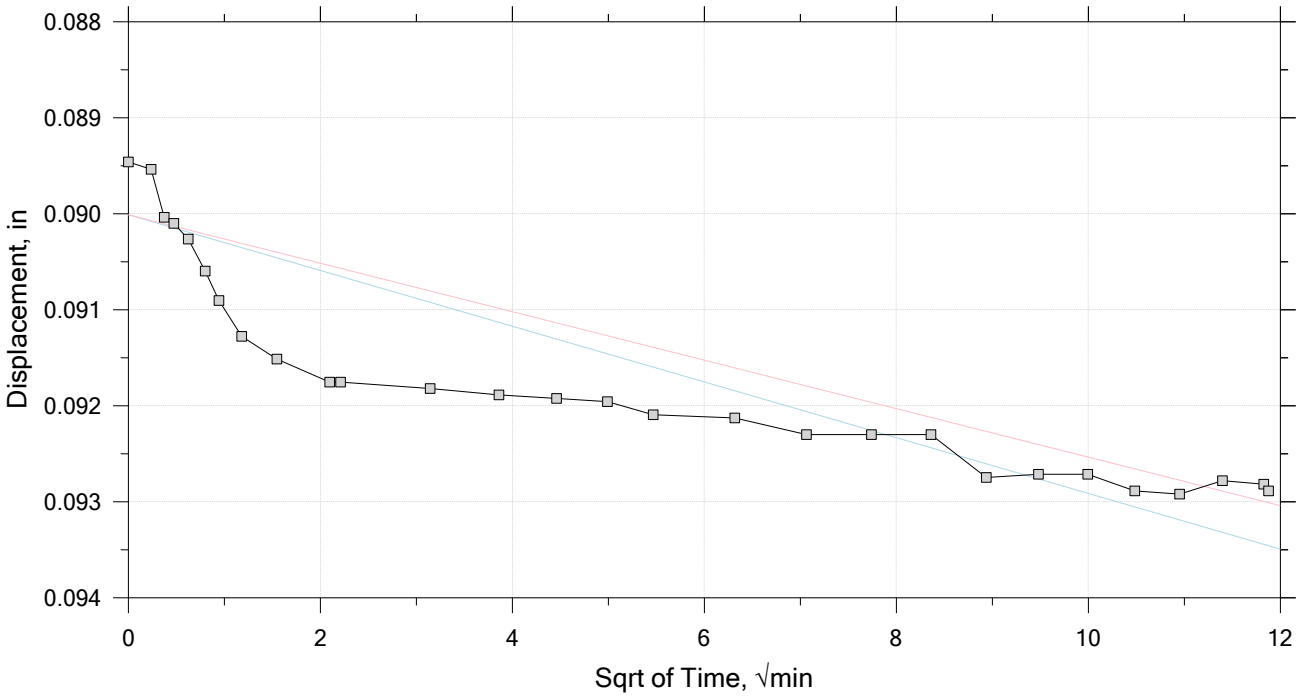


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 21 of 30
Constant Load Step
Stress: 3.23e+03 psf

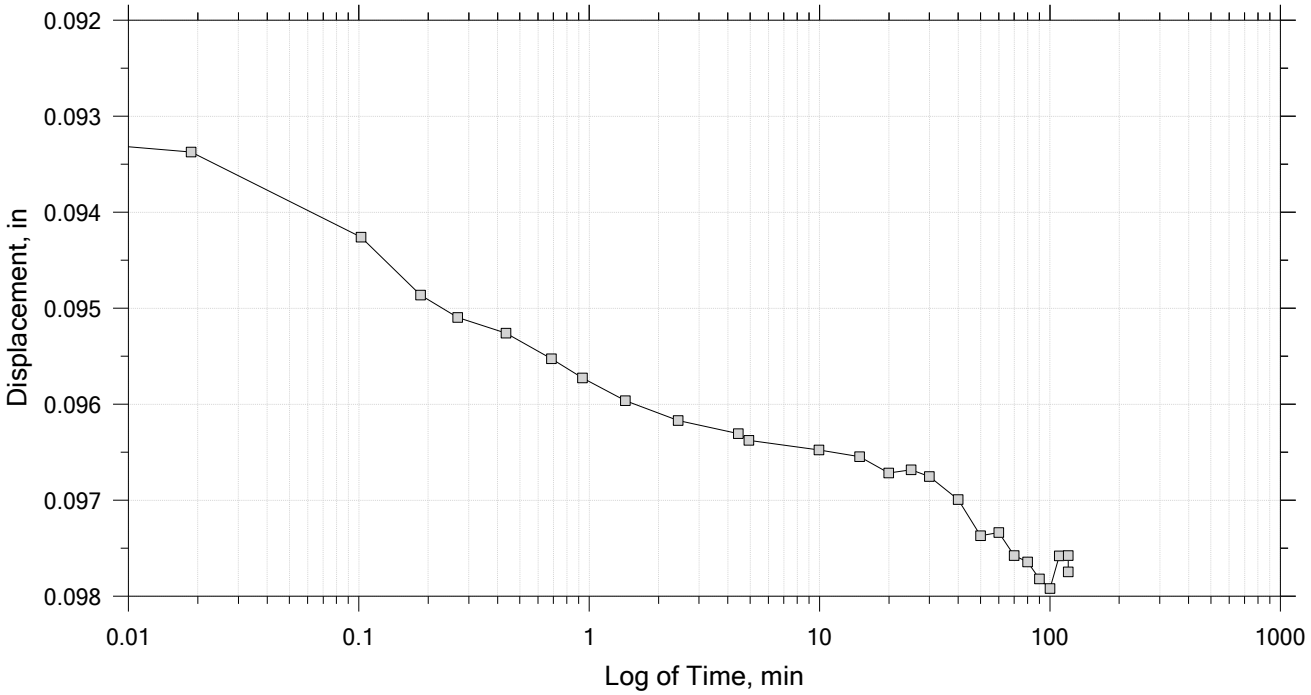


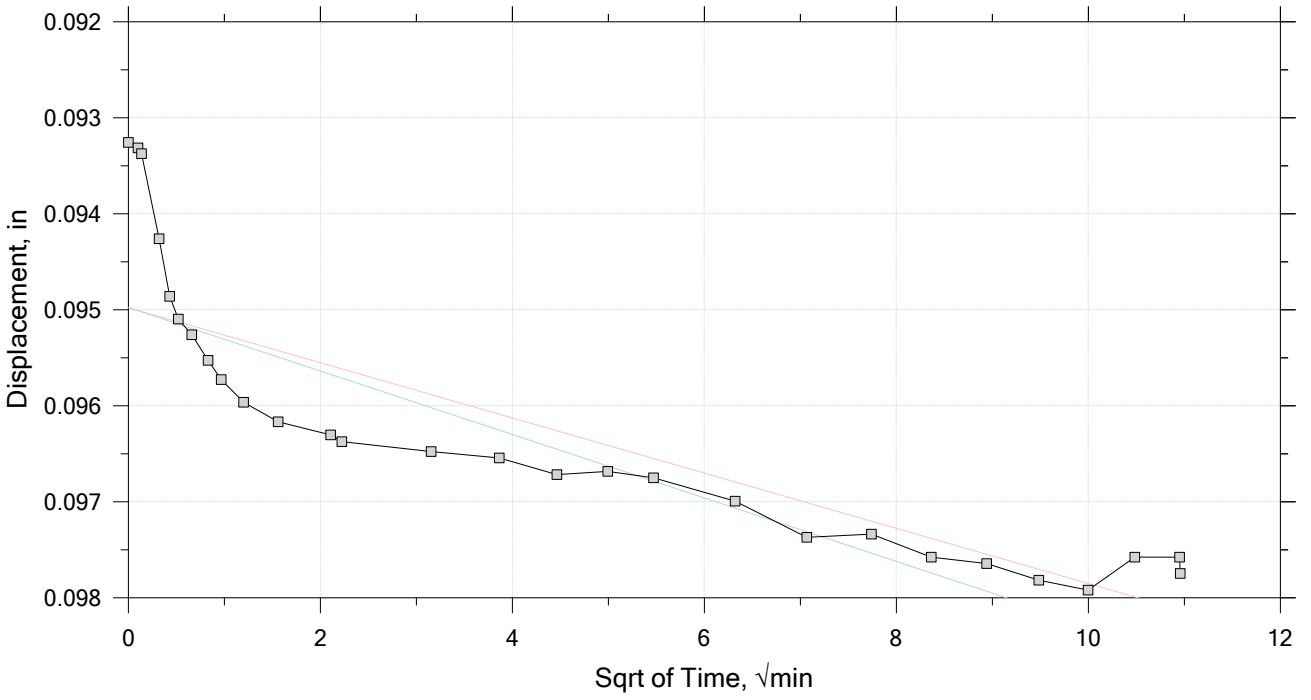


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 22 of 30
Constant Load Step
Stress: 6.46e+03 psf

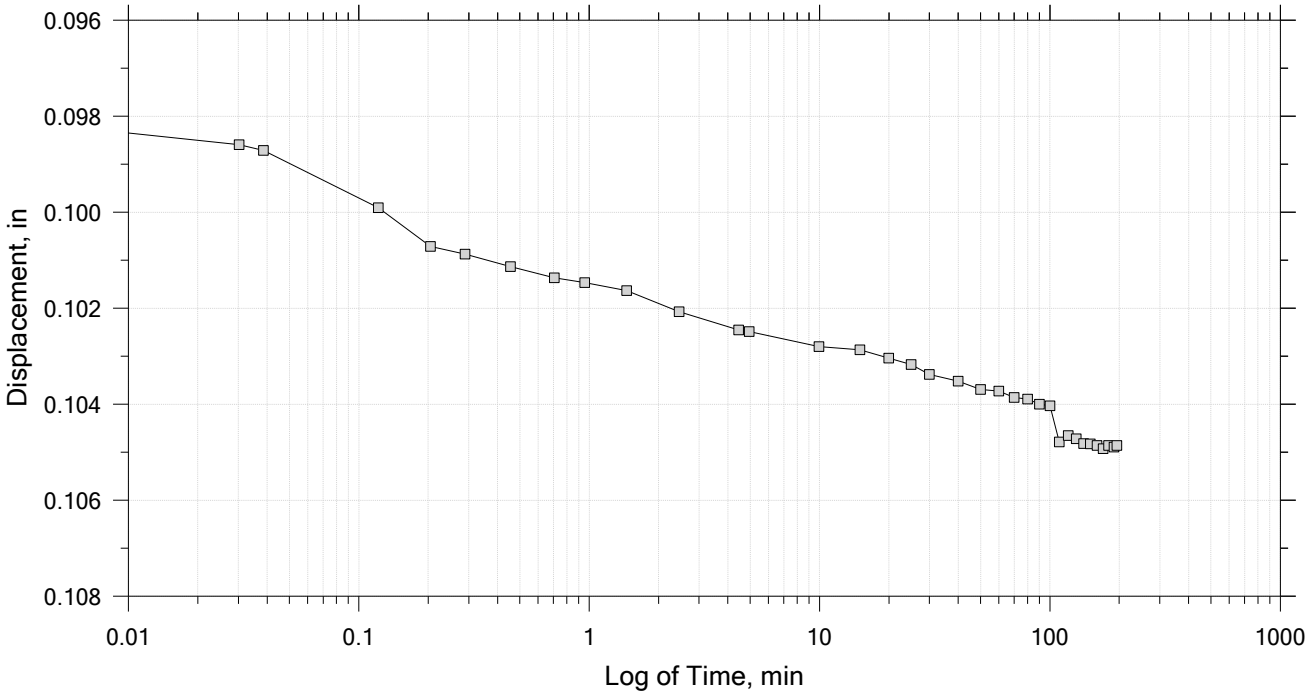


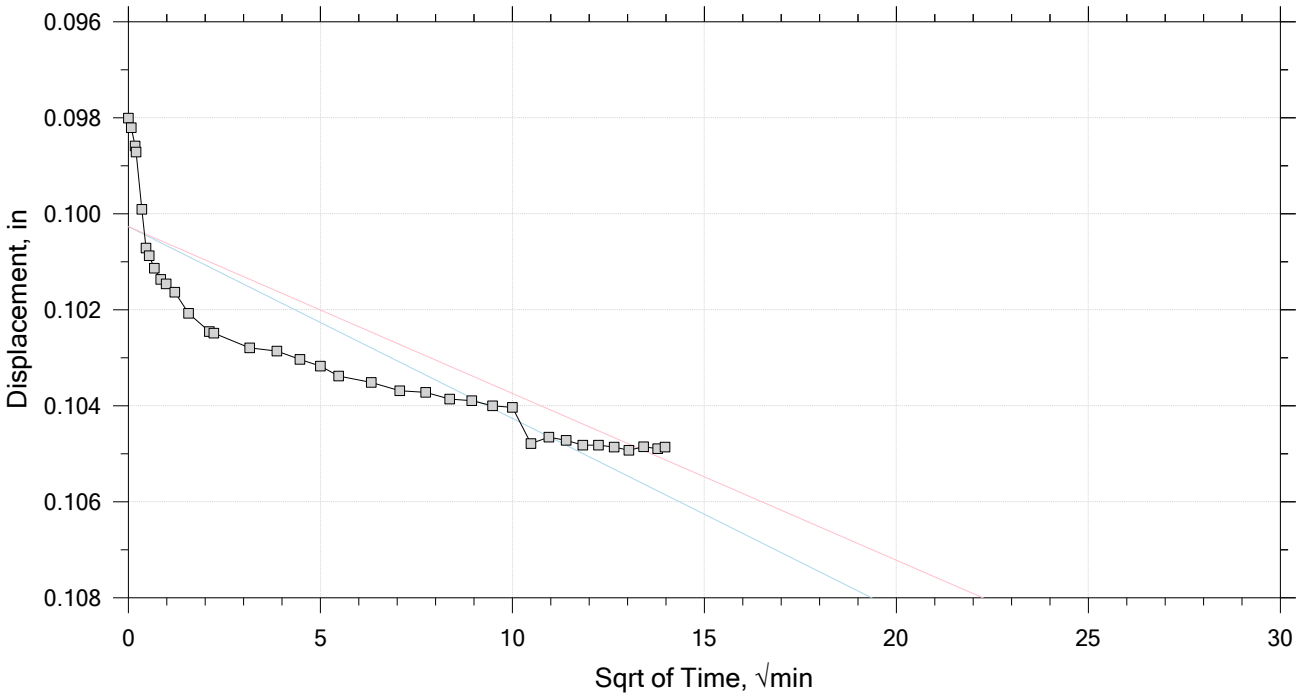


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 23 of 30
Constant Load Step
Stress: 1.29e+04 psf

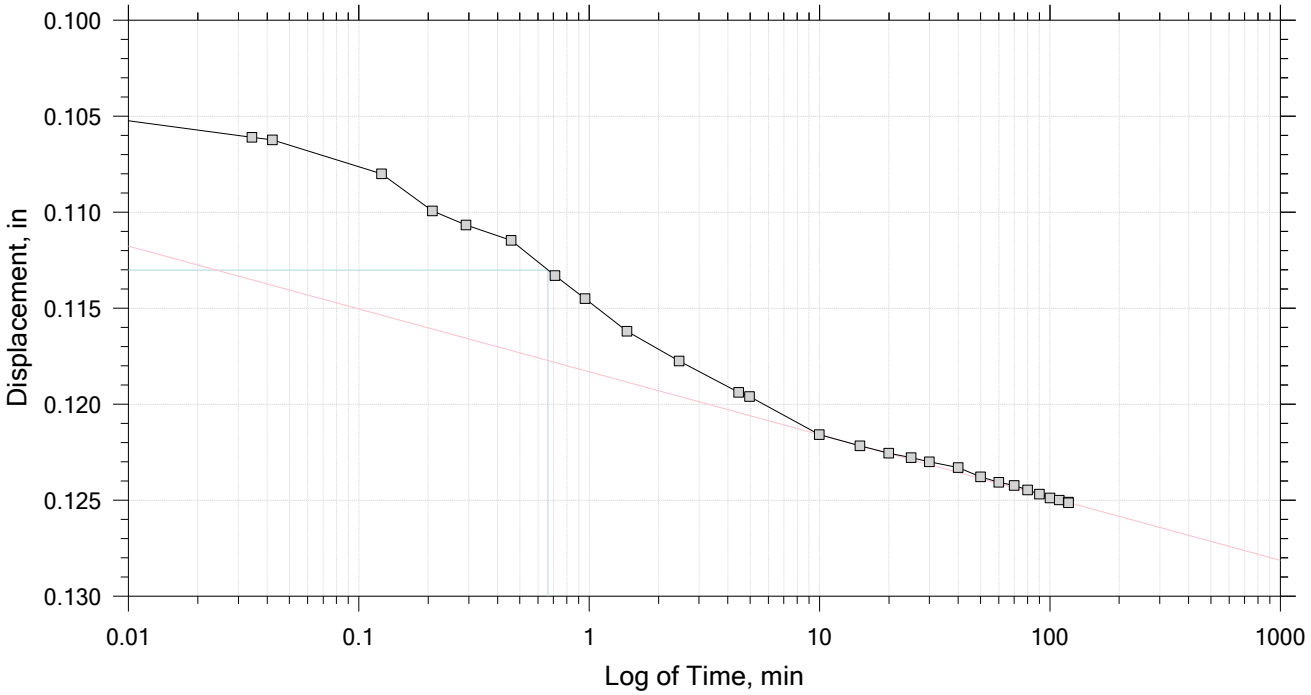


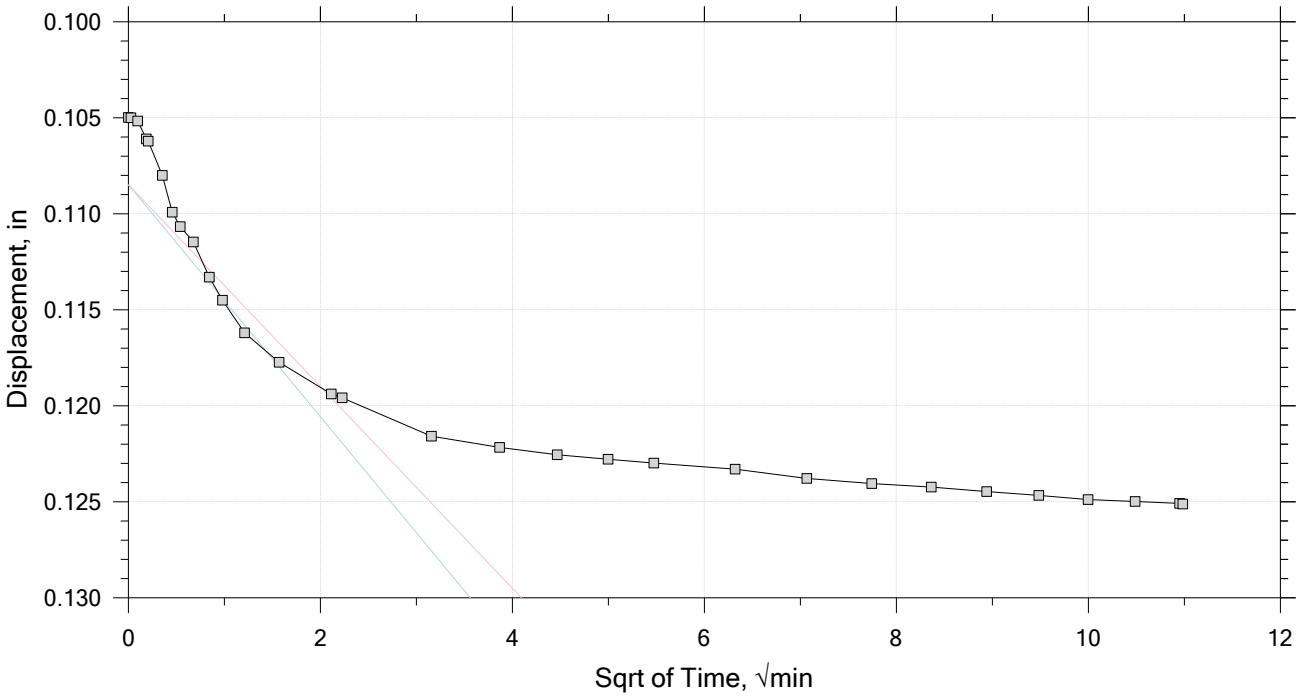


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 24 of 30
Constant Load Step
Stress: 2.58e+04 psf

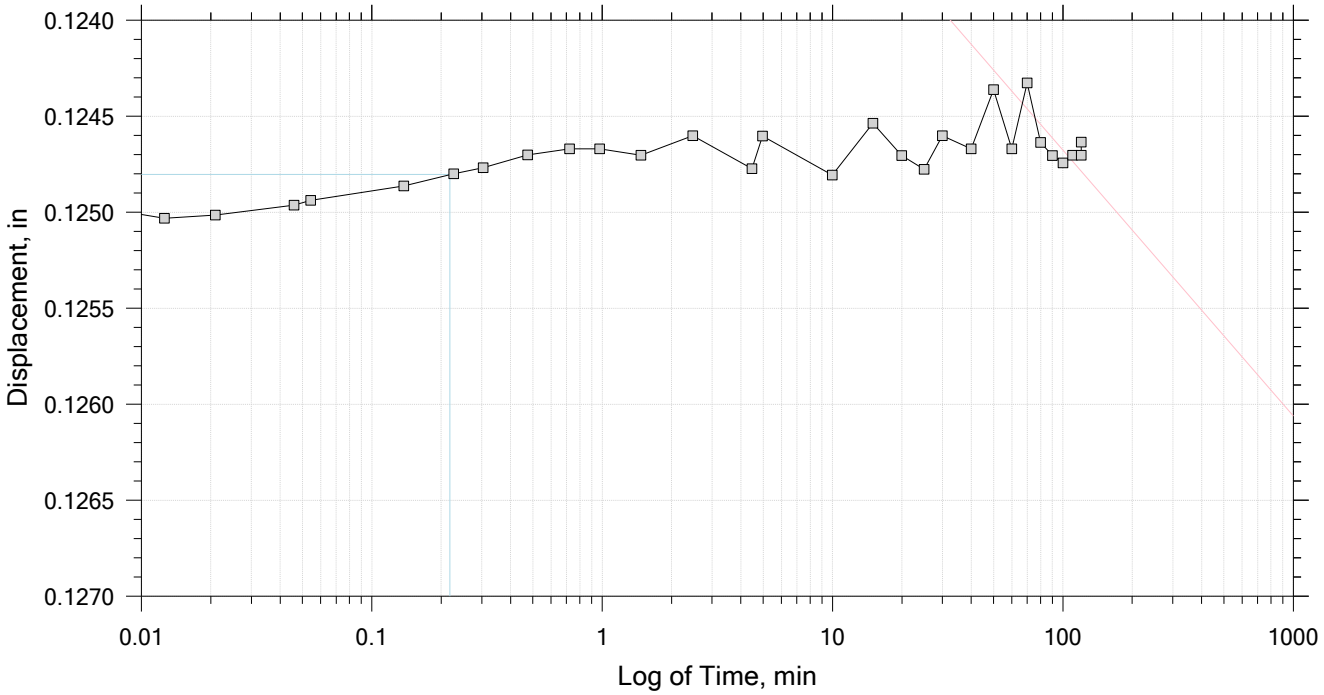


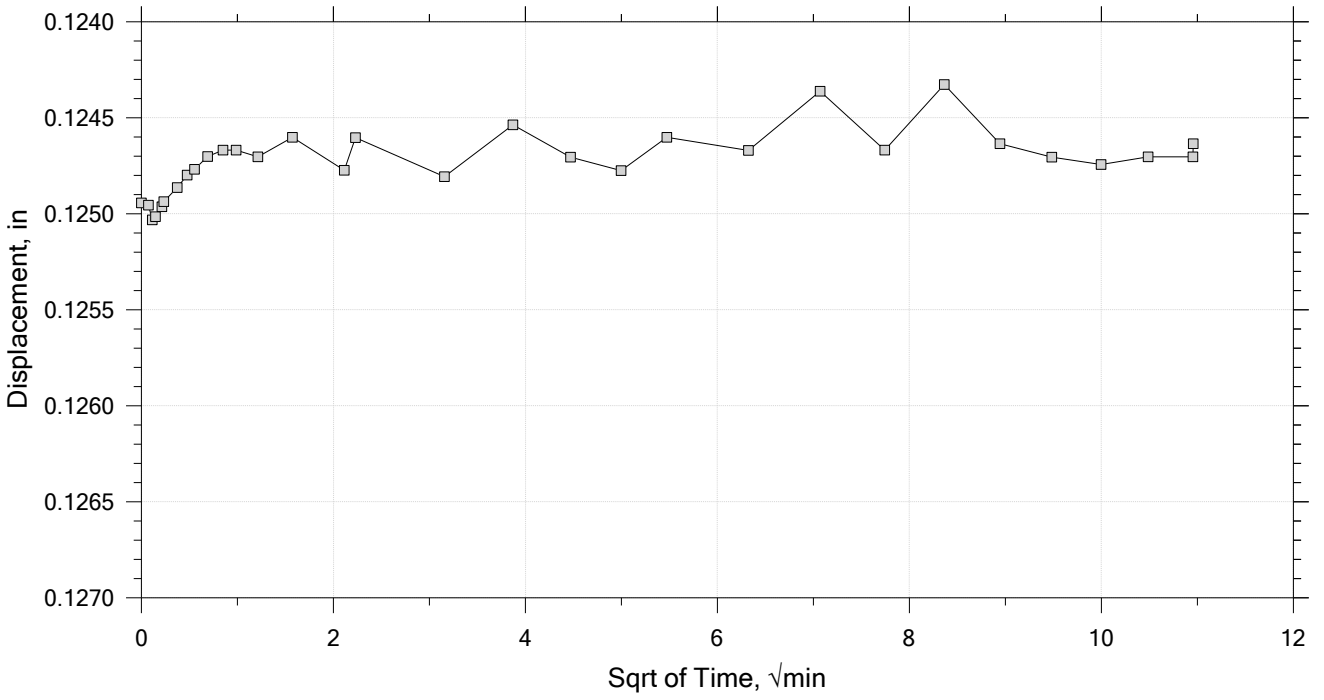


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 25 of 30
Constant Load Step
Stress: 1.29e+04 psf

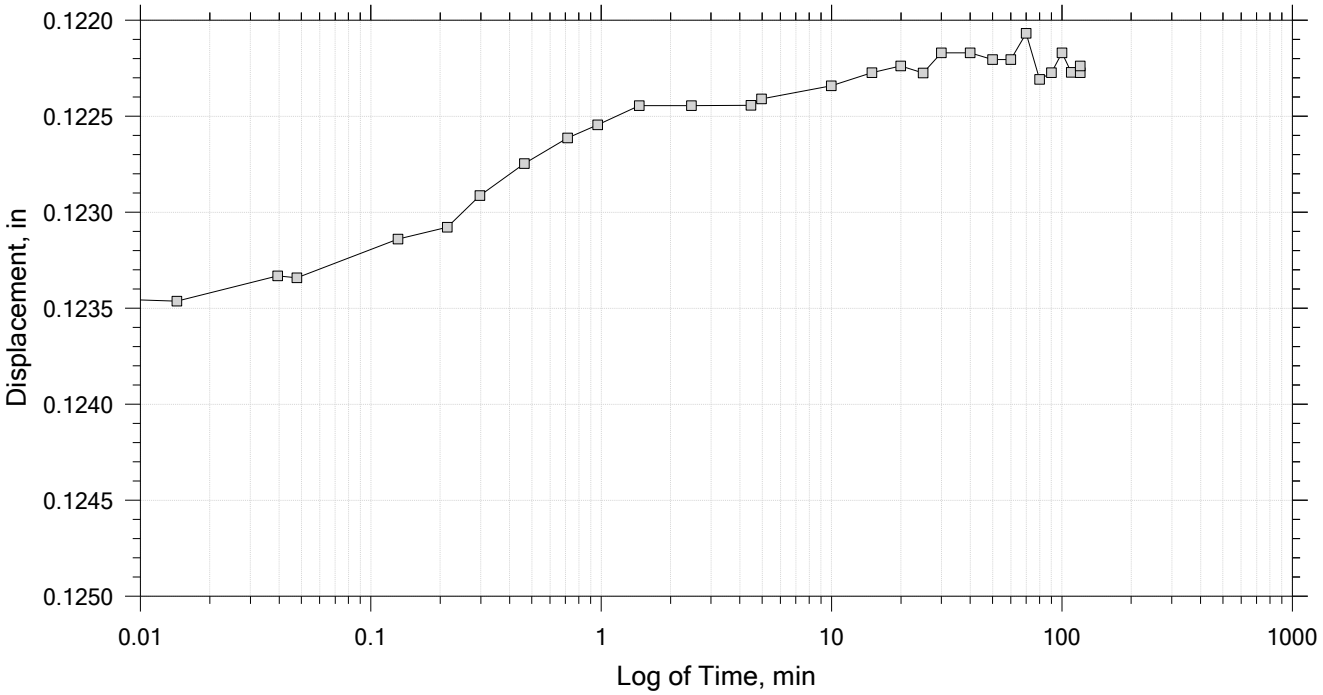


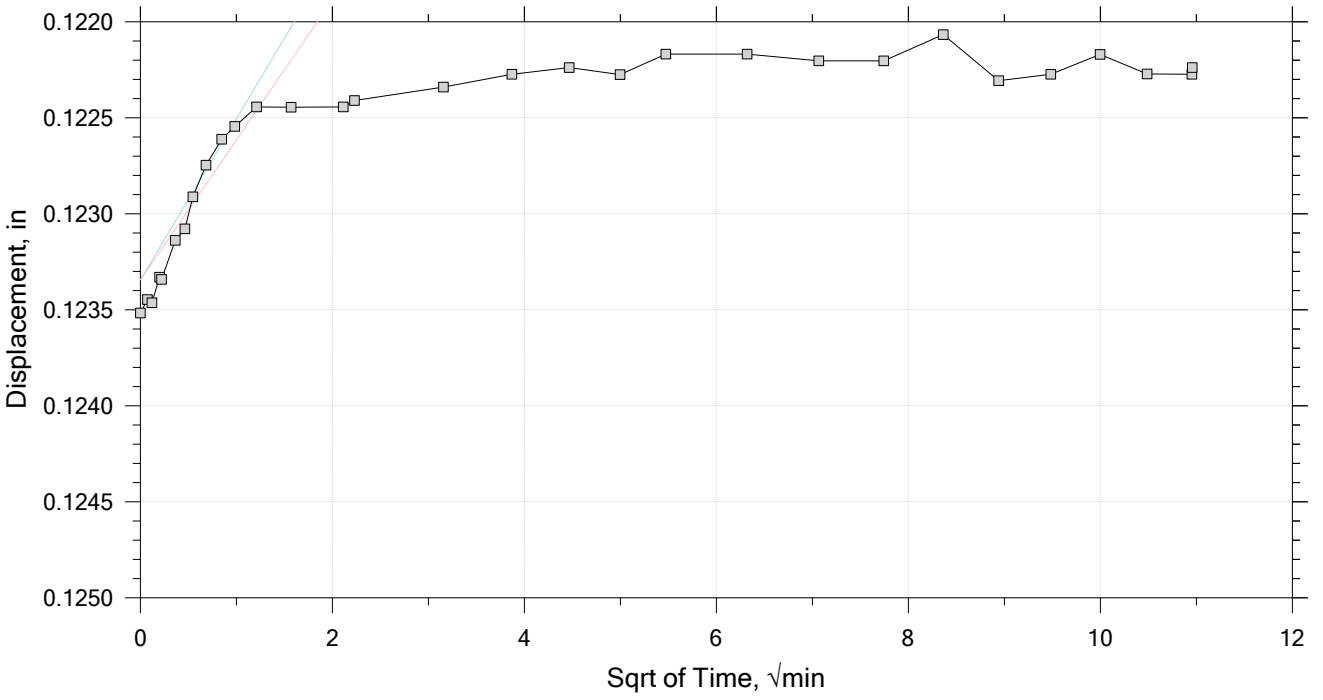


Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 26 of 30
Constant Load Step
Stress: 6.46e+03 psf

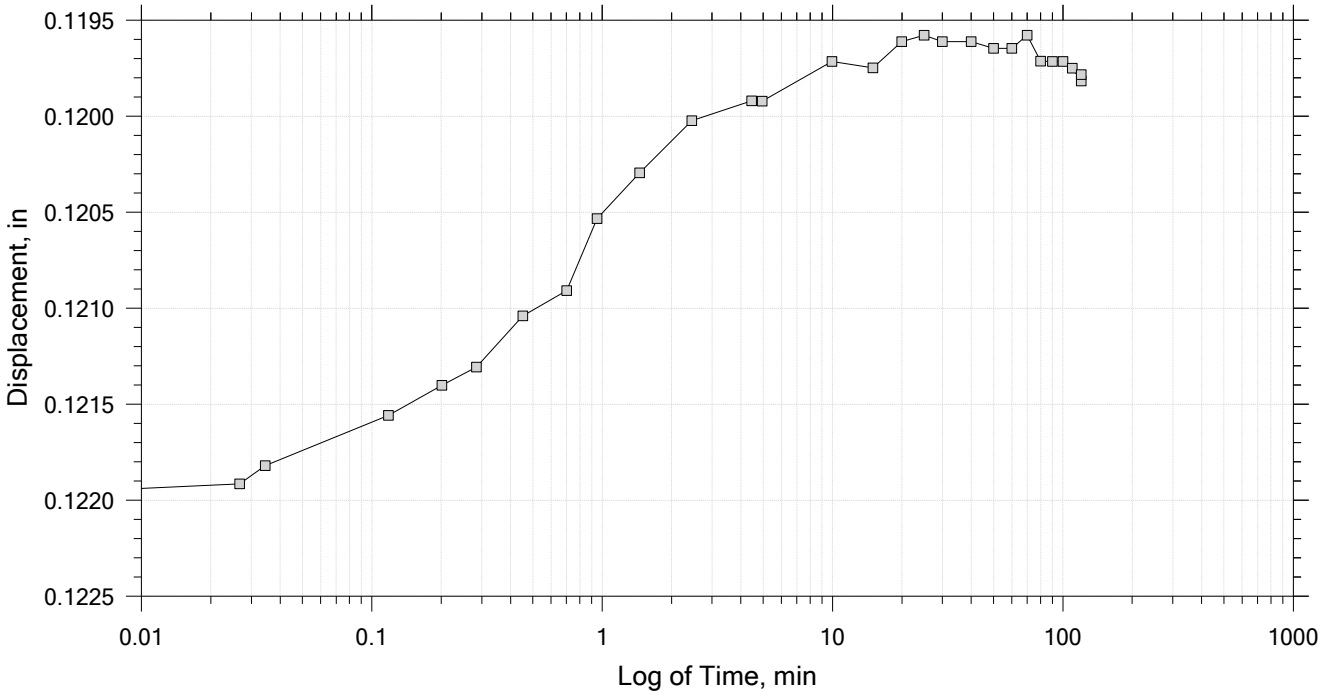


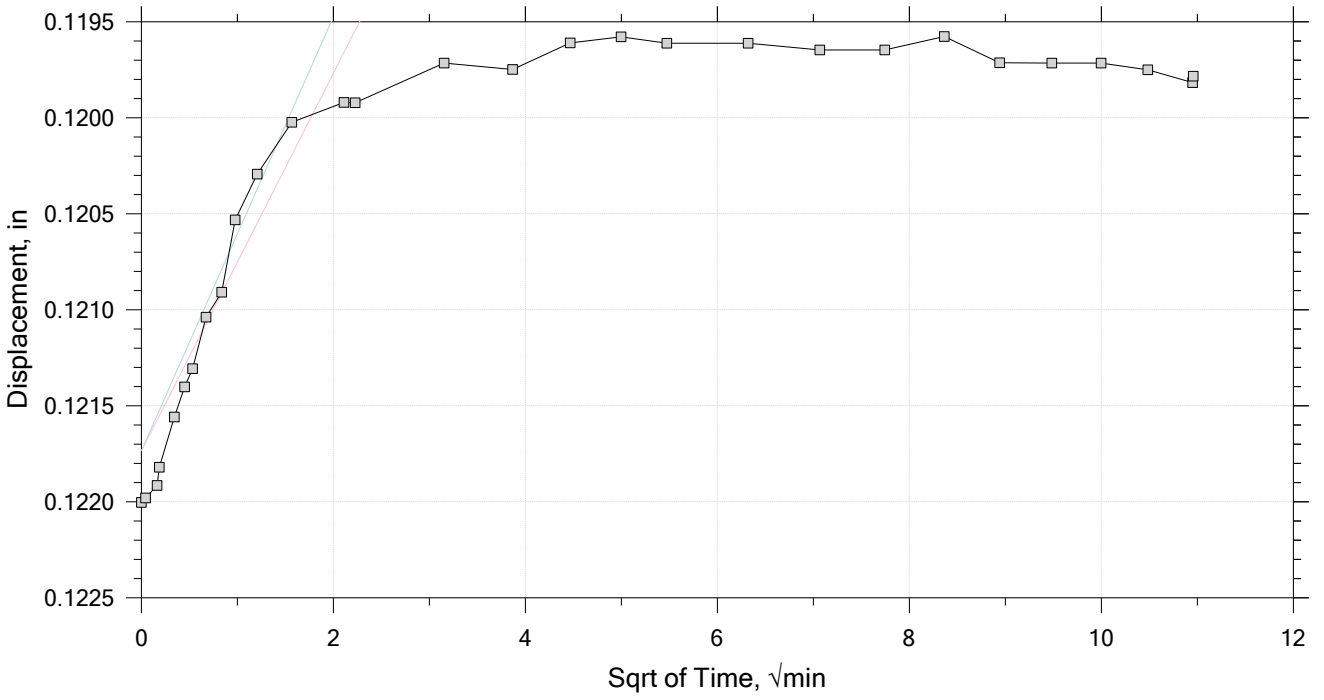


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 27 of 30
Constant Load Step
Stress: 3.23e+03 psf

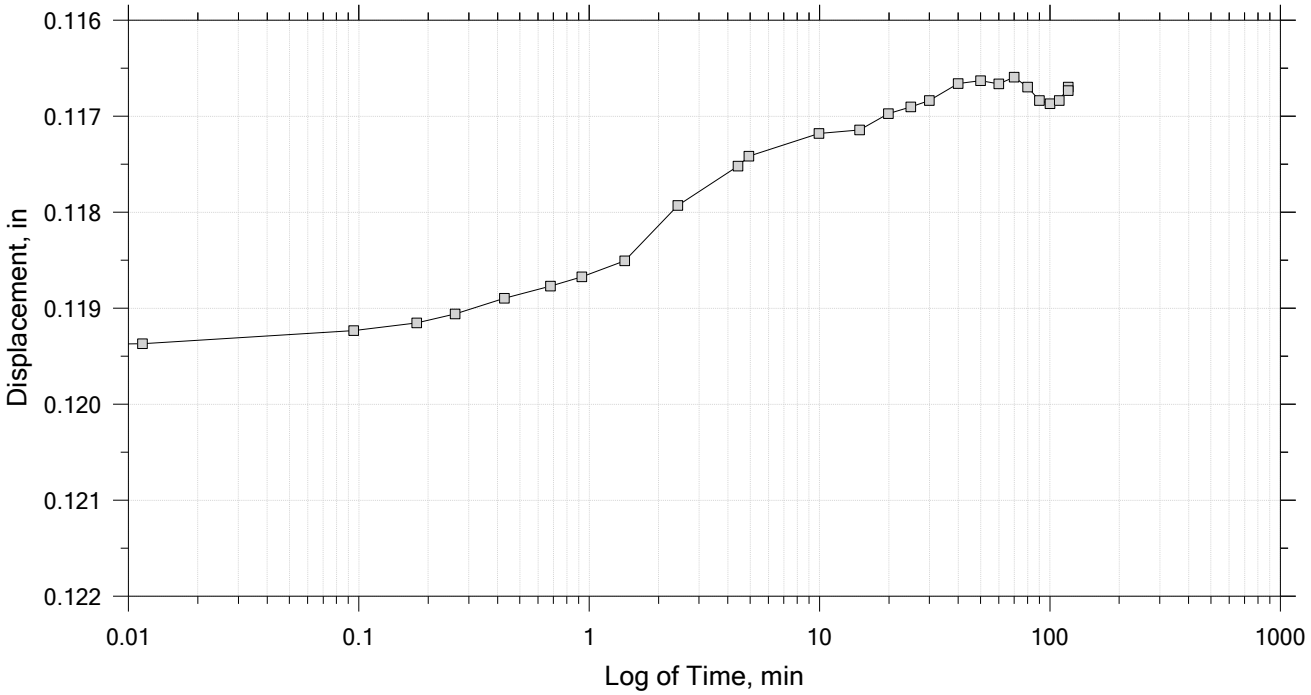


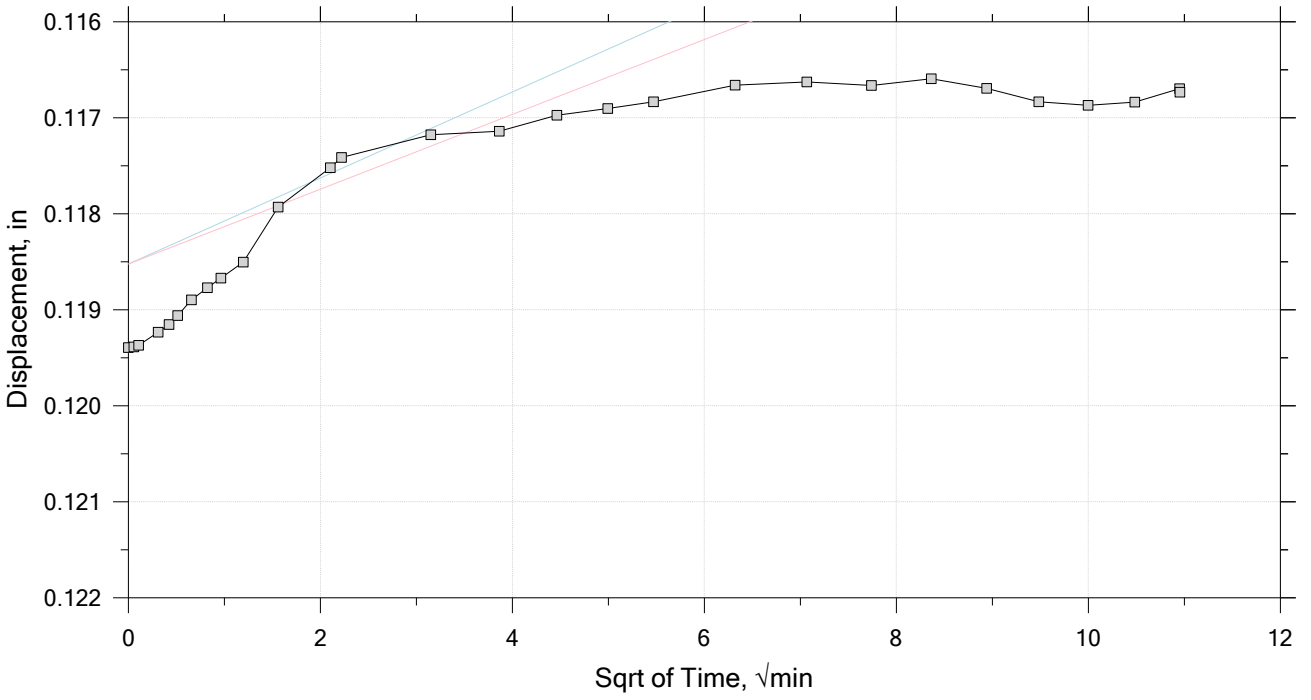


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 28 of 30
Constant Load Step
Stress: 1.61e+03 psf

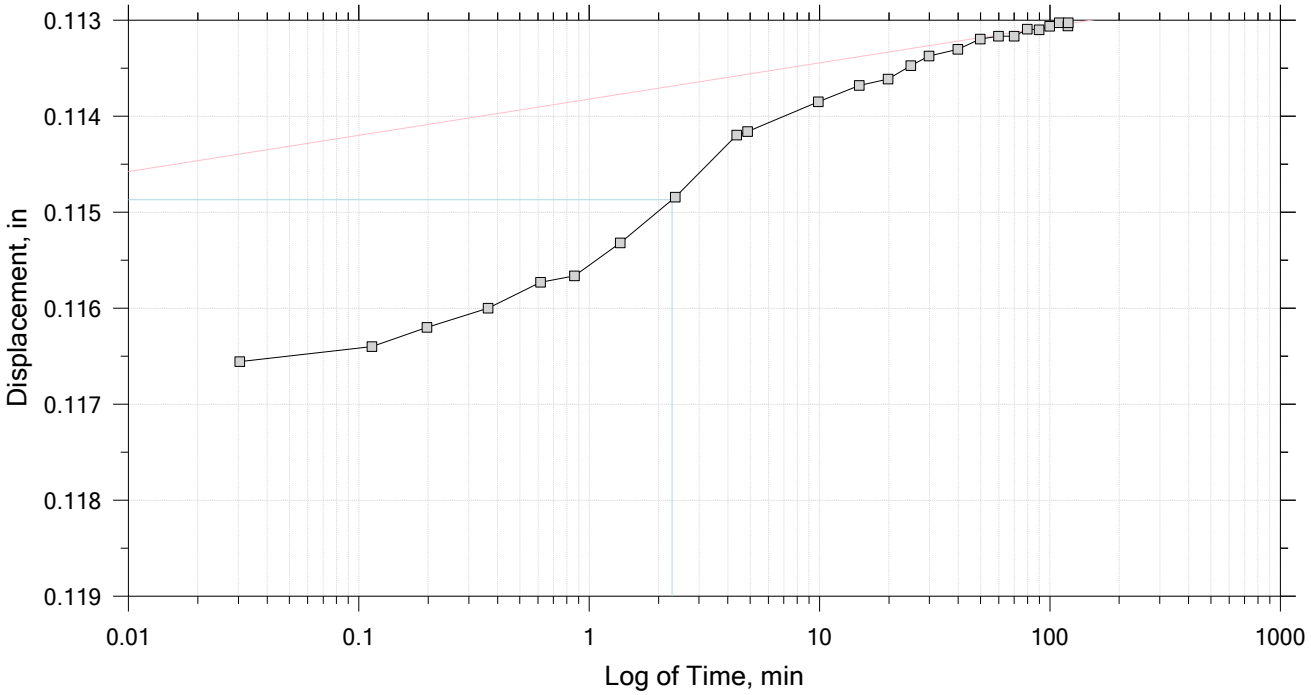


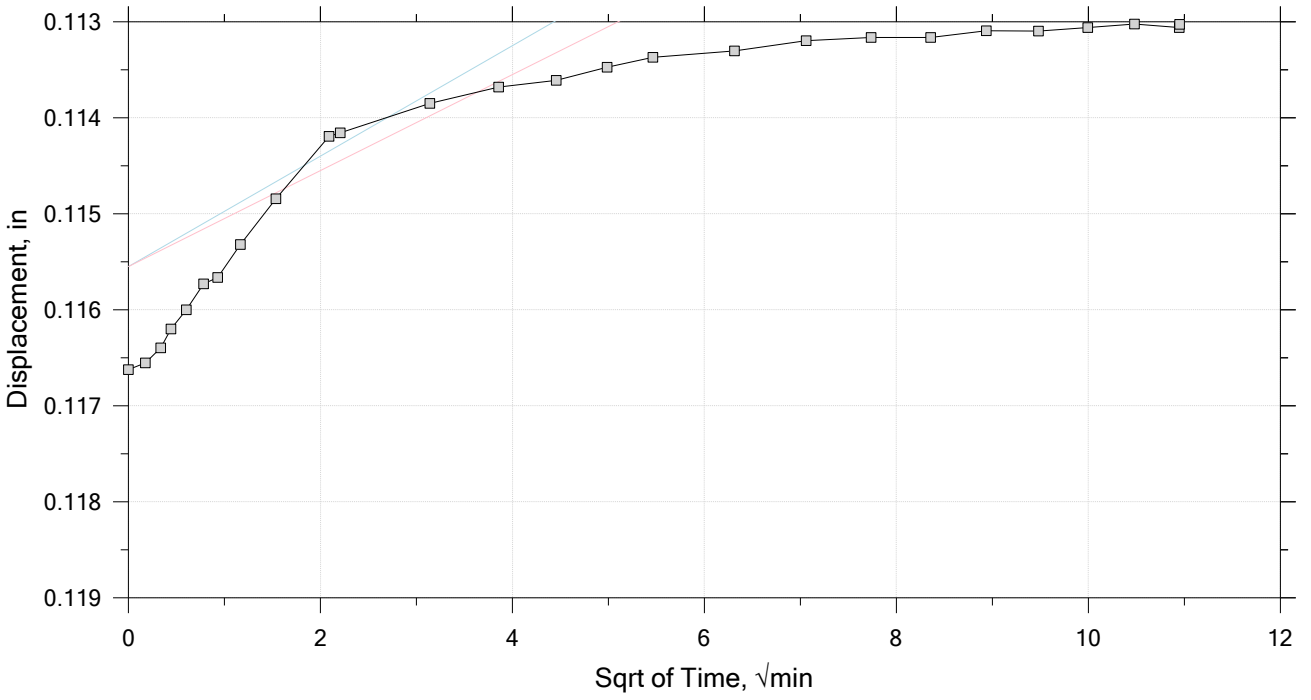


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 29 of 30
Constant Load Step
Stress: 807 psf

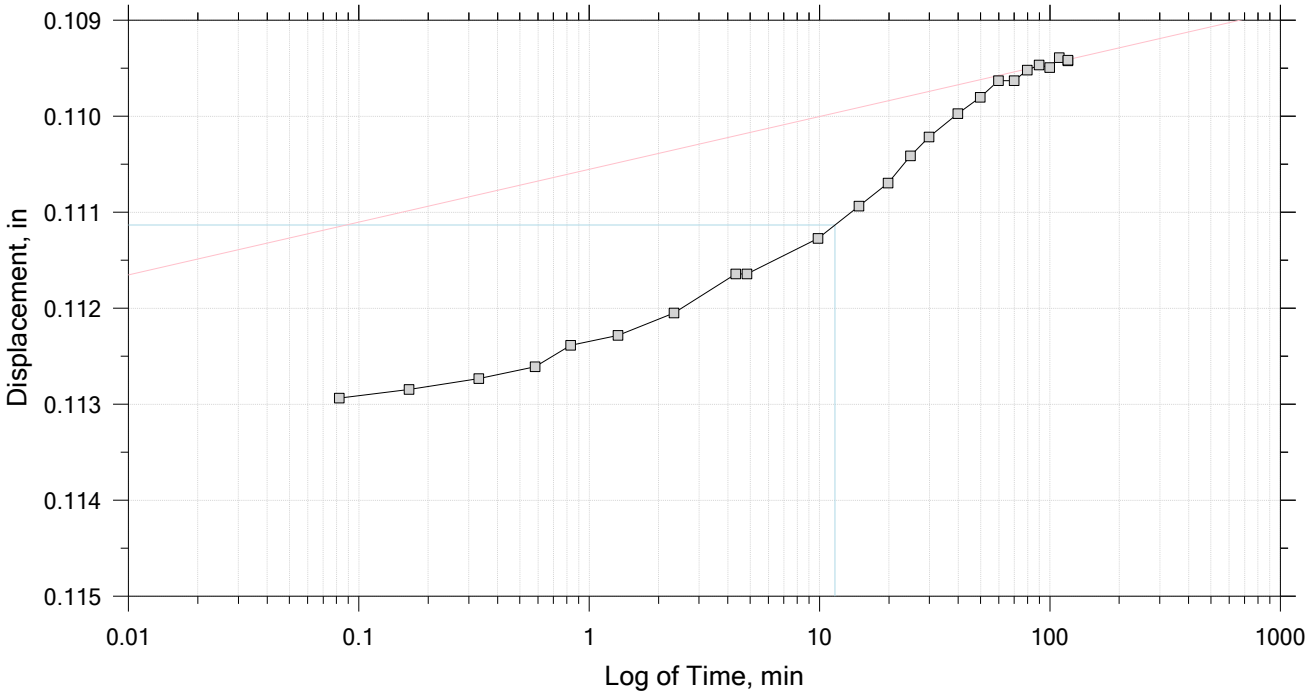


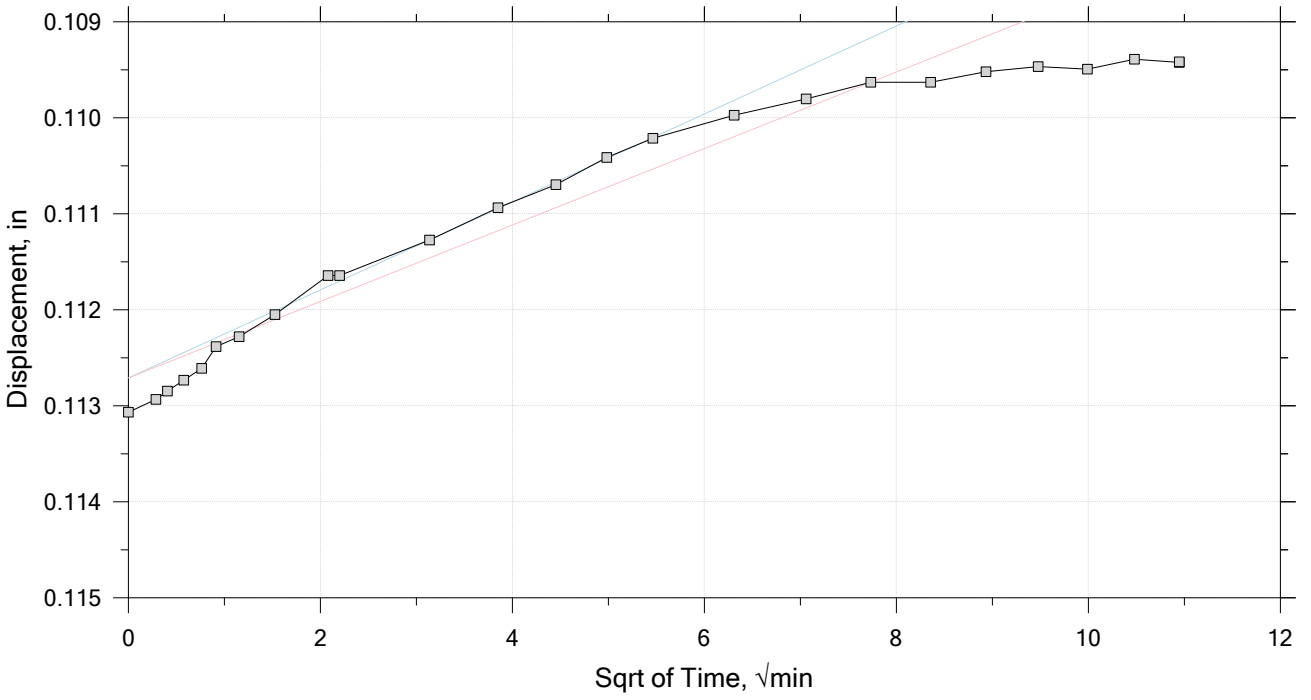


Soil Metrics LLC	Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
	Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
	Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
	Test Number: ICONP 65-430	Preparation: wet	Elevation: --
	Description: Gray silty clay		
	Remarks: 24 hour load hold on load step 11 for C alpha		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 30 of 30
Constant Load Step
Stress: 404 psf





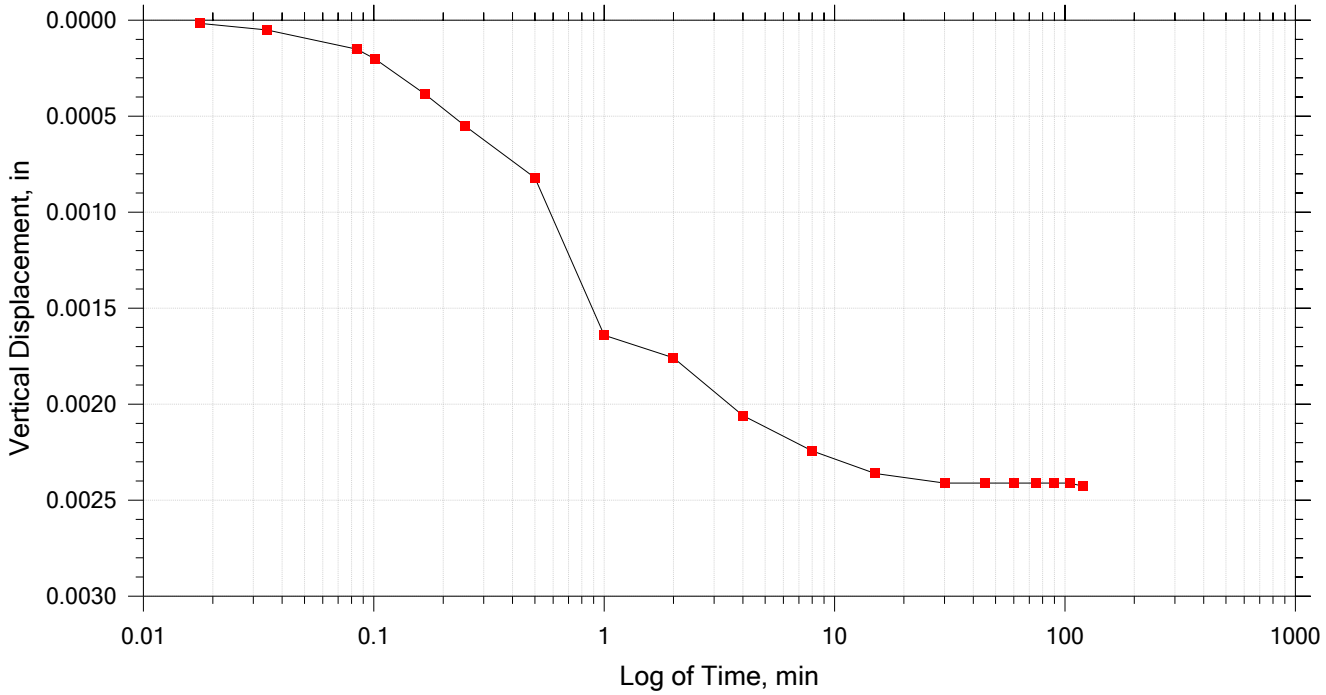
Project Name: Route 1 Bridge	Location: Yarmouth, Maine	Project Number: 164-35
Boring Number: BB-YR1-202	Tester: sjr	Checker: sjr
Sample Number: 1U	Test Date: 5/25/2024	Depth: 11.7
Test Number: ICONP 65-430	Preparation: wet	Elevation: --
Description: Gray silty clay		
Remarks: 24 hour load hold on load step 11 for C alpha		

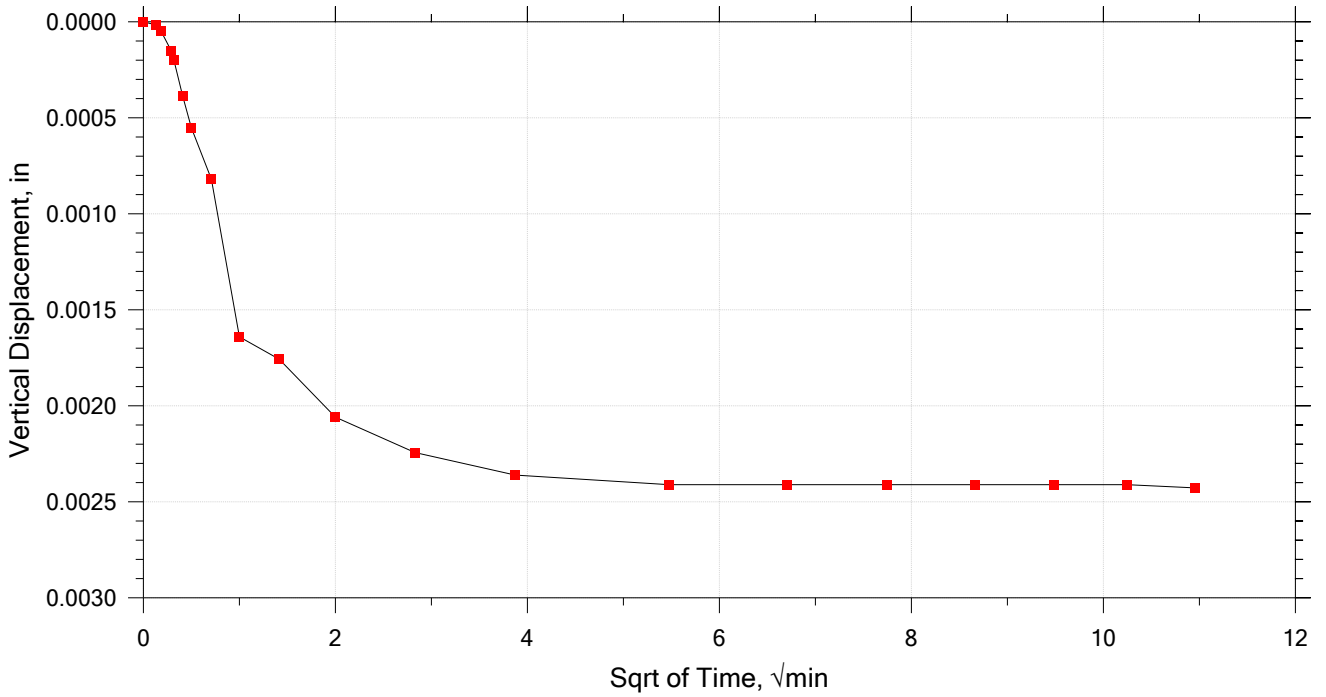
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 1 of 9

Constant Load Step

Stress: 260 psf





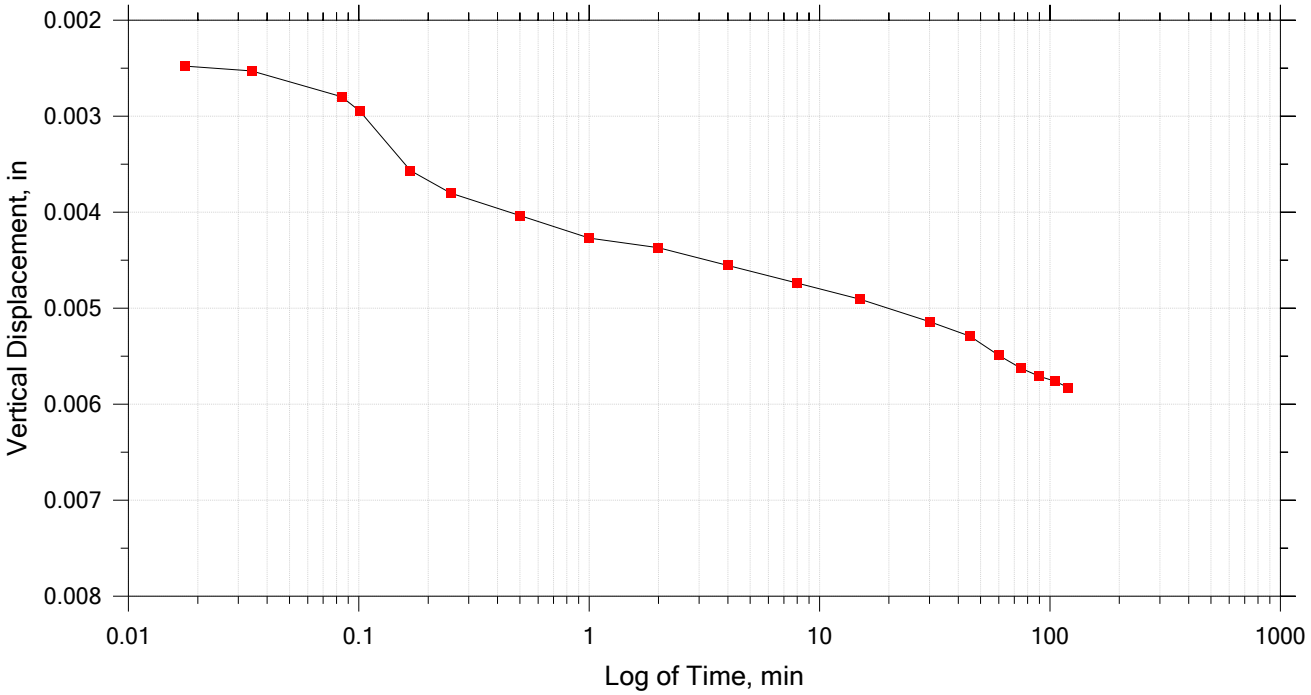
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

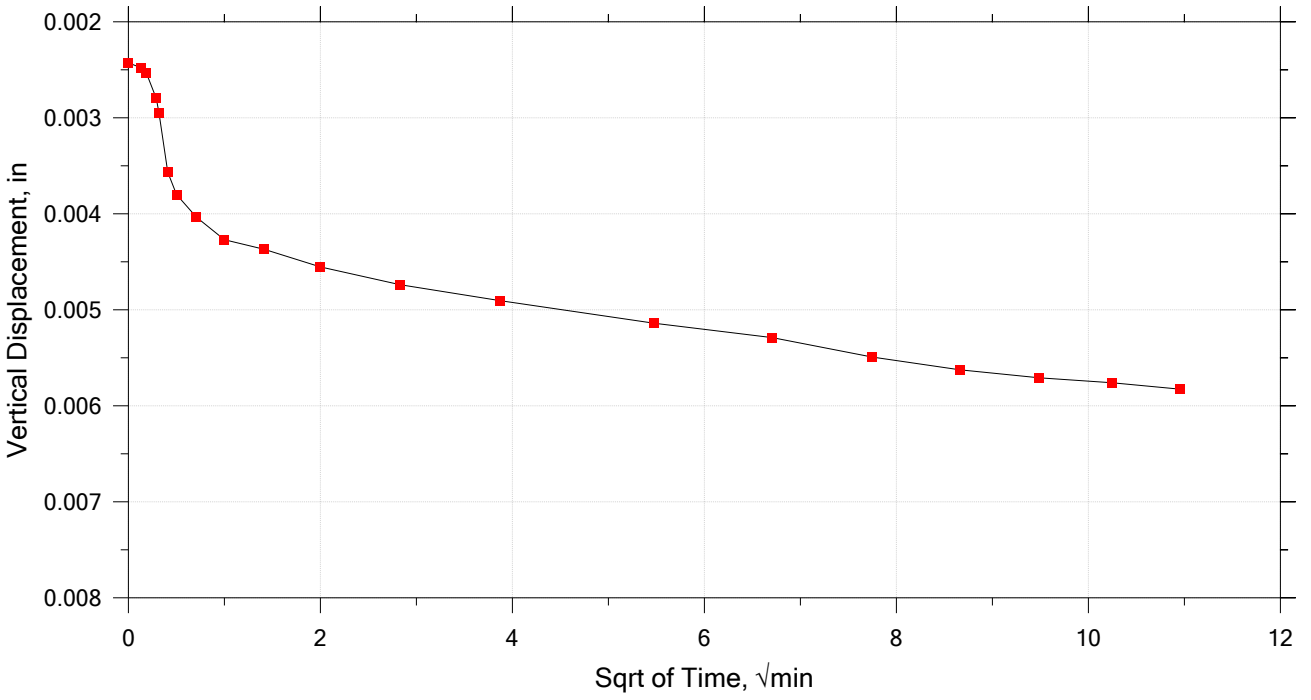
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 2 of 9

Constant Load Step

Stress: 390 psf





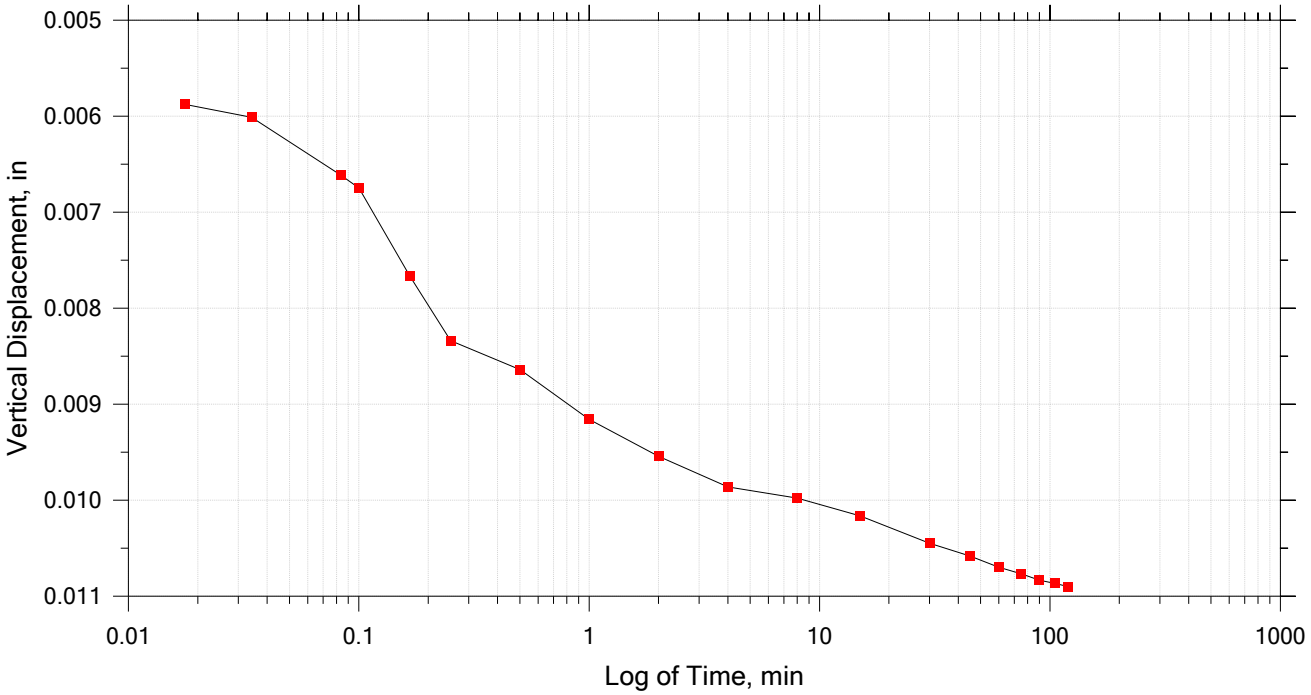
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

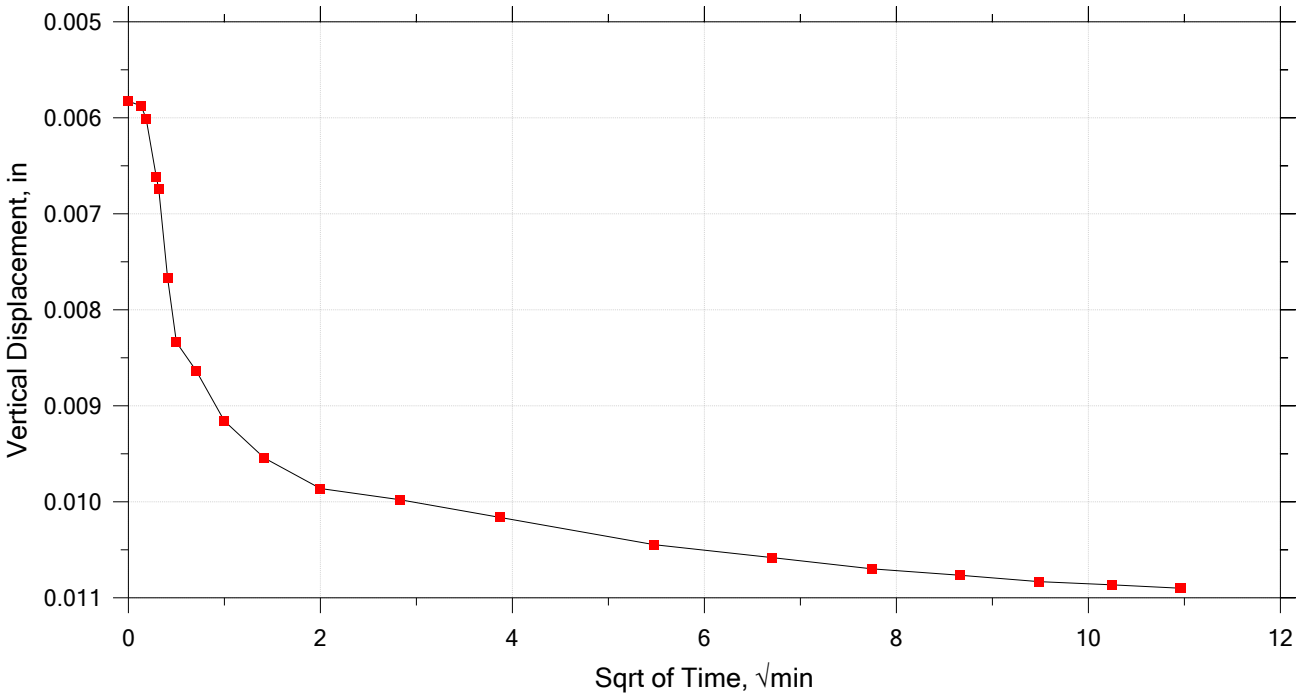
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 3 of 9

Constant Load Step

Stress: 585 psf





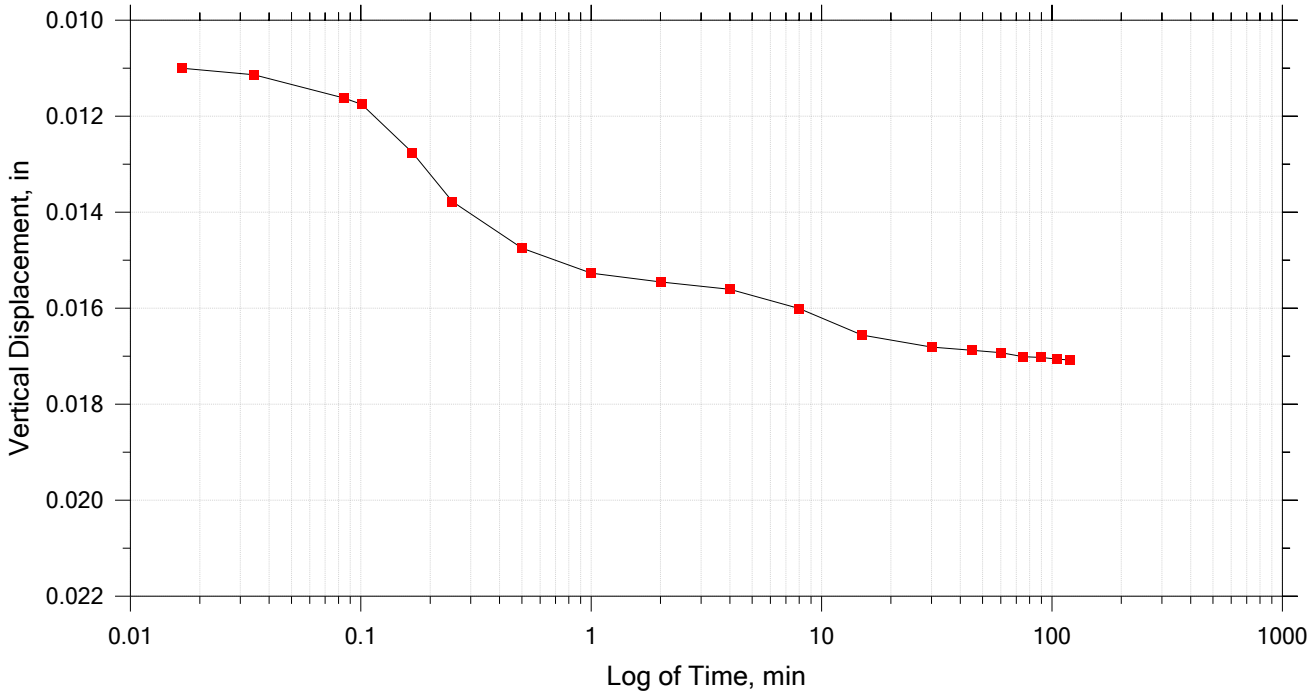
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

