



GEOTECHNICAL DESIGN REPORT CAPELL BRIDGE BRIDGE NO. 2126 OVER THE MERRILAND RIVER MAINE DOT WIN 20814.00 WELLS, MAINE

Proactive By Design.
Our Company Commitment

Prepared for:
Maine Department of Transportation
Augusta, ME

December 2017
09.0025946.00

Prepared by:
GZA GeoEnvironmental, Inc.
477 Congress Street | Suite 700 | Portland, Maine 04101
207.879.9190

27 Offices Nationwide
www.gza.com



Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION
MANAGEMENT

477 Congress Street
Suite 700
Portland, ME 04101
T: 207.879.9190
F: 207.879.0099
www.gza.com



VIA EMAIL

December 4, 2017
File No. 09.0025946.00

Ms. Laura Krusinski
Maine Department of Transportation
16 State House Station
Augusta, Maine 04333-0016

Re: Final Geotechnical Design Report
Capell Bridge No. 2126, Route 1/9 over Merriland River
MaineDOT WIN 20814.00
Wells, Maine

Dear Laura:

GZA GeoEnvironmental, Inc. (GZA) has prepared this final geotechnical design report for the proposed replacement of Maine Department of Transportation (MaineDOT) Capell Bridge No. 2126 which carries Route 1/9 over the Merriland River in Wells, Maine. Our services were provided in accordance with Assignment Letter No. 9 (dated June 14, 2017) associated with the Bridge Program Multi-PIN Project Contract Number 20150608000000000793 between MaineDOT and GZA dated July 22, 2015, which incorporates GZA's Proposal No. 09.P000035.18, dated June 14, 2017. This report is subject to the *Limitations* included in **Appendix A**.

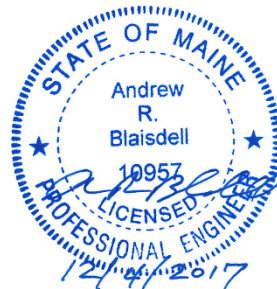
It has been a pleasure serving the Maine Department of Transportation team on this project. If you have any questions regarding the report, or if we can provide further assistance, please do not hesitate to contact the undersigned.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Blaine M. Cardali, E.I.T.
Project Engineer

Christopher L. Snow, P.E.
Consultant Reviewer



Andrew R. Blaisdell, P.E.
Associate Principal

BMC/ARB/CLS:erc

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1.0 INTRODUCTION

This report presents the results of the geotechnical evaluation completed by GZA GeoEnvironmental, Inc. (GZA) for the proposed replacement of Maine Department of Transportation (MaineDOT) Capell Bridge No. 2126 which carries Route 1/9 over the Merriland River in Wells, Maine. Our services were provided in accordance with Assignment Letter No. 9 (dated June 14, 2017) associated with the Bridge Program Multi-PIN Project Contract Number 2015060800000000793 between MaineDOT and GZA dated July 22, 2015, which incorporates GZA's Proposal No. 09.P000035.18, dated June 14, 2017. This report is subject to the *Limitations* included in **Appendix A**.

1.1 BACKGROUND

The existing Capell Bridge No. 2126 carries Route 1 over the Merriland River in Wells, at the location shown on **Figure 1, Locus Plan**. Our understanding of the existing bridge is based on our review of the Preliminary Design Report¹ (PDR). The existing bridge was constructed in 1908 and widened in 1931 and 1941. The existing bridge consists of a 27-foot-long single-span skewed at 35 degrees, consisting of reinforced concrete girders bearing on a combination of concrete-capped stone masonry abutment on a gravel foundation (original bridge) and concrete mass abutments on driven timber piles (widened bridge).

The PDR indicates that the replacement bridge is planned to consist of an approximately 70-foot-long, single-span bridge, the location of which is shown on **Figure 2, Boring Location Plan**. The replacement bridge will be skewed 20 degrees left and consist of five NEXT (36D) precast concrete beams on integral abutments. Each abutment will be supported by five or six driven piles. Based on information provided by MaineDOT, the bridge designer, we understand the maximum factored pile loads are 412 kips and 361 kips for 5-pile and 6-pile configurations, respectively. MaineDOT estimated that thermal deformation of the bridge superstructure could result in 0.5 inches of lateral deflection at each abutment. The new cast-in-place abutments will be constructed behind the existing abutment locations.

The horizontal alignment of the roadway and bridge in the project area is not being modified as part of the project. Proposed pavement grades will generally match existing grades. The new bridge and approaches are narrower than the existing ones, resulting in minor regrading along the approach sideslopes. The bridge opening at river level will be increased from approximately 27 to 40 feet, which will result in removal of the abutments and excavation of soil on the water side of the new abutments to proposed grades. Riprap will be placed in front of each abutment and along the river banks upstream and downstream of the bridge.

1.2 OBJECTIVES AND SCOPE OF SERVICES

The objectives of our work were to evaluate subsurface conditions and to provide final geotechnical engineering recommendations for the proposed Capell Bridge No. 2126 replacement. To meet these objectives, GZA completed the following Scope of Services:

¹ MaineDOT's "Preliminary Design Report, Capell Bridge #2604 over Merriland River, WIN 020814.00."



- Conducted site visits to observe surficial conditions and reviewed mapped surficial and bedrock geology of the site;
- Reviewed existing test boring data from three test borings conducted by MaineDOT;
- Coordinated and observed a subsurface exploration program, consisting of one (1) test boring, to provide supplemental data to evaluate subsurface conditions;
- Conducted an independent review of the MaineDOT boring rock cores;
- Conducted a laboratory testing program to evaluate engineering properties and index properties of the site soils;
- Conducted geotechnical engineering analyses to evaluate foundation design for the replacement bridge, embankment design considerations, and seismic design considerations;
- Developed geotechnical engineering recommendations including foundation design recommendations for driven H-piles, lateral earth pressures and seismic design parameters;
- Prepared a preliminary email memorandum summarizing our findings and preliminary design recommendations; and
- Prepared this final report summarizing our findings and design recommendations.

2.0 SUBSURFACE EXPLORATIONS

Prior to GZA's engagement in the project, an exploration program was completed by MaineDOT in 2016. GZA completed a supplemental subsurface exploration program in 2017. Details of these programs are described below.

2.1 PREVIOUS TEST BORINGS

On July 19 and 20, 2016, MaineDOT drilled and logged three test borings, designated as BB-WMR-101 through -103. The borings (BB-WMR-101 through -103) were drilled through overburden soil and terminated in apparent boulders (BB-WMR-101), sand (BB-WMR-102), and bedrock (BB-WMR-103). Depths of the borings ranged from approximately 101 to 219 feet below ground surface (bgs). The borings were drilled using 3- and 4-inch driven casing and drive-and-wash drilling techniques. Standard penetration testing (SPT) and split-spoon sampling were performed in BB-WMR-101 in the overburden using a 24-inch-long, 1-3/8-inch inside-diameter sampler, driven with an automatic hammer. Samples were collected at 5-foot typical intervals between ground surface and 60 feet bgs, 10-foot typical intervals between 60 and 120 feet bgs, and every 20 to 30 feet below 120 feet bgs. Soil sampling was not conducted in borings BB-WMR-102 or -103. Cores were obtained using NQ2 wire-line coring equipment in test borings BB-WMR-101 (boulders) and -103 (rock). In-situ field vanes were taken at approximately 5-foot typical intervals within the clay layer, and two Shelby tube samples were also collected in the clay.

Boring logs provided by MaineDOT are presented in **Appendix B**. GZA reviewed and edited the logs as appropriate (specifically, bedrock classifications).



2.2 SUPPLEMENTAL TEST BORING

GZA completed a supplemental test boring (BB-WMR-201) during final design. The boring was drilled in the northbound shoulder behind the northern existing abutment. The boring was drilled to a depth of approximately 174 feet bgs and terminated following approximately 10 feet of roller cone advancement into one or more apparent boulders in very dense glacial till. New England Boring Contractors of Hermon, Maine provided drilling services and coordinated utility clearance. The drilling was completed between June 19 and July 5, 2017. GZA personnel monitored the drilling work and prepared a log of the boring that is included in **Appendix B**.

The boring was drilled using 4-inch and 3-inch driven casing and drive-and-wash drilling techniques with a truck-mounted drill rig. SPT and split-spoon sampling were performed at 5-foot typical intervals in the overburden using a 24-inch-long, 1-3/8-inch inside-diameter sampler, driven with an automatic hammer with a rated hammer efficiency factor of 0.793 for samples from 0 to 146 feet bgs and 0.659 for samples below 146 feet bgs, as noted on the logs. A Sprague and Henwood (a.k.a., California) 3-inch outside diameter split spoon sampler fitted with 2.5-inch inside-diameter sleeves was driven at two depth intervals instead of the SPT split-spoon to obtain sand specimens that could be extracted directly from the sleeve into a laboratory direct shear test apparatus. *In-situ* field vanes were taken at approximately 10-foot typical intervals within the clay layer.

The boring was backfilled with cuttings, crushed stone, and asphalt cold patch. The approximate as-drilled boring location was determined by GZA using taped ties to existing bridge structure components and nearby sign structures, and later surveyed by MaineDOT surveyors. See **Figure 2** for the as-drilled boring locations. Elevations referenced are in feet and refer to the North American Vertical Datum of 1988 (NAVD88).

2.3 REVIEW OF ROCK CORE

GZA requested access to the rock core samples in order to make an independent assessment of the rock. After receiving approval of the MaineDOT Geotechnical Group, a GZA engineer visited MaineDOT's laboratory in Bangor, reviewed the available rock core specimens, and prepared descriptions for core samples of apparent boulders and rock from borings BB-WMR-101 and BB-WMR-103. The assessment included interpretation of apparent boulders versus bedrock. Our observations were used to develop the rock descriptions included on the logs in **Appendix B**.

3.0 LABORATORY TESTING

MaineDOT completed a laboratory testing program for the BB-WMR-100 series borings, consisting of water content and gradation analysis/AASHTO Classification/Frost Classification assessments on 11 soil samples, hydrometer analysis on six of the gradation samples, and two consolidation tests on clay specimens.



GZA retained GeoTesting Express of Acton, Massachusetts to complete a supplemental soil testing program on samples from boring BB-WMR-201 to assess the gradation and engineering characteristics of the soil. The program included the following tests: 13 gradation analyses, four Frost Classifications / AASHTO Classifications, 16 moisture content tests, four Atterberg limits, and Direct Shear tests on sand and glacial till (two total) with total unit weight and water content measurements.

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

4.0 SUBSURFACE CONDITIONS

4.1 SURFICIAL AND BEDROCK GEOLOGY

Based on available surficial geology mapping², the surficial unit along the river at the bridge alignment consists of Stream Alluvium, described as gray to brown fine sand and silt with some gravel. Marine nearshore deposits are mapped adjacent to the stream alluvium near the bridge alignment, which are described as brown to gray, sand and mud deposited in nearshore or shallow marine environments. Presumpscot formation was mapped west of the bridge and is described as gray-blue, silty clay.

Bedrock in the vicinity of the site is mapped as the Kittery formation of the Merrimack group, consisting of metasandstone and phyllite. Based on our review of bedrock geologic mapping for the area³, the Kittery formation is described as thin-bedded to medium-bedded calcareous and feldspathic quartz-rich granofels with interbeds of dark gray chlorite, phyllite or biotite schist, depending on the degree of metamorphism.

4.2 SUBSURFACE PROFILE

Five soil units were encountered in the test borings overlying bedrock: Fill, Alluvial Deposit, Marine Clay, Sand, and Glacial Till. Approximately 4 to 5 inches of asphalt pavement was encountered in the borings. The thicknesses and generalized descriptions of the soil units are presented in the following table, in descending order from existing ground surface. Detailed descriptions of the materials encountered at specific locations are provided in the boring logs in **Appendix B**. The subsurface conditions are also shown in relation to the bridge alignment on **Figure 3**.

² Smith, Geoffrey W., 1999, Surficial geology of the Wells quadrangle, Maine: Maine Geological Survey, Open-File Map 99-104, map, scale 1:24,000. *Maine Geological Survey Maps*. 1014. http://digitalmaine.com/mgs_maps/1014

³ Hussey, Arthur M., II, 2013, Bedrock geology of the Wells quadrangle, Maine: Maine Geological Survey, Open-File Map 13-20, color map and 6 p. report, scale 1:24,000. *Maine Geological Survey Maps*. 70. http://digitalmaine.com/mgs_maps/70



GENERALIZED SUBSURFACE CONDITIONS		
Soil Unit	Approximate Encountered Thickness (ft)	Generalized Description
Fill	7 to 9	Brown, moist to wet, loose to very dense, fine to coarse SAND, trace to little Gravel, trace to little Silt (USCS: SP, SW, SM). MaineDOT Frost Classification = II to III <i>Encountered in all borings</i>
Alluvial Deposit	5 to 10	Dark brown to brown, wet, very loose to medium dense, fine to coarse SAND, trace Silt with organics odor (USCS: SP-SM, SM). MaineDOT Frost Classification = II to III <i>Encountered in all borings below the Fill</i>
Marine Clay	49 to 56	Variable, ranging <u>from</u> : Gray, wet, stiff to soft, silty CLAY, trace to little Sand; <u>to</u> : Gray, wet, medium stiff, Clayey SILT, little Sand, trace Gravel (USCS: CL, ML). The upper 13 feet is stiff to medium stiff (crust), and the unit becomes medium stiff to soft with depth. - Conducted 22 field vanes: Peak Undrained Shear Strength (Su) = 536-982 psf, Residual Su = 22-124 psf. Average Peak Su = 900 psf in upper 13 feet of clay and 700 psf below 2 Consolidation tests: Compression Ratio (CR) = 0.1-0.22, Recompression Ratio (RR) = 0.02-0.023, Preconsolidation Pressure = 5,300-4,500 psf, Overconsolidation Ratio (OCR) = 2.7 to 1.5. - Atterberg limits: Liquid Limit (LL) = 20-35, Plasticity Index (PI) = 4-15, water content = 17.9-43.4 percent <i>Encountered in all borings below the Alluvial Deposit</i>
Sand	38 to 48	Gray to brown, wet, medium dense to very dense, fine to medium SAND, trace to some Silt (USCS: SP, SP-SM, SM). Direct Shear Test: Effective Friction Angle (ϕ') = 42.2 degrees <i>Encountered in all borings below the Marine Clay.</i>
Glacial Till	65 to 85	Variable, ranging <u>from</u> : gray, wet, medium dense to very dense, fine to coarse SAND, trace to some Gravel, trace to some Silt, <u>to</u> : Gray, wet, very dense, GRAVEL, some Sand, trace Silt. (USCS: SW, SP, SP-SM, SM, GP). With cobbles and boulders, as summarized below. - Direct Shear Test: Effective Friction Angle (ϕ') = 45.7 degrees <i>Encountered in borings BB-WMR-101, -103, and -201; boring BB-WMR 102 did not penetrate the Glacial Till.</i> <u>Cobbles and Boulders</u> - Intermittent 3-inch cobbles to 12-inch boulders penetrated by roller cone from approximately from EL. -86 to -160 (<i>borings BB-WMR-101 and BB-WMR-201</i>) - Boulders (individual or nested layers) ranging from 6 to 14.5 feet thick from EL. -141 to -177 (<i>borings BB-WMR-101, -103 and -201; see boulder intervals encountered in each boring on Figure 3</i>)
Top of Bedrock Elevation	<u>Encountered Top of Rock:</u> Approximate EL. -185.1 (BB-WMR-103)	

GZA did not observe the soil samples from the BB-WMR-100 series borings. We relied on classifications made by MaineDOT combined with laboratory test results for our description of the soil.



4.2.1 Bedrock

Bedrock was cored in one test boring drilled by MaineDOT (BB-WMR-103). GZA completed an independent review of the rock core and updated descriptions as appropriate on the boring log. Based on GZA's review of the rock core specimens on June 15, 2017, the bedrock was described as light olive-gray, medium hard, aphanitic to fine-grained QUARTZITE. Joints were described as low angle, close, rough, and undulating. The Rock Quality Designation (RQD) in the core runs was 0 percent.

4.2.2 Groundwater

The groundwater level was measured in boring BB-WMR-201 after drilling at a depth of 13.7 feet bgs, corresponding to El. 8.6. Measurements were taken approximately 16 hours after completion of drilling. Considering the presence of the river adjacent to the approaches, groundwater levels in the approaches near the abutments are anticipated to be at or above the river level. Fluctuations in groundwater levels will occur due to variations in season, precipitation, river level, nearby construction and other factors. Consequently, water levels during and after construction are likely to vary from those encountered in the borings at the time the observations were made.

5.0 ENGINEERING EVALUATIONS

5.1 GENERAL

GZA has conducted geotechnical engineering evaluations in accordance with 2014 AASHTO LRFD Bridge Design Specifications, 7th Edition, with Interims (herein designated as AASHTO), the 2011 AASHTO Guide Specifications for LRFD Bridge Design and the MaineDOT Bridge Design Guide, 2014 Edition (MaineDOT BDG). The sections that follow describe the evaluations and the geotechnical basis for each element. Supporting calculations developed by GZA for the project are attached in **Appendix D** of this report.

5.2 APPROACH EMBANKMENTS

The approach embankments are expected to remain approximately at existing grades, with minor lowering and flattening of the side slopes. The existing abutments will be removed and grades will be lowered between the old and new abutments in order to widen the stream channel. Therefore, negligible settlement is anticipated at the approaches. Based on the proposed geometries, it is our opinion that the potential for global instability of the approach embankments is low.

5.3 SEISMIC DESIGN CONSIDERATIONS

Seismic site class was evaluated in accordance with the 2014 AASHTO LRFD, along with consideration of the 2011 AASHTO Guide Specifications for LRFD Bridge Design (Seismic Guide Specification).

Commentary Article C3.4.2.2 of the Seismic Guide Specification indicates that the ground motion at the abutment controls transfer of earthquake motion to relatively short bridges, and the site classification should be determined at the base of the approach fill. Considering the presence of approximately 50



feet of clay with an undrained shear strength less than 1,000 psf, the bridge should be assigned to Site Class E.

5.3.1 Liquefaction

Liquefaction evaluation is not specifically required in AASHTO for Seismic Design Category (SDC) B bridges. However, Article C6.8 of the AASHTO Seismic Guide Specification indicates that “a liquefaction assessment should be made if loose to very loose sands are present to a sufficient extent to impact bridge stability and A_s is greater than or equal to 0.15”. The properties of the Alluvial Deposit and seismic design parameters for this project meet these criteria; therefore, we conducted a liquefaction assessment.

Based on liquefaction triggering analyses using the Boulanger and Idriss 2014 method, portions of the Alluvial Deposit stratum sampled in borings BB-WMR-101 and BB-WMR-201 are susceptible to liquefaction during the design earthquake. Post-liquefaction ground surface settlement could be on the order of 2 to 5 inches following the design event. Article 5.9.4 of the BDG states that a maximum allowable seismic settlement of 6 inches is acceptable. Therefore, we conclude liquefaction mitigation is not necessary to meet the requirements of the BDG.

Potentially liquefiable soils are present between approximately 7 and 14 feet below grade in both borings, corresponding to approximately El. 16 to El. 9. This layer is partially within the elevation of the riverbank, indicating lateral displacement of the riverbank slopes toward the river is likely following a design-level earthquake. The potentially liquefiable soil will be located adjacent to approximately the lower 3 feet of the integral abutments and upper 4 feet of the piles.

The primary effects of liquefaction on the bridge would be additional lateral load acting against the integral backwalls and soil strength loss within the upper few feet of the piles. Excavation and backfill for backwall construction will result in replacement of the liquefiable soil directly adjacent to the bridge and within at least the upper foot of the pile with engineered fill. Therefore, the potential for lateral soil displacement to impose loading in excess of passive earth pressure on the backwalls is considered low. Downdrag loading will be negligible since the liquefied material is only in contact with the upper few feet of the pile.

Based on these considerations, the implications of liquefaction are not anticipated to affect bridge design.

5.4 EVALUATION OF FOUNDATIONS

5.4.1 Foundation Type Assessment

GZA conducted preliminary evaluations for several H-pile and pipe pile sections for support of the integral abutments. Based on the results of our preliminary evaluations, MaineDOT selected steel HP14x89 piles. Design considerations and evaluations are presented below.



5.4.2 Pile Design Considerations

Evaluations were conducted for axial compressive geotechnical resistance of the piles. We considered the α -method for evaluation of side resistance in the Marine Clay and considered the Meyerhof SPT-based method and the Nordlund-Thurman method for evaluation of side resistance and end bearing in Sand and Glacial Till, in general accordance with AASHTO Article 10.7. Based on our experience with similar subsurface materials, comparison of unit side resistance predicted by each method, and our review of dynamic pile analyses performed in the site vicinity, we selected the Meyerhof SPT-based method for a plugged pile to evaluate side resistance. This method was considered appropriate for H-piles at this site because it provided a reasonable prediction of side resistance for H-piles driven at a nearby site (Pumping Station Bridge 2693 over Branch Brook, MaineDOT WIN 20474) when compared to the results of dynamic pile analyses and test boring data from the same location. We evaluated side resistance in the clay by multiplying the average undrained shear strength by 0.15, which was evaluated based on pile driving analysis through clay at the above-mentioned site. The Meyerhof SPT-based method was also selected for end bearing, with plug conditions ranging from no plug to half plugged.

Given the very dense till anticipated at the pile tip and the primarily granular soil profile, settlement of the pile tips after installation is not anticipated. The total and differential settlement will be limited to elastic compression of the piles and should be less than $\frac{1}{2}$ inch.

The piles will be installed on land through the approach embankments. Therefore, corrosion was not considered in the design.

Pile design recommendations are presented in **Section 6.3** of this report.

5.4.3 Load and Resistance Factors

Pile lengths will be estimated using static resistance estimates as described above. Verification of the resistance of the driven piles will involve wave equation analysis, and dynamic pile testing with signal matching analysis. The piles will be driven to a nominal resistance calculated by dividing the maximum factored pile load by a resistance factor of 0.65, per AASHTO Table 10.5.5.2.3-1.

AASHTO LRFD load factors should be applied to horizontal earth pressure (EH), vertical earth pressure (EV) and earth surcharge (ES) loads using the load factors for permanent loads (γ_p) provided in AASHTO Table 3.4.1-2 for strength and extreme limit state design. A load factor of 1.5 may be applied to the passive pressure used to design the integral backwall (end diaphragm) to account for deformation of the backwall into the soil as a result of thermal expansion of the integral bridge deck.

5.4.4 Pile Type and Loading Data

The abutments are planned to be supported on ASTM A572, Grade 50 ($f_y=50$ ksi) steel H-piles. Each abutment will include a single row of five or six HP14x89 piles. The maximum factored axial loads for the strength condition provided by MaineDOT are 412 and 361 kips per pile for 5-pile and 6-pile



configurations, respectively. Therefore, the required geotechnical nominal pile resistance values are as presented in the following table.

REQUIRED GEOTECHNICAL PILE RESISTANCE					
Pile Type	Geotechnical Resistance Factor	5 Pile Configuration		6 Pile Configuration	
		Maximum Factored Load (kips)	Required Geotechnical Nominal Resistance (kips)	Maximum Factored Load (kips)	Required Geotechnical Nominal Resistance (kips)
HP 14 x 89	0.65	412	634	361	556

5.4.5 Axial Pile Resistance

We calculated side resistance and end bearing in soils using the α -method in the Marine Clay and the Meyerhof SPT-based method in Sand and Glacial Till, as described previously.

For H-piles, the potential for the tip to become partially- or fully-plugged depends on the presence of very dense soil and gravel, cobbles or boulders, which is difficult to predict. As a result, H-Pile tip resistance was calculated for two scenarios, unplugged and half plugged. The half-plugged condition assumes 50 percent of the end bearing area of a fully plugged condition. The resistance is based on uniform granular soil properties in the Sand and Glacial Till strata and does not consider the potential for discrete layers of dense gravel, cobbles, and boulders to cause a pile to refuse at shallower depth.

An axial resistance chart presenting the resistance versus depth for no plug and half-plugged pile tip conditions is presented in **Appendix D**. The predicted pile lengths indicate the piles will gain support primarily through side resistance in the sand, in the absence of achieving a partially- or fully-plugged condition or meeting refusal in cobble/boulder layers.

The approximate estimated pile lengths measured from proposed cutoff El. 10 for each scenario calculated from the chart are tabulated below:

Pile Type	End Condition	Estimated Pile Length (feet)	
		6-Pile Loading	5-Pile Loading
HP 14x89	No Plug	156	172
HP 14x89	Half Plugged	127	143

It is our understanding that it is MaineDOT's preference to conservatively predict pile lengths to limit the potential that insufficient pile will be available to complete the project. Therefore, pile lengths recommended for inclusion in the plans in **Section 6.3** of this report assume no plug will be developed.

5.4.6 Wave Equation Analyses

Preliminary wave equation analyses were performed to assess the drivability of an HP 14x89 pile with a nominal geotechnical resistance of 634 kips corresponding to the 5-pile configuration. A Delmag D44,



open-end diesel hammer with a rated energy of 90 ft-kips, was used in the analyses. The Delmag has adjustable fuel settings. A reduced hammer energy was used in the analysis based on Fuel Setting 3.

The calculated side resistance was used as an input in wave equation analyses. We modeled a pile length of 172 feet corresponding to the unplugged condition. For this length, we estimate the side resistance to be 586 kips, corresponding to approximately 90 percent side friction. We used a toe quake of 0.3, which is considered appropriate to assess drivability of a long friction pile driven in sand, where it may be difficult getting energy to the tip during driving.

Pile Type	Embedded Pile Length	Driving System	Required Nominal Geotechnical Resistance (kips)	Max Driving Stress (ksi)	Final Penetration Resistance (blows per inch)
HP 14x89, Toe Quake = 0.30	172 feet	Delmag D44 (90.155 ft-kips, Fuel Setting 3)	634	31	6

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 is within the MaineDOT preferred range of 6 to 15 blows per inch, the analyzed hammer system is judged acceptable to install the piles to a nominal resistance of 634 kips.

Results of the preliminary wave equation analysis are included in **Appendix D**.

5.4.7 Lateral Pile Analysis

The subsurface strata encountered near the top of the piles included primarily Clay overlying Sand. The following soil profile was developed for lateral pile evaluations. A single profile was used considering the similarity of the subsurface strata at both abutments.

Stratum	Soil Model	Top of Layer Elevation (ft)	Layer Thickness (ft)	ϕ' (deg)/ S_u (psf)	k (pci) / E50	γ_e (pcf)
Clay Crust	Stiff Clay	10	13	900 psf	$E_{50} = 0.007$	54
Clay	Stiff Clay	-3.0	43	700 psf	$E_{50} = 0.008$	54
Sand	Reese Sand	-46.0	42	40	85	61
Glacial Till	Reese Sand	-88.0	98	40	160	66

GZA conducted lateral pile analyses based on a maximum thermal deflection of 0.5 inches, as provided by MaineDOT. We assumed a fixed-head condition (zero rotation) and imposed the estimated thermal deflection at the pile head. The orientation of the HP14x89 piles represented weak-axis bending. The assumed axial load was 361 and 412 kips, representing the maximum factored axial load provided by MaineDOT for 5-pile and 6-pile configurations. Our results are summarized in the table below.



Pile Type	Axial Load (kips)	Shear Force for Lateral deflection of 0.5 in. (kips)	Moment at Pile Head (in-kips)	Total Stress at Pile Head (ksi)
HP 14x89	412	28.6	1511	48.0
HP 14x89	361	28.6	1511	46.0

5.4.9 Lateral Earth Pressure

Thermal expansion of the bridge will cause the backwalls and wingwalls 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.

Based on the estimated thermal bridge expansion of 0.5 inches and the abutment height of 10.5 feet, the calculated abutment rotation is 0.004 feet/foot. In accordance with the requirements of the BDG Section 5.4.2.11, integral abutment reinforcement is to be designed for full Coloumb passive pressure if the wall rotation is greater than 0.005 feet/foot. The calculated rotation is less than the criteria to apply full Coloumb pressure, but the bridge will be constructed on a skew, which has been shown to increase the potential for cracking in concrete for integral abutment bridges. Therefore, we conclude that full Coloumb passive earth pressure is appropriate for design.

Lateral earth pressure evaluations for abutments based on the BDG summarized below:

- Passive earth pressure coefficients were developed using Coloumb theory for Type 4 soil.
- AASHTO Commentary C3.10.9.1 specifies that single-span bridges are not required to include acceleration-augmented (earthquake-induced) soil pressures for design.

Design lateral earth pressure recommendations are provided in **Section 6.2** of this report.

5.4.10 Frost Penetration

Fill soils are anticipated to be present at the abutments, either as existing fill or imported backfill. Based on the MaineDOT BDG, Section 5.2.1, the Freezing Index for the site is 1,100, and with low to moderate moisture content (± 5 percent) soils, the estimated depth of frost penetration is 5.8 feet.

6.0 RECOMMENDATIONS

6.1 SEISMIC DESIGN

The United States Geological Survey online Design Maps Tool was used to develop parameters for bridge design. Based on the site coordinates, the software provided the recommended AASHTO Response Spectra (Site Class E) for a 7 percent probability of exceedance in 75 years. These results are summarized for the site as follows:



SITE CLASS E SEISMIC DESIGN PARAMETERS	
Parameter	Design Value
Fpga	2.5
Fa	2.5
Fv	3.5
As (Period = 0.0 sec)	0.236 g
SDs (Period = 0.2 sec)	0.459 g
SD1 (Period = 1.0 sec)	0.156 g

6.2 ABUTMENT AND WINGWALL DESIGN

- Backfill between new abutments and a 1.5H:1V plane extending up from the bottom of the abutment to the pavement subgrade should consist of Maine DOT 703.19 Granular Borrow for Underwater Backfill, BDG Type 4 soil. Recommended soil properties for Type 4 soils to be used as backfill are as follows:
 - Internal Friction Angle of Soil = 32°
 - Soil Total Unit Weight = 125 pcf
 - Coefficient of Passive Earth Pressure, $K_p = 6.73$ (use for design of backwalls and wingwalls)
- 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 Article 3.11.6.4, based on the abutment/wingwall height and distance from the wall backface to the edge of traffic.
- Foundation drainage should be provided in accordance with Section 5.4.1.9 of the BDG.
 - We recommend the use of French drains on the uphill side of abutments and wing walls to prevent buildup of differential hydrostatic pressure. Foundation drains should be sloped to drain by gravity and should daylight through weep holes in the abutments.

6.3 PILE DESIGN

- The proposed abutments may be supported on HP14x89 ASTM A572, Grade 50 steel (50 ksi yield stress) H-piles driven to the required nominal resistance, anticipated to be developed primarily through skin friction in, Sand and Glacial Till and end-bearing in Glacial Till.
- As a precaution against encountering refusal in a boulder in the overburden, cast steel pile points should be provided to limit pile damage during driving.
- 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.
- The piles should be driven to a nominal resistance of 634 kips for the 5-pile configuration or 556 kips for the 6-pile configuration, calculated by dividing the maximum factored pile load by a resistance factor of 0.65.



- Preliminary wave equation analysis indicated that the piles can be driven to a nominal resistance of 634 kips using a diesel hammer with a rated energy of about 90 foot-kips for the anticipated 172-foot-long, ASTM A572 Grade 50 HP14x89 piles without exceeding the allowable driving stress of 45 ksi (0.9F_y for 50 ksi steel). The final penetration resistance was approximately 6 bpi, which is within the Maine DOT range of 3 to 15 blows per inch.
- Considering HP 14x89 piles that may not achieve a plugged condition, recommended pile lengths are summarized in the following table. Pile lengths will likely be shorter if plugging occurs. As noted, we recommend that the piles be assumed to be 10 feet longer than the lengths predicted by geotechnical resistance methods as a contingency.

RECOMMENDED PILE LENGTHS FOR DRAWINGS				
Location, Required Nominal Resistance	Predicted Pile Length (feet)	Additional Contingency Length (feet)	Recommended Pile Length for Plans (feet)	Recommended Pile Tip Elevation for Plans (feet, NAVD 88)
Abutment 1, 556 kips	155	10	165	-151
Abutment 1, 634 kips	171	10	181	-167
Abutment 2, 556 kips	156	10	166	-153
Abutment 2, 634 kips	172	10	182	-169

Note: Pile lengths presented in this table are measured below bottom of pile cap. Additional pile length should be included as necessary for the portion of the pile embedded in the pile cap. Tip Elevations are rounded down (i.e., deeper than the calculated value) to the nearest foot.

- Piles shall be spliced in accordance with MaineDOT Section 501.047.
- The structural engineer should complete structural evaluation of the piles using the bending stress results from the LPILE analyses summarized in **Section 5.4.7** (output provided in **Appendix D**) in accordance with the design steps listed in BDG Section 5.4.2.4.C.

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 PILE INSTALLATION CONTROL

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

AASHTO Table 10.5.5.2.3-1 requires that at least one load test with signal matching be performed per substructure to use a resistance factor of 0.65. Considering the uncertainty in pile length and geotechnical resistance for this project, it is recommended that two PDA tests with Signal Matching be



completed at each abutment, including at least one pile restrike at each abutment. Pile restrikes with PDA testing may be warranted at both piles at each abutment if significant variation is found between end of drive and beginning of restrike resistance.

Additional PDA testing may be recommended if unanticipated conditions are encountered during installation, including early pile take-up, pile driving out-of-plumb, or otherwise unexplained variations in hammer performance. Restrike tests should not be waived for this project.

7.2 PILE OBSTRUCTIONS

Although no evidence of cobbles and boulders were seen in the shallower strata (Fill and Alluvial Deposit) in the test borings, it is possible that pre-drilling, pre-excavation or spudding may be necessary to bypass potential obstructions, such as boulders, rock fill or existing foundations and stone masonry.

7.3 EXCAVATION, TEMPORARY LATERAL SUPPORT AND DEWATERING

Excavations for abutment foundations are anticipated to range from 10 to 12 feet below existing pavement grades. It is our understanding that Route 1 will remain in service during construction of the new bridge. Therefore, we anticipate it will be necessary to install temporary sheet pile excavation support to allow excavation adjacent to vehicular traffic areas. In areas where sufficient space is available and water conditions permit, the excavation slopes may consist of sloped, open-cuts. In all cases, temporary excavations should comply with OSHA excavation safety requirements.

Considering the proximity of the required abutment excavations to the river water level, management of water will be related to river water levels at the time of construction. Considering bottom of backwall elevations at approximately El. 13 to El. 14.5 and Q1.1 at El. 15.5 for the existing structure, and El. 14.6 for the proposed structure, water levels may be at or above the bottom of excavation level during construction. It may be desirable to over-excavate and place an 8- to 12-inch thick crushed stone working mat to improve accessibility and allow dewatering.

We anticipate that the inflow of groundwater or surface water to excavations could be handled by open pumping from sumps installed at the bottom of excavations if cofferdams are installed. Stacked sand bags or a porta-dam type system may be sufficient to limit inflow of surface water in lieu of a sheet pile cofferdam, given the relatively small anticipated head. The contractor should be responsible for controlling groundwater, surface runoff, infiltration and water from all other sources by methods which preserve the subgrade and permit concrete placement in-the-dry. Discharge of pumped groundwater and river water should comply with all local, State, and federal regulations.

7.4 REUSE OF ON-SITE MATERIALS

Based on the test boring results, neither of the two fill samples tested had greater than 20 percent passing the No. 200 sieve, indicating the fill may meet MaineDOT specifications for Granular Borrow and/or Granular Borrow for Underwater Backfill. The material is considered suitable for use as Common Borrow.



If the contractor wishes to reuse excavated material as embankment fill or in other areas, we recommend that the proposed material be stockpiled and tested for grain size distribution. Stockpiled materials meeting the appropriate MaineDOT specifications may be reused on the project.

P:\09 Jobs\0025900s\09.0025946.00 - MDOT Capell Bridge Wells\Report\Final\FINAL 25946 Capell Bridge Geotech RPT 120417.docx



FIGURES



Copyright:© 2013 National Geographic Society, i-cubed



USGS
QUADRANGLE
LOCATION

SOURCE : THIS MAP CONTAINS THE ESRI ARCGIS ONLINE USA TOPOGRAPHIC MAP SERVICE, PUBLISHED DECEMBER 12, 2009 BY ESRI ARCMS 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 :



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

DATE: 11-15-2017

LOCUS PLAN

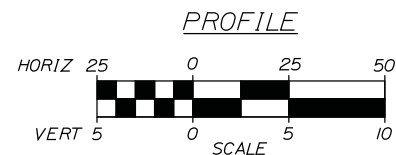
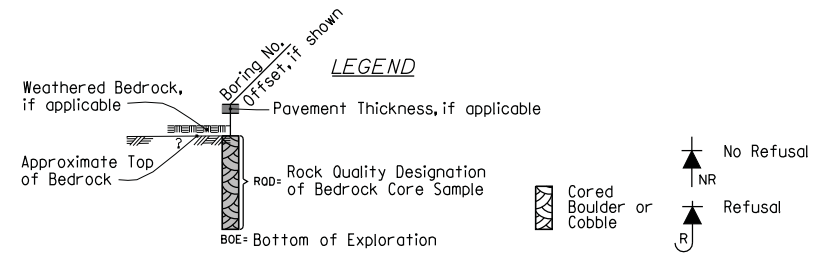
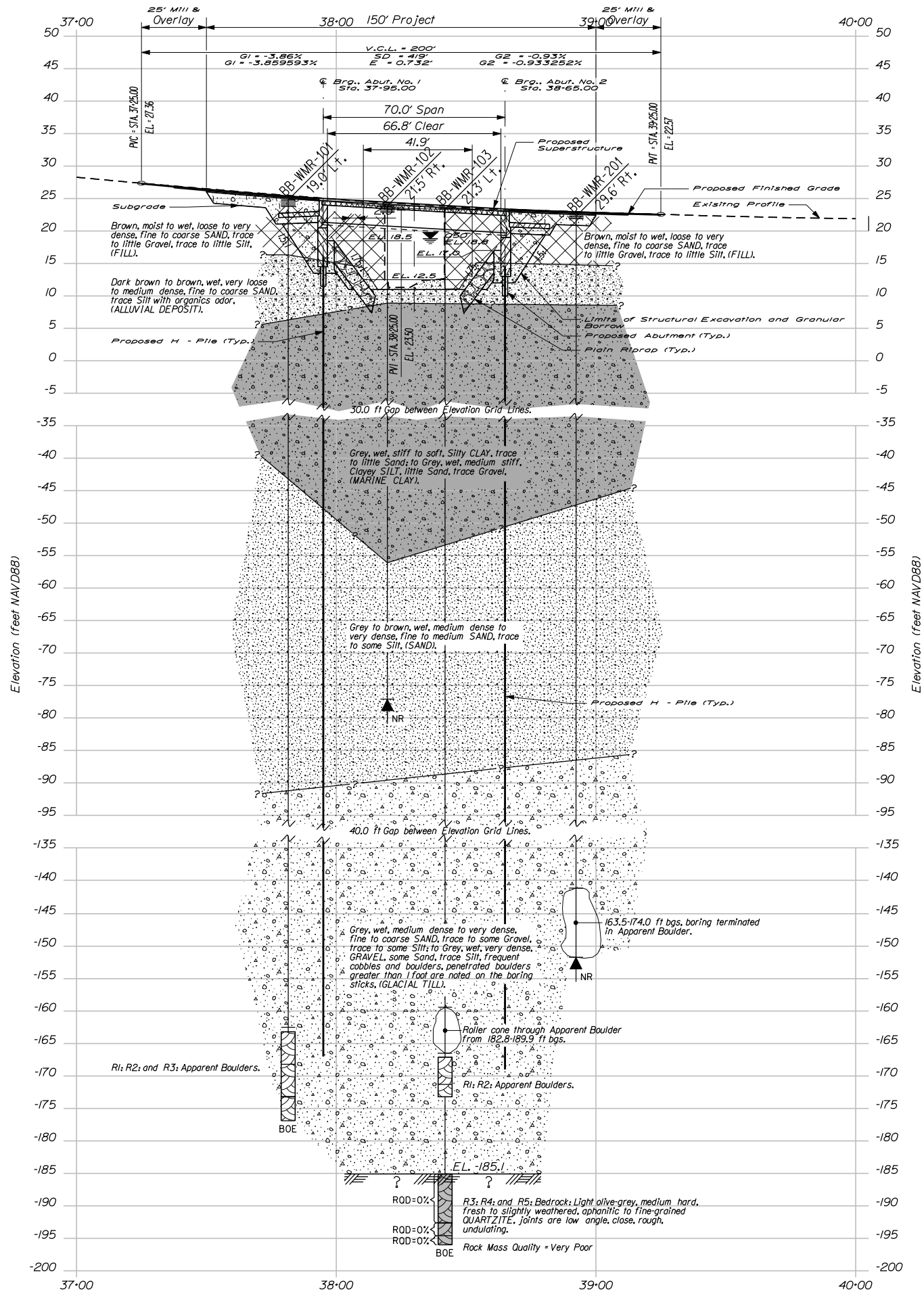
CAPELL BRIDGE NO. 2126, MAINEDOT WIN 020814.00
WELLS, MAINE

JOB NO.

09.0025946.00

FIGURE NO.

1



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

CAPELL BRIDGE NO. 2126 OVER MERILLAND RIVER MAINEDOT WIN 020814.00 WELLS, ME			
INTERPRETIVE SUBSURFACE PROFILE			
PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: MAINE DEPARTMENT OF TRANSPORTATION	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG
DESIGNED BY: BMC	DRAWN BY: TW	SCALE: AS SHOWN	3
DATE: 12/4/17	PROJECT NO. 09.0025946.00	REVISION NO. 0	
			SHEET NO. 1 OF 1

STATE OF MAINE DEPARTMENT OF TRANSPORTATION STP-2081(400)	SIGNATURE P.E. NUMBER DATE	PROJ. MANAGER J. Kirtledge	BY D. Dornen	DATE April 2017
		CHECKED-REVIEWED K. Nash		
		DESIGNED-DETAILED T. White		
CAPELL BRIDGE MERRILLAND RIVER WELLS YORK COUNTY	INTERPRETIVE SUBSURFACE PROFILE	REVISIONS 1		
		REVISIONS 2		
		REVISIONS 3		
		REVISIONS 4		
		FIELD CHANGES		
SHEET NUMBER		BRIDGE NO. 2126 WIN 020814.00 BRIDGE PLANS		



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

TEST BORING LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM					MODIFIED BURMISTER 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	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Descriptive Term		Portion of Total (%)	
		(little or no fines)	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.	trace	0 - 10		
					little	11 - 20		
					some	21 - 35		
					adjective (e.g. sandy, clayey)	36 - 50		
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	TERMS DESCRIBING DENSITY/CONSISTENCY			
		GC	Clayey gravels, gravel-sand-clay mixtures.					
		CLEAN SANDS	SW	Well-graded sands, gravelly sands, little or no fines	Density of Cohesionless Soils		Standard Penetration Resistance	
		(little or no fines)	SP	Poorly-graded sands, gravelly sand, little or no fines.	N-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 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.	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).				
		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.	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.				
		SILTS AND CLAYS (liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Approximate Undrained Shear		Field	
			CH	Inorganic clays of high plasticity, fat clays.	Strength (psf)		Guidelines	
	OH		Organic clays of medium to high plasticity, organic silts.	Consistency of Cohesive soils	SPT N-Value (blows per foot)			
				Very Soft	WOH, WOR, WOP, <2	0 - 250		Fist easily penetrates
				Soft	2 - 4	250 - 500		Thumb easily penetrates
	HIGHLY ORGANIC SOILS			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	
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					Rock Quality Designation (RQD): RQD (%) = $\frac{\text{sum of the lengths of intact pieces of core} * > 4 \text{ inches}}{\text{length of core advance}}$ *Minimum NQ rock core (1.88 in. OD of core)			
					Correlation of RQD to Rock Mass Quality			
					Rock Mass 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 mass quality (very poor, poor, etc.) ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A Recovery (inch/inch and percentage) Rock Core Rate (X.X ft - Y.Y ft (min:sec))			
					Sample Container Labeling Requirements: WIN Bridge Name / Town Boring Number Sample Number Sample Depth Blow Counts Sample Recovery Date Personnel Initials			

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

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-101 1 PIN: 20814.00																																																																																																																																																																																																																																									
Driller: New England Boring			Elevation (ft.) 24.8			Auger ID/OD: 5" Solid Stem																																																																																																																																																																																																																																									
Operator: Chris/James			Datum: NAVD88			Sampler: Standard Split																																																																																																																																																																																																																																									
Logged By: B. Wilder			Rig Type: Mobile B-53 Truck/Track			Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																																																									
Date Start/Finish: 1/27/2017-3/7/2017			Drilling Method: Cased Wash Boring			Core Barrel: NQ-2"																																																																																																																																																																																																																																									
Boring Location: Sta. 37+81.5, 19.0 feet Lt.			Casing ID/OD: HW-4" & NW-3"			Water Level*: None Observed																																																																																																																																																																																																																																									
Hammer Efficiency Factor: 0.572			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																																																																																																																																																																																																																																												
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-101 2 PIN: 20814.00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Date Start/Finish: 1/27/2017-3/7/2017			Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
Boring Location: Sta. 37+81.5, 19.0 feet Lt.			Casing ID/OD: HW-4" & NW-3"		Water Level*: None Observed																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
Hammer Efficiency Factor: 0.750			Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-101 2 PIN: 20814.00							
Driller: New England Boring				Elevation (ft.) 24.8				Auger ID/OD: 5" Solid Stem							
Operator: Chris/James				Datum: NAVD88				Sampler: Standard Split							
Logged By: B. Wilder				Rig Type: Mobile B-53 Truck/Track				Hammer Wt./Fall: 140#/30"							
Date Start/Finish: 1/27/2017-3/7/2017				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"							
Boring Location: Sta. 37+81.5, 19.0 feet Lt.				Casing ID/OD: HW-4" & NW-3"				Water Level*: None Observed							
Hammer Efficiency Factor: 0.750				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 Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.				
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)							
25	1U	24/12	25.0 - 27.0	Piston Sampler			45			Grey, wet, Silty CLAY, trace fine sand. -MARINE CLAY- (CL) 55x110 mm vane raw torque readings: V1: 22.0/2.0 ft-lbs V2: 22.0/1.0 ft-lbs Grey, wet, medium stiff, Silty CLAY, trace fine sand. -MARINE CLAY- (CL) 55x110 mm vane raw torque readings: V3: 16.0/0.5 ft-lbs V4: 14.0/0.5 ft-lbs Failed sample attempt. Similar to above. 55x110 mm vane raw torque readings: V5: 14.0/2.0 ft-lbs V6: 18.0/1.0 ft-lbs Similar to above. 55x110 mm vane raw torque readings: V7: 20.0/1.0 ft-lbs V8: 14.0/0.5 ft-lbs	G,C#271108 A-4, CL WC=33.3% LL=31 PL=21 PI=10 G#271109 A-4, CL WC=34.9% LL=27 PL=18 PI=9				
							40								
	V1		27.6 - 28.0	Su=982/89 psf			42								
	V2		28.6 - 29.0	Su=982/45 psf			47								
							43								
							44								
	6D	24/5	31.5 - 33.5	WOR/WOR/WOR/ WOR	---		43								
	V3		32.1 - 32.5	Su=714/22 psf			44								
	V4		33.1 - 33.5	Su=625/22 psf			49								
							45								
							46								
							47								
							38								
							38								
							30								
	MD	24/0	40.0 - 42.0	WOR/WOR/WOR/ WOR	---		33								
	V5		40.6 - 41.0	Su=625/89 psf			31								
	V6		41.6 - 42.0	Su=804/45 psf			32								
							36								
							38								
	2U	24/12	45.0 - 47.0	Piston Sampler			47								
							42								
	V7		47.6 - 48.0	Su=893/45 psf			38								
	V8		48.6 - 49.0	Su=625/22 psf			36								
							34								
50															
Remarks: -Hammer AH-2 broke down after taking Samples 1D, 2D, 3D and 4D. Changed to new hammer at 20.0 feet bgs, ETR = 0.750. -Left 10.0 feet of casing in borehole. -Soil descriptions and blow counts updated by GZA based on ETRs, vane shear strengths, laboratory test results, and interpretations of strata designations. GZA did not observe soil samples. -Descriptions of cored material prepared by GZA based on observation of samples at MaineDOT lab in Bangor and photographs taken by MaineDOT immediately after coring.															
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 2 of 9 Boring No.: BB-WMR-101 2					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-101 2 PIN: 20814.00	
Driller: New England Boring			Elevation (ft.) 24.8		Auger ID/OD: 5" Solid Stem		
Operator: Chris/James			Datum: NAVD88		Sampler: Standard Split		
Logged By: B. Wilder			Rig Type: Mobile B-53 Truck/Track		Hammer Wt./Fall: 140#/30"		
Date Start/Finish: 1/27/2017-3/7/2017			Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"		
Boring Location: Sta. 37+81.5, 19.0 feet Lt.			Casing ID/OD: HW-4" & NW-3"		Water Level*: None Observed		
Hammer Efficiency Factor: 0.750			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 Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
50	7D	24/4	50.0 - 52.0	WOR/WOR/WOR/	---		HP		-28.2	Similar to above. -MARINE CLAY- (CL) 55x110 mm vane raw torque readings: V9: 21.0/1.0 ft-lbs V10: 18.0/1.0 ft-lbs	
	V9		50.6 - 51.0	Su=937/45 psf							
	V10		51.6 - 52.0	Su=804/45 psf							
55	8D	24/24	55.0 - 57.0	WOR/WOR/WOR/	---				-28.2	Grey, wet, medium stiff, Clayey SILT, little Sand, trace Gravel. -MARINE CLAY- (CL) 55x110 mm vane raw torque readings: V11: 15.0/2.0 ft-lbs V12: 17.0/1.5 ft-lbs	G#271111 A-4, ML WC=17.9% LL=20 PL=16 PI=4
	V11		55.6 - 56.0	Su=670/89 psf							
	V12		56.6 - 57.0	Su=759/67 psf							
60	9D	24/24	60.0 - 62.0	WOR/WOR/WOR/	---		WOC		-43.2	Grey, wet, medium stiff, Clayey SILT, little Sand. -MARINE CLAY- (CL) Set in NW casing at 60.0 feet bgs. 55x110 mm vane raw torque readings: V13: 16.5/1.0 ft-lbs Failed vane attempt, could not push.	G#271112 A-4, CL-ML WC=20.5% LL=20 PL=15 PI=5
	V13		60.6 - 61.0	Su=737/45 psf							
	MV		61.6 - 61.7								
65											
70	10D	12/12	70.0 - 71.0	WOH/WOH	---		HP		-43.2	Grey, wet, loose, fine to medium SAND, little silt. -SAND-(SM)	G#271113 A-2-4, SM WC=19.6%
75								20			

Remarks:
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 -Left 10.0 feet of casing in borehole.
 -Soil descriptions and blow counts updated by GZA based on ETRs, vane shear strengths, laboratory test results, and interpretations of strata designations. GZA did not observe soil samples.
 -Descriptions of cored material prepared by GZA based on observation of samples at MaineDOT lab in Bangor and photographs taken by MaineDOT immediately after coring.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-101 2 PIN: 20814.00							
Driller: New England Boring				Elevation (ft.) 24.8				Auger ID/OD: 5" Solid Stem							
Operator: Chris/James				Datum: NAVD88				Sampler: Standard Split							
Logged By: B. Wilder				Rig Type: Mobile B-53 Truck/Track				Hammer Wt./Fall: 140#/30"							
Date Start/Finish: 1/27/2017-3/7/2017				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"							
Boring Location: Sta. 37+81.5, 19.0 feet Lt.				Casing ID/OD: HW-4" & NW-3"				Water Level*: None Observed							
Hammer Efficiency Factor: 0.750				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							
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Sample Information												Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.	
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						
100	13D	24/16	100.0 - 102.0	18/21/31/55	52	65	180				Grey, wet, very dense, fine to coarse SAND, trace gravel, trace silt. -SAND- (SP)	G#271114 A-3, SW-SM WC=12.6%			
							187								
							134								
							201								
							288								
-105							132								
							126								
							136								
							125								
							225								
-110	14D	24/15	110.0 - 112.0	21/18/21/14	39	49	211				Similar to above, except dense. -SAND- (SP)				
							230								
							233								
							273								
							351								
-115							152								
							275								
							342								
							291								
							289								
-120	15D	24/18	120.0 - 122.0	12/18/25/60	43	54	218				Grey, wet, very dense, fine to coarse SAND, little gravel, trace silt. -GLACIAL TILL- (SP)				
							257								
							304								
							402								
							406								
125															
Remarks: -Hammer AH-2 broke down after taking Samples 1D, 2D, 3D and 4D. Changed to new hammer at 20.0 feet bgs, ETR = 0.750. -Left 10.0 feet of casing in borehole. -Soil descriptions and blow counts updated by GZA based on ETRs, vane shear strengths, laboratory test results, and interpretations of strata designations. GZA did not observe soil samples. -Descriptions of cored material prepared by GZA based on observation of samples at MaineDOT lab in Bangor and photographs taken by MaineDOT immediately after coring.															
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-101 2 PIN: 20814.00	
Driller: New England Boring			Elevation (ft.) 24.8		Auger ID/OD: 5" Solid Stem		
Operator: Chris/James			Datum: NAVD88		Sampler: Standard Split		
Logged By: B. Wilder			Rig Type: Mobile B-53 Truck/Track		Hammer Wt./Fall: 140#/30"		
Date Start/Finish: 1/27/2017-3/7/2017			Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"		
Boring Location: Sta. 37+81.5, 19.0 feet Lt.			Casing ID/OD: HW-4" & NW-3"		Water Level*: None Observed		
Hammer Efficiency Factor: 0.750			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		
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Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
175							479			Roller Coned ahead to 185.0 feet bgs.	
							481				
							488				
							496				
							520				
-180							470				
							334				
							515				
							409				
							408				
-185										Increased resistance at 187.3 feet, Roller Coned ahead to 188.0 feet and started to core. R1: Gray rock fragments, apparent cobbles/boulders. R1: Core Times (min:sec) 188.0-189.0 feet (5:43) 189.0-190.0 feet (5:01) 190.0-191.0 feet (5:27) no water return 191.0-192.0 feet (10:19) 192.0-193.0 feet (8:50) 39% Recovery	
	R1	60/22	188.0 - 193.0	RQD = 0%							
-190										R2: Gray rock fragments (syenite and basalt), rounded, apparent cobbles/boulders. R2: Core Times (min:sec) 193.0-194.0 feet (3:26) 194.0-195.0 feet (2:56) 195.0-196.0 feet (2:01) 197.0-198.0 feet (4:06) no water return 18% Recovery	
	R2	60/11	193.0 - 198.0	RQD = 0%							
-195										R3: Gray rock fragments (granite, quartz and syenite), rounded, apparent cobbles/boulders. R3: Core Times (min:sec) 198.0-199.0 feet (7:12)	
	R3	44.4/8	198.0 - 201.7	RQD = 0%							
200											

Remarks:
 -Hammer AH-2 broke down after taking Samples 1D, 2D, 3D and 4D. Changed to new hammer at 20.0 feet bgs, ETR = 0.750.
 -Left 10.0 feet of casing in borehole.
 -Soil descriptions and blow counts updated by GZA based on ETRs, vane shear strengths, laboratory test results, and interpretations of strata designations. GZA did not observe soil samples.
 -Descriptions of cored material prepared by GZA based on observation of samples at MaineDOT lab in Bangor and photographs taken by MaineDOT immediately after coring.

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.

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Boring No.: BB-WMR-101 2

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-102 PIN: 20814.00																																																																																																																																																																																																																																																																																																																						
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Logged By: N. Sherwood		Rig Type: Truck mounted Mobile B-53		Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																																																																																																																																								
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Driller: New England Boring				Elevation (ft.) 23.9				Auger ID/OD: 5" Solid Stem																																																																																																																																																																																																							
Operator: Chris/James				Datum: NAVD88				Sampler: Standard Split																																																																																																																																																																																																							
Logged By: N. Sherwood				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																							
Date Start/Finish: 1/26/2017; 10:02-12:45				Drilling Method: Cased Wash Boring				Core Barrel: N/A																																																																																																																																																																																																							
Boring Location: Sta. 38+19.7, 21.5 feet Rt.				Casing ID/OD: HW-4" & NW-3"				Water Level*: None Observed																																																																																																																																																																																																							
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-103 PIN: 20814.00																																													
Driller: New England Boring						Elevation (ft.): 23.4				Auger ID/OD: N/A																																													
Operator: Tom/Mark						Datum: NAVD88				Sampler: N/A																																													
Logged By: B. Wilder/Travis						Rig Type: Track mounted Mobile B-53				Hammer Wt./Fall: N/A																																													
Date Start/Finish: 2/2/2017-2/28/2017						Drilling Method: Cased Wash Boring				Core Barrel: NQ2																																													
Boring Location: Sta. 38+41.9, 21.3 feet Lt.						Casing ID/OD: NW-3"				Water Level*: None Observed																																													
Hammer Efficiency Factor: --						Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☐																																																	
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Page 3 of 9 Boring No.: BB-WMR-103																																																							

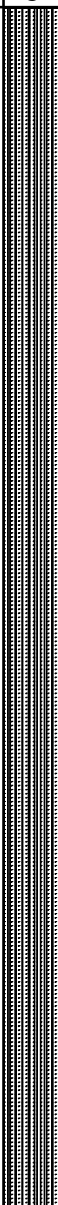
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-103 PIN: 20814.00																																																																																																																																																																																																																																																																																																																											
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-201 1					
Driller: New England Boring		Elevation (ft.) 22.3		Auger ID/OD: -							
Operator: Ken Smith/Pete Labossier		Datum: NAVD88		Sampler: Split Spoon							
Logged By: B. Woodman/B. Cardali/N. Williams		Rig Type: Truck mounted Mobile B-53		Hammer Wt./Fall: 140/30							
Date Start/Finish: 6/19/17-7/5/17		Drilling Method: Drive & Wash		Core Barrel: -							
Boring Location: Sta. 38+92.4, 29.6' Rt.		Casing ID/OD: 4"		Water Level*: 13.7'							
Hammer Efficiency Factor: 0.793		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 Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
0							36	21.9	-ASPHALT-		
	1D	24/14	1.0 - 3.0	30-33-22-24	55	73	61		Light brown/orange, moist, very dense, fine to coarse SAND, little Silt, little Gravel.	G#1 A-1-b (SM) WC=5.2	
							74		-FILL- (SM)	G#2	
	2D	24/14	3.0 - 5.0	17-15-18-13	36	48	55		Light brown/orange, moist, dense, fine to coarse SAND, little Silt, little Gravel.	A-1-b (SM) WC=5.9	
							36		-FILL- (SM)		
5	3D	24/3	5.0 - 7.0	4-4-3-1	7	9	12		Brown, wet, loose, fine to coarse SAND, little Gravel, trace Silt.		
							10		-FILL- (SW)		
	4D	24/12	7.0 - 9.0	2-2-1-2	3	4	7	14.8	Top 6": Brown, wet, loose, fine to coarse SAND, little Gravel, trace Silt.		
							5		-FILL- (SW)		
10	5D	24/1	9.0 - 11.0	2-1-1-2	2	3	5		Bottom 6": Dark brown, wet, very loose, fine to coarse SAND, trace Silt.		
							7		-ALLUVIAL DEPOSIT- (SP-SM)		
	6D	24/9	11.0 - 13.0	3-2-2-2	4	5	9		Dark brown, wet, very loose, fine to medium SAND, trace Silt.	G#3 A-3 (SP-SM) WC=32.9	
							9		-ALLUVIAL DEPOSIT- (SP-SM)		
	7D	24/12	13.0 - 15.0	3-2-2-3	4	5	11		Gray/brown, moist, very loose, fine to medium SAND, some Gravel, trace Silt, with wood fragments, organic odor.		
							16		-ALLUVIAL DEPOSIT- (SP-SM)	G#4 A-2-4 (SM) WC=27.5	
15	8D	24/8	15.0 - 17.0	WOR-WOH-2-2	2	3	10	8.6	Top 8": Dark brown, wet, very loose, fine to medium SAND, some Silt, trace Gravel, organic odor.		
							15		-ALLUVIAL DEPOSIT- (SP)		
							16		Bottom 4": Gray, wet, Silty CLAY, little fine Sand.		
							13		-MARINE CLAY- (CL)		
							10		Gray, wet, soft to medium stiff, Silty CLAY , little fine Sand.		
20	9D	24/24	20.0 - 22.0	WOR-WOR-WOR-WOH			11		-MARINE CLAY- (CL)		
							9			WC=41.4 LL=35 PL=20 PI=15	
							11				
							13				
25							12				
Remarks: 1. Automatic Hammer: Truck 21, ETR = 0.793 broke down after taking samples 1D-35D. Changed to new hammer at 146.0' bgs. 2. Rod dropped when sampling 21D, first 5" of SPT missed ("X"). 3. 26D and 29D taken using 3" OD split spoon with 2.5" sleeves (140 lb Auto Hammer). 4. Samples 21D, 22D, 24D, and 25D used for auto hammer calibration. 5. Coordinates: N186082.8, E934557.0.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 6 Boring No.: BB-WMR-201 1	

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Driller: New England Boring					Elevation (ft.) 22.3					Auger ID/OD: -														
Operator: Ken Smith/Pete Labossier					Datum: NAVD88					Sampler: Split Spoon														
Logged By: B. Woodman/B. Cardali/N. Williams					Rig Type: Truck mounted Mobile B-53					Hammer Wt./Fall: 140/30														
Date Start/Finish: 6/19/17-7/5/17					Drilling Method: Drive & Wash					Core Barrel: -														
Boring Location: Sta. 38+92.4, 29.6' Rt.					Casing ID/OD: 4"					Water Level*: 13.7'														
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25	10D V1	24/24	25.0 - 27.0 25.6 - 26.0	WOR-WOR-WOH-WOH S _u > 824 psf	--		16	-2.7		Gray, wet, medium stiff to stiff, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL) Vane advanced with extreme difficulty. 65x130 mm vane raw torque reading: V1: >30 ft lbs					WC=43.4 LL=35 PL=20 PI=15									
							17																	
							16																	
							14																	
							9																	
30	11D V2	24/24	30.0 - 32.0 30.6 - 31.0	Push thru vane S _u =580/22 psf	0	0	16			Gray, wet, medium stiff, Silty CLAY. -MARINE CLAY- (CL) 55x110 mm vane raw torque readings: V2: 13.0/0.5 ft lbs V3: 12.0/1.0 ft lbs														
	V3		31.6 - 32.0	S _u =536/45 psf			15																	
							16																	
							16																	
							13																	
35	12D	24/24	35.0 - 37.0	WOR-WOR-WOR-WOR	0	0	16			Gray, wet, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL)														
							13																	
							14																	
							14																	
							15																	
40	13D V4	24/24	40.0 - 42.0 40.6 - 41.0	Push thru vane S _u =659/41 psf	--		15			Gray, wet, medium stiff, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL) 65x130 mm vane raw torque readings: V4: 24.0/1.5 ft lbs V5: 23.0/1.0 ft lbs														
	V5		41.6 - 42.0	S _u =632/27 psf			13																	
							13																	
							16																	
							12																	
45	14D	24/24	45.0 - 47.0	WOR-WOR-WOR-WOR	0	0	20		Gray, wet, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL)															
							18																	
							14																	
							12																	
							13																	
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Remarks: 1. Automatic Hammer: Truck 21, ETR = 0.793 broke down after taking samples 1D-35D. Changed to new hammer at 146.0' bgs. 2. Rod dropped when sampling 21D, first 5" of SPT missed ("X"). 3. 26D and 29D taken using 3" OD split spoon with 2.5" sleeves (140 lb Auto Hammer). 4. Samples 21D, 22D, 24D, and 25D used for auto hammer calibration. 5. Coordinates: N186082.8, E934557.0. 6. Multiply field blow counts by 0.6 for approximate equivalent SPT N.																								
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-201 1 PIN: 20814.00									
Driller: New England Boring				Elevation (ft.) 22.3				Auger ID/OD: -									
Operator: Ken Smith/Pete Labossier				Datum: NAVD88				Sampler: Split Spoon									
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140/30									
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash				Core Barrel: -									
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"				Water Level*: 13.7'									
Hammer Efficiency Factor: 0.793				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												Graphic Log		Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.	
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.)									
50	15D	24/24	50.0 - 52.0	Push thru vane	--		17				Gray, wet, medium stiff, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL) 65x130 mm vane raw torque readings: V6: 28.0/2.5 ft lbs V7: 24.0/1.0 ft lbs	WC=26.9 LL=24 PL=14 PI=10					
	V6		50.6 - 51.0	S _u =769/69 psf			18										
	V7		51.6 - 52.0	S _u =659/27 psf			13										
							13										
55							14					Gray, wet, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL)					
	16D	24/24	55.0 - 57.0	WOH-WOH-WOH-1	0	0	16										
							14										
							17										
60							15					Gray, wet, medium stiff, Silty CLAY, trace fine Sand. -MARINE CLAY- (CL) 65x130 mm vane raw torque readings: V8: 28.0/4.5 ft lbs V9: 29.0/1.5 ft lbs	WC=25.2 LL=22 PL=14 PI=8				
							14										
	17D	24/24	60.0 - 62.0	Push thru vane	--		23										
	V8		60.6 - 61.0	S _u =769/124 psf			25										
65	V9		61.6 - 62.0	S _u =796/41 psf			22					Gray, wet, Silty CLAY, little Sand. -MARINE CLAY- (CL)					
							20										
							25										
	18D	24/24	65.0 - 67.0	WOR-WOR-WOR-WOR	0	0	20										
70							16			Gray, wet, medium dense, fine SAND, some Silt. -SAND- (SM) Failed vane attempt, could not advance vane.							
							19										
							14										
							20										
75							18	24	31	47.7	70.0						
	19D	24/24	70.0 - 72.0	8-10-8-4			48										
	MV		70.6 - 70.6				25										
							71										
Remarks: 1. Automatic Hammer: Truck 21, ETR = 0.793 broke down after taking samples 1D-35D. Changed to new hammer at 146.0' bgs. 2. Rod dropped when sampling 21D, first 5" of SPT missed ("X"). 3. 26D and 29D taken using 3" OD split spoon with 2.5" sleeves (140 lb Auto Hammer). 4. Samples 21D, 22D, 24D, and 25D used for auto hammer calibration. 5. Coordinates: N186082.8, E934557.0. 6. Multiply field blow counts by 0.6 for approximate equivalent SPT N.																	
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.												Page 3 of 6		Boring No.: BB-WMR-201 1			

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine			Boring No.: BB-WMR-201 1 PIN: 20814.00							
Driller: New England Boring				Elevation (ft.) 22.3				Auger ID/OD: -							
Operator: Ken Smith/Pete Labossier				Datum: NAVD88				Sampler: Split Spoon							
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140/30							
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash				Core Barrel: -							
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"				Water Level*: 13.7'							
Hammer Efficiency Factor: 0.793				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 Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.				
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)							
75	20D	24/16	75.0 - 77.0	48-50-53-63	103	136	RC		Gray, wet, very dense, fine SAND, some Silt. -SAND- (SM)	G#5 A-2-4 (SM) WC=18.1					
80								66							
	21D	24/13	80.0 - 82.0	X-21-26-33	47	62	59		Gray, wet, dense, fine SAND, trace Silt. -SAND- (SP)	G#6 A-3 (SP) WC=22.4					
								70							
	22D	24/24	82.0 - 84.0	12-17-26-25	43	57	94								
							111								
85								122							
	23D	24/13	85.0 - 87.0	7-3-5-12	8	11	95		Gray, wet, loose, fine to medium SAND, little Silt, trace Gravel. -SAND- (SM)	G#7 A-2-4 WC=22.1					
								84							
	24D	24/24	87.0 - 89.0	8-12-13-17	25	33	89								
							111								
90								143							
	25D	24/14	90.0 - 92.0	6-10-10-15	20	26	93		Gray, wet, medium dense, fine to coarse SAND, little Silt. -SAND- (SM)						
								140							
								184							
							171								
95								181							
	26D	24/17	95.0 - 97.0	15-20-30-42	50	66	RC		Gray, wet, dense, fine to medium SAND, trace Silt. -SAND- (SP) Sample taken using 5" O.D. split spoon see Remark 3. Starting after 26D, borehole was advanced to 1.0' above next sample interval using roller cone, then casing was driven to the top of the next interval. Followed by clean-out prior to sampling.	G#8 A-3 (SP) WC=12.9					
100								152							
Remarks: 1. Automatic Hammer: Truck 21, ETR = 0.793 broke down after taking samples 1D-35D. Changed to new hammer at 146.0' bgs. 2. Rod dropped when sampling 21D, first 5" of SPT missed ("X"). 3. 26D and 29D taken using 3" OD split spoon with 2.5" sleeves (140 lb Auto Hammer). 4. Samples 21D, 22D, 24D, and 25D used for auto hammer calibration. 5. Coordinates: N186082.8, E934557.0. 6. Multiply field blow counts by 0.6 for approximate equivalent SPT N.															
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Driller: New England Boring				Elevation (ft.) 22.3		Auger ID/OD: -					
Operator: Ken Smith/Pete Labossier				Datum: NAVD88		Sampler: Split Spoon					
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53		Hammer Wt./Fall: 140/30					
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash		Core Barrel: -					
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"		Water Level*: 13.7'					
Hammer Efficiency Factor: 0.793				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				
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Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
100	27D	24/19	100.0 - 102.0	9-20-18-22	38	50	RC		Gray-brown, wet, dense, fine to medium SAND, trace Silt. -SAND- (SP)	G#9 A-1-a (SP) WC=12.8	
105	28D	24/16	105.0 - 107.0	6-9-16-20	25	33	RC		Gray, wet, medium dense, fine SAND, trace Silt. -SAND- (SP)	G#9 A-1-a (SP) WC=12.8	
110	29D	24/15	110.0 - 112.0	27-22-39-15	61	81	RC		Slight increase in roller cone resistance at 108.8'-109.3', possible cobble. Gray, wet, dense, fine to coarse SAND, some Gravel, trace Silt. -GLACIAL TILL- (SP) Sample taken using 3" O.D. split spoon, see Remark 3.	G#9 A-1-a (SP) WC=12.8	
115	30D	24/16	115.0 - 117.0	12-27-32-36	59	78	RC		Gray, wet, very dense, fine to coarse SAND, little Gravel, trace Silt. -GLACIAL TILL- (SP)	G#10 A-3 (SP) WC=17.7	
120	31D	24/16	120.0 - 122.0	5-7-15-26	22	29	RC		Gray, wet, medium dense, fine to medium SAND, trace Gravel, trace Silt. -GLACIAL TILL- (SP)	G#10 A-3 (SP) WC=17.7	
125											
Remarks: 1. Automatic Hammer: Truck 21, ETR = 0.793 broke down after taking samples 1D-35D. Changed to new hammer at 146.0' bgs. 2. Rod dropped when sampling 21D, first 5" of SPT missed ("X"). 3. 26D and 29D taken using 3" OD split spoon with 2.5" sleeves (140 lb Auto Hammer). 4. Samples 21D, 22D, 24D, and 25D used for auto hammer calibration. 5. Coordinates: N186082.8, E934557.0. 6. Multiply field blow counts by 0.6 for approximate equivalent SPT N.											
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Date Start/Finish: 6/19/17-7/5/17		Drilling Method: Drive & Wash		Core Barrel: -																																																																																																																																																																																																																																																																																					
Boring Location: Sta. 38+92.4, 29.6' Rt.		Casing ID/OD: 4"		Water Level*: 13.7'																																																																																																																																																																																																																																																																																					
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-201 2 PIN: 20814.00			
Driller: New England Boring				Elevation (ft.) 23.4				Auger ID/OD: -			
Operator: Ken Smith/Pete Labossier				Datum: NAVD88				Sampler: Split Spoon			
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140/30			
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash				Core Barrel: -			
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"				Water Level*: 13.7'			
Hammer Efficiency Factor: 0.659				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 N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (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											
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50											
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Page 2 of 8 Boring No.: BB-WMR-201 2											

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Driller:		New England Boring		Elevation (ft.)		23.4		Auger ID/OD:		-					
Operator:		Ken Smith/Pete Labossier		Datum:		NAVD88		Sampler:		Split Spoon					
Logged By:		B. Woodman/B. Cardali/N. Williams		Rig Type:		Truck mounted Mobile B-53		Hammer Wt./Fall:		140/30					
Date Start/Finish:		6/19/17-7/5/17		Drilling Method:		Drive & Wash		Core Barrel:		-					
Boring Location:		Sta. 38+92.4, 29.6' Rt.		Casing ID/OD:		4"		Water Level*:		13.7'					
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)							
50															
55															
60															
65															
70															
75															
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[illegible]

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Driller: New England Boring				Elevation (ft.) 23.4				Auger ID/OD: -			
Operator: Ken Smith/Pete Labossier				Datum: NAVD88				Sampler: Split Spoon			
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140/30			
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash				Core Barrel: -			
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"				Water Level*: 13.7'			
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100											
105											
110											
115											
120											
125											
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[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine		Boring No.: BB-WMR-201 2 PIN: 20814.00	
Driller: New England Boring			Elevation (ft.) 23.4		Auger ID/OD: -		
Operator: Ken Smith/Pete Labossier			Datum: NAVD88		Sampler: Split Spoon		
Logged By: B. Woodman/B. Cardali/N. Williams			Rig Type: Truck mounted Mobile B-53		Hammer Wt./Fall: 140/30		
Date Start/Finish: 6/19/17-7/5/17			Drilling Method: Drive & Wash		Core Barrel: -		
Boring Location: Sta. 38+92.4, 29.6' Rt.			Casing ID/OD: 4"		Water Level*: 13.7'		
Hammer Efficiency Factor: 0.659			Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐				
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Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
150												
	38D	24/10	154.0 - 156.0	43-26-20-32	46	51	RC				Gray, wet, dense, fine to coarse SAND, little Gravel, trace Silt. -GLACIAL TILL- (SP)	G#13 A-1-b (SP) WC=12.3
	39D	24/8	159.0 - 161.0	33-38-22-9	60	66	626				Gray, wet, very dense, GRAVEL, some fine to coarse Sand, trace Silt. -GLACIAL TILL- (GP)	
							186					
							250					
							2000					
							RC					
	40D	1/1	164.0 - 164.1	100/1"	R						Casing refusal at 163.0'. Increased roller cone resistance at 163. 5'. Smooth, consistent bit action; rock chips in return. Gray/blue, wet, GRAVEL, little fine to medium Sand. Rock in tip of spoon. -GLACIAL TILL- (GP) Continued roller cone advancement from 164.0'-169.0', similar smooth bit action. Roller Cone Times (min:sec): 164-165 - 2:20 165-166 - 8:30 166-167 - 8:35 167-168 - 4:08 168-169 - 4:23 No recovery. Continued roller cone advancement from 169.0'-174.0', similar smooth bit action. Roller Cone Times (min:sec): 169-170 - 8:30 170-171 - 7:04 171-172 - 7:35 172-173 - 5:30 173-174 - 5:30	
	41D	0/0	169.0 - 169.0	50/0"	R		RC					
175											Bottom of Exploration at 174.00 feet below ground	

Remarks:
 1. Automatic Hammer, Truck 67, ETR = 0.659.
 2. Coordinates: N186082.8, E934557.0
 3. Starting after 36D, borehole was advanced to top of next sample interval with roller cone, then casing was driven and cleaned out prior to sampling.

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Page 7 of 8
Boring No.: BB-WMR-201 2

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Capell Bridge #2126 carries US Route 1 over Merrilland River Location: Wells, Maine				Boring No.: BB-WMR-201 2 PIN: 20814.00			
Driller: New England Boring				Elevation (ft.) 23.4				Auger ID/OD: -			
Operator: Ken Smith/Pete Labossier				Datum: NAVD88				Sampler: Split Spoon			
Logged By: B. Woodman/B. Cardali/N. Williams				Rig Type: Truck mounted Mobile B-53				Hammer Wt./Fall: 140/30			
Date Start/Finish: 6/19/17-7/5/17				Drilling Method: Drive & Wash				Core Barrel: -			
Boring Location: Sta. 38+92.4, 29.6' Rt.				Casing ID/OD: 4"				Water Level*: 13.7'			
Hammer Efficiency Factor: 0.659				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
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175 surface.											
180											
185											
190											
195											
200											
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APPENDIX C

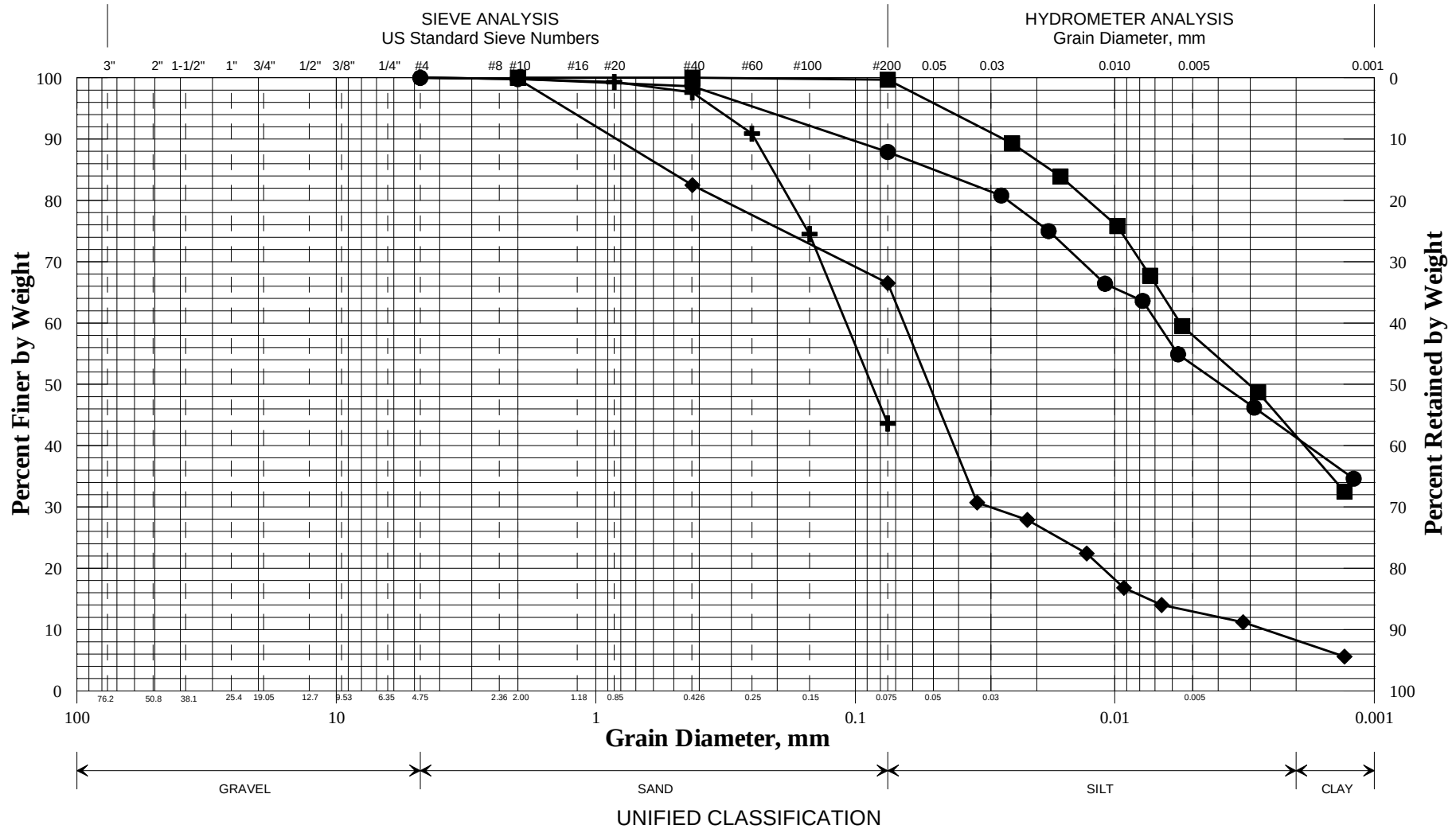
LABORATORY TESTING RESULTS

Work Number: 20814.00

Laboratory test results performed on soil samples from BB-WMR-201 are not listed here, see GeoTesting Express results in this appendix.