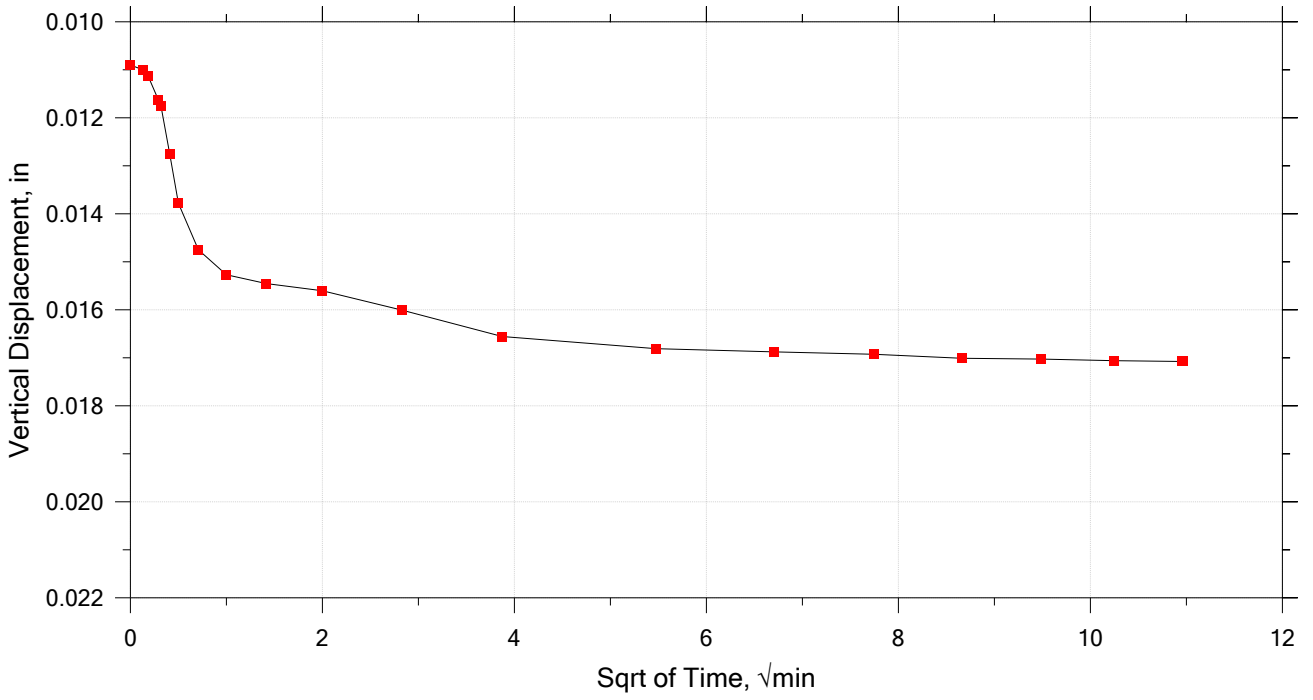
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 4 of 9

Constant Load Step

Stress: 878 psf





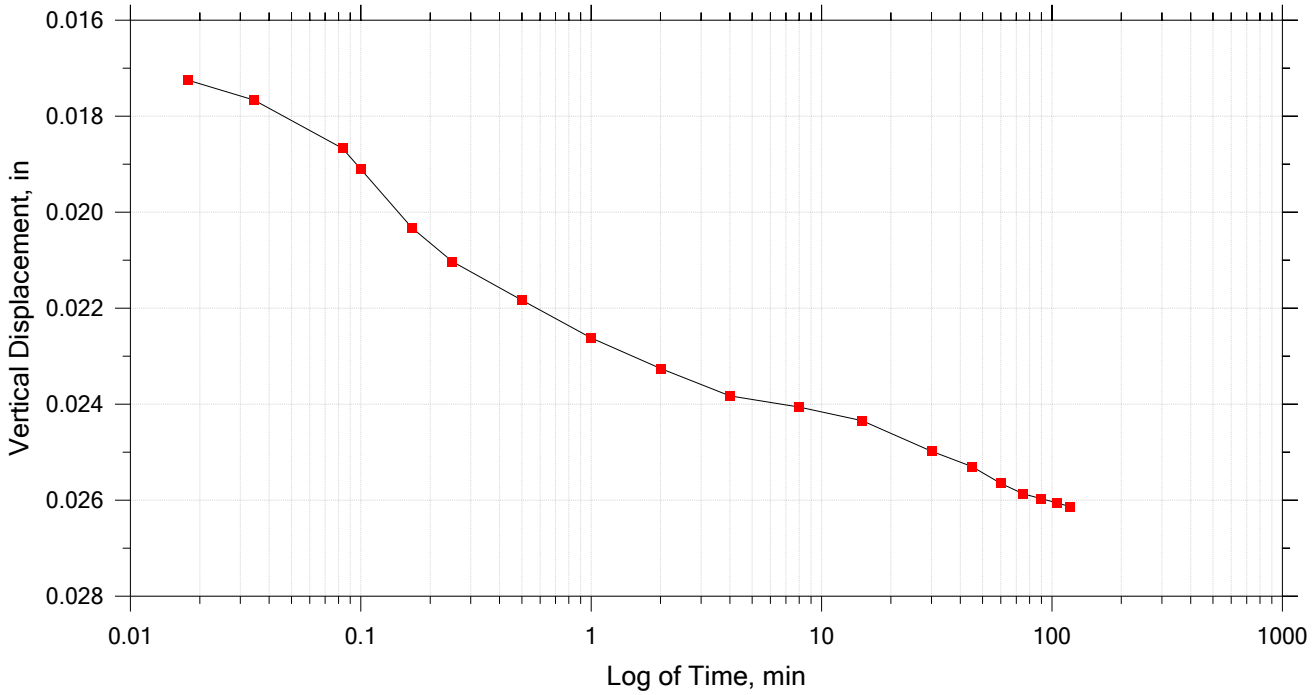
Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

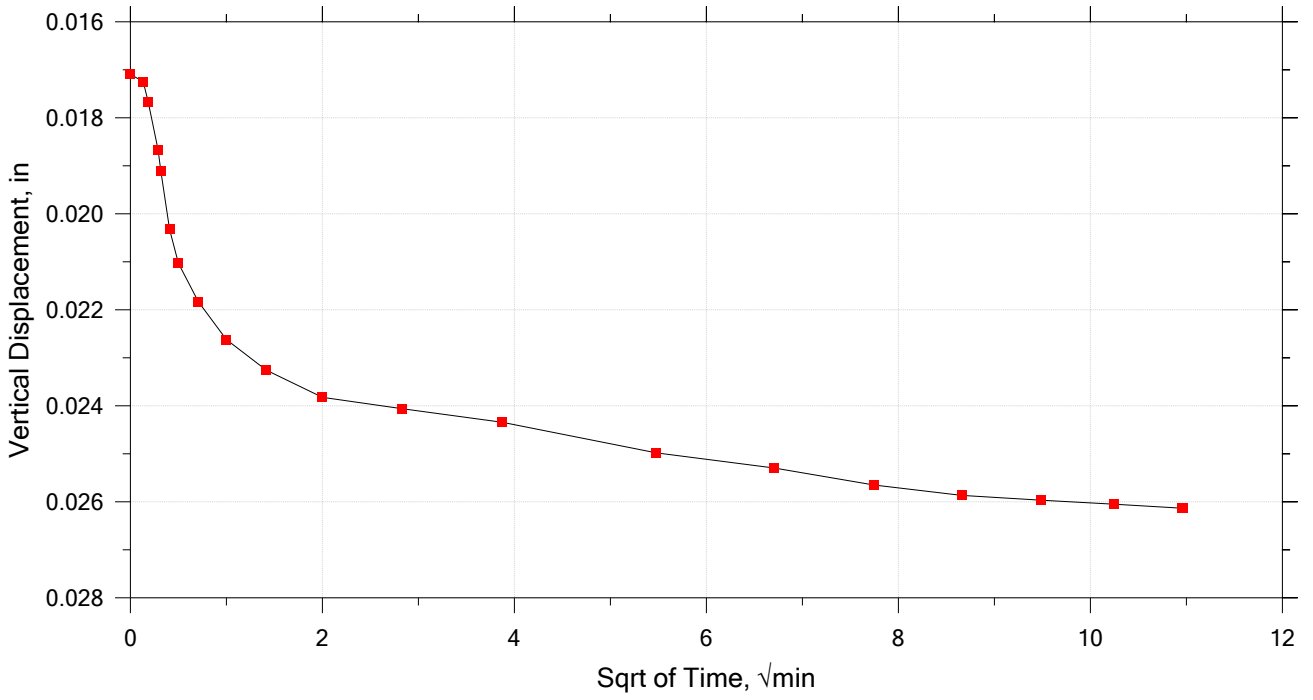
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 5 of 9

Constant Load Step

Stress: 1.31e+03 psf





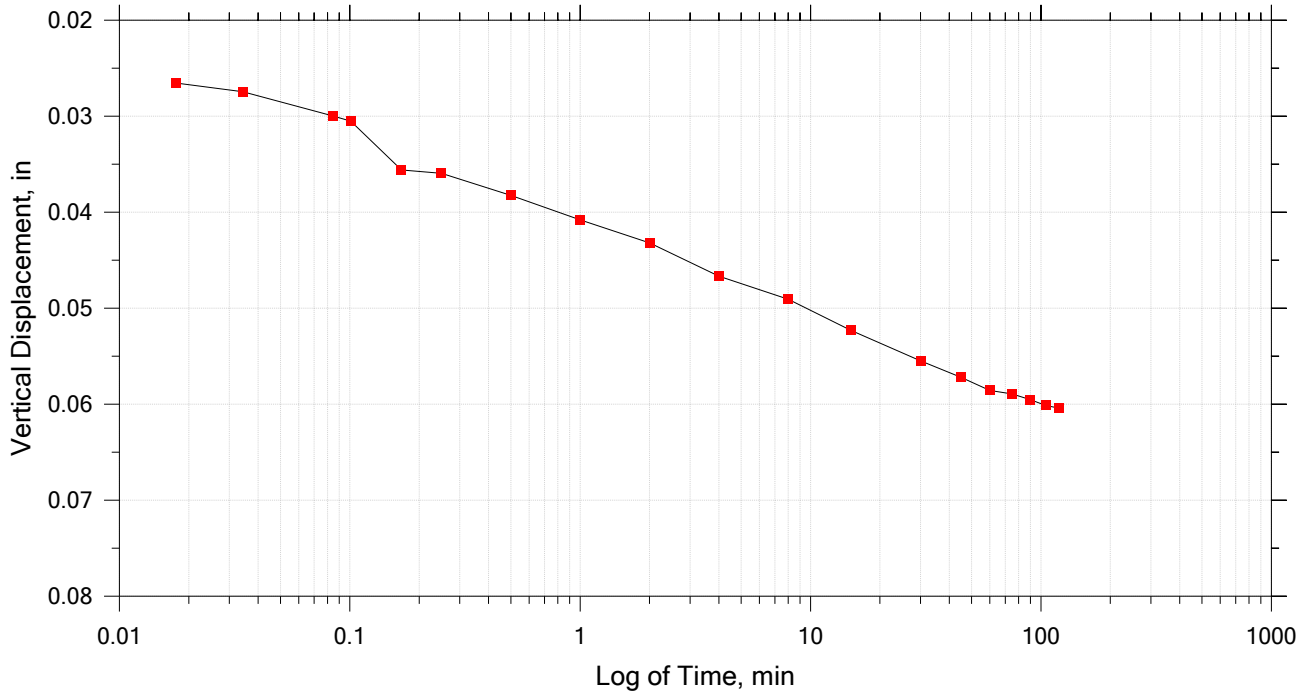
Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

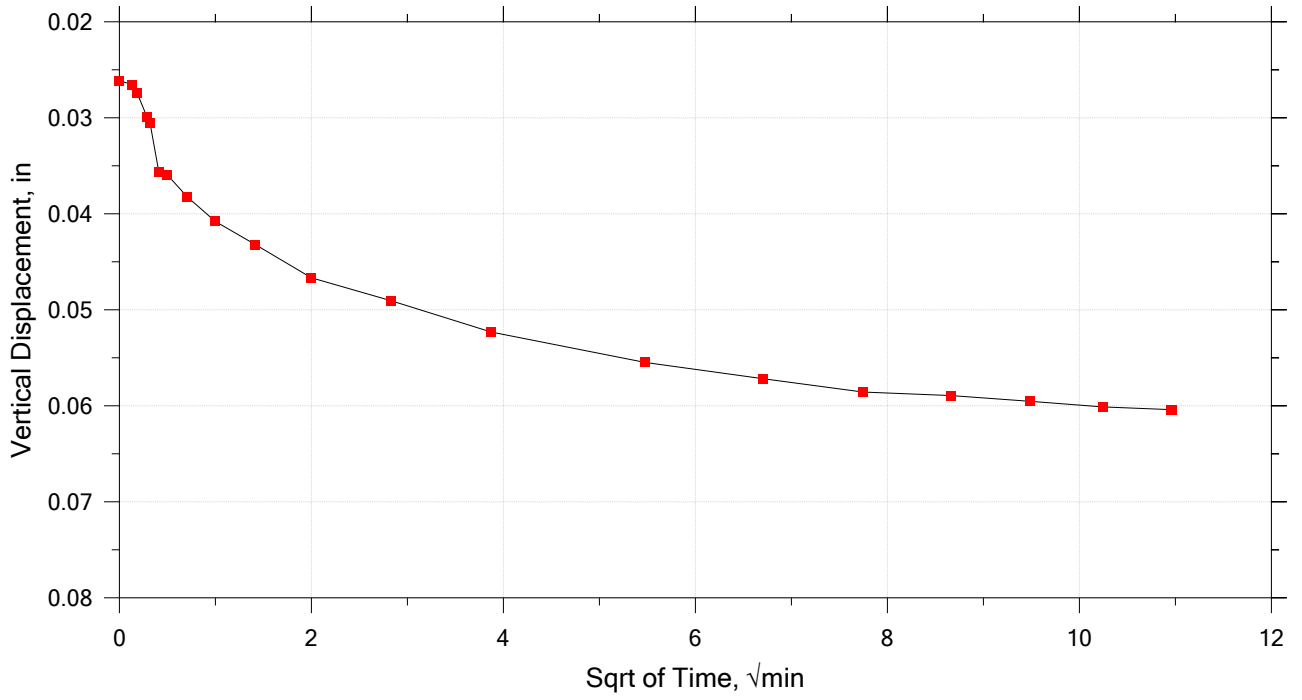
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 6 of 9

Constant Load Step

Stress: 2.96e+03 psf





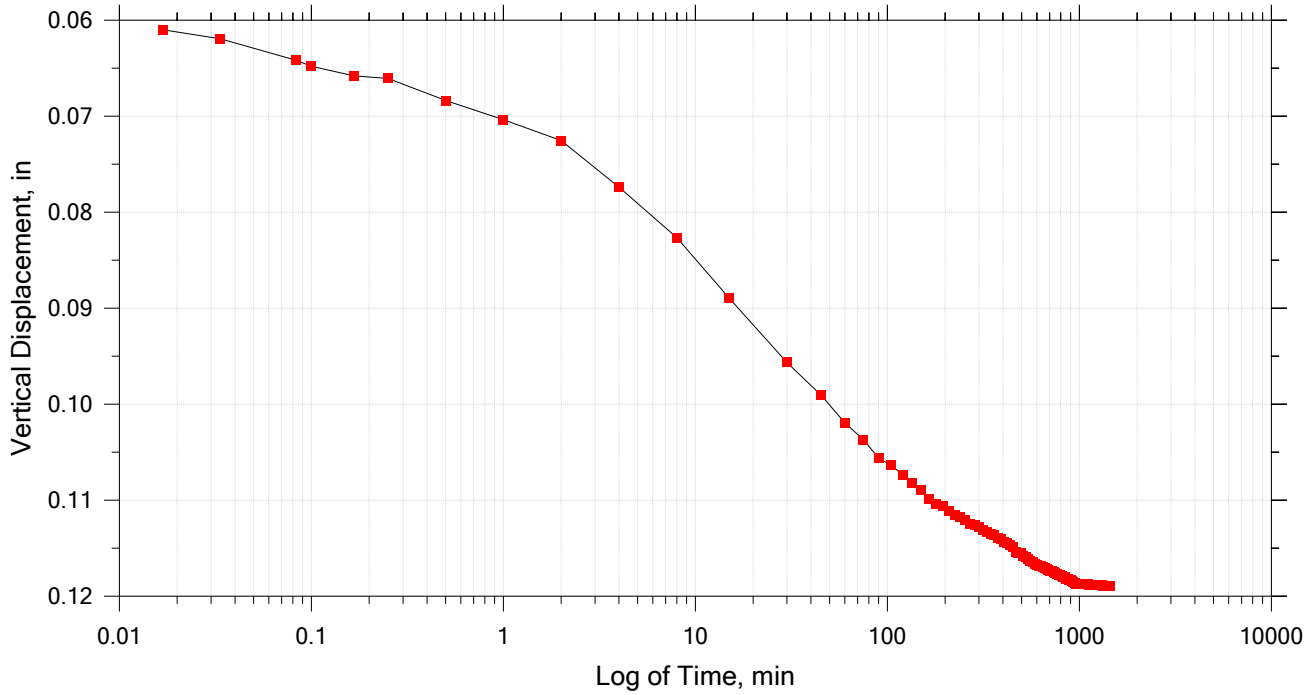
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

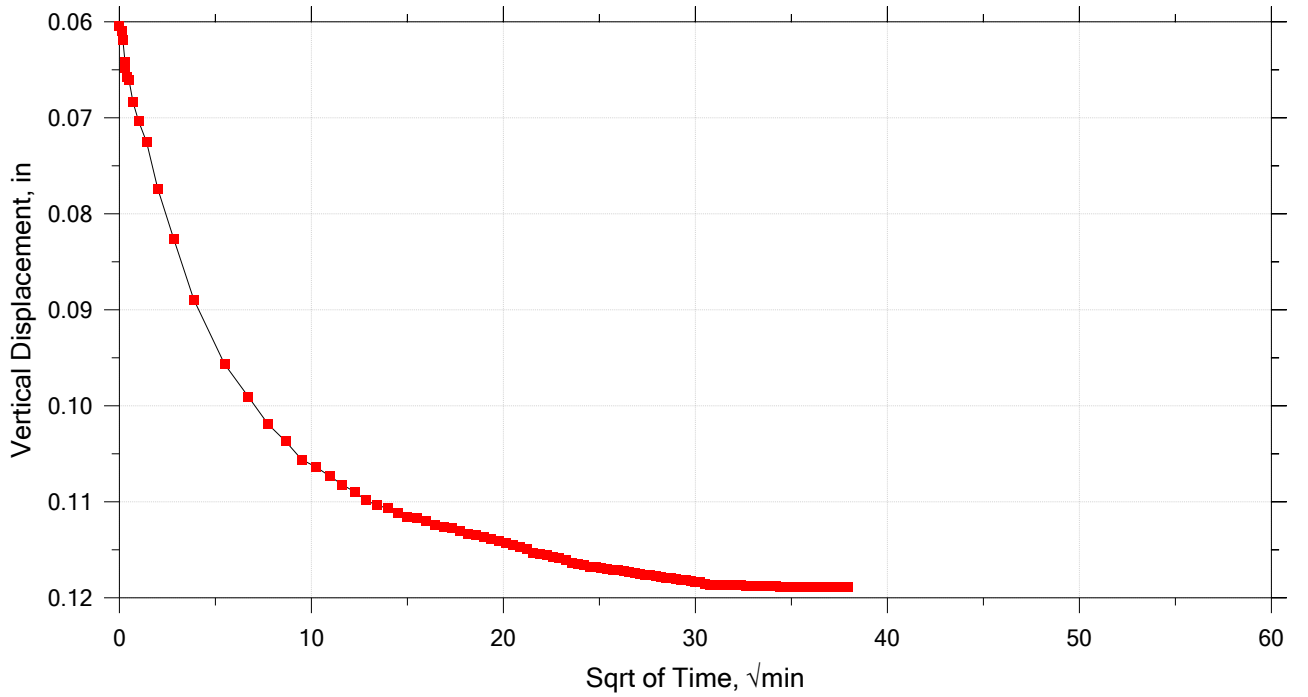
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 7 of 9

Constant Load Step

Stress: 4.5e+03 psf





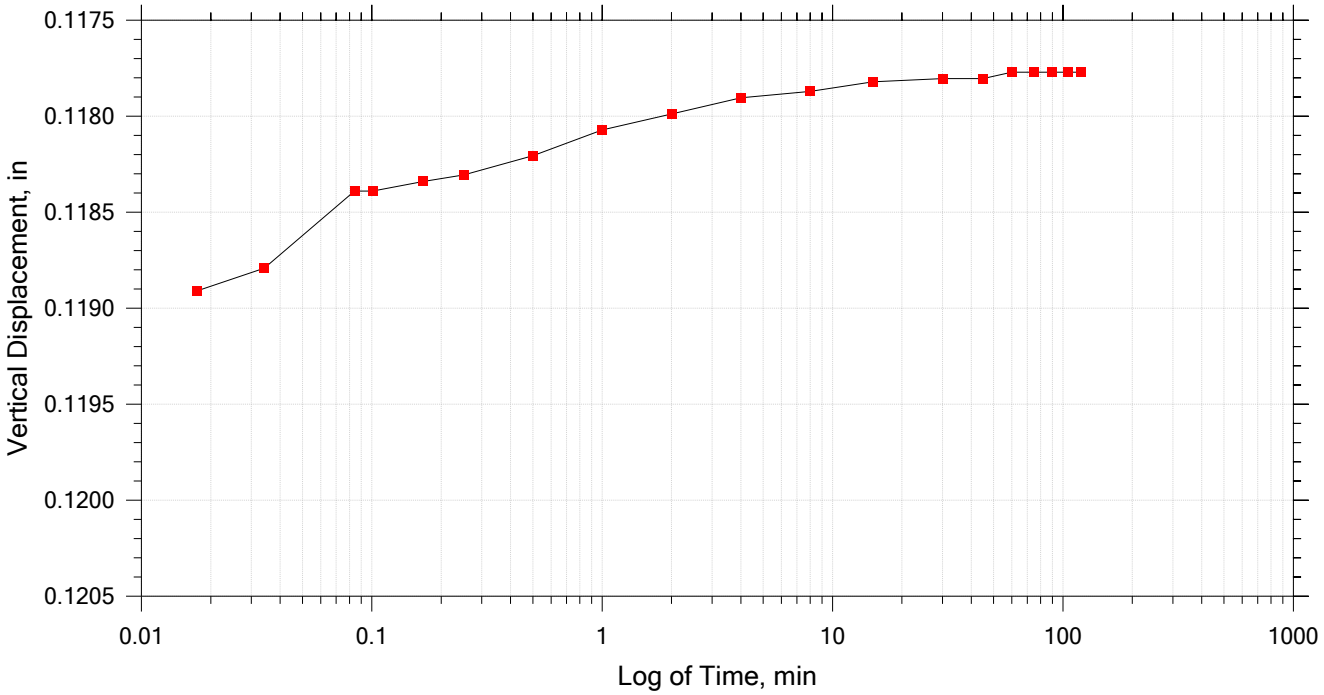
Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

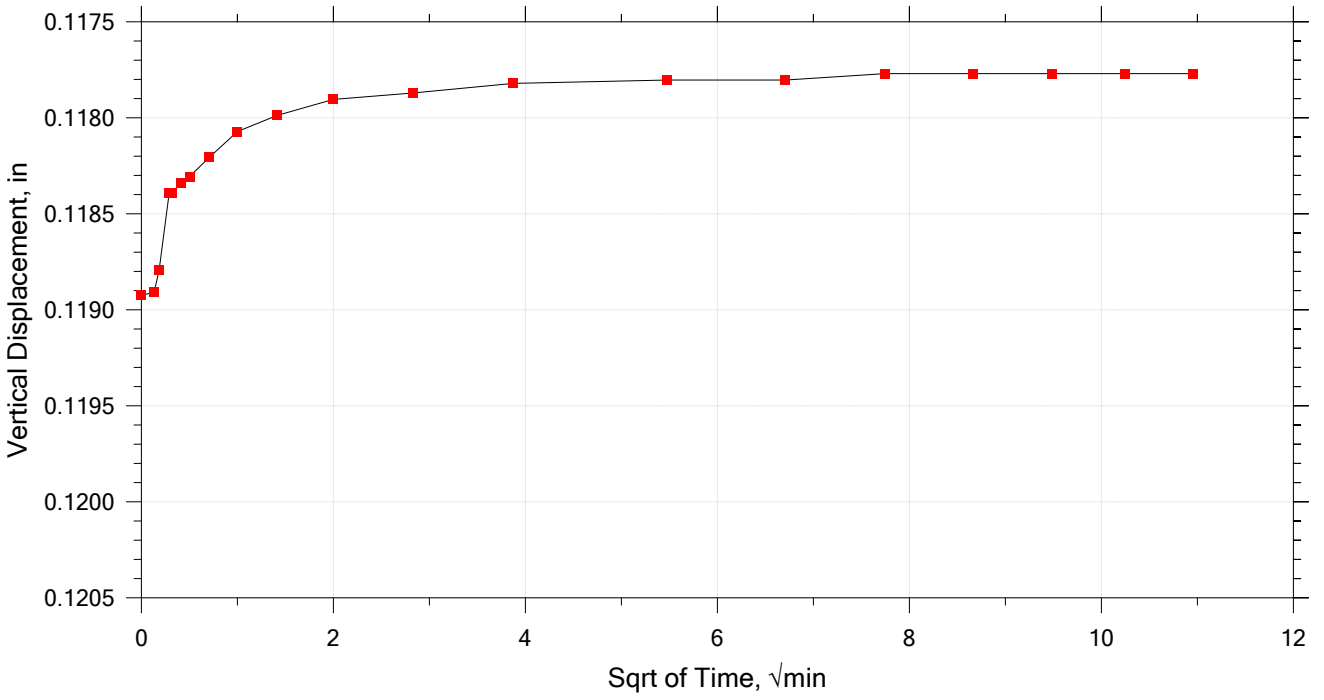
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 8 of 9

Constant Load Step

Stress: 3e+03 psf





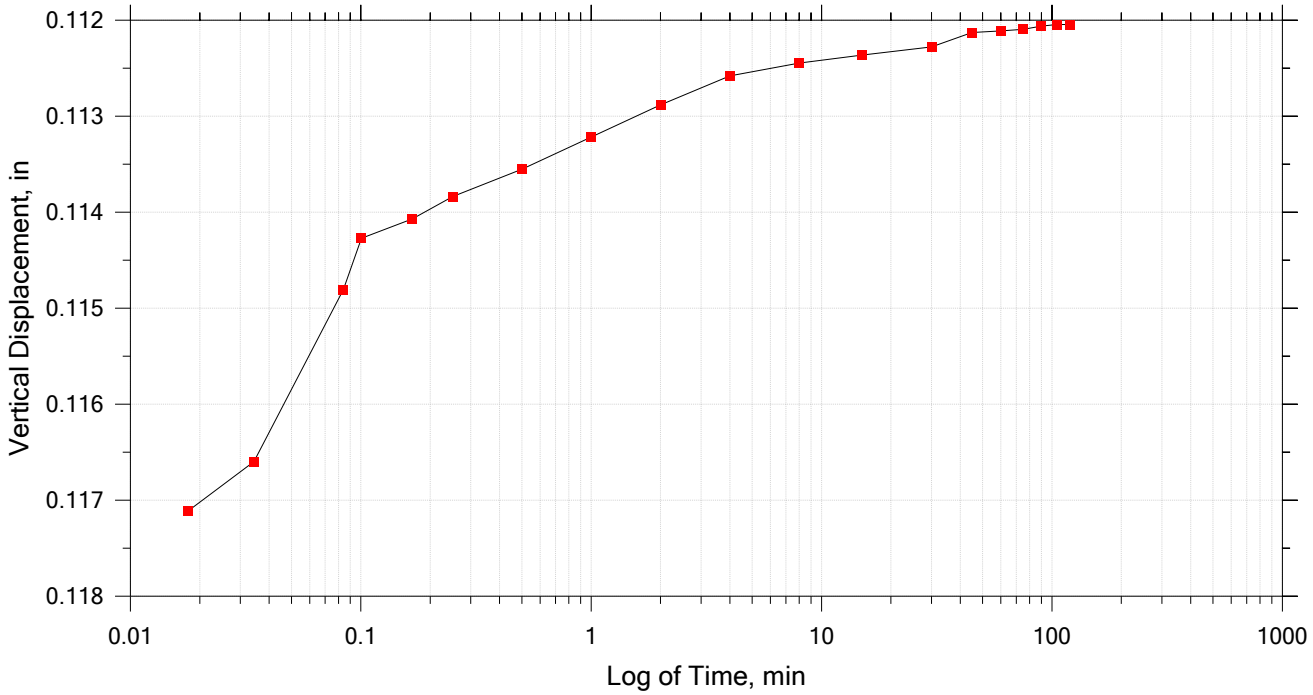
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

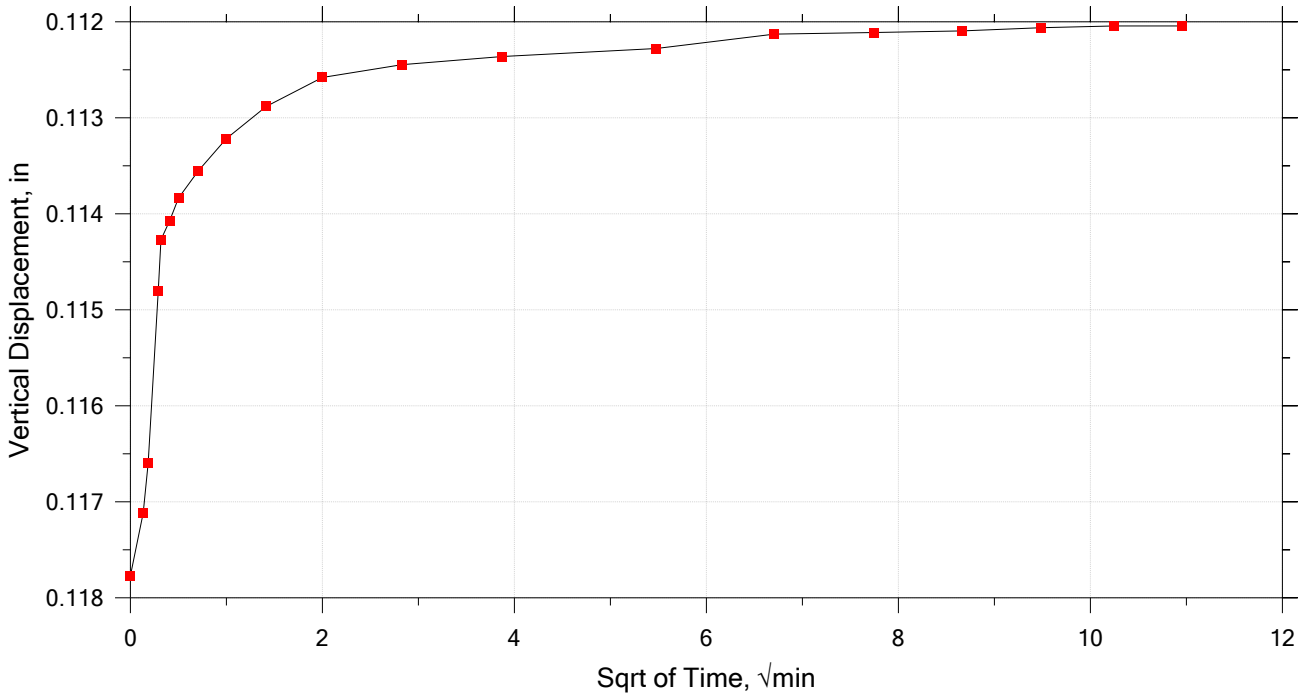
Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 9 of 9

Constant Load Step

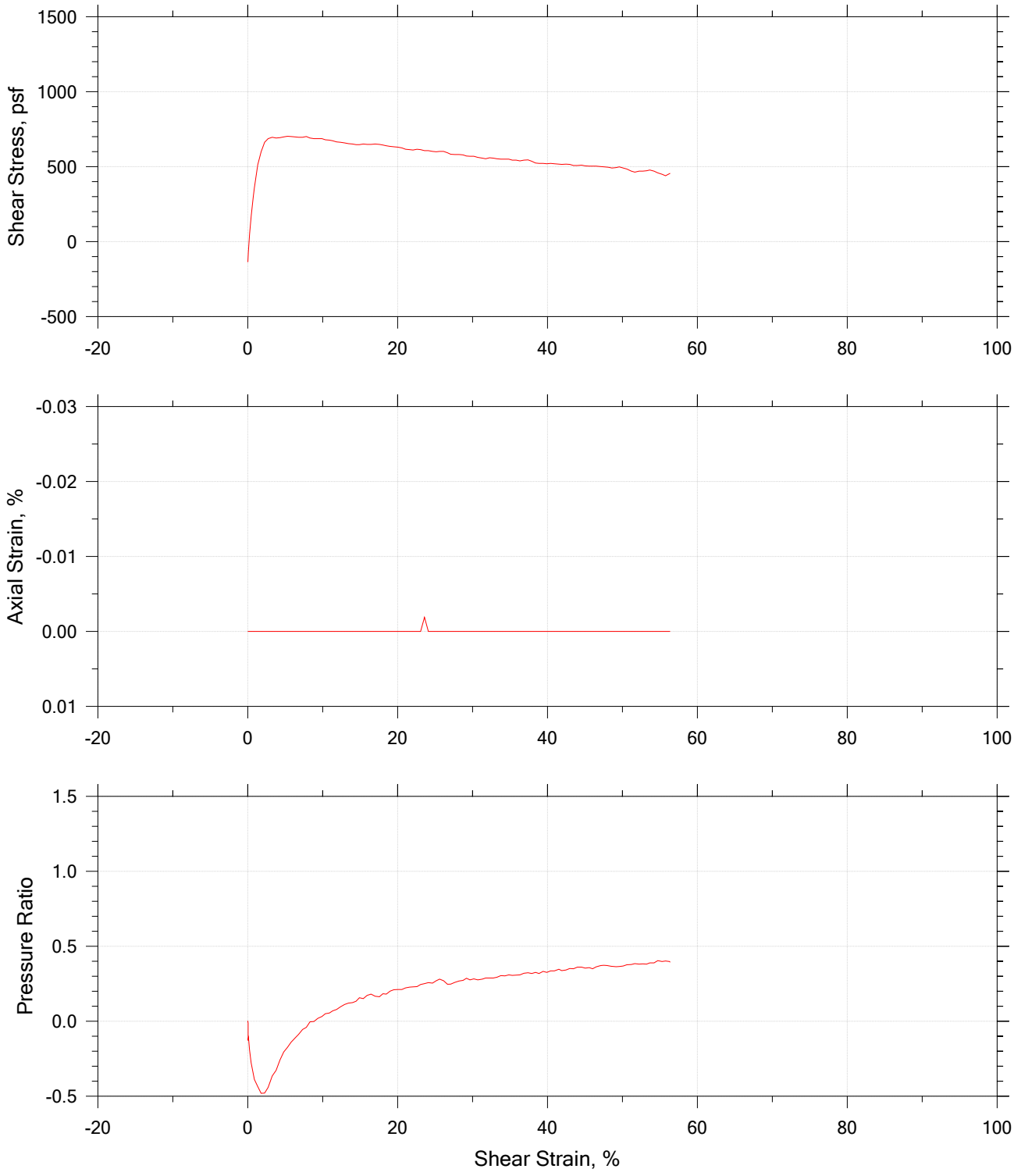
Stress: 1.5e+03 psf





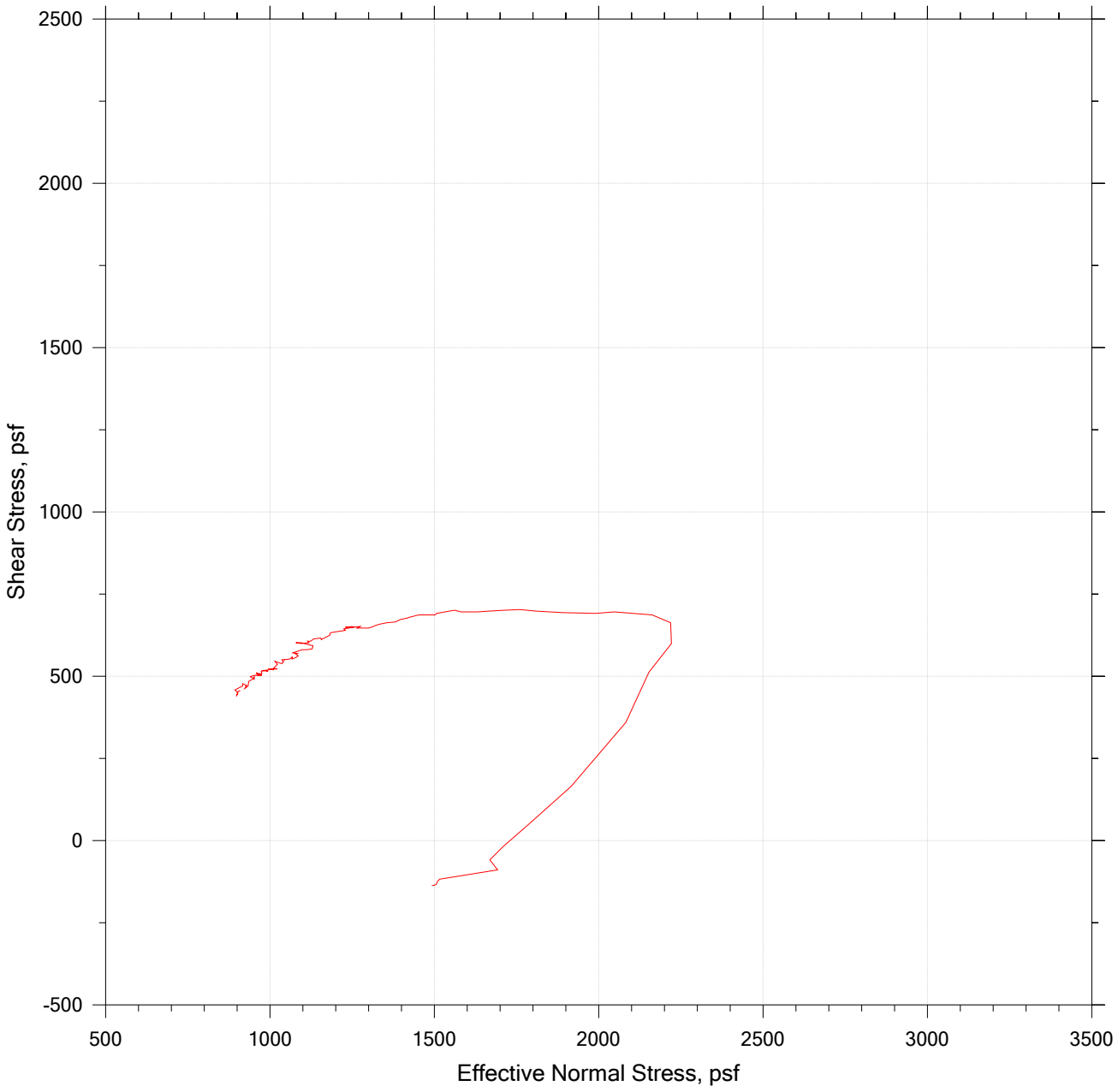
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528



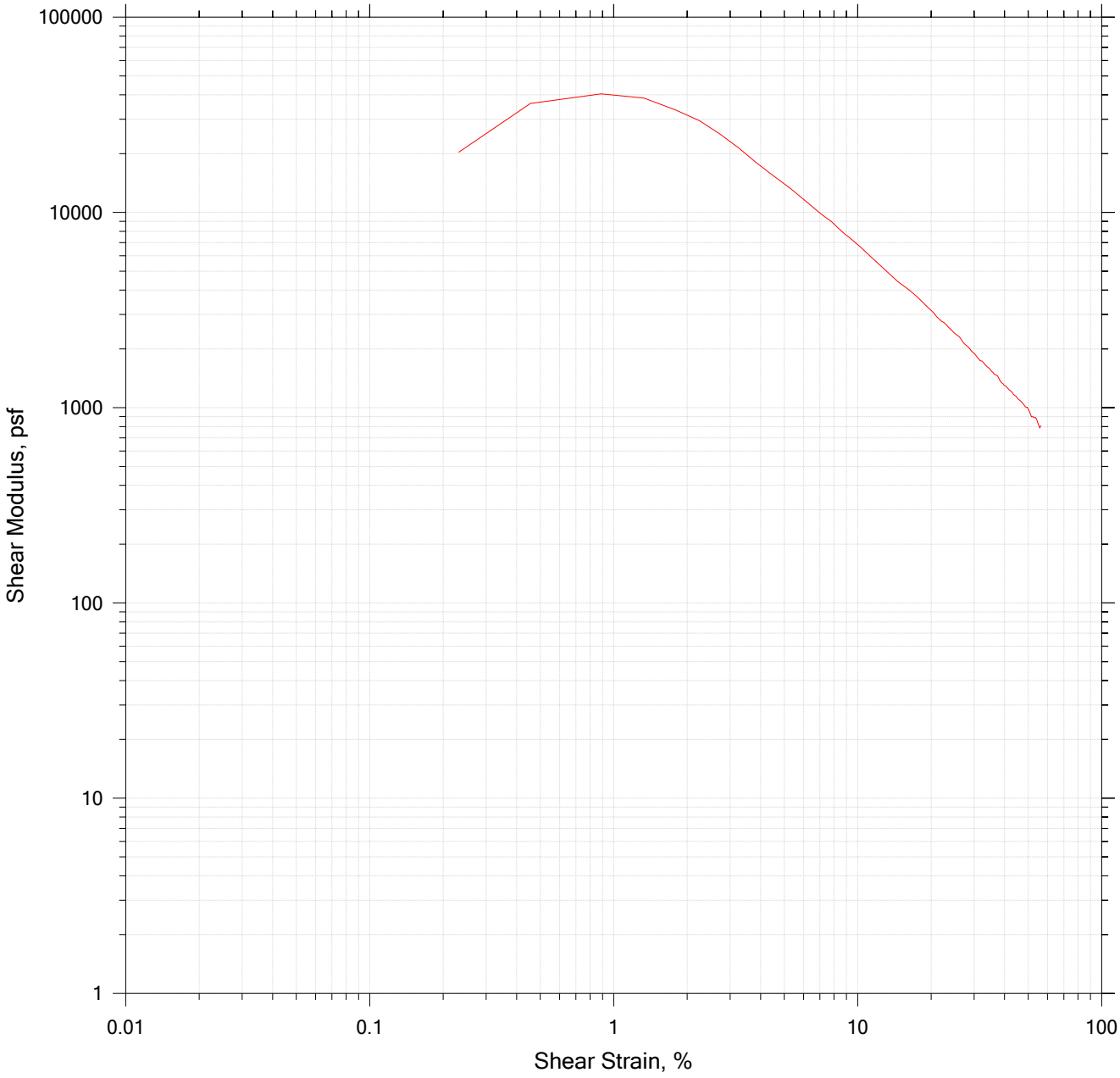
Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528



Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528



Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Specimen Dimension, in: 2.50	Specific Gravity: 2.88 (Estimated)	Liquid Limit: Unknown
Specimen Height, in: 1.00	Initial Void Ratio: 1.09	Plastic Limit: Unknown
Final Height, in: 0.89	Final Void Ratio: 0.86	Plasticity Index: Unknown

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	213	---		317
Mass Container, gm	36.8	0	0	60.9
Mass Container + Wet Soil, gm	173.37	151.12	143.89	204.79
Mass Container + Dry Soil, gm	138.23	110.61	110.61	171.51
Mass Dry Soil, gm	101.43	110.61	110.61	110.61
Water Content, %	34.64	36.62	30.09	30.09
Void Ratio	---	1.09	0.86	---
Degree of Saturation, %	---	96.38	100.79	---
Dry Unit Weight, pcf	---	85.843	96.674	---

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 1 of 9

Constant Load Step

Stress: 260 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	0.000	0.0000	0.0000	0.000	1.09
0.018	0.133	44.7	0.0000	1.674e-05	0.00167	1.09
0.034	0.185	96.4	0.0000	5.023e-05	0.00502	1.09
0.084	0.290	169.	0.0000	0.0001507	0.0151	1.09
0.101	0.318	176.	0.0000	0.0002009	0.0201	1.09
0.167	0.408	209.	0.0000	0.0003851	0.0385	1.09
0.250	0.500	212.	0.0000	0.0005525	0.0553	1.09
0.500	0.707	200.	0.0000	0.0008204	0.0820	1.09
1.000	1.000	256.	0.0000	0.001641	0.164	1.09
2.000	1.414	259.	0.0000	0.001758	0.176	1.09
4.000	2.000	256.	0.0000	0.002059	0.206	1.09
8.000	2.828	259.	0.0000	0.002244	0.224	1.09
15.000	3.873	259.	0.0000	0.002361	0.236	1.09
30.000	5.477	259.	0.0000	0.002411	0.241	1.09
45.001	6.708	259.	0.0000	0.002411	0.241	1.09
60.001	7.746	259.	0.0000	0.002411	0.241	1.09
75.000	8.660	259.	0.0000	0.002411	0.241	1.09
90.001	9.487	259.	0.0000	0.002411	0.241	1.09
105.000	10.247	259.	0.0000	0.002411	0.241	1.09
120.001	10.954	259.	0.0000	0.002428	0.243	1.09
120.110	10.959	259.	0.0000	0.002428	0.243	1.09

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 2 of 9

Constant Load Step

Stress: 390 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	259.	0.0000	0.002428	0.243	1.09
0.018	0.133	284.	0.0000	0.002478	0.248	1.09
0.034	0.185	308.	0.0000	0.002528	0.253	1.09
0.084	0.290	303.	0.0000	0.002796	0.280	1.09
0.101	0.318	310.	0.0000	0.002947	0.295	1.09
0.168	0.409	350.	0.0000	0.003566	0.357	1.09
0.251	0.501	388.	0.0000	0.003801	0.380	1.09
0.500	0.707	383.	0.0000	0.004035	0.404	1.09
1.001	1.000	388.	0.0000	0.004269	0.427	1.09
2.000	1.414	388.	0.0000	0.004370	0.437	1.09
4.001	2.000	388.	0.0000	0.004554	0.455	1.08
8.000	2.828	388.	0.0000	0.004738	0.474	1.08
15.001	3.873	388.	0.0000	0.004906	0.491	1.08
30.000	5.477	388.	0.0000	0.005140	0.514	1.08
45.001	6.708	388.	0.0000	0.005291	0.529	1.08
60.001	7.746	388.	0.0000	0.005492	0.549	1.08
75.001	8.660	388.	0.0000	0.005626	0.563	1.08
90.000	9.487	388.	0.0000	0.005709	0.571	1.08
105.000	10.247	388.	0.0000	0.005760	0.576	1.08
120.000	10.954	388.	0.0000	0.005827	0.583	1.08
120.109	10.959	388.	0.0000	0.005827	0.583	1.08

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 3 of 9

Constant Load Step

Stress: 585 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	388.	0.0000	0.005827	0.583	1.08
0.018	0.133	404.	0.0000	0.005877	0.588	1.08
0.034	0.185	418.	0.0000	0.006011	0.601	1.08
0.083	0.289	463.	0.0000	0.006613	0.661	1.08
0.100	0.316	480.	0.0000	0.006747	0.675	1.08
0.167	0.408	534.	0.0000	0.007668	0.767	1.08
0.250	0.500	571.	0.0000	0.008338	0.834	1.08
0.501	0.708	578.	0.0000	0.008639	0.864	1.08
1.000	1.000	576.	0.0000	0.009158	0.916	1.08
2.000	1.414	581.	0.0000	0.009544	0.954	1.07
4.000	2.000	581.	0.0000	0.009862	0.986	1.07
8.001	2.829	583.	0.0000	0.009979	0.998	1.07
15.000	3.873	583.	0.0000	0.01016	1.02	1.07
30.000	5.477	583.	0.0000	0.01045	1.04	1.07
45.000	6.708	583.	0.0000	0.01058	1.06	1.07
60.000	7.746	583.	0.0000	0.01070	1.07	1.07
75.001	8.660	583.	0.0000	0.01077	1.08	1.07
90.000	9.487	583.	0.0000	0.01083	1.08	1.07
105.001	10.247	583.	0.0000	0.01087	1.09	1.07
120.000	10.954	583.	0.0000	0.01090	1.09	1.07
120.138	10.961	583.	0.0000	0.01090	1.09	1.07

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 4 of 9

Constant Load Step

Stress: 878 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	583.	0.0000	0.01090	1.09	1.07
0.017	0.129	613.	0.0000	0.01100	1.10	1.07
0.034	0.185	644.	0.0000	0.01113	1.11	1.07
0.084	0.290	729.	0.0000	0.01162	1.16	1.07
0.101	0.318	752.	0.0000	0.01175	1.18	1.07
0.168	0.409	832.	0.0000	0.01276	1.28	1.07
0.250	0.500	841.	0.0000	0.01378	1.38	1.07
0.501	0.708	865.	0.0000	0.01475	1.48	1.06
1.001	1.000	872.	0.0000	0.01527	1.53	1.06
2.001	1.414	877.	0.0000	0.01545	1.55	1.06
4.000	2.000	874.	0.0000	0.01560	1.56	1.06
8.001	2.829	877.	0.0000	0.01601	1.60	1.06
15.000	3.873	877.	0.0000	0.01656	1.66	1.06
30.000	5.477	877.	0.0000	0.01681	1.68	1.06
45.001	6.708	877.	0.0000	0.01688	1.69	1.06
60.000	7.746	877.	0.0000	0.01693	1.69	1.06
75.000	8.660	877.	0.0000	0.01701	1.70	1.06
90.000	9.487	877.	0.0000	0.01703	1.70	1.06
105.000	10.247	877.	0.0000	0.01706	1.71	1.06
120.001	10.954	877.	0.0000	0.01708	1.71	1.06
120.143	10.961	877.	0.0000	0.01708	1.71	1.06

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 5 of 9

Constant Load Step

Stress: 1315 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	877.	0.0000	0.01709	1.71	1.06
0.018	0.133	931.	0.0000	0.01725	1.72	1.06
0.034	0.185	983.	0.0000	0.01766	1.77	1.06
0.083	0.289	1.11e+03	0.0000	0.01867	1.87	1.06
0.100	0.316	1.15e+03	0.0000	0.01910	1.91	1.05
0.167	0.408	1.26e+03	0.0000	0.02033	2.03	1.05
0.250	0.500	1.28e+03	0.0000	0.02103	2.10	1.05
0.501	0.707	1.31e+03	0.0000	0.02183	2.18	1.05
1.000	1.000	1.31e+03	0.0000	0.02262	2.26	1.05
2.001	1.414	1.31e+03	0.0000	0.02326	2.33	1.05
4.001	2.000	1.31e+03	0.0000	0.02383	2.38	1.04
8.000	2.828	1.31e+03	0.0000	0.02406	2.41	1.04
15.000	3.873	1.31e+03	0.0000	0.02434	2.43	1.04
30.000	5.477	1.31e+03	0.0000	0.02498	2.50	1.04
45.000	6.708	1.31e+03	0.0000	0.02530	2.53	1.04
60.001	7.746	1.31e+03	0.0000	0.02565	2.57	1.04
75.001	8.660	1.31e+03	0.0000	0.02587	2.59	1.04
90.001	9.487	1.31e+03	0.0000	0.02597	2.60	1.04
105.001	10.247	1.31e+03	0.0000	0.02605	2.61	1.04
120.001	10.954	1.31e+03	0.0000	0.02614	2.61	1.04
120.149	10.961	1.31e+03	0.0000	0.02614	2.61	1.04

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 6 of 9

Constant Load Step

Stress: 2960 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	1.31e+03	0.0000	0.02614	2.61	1.04
0.018	0.133	1.55e+03	0.0000	0.02654	2.65	1.04
0.034	0.185	1.71e+03	0.0000	0.02744	2.74	1.04
0.084	0.290	2.08e+03	0.0000	0.02997	3.00	1.03
0.101	0.318	2.28e+03	0.0000	0.03051	3.05	1.03
0.168	0.409	2.96e+03	0.0000	0.03560	3.56	1.02
0.250	0.500	2.79e+03	0.0000	0.03595	3.59	1.02
0.500	0.707	2.89e+03	0.0000	0.03824	3.82	1.01
1.001	1.000	2.91e+03	0.0000	0.04080	4.08	1.01
2.000	1.414	2.93e+03	0.0000	0.04320	4.32	1.00
4.000	2.000	2.96e+03	0.0000	0.04666	4.67	0.997
8.001	2.829	2.95e+03	0.0000	0.04906	4.91	0.992
15.001	3.873	2.96e+03	0.0000	0.05232	5.23	0.985
30.000	5.477	2.96e+03	0.0000	0.05549	5.55	0.978
45.001	6.708	2.96e+03	0.0000	0.05719	5.72	0.975
60.001	7.746	2.96e+03	0.0000	0.05857	5.86	0.972
75.001	8.660	2.96e+03	0.0000	0.05894	5.89	0.971
90.001	9.487	2.96e+03	0.0000	0.05954	5.95	0.970
105.001	10.247	2.96e+03	0.0000	0.06012	6.01	0.969
120.001	10.954	2.96e+03	0.0000	0.06041	6.04	0.968
120.161	10.962	2.96e+03	0.0000	0.06041	6.04	0.968

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 7 of 9

Constant Load Step

Stress: 4500 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	2.96e+03	0.0000	0.06041	6.04	0.968
0.017	0.130	3.32e+03	0.0000	0.06099	6.10	0.967
0.034	0.183	3.60e+03	0.0000	0.06193	6.19	0.965
0.083	0.289	4.16e+03	0.0000	0.06418	6.42	0.960
0.100	0.316	4.32e+03	0.0000	0.06480	6.48	0.959
0.167	0.408	4.34e+03	0.0000	0.06580	6.58	0.957
0.250	0.500	4.42e+03	0.0000	0.06607	6.61	0.956
0.501	0.708	4.47e+03	0.0000	0.06836	6.84	0.951
1.001	1.000	4.49e+03	0.0000	0.07035	7.04	0.947
2.001	1.414	4.48e+03	0.0000	0.07253	7.25	0.943
4.000	2.000	4.50e+03	0.0000	0.07740	7.74	0.932
8.001	2.829	4.48e+03	0.0000	0.08264	8.26	0.921
15.000	3.873	4.49e+03	0.0000	0.08894	8.89	0.908
30.001	5.477	4.49e+03	0.0000	0.09565	9.57	0.894
45.001	6.708	4.49e+03	0.0000	0.09903	9.90	0.887
60.001	7.746	4.50e+03	0.0000	0.1019	10.2	0.881
75.000	8.660	4.50e+03	0.0000	0.1037	10.4	0.877
90.001	9.487	4.50e+03	0.0000	0.1056	10.6	0.873
105.000	10.247	4.50e+03	0.0000	0.1064	10.6	0.872
120.001	10.954	4.50e+03	0.0000	0.1073	10.7	0.870
135.001	11.619	4.50e+03	0.0000	0.1082	10.8	0.868
150.000	12.247	4.50e+03	0.0000	0.1090	10.9	0.866
165.001	12.845	4.50e+03	0.0000	0.1098	11.0	0.864
180.001	13.416	4.50e+03	0.0000	0.1104	11.0	0.863
195.001	13.964	4.50e+03	0.0000	0.1107	11.1	0.863
210.001	14.491	4.50e+03	0.0000	0.1111	11.1	0.862
225.001	15.000	4.50e+03	0.0000	0.1116	11.2	0.861
240.001	15.492	4.50e+03	0.0000	0.1117	11.2	0.860
255.001	15.969	4.50e+03	0.0000	0.1121	11.2	0.860
270.001	16.432	4.50e+03	0.0000	0.1124	11.2	0.859
285.001	16.882	4.50e+03	0.0000	0.1126	11.3	0.859
300.001	17.321	4.50e+03	0.0000	0.1128	11.3	0.858
315.000	17.748	4.50e+03	0.0000	0.1131	11.3	0.858
330.001	18.166	4.50e+03	0.0000	0.1133	11.3	0.857
345.000	18.574	4.50e+03	0.0000	0.1135	11.3	0.857
360.000	18.974	4.50e+03	0.0000	0.1136	11.4	0.856
375.000	19.365	4.50e+03	0.0000	0.1139	11.4	0.856
390.000	19.748	4.50e+03	0.0000	0.1140	11.4	0.856
405.001	20.125	4.50e+03	0.0000	0.1143	11.4	0.855
420.000	20.494	4.50e+03	0.0000	0.1145	11.4	0.855
435.000	20.857	4.50e+03	0.0000	0.1147	11.5	0.854
450.000	21.213	4.50e+03	0.0000	0.1149	11.5	0.854
465.000	21.564	4.50e+03	0.0000	0.1153	11.5	0.853
480.001	21.909	4.50e+03	0.0000	0.1155	11.5	0.853
495.001	22.249	4.50e+03	0.0000	0.1155	11.6	0.852
510.001	22.583	4.50e+03	0.0000	0.1158	11.6	0.852
525.000	22.913	4.50e+03	0.0000	0.1159	11.6	0.852
540.001	23.238	4.50e+03	0.0000	0.1161	11.6	0.851
555.000	23.558	4.50e+03	0.0000	0.1163	11.6	0.851
570.001	23.875	4.50e+03	0.0000	0.1165	11.6	0.851

Soil Metrics LLC

Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 7 of 9

Constant Load Step

Stress: 4500 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
585.000	24.187	4.50e+03	0.0000	0.1166	11.7	0.850
600.001	24.495	4.50e+03	0.0000	0.1167	11.7	0.850
615.000	24.799	4.50e+03	0.0000	0.1168	11.7	0.850
630.001	25.100	4.50e+03	0.0000	0.1169	11.7	0.850
645.001	25.397	4.50e+03	0.0000	0.1169	11.7	0.850
660.000	25.690	4.50e+03	0.0000	0.1171	11.7	0.849
675.000	25.981	4.50e+03	0.0000	0.1171	11.7	0.849
690.001	26.268	4.50e+03	0.0000	0.1173	11.7	0.849
705.001	26.552	4.50e+03	0.0000	0.1174	11.7	0.849
720.001	26.833	4.50e+03	0.0000	0.1174	11.7	0.849
735.001	27.111	4.50e+03	0.0000	0.1175	11.8	0.848
750.001	27.386	4.50e+03	0.0000	0.1176	11.8	0.848
765.001	27.659	4.50e+03	0.0000	0.1177	11.8	0.848
780.000	27.928	4.50e+03	0.0000	0.1178	11.8	0.848
795.000	28.196	4.50e+03	0.0000	0.1178	11.8	0.848
810.000	28.461	4.50e+03	0.0000	0.1179	11.8	0.847
825.001	28.723	4.50e+03	0.0000	0.1180	11.8	0.847
840.000	28.983	4.50e+03	0.0000	0.1180	11.8	0.847
855.001	29.240	4.50e+03	0.0000	0.1182	11.8	0.847
870.000	29.496	4.50e+03	0.0000	0.1182	11.8	0.847
885.000	29.749	4.50e+03	0.0000	0.1183	11.8	0.847
900.001	30.000	4.50e+03	0.0000	0.1183	11.8	0.847
915.001	30.249	4.50e+03	0.0000	0.1184	11.8	0.847
930.001	30.496	4.50e+03	0.0000	0.1186	11.9	0.846
945.001	30.741	4.50e+03	0.0000	0.1186	11.9	0.846
960.000	30.984	4.50e+03	0.0000	0.1187	11.9	0.846
975.000	31.225	4.50e+03	0.0000	0.1187	11.9	0.846
990.001	31.464	4.50e+03	0.0000	0.1187	11.9	0.846
1005.000	31.702	4.50e+03	0.0000	0.1187	11.9	0.846
1020.000	31.937	4.50e+03	0.0000	0.1187	11.9	0.846
1035.000	32.171	4.50e+03	0.0000	0.1187	11.9	0.846
1050.001	32.404	4.50e+03	0.0000	0.1187	11.9	0.846
1065.001	32.634	4.50e+03	0.0000	0.1187	11.9	0.846
1080.001	32.863	4.50e+03	0.0000	0.1187	11.9	0.846
1095.000	33.091	4.50e+03	0.0000	0.1188	11.9	0.846
1110.001	33.317	4.50e+03	0.0000	0.1188	11.9	0.846
1125.000	33.541	4.50e+03	0.0000	0.1188	11.9	0.846
1140.000	33.764	4.50e+03	0.0000	0.1188	11.9	0.846
1155.001	33.985	4.50e+03	0.0000	0.1188	11.9	0.846
1170.001	34.205	4.50e+03	0.0000	0.1188	11.9	0.846
1185.001	34.424	4.50e+03	0.0000	0.1188	11.9	0.846
1200.001	34.641	4.50e+03	0.0000	0.1188	11.9	0.846
1215.001	34.857	4.50e+03	0.0000	0.1188	11.9	0.846
1230.001	35.071	4.50e+03	0.0000	0.1189	11.9	0.846
1245.000	35.285	4.50e+03	0.0000	0.1189	11.9	0.846
1260.000	35.496	4.50e+03	0.0000	0.1189	11.9	0.845
1275.000	35.707	4.50e+03	0.0000	0.1189	11.9	0.845
1290.001	35.917	4.50e+03	0.0000	0.1189	11.9	0.845
1305.001	36.125	4.50e+03	0.0000	0.1189	11.9	0.845
1320.001	36.332	4.50e+03	0.0000	0.1189	11.9	0.845

Soil Metrics LLC

Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 7 of 9

Constant Load Step

Stress: 4500 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
1335.001	36.538	4.50e+03	0.0000	0.1189	11.9	0.845
1350.000	36.742	4.50e+03	0.0000	0.1189	11.9	0.845
1365.001	36.946	4.50e+03	0.0000	0.1189	11.9	0.845
1380.001	37.148	4.50e+03	0.0000	0.1189	11.9	0.845
1395.000	37.350	4.50e+03	0.0000	0.1189	11.9	0.845
1410.000	37.550	4.50e+03	0.0000	0.1189	11.9	0.845
1425.001	37.749	4.50e+03	0.0000	0.1189	11.9	0.845
1440.000	37.947	4.50e+03	0.0000	0.1189	11.9	0.845
1440.114	37.949	4.50e+03	0.0000	0.1189	11.9	0.845

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 8 of 9

Constant Load Step

Stress: 3000 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	4.50e+03	0.0000	0.1189	11.9	0.845
0.018	0.132	3.94e+03	0.0000	0.1189	11.9	0.845
0.034	0.185	3.50e+03	0.0000	0.1188	11.9	0.846
0.084	0.290	3.02e+03	0.0000	0.1184	11.8	0.846
0.101	0.317	3.03e+03	0.0000	0.1184	11.8	0.846
0.167	0.409	3.01e+03	0.0000	0.1183	11.8	0.847
0.251	0.501	3.01e+03	0.0000	0.1183	11.8	0.847
0.500	0.707	3.00e+03	0.0000	0.1182	11.8	0.847
1.000	1.000	3.00e+03	0.0000	0.1181	11.8	0.847
2.001	1.415	3.00e+03	0.0000	0.1180	11.8	0.847
4.001	2.000	3.00e+03	0.0000	0.1179	11.8	0.848
8.001	2.829	3.00e+03	0.0000	0.1179	11.8	0.848
15.001	3.873	3.00e+03	0.0000	0.1178	11.8	0.848
30.000	5.477	3.00e+03	0.0000	0.1178	11.8	0.848
45.000	6.708	3.00e+03	0.0000	0.1178	11.8	0.848
60.001	7.746	3.00e+03	0.0000	0.1178	11.8	0.848
75.001	8.660	3.00e+03	0.0000	0.1178	11.8	0.848
90.001	9.487	3.00e+03	0.0000	0.1178	11.8	0.848
105.000	10.247	3.00e+03	0.0000	0.1178	11.8	0.848
120.001	10.954	3.00e+03	0.0000	0.1178	11.8	0.848
120.060	10.957	3.00e+03	0.0000	0.1178	11.8	0.848

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Consolidation Time Curve 9 of 9

Constant Load Step

Stress: 1500 psf

Elapsed Time min	Sq.Rt. of Time min	Stress psf	Displacement Correction in	Corrected Displacement in	Strain %	Void Ratio
0.000	0.000	3.00e+03	0.0000	0.1178	11.8	0.848
0.018	0.133	2.61e+03	0.0000	0.1171	11.7	0.849
0.034	0.185	2.28e+03	0.0000	0.1166	11.7	0.850
0.084	0.290	1.62e+03	0.0000	0.1148	11.5	0.854
0.101	0.317	1.51e+03	0.0000	0.1143	11.4	0.855
0.167	0.409	1.55e+03	0.0000	0.1141	11.4	0.856
0.251	0.501	1.51e+03	0.0000	0.1138	11.4	0.856
0.501	0.708	1.52e+03	0.0000	0.1136	11.4	0.857
1.001	1.000	1.50e+03	0.0000	0.1132	11.3	0.857
2.001	1.414	1.50e+03	0.0000	0.1129	11.3	0.858
4.001	2.000	1.50e+03	0.0000	0.1126	11.3	0.859
8.000	2.828	1.50e+03	0.0000	0.1124	11.2	0.859
15.000	3.873	1.50e+03	0.0000	0.1124	11.2	0.859
30.001	5.477	1.50e+03	0.0000	0.1123	11.2	0.859
45.000	6.708	1.50e+03	0.0000	0.1121	11.2	0.860
60.000	7.746	1.50e+03	0.0000	0.1121	11.2	0.860
75.001	8.660	1.50e+03	0.0000	0.1121	11.2	0.860
90.000	9.487	1.50e+03	0.0000	0.1121	11.2	0.860
105.001	10.247	1.50e+03	0.0000	0.1120	11.2	0.860
120.001	10.954	1.50e+03	0.0000	0.1120	11.2	0.860
120.091	10.959	1.50e+03	0.0000	0.1120	11.2	0.860

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Shear Phase

Elapsed Time min	Shear Strain %	Shear Stress psf	Shear Modulus psf	Normal Strain %	Normal Stress psf	Pressure Ratio
0.00000	0.00000	-136.38	0.00000	0.00000	1499.6	0.00000
0.00015000	-0.0036146	-136.38	0.00000	0.00000	1499.6	0.00000
0.016733	-0.0072292	-136.38	0.00000	0.00000	1499.6	0.00000
0.033383	0.00000	-136.38	0.00000	0.00000	1497.3	0.0015674
0.084333	0.0072292	-134.03	-1.8540e+06	0.00000	1504.3	-0.0031348
0.10100	0.0072292	-134.03	-1.8540e+06	0.00000	1504.3	-0.0031348
0.16768	0.0072292	-131.68	-1.8214e+06	0.00000	1506.7	-0.0047022
0.25105	0.021688	-124.62	-5.7462e+05	0.00000	1509.0	-0.0062696
0.50095	0.050604	-117.57	-2.3233e+05	0.00000	1516.1	-0.010972
1.0007	0.054219	-89.351	-1.6480e+05	0.00000	1692.4	-0.12853
2.0006	0.090365	-58.784	-65052.	0.00000	1668.9	-0.11285
4.0004	0.14458	-18.811	-13010.	0.00000	1708.8	-0.13950
8.0006	0.23133	47.027	20329.	0.00000	1784.1	-0.18966
15.000	0.45544	164.59	36140.	0.00000	1915.7	-0.27743
30.001	0.88919	359.76	40459.	0.00000	2082.6	-0.38871
45.000	1.3302	512.59	38536.	0.00000	2153.1	-0.43574
60.000	1.7892	599.59	33511.	0.00000	2221.3	-0.48119
75.000	2.2483	663.08	29493.	0.00000	2218.9	-0.47962
90.000	2.7182	686.60	25259.	0.00000	2162.5	-0.44201
105.00	3.2676	696.00	21300.	0.00000	2047.3	-0.36520
120.00	3.7736	691.30	18319.	0.00000	1990.9	-0.32759
135.00	4.2905	693.65	16167.	0.00000	1887.5	-0.25862
150.00	4.7930	698.35	14570.	0.00000	1807.6	-0.20533
165.00	5.2954	703.05	13277.	0.00000	1760.5	-0.17398
180.00	5.7580	700.70	12169.	0.00000	1711.2	-0.14107
195.00	6.2966	698.35	11091.	0.00000	1668.9	-0.11285
210.00	6.7882	696.00	10253.	0.00000	1631.3	-0.087774
225.00	7.3232	696.00	9504.1	0.00000	1581.9	-0.054859
240.00	7.8148	700.70	8966.4	0.00000	1560.8	-0.040752
255.00	8.2991	691.30	8329.8	0.00000	1506.7	-0.0047022
270.00	8.8341	686.60	7772.1	0.00000	1502.0	-0.0015674
285.00	9.3473	686.60	7345.4	0.00000	1471.4	0.018809
300.00	9.8968	686.60	6937.6	0.00000	1452.6	0.031348
315.00	10.356	679.54	6561.9	0.00000	1424.4	0.050157
330.00	10.905	677.19	6209.8	0.00000	1417.4	0.054859
345.00	11.339	672.49	5930.8	0.00000	1396.2	0.068966
360.00	11.841	665.43	5619.5	0.00000	1382.1	0.078370
375.00	12.373	663.08	5359.2	0.00000	1356.3	0.095611
390.00	12.915	658.38	5097.8	0.00000	1332.8	0.11129
405.00	13.435	653.68	4865.3	0.00000	1318.6	0.12069
420.00	13.974	651.32	4661.0	0.00000	1313.9	0.12382
435.00	14.451	646.62	4474.5	0.00000	1299.8	0.13323
450.00	14.896	646.62	4341.0	0.00000	1264.6	0.15674
465.00	15.409	651.32	4226.9	0.00000	1274.0	0.15047
480.00	15.933	648.97	4073.1	0.00000	1241.1	0.17241
495.00	16.443	648.97	3946.9	0.00000	1229.3	0.18025
510.00	16.992	651.32	3833.1	0.00000	1250.5	0.16614
525.00	17.560	648.97	3695.8	0.00000	1255.2	0.16301
540.00	18.026	644.27	3574.1	0.00000	1224.6	0.18339
555.00	18.489	639.57	3459.2	0.00000	1229.3	0.18025

Soil Metrics LLC

Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Shear Phase

Elapsed Time min	Shear Strain %	Shear Stress psf	Shear Modulus psf	Normal Strain %	Normal Stress psf	Pressure Ratio
570.00	19.006	634.87	3340.4	0.00000	1198.8	0.20063
585.00	19.490	632.51	3245.3	0.00000	1184.7	0.21003
600.00	20.014	630.16	3148.6	0.00000	1182.3	0.21160
615.00	20.571	625.46	3040.5	0.00000	1182.3	0.21160
630.00	21.069	616.05	2923.9	0.00000	1165.9	0.22257
645.00	21.604	613.70	2840.6	0.00000	1158.8	0.22727
660.00	22.056	611.35	2771.8	0.00000	1156.5	0.22884
675.00	22.588	616.05	2727.4	0.00000	1154.1	0.23041
690.00	23.068	613.70	2660.4	0.00000	1133.0	0.24451
705.00	23.589	606.65	2571.8	-0.0018856	1123.6	0.25078
720.00	24.098	606.65	2517.4	0.00000	1114.2	0.25705
735.00	24.644	601.95	2442.5	0.00000	1118.9	0.25392
750.00	25.147	599.59	2384.4	0.00000	1095.3	0.26959
765.00	25.595	601.95	2351.8	0.00000	1078.9	0.28056
780.00	26.126	601.95	2304.0	0.00000	1095.3	0.26959
795.00	26.643	592.54	2224.0	0.00000	1130.6	0.24608
810.00	27.084	583.14	2153.1	0.00000	1128.3	0.24765
825.00	27.641	580.78	2101.2	0.00000	1111.8	0.25862
840.00	28.201	580.78	2059.4	0.00000	1097.7	0.26803
855.00	28.732	578.43	2013.2	0.00000	1090.6	0.27273
870.00	29.184	571.38	1957.8	0.00000	1069.5	0.28683
885.00	29.654	569.03	1918.9	0.00000	1085.9	0.27586
900.00	30.164	569.03	1886.5	0.00000	1076.5	0.28213
915.00	30.706	561.97	1830.2	0.00000	1085.9	0.27586
930.00	31.306	557.27	1780.1	0.00000	1078.9	0.28056
945.00	31.754	552.57	1740.1	0.00000	1067.1	0.28840
960.00	32.271	559.62	1734.1	0.00000	1067.1	0.28840
975.00	32.770	557.27	1700.6	0.00000	1067.1	0.28840
990.00	33.251	552.57	1661.8	0.00000	1060.1	0.29310
1005.0	33.768	550.22	1629.4	0.00000	1043.6	0.30408
1020.0	34.321	550.22	1603.2	0.00000	1046.0	0.30251
1035.0	34.827	550.22	1579.9	0.00000	1036.6	0.30878
1050.0	35.307	543.16	1538.4	0.00000	1041.3	0.30564
1065.0	35.821	543.16	1516.3	0.00000	1038.9	0.30721
1080.0	36.316	538.46	1482.7	0.00000	1036.6	0.30878
1095.0	36.858	543.16	1473.7	0.00000	1020.1	0.31975
1110.0	37.407	545.51	1458.3	0.00000	1015.4	0.32288
1125.0	37.903	536.11	1414.4	0.00000	1022.5	0.31818
1140.0	38.405	524.35	1365.3	0.00000	1010.7	0.32602
1155.0	38.871	522.00	1342.9	0.00000	1022.5	0.31818
1170.0	39.417	522.00	1324.3	0.00000	1001.3	0.33229
1185.0	39.894	519.65	1302.6	0.00000	1010.7	0.32602
1200.0	40.411	522.00	1291.7	0.00000	996.63	0.33542
1215.0	40.910	519.65	1270.2	0.00000	996.63	0.33542
1230.0	41.514	517.30	1246.1	0.00000	980.17	0.34639
1245.0	41.900	514.95	1229.0	0.00000	994.27	0.33699
1260.0	42.475	517.30	1217.9	0.00000	987.22	0.34169
1275.0	42.959	514.95	1198.7	0.00000	973.12	0.35110
1290.0	43.473	507.89	1168.3	0.00000	975.47	0.34953
1305.0	43.982	507.89	1154.8	0.00000	959.02	0.36050

Soil Metrics LLC

Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
Test Number: DSS 163	Preparation: wet	Elevation:
Description:		
Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

Direct Simple Shear Test by ASTM D6528

Shear Phase

Elapsed Time min	Shear Strain %	Shear Stress psf	Shear Modulus psf	Normal Strain %	Normal Stress psf	Pressure Ratio
1320.0	44.550	510.24	1145.3	0.00000	959.02	0.36050
1335.0	45.031	505.54	1122.7	0.00000	968.42	0.35423
1350.0	45.566	503.19	1104.3	0.00000	963.72	0.35737
1365.0	46.021	503.19	1093.4	0.00000	975.47	0.34953
1380.0	46.484	503.19	1082.5	0.00000	956.67	0.36207
1395.0	47.008	500.84	1065.4	0.00000	944.91	0.36991
1410.0	47.586	498.49	1047.5	0.00000	940.21	0.37304
1425.0	48.117	496.14	1031.1	0.00000	944.91	0.36991
1440.0	48.595	491.43	1011.3	0.00000	951.97	0.36520
1455.0	49.111	493.78	1005.4	0.00000	951.97	0.36520
1470.0	49.592	498.49	1005.2	0.00000	951.97	0.36520
1485.0	50.102	491.43	980.87	0.00000	947.26	0.36834
1500.0	50.586	484.38	957.53	0.00000	935.51	0.37618
1515.0	51.190	470.27	918.68	0.00000	933.16	0.37774
1530.0	51.649	463.22	896.86	0.00000	923.76	0.38401
1545.0	52.216	470.27	900.62	0.00000	928.46	0.38088
1560.0	52.719	470.27	892.03	0.00000	926.11	0.38245
1575.0	53.210	472.62	888.21	0.00000	928.46	0.38088
1590.0	53.659	477.32	889.56	0.00000	916.71	0.38871
1605.0	54.215	470.27	867.41	0.00000	916.71	0.38871
1620.0	54.718	458.51	837.96	0.00000	893.20	0.40439
1635.0	55.282	449.11	812.40	0.00000	902.60	0.39812
1650.0	55.759	439.70	788.58	0.00000	897.90	0.40125
1665.0	56.290	453.81	806.20	0.00000	902.60	0.39812
1667.0	56.362	456.16	809.34	0.00000	909.66	0.39342

Soil Metrics LLC	Project Name: Yarmouth Rt 1 Bridge	Location: Yarmouth, ME	Project Number: 166-35
	Boring Number: YR1-BB-201	Tester: sjr	Checker: sjr
	Sample Number: 2U	Test Date: 9/26/2024	Depth: 14.9
	Test Number: DSS 163	Preparation: wet	Elevation:
	Description:		
	Remarks: Consolidated to 4500 psf, hold for 24 hours, unload to 1,500 psf and sheared.		

APPENDIX F - ENGINEERING CALCULATIONS

Abutment 1 Settlement Evaluations

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	E. Tome	Date:	8/10/2024
Checked by:	A. Blaisdell / B. Cardali	Date:	8/20/2024

Objective

The purpose of this calculation package is to evaluate post-construction settlement due to the proposed Abutment 1 embankment fills. MaineDOT provided a project specific settlement criterion of 2 inches over the first 5 years post-construction and an additional 2 inches between 5 and 20 years to limit settlement within 100 feet of the abutments.

Steps:

1. Develop settlement properties and Settle3 inputs.
2. Complete settlement analysis using Settle3 for both no mitigation and with ultra-lightweight fill (ULFGA) at 75 years post-construction.
3. Generate total consolidation profiles at 5, 20, and 75 years post-construction.