1 of 1

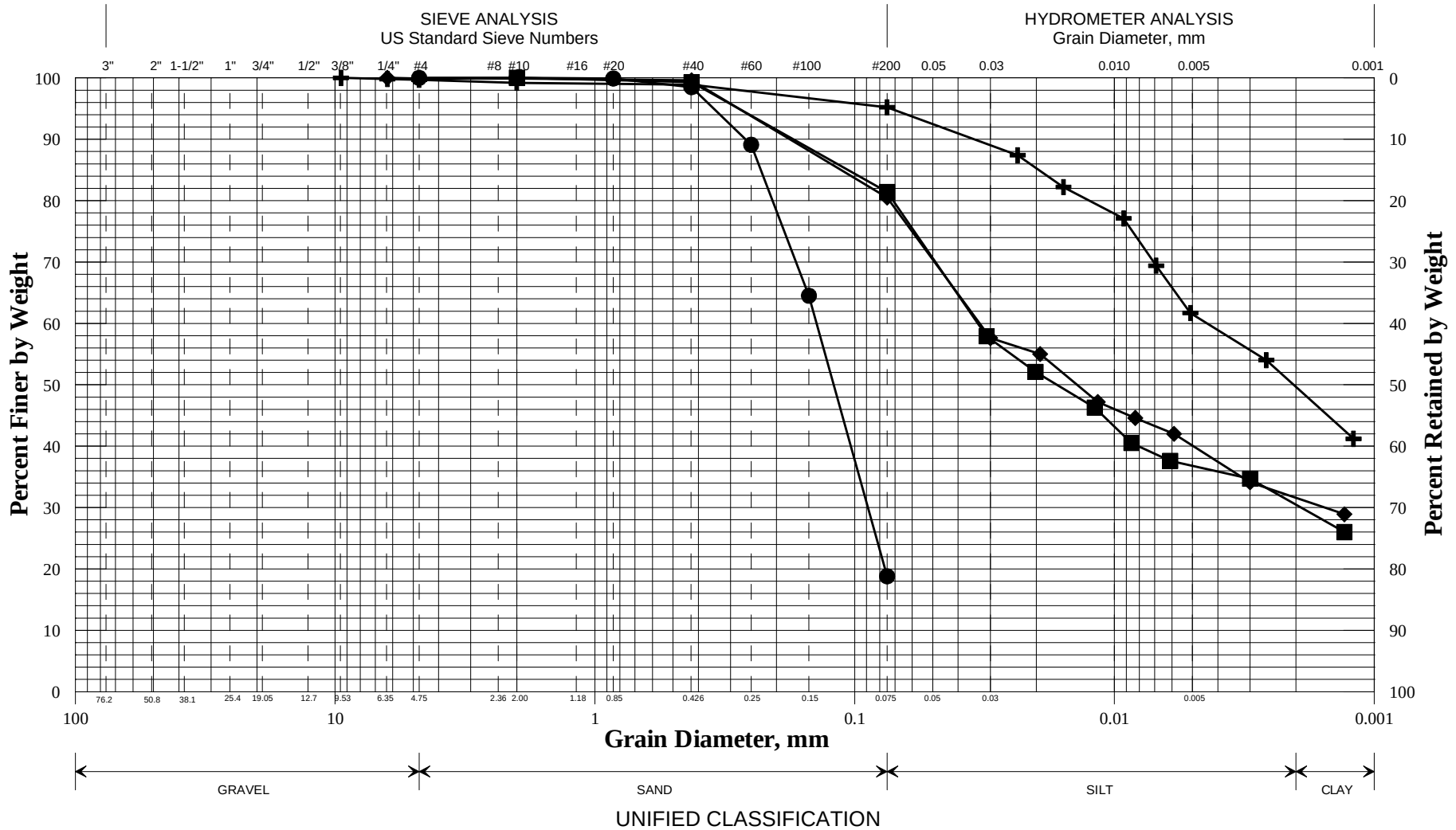
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WMR-101/3D	37+81.5	19.0 LT	10.0-12.0	Silty SAND.	23.4			
◆	BB-WMR-101/5D	37+81.5	19.0 LT	20.0-22.0	SILT, some sand, trace clay.	32.1			
■	BB-WMR-101/1U	37+81.5	19.0 LT	25.0-27.0	Clayey SILT, trace sand.	33.3	31	21	10
●	BB-WMR-101/6D	37+81.5	19.0 LT	31.5-33.5	Clayey SILT, some sand.	34.9	27	18	9
▲									
×									

WIN	
020814.00	
Town	
Wells	
Reported by/Date	
WHITE, TERRY A	4/27/2017

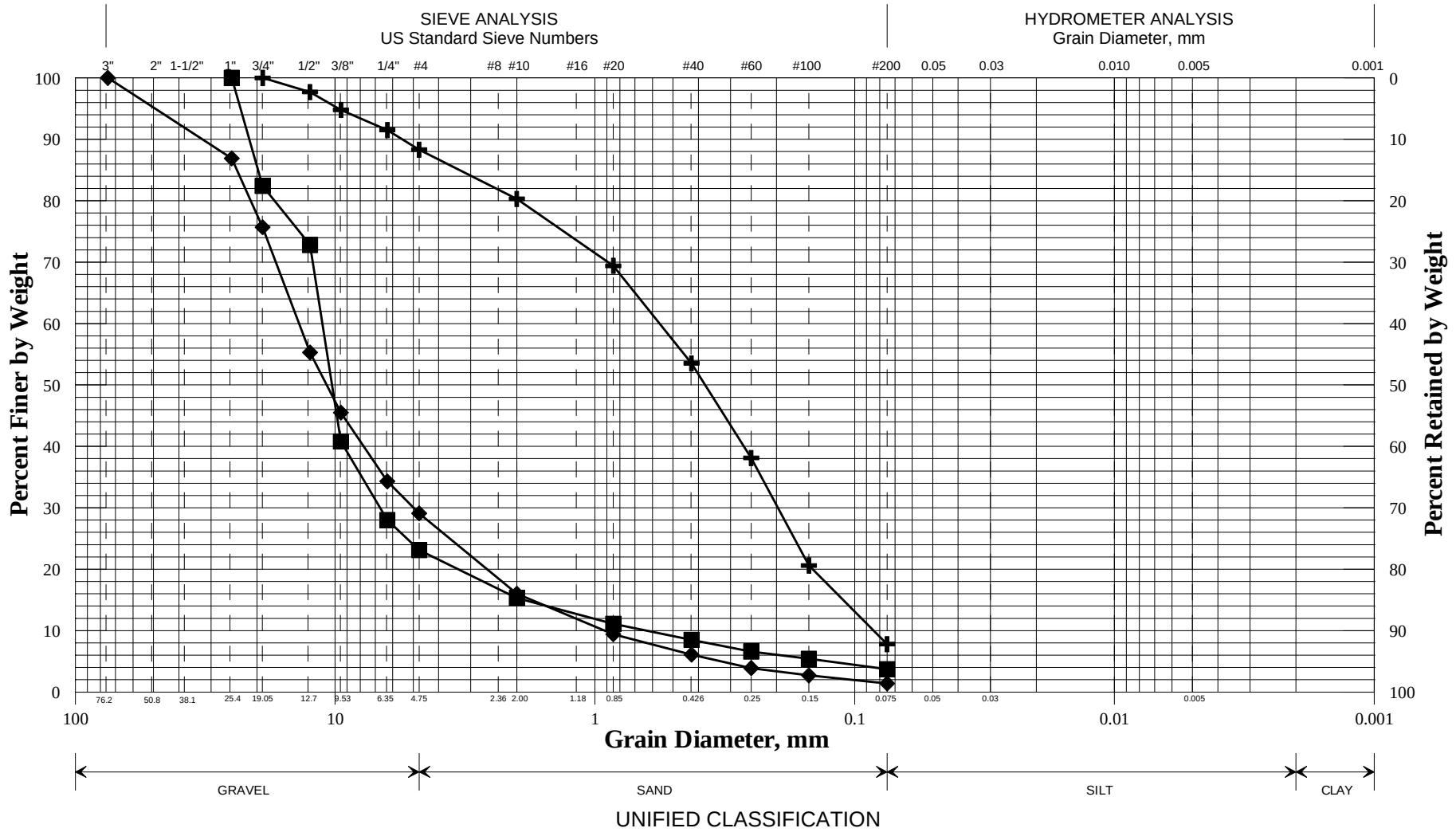
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WMR-101/2U	37+81.5	19.0 LT	45.0-47.0	Silty CLAY, trace sand, trace gravel.	34.4	29	20	9
◆	BB-WMR-101/8D	37+81.5	19.0 LT	55.0-57.0	Clayey SILT, little sand, trace gravel.	17.9	20	16	4
■	BB-WMR-101/9D	37+81.5	19.0 LT	60.0-62.0	Clayey SILT, little sand.	20.5	20	15	5
●	BB-WMR-101/10D	37+81.5	19.0 LT	70.0-71.0	SAND, little silt.	19.6			
▲									
×									

WIN	
020814.00	
Town	
Wells	
Reported by/Date	
WHITE, TERRY A	4/27/2017

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE

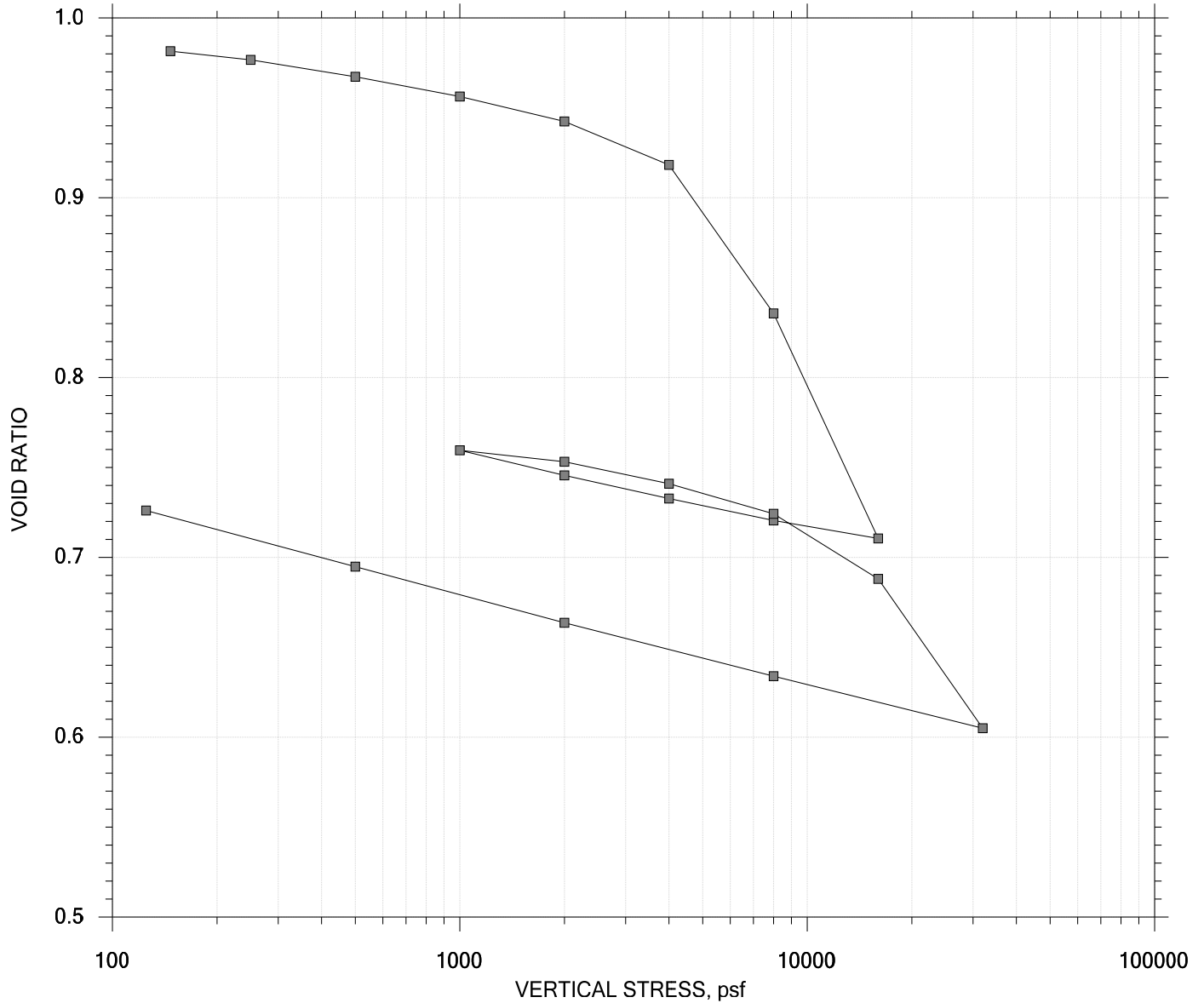


	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WMR-101/15D	37+81.5	19.0 LT	120.0-122.0	SAND, little gravel, trace silt.	12.6			
◆	BB-WMR-101/16D	37+81.5	19.0 LT	150.0-152.0	GRAVEL, some sand, trace silt.	6.3			
■	BB-WMR-101/17D	37+81.5	19.0 LT	170.0-172.0	GRAVEL, little sand, trace silt.	3.8			
●									
▲									
×									

WIN	
020814.00	
Town	
Wells	
Reported by/Date	
WHITE, TERRY A	4/27/2017

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test	
Current Vertical Effective Stress: ---				Water Content, %	37.51	28.75
Preconsolidation Stress: ---				Dry Unit Weight, pcf	83.787	94.295
Compression Ratio: ---				Saturation, %	101.22	100.00
Diameter: 2.495 in		Height: 1.005 in		Void Ratio	0.99	0.77
LL: 31	PL: 21	PI: 10	GS: 2.67			

	Project: WELLS	Location: --	Project No.: 20814.00
	Boring No.: BB-WMR-101	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 4/6/2017	Test No.: 271108
	Depth: 25.0-27.0 FT	Sample Type: intact	Elevation: –
	Description: Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WELLS
 Boring No.: BB-WMR-101
 Sample No.: 1U
 Test No.: 271108

Location: --
 Tested By: GSL
 Test Date: 4/6/2017
 Sample Type: intact

Project No.: 20814.00
 Checked By: --
 Depth: 25.0-27.0 FT
 Elevation: --

Soil Description: Gray Clay

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.67
 Initial Void Ratio: 0.989
 Final Void Ratio: 0.768

Liquid Limit: 31
 Plastic Limit: 21
 Plasticity Index: 10

Specimen Diameter: 2.50 in
 Initial Height: 1.00 in
 Final Height: 0.89 in

Container ID	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
	227	RING	RING	221
Wt. Container + Wet Soil, gm	208.07	410.55	401.09	204.52
Wt. Container + Dry Soil, gm	171.34	370.02	370.02	173.51
Wt. Container, gm	63.010	261.95	261.95	65.660
Wt. Dry Soil, gm	108.33	108.07	108.07	107.85
Water Content, %	33.91	37.51	28.75	28.75
Void Ratio	---	0.989	0.768	---
Degree of Saturation, %	---	101.22	100.00	---
Dry Unit Weight, pcf	---	83.787	94.295	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WELLS
 Boring No.: BB-WMR-101
 Sample No.: 1U
 Test No.: 271108

Location: --
 Tested By: GSL
 Test Date: 4/6/2017
 Sample Type: intact

Project No.: 20814.00
 Checked By: --
 Depth: 25.0-27.0 FT
 Elevation: --

Soil Description: Gray Clay

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

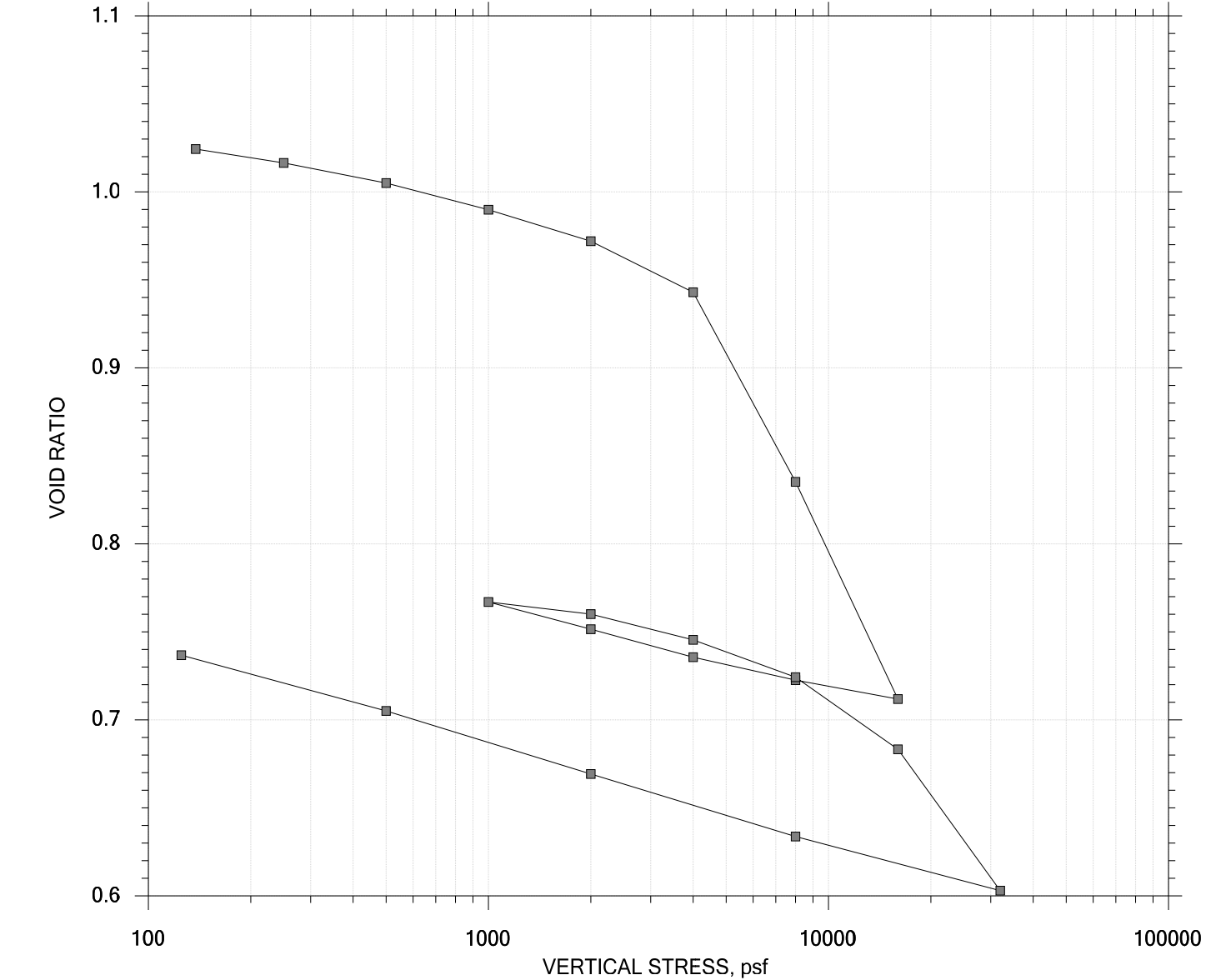
Displacement at End of Increment

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft ² /sec	Mv 1/psf	k ft/day
1	147.	0.003930	0.982	0.391	44.477	5.55e-007	2.66e-005	7.97e-005
2	250.	0.006407	0.977	0.638	2.555	9.60e-006	2.39e-005	1.24e-003
3	500.	0.01114	0.967	1.11	1.869	1.30e-005	1.89e-005	1.33e-003
4	1.00e+003	0.01669	0.956	1.66	2.820	8.55e-006	1.10e-005	5.09e-004
5	2.00e+003	0.02369	0.942	2.36	1.972	1.21e-005	6.96e-006	4.53e-004
6	4.00e+003	0.03591	0.918	3.57	6.049	3.86e-006	6.08e-006	1.27e-004
7	8.00e+003	0.07764	0.836	7.73	9.684	2.28e-006	1.04e-005	1.28e-004
8	1.60e+004	0.1408	0.711	14.0	8.204	2.40e-006	7.86e-006	1.02e-004
9	8.00e+003	0.1358	0.721	13.5	0.553	3.33e-005	6.29e-007	1.13e-004
10	4.00e+003	0.1296	0.733	12.9	1.408	1.33e-005	1.53e-006	1.09e-004
11	2.00e+003	0.1231	0.746	12.3	3.092	6.13e-006	3.24e-006	1.07e-004
12	1.00e+003	0.1161	0.760	11.6	14.022	1.37e-006	7.02e-006	5.19e-005
13	2.00e+003	0.1193	0.753	11.9	2.014	9.59e-006	3.21e-006	1.66e-004
14	4.00e+003	0.1254	0.741	12.5	3.509	5.45e-006	3.05e-006	8.97e-005
15	8.00e+003	0.1339	0.724	13.3	2.170	8.66e-006	2.10e-006	9.83e-005
16	1.60e+004	0.1522	0.688	15.1	5.889	3.10e-006	2.28e-006	3.80e-005
17	3.20e+004	0.1941	0.605	19.3	3.793	4.48e-006	2.61e-006	6.30e-005
18	8.00e+003	0.1796	0.634	17.9	0.555	2.96e-005	6.05e-007	9.66e-005
19	2.00e+003	0.1645	0.664	16.4	3.752	4.54e-006	2.49e-006	6.10e-005
20	500.	0.1488	0.695	14.8	22.420	7.88e-007	1.05e-005	4.45e-005
21	125.	0.1330	0.726	13.2	83.261	2.20e-007	4.19e-005	4.97e-005

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft ² /sec	Mv 1/psf	k ft/day	Ca %
1	147.	0.003930	0.982	0.391	0.000	0.00e+000	2.66e-005	0.00e+000	0.00e+000
2	250.	0.006407	0.977	0.638	0.000	0.00e+000	2.39e-005	0.00e+000	0.00e+000
3	500.	0.01114	0.967	1.11	0.184	3.08e-005	1.89e-005	3.13e-003	0.00e+000
4	1.00e+003	0.01669	0.956	1.66	0.543	1.03e-005	1.10e-005	6.14e-004	0.00e+000
5	2.00e+003	0.02369	0.942	2.36	0.000	0.00e+000	6.96e-006	0.00e+000	0.00e+000
6	4.00e+003	0.03591	0.918	3.57	0.496	1.09e-005	6.08e-006	3.58e-004	0.00e+000
7	8.00e+003	0.07764	0.836	7.73	2.144	2.39e-006	1.04e-005	1.34e-004	0.00e+000
8	1.60e+004	0.1408	0.711	14.0	2.038	2.24e-006	7.86e-006	9.52e-005	0.00e+000
9	8.00e+003	0.1358	0.721	13.5	0.000	0.00e+000	6.29e-007	0.00e+000	0.00e+000
10	4.00e+003	0.1296	0.733	12.9	0.000	0.00e+000	1.53e-006	0.00e+000	0.00e+000
11	2.00e+003	0.1231	0.746	12.3	1.033	4.26e-006	3.24e-006	7.45e-005	0.00e+000
12	1.00e+003	0.1161	0.760	11.6	2.129	2.10e-006	7.02e-006	7.94e-005	0.00e+000
13	2.00e+003	0.1193	0.753	11.9	0.731	6.14e-006	3.21e-006	1.06e-004	0.00e+000
14	4.00e+003	0.1254	0.741	12.5	0.513	8.65e-006	3.05e-006	1.43e-004	0.00e+000
15	8.00e+003	0.1339	0.724	13.3	0.468	9.34e-006	2.10e-006	1.06e-004	0.00e+000
16	1.60e+004	0.1522	0.688	15.1	0.650	6.52e-006	2.28e-006	8.01e-005	0.00e+000
17	3.20e+004	0.1941	0.605	19.3	1.128	3.50e-006	2.61e-006	4.92e-005	0.00e+000
18	8.00e+003	0.1796	0.634	17.9	0.144	2.65e-005	6.05e-007	8.64e-005	0.00e+000
19	2.00e+003	0.1645	0.664	16.4	1.090	3.63e-006	2.49e-006	4.87e-005	0.00e+000
20	500.	0.1488	0.695	14.8	6.364	6.45e-007	1.05e-005	3.64e-005	0.00e+000
21	125.	0.1330	0.726	13.2	0.000	0.00e+000	4.19e-005	0.00e+000	0.00e+000

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test	
Current Vertical Effective Stress: ---				Water Content, %	38.91	28.68
Preconsolidation Stress: ---				Dry Unit Weight, pcf	83.421	95.987
Compression Ratio: ---				Saturation, %	101.15	100.00
Diameter: 2.495 in		Height: 1.004 in		Void Ratio	1.06	0.79
LL: 29	PL: 20	PI: 9	GS: 2.75			

	Project: WELLS	Location: --	Project No.: 20814.00
	Boring No.: BB-WMR-101	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 4/6/2017	Test No.: 271110
	Depth: 45.0-47.0 FT	Sample Type: intact	Elevation: --
	Description: Gray Clay		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WELLS
 Boring No.: BB-WMR-101
 Sample No.: 2U
 Test No.: 271110

Location: --
 Tested By: GSL
 Test Date: 4/6/2017
 Sample Type: intact

Project No.: 20814.00
 Checked By: --
 Depth: 45.0-47.0 FT
 Elevation: --

Soil Description: Gray Clay

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.75
 Initial Void Ratio: 1.06
 Final Void Ratio: 0.789

Liquid Limit: 29
 Plastic Limit: 20
 Plasticity Index: 9

Specimen Diameter: 2.50 in
 Initial Height: 1.00 in
 Final Height: 0.87 in

Container ID	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
	103	RING	RING	224
Wt. Container + Wet Soil, gm	192.33	411.35	400.34	204.01
Wt. Container + Dry Soil, gm	155.70	369.50	369.50	173.27
Wt. Container, gm	50.820	261.96	261.96	66.070
Wt. Dry Soil, gm	104.88	107.54	107.54	107.20
Water Content, %	34.93	38.91	28.68	28.68
Void Ratio	---	1.06	0.789	---
Degree of Saturation, %	---	101.15	100.00	---
Dry Unit Weight, pcf	---	83.421	95.987	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WELLS
 Boring No.: BB-WMR-101
 Sample No.: 2U
 Test No.: 271110

Location: --
 Tested By: GSL
 Test Date: 4/6/2017
 Sample Type: intact

Project No.: 20814.00
 Checked By: --
 Depth: 45.0-47.0 FT
 Elevation: --

Soil Description: Gray Clay

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Displacement at End of Increment

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft ² /sec	Mv 1/psf	k ft/day
1	138.	0.01642	1.02	1.63	45.164	5.39e-007	1.19e-004	3.45e-004
2	250.	0.02024	1.02	2.02	7.692	3.10e-006	3.39e-005	5.67e-004
3	500.	0.02584	1.01	2.57	5.217	4.53e-006	2.23e-005	5.45e-004
4	1.00e+003	0.03322	0.990	3.31	5.559	4.20e-006	1.47e-005	3.32e-004
5	2.00e+003	0.04194	0.972	4.18	4.807	4.77e-006	8.68e-006	2.23e-004
6	4.00e+003	0.05610	0.943	5.59	7.318	3.06e-006	7.05e-006	1.16e-004
7	8.00e+003	0.1087	0.835	10.8	25.449	8.20e-007	1.31e-005	5.79e-005
8	1.60e+004	0.1690	0.712	16.8	18.003	1.02e-006	7.50e-006	4.13e-005
9	8.00e+003	0.1637	0.723	16.3	1.450	1.19e-005	6.57e-007	4.21e-005
10	4.00e+003	0.1573	0.736	15.7	3.933	4.44e-006	1.58e-006	3.79e-005
11	2.00e+003	0.1496	0.752	14.9	7.365	2.41e-006	3.86e-006	5.02e-005
12	1.00e+003	0.1420	0.767	14.1	19.436	9.31e-007	7.50e-006	3.77e-005
13	2.00e+003	0.1454	0.760	14.5	6.469	2.81e-006	3.32e-006	5.04e-005
14	4.00e+003	0.1525	0.745	15.2	7.653	2.35e-006	3.56e-006	4.51e-005
15	8.00e+003	0.1629	0.724	16.2	6.845	2.57e-006	2.57e-006	3.57e-005
16	1.60e+004	0.1829	0.683	18.2	8.291	2.05e-006	2.49e-006	2.75e-005
17	3.20e+004	0.2221	0.603	22.1	10.318	1.53e-006	2.44e-006	2.01e-005
18	8.00e+003	0.2071	0.634	20.6	1.118	1.37e-005	6.23e-007	4.60e-005
19	2.00e+003	0.1897	0.669	18.9	11.482	1.39e-006	2.88e-006	2.15e-005
20	500.	0.1722	0.705	17.1	51.425	3.24e-007	1.16e-005	2.03e-005
21	125.	0.1568	0.737	15.6	132.142	1.31e-007	4.10e-005	2.90e-005

	Applied Stress psf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft ² /sec	Mv 1/psf	k ft/day	Ca %
1	138.	0.01642	1.02	1.63	0.000	0.00e+000	1.19e-004	0.00e+000	0.00e+000
2	250.	0.02024	1.02	2.02	0.000	0.00e+000	3.39e-005	0.00e+000	0.00e+000
3	500.	0.02584	1.01	2.57	0.000	0.00e+000	2.23e-005	0.00e+000	0.00e+000
4	1.00e+003	0.03322	0.990	3.31	1.719	3.15e-006	1.47e-005	2.50e-004	0.00e+000
5	2.00e+003	0.04194	0.972	4.18	1.873	2.85e-006	8.68e-006	1.33e-004	0.00e+000
6	4.00e+003	0.05610	0.943	5.59	1.543	3.37e-006	7.05e-006	1.28e-004	0.00e+000
7	8.00e+003	0.1087	0.835	10.8	6.350	7.63e-007	1.31e-005	5.39e-005	0.00e+000
8	1.60e+004	0.1690	0.712	16.8	4.575	9.34e-007	7.50e-006	3.78e-005	0.00e+000
9	8.00e+003	0.1637	0.723	16.3	0.000	0.00e+000	6.57e-007	0.00e+000	0.00e+000
10	4.00e+003	0.1573	0.736	15.7	0.000	0.00e+000	1.58e-006	0.00e+000	0.00e+000
11	2.00e+003	0.1496	0.752	14.9	0.000	0.00e+000	3.86e-006	0.00e+000	0.00e+000
12	1.00e+003	0.1420	0.767	14.1	5.505	7.64e-007	7.50e-006	3.09e-005	0.00e+000
13	2.00e+003	0.1454	0.760	14.5	1.187	3.56e-006	3.32e-006	6.38e-005	0.00e+000
14	4.00e+003	0.1525	0.745	15.2	1.342	3.11e-006	3.56e-006	5.98e-005	0.00e+000
15	8.00e+003	0.1629	0.724	16.2	1.213	3.37e-006	2.57e-006	4.67e-005	0.00e+000
16	1.60e+004	0.1829	0.683	18.2	1.990	1.98e-006	2.49e-006	2.66e-005	0.00e+000
17	3.20e+004	0.2221	0.603	22.1	2.357	1.56e-006	2.44e-006	2.05e-005	0.00e+000
18	8.00e+003	0.2071	0.634	20.6	0.391	9.10e-006	6.23e-007	3.06e-005	0.00e+000
19	2.00e+003	0.1897	0.669	18.9	0.000	0.00e+000	2.88e-006	0.00e+000	0.00e+000
20	500.	0.1722	0.705	17.1	0.000	0.00e+000	1.16e-005	0.00e+000	0.00e+000
21	125.	0.1568	0.737	15.6	0.000	0.00e+000	4.10e-005	0.00e+000	0.00e+000



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	08/07/17
Depth :	---	Test Id:	418893
		Tested By:	jbr
		Checked By:	jdt

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BB-WMR-201	1D	1-3 ft	Moist, brown sand, little silt, little gravel	5.2
BB-WMR-201	2D	3-5 ft	Moist, brown sand, little silt, little gravel	5.9
BB-WMR-201	6D	11-13 ft	Moist, dark brown sand, some gravel, trace silt	32.9
BB-WMR-201	7D	13-15 ft	Moist, very dark gray sand, some silt, trace gravel	27.5
BB-WMR-201	9D	20-22 ft	Wet, olive clay	41.4
BB-WMR-201	11D	30-32 ft	Wet, olive clay	43.4
BB-WMR-201	13D	40-42 ft	Moist, olive clay	37.8
BB-WMR-201	15D	50-52 ft	Moist, olive clay	26.9

MEDOT Modified Burmister soil descriptions are listed where applicable.

Notes: Temperature of Drying : 110° Celsius



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	08/07/17
Depth :	---	Test Id:	418901
		Tested By:	jbr
		Checked By:	jdt

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BB-WMR-201	17D	60-62 ft	Moist, olive clay	25.2
BB-WMR-201	20D	75-77 ft	Moist, gray sand, some silt	18.1
BB-WMR-201	21D	80-82 ft	Moist, gray sand, trace silt	22.4
BB-WMR-201	23D	85-87 ft	Moist, gray sand, little silt, trace gravel	22.1
BB-WMR-201	31D	120-122 ft	Moist, gray sand, trace gravel, trace silt	17.7
BB-WMR-201	34D	135-137 ft	Moist, gray sand, little gravel, trace silt	13.9
BB-WMR-201	36D	146-148 ft	Moist, dark gray sand, little gravel, trace silt	10.6
BB-WMR-201	38D	154-156 ft	Moist, dark gray sand, little gravel, trace silt	12.3

MEDOT Modified Burmister soil descriptions are listed where applicable.

Notes: Temperature of Drying : 110° Celsius



Client: GZA GeoEnvironmental, Inc.
Project Name: Capell Bridge Replacement
Project Location: Wells, ME
GTX #: GTX-306793
Date: 08/18/17

Soil Classification - AASHTO M 145

Boring ID	Sample ID	Depth, ft	Group Name	Group Symbol	Gravel, %	Sand, %	Fines, %
BB-WMR-201	1D	1-3	Stone fragments, Gravel and Sand	A-1-b (0)	16.4	65.0	18.6
BB-WMR-201	2D	3-5	Stone fragments, Gravel and Sand	A-1-b (0)	10.5	76.4	13.1
BB-WMR-201	6D	11-13	Fine Sand	A-3 (1)	27.9	65.7	6.4
BB-WMR-201	7D	13-15	Silty Gravel and Sand	A-2-4 (0)	2.3	73.5	24.2

Remarks: Grain Size Analysis performed by ASTM D422, results enclosed
Atterberg Limits performed by ASTM D4318, results enclosed



Client: GZA GeoEnvironmental, Inc.
Project Name: Capell Bridge Replacement
Project Location: Wells, ME
GTX #: GTX-306793
Date: 08/18/17

Maine DOT - Frost Classifications

Boring ID	Sample ID	Depth, ft	% Finer than 0.02 mm	USCS Soil Classification	Maine DOT Frost Group
BB-WMR-201	1D	1-3	9.1	SM	FG-2
BB-WMR-201	2D	3-5	6.5	SM	FG-2
BB-WMR-201	6D	11-13	3.7	SP-SM	FG-2
BB-WMR-201	7D	13-15	8.3	SM	FG-2

Remarks: Grain Size Analysis performed by ASTM D422, results enclosed
Atterberg Limits performed by ASTM D4318, results enclosed



Client:	GZA GeoEnvironmental, Inc.				
Project:	Capell Bridge Replacement				
Location:	Wells, ME			Project No:	GTX-306793
Boring ID: ---	Sample Type: ---		Tested By:	md	
Sample ID: ---	Test Date: 08/11/17		Checked By:	jdt	
Depth : ---	Test Id: 419089				

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
B-WMR-201	26D (A)	95-95.5 ft	Moist, olive gray sand, trace silt	127.7	12.90	113.1	(1)
B-WMR-201	29D (A)	10.3-110. ft	Moist, gray sand, some gravel, trace silt	141.1	12.84	125.1	(2)

* Sample Comments

(1): MEDOT Modified Burmister description as requested

Method B-Cylinder, Intact

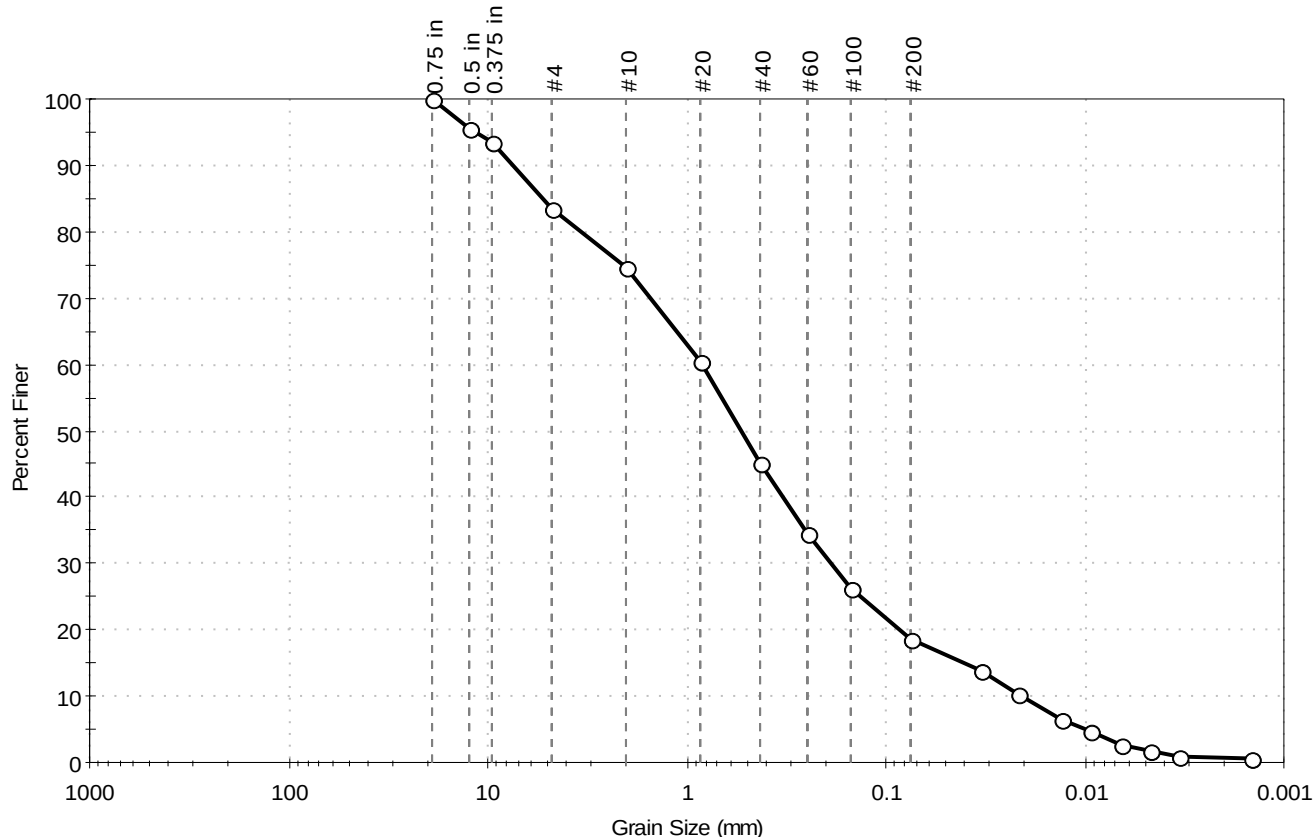
(2): MEDOT Modified Burmister description as requested

Method B-Cylinder, Intact

Notes: Moisture Content determined by ASTM D2216.

Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	1D	Test Date:	08/08/17
Depth :	1-3 ft	Test Id:	419111
Test Comment:	---		
Visual Description:	Moist, brown sand, little silt, little gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	16.4	65.0	18.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	96		
0.375 in	9.50	93		
#4	4.75	84		
#10	2.00	75		
#20	0.85	60		
#40	0.42	45		
#60	0.25	34		
#100	0.15	26		
#200	0.075	19		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0331	14		
---	0.0219	10		
---	0.0130	6		
---	0.0093	5		
---	0.0065	3		
---	0.0047	2		
---	0.0033	1		
---	0.0015	1		

Coefficients

$D_{85} = 5.2561 \text{ mm}$ $D_{30} = 0.1903 \text{ mm}$
 $D_{60} = 0.8320 \text{ mm}$ $D_{15} = 0.0400 \text{ mm}$
 $D_{50} = 0.5285 \text{ mm}$ $D_{10} = 0.0213 \text{ mm}$
 $C_u = 39.061$ $C_c = 2.044$

Classification

ASTM Silty sand with gravel (SM)

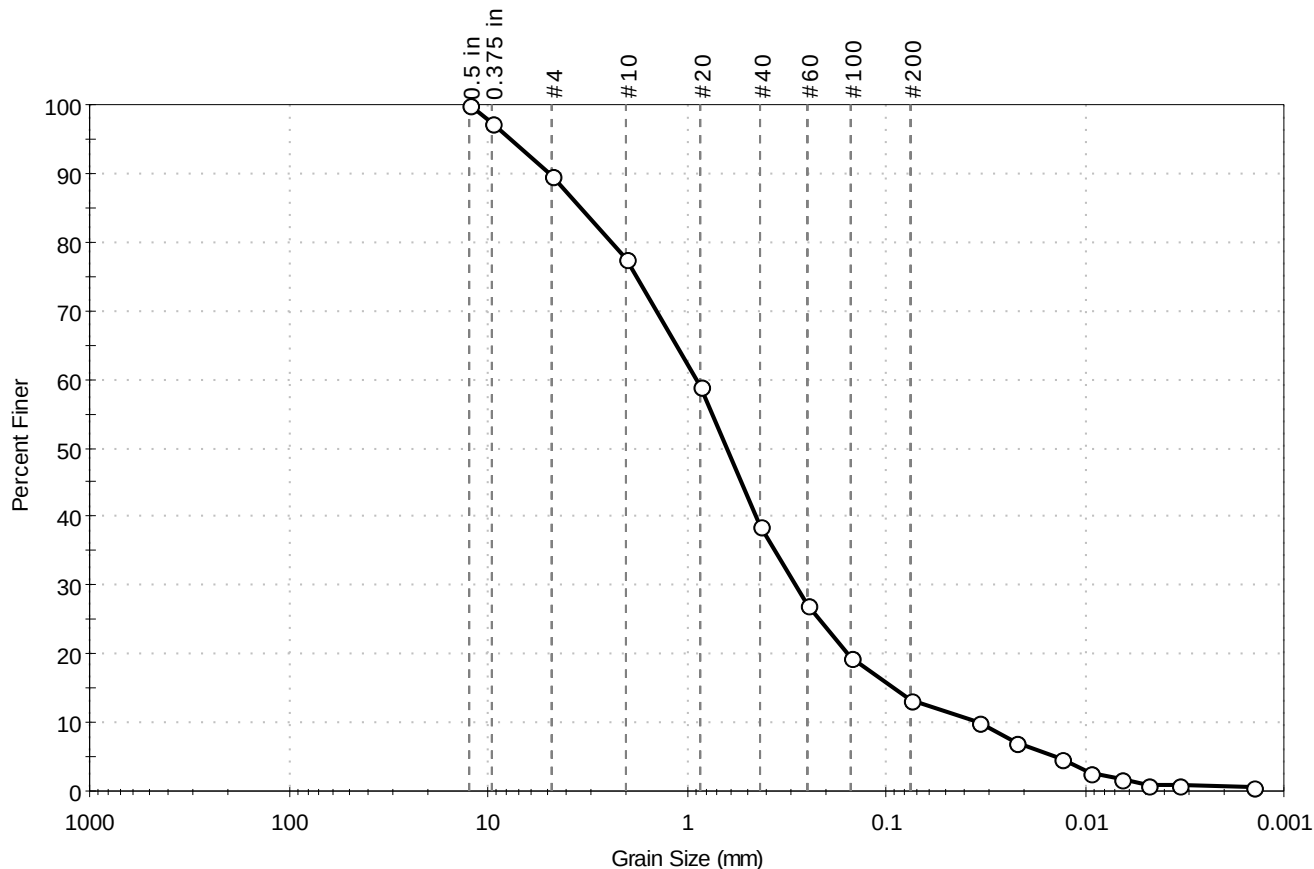
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
 Sand/Gravel Hardness : HARD
 Dispersion Device : Apparatus A - Mech Mixer
 Dispersion Period : 1 minute
 Specific Gravity : 2.65
 Separation of Sample: #200 Sieve

Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	2D	Test Date:	08/08/17
Depth :	3-5 ft	Test Id:	419112
Test Comment:	---		
Visual Description:	Moist, brown sand, little silt, little gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.5	76.4	13.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	97		
#4	4.75	90		
#10	2.00	78		
#20	0.85	59		
#40	0.42	39		
#60	0.25	27		
#100	0.15	19		
#200	0.075	13		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0341	10		
---	0.0224	7		
---	0.0132	5		
---	0.0095	3		
---	0.0067	2		
---	0.0048	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D ₈₅ = 3.4059 mm	D ₃₀ = 0.2837 mm
D ₆₀ = 0.8902 mm	D ₁₅ = 0.0920 mm
D ₅₀ = 0.6248 mm	D ₁₀ = 0.0348 mm
C _u = 25.580	C _c = 2.598

Classification

ASTM Silty sand (SM)

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

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

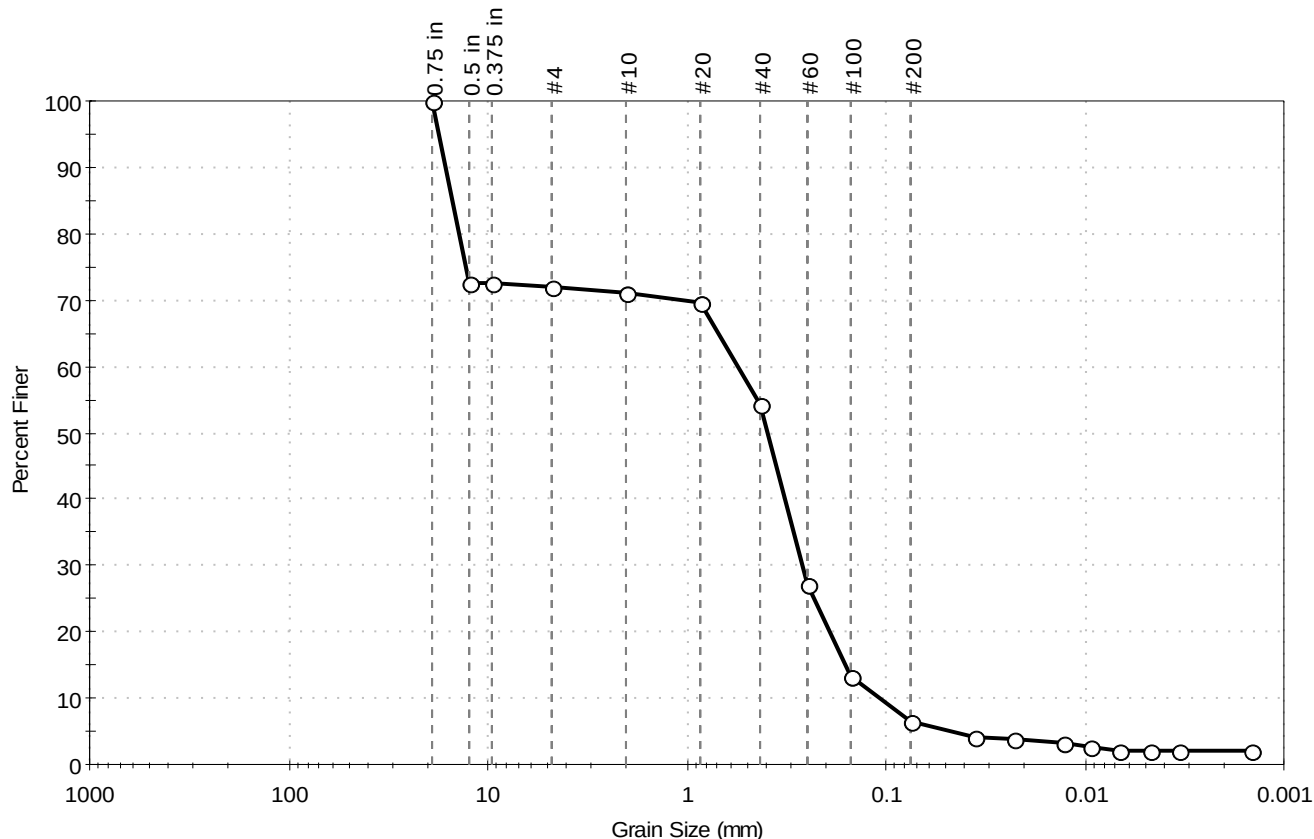
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	6D	Test Date:	08/08/17
Depth :	11-13 ft	Test Id:	419113
Test Comment:	---		
Visual Description:	Moist, dark brown sand, some gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	27.9	65.7	6.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	73		
0.375 in	9.50	72		
#4	4.75	72		
#10	2.00	71		
#20	0.85	70		
#40	0.42	54		
#60	0.25	27		
#100	0.15	13		
#200	0.075	6.4		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0363	4		
---	0.0227	4		
---	0.0129	3		
---	0.0095	3		
---	0.0068	2		
---	0.0047	2		
---	0.0034	2		
---	0.0015	2		

Coefficients

D ₈₅ = 15.1113 mm	D ₃₀ = 0.2648 mm
D ₆₀ = 0.5517 mm	D ₁₅ = 0.1599 mm
D ₅₀ = 0.3917 mm	D ₁₀ = 0.1078 mm
C _u = 5.118	C _c = 1.179

Classification

ASTM Poorly graded sand with silt and gravel (SP-SM)

AASHTO Fine Sand (A-3 (1))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

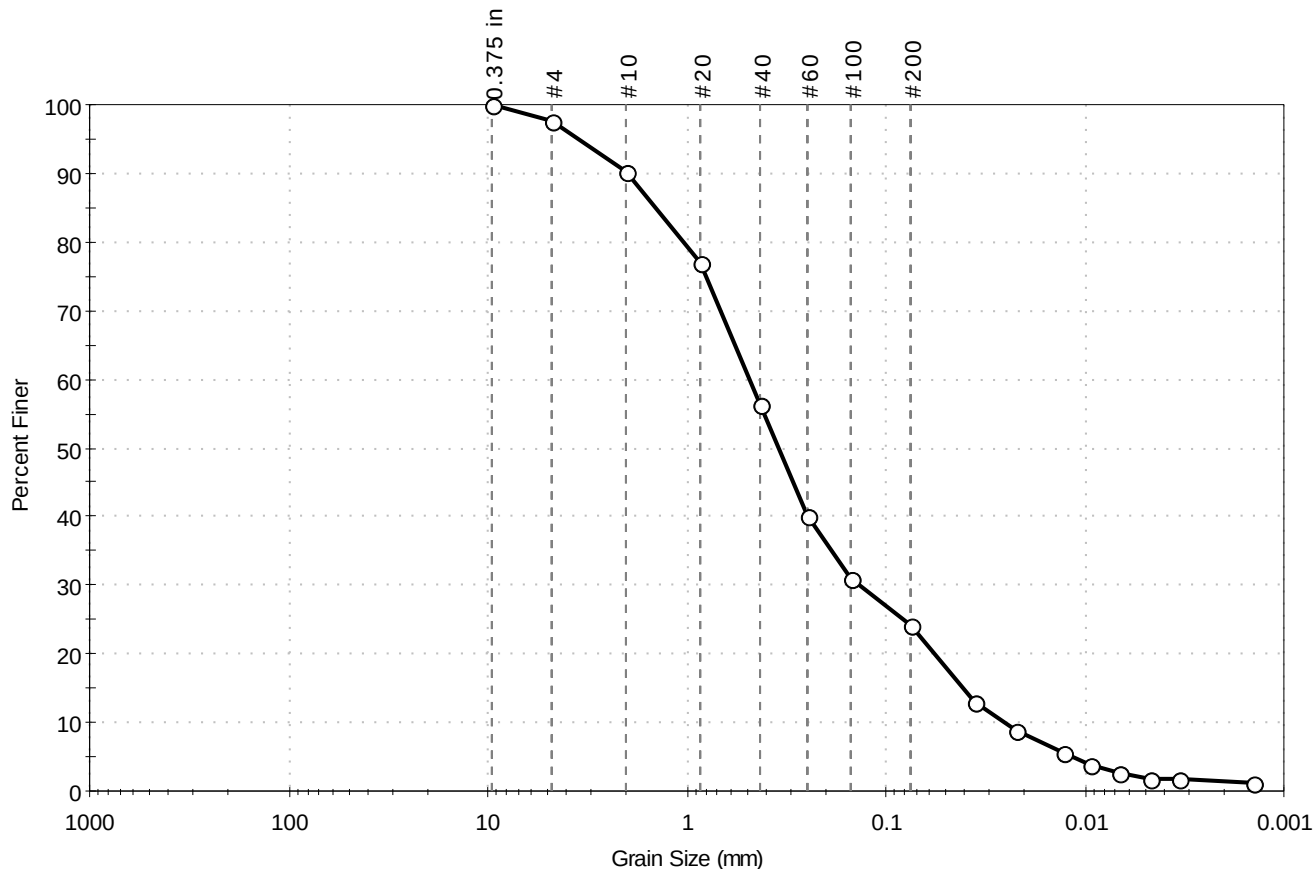
Specific Gravity : 2.65

Separation of Sample: #200 Sieve



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	7D	Test Date:	08/08/17
Depth :	13-15 ft	Test Id:	419114
Test Comment:	---		
Visual Description:	Moist, very dark gray sand, some silt, trace gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.3	73.5	24.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	90		
#20	0.85	77		
#40	0.42	56		
#60	0.25	40		
#100	0.15	31		
#200	0.075	24		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	13		
---	0.0223	9		
---	0.0129	6		
---	0.0095	4		
---	0.0067	3		
---	0.0048	2		
---	0.0034	2		
---	0.0014	1		

Coefficients

D ₈₅ = 1.4237 mm	D ₃₀ = 0.1364 mm
D ₆₀ = 0.4821 mm	D ₁₅ = 0.0413 mm
D ₅₀ = 0.3465 mm	D ₁₀ = 0.0253 mm
C _u = 19.055	C _c = 1.525

Classification

ASTM Silty sand (SM)

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

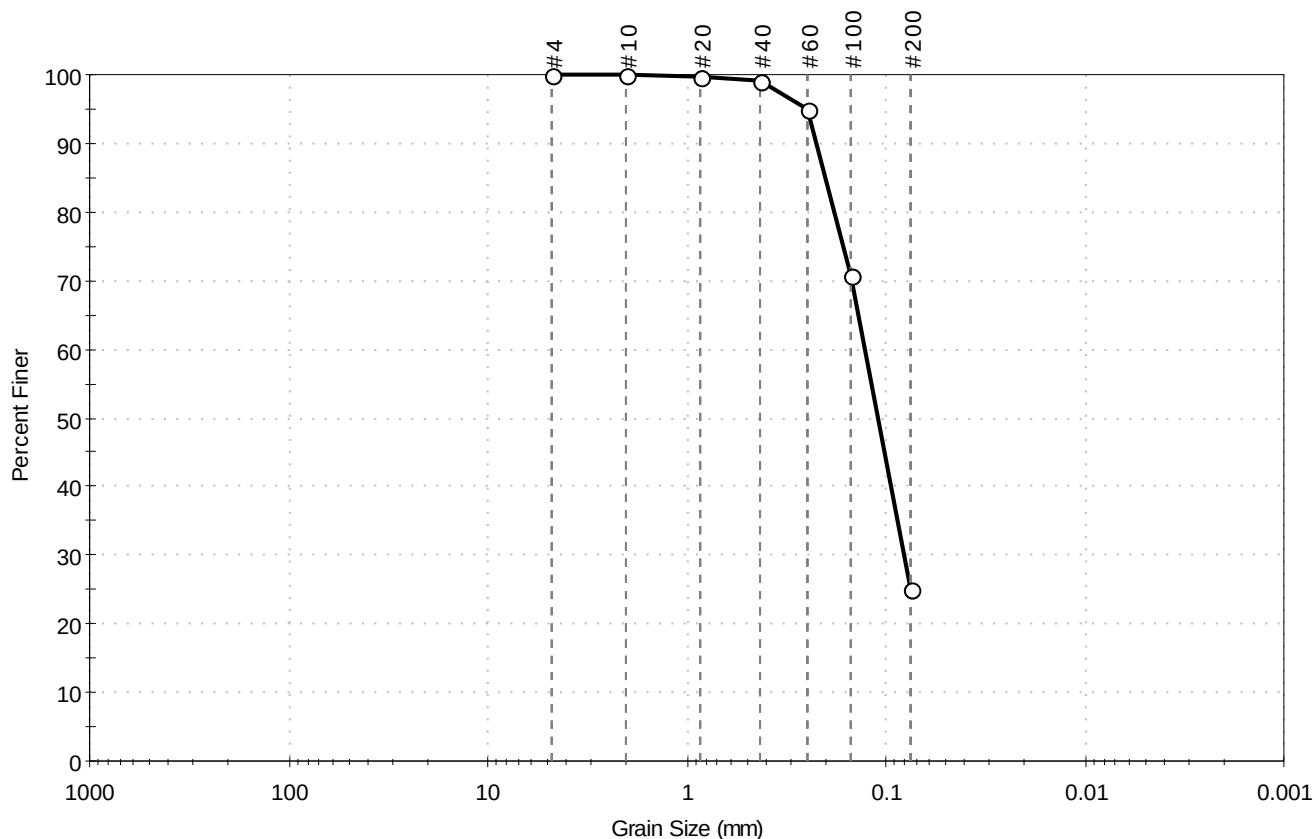
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
 Sand/Gravel Hardness : HARD
 Dispersion Device : Apparatus A - Mech Mixer
 Dispersion Period : 1 minute
 Specific Gravity : 2.65
 Separation of Sample: #200 Sieve



Client:	GZA GeoEnvironmental, Inc.	Project No:	GTX-306793
Project:	Capell Bridge Replacement		
Location:	Wells, ME		
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	20D	Test Date:	08/08/17
Depth :	75-77 ft	Test Id:	419079
Test Comment:	---		
Visual Description:	Moist, gray sand, some silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	75.0	25.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	95		
#100	0.15	71		
#200	0.075	25		

Coefficients

D ₈₅ = 0.2023 mm	D ₃₀ = 0.0809 mm
D ₆₀ = 0.1274 mm	D ₁₅ = N/A
D ₅₀ = 0.1095 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

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

Sample / Test Description

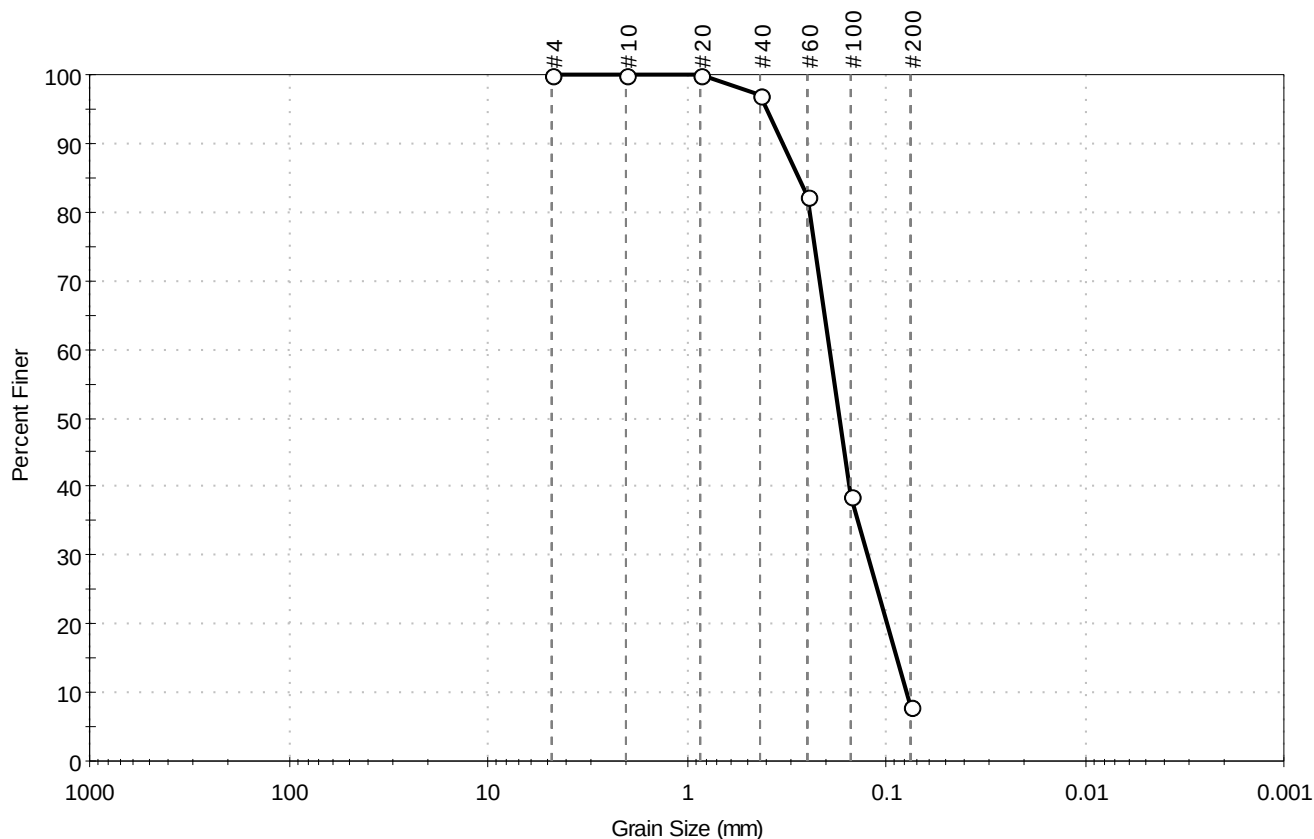
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---



Client:	GZA GeoEnvironmental, Inc.	Project No:	GTX-306793
Project:	Capell Bridge Replacement		
Location:	Wells, ME		
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	21D	Test Date:	08/07/17
Depth :	80-82 ft	Test Id:	419080
Test Comment:	---		
Visual Description:	Moist, gray sand, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	91.9	8.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	97		
#60	0.25	82		
#100	0.15	39		
#200	0.075	8.1		

Coefficients

D ₈₅ = 0.2759 mm	D ₃₀ = 0.1231 mm
D ₆₀ = 0.1925 mm	D ₁₅ = 0.0877 mm
D ₅₀ = 0.1712 mm	D ₁₀ = 0.0783 mm
C _u = 2.458	C _c = 1.005

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

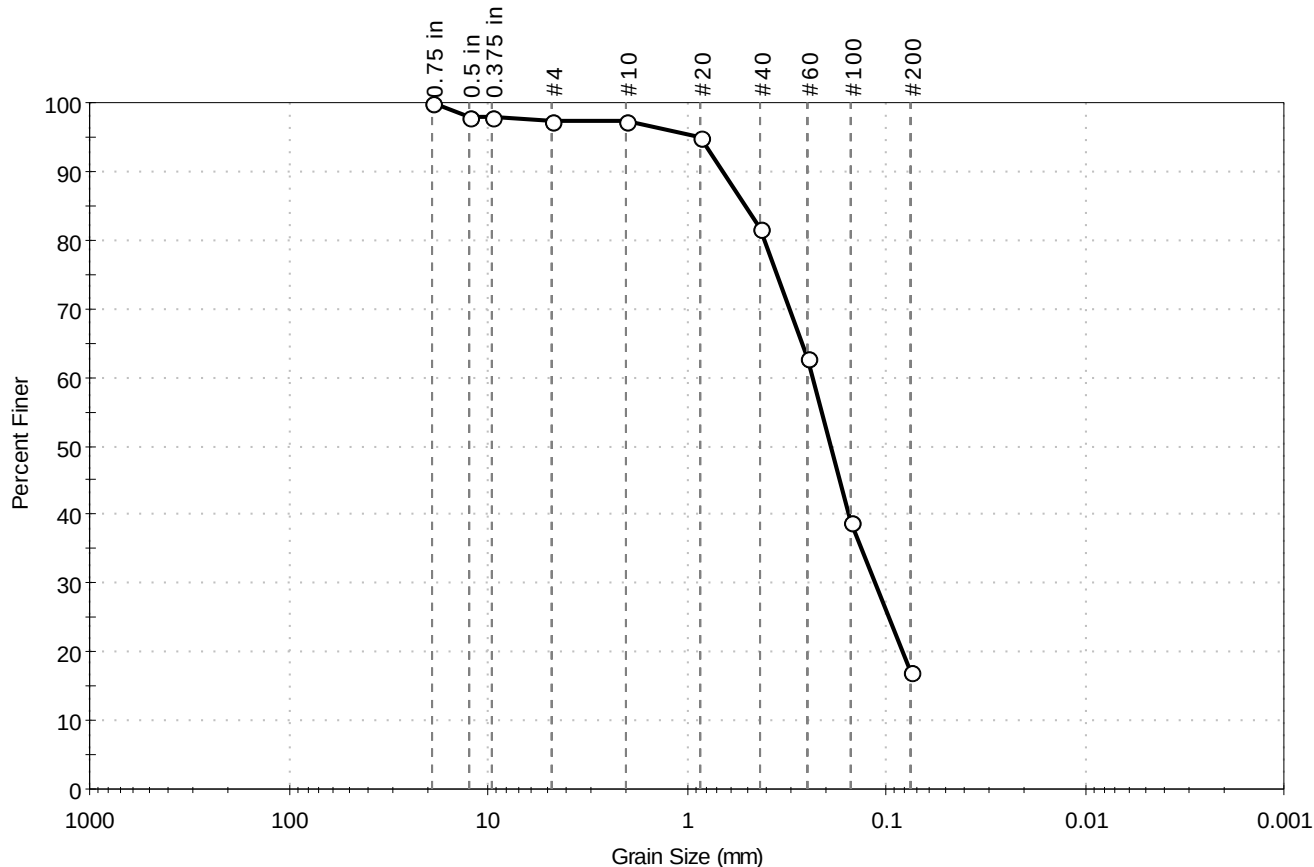
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	23D	Test Date:	08/07/17
Depth :	85-87 ft	Test Id:	419081
Test Comment:	---		
Visual Description:	Moist, gray sand, little silt, trace gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.6	80.2	17.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	98		
0.375 in	9.50	98		
#4	4.75	97		
#10	2.00	97		
#20	0.85	95		
#40	0.42	82		
#60	0.25	63		
#100	0.15	39		
#200	0.075	17		

Coefficients

D ₈₅ = 0.5045 mm	D ₃₀ = 0.1129 mm
D ₆₀ = 0.2359 mm	D ₁₅ = N/A
D ₅₀ = 0.1904 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

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

Sample / Test Description

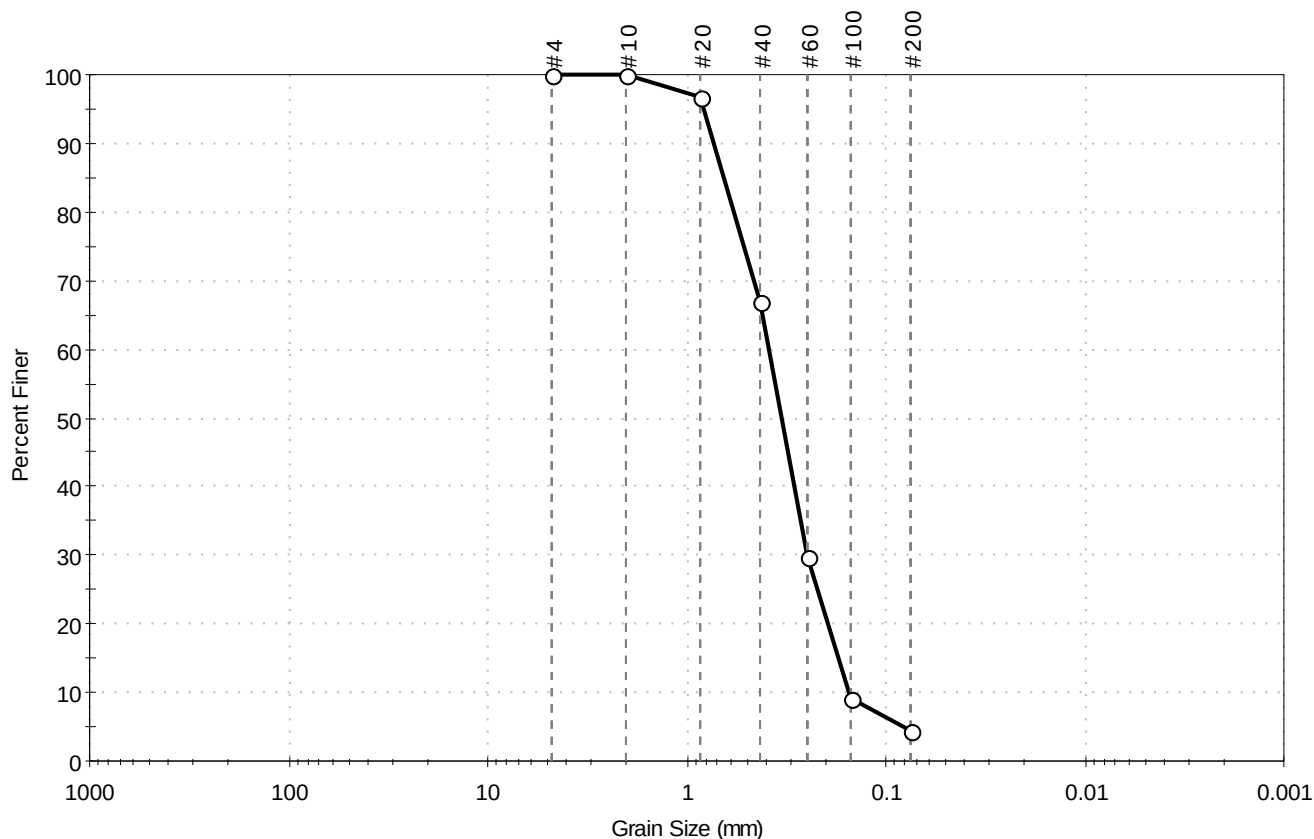
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	tube
Sample ID:	26D (A)	Test Date:	08/14/17
Depth :	95-95.5 ft	Test Id:	419082
Test Comment:	---		
Visual Description:	Moist, olive gray sand, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	95.5	4.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	97		
#40	0.42	67		
#60	0.25	30		
#100	0.15	9		
#200	0.075	4.5		

Coefficients

D ₈₅ = 0.6477 mm	D ₃₀ = 0.2509 mm
D ₆₀ = 0.3854 mm	D ₁₅ = 0.1734 mm
D ₅₀ = 0.3340 mm	D ₁₀ = 0.1531 mm
C _u = 2.517	C _c = 1.067

Classification

ASTM Poorly graded sand (SP)

AASHTO Fine Sand (A-3 (1))

Sample / Test Description

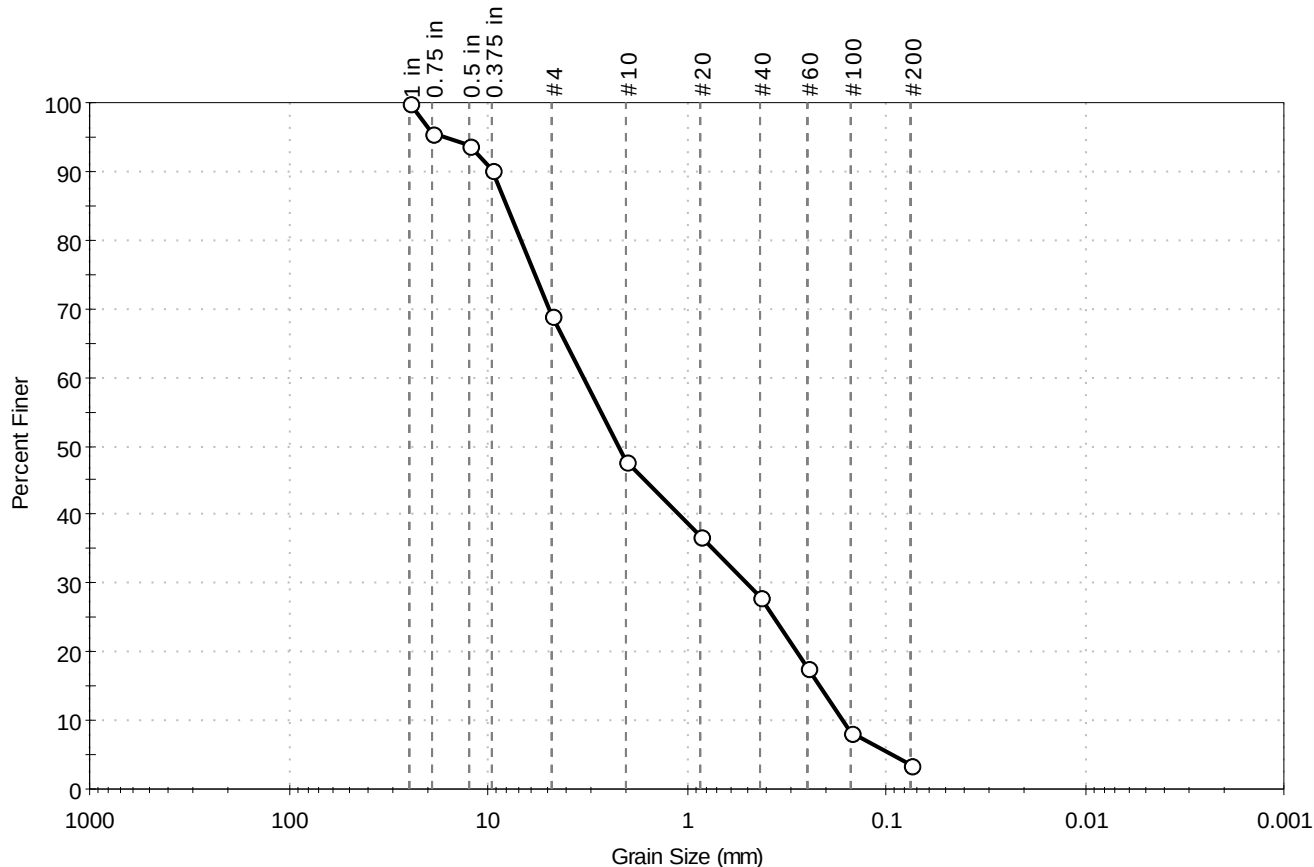
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	tube
Sample ID:	29D (A)	Test Date:	08/16/17
Depth :	110.3-110.8 ft	Test Id:	419083
Test Comment:	---		
Visual Description:	Moist, gray sand, some gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	31.1	65.3	3.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	96		
0.5 in	12.50	94		
0.375 in	9.50	90		
#4	4.75	69		
#10	2.00	48		
#20	0.85	37		
#40	0.42	28		
#60	0.25	18		
#100	0.15	8		
#200	0.075	3.6		

Coefficients

D ₈₅ = 8.0245 mm	D ₃₀ = 0.4985 mm
D ₆₀ = 3.2996 mm	D ₁₅ = 0.2151 mm
D ₅₀ = 2.1954 mm	D ₁₀ = 0.1646 mm
C _u = 20.046	C _c = 0.458

Classification

ASTM Poorly graded sand with gravel (SP)