References

Documents that were used as a basis of our evaluation include:

1. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
2. C. Ladd, Portsmouth NH Sensitive Clay, 1972

Attachments

Appendix A – GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils
Appendix B – Abutment 1 ULFGA Plan and Profile Sketches
Appendix C – Settle3 Results Figures
Appendix D – Lightweight Fill Settle3 Input Report

Assumptions

The following assumptions were made for our analyses:

- GZA understands that the construction phasing of the proposed embankment will require new fill to the bottom of the MSE wall elevation and that these fills will be placed at least 6 months prior to final paving. GZA assumes that fills will be placed up to El. 129 well before construction and corresponding consolidation will be recompression and occur rapidly during construction. Therefore, GZA assumes that primary consolidation from these initial fills is not included in the post-construction total settlement.
- The existing and new embankment were modeled at the same time to calculate secondary compression settlement starting at completion of consolidation under the new embankment. This means that roughly ¼" of primary consolidation that occurred under the existing embankment is included in the post-construction roadway consolidation estimates herein, which is conservative.

Soil Properties

GZA developed consolidation properties for the Marine Clay deposits based on laboratory and measured field data as shown in Appendix A, GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils.

Alternative	Layers for Settlement Model	Soil Properties					
		CR	RR	Max Past Pressure (ksf)	Cv	Cvr	Unit Weight (pcf)
No Mitigation	Marine Clay (Crust)	0.16	0.016	4.5	0.25	0.25	120
	Marine Clay	0.16	0.016	2.95	0.25	0.25	118
Lightweight Fill	Marine Clay (Crust)	0.16	0.016	4.5	0.25	0.25	120
	Marine Clay	0.16	0.016	2.95	0.25	0.25	118

Calculation of Stress Ratios and Secondary Compression

GZA utilized the final effective stresses at the mid points of the Marine Clay Crust and Marine Clay from Settle3 for stress ratio calculations discussed herein. The secondary compression rate is estimated using the Ladd plot shown below. The stress ratio used for the plot is calculated by dividing the final effective stress by the maximum past pressure. GZA utilized the final effective stresses at the mid points of the Marine Clay Crust and Marine Clay from Settle3 for the stress ratio calculation which are shown in Table 1. Cα is estimated as a function of the stress ratio from Figure 1 below (Reference 2).

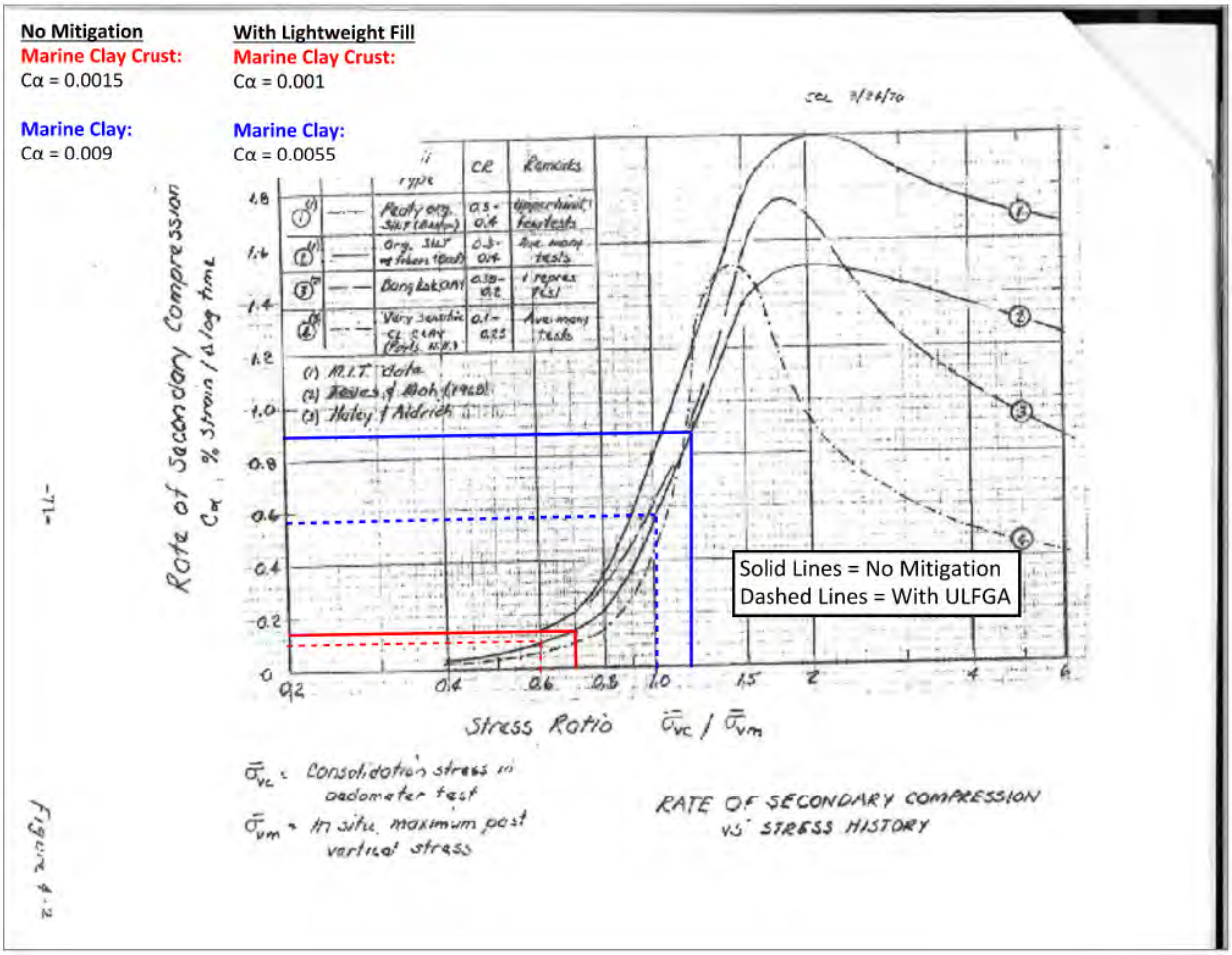


Figure 1 – Stress Ratios vs. Cα (Ladd)

Table 1: Stress Ratios and Secondary Compression Summary Table

Alternative	Layer	Maximum Past Pressure (ksf)	Final Effective Stress (ksf)	Stress Ratio	Cα
No Mitigation	Marine Clay (Crust)	4.5	3.1	0.7	0.0015
	Marine Clay	2.95	3.5	1.2	0.009
Lightweight Fill	Marine Clay (Crust)	4.5	2.5	0.6	0.001
	Marine Clay	2.95	3.0	1.0	0.0055

Settle3 Model Staging

The Settle3 model staging for the project is:

Year 0: Existing Roadway Embankment and Proposed Fill Placed Up To El. 129
Year 0.2: Remaining Fills Placed (ULFGA for Lightweight Fill Alternative)
Year 5.2: 5 years post-construction
Year 20.2: 20 years post-construction
Year 75.2: 75 years post-construction

No Mitigation

Settlement evaluations were conducted on the proposed embankment without the effects of ULFGA to determine the anticipated settlement under the proposed fills. The estimated maximum total settlement of approximately 2.9 inches was computed near Abutment 1 within the first 5 years, as shown in **Figure 2** below, and therefore the settlement without mitigation exceeds the limit of 2 inches in the first 5 years.

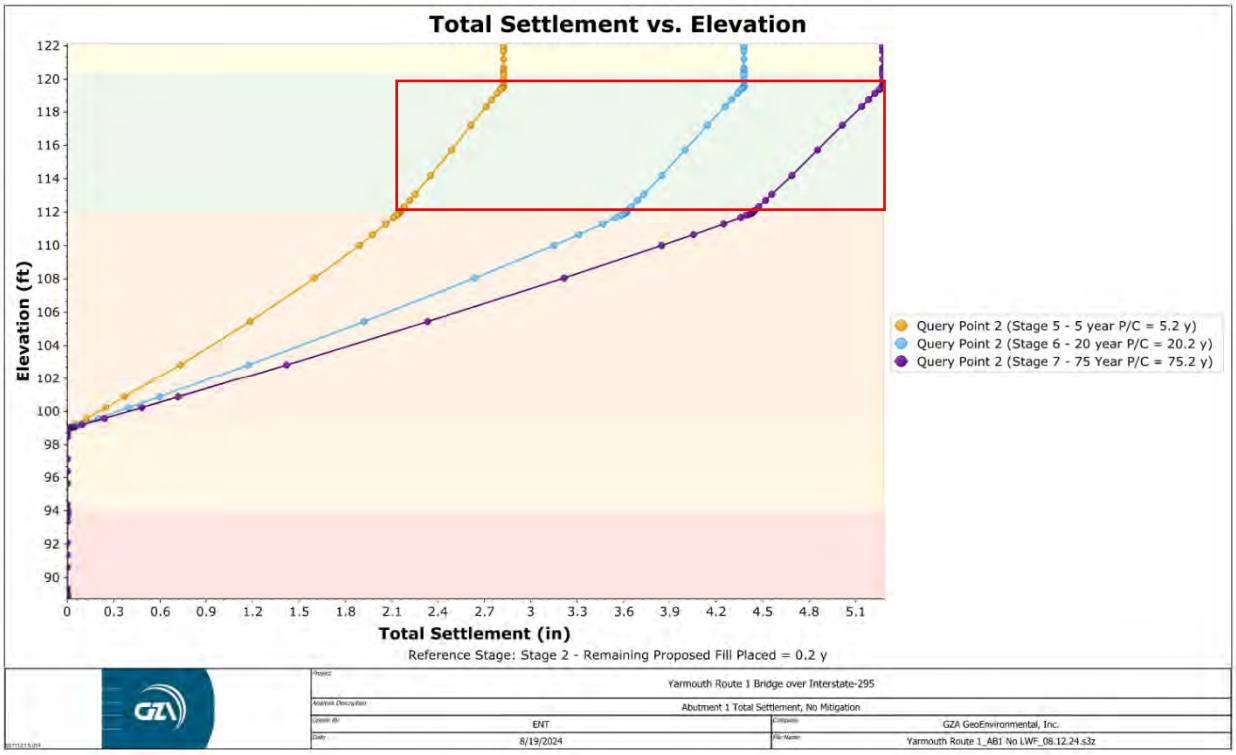


Figure 2 – Total Settlement, No Mitigation

Lightweight Fill Results

Considering the no mitigation alternative does not meet the MaineDOT settlement criterion, GZA conducted settlement evaluations considering ULFGA placed behind the abutment to evaluate the anticipated settlement under the proposed fills. A maximum ULFGA thickness of 6 feet was modeled as a negative pressure of -0.63 ksf at El. 135 to represent the difference in unit weight between the proposed fill (125 pcf) and ULFGA (20 pcf). The estimated maximum total settlement of approximately 1.8 inches in the first 5 years and an additional 0.8 inches between 5 and 20 years post-construction, as shown in **Figure 2** below. The total settlement during the design life is 3.1 inches, however, GZA anticipates that remaining settlement can be mitigated by shimming during the typical paving cycle.

The limits of the ULFGA are shown in **Appendix A** and the Settle3 results are shown in **Appendix B**.

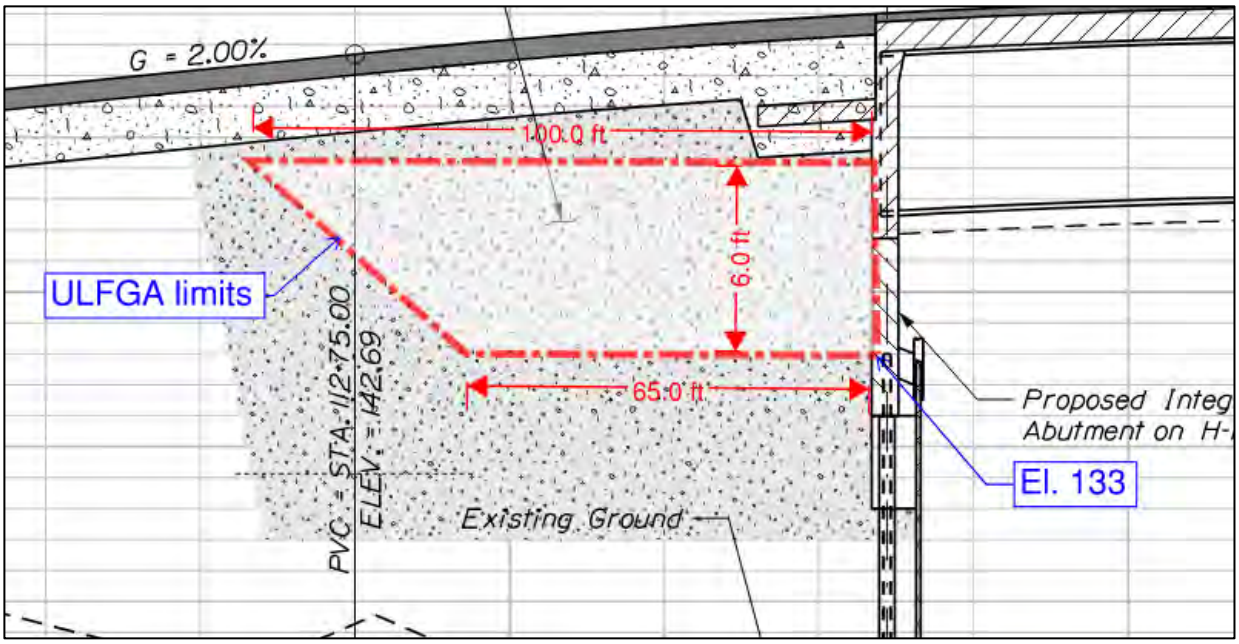


Figure 3 - Limits of Lightweight Fill Profile View

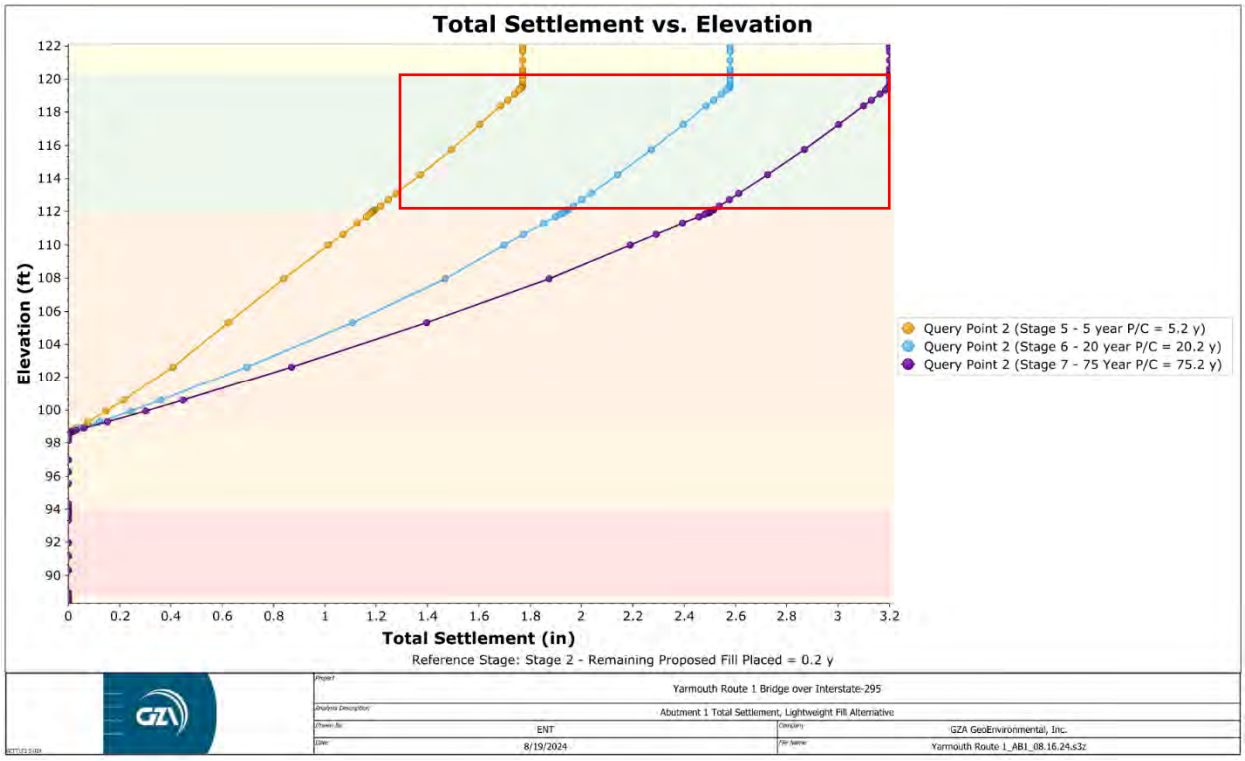


Figure 4 – Total Settlement, Lightweight Fill Alternative

Abutment 1 Settlement Evaluations

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	E. Tome	Date:	8/10/2024
Checked by:	A. Blaisdell / B. Cardali	Date:	11/14/2024

Summary of Results

The estimated total settlement with the no mitigation and lightweight fill alternatives are summarized in the table below.

Alternative	Table 2: Summary of Settlement Estimates (inches)		
	5 Years Post-Construction	20 Years Post-Construction	75 Years Post-Construction
No Mitigation	2.9	4.2	5.1
Lightweight Fill	1.8	2.6	3.1

Conclusions

The No Mitigation results indicate that predicted settlements are slightly over the project criterion. Therefore, the lightweight fill scheme was considered to be appropriate.

The results show that the configuration of ultra-light weight foamed glass aggregate shown on typical sections herein provide settlement mitigation to achieve the project settlement criterion of less than 2 inches in the first 5 years and another 2 inches between 5 and 20 years within 100 feet of the abutment, with predictions of approximately 1.8 inches and 0.8 inches, respectively. Additionally, we predict greater than 0.5 inches of consolidation at the bridge abutments during the design life of the bridge, therefore downdrag needs to be considered in pile design at Abutment 1.

Recommendations

The required thickness of ULFGA with a maximum total unit weight of 20 pcf is 6 feet in full-height areas. The coordinates of the recommended ULFGA areas in plan view are shown in **Figure 5**.

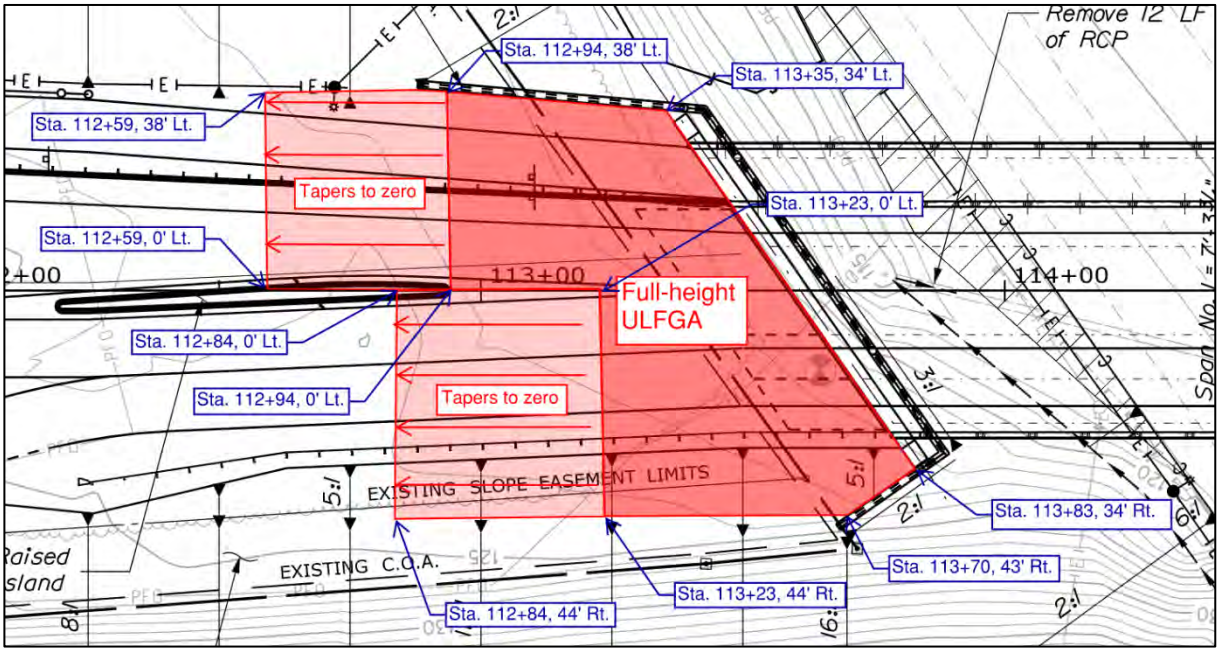
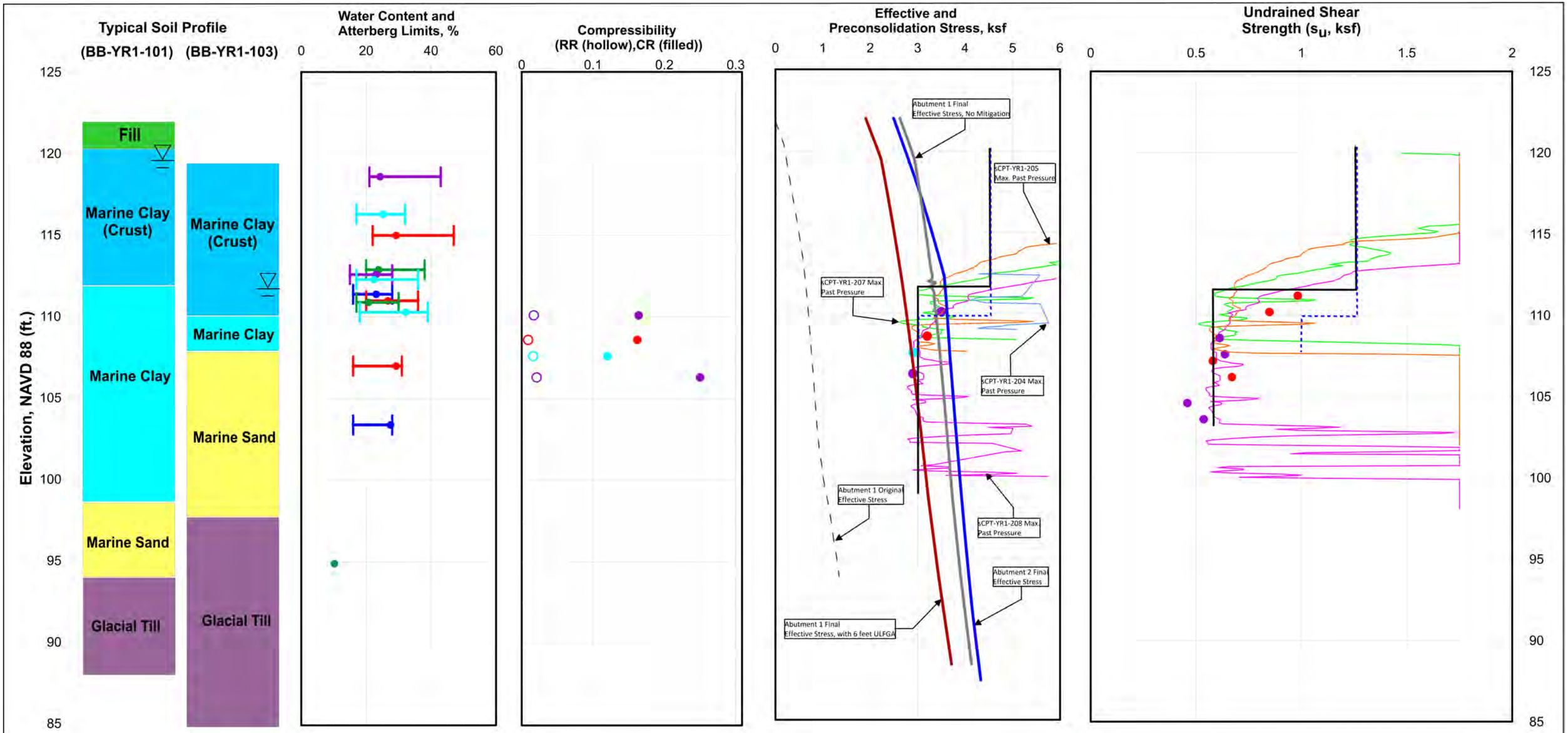


Figure 5 – Limits of Lightweight Fill Plan View

APPENDIX A

GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils



NOTES:

1. DATA BASED ON TEST BORINGS BB-YR1-101, -102, AND -103. THE -101 SERIES BORINGS WERE PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF HERMON, MAINE BETWEEN FEBRUARY 21 AND APRIL 11, 2022. THE -200 SERIES BORINGS WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE BETWEEN APRIL 26 and 30, 2014. ALL BORINGS WERE OBSERVED AND LOGGED BY GZA PERSONNEL.
2. SCPT EXPLORATIONS (SCPT-YR1-101 THROUGH -108, AND SCPT-YR1-107A) WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE ON APRIL 25 AND 29, 2024.
3. TYPICAL SOIL PROFILES BASED ON BORING BB-YR1-101 (ABUTMENT 1) AND BB-YR1-202 (ABUTMENT 2).
4. WATER CONTENTS BASED ON LABORATORY TESTS PERFORMED ON SAMPLES TAKEN FROM RECENT BORINGS.
5. PRECONSOLIDATION PRESSURE CALCULATED FROM CONSOLIDATION TESTS AND ESTIMATED FROM SCPT DATA ASSUMING A K=0.30
6. CORRELATED UNDRAINED SHEAR STRENGTH FROM CPT DATA IS BASED ON N_{KT} = 17.
7. IN LEGEND, FV=UNDRAINED SHEAR STRENGTH FROM IN-SITU FIELD VANE, CONSOL=LAB DATA FROM CONSOLIDATION TEST.

LEGEND

- BB-YR1-101 (FV, Consol)
- BB-YR1-102
- BB-YR1-103
- BB-YR1-201 (FV, Consol)
- BB-YR1-202 (Consol)
- sCPT-YR1-204
- sCPT-YR1-205 (Nkt 17)
- sCPT-YR1-207 (Nkt 17)
- sCPT-YR1-208 (Nkt 17)
- Design Profile Abutment 1
- Design Profile Abutment 2

Plastic Limit, PL — Water Content, Wn — Liquid Limit, LL

UNLESS SPECIFICALLY STATED BY WRITTEN AGREEMENT, THIS DRAWING IS THE SOLE PROPERTY OF GZA GEOENVIRONMENTAL, INC. (GZA). THE INFORMATION DEPICTED ON THIS DRAWING IS SOLELY FOR USE BY GZA'S CLIENT OR THE CLIENT'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY THE CLIENT OR OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA.

YARMOUTH ROUTE 1 BRIDGE REPLACEMENT
YARMOUTH, ME

IN-SITU SOIL CONDITIONS VS. ELEVATION
Abutment 1 & 2 Approaches

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers & Scientists www.gza.com		PREPARED FOR: MAINE DEPARTMENT OF TRANSPORTATION	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIGURE 4
DESIGNED BY: BMC	DRAWN BY: ENT	SCALE: N/A	
DATE: 11/15/2024	PROJECT NUMBER: 09.0026144.00	REVISION NUMBER: 0	

APPENDIX B

Abutment 1 ULFGA Plan and Profile Sketches

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 22382.00
BRIDGE NO. 5804
BRIDGE PLANS

STATE OF MAINE

STATE OF MAINE

I-295 Southbound

I-295 Northbound

EXISTING C.O.A.

remove existing type 3C and replace with 31"?

make sure we account for 25' transition will be incidental to GR item

do we want to extend to existing limits - that is where double sided ends on SB

Remove Existing Guardrail
31" W-Beam Guardrail Mid-Way Splice

31" W-Beam Guardrail Mid-Way Splice Extended 50' Beyond Bridge Pier

31" W-Beam Guardrail Mid-Way Splice Tangent Terminal (Typ.)

5' Clearing Limit Line (Typ.)

35° Skew

Fence (48" Min. Height) (Typ.)

Catch Basin (Typ.)

Multi-Use Path (Typ.)

12" Underdrain Type C

MSE Retaining Wall

℄ Brg., Abut. No. 1 Sta. 113+61.00

℄ Brg., Pier Sta. 115+21.00

Brg., Abut. No. 2 ℄ Sta. 116+41.00

Remove 12 LF of RCP

Sta. 112+94, 38' Lt.

Sta. 113+35, 34' Lt.

Sta. 112+59, 38' Lt.

Tapers to zero

Sta. 113+23, 0' Lt.

Sta. 112+59, 0' Lt.

Full-height ULFGA

Sta. 112+84, 0' Lt.

Sta. 112+94, 0' Lt.

Tapers to zero

Sta. 113+83, 34' Rt.

Sta. 113+70, 43' Rt.

Sta. 112+84, 44' Rt.

Sta. 113+23, 44' Rt.

112+00 113+00 114+00 115+00 116+00 117+00 118+00

US Route 1

EXISTING SLOPE EASEMENT LIMITS

EXISTING

Span No. 1 = 7'-3¼"

Span No. 2 = 5'-5¼"

Raised Island

Lightweight Embankment Fill (Exact limit and quantity to be determined) (Typ.)

Remove Existing Bridge and Retaining Wall

Remove Existing Guardrail

Existing Signs to be Removed and Replaced (Typ.)

Existing Lighting to be Removed and Relocated (Typ.)

Remove Existing Guardrail

Remove Existing Pavement, Loam & Seed (Typ.)

PLAN

25 0 25 50

Scale of Feet

PROJ. MANAGER	BY	DATE
DESIGN-DETAILED	JCC	LDC	NOV 2023
CHECKED-REVIEWED	STJ	TAS	NOV 2023
DESIGN2-DETAILED2	EGW	PBD	NOV 2023
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

J.Brosk

SIGNATURE

P.E. NUMBER

DATE

RELOC. RTE. 1 BRIDGE OVER I-295

YARMOUTH CUMBERLAND COUNTY

GENERAL PLAN (3 OF 4)

SHEET NUMBER

6

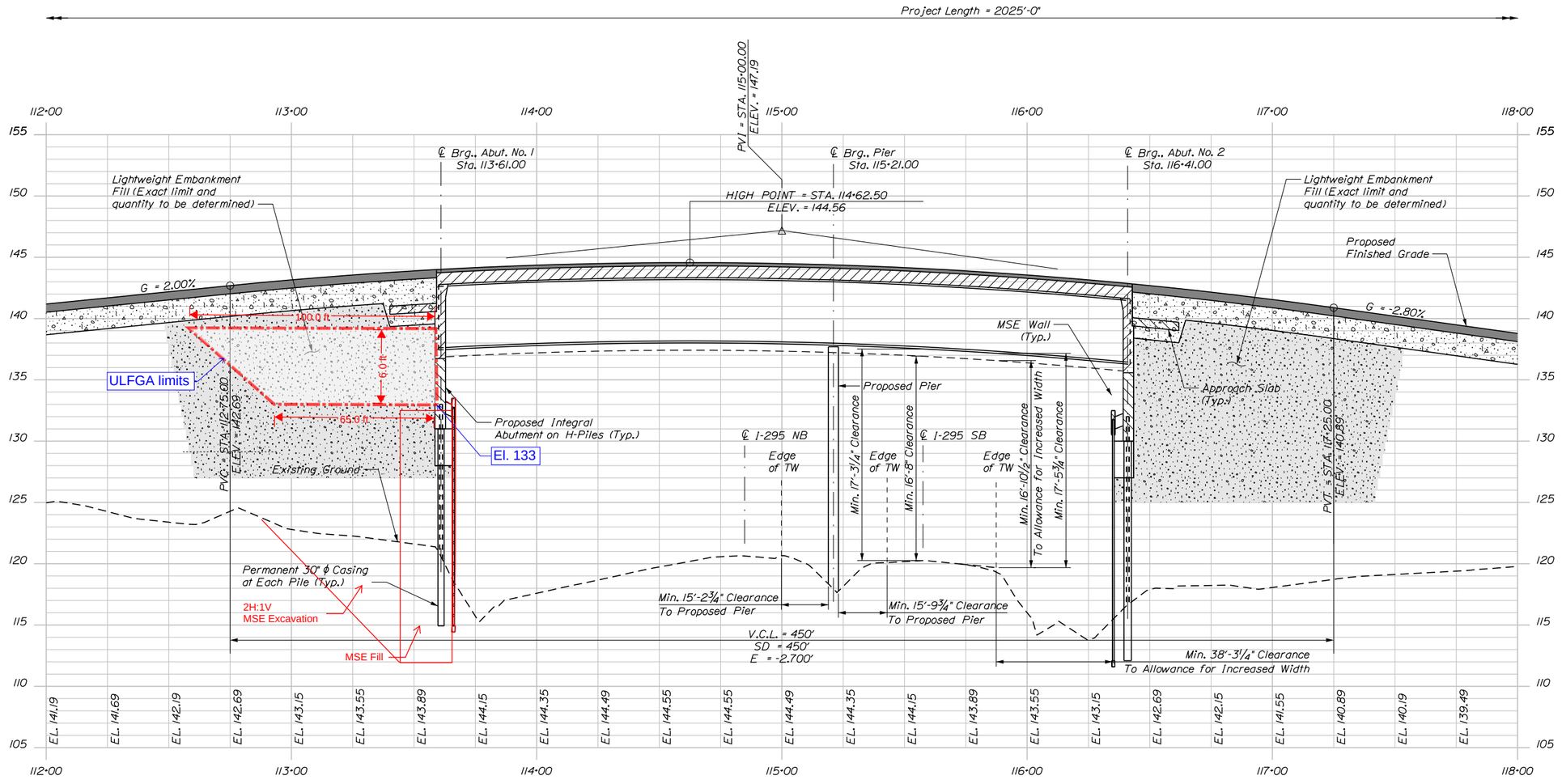
OF 66

Date:6/14/2024

Username:

Division: BRIDGE

Filename: ...\00\BRIDGE\MSTA\006_BDPlan3.dgn



PROFILE

Horiz. 25 0 25 50

Vert. 5 0 5 10

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN 22382.00

BRIDGE NO. 5804

BRIDGE PLANS

	BY	DATE
PROJ. MANAGER	J.Brosk	
DESIGN-DETAILED	JCC	NOV 2023
CHECKED-REVIEWED	STJ	NOV 2023
DESIGN2-DETAILED2	EGW	NOV 2023
DESIGN3-DETAILED3	PBD	NOV 2023
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

RELOC. RTE. 1 BRIDGE
OVER I-295
YARMOUTH CUMBERLAND COUNTY

PROFILE (3 OF 6)

SHEET NUMBER

10

OF 66

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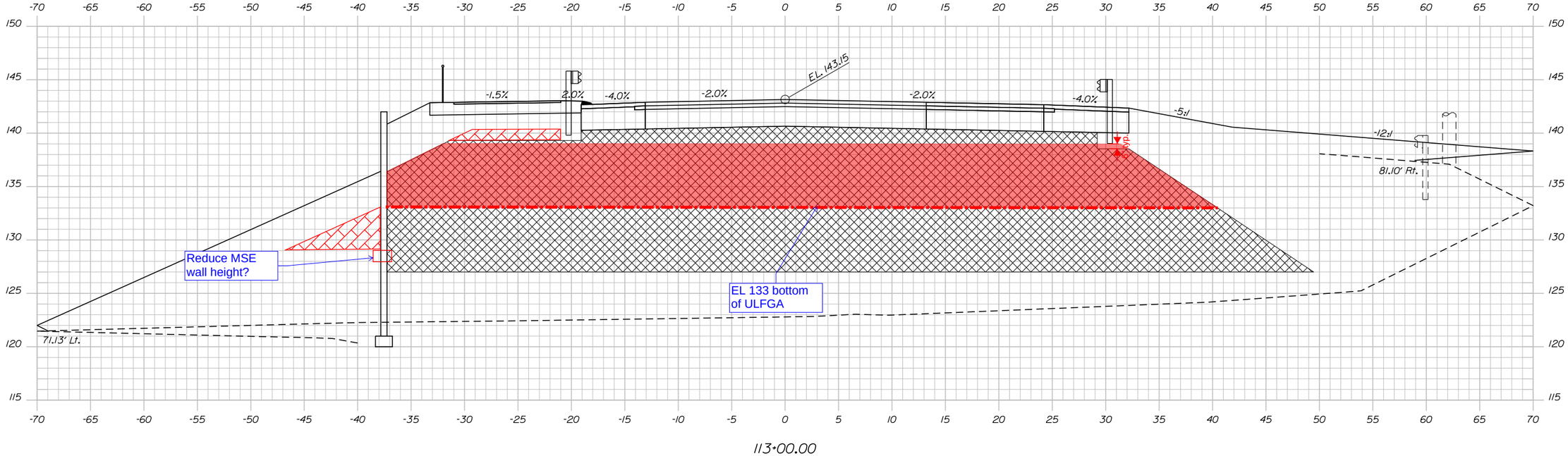
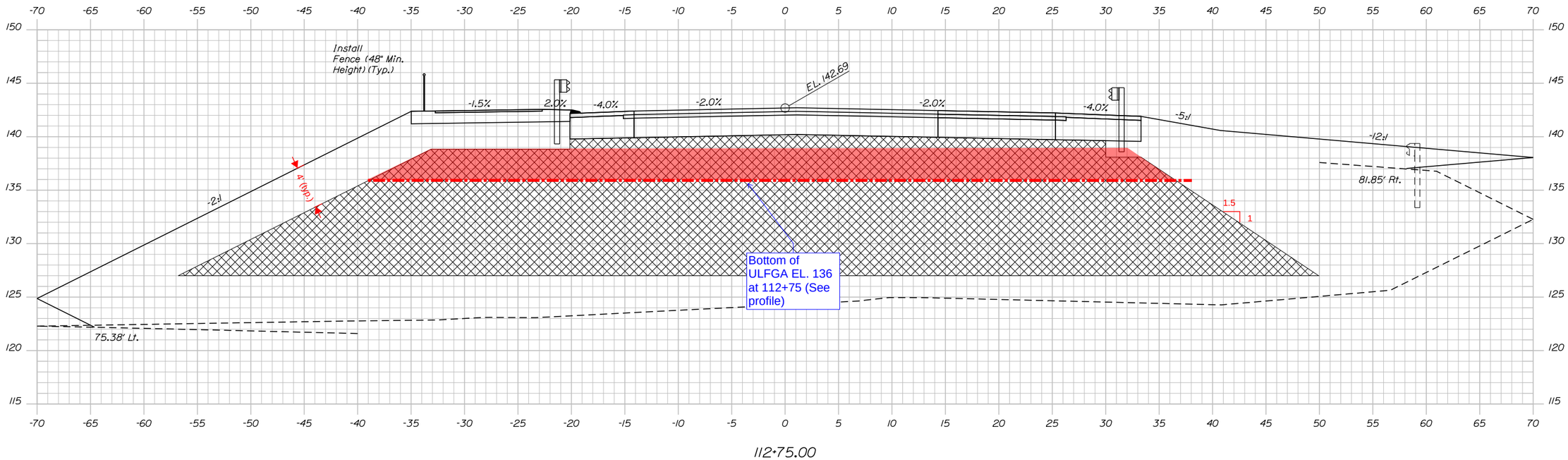


113+00.00



112+75.00

Sta. 112+75.00 to Sta. 113+00.00

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00

BRIDGE PLANS

BRIDGE NO. 5804

P.E. NUMBER

SIGNATURE

DATE

	BY	DATE
J.Brosk		
PROJ. MANAGER	JCC	
DESIGN-DETAILED	LDC	NOV 2023
CHECKED-REVIEWED	STJ	NOV 2023
DESIGN2-DETAILED2	EGW	NOV 2023
DESIGN3-DETAILED3	PBD	NOV 2023
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

RELOC. RTE. 1 BRIDGE OVER I-295
YARMOUTH CUMBERLAND COUNTY

CROSS SECTIONS

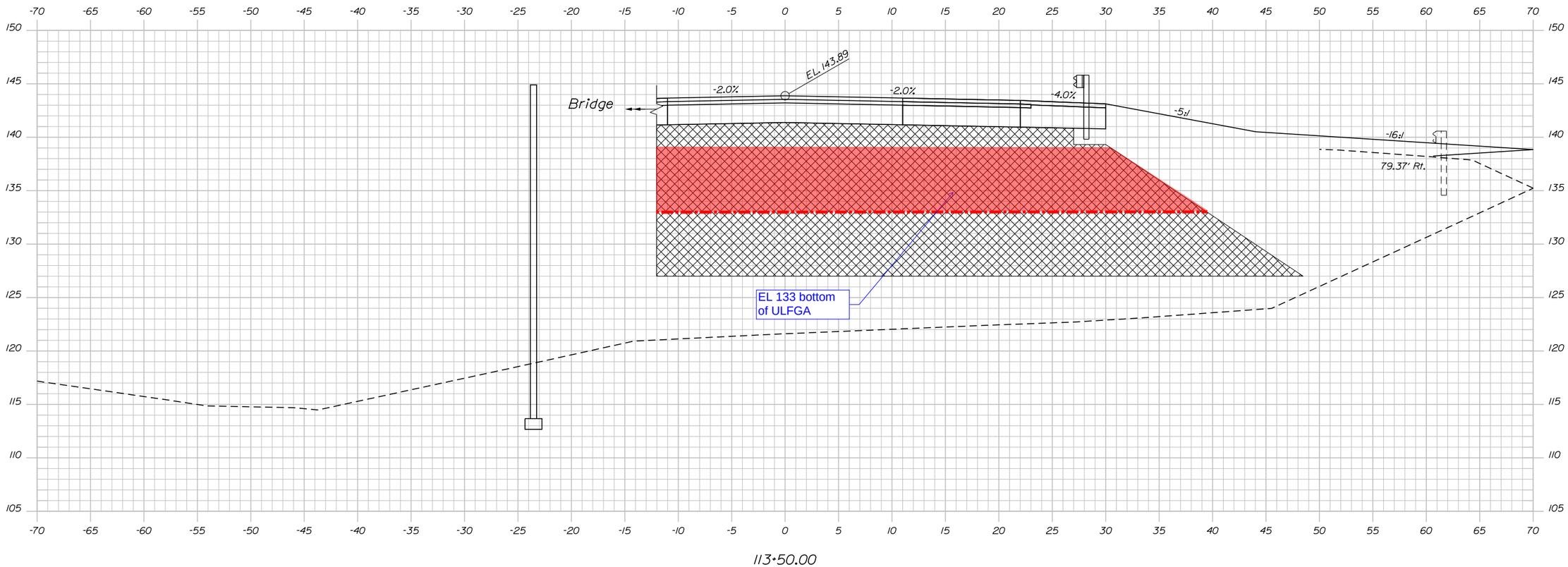
SHEET NUMBER

62

OF 66

Date:6/14/2024 Username: Division: BRIDGE

Filename: ...\MSTA\062_XSECT_112+75_021.dgn



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00

BRIDGE PLANS

BRIDGE NO. 5804

		BY	DATE
PROJ. MANAGER	J.Brosk		
DESIGN-DETAILED	JCC	LDC	NOV 2023
CHECKED-REVIEWED	STJ	TAS	NOV 2023
DESIGN2-DETAILED2	EGW	PBD	NOV 2023
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

RELOC. RTE. 1 BRIDGE
OVER I-295
YARMOUTH CUMBERLAND COUNTY

CROSS SECTIONS

SHEET NUMBER

63

OF 66

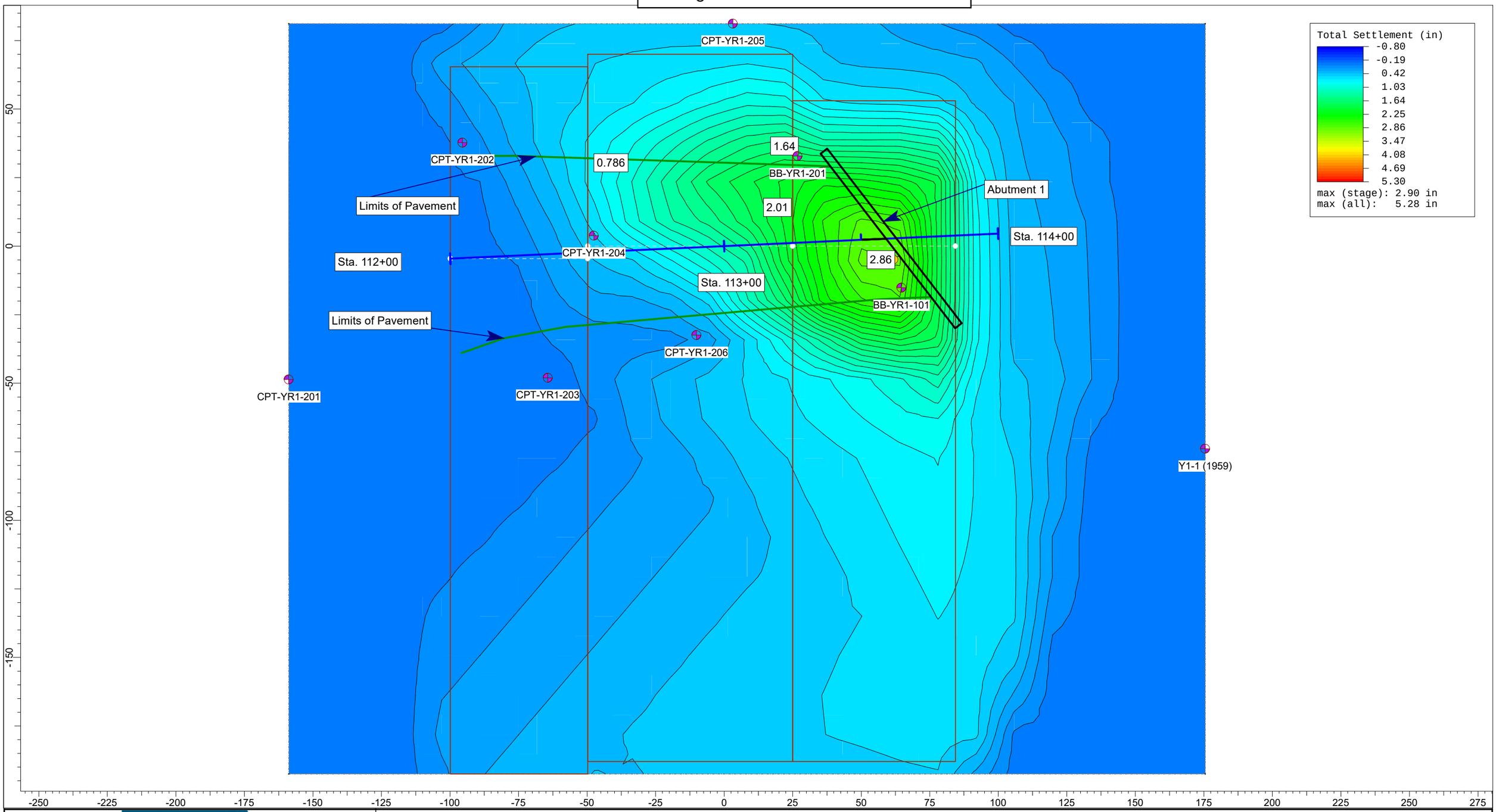
Sta. 113+25.00 to Sta. 113+50.00

Filename: ...\MSTA\063_XSECT_113+25_022.dgn Division: BRIDGE Username: Date:6/14/2024

APPENDIX C

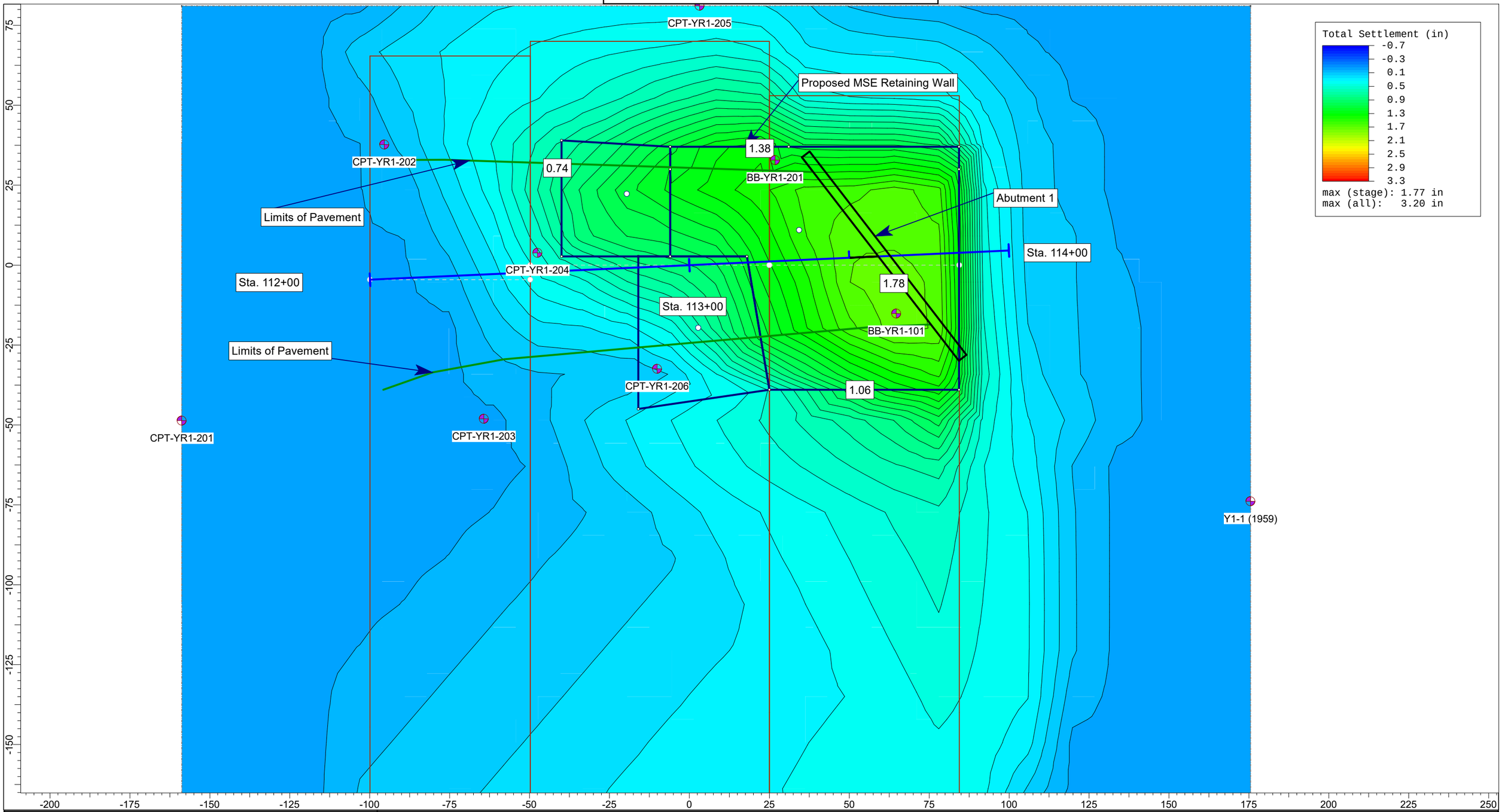
Settle3 Results Figures

No Mitigation - 5 Years Post-Construction



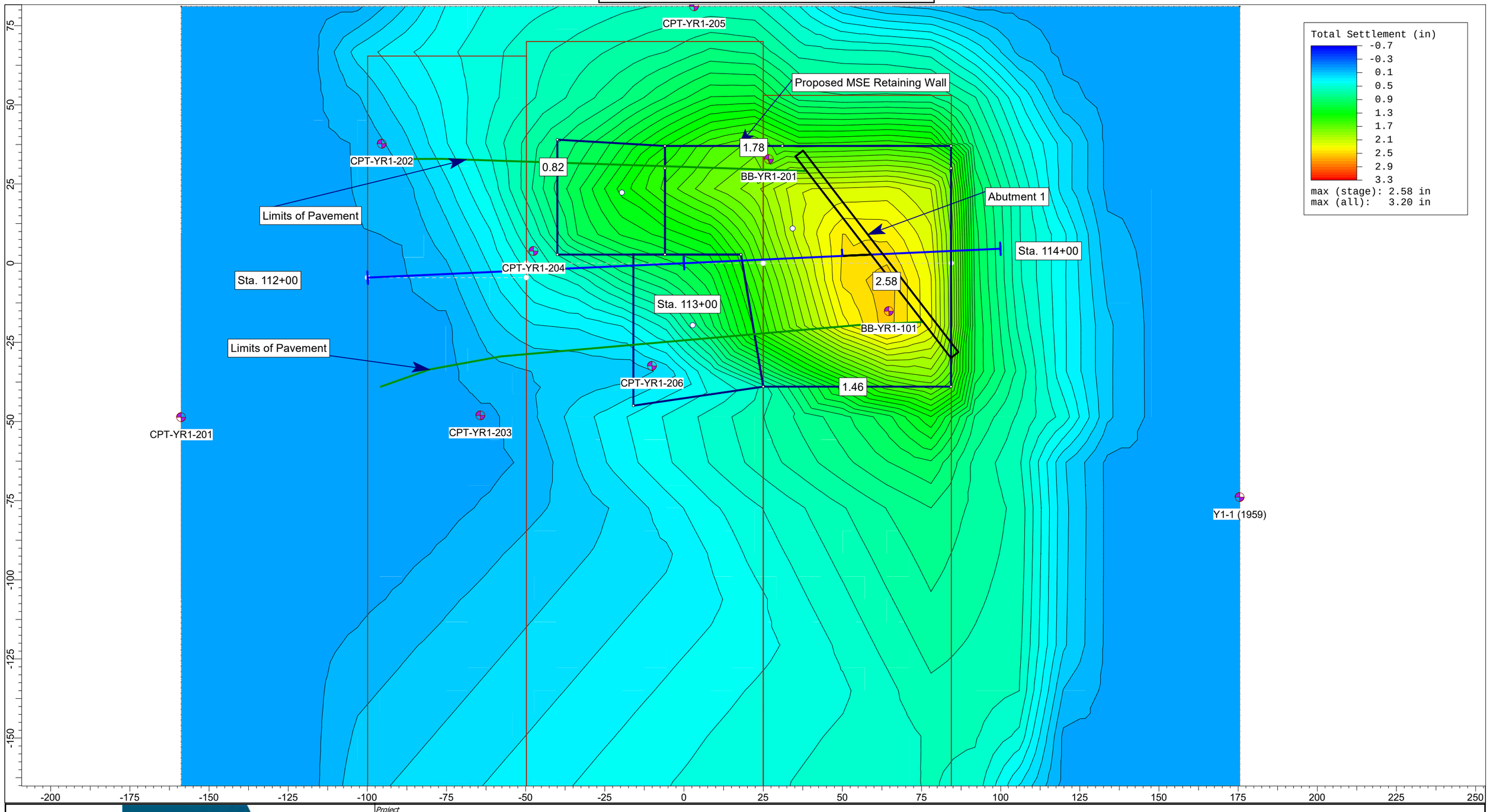
	Project	Yarmouth Route 1 Bridge over Interstate-295	
	Analysis Description	Abutment 1 Settlement, No Mitigation - 5 Years Post Construction	
	Drawn By	ENT	*Company* GZA GeoEnvironmental, Inc.
SETTLE3 5.024	*Date*	8/19/2024	*File Name* Yarmouth Route 1_AB1 No LWF_08.12.24.s3z

With ULFGA - 5 Years Post-Construction



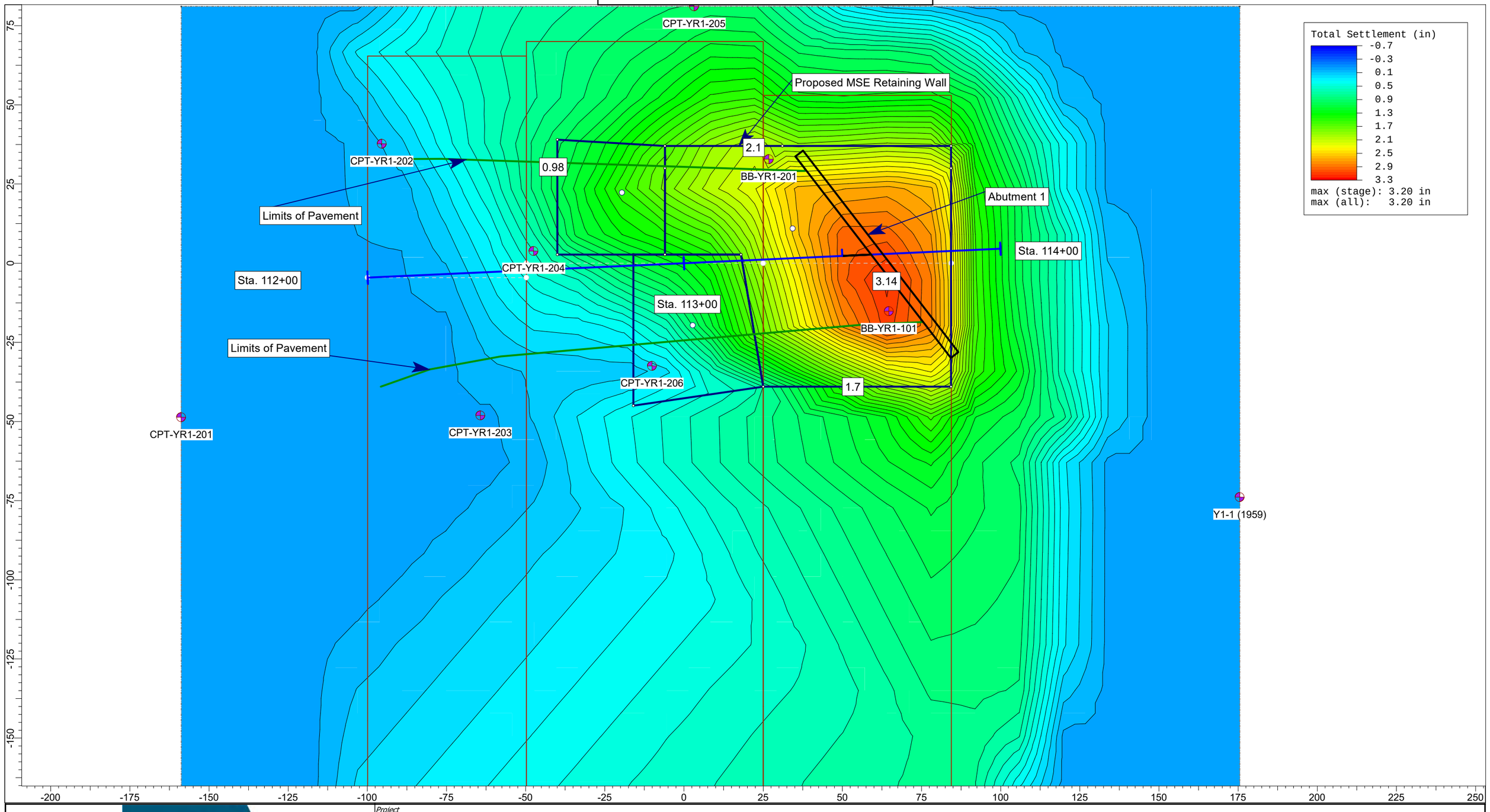
	Project	Yarmouth Route 1 Bridge over Interstate-295	
	Analysis Description	Abutment 1 Settlement with Lightweight Fill - 5 Years Post Construction	
SETTLE3 5.024	*Drawn By*	ENT	*Company* GZA GeoEnvironmental, Inc.
	Date	8/19/2024	*File Name* Yarmouth Route 1_AB1_08.16.24.s3z

With ULFGA - 20 Years Post-Construction



	Project	Yarmouth Route 1 Bridge over Interstate-295	
	Analysis Description	Abutment 1 Settlement with Lightweight Fill - 20 Years Post Construction	
	Drawn By	ENT	*Company* GZA GeoEnvironmental, Inc.
SETTLE3 5.024	*Date*	8/19/2024	*File Name* Yarmouth Route 1_AB1_08.16.24.s3z

With ULFGA - 75 Years Post-Construction

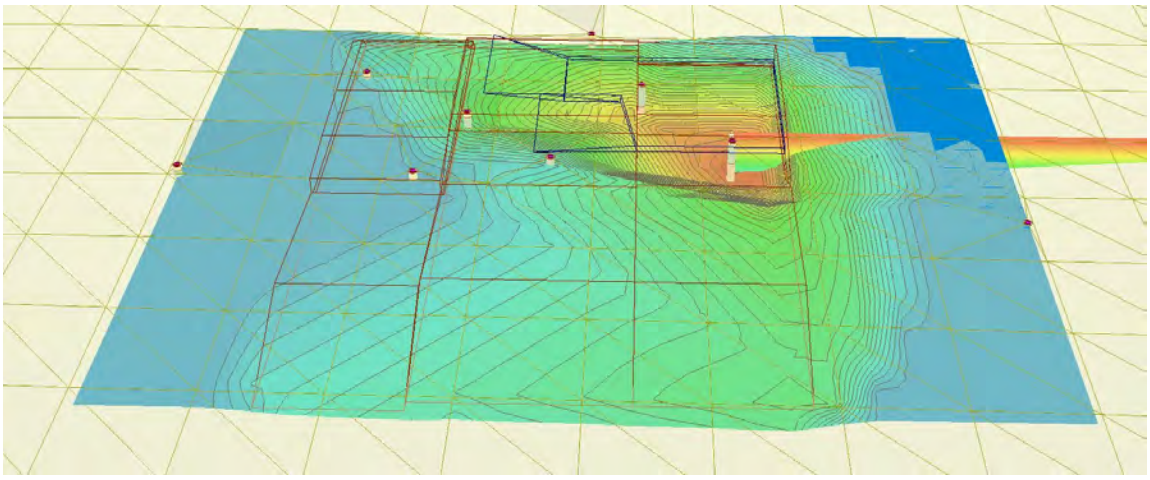


Project	Yarmouth Route 1 Bridge over Interstate-295		
Analysis Description	Abutment 1 Settlement with Lightweight Fill - 75 Years Post Construction		
Drawn By	ENT	*Company*	GZA GeoEnvironmental, Inc.
Date	8/19/2024	*File Name*	Yarmouth Route 1_AB1_08.16.24.s3z

SETTLE3 5.024

APPENDIX D

Settle3 Input Report: Lightweight Fill Alternative



GZA GeoEnvironmental, Inc.
Yarmouth Route 1 - Abutment 1 Settlement Evaluation
Report Creation Date: 2024/08/19, 12:32:12

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Settle3 Analysis Information

Yarmouth Route 1_AB1_08.16

Project Settings

Document Name	Yarmouth Route 1_AB1_08.16.24
Date Created	7/23/2024, 6:10:06 AM
Last saved with Settle3 version	5.024
Stress Computation Method	Boussinesq
Stress Units	Imperial, stress as ksf
Settlement Units	inches
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day

Advanced Settings

Start of secondary consolidation (% of primary)	95
Min. stress for secondary consolidation (% of initial)	1
Reset time when load changes for secondary consolidation	No
Minimum settlement ratio for subgrade modulus	0.9
Use average poisson's ratio to calculate layered stresses	
Update Cv in each time step (improves consolidation accuracy)	
Ignore negative effective stresses in settlement calculations	
Add field points to load edges	

Soil Profile

Layer Option	Extruded Section Layers

Stage Settings

Stage #	Name	Time [years]
1	Stage 1 - Proposed Fill Placed Up To El. 129	0
2	Stage 2 - Remaining Proposed Fill Placed	0.2
3	Stage 3 - 0.5 year P/C	0.7
4	Stage 4 - 1 year P/C	1.2
5	Stage 5 - 5 year P/C	5.2
6	Stage 6 - 20 year P/C	20.2
7	Stage 7 - 75 Year P/C	75.2

Loads

1. Polygonal Load: "Polygonal Load 1"

Label	Polygonal Load 1
Load Type	Flexible
Area of Load	5716.05 ft2
Elevation	135 ft
Installation Stage	Stage 2 - Remaining Proposed Fill Placed = 0.2 y

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
84.3	30	-0.63
84.3	37	-0.21
31.086	37	-0.21
-6	37	-0.105
-6	30	-0.525
-6	2.7	-0.63
18	2.7	-0.63
25	-39	-0.42
84.3	-39	-0.42

2. Polygonal Load: "Polygonal Load 3"

Label	Polygonal Load 3
Load Type	Flexible
Area of Load	1686.75 ft2
Elevation	135 ft
Installation Stage	Stage 2 - Remaining Proposed Fill Placed = 0.2 y

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
18	2.7	-0.63
-16	2.7	0
-16	-45	0
25	-39	-0.42

3. Polygonal Load: "Polygonal Load 4"

Label	Polygonal Load 4
Load Type	Flexible
Area of Load	1200.2 ft2
Elevation	135 ft
Installation Stage	Stage 2 - Remaining Proposed Fill Placed = 0.2 y

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-40	39	0
-40	2.7	0
-6	2.7	-0.63
-6	30	-0.525
-6	37	-0.105

Embankments

1. Embankment: "Proposed Fill"

Label	Proposed Fill
Center Line	(-49.778, 0) to (25, 0)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Proposed Fill Placed Up To El. 129	0.125
2	Stage 2 - Remaining Proposed Fill Placed	0.125
3	Stage 1 - Proposed Fill Placed Up To El. 129	0.125

2. Embankment: "Embankment Load 3"

Label	Embankment Load 3
Center Line	(-99.8956, -4.568) to (-49.778, -4.568)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Proposed Fill Placed Up To El. 129	0.125
2	Stage 1 - Proposed Fill Placed Up To El. 129	0.125
3	Stage 2 - Remaining Proposed Fill Placed	0.125

3. Embankment: "Proposed Fill"

Label	Proposed Fill
Center Line	(25, 0) to (84.396, 0)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Proposed Fill Placed Up To El. 129	0.125
2	Stage 2 - Remaining Proposed Fill Placed	0.125
3	Stage 1 - Proposed Fill Placed Up To El. 129	0.125

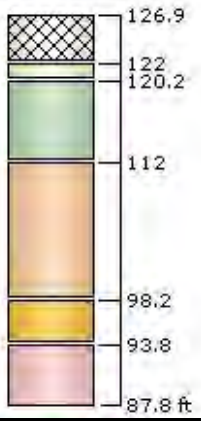
Soil Layers

Ground Surface Drained: Yes

BB-YR1-101

XY Location: BB-YR1-101: (64.7, -15.2)

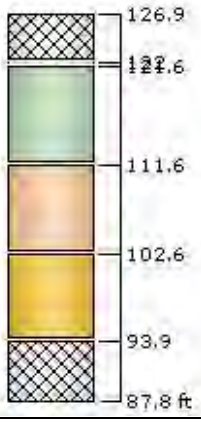
Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	1.8	122	No
2	Marine Clay (Crust)	8.2	120.2	No
3	Marine Clay	13.8	112	No
4	Lower Marine Sand	4.4	98.2	No
5	Glacial Till	6	93.8	No



BB-YR1-201

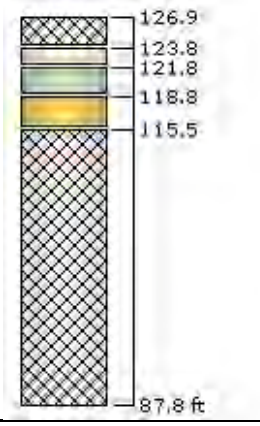
XY Location: BB-YR1-201: (26.8, 32.8)

Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	0.4	122	No
2	Marine Clay (Crust)	10	121.6	No
3	Marine Clay	9	111.6	No
4	Lower Marine Sand	8.7	102.6	No
5	Glacial Till	0	93.9	No



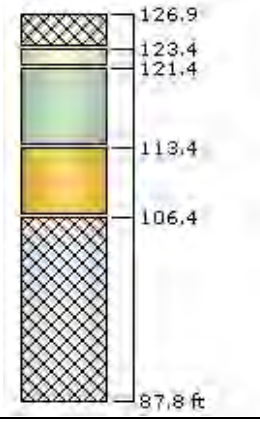
CPT-YR1-202

XY Location:		CPT-YR1-202: (-95.4, 37.7)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	2	123.8	No
2	Marine Clay (Crust)	3	121.8	No
3	Marine Clay	0	118.8	No
4	Lower Marine Sand	3.3	118.8	No
5	Glacial Till	0	115.5	No



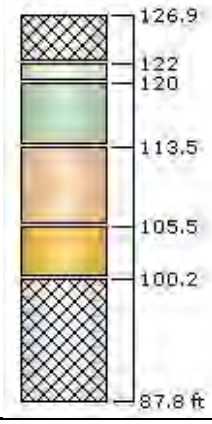
CPT-YR1-204

XY Location:		CPT-YR1-204: (-47.5, 3.8)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	2	123.4	No
2	Marine Clay (Crust)	8	121.4	No
3	Marine Clay	0	113.4	No
4	Lower Marine Sand	7	113.4	No
5	Glacial Till	0	106.4	No



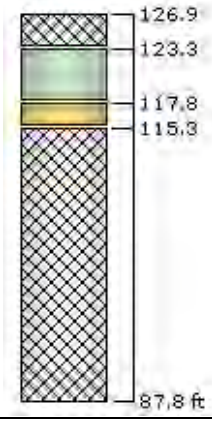
CPT-YR1-205

XY Location:		CPT-YR1-205: (3.2, 81.1)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	2	122	No
2	Marine Clay (Crust)	6.5	120	No
3	Marine Clay	8	113.5	No
4	Lower Marine Sand	5.3	105.5	No
5	Glacial Till	0	100.2	No



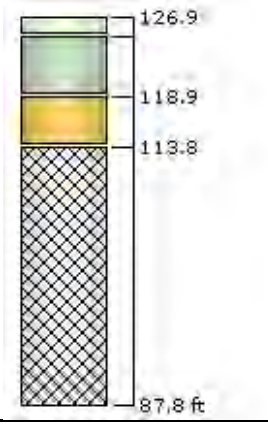
CPT-YR1-206

XY Location:		CPT-YR1-206: (-10.1, -32.5)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	0	123.3	No
2	Marine Clay (Crust)	5.5	123.3	No
3	Marine Clay	0	117.8	No
4	Lower Marine Sand	2.5	117.8	No
5	Glacial Till	0	115.3	No



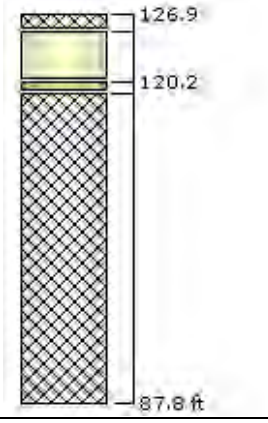
CPT-YR1-201

XY Location:		CPT-YR1-201: (-158.8, -48.7)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	2	126.9	No
2	Marine Clay (Crust)	6	124.9	No
3	Marine Clay	0	118.9	No
4	Lower Marine Sand	5.1	118.9	No
5	Glacial Till	0	113.8	No



CPT-YR1-203

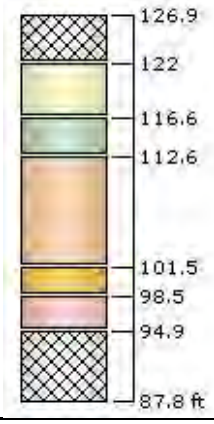
XY Location:		CPT-YR1-203: (-64.3, -48.1)		
Layer #	**Type**	**Thickness [ft]**	**Elevation [ft]**	**Drained at Bottom**
1	Fill	5	125.2	No
2	Marine Clay (Crust)	0	120.2	No
3	Marine Clay	0	120.2	No
4	Lower Marine Sand	1.1	120.2	No
5	Glacial Till	0	119.1	No



Y1-1 (1959)

XY Location: Y1-1 (1959): (175.5, -73.93)

Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	5.4	122	No
2	Marine Clay (Crust)	4	116.6	No
3	Marine Clay	11.1	112.6	No
4	Lower Marine Sand	3	101.5	No
5	Glacial Till	3.6	98.5	No



Soil Properties

Property	Fill	Marine Clay (Crust)	Marine Clay	Lower Marine Sand
Color				
Unit Weight [kips/ft3]	0.125	0.12	0.118	0.125
Saturated Unit Weight [kips/ft3]	0.125	0.12	0.118	0.125
K0	1	1	1	1
Primary Consolidation	Disabled	Enabled	Enabled	Disabled
Material Type		Non-Linear	Non-Linear	
Cce	-	0.16	0.16	-
Cre	-	0.016	0.016	-
e0	-	1.1	1.1	-
Pc [ksf]	-	4.5	2.95	-
Cv [ft2/d]	-	0.25	0.25	-
Cvr [ft2/d]	-	0.25	0.25	-
B-bar	-	1	1	-
Secondary Consolidation	Disabled	Standard	Standard	Disabled
Cae	-	0.001	0.0055	-
Care	-	0.001	0.0055	-
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1

Property	Glacial Till
Color	
Unit Weight [kips/ft3]	0.13
Saturated Unit Weight [kips/ft3]	0.13
K0	1
B-bar	-
Undrained Su A [kips/ft2]	0
Undrained Su S	0.2
Undrained Su m	0.8
Piezo Line ID	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft3

Piezometric Line Entities

ID	Elevation (ft)
1	119.5 ft

Abutment 2 Settlement Evaluations

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	E. Tome	Date:	9/6/2024
Checked by:	A. Blaisdell / B. Cardali	Date:	11/14/24

Objective

The purpose of this calculation package is to evaluate post-construction settlement due to the proposed Abutment 2 embankment fills. MaineDOT provided a project specific settlement criterion of 2 inches over the first 5 years post-construction and an additional 2 inches between 5 and 20 years to limit settlement within 100 feet of the abutments.

Steps:

1. Develop settlement properties and Settle3 inputs.
2. Complete settlement analysis using Settle3 for embankment fills at Abutment 2.
3. Generate total consolidation profiles at 5, 20, and 75 years post-construction.

References

Documents that were used as a basis of our evaluation include:

1. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
2. C. Ladd, Portsmouth NH Sensitive Clay, 1972

Attachments

Appendix A – GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils
Appendix B – Settle3 Results Figures
Appendix C – Settle3 Input Report

Assumptions

The following assumptions were made for our analyses:

- The existing and new embankment were modeled at the same time to calculate secondary compression settlement starting at completion of consolidation under the new embankment. This means that roughly ¼" of primary consolidation that occurred under the existing embankment is included in the post-construction roadway consolidation estimates herein, which is conservative.

Soil Properties

GZA developed consolidation properties for the Marine Clay deposits based on laboratory and measured field data as shown in **Appendix A**, GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils.

Layers for Settlement Model	Soil Properties				
	CR	RR	Max Past Pressure (ksf)	Cv	Unit Weight (pcf)
Marine Clay (Crust)	0.16	0.016	4.5	0.25	120
Marine Clay	0.16	0.016	2.95	0.25	118

Calculation of Stress Ratios and Secondary Compression

GZA utilized the final effective stresses at the mid points of the Marine Clay Crust and Marine Clay from Settle3 for stress ratio calculations discussed herein. The secondary compression rate is estimated using the Ladd plot shown below. The stress ratio used for the plot is calculated by dividing the final effective stress by the maximum past pressure. GZA utilized the final effective stresses at the mid points of the Marine Clay Crust and Marine Clay from Settle3 for the stress ratio calculation which are shown in **Table 1**. Cα is estimated as a function of the stress ratio from **Figure 1** below (Reference 2).