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

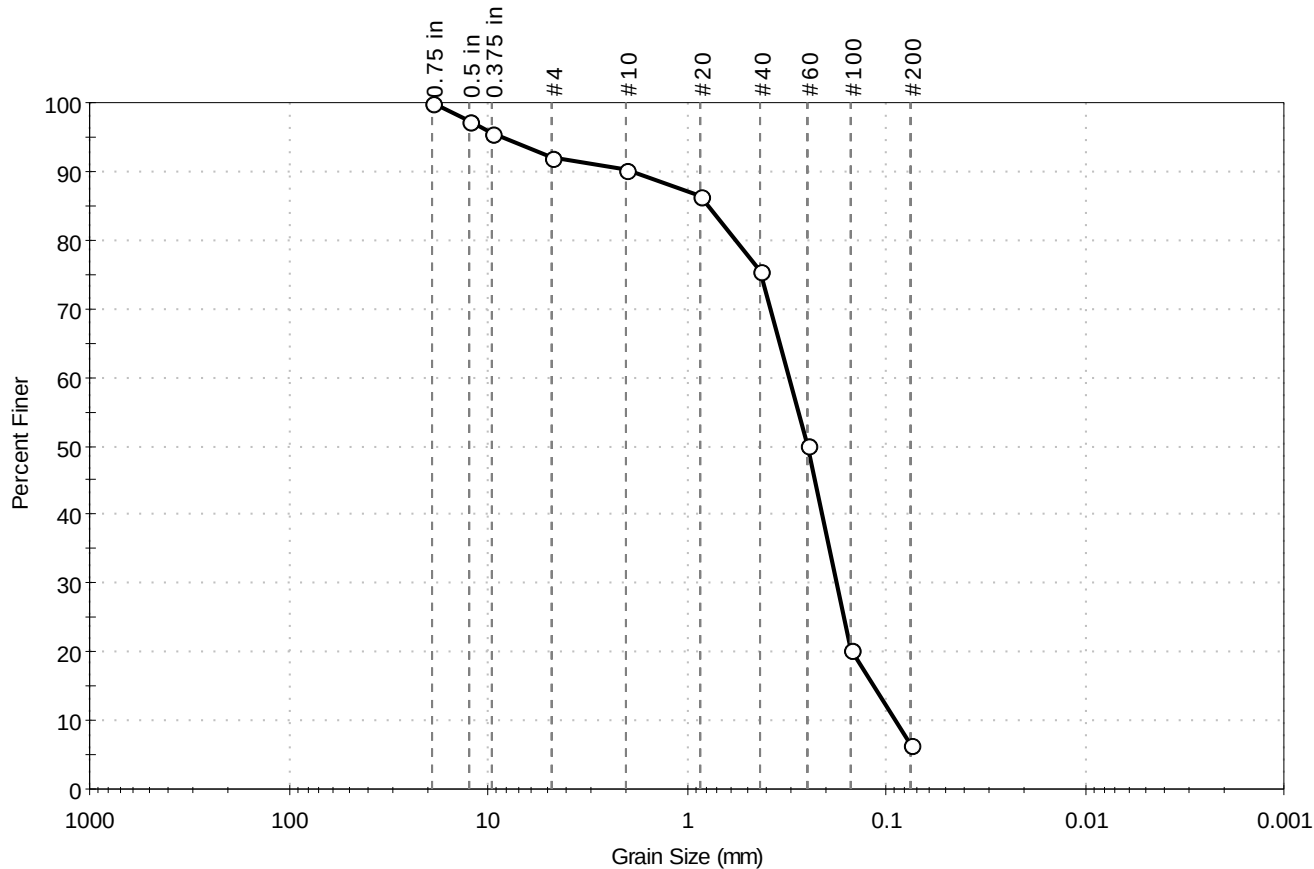
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	31D	Test Date:	08/07/17
Depth :	120-122 ft	Test Id:	419084
Test Comment:	---		
Visual Description:	Moist, gray sand, trace gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	8.0	85.5	6.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	96		
#4	4.75	92		
#10	2.00	90		
#20	0.85	87		
#40	0.42	76		
#60	0.25	50		
#100	0.15	20		
#200	0.075	6.5		

Coefficients

D ₈₅ = 0.7713 mm	D ₃₀ = 0.1771 mm
D ₆₀ = 0.3069 mm	D ₁₅ = 0.1150 mm
D ₅₀ = 0.2491 mm	D ₁₀ = 0.0894 mm
C _u = 3.433	C _c = 1.143

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

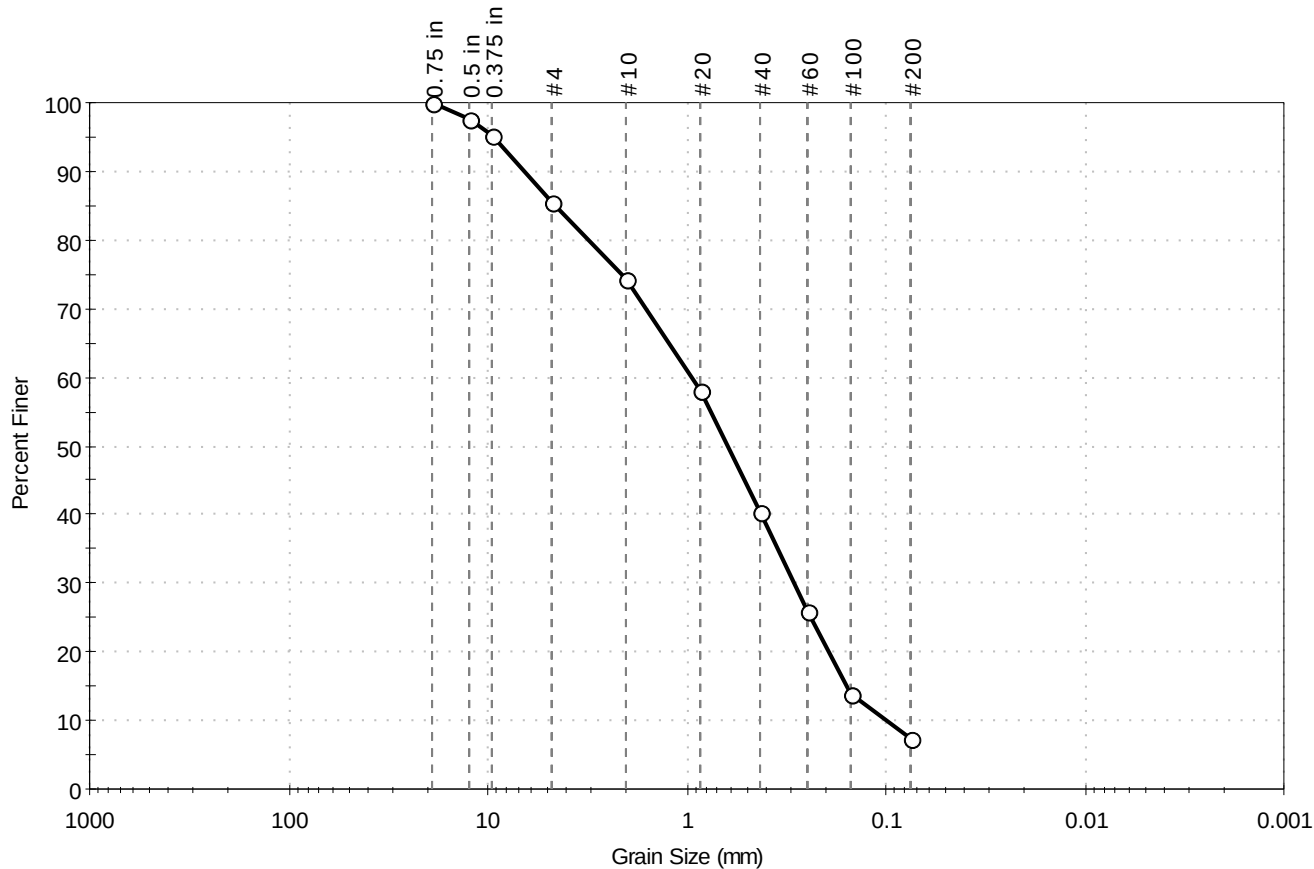
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	34D	Test Date:	08/07/17
Depth :	135-137 ft	Test Id:	419085
Test Comment:	---		
Visual Description:	Moist, gray sand, little gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	14.5	78.2	7.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	98		
0.375 in	9.50	95		
#4	4.75	86		
#10	2.00	74		
#20	0.85	58		
#40	0.42	40		
#60	0.25	26		
#100	0.15	14		
#200	0.075	7.3		

Coefficients

D ₈₅ = 4.5624 mm	D ₃₀ = 0.2905 mm
D ₆₀ = 0.9431 mm	D ₁₅ = 0.1581 mm
D ₅₀ = 0.6202 mm	D ₁₀ = 0.1001 mm
C _u = 9.422	C _c = 0.894

Classification

ASTM N/A

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

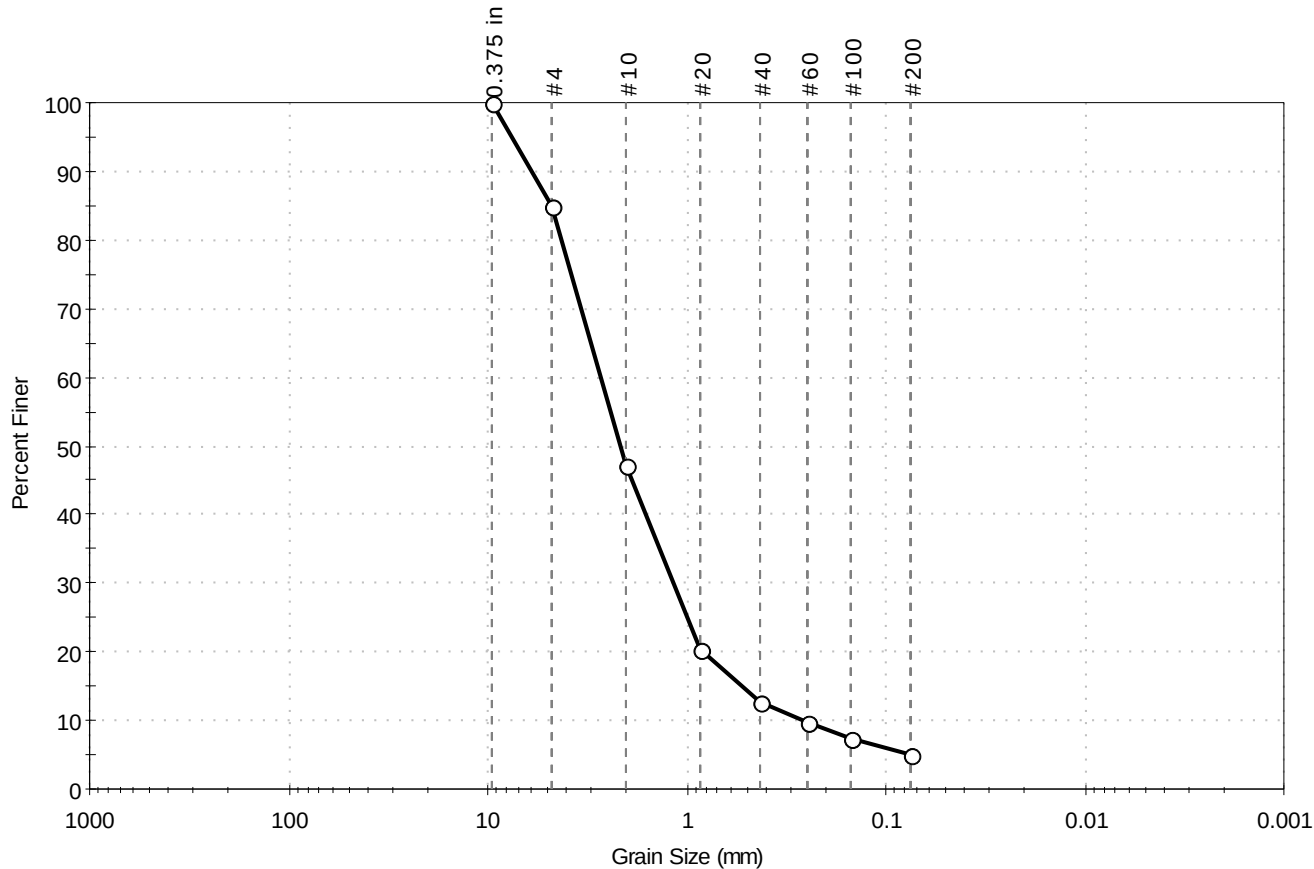
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	36D	Test Date:	08/07/17
Depth :	146-148 ft	Test Id:	419086
Test Comment:	---		
Visual Description:	Moist, dark gray sand, little gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	14.9	80.0	5.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	85		
#10	2.00	47		
#20	0.85	20		
#40	0.42	13		
#60	0.25	10		
#100	0.15	7		
#200	0.075	5.1		

Coefficients

D ₈₅ = 4.7477 mm	D ₃₀ = 1.1543 mm
D ₆₀ = 2.6825 mm	D ₁₅ = 0.5206 mm
D ₅₀ = 2.1348 mm	D ₁₀ = 0.2666 mm
C _u = 10.062	C _c = 1.863

Classification

ASTM N/A

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

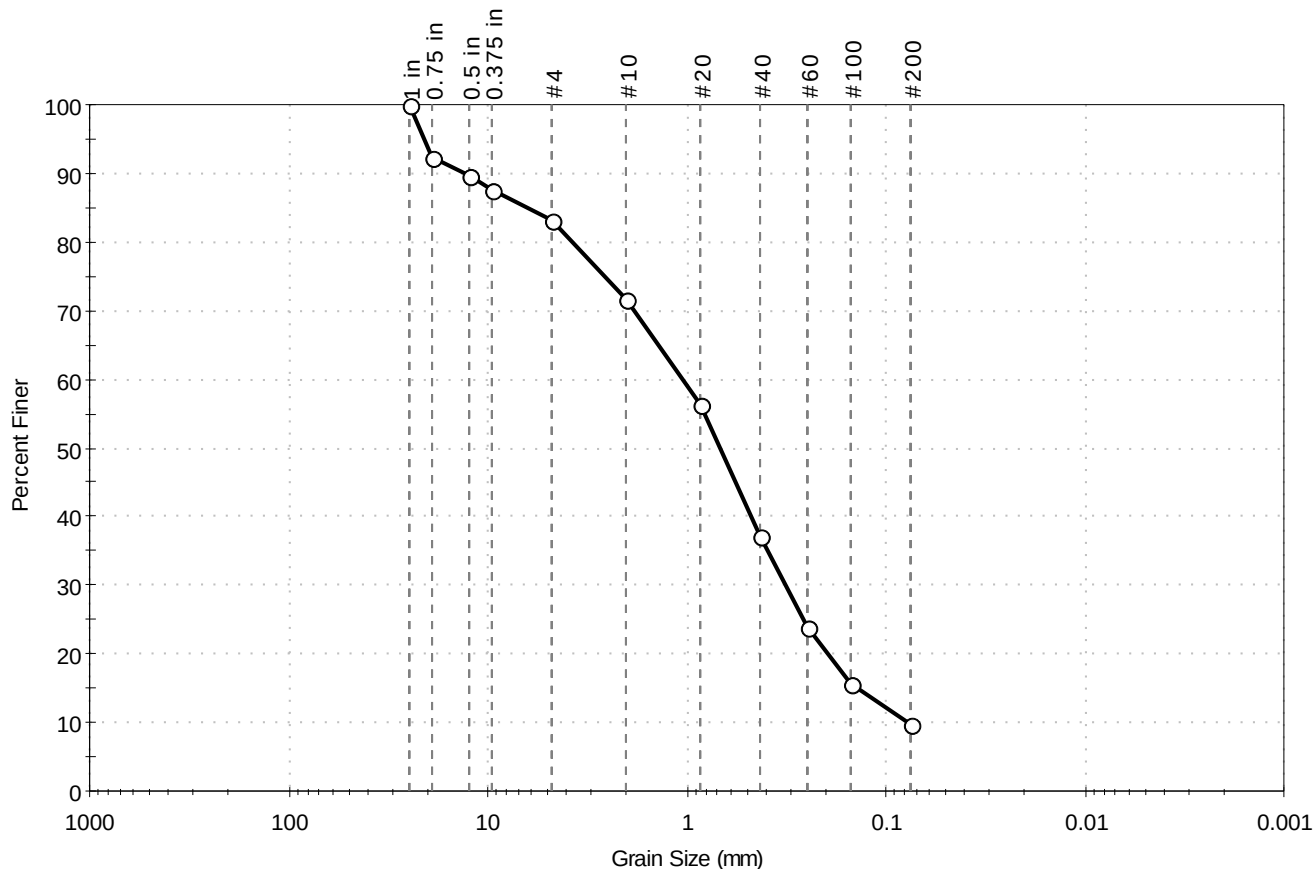
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	38D	Test Date:	08/07/17
Depth :	154-156 ft	Test Id:	419087
Test Comment:	---		
Visual Description:	Moist, dark gray sand, little gravel, trace silt		
Sample Comment:	MEDOT Modified Burmister description as requested		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	16.6	73.6	9.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	92		
0.5 in	12.50	90		
0.375 in	9.50	88		
#4	4.75	83		
#10	2.00	72		
#20	0.85	56		
#40	0.42	37		
#60	0.25	24		
#100	0.15	16		
#200	0.075	9.8		

Coefficients

D ₈₅ = 6.2004 mm	D ₃₀ = 0.3199 mm
D ₆₀ = 1.0457 mm	D ₁₅ = 0.1397 mm
D ₅₀ = 0.6786 mm	D ₁₀ = 0.0772 mm
C _u = 13.545	C _c = 1.268

Classification

ASTM N/A

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

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	1D	Test Date:	08/10/17
Depth :	1-3 ft	Test Id:	419101
Test Comment:	---		
Visual Description:	Moist, brown sand, little silt, little gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	1D	BB-WMR-201	1-3 ft	5	n/a	n/a	n/a	n/a	Silty sand with gravel (SM)

55% Retained on #40 Sieve

Dry Strength: MEDIUM

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	2D	Test Date:	08/08/17
Depth :	3-5 ft	Test Id:	419102
Test Comment:	---		
Visual Description:	Moist, brown sand, little silt, little gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	2D	BB-WMR-201	3-5 ft	6	n/a	n/a	n/a	n/a	Silty sand (SM)

61% Retained on #40 Sieve

Dry Strength: LOW

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic



Client:	GZA GeoEnvironmental, Inc.				
Project:	Capell Bridge Replacement				
Location:	Wells, ME			Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar	Tested By:	cam
Sample ID:	6D	Test Date:	08/09/17	Checked By:	jdt
Depth :	11-13 ft	Test Id:	419103		
Test Comment:	---				
Visual Description:	Moist, dark brown sand, some gravel, trace silt				
Sample Comment:	MEDOT Modified Burmister description as requested				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	6D	BB-WMR-201	11-13 ft	33	n/a	n/a	n/a	n/a	Poorly graded sand with silt and gravel (SP-SM)

46% Retained on #40 Sieve

Dry Strength: MEDIUM

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic



Client:	GZA GeoEnvironmental, Inc.		
Project:	Capell Bridge Replacement		
Location:	Wells, ME	Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	7D	Test Date:	08/09/17
Depth :	13-15 ft	Test Id:	419104
Test Comment:	---		
Visual Description:	Moist, very dark gray sand, some silt, trace gravel		
Sample Comment:	MEDOT Modified Burmister description as requested		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	7D	BB-WMR-201	13-15 ft	27	n/a	n/a	n/a	n/a	Silty sand (SM)

44% Retained on #40 Sieve

Dry Strength: MEDIUM

Dilatancy: RAPID

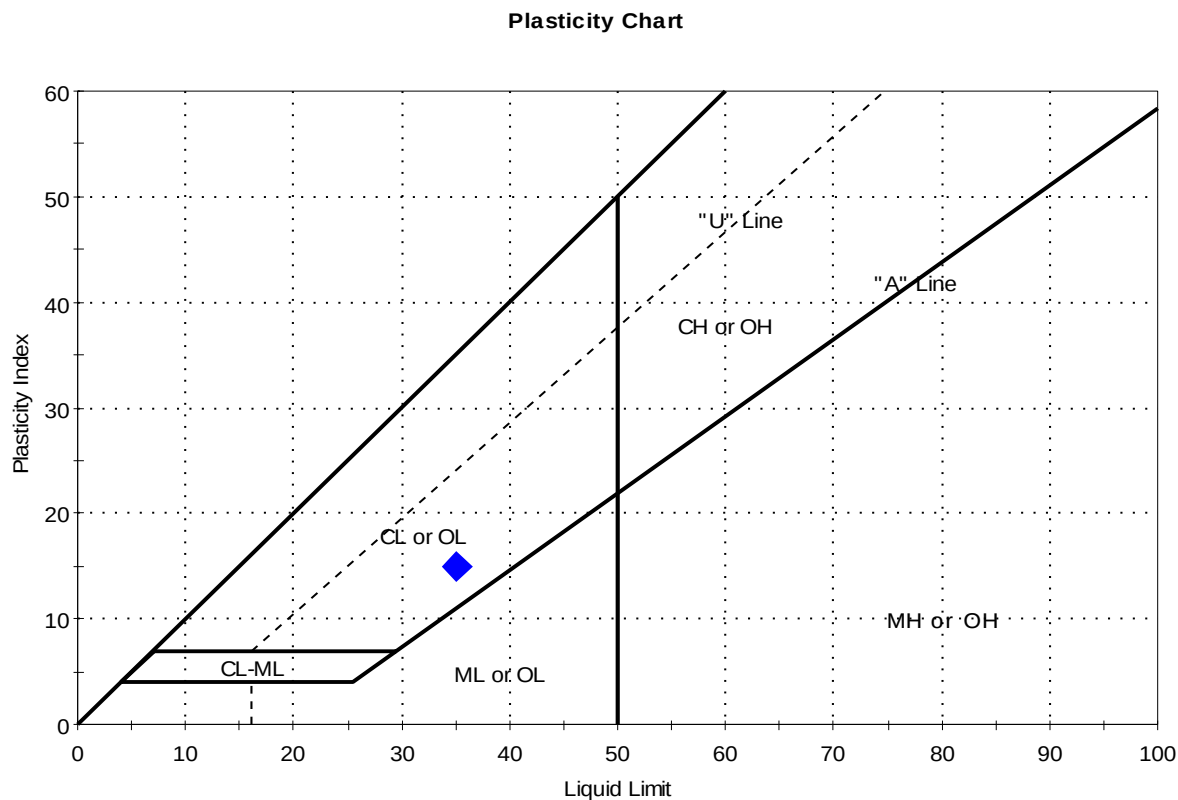
Toughness: n/a

The sample was determined to be Non-Plastic



Client:	GZA GeoEnvironmental, Inc.				
Project:	Capell Bridge Replacement				
Location:	Wells, ME			Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar	Tested By:	cam
Sample ID:	9D	Test Date:	08/09/17	Checked By:	jdt
Depth :	20-22 ft	Test Id:	419092		
Test Comment:	---				
Visual Description:	Wet, olive clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	9D	BB-WMR-201	20-22 ft	41	35	20	15	1.4	

Sample Prepared using the WET method

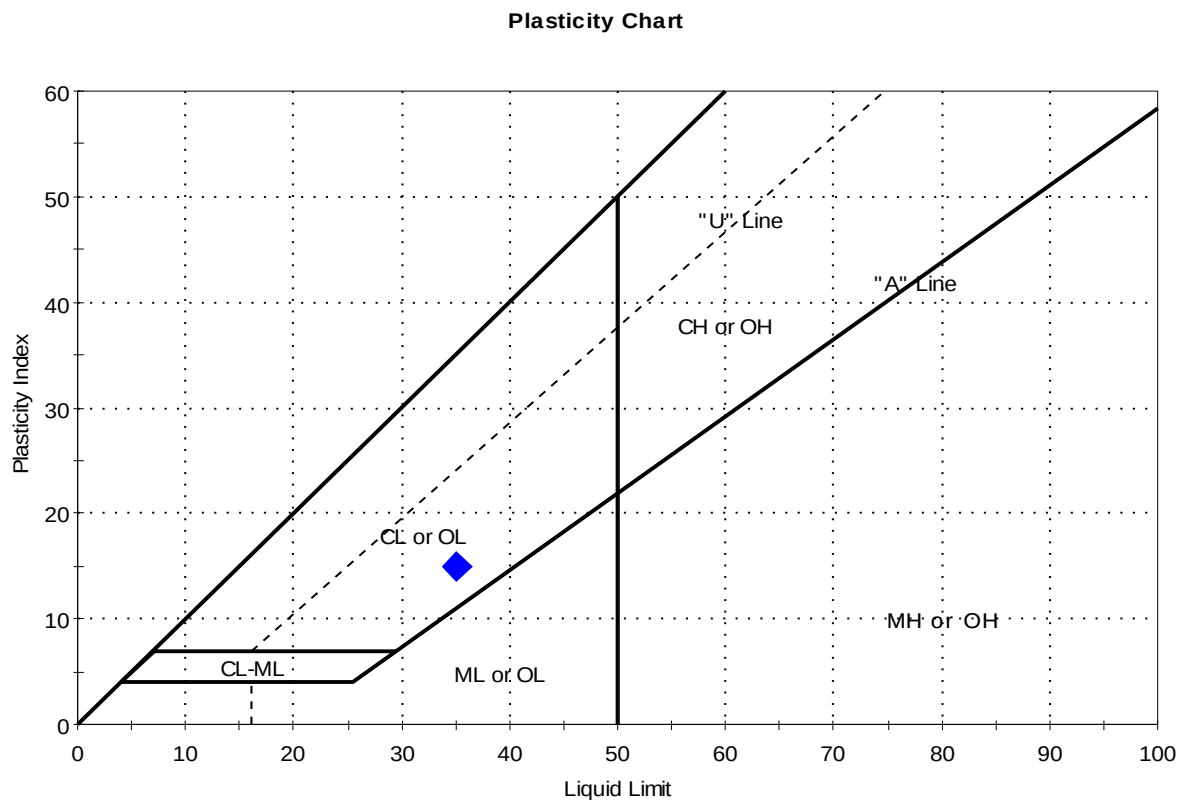
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	GZA GeoEnvironmental, Inc.	Project No:	GTX-306793
Project:	Capell Bridge Replacement		
Location:	Wells, ME		
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	11D	Test Date:	08/09/17
Depth :	30-32 ft	Test Id:	419093
Test Comment:	---	Tested By:	cam
Visual Description:	Wet, olive clay	Checked By:	jdt
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	11D	BB-WMR-201	30-32 ft	43	35	20	15	1.6	

Sample Prepared using the WET method

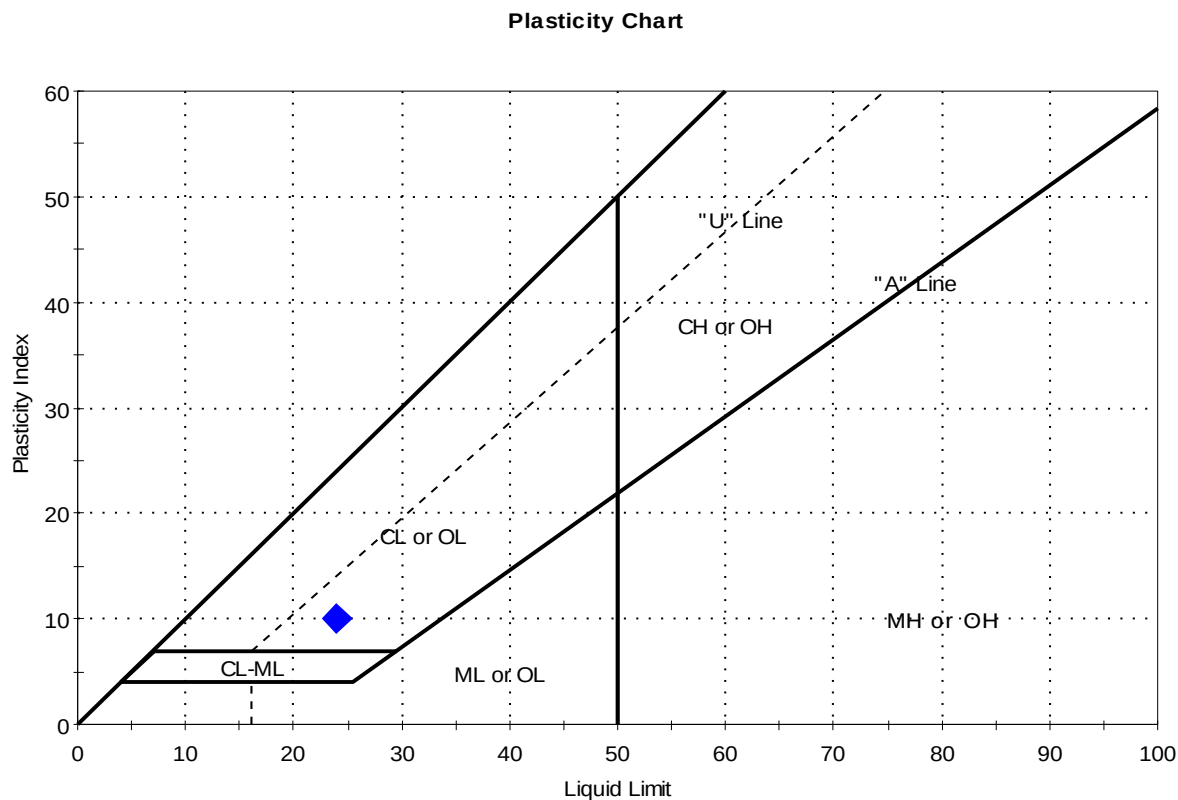
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	GZA GeoEnvironmental, Inc.				
Project:	Capell Bridge Replacement				
Location:	Wells, ME			Project No:	GTX-306793
Boring ID:	BB-WMR-201	Sample Type:	jar	Tested By:	cam
Sample ID:	15D	Test Date:	08/09/17	Checked By:	jdt
Depth :	50-52 ft	Test Id:	419094		
Test Comment:	---				
Visual Description:	Moist, olive clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	15D	BB-WMR-201	50-52 ft	27	24	14	10	1.3	

Sample Prepared using the WET method

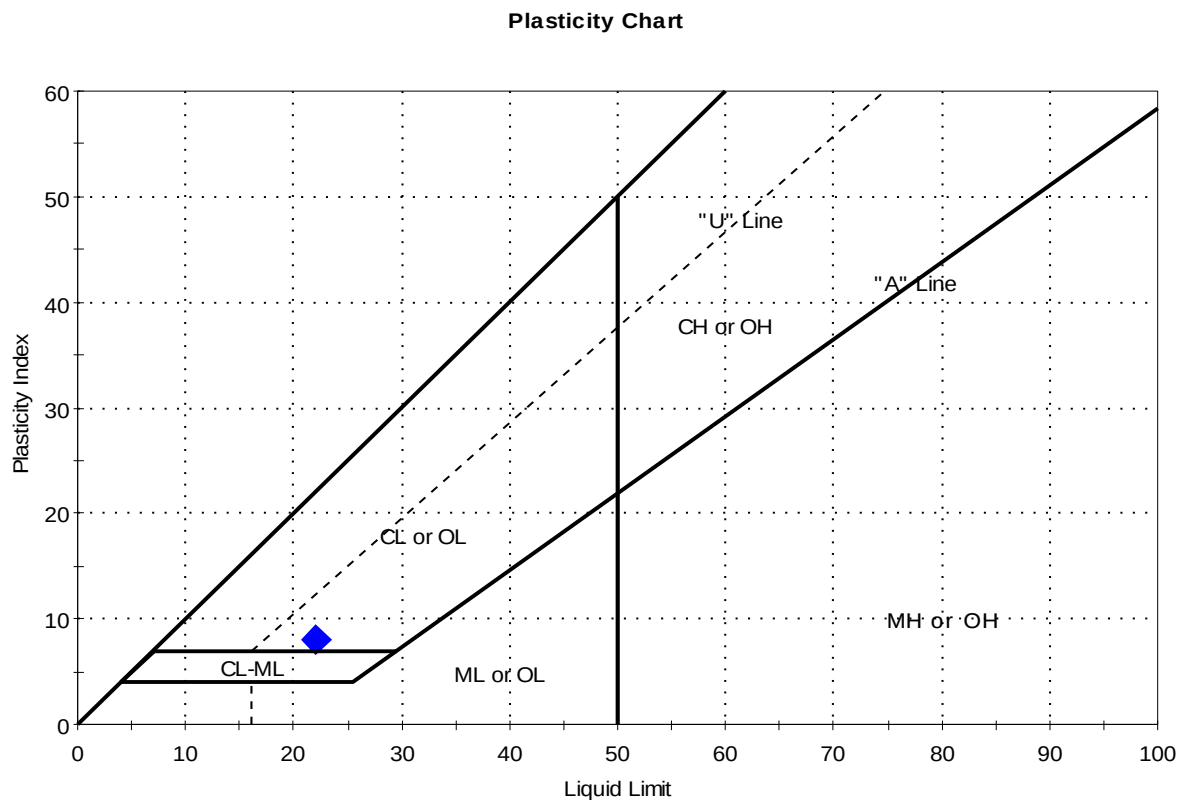
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	GZA GeoEnvironmental, Inc.	Project No:	GTX-306793
Project:	Capell Bridge Replacement		
Location:	Wells, ME		
Boring ID:	BB-WMR-201	Sample Type:	jar
Sample ID:	17D	Test Date:	08/09/17
Depth :	60-62 ft	Test Id:	419095
Test Comment:	---	Tested By:	cam
Visual Description:	Moist, olive clay	Checked By:	jdt
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	17D	BB-WMR-201	60-62 ft	25	22	14	8	1.4	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

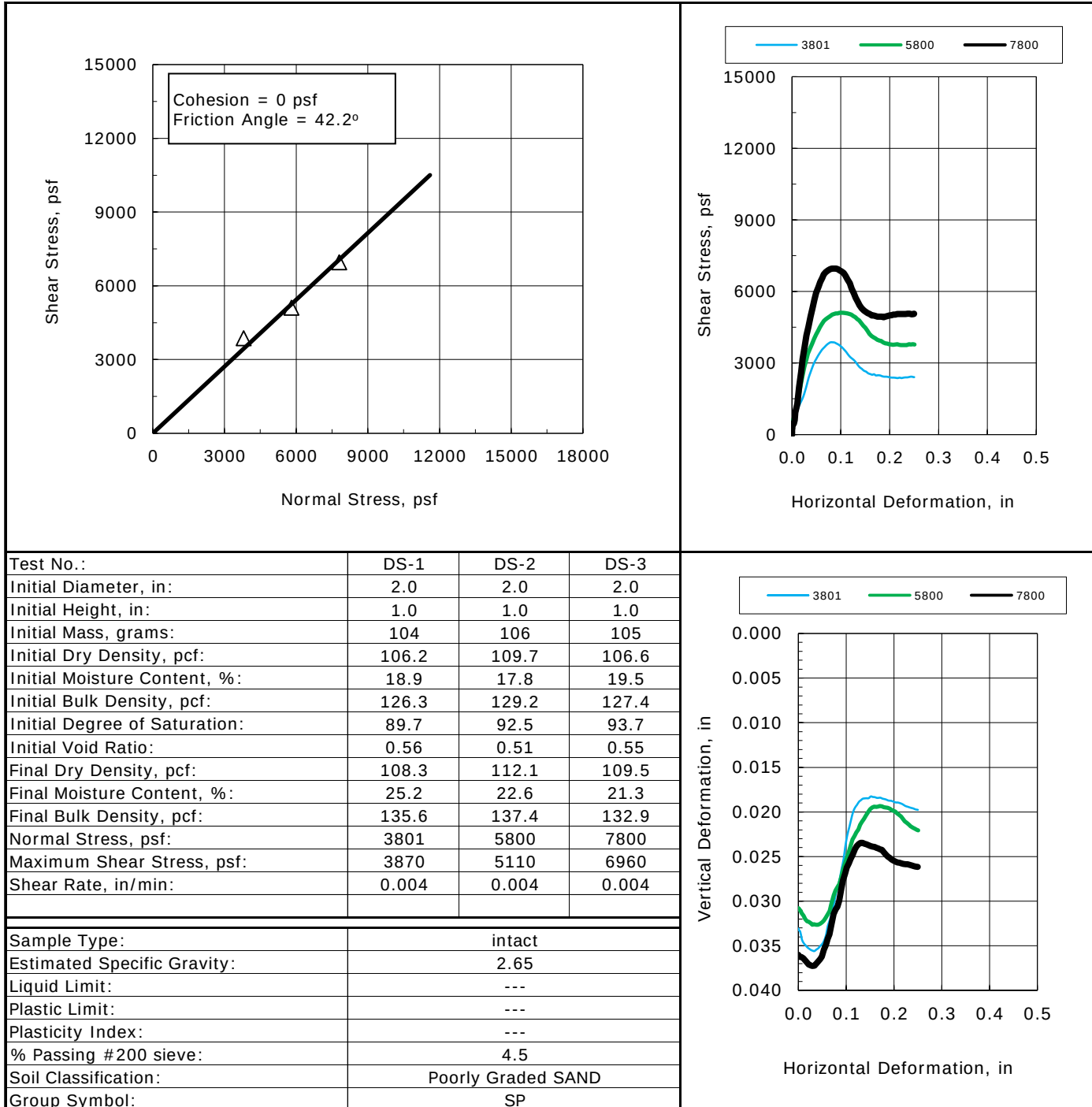
Dilatancy: SLOW

Toughness: LOW



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Capell Bridge Replacement
Project Location:	Wells, ME
GTX #:	306793
Test Date:	08/07/17
Tested By:	md
Checked By:	njh
Boring ID:	BB-WMR-201
Sample ID:	26D (A)
Depth, ft:	95-95.5
Visual Description:	Moist, olive gray sand, trace silt MEDOT Modified Burmister description as requested

Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080



Notes:

Moisture content obtained before shear from sample trimmings

Moisture Content determined by ASTM D2216

Percent passing #200 sieve determined by ASTM D422

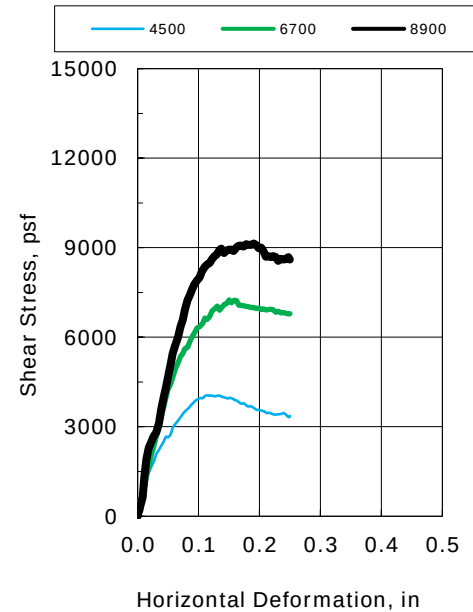
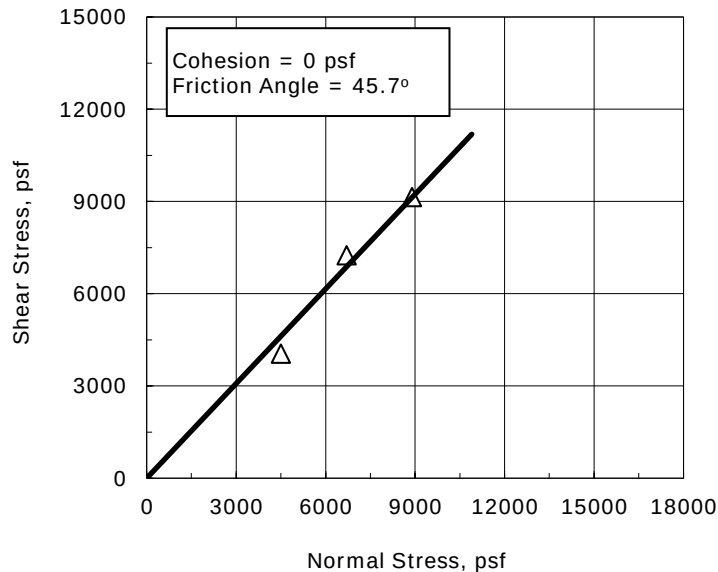
Extruded from tube, cut, trimmed and placed into apparatus at the as-received density and moisture content.

As requested, the cohesion value was set to zero. The friction angle was determined from best-fit straight line to the data through zero cohesion for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.