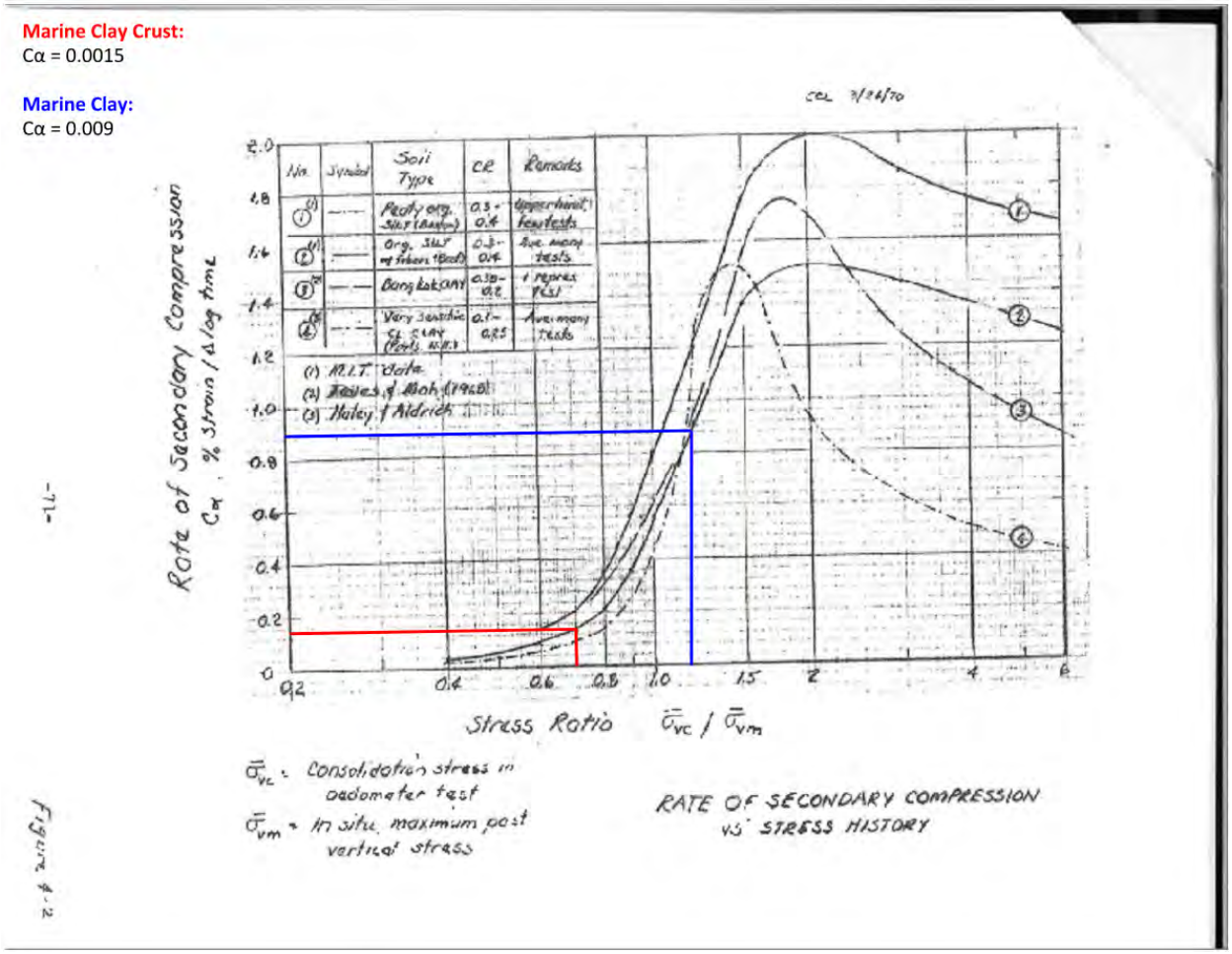


Figure 1 – Stress Ratios vs. Cα (Ladd)

Table 1: Stress Ratios and Secondary Compression Summary Table				
Layer	Maximum Past Pressure (ksf)	Final Effective Stress (ksf)	Stress Ratio	Cα
Marine Clay (Crust)	4.5	3.1	0.7	0.0015
Marine Clay	2.95	3.5	1.2	0.009

Settle3 Model Staging

The Settle3 model staging for the project is:

Year 0: Existing Roadway Embankment and Proposed Fills Placed Up To El. 128
Year 0.2: Remaining Fills Placed
Year 5.2: 5 years post-construction
Year 20.2: 20 years post-construction
Year 75.2: 75 years post-construction

Settle3 Results

Settlement evaluations were conducted on the proposed embankment to estimate the anticipated settlement under the proposed fills. The roadway settlement is calculated in the clay below El. 113, which is the bearing level for the MSE wall. All clay within the MSE limits above that elevation will be excavated. The estimated maximum total settlement of approximately 1.0 inch was computed near Abutment 2 within the first 5 years and an additional 0.3 inches between 5 and 20 years post-construction, as shown in **Figure 2** below. The total settlement during the design life of 75 years is 1.5 inches, however, GZA anticipates that remaining settlement can be mitigated by shimming during the typical paving cycle. The Settle3 results are shown in **Appendix B**.

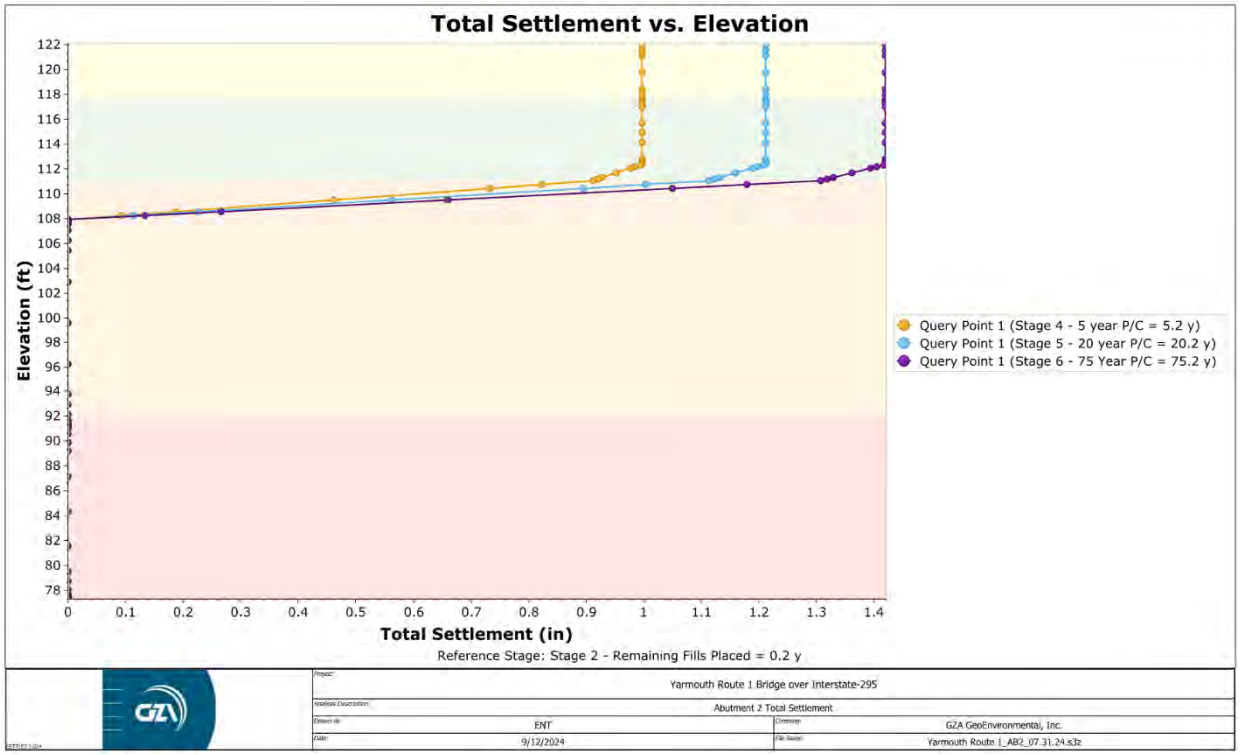


Figure 2 – Total Settlement

Summary of Results

The estimated total settlement are summarized in the table below.

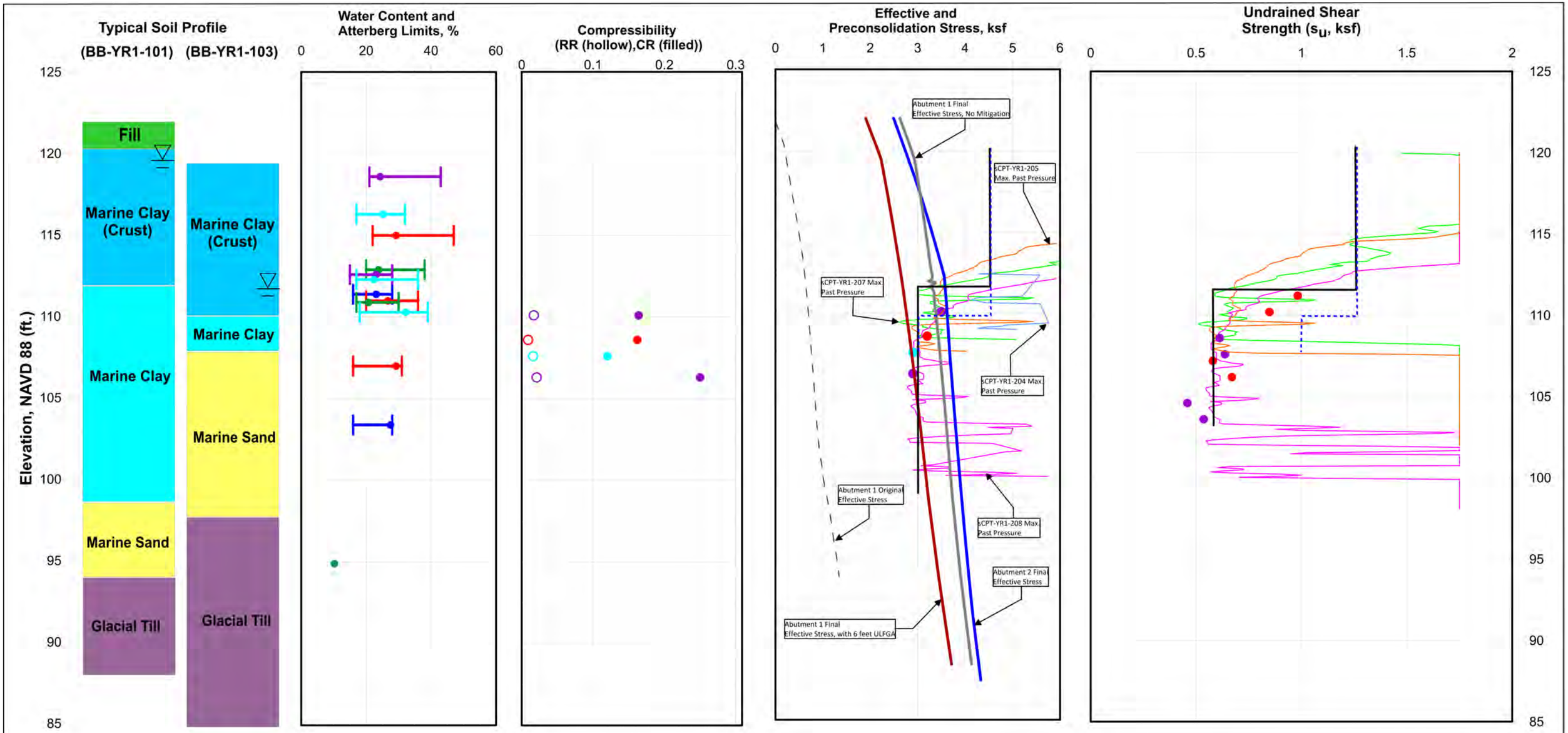
Table 2: Summary of Settlement Estimates (inches)		
5 Years Post-Construction	20 Years Post-Construction	75 Years Post-Construction
1.0	1.3	1.5

Conclusions

The results show that the settlement of the proposed fills achieve the project criterion of less than 2 inches in the first 5 years and another 2 inches between 5 and 20 years within 100 feet of the abutment, with predictions of approximately 1.0 inches and 0.3 inches, respectively. Additionally, we predict greater than 0.5 inches of consolidation at the bridge abutments during the design life of the bridge, therefore downdrag needs to be considered in pile design at Abutment 2.

APPENDIX A

GZA Plot Water Content, Compressibility, Stress History and Strength of Cohesive Soils



NOTES:

1. DATA BASED ON TEST BORINGS BB-YR1-101, -102, AND -103. THE -101 SERIES BORINGS WERE PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF HERMON, MAINE BETWEEN FEBRUARY 21 AND APRIL 11, 2022. THE -200 SERIES BORINGS WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE BETWEEN APRIL 26 and 30, 2014. ALL BORINGS WERE OBSERVED AND LOGGED BY GZA PERSONNEL.
2. SCPT EXPLORATIONS (SCPT-YR1-101 THROUGH -108, AND SCPT-YR1-107A) WERE PERFORMED BY SEABOARD DRILLING OF BANGOR, MAINE ON APRIL 25 AND 29, 2024.
3. TYPICAL SOIL PROFILES BASED ON BORING BB-YR1-101 (ABUTMENT 1) AND BB-YR1-202 (ABUTMENT 2).
4. WATER CONTENTS BASED ON LABORATORY TESTS PERFORMED ON SAMPLES TAKEN FROM RECENT BORINGS.
5. PRECONSOLIDATION PRESSURE CALCULATED FROM CONSOLIDATION TESTS AND ESTIMATED FROM SCPT DATA ASSUMING A K=0.30
6. CORRELATED UNDRAINED SHEAR STRENGTH FROM CPT DATA IS BASED ON N_{KT} = 17.
7. IN LEGEND, FV=UNDRAINED SHEAR STRENGTH FROM IN-SITU FIELD VANE, CONSOL=LAB DATA FROM CONSOLIDATION TEST.

LEGEND

- BB-YR1-101 (FV, Consol)
- BB-YR1-102
- BB-YR1-103
- BB-YR1-201 (FV, Consol)
- BB-YR1-202 (Consol)
- sCPT-YR1-204
- sCPT-YR1-205 (Nkt 17)
- sCPT-YR1-207 (Nkt 17)
- sCPT-YR1-208 (Nkt 17)
- Design Profile Abutment 1
- Design Profile Abutment 2

Plastic Limit, PL — Water Content, Wn — Liquid Limit, LL

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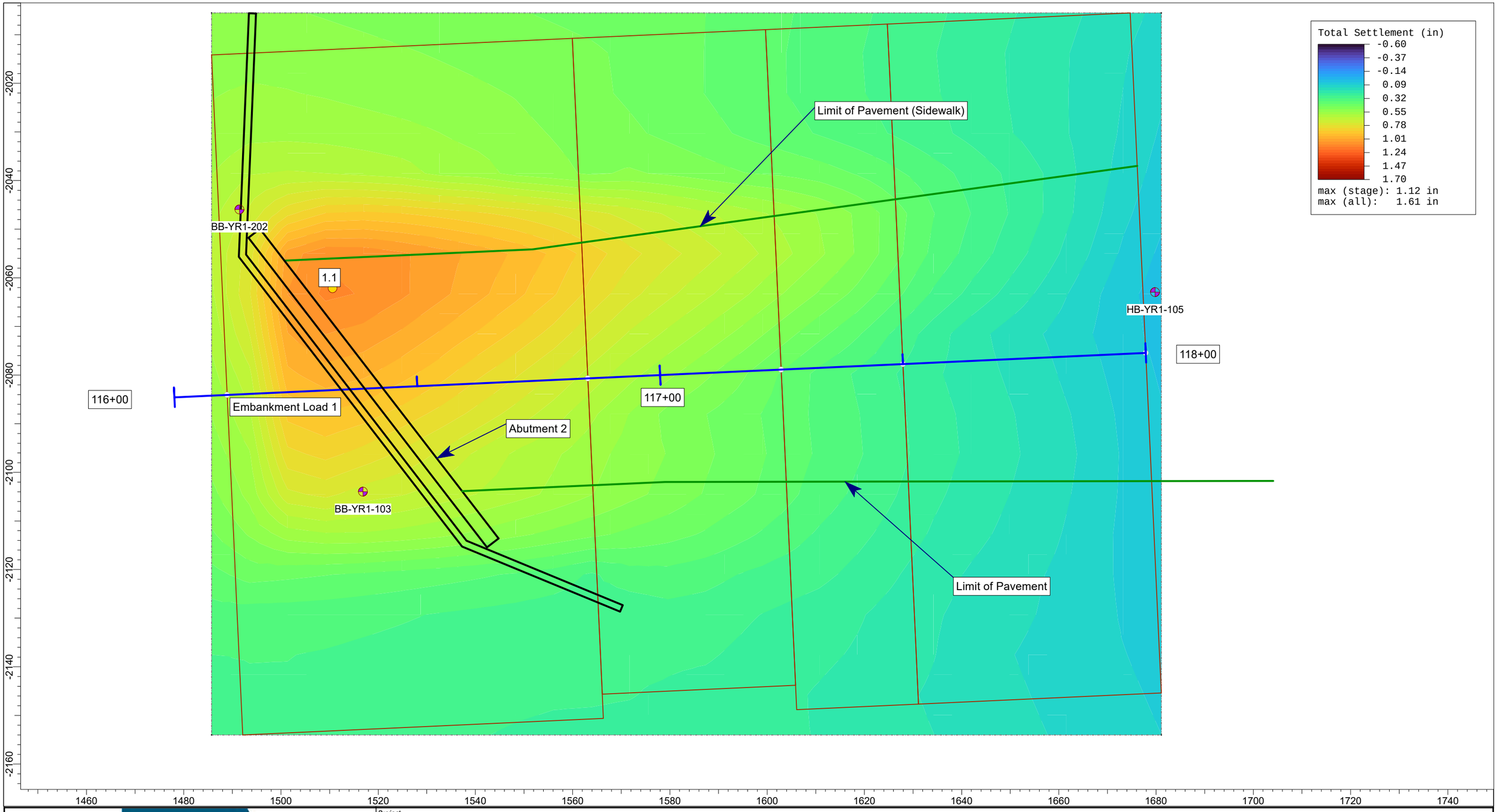
YARMOUTH ROUTE 1 BRIDGE REPLACEMENT
YARMOUTH, ME

IN-SITU SOIL CONDITIONS VS. ELEVATION
Abutment 1 & 2 Approaches

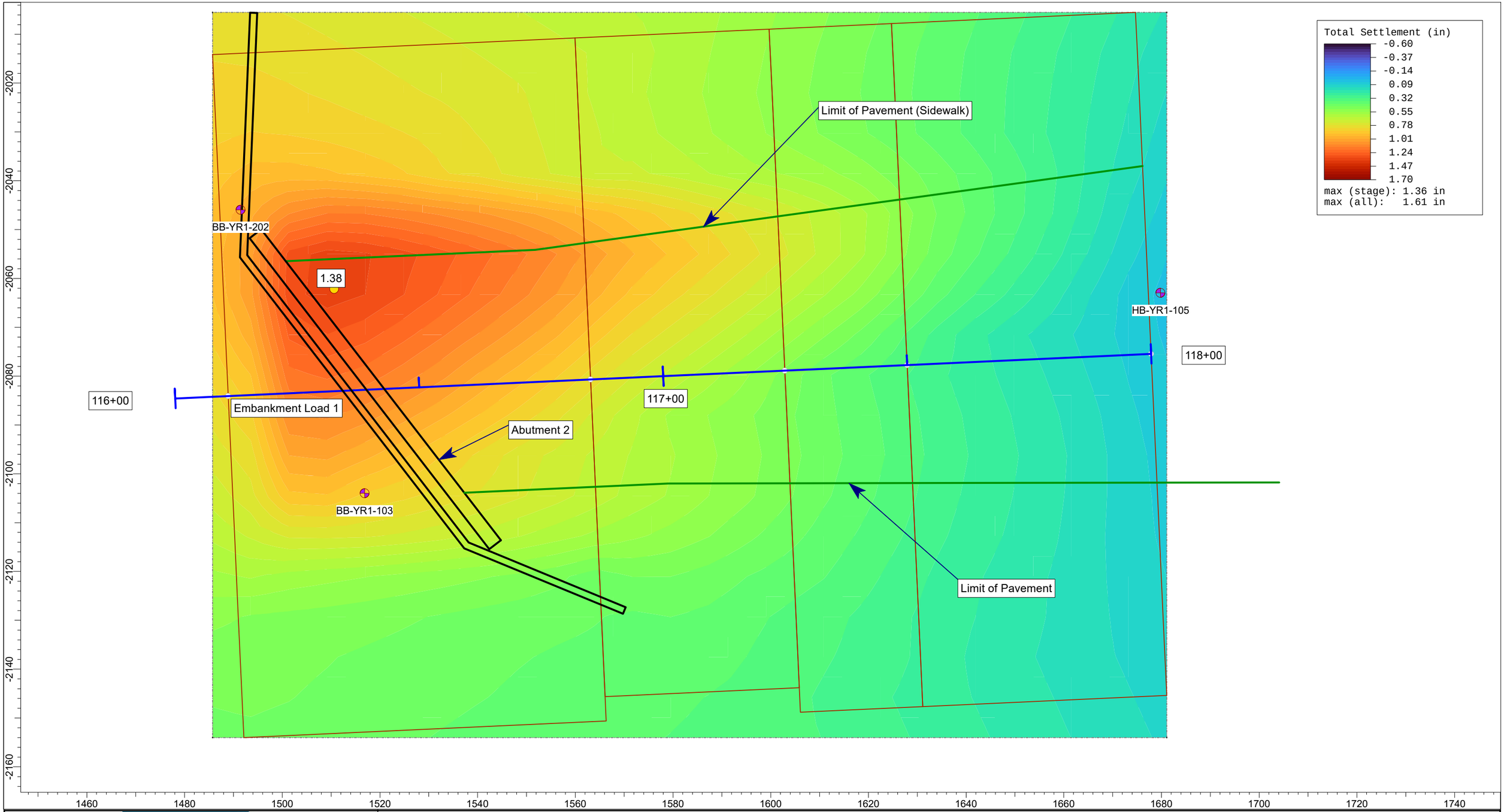
PREPARED BY: GZA GeoEnvironmental, Inc. Engineers & Scientists www.gza.com		PREPARED FOR: MAINE DEPARTMENT OF TRANSPORTATION	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIGURE 4
DESIGNED BY: BMC	DRAWN BY: ENT	SCALE: N/A	
DATE: 11/15/2024	PROJECT NUMBER: 09.0026144.00	REVISION NUMBER: 0	

APPENDIX B

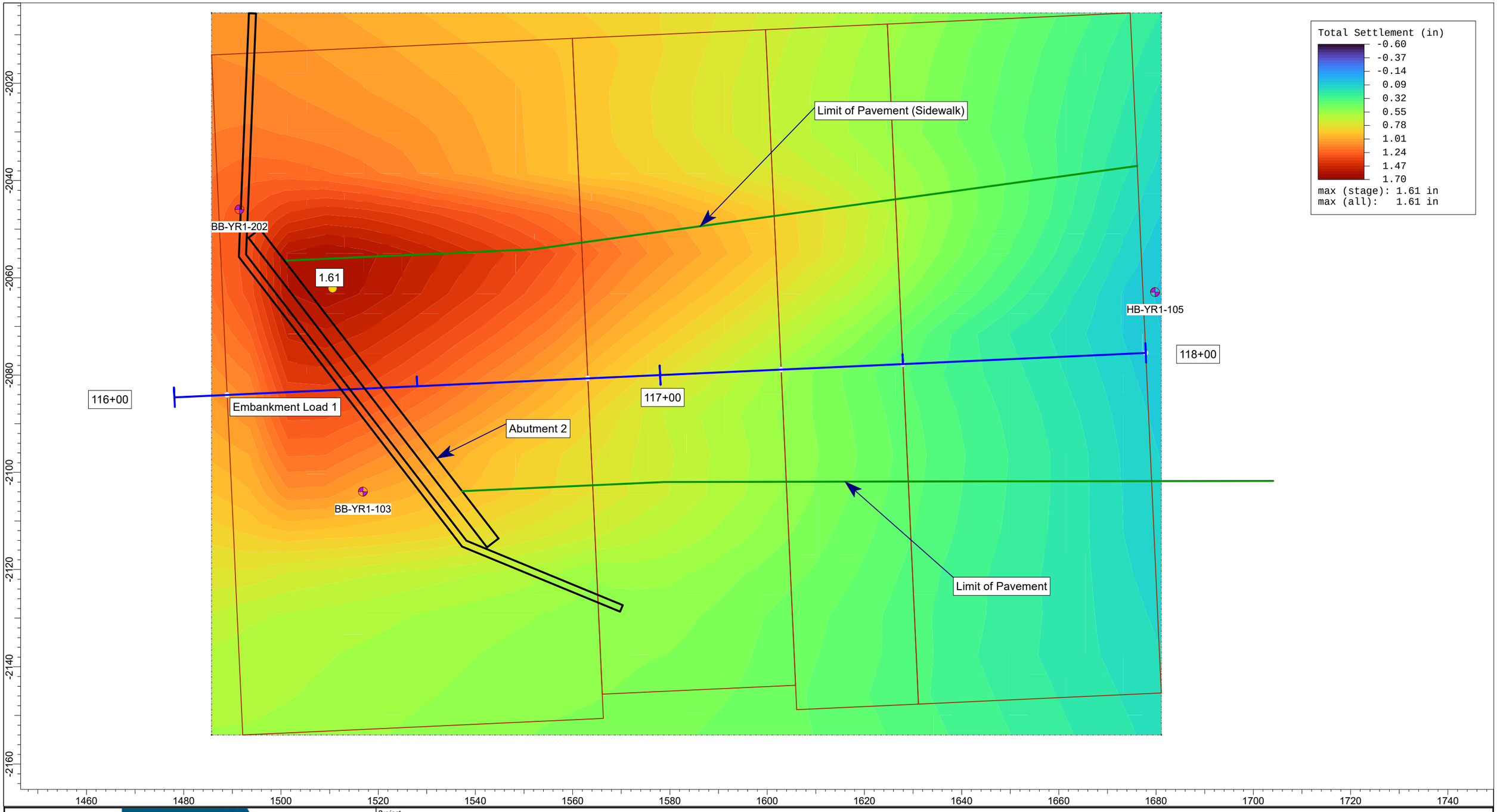
Settle3 Results Figures



	Project	Yarmouth Route 1 Bridge over Interstate-295	
	Analysis Description	Abutment 2 Settlement - 5 Years Post-Construction	
	Drawn By	ENT	*Company* GZA GeoEnvironmental, Inc.
SETTLE3 5.024	*Date*	8/21/2024	*File Name* Yarmouth Route 1_AB2_07.31.24.s3z



	Project	Yarmouth Route 1 Bridge over Interstate-295	
	Analysis Description	Abutment 2 Settlement - 20 Years Post-Construction	
	Drawn By	ENT	*Company* GZA GeoEnvironmental, Inc.
SETTLE3 5.024	*Date*	8/21/2024	*File Name* Yarmouth Route 1_AB2_07.31.24.s3z

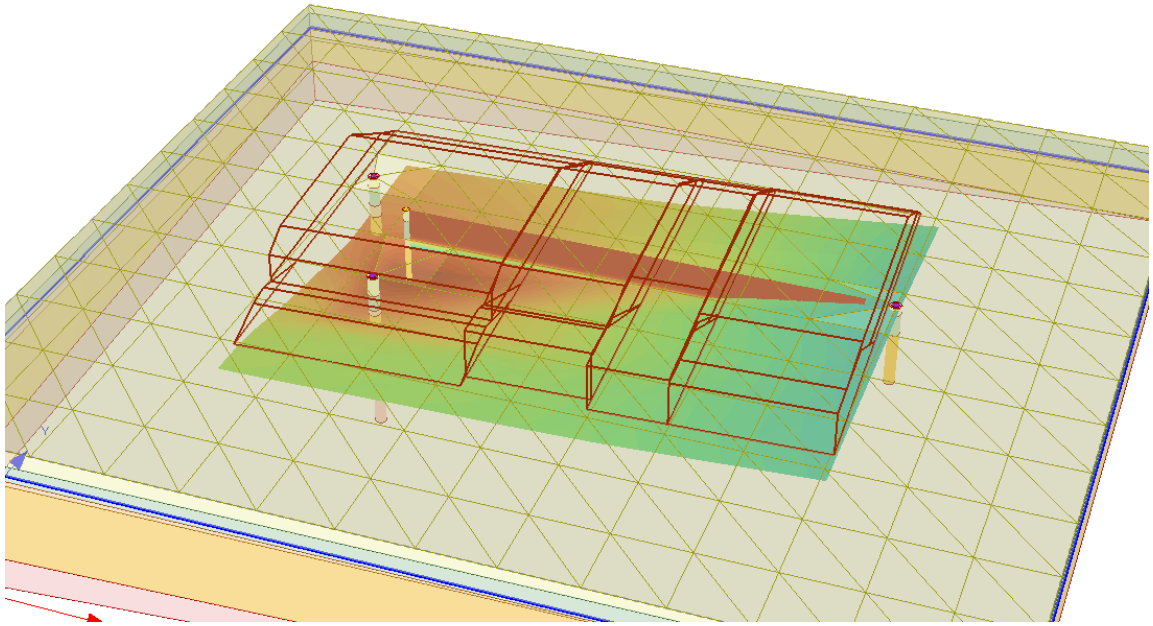


Project	Yarmouth Route 1 Bridge over Interstate-295
Analysis Description	Abutment 2 Settlement - 75 Years Post-Construction
Drawn By: ENT	Company: GZA GeoEnvironmental, Inc.
Date: 8/21/2024	File Name: Yarmouth Route 1_AB2_07.31.24.s3z

SETTLE3 5.024

APPENDIX C

Settle3 Input Report



GZA GeoEnvironmental, Inc.

Yarmouth Route 1 - Abutment 2 Settlement Evaluation

Report Creation Date: 2024/08/21, 14:51:49

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Settle3 Analysis Information

Yarmouth Route 1_AB2_07.31

Project Settings

Document Name	Yarmouth Route 1_AB2_07.31.24
Date Created	7/23/2024, 6:10:06 AM
Last saved with Settle3 version	5.024
Stress Computation Method	Boussinesq
Stress Units	Imperial, stress as ksf
Settlement Units	inches
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day

Advanced Settings

Start of secondary consolidation (% of primary)	95
Min. stress for secondary consolidation (% of initial)	1
Reset time when load changes for secondary consolidation	No
Minimum settlement ratio for subgrade modulus	0.9
Use average poisson's ratio to calculate layered stresses	
Update Cv in each time step (improves consolidation accuracy)	
Ignore negative effective stresses in settlement calculations	
Add field points to load edges	

Soil Profile

Layer Option	Extruded Section Layers

Stage Settings

Stage #	Name	Time [years]
1	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0
2	Stage 2 - Remaining Fills Placed	0.2
3	Stage 4 - 5 year P/C	5.2
4	Stage 5 - 20 year P/C	20.2
5	Stage 6 - 75 Year P/C	75.2

Embankments

1. Embankment: "Embankment Load 2"

Label	Embankment Load 2
Center Line	(1602.87, -2078.88) to (1627.93, -2077.73)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125
2	Stage 2 - Remaining Fills Placed	0.125
3	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125

2. Embankment: "Embankment Load 3"

Label	Embankment Load 3
Center Line	(1627.93, -2077.73) to (1677.87, -2075.45)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125
2	Stage 2 - Remaining Fills Placed	0.125
3	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125

3. Embankment: "Embankment Load 4"

Label	Embankment Load 4
Center Line	(1563.12, -2080.7) to (1602.87, -2078.88)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125
2	Stage 2 - Remaining Fills Placed	0.125
3	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125

4. Embankment: "Embankment Load 1"

Label	Embankment Load 1
Center Line	(1488.93, -2084.09) to (1563.12, -2080.7)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	3

Layer	Stage	Unit Weight (kips/ft3)
1	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125
2	Stage 2 - Remaining Fills Placed	0.125
3	Stage 1 - Existing & Proposed Fills Placed Up To El. 128	0.125

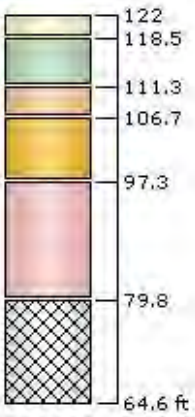
Soil Layers

Ground Surface Drained: Yes

BB-YR1-202

XY Location: BB-YR1-202: (1491.49, -2045.98)

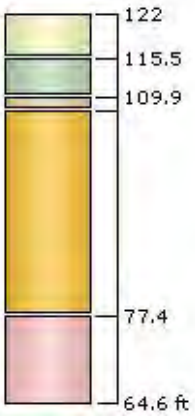
Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	3.5	122	No
2	Marine Clay (Crust)	7.2	118.5	No
3	Marine Clay	4.6	111.3	No
4	Lower Marine Sand	9.4	106.7	No
5	Glacial Till	17.5	97.3	No



BB-YR1-103

XY Location: BB-YR1-103: (1516.88, -2103.99)

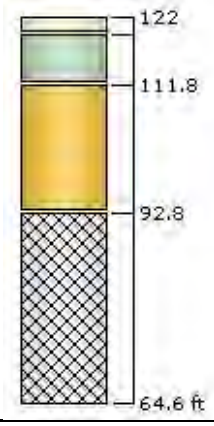
Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	6.5	122	No
2	Marine Clay (Crust)	5.6	115.5	No
3	Marine Clay	2	109.9	No
4	Lower Marine Sand	30.5	107.9	No
5	Glacial Till	12.8	77.4	No



HB-YR1-105

XY Location: HB-YR1-105: (1679.81, -2062.98)

Layer #	Type	Thickness [ft]	Elevation [ft]	Drained at Bottom
1	Fill	2.6	122	No
2	Marine Clay (Crust)	7.6	119.4	No
3	Marine Clay	0	111.8	No
4	Lower Marine Sand	19	111.8	No
5	Glacial Till	0	92.8	No



Soil Properties

Property	Fill	Marine Clay (Crust)	Marine Clay	Lower Marine Sand
Color				
Unit Weight [kips/ft3]	0.125	0.12	0.118	0.125
Saturated Unit Weight [kips/ft3]	0.125	0.12	0.118	0.125
K0	1	1	1	1
Primary Consolidation	Disabled	Enabled	Enabled	Disabled
Material Type		Non-Linear	Non-Linear	
Cce	-	0.16	0.16	-
Cre	-	0.016	0.016	-
e0	-	1.1	1.1	-
Pc [ksf]	-	4.5	2.95	-
Cv [ft2/d]	-	0.25	0.25	-
Cvr [ft2/d]	-	0.25	0.25	-
B-bar	-	1	1	-
Secondary Consolidation	Disabled	Standard	Standard	Disabled
Cae	-	0.0015	0.009	-
Care	-	0.0015	0.009	-
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1

Property	Glacial Till
Color	
Unit Weight [kips/ft3]	0.13
Saturated Unit Weight [kips/ft3]	0.13
K0	1
B-bar	-
Undrained Su A [kips/ft2]	0
Undrained Su S	0.2
Undrained Su m	0.8
Piezo Line ID	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft3

Piezometric Line Entities

ID	Elevation (ft)
1	112.3 ft

Yarmouth Route 1 Bridge Global Stability

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	L.Hailey/E.Tome	Date:	9/27/2024
Checked by:	B.Cardali/A.Blaisdell	Date:	11/18/2024

Objective

Evaluate global stability of the proposed approach embankments at critical transverse sections near the proposed abutments and in the longitudinal direction beneath each abutment using the profile and properties shown in the Interpretive Subsurface Profile, Design profile, and sections for the Yarmouth Route 1 Bridge replacement.

References

Documents that were used as a basis of our evaluation include:

1. American Association of State Highway and Transportation Officials, AASHTO LRFD Bridge Design Specifications: Customary U.S. Units, 9th Edition, 2020. (AASHTO LRFD)
2. Hynes-Griffin and Franklin (1984), "Rationalizing the seismic coefficient method," Miscellaneous Paper GL-84-13, U.S. Army Corps of Engineers Waterway Experiment Station, Vicksburg, Mississippi.
3. Kramer (1996), "Geotechnical Earthquake Engineering," Prence-Hall, Inc., Upper Saddle River, NY.

Attachments

Appendix A – Location Plan for Transverse Sections and Longitudinal Profile
Appendix B – Slope/W Output Files
Appendix C – Lateral Pile Resistance Calculation (Broms)

SECTION 1 –Soil Profile

Soil Profile

Friction angles were developed for granular and construction materials based on corrected N60 blow counts of existing materials or anticipated/MaineDOT BDG design properties. The existing granular materials that were based on N60 blow counts are presented below in **Figure 1**. Shear strengths and unit weights of the Marine Clay Crust and Marine Clay layers were develop based on laboratory testing, field vane testing, and CPT correlations and are shown in **Figure 2**, below (also presented in Figure 4 of the Geotechnical Design Report).

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	L.Hailey/E.Tome	Date:	9/27/2024
Checked by:	B.Cardali/A.Blaisdell	Date:	11/18/2024

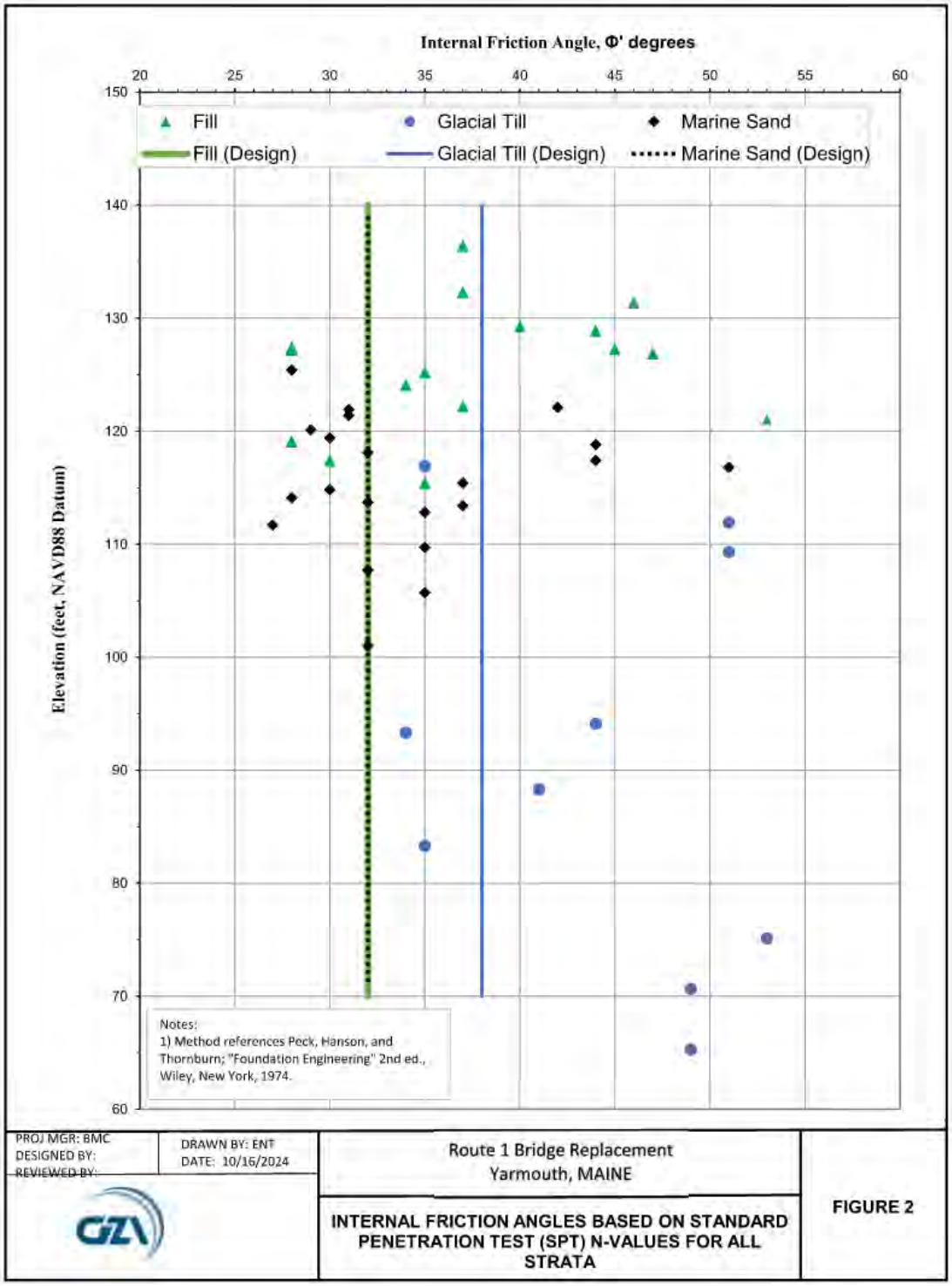


Figure 1 - Internal Friction Angles

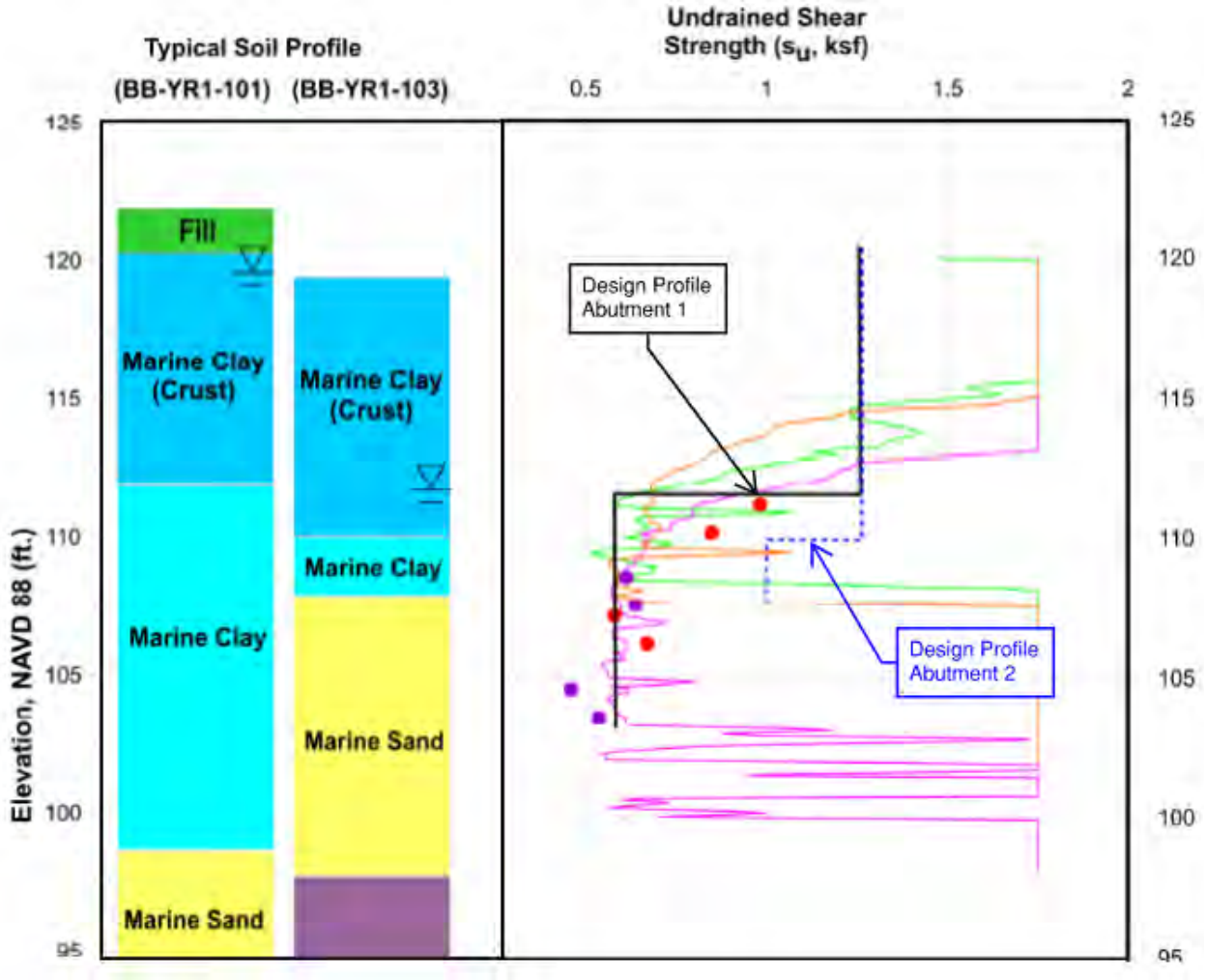


Figure 2 – Design Profiles at Abutments

Design soil properties are shown in the table below and on the Slope/W outputs.

Table 1: Input Soil Parameters

Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (degrees)
New Fill	125	0	32
Existing Fill	125	0	32
Marine Clay Crust	120	1250	0
Marine Clay, medium stiff	118	575	0
Marine Clay, stiff	118	1000	0
Marine Sand	120	0	32
Glacial Till	130	0	38
MSE Fill	128	0	34
UFLGA	20	0	40

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	L.Hailey/E.Tome	Date:	9/27/2024
Checked by:	B.Cardali/A.Blaisdell	Date:	11/18/2024

SECTION 2 – Analysis

Performance Criteria

The basis for acceptable global stability for embankments is specified in AASHTO LRFD Article 11.6.3.7 and utilizes a resistance factor of 0.75 (corresponding to a safety factor of 1.3) where the geotechnical parameters and subsurface stratigraphy are well defined.

Transverse Section Analysis

GZA evaluated the stability of the proposed approach embankments using the computer analytical software Slope/W 2022 developed by Geo-Slope International, based on the Morgenstern-Price method.

The tallest proposed embankment is located at the Abutment 1 approach (Station 113+25) and includes a mechanically stabilized earth (MSE) wall. The MSE wall base is at EL. 113.5 extending to the top of the embankment. GZA modeled the width of the MSE section to be 0.7 times the height of the wall. Section 113+25 considered the thickest portion of the medium stuff clay and includes lightweight fill. The thicknesses and limits of the lightweight fill are based on the proposed settlement mitigation alternative presented in the settlement calculations. GZA evaluated a section at the Abutment 1 approach at Station 112+25, which is located beyond the limits of the lightweight fill and MSE wall. Station 116+75 is considered the tallest proposed embankment for the Abutment 2 approach and does not include any lightweight fill for settlement mitigation. The Slope/W model was developed for the proposed 44-foot-wide travel way and auxiliary turn lanes with a traffic surcharge load of 250 psf placed over the travel way. The cross-section geometries were developed to be consistent with the Draft PSE Plans dated 10/04/2024 provided by HTA. Sections were evaluated with either the grid and radius or entry exit methods.

The attached Slope/W outputs show that the proposed embankment provides the following minimum global factors of safety in the transverse direction:

Station	Analysis	Direction Analyzed	Factor of Safety Against Rotation	Required Factor of Safety
112+25	Static	Right to Left	2.2	1.3
113+25	Static	Right to Left	1.7	1.3
116+75	Static	Left to Right	2.0	1.3
116+75	Static	Right to Left	2.1	1.3

Based on these results, global stability is suitable for both approach embankments.

Longitudinal Section Analysis

The analyzed profile considered the interpreted subsurface conditions along the project baseline in the longitudinal direction consistent with the Interpretive Subsurface Profile. The Abutment 1 profile includes the limits of lightweight fill which are based on the proposed settlement mitigation alternative. Additionally, the analyses included the beneficial effects of the reinforcing HP14x89 piles. Supporting Broms calculations are presented in Appendix C for the HP14x89 in strong axis bending. The proposed embankment at the abutments consists of the travel way with a traffic surcharge load of 250 psf placed over new MSE walls and side slopes of 2H:1V. Sections were evaluated with the grid and radius method. The MSE wall base is at EL. 113.5 at Abutment 1 and 110.5 at Abutment 2 extending to the top of the embankment. GZA modeled the width of the MSE section to be 0.7 times the height of the wall.

GZA also considered the seismic effects on the embankment and conducted a psuedostatic analysis for the longitudinal profile that yielded the lowest factor of safety in the static condition. For this case, the minimum factor of safety for global stability is selected as 1.0, which is recommended by Hynes-Griffin and Franklin (1984), referenced in Geotechnical Earthquake Engineering (1996). The pseudostatic analysis includes an additional earthquake load by incorporating the horizontal seismic coefficient, kh, as defined in AASHTO 11.6.5.2.2 and recommended by Hynes-Griffin and Franklin using the Newmark method as half of the maximum peak ground

acceleration at the ground surface (see seismic analysis), corresponding to k_h = 0.07 g. This criterion is considered suitable to limit potential for large deformation of the embankments, which is considered suitable for this Extreme Event scenario.

The attached Slope/W outputs show that the proposed embankment provides the following minimum global factors of safety in the longitudinal direction:

Abutment	Analysis	Factor of Safety Against Rotation (With Reinforcement)	Factor of Safety Against Rotation (Without Reinforcement)	Required Factor of Safety
1	Static	1.6	1.3	1.3
2	Static	1.6	1.3	1.3
2	Pseudostatic	--	1.2	1.0

Based on these results, the longitudinal global stability is sufficient if the MSE wall reinforcement extends 0.7 times the height of the wall is included.

SECTION 3 – Conclusion

Transverse The global stability meets the minimum required criteria for static conditions.

Longitudinal The global stability meets the minimum required criteria for static and psuedostatic conditions in both directions.

APPENDIX A

Location Plan for Transverse Sections and Longitudinal Profile

Location Plan for Transverse Sections and Longitudinal Profile

I-295 Southbound

I-295 Northbound

112+25

113+25

116+75

12" Underdrain Type C

MSE Retaining Wall

℄ Brg., Abut. No. 1 Sta. 113+61.00

℄ Brg., Pier Sta. 115+21.00

Brg., Abut. No. 2 ℄ Sta. 116+41.00

Remove Existing Guardrail 31" W-Beam Guardrail Mid-Way Splice

31" W-Beam Guardrail Mid-Way Splice Extended 50' Beyond Bridge Pier

35° Skew

Fence (48" Min. Height) (Typ.)

Catch Basin (Typ.)

31" W-Beam Guardrail Mid-Way Splice Tangent Terminal (Typ.)

Multi-Use Path (Typ.)

Remove 12 LF of RCP

112+00 113+00 114+00 115+00 116+00 US Route 1 117+00

Longitudinal Sta. 112+00 to 118+00

Raised Island

Lightweight Embankment Fill (Exact limit and quantity to be determined) (Typ.)

Existing Signs to be Removed and Replaced (Typ.)

Existing Lighting to be Removed and Relocated (Typ.)

Remove Existing Guardrail

Remove Existing Pavement, Loam & Seed (Typ.)

Remove Existing Bridge and Retaining Wall

Remove Existing Guardrail & Pavement

Remove Existing Piers to Top of Footing (Typ.)

Remove Existing Guardrail

PLAN

25 0 25 50

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BRIDGE PLANS

WIN 22382.00

BRIDGE NO. 5804

	DATE	BY
J.Brosk		
PROJ. MANAGER		
DESIGN-DETAILED	JUNE 2024	LDC
CHECKED-REVIEWED	JUNE 2024	TAS
DESIGN2-DETAILED2		PBD
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

RELOCATED US 1 BRIDGE
INTERSTATE 295
CUMBERLAND COUNTY
YARMOUTH

GENERAL PLAN
(3 OF 4)

SHEET NUMBER

6

OF 131

Filename: ...\00\BRIDGE\MSTA\006_BDPlan3.dgn Username: Division: BRIDGE Date:6/28/2024

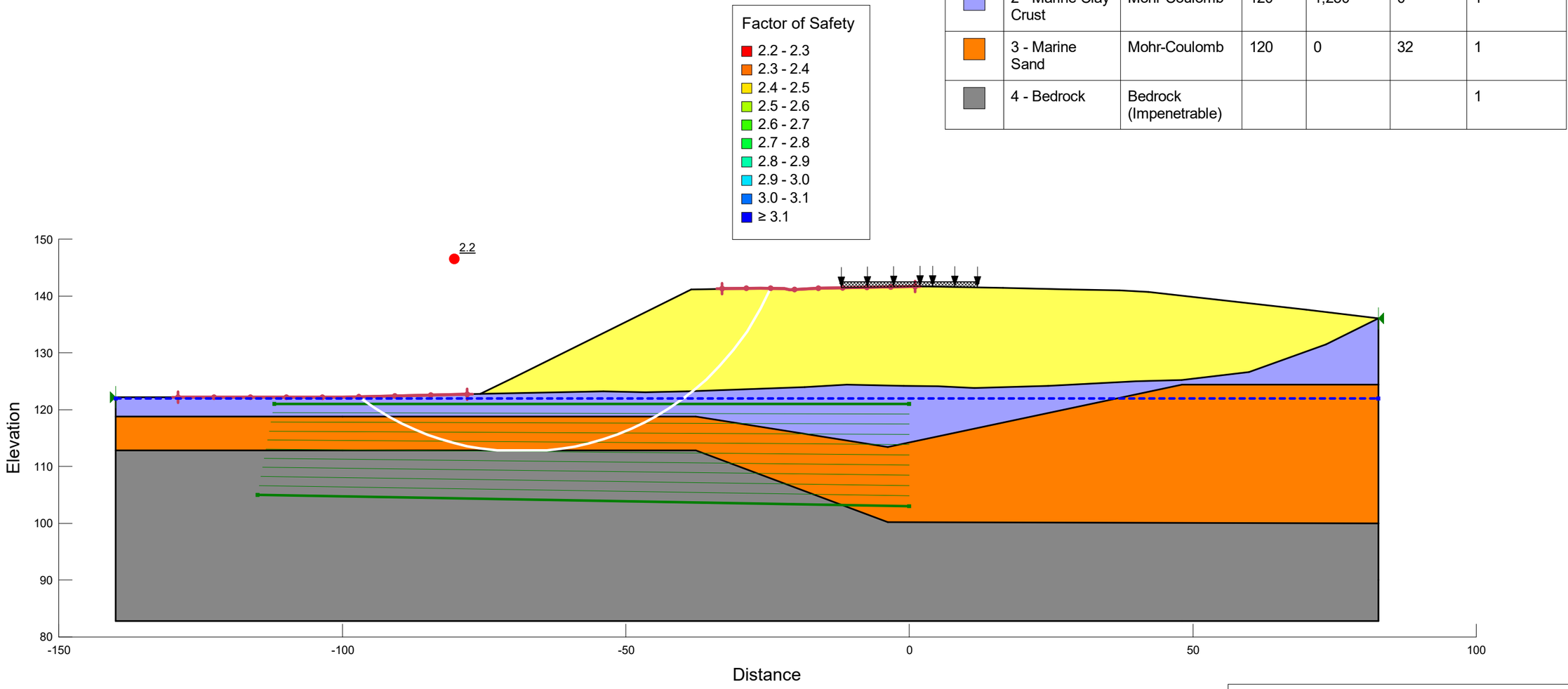
APPENDIX B

Slope/W Output Files

File Name: Yarmouth Rt. 1_Station 112+25_7.11.2024.gsz
Date: 10/15/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	1 - New Fill	Mohr-Coulomb	125	0	32	1
	2 - Marine Clay Crust	Mohr-Coulomb	120	1,250	0	1
	3 - Marine Sand	Mohr-Coulomb	120	0	32	1
	4 - Bedrock	Bedrock (Impenetrable)				1



112+25

SLOPE/W 112+25

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
MaineDOT

PROJ MGR: BMC
REVIEWED BY: BMC
CALCULATIONS: Riley Franklin
DATE: 10/15/2024
PROJECT NO.: 09.0026144.00

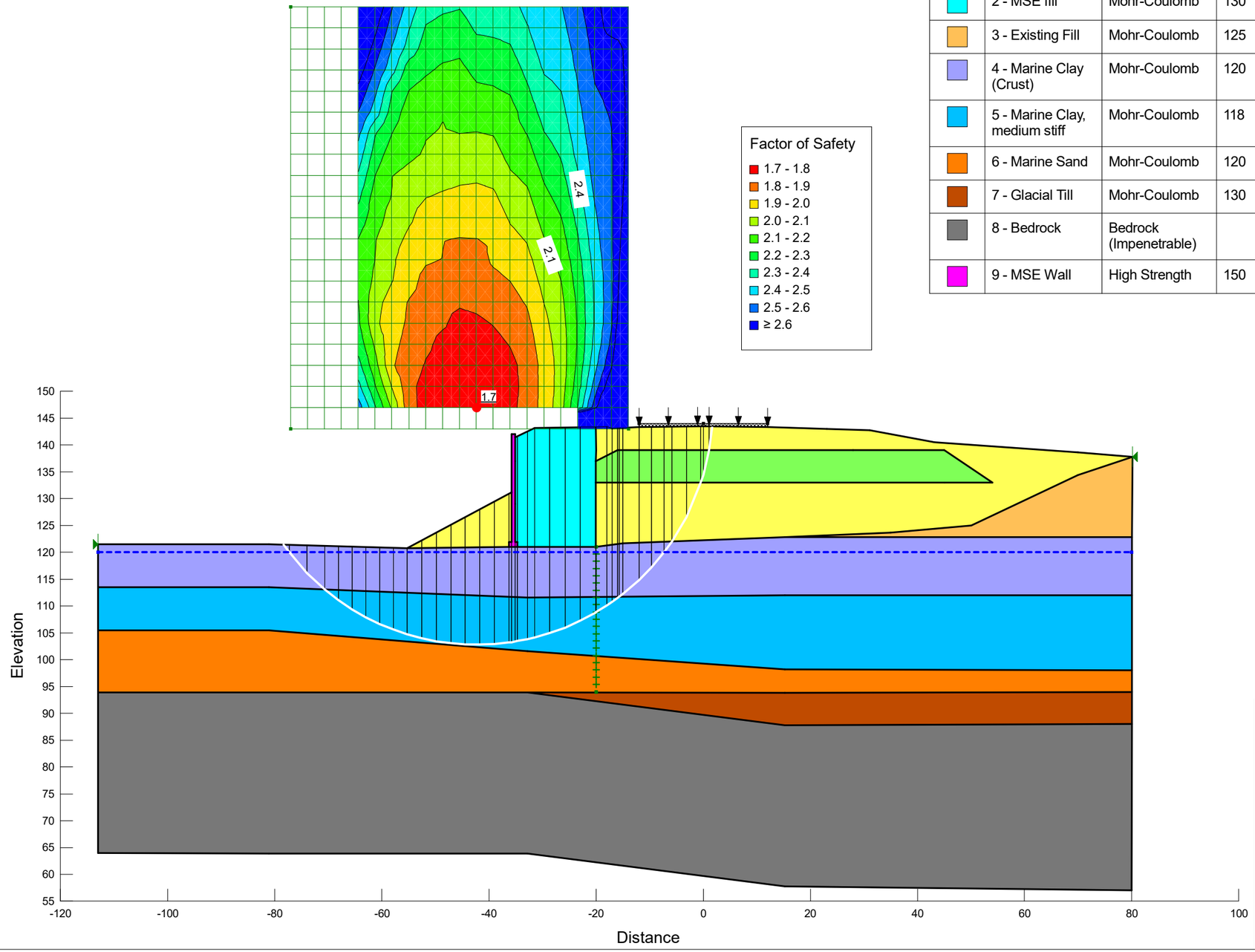
FIGURE
1

P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

File Name: Yarmouth Rt. 1_Station 113+25_7.24.2024.gsz
Date: 10/23/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	1 - New Fill	Mohr-Coulomb	125	0	32	1
	1A - ULFGA	Mohr-Coulomb	20	0	40	1
	2 - MSE fill	Mohr-Coulomb	130	0	34	1
	3 - Existing Fill	Mohr-Coulomb	125	0	32	1
	4 - Marine Clay (Crust)	Mohr-Coulomb	120	1,250	0	1
	5 - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0	1
	6 - Marine Sand	Mohr-Coulomb	120	0	32	1
	7 - Glacial Till	Mohr-Coulomb	130	0	34	1
	8 - Bedrock	Bedrock (Impenetrable)				1
	9 - MSE Wall	High Strength	150			1



113+25

SLOPE/W 113+25 With ULFGA

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PROJ MGR: BMC	REVIEWED BY: BMC
CALCULATIONS: Riley Franklin	
DATE: 10/23/2024	PROJECT NO.: 09.0026144.00

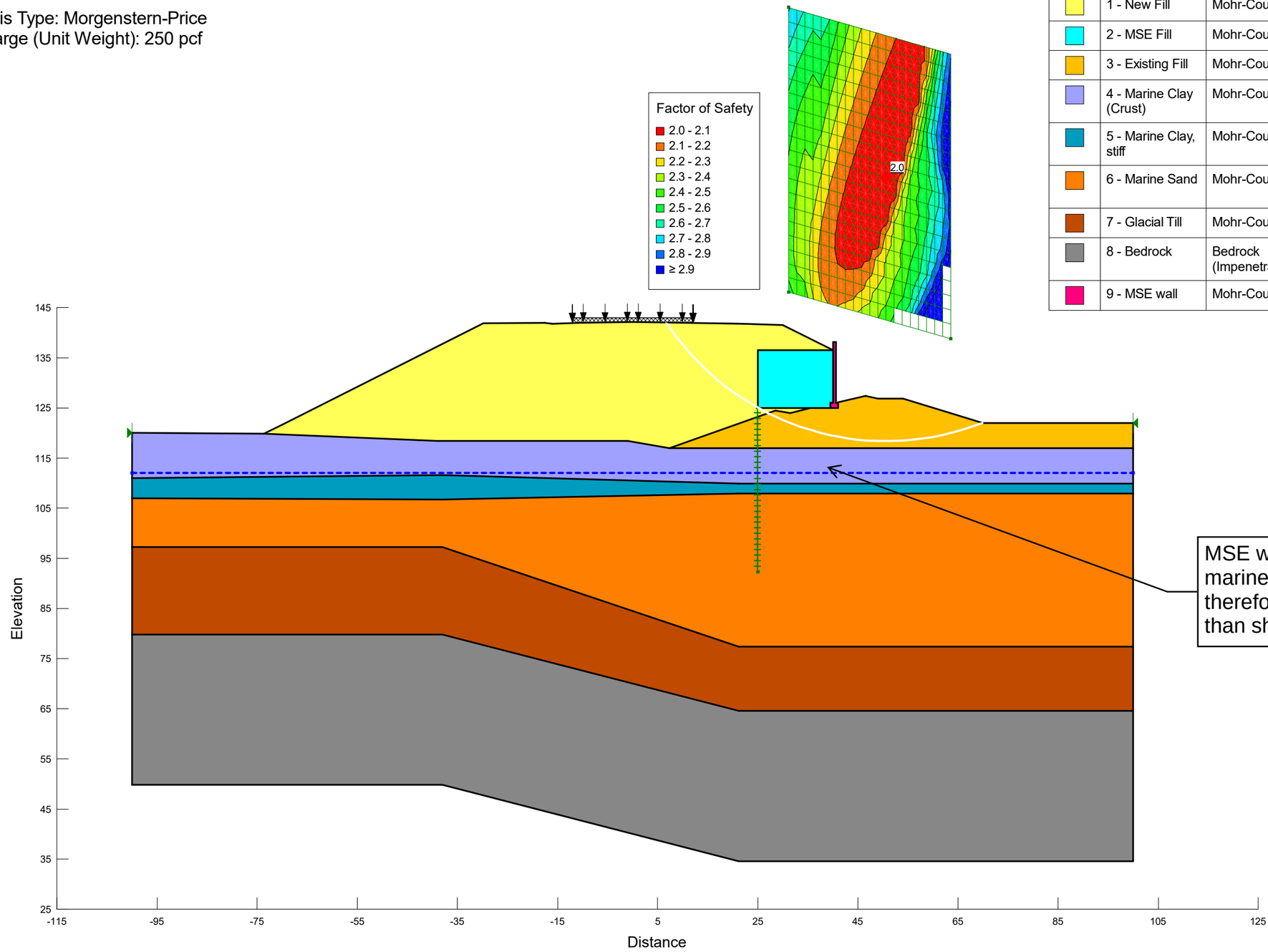
FIGURE 2

P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

File Name: Yarmouth Rt. 1_Station 116+75_7.11.2024.gsz
Date: 11/18/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - New Fill	Mohr-Coulomb	125	0	32
	2 - MSE Fill	Mohr-Coulomb	130	0	34
	3 - Existing Fill	Mohr-Coulomb	125	0	32
	4 - Marine Clay (Crust)	Mohr-Coulomb	120	1,250	0
	5 - Marine Clay, stiff	Mohr-Coulomb	118	1,000	0
	6 - Marine Sand	Mohr-Coulomb	120	0	32
	7 - Glacial Till	Mohr-Coulomb	130	0	34
	8 - Bedrock	Bedrock (Impenetrable)			
	9 - MSE wall	Mohr-Coulomb	150	0	40



MSE wall at Sta. 116+75 is beyond marine clay crust excavation and therefore is thicker under the MSE wall than shown in the longitudinal profile.

116+75 Left to Right

SLOPE/W 116+75 L-R

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www.gza.com

PREPARED FOR:
MaineDOT

PROJ MGR: BMC | REVIEWED BY: BMC

CALCULATIONS: Riley Franklin

DATE: 11/18/2024 | PROJECT NO.: 09.0026144.00

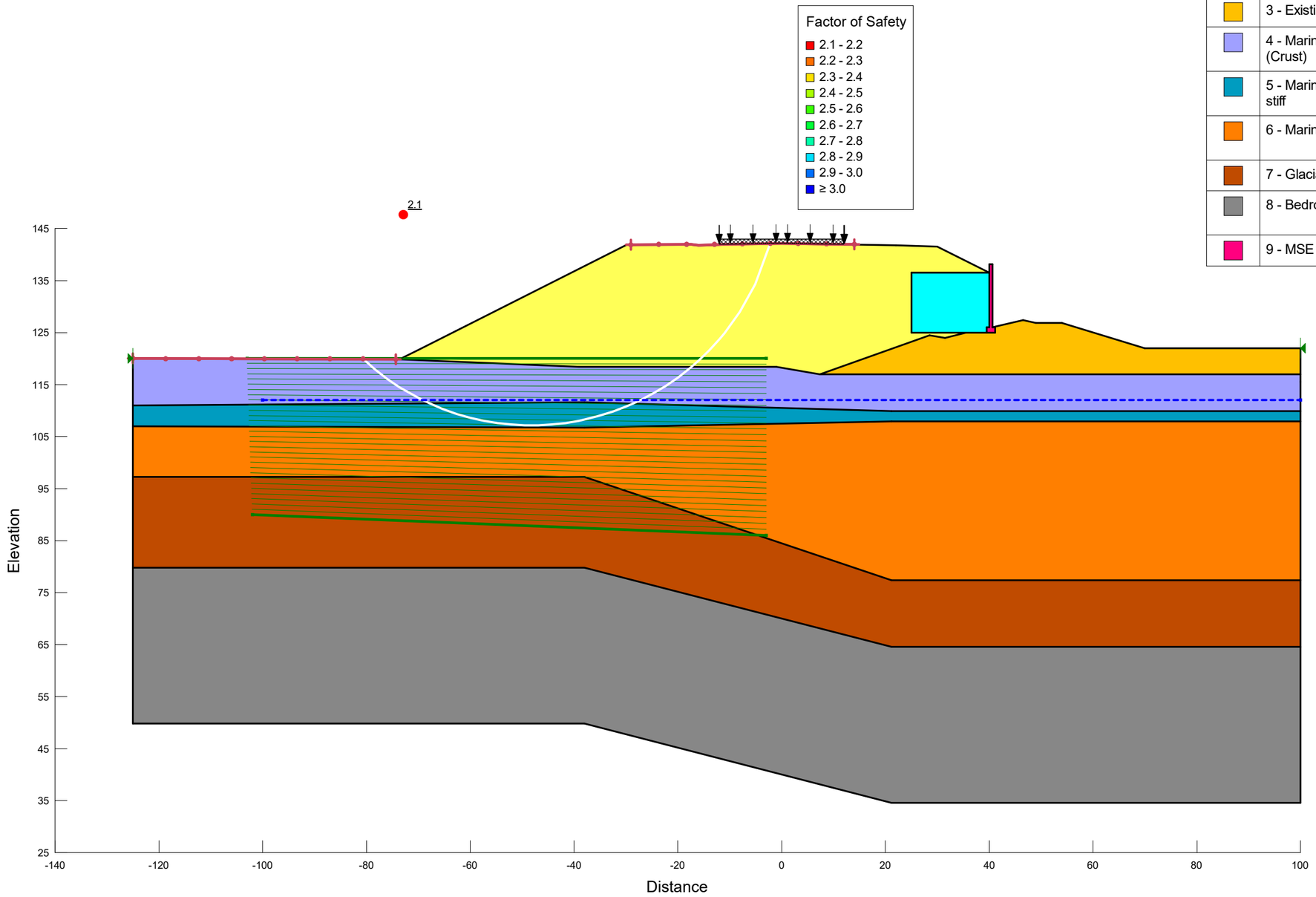
FIGURE 4

P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

File Name: Yarmouth Rt. 1_Station 116+75_7.11.2024.gsz
Date: 11/18/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - New Fill	Mohr-Coulomb	125	0	32
	2 - MSE Fill	Mohr-Coulomb	130	0	34
	3 - Existing Fill	Mohr-Coulomb	125	0	32
	4 - Marine Clay (Crust)	Mohr-Coulomb	120	1,250	0
	5 - Marine Clay, stiff	Mohr-Coulomb	118	1,000	0
	6 - Marine Sand	Mohr-Coulomb	120	0	32
	7 - Glacial Till	Mohr-Coulomb	130	0	34
	8 - Bedrock	Bedrock (Impenetrable)			
	9 - MSE wall	Mohr-Coulomb	150	0	40



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116+75 Right to Left

SLOPE/W 116+75 R-L

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PREPARED FOR: MaineDOT

PROJ MGR: BMC | REVIEWED BY: BMC

CALCULATIONS: Riley Franklin

DATE: 11/18/2024 | PROJECT NO.: 09.0026144.00

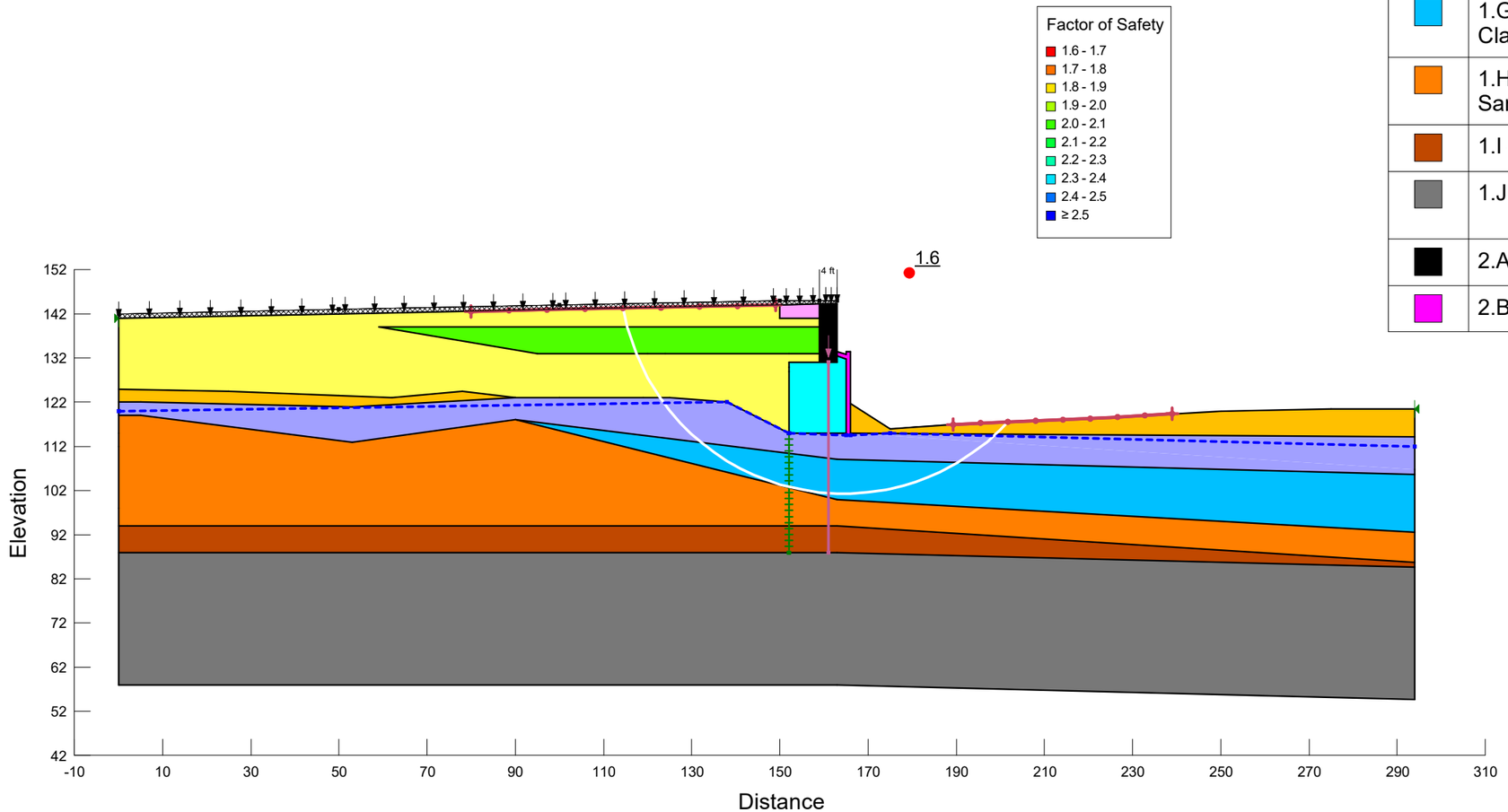
FIGURE 5

File Name: Yarmouth Rt. 1_Longitudinal Analysis_9.12.2024.gsz
Date: 11/20/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Name: HP14x89 (Strong Axis)
Shear Force: 86,300 lbf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1.A - 1 UW Fill	Mohr-Coulomb	1	0	0
	1.B - New Fill	Mohr-Coulomb	125	0	32
	1.C - ULFGA	Mohr-Coulomb	20	0	40
	1.D - MSE Fill	Mohr-Coulomb	130	0	34
	1.E - Existing Fill	Mohr-Coulomb	125	0	32
	1.F - Marine Clay Crust	Mohr-Coulomb	120	1,250	0
	1.G - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0
	1.H - Marine Sand	Mohr-Coulomb	120	0	32
	1.I - Glacial Till	Mohr-Coulomb	130	0	38
	1.J - Bedrock	Bedrock (Impenetrable)			
	2.A - Abutment	High Strength	1		
	2.B - MSE Wall	High Strength	150		



Abutment 1 Longitudinal Stability

Abutment 1 Stability With Reinforcement

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com
PREPARED FOR: MaineDOT

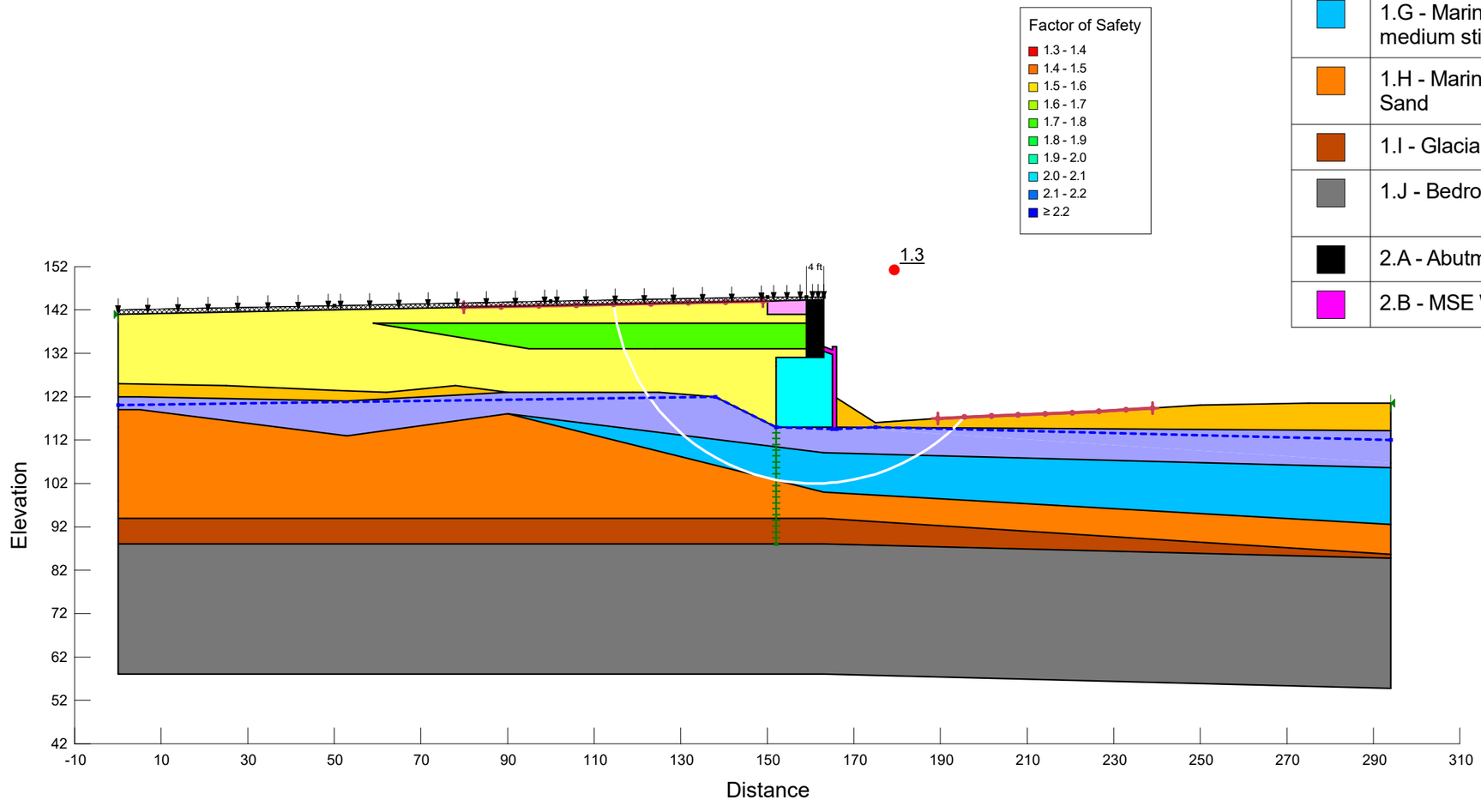
PROJ MGR: BMC | REVIEWED BY: BMC
CALCULATIONS: Logan Hailey
DATE: 11/20/2024 | PROJECT NO.: 09.0026144.00