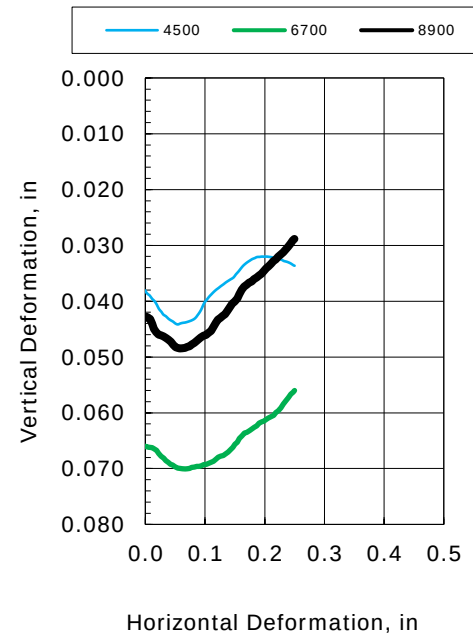
"---" indicates testing required to determine these values was not requested.



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Capell Bridge Replacement
Project Location:	Wells, ME
GTX #:	306793
Test Date:	08/10/17
Tested By:	md
Checked By:	njh
Boring ID:	BB-WMR-201
Sample ID:	29D (A)
Depth, ft:	110.3-110.8
Visual Description:	Moist, gray sand, some gravel, trace silt MEDOT Modified Burmister description as requested.



Test No.:	DS-4	DS-5	DS-6
Initial Diameter, in:	2.0	2.0	2.0
Initial Height, in:	1.0	1.0	1.0
Initial Mass, grams:	109	112	109
Initial Dry Density, pcf:	120.5	125.4	116.7
Initial Moisture Content, %:	9.3	8.5	12.9
Initial Bulk Density, pcf:	131.7	136.1	131.7
Initial Degree of Saturation:	66.1	70.7	81.6
Initial Void Ratio:	0.37	0.32	0.42
Final Dry Density, pcf:	124.7	132.8	120.2
Final Moisture Content, %:	16.3	13.1	16.6
Final Bulk Density, pcf:	145.1	150.1	140.2
Normal Stress, psf:	4500	6700	8900
Maximum Shear Stress, psf:	4050	7250	9140
Shear Rate, in/min:	0.004	0.004	0.004
Sample Type:	intact		
Estimated Specific Gravity:	2.65		
Liquid Limit:	---		
Plastic Limit:	---		
Plasticity Index:	---		
% Passing #200 sieve:	3.6		
Soil Classification:	Poorly Graded SAND with Gravel		
Group Symbol:	SP		



Notes:

Moisture content obtained before shear from sample trimmings
 Moisture Content determined by ASTM D2216
 Percent passing #200 sieve determined by ASTM D422
 Extruded from tube, cut, trimmed and placed into apparatus at the as-received density and moisture content.
 Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.
 "---" indicates testing required to determine these values was not requested.



APPENDIX D

GEOTECHNICAL ENGINEERING CALCULATIONS

Seismic Evaluation

 Design Maps Detailed Report

2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (43.3433°N,
70.56219°W)

Site Class E – “Soft Clay Soil”

Article 3.4.1 — Design Spectra Based on General Procedure

Note: Maps in the 2009 AASHTO Specifications are provided by AASHTO for Site Class B.
Adjustments for other Site Classes are made, as needed, in Article 3.4.2.3.

From [Figure 3.4.1-2](#)^[1]

PGA = 0.094 g

From [Figure 3.4.1-3](#)^[2]

S_s = 0.184 g

From [Figure 3.4.1-4](#)^[3]

S_1 = 0.045 g

Article 3.4.2.1 — Site Class Definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class E, based on the site soil properties in accordance with Article 3.4.2.

Table 3.4.2.1–1 Site Class Definitions

SITE CLASS	SOIL PROFILE NAME	Soil shear wave velocity, $\bar{v}_s$, (ft/s)	Standard penetration resistance, $\bar{N}$	Soil undrained shear strength, $\bar{s}_u$, (psf)
A	Hard rock	$\bar{v}_s > 5,000$	N/A	N/A
B	Rock	$2,500 < \bar{v}_s \leq 5,000$	N/A	N/A
C	Very dense soil and soft rock	$1,200 < \bar{v}_s \leq 2,500$	$\bar{N} > 50$	>2,000 psf
D	Stiff soil profile	$600 \leq \bar{v}_s < 1,200$	$15 \leq \bar{N} \leq 50$	1,000 to 2,000 psf
E	Stiff soil profile	$\bar{v}_s < 600$	$\bar{N} < 15$	<1,000 psf
E	—	Any profile with more than 10 ft of soil having the characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \geq 40\%$, and 3. Undrained shear strength $\bar{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays ($H > 10$ feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays ($H > 25$ feet with plasticity index $PI > 75$) 4. Very thick soft/medium stiff clays ($H > 120$ feet)		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Article 3.4.2.3 — Site Coefficients

Table 3.4.2.3-1 (for F_{PGA})—Values of F_{PGA} as a Function of Site Class and Mapped Peak Ground Acceleration Coefficient

Site Class	Mapped Peak Ground Acceleration				
	PGA $\leq$ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA $\geq$ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See AASHTO Article 3.4.3				

Note: Use straight-line interpolation for intermediate values of PGA

For Site Class = E and PGA = 0.094 g, F_{PGA} = 2.500

Table 3.4.2.3-1 (for F_a)—Values of F_a as a Function of Site Class and Mapped Short-Period Spectral Acceleration Coefficient

Site Class	Spectral Response Acceleration Parameter at Short Periods				
	$S_s \leq 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See AASHTO Article 3.4.3				

Note: Use straight-line interpolation for intermediate values of S_s

For Site Class = E and S_s = 0.184 g, F_a = 2.500

Table 3.4.2.3-2—Values of F_v as a Function of Site Class and Mapped 1-sec Period Spectral Acceleration Coefficient

Site Class	Mapped Spectral Response Acceleration Coefficient at 1-sec Periods				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See AASHTO Article 3.4.3				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = E and $S_1 = 0.045$ g, $F_v = 3.500$

Equation (3.4.1-1):

$$A_S = F_{PGA} \text{ PGA} = 2.500 \times 0.094 = 0.236 \text{ g}$$

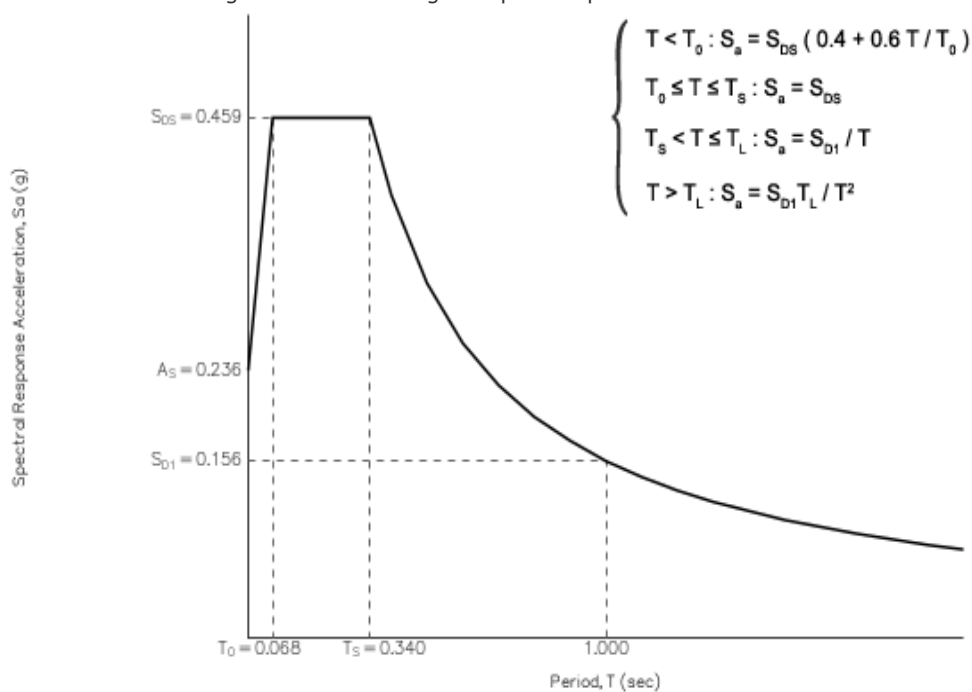
Equation (3.4.1-2):

$$S_{DS} = F_a S_S = 2.500 \times 0.184 = 0.459 \text{ g}$$

Equation (3.4.1-3):

$$S_{D1} = F_v S_1 = 3.500 \times 0.045 = 0.156 \text{ g}$$

Figure 3.4.1-1: Design Response Spectrum



Article 3.5 - Selection of Seismic Design Category (SDC)

Table 3.5-1—Partitions for Seismic Design Categories A, B, C, and D

VALUE OF S_{D1}	SDC
$S_{D1} < 0.15g$	A
$0.15g \leq S_{D1} < 0.30g$	B
$0.30g \leq S_{D1} < 0.50g$	C
$0.50g \leq S_{D1}$	D

For $S_{D1} = 0.156g$, Seismic Design Category = B

Seismic Design Category $\equiv$ "the design category in accordance with Table 3.5-1" = B

References

1. *Figure 3.4.1-2*: <https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-2.pdf>
2. *Figure 3.4.1-3*: <https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-3.pdf>
3. *Figure 3.4.1-4*: <https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-4.pdf>



SPT BASED LIQUEFACTION ANALYSIS REPORT

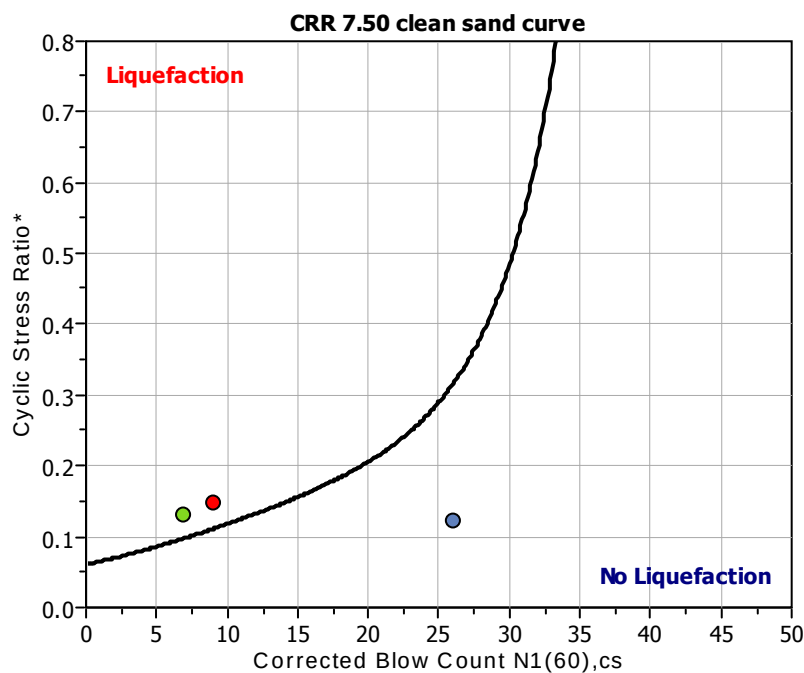
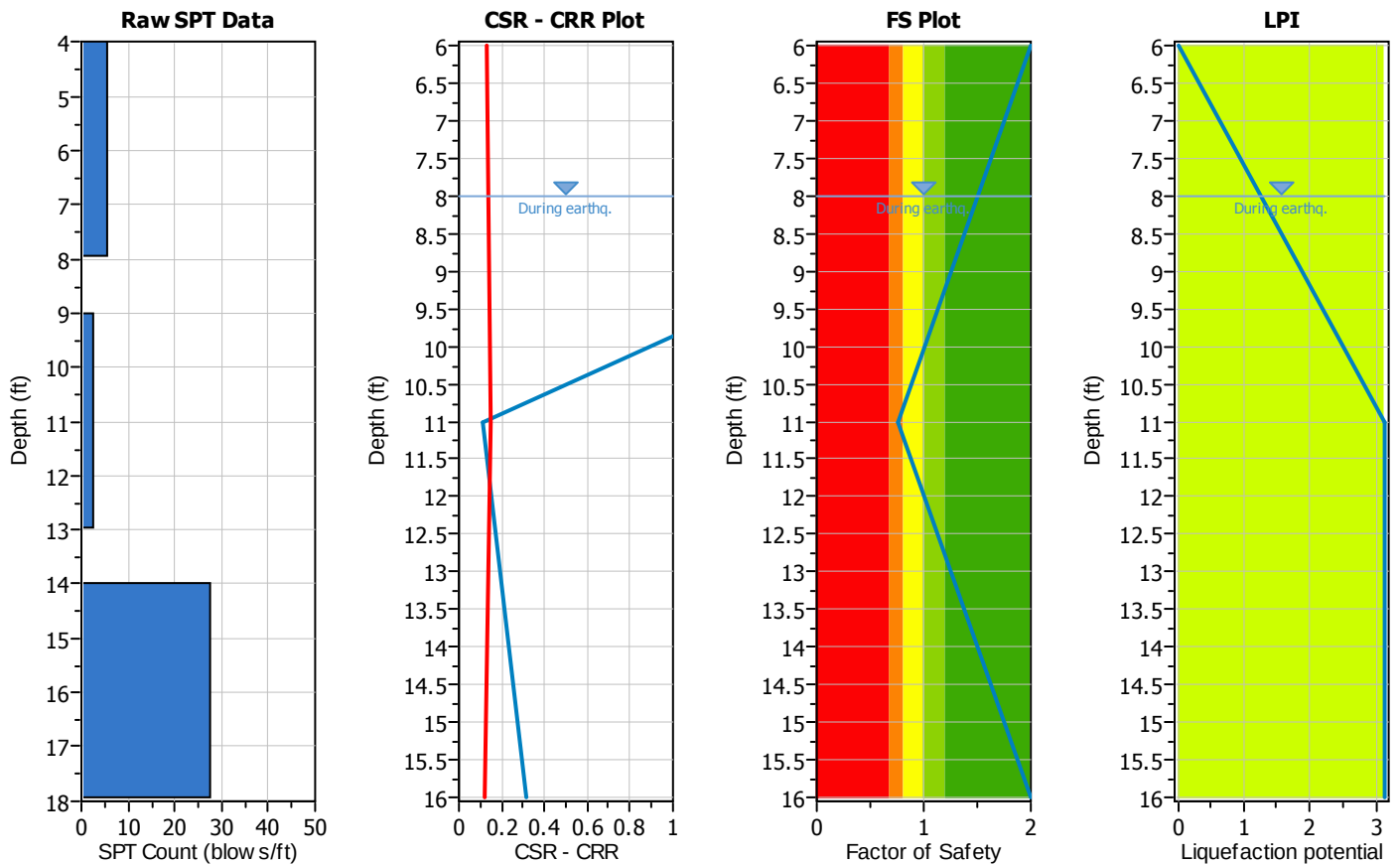
Project title : Capell Bridge

SPT Name: BB-WMR-101

Location : Wells, ME

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	8.00 ft
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	8.00 ft
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	5.93 ft
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.24 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	0.95		



F.S. color scheme

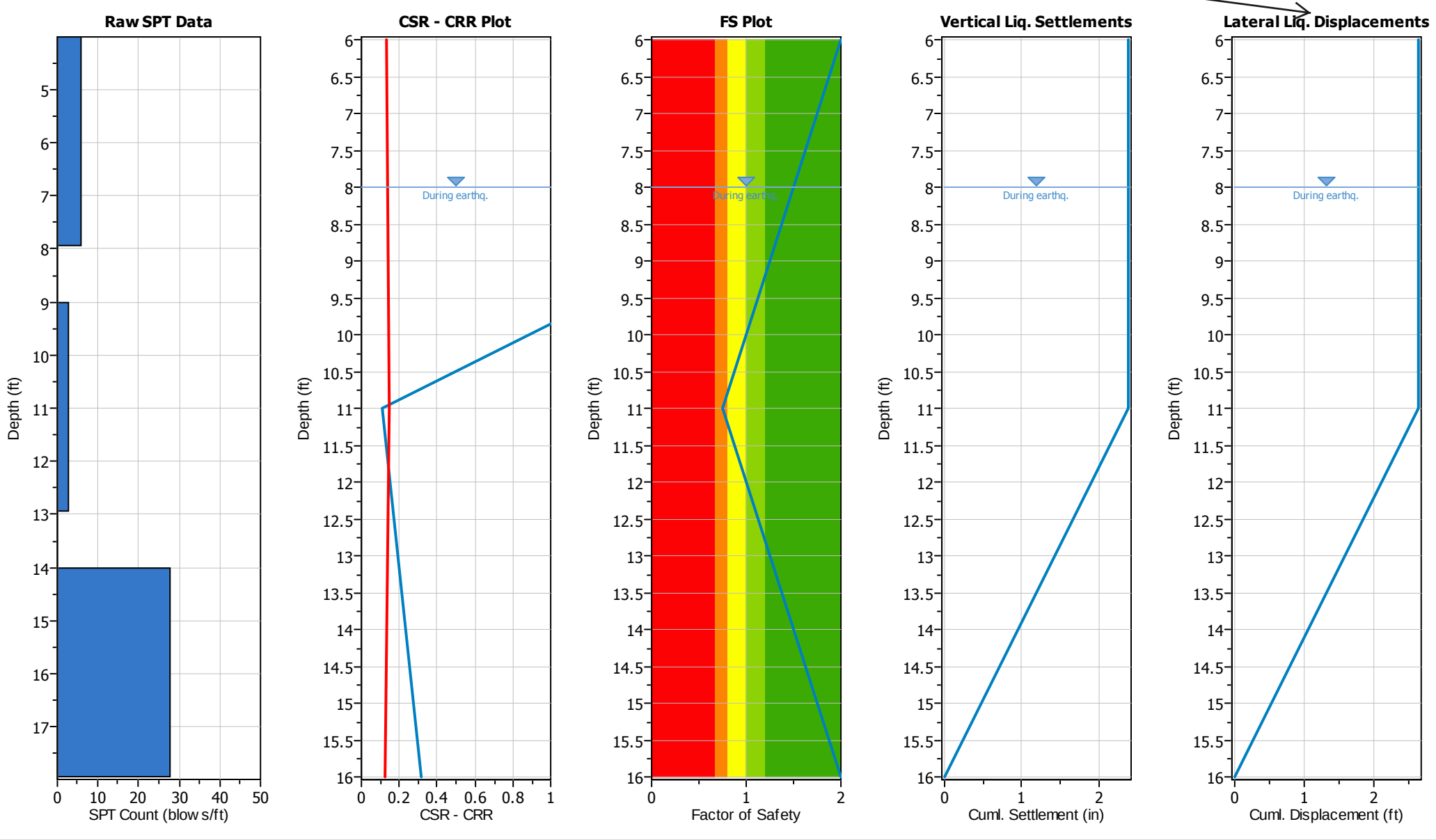
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Represents unrestricted slope movement, not approach retained by abutment

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
6.00	6	5.00	120.00	4.50	Yes
11.00	3	44.00	120.00	5.00	Yes
16.00	28	5.00	125.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
 SPT Field Value: Number of blows per foot
 Fines Content: Fines content at test depth (%)
 Unit Weight: Unit weight at test depth (pcf)
 Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
 Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	m	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	FC (%)	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	CRR _{7.5}
6.00	6	120.00	0.36	0.00	0.36	0.58	1.70	0.95	1.00	0.75	1.00	7	5.00	0.00	7	4.000
11.00	3	120.00	0.66	0.09	0.57	0.53	1.39	0.95	1.00	0.85	1.00	3	44.00	5.60	9	0.111
16.00	28	125.00	0.97	0.25	0.72	0.39	1.16	0.95	1.00	0.85	1.00	26	5.00	0.00	26	0.316

Abbreviations

σ_v : Total stress during SPT test (tsf)
 u_o : Water pore pressure during SPT test (tsf)
 σ'_{vo} : Effective overburden pressure during SPT test (tsf)
 m: Stress exponent normalization factor
 C_N : Overburden correction factor
 C_E : Energy correction factor
 C_B : Borehole diameter correction factor
 C_R : Rod length correction factor
 C_S : Liner correction factor
 $N_{I(60)}$: Corrected N_{SPT} to a 60% energy ratio
 $\Delta(N_1)_{60}$: Equivalent clean sand adjustment
 $N_{I(60)cs}$: Corrected $N_{I(60)}$ value for fines content
 CRR_{7.5}: Cyclic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF _{max}	$(N_1)_{60cs}$	MSF	CSR _{eq,M=7.5}	K_{σ}	CSR*	FS
6.00	120.00	0.36	0.00	0.36	0.98	1.00	0.153	1.14	7	1.09	0.140	1.09	0.129	2.000 
11.00	120.00	0.66	0.09	0.57	0.95	1.00	0.173	1.17	9	1.11	0.156	1.06	0.148	0.753 
16.00	125.00	0.97	0.25	0.72	0.92	1.00	0.193	1.77	26	1.49	0.129	1.06	0.122	2.000 

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
 $u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
 $\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
 r_d : Nonlinear shear mass factor
 α : Improvement factor due to stone columns
 CSR : Cyclic Stress Ratio
 MSF : Magnitude Scaling Factor
 CSR_{eq,M=7.5}: CSR adjusted for M=7.5
 K_{σ} : Effective overburden stress factor
 CSR*: CSR fully adjusted
 FS: Calculated factor of safety against soil liquefaction

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I _L
6.00	2.000	0.00	9.09	5.00	0.00
11.00	0.753	0.25	8.32	5.00	3.13
16.00	2.000	0.00	7.56	5.00	0.00

Overall potential I_L : 3.13I_L = 0.00 - No liquefactionI_L between 0.00 and 5 - Liquefaction not probableI_L between 5 and 15 - Liquefaction probableI_L > 15 - Liquefaction certain**:: Vertical settlements estimation for dry sands ::**

Depth (ft)	(N ₁) ₆₀	T _{av}	p	G _{max} (tsf)	α	b	γ	ε ₁₅	N _c	ε _{Nc} (%)	Δh (ft)	ΔS (in)
6.00	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	0.000

Cumulative settlements: 0.000**Abbreviations**T_{av}: Average cyclic shear stress

p: Average stress

G_{max}: Maximum shear modulus (tsf)

α, b: Shear strain formula variables

γ: Average shear strain

ε₁₅: Volumetric strain after 15 cyclesN_c: Number of cyclesε_{Nc}: Volumetric strain for number of cycles N_c (%)

Δh: Thickness of soil layer (in)

ΔS: Settlement of soil layer (in)

:: Vertical & Lateral displacements estimation for saturated sands ::

Depth (ft)	(N ₁) _{60cs}	γ _{lim} (%)	F _α	FS _{liq}	γ _{max} (%)	e _v (%)	dz (ft)	S _{v-1D} (in)	LDI (ft)
11.00	9	52.88	0.93	0.753	52.88	3.97	5.00	2.380	2.64
16.00	26	7.85	0.17	2.000	0.00	0.00	5.00	0.000	0.00

Cumulative settlements: 2.380 2.64**Abbreviations**γ_{lim}: Limiting shear strain (%)F_α/N: Maximum shear strain factorγ_{max}: Maximum shear strain (%)e_v:: Post liquefaction volumetric strain (%)S_{v-1D}: Estimated vertical settlement (in)

LDI: Estimated lateral displacement (ft)



SPT BASED LIQUEFACTION ANALYSIS REPORT

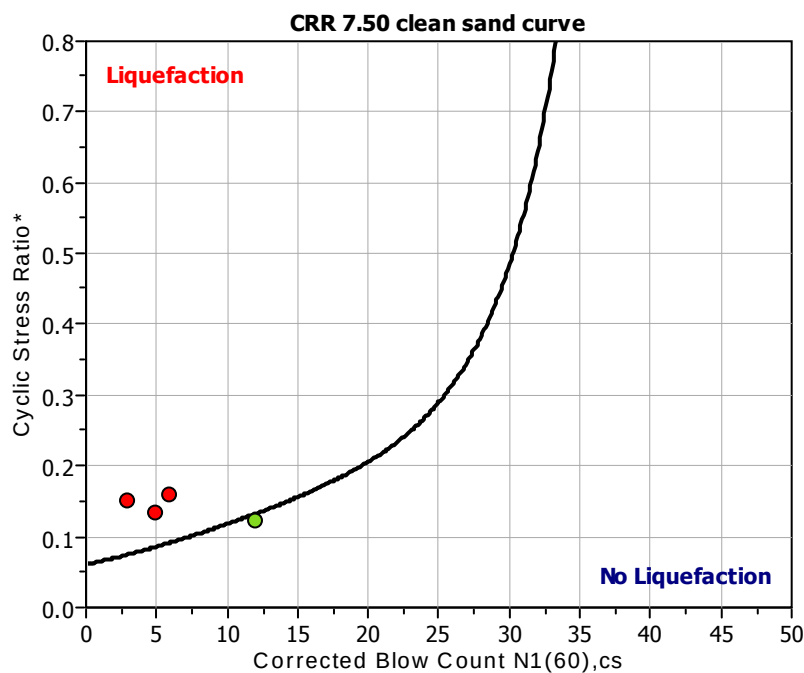
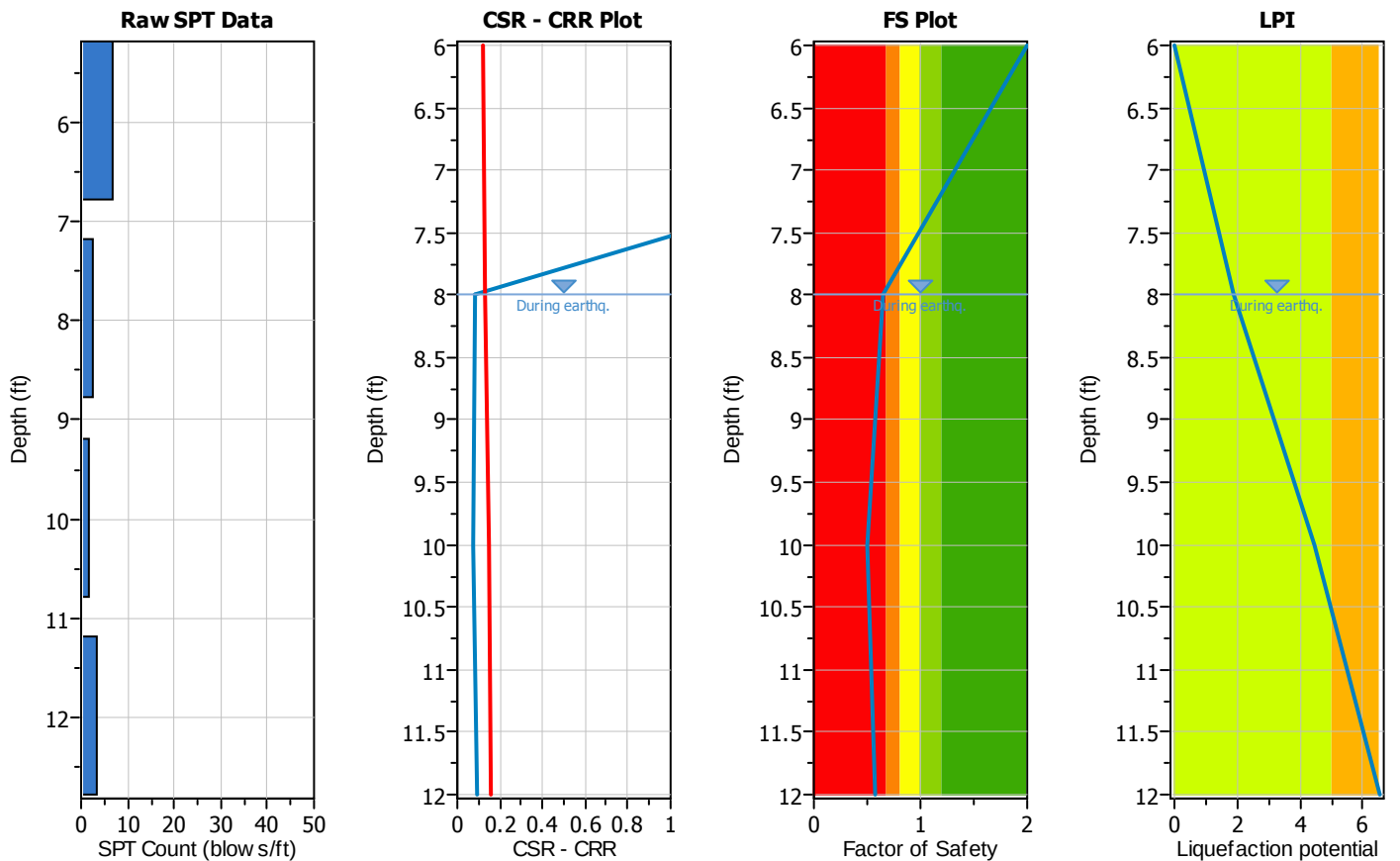
Project title : Capell Bridge

SPT Name: BB-WMR-201

Location : Wells, ME

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	8.00 ft
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	8.00 ft
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	5.93 ft
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.24 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.32		



F.S. color scheme

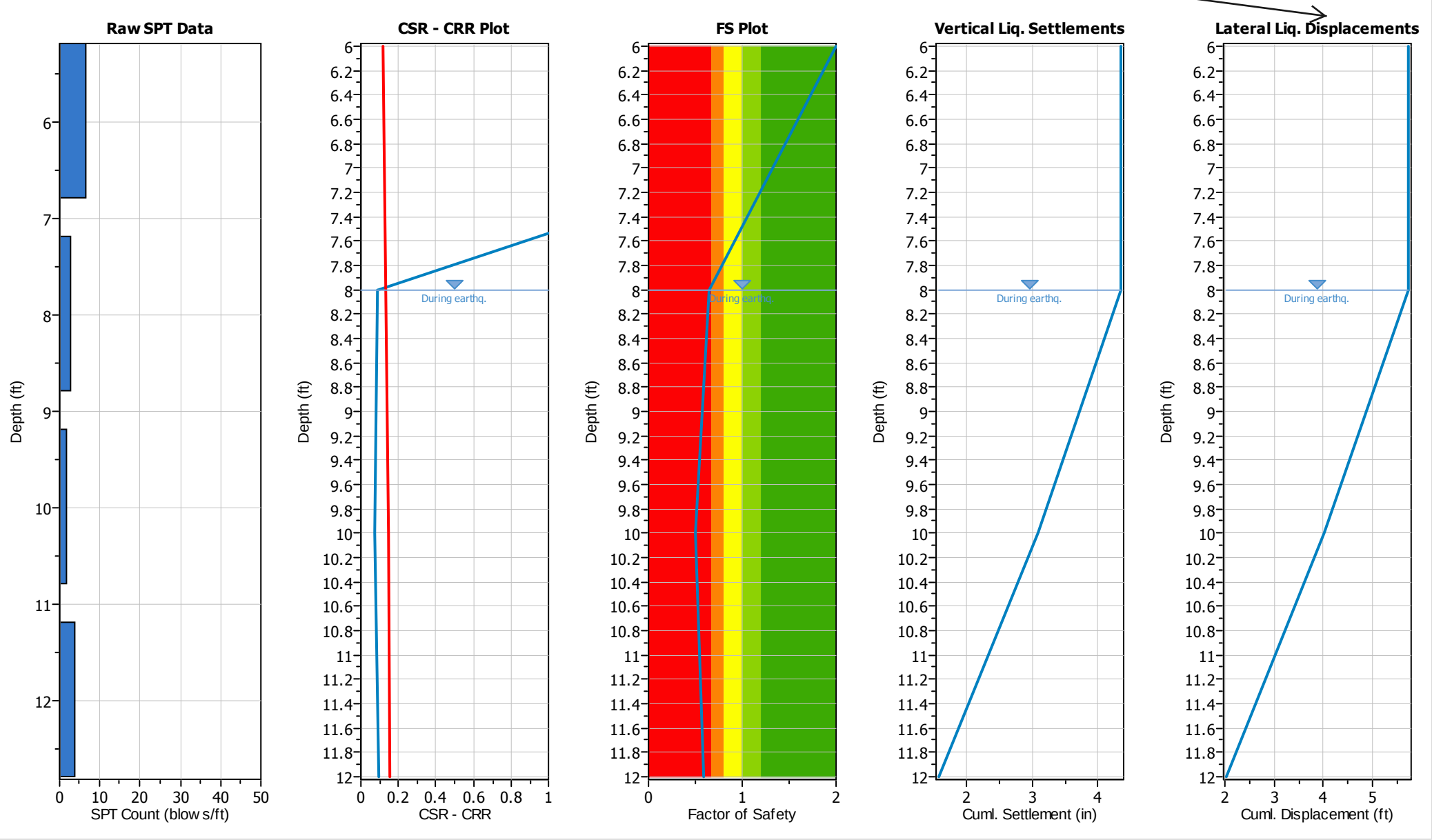
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Represents unrestricted slope movement, not approach retained by abutment

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
6.00	7	5.00	120.00	2.00	No
8.00	3	5.00	120.00	2.00	Yes
10.00	2	5.00	120.00	2.00	Yes
12.00	4	5.00	120.00	2.70	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
 SPT Field Value: Number of blows per foot
 Fines Content: Fines content at test depth (%)
 Unit Weight: Unit weight at test depth (pcf)
 Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
 Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	m	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	FC (%)	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	CRR _{7.5}
6.00	7	120.00	0.36	0.00	0.36	0.52	1.70	1.32	1.00	0.75	1.00	12	5.00	0.00	12	4.000
8.00	3	120.00	0.48	0.00	0.48	0.61	1.62	1.32	1.00	0.80	1.00	5	5.00	0.00	5	0.086
10.00	2	120.00	0.60	0.06	0.54	0.64	1.54	1.32	1.00	0.85	1.00	3	5.00	0.00	3	0.075
12.00	4	120.00	0.72	0.12	0.60	0.59	1.41	1.32	1.00	0.85	1.00	6	5.00	0.00	6	0.092

Abbreviations

σ_v : Total stress during SPT test (tsf)
 u_o : Water pore pressure during SPT test (tsf)
 σ'_{vo} : Effective overburden pressure during SPT test (tsf)
 m: Stress exponent normalization factor
 C_N : Overburden correction factor
 C_E : Energy correction factor
 C_B : Borehole diameter correction factor
 C_R : Rod length correction factor
 C_S : Liner correction factor
 $N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
 $\Delta(N_1)_{60}$: Equivalent clean sand adjustment
 $N_{1(60)cs}$: Corrected $N_{1(60)}$ value for fines content
 CRR_{7.5}: Cyclic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF _{max}	$(N_1)_{60cs}$	MSF	CSR _{eq,M=7.5}	K_{sigma}	CSR*	FS
6.00	120.00	0.36	0.00	0.36	0.98	1.00	0.153	1.24	12	1.15	0.133	1.10	0.121	2.000 ●
8.00	120.00	0.48	0.00	0.48	0.97	1.00	0.151	1.12	5	1.07	0.141	1.06	0.133	0.648 ●
10.00	120.00	0.60	0.06	0.54	0.96	1.00	0.167	1.10	3	1.06	0.157	1.05	0.150	0.502 ●
12.00	120.00	0.72	0.12	0.60	0.95	1.00	0.178	1.13	6	1.08	0.165	1.05	0.158	0.583 ●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
 $u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
 $\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
 r_d : Nonlinear shear mass factor
 α : Improvement factor due to stone columns
 CSR : Cyclic Stress Ratio
 MSF : Magnitude Scaling Factor
 CSR_{eq,M=7.5}: CSR adjusted for M=7.5
 K_{sigma} : Effective overburden stress factor
 CSR*: CSR fully adjusted
 FS: Calculated factor of safety against soil liquefaction

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I _L
6.00	2.000	0.00	9.09	2.00	0.00
8.00	0.648	0.35	8.78	2.00	1.88
10.00	0.502	0.50	8.48	2.00	2.58
12.00	0.583	0.42	8.17	2.00	2.08

Overall potential I_L : 6.54I_L = 0.00 - No liquefactionI_L between 0.00 and 5 - Liquefaction not probableI_L between 5 and 15 - Liquefaction probableI_L > 15 - Liquefaction certain**:: Vertical settlements estimation for dry sands ::**

Depth (ft)	(N ₁) ₆₀	T _{av}	p	G _{max} (tsf)	a	b	γ	ε ₁₅	N _c	ε _{Nc} (%)	Δh (ft)	ΔS (in)
6.00	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.000

Cumulative settlements: 0.000**Abbreviations**T_{av}: Average cyclic shear stress

p: Average stress

G_{max}: Maximum shear modulus (tsf)

a, b: Shear strain formula variables

γ: Average shear strain

ε₁₅: Volumetric strain after 15 cyclesN_c: Number of cyclesε_{Nc}: Volumetric strain for number of cycles N_c (%)

Δh: Thickness of soil layer (in)

ΔS: Settlement of soil layer (in)

:: Vertical & Lateral displacements estimation for saturated sands ::

Depth (ft)	(N ₁) _{60cs}	γ _{lim} (%)	F _a	FS _{liq}	γ _{max} (%)	e _v (%)	dz (ft)	S _{v-1D} (in)	LDI (ft)
8.00	5	84.97	0.95	0.648	84.97	5.26	2.00	1.262	1.70
10.00	3	100.00	0.95	0.502	100.00	6.33	2.00	1.520	2.00
12.00	6	74.98	0.95	0.583	74.98	4.86	2.70	1.575	2.02

Cumulative settlements: 4.357 5.72**Abbreviations**γ_{lim}: Limiting shear strain (%)F_a/N: Maximum shear strain factorγ_{max}: Maximum shear strain (%)e_v: Post liquefaction volumetric strain (%)S_{v-1D}: Estimated vertical settlement (in)

LDI: Estimated lateral displacement (ft)

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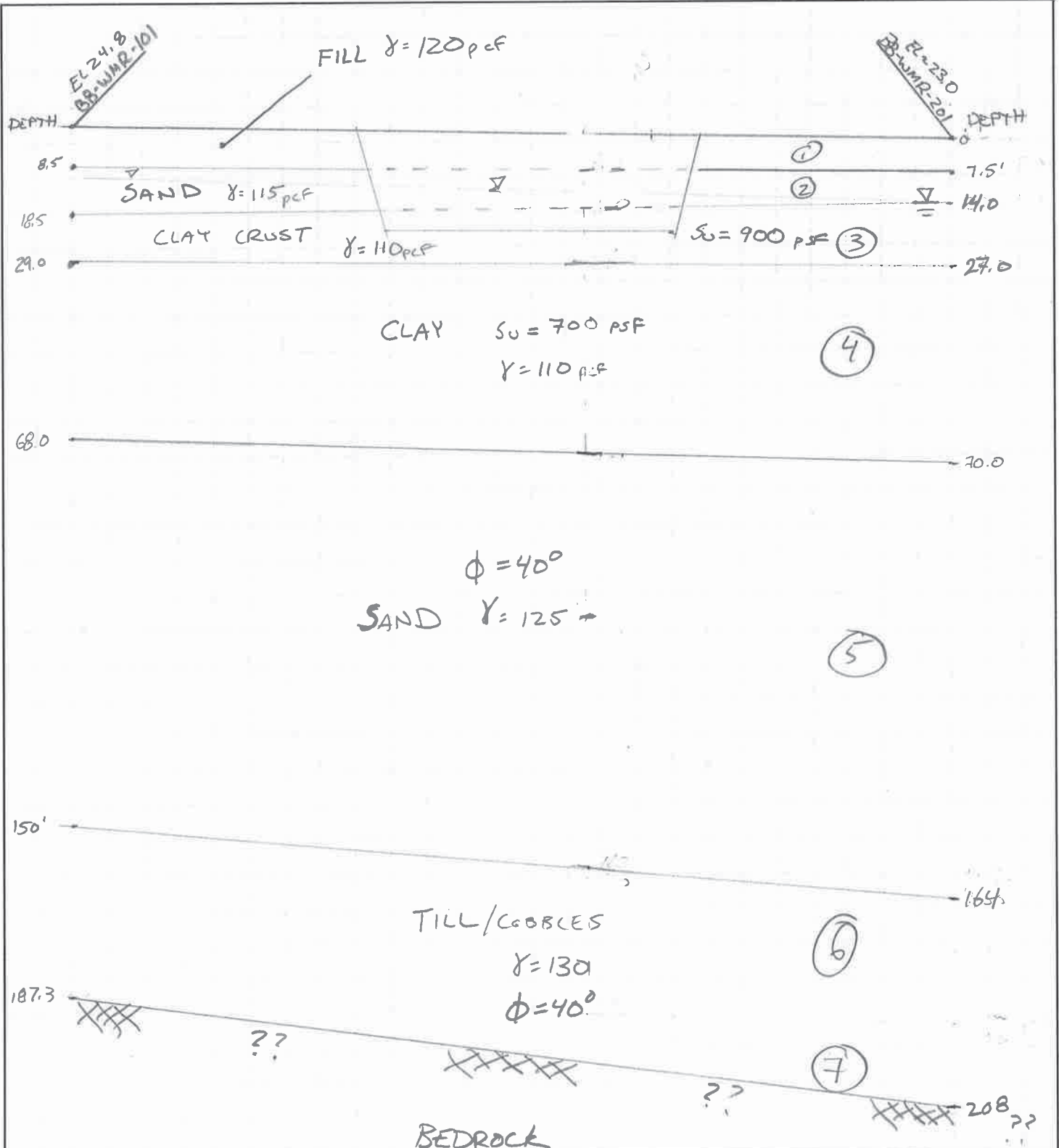
Geotechnical Resistance Evaluation



GZA
GeoEnvironmental, Inc.
477 Congress Street, Suite 700
Portland, Maine 04101
(207) 879-9190
Fax (207) 879-0099
<http://www.gza.com>

Engineers and
Scientists

JOB 09.0025946.00 CAPELL BRIDGE
SHEET NO 1 OF 1
Calculated By B. CARDALI Date
Checked By Date
Scale V=30 H=20



DESIGN SUBSURFACE PROFILE

Unit Side Resistance Summary**Capell Bridge #2126 Over Merriland River, Wells, ME**

GZA GeoEnvironmental, Inc.