FIGURE 6

P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

File Name: Yarmouth Rt. 1_Longitudinal Analysis_9.12.2024.gsz
Date: 11/20/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1.A - 1 UW Fill	Mohr-Coulomb	1	0	0
	1.B - New Fill	Mohr-Coulomb	125	0	32
	1.C - ULFGA	Mohr-Coulomb	20	0	40
	1.D - MSE Fill	Mohr-Coulomb	130	0	34
	1.E - Existing Fill	Mohr-Coulomb	125	0	32
	1.F - Marine Clay Crust	Mohr-Coulomb	120	1,250	0
	1.G - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0
	1.H - Marine Sand	Mohr-Coulomb	120	0	32
	1.I - Glacial Till	Mohr-Coulomb	130	0	38
	1.J - Bedrock	Bedrock (Impenetrable)			
	2.A - Abutment	High Strength	1		
	2.B - MSE Wall	High Strength	150		

P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Abutment 1 Longitudinal Stability

Abutment 1 Stability Without Reinforcement

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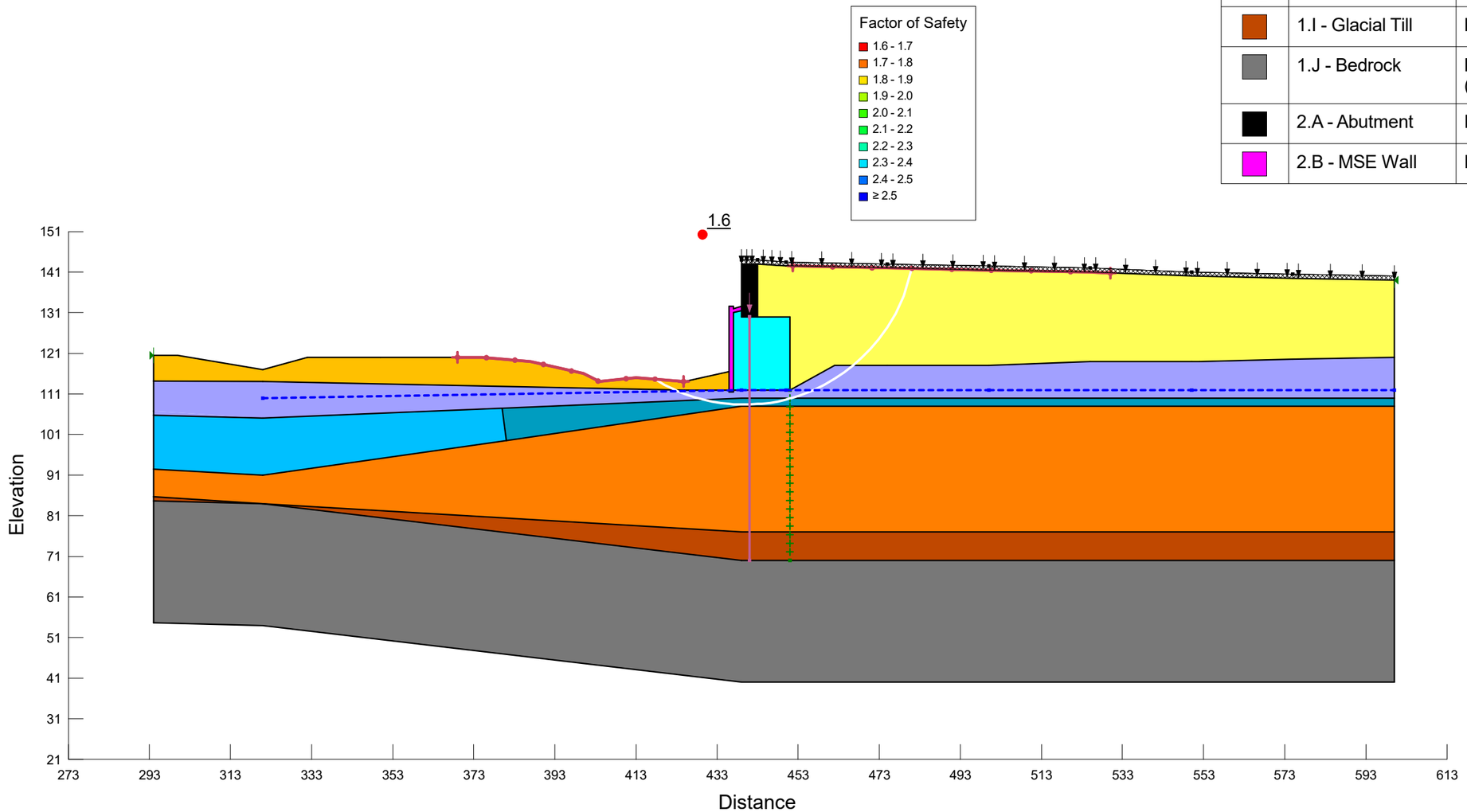
PROJ MGR: BMC	REVIEWED BY: BMC
CALCULATIONS: Logan Hailey	
DATE: 11/20/2024	PROJECT NO.: 09.0026144.00

FIGURE 7

File Name: Yarmouth Rt. 1_Longitudinal Analysis_9.12.2024.gsz
Date: 11/20/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\
Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Name: HP14x89 (Strong Axis)
Shear Force: 86,300 lbf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1.B - New Fill	Mohr-Coulomb	125	0	32
	1.D - MSE Fill	Mohr-Coulomb	130	0	34
	1.E - Existing Fill	Mohr-Coulomb	125	0	32
	1.F - Marine Clay Crust	Mohr-Coulomb	120	1,250	0
	1.G - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0
	1.G - Marine Clay, stiff	Mohr-Coulomb	118	1,000	0
	1.H - Marine Sand	Mohr-Coulomb	120	0	32
	1.I - Glacial Till	Mohr-Coulomb	130	0	38
	1.J - Bedrock	Bedrock (Impenetrable)			
	2.A - Abutment	High Strength	1		
	2.B - MSE Wall	High Strength	150		



P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Abutment 2 Longitudinal Stability

Abutment 2 Stability With Reinforcement

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Engineers and Scientists
www.gza.com

PREPARED FOR:
MaineDOT

PROJ MGR: BMC | REVIEWED BY: BMC

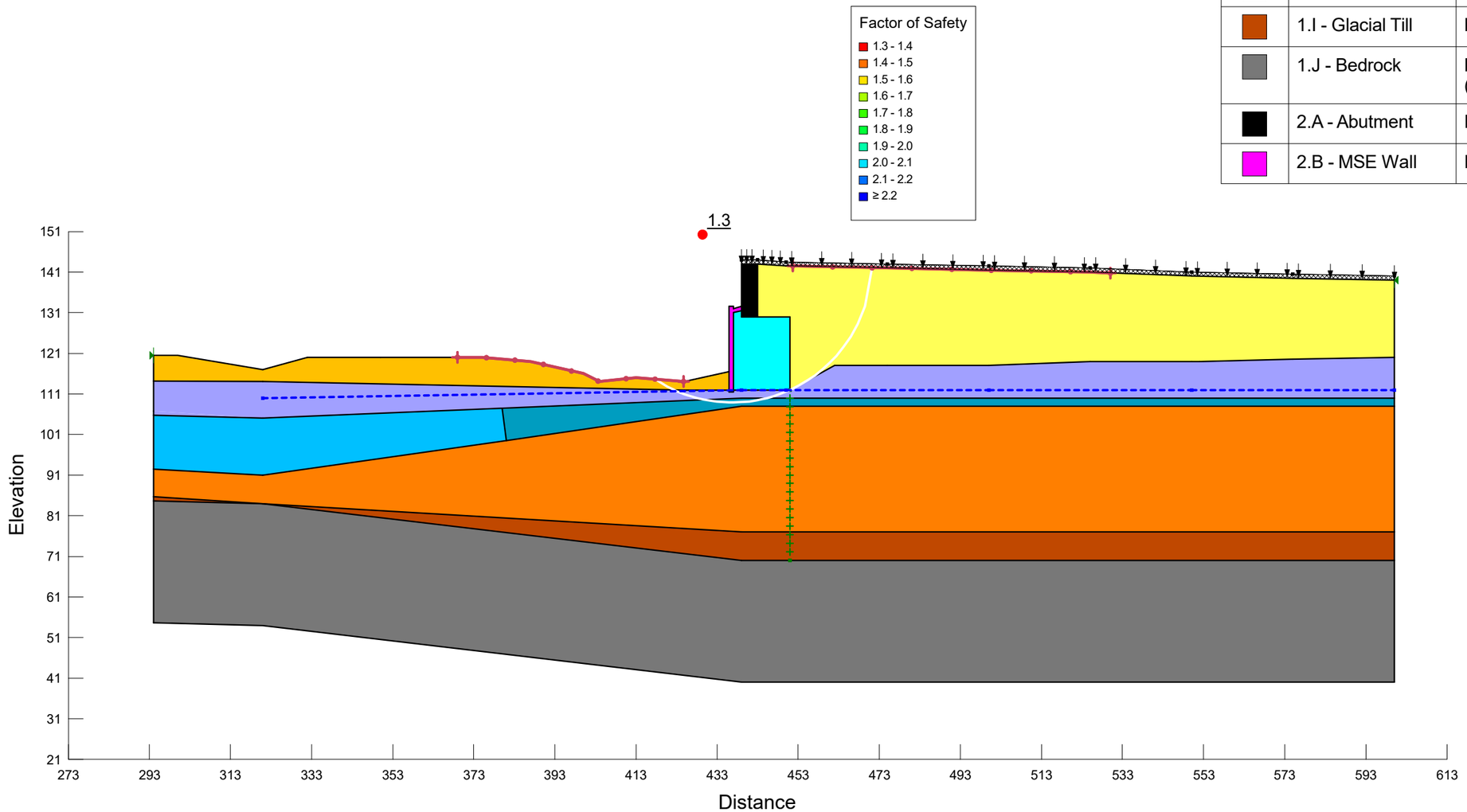
CALCULATIONS: Logan Hailey

DATE: 11/20/2024 | PROJECT NO.: 09.0026144.00

FIGURE
8

File Name: Yarmouth Rt. 1_Longitudinal Analysis_9.12.2024.gsz
Date: 11/20/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\
Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1.B - New Fill	Mohr-Coulomb	125	0	32
	1.D - MSE Fill	Mohr-Coulomb	130	0	34
	1.E - Existing Fill	Mohr-Coulomb	125	0	32
	1.F - Marine Clay Crust	Mohr-Coulomb	120	1,250	0
	1.G - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0
	1.G - Marine Clay, stiff	Mohr-Coulomb	118	1,000	0
	1.H - Marine Sand	Mohr-Coulomb	120	0	32
	1.I - Glacial Till	Mohr-Coulomb	130	0	38
	1.J - Bedrock	Bedrock (Impenetrable)			
	2.A - Abutment	High Strength	1		
	2.B - MSE Wall	High Strength	150		



P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Abutment 2 Longitudinal Stability

Abutment 2 Stability Without Reinforcement

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
MaineDOT

PROJ MGR: BMC | REVIEWED BY: BMC

CALCULATIONS: Logan Hailey

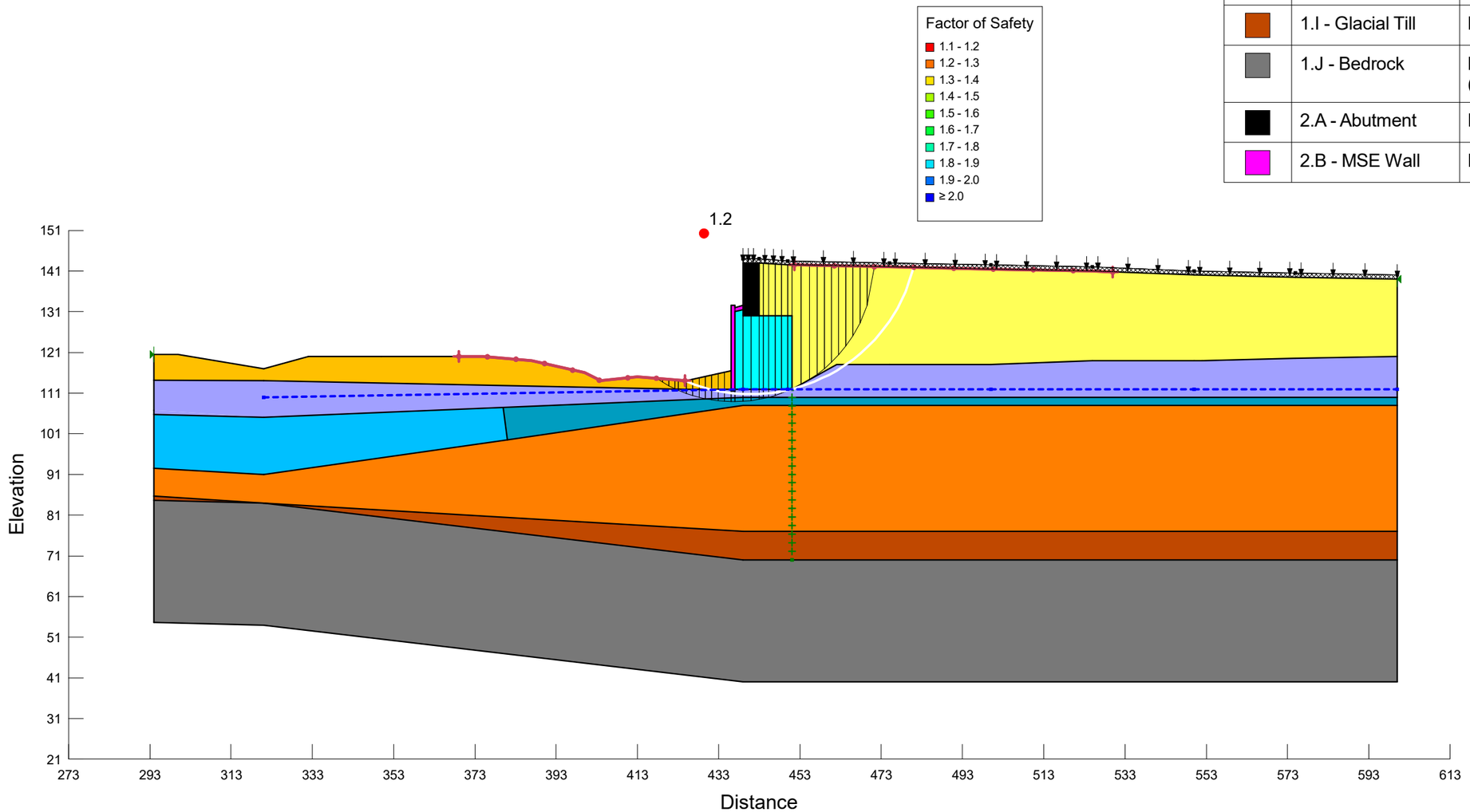
DATE: 11/20/2024 | PROJECT NO.: 09.0026144.00

FIGURE
9

File Name: Yarmouth Rt. 1_Longitudinal Analysis_9.12.2024.gsz
Date: 11/20/2024
Directory: P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Analysis Type: Morgenstern-Price
Surcharge (Unit Weight): 250 pcf
Horz Seismic Coef.: 0.07

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1.B - New Fill	Mohr-Coulomb	125	0	32
	1.D - MSE Fill	Mohr-Coulomb	130	0	34
	1.E - Existing Fill	Mohr-Coulomb	125	0	32
	1.F - Marine Clay Crust	Mohr-Coulomb	120	1,250	0
	1.G - Marine Clay, medium stiff	Mohr-Coulomb	118	575	0
	1.G - Marine Clay, stiff	Mohr-Coulomb	118	1,000	0
	1.H - Marine Sand	Mohr-Coulomb	120	0	32
	1.I - Glacial Till	Mohr-Coulomb	130	0	38
	1.J - Bedrock	Bedrock (Impenetrable)			
	2.A - Abutment	High Strength	1		
	2.B - MSE Wall	High Strength	150		



P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Stability\SlopeW\

Abutment 2 Longitudinal Stability

Abutment 2 Stability Without Reinforcement Psuedostatic

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com	PREPARED FOR: MaineDOT
PROJ MGR: BMC	REVIEWED BY: BMC
CALCULATIONS: Logan Hailey	
DATE: 11/20/2024	PROJECT NO.: 09.0026144.00

FIGURE 10

APPENDIX C

Lateral Pile Resistance Calculation (Broms)

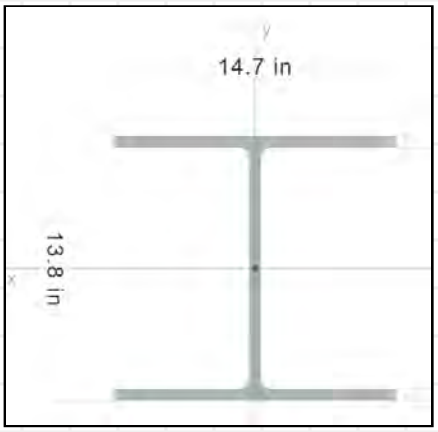
GZA
GeoEnvironmental, Inc.
707 Sable Oaks Drive, Suite 150
South Portland, ME 04106
(207) 879-9190
http://www.gza.com

Engineers and Scientists

JOB Yarmouth Route 1 Bridge No. 5804
SHEET NO
Calculated By E. Tome Date Sept. 16, 2024
Checked By B. Cardali Date Sept. 16, 2024
Scale

Objective: Evaluate lateral capacity for proposed driven piles.

HP14X89



σ_y = 50 ksi
I = 326 in^4 (weak axis)
I = 904 in^4 (strong axis)
c = 14.7/2 = 7.4 in (weak axis)
c = 13.8/2 = 6.9 in (strong axis)

Find Yield Moment:

$M_y = \frac{\sigma_y (I)}{c} = \frac{50 \text{ ksi } (326 \text{ in}^4)}{7.4 \text{ in}} = 2217.7 \text{ kip-in} = 184.8 \text{ kip-ft (weak)}$

$M_y = \frac{\sigma y (I)}{c} = \frac{50 \text{ ksi } (904 \text{ in}^4)}{6.9 \text{ in}} = 6550.7 \text{ kip-in} = 545.9 \text{ kip-ft (strong)}$

From Brohm's Method Fig. 16.8 for Long Piles in Cohesive Soil:

Average Shear Strength of Clay = 0.575 ksf

Ultimate Resistance Moment:

$\frac{M_y}{Su(d^3)} = \frac{184.8 \text{ kip-ft}}{0.575\text{ksf}(13.8 \text{ in})^3} = 211.3 \text{ (weak)}$

$\frac{M_y}{Su(d^3)} = \frac{545.9 \text{ kip-ft}}{0.575\text{ksf}(14.7 \text{ in})^3} = 516.5 \text{ (strong)}$

From Fig. 16.8:

Weak Axis:

$\frac{P_u}{Su(d^2)} = 78$, $P_u = (78)(0.575 \text{ ksf})(13.8 \text{ in})^2 = 59.3$ kips

Strong Axis:

$\frac{P_u}{Su(d^2)} = 100$, $P_u = (100)(0.575 \text{ ksf})(14.7 \text{ in})^2 = 86.3$ kips

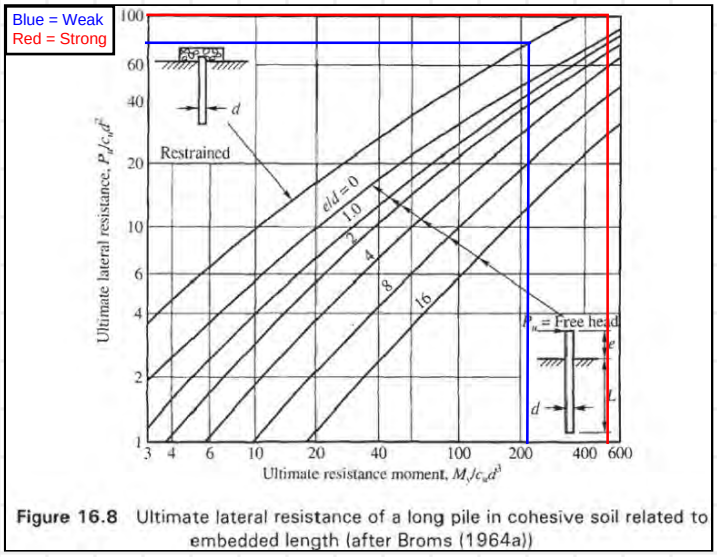


Figure 16.8 Ultimate lateral resistance of a long pile in cohesive soil related to embedded length (after Broms (1964a))

Conclusion:

The lateral pile capacity of the proposed HP14x89 driven piles in the weak axis and strong axis are 59.3 kips and 86.3 kips, respectively.

Seismic Site Class Calculation Summary

Project: Route 1 Bridge Over Interstate-295 **Project No.:** 09.0026144.00

Location: Yarmouth, ME

Evaluated By/Date: E. Tome **Date** 9/25/2024

Checked By/Date: B. Cardali/A. Blaisdell **Date** 11/18/2024

Objective: Determine seismic site class by performing calculations in accordance with the MaineDOT Bridge Manual 2003 Edition with updates in 2020, which references the AASHTO LRFD Seismic Bridge Design Specifications, 9th Edition.

Subsurface Data: Borings BB-YR1-101 through -103 were drilled by New England Boring Contractors, of Hermon, Maine between February 21 and 24, 2022 and on April 11, 2022. Borings BB-YR1-201 and -202 and Seismic Cone Penetration Tests sCPT-YR1-207 and -208 were performed by Seaboard Drilling, LLC between April 25 to April 30, 2024.

Assumptions: Soil borings extended to depths between 45 and 65 feet below the roadway level and bedrock was encountered in the soil borings.

Approach: 1) Evaluate if the procedure in AASHTO LRFD Seismic Section 3.10.2.1 for classifying a site is appropriate for the site. Sites with highly variable subsurface conditions or very large sites may require multiple site class determinations or a site-specific seismic response analysis. Furthermore, classifying a site based on the 100 feet of soil and rock beneath the ground surface may be inappropriate if deep deposits of weak soils are present below 100 feet, or if foundation structures are supported on firm soil or rock below soft soils which can be justified as having little effect on the structure's seismic response.

2) Evaluate if soil properties are known in sufficient detail to determine site class. If data is not known in sufficient detail, AASHTO permits the use of Site Class D, unless conditions for Site Class E or Site Class F are likely to be present.

3) Check for the four categories of Site Class F requiring site-specific evaluation:
- Soils vulnerable to potential failure (liquefiable soils, sensitive clays, weakly cemented soils)
- Peats or highly organic clays greater than 10 feet in thickness
- Thick layers (greater than 25 feet) of highly plastic clay (PI > 75)
- Very thick soft/medium stiff clays (greater than 125 feet)

4) Check for existence of greater than 10 feet of soft clay (where s_u < 500 psf, w > 40%, and PI > 20). If these conditions are met, classify as Site Class E.

5) Categorize the site using one of the following three methods in AASHTO C3.10.3.1-1:
- $\overline{v}_s$ (Method A) - $\overline{N}$ (Method B) - $\overline{N}_{ch}$ *and* $\overline{s_u}$ (Method C)

If shear wave velocity data are available, they should be used to classify the site. The $\overline{N}$ and $\overline{s_u}$ methods should only be used if shear wave velocity data is not available, as the correlation between site amplification and these geotechnical parameters is more uncertain (and therefore more conservative) than the correlation with $\overline{v}_s$.

Results: Calculations of the Seismic Site Class based on Method B as described in section 3.10.3.1 of the LRFD Seismic Bridge Design Specifications are attached. Calculations results are summarized in the table below.

Boring ID	BB-YR1-101	BB-YR1-102	BB-YR1-103	BB-YR1-201	BB-YR1-202	Average
N-Value	14	10	28	16	14	16

sCPT ID	sCPT-YR1-207	sCPT-YR1-208	Average
$\overline{Vs}$	1113	1054	1083

Conclusions: Based on the procedure outlined in section 3.10.3.1 and table 3.10.3.1-1 of the LRFD Seismic Bridge Design Specifications, we recommend that Site Class "D" be used for design.

Route 1 Bridge Over Interstate-295
Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: **BB-YR1-101**

estimated from boring location plan
Ground Surface Elevation: 122.0 ft

Depth of Boring: 48.1 ft

Depth to Bedrock: 34.2 ft

EQUATIONS

$$\overline{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$\overline{N}$ = 14.0

Soil Strata	SPT Interval Depth Top, ft	SPT Interval Depth Bottom, ft	SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
Fill	0.0	1.8	121.1	77	1.9	0.02	this field N value is because the spoon went through a cobble
Marine Clay Crust	2.0	4.0	119.0	18	2.1	0.12	
	4.0	6.0	117.0	28	2.0	0.07	
	6.0	8.0	115.0	26	2.0	0.08	
	8.0	10.0	113.0	6	2.0	0.33	
Marine Sand	10.0	12.0	111.0	2	3.0	1.50	pushed spoon through vane so placeholder field N of 1
	14.0	16.0	107.0	2	5.0	2.50	pushed spoon through vane so placeholder field N of 1
	20.0	22.0	101.0	8	5.5	0.69	
Glacial Till	25.0	27.0	96.0	5	5.0	1.00	
	30.0	30.7	91.7	100	4.0	0.04	Refusal
Bedrock	34.2	100.0	54.9	100	67.6	0.68	
Top of Rock	34.2				100.00		

Route 1 Bridge Over Interstate-295
Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: BB-YR1-102

Ground Surface Elevation: 118.4 ft (estimated from boring location plan)

Depth of Boring: 45.6 ft

Depth to Bedrock: 34.9 ft

EQUATIONS

$$\overline{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$\overline{N}$ = 9.9

Soil Strata	SPT Interval Depth Top, ft	SPT Interval Depth Bottom, ft	SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
Fill	0.0	2.0	117.4	9	2.0	0.22	
	2.0	4.0	115.4	22	2.0	0.09	
Marine Clay Crust	4.0	6.0	113.4	30	2.0	0.07	
	6.0	8.0	111.4	36	2.0	0.06	
	8.0	10.0	109.4	35	4.0	0.11	
Marine Clay	14.0	16.0	103.4	1	5.5	5.50	WOH so placeholder N-value of 1
	19.0	21.0	98.4	3	5.0	1.67	
	24.0	26.0	93.4	3	5.0	1.67	
Marine Sand	29.0	31.0	88.4	60	5.0	0.08	
Weathered Bedrock	34.0	34.9	84.0	100	2.4	0.02	Refusal
Bedrock	34.9	100.0	51.0	100	65.1	0.65	
Top of Rock	34.9				100.00		

Route 1 Bridge Over Interstate-295
Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: BB-YR1-103 Ground Surface Elevation: 115.9 ft Depth of Boring: 61.3 ft

Depth to Bedrock: 51.3 ft

EQUATIONS

$$\overline{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$\overline{N}$ = 28.3

Soil Strata	SPT Interval Depth Top, ft	SPT Interval Depth Bottom, ft	SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
Marine Clay Crust	0.0	2.0	114.9	11	2.0	0.18	
	2.0	4.0	112.9	35	2.0	0.06	
	4.0	6.0	110.9	9	2.0	0.22	
Marine Clay	6.0	8.0	108.9	6	2.0	0.33	
Marine Sand	8.0	10.0	106.9	6	4.5	0.75	
	15.0	17.0	99.9	14	6.0	0.43	
	20.0	22.0	94.9	8	5.0	0.63	
	25.0	27.0	89.9	25	5.0	0.20	
	30.0	32.0	84.9	71	5.0	0.07	
	35.0	37.0	79.9	100	5.0	0.05	
Glacial Till	40.0	41.6	75.1	100	4.8	0.05	
	45.0	45.5	70.7	100	4.5	0.04	
	50.0	51.2	65.3	100	3.5	0.04	
Bedrock	51.3	100.0	40.3	100	48.8	0.49	
Top of Rock	51.3				100.00		

Route 1 Bridge Over Interstate-295
Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: BB-YR1-201 Ground Surface Elevation: 121.6 ft Depth of Boring: 42.0 ft

Depth to Bedrock: 27.7 ft

EQUATIONS

$$\overline{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where: m = number of layers
d_i = the thickness of all layers between 0 and 100 feet.
d_c = the thickness of any clay layers between 0 and 100 feet.
N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).
Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$\overline{N}$ = 15.8

Soil Strata	SPT Interval Depth Top, ft	Bottom, ft	SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
Marine Clay Crust	0.0	2.0	120.6	5	2.0	0.40	
	2.0	4.0	118.6	21	2.0	0.10	
	4.0	6.0	116.6	23	2.0	0.09	
	6.0	8.0	114.6	32	2.0	0.06	
	8.0	10.0	112.6	11	3.0	0.27	
Marine Clay	12.0	14.0	108.6	2	4.0	2.00	pushed spoon through vane so placeholder field N of 1
	16.0	18.0	104.6	2	4.0	2.00	pushed spoon through vane so placeholder field N of 1
Marine Sand	20.0	22.0	100.6	11	4.5	0.41	
	25.0	27.0	95.6	14	3.9	0.28	
Bedrock	27.7	100.0	57.8	100	72.7	0.73	
Top of Rock	27.7				100.00		

Route 1 Bridge Over Interstate-295
Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: **BB-YR1-202** Ground Surface Elevation: 119.3 ft Depth of Boring: 46.0 ft

Depth to Bedrock: 39.5 ft

EQUATIONS

$$\overline{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$\overline{N}$ = 14.4

Soil Strata	SPT Interval Depth Top, ft	SPT Interval Depth Bottom, ft	SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
Marine Clay Crust	0.0	2.0	118.3	11	2.0	0.18	
	2.0	4.0	116.3	12	2.0	0.17	
	4.0	6.0	114.3	23	2.0	0.09	
	6.0	8.0	112.3	36	2.0	0.06	
Marine Clay	8.0	10.0	110.3	2	4.5	2.25	pushed spoon through vane so placeholder field N of 1
Marine Sand	15.0	17.0	103.3	2	6.0	3.00	WOH so placeholder N-value of 1
	20.0	22.0	98.3	25	5.0	0.20	
Glacial Till	25.0	27.0	93.3	25	5.0	0.20	
	30.0	32.0	88.3	57	5.0	0.09	
	35.0	37.0	83.3	32	3.5	0.11	
Bedrock	37.0	100.0	50.8	100	63.0	0.63	
Top of Rock	39.5				100.00		

Route 1 Bridge Over Interstate-295
Route 1 Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: **sCPT-YR1-207** Ground Surface Elevation: 121.6 ft Depth of CPT: 14.5 ft

Depth to Bedrock: NE

CALCULATION

$\overline{V}$ = 1113.2

Soil Strata	CPT Interval Depth Top, ft	CPT Interval Depth Bottom, ft	CPT Elevation (mid-interval)	V_s	d_i	d_i / V_s	Comment
Marine Clay Crust	3.0	4.0	118.1	358	5.0	0.01	
	6.0	7.0	115.1	563	3.3	0.01	
Marine Clay	9.5	10.5	111.6	427	3.0	0.01	
	12.0	13.0	109.1	480	2.8	0.01	
	14.0	100.0	64.6	1500	86.0	0.06	
Bottom of CPT	14.0				100.00		

Route 1 Bridge Over Interstate-295
Route 1 Yarmouth, ME

Calculated By: E. Tome Date: 9/25/2024
Checked By: B. Cardali/A. Blaisdell Date: 11/18/2024

INPUT

Exploration ID: **sCPT-YR1-208** Ground Surface Elevation: 121.9 ft Depth of CPT: 28.1 ft

Depth to Bedrock: NE

CALCULATION

$\bar{V}$ = 1053.6

Soil Strata	CPT Interval Depth Top, ft	CPT Interval Depth Bottom, ft	CPT Elevation (mid-interval)	V_s	d_i	d_i / V_s	Comment
Marine Clay Crust	3.0	4.0	118.4	665	5.0	0.01	
	6.0	7.0	115.4	732	3.3	0.00	
Marine Clay	9.5	10.5	111.9	505	4.0	0.01	
	14.0	15.0	107.4	512	4.8	0.01	
	19.0	20.0	102.4	566	4.3	0.01	
Marine Sand	22.5	23.5	98.9	615	3.5	0.01	
	26.0	27.0	95.4	713	3.3	0.00	
	28.0	100.0	57.9	1500	72.0	0.05	
Bottom of CPT	28.0				100.00		

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WITH 7 PERCENT PROBABILTIY OF EXCEEDANCE
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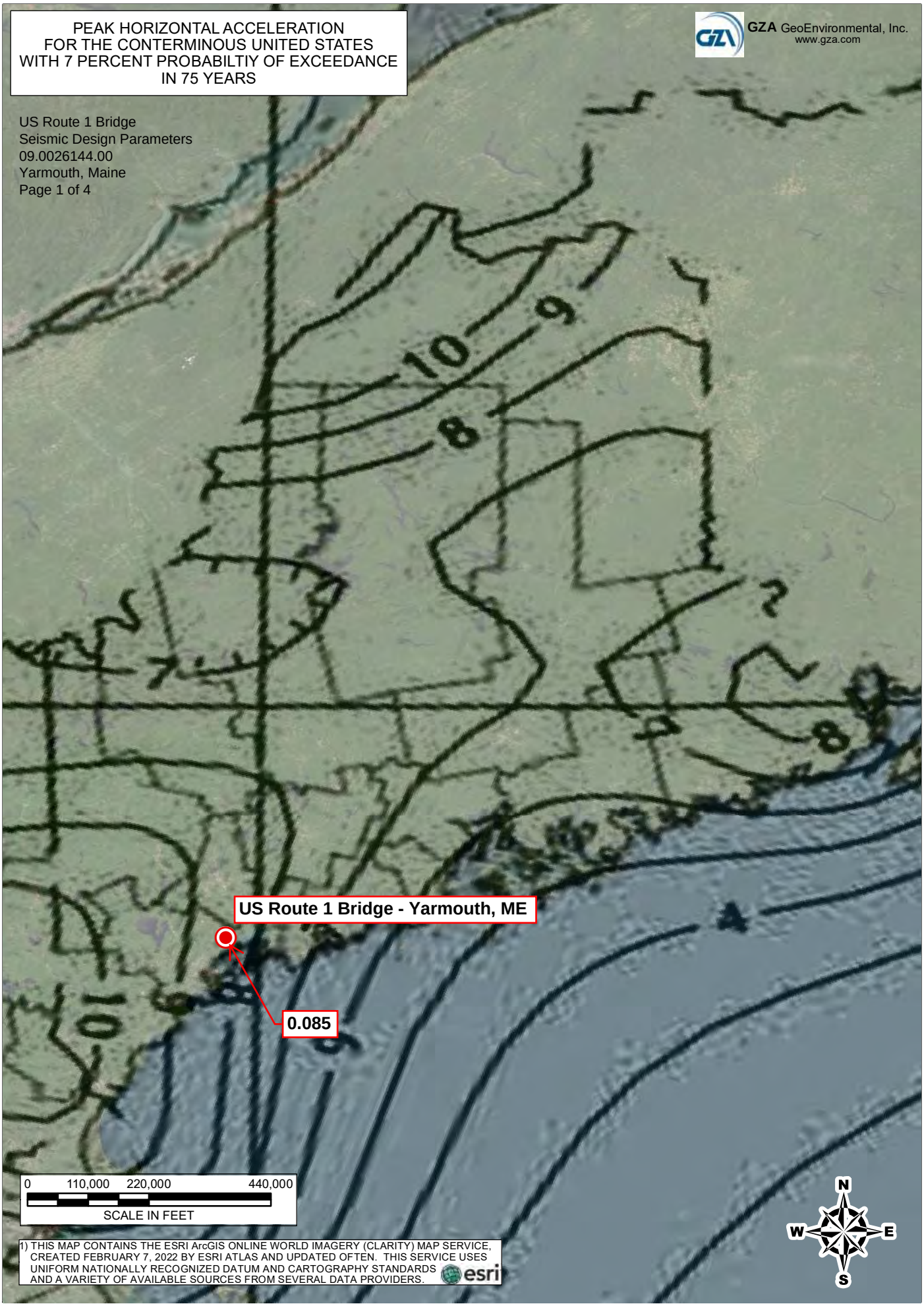
US Route 1 Bridge
Seismic Design Parameters
09.0026144.00
Yarmouth, Maine



1) THIS MAP CONTAINS THE ESRI ArcGIS ONLINE WORLD IMAGERY (CLARITY) MAP SERVICE, CREATED FEBRUARY 7, 2022 BY ESRI ATLAS AND UPDATED OFTEN. THIS SERVICE USES UNIFORM NATIONALLY RECOGNIZED DATUM AND CARTOGRAPHY STANDARDS AND A VARIETY OF AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS.

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OF 0.2-SECOND PERIOD (5 PERCENT OF CRITICAL DUMPING)
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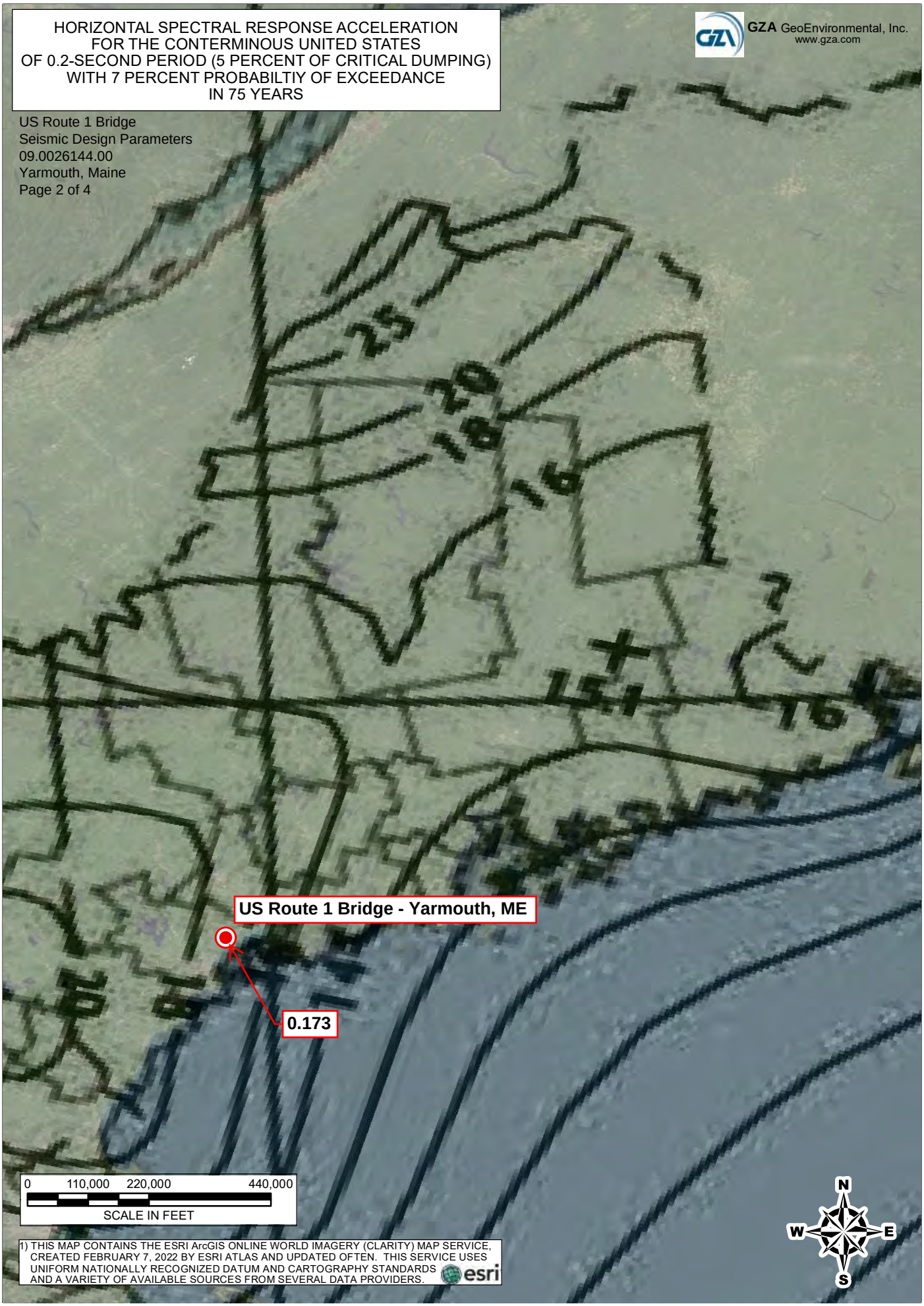
US Route 1 Bridge
Seismic Design Parameters
09.0026144.00
Yarmouth, Maine



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HORIZONTAL SPECTRAL RESPONSE ACCELERATION
FOR THE CONTERMINOUS UNITED STATES
OF 1.0-SECOND PERIOD (5 PERCENT OF CRITICAL DUMPING)
WITH 7 PERCENT PROBABILTIY OF EXCEEDANCE
IN 75 YEARS

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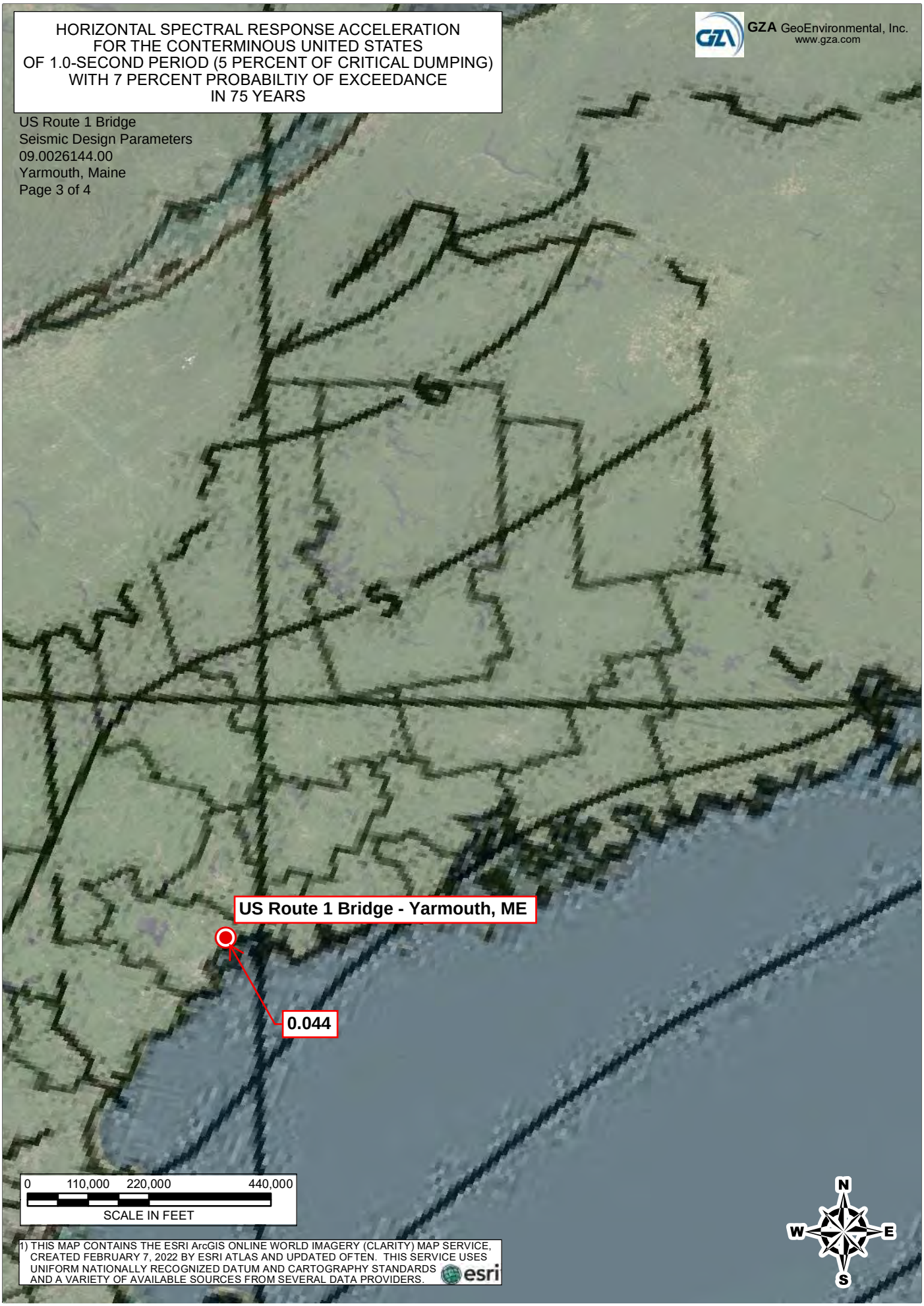
US Route 1 Bridge
Seismic Design Parameters
09.0026144.00
Yarmouth, Maine



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Seismic Parameter	Design Parameter[1]
Horizontal Peak ground Acceleration Coefficient	$PGA = 0.085$
Horizontal Response Spectral Acceleration Coefficient for Period of 0.2s	$S_s = 0.173$
Horizontal Response Spectral Acceleration Coefficient for Period of 1.0s	$S_1 = 0.044$

Notes: 1. AASHTO Figures 3.10.2.1-1,-2, and -3 were overlaid within GIS software. Coefficients were interpolated between lines on these figures as presented in pages 1 through 3 of this calculation.

For Class D, values of F_{PGA} and F_a = 1.6, and F_v = 2.4

Therefore:

$$A_s = F_{PGA} \times PGA = 1.6 \times 0.085 = 0.14\ g$$

$$S_{DS} = F_a \times S_s = 1.6 \times 0.173 = 0.28\ g$$

$$S_{D1} = F_v \times S_1 = 2.4 \times 0.044 = 0.11\ g$$

Summary:

SITE CLASS D SEISMIC DESIGN PARAMETERS	
Parameter	**Design Value**
Fpga	1.6
Fa	1.6
Fv	2.4
As (Period = 0.0 sec)	0.14 g
SDs (Period = 0.2 sec)	0.28 g
SD1 (Period = 1.0 sec)	0.11 g

GZA
GeoEnvironmental, Inc.
707 Sable Oaks Drive Suite 150
South Portland, Maine 04106
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http://www.gza.com

JOB:	**US Route 1 Bridge # 5804 Yarmouth, ME**
GZA PROJECT NO:	**09.0026144.00**
SUBJECT:	**Downdrag Calculation, Abutment 1**
SHEET:	
CALCULATED BY:	**E. Tome 10/23/2024**
CHECKED BY:	**A. Blaisdell / B. Cardali 10/23/2024**

Type of Pile	**HP14x89**	
Diameter of Pile	14.3	in
Perimeter of Pile	4.77	ft
Maximum Factored Pile Load (5 piles)	356	kips

No of HP14x89 Piles	Maximum Factored Axial Load per Pile ($\Sigma\gamma i$ Qi)	Factored Load from Downdrag (γ_p DD)	Total Factored Load ($\Sigma\gamma i$ Qi + γ_p DD)	Resistance Factor for Dynamic Pile Analysis (ϕ_{dyn})	Nominal Driving Resistance Required (Rn=Rndr)
7	356	60	416	0.65	641

NOTES:
1. Downdrag load calculated using β method as shown on attached sheet. Load factor γ_p=1.0 applied to calculated downdrag load.
2. Maximum factored axial load provided by Hoyle, Tanner.

Reference from AASHTO LRFD, 9th Edition, Article 10.7.3.7:

Pile design for downdrag is illustrated in Figure C10.7.3.7-1.

where:

R_{Sdd} = side resistance which must be overcome during driving through downdrag zone (kips)
$Q_p = \Sigma\gamma_i Q_i$ = factored load per pile, excluding downdrag load (kips)
DD = downdrag load per pile (kips)
$D_{est.}$ = estimated pile length needed to obtain desired nominal resistance per pile (ft)
φ_{dyn} = resistance factor, assuming that a dynamic method is used to estimate nominal pile resistance during installation of the pile (if a static analysis method is used instead, use φ_{stat})
γ_p = load factor for downdrag

The summation of the factored loads ($\Sigma\gamma_i Q_i$) should be less than or equal to the factored resistance ($\varphi_{dyn} R_n$). Therefore, the nominal resistance R_n should be greater than or equal to the sum of the factored loads divided by the resistance factor φ_{dyn}. The nominal bearing resistance (kips) of the pile needed to resist the factored loads, including downdrag, is therefore taken as:

$$R_n = \frac{(\Sigma\gamma_i Q_i)}{\varphi_{dyn}} + \frac{\gamma_p DD}{\varphi_{dyn}} \qquad \text{(C10.7.3.7-1)}$$

The total nominal driving resistance, R_{ndr} (kips), needed to obtain R_n, accounting for the side resistance that must be overcome during pile driving that does not contribute to the nominal resistance of the pile, is taken as:

$$R_{ndr} = R_{Sdd} + R_n \qquad \text{(C10.7.3.7-2)}$$

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JOB:	**US Route 1 Bridge # 5804 Yarmouth, ME**
GZA PROJECT NO:	**09.0026144.00**
SUBJECT:	**Downdrag Calculation, Abutment 1**
SHEET:	
CALCULATED BY:	**E. Tome 10/23/2024**
CHECKED BY:	**A. Blaisdell / B. Cardali 10/23/2024**

Type of Pile

HP14x89

Finish Ground Surface Elevation	131.5	ft	
Pile Embedment below Ex. Grade	0.0	ft	
Elevation of Water Table	119.5	ft	
Depth of Water Table	12.0	ft	
Diameter of Pile	14.3	in	
Perimeter of Pile	4.77	ft	
Depth of Critical Effective Stress	23.8	ft	(20 times pile diameter)
Critical Total Stress	2956	psf	
Critical Effective Stress	2218	psf	
Unit Weight of Water	62.4	pcf	

Soil	Thickness (ft)	Bottom Elev. (ft)	Bottom Depth. (ft)	Midpoint Elev. (ft)	Depth to Midpoint of Layer (ft)	Soil Unit Weight (pcf)	Total Stress (psf)	Effective Stress (psf)	Limiting Effective Stress (psf)	Beta (β)	Beta Unit Skin Friction, fs (psf)	Clay Su, Max Unit Skin Friction, fs,m (psf)	Max Nominal Load from Downdrag (DD) (kip)	Settlement of Layer from Settle3 (inches)	Nominal Load from Downdrag (DD) (kip)
Top of pile	0	131.5	0	131.5	0	125	0	0	0	0.35	0	--			
Pea Stone (Densified Upper Casing)	8	123.5	8	127.5	4.0	136	544	544	544	0.35	190	--	7	3.2	7
Pea Stone (Densified Lower Casing)	3	120.5	11	122.0	9.5	122	1271	1271	1271	0.35	445	--	6	3.2	6
Pea Stone (Loose Dump)	5	115.5	16	118.0	13.5	115	1630	1536	1536	0.35	538	--	13	3.2	13
Marine Clay Crust	3.5	112.0	19.5	113.8	17.8	120	2050	1691	1691	0.25	423	1250	7	2.5	7
Marine Clay	11.5	100.5	31	106.3	25.3	118	3019	2192	2218	0.22	488	575	27	0.5	27
Marine Clay Below Neutral Axis	2	98.5	33	99.5	32.0	119	3777	2529	2218	0.22	488	576	5	0.4	0
Marine Sand	4.5	94.0	37.5	96.3	35.3	120	4197	2746	2218	0.35	776	--	17	0	0
												TOTAL	**82**		**60**

NOTES:

1. Stress influence calculated based on elastic theory.
2. Beta values were selected based on NAVFAC DM 7.2-211.
3. Yellow cells are input, white are calculated.
4. Settlement is caused by widening and raise of grade at proposed bridge
5. Settlement and final effective stresses were calculated using Settle3D.
6. The neutral axis is defined as the depth at which 0.4 inches of settlement or less is achieved, and is not considered to contribute to additional downdrag loading based on FHWA-NHI-05-042. GZA utilized settlement versus depth plots from Settle3 to establish the neutral axis.

Green is soil above top of pile, used to calculate effective stress only

Profile:
Pea Stone (Densified Upper Casing), 0-8
Pea Stone (Densified Lower Casing), 8-11
Pea Stone (Loose Dump), 11-16
Marine Clay Crust, 16-19.5
Marine Clay, 19.5-33
Marine Sand, 33-37.5

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JOB:	**US Route 1 Bridge # 5804 Yarmouth, ME**
GZA PROJECT NO:	**09.0026144.00**
SUBJECT:	**Downdrag Calculation, Abutment 2**
SHEET:	
CALCULATED BY:	**E. Tome 10/23/2024**
CHECKED BY:	**A. Blaisdell / B. Cardali 10/23/2024**

Type of Pile	**HP14x89**	
Diameter of Pile	14.3	in
Perimeter of Pile	4.77	ft
Maximum Factored Pile Load (5 piles)	288	kips

No of HP14x89 Piles	Maximum Factored Axial Load per Pile ($\Sigma\gamma i$ Qi)	Factored Load from Downdrag (γ_p DD)	Total Factored Load ($\Sigma\gamma i$ Qi + γ_p DD)	Resistance Factor for Dynamic Pile Analysis (ϕ_{dyn})	Nominal Driving Resistance Required (Rn=Rndr)
7	288	41	329	0.65	506

NOTES:
1. Downdrag load calculated using β method as shown on attached sheet. Load factor γ_p=1.0 applied to calculated downdrag load.
2. Maximum factored axial load provided by Hoyle, Tanner.

Reference from AASHTO LRFD, 9th Edition, Article 10.7.3.7:

Pile design for downdrag is illustrated in Figure C10.7.3.7-1.

where:

R_{Sdd} = side resistance which must be overcome during driving through downdrag zone (kips)
$Q_p = \Sigma\gamma_i Q_i$ = factored load per pile, excluding downdrag load (kips)
DD = downdrag load per pile (kips)
$D_{est.}$ = estimated pile length needed to obtain desired nominal resistance per pile (ft)
φ_{dyn} = resistance factor, assuming that a dynamic method is used to estimate nominal pile resistance during installation of the pile (if a static analysis method is used instead, use φ_{stat})
γ_p = load factor for downdrag

The summation of the factored loads ($\Sigma\gamma_i Q_i$) should be less than or equal to the factored resistance ($\varphi_{dyn} R_n$). Therefore, the nominal resistance R_n should be greater than or equal to the sum of the factored loads divided by the resistance factor φ_{dyn}. The nominal bearing resistance (kips) of the pile needed to resist the factored loads, including downdrag, is therefore taken as:

$$R_n = \frac{(\Sigma\gamma_i Q_i)}{\varphi_{dyn}} + \frac{\gamma_p DD}{\varphi_{dyn}} \qquad \text{(C10.7.3.7-1)}$$

The total nominal driving resistance, R_{ndr} (kips), needed to obtain R_n, accounting for the side resistance that must be overcome during pile driving that does not contribute to the nominal resistance of the pile, is taken as:

$$R_{ndr} = R_{Sdd} + R_n \qquad \text{(C10.7.3.7-2)}$$

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JOB:	**US Route 1 Bridge # 5804 Yarmouth, ME**
GZA PROJECT NO:	**09.0026144.00**
SUBJECT:	**Downdrag Calculation, Abutment 2**
SHEET:	
CALCULATED BY:	**E. Tome 10/23/2024**
CHECKED BY:	**A. Blaisdell / B. Cardali 10/23/2024**

Type of Pile	**HP14x89**		
Finish Ground Surface Elevation	130.0	ft	
Pile Embedment below Ex. Grade	0.0	ft	
Elevation of Water Table	111.5	ft	
Depth of Water Table	18.5	ft	
Diameter of Pile	14.3	in	
Perimeter of Pile	4.77	ft	
Depth of Critical Effective Stress	23.8	ft	(20 times pile diameter)
Critical Total Stress	2927	psf	
Critical Effective Stress	2594	psf	
Unit Weight of Water	62.4	pcf	

Soil	Thickness (ft)	Bottom Elev. (ft)	Bottom Depth. (ft)	Midpoint Elev. (ft)	Depth to Midpoint of Layer (ft)	Soil Unit Weight (pcf)	Total Stress (psf)	Effective Stress (psf)	Limiting Effective Stress (psf)	Beta (β)	Beta Unit Skin Friction, fs (psf)	Clay Su, Max Unit Skin Friction, fs,m (psf)	Max Nominal Load from Downdrag (DD) (kip)	Settlement of Layer from Settle3 (inches)	Nominal Load from Downdrag (DD) (kip)
Fill	0	130.0	0	130.0	0	125	0	0	0	0.35	0	--			
Pea Stone (Densified Upper Casing)	6	124.0	6	127.0	3.0	136	408	408	408	0.35	143	--	4	1.4	4
Pea Stone (Densified Lower Casing)	6	118.0	12	121.0	9.0	122	1098	1098	1098	0.35	384	--	11	1.4	11
Pea Stone (Loose Dump)	6	112.0	18	115.0	15.0	115	1809	1809	1809	0.35	633	--	18	1.4	18
Marine Clay Crust	1	111.0	19	111.5	18.5	120	2130	2130	2130	0.25	533	1250	3	1.3	3
Marine Clay	2	109.0	21	110.0	20.0	118	2398	2304	2304	0.23	530	575	5	0.5	5
Marine Clay Below Neutral Axis	1.5	107.5	22.5	108.3	21.8	118	2567	2364	2364	0.23	544	575	4	0.4	0
Marine Sand	15.5	92.0	38	99.8	30.3	120	3585	2852	2594	0.35	908	--	67	0	0
Glacial Till	12	80.0	50	86.0	44.0	130	5340	3749	2594	0.35	908	--	52	0	0
												TOTAL	**164**		**41**

NOTES:

1. Stress influence calculated based on elastic theory.
2. Beta values were selected based on NAVFAC DM 7.2-211.
3. Yellow cells are input, white are calculated.
4. Settlement is caused by widening and raise of grade at proposed bridge
5. Settlement and final effective stresses were calculated using Settle3D.
6. The neutral axis is defined as the depth at which 0.4 inches of settlement or less is achieved, and is not considered to contribute to additional downdrag loading based on FHWA-NHI-05-042. GZA utilized settlement versus depth plots from Settle3 to establish the neutral axis.

Green is soil above top of pile, used to calculate effective stress only

Profile:
Pea Stone (Densified Upper Casing), 0-6
Pea Stone (Densified Lower Casing), 6-12
Pea Stone (Loose Dump), 12-18
Marine Clay Crust, 18-19
Marine Clay, 19-22.5
Marine Sand, 22.5-38
Glacial Till, 38-50

Lateral Pile Analysis for Abutments

Project:	Yarmouth Route 1 Bridge No. 5804	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	E. Tome	Date:	9/6/2024
Checked by:	A. Blaisdell / B. Cardali	Date:	11/14/24

Objective

The purpose of this calculation package is to evaluate the behavior of the proposed HP14x89 abutment piles under lateral loading conditions provided by Hoyle Tanner Associates (HTA).

Steps:

1. Develop soil properties and LPile inputs.
2. Complete densification calculation of permanent casing infill soils under cyclical movement.
3. Complete initial LPile evaluation.
4. Complete plastic hinge analysis.

References

Documents that were used as a basis of our evaluation include:

1. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
2. Maine BDG Chapter 5 – Substructures 2018
3. VTrans Integral Abutment Bridge Design Guidelines 2008

Attachments

Appendix A – Cyclical Densification Calculation of Permanent Casing Infill
Appendix B – LPile Inputs & Summary Tables
Appendix C – Integral Abutment Plastic Hinge Evaluation

Given

The following information was provided by HTA:

- The maximum factored axial loads were 356 kips at Abutment 1 and 288 kips at Abutment 2.
- Lateral deflections for expansion were 1.126 inches at Abutment 1 and 0.842 inches at Abutment 2 and zero rotation at the pile head.
- Lateral deflections for contraction were 1.5 inches at Abutment 1 and 1.12 inches at Abutment 2 and zero rotation at the pile head.

Assumptions

The following assumptions were made for our analyses:

- Since the piles will be placed within a corrugated pipe within the MSE backfill, the vertical effective stress influence from the backfill above the top of pile is not anticipated to increase effective stress and create a p-y reaction along the upper portion of the pile.
- The soil profiles at both abutments are similar, however, Abutment 1 was evaluated to be representative of both abutments because it has a larger proposed deflection and axial load.

LPile Results

The initial LPile evaluation for the proposed HP14x89 abutment piles shows the pile overstressing at the pile head. A plastic hinge analysis was conducted to check the axial capacity and assess the suitability of the pile section, which shows a plastic hinge does not form in the lower section of the pile and the pile section is suitable to support combined axial load and flexure for the proposed abutments.

APPENDIX A

Cyclical Densification Calculation of Permanent Casing Infill

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JOB 09.0026144.00 US Route 1 Bridge, Yarmouth

SHEET NO 1 OF 2

Calculated By E. Tome Date 10/30/2024

Checked By A. Blaisdell / B. Cardali Date 10/30/2024

Scale

OBJECTIVE

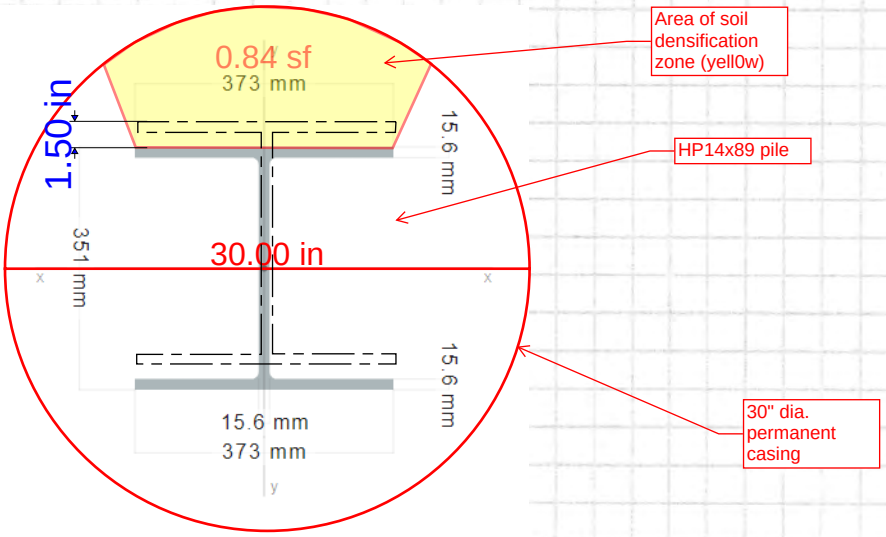
Develop basis to estimate strength properties of infill gravel (Underdrain material) in a rigid permanent casing considering densification that occurs over time resulting from cyclical movement of integral abutment piles.

EVALUATION

Sketch shows proposed HP14x89 pile oriented strong axis in 30" dia. permanent casing. Estimated lateral deflection of top of pile is approximately 1.5". Develop soil properties considering densification of infill material between the pile and casing wall over time.

The area of soil in front of the H-pile box section engaged by passive resistance of infill material is 0.84 square feet. The reduction in soil area is equal to 14.7" x 1.5" movement = 22.1 sq. in. = 0.15 sf, or a 18.2% reduction in volume. Similarly, lower in the casing at a point where the maximum lateral movement is 0.5", the volume reduction is about 6.1%.

UFC 3-220-10, 2/1/22 (DM7.1) can be used to calculate change in relative density and friction angle based on changes in unit weight. Assume the unit weight in the socket infill area subject to densification is increased by a percentage equal to the calculated volume reduction. See attachment for calculated friction angles as a function of pile movement in the casing. However, the calculation for the maximum deflection of 43 degrees is unreasonably high for the non-angular peastone infill. Therefore, a friction angle of 40 degrees was selected for the upper portion of the pile.



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JOB 09.0026144.00 US Route 1 Bridge, Yarmouth

SHEET NO 2 OF 2

Calculated By E. Tome Date 10/30/2024

Checked By A. Blaisdell / B. Cardali Date 10/30/2024

Scale

UFC 3-220-10
1 February 2022

A correlation for the drained friction angle as a function of relative density, dry unit weight and soil type is presented in Figure 8-1.

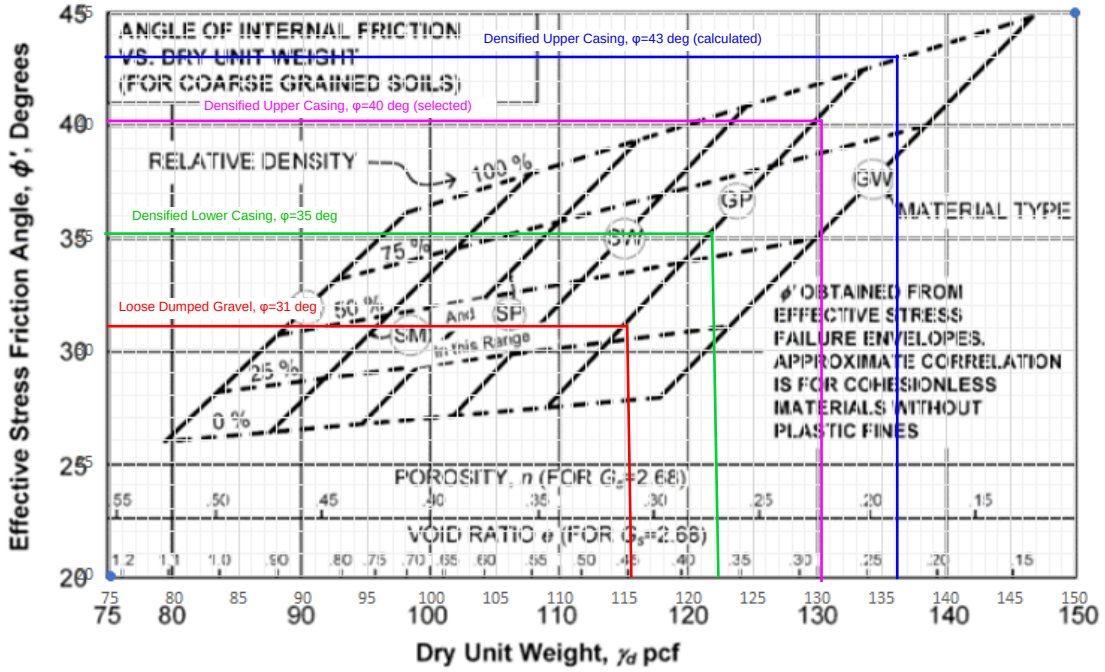

Figure 8-1 Approximate Relationship between the Effective Stress Friction Angle and Dry Unit Weight for Various Relative Densities and Types of Soil

Soil Type	Condition	Movement (in)	% Volume Decrease	Unit Weight (pcf)	Relative Density (%)	Friction Angle (degrees)
GP	Loose Dump	0	0%	115	30%	31
GP	Densified, Upper Casing (Calculated)	1.5	18.2%	136.0	100%	43
GP	Densified, Upper Casing (Selected)	1.1	13.0%	130.0	88%	40
GP	Densified, Lower Casing	0.5	6.1%	122.0	60%	35

Legend:

Existing Condition

Final Condition, 1.1" movement

Final Condition, 0.5" movement

Notes:

1. Relative density of loose-dumped pea stone gravel assumed to be 30%. Unit weight and friction angle calculated from plot based on Dr=30%.
2. Upper casing is portion with pile movement indicated in legend. Lower casing is portion with pile movement less than min value.
3. % Volume Decrease calculated assuming the infill in front of the H-pile box section inside a 2.5' diameter permanent casing is compressed by the amount shown.
4. Unit weight for densified condition considers dry weight increase caused by the calculated volume decrease in front of the pile.
5. Relative density and friction angle of densified material taken from the plot based on Dr value at unit weight.

APPENDIX B

LPile Inputs & Summary Tables

LPile Input Parameters
MaineDOT - US Route 1 Bridge No. 5804
Yarmouth, Maine

GZA FILE NO.	09.0026144.00
CALCULATED BY	L. Hailey / E. Tome
CHECKED BY	A. Blaisdell / B.Cardali

Objective: To estimate the horizontal modulus of subgrade reaction (k) or E50 of subsurface strata for use in lateral analyses. K values are estimated using strata internal friction angles (ϕ') or shear strength.

Methods: Correlations between the horizontal modulus of subgrade reaction and the soil internal friction angle of a given stratum are based on Figure 3-34 presented in the 2022 LPile Technical Manual.

Given Information: SPT measurements, In-situ vanes, and subsurface conditions in borings BB-YR1-101 and -103 were performed by New England Borings Contractors (NEBC) between February 22 and February 24, 2022. BB-YR1-201 was performed by Seaboard Drilling on April 26, 2024. Boring BB-YR1-202 was performed by Seaboard Drilling between April 29 and April 30, 2024.

Abutment 1: Pile length = 37 ft					
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**k (pci) / E50**	**ϕ' (deg)/ Su (psf)**	**γ_e (pcf)**
Pea Stone (Densified Upper Casing)	Reese Sand	131	258	40	130
Pea Stone (Densified Lower Casing)	Reese Sand	123	143	35	122
Pea Stone (Loose Dump)**	Reese Sand	120	54.7	31	52.6
Marine Clay Crust	Stiff Clay w/o Free Water	115	0.007	1250	57.6
Marine Clay	Soft Clay	112	0.008	575	55.6
Marine Sand	Reese Sand	103	55	32	57.6
Top of Rock	--	94	--	--	--

Abutment 2: Pile length = 50 ft					
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**k (pci) / E50**	**ϕ' (deg)/ Su (psf)**	**γ_e (pcf)**
Pea Stone (Densified Upper Casing)	Reese Sand	130	258	40	130
Pea Stone (Densified Lower Casing)	Reese Sand	124	143	35	122
Pea Stone (Loose Dump)	Reese Sand	118	83.1	31	115
Marine Clay Crust**	Stiff Clay w/o Free Water	112	0.007	1250	57.6
Marine Clay	Soft Clay	111	0.008	1000	55.6
Marine Sand	Reese Sand	107	55	32	57.6
Glacial Till	Reese Sand	97	120	38	67.6
Top of Rock	--	80	--	--	--

Notes: 1. Pile tip elevation should be assumed to be top of Rock.
2. pci = pounds per cubic inch, deg = degrees, psi =pounds per square inch, γe = effective unit weight, pcf = pounds per square foot.
3. These parameters do not include reductions for group interaction. Reduction factors should be applied in accordance with AASHTO 10.7.2.4 for spacing of 3 to 5 pile diameters or less.

Table 2 - LPile Output Summary
MaineDOT - US Route 1 Bridge No. 5804
GZA GeoEnvironmental, Inc.

GZA FILE NO.	09.0026144.00
CALCULATED BY	L. Hailey / E. Tome
CHECKED BY	A. Blaisdell / B.Cardali

Abutment 1: Pile Length = 37 ft										
Pile Section	**Axial Load (kips)**	**Shear Force for Lateral deflection of 1.5 in. (kips)**	**Depth below Pile Head to Fixity (ft)**	**Max Moment in Upper Section (in-kip)**	**Upper Section Length[5] (ft)**	**Max Moment in Lower Section (in-kip)**	**Lower Section Length[5] (ft)**	**Total Stress at Pile Head (ksi)**	**Bending Stress at Pile Head (ksi)**	**Axial Stress at Pile Head (ksi)**
HP 14x89 (Strong axis)	356	130.7	26.3	-499.2	3.9	3701	17.7	63.4	49.8	13.6
HP 14x89 (Strong axis) Plastic Hinge	356	113.2	25.5	-4318	3.2	3699	17.6	49.5	35.9	13.6

Notes:

1. Soil layering and properties are presented in Table 1.
2. The axial load is the maximum Factored Axial Load provided by Hoyle Tanner Associates (HTA), which was 356 kips at Abutment 1.
3. The lateral deflection is the maximum deflection provided by HTA, which was 1.5 inches at Abutment 1. Zero rotation was applied at the pile head.
4. The axial stress at pile head is calculated as the axial load divided by the pile cross-sectional area.
5. The upper section length is measured from the top of pile to first moment inflection point. The lower section length is measured between first and second moment inflection points.
6. Plastic hinge case included applied moment of 4,318 in-kips applied deflection at pile head.

APPENDIX C

Integral Abutment Plastic Hinge Evaluation

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Engineers and Scientists

JOB: 09.0026144.00
SUBJECT: Pile Eval. for Integral Abutment
SHEET: 1 OF 9
CALCULATED BY: ENT 10/30/2024
CHECKED BY: ARB/BMC 11/14/2024

Integral Abutment LRFD Pile Design

Subject: Pile Design for the Yarmouth Route 1 Replacement in Yarmouth, Maine. Contraction pile embedment profile and Abutment 1 parameters and results were used and are considered representative for shallow rock.

Reference:

- AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
- Maine BDG Chapter 5 - Substructures 2018
- VTRANS Integral Abutment Bridge Design Guidelines 2008

Design Steps - Maine BDG

Step 1 - Determine the foundation displacements and the load effects (P_u and M_u) from the superstructure and substructure designs.

$P_u := 356 \cdot kip$ Maximum Factored Axial Load from HTA

The limitations of the software require the plastic hinge evaluations be complete using a single deflection. HTA provided a total deflection of 1.5 inches with zero end rotation for these analyses.

Step 2 - If applicable, determine the magnitude of scour. N/A

Step 3 - Select preliminary pile size.

HP14 x 89, Strong Axis Properties

Steel yield strength	$F_{y50} := 50ksi$
Modulus of elasticity for steel	$E := 29000ksi$
Cross sectional area of pile	$A_g := 26.1in^2$
Radius of gyration	$r_x := 5.88in$
Width of Flange	$b_f := 14.7 \cdot in$
Thickness of Flange	$t_f := 0.615 \cdot in$
Elastic Section Modulus	$S_x := 131 \cdot in^3$
Plastic Section Modulus	$Z_x := 146 \cdot in^3$

Step 4 - Determine the pile unbraced length and maximum moment at the top of the pile by running LPile software for top translation = 1.5 inches, P_u = 356 kip, and Live Load Rotation = 0 (Fixed against rotation)

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SUBJECT: Pile Eval. for Integral Abutment
SHEET: 2 OF 9
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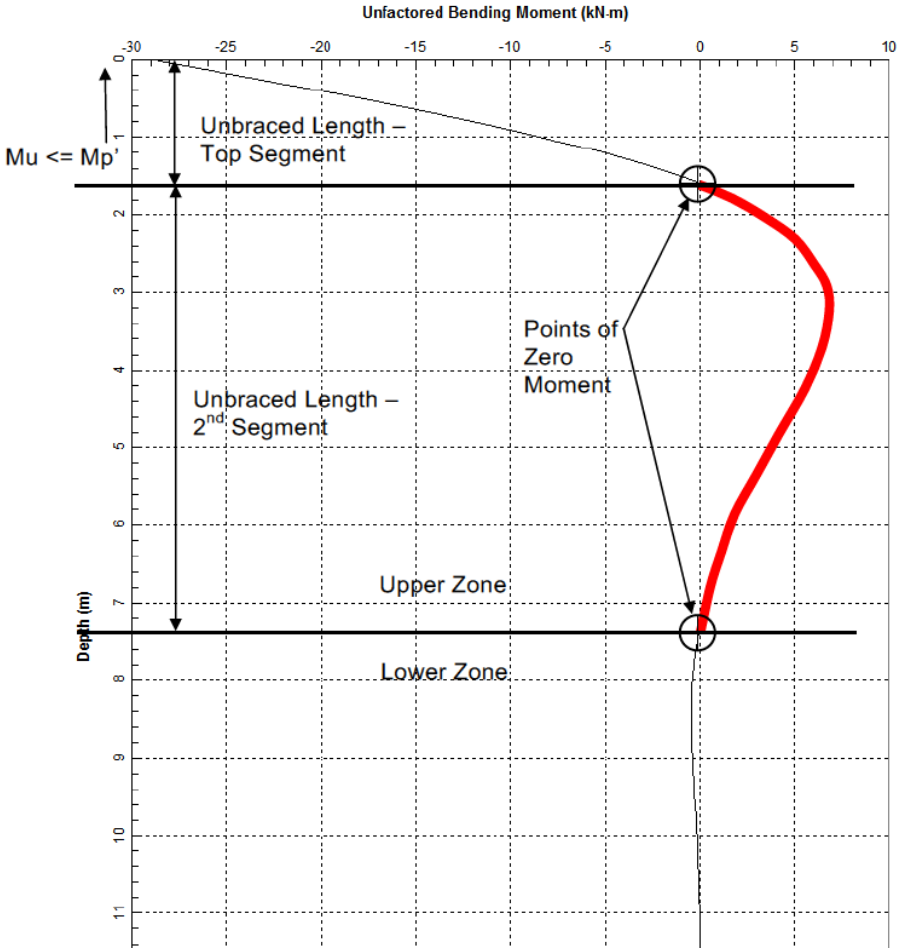
CHECKED BY: ARB/BMC 11/14/2024



Maximum moment from LPile output (page 22) $M_u := 5991\text{kip}\cdot\text{in} = 499.2\cdot\text{kip}\cdot\text{ft}$

Unbraced lengths from LPile output (pages 22-23)

Upper segment $L_1 := 3.9\cdot\text{ft}$

Lower segment $L_2 := 17.7\cdot\text{ft}$

Step 5 - Determine if the applied moment on the pile will cause pile head plastic deformation considering the interaction of combined axial and flexural load effects on a single pile (LRFD 6.9.2.2)

a. Obtain the unbraced lengths of the top and lower segments of the pile and calculate the column slenderness factor (λ) for each segment.