GZA FILE NO. 09.0025946.00**CALCULATED BY** B.Cardali, 08/18/17**CHECKED BY** A. Blaisdell, 09/08/17

C. Snow 11/30/2017

Nominal Unit Side Resistance (ksf), by Analytical Method		
	Back-Analyzed (see Note 1)	Increased Meyerhof (Br#2693)
Clay Crust	0.14	--
Clay	0.11	--
Sand	--	1.10
Glacial Till	--	1.10

Notes:

1. Unit side resistance in Clay Crust and Clay calculated using $0.15 \cdot S_u$ (900/700 psf), based on recorded skin friction in CAPWAP in Clay at Br#2693.
2. Standard Meyerhof side resistance calculated using AASHTO equation for non-displacement pile and a representative N160 value of 29 bpf for the Sand Stratum.
3. Increased Meyerhof side resistance calculated using a site-specific ratio of $N160/q_s=26$ calculated from Bridge #2693 CAPWAP and SPT data, approximately equivalent to Meyerhof plugged equation and a representative n160 value of 29 bpf for the Sand stratum.
4. Sand and Glacial Till side resistance values assume uniform properties through these strata, neglecting potential increased resistance in gravel/cobble/boulder strata.



GZA
GeoEnvironmental, Inc.
477 Congress Street, Suite 700
Portland, Maine 04101
(207) 879-9190
Fax (207) 879-0099
http://www.gza.com

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09.0025946.00
JOB Capell Bridge
SHEET NO 1 OF 1
Calculated By A. Blazelle Date 9/11/17
Checked By _____ Date _____
Scale _____

EVALUATE NEARBY TEST BORING & CAPWAP DATA RELATIVE TO ANTICIPATED SKIN FRICTION

- Nearby Project: Pumping Sta Bridge 2693 over Branch Brook, WIN 20474 (approx. 1.25 mi north)
- PDA/CAPWAP on Abutment I Pile, boring BB-KWBB-102
↳ Similar Profile to Capell, except lower strength clay, weaker sand, and shallower rock. Results are summarized below:

Depth Range	Avg N_{60}	Avg N_{160}	Avg q_s (ksf)	$\frac{N_{160}}{q_s}$
70-90'	25	16	0.21	76.2
90-115'	18	10	0.74	13.5
Total 45' sand	21	13	0.50	26

- Meyerhof friction resistance calc:

$$\text{Displacement: } q_s = \frac{N_{160}}{25}, \text{ or } \frac{N_{160}}{q_s} = 25$$

$$\text{Non Displacement: } q_s = \frac{N_{160}}{50}, \text{ or } \frac{N_{160}}{q_s} = 50$$

RESULTS

On average, Meyerhof displacement equation was a better predictor of q_s , i.e., non displacement conservative by a factor of about 2

* SEE ATTACHED LOG OF BB-KWBB-102 WITH MARKUPS INDICATING PDA INTERPRETATIONS. (5 pages)

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pumping Station Bridge #2693 carries Route 1 over Branch Brook Location: Kennebunk and Wells, Maine		Boring No.: BB-KWBB-102 WIN: 20474.00					
Driller: MaineDOT			Elevation (ft.) 19.5		Auger ID/OD: 5" Solid Stem						
Operator: Giles/Daggett			Datum: NAVD88		Sampler: Standard Split Spoon						
Logged By: B. Wilder/K. Maguire			Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"						
Date Start/Finish: 2/22,23,24,28/2014			Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"						
Boring Location: 15+71.6, 13.1 ft Rt.			Casing ID/OD: NW & HW		Water Level*: None Observed						
Hammer Efficiency Factor: 0.867			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 N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (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								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
0							SSA	19.08	5" Pavement	0.4	G#243240 A-2-4, SM WC=13.0%
									Brown, damp, fine to coarse SAND, some silt, little gravel, (Fill).		
5	1D	24/18	4.5 - 6.5	2/2/2/2	4	6			Brown, moist, loose, fine to coarse SAND, some silt, little gravel, (Fill).		
10	2D	24/20	9.5 - 11.5	2/2/2/2	4	6					
								26			
								30			
								22			
								20			
								19			
15	MDMV	24/0	15.5 - 17.5	1/WOH/WOH/1	---			12	Failed sample attempt.		
								20	Failed 55x110 mm vane attempt, would not push.		
								18			
								16			
								22			
20	3D/MU	24/6	20.0 - 22.0	WOR/WOR/WOR/ WOR	---			17	Grey, wet, very soft to soft, Clayey SILT, trace fine sand.		
								13	Failed Tube attempt, set for 20 minutes. Tube pushed with WOH.		
	V1		22.6 - 23.0	Su=223/67 psf				11			
	V2		23.6 - 24.0	Su=312/45 psf				9			
25								9	55x110 mm vane raw torque readings: V1: 5.0/1.5 ft-lbs V2: 7.0/1.0 ft-lbs		
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 6	
* 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.										Boring No.: BB-KWBB-102	

Maine Department of Transportation				Project: Pumping Station Bridge #2693 carries Route 1 over Branch Brook Location: Kennebunk and Wells, Maine		Boring No.: BB-KWBB-102 WIN: 20474.00							
Soil/Rock Exploration Log US CUSTOMARY UNITS													
Driller: MaineDOT		Elevation (ft.): 19.5		Auger ID/OD: 5" Solid Stem									
Operator: Giles/Daggett		Datum: NAVD88		Sampler: Standard Split Spoon									
Logged By: B. Wilder/K. Maguire		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"									
Date Start/Finish: 2/22,23,24,28/2014		Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"									
Boring Location: 15+71.6, 13.1 ft Rt.		Casing ID/OD: NW & HW		Water Level*: None Observed									
Hammer Efficiency Factor: 0.867		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 WOIP = Weight of one person S_u = Insitu Field Vane Shear Strength (psf) T_v = Pocket Torrvane Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N_{uncorrected} = Raw field SPT N-value Hammer Efficiency Factor = Annual Calibration Value N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (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							Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.			
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				Elevation (ft.)		
25	4D/MU	24/10	25.0 - 27.0	WOR/WOR/WOR/ WOR	---		11			Grey, wet, soft, Silty CLAY, trace sand, trace gravel. Failed tube attempt, set for 45 minutes. Pushed with WOR. 55x110 mm vane raw torque readings: V3: 9.0/2.0 ft-lbs V4: 8.0/4.0 ft-lbs No resistance in CAPWAP in upper 30'	G#243242 A-6, CL WC=41.0%		
							9						
	V3		27.6 - 28.0	Su=402/89 psf			6						
	V4		28.6 - 29.0	Su=357/179 psf			5						
30							5				Grey, wet, soft, Silty CLAY, trace gravel, trace sand. 55x110 mm vane raw torque readings: V5: 6.5/2.0 ft-lbs V6: 8.0/1.0 ft-lbs Skin Resistance = 60 psf at 30' Approx Su x 0.15	G#243243 A-6, ML WC=34.4% LL=36 PL=25 PI=11	
	5D	24/16	30.0 - 32.0	WOR/WOR/WOR/ WOR	---		5						
	V5		30.6 - 31.0	Su=290/89 psf			24						
	V6		31.6 - 32.0	Su=357/45 psf			26						
35							20					Similar to above. 55x110 mm vane raw torque readings: V7: 9.0/3.0 ft-lbs V8: 9.5/1.5 ft-lbs	
							21						
	6D	24/20	35.0 - 37.0	WOR/WOR/WOR/ WOR	---		10						
	V7		35.6 - 36.0	Su=402/134 pdf			11						
40							12					Grey, wet, soft, Clayey SILT, little fine sand. 55x110 mm vane raw torque readings: V9: 9.5/2.0 ft-lbs V10: 9.5/1.0 ft-lbs	G#243244 A-6, CL WC=32.2% LL=28 PL=17 PI=11
							5						
							5						
	7D	24/17	40.0 - 42.0	WOR/WOR/WOR/ WOR	---		WOH						
45							WOH					Grey, wet, very loose, Silty fine to coarse SAND, some clay. Failed 55x110 mm vane attempt.	G#243245 A-4, ML WC=19.5% Non-Plastic
							WOH						
							23						
							24						
50							20						
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.

Page 2 of 6

Boring No.: BB-KWBB-102

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pumping Station Bridge #2693 carries Route 1 over Branch Brook Location: Kennebunk and Wells, Maine				Boring No.: BB-KWBB-102 WIN: 20474.00			
Driller: MaineDOT				Elevation (ft.): 19.5				Auger ID/OD: 5" Solid Stem			
Operator: Giles/Daggett				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: B. Wilder/K. Maguire				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 2/22,23,24,28/2014				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"			
Boring Location: 15+71.6, 13.1 ft Rt.				Casing ID/OD: NW & HW				Water Level*: None Observed			
Hammer Efficiency Factor: 0.867				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 Torrvane 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.
50	9D	24/20	50.0 - 52.0	WOR/WOR/WOR/ WOR	---		WOC			Grey, wet, very loose, Silty fine to coarse SAND, some clay.	Combined with 8D for lab testing
							WOC				
							18				
							26			Set in NW casing at 53.0 ft bgs.	
							22				
55							15				
							8				
							7				
							7				
							6				
60	10D	24/14	60.0 - 62.0	2 1/2/2	3	4	aHP			Grey, wet, loose, fine to coarse SAND, some silt, little clay, trace gravel. aHydraulic Push	G#243246 A-4, SC-SM WC=19.7%
							HP				
							HP				
							HP				
							8				
65							35				
							14				
							24				
							22			Running sand, kept a head of water in casing.	
							30	-49.50		Skin Resistance = 60 psf to 70'	
70	11D	24/18	70.0 - 72.0	8/10/11/12	21	30	1			Grey, wet, medium dense, fine SAND, some silt, trace medium sand, trace clay.	G#243247 A-2-4, SC-SM WC=20.8%
							WOC			Skin Resistance = 150-210 psf at 70'	
							7				
							26				
75							105				
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 3 of 6	
* 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.										Boring No.: BB-KWBB-102	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pumping Station Bridge #2693 carries Route 1 over Branch Brook Location: Kennebunk and Wells, Maine		Boring No.: BB-KWBB-102 WIN: 20474.00					
Driller: MaineDOT		Elevation (ft.) 19.5		Auger ID/OD: 5" Solid Stem							
Operator: Giles/Daggett		Datum: NAVD88		Sampler: Standard Split Spoon							
Logged By: B. Wilder/K. Maguire		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"							
Date Start/Finish: 2/22,23,24,28/2014		Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"							
Boring Location: 15+71.6, 13.1 ft Rt.		Casing ID/OD: NW & HW		Water Level*: None Observed							
Hammer Efficiency Factor: 0.867		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 N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (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								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
75							236		Kept a head of water in casing.	G#243248 A-2-4, SC-SM WC=21.4%	
							210				
							186				
							188				
							234				
80	12D	24/18	80.0 - 82.0	6/6/8/8	14	20	91				Grey, wet, medium dense, fine SAND, little silt, trace medium sand, trace clay.
							68				
							83				
							91				
							252				Roller coned ahead to 90.0 ft bgs.
85							209				
							175				
							182				
							263				
							258				
90	13D	24/19	90.0 - 92.0	4/4/12/23	16	23	211			Unit Skin Resistance = 150-210 psf to 90'	G#243249 A-2-4, SC-SM WC=20.0%
							137			Grey, wet, medium dense, fine SAND, little medium sand, little silt, trace clay.	
							143			Unit Skin Resistance = 890 psf at 90'	
							189				
							271				
95							101		Washed ahead to 100.0 ft bgs.		
							121				
							136				
							189				
100							216				
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 4 of 6	
* 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.										Boring No.: BB-KWBB-102	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pumping Station Bridge #2693 carries Route 1 over Branch Brook Location: Kennebunk and Wells, Maine				Boring No.: BB-KWBB-102 WIN: 20474.00																							
Driller: MaineDOT				Elevation (ft.) 19.5				Auger ID/OD: 5" Solid Stem																							
Operator: Giles/Daggett				Datum: NAVD88				Sampler: Standard Split Spoon																							
Logged By: B. Wilder/K. Maguire				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"																							
Date Start/Finish: 2/22,23,24,28/2014				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"																							
Boring Location: 15+71.6, 13.1 ft Rt.				Casing ID/OD: NW & HW				Water Level*: None Observed																							
Hammer Efficiency Factor: 0.867				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																							
<table><tr><th colspan="8">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/ AASHTO and Unified Class</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N₆₀</th><th>Casing Blows</th></tr></table>												Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class	Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows
Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class																				
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows																								
100	14D	24/9	100.0 - 102.0	11/6/4/10	10	14	128					Grey, wet, medium dense, fine SAND, little silt, trace medium sand, trace clay. Washed ahead of casing to 120.0 ft bgs.																			
							160																								
							206																								
							308																								
							301																								
105							230																								
							220																								
							204																								
							254																								
							191																								
110	15D	24/24	110.0 - 112.0	2/4/8/8	12	17	190					Grey, wet, medium dense, fine to coarse SAND, some silt, little clay, trace gravel.	G#243250 A-4, SC-SM WC=10.7%																		
							240																								
							290																								
							252																								
							259																								
115							333																								
							333																								
							345																								
							525																								
							412																								
120	16D	7.2/7.2	120.5 - 121.1	40/50(1.2")	---		156+					Grey clay silt, little gravel, little	G#262320 A-4, SC-SM WC=7.1%																		
	R1	60/60	122.7 - 127.7	RQD = 72%			NQ-2					Roller coned ahead to 122.7 ft bgs.																			
125												Top of Bedrock at Elev. -103.2 ft. R1:Bedrock: Dark grey to black, fine grained, very hard, fresh, SANDSTONE with quartz, pyrite and calcite veins, several healed and open joints dipping at 35 to 55 degrees (Kittery Formation).																			
Remarks:																															
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.												Page 5 of 6																			
* 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.												Boring No.: BB-KWBB-102																			



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GeoEnvironmental, Inc.
477 Congress Street, Suite 700
Portland, Maine 04101
(207) 879-9190
Fax (207) 879-0099
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JOB CAPEL BRIDGE 25946.00
SHEET NO 2 OF 2
Calculated By B. CARDALI Date 9/5/17
Checked By _____ Date _____
Scale NTS

MEYERHOF TIP RESISTANCE (NOMINAL)

BEARING IN SAND/GRAVEL

$$q_p = \frac{0.8 (N_{160}) D_b}{D} \leq q_t$$

ASSUME 10' INTO LAYER

$$q_p = \frac{(0.8)(42)(10')}{(14\frac{1}{2}')} = 280 \text{ ksf}$$

$$q_t = 8 \times 42 = 336 \text{ ksf}$$

SINCE $q_p \leq q_t$ USE q_p

$$\text{TIP} = (280 \text{ ksf})(.18 \text{ ft}^2) = \boxed{50.4 \text{ k}} \quad (\text{NO PLUG})$$

$$q_t = 8 \times N_{160} \quad (\text{ksf})$$

D_b = PENETRATION INTO BEARING
STRATA (FT)

D = PILE DIAMETER/WIDTH (FT)

Nominal Pile Resistance in Soil
Capell Bridge #2126 Over Merriland River, Wells, ME
 GZA GeoEnvironmental, Inc.

GZA FILE NO. 09.0025946.00
CALCULATED BY B.Cardali, 11/29/17
CHECKED BY A. Blaisdell, 11/29/17

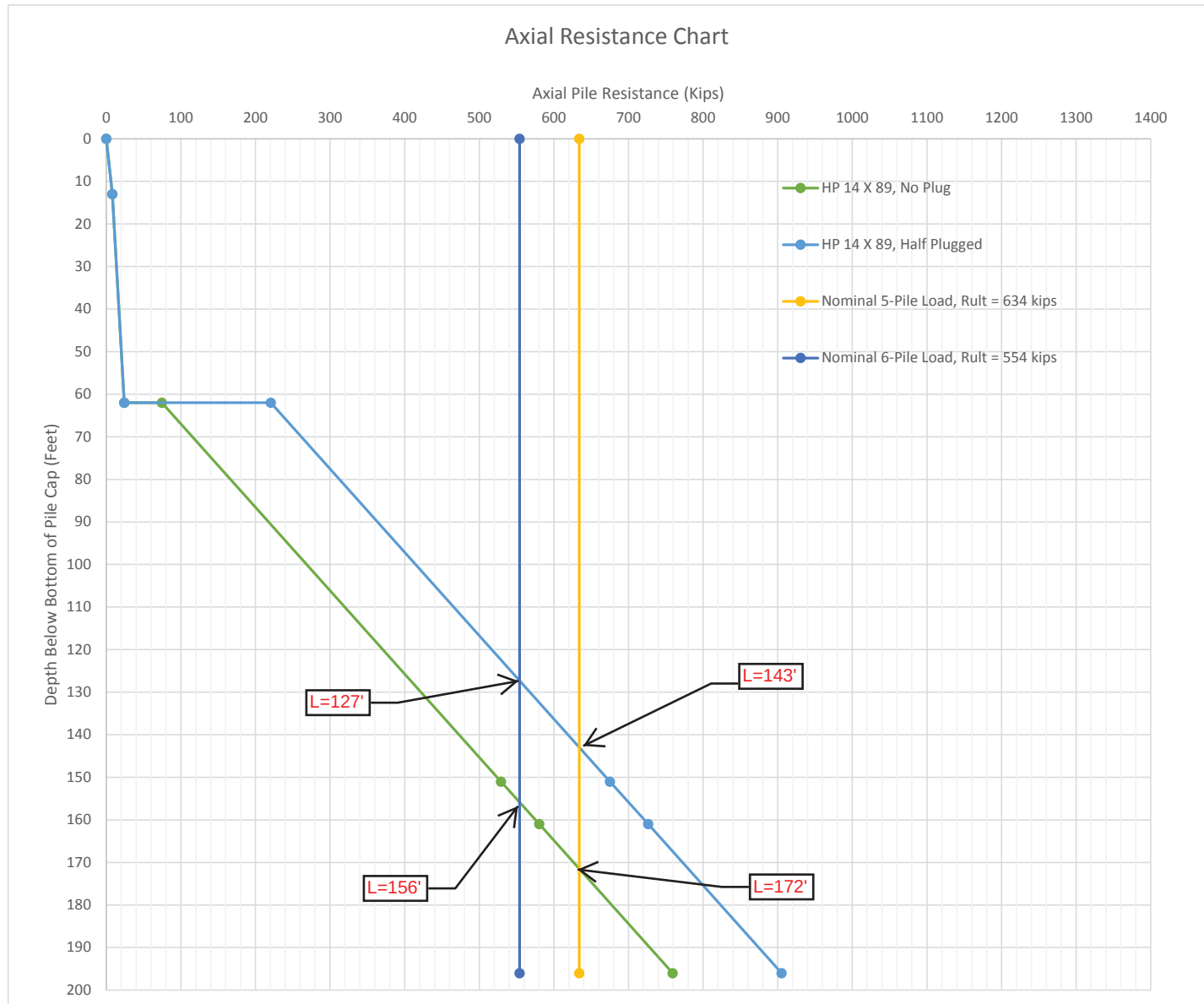
Nominal Pile Resistance in Soil				
Depth (BGS)	Depth (BPC)	Stratum	HP 14x89 No Plug (kips)	HP 14 X 89 Half Plugged (kips)
14	0	Clay Crust	0	0
27	13		8	8
70	62	Clay	24	24
70	62	Sand	74	220
165	151		529	675
175	161	Glacial Till	580	726
210	196		759	905

Notes:

1. Pile side resistance based on Tomlinson/Alpha method in Clay and Increased Meyerhof in Sand and Glacial Till. End bearing based on Meyerhof.
2. Side resistance calculated for the H-pile box perimeter. Tip resistance calculated for the H-pile steel area only for No Plug and half the end area for Half Plugged.
2. "BGS" = Below ground surface, "BPC" = Below bottom of pile cap

Nominal Pile Resistance in Soil
Capell Bridge #2126 Over Merriland River, Wells, ME
 GZA GeoEnvironmental, Inc.

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Drivability Evaluation



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GeoEnvironmental, Inc
477 Congress Street, Suite 700
Portland, Maine 04101
207-879-9190
Fax 207-879-0099
<http://www.gza.com>

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JOB: 09.0025946.00 Capell Bridge
SUBJECT: Axial Pile Resistance
SHEET: 1 OF 4
CALCULATED BY B. Cardali, 11/30/17
REVIEWED BY A. Blaisdell, 11/30/17

Objective

Evaluate the axial geotechnical resistance of the abutment piles for the Capell Bridge Replacement in Wells, ME. Evaluations were conducted to assess a suitable driving system to install piles to the required geotechnical nominal resistance of 634 kips for a 5-pile group.

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, 7th edition, 2014 with interims. (AASHTO LRFD)

Soil Properties

Consider Capell Bridge Interpretive Subsurface Profile (see Figure 3), subsurface layering and properties relative to pile design are presented on the side friction hand calculation.

Structural Properties

HP14x89, ASTM A572, Gr. 50

Yield Strength of Steel

$$F_y := 50 \text{ksi}$$

Area of section

$$A_s := 26.1 \text{in}^2$$

Young's Modulus of Steel

$$E_s := 30000 \cdot \text{ksi}$$



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GeoEnvironmental, Inc
 477 Congress Street, Suite 700
 Portland, Maine 04101
 207-879-9190
 Fax 207-879-0099
 http://www.gza.com

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JOB: 09.0025946.00 Capell Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 2 OF 4
 CALCULATED BY B. Cardali, 11/30/17
 REVIEWED BY A. Blaisdell, 11/30/17

1. Nominal Structural Compressive Resistance P_n

Nominal Compressive Resistance: $P_n := 0.66 \cdot F_y \cdot A_s$ AASHTO Eq. 6.9.5.1-1

Determine normalized column slenderness factor λ

$$\lambda := \left(\frac{K \cdot l}{r_s \cdot \pi} \right)^2 \cdot \frac{F_y}{E} \quad \text{AASHTO Eq. 6.9.4.1-3} \quad \text{pg. 6-74}$$

$\lambda := 0$ Where the pile is fully embedded, AASHTO 10.7.3.13.1.
 NOTE: Assumption may not be applicable for integral abutment pile, to be assessed by bridge designer.

Giving: $P_n := 0.66 \cdot F_y \cdot A_s$ $P_n = 1305 \cdot \text{kip}$

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:

$$P_r := \phi_c \cdot P_n \quad \text{AASHTO Eq. 6.9.2.1-1} \quad \text{pg. 6-71}$$

$$P_r = 653 \cdot \text{kip}$$

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:

$$P_r := \phi \cdot P_n \quad \text{AASHTO Eq. 6.9.2.1-1} \quad \text{pg. 6-71}$$

$$P_r = 1305 \cdot \text{kip}$$

4. Geotechnical Axial Resistance - Static Analysis

Required nominal resistance of 634 kips for design of the 5-pile configuration based on a maximum factored pile load of 412 kips and a 0.65 resistance factor.

Based on geotechnical resistance calculations, the required nominal capacity is achieved with a 172-foot long non-plugged pile, corresponding estimated side friction of 586 kips.



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GeoEnvironmental, Inc
 477 Congress Street, Suite 700
 Portland, Maine 04101
 207-879-9190
 Fax 207-879-0099
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JOB: 09.0025946.00 Capell Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 3 OF 4
 CALCULATED BY B. Cardali, 11/30/17
 REVIEWED BY A. Blaisdell, 11/30/17

The estimated % skin friction resistance is about 90% for the 172-foot pile and at the required nominal pile resistance, based on the estimated friction resistance.

5. Geotechnical Axial Resistance - Drivability Analysis

$$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y \quad \text{AASHTO Eq. 10.7.8.1}$$

$$f_y := 50 \text{ ksi} \quad \text{yield Strength of steel}$$

$$\phi_{da} := 1.0 \quad \text{AASHTO Table 10.5.5.2.3-1 Refers to Article 6.5.4.2, Pg. 6-28}$$

$$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y \quad \sigma_{dr} = 45 \cdot \text{ksi} \quad \text{Driving Stress in pile cannot exceed 45 ksi}$$

172-foot Friction Pile: Drive pile through 172 feet of soil into the glacial till with toe quake representative of moderate driving conditions (0.3in)

Drive piles with a Delmag D44 open-ended diesel hammer with a rated energy of 90,155 ft-lb (fuel setting 2, 1 below maximum). **The proposed hammer is sized to achieve the required nominal pile resistance for each of the potential driving scenarios; not the maximum driveability resistance for the pile section and profile.**

GRLWEAP Output is attached on Sheets 7 through 10.

5-pile: $R_{ndr1} := 634 \text{ kip}$ Required nominal geotechnical resistance.
 L = 172 feet: Pile Driving Stress = 31 ksi
 Final Penetration Resistance = 6 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

5-Pile: $R_{ndr1_factored} := R_{ndr1} \cdot \phi_{dyn}$

$$R_{ndr1_factored} = 412 \cdot \text{kip}$$



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GeoEnvironmental, Inc
477 Congress Street, Suite 700
Portland, Maine 04101
207-879-9190
Fax 207-879-0099
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JOB: 09.0025946.00 Capell Bridge
SUBJECT: Axial Pile Resistance
SHEET: 4 OF 4
CALCULATED BY B. Cardali, 11/30/17
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7. Factored Drivability Resistance - Service/Extreme Limit States:

Service and Extreme Limit State Factored Drivability Resistance:

Resistance Factors for Extreme Limit States: $\phi_{\text{serv_ext}} := 1$

From Article 10.5.5.1 and 10.5.5.3

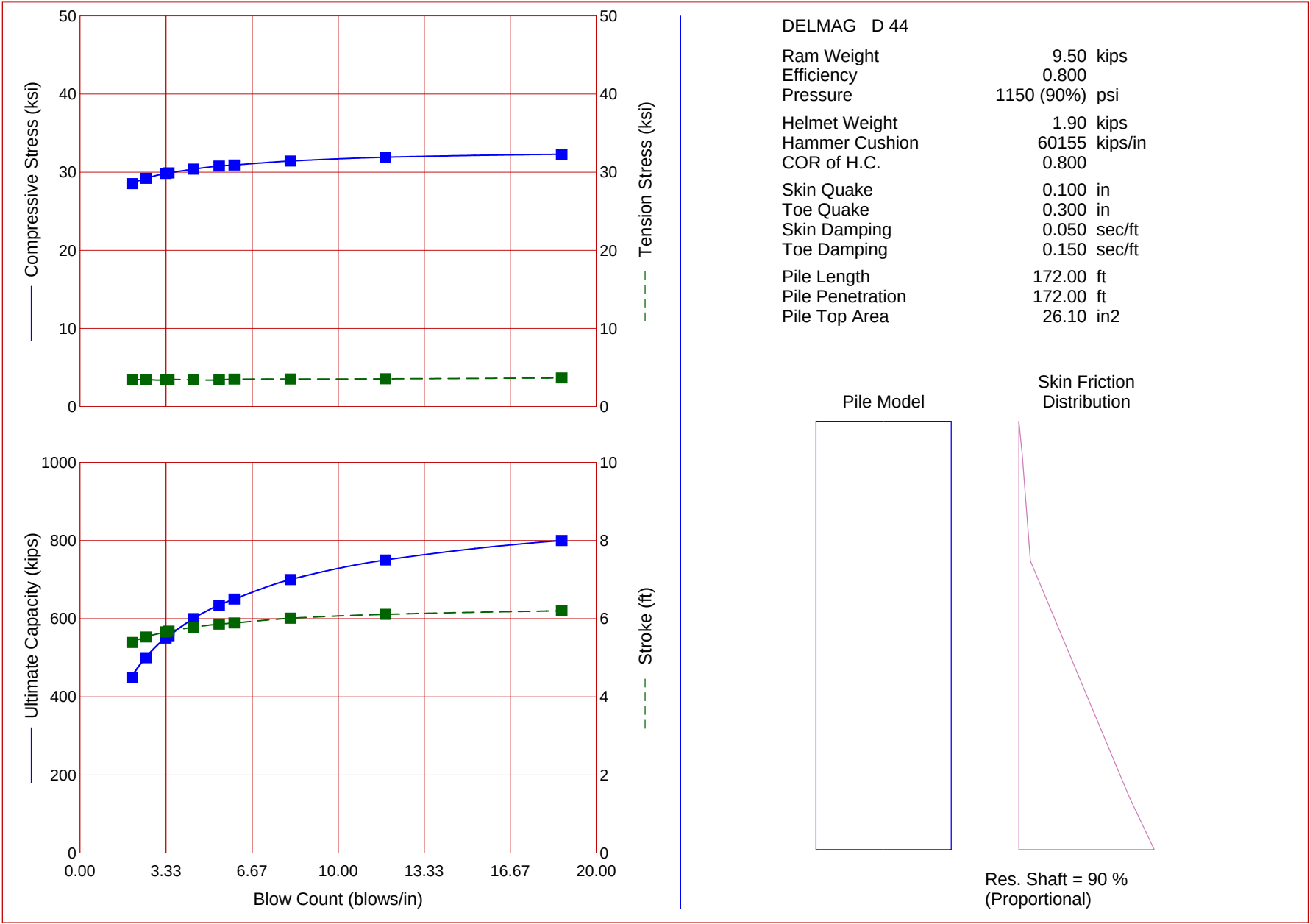
$$R_{\text{ndr1_serv_ext}} := R_{\text{ndr1}} \cdot \phi_{\text{serv_ext}}$$

$$R_{\text{ndr1_serv_ext}} = 634 \cdot \text{kip}$$

Summary of Results - Axial Loading:

ASTM A572, HP 14x89	Structural Resistance (kips)	Geotechnical Static Resistance (kips)	Required Geotechnical Resistance (kips)	Governing Resistance (kips)
5-Pile: Strength Limit State, Design	653	n/a	412	412
5-Pile: Service/Extreme Limit State, Design	1305	n/a	634	634

Results indicate the selected hammer is suitable to meet the required nominal pile resistance.



Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
450.0	28.52	3.44	2.0	5.39	37.38
500.0	29.20	3.46	2.6	5.53	37.94
550.0	29.83	3.43	3.3	5.66	38.49
556.0	29.91	3.50	3.4	5.68	38.50
600.0	30.38	3.44	4.4	5.78	38.95
634.0	30.77	3.41	5.4	5.86	39.34
650.0	30.91	3.52	6.0	5.89	39.35
700.0	31.42	3.53	8.1	6.01	39.80
750.0	31.91	3.55	11.8	6.11	40.35
800.0	32.29	3.67	18.7	6.20	40.56

Lateral Pile Evaluation

Lpile Input Parameters**Capell Bridge #2126 Over Merriland River, Wells, ME**

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Stratum	Soil Model	Top of Layer Elevation (ft)	Layer Thickness (ft)	ϕ' (deg)/ Su (psf)	k (pci) / E50	γ_e (pcf)
Clay Crust	Stiff Clay	8.0	13	900 psf	$E_{50} = 0.007$	54
Clay	Stiff Clay	-5.0	43	700 psf	$E_{50} = 0.008$	54
Sand	Reese Sand	-48.0	42	40	85	61
Glacial Till	Reese Sand	-90.0	98	40	160	66

Notes:

1. Layering is based on boring data at BB-WMR-201 and -103 and was assumed to be similar at both abutments. Therefore one profile was used for both abutments.