See above for unbraced lengths (critical lengths L_1 and L_2).

Upper segment slenderness factor

$$\lambda_1 := \frac{(L_1)}{r_x} = 7.959$$

Lower segment slenderness factor

$$\lambda_2 := \frac{(L_2)}{r_x} = 36.122$$

b. Determine K values for top and bottom of the pile per LRFD Table C4.6.2.5-1

Buckled shape of column is shown by dashed line	(a)	(b)	(c)	(d)	(e)	(f)
Theoretical *K* value	0.5	0.7	1.0	1.0	2.0	2.0
Design value of *K* when ideal conditions are approximated	0.65	0.80	1.0	1.2	2.1	2.0
End condition code		Rotation fixed Translation fixed Rotation free Translation fixed Rotation fixed Translation free Rotation free Translation free				

Upper segment K value (Type d)

$$K_1 := 1.2$$

Lower segment K value (Type c)

$$K_2 := 1$$

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CALCULATED BY: ENT 10/30/2024
CHECKED BY: ARB/BMC 11/14/2024

c. Calculate the nominal and factored structural pile resistance P_n, per AASHTO LRFD 6.9.4.1 using the λ values

Elastic critical buckling resistance, P_e, based on flexural buckling (AASHTO LRFD Eq. 6.9.4.1.2-1)

Upper P_e

$$P_{e1} := \frac{\left(\pi^2 \cdot E\right) \cdot A_g}{\left(K_1 \cdot \lambda_1\right)^2} = 81891 \cdot kip$$

Lower P_e

$$P_{e2} := \frac{\left(\pi^2 \cdot E\right) \cdot A_g}{\left(K_2 \cdot \lambda_2\right)^2} = 5725 \cdot kip$$

Nominal yield resistance, P_o

$$P_o := F_{y50} \cdot A_g = 1305 \cdot kip$$

Check that the ratio of Pe to Po is > 0.44

If $P_e/P_o > 0.44$ then use AASHTO LRFD Eq. 6.9.4.1.1-1
If $P_e/P_o < 0.44$ then use AASHTO LRFD Eq. 6.9.4.1.1-2

$$P_n = \left[0.658^{\left(\frac{P_o}{P_e}\right)}\right] P_o \qquad (6.9.4.1.1\text{-}1)$$

$$P_n = 0.877 P_e \qquad (6.9.4.1.1\text{-}2)$$

$$\frac{P_{e1}}{P_o} = 62.752 \qquad \frac{P_{e2}}{P_o} = 4.387$$

Both ratios are greater than 0.44, therefore, use AASHTO LRFD Eq. 6.9.4.1.1-1: Nominal structural Pile resistance, P_n for both segments

$$P_{n1} := \left[0.658^{\left(\frac{P_o}{P_{e1}}\right)}\right] \cdot P_o = 1296 \cdot kip$$

$$P_{n2} := \left[0.658^{\left(\frac{P_o}{P_{e2}}\right)}\right] \cdot P_o = 1186 \cdot kip$$

Factored structural Pile Resistance, $P_r = \varphi_c (P_n)$

$\phi_c := 0.7$ for axial resistance according to AASHTO LRFD 6.5.4.2

$P_{r1} := \phi_c \cdot P_{n1} = 907.4 \cdot kip$

$P_{r2} := \phi_c \cdot P_{n2} = 830.4 \cdot kip$

d. Compare the ratio of P_u, the maximum factored axial load, to P_r, the structural resistance in the specified portion of the pile - the pile size should be such that the ratio is not less than 0.20.

Check for both segments

$\frac{P_u}{P_{r1}} = 0.392$ > 0.20, OK $\frac{P_u}{P_{r2}} = 0.429$ > 0.20, OK

e. Determine the nominal and factored flexural resistance about H-Pile strong axis, (AASHTO LRFD Eq. 6.12.2.2)

Check slenderness ratio for flange, limiting slenderness ratio for compact flange, and limiting slenderness ratio for a noncompact flange.

$\lambda_f := \frac{b_f}{2 \cdot t_f} = 11.951$ slenderness ratio for flange (AASHTO LRFD Eq. 6.12.2.2.1-3)

$\lambda_{pf} := 0.38 \cdot \left(\frac{E}{F_{y50}} \right)^{.5} = 9.152$

$\lambda_{rf} := 0.83 \cdot \left(\frac{E}{F_{y50}} \right)^{.5} = 19.989$

If $\lambda_{pf} < \lambda_f < \lambda_{rf}$ Use ASSHTO LRFD Eq. 6.12.2.2.1-2 to find the nominal flexural resistance

$M_n := \left[1 - \left(1 - \frac{S_x}{Z_x} \right) \cdot \left[\frac{\lambda_f - \lambda_{pf}}{0.45 \cdot \left(\frac{E}{F_{y50}} \right)^{.5}} \right] \right] \cdot F_{y50} \cdot Z_x = 592.19 \cdot ft \cdot kip$

$\phi_f := 1.0$ for flexural resistance according to AASHTO LRFD 6.5.4.2

$M_r := M_n \cdot \phi_f = 592.2 \cdot ft \cdot kip$

$M_u = 499.2 \cdot ft \cdot kip$

$\frac{P_u}{P_{r1}} + \frac{M_u}{M_r} = 1.2$ If less than 1, remains in elastic zone. Since it exceeds 1, yielding is expected at the base of the pile cap.

j. Calculate the moment that will cause a plastic hinge at the top of the pile, M_p',
Note: M_p' will be lower than M_n due to the inclusion of the axial load in the interaction equation for pile overstresses

$$\frac{P_u}{P_r} + \frac{M_{ux}}{M_{rx}} + \frac{M_{uy}}{M_{ry}} \leq 1.0$$ AASHTO LRFD Eq. 6.9.2.2 Interaction equation

Use the interaction equation to find the moment that will cause a plastic hinge at the top of the pile. Assume M_{ux} and $M_{rx} = 0$ (out-of-plane), $M_{ry} = M_r$ and $M_u = M_p'$, solve for M_p'

$M_p := \left[1 - \left(\frac{P_u}{P_{r1}}\right)\right] \cdot M_r = 359.9 \cdot ft \cdot kip$ $M_p = 4318343.4 \cdot in \cdot lbf$

k. The calculated moment from LPile Run 1 (shown in step 4) exceeds the moment that would cause a plastic hinge (above), therefore a plastic hinge forms, and the moment (M_p') represents the limiting moment reaction at the pile top for the subsequent analysis.

Step 6 - For fixed head piles, run a second LPILE analysis with end conditions 1) Top moment = M_p', top translation = 1.5 in; and axial load equal to P_u. Recalculate unbraced lengths from the moment vs. depth curve.

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Engineers and Scientists

JOB: 09.0026144.00
SUBJECT: Pile Eval. for Integral Abutment
SHEET: 7 OF 9
CALCULATED BY: ENT 10/30/2024
CHECKED BY: ARB/BMC 11/14/2024

New unbraced lengths were determined from the second LPile analysis

Upper segment $L_{1p} := 3.2 \cdot ft$

Lower segment $L_{2p} := 17.6 \cdot ft$

6a. Repeat steps 5a through 5d above.

6b - If the pile size is such that the ratio of Pu to structural resistance exceeds 0.2, check the upper segment of the pile with the interaction equation of AASHTO LRFD Eq. 6.9.2.2. If a plastic hinge forms at the top of the pile, the K value of the upper segment changes from 1.2, for a rotation fixed head condition, to 2.1, for a rotation free head condition. With the new K value and lengths repeat step 5.

5a.

Upper segment slenderness factor $\lambda_{1p} := \frac{(L_{1p})}{r_x} = 6.531$

Lower segment slenderness factor $\lambda_{2p} := \frac{(L_{2p})}{r_x} = 35.918$

5b.

Upper segment K value (Type e) $K_{1p} := 2.1$

Lower segment K value (Type c) $K_{2p} := 1$

5c.

Elastic critical buckling resistance, P_e, based on flexural buckling

Upper P_e $P_{ep1} := \frac{(\pi^2 \cdot E) \cdot A_g}{(K_{1p} \cdot \lambda_{1p})^2} = 39718 \cdot kip$

Lower P_e $P_{ep2} := \frac{(\pi^2 \cdot E) \cdot A_g}{(K_{2p} \cdot \lambda_{2p})^2} = 5790 \cdot kip$

Nominal yield resistance, P_o $P_{oo} := F_{y50} \cdot A_g = 1305 \cdot kip$

Check that the ratio of Pe to Po is > 0.44

If $P_e/P_o > 0.44$ then use equation 6.9.4.1.1-1
If $P_e/P_o < 0.44$ then use equation 6.9.4.1.1-2

$$\frac{P_{ep1}}{P_o} = 30.436 \qquad \frac{P_{ep2}}{P_o} = 4.437$$

Both ratios are greater than 0.44, therefore, use eq. 6.9.4.1.1-1: Nominal structural Pile resistance, P_n for both segments

$$P_{np1} := \left[0.658^{\left(\frac{P_o}{P_{ep1}}\right)}\right] \cdot P_o = 1287 \cdot kip$$

$$P_{np2} := \left[0.658^{\left(\frac{P_o}{P_{ep2}}\right)}\right] \cdot P_o = 1188 \cdot kip$$

Factored structural Pile Resistance, $P_r = \varphi_c (P_n)$

$$P_{rp1} := \phi_c \cdot P_{np1} = 901 \cdot kip$$

$$P_{rp2} := \phi_c \cdot P_{np2} = 831.3 \cdot kip$$

d. Compare the ratio of P_u to the structural resistance in the upper portion of the pile - the pile size should be such that the ratio is not less than 0.20.

Check for both segments

$$\frac{P_u}{P_{rp1}} = 0.395 \quad > 0.20, \text{ OK} \qquad \frac{P_u}{P_{rp2}} = 0.428 \quad > 0.20, \text{ OK}$$

From VTrans Integral Abutment Design Section 4.5.2 - Check the axial capacity of the upper segment and the interaction equation for the second segment to assess suitability of pile section.

Upper Segment

Check that P_u/P_{rp1} is < 1

$$\frac{P_u}{P_{rp1}} = 0.395 \quad < 1, \text{ OK}$$

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Engineers and Scientists

JOB: 09.0026144.00
SUBJECT: Pile Eval. for Integral Abutment
SHEET: 9 OF 9
CALCULATED BY: ENT 10/30/2024
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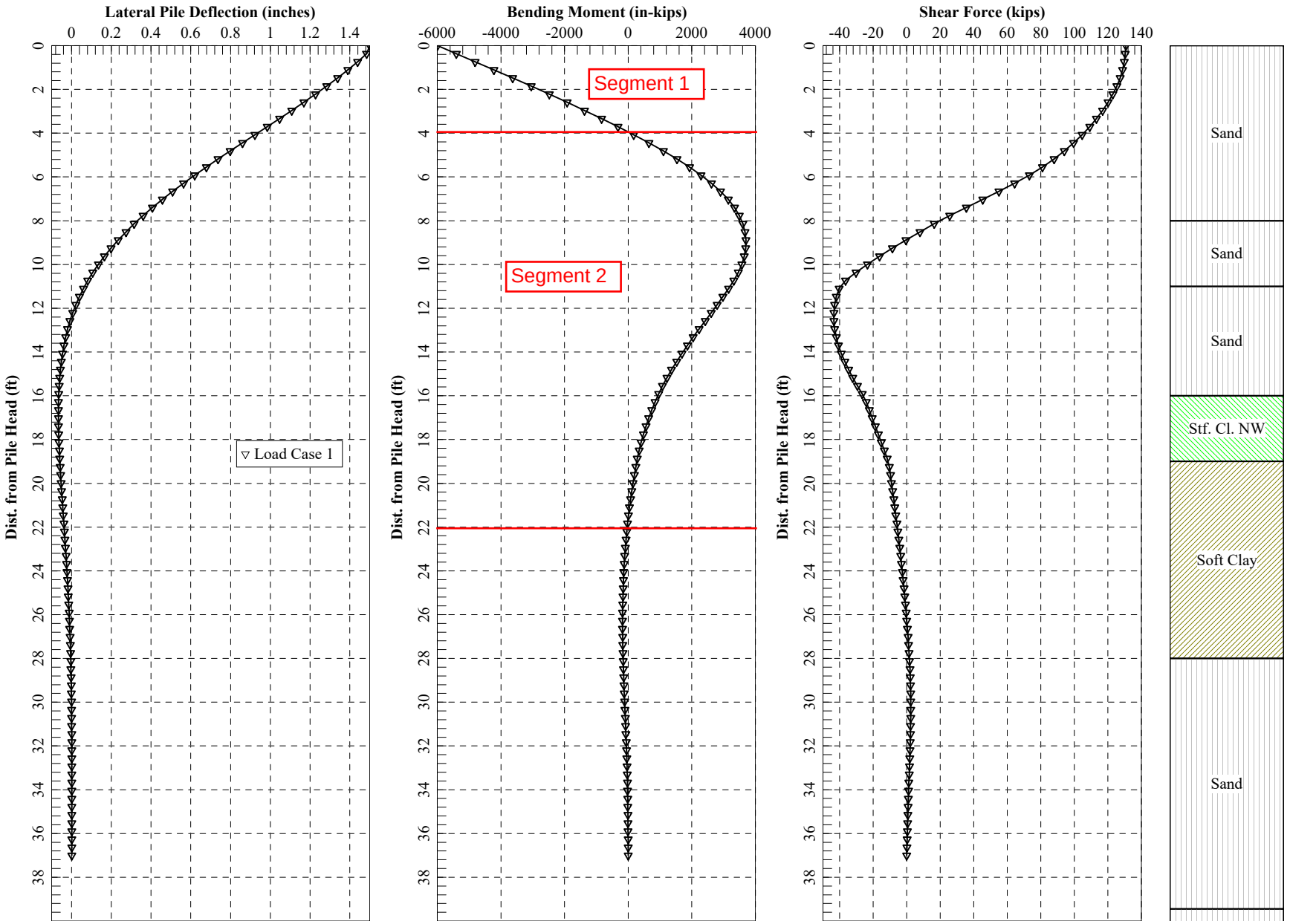
Lower Segment

Ultimate moment along the lower segment from LPile output

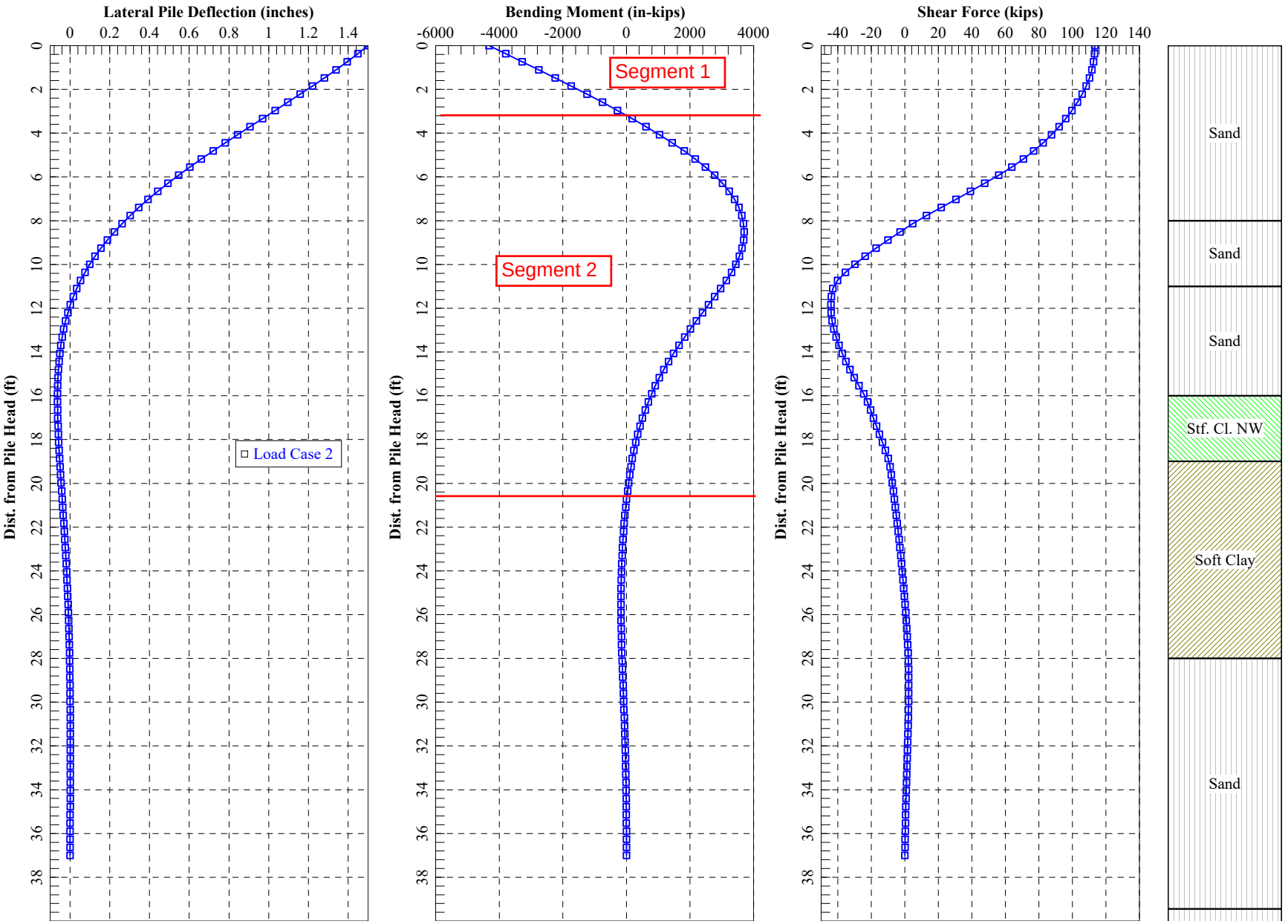
$$M_{maxp2} := 3699178 \cdot in \cdot lbf$$

$$\frac{P_u}{P_{rp2}} + \frac{M_{maxp2}}{M_r} = 0.949$$ < 1, OK

Initial LPile Plots



Plastic Hinge LPile Plots



```
================================================================================

                     LPile for Windows, Version 2022-12.011

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge 5804\Work\Calcs\Lpile\

Name of input data file:
AB1_14x89.lp12d

Name of output report file:
AB1_14x89.lp12o

Name of plot output file:
AB1_14x89.lp12p
```

```
Name of runtime message file:
AB1_14x89.lp12r


--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 19, 2024          Time:   6:20:44


--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Project Name: Yarmouth Route 1 Bridge


Job Number: 09.0026144.00


Client: MEDOT


Engineer: E. Tome


Description:




--------------------------------------------------------------------------------
                         Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)
```

Analysis Control Options:
 - Maximum number of iterations allowed = 500
 - Deflection tolerance for convergence = 1.0000E-05 in
 - Maximum allowable deflection = 100.0000 in
 - Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 37.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.7000
2	37.000	14.7000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a H strong axis steel pile
   Length of section = 37.000000 ft
   Pile width = 14.700000 in

Soil and Rock Layering Information

The soil profile is modelled using 6 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer = 0.0000 ft
   Distance from top of pile to bottom of layer = 8.000000 ft
   Effective unit weight at top of layer = 130.000000 pcf
   Effective unit weight at bottom of layer = 130.000000 pcf
   Friction angle at top of layer = 40.000000 deg.
   Friction angle at bottom of layer = 40.000000 deg.
   Subgrade k at top of layer = 258.000000 pci
   Subgrade k at bottom of layer = 258.000000 pci

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer = 8.000000 ft
   Distance from top of pile to bottom of layer = 11.000000 ft
   Effective unit weight at top of layer = 122.000000 pcf

```
   Effective unit weight at bottom of layer           =   122.000000 pcf
   Friction angle at top of layer                     =    35.000000 deg.
   Friction angle at bottom of layer                  =    35.000000 deg.
   Subgrade k at top of layer                         =   143.000000 pci
   Subgrade k at bottom of layer                      =   143.000000 pci


Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer          =    11.000000 ft
   Distance from top of pile to bottom of layer       =    16.000000 ft
   Effective unit weight at top of layer              =    52.600000 pcf
   Effective unit weight at bottom of layer           =    52.600000 pcf
   Friction angle at top of layer                     =    31.000000 deg.
   Friction angle at bottom of layer                  =    31.000000 deg.
   Subgrade k at top of layer                         =    54.700000 pci
   Subgrade k at bottom of layer                      =    54.700000 pci


Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer          =    16.000000 ft
   Distance from top of pile to bottom of layer       =    19.000000 ft
   Effective unit weight at top of layer              =    57.600000 pcf
   Effective unit weight at bottom of layer           =    57.600000 pcf
   Undrained cohesion at top of layer                 =        1250. psf
   Undrained cohesion at bottom of layer              =        1250. psf
   Epsilon-50 at top of layer                         =     0.007000
   Epsilon-50 at bottom of layer                      =     0.007000


Layer 5 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer          =    19.000000 ft
   Distance from top of pile to bottom of layer       =    28.000000 ft
   Effective unit weight at top of layer              =    55.600000 pcf
   Effective unit weight at bottom of layer           =    55.600000 pcf
   Undrained cohesion at top of layer                 =   575.000000 psf
   Undrained cohesion at bottom of layer              =   575.000000 psf
   Epsilon-50 at top of layer                         =     0.008000
   Epsilon-50 at bottom of layer                      =     0.008000
```

```
Layer 6 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer          =    28.000000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =    57.600000 pcf
   Effective unit weight at bottom of layer           =    57.600000 pcf
   Friction angle at top of layer                     =    32.000000 deg.
   Friction angle at bottom of layer                  =    32.000000 deg.
   Subgrade k at top of layer                         =    54.700000 pci
   Subgrade k at bottom of layer                      =    54.700000 pci

 (Depth of the lowest soil layer extends 13.000 ft below the pile tip)


--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------
```

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	E50 or krm	kpy pci
1	Sand	0.00	130.0000	--	40.0000	--	258.0000
	(Reese, et al.)	8.0000	130.0000	--	40.0000	--	258.0000
2	Sand	8.0000	122.0000	--	35.0000	--	143.0000
	(Reese, et al.)	11.0000	122.0000	--	35.0000	--	143.0000
3	Sand	11.0000	52.6000	--	31.0000	--	54.7000
	(Reese, et al.)	16.0000	52.6000	--	31.0000	--	54.7000
4	Stiff Clay	16.0000	57.6000	1250.	--	0.00700	--
	w/o Free Water	19.0000	57.6000	1250.	--	0.00700	--
5	Soft	19.0000	55.6000	575.0000	--	0.00800	--
	Clay	28.0000	55.6000	575.0000	--	0.00800	--
6	Sand	28.0000	57.6000	--	32.0000	--	54.7000
	(Reese, et al.)	50.0000	57.6000	--	32.0000	--	54.7000

```
--------------------------------------------------------------------------------
                             Static Loading Type
--------------------------------------------------------------------------------

Static loading criteria were used when computing p-y curves for all analyses.
```

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	5	y = 1.500000 in	S = 0.0000 in/in	356000.	N.A.	Yes
2	4	y = 1.500000 in	M = -4318343. in-lbs	356000.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Strong Axis:

Length of Section	=	37.000000 ft
Flange Width	=	14.700000 in
Section Depth	=	13.800000 in
Flange Thickness	=	0.615000 in
Web Thickness	=	0.615000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	25.811550 sq. in.
Moment of Inertia	=	888.177980 in^4
Elastic Bending Stiffness	=	25757161. kip-in^2
Plastic Modulus, Z	=	143.492246in^3
Plastic Moment Capacity = Fy Z	=	7175.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1290.578 kips
Nominal Axial Tensile Capacity	=	-1290.578 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	356.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 356.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000418	107.4535462	25731729.	120.7901406	14.6195199	
0.00000835	214.9070924	25731729.	63.8450703	15.4467648	
0.00001253	322.3606385	25731729.	44.8633802	16.2740097	
0.00001670	429.8141847	25731729.	35.3725352	17.1012545	
0.00002088	537.2677309	25731729.	29.6780281	17.9284994	
0.00002506	644.7212771	25731729.	25.8816901	18.7557442	

0.00002923	752.1748233	25731729.	23.1700201	19.5829891	
0.00003341	859.6283694	25731729.	21.1362676	20.4102339	
0.00003758	967.0819156	25731729.	19.5544601	21.2374789	
0.00004176	1075.	25731729.	18.2890141	22.0647237	
0.00004594	1182.	25731729.	17.2536491	22.8919685	
0.00005011	1289.	25731729.	16.3908451	23.7192134	
0.00005429	1397.	25731729.	15.6607800	24.5464583	
0.00005846	1504.	25731729.	15.0350100	25.3737031	
0.00006264	1612.	25731729.	14.4926760	26.2009480	
0.00006681	1719.	25731729.	14.0181338	27.0281929	
0.00007099	1827.	25731729.	13.5994200	27.8554377	
0.00007517	1934.	25731729.	13.2272300	28.6826825	
0.00007934	2042.	25731729.	12.8942179	29.5099274	
0.00008352	2149.	25731729.	12.5945070	30.3371723	
0.00008769	2257.	25731729.	12.3233400	31.1644171	
0.00009187	2364.	25731729.	12.0768246	31.9916620	
0.00009605	2471.	25731729.	11.8517452	32.8189069	
0.0001002	2579.	25731729.	11.6454225	33.6461517	
0.0001044	2686.	25731729.	11.4556056	34.4733965	
0.0001086	2794.	25731729.	11.2803900	35.3006414	
0.0001127	2901.	25731729.	11.1181534	36.1278863	
0.0001169	3009.	25731729.	10.9675050	36.9551311	
0.0001211	3116.	25731729.	10.8272462	37.7823760	
0.0001253	3224.	25731729.	10.6963380	38.6096208	
0.0001295	3331.	25731729.	10.5738755	39.4368657	
0.0001336	3439.	25731729.	10.4590669	40.2641105	
0.0001378	3546.	25731729.	10.3512164	41.0913554	
0.0001420	3653.	25731729.	10.2497100	41.9186002	
0.0001462	3761.	25731729.	10.1540040	42.7458451	
0.0001503	3868.	25731729.	10.0636150	43.5730900	
0.0001545	3976.	25731729.	9.9781119	44.4003348	
0.0001587	4083.	25731729.	9.8971090	45.2275796	
0.0001629	4191.	25731729.	9.8202600	46.0548245	
0.0001712	4406.	25731729.	9.6778083	47.7093142	
0.0001796	4621.	25731729.	9.5486079	49.3638040	
0.0001879	4814.	25619912.	9.4528725	50.0000000	Y
0.0001963	4930.	25118591.	9.4458026	50.0000000	Y
0.0002046	4995.	24411094.	9.4905132	50.0000000	Y
0.0002130	5055.	23734322.	9.5371326	50.0000000	Y
0.0002213	5110.	23086855.	9.5851927	50.0000000	Y
0.0002297	5161.	22468709.	9.6339621	50.0000000	Y
0.0002380	5208.	21877763.	9.6832818	50.0000000	Y
0.0002464	5251.	21313122.	9.7327613	50.0000000	Y
0.0002547	5292.	20773590.	9.7821368	50.0000000	Y
0.0002631	5329.	20257859.	9.8312253	50.0000000	Y
0.0002714	5365.	19764741.	9.8798581	50.0000000	Y
0.0002798	5398.	19292592.	9.9280460	50.0000000	Y
0.0002881	5429.	18840620.	9.9755960	50.0000000	Y
0.0002965	5458.	18408072.	10.0223257	50.0000000	Y
0.0003048	5485.	17992921.	10.0684947	50.0000000	Y
0.0003132	5511.	17595263.	10.1137173	50.0000000	Y
0.0003215	5535.	17213372.	10.1582290	50.0000000	Y
0.0003299	5558.	16846735.	10.2018923	50.0000000	Y
0.0003382	5579.	16494650.	10.2446527	50.0000000	Y
0.0003466	5600.	16156253.	10.2865370	50.0000000	Y
0.0003550	5619.	15830444.	10.3276872	50.0000000	Y
0.0003633	5637.	15516911.	10.3679734	50.0000000	Y
0.0003717	5655.	15215000.	10.4074094	50.0000000	Y
0.0003800	5671.	14924098.	10.4460119	50.0000000	Y
0.0003884	5687.	14643639.	10.4837949	50.0000000	Y
0.0003967	5702.	14373102.	10.5207705	50.0000000	Y
0.0004051	5716.	14112005.	10.5569487	50.0000000	Y
0.0004134	5730.	13859903.	10.5923376	50.0000000	Y
0.0004218	5743.	13616152.	10.6270465	50.0000000	Y
0.0004301	5755.	13380478.	10.6610365	50.0000000	Y
0.0004385	5767.	13152595.	10.6942792	50.0000000	Y
0.0004468	5778.	12932171.	10.7267762	50.0000000	Y
0.0004552	5789.	12718895.	10.7585279	50.0000000	Y
0.0004635	5800.	12511982.	10.7897792	50.0000000	Y
0.0004719	5810.	12311605.	10.8203184	50.0000000	Y
0.0004802	5819.	12117529.	10.8501315	50.0000000	Y
0.0004886	5828.	11929096.	10.8794338	50.0000000	Y
0.0004969	5837.	11746288.	10.9081239	50.0000000	Y
0.0005303	5869.	11066736.	11.0170328	50.0000000	Y
0.0005637	5897.	10459818.	11.1175065	50.0000000	Y
0.0005972	5921.	9914580.	11.2104870	50.0000000	Y
0.0006306	5941.	9422300.	11.2966909	50.0000000	Y
0.0006640	5960.	8975928.	11.3766645	50.0000000	Y
0.0006974	5976.	8569096.	11.4512641	50.0000000	Y
0.0007308	5990.	8197184.	11.5207389	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	356.0000000000	5990.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	118491.
2	8.0000	9.3174	Yes	No	118491.	134244.
3	11.0000	13.9122	Yes	No	252735.	269636.
4	16.0000	41.9727	No	No	522371.	41307.
5	19.0000	92.3847	No	No	563678.	57166.
6	28.0000	21.5111	No	No	620844.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 356000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.5000	-5990575.	130770.	0.00	63366.	3.69E+09	0.00	0.00	0.00
0.3700	1.4840	-5405542.	130315.	-0.00686	58525.	3.69E+09	-74.293	222.2804	0.00
0.7400	1.4391	-4811688.	129774.	-0.01053	53611.	2.56E+10	-169.311	522.3751	0.00
1.1100	1.3905	-4219852.	128788.	-0.01131	48713.	2.57E+10	-275.182	878.7024	0.00
1.4800	1.3386	-3632291.	127323.	-0.01199	43851.	2.57E+10	-384.565	1276.	0.00
1.8500	1.2840	-3051320.	125383.	-0.01257	39043.	2.57E+10	-489.466	1693.	0.00
2.2200	1.2270	-2479167.	122973.	-0.01304	34308.	2.57E+10	-595.949	2156.	0.00
2.5900	1.1682	-1918085.	120113.	-0.01342	29665.	2.57E+10	-692.394	2632.	0.00
2.9600	1.1078	-1370130.	116851.	-0.01371	25131.	2.57E+10	-777.094	3114.	0.00
3.3300	1.0465	-837120.	113203.	-0.01390	20720.	2.57E+10	-865.770	3673.	0.00
3.7000	0.9844	-320950.	109168.	-0.01400	16448.	2.57E+10	-952.016	4294.	0.00
4.0700	0.9222	176541.	104667.	-0.01401	15253.	2.57E+10	-1075.	5178.	0.00
4.4400	0.8600	652783.	99625.	-0.01394	19194.	2.57E+10	-1196.	6174.	0.00
4.8100	0.7984	1105271.	94058.	-0.01379	22939.	2.57E+10	-1312.	7294.	0.00
5.1800	0.7376	1531600.	87875.	-0.01356	26467.	2.57E+10	-1473.	8868.	0.00
5.5500	0.6780	1928468.	80921.	-0.01326	29751.	2.57E+10	-1659.	10867.	0.00
5.9200	0.6198	2292100.	73120.	-0.01290	32760.	2.57E+10	-1855.	13286.	0.00
6.2900	0.5635	2618541.	64416.	-0.01247	35462.	2.57E+10	-2066.	16279.	0.00
6.6600	0.5091	2903542.	55035.	-0.01200	37820.	2.57E+10	-2160.	18834.	0.00
7.0300	0.4569	3145179.	45356.	-0.01147	39820.	2.57E+10	-2201.	21384.	0.00
7.4000	0.4072	3342574.	35530.	-0.01091	41453.	2.57E+10	-2225.	24265.	0.00
7.7700	0.3600	3495189.	25630.	-0.01032	42716.	2.57E+10	-2234.	27553.	0.00
8.1400	0.3155	3602808.	16361.	-0.00971	43607.	2.57E+10	-1941.	27314.	0.00
8.5100	0.2738	3671181.	7842.	-0.00908	44173.	2.57E+10	-1897.	30761.	0.00
8.8800	0.2348	3701161.	-464.490	-0.00845	44421.	2.57E+10	-1845.	34878.	0.00

L1=3.9'

9.2500	0.1987	3693765.	-8508.	-0.00781	44360.	2.57E+10	-1778.	39728.	0.00
9.6200	0.1655	3650304.	-16216.	-0.00718	44000.	2.57E+10	-1694.	45450.	0.00
9.9900	0.1350	3572454.	-23508.	-0.00655	43356.	2.57E+10	-1591.	52314.	0.00
10.3600	0.1073	3462270.	-30298.	-0.00595	42444.	2.57E+10	-1467.	60733.	0.00
10.7300	0.08220	3322212.	-36490.	-0.00536	41285.	2.57E+10	-1322.	71397.	0.00
11.1000	0.05967	3155190.	-40390.	-0.00480	39903.	2.57E+10	-434.757	32350.	0.00
11.4700	0.03955	2978737.	-42016.	-0.00427	38442.	2.57E+10	-297.796	33428.	0.00
11.8400	0.02172	2795600.	-43052.	-0.00378	36927.	2.57E+10	-168.801	34507.	0.00
12.2100	0.00603	2608373.	-43534.	-0.00331	35378.	2.57E+10	-48.308	35585.	0.00
12.5800	-0.00767	2419483.	-43500.	-0.00288	33814.	2.57E+10	63.3062	36663.	0.00
12.9500	-0.01951	2231181.	-42992.	-0.00247	32256.	2.57E+10	165.8153	37742.	0.00
13.3200	-0.02964	2045539.	-42048.	-0.00211	30720.	2.57E+10	259.1305	38820.	0.00
13.6900	-0.03820	1864447.	-40711.	-0.00177	29221.	2.57E+10	343.2842	39898.	0.00
14.0600	-0.04534	1689614.	-39020.	-0.00146	27774.	2.57E+10	418.4150	40977.	0.00
14.4300	-0.05118	1522569.	-37015.	-0.00118	26392.	2.57E+10	484.7511	42055.	0.00
14.8000	-0.05585	1364665.	-34734.	-9.35E-04	25085.	2.57E+10	542.5923	43133.	0.00
15.1700	-0.05948	1217085.	-32215.	-7.12E-04	23864.	2.57E+10	592.2935	44212.	0.00
15.5400	-0.06218	1080850.	-29492.	-5.14E-04	22737.	2.57E+10	634.2462	45290.	0.00
15.9100	-0.06405	956823.	-26599.	-3.38E-04	21710.	2.57E+10	668.8610	46368.	0.00
16.2800	-0.06518	845720.	-24210.	-1.83E-04	20791.	2.57E+10	407.3989	27751.	0.00
16.6500	-0.06567	742419.	-22399.	-4.58E-05	19936.	2.57E+10	408.1577	27596.	0.00
17.0200	-0.06559	646961.	-20587.	7.41E-05	19146.	2.57E+10	408.0307	27622.	0.00
17.3900	-0.06501	559370.	-18778.	1.78E-04	18421.	2.57E+10	407.1298	27805.	0.00
17.7600	-0.06401	479653.	-16973.	2.68E-04	17762.	2.57E+10	405.5458	28132.	0.00
18.1300	-0.06263	407799.	-15178.	3.44E-04	17167.	2.57E+10	403.3527	28593.	0.00
18.5000	-0.06095	343786.	-13393.	4.09E-04	16637.	2.57E+10	400.6110	29184.	0.00
18.8700	-0.05900	287577.	-11621.	4.64E-04	16172.	2.57E+10	397.3690	29904.	0.00
19.2400	-0.05683	239123.	-10400.	5.09E-04	15771.	2.57E+10	152.7238	11932.	0.00
19.6100	-0.05448	193615.	-9727.	5.46E-04	15395.	2.57E+10	150.5868	12273.	0.00
19.9800	-0.05198	151022.	-9063.	5.76E-04	15042.	2.57E+10	148.2464	12663.	0.00
20.3500	-0.04936	111310.	-8411.	5.99E-04	14713.	2.57E+10	145.7160	13107.	0.00
20.7200	-0.04666	74441.	-7770.	6.15E-04	14408.	2.57E+10	143.0074	13608.	0.00
21.0900	-0.04390	40371.	-7141.	6.25E-04	14126.	2.57E+10	140.1316	14172.	0.00
21.4600	-0.04111	9052.	-6526.	6.29E-04	13867.	2.57E+10	137.0982	14806.	0.00
21.8300	-0.03832	-19567.	-5924.	6.28E-04	13954.	2.57E+10	133.9163	15518.	0.00
22.2000	-0.03553	-45540.	-5337.	6.23E-04	14169.	2.57E+10	130.5939	16318.	0.00
22.5700	-0.03279	-68927.	-4765.	6.13E-04	14363.	2.57E+10	127.1384	17217.	0.00
22.9400	-0.03009	-89788.	-4208.	5.99E-04	14535.	2.57E+10	123.5564	18229.	0.00
23.3100	-0.02747	-108189.	-3668.	5.82E-04	14688.	2.57E+10	119.8539	19373.	0.00
23.6800	-0.02493	-124198.	-3144.	5.62E-04	14820.	2.57E+10	116.0362	20668.	0.00
24.0500	-0.02248	-137886.	-2638.	5.39E-04	14933.	2.57E+10	112.1076	22142.	0.00
24.4200	-0.02014	-149325.	-2149.	5.14E-04	15028.	2.57E+10	108.0718	23827.	0.00
24.7900	-0.01791	-158594.	-1678.	4.88E-04	15105.	2.57E+10	103.9316	25762.	0.00

L2= 21.6'-3.9'=17.7'

25.1600	-0.01581	-165770.	-1226.	4.60E-04	15164.	2.57E+10	99.6884	28002.	0.00
25.5300	-0.01383	-170937.	-793.241	4.31E-04	15207.	2.57E+10	95.3424	30613.	0.00
25.9000	-0.01198	-174176.	-379.801	4.01E-04	15234.	2.57E+10	90.8917	33684.	0.00
26.2700	-0.01027	-175577.	13.6359	3.71E-04	15245.	2.57E+10	86.3322	37335.	0.00
26.6400	-0.00869	-175228.	386.5698	3.41E-04	15242.	2.57E+10	81.6560	41733.	0.00
27.0100	-0.00724	-173221.	738.4540	3.11E-04	15226.	2.57E+10	76.8504	47114.	0.00
27.3800	-0.00593	-169652.	1069.	2.81E-04	15196.	2.57E+10	71.8947	53832.	0.00
27.7500	-0.00475	-164619.	1376.	2.52E-04	15155.	2.57E+10	66.7566	62435.	0.00
28.1200	-0.00369	-158226.	1676.	2.24E-04	15102.	2.57E+10	68.1270	81953.	0.00
28.4900	-0.00276	-150446.	1942.	1.98E-04	15037.	2.57E+10	51.5349	83032.	0.00
28.8600	-0.00194	-141610.	2137.	1.72E-04	14964.	2.57E+10	36.6720	84110.	0.00
29.2300	-0.00122	-132012.	2271.	1.49E-04	14885.	2.57E+10	23.4924	85188.	0.00
29.6000	-6.14E-04	-121914.	2350.	1.27E-04	14801.	2.57E+10	11.9323	86267.	0.00
29.9700	-9.72E-05	-111548.	2380.	1.07E-04	14715.	2.57E+10	1.9131	87345.	0.00
30.3400	3.34E-04	-101114.	2370.	8.84E-05	14629.	2.57E+10	-6.655	88423.	0.00
30.7100	6.88E-04	-90784.	2324.	7.19E-05	14544.	2.57E+10	-13.871	89502.	0.00
31.0800	9.73E-04	-80703.	2249.	5.71E-05	14460.	2.57E+10	-19.841	90580.	0.00
31.4500	0.00120	-70990.	2151.	4.40E-05	14380.	2.57E+10	-24.672	91658.	0.00
31.8200	0.00136	-61745.	2033.	3.26E-05	14303.	2.57E+10	-28.475	92737.	0.00
32.1900	0.00148	-53044.	1900.	2.27E-05	14231.	2.57E+10	-31.361	93815.	0.00
32.5600	0.00156	-44946.	1756.	1.42E-05	14164.	2.57E+10	-33.436	94893.	0.00
32.9300	0.00161	-37496.	1604.	7.08E-06	14103.	2.57E+10	-34.807	95972.	0.00
33.3000	0.00163	-30722.	1448.	1.20E-06	14047.	2.57E+10	-35.571	97050.	0.00
33.6700	0.00162	-24640.	1290.	-3.58E-06	13996.	2.57E+10	-35.824	98128.	0.00
34.0400	0.00160	-19258.	1131.	-7.36E-06	13952.	2.57E+10	-35.652	99207.	0.00
34.4100	0.00156	-14574.	973.8475	-1.03E-05	13913.	2.57E+10	-35.134	100285.	0.00
34.7800	0.00150	-10578.	819.6104	-1.25E-05	13880.	2.57E+10	-34.342	101363.	0.00
35.1500	0.00144	-7256.	669.3604	-1.40E-05	13852.	2.57E+10	-33.338	102442.	0.00
35.5200	0.00138	-4590.	523.9196	-1.50E-05	13830.	2.57E+10	-32.176	103520.	0.00
35.8900	0.00131	-2556.	383.8935	-1.56E-05	13813.	2.57E+10	-30.899	104598.	0.00
36.2600	0.00124	-1131.	249.7134	-1.59E-05	13802.	2.57E+10	-29.542	105677.	0.00
36.6300	0.00117	-288.415	121.6786	-1.61E-05	13795.	2.57E+10	-28.131	106755.	0.00
37.0000	0.00110	0.00	0.00	-1.61E-05	13792.	2.57E+10	-26.679	53917.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

* WARNING: Some values of computed curvature exceeded the maximum curvature calculated or entered by the user
  Depth = 0.00 ft Computed Curv. = 0.00162 rad/in Maximum Curv. = 7.31E-04 rad/in

Depth = 0.3700 ft Computed Curv. = 0.00147 rad/in Maximum Curv. = 7.31E-04 rad/in

Output Summary for Load Case No. 1:

Pile-head deflection = 1.50000000 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -5990575. inch-lbs
Maximum shear force = 130770. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 0.000000 feet below pile head
Number of iterations = 24
Number of zero deflection points = 2

Plastic Hinge LPile Output

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.500000 inches
Moment at pile head = -4318343.4 in-lbs
Axial load at pile head = 356000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.5000	-4318343.	113329.	-0.01112	49528.	2.57E+10	0.00	0.00	0.00
0.3700	1.4490	-3796991.	113164.	-0.01182	45214.	2.57E+10	-74.293	227.6548	0.00
0.7400	1.3950	-3276067.	112623.	-0.01243	40903.	2.57E+10	-169.311	538.8814	0.00
1.1100	1.3385	-2757588.	111636.	-0.01296	36612.	2.57E+10	-275.182	912.7950	0.00
1.4800	1.2800	-2243782.	110172.	-0.01339	32360.	2.57E+10	-384.566	1334.	0.00
1.8500	1.2197	-1736944.	108231.	-0.01373	28166.	2.57E+10	-489.468	1782.	0.00
2.2200	1.1580	-1239282.	105822.	-0.01399	24048.	2.57E+10	-595.952	2285.	0.00
2.5900	1.0955	-753031.	102962.	-0.01416	20024.	2.57E+10	-692.399	2806.	0.00
2.9600	1.0323	-280224.	99699.	-0.01425	16111.	2.57E+10	-777.099	3342.	0.00
3.3300	0.9689	177341.	96052.	-0.01426	15260.	2.57E+10	-865.777	3967.	0.00
3.7000	0.9057	617789.	92017.	-0.01419	18905.	2.57E+10	-952.024	4667.	0.00
4.0700	0.8430	1039301.	87516.	-0.01405	22393.	2.57E+10	-1075.	5664.	0.00
4.4400	0.7810	1439329.	82473.	-0.01383	25703.	2.57E+10	-1196.	6799.	0.00

L1p= 3.2'

4.8100	0.7201	1815389.	76906.	-0.01355	28815.	2.57E+10	-1312.	8087.	0.00
5.1800	0.6607	2165095.	70724.	-0.01321	31709.	2.57E+10	-1473.	9901.	0.00
5.5500	0.6029	2485167.	63770.	-0.01281	34358.	2.57E+10	-1659.	12221.	0.00
5.9200	0.5469	2771851.	55993.	-0.	.57E+10	-1844.	14967.	0.00
6.2900	0.4932	3021432.	47689.	-0.	.57E+10	-1897.	17076.	0.00
6.6600	0.4417	3232799.	39169.	-0.	.57E+10	-1941.	19515.	0.00
7.0300	0.3927	3405012.	30483.	-0.	.57E+10	-1971.	22283.	0.00
7.4000	0.3463	3537444.	21700.	-0.01014	43066.	2.57E+10	-1986.	25457.	0.00
7.7700	0.3027	3629767.	12881.	-0.00952	43830.	2.57E+10	-1987.	29145.	0.00
8.1400	0.2618	3681935.	4651.	-0.00889	44262.	2.57E+10	-1721.	29186.	0.00
8.5100	0.2237	3699178.	-2888.	-0.00826	44404.	2.57E+10	-1675.	33248.	0.00
8.8800	0.1885	3682391.	-10189.	-0.00762	44265.	2.57E+10	-1614.	38020.	0.00
9.2500	0.1560	3632786.	-17179.	-0.00699	43855.	2.57E+10	-1535.	43680.	0.00
9.6200	0.1264	3551928.	-23780.	-0.00637	43186.	2.57E+10	-1438.	50512.	0.00
9.9900	0.09950	3441751.	-29906.	-0.00576	42274.	2.57E+10	-1321.	58964.	0.00
10.3600	0.07522	3304586.	-35465.	-0.00518	41139.	2.57E+10	-1183.	69801.	0.00
10.7300	0.05348	3143207.	-40276.	-0.00463	39803.	2.57E+10	-984.752	81752.	0.00
11.1000	0.03415	2961557.	-43015.	-0.00410	38300.	2.57E+10	-248.805	32350.	0.00
11.4700	0.01708	2774195.	-43853.	-0.00360	36750.	2.57E+10	-128.615	33428.	0.00
11.8400	0.00214	2583541.	-44175.	-0.00314	35172.	2.57E+10	-16.654	34507.	0.00
12.2100	-0.01082	2391854.	-44020.	-0.00271	33586.	2.57E+10	86.6998	35585.	0.00
12.5800	-0.02195	2201223.	-43425.	-0.00232	32008.	2.57E+10	181.2179	36663.	0.00
12.9500	-0.03139	2013565.	-42430.	-0.00195	30455.	2.57E+10	266.8063	37742.	0.00
13.3200	-0.03929	1830617.	-41075.	-0.00162	28941.	2.57E+10	343.4933	38820.	0.00
13.6900	-0.04578	1653942.	-39399.	-0.00132	27479.	2.57E+10	411.4144	39898.	0.00
14.0600	-0.05101	1484925.	-37441.	-0.00105	26081.	2.57E+10	470.7970	40977.	0.00
14.4300	-0.05510	1324785.	-35237.	-8.07E-04	24755.	2.57E+10	521.9442	42055.	0.00
14.8000	-0.05818	1174573.	-32823.	-5.92E-04	23512.	2.57E+10	565.2191	43133.	0.00
15.1700	-0.06036	1035184.	-30234.	-4.01E-04	22359.	2.57E+10	601.0281	44212.	0.00
15.5400	-0.06174	907360.	-27502.	-2.33E-04	21301.	2.57E+10	629.8049	45290.	0.00
15.9100	-0.06243	791704.	-24656.	-8.68E-05	20344.	2.57E+10	651.9943	46368.	0.00
16.2800	-0.06251	688686.	-22314.	4.09E-05	19491.	2.57E+10	403.1887	28636.	0.00
16.6500	-0.06207	593428.	-20525.	1.51E-04	18703.	2.57E+10	402.4707	28790.	0.00
17.0200	-0.06117	505943.	-18742.	2.46E-04	17979.	2.57E+10	401.0060	29107.	0.00
17.3900	-0.05988	426225.	-16966.	3.27E-04	17319.	2.57E+10	398.8812	29576.	0.00
17.7600	-0.05827	354253.	-15201.	3.94E-04	16724.	2.57E+10	396.1681	30188.	0.00
18.1300	-0.05638	289996.	-13449.	4.50E-04	16192.	2.57E+10	392.9262	30943.	0.00
18.5000	-0.05427	233405.	-11713.	4.95E-04	15724.	2.57E+10	389.2043	31840.	0.00
18.8700	-0.05199	184423.	-9994.	5.31E-04	15318.	2.57E+10	385.0418	32885.	0.00
19.2400	-0.04956	142981.	-8815.	5.59E-04	14975.	2.57E+10	145.9281	13074.	0.00
19.6100	-0.04702	104377.	-8173.	5.80E-04	14656.	2.57E+10	143.3952	13540.	0.00
19.9800	-0.04441	68572.	-7542.	5.95E-04	14360.	2.57E+10	140.6850	14067.	0.00
20.3500	-0.04174	35521.	-6924.	6.04E-04	14086.	2.57E+10	137.8084	14661.	0.00

Max Moment in Lower Segment

20.7200	-0.03904	5177.	-6319.	6.08E-04	13835.	2.57E+10	134.7750	15329.	0.00
21.0900	-0.03634	-22511.	-5727.	6.06E-04	13979.	2.57E+10	131.5937	16079.	0.00
21.4600	-0.03365	-47599.	-5151.	6.00E-04	14186.	2.57E+10	128.2725	16923.	0.00
21.8300	-0.03101	-70146.	-4589.	5.90E-04	14373.	2.57E+10	124.8186	17874.	0.00
22.2000	-0.02841	-90212.	-4042.	5.76E-04	14539.	2.57E+10	121.2385	18946.	0.00
22.5700	-0.02589	-107864.	-3512.	5.59E-04	14685.	2.57E+10	117.5380	20158.	0.00
22.9400	-0.02345	-123170.	-2999.	5.39E-04	14812.	2.57E+10	113.7222	21535.	0.00
23.3100	-0.02110	-136200.	-2503.	5.17E-04	14919.	2.57E+10	109.7951	23105.	0.00
23.6800	-0.01886	-147028.	-2024.	4.93E-04	15009.	2.57E+10	105.7603	24903.	0.00
24.0500	-0.01673	-155731.	-1564.	4.66E-04	15081.	2.57E+10	101.6198	26976.	0.00
24.4200	-0.01471	-162389.	-1122.	4.39E-04	15136.	2.57E+10	97.3748	29382.	0.00
24.7900	-0.01283	-167082.	-699.338	4.11E-04	15175.	2.57E+10	93.0246	32197.	0.00
25.1600	-0.01107	-169897.	-296.205	3.81E-04	15198.	2.57E+10	88.5665	35525.	0.00
25.5300	-0.00944	-170919.	86.8809	3.52E-04	15207.	2.57E+10	83.9949	39503.	0.00
25.9000	-0.00794	-170238.	449.3958	3.23E-04	15201.	2.57E+10	79.3001	44326.	0.00
26.2700	-0.00658	-167948.	790.7578	2.93E-04	15182.	2.57E+10	74.4665	50279.	0.00
26.6400	-0.00534	-164144.	1110.	2.65E-04	15151.	2.57E+10	69.4692	57788.	0.00
27.0100	-0.00422	-158925.	1407.	2.37E-04	15107.	2.57E+10	64.2685	67543.	0.00
27.3800	-0.00323	-152397.	1680.	2.10E-04	15053.	2.57E+10	58.7992	80733.	0.00
27.7500	-0.00236	-144667.	1928.	1.84E-04	14989.	2.57E+10	52.9480	99635.	0.00
28.1200	-0.00160	-135855.	2111.	1.60E-04	14917.	2.57E+10	29.4605	81953.	0.00
28.4900	-9.37E-04	-126424.	2216.	1.38E-04	14838.	2.57E+10	17.5181	83032.	0.00
28.8600	-3.74E-04	-116614.	2270.	1.17E-04	14757.	2.57E+10	7.0903	84110.	0.00
29.2300	9.88E-05	-106632.	2282.	9.74E-05	14675.	2.57E+10	-1.897	85188.	0.00
29.6000	4.90E-04	-96659.	2257.	7.98E-05	14592.	2.57E+10	-9.526	86267.	0.00
29.9700	8.08E-04	-86847.	2200.	6.40E-05	14511.	2.57E+10	-15.889	87345.	0.00
30.3400	0.00106	-77324.	2118.	4.98E-05	14432.	2.57E+10	-21.081	88423.	0.00
30.7100	0.00125	-68196.	2015.	3.73E-05	14357.	2.57E+10	-25.200	89502.	0.00
31.0800	0.00139	-59546.	1896.	2.63E-05	14285.	2.57E+10	-28.347	90580.	0.00
31.4500	0.00148	-51439.	1766.	1.67E-05	14218.	2.57E+10	-30.620	91658.	0.00
31.8200	0.00154	-43921.	1626.	8.45E-06	14156.	2.57E+10	-32.115	92737.	0.00
32.1900	0.00156	-37025.	1482.	1.46E-06	14099.	2.57E+10	-32.925	93815.	0.00
32.5600	0.00155	-30767.	1335.	-4.38E-06	14047.	2.57E+10	-33.140	94893.	0.00
32.9300	0.00152	-25155.	1189.	-9.21E-06	14000.	2.57E+10	-32.841	95972.	0.00
33.3000	0.00147	-20182.	1045.	-1.31E-05	13959.	2.57E+10	-32.106	97050.	0.00
33.6700	0.00140	-15838.	904.4231	-1.62E-05	13923.	2.57E+10	-31.004	98128.	0.00
34.0400	0.00132	-12100.	769.8841	-1.86E-05	13892.	2.57E+10	-29.599	99207.	0.00
34.4100	0.00124	-8942.	642.1312	-2.05E-05	13866.	2.57E+10	-27.947	100285.	0.00
34.7800	0.00114	-6333.	522.1548	-2.18E-05	13845.	2.57E+10	-26.096	101363.	0.00
35.1500	0.00104	-4237.	410.7466	-2.27E-05	13827.	2.57E+10	-24.088	102442.	0.00
35.5200	9.42E-04	-2614.	308.5314	-2.33E-05	13814.	2.57E+10	-21.955	103520.	0.00
35.8900	8.37E-04	-1423.	215.9993	-2.36E-05	13804.	2.57E+10	-19.726	104598.	0.00
36.2600	7.32E-04	-621.115	133.5354	-2.38E-05	13797.	2.57E+10	-17.420	105677.	0.00

L2p= 20.8'-3.2'=17.6'

36.6300	6.26E-04	-162.221	61.4490	-2.39E-05	13794.	2.57E+10	-15.051	106755.	0.00
37.0000	5.20E-04	0.00	0.00	-2.39E-05	13792.	2.57E+10	-12.628	53917.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     1.50000000 inches
Computed slope at pile head      =     -0.0111241 radians
Maximum bending moment           =      -4318343. inch-lbs
Maximum shear force              =        113329. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             16
Number of zero deflection points =              2
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	1.5000	S, rad	0.00	356000.	1.5000	0.00	130770.	-5990575.
2	y, in	1.5000	M, in-lb	-4318343.	356000.	1.5000	-0.01112	113329.	-4318343.

```
Maximum pile-head deflection = 1.5000000000 inches
Maximum pile-head rotation   = -0.0111240809 radians = -0.637363 deg.

The analysis ended normally.
```

Project:	US Route 1 Bridge #5804 over I-295	GZA File No.:	09.0026144.00
Location:	Yarmouth, Maine		
Prepared by:	E. Tome	Date:	10/14/2024
Checked by:	A. Blaisdell/B. Cardali	Date:	10/24/2024

Objective

The purpose of this calculation package is to conduct an FB-MultiPier analysis to evaluate the proposed HP 14x89 pile response at the center pier due to the anticipated loading.

Steps:

1. Evaluate soil parameters and develop a design profile for use in lateral analyses based on available boring data. The design profile for the pier was based on boring BB-YR1-102.
2. Develop an FB-MultiPier model (Florida Bridge Software Institute (BSI) FB-MultiPier version 6.1.0) for the proposed pile cap and pile geometry based on provided geometry and loads from Hoyle, Tanner (HTA).
3. Assess the group and individual pile reactions for deformation, structural capacity, and axial loading.

References

Documents that were used as a basis of our evaluation include:

1. Pile and pile cap geometry: Draft PSE Plans by HTA, "Yarmouth Cumberland County Relocated US 1 Bridge over Interstate 295," dated 10/04/2024.
2. Subsurface Profile: Boring log BB-YR1-102
3. Applied Loads: Abutment Pile Loads.pdf provided by Hoyle, Tanner Associates, Inc. (HTA) on August 7, 2024.
4. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
5. FB-MultiPier Help Manual (FB-MultiPier v6.1.0)

Attachments

Table 1 – Soil Design Profile Summary Table
Appendix A – Draft PSE Plans dated 10/04/2024
Appendix B – Pier Pile Reactions
Appendix C – Boring Location Plan and Boring Logs
Appendix D – FB-MultiPier Output

Assumptions

The following assumptions were made for our analyses:

- The provided loads are Strength limit state.
- Subsurface layering is horizontal and material properties are isotropic within each layer.
- Loading Schedule shown in **Appendix B** is applied at midpoint of cap (default in FB-MultiPier). The maximum load and moment from the Loading Schedule was applied to the pile cap.
- The superstructure is not included in the model.

FB MultiPier Model Setup

The FB-MultiPier model was developed with soil layering and material properties as summarized in the attached **Table 1**, which is based on boring BB-YR1-102. P-Multipliers were applied per AASHTO 10.7.2.4, as shown in **Figure 1** below. The pile cap was modeled based on the dimensions provided by HTA presented in **Appendix B**, and includes 3 rows of 7 HP14x89 piles spaced 3 feet on-center in the longitudinal direction and 9.5 feet on-center in the transverse direction, as shown in **Figure 2**. The pile cap loading was applied at the center of the cap in plan view, and at cap mid-height elevation (EL. 114 as shown in **Figure 2**), which is the load application elevation for caps in the FB-MultiPier software.

p-Multiplier Values

Xp	Yp
1.000000	1.000000
0.850000	0.850000
0.700000	0.700000
	0.700000

Figure 1: P-Multipliers

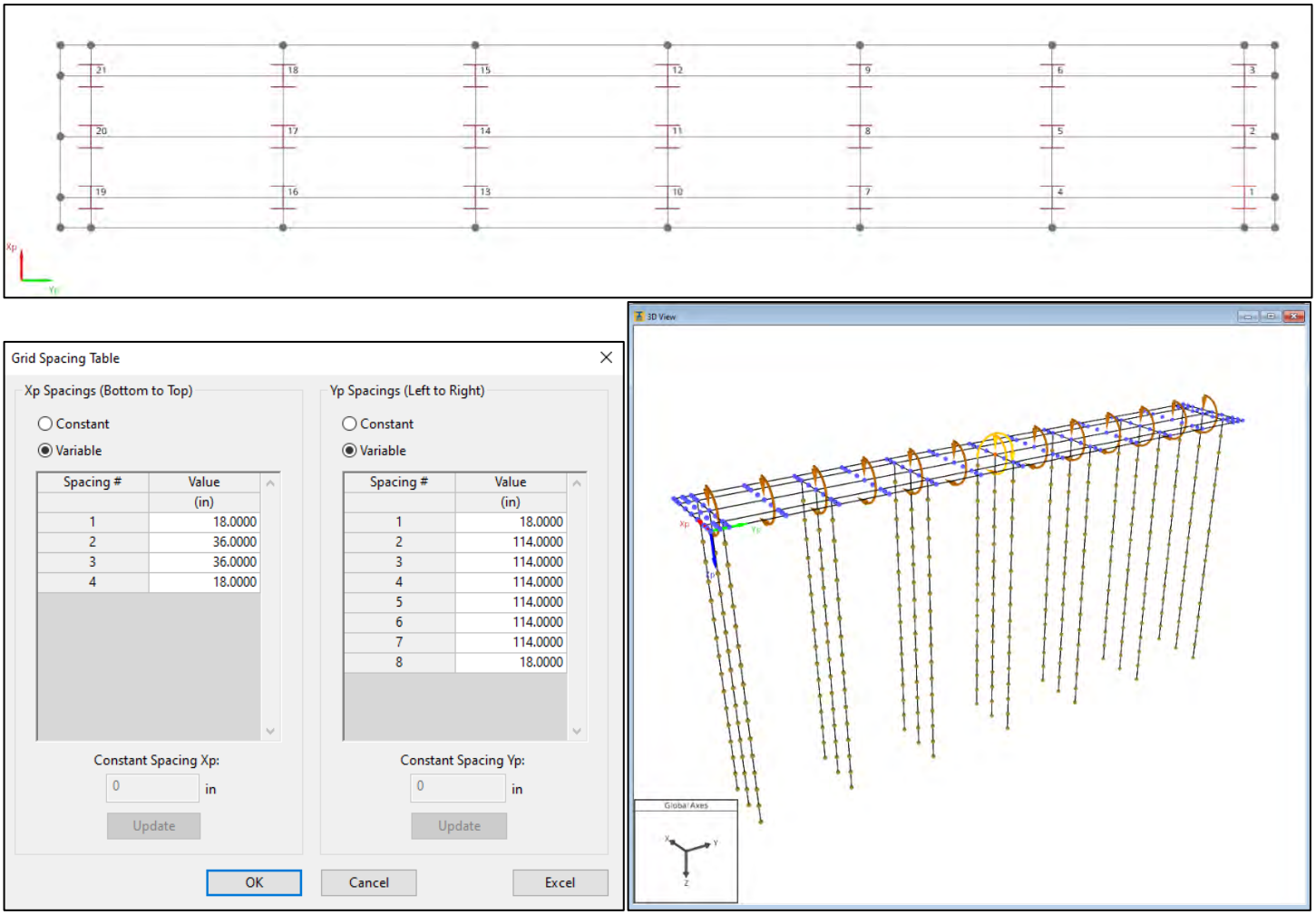


Figure 2: Pile/Pile Cap Geometry and Loading

In FB-MultiPier, the flexibility of the pile cap is considered in development of axial loads in the piles from imposed moments. Preliminary analyses considering the modulus of elasticity of concrete showed unrealistically high axial loads and deflection focused in the center piles below the applied transverse moment. In reality, the presence of the pier wall above the pile cap has a very significant stiffening effect that will prevent the pile cap from bending locally. The moment of inertia of bending around the transverse axis is over 100 times greater when considering the pier cap than it is for the pile cap alone. Because the pile cap structural response is related to the moment of elasticity multiplied by moment of inertia (EI), we increased the modulus of elasticity used for the pile cap concrete to address the unrealistic results created by the moment concentration. It is noted that this increase results in consistent pile reactions with the program Group by Ensoft.

A summary of the structural properties is provided below:

PILE CAP

- Young's Modulus = 426,620 ksi (Increased E by a factor of 100 to replicate a rigid pile cap as noted above)
- Poisson's Ratio = 0.2

- Unit weight = 0 pcf (self-weight understood to be included in reactions provided by HTA)
- Thickness = 4 feet (**Appendix B**)
- Pile cap Midplane set at El. 114 feet

PILES

- Fixed pile-to-cap connection (Piles embedded in cap)
- Section Properties
  - HP14x89 piles, 28 feet long from bottom of cap to top of bedrock
  - Steel yield stress 50 ksi (Grade 50)
  - Young's Modulus = 29,000 ksi (all steel)

FB MultiPier Results

The FB-MultiPier output plots versus depth of forces, moment, and demand-capacity ratio for each pile are provided as **Appendix D**, and the estimated maximum forces and deflection within the piles from the FB-MultiPier model are summarized in **Table 1** below.

Table A - FB-MultiPier Output Summary

Maximum Bending Moment (in-kips)	Maximum Axial Compression (kips)	Minimum Axial Compression (kips)	Maximum Lateral Deflection, Longitudinal (inches)	Maximum Lateral Deflection, Transverse (inches)	Maximum Vertical Deflection, Downward (inches)	Maximum D/C ratio	Approximate Depth to Fixity (feet below bottom of pile cap)
35.9 (Pile 21)	388 (Pile 1)	103 (Pile 21)	0.02	0.0	0.2	0.47 (Pile 10)	9

The maximum moment and demand-capacity ratio occur at the pile head. The maximum demand-capacity ratio is less than half of the structural capacity using the provided AASHTO LRFD Strength limit state loads. Refer to page 4 of **Appendix D,** which shows the demand-capacity ratios of the piles with depth. The results indicate that the proposed HP14x89 layout, orientation, and sections provide adequate resistance for the design loads.

TABLE

Table 1 - FB-MultiPier Input Parameters
MaineDOT - US Route 1 Bridge No. 5804
Yarmouth, Maine

GZA FILE NO.	09.0026144.00
CALCULATED BY	L. Hailey / E. Tome
CHECKED BY	A. Blaisdell 11/14/24

Objective: To estimate the horizontal modulus of subgrade reaction (k) or E50 of subsurface strata for use in lateral analyses. K values are estimated using strata internal friction angles (ϕ') or shear strength.

Methods: Correlations between the horizontal modulus of subgrade reaction and the soil internal friction angle of a given stratum are based on Figure 3-34 presented in the 2022 LPile Technical Manual.

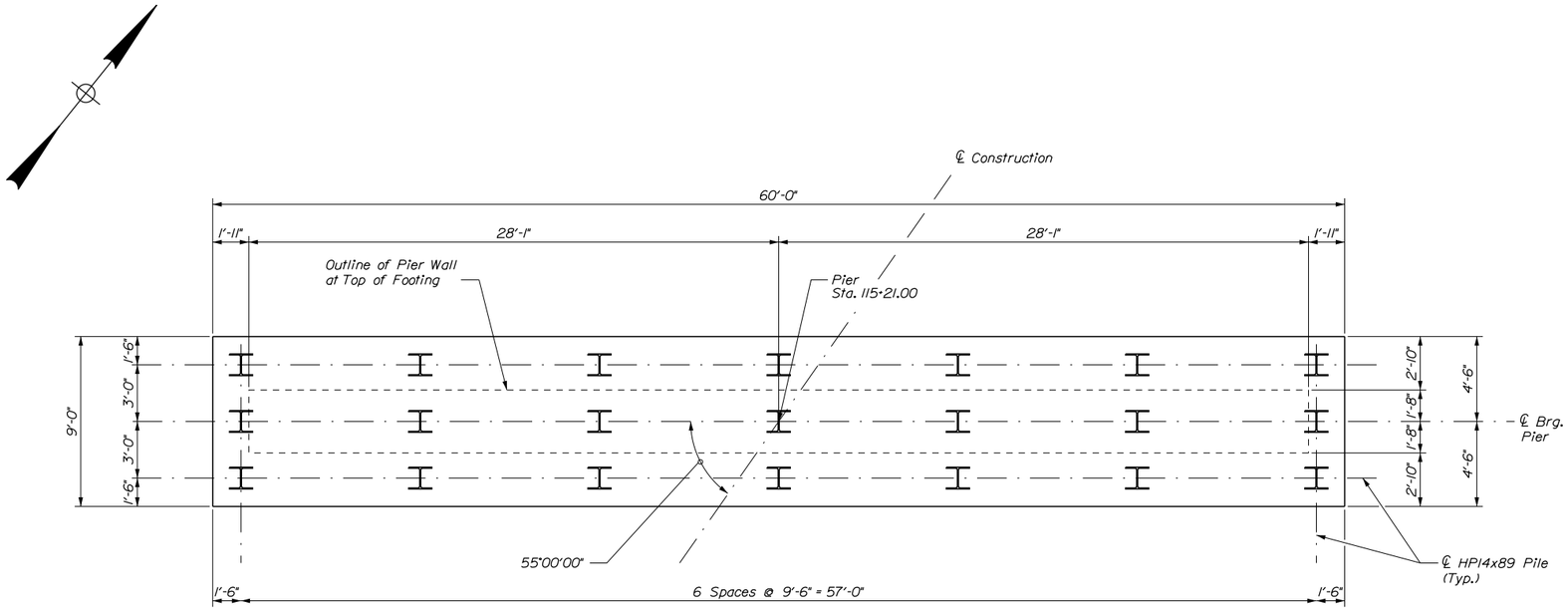
Given Information: SPT measurements, In-situ vanes, and subsurface conditions in borings BB-YR1-102 were performed by New England Borings Contractors (NEBC) on April 11, 2022.

Pier 1: Pile length = 28'								
Stratum	**Top of Layer Elevation (NAVD88 ft)**	**Lateral Model**	**Axial Model**	**Torsional Model**	**Tip Model**	**k (pci) / E50**	**ϕ' (deg)/ Su (psf)**	**γ_e (pcf)**
Fill	119	Reese Sand	Driven Pile (McVay)	Hyperbolic	--	83	32	125
Marine Clay Crust	114	Stiff Clay w/o Free Water	Driven Pile (McVay)	Hyperbolic	--	0.007	1250	120
Marine Clay Crust**	111	Stiff Clay w/o Free Water	Driven Pile (McVay)	Hyperbolic	--	0.007	1250	57.6
Marine Clay	105	Soft Clay	Driven Pile (McVay)	Hyperbolic	--	0.008	575	55.6
Marine Sand	91	Reese Sand	Driven Pile (McVay)	Hyperbolic	--	55	32	57.6
Top of Rock	84	--	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	--	--	--

Notes:
1. Pile tip elevation should be assumed to be top of Rock.
2. pci = pounds per cubic inch, deg = degrees, psi =pounds per square inch, γe = effective unit weight, pcf = pounds per square foot.
3. These parameters do not include reductions for group interaction. Reduction factors were applied in accordance with AASHTO 10.7.2.4 for spacing of 3 to 5 pile diameters or less.

APPENDIX A

Draft PSE Plans dated 10/04/2024



PIER FOOTING PLAN

PILE NOTES

1. The maximum factored pile load is 408 kips (including XX kips allowed for downdrag) at the Strength Limit State.

2. Piles shall be driven to the required resistance on or within bedrock in accordance with Standard Specification Section 501.

3. Estimate of piles required:

Pier: 21 - HP14x89 @ 35 feet
establishment of the final driving criteria.

The order lengths of the piles shall include an additional 5 feet of length for each test pile to accommodate dynamic pile testing equipment.

4. H-pile material shall be ASTM A572, Grade 50.

5. H-pile splices shall be in accordance with Standard Detail 501(03). Piles splices are not permitted within the upper 15 feet of piles.

6. All piles shall be equipped with a pile tip in accordance with Standard Specifications Subsections 501.048 , Prefabricated Pile Tips and 711.10 H-Beam Piles, Spliced and Tips (or 711.01 Steel Pipe Piles, Splices and Tips).

7. Piles shall not be out of position shown by more than 2 inches in any direction.

8. The Contractor shall perform and submit a wave equation analysis for review and acceptance, their proposed pile driving equipment with a compiles "Pile Driving and Equipment Data Form," Figure 1, of Standard Section 501 - Foundation Piles. Approval of the proposed pile driving equipment by the Department will be based on the Department - conducted wave equation analysis and the criteria specified in Section 501 and Subsection 501.042, Equipment for Driving Piles. If the Department - conducted wave equation analyses show that the proposed system(s) is unacceptable, the Contractor shall modify or replace the proposed driving equipment in an amendment of the QCP, at their own expense, until subsequent wave equation analyses by the Department indicate the pile can be driven to the required resistance, without damage or excessive blows.

9. The Contractor shall provide access for the agents of the Department to perform three (3) dynamic load test with signal matching and restrike, as specified in Special Provision 501 - Dynamic Load Test, to confirm the nominal resistance of the piles. The dynamic pile load tests will be complete of the first production pile at Abutment 1, Abutment 2 and Pier 1. The required nominal resistance for the piles are the maximum factored axial pile load divided by 0.65 for the controlling Strength Limit State. The Contractor may drive production piles to the preliminary driving criteria, however pile cut-off will not be permitted until completion of restrike testing and

PIER NOTES

1. Reinforcing steel shall have a minimum concrete cover of 3 inches unless otherwise noted.

2. Payment for Concrete Formliner is considered incidental to related Contract Items.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00

BRIDGE NO. 5804

BRIDGE PLANS

PROJ. MANAGER	J.Brook		
DESIGN-DETAILED	JCC	LDC	OCT 2024
CHECKED-REVIEWED	OGK	STJ	OCT 2024
DESIGN2-DETAILED2	RPM	SA	OCT 2024
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

P.E. NUMBER

SIGNATURE

DATE

RELOCATED US 1 BRIDGE
INTERSTATE 295
YARMOUTH CUMBERLAND COUNTY

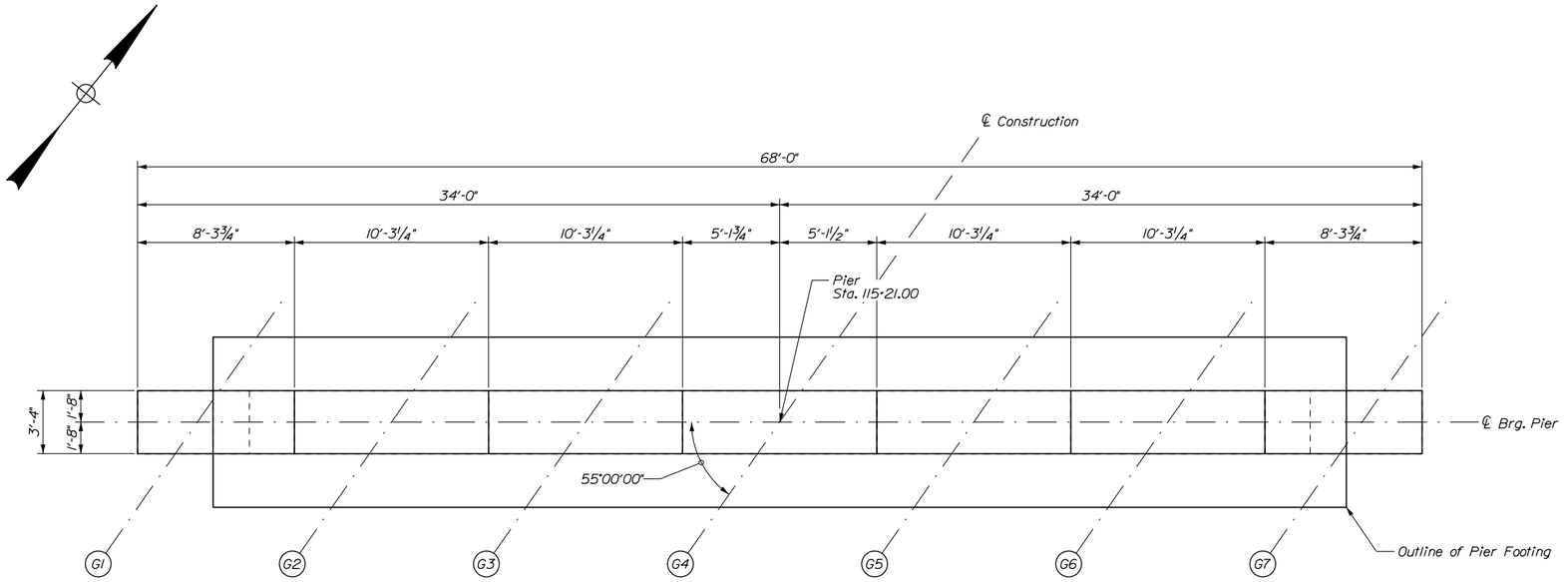
PIER FOOTING PLAN
MASONRY & REINFORCING

SHEET NUMBER

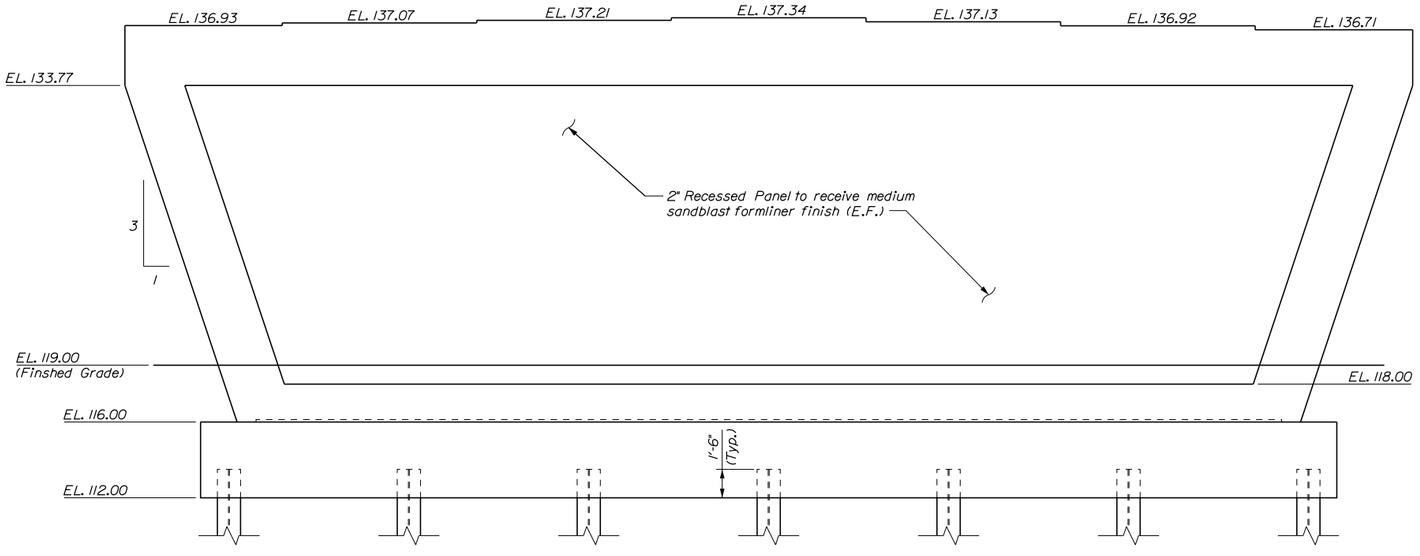
99

OF 121

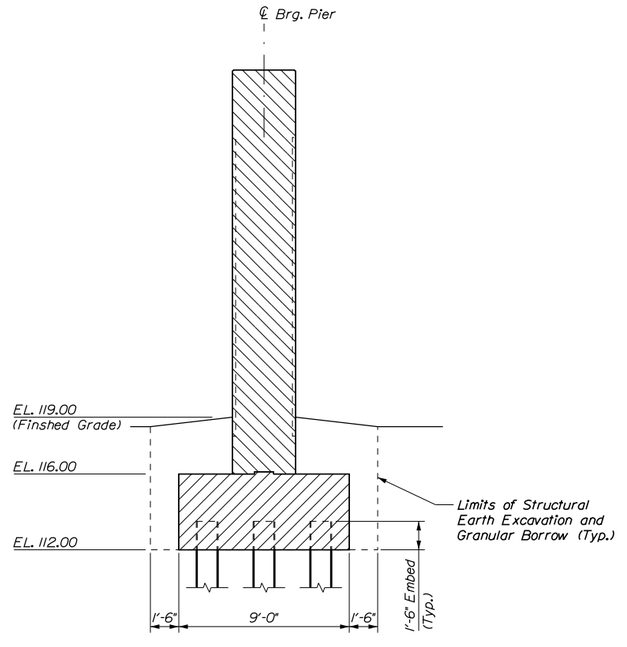
Filename: ...\BRIDGE\MSTA\099_Pier_Plan.dgn Division: BRIDGE Username: Date:10/4/2024



PIER CAP PLAN



PIER ELEVATION PLAN



TYPICAL PIER SECTION

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00

BRIDGE NO. 5804

BRIDGE PLANS

PROJ. MANAGER	J.Brosk		
DESIGN-DETAILED	JCC	LDC	OCT 2024
CHECKED-REVIEWED	OGK	STJ	OCT 2024
DESIGN2-DETAILED2	RPM	SA	OCT 2024
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

RELOCATED US 1 BRIDGE
INTERSTATE 295
YARMOUTH CUMBERLAND COUNTY

PIER ELEVATION
MASONRY

SHEET NUMBER

100

OF 121

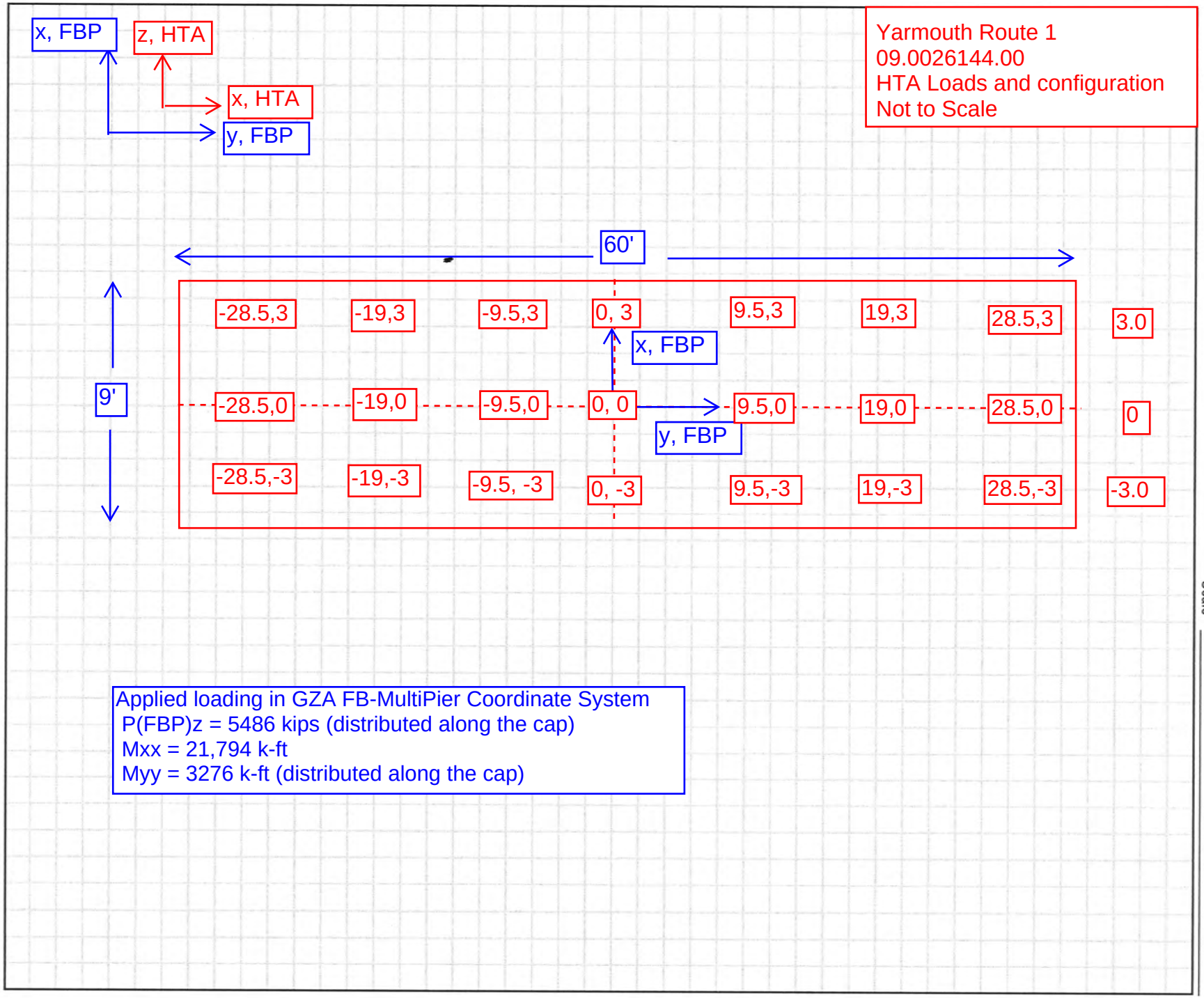
Filename: ...\BRIDGE\MSTA\100_Pier_Elev.dgn Division: BRIDGE Username: Date:10/4/2024

APPENDIX B

Pier Pile Reactions

Pile Reactions, Factored **Load Effect @ Footing Bot.**

Pile	X in	Z in	Batter X degree	Batter Z degree	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	702.0	36.0	-0	-0	17	---	-5204.37	3254.60	-17236.65	390.12
					144	---	-3462.14	-3254.60	12870.87	38.99
2	588.0	36.0	-0	-0	17	---	-5204.37	3254.60	-17236.65	368.52
					3022	---	-3333.34	-3275.54	10586.58	54.21
3	474.0	36.0	-0	-0	17	---	-5204.37	3254.60	-17236.65	346.92
					3022	---	-3333.34	-3275.54	10586.58	67.47
4	360.0	36.0	-0	-0	16	---	-5486.12	3254.60	11228.40	338.73
					3022	---	-3333.34	-3275.54	10586.58	80.74
5	246.0	36.0	-0	-0	16	---	-5486.12	3254.60	11228.40	352.80
					3028	---	-3333.34	-3268.51	-13021.87	64.59
6	132.0	36.0	-0	-0	18	---	-5204.37	3254.60	21791.58	379.93
					145	---	-3462.14	-3254.60	-17424.98	43.70
7	18.0	36.0	-0	-0	18	---	-5204.37	3254.60	21791.58	407.24
					145	---	-3462.14	-3254.60	-17424.98	21.87
8	702.0	-0.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	329.76
					159	---	-3462.14	3254.60	17428.66	99.34
9	588.0	-0.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	302.45
					430	---	-2740.80	-676.12	3762.89	121.08
10	474.0	-0.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	275.14
					430	---	-2740.80	-676.12	3762.89	125.80
11	360.0	-0.0	-0	-0	1	---	-5486.12	-3254.60	6670.61	261.24
					421	---	-2740.80	-1037.42	3509.90	130.51
12	246.0	-0.0	-0	-0	16	---	-5486.12	3254.60	11228.40	275.31
					421	---	-2740.80	-1037.42	3509.90	134.91
13	132.0	-0.0	-0	-0	18	---	-5204.37	3254.60	21791.58	302.44
					145	---	-3462.14	-3254.60	-17424.98	121.19
14	18.0	-0.0	-0	-0	18	---	-5204.37	3254.60	21791.58	329.75
					145	---	-3462.14	-3254.60	-17424.98	99.36
15	702.0	-36.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	407.25
					159	---	-3462.14	3254.60	17428.66	21.85
16	588.0	-36.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	379.94
					159	---	-3462.14	3254.60	17428.66	43.69
17	474.0	-36.0	-0	-0	2	---	-5204.37	-3254.60	-21794.44	352.63
					3342	---	-3333.34	3268.51	13032.11	64.58
18	360.0	-36.0	-0	-0	1	---	-5486.12	-3254.60	6670.61	338.73
					3337	---	-3333.34	3275.54	12794.74	80.74
19	246.0	-36.0	-0	-0	1	---	-5486.12	-3254.60	6670.61	347.09
					3338	---	-3333.34	3275.54	-10576.35	67.49
20	132.0	-36.0	-0	-0	3	---	-5204.37	-3254.60	17233.79	368.51
					3338	---	-3333.34	3275.54	-10576.35	54.23
21	18.0	-36.0	-0	-0	3	---	-5204.37	-3254.60	17233.79	390.11
					160	---	-3462.14	3254.60	-12867.19	39.00



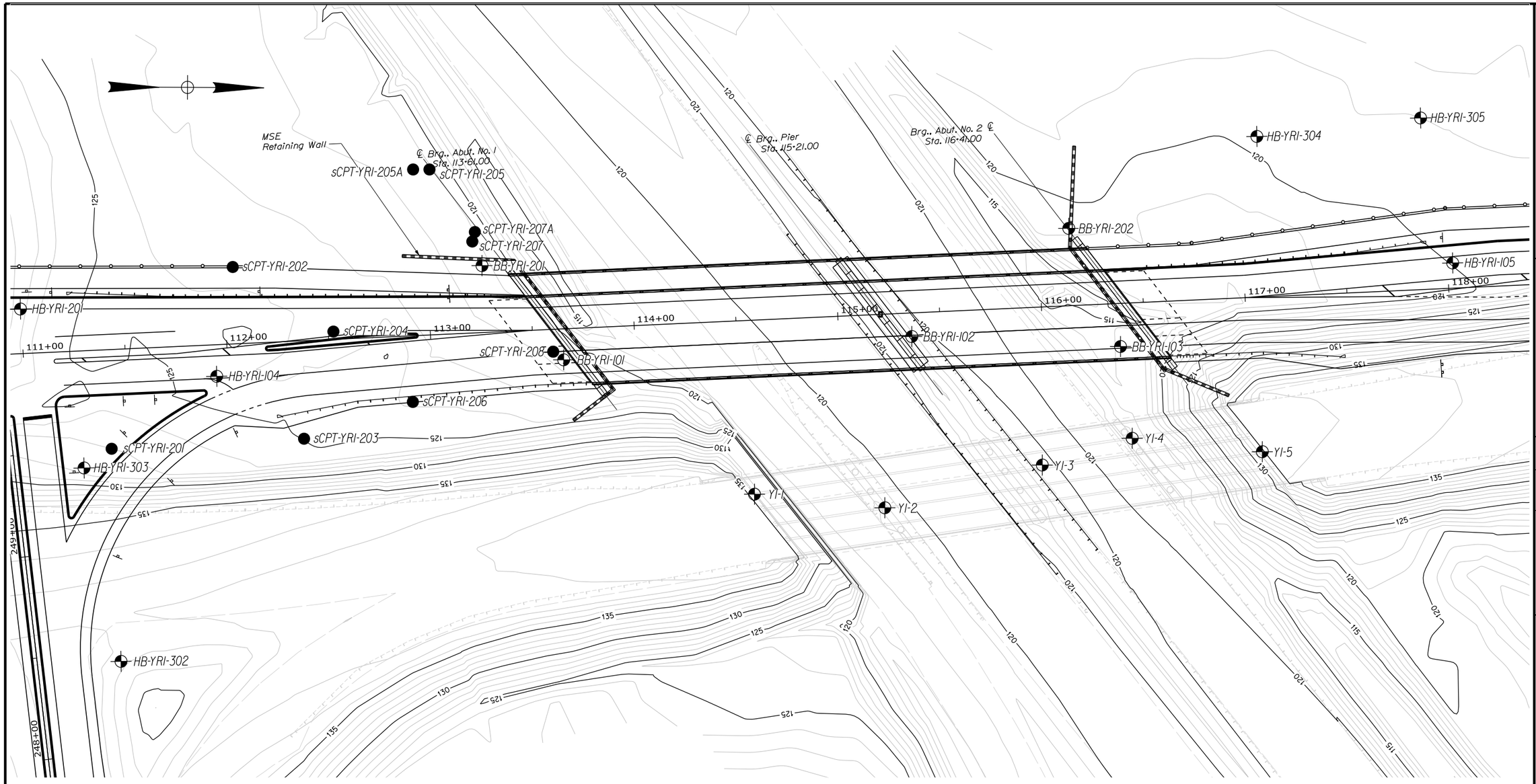
GZA GeoEnvironmental, Inc.
Engineers and Scientists
707 Sable Oaks Drive, Suite 150
South Portland, ME 04106
(207) 879-9190
http://www.gza.com

JOB
SHEET NO OF
Calculated By Date
Checked By Date
Scale

APPENDIX C

Boring Location Plan and Boring Logs

Filename: ...\1 - BLP\BLP - 09.23.24.dgn Division: HIGHWAY Username: common Date:10/4/2024



NOTES

1) Base map developed from electronic files (Alignments.dgn, Bridge.dgn, 3DTopo_071222.dgn, and Contours.dgn) provided by Hoyle, Tanner & Associates on June 17, 2024.

2) The as-drilled locations of the BB-YRI-100 and -200 bridge borings, HB-YRI-100, -200 and -300 series highway borings, and sCPT-YRI-200 series Seismic Cone Penetration Tests were surveyed and provided by MaineDOT in an electronic file (Borings_090324.dgn).

BORING LOCATION PLAN LEGEND

BB-YRI-103, HB-YRI-105	Locations and designations of BB- and HB-YRI-100 series borings performed by New England Boring Contractors of Hermon, Maine between February 21 and April 11, 2022.
BB-YRI-202, HB-YRI-201	Locations and designations of BB- and HB-YRI-200 series borings performed by Seaboard Drilling, LLC of Bangor, Maine between April 26 and 30, 2024.
sCPT-YRI-208	Locations and designations of sCPT-YRI-200 series seismic cone penetration tests performed by Seaboard Drilling, LLC of Bangor, Maine on April 25 and 29, 2024.
HB-YRI-305	Locations and designations of HB-YRI-300 series borings performed by Seaboard Drilling, LLC of Bangor, Maine between August, 22 and 26, 2024.
YI-5	Approximate locations and designations of YI series borings performed by the Maine State Highway Commission in April, 1957.

PLAN

25 0 25 50

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2238200

WIN 22382.00

BRIDGE NO. 5804

BRIDGE PLANS

PROJ. MANAGER	M. WIGHT	BY	DATE
DESIGN-DETAILED	E. TOME	B. CARDALI	09/2024
CHECKED-REVIEWED	A. BLASDELL	------	09/2024
DESIGN2-DETAILED2	------	------	------
DESIGN3-DETAILED3	------	------	------
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

SIGNATURE

P.E. NUMBER

DATE

RELOC. RTE. 1 BRIDGE
I-295
CUMBERLAND COUNTY
YARMOUTH

BORING LOCATION PLAN

SHEET NUMBER

13

OF 129

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-102

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	118.4	**Auger ID/OD:**	4.25" OD
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4/11/22-4/11/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 115+35.8, 11.6' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.9'
Hammer Efficiency Factor: 0.863		**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.
				Sample Information							
0	1D	24/10	0.0 - 2.0	3-3-3-4	6	9	SSA	118.0		Top 5": Topsoil.	
										0.4	
										Bottom 5": Brown, dry, loose, fine to coarse SAND, (Fill).	
	2D	24/3	2.0 - 4.0	4-7-8-10	15	22				Brown, dry, medium dense, fine to coarse SAND, (Fill).	
								114.4		4.0	
	3D	24/24	4.0 - 6.0	10-10-11-10	21	30				Grey, moist, very stiff, Silty CLAY, (Marine Clay Crust).	
5											
	4D	24/24	6.0 - 8.0	9-13-12-11	25	36				Grey, moist, hard, Silty CLAY, 2" sand seam at 7.2', (Marine Clay Crust).	LL=28 PL=16 PI=12 WC=23.1
	5D	24/24	8.0 - 10.0	6-11-13-10	24	35				Grey, moist, hard, Silty CLAY, (Marine Clay Crust).	
10							SPIN				
							73				
							97				
							85	105.4		13.0	
	6D	24/24	14.0 - 16.0	WOH-WOH-WOH-WOH	--		RC			Grey, wet, Silty CLAY, trace fine sand, (Marine Clay).	LL=28 PL=16 PI=12 WC=27.5
15											
20	MV1 7D	24/13	19.0 - 21.0	1-1-1-1	2	3				MV1: Could not advance vane at 19.0'. Grey, wet, Silty CLAY, trace fine sand, (Marine Clay).	
	MV2									MV2: Could not advance vane at 24.0'.	
25	8D	24/24	24.0 - 26.0	1-1-1-WOH	2	3				Grey, wet, Silty CLAY, fine sand in top 4", (Marine Clay).	

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.863.
2. Water level measured immediately after removal of casing.
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346804.4N, 1032937.5E).
5. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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: Yarmouth Route 1
Bridge No. 5804 over I-295
Location: Yarmouth, Maine

Boring No.: BB-YR1-102

WIN: 22382.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	118.4	**Auger ID/OD:**	4.25" OD
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	E. Tombaugh	**Rig Type:**	B-53 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	4/11/22-4/11/22	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NX
Boring Location:	Sta. 115+35.8, 11.6' Rt	**Casing ID/OD:**	4.25"/4.5"	**Water Level*:**	7.9'
Hammer Efficiency Factor:	0.863	**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
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
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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
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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											
								90.9		27.5	
										Probable transition between Marine Clay and Marine Sand at 27.5' bgs based on increased rollerbit resistance and wash return.	
	9D	24/16	29.0 - 31.0	16-22-20-19	42	60				Grey, wet, very dense, fine to medium SAND, some silt, trace gravel, (Marine Sand).	G#22-S-1265
30											
	10D	11/5	34.0 - 34.9	24-57/5"	--		NX			Grey, wet, very dense, fine SAND and weathered rock. Top 3" is black rock, then 1.5" fine white sand, then 0.5" white weathered rock. Probable top of bedrock at 34.9'.	
35	R1	60/60	35.0 - 40.0	RQD = 92%				83.5		34.9	
										Advanced roller bit to 35.0' and set up to core. R1: Hard, fresh to weathered, coarse to very coarse grained, white and grey, GRANITE. Joints are close to widely spaced, high angle, planar, smooth, fresh to decomposed, partially open, bottom 15" is weathered. Recovery = 100% Rock Quality = Excellent Rock Core Times (min:sec): 35.0-36.0' (3:36), 36.0-37.0' (2:56), 37.0-38.0' (2:42), 38.0-39.0' (3:05), 39.0-40.0' (2:27)	
40	R2	28/28	40.0 - 42.3	RQD = 63%						R2: Hard, weathered, coarse grained to very coarse grained, grey and white, GRANITE. Primary joints are close to moderately spaced, high angle, planar, smooth, decomposed, partially open to open. Secondary joints are close to moderately spaced, low angle, planar, smooth, decomposed, partially open to open. Recovery = 100% Rock Quality = Fair Rock Core Times (min:sec): 40.0-41.0' (1:40), 41.0-42.0' (2:31), 42.0-42.3' (1:11)	
	R3	40/32	42.3 - 45.6	RQD = 48%				74.4		R3: Top 19": Hard, weathered, coarse grained to very coarse grained, grey and white, GRANITE. Joints are closely spaced, high angle, planar, smooth, decomposed, open.	
										44.0	
45								72.8		R3: Bottom 13": Hard, fresh, aphanitic, grey, SCHIST. One joint is moderately dipping, planar, smooth, fresh, partially open. Recovery = 80% Rock Quality = Poor Rock Core Times (min:sec): 42.3-43.0' (1:50), 43.0-44.0' (3:26), 44.0-45.0' (3:08), 45.0-45.6' (0:50)	
										45.6	
										Bottom of Exploration at 45.6 feet below ground surface.	
50											

Remarks:

1. Automatic hammer NEBC #28 Energy Transfer Ratio = 0.863.
2. Water level measured immediately after removal of casing.
3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.
4. As-drilled boring locations were surveyed by MaineDOT in the field (346804.4N, 1032937.5E).
5. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based on percentages passing specific grain sizes.

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 D

FB-MultiPier Output

Soil Properties

Global | Lateral | Axial | Torsional | Tip

Soil Set Table

Soil Set	Soil Layers	Water Table (ft)	Cyclic Loading	Use SPT 'N' Values	Delete Soil Set
1	5	111.00	☐	SPT	Delete
Add Set					

Notes

1. Enter number of soil sets and soil layers in Soil Set Table.
2. Enter layer elevations, select soil models, etc, in Soil Layer Table.
3. Enter soil properties appropriate to each model on Lateral, Axial, Torsional, and Tip pages.
4. The 'Add Layer' button adds a layer to the soil set above the button.
5. When a layer elevation is changed, all affected layers will have their elevations automatcially adjusted.
6. API soils are designed specifically for steel pipe piles.
7. If 'Specify Top & Bottom Properties' is not checked, the 'Unit Weight (Top)' will apply to both the top and bo

Soil Layer Table

Soil Layer	Soil Type	Top Layer Elevation (ft)	Bottom Layer Elevation (ft)	Lateral Model	Axial Model	Torsional Model	Tip Model	Unit Weight (Top) (pcf)
1	Cohesionless	119.00	114.00	Sand (Reese)	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	125.000
2	Cohesive	114.00	105.00	Clay (Stiff without free water)	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	120.000
3	Cohesive	105.00	91.00	Clay (Soft; Matlock)	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	118.000
4	Cohesionless	91.00	84.00	Sand (Reese)	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	120.000
5	Rock	84.00	77.00	Strong Rock	Driven Pile (McVay)	Hyperbolic	Driven Pile (McVay)	170.000

Global | Lateral | Axial | Torsional | Tip

Notes

1 .Only the soil properties relevant to the currently selected model are enabled.
2. To enter 'Custom P-Y' data, select 'Custom P-Y' as Lateral model, then right click the cell.
3. API soils are designed specifically for steel pipe piles.
4. The 'Print' button prints the table data for the current page. Landscape orientation is recommended.

Lateral Model Table

Soil Set	Soil Layer	Lateral Model	Internal Friction Angle (deg)	Subgrade Modulus (lb/in^3)	Mass Modulus (ksi)	Stiffness Constant krm	Undrained Shear Strength (psf)	Major Principal Strain @50%	Major Principal Strain @100%	Average Undrained Shear Strength (psf)	Unconfined Compressive Strength (psf)
1	1	Sand (Reese)	32.0000	83.0000							
1	2	Clay (Stiff without free water)					1250.0000	0.0070		1250.0000	
1	3	Clay (Soft; Matlock)					575.0000	0.0080			
1	4	Sand (Reese)	32.0000	55.0000							
1	5	Strong Rock									1000000.0000

Global | Lateral | Axial | Torsional | Tip

Notes

1. Only the soil properties relevant to the currently selected model are enabled.
2. To enter 'Custom T-Z' data, select 'Custom T-Z' as Axial model, then right click the cell.
3. API soils are designed specifically for steel pipe piles. The API method 'API RP 2A-LRFD (1993)' requires 'Internal Friction Angle' and 'Coefficient Side Friction' and 'Disp. at Nominal Unit Side Friction'.
4. If the Axial model Driven Pile (McVay) is selected for any layer in a soil set, it must be used for all layers in the soil set.
5. The Driven Pile (McVay) model recommends using Small Strain Shear Modulus. See the Help Manual for more details.
6. Drilled Shaft IGM (Cohesive) only allows one input each for Pile Concrete, Unit Weight, and Slump.
7. The 'Print' button prints the table data for the current page. Landscape orientation is recommended.

Axial Model Table

Soil Set	Soil Layer	Axial Model	API Method	Internal Friction Angle (deg)	Small Strain Shear Modulus (ksi)	Poisson's Ratio
1	1	Driven Pile (McVay)			0.60	0.30
1	2	Driven Pile (McVay)			0.60	0.47
1	3	Driven Pile (McVay)			0.60	0.43
1	4	Driven Pile (McVay)			0.60	0.30
1	5	Driven Pile (McVay)			0.60	0.30

Global | Lateral | Axial | Torsional | Tip

Notes

1. Only the soil properties relevant to the currently selected model are enabled.
2. To enter 'Custom T-0' data, select 'Custom T-0' as Torsional model, then right click the cell.
3. The foundation type should be considered when selecting a representative Shear Modulus. See the Help Manual for more details.
4. The 'Print' button prints the table data for the current page. Landscape orientation is recommended.

Torsional Model Table

Soil Set	Soil Layer	Torsional Model	Shear Modulus (ksi)	Torsional Shear Stress (psf)
1	1	Hyperbolic	0.60	1000.00
1	2	Hyperbolic	0.60	1000.00
1	3	Hyperbolic	0.60	1000.00
1	4	Hyperbolic	0.60	1000.00
1	5	Hyperbolic	0.60	1000.00

Global | Lateral | Axial | Torsional | Tip

Notes

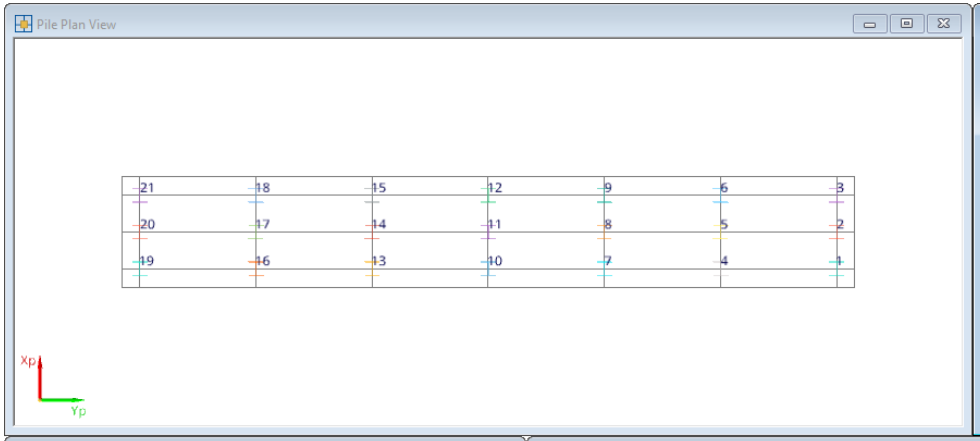
1. Only the soil properties relevant to the currently selected model are enabled.
2. Only the 'Tip' layer for each soil set is shown on this page.
3. Tip properties can be distinct from properties for other soil models. For example, internal friction angle can have different values for the tip and lateral mo
4. API soils are designed specifically for steel pipe piles. The API method 'API RP 2A-LRFD (1993)' requires 'Internal Friction Angle'. The API method 'API RP 2
5. The Driven Pile (McVay) model recommends using Small Strain Shear Modulus. See the Help Manual for more details.
6. To enter 'Custom Q-Z' data, select 'Custom Q-Z' as Tip model, then right click the cell.
7. The 'Print' button prints the table data for the current page. Landscape orientation is recommended.

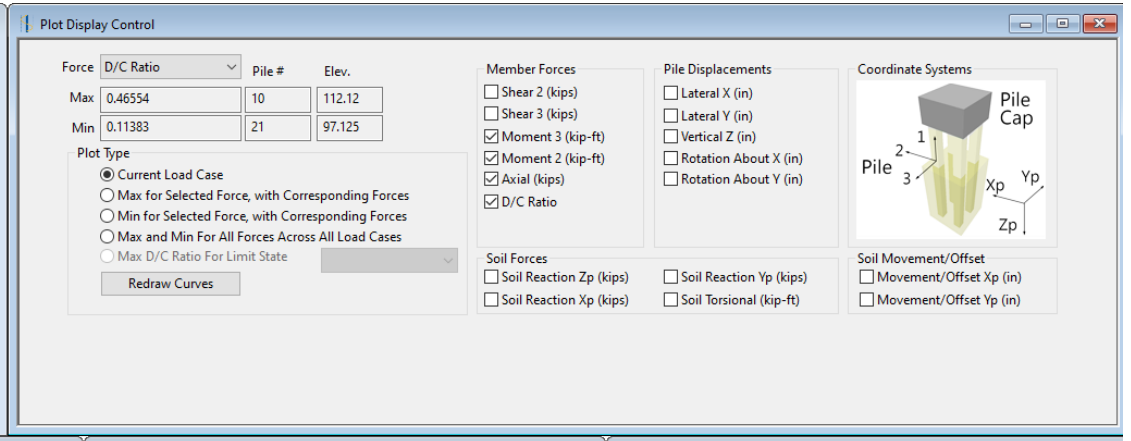
Tip Model Table

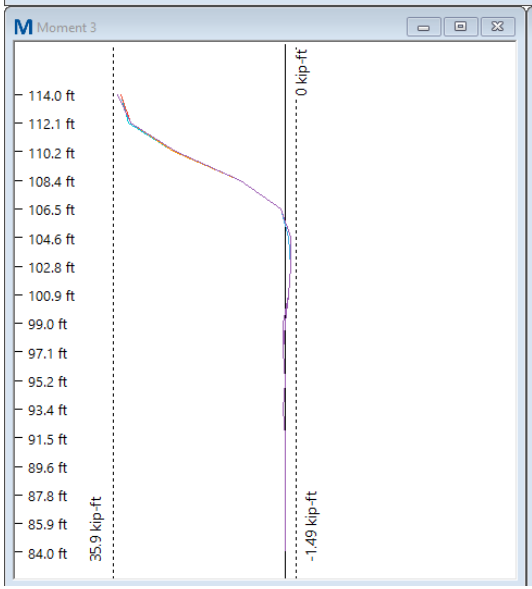
Soil Set	Soil Layer	Tip Model	API Method	Internal Friction Angle (deg)	Small Strain Shear Modulus (ksi)	Poisson's Ratio	Nominal Tip Resistance (kips)
1	Tip	Driven Pile (McVay)			1000.0000	0.2300	1000.0000

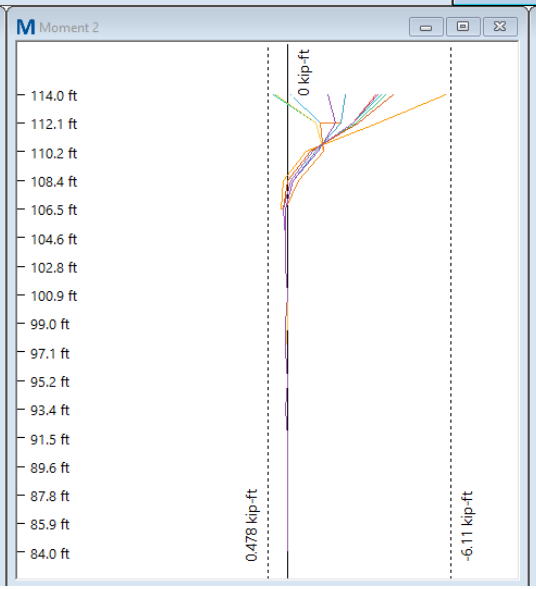
Appendix D - FB-MultiPier Output (4 of 5)

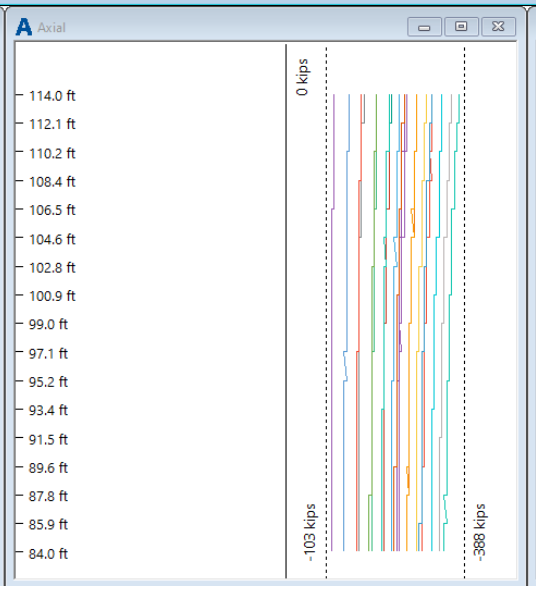
FBP Outputs

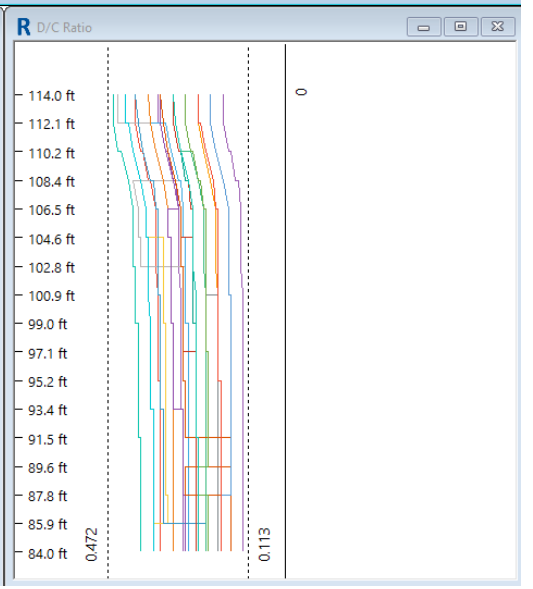




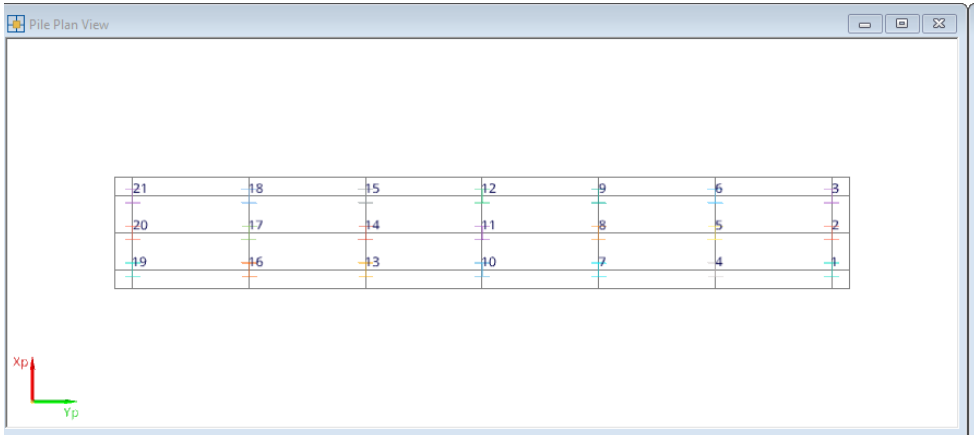


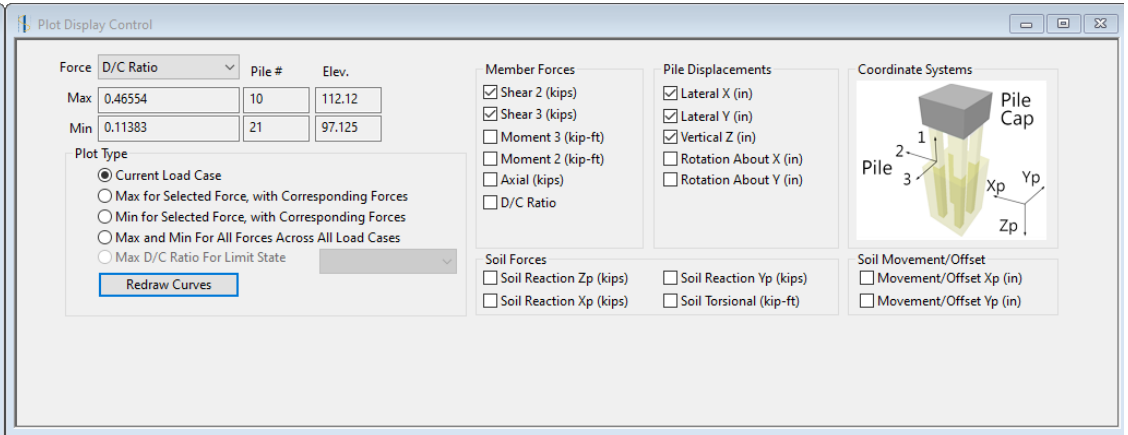


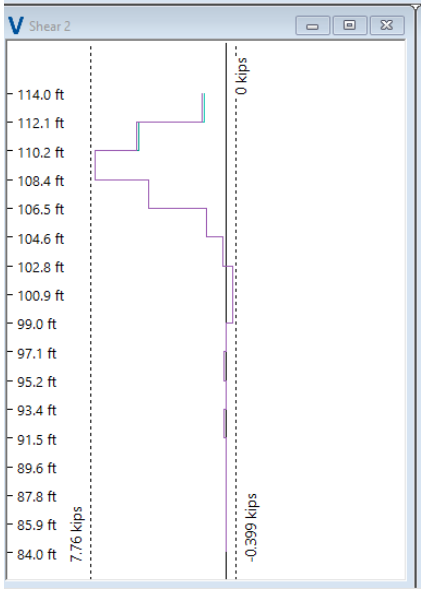


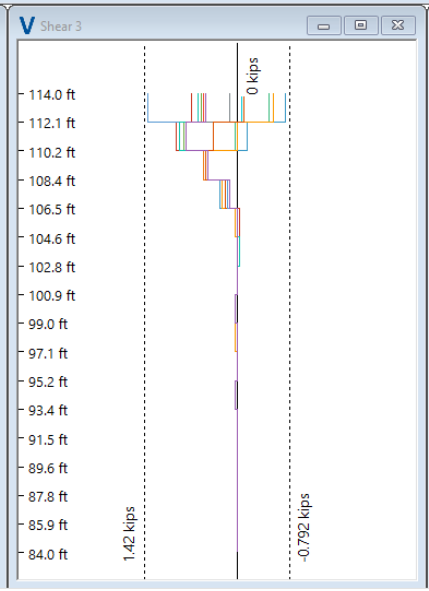


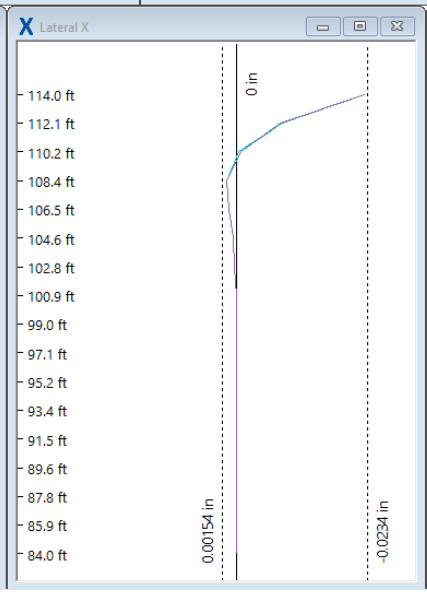
Appendix D - FB-MultiPier Output (5 of 5)

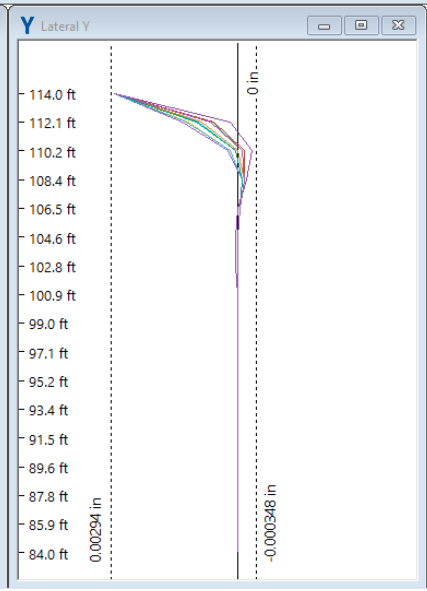


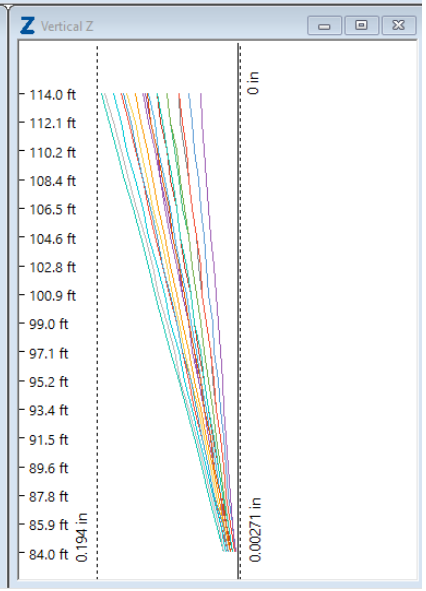




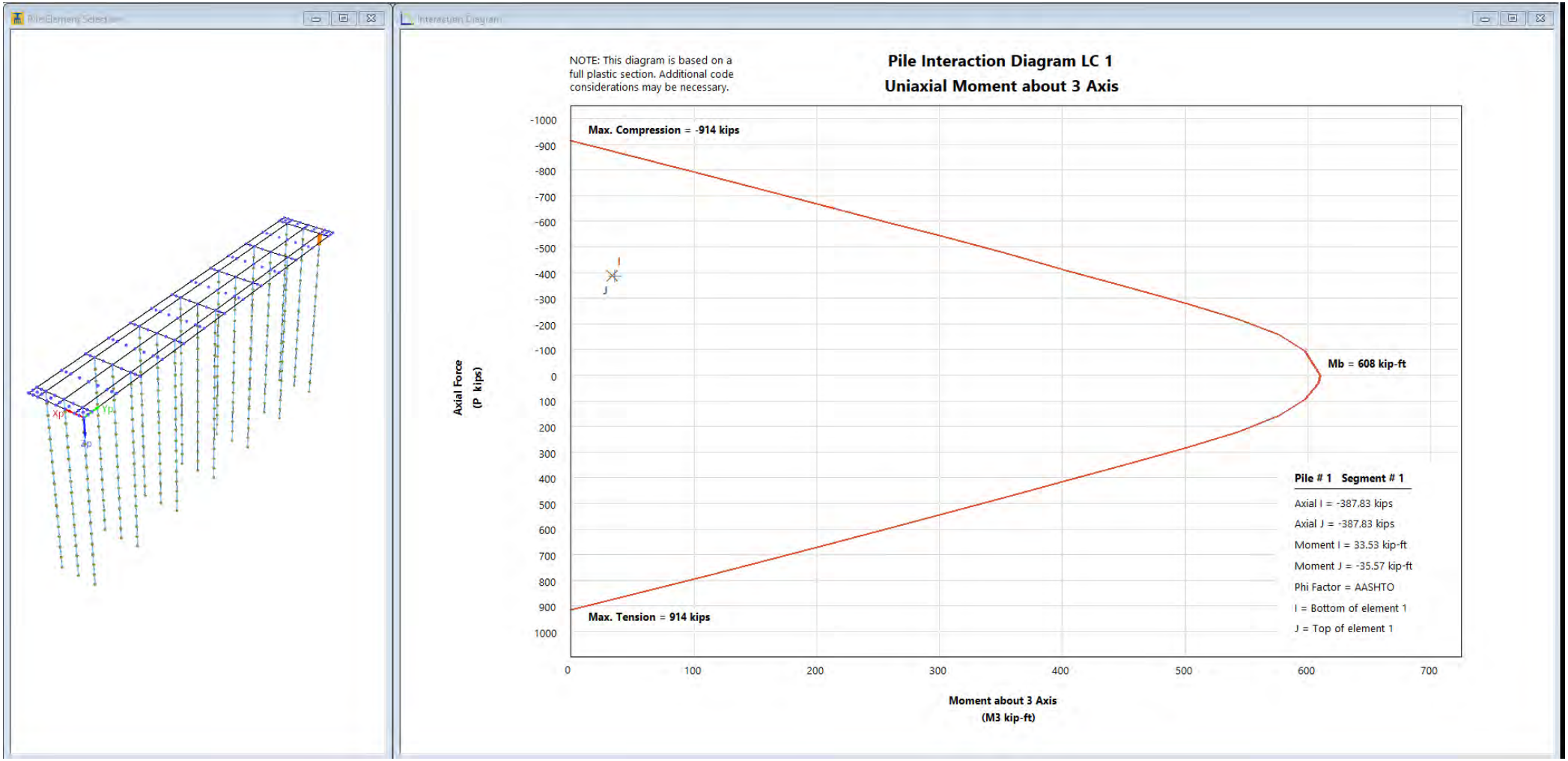








P-M Curve for Pile With Largest Demand-Capacity Ratio (Pile #1, Segment #1)



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Engineers and Scientists

JOB: 09.0026144.00 US Route 1 Bridge
SUBJECT: Axial Pile Resistance
SHEET: 1 OF 5
CALCULATED BY: E. Tome, 10/28/24
REVIEWED BY: BMC/ARB, 11/14/24

Objective

Evaluate the axial geotechnical resistance of the abutment and pier piles for the US Route 1 Bridge over I-295 in Yarmouth ME. Evaluations were conducted to assess a suitable driving system to install a HP 14x89 pile to the required geotechnical nominal resistance of 641 kips for Abutment 1, 506 kips for Abutment 2, and 597 kips for the pier piles.

Methodology

Evaluate proposed pile section for governing factored axial compression resistance as follows.

1. Nominal Compressive Resistance
2. Factored Structural Compressive Resistance - Strength Limit State
3. Factored Structural Compressive Resistance - Extreme/Service Limit State
4. Geotechnical Resistance (Static Analysis)
5. Geotechnical Resistance (Drivability Analysis)
6. Factored Geotechnical Resistance - Strength Limit State
7. Factored Geotechnical Resistance - Extreme/Service Limit State

References

1. American Association of State Highway and Transportation Officials, AASHTO LRFD Bridge Design Specifications: Customary U.S. Units, 9th edition. (AASHTO LRFD)

Soil Properties

Consider US Route 1 Bridge Interpretive Subsurface Profile (see Figure 3), subsurface layering and properties relative to pile design are presented in the Apile outputs attached.

Structural Properties

ASTM A572, Gr. 50 piles

Yield Strength of Steel $F_y := 50ksi$

Young's Modulus of Steel $E_s := 30000 \cdot ksi$

Pier: HP14x89

Radius of gyration (weak axis) $r_y := 3.53in$

Radius of gyration (strong axis) $r_x := 5.88in$

Area of section $A_s := 26.1in^2$

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JOB: 09.0026144.00 US Route 1 Bridge
SUBJECT: Axial Pile Resistance
SHEET: 2 OF 5
CALCULATED BY: E. Tome, 10/28/24
REVIEWED BY: BMC/ARB, 11/14/24

1. Nominal Structural Compressive Resistance P_n

Nominal Compressive Resistance: $P_n := 0.66^{\lambda} \cdot F_y \cdot A_s$ AASHTO Eq. 6.9.5.1-1

Determine normalized column slenderness factor λ

$$\lambda := \left(\frac{K \cdot l}{r_y \cdot \pi}\right)^2 \cdot \frac{F_y}{E_s}$$ AASHTO Eq. 6.9.4.1-3 pg. 6-74

$\lambda := 0$ Where the pile is fully embedded, AASHTO 10.7.3.13.1.

Giving: $P_n := 0.66^{\lambda} \cdot F_y \cdot A_s$ $P_n = 1305 \cdot kip$

2. Factored Structural Compressive Resistance - Strength Limit State:

Factor for piles in compression under hard driving conditions:

From Article 6.5.4.2 $\phi_c := 0.5$

Factored Compressive Resistance for Strength Limit State per AASHTO Eq. 6.9.2.1-1:

$P_r := \phi_c \cdot P_n = 652.5 \cdot kip$

3. Factored Structural Compressive Resistance - Service/Extreme Limit State:

Resistance Factors for Extreme Limit States:

From Article 10.5.5.1 and 10.5.5.3 $\phi := 1$

Factored Compressive Resistance for Service/Extreme Limit State per AASHTO Eq. 6.9.2.1-1 :

$P_{r.1} := \phi \cdot P_n = 1305 \cdot kip$

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JOB: 09.0026144.00 US Route 1 Bridge
SUBJECT: Axial Pile Resistance
SHEET: 3 OF 5
CALCULATED BY: E. Tome, 10/28/24
REVIEWED BY: BMC/ARB, 11/14/24

4. Geotechnical Axial Resistance - Static Analysis

AASHTO Article 10.7.3.2.3 states that the nominal resistance of piles driven to point bearing on hard rock is controlled by the structural limit state or potential for driving damage to occur during hard driving.

Abutment 1: Required nominal resistance of 641 kips for the pile configuration based on a maximum factored pile load of 416 kips (max factored 356 kips provided by HTA and 60 kips downdrag) and a 0.65 resistance factor.

Abutment 2: Required nominal resistance of 506 kips for the pile configuration based on a maximum factored pile load of 329 kips (max factored 288 kips provided by HTA and 41 kips downdrag) and a 0.65 resistance factor.

Pier: Required nominal resistance of 597 kips for the pile configuration based on a maximum factored pile load of 388 kips (see pier pile analysis) and a 0.65 resistance factor.

The estimated % skin friction resistance is 10-20% for the piles for Abutment 1 and the central pier at the required nominal pile resistance, based on the estimated friction resistance. The estimated % skin friction resistance is 60% for the piles for Abutment 2 at the required nominal pile resistance, based on the estimated friction resistance. A-pile is higher, but we anticipate driving resistance in the Marine clay may be lower than the calculated static resistance.

5. Geotechnical Axial Resistance - Drivability Analysis

$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y$ AASHTO Eq. 10.7.8.1

$f_y := 50\text{ksi}$ yield Strength of steel

$\phi_{da} := 1.0$ AASHTO Table 10.5.5.2.3-1 Refers to Article 6.5.4.2, Pg. 6-28

$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y$ $\sigma_{dr} = 45 \cdot \text{ksi}$ Driving Stress in pile cannot exceed 45 ksi

Abutment 1 Piles - Drive piles plumb through 23 feet of soil to rock with toe quake representative of tip resistance on rock (0.04 in) and no plug. Model pile length as 45 feet (22 foot stickup at end of drive). Install piles prior to peastone placement.

Drive Abutment 1 piles with a Pileco D30-32 open-ended diesel hammer with a maximum rated energy of 70,066 ft-lbs (fuel setting 4, three below max).

Abutment 2 Piles - Drive piles plumb through 46 feet of soil to rock with toe quake representative of tip resistance on rock (0.1 in) and no plug. Model pile length as 70 feet (24 foot stickup at end of drive). Install piles prior to peastone placement.

Drive abutment piles with a Pileco D30-32 open-ended diesel hammer with a maximum rated energy of 70,066 ft-lbs (fuel setting 4, three below max)

Pier Piles - Drive piles plumb through 28 feet of soil to rock with toe quake representative of tip resistance on rock (0.04 in) and no plug. Model pile length as 38 feet (10 foot stickup at end of drive).

Drive pier piles with a Pileco D30-32 open-ended diesel hammer with a rated energy of 70,066 ft-lbs (fuel setting 4, three below max).

GRLWEAP Output is attached for the piles.

$R_{ndr1} := 641kip$ Abutment 1 Required nominal geotechnical resistance:
Toe quake 0.04 in (fuel setting 4) - pile driving stress=45 ksi, final penetration resistance=8 bpi.

$R_{ndr2} := 506kip$ Abutment 2 Required nominal geotechnical resistance:
Toe quake 0.1 in (fuel setting 4) - pile driving stress=27 ksi, final penetration resistance=7 bpi.

$R_{ndr3} := 597kip$ Pier Required nominal geotechnical resistance:
Toe quake 0.04 in (fuel setting 2) - pile driving stress=41 ksi, final penetration resistance=7 bpi.

6. Factored Drivability Resistance - Strength Limit State:

Strength Limit State Factored Drivability Resistance:

PDA, WEAP and CAPWAP used to establishing driving criteria $\phi_{dyn} := 0.65$ AASHTO Table 10.5.5.2.3-1

Abutment 1: $R_{ndr1_factored} := R_{ndr1} \cdot \phi_{dyn}$

$R_{ndr1_factored} = 417 \cdot kip$ 60 kips downdrag and 356 kips maximum factored axial load

Abutment 2: $R_{ndr2_factored} := R_{ndr2} \cdot \phi_{dyn}$

$R_{ndr2_factored} = 329 \cdot kip$ 41 kips downdrag and 288 kips maximum factored axial load

Pier: $R_{ndr3_factored} := R_{ndr3} \cdot \phi_{dyn}$

$R_{ndr3_factored} = 388 \cdot kip$

7. Factored Drivability Resistance - Service/Extreme Limit States:

Service and Extreme Limit State Factored Drivability Resistance:

Resistance Factors for Extreme Limit States: $\phi_{serv_ext} := 1$

From Article 10.5.5.1 and 10.5.5.3

Abutment 1: $R_{ndr1_serv_ext} := R_{ndr1} \cdot \phi_{serv_ext}$

$R_{ndr1_serv_ext} = 641 \cdot kip$

Abutment 2: $R_{ndr2_serv_ext} := R_{ndr2} \cdot \phi_{serv_ext}$

$R_{ndr2_serv_ext} = 506 \cdot kip$

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JOB: 09.0026144.00 US Route 1 Bridge
SUBJECT: Axial Pile Resistance
SHEET: 5 OF 5
CALCULATED BY: E. Tome, 10/28/24
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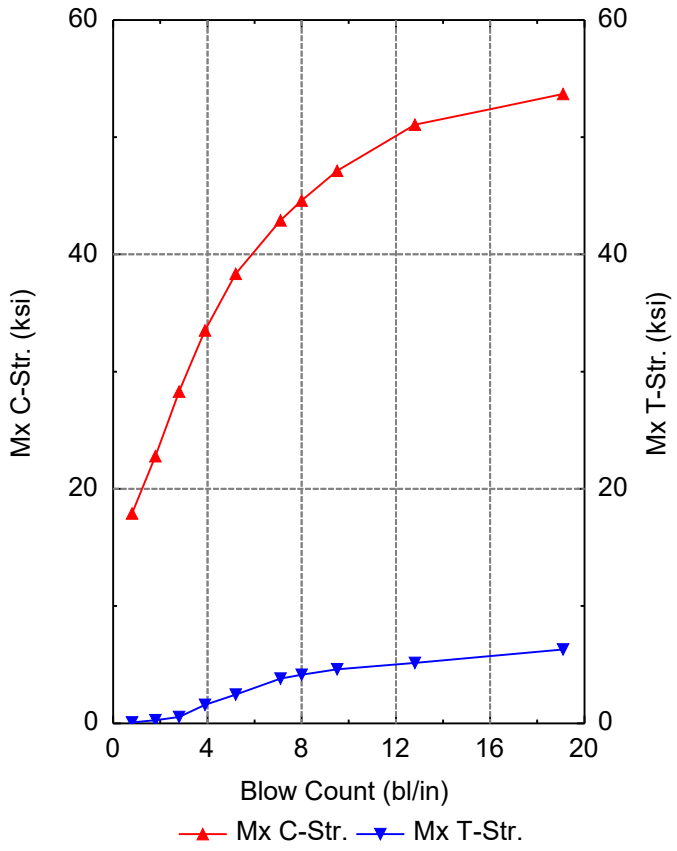
Pier:

$$R_{ndr3_serv_ext} := R_{ndr3} \cdot \phi_{serv_ext}$$

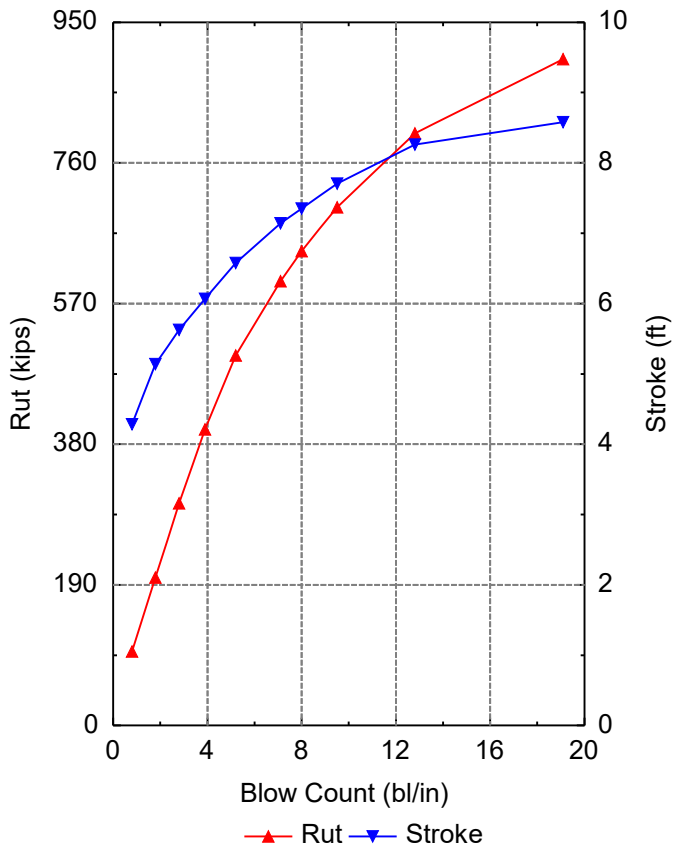
$$R_{ndr3_serv_ext} = 597 \cdot kip$$

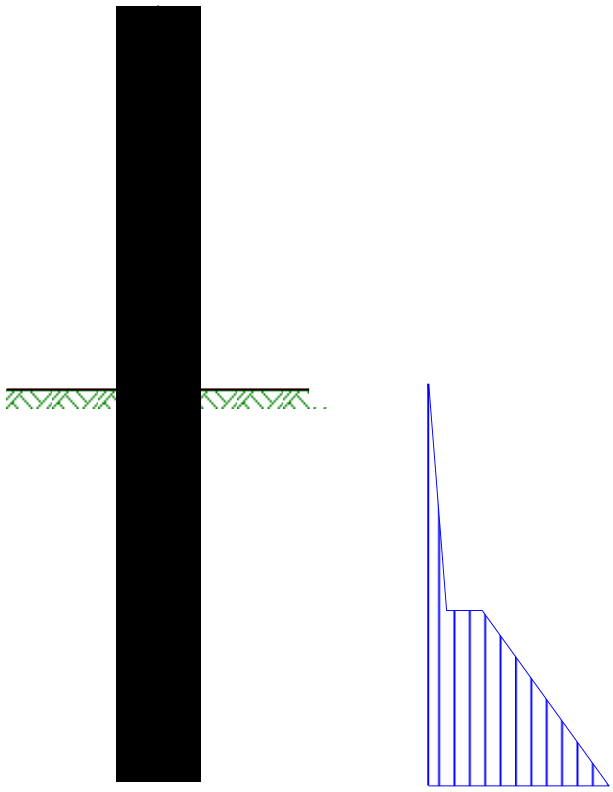
Since the driving stresses do not exceed the limiting driving stress of 45 ksi for ASTM A572 steel (50 ksi yield stress), and the calculated penetration resistance for both abutment and pier piles are within the MaineDOT preferred range of 6 to 15 blows per inch, the analyzed hammer systems are judged acceptable to install the piles to the required nominal resistances.



PILECO D30-32

Ram Weight	6.61	kips
Efficiency	0.800	
Pressure	1000.0 (73%)	psi
Helmet Weight	3.100	kips
Hammer Cushion	109976.0	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.040	in
Skin Damping	0.100	s/ft
Toe Damping	0.150	s/ft
Pile Length	45.00	ft
Pile Penetration	23.00	ft
Pile Top Area	26.10	in²
RSA	No	



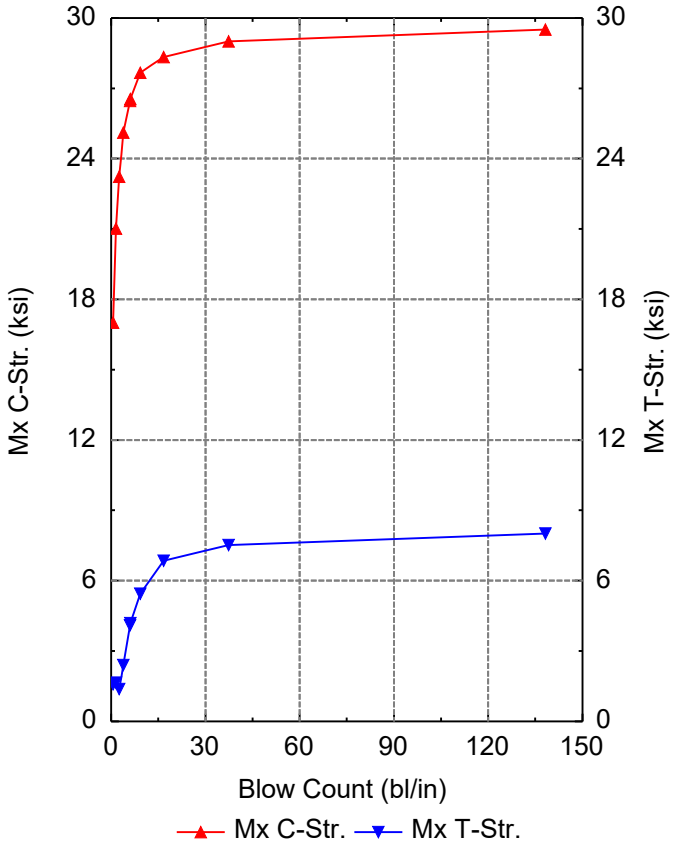


Pile Model

Shaft=5%
(Prop.)

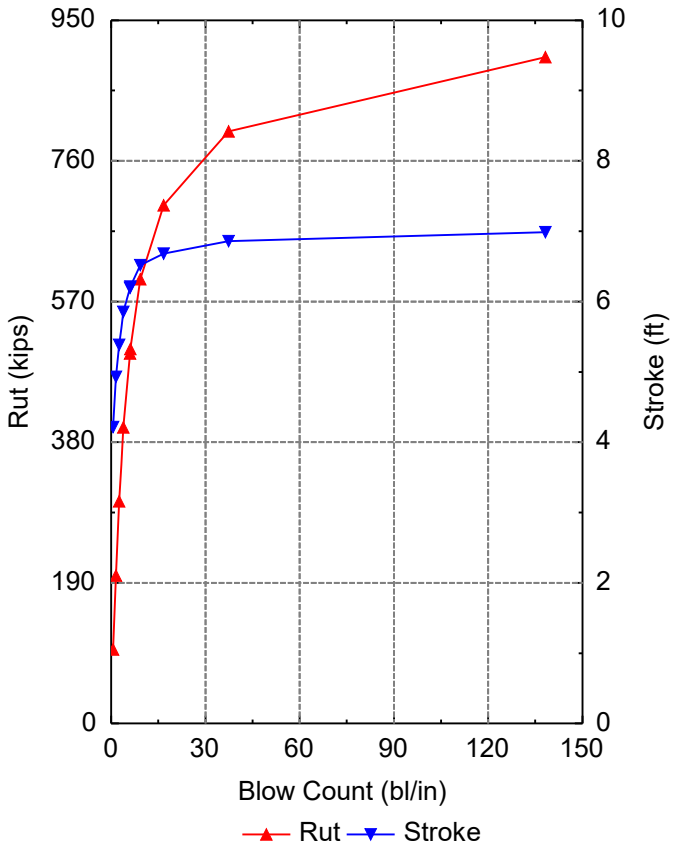
Bearing Graph Summary — PILECO D30-32

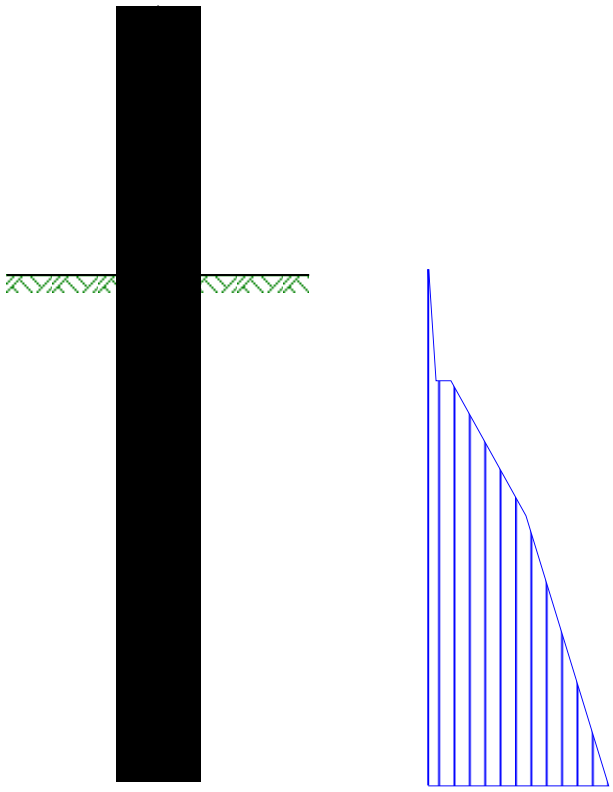
Rut	Mx C-Str.	Top Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Ham. Pow.	Trfr. R.
kips	ksi	ksi	ksi	bl/in	ft	kip-ft	PILECO	%
100.0	17.89	17.15	0.07	0.8	4.29	19.91	D30-32	28.4
200.0	22.79	20.85	0.26	1.8	5.14	18.11	D30-32	25.9
300.0	28.31	22.69	0.53	2.8	5.62	18.45	D30-32	26.3
400.0	33.51	24.23	1.57	3.9	6.07	19.66	D30-32	28.1
500.0	38.35	28.69	2.44	5.2	6.58	21.17	D30-32	30.2
600.0	42.90	34.02	3.82	7.1	7.14	23.29	D30-32	33.2
641.0	44.60	35.95	4.13	8.0	7.35	24.19	D30-32	34.5
700.0	47.13	38.64	4.61	9.5	7.71	25.69	D30-32	36.7
800.0	51.06	42.71	5.16	12.8	8.26	28.08	D30-32	40.1
900.0	53.68	45.81	6.30	19.1	8.58	29.41	D30-32	42.0



PILECO D30-32

Ram Weight	6.61	kips
Efficiency	0.800	
Pressure	1000.0 (73%)	psi
Helmet Weight	3.100	kips
Hammer Cushion	109976.0	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.100	in
Skin Damping	0.050	s/ft
Toe Damping	0.150	s/ft
Pile Length	70.00	ft
Pile Penetration	46.00	ft
Pile Top Area	26.10	in²
RSA	No	



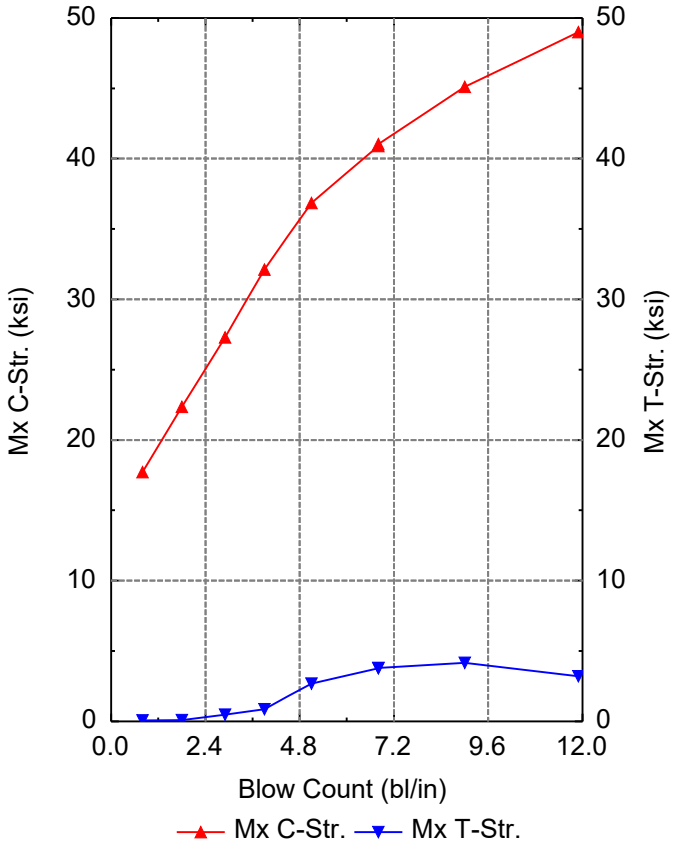


Pile Model

Shaft=60%
(Prop.)

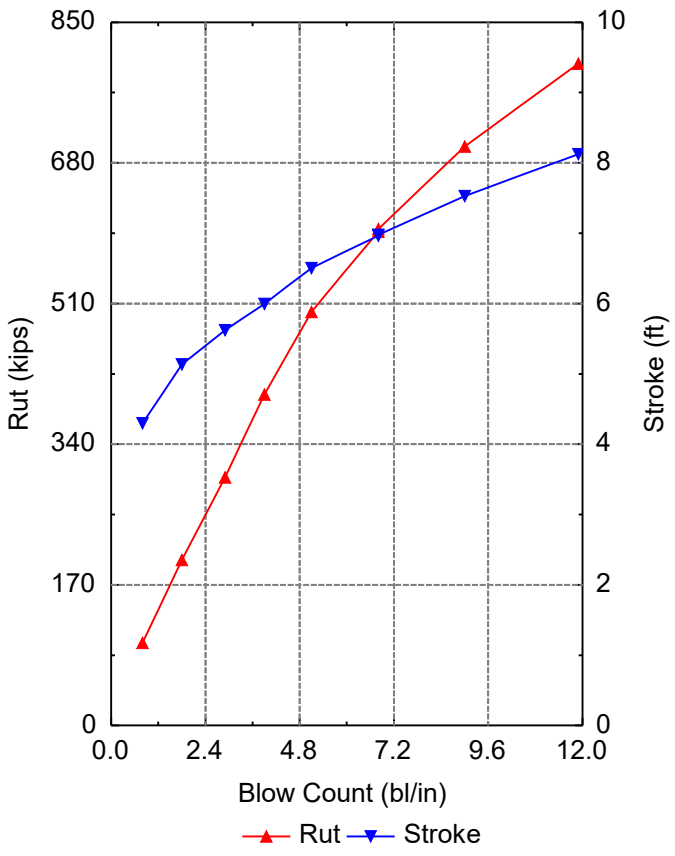
Bearing Graph Summary — PILECO D30-32

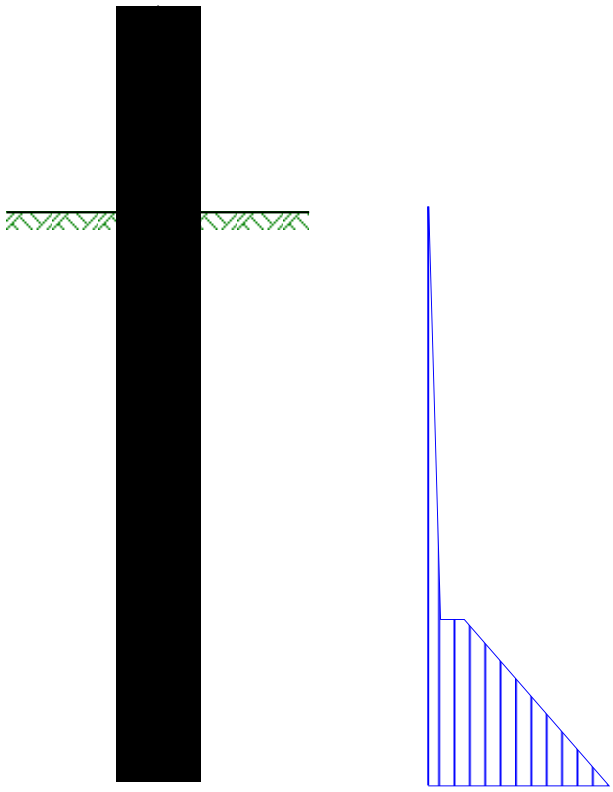
Rut	Mx C-Str.	Top Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Ham. Pow.	Trfr. R.
kips	ksi	ksi	ksi	bl/in	ft	kip-ft	PILECO	%
100.0	17.01	16.35	1.58	0.6	4.22	20.77	D30-32	29.6
200.0	21.01	20.13	1.64	1.5	4.93	18.73	D30-32	26.7
300.0	23.23	22.19	1.38	2.6	5.39	18.62	D30-32	26.6
400.0	25.11	23.96	2.40	3.9	5.85	20.04	D30-32	28.6
500.0	26.47	25.17	4.09	6.0	6.19	21.26	D30-32	30.3
506.0	26.54	25.25	4.18	6.1	6.21	21.32	D30-32	30.4
600.0	27.67	26.28	5.44	9.3	6.52	22.50	D30-32	32.1
700.0	28.33	26.84	6.84	16.7	6.68	23.06	D30-32	32.9
800.0	29.01	27.42	7.52	37.4	6.86	23.68	D30-32	33.8
900.0	29.50	27.83	8.01	138.2	6.99	24.12	D30-32	34.4



PILECO D30-32

Ram Weight	6.61	kips
Efficiency	0.800	
Pressure	1000.0 (73%)	psi
Helmet Weight	3.100	kips
Hammer Cushion	109976.0	kips/in
COR of H.C.	0.800	
Skin Quake	0.100	in
Toe Quake	0.040	in
Skin Damping	0.100	s/ft
Toe Damping	0.150	s/ft
Pile Length	38.00	ft
Pile Penetration	28.00	ft
Pile Top Area	26.10	in²
RSA	No	





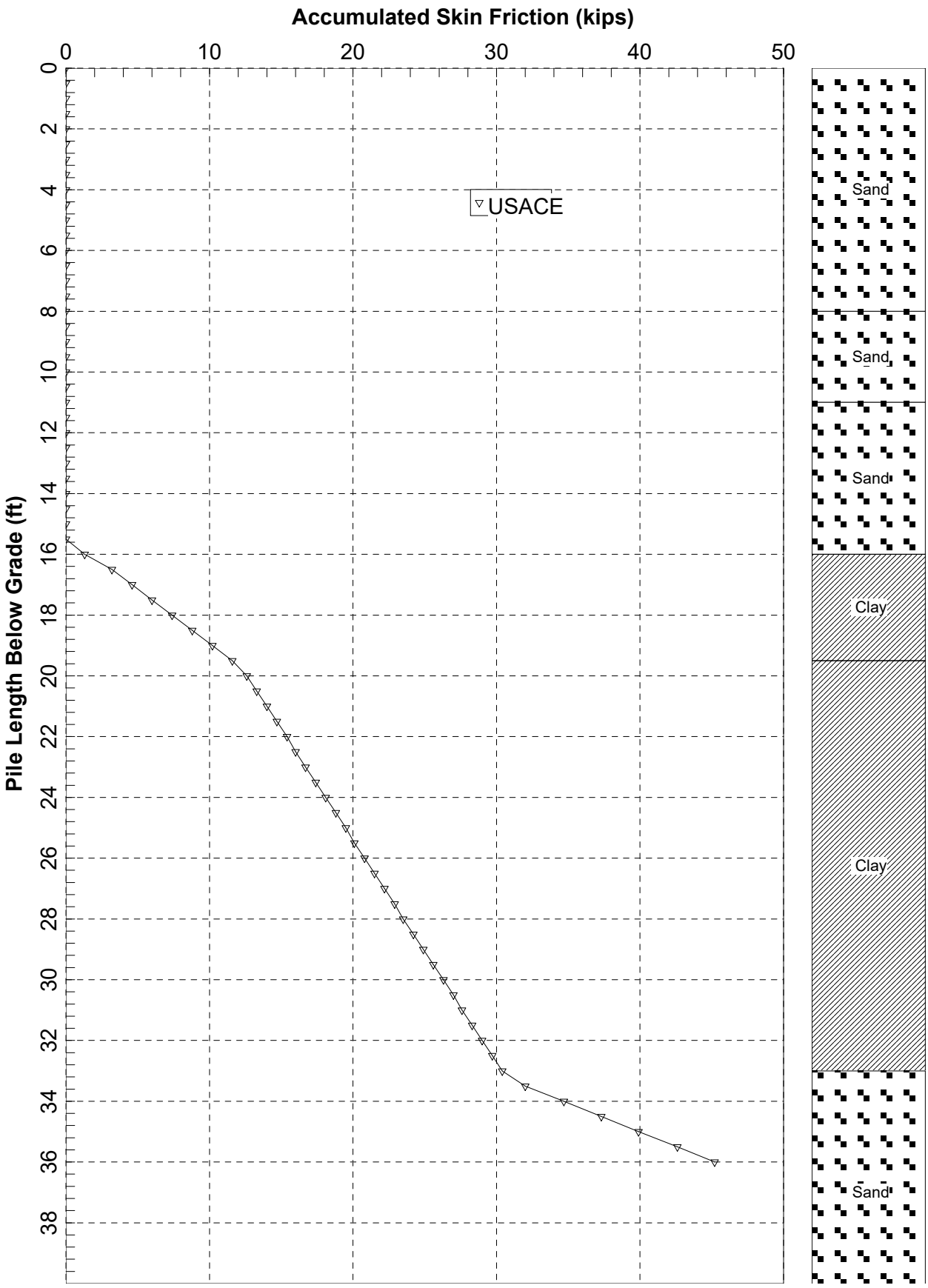
Pile Model

Shaft=10%
(Prop.)

Bearing Graph Summary — PILECO D30-32

Rut	Mx C-Str.	Top Str.	Mx T-Str.	Blow Ct	Stroke	ENTHRU	Ham. Pow.	Trfr. R.
kips	ksi	ksi	ksi	bl/in	ft	kip-ft	PILECO	%
100.0	17.72	17.27	0.05	0.8	4.30	20.28	D30-32	28.9
200.0	22.35	20.86	0.08	1.8	5.13	18.05	D30-32	25.8
300.0	27.29	22.63	0.47	2.9	5.62	18.16	D30-32	25.9
400.0	32.12	23.93	0.87	3.9	6.00	18.98	D30-32	27.1
500.0	36.85	29.93	2.68	5.1	6.51	20.60	D30-32	29.4
597.0	40.91	35.25	3.77	6.8	6.96	22.01	D30-32	31.4
600.0	41.04	35.41	3.79	6.8	6.98	22.06	D30-32	31.5
700.0	45.10	40.38	4.16	9.0	7.53	23.85	D30-32	34.0
800.0	48.99	44.79	3.21	11.8	8.13	26.23	D30-32	37.4

Abutment 1 APile Output



```
     ==========================================================================

                     APILE for Windows, Version 2023.10.5

                      Serial Number : 653550831

                      A Program for Analyzing the Axial Capacity
                      and Short-term Settlement of Driven Piles
                                under Axial Loading.
                    (c) Copyright ENSOFT, Inc., 1987-2023
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     ==========================================================================


     This program is licensed to :

     GZA GeoEnvironmental, Inc.
     Portland, OR

     Path to file locations      : P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge
5804\Work\Calcs\Drivability\Apile\
     Name of input data file     : Apile AB1 14x89.ap10d
     Name of output file         : Apile AB1 14x89.ap10o
     Name of plot output file    : Apile AB1 14x89.ap10p

     --------------------------------------------------------------------------
                          Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  November 20, 2024     Time:  09:21:22



1
          ********************
          * INPUT INFORMATION *
          ********************

          PROJECT DESCRIPTION   :
          14x89 Abutment 1
          DESIGNER   : E. Tome
          JOB NUMBER : 09.0026144.00
```

```
          METHOD FOR UNIT LOAD TRANSFERS :
          - USACE (U.S. Army Corps of Engineers)
            Unfactored Unit Side Friction and Unit Side Resistance are used.

          COMPUTATION METHOD(S) FOR PILE CAPACITY :
          - USACE (U.S. Army Corps of Engineers)
            # Critical Depth Method for Sand:
              10 to 20 Pile Diameter based on the Density

          TYPE OF LOADING :
          - COMPRESSION

          PILE TYPE :
          H-Pile/Steel Pile

           AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
          - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

          DATA FOR AXIAL STIFFNESS :
          - MODULUS OF ELASTICITY     = 0.290E+08 PSI
          - CROSS SECTION AREA        =     26.10 IN2

          NONCIRCULAR PILE PROPERTIES :
          - TOTAL PILE LENGTH, TL     =     41.00 FT.
          - BATTER ANGLE              =      0.00 DEG
          - PILE STICKUP LENGTH, PSL  =      5.00 FT.
          - ZERO FRICTION LENGTH, ZFL =     16.00 FT.
          - PERIMETER OF PILE         =     57.00 IN.
          - TIP AREA OF PILE          =    202.86 IN2
          - INCREMENT OF PILE LENGTH
            USED IN COMPUTATION       =      0.50 FT.
          - PRINTING INCREMENT        =         1


          SOIL INFORMATIONS :

                           LATERAL    EFFECTIVE    FRICTION      Nq
                    SOIL   EARTH      UNIT         ANGLE       FACTOR
           DEPTH    TYPE   PRESSURE   WEIGHT       DEGREES     ARMY C.
            FT.                      LB/FT^3
             0.00   SAND      1.25       136.00        43.00    155.20**
             8.00   SAND      1.25       136.00        43.00    155.20**
```

8.00	SAND	1.25	122.00	35.00	49.50**
11.00	SAND	1.25	122.00	35.00	49.50**
11.00	SAND	1.25	52.60	31.00	26.50**
16.00	SAND	1.25	52.60	31.00	26.50**
16.00	CLAY	0.94*	57.60	0.00	1.00**
19.50	CLAY	0.94*	57.60	0.00	1.00**
19.50	CLAY	1.00*	55.60	0.00	1.00**
33.00	CLAY	1.00*	55.60	0.00	1.00**
33.00	SAND	1.25	57.60	32.00	30.00**
41.00	SAND	1.25	57.60	32.00	30.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
8.00	1.000	1.000
8.00	1.000	1.000
11.00	1.000	1.000
11.00	1.000	1.000
16.00	1.000	1.000
16.00	1.000	1.000
19.50	1.000	1.000
19.50	1.000	1.000
33.00	1.000	1.000
33.00	1.000	1.000
41.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* ARMY CORPS METHOD *
****

PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	16.9	16.9
0.50	0.0	25.1	25.1
1.00	0.0	35.0	35.0
1.50	0.0	46.5	46.5
2.00	0.0	59.7	59.7
2.50	0.0	74.3	74.3
3.00	0.0	89.2	89.2
3.50	0.0	104.1	104.1
4.00	0.0	118.9	118.9
4.50	0.0	133.8	133.8
5.00	0.0	148.7	148.7
5.50	0.0	163.5	163.5
6.00	0.0	168.7	168.7

6.50	0.0	164.5	164.5
7.00	0.0	159.1	159.1
7.50	0.0	152.6	152.6
8.00	0.0	144.8	144.8
8.50	0.0	136.0	136.0
9.00	0.0	123.1	123.1
9.50	0.0	106.3	106.3
10.00	0.0	88.0	88.0
10.50	0.0	76.5	76.5
11.00	0.0	74.1	74.1
11.50	0.0	71.4	71.4
12.00	0.0	68.3	68.3
12.50	0.0	64.8	64.8
13.00	0.0	60.9	60.9
13.50	0.0	59.2	59.2
14.00	0.0	56.8	56.8
14.50	0.0	51.5	51.5
15.00	0.0	46.1	46.1
15.50	0.0	40.5	40.5
16.00	1.3	34.9	36.2
16.50	3.2	29.1	32.4
17.00	4.6	23.3	27.9
17.50	6.0	17.1	23.1
18.00	7.4	10.5	17.9
18.50	8.8	6.7	15.5
19.00	10.2	6.3	16.5
19.50	11.6	5.8	17.4
20.00	12.6	5.3	17.9
20.50	13.3	4.8	18.1
21.00	14.0	4.4	18.4
21.50	14.7	3.9	18.6
22.00	15.4	3.6	19.0
22.50	16.0	3.6	19.7
23.00	16.7	3.6	20.4
23.50	17.4	3.6	21.0
24.00	18.1	3.6	21.7
24.50	18.8	3.6	22.4
25.00	19.5	3.6	23.1
25.50	20.1	3.6	23.8
26.00	20.8	3.6	24.5
26.50	21.5	3.6	25.1
27.00	22.2	3.6	25.8
27.50	22.9	3.6	26.5

28.00	23.5	3.6	27.2
28.50	24.2	3.6	27.9
29.00	24.9	3.6	28.6
29.50	25.6	3.6	29.2
30.00	26.3	3.6	29.9
30.50	27.0	3.6	30.6
31.00	27.6	7.6	35.2
31.50	28.3	15.0	43.3
32.00	29.0	22.4	51.4
32.50	29.7	29.7	59.4
33.00	30.4	37.1	67.5
33.50	32.0	44.5	76.5
34.00	34.7	51.9	86.6
34.50	37.3	59.3	96.6
35.00	39.9	66.7	106.6
35.50	42.6	70.6	113.2
36.00	45.2	70.6	115.8

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00

```
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
2         10      0.4000E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
3         10      0.7958E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
4         10      0.8042E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
5         10      0.9500E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
```

```
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
6         10      0.1096E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
7         10      0.1104E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
8         10      0.1350E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
9         10      0.1596E+02
                                0.0000E+00      0.0000E+00
                                0.6302E+00      0.1000E-01
                                0.1154E+01      0.2000E-01
                                0.1973E+01      0.4000E-01
                                0.2585E+01      0.6000E-01
```

```
                                0.3060E+01      0.8000E-01
                                0.3748E+01      0.1200E+00
                                0.4222E+01      0.1600E+00
                                0.5694E+01      0.5000E+00
                                0.6744E+01      0.1000E+02
10          10      0.1604E+02
                                0.0000E+00      0.0000E+00
                                0.1287E+01      0.1000E-01
                                0.2717E+01      0.2000E-01
                                0.5648E+01      0.4000E-01
                                0.6935E+01      0.6000E-01
                                0.7149E+01      0.8000E-01
                                0.6935E+01      0.1200E+00
                                0.6649E+01      0.1600E+00
                                0.6649E+01      0.5000E+00
                                0.6649E+01      0.1000E+02
11          10      0.1775E+02
                                0.0000E+00      0.0000E+00
                                0.7324E+00      0.1000E-01
                                0.1546E+01      0.2000E-01
                                0.3215E+01      0.4000E-01
                                0.3947E+01      0.6000E-01
                                0.4069E+01      0.8000E-01
                                0.3947E+01      0.1200E+00
                                0.3784E+01      0.1600E+00
                                0.3784E+01      0.5000E+00
                                0.3784E+01      0.1000E+02
12          10      0.1946E+02
                                0.0000E+00      0.0000E+00
                                0.7324E+00      0.1000E-01
                                0.1546E+01      0.2000E-01
                                0.3215E+01      0.4000E-01
                                0.3947E+01      0.6000E-01
                                0.4069E+01      0.8000E-01
                                0.3947E+01      0.1200E+00
                                0.3784E+01      0.1600E+00
                                0.3784E+01      0.5000E+00
                                0.3784E+01      0.1000E+02
13          10      0.1954E+02
                                0.0000E+00      0.0000E+00
                                0.7013E+00      0.1000E-01
                                0.1481E+01      0.2000E-01
                                0.3078E+01      0.4000E-01
```

```
                                0.3779E+01      0.6000E-01
                                0.3896E+01      0.8000E-01
                                0.3779E+01      0.1200E+00
                                0.3624E+01      0.1600E+00
                                0.3624E+01      0.5000E+00
                                0.3624E+01      0.1000E+02
14          10      0.2625E+02
                                0.0000E+00      0.0000E+00
                                0.3594E+00      0.1000E-01
                                0.7587E+00      0.2000E-01
                                0.1577E+01      0.4000E-01
                                0.1937E+01      0.6000E-01
                                0.1997E+01      0.8000E-01
                                0.1937E+01      0.1200E+00
                                0.1857E+01      0.1600E+00
                                0.1857E+01      0.5000E+00
                                0.1857E+01      0.1000E+02
15          10      0.3296E+02
                                0.0000E+00      0.0000E+00
                                0.3594E+00      0.1000E-01
                                0.7587E+00      0.2000E-01
                                0.1577E+01      0.4000E-01
                                0.1937E+01      0.6000E-01
                                0.1997E+01      0.8000E-01
                                0.1937E+01      0.1200E+00
                                0.1857E+01      0.1600E+00
                                0.1857E+01      0.5000E+00
                                0.1857E+01      0.1000E+02
16          10      0.3304E+02
                                0.0000E+00      0.0000E+00
                                0.5422E+00      0.1000E-01
                                0.8894E+00      0.2000E-01
                                0.1308E+01      0.4000E-01
                                0.1552E+01      0.6000E-01
                                0.1711E+01      0.8000E-01
                                0.1907E+01      0.1200E+00
                                0.2023E+01      0.1600E+00
                                0.2308E+01      0.5000E+00
                                0.2464E+01      0.1000E+02
17          10      0.3700E+02
                                0.0000E+00      0.0000E+00
                                0.6371E+00      0.1000E-01
                                0.1177E+01      0.2000E-01
```

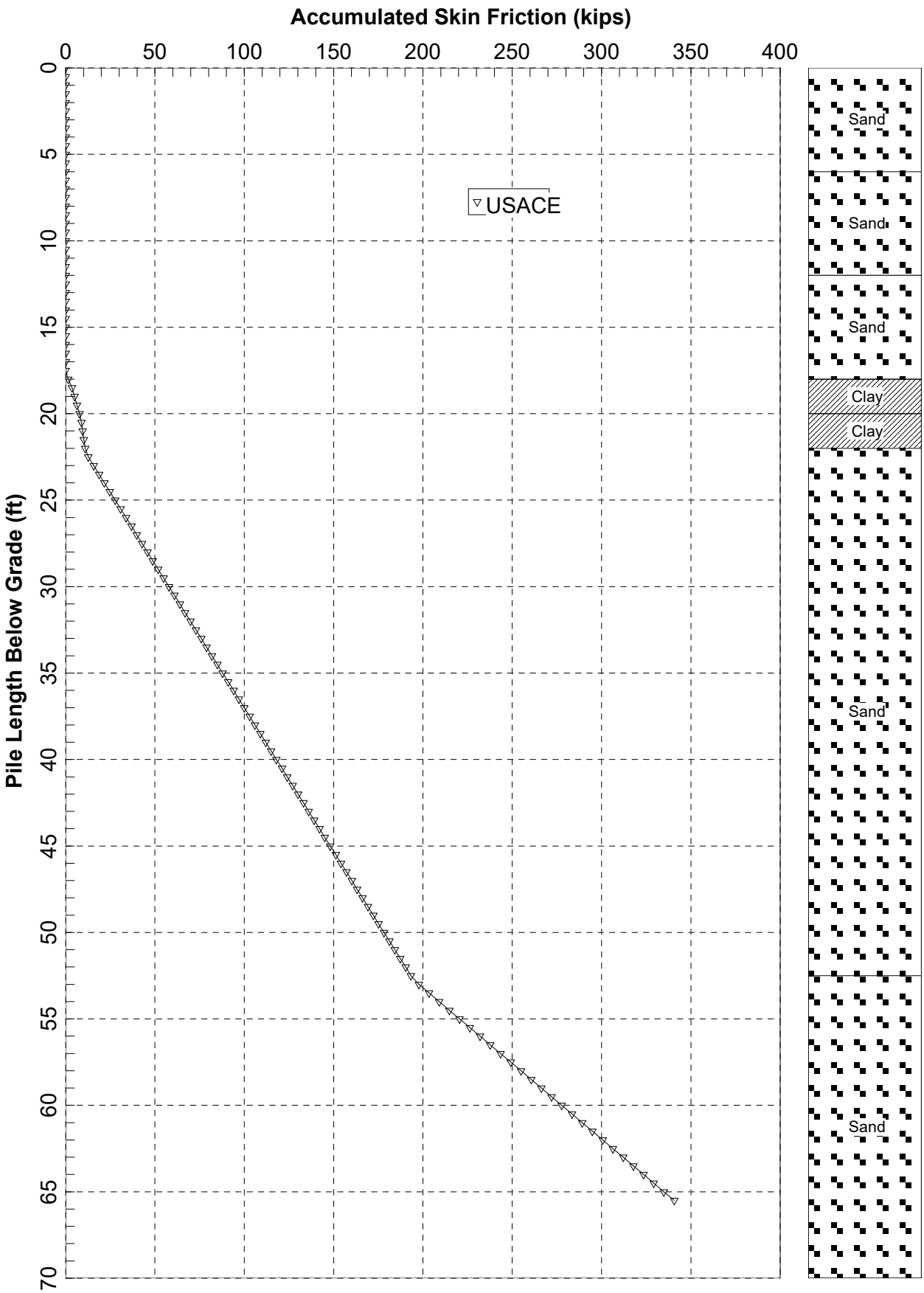
			0.2042E+01	0.4000E-01
			0.2705E+01	0.6000E-01
			0.3229E+01	0.8000E-01
			0.4005E+01	0.1200E+00
			0.4552E+01	0.1600E+00
			0.6310E+01	0.5000E+00
			0.7626E+01	0.1000E+02
18	10	0.4096E+02		
			0.0000E+00	0.0000E+00
			0.6371E+00	0.1000E-01
			0.1177E+01	0.2000E-01
			0.2042E+01	0.4000E-01
			0.2705E+01	0.6000E-01
			0.3229E+01	0.8000E-01
			0.4005E+01	0.1200E+00
			0.4552E+01	0.1600E+00
			0.6310E+01	0.5000E+00
			0.7626E+01	0.1000E+02

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.7413E+00	0.1000E-03
0.5242E+01	0.5000E-02
0.7413E+01	0.1000E-01
0.1658E+02	0.5000E-01
0.2344E+02	0.1000E+00
0.3315E+02	0.2000E+00
0.5242E+02	0.5000E+00
0.7413E+02	0.1000E+01
0.1048E+03	0.2000E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.8797E+00	0.6428E-03	0.7413E+00	0.1000E-03
0.2343E+01	0.2375E-02	0.1568E+01	0.1000E-02
0.8848E+01	0.1007E-01	0.5242E+01	0.5000E-02
0.1440E+02	0.1806E-01	0.7413E+01	0.1000E-01
0.2361E+02	0.3276E-01	0.9704E+01	0.2000E-01
0.4624E+02	0.7463E-01	0.1658E+02	0.5000E-01
0.5388E+02	0.1092E+00	0.2070E+02	0.8000E-01
0.5698E+02	0.1312E+00	0.2344E+02	0.1000E+00
0.6778E+02	0.2383E+00	0.3315E+02	0.2000E+00
0.9103E+02	0.5532E+00	0.5242E+02	0.5000E+00
0.1042E+03	0.8618E+00	0.6545E+02	0.8000E+00
0.1130E+03	0.1067E+01	0.7413E+02	0.1000E+01
0.1441E+03	0.2088E+01	0.1048E+03	0.2000E+01

Abutment 2 APile Output



```
     ============================================================================

                     APILE for Windows, Version 2023.10.5

                      Serial Number : 653550831

                      A Program for Analyzing the Axial Capacity
                      and Short-term Settlement of Driven Piles
                                under Axial Loading.
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     GZA GeoEnvironmental, Inc.
     Portland, OR

     Path to file locations      : P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge
5804\Work\Calcs\Drivability\Apile\
     Name of input data file     : Apile AB2 14x89.ap10d
     Name of output file         : Apile AB2 14x89.ap10o
     Name of plot output file    : Apile AB2 14x89.ap10p

     ----------------------------------------------------------------------------
                          Time and Date of Analysis
     ----------------------------------------------------------------------------

               Date:  November 20, 2024     Time:  09:15:20



1
          ********************
          * INPUT INFORMATION *
          ********************

          PROJECT DESCRIPTION   :
          14x89 Abutment 2
          DESIGNER   : E. Tome
          JOB NUMBER : 09.0026144.00
```

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          METHOD FOR UNIT LOAD TRANSFERS :
          - USACE (U.S. Army Corps of Engineers)
            Unfactored Unit Side Friction and Unit Side Resistance are used.

          COMPUTATION METHOD(S) FOR PILE CAPACITY :
          - USACE (U.S. Army Corps of Engineers)
            # Critical Depth Method for Sand:
              10 to 20 Pile Diameter based on the Density

          TYPE OF LOADING :
          - COMPRESSION

          PILE TYPE :
          H-Pile/Steel Pile

           AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
          - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

          DATA FOR AXIAL STIFFNESS :
          - MODULUS OF ELASTICITY     = 0.290E+08 PSI
          - CROSS SECTION AREA        =     26.10 IN2

          NONCIRCULAR PILE PROPERTIES :
          - TOTAL PILE LENGTH, TL     =     70.50 FT.
          - BATTER ANGLE              =      0.00 DEG
          - PILE STICKUP LENGTH, PSL  =      5.00 FT.
          - ZERO FRICTION LENGTH, ZFL =     18.00 FT.
          - PERIMETER OF PILE         =     57.00 IN.
          - TIP AREA OF PILE          =    202.86 IN2
          - INCREMENT OF PILE LENGTH
            USED IN COMPUTATION       =      0.50 FT.
          - PRINTING INCREMENT        =         1


          SOIL INFORMATIONS :

                           LATERAL    EFFECTIVE    FRICTION      Nq
                    SOIL   EARTH      UNIT         ANGLE       FACTOR
           DEPTH    TYPE   PRESSURE   WEIGHT       DEGREES     ARMY C.
            FT.                      LB/FT^3
             0.00   SAND      1.25       136.00        43.00    155.20**
             6.00   SAND      1.25       136.00        43.00    155.20**
```

6.00	SAND	1.25	122.00	35.00	49.50**
12.00	SAND	1.25	122.00	35.00	49.50**
12.00	SAND	1.25	115.00	31.00	26.50**
18.00	SAND	1.25	115.00	31.00	26.50**
18.00	CLAY	0.94*	57.60	0.00	1.00**
20.00	CLAY	0.94*	57.60	0.00	1.00**
20.00	CLAY	1.00*	55.60	0.00	1.00**
22.00	CLAY	1.00*	55.60	0.00	1.00**
22.00	SAND	1.25	57.60	32.00	30.00**
52.50	SAND	1.25	57.60	32.00	30.00**
52.50	SAND	1.25	67.60	38.00	68.00**
70.00	SAND	1.25	67.60	38.00	68.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

LRFD FACTOR LRFD FACTOR

DEPTH FT.	ON UNIT FRICTION	ON UNIT BEARING
0.00	1.000	1.000
6.00	1.000	1.000
6.00	1.000	1.000
12.00	1.000	1.000
12.00	1.000	1.000
18.00	1.000	1.000
18.00	1.000	1.000
20.00	1.000	1.000
20.00	1.000	1.000
22.00	1.000	1.000
22.00	1.000	1.000
52.50	1.000	1.000
52.50	1.000	1.000
70.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* ARMY CORPS METHOD *
****

PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	16.9	16.9
0.50	0.0	25.1	25.1
1.00	0.0	35.0	35.0
1.50	0.0	46.5	46.5
2.00	0.0	59.7	59.7
2.50	0.0	74.3	74.3
3.00	0.0	89.2	89.2

3.50	0.0	104.1	104.1
4.00	0.0	111.6	111.6
4.50	0.0	111.9	111.9
5.00	0.0	110.9	110.9
5.50	0.0	108.9	108.9
6.00	0.0	105.6	105.6
6.50	0.0	101.2	101.2
7.00	0.0	95.6	95.6
7.50	0.0	88.9	88.9
8.00	0.0	80.9	80.9
8.50	0.0	78.2	78.2
9.00	0.0	82.4	82.4
9.50	0.0	86.7	86.7
10.00	0.0	87.9	87.9
10.50	0.0	86.4	86.4
11.00	0.0	84.7	84.7
11.50	0.0	82.7	82.7
12.00	0.0	80.5	80.5
12.50	0.0	78.0	78.0
13.00	0.0	75.4	75.4
13.50	0.0	72.4	72.4
14.00	0.0	69.3	69.3
14.50	0.0	68.1	68.1
15.00	0.0	69.4	69.4
15.50	0.0	70.4	70.4
16.00	0.0	67.4	67.4
16.50	0.0	61.0	61.0
17.00	0.0	54.3	54.3
17.50	0.0	47.4	47.4
18.00	1.4	40.0	41.5
18.50	3.6	32.2	35.8
19.00	5.0	24.4	29.4
19.50	6.4	17.0	23.3
20.00	7.8	14.1	21.8
20.50	8.8	18.3	27.1
21.00	9.5	26.3	35.8
21.50	10.2	34.4	44.5
22.00	10.9	42.4	53.2
22.50	12.7	50.6	63.3
23.00	15.7	59.1	74.8
23.50	18.7	67.6	86.3
24.00	21.7	76.0	97.8
24.50	24.7	80.6	105.3

25.00	27.8	80.6	108.3
25.50	30.8	80.6	111.3
26.00	33.8	80.6	114.4
26.50	36.8	80.6	117.4
27.00	39.8	80.6	120.4
27.50	42.8	80.6	123.4
28.00	45.8	80.6	126.4
28.50	48.8	80.6	129.4
29.00	51.8	80.6	132.4
29.50	54.8	80.6	135.4
30.00	57.8	80.6	138.4
30.50	60.9	80.6	141.4
31.00	63.9	80.6	144.5
31.50	66.9	80.6	147.5
32.00	69.9	80.6	150.5
32.50	72.9	80.6	153.5
33.00	75.9	80.6	156.5
33.50	78.9	80.6	159.5
34.00	81.9	80.6	162.5
34.50	84.9	80.6	165.5
35.00	87.9	80.6	168.5
35.50	91.0	80.6	171.5
36.00	94.0	80.6	174.6
36.50	97.0	80.6	177.6
37.00	100.0	80.6	180.6
37.50	103.0	80.6	183.6
38.00	106.0	80.6	186.6
38.50	109.0	80.6	189.6
39.00	112.0	80.6	192.6
39.50	115.0	80.6	195.6
40.00	118.0	80.6	198.6
40.50	121.1	80.6	201.6
41.00	124.1	80.6	204.7
41.50	127.1	80.6	207.7
42.00	130.1	80.6	210.7
42.50	133.1	80.6	213.7
43.00	136.1	80.6	216.7
43.50	139.1	80.6	219.7
44.00	142.1	80.6	222.7
44.50	145.1	80.6	225.7
45.00	148.1	80.6	228.7
45.50	151.2	80.6	231.7
46.00	154.2	80.6	234.7

46.50	157.2	80.6	237.8
47.00	160.2	80.6	240.8
47.50	163.2	80.6	243.8
48.00	166.2	80.6	246.8
48.50	169.2	80.6	249.8
49.00	172.2	80.6	252.8
49.50	175.2	80.6	255.8
50.00	178.2	80.6	258.8
50.50	181.3	92.5	273.7
51.00	184.3	114.6	298.9
51.50	187.3	136.8	324.0
52.00	190.3	158.9	349.2
52.50	193.3	181.1	374.4
53.00	197.7	203.2	400.9
53.50	203.4	225.4	428.7
54.00	209.1	247.5	456.6
54.50	214.8	269.7	484.5
55.00	220.5	281.5	502.1
55.50	226.3	281.5	507.8
56.00	232.0	281.5	513.5
56.50	237.7	281.5	519.2
57.00	243.4	281.5	525.0
57.50	249.1	281.5	530.7
58.00	254.9	281.5	536.4
58.50	260.6	281.5	542.1
59.00	266.3	281.5	547.8
59.50	272.0	281.5	553.6
60.00	277.7	281.5	559.3
60.50	283.5	281.5	565.0
61.00	289.2	281.5	570.7
61.50	294.9	281.5	576.4
62.00	300.6	281.5	582.2
62.50	306.3	281.5	587.9
63.00	312.1	281.5	593.6
63.50	317.8	281.5	599.3
64.00	323.5	281.5	605.0
64.50	329.2	281.5	610.8
65.00	334.9	281.5	616.5
65.50	340.7	281.5	622.2

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN

IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.1000E+02
2	10	0.3000E+01		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.1000E+02
3	10	0.5958E+01		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01

```
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   4         10      0.6042E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   5         10      0.9000E+01
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   6         10      0.1196E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   7         10      0.1204E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
```

```
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   8         10      0.1500E+02
                                0.0000E+00      0.0000E+00
                                0.0000E+00      0.1000E-01
                                0.0000E+00      0.2000E-01
                                0.0000E+00      0.4000E-01
                                0.0000E+00      0.6000E-01
                                0.0000E+00      0.8000E-01
                                0.0000E+00      0.1200E+00
                                0.0000E+00      0.1600E+00
                                0.0000E+00      0.5000E+00
                                0.0000E+00      0.1000E+02
   9         10      0.1796E+02
                                0.0000E+00      0.0000E+00
                                0.6375E+00      0.1000E-01
                                0.1178E+01      0.2000E-01
                                0.2046E+01      0.4000E-01
                                0.2713E+01      0.6000E-01
                                0.3240E+01      0.8000E-01
                                0.4022E+01      0.1200E+00
                                0.4573E+01      0.1600E+00
                                0.6351E+01      0.5000E+00
                                0.7686E+01      0.1000E+02
  10         10      0.1804E+02
                                0.0000E+00      0.0000E+00
                                0.1460E+01      0.1000E-01
                                0.3082E+01      0.2000E-01
                                0.6408E+01      0.4000E-01
                                0.7868E+01      0.6000E-01
                                0.8112E+01      0.8000E-01
                                0.7868E+01      0.1200E+00
                                0.7544E+01      0.1600E+00
                                0.7544E+01      0.5000E+00
                                0.7544E+01      0.1000E+02
  11         10      0.1900E+02
                                0.0000E+00      0.0000E+00
                                0.7324E+00      0.1000E-01
                                0.1546E+01      0.2000E-01
                                0.3215E+01      0.4000E-01
```

```
                                0.3947E+01      0.6000E-01
                                0.4069E+01      0.8000E-01
                                0.3947E+01      0.1200E+00
                                0.3784E+01      0.1600E+00
                                0.3784E+01      0.5000E+00
                                0.3784E+01      0.1000E+02
12          10      0.1996E+02
                                0.0000E+00      0.0000E+00
                                0.7324E+00      0.1000E-01
                                0.1546E+01      0.2000E-01
                                0.3215E+01      0.4000E-01
                                0.3947E+01      0.6000E-01
                                0.4069E+01      0.8000E-01
                                0.3947E+01      0.1200E+00
                                0.3784E+01      0.1600E+00
                                0.3784E+01      0.5000E+00
                                0.3784E+01      0.1000E+02
13          10      0.2004E+02
                                0.0000E+00      0.0000E+00
                                0.7013E+00      0.1000E-01
                                0.1481E+01      0.2000E-01
                                0.3078E+01      0.4000E-01
                                0.3779E+01      0.6000E-01
                                0.3896E+01      0.8000E-01
                                0.3779E+01      0.1200E+00
                                0.3624E+01      0.1600E+00
                                0.3624E+01      0.5000E+00
                                0.3624E+01      0.1000E+02
14          10      0.2100E+02
                                0.0000E+00      0.0000E+00
                                0.3594E+00      0.1000E-01
                                0.7587E+00      0.2000E-01
                                0.1577E+01      0.4000E-01
                                0.1937E+01      0.6000E-01
                                0.1997E+01      0.8000E-01
                                0.1937E+01      0.1200E+00
                                0.1857E+01      0.1600E+00
                                0.1857E+01      0.5000E+00
                                0.1857E+01      0.1000E+02
15          10      0.2196E+02
                                0.0000E+00      0.0000E+00
                                0.3594E+00      0.1000E-01
                                0.7587E+00      0.2000E-01
```

```
                                0.1577E+01      0.4000E-01
                                0.1937E+01      0.6000E-01
                                0.1997E+01      0.8000E-01
                                0.1937E+01      0.1200E+00
                                0.1857E+01      0.1600E+00
                                0.1857E+01      0.5000E+00
                                0.1857E+01      0.1000E+02
16          10      0.2204E+02
                                0.0000E+00      0.0000E+00
                                0.5464E+00      0.1000E-01
                                0.9008E+00      0.2000E-01
                                0.1333E+01      0.4000E-01
                                0.1587E+01      0.6000E-01
                                0.1754E+01      0.8000E-01
                                0.1960E+01      0.1200E+00
                                0.2083E+01      0.1600E+00
                                0.2387E+01      0.5000E+00
                                0.2554E+01      0.1000E+02
17          10      0.3725E+02
                                0.0000E+00      0.0000E+00
                                0.6437E+00      0.1000E-01
                                0.1200E+01      0.2000E-01
                                0.2111E+01      0.4000E-01
                                0.2828E+01      0.6000E-01
                                0.3406E+01      0.8000E-01
                                0.4280E+01      0.1200E+00
                                0.4911E+01      0.1600E+00
                                0.7021E+01      0.5000E+00
                                0.8691E+01      0.1000E+02
18          10      0.5246E+02
                                0.0000E+00      0.0000E+00
                                0.6437E+00      0.1000E-01
                                0.1200E+01      0.2000E-01
                                0.2111E+01      0.4000E-01
                                0.2828E+01      0.6000E-01
                                0.3406E+01      0.8000E-01
                                0.4280E+01      0.1200E+00
                                0.4911E+01      0.1600E+00
                                0.7021E+01      0.5000E+00
                                0.8691E+01      0.1000E+02
19          10      0.5254E+02
                                0.0000E+00      0.0000E+00
                                0.1104E+01      0.1000E-01
```

			0.1977E+01	0.2000E-01
			0.3271E+01	0.4000E-01
			0.4184E+01	0.6000E-01
			0.4862E+01	0.8000E-01
			0.5802E+01	0.1200E+00
			0.6423E+01	0.1600E+00
			0.8217E+01	0.5000E+00
			0.9390E+01	0.1000E+02
20	10	0.6125E+02		
			0.0000E+00	0.0000E+00
			0.1163E+01	0.1000E-01
			0.2175E+01	0.2000E-01
			0.3849E+01	0.4000E-01
			0.5178E+01	0.6000E-01
			0.6258E+01	0.8000E-01
			0.7908E+01	0.1200E+00
			0.9109E+01	0.1600E+00
			0.1320E+02	0.5000E+00
			0.1651E+02	0.1000E+02
21	10	0.6996E+02		
			0.0000E+00	0.0000E+00
			0.1163E+01	0.1000E-01
			0.2175E+01	0.2000E-01
			0.3849E+01	0.4000E-01
			0.5178E+01	0.6000E-01
			0.6258E+01	0.8000E-01
			0.7908E+01	0.1200E+00
			0.9109E+01	0.1600E+00
			0.1320E+02	0.5000E+00
			0.1651E+02	0.1000E+02

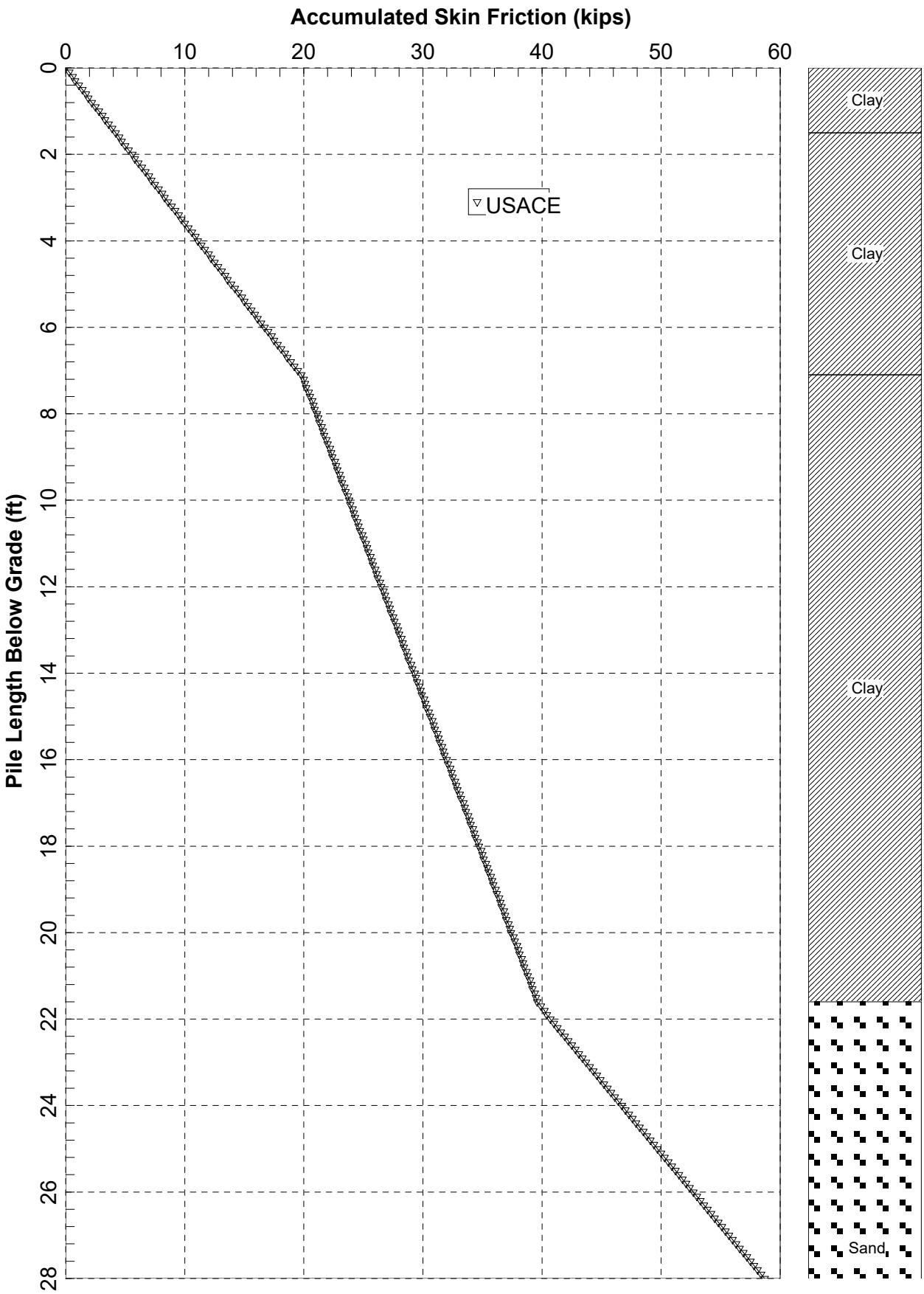
TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2956E+01	0.1000E-03
0.2090E+02	0.5000E-02
0.2956E+02	0.1000E-01
0.6610E+02	0.5000E-01
0.9347E+02	0.1000E+00
0.1322E+03	0.2000E+00
0.2090E+03	0.5000E+00
0.2956E+03	0.1000E+01
0.4180E+03	0.2000E+01

LOAD VERSUS SETTLEMENT CURVE

****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.4774E+01	0.4495E-02	0.2956E+01	0.1000E-03
0.1135E+02	0.1117E-01	0.6252E+01	0.1000E-02
0.4047E+02	0.4075E-01	0.2090E+02	0.5000E-02
0.6089E+02	0.6319E-01	0.2956E+02	0.1000E-01
0.8576E+02	0.9458E-01	0.3869E+02	0.2000E-01
0.1474E+03	0.1813E+00	0.6610E+02	0.5000E-01
0.1875E+03	0.2484E+00	0.8252E+02	0.8000E-01
0.2109E+03	0.2910E+00	0.9347E+02	0.1000E+00
0.2867E+03	0.4649E+00	0.1322E+03	0.2000E+00
0.4297E+03	0.9073E+00	0.2090E+03	0.5000E+00
0.4853E+03	0.1268E+01	0.2610E+03	0.8000E+00
0.5224E+03	0.1509E+01	0.2956E+03	0.1000E+01
0.6569E+03	0.2656E+01	0.4180E+03	0.2000E+01

Pier APile Output



```
     ========================================================================

                     APILE for Windows, Version 2023.10.5

                      Serial Number : 653550831

                      A Program for Analyzing the Axial Capacity
                      and Short-term Settlement of Driven Piles
                                under Axial Loading.
                    (c) Copyright ENSOFT, Inc., 1987-2023
                          All Rights Reserved

     ========================================================================


     This program is licensed to :

     GZA GeoEnvironmental, Inc.
     Portland, OR

     Path to file locations      : P:\09 Jobs\0026100s\09.0026144.00 - HTA - MEDOT Yarmouth Rt 1 Bridge
5804\Work\Calcs\Drivability\Apile\
     Name of input data file     : Apile Pier 14x89.ap10d
     Name of output file         : Apile Pier 14x89.ap10o
     Name of plot output file    : Apile Pier 14x89.ap10p

     ------------------------------------------------------------------------
                          Time and Date of Analysis
     ------------------------------------------------------------------------

               Date:  November 20, 2024     Time:  09:57:26



1
          **********************
          * INPUT INFORMATION *
          **********************

          PROJECT DESCRIPTION   :
          14x89 Pier
          DESIGNER   : E. Tome
          JOB NUMBER : 09.0026144.00
```

```
          METHOD FOR UNIT LOAD TRANSFERS :
          - USACE (U.S. Army Corps of Engineers)
            Unfactored Unit Side Friction and Unit Side Resistance are used.

          COMPUTATION METHOD(S) FOR PILE CAPACITY :
          - USACE (U.S. Army Corps of Engineers)
            # Critical Depth Method for Sand:
              10 to 20 Pile Diameter based on the Density

          TYPE OF LOADING :
          - COMPRESSION

          PILE TYPE :
          H-Pile/Steel Pile

           AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
          - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

          DATA FOR AXIAL STIFFNESS :
          - MODULUS OF ELASTICITY     = 0.290E+08 PSI
          - CROSS SECTION AREA        =     26.10 IN2

          NONCIRCULAR PILE PROPERTIES :
          - TOTAL PILE LENGTH, TL     =     38.00 FT.
          - BATTER ANGLE              =      0.00 DEG
          - PILE STICKUP LENGTH, PSL  =     10.00 FT.
          - ZERO FRICTION LENGTH, ZFL =      0.00 FT.
          - PERIMETER OF PILE         =     57.00 IN.
          - TIP AREA OF PILE          =    202.86 IN2
          - INCREMENT OF PILE LENGTH
            USED IN COMPUTATION       =      0.10 FT.
          - PRINTING INCREMENT        =         1


          SOIL INFORMATIONS :

                          LATERAL    EFFECTIVE    FRICTION      Nq
                   SOIL   EARTH      UNIT         ANGLE       FACTOR
           DEPTH   TYPE   PRESSURE   WEIGHT       DEGREES     ARMY C.
            FT.                      LB/FT^3
             0.00  CLAY      0.94*      120.00         0.00      1.00**
             1.50  CLAY      0.94*      120.00         0.00      1.00**
```

1.50	CLAY	0.94*	57.60	0.00	1.00**
7.10	CLAY	0.94*	57.60	0.00	1.00**
7.10	CLAY	1.00*	55.60	0.00	1.00**
21.60	CLAY	1.00*	55.60	0.00	1.00**
21.60	SAND	1.25	57.60	32.00	30.00**
33.00	SAND	1.25	57.60	32.00	30.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.62	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.29	0.03	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
1.50	1.000	1.000
1.50	1.000	1.000
7.10	1.000	1.000
7.10	1.000	1.000
21.60	1.000	1.000
21.60	1.000	1.000
33.00	1.000	1.000

****
* COMPUTATION RESULT *
****

****
* ARMY CORPS METHOD *
****

PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	4.0	4.0
0.10	0.3	4.1	4.4
0.20	0.6	4.3	4.9
0.30	0.8	4.5	5.3
0.40	1.1	4.7	5.8
0.50	1.4	4.8	6.2
0.60	1.7	5.0	6.7
0.70	1.9	5.2	7.1
0.80	2.2	5.4	7.6
0.90	2.5	5.5	8.0
1.00	2.8	5.7	8.5
1.10	3.1	5.9	8.9
1.20	3.3	6.1	9.4
1.30	3.6	6.2	9.9
1.40	3.9	6.4	10.3
1.50	4.2	6.6	10.8
1.60	4.5	6.8	11.2
1.70	4.7	6.9	11.7
1.80	5.0	7.1	12.1
1.90	5.3	7.3	12.6
2.00	5.6	7.5	13.0
2.10	5.8	7.6	13.5
2.20	6.1	7.8	13.9
2.30	6.4	7.9	14.3
2.40	6.7	7.9	14.6

2.50	7.0	7.9	14.9
2.60	7.2	7.9	15.2
2.70	7.5	7.9	15.4
2.80	7.8	7.9	15.7
2.90	8.1	7.9	16.0
3.00	8.3	7.9	16.3
3.10	8.6	7.9	16.6
3.20	8.9	7.9	16.8
3.30	9.2	7.9	17.1
3.40	9.5	7.9	17.4
3.50	9.7	7.9	17.7
3.60	10.0	7.9	17.9
3.70	10.3	7.9	18.2
3.80	10.6	7.9	18.5
3.90	10.9	7.9	18.8
4.00	11.1	7.9	19.1
4.10	11.4	7.9	19.3
4.20	11.7	7.9	19.6
4.30	12.0	7.9	19.9
4.40	12.2	7.9	20.2
4.50	12.5	7.9	20.4
4.60	12.8	7.9	20.7
4.70	13.1	7.9	21.0
4.80	13.4	7.9	21.3
4.90	13.6	7.9	21.5
5.00	13.9	7.8	21.7
5.10	14.2	7.7	21.9
5.20	14.5	7.6	22.0
5.30	14.8	7.5	22.2
5.40	15.0	7.4	22.4
5.50	15.3	7.3	22.6
5.60	15.6	7.2	22.8
5.70	15.9	7.1	23.0
5.80	16.1	7.0	23.2
5.90	16.4	6.9	23.3
6.00	16.7	6.8	23.5
6.10	17.0	6.7	23.7
6.20	17.3	6.6	23.9
6.30	17.5	6.5	24.1
6.40	17.8	6.4	24.3
6.50	18.1	6.4	24.4
6.60	18.4	6.3	24.6
6.70	18.6	6.2	24.8

6.80	18.9	6.1	25.0
6.90	19.2	6.0	25.2
7.00	19.5	5.9	25.4
7.10	19.8	5.8	25.5
7.20	20.0	5.7	25.7
7.30	20.1	5.6	25.7
7.40	20.2	5.5	25.7
7.50	20.4	5.4	25.8
7.60	20.5	5.3	25.8
7.70	20.7	5.2	25.9
7.80	20.8	5.1	25.9
7.90	20.9	5.0	26.0
8.00	21.1	4.9	26.0
8.10	21.2	4.8	26.0
8.20	21.3	4.7	26.1
8.30	21.5	4.7	26.1
8.40	21.6	4.6	26.2
8.50	21.7	4.5	26.2
8.60	21.9	4.4	26.2
8.70	22.0	4.3	26.3
8.80	22.2	4.2	26.3
8.90	22.3	4.1	26.4
9.00	22.4	4.0	26.4
9.10	22.6	3.9	26.5
9.20	22.7	3.8	26.5
9.30	22.8	3.7	26.5
9.40	23.0	3.6	26.6
9.50	23.1	3.6	26.8
9.60	23.2	3.6	26.9
9.70	23.4	3.6	27.0
9.80	23.5	3.6	27.2
9.90	23.7	3.6	27.3
10.00	23.8	3.6	27.4
10.10	23.9	3.6	27.6
10.20	24.1	3.6	27.7
10.30	24.2	3.6	27.8
10.40	24.3	3.6	28.0
10.50	24.5	3.6	28.1
10.60	24.6	3.6	28.3
10.70	24.7	3.6	28.4
10.80	24.9	3.6	28.5
10.90	25.0	3.6	28.7
11.00	25.2	3.6	28.8

11.10	25.3	3.6	28.9
11.20	25.4	3.6	29.1
11.30	25.6	3.6	29.2
11.40	25.7	3.6	29.3
11.50	25.8	3.6	29.5
11.60	26.0	3.6	29.6
11.70	26.1	3.6	29.8
11.80	26.2	3.6	29.9
11.90	26.4	3.6	30.0
12.00	26.5	3.6	30.2
12.10	26.7	3.6	30.3
12.20	26.8	3.6	30.4
12.30	26.9	3.6	30.6
12.40	27.1	3.6	30.7
12.50	27.2	3.6	30.9
12.60	27.3	3.6	31.0
12.70	27.5	3.6	31.1
12.80	27.6	3.6	31.3
12.90	27.8	3.6	31.4
13.00	27.9	3.6	31.5
13.10	28.0	3.6	31.7
13.20	28.2	3.6	31.8
13.30	28.3	3.6	31.9
13.40	28.4	3.6	32.1
13.50	28.6	3.6	32.2
13.60	28.7	3.6	32.4
13.70	28.8	3.6	32.5
13.80	29.0	3.6	32.6
13.90	29.1	3.6	32.8
14.00	29.3	3.6	32.9
14.10	29.4	3.6	33.0
14.20	29.5	3.6	33.2
14.30	29.7	3.6	33.3
14.40	29.8	3.6	33.4
14.50	29.9	3.6	33.6
14.60	30.1	3.6	33.7
14.70	30.2	3.6	33.9
14.80	30.3	3.6	34.0
14.90	30.5	3.6	34.1
15.00	30.6	3.6	34.3
15.10	30.8	3.6	34.4
15.20	30.9	3.6	34.5
15.30	31.0	3.6	34.7

15.40	31.2	3.6	34.8
15.50	31.3	3.6	34.9
15.60	31.4	3.6	35.1
15.70	31.6	3.6	35.2
15.80	31.7	3.6	35.4
15.90	31.8	3.6	35.5
16.00	32.0	3.6	35.6
16.10	32.1	3.6	35.8
16.20	32.3	3.6	35.9
16.30	32.4	3.6	36.0
16.40	32.5	3.6	36.2
16.50	32.7	3.6	36.3
16.60	32.8	3.6	36.5
16.70	32.9	3.6	36.6
16.80	33.1	3.6	36.7
16.90	33.2	3.6	36.9
17.00	33.4	3.6	37.0
17.10	33.5	3.6	37.1
17.20	33.6	3.6	37.3
17.30	33.8	3.6	37.4
17.40	33.9	3.6	37.5
17.50	34.0	3.6	37.7
17.60	34.2	3.6	37.8
17.70	34.3	3.6	38.0
17.80	34.4	3.6	38.1
17.90	34.6	3.6	38.2
18.00	34.7	3.6	38.4
18.10	34.9	3.6	38.5
18.20	35.0	3.6	38.6
18.30	35.1	3.6	38.8
18.40	35.3	3.6	38.9
18.50	35.4	3.6	39.0
18.60	35.5	3.6	39.2
18.70	35.7	3.6	39.3
18.80	35.8	3.6	39.5
18.90	35.9	3.6	39.6
19.00	36.1	3.6	39.7
19.10	36.2	3.6	39.9
19.20	36.4	3.6	40.0
19.30	36.5	3.6	40.1
19.40	36.6	4.2	40.8
19.50	36.8	5.0	41.8
19.60	36.9	5.8	42.7

19.70	37.0	6.6	43.6
19.80	37.2	7.4	44.6
19.90	37.3	8.2	45.5
20.00	37.4	9.0	46.5
20.10	37.6	9.8	47.4
20.20	37.7	10.6	48.3
20.30	37.9	11.4	49.3
20.40	38.0	12.2	50.2
20.50	38.1	13.0	51.2
20.60	38.3	13.8	52.1
20.70	38.4	14.6	53.0
20.80	38.5	15.4	54.0
20.90	38.7	16.2	54.9
21.00	38.8	17.0	55.9
21.10	39.0	17.8	56.8
21.20	39.1	18.7	57.7
21.30	39.2	19.5	58.7
21.40	39.4	20.3	59.6
21.50	39.5	21.1	60.6
21.60	39.6	21.9	61.5
21.70	39.9	22.7	62.5
21.80	40.2	23.5	63.6
21.90	40.4	24.3	64.7
22.00	40.7	25.1	65.8
22.10	41.0	25.9	66.9
22.20	41.3	26.7	68.0
22.30	41.6	27.5	69.1
22.40	41.9	28.3	70.2
22.50	42.2	29.1	71.3
22.60	42.5	29.9	72.4
22.70	42.8	30.7	73.5
22.80	43.1	31.5	74.6
22.90	43.4	32.3	75.8
23.00	43.7	33.1	76.9
23.10	44.0	33.9	78.0
23.20	44.3	34.7	79.1
23.30	44.6	35.5	80.2
23.40	44.9	36.3	81.3
23.50	45.2	37.1	82.4
23.60	45.5	37.9	83.5
23.70	45.8	38.7	84.6
23.80	46.1	39.5	85.7
23.90	46.4	40.1	86.5

24.00	46.7	40.1	86.8
24.10	47.0	40.1	87.1
24.20	47.3	40.1	87.4
24.30	47.6	40.1	87.7
24.40	47.9	40.1	88.0
24.50	48.2	40.1	88.3
24.60	48.5	40.1	88.6
24.70	48.8	40.1	88.9
24.80	49.1	40.1	89.2
24.90	49.4	40.1	89.5
25.00	49.7	40.1	89.8
25.10	50.0	40.1	90.1
25.20	50.3	40.1	90.4
25.30	50.6	40.1	90.7
25.40	50.9	40.1	91.0
25.50	51.2	40.1	91.3
25.60	51.5	40.1	91.6
25.70	51.8	40.1	91.9
25.80	52.1	40.1	92.2
25.90	52.4	40.1	92.5
26.00	52.7	40.1	92.8
26.10	53.0	40.1	93.1
26.20	53.3	40.1	93.4
26.30	53.6	40.1	93.7
26.40	53.9	40.1	94.0
26.50	54.2	40.1	94.3
26.60	54.5	40.1	94.6
26.70	54.8	40.1	94.9
26.80	55.1	40.1	95.2
26.90	55.4	40.1	95.5
27.00	55.7	40.1	95.8
27.10	56.0	40.1	96.1
27.20	56.3	40.1	96.4
27.30	56.6	40.1	96.7
27.40	56.9	40.1	97.0
27.50	57.2	40.1	97.3
27.60	57.5	40.1	97.6
27.70	57.8	40.1	97.9
27.80	58.1	40.1	98.2
27.90	58.4	40.1	98.5
28.00	58.7	40.1	98.8

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
2	10	0.7500E+00		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
3	10	0.1458E+01		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
4	10	0.1542E+01		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
5	10	0.4300E+01		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
6	10	0.7058E+01		
			0.0000E+00	0.0000E+00
			0.7324E+00	0.1000E-01
			0.1546E+01	0.2000E-01
			0.3215E+01	0.4000E-01
			0.3947E+01	0.6000E-01
			0.4069E+01	0.8000E-01
			0.3947E+01	0.1200E+00
			0.3784E+01	0.1600E+00
			0.3784E+01	0.5000E+00
			0.3784E+01	0.1000E+02
7	10	0.7142E+01		
			0.0000E+00	0.0000E+00
			0.5770E+00	0.1000E-01
			0.1218E+01	0.2000E-01

```
                                    0.2532E+01      0.4000E-01
                                    0.3109E+01      0.6000E-01
                                    0.3205E+01      0.8000E-01
                                    0.3109E+01      0.1200E+00
                                    0.2981E+01      0.1600E+00
                                    0.2981E+01      0.5000E+00
                                    0.2981E+01      0.1000E+02
     8          10      0.1435E+02
                                    0.0000E+00      0.0000E+00
                                    0.3594E+00      0.1000E-01
                                    0.7587E+00      0.2000E-01
                                    0.1577E+01      0.4000E-01
                                    0.1937E+01      0.6000E-01
                                    0.1997E+01      0.8000E-01
                                    0.1937E+01      0.1200E+00
                                    0.1857E+01      0.1600E+00
                                    0.1857E+01      0.5000E+00
                                    0.1857E+01      0.1000E+02
     9          10      0.2156E+02
                                    0.0000E+00      0.0000E+00
                                    0.3594E+00      0.1000E-01
                                    0.7587E+00      0.2000E-01
                                    0.1577E+01      0.4000E-01
                                    0.1937E+01      0.6000E-01
                                    0.1997E+01      0.8000E-01
                                    0.1937E+01      0.1200E+00
                                    0.1857E+01      0.1600E+00
                                    0.1857E+01      0.5000E+00
                                    0.1857E+01      0.1000E+02
    10          10      0.2164E+02
                                    0.0000E+00      0.0000E+00
                                    0.5635E+00      0.1000E-01
                                    0.9482E+00      0.2000E-01
                                    0.1440E+01      0.4000E-01
                                    0.1740E+01      0.6000E-01
                                    0.1943E+01      0.8000E-01
                                    0.2200E+01      0.1200E+00
                                    0.2355E+01      0.1600E+00
                                    0.2752E+01      0.5000E+00
                                    0.2976E+01      0.1000E+02
    11          10      0.2730E+02
                                    0.0000E+00      0.0000E+00
                                    0.5994E+00      0.1000E-01
```

```
                                    0.1054E+01      0.2000E-01
                                    0.1699E+01      0.4000E-01
                                    0.2135E+01      0.6000E-01
                                    0.2448E+01      0.8000E-01
                                    0.2870E+01      0.1200E+00
                                    0.3140E+01      0.1600E+00
                                    0.3888E+01      0.5000E+00
                                    0.4350E+01      0.1000E+02
    12          10      0.3296E+02
                                    0.0000E+00      0.0000E+00
                                    0.5994E+00      0.1000E-01
                                    0.1054E+01      0.2000E-01
                                    0.1699E+01      0.4000E-01
                                    0.2135E+01      0.6000E-01
                                    0.2448E+01      0.8000E-01
                                    0.2870E+01      0.1200E+00
                                    0.3140E+01      0.1600E+00
                                    0.3888E+01      0.5000E+00
                                    0.4350E+01      0.1000E+02


TIP   LOAD        TIP MOVEMENT
    KIP              IN.

0.0000E+00         0.0000E+00
0.4208E+00         0.1000E-03
0.2976E+01         0.5000E-02
0.4208E+01         0.1000E-01
0.9410E+01         0.5000E-01
0.1331E+02         0.1000E+00
0.1882E+02         0.2000E+00
0.2976E+02         0.5000E+00
0.4208E+02         0.1000E+01
0.5952E+02         0.2000E+01


             LOAD VERSUS SETTLEMENT CURVE
             ****************************
```

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.6111E+00	0.4122E-03	0.4208E+00	0.1000E-03
0.2032E+01	0.1913E-02	0.8901E+00	0.1000E-02
0.8347E+01	0.8584E-02	0.2976E+01	0.5000E-02
0.1472E+02	0.1605E-01	0.4208E+01	0.1000E-01
0.2634E+02	0.3024E-01	0.5509E+01	0.2000E-01
0.5257E+02	0.7009E-01	0.9410E+01	0.5000E-01
0.5933E+02	0.1035E+00	0.1175E+02	0.8000E-01
0.6124E+02	0.1248E+00	0.1331E+02	0.1000E+00
0.6763E+02	0.2290E+00	0.1882E+02	0.2000E+00
0.8231E+02	0.5377E+00	0.2976E+02	0.5000E+00
0.8981E+02	0.8422E+00	0.3715E+02	0.8000E+00
0.9480E+02	0.1045E+01	0.4208E+02	0.1000E+01
0.1126E+03	0.2056E+01	0.5952E+02	0.2000E+01

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Engineers and Scientists

JOB: 09.0026144.00 Yarmouth Route 1 Bridge
SUBJECT: Lateral Earth Pressures
SHEET: 1 OF 2
CALCULATED BY E. Tome 9/13/2024
CHECKED BY B. Cardali 9/13/2024

Subject:

Evaluate lateral earth pressure coefficients of backfill behind abutments and wingwalls for the Yarmouth Route 1 Bridge No. 5804 in Yarmouth, Maine.

References:

1. AASHTO LRFD Bridge Design Specifications, 9th Edition (2020)
2. Massachusetts Department of Transportation Highway Division LRFD Bridge Manual Part I, section 3.10.8

Input Parameters:

$\beta := 0deg$ — Angle of backfill to the horizontal

$\theta := 90deg$ — Angle of backface of wall to the horizontal

$\phi := 32deg$ — Effective angle of internal friction *(Granular borrow, Soil Type 4, BDG Table 3-3)*

$\delta_f := 19.5deg$ — Average value of friction angle between, precast concrete and clean sand/silty sand-gravel mixture *(AASHTO LRFD Table 3.11.5.3-1)*

Passive Earth Pressure on Integral Backwall:

We understand that recent practice by MaineDOT is to utilize methodology consistent with MassDOT Section 3.10.8. Per Section 3.10.8, the ratio of lateral abutment movement (y) to abutment height (Hb) is required.

$y := 1.22in$ — Maximum deflection from 65% Design provided by structural engineer

$H_b := 12.6ft$ — Abutment height with the largest thermal deflection (Abutment 1)

$\frac{y}{H_b} = 0.0081$ — Ratio of lateral movement to abutment height

Earth Pressure Coefficients:

MassDOT Section 3.10.8 presents the plot and calculation shown below for a gravel borrow material.

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$$K = 0.43 + 5.7[1 - e^{-190(\delta_T/H)}]$$

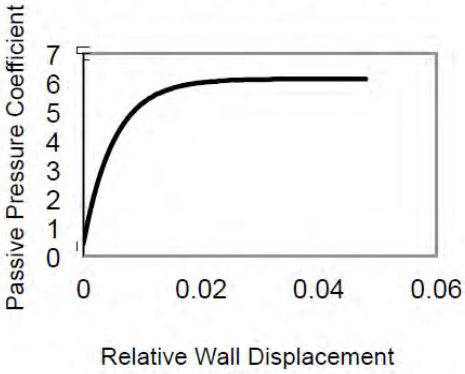


Figure 3.10.8-1: Plot of Passive Pressure Coefficient, K, vs. Relative Wall Displacement, δ_T/H.

$$\omega := \frac{y}{H_b} = 0.0081$$

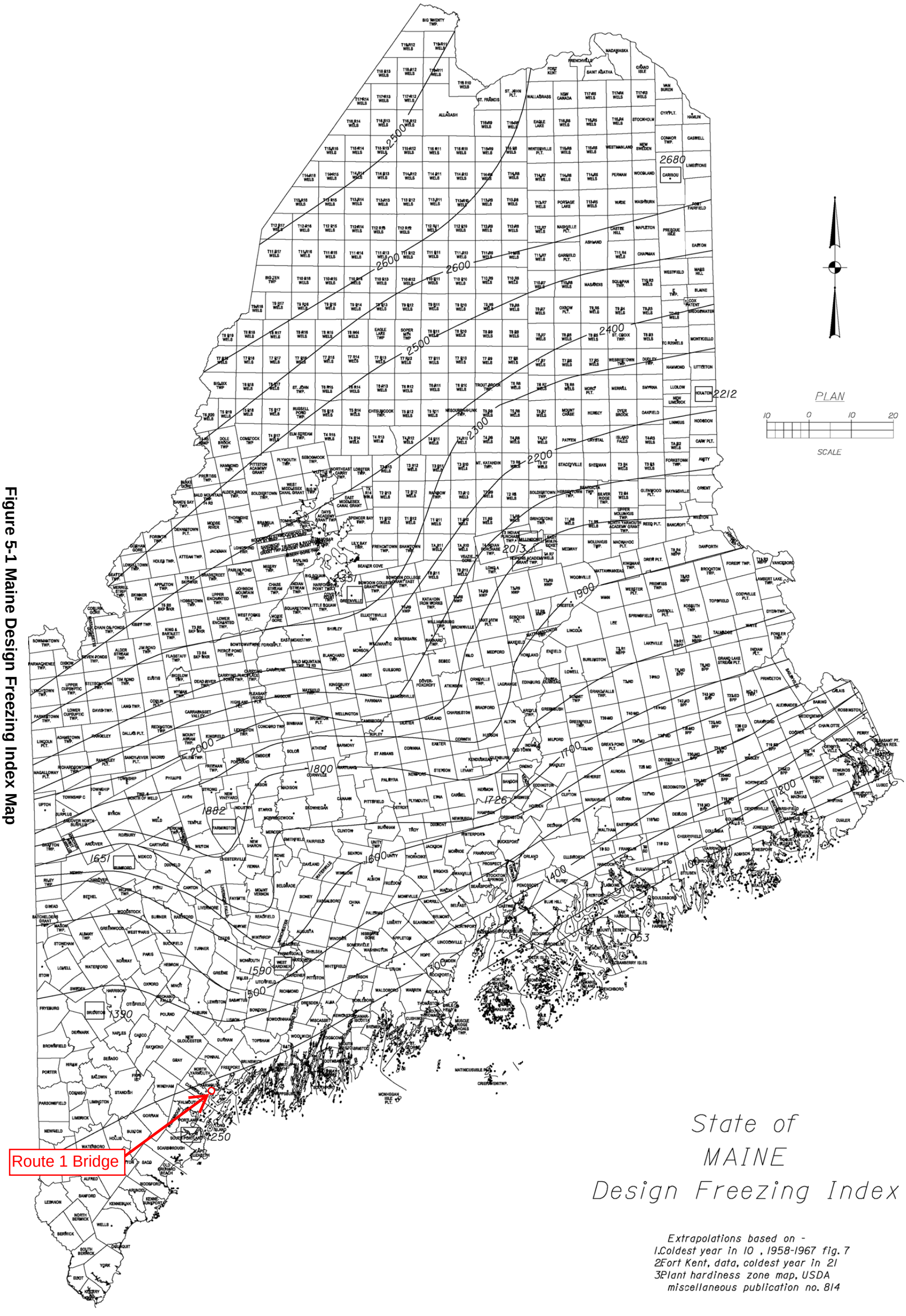
$$K_{p.mass} := 0.43 + 5.7\left(1 - \exp\left(-190 \cdot \frac{y}{H_b}\right)\right) = 4.9$$

$K_{p.mass} = 4.9$

GZA recommends that a passive earth pressure coeffcient of 4.9, as calculated by the MassDOT methodology, and is recommended for the abutment design for the Yarmouth Route 1 bridge project.

March 2014

Figure 5-1 Maine Design Freezing Index Map



State of
MAINE
Design Freezing Index

Extrapolations based on -
1.Coldest year in 10 , 1958-1967 fig. 7
2.Fort Kent, data, coldest year in 21
3.Plant hardiness zone map, USDA
miscellaneous publication no. 814

Table 5-1 Depth of Frost Penetration

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		62			
1800	90.1		64			
1900	92.6	76.6	65			
2000	95.1	78.7	67			
2100	97.6	80.7	69			
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

1285

5.75' for Abutment fills

Average of coarse and fine grained 20% wc, 41.8"=4.5' at Pier and embedded portion of MSE wall. Both embedded below the top of clay and the ground water line but fill soils will have granular backfill placed up to grade.

Notes: 1. w = water content
2. Where the Freezing Index and/or water content is between the presented values, linear interpretation may be used to determine the frost penetration.

Abutments: Granular materials with approximately 10 to 20 percent water content are anticipated near the abutment bearing elevations, therefore based on the freezing index of 1285 the estimated frost depth is 5.75 feet.

Pier: Marine clay deposit soils are anticipated to be present near the elevation of the pier pile caps but granular fill is anticipated to be placed adjacent to the pile cap. The granular material controls, therefore material is coarse-grained with water contents of approximately 30%. Based on the MaineDOT BDG, Section 5.2.1 and a Freezing Index of 1285 the estimated depth of frost penetration is 4.5 feet.

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Engineers and Scientists

JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 1 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

Objective

Calculate soil bearing resistance for an MSE wall bearing on a marine clay deposit using the Theoretical Method (Munfakh et al., 2001). Assume bearing resistance reflects a drained condition. Therefore, a friction angle will be utilized. Evaluate strength bearing resistance for a range of footing widths based on anticipated MSE heights.

References

1. American Association of State Highway and Transportation Officials, AASHTO LRFD Bridge Design Specifications: Customary U.S. Units, 9th edition, 2020, (AASHTO LRFD), Articles 10.5.5.2.2 and 10.6.3.1.
2. Terzaghi, Peck & Mesri, Soil Mechanics in Engineering Practice, Third Edition, 1996.
3. Mitchell, Fundamentals of Soil Behavior, Second Edition, 1992.

Soil Properties and Geotechnical Inputs

$\phi_b := 0.65$ MSE bearing resistance factor as specified in Table 10.5.5.2.2-1 (Theoretical Method, SPT Data, Strength Limit)

$\gamma := 120pcf$ Unit weight of soil above or below the bearing depth of the footing

$N_c := 30.1$ Cohesion term bearing capacity factor as specified in Table 10.6.3.1.2a-1

$N_q := 18.4$ Surcharge term bearing capacity factor as specified in Table 10.6.3.1.2a-1

$N_\gamma := 22.4$ Total unit weight term bearing capacity factor as specified in Table 10.6.3.1.2a-1

Correction factors to account for the location of the groundwater table as specified in Table 10.6.3.1.2a-2

C_{wq}, $C_{w\gamma}$:= Depth to water table at or below depth of footing (D_f) $C_{wq} := 0.5$ $C_{w\gamma} := 0.5$

Clay Strength

Consider the marine clay in a drained condition for global stability, using an effective friction angle and zero effective cohesion. Mitchell (1992) presents a correlation between sin ϕ' and plasticity index (PI), shown on the plot below. Laboratory PI values range from about 12 to 25, with a typical value of about 15 and a maximum value of 21 below the crust. Select PI=20 as the representative value to select the effective friction angle.

Based on the correlation, sin ϕ' is approximately 0.5, corresponding to a drained friction angle of 30 degrees. This is consistent with consolidated undrained compression test results on Presumpscot clay. Therefore:

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JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 2 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

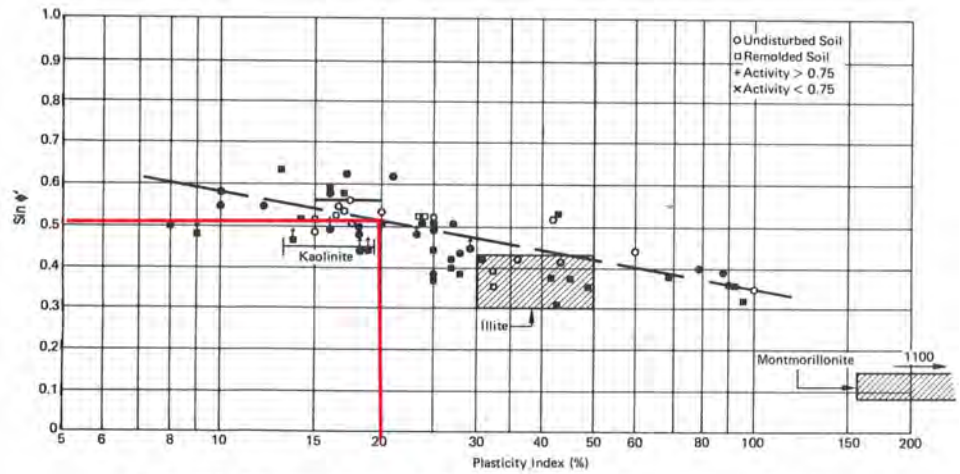

Figure 14.2 Relationship between $\sin\phi'$ and plasticity index for normally consolidated soils (adapted from Kenney, 1959). Data for pure clays from Olson, 1974.

$\phi_f := 30deg$ Effective friction angle

$c := 0ksf$ Effective cohesion

Footing Dimensions

$B_{1.max} := 16 \cdot ft$ Maximum Effective Footing Width (actual max likely higher for highest wall)

$B_1 := 12 \cdot ft, 14 \cdot ft .. B_{1.max}$ Range of effective footing widths considered (includes eccentricity)

$L_1 := 75ft$ Length of Abutment

$D_f := 0ft$ Footing embedment depth (ignore embedment, actual is approximately 5')

Strength Limit Design

$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$ Nominal Bearing Resistance Formula

$q.D = \phi_b \times q_n$ Factored Bearing Resistance Formula

Correction Factors

$d_{qtable}(B_1) := \frac{D_f}{B_1}$ $d_{qtable}(B_1)$ Using Table 10.6.3.1.2a-4 $d_q := 1$ dq assumed soil above footing less competent than soil below footing.

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JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 3 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

$$s_c(B_1) := 1 + \left(\frac{B_1}{L_1}\right)\left(\frac{N_q}{N_c}\right) \qquad s_q(B_1) := 1 + \left(\frac{B_1}{L_1}\tan(\phi_f)\right) \qquad s_\gamma(B_1) := 1 - 0.4\left(\frac{B_1}{L_1}\right)$$

$s_c(B_1) =$

1.1
1.11
1.13

$s_q(B_1) =$

1.09
1.11
1.12

$s_\gamma(B_1) =$

0.94
0.93
0.91

Bearing Capacity Factors

$$N_{cm}(B_1) := N_c \cdot s_c(B_1)$$

$N_{cm}(B_1) =$

33.04
33.53
34.03

$$N_{qm}(B_1) := N_q \cdot s_q(B_1) \cdot d_q$$

$N_{qm}(B_1) =$

20.1
20.4
20.7

$$N_{\gamma m}(B_1) := N_\gamma \cdot s_\gamma(B_1)$$

$N_{\gamma m}(B_1) =$

21
20.7
20.5

Nominal Bearing Resistance

$$q_n(B_1) := \overrightarrow{\left(c \cdot N_{cm}(B_1) + \gamma \cdot D_f \cdot N_{qm}(B_1) \cdot C_{wq} + 0.5 \cdot \gamma \cdot B_1 \cdot N_{\gamma m}(B_1) \cdot C_{w\gamma}\right)}$$

$q_n(B_1) =$ for $B_1 =$

7.5	·ksf	12	·ft
8.7		14	
9.8		16	

Factored Bearing Resistance - Strength Limit State

$$q_D(B_1) := \phi_b \cdot q_n(B_1)$$

$q_D(B_1) =$ for $B_1 =$

4.9	·ksf	12	·ft
5.7		14	
6.4		16	

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JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 4 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

Service Limit Design

AASHTO provides Table C10.6.2.5.1-1 (attached) of presumptive bearing resistances of spread footings when a settlement limited bearing resistance is required. This table may be used with sufficient knowledge of the geological conditions present at the site and in combination with settlement analyses.

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value
Homogeneous Inorganic clay, sandy or silty clay (CL,CH)	Medium stiff to stiff	2 - 6	4

Conclusion

GZA recommends a nominal bearing resistance of 7.5 ksf and a factored bearing resistance of 4.9 ksf based on a resistance factor of 0.65 and the minimum evaluated effective footing width. Based on GZA's settlement evaluations, GZA recommends utilizing a service bearing resistance of 4.0 ksf, based on a a homogeneous inorganic clay, sandy or silty clay (CL,CH) that is medium stiff to stiff.

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JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 5 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

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	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

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JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 6 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$>1.5B + D_f$	1.0	1.0

Where the position of groundwater is at a depth less than 1.5 times the footing width below the footing base, the bearing resistance is affected. The highest anticipated groundwater level should be used in design.

Table 10.6.3.1.2a-3—Shape Correction Factors s_c, s_γ, s_q

Factor	Friction Angle	Cohesion Term (s_c)	Unit Weight Term (s_γ)	Surcharge Term (s_q)
Shape Factors s_c, s_γ, s_q	$\phi_f = 0$	$1+\left(\frac{B}{5L}\right)$	1.0	1.0
	$\phi_f > 0$	$1+\left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$	$1-0.4\left(\frac{B}{L}\right)$	$1+\left(\frac{B}{L}\tan\phi_f\right)$

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Engineers and Scientists

JOB: 09.0026144.00 US Route 1 Bridge - Yarmouth,ME
SUBJECT: MSE Bearing Resistance
SHEET: 7 OF 7
CALCULATED BY: E. Tome/A. Blaisdell 11/20/2024
CHECKED BY: C. Snow 11/20/2024

Table 10.6.3.1.2a-4—Depth Correction Factor d_q

Friction Angle, ϕ_f (degrees)	D_f/B	d_q
32	1	1.20
	2	1.30
	4	1.35
	8	1.40
37	1	1.20
	2	1.25
	4	1.30
	8	1.35
42	1	1.15
	2	1.20
	4	1.25
	8	1.30

The depth correction factor should be used only when the soils above the footing bearing elevation are as competent as the soils beneath the footing level; otherwise, the depth correction factor should be taken as 1.0.

Linear interpolations may be made for friction angles in between those values shown in Table 10.6.3.1.2a-4.