LPILE Result Summary**Capell Bridge #2126 Over Merriland River, Wells, ME**

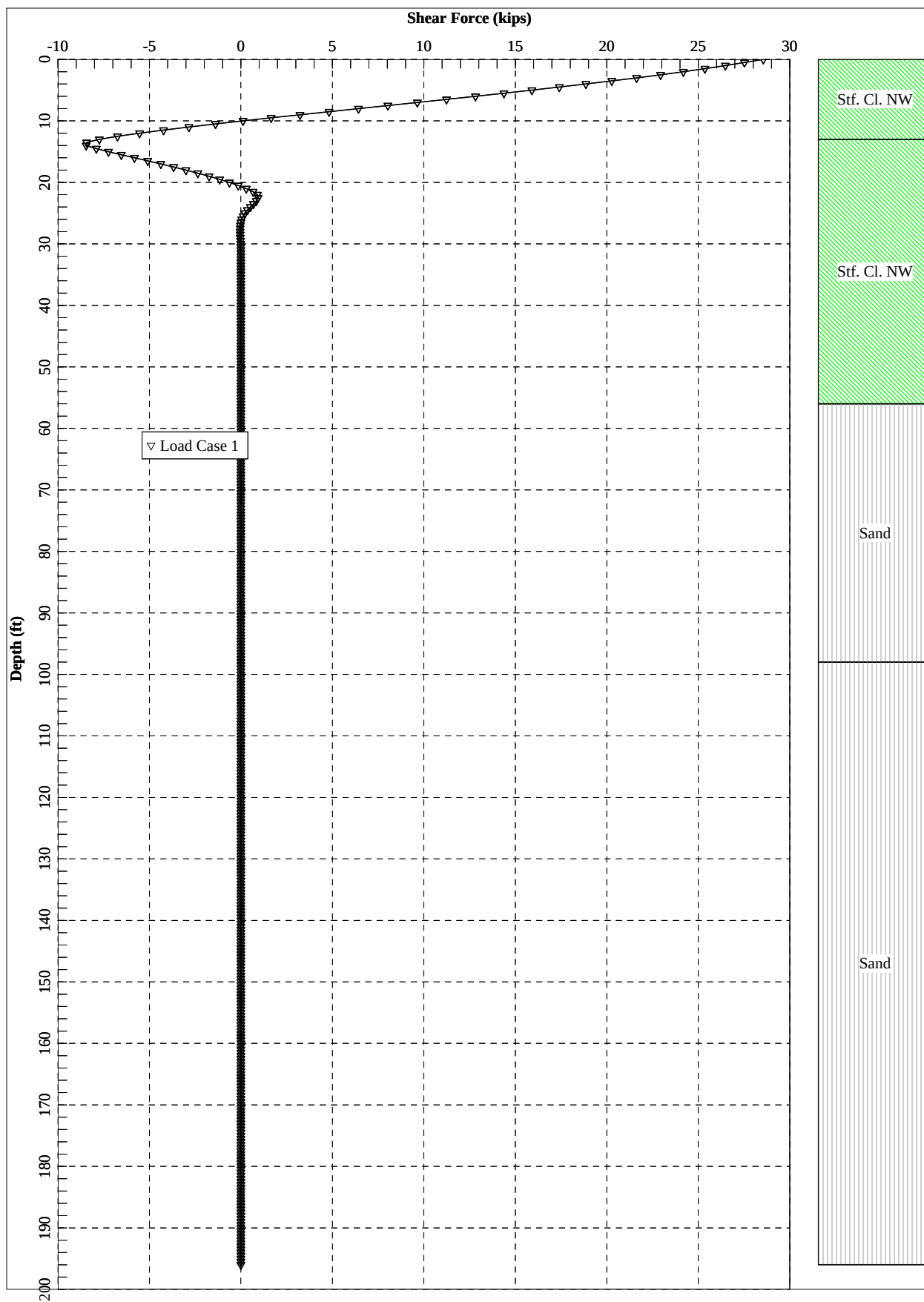
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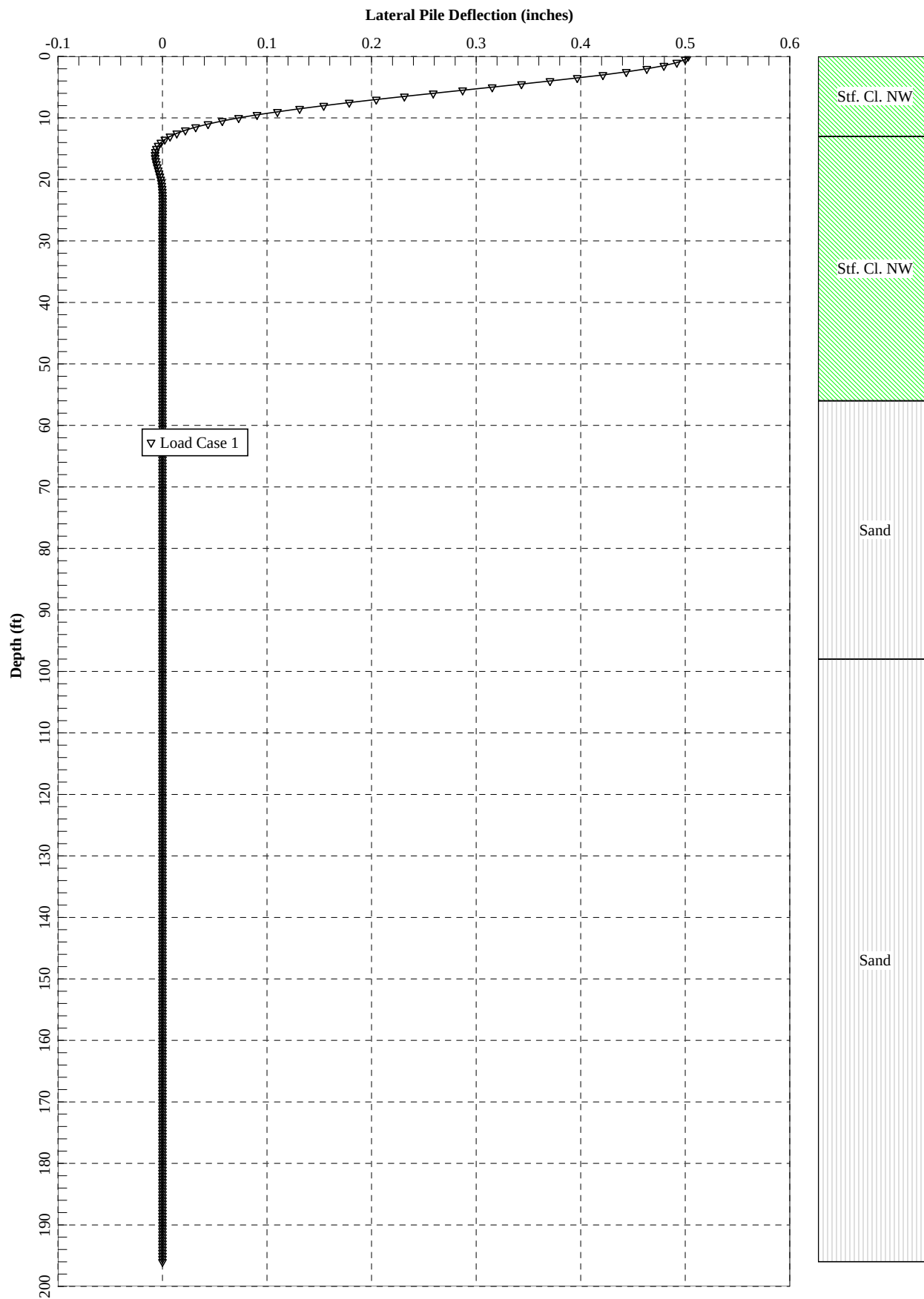
GZA FILE NO. 09.0025946.00**CALCULATED BY** B.Cardali**CHECKED BY** A. Blaisdell**DATE** 11/29/2017

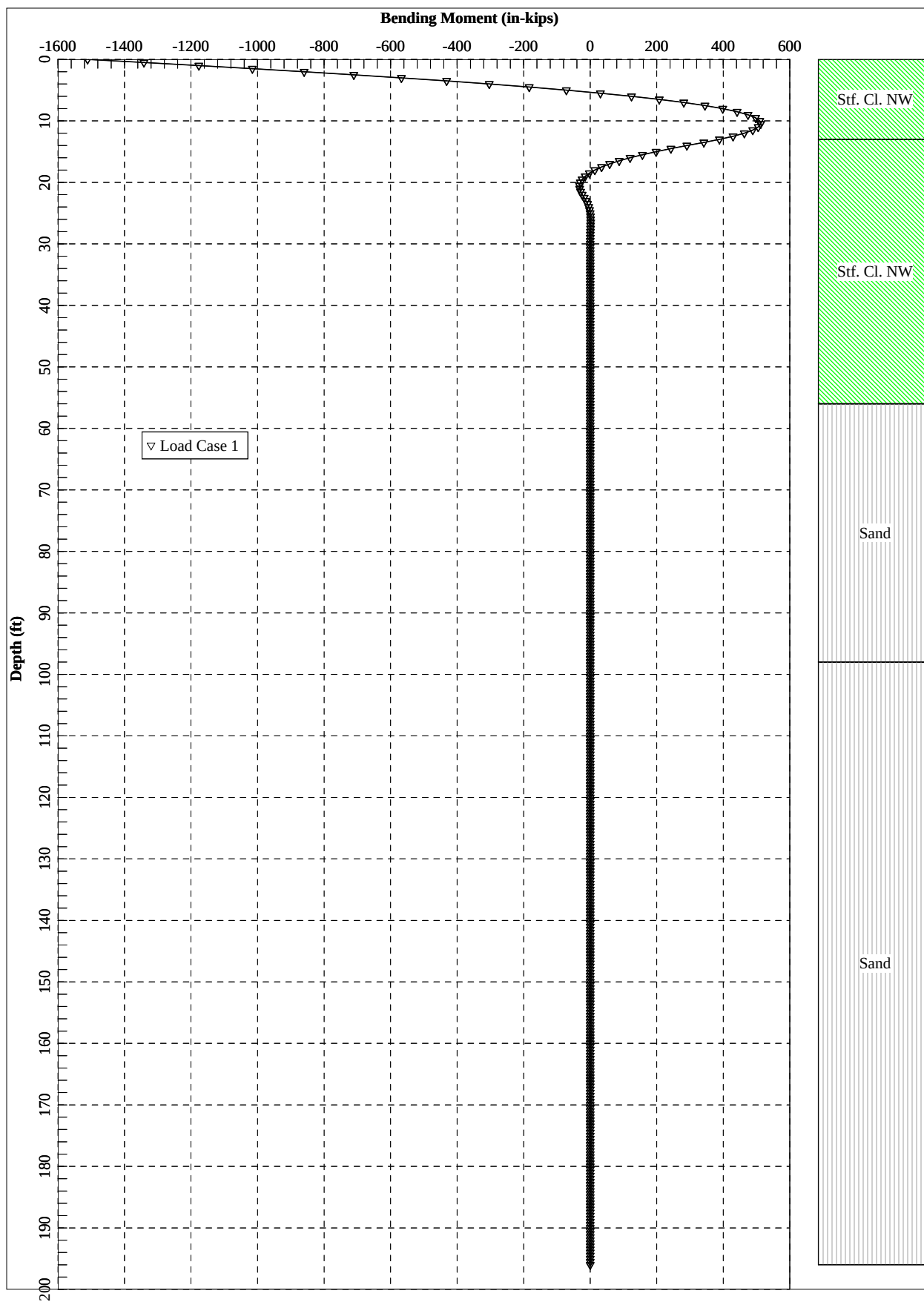
Lpile Summary Table						
Pile Type and Size	Maximum Factored Axial Load (kips)	Shear Force for Lateral deflection of 0.50 in. (kips)	Moment at Pile Head (in-kips)	Total Stress at Pile Head (ksi)	Bending Stress at Pile Head (ksi)	Axial Stress at Pile Head (ksi)
HP 14 x 89	412	28.6	-1511	48.0	32.2	15.8
HP 14 x 89	361	28.6	-1511	46.0	32.2	13.8

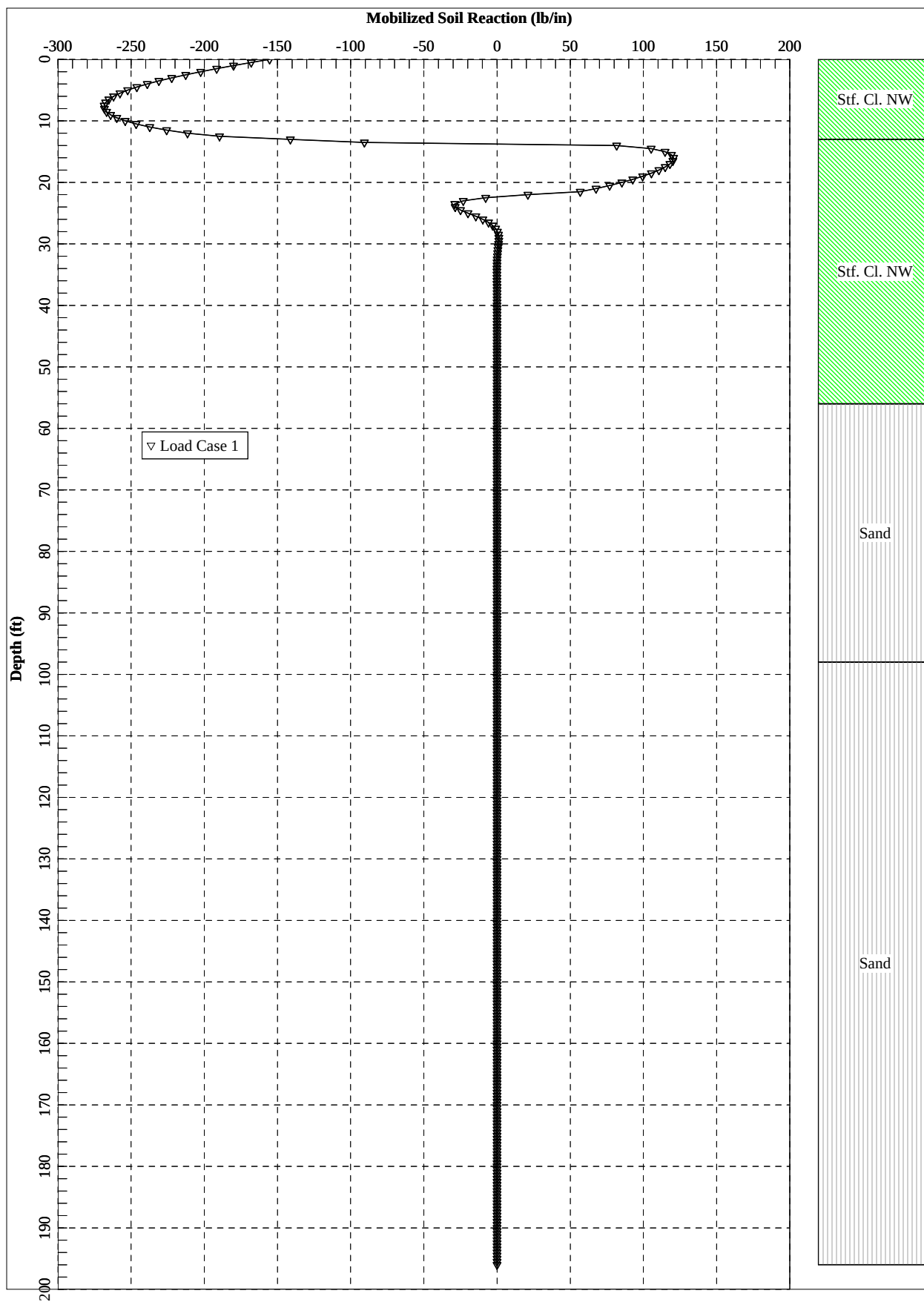
Notes:

1. The axial load is the maximum Factored Axial Loads provided by Kendra Nash (MaineDOT) via email on 10/31/17. 412 kip axial load is for 5-pile configuration, 361 kip axial load is for 6-pile configuration.
2. The maximum thermal deflection of 0.5 in., from MaineDOT, was applied at the pile head with no rotation.









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Analysis of Individual Piles and Drilled Shafts
 Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:
 \09 Jobs\0025900s\09.0025946.00 - MDOT Capell Bridge Wells\Work\Calcs\Pile\Lpile\

Name of input data file:
 Capell Bridge Lpile 14 x 89.lp9d

Name of output report file:
 Capell Bridge Lpile 14 x 89.lp9o

Name of plot output file:
 Capell Bridge Lpile 14 x 89.lp9p

Name of runtime message file:
 Capell Bridge Lpile 14 x 89.lp9r

Date and Time of Analysis

Date: November 14, 2017 Time: 16:04:10

Problem Title

Project Name: Capell Bridge

Job Number: 09.0025946.00

Page 1

Capell Bridge Lpile 14 x 89.lp9o

Client: MaineDOT

Engineer: B.Cardali

Description: Lpile analysis

Program Options and Settings

Computational Options:
 - Use unfactored loads in computations (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 = 392

Loading Type and Number of Cycles of Loading:
 - Static loading specified

- Use of p-y modification factors for p-y curves not selected
- 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
- 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 = 196.000 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
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1	0.000	13.8000
2	196.000	13.8000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
 Cross-sectional Shape = Weak H-Pile
 Length of section = 196.000000 ft
 Flange width = 14.700000 in
 Section Depth = 13.800000 in
 Flange Thickness = 0.615000 in
 Web Thickness = 0.615000 in
 Section Area = 25.811550 sq. in
 Moment of Inertia = 325.837265 in⁴
 Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians
 Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.0000 ft
 Distance from top of pile to bottom of layer = 13.000000 ft
 Effective unit weight at top of layer = 54.000000 pcf
 Effective unit weight at bottom of layer = 54.000000 pcf
 Undrained cohesion at top of layer = 900.000000 psf
 Undrained cohesion at bottom of layer = 900.000000 psf
 Epsilon-50 at top of layer = 0.007000
 Epsilon-50 at bottom of layer = 0.007000

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 13.000000 ft
 Distance from top of pile to bottom of layer = 56.000000 ft
 Effective unit weight at top of layer = 54.000000 pcf
 Effective unit weight at bottom of layer = 54.000000 pcf
 Undrained cohesion at top of layer = 700.000000 psf
 Undrained cohesion at bottom of layer = 700.000000 psf
 Epsilon-50 at top of layer = 0.008000

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Capell Bridge Lpile 14 x 89.lp90
 Epsilon-50 at bottom of layer = 0.008000

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 56.000000 ft
 Distance from top of pile to bottom of layer = 98.000000 ft
 Effective unit weight at top of layer = 61.000000 pcf
 Effective unit weight at bottom of layer = 61.000000 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 = 85.000000 pci
 Subgrade k at bottom of layer = 85.000000 pci

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 98.000000 ft
 Distance from top of pile to bottom of layer = 196.000000 ft
 Effective unit weight at top of layer = 66.000000 pcf
 Effective unit weight at bottom of layer = 66.000000 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 = 160.000000 pci
 Subgrade k at bottom of layer = 160.000000 pci

(Depth of the lowest soil layer extends 0.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	E50 or krm	kpy pci
1	Stiff Clay	0.00	54.0000	900.0000	--	0.00700	--
2	w/o Free Water	13.0000	54.0000	900.0000	--	0.00700	--
3	Stiff Clay	13.0000	54.0000	700.0000	--	0.00800	--
4	w/o Free Water	56.0000	54.0000	700.0000	--	0.00800	--
3	Sand	56.0000	61.0000	--	40.0000	--	85.0000
	(Reese, et al.)	98.0000	61.0000	--	40.0000	--	85.0000
4	Sand	98.0000	66.0000	--	40.0000	--	160.0000
	(Reese, et al.)	196.0000	66.0000	--	40.0000	--	160.0000

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 = 1

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Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	5	y = 0.500000 in	S = 0.0000 in/in	412000.	N.A.

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:

Moment-curvature properties were derived from elastic section properties

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	83397.
2	13.0000	13.0000	Yes	No	83397.	311683.
3	56.0000	56.0000	No	No	395081.	1.91E+07
4	98.0000	98.0000	Yes	No	1.95E+07	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 = 0.500000 inches

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Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 412000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5029	-1510911.	28552.	0.00	47957.	9.45E+09	-155.4128	927.1398	0.00
0.5000	0.5000	-1341569.	27522.	-9.06E-04	44371.	9.45E+09	-167.9875	2016.	0.00
1.0000	0.4920	-1176168.	26478.	-0.00170	40869.	9.45E+09	-180.0585	2196.	0.00
1.5000	0.4795	-1015404.	25363.	-0.00240	37464.	9.45E+09	-191.5712	2397.	0.00
2.0000	0.4632	-859942.	24181.	-0.00300	34172.	9.45E+09	-202.4735	2623.	0.00
2.5000	0.4436	-710419.	22935.	-0.00349	31006.	9.45E+09	-212.7154	2877.	0.00
3.0000	0.4213	-567440.	21630.	-0.00390	27978.	9.45E+09	-222.2485	3165.	0.00
3.5000	0.3968	-431570.	20271.	-0.00422	25101.	9.45E+09	-231.0254	3493.	0.00
4.0000	0.3707	-303340.	18861.	-0.00445	22385.	9.45E+09	-238.9996	3869.	0.00
4.5000	0.3434	-183238.	17405.	-0.00461	19842.	9.45E+09	-246.1249	4301.	0.00
5.0000	0.3154	-71708.	15910.	-0.00469	17480.	9.45E+09	-252.3552	4801.	0.00
5.5000	0.2871	30849.	14380.	-0.00470	16615.	9.45E+09	-257.6439	5384.	0.00
6.0000	0.2590	124082.	12821.	-0.00465	18589.	9.45E+09	-261.9435	6068.	0.00
6.5000	0.2313	207691.	11240.	-0.00454	20360.	9.45E+09	-265.2053	6879.	0.00
7.0000	0.2045	281426.	9642.	-0.00439	21921.	9.45E+09	-267.3779	7846.	0.00
7.5000	0.1787	345095.	8034.	-0.00419	23270.	9.45E+09	-268.4071	9014.	0.00
8.0000	0.1542	398558.	6425.	-0.00395	24402.	9.45E+09	-268.2341	10439.	0.00
8.5000	0.1312	441740.	4819.	-0.00369	25316.	9.45E+09	-266.7936	12200.	0.00
9.0000	0.1099	474624.	3227.	-0.00340	26013.	9.45E+09	-264.0107	14411.	0.00
9.5000	0.09045	497258.	1656.	-0.00309	26492.	9.45E+09	-259.7967	17235.	0.00
10.0000	0.07286	509759.	114.1875	-0.00277	26757.	9.45E+09	-254.0411	20919.	0.00
10.5000	0.05722	512315.	-1388.	-0.00244	26811.	9.45E+09	-246.5991	25857.	0.00
11.0000	0.04353	505189.	-2839.	-0.00212	26660.	9.45E+09	-237.2674	32700.	0.00
11.5000	0.03177	488728.	-4228.	-0.00181	26311.	9.45E+09	-225.7367	42630.	0.00
12.0000	0.02187	463373.	-5540.	-0.00150	25774.	9.45E+09	-211.4855	58021.	0.00
12.5000	0.01373	429678.	-6743.	-0.00122	25061.	9.45E+09	-189.6109	82836.	0.00
13.0000	0.00723	388483.	-7736.	-9.60E-04	24188.	9.45E+09	-141.1830	117086.	0.00
13.5000	0.00222	341595.	-8431.	-7.28E-04	23196.	9.45E+09	-90.5805	245280.	0.00
14.0000	-0.00150	290910.	-8458.	-5.27E-04	22122.	9.45E+09	81.7038	326403.	0.00
14.5000	-0.00411	242709.	-7897.	-3.58E-04	21102.	9.45E+09	105.3306	153721.	0.00
15.0000	-0.00580	197920.	-7236.	-2.18E-04	20153.	9.45E+09	114.8189	118862.	0.00
15.5000	-0.00673	156953.	-6534.	-1.05E-04	19286.	9.45E+09	119.1920	106318.	0.00
16.0000	-0.00706	120031.	-5815.	-1.73E-05	18504.	9.45E+09	120.6478	102545.	0.00
16.5000	-0.00693	87264.	-5092.	4.85E-05	17810.	9.45E+09	120.1158	103928.	0.00
17.0000	-0.00648	58684.	-4378.	9.48E-05	17205.	9.45E+09	118.0868	109382.	0.00
17.5000	-0.00580	34263.	-3679.	1.24E-04	16687.	9.45E+09	114.8537	118879.	0.00
18.0000	-0.00499	13923.	-3002.	1.40E-04	16257.	9.45E+09	110.6034	133106.	0.00
18.5000	-0.00412	-2457.	-2354.	1.43E-04	16014.	9.45E+09	105.4592	153529.	0.00
19.0000	-0.00327	-15037.	-1739.	1.38E-04	16280.	9.45E+09	99.4999	182763.	0.00
19.5000	-0.00247	-24011.	-1163.	1.25E-04	16470.	9.45E+09	92.7679	225444.	0.00
20.0000	-0.00176	-29608.	-628.5152	1.00E-04	16589.	9.45E+09	85.2667	290216.	0.00
20.5000	-0.00117	-32089.	-141.8887	8.87E-05	16641.	9.45E+09	76.9422	394738.	0.00
21.0000	-6.98E-04	-31749.	291.8070	6.84E-05	16634.	9.45E+09	67.6231	580905.	0.00
21.5000	-3.48E-04	-28925.	665.0815	4.92E-05	16574.	9.45E+09	56.8017	978331.	0.00
22.0000	-1.08E-04	-24011.	898.7726	3.24E-05	16470.	9.45E+09	21.0953	1166996.	0.00
22.5000	4.00E-05	-18300.	938.7406	1.89E-05	16349.	9.45E+09	-7.7726	1166996.	0.00
23.0000	1.19E-04	-12840.	846.1828	9.04E-06	16234.	9.45E+09	-23.0800	1166996.	0.00
23.5000	1.48E-04	-8191.	690.3239	2.36E-06	16135.	9.45E+09	-28.8730	1166996.	0.00
24.0000	1.47E-04	-4568.	517.9149	-1.69E-06	16059.	9.45E+09	-28.5967	1166996.	0.00
24.5000	1.28E-04	-1967.	357.3177	-3.76E-06	16004.	9.45E+09	-24.9357	1166996.	0.00
25.0000	1.02E-04	-261.3073	223.0595	-4.47E-06	15967.	9.45E+09	-19.8170	1166996.	0.00
25.5000	7.46E-05	731.5964	120.0944	-4.32E-06	15977.	9.45E+09	-14.5047	1166996.	0.00
26.0000	5.00E-05	1201.	47.3769	-3.71E-06	15987.	9.45E+09	-9.7345	1166996.	0.00
26.5000	3.01E-05	1318.	0.6105	-2.91E-06	15990.	9.45E+09	-5.8543	1166996.	0.00
27.0000	1.52E-05	1223.	-25.8061	-2.10E-06	15988.	9.45E+09	-2.9512	1166996.	0.00

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Capell Bridge Lpile 14 x 89.lp90									
27.5000	4.91E-06	1019.	-37.5223	-1.39E-06	15983.	9.45E+09	-0.9542	1166996.	0.00
28.0000	-1.48E-06	779.4702	-39.5222	-8.17E-07	15978.	9.45E+09	0.2876	1166996.	0.00
28.5000	-4.89E-06	548.9209	-35.8040	-3.95E-07	15973.	9.45E+09	0.9518	1166996.	0.00
29.0000	-6.22E-06	351.7747	-29.3208	-1.09E-07	15969.	9.45E+09	1.2092	1166996.	0.00
29.5000	-6.20E-06	197.6094	-22.0750	6.55E-08	15966.	9.45E+09	1.2060	1166996.	0.00
30.0000	-5.43E-06	86.5510	-15.2877	1.56E-07	15964.	9.45E+09	1.0564	1166996.	0.00
30.5000	-4.33E-06	13.3866	-9.5908	1.87E-07	15962.	9.45E+09	0.8426	1166996.	0.00
31.0000	-3.18E-06	-29.4651	-5.2063	1.82E-07	15962.	9.45E+09	0.6189	1166996.	0.00
31.5000	-2.14E-06	-49.9900	-2.0984	1.57E-07	15963.	9.45E+09	0.4170	1166996.	0.00
32.0000	-1.30E-06	-55.4232	-0.09070	1.24E-07	15963.	9.45E+09	0.2522	1166996.	0.00
32.5000	-6.60E-07	-51.6898	1.0513	8.96E-08	15963.	9.45E+09	0.1285	1166996.	0.00
33.0000	-2.21E-07	-43.2508	1.5657	5.95E-08	15963.	9.45E+09	0.04300	1166996.	0.00
33.5000	5.35E-08	-33.1957	1.6635	3.52E-08	15963.	9.45E+09	-0.01040	1166996.	0.00
34.0000	2.02E-07	-23.4630	1.5147	1.72E-08	15962.	9.45E+09	-0.03921	1166996.	0.00
34.5000	2.60E-07	-15.1048	1.2452	4.90E-09	15962.	9.45E+09	-9.05662	1166996.	0.00
35.0000	2.61E-07	-8.5454	0.9408	-2.52E-09	15962.	9.45E+09	-0.05085	1166996.	0.00
35.5000	2.30E-07	-3.8033	0.6540	-6.44E-09	15962.	9.45E+09	-0.04475	1166996.	0.00
36.0000	1.84E-07	-0.6660	0.4123	-7.86E-09	15962.	9.45E+09	-0.03582	1166996.	0.00
36.5000	1.36E-07	1.1827	0.2256	-7.69E-09	15962.	9.45E+09	-0.02640	1166996.	0.00
37.0000	9.18E-08	2.0791	0.09279	-6.66E-09	15962.	9.45E+09	-0.01786	1166996.	0.00
37.5000	5.58E-08	2.3291	0.00661	-5.26E-09	15962.	9.45E+09	-0.01086	1166996.	0.00
38.0000	2.87E-08	2.1844	-0.04274	-3.83E-09	15962.	9.45E+09	-0.00559	1166996.	0.00
38.5000	9.93E-09	1.8352	-0.06530	-2.55E-09	15962.	9.45E+09	-0.00193	1166996.	0.00
39.0000	-1.87E-09	1.4135	-0.07000	-1.52E-09	15962.	9.45E+09	3.64E-04	1166996.	0.00
39.5000	-8.29E-09	1.0027	-0.06407	-7.52E-10	15962.	9.45E+09	0.00161	1166996.	0.00
40.0000	-1.09E-08	0.6484	-0.05287	-2.27E-10	15962.	9.45E+09	0.00212	1166996.	0.00
40.5000	-1.10E-08	0.3694	-0.04009	9.58E-11	15962.	9.45E+09	0.00214	1166996.	0.00
41.0000	-9.74E-09	0.1669	-0.02797	2.66E-10	15962.	9.45E+09	0.00189	1166996.	0.00
41.5000	-7.83E-09	0.03244	-0.01772	3.29E-10	15962.	9.45E+09	0.00152	1166996.	0.00
42.0000	-5.79E-09	-0.04730	-0.00977	3.25E-10	15962.	9.45E+09	0.00113	1166996.	0.00
42.5000	-3.93E-09	-0.08641	-0.00410	2.82E-10	15962.	9.45E+09	7.65E-04	1166996.	0.00
43.0000	-2.40E-09	-0.09785	-3.09E-04	2.24E-10	15962.	9.45E+09	4.68E-04	1166996.	0.00
43.5000	-1.25E-09	-0.09230	0.00173	1.63E-10	15962.	9.45E+09	2.43E-04	1166996.	0.00
44.0000	-4.45E-10	-0.07786	0.00272	1.09E-10	15962.	9.45E+09	8.65E-05	1166996.	0.00
44.5000	6.26E-11	-0.06018	0.00294	6.55E-11	15962.	9.45E+09	-1.22E-05	1166996.	0.00
45.0000	3.41E-10	-0.04285	0.00271	3.28E-11	15962.	9.45E+09	-6.63E-05	1166996.	0.00
45.5000	4.56E-10	-0.02783	0.00224	1.03E-11	15962.	9.45E+09	-8.86E-05	1166996.	0.00
46.0000	4.64E-10	-0.01596	0.00171	-3.59E-12	15962.	9.45E+09	-9.03E-05	1166996.	0.00
46.5000	4.13E-10	-0.00732	0.00120	-1.10E-11	15962.	9.45E+09	-8.02E-05	1166996.	0.00
47.0000	3.33E-10	-0.00155	7.61E-04	-1.38E-11	15962.	9.45E+09	-6.47E-05	1166996.	0.00
47.5000	2.47E-10	0.00188	4.23E-04	-1.37E-11	15962.	9.45E+09	-4.80E-05	1166996.	0.00
48.0000	1.68E-10	0.00359	1.81E-04	-1.20E-11	15962.	9.45E+09	-3.28E-05	1166996.	0.00
48.5000	1.03E-10	0.00411	2.19E-05	-9.51E-12	15962.	9.45E+09	-2.01E-05	1166996.	0.00
49.0000	5.43E-11	0.00390	-7.01E-05	-6.97E-12	15962.	9.45E+09	-1.06E-05	1166996.	0.00
49.5000	1.99E-11	0.00330	-1.13E-04	-4.68E-12	15962.	9.45E+09	-3.86E-06	1166996.	0.00
50.0000	-1.95E-12	0.00256	-1.24E-04	-2.82E-12	15962.	9.45E+09	3.80E-07	1166996.	0.00
50.5000	-1.40E-11	0.00183	-1.14E-04	-1.43E-12	15962.	9.45E+09	2.72E-06	1166996.	0.00
51.0000	-1.91E-11	0.00119	-9.52E-05	0.00	15962.	9.45E+09	3.71E-06	1166996.	0.00
51.5000	-1.96E-11	6.91E-04	-7.26E-05	0.00	15962.	9.45E+09	3.81E-06	1166996.	0.00
52.0000	-1.75E-11	3.21E-04	-5.10E-05	0.00	15962.	9.45E+09	3.40E-06	1166996.	0.00
52.5000	-1.42E-11	7.69E-05	-3.25E-05	0.00	15962.	9.45E+09	2.75E-06	1166996.	0.00
53.0000	-1.05E-11	-7.00E-05	-1.81E-05	0.00	15962.	9.45E+09	2.05E-06	1166996.	0.00
53.5000	-7.16E-12	-1.43E-04	-7.77E-06	0.00	15962.	9.45E+09	1.39E-06	1166996.	0.00
54.0000	-4.34E-12	-1.66E-04	-1.06E-06	0.00	15962.	9.45E+09	8.45E-07	1166996.	0.00
54.5000	-2.16E-12	-1.58E-04	2.73E-06	0.00	15962.	9.45E+09	4.19E-07	1166996.	0.00
55.0000	0.00	-1.35E-04	4.32E-06	0.00	15962.	9.45E+09	1.11E-07	1166996.	0.00
55.5000	0.00	-1.07E-04	4.36E-06	0.00	15962.	9.45E+09	-9.83E-08	1166996.	0.00
56.0000	1.17E-12	-8.29E-05	3.86E-06	0.00	15962.	9.45E+09	-6.69E-08	342720.	0.00
56.5000	1.52E-12	-6.11E-05	3.40E-06	0.00	15962.	9.45E+09	-8.77E-08	345780.	0.00
57.0000	1.64E-12	-4.23E-05	2.85E-06	0.00	15962.	9.45E+09	-9.54E-08	348840.	0.00
57.5000	1.60E-12	-2.69E-05	2.28E-06	0.00	15962.	9.45E+09	-9.37E-08	351900.	0.00
58.0000	1.45E-12	-1.48E-05	1.75E-06	0.00	15962.	9.45E+09	-8.59E-08	354960.	0.00

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Capell Bridge Lpile 14 x 89.lp90									
58.5000	1.25E-12	-5.79E-06	1.26E-06	0.00	15962.	9.45E+09	-7.45E-08	358020.	0.00
59.0000	1.03E-12	5.51E-07	8.56E-07	0.00	15962.	9.45E+09	-6.17E-08	361080.	0.00
59.5000	0.00	4.67E-06	5.24E-07	0.00	15962.	9.45E+09	-4.88E-08	364140.	0.00
60.0000	0.00	7.02E-06	2.68E-07	0.00	15962.	9.45E+09	-3.67E-08	367200.	0.00
60.5000	0.00	8.04E-06	8.01E-08	0.00	15962.	9.45E+09	-2.60E-08	370260.	0.00
61.0000	0.00	8.12E-06	-4.93E-08	0.00	15962.	9.45E+09	-1.71E-08	373320.	0.00
61.5000	0.00	7.56E-06	-1.31E-07	0.00	15962.	9.45E+09	-9.98E-09	376380.	0.00
62.0000	0.00	6.63E-06	-1.74E-07	0.00	15962.	9.45E+09	-4.55E-09	379440.	0.00
62.5000	0.00	5.53E-06	-1.90E-07	0.00	15962.	9.45E+09	-6.49E-10	382500.	0.00
63.0000	0.00	4.40E-06	-1.86E-07	0.00	15962.	9.45E+09	1.96E-09	385560.	0.00
63.5000	0.00	3.33E-06	-1.69E-07	0.00	15962.	9.45E+09	3.53E-09	388620.	0.00
64.0000	0.00	2.38E-06	-1.46E-07	0.00	15962.	9.45E+09	4.30E-09	391680.	0.00
64.5000	0.00	1.59E-06	-1.39E-07	0.00	15962.	9.45E+09	4.47E-09	394740.	0.00
65.0000	0.00	9.48E-07	-9.33E-08	0.00	15962.	9.45E+09	4.26E-09	397800.	0.00
65.5000	0.00	4.61E-07	-6.92E-08	0.00	15962.	9.45E+09	3.79E-09	400860.	0.00
66.0000	0.00	1.11E-07	-4.82E-08	0.00	15962.	9.45E+09	3.20E-09	403920.	0.00
66.5000	0.00	-1.25E-07	-3.09E-08	0.00	15962.	9.45E+09	2.57E-09	406980.	0.00
67.0000	0.00	-2.67E-07	-1.73E-08	0.00	15962.	9.45E+09	1.97E-09	410040.	0.00
67.5000	0.00	-3.39E-07	-7.10E-09	0.00	15962.	9.45E+09	1.42E-09	413100.	0.00
68.0000	0.00	-3.59E-07	3.86E-11	0.00	15962.	9.45E+09	9.57E-10	416160.	0.00
68.5000	0.00	-3.43E-07	4.66E-09	0.00	15962.	9.45E+09	5.82E-10	419220.	0.00
69.0000	0.00	-3.07E-07	7.28E-09	0.00	15962.	9.45E+09	2.93E-10	422280.	0.00
69.5000	0.00	-2.59E-07	8.41E-09	0.00	15962.	9.45E+09	8.32E-11	425340.	0.00
70.0000	0.00	-2.08E-07	8.48E-09	0.00	15962.	9.45E+09	-5.95E-11	428400.	0.00
70.5000	0.00	-1.59E-07	7.86E-09	0.00	15962.	9.45E+09	-1.47E-10	431460.	0.00
71.0000	0.00	-1.14E-07	6.84E-09	0.00	15962.	9.45E+09	-1.93E-10	434520.	0.00
71.5000	0.00	-7.68E-08	5.64E-09	0.00	15962.	9.45E+09	-2.07E-10	437580.	0.00
72.0000	0.00	-4.66E-08	4.43E-09	0.00	15962.	9.45E+09	-2.00E-10	440640.	0.00
72.5000	0.00	-2.35E-08	3.29E-09	0.00	15962.	9.45E+09	-1.79E-10	443700.	0.00
73.0000	0.00	-6.84E-09	2.30E-09	0.00	15962.	9.45E+09	-1.52E-10	446760.	0.00
73.5000	0.00	4.38E-09	1.48E-09	0.00	15962.	9.45E+09	-1.22E-10	449820.	0.00
74.0000	0.00	1.12E-08	8.30E-10	0.00	15962.	9.45E+09	-9.31E-11	452880.	0.00
74.5000	0.00	1.47E-08	3.50E-10	0.00	15962.	9.45E+09	-6.71E-11	455940.	0.00
75.0000	0.00	1.57E-08	1.34E-11	0.00	15962.	9.45E+09	-4.50E-11	459000.	0.00
75.5000	0.00	1.50E-08	-2.03E-10	0.00	15962.	9.45E+09	-2.71E-11	462060.	0.00
76.0000	0.00	1.34E-08	-3.25E-10	0.00	15962.	9.45E+09	-1.35E-11	465120.	0.00
76.5000	0.00	1.13E-08	-3.76E-10	0.00	15962.	9.45E+09	-3.64E-12	468180.	0.00
77.0000	0.00	8.97E-09	-3.78E-10	0.00	15962.	9.45E+09	2.96E-12	471240.	0.00
77.5000	0.00	6.78E-09	-3.48E-10	0.00	15962.	9.45E+09	6.94E-12	474300.	0.00
78.0000	0.00	4.82E-09	-3.01E-10	0.00	15962.	9.45E+09	8.92E-12	477360.	0.00
78.5000	0.00	3.18E-09	-2.46E-10	0.00	15962.	9.45E+09	9.45E-12	480420.	0.00
79.0000	0.00	1.88E-09	-1.90E-10	0.00	15962.	9.45E+09	9.02E-12	483480.	0.00
79.5000	0.00	8.91E-10	-1.39E-10	0.00	15962.	9.45E+09	7.99E-12	486540.	0.00
80.0000	0.00	1.93E-10	-9.52E-11	0.00	15962.	9.45E+09	6.68E-12	489600.	0.00
80.5000	0.00	-2.65E-10	-5.93E-11	0.00	15962.	9.45E+09	5.29E-12	492660.	0.00
81.0000	0.00	-5.33E-10	-3.16E-11	0.00	15962.	9.45E+09	3.96E-12	495720.	0.00
81.5000	0.00	-6.57E-10	-1.13E-11	0.00	15962.	9.45E+09	2.79E-12	498780.	0.00
82.0000	0.00	-6.80E-10	2.43E-12	0.00	15962.	9.45E+09	1.81E-12	501840.	0.00
82.5000	0.00	-6.37E-10	1.09E-11	0.00	15962.	9.45E+09	1.03E-12	504900.	0.00
83.0000	0.00	-5.55E-10	1.54E-11	0.00	15962.	9.45E+09	0.00	507960.	0.00
83.5000	0.00	-4.56E-10	1.69E-11	0.00	15962.	9.45E+09	0.00	511020.	0.00
84.0000	0.00	-3.55E-10	1.64E-11	0.00	15962.	9.45E+09	0.00	514080.	0.00
84.5000	0.00	-2.61E-10	1.47E-11	0.00	15962.	9.45E+09	0.00	517140.	0.00
85.0000	0.00	-1.80E-10	1.24E-11	0.00	15962.	9.45E+09	0.00	520200.	0.00
85.5000	0.00	-1.13E-10	9.86E-12	0.00	15962.	9.45E+09	0.00	523260.	0.00
86.0000	0.00	-6.11E-11	7.44E-12	0.00	15962.	9.45E+09	0.00	526320.	0.00
86.5000	0.00	-2.34E-11	5.24E-12	0.00	15962.	9.45E+09	0.00	529380.	0.00
87.0000	0.00	2.32E-12	3.41E-12	0.00	15962.	9.45E+09	0.00	532440.	0.00
87.5000	0.00	1.82E-11	1.97E-12	0.00	15962.	9.45E+09	0.00	535500.	0.00
88.0000	0.00	2.66E-11	0.00	0.00	15962.	9.45E+09	0.00	538560.	0.00
88.5000	0.00	2.95E-11	0.00	0.00	15962.	9.45E+09	0.00	541620.	0.00
89.0000	0.00	2.87E-11	0.00	0.00	15962.	9.45E+09	0.00	544680.	0.00

Capell Bridge Lpile 14 x 89.lp90									
89.5000	0.00	2.57E-11	0.00	0.00	15962.	9.45E+09	0.00	547740.	0.00
90.0000	0.00	2.16E-11	0.00	0.00	15962.	9.45E+09	0.00	550800.	0.00
90.5000	0.00	1.71E-11	0.00	0.00	15962.	9.45E+09	0.00	553860.	0.00
91.0000	0.00	1.28E-11	0.00	0.00	15962.	9.45E+09	0.00	556920.	0.00
91.5000	0.00	8.93E-12	0.00	0.00	15962.	9.45E+09	0.00	559980.	0.00
92.0000	0.00	5.76E-12	0.00	0.00	15962.	9.45E+09	0.00	563040.	0.00
92.5000	0.00	3.26E-12	0.00	0.00	15962.	9.45E+09	0.00	566100.	0.00
93.0000	0.00	1.42E-12	0.00	0.00	15962.	9.45E+09	0.00	569160.	0.00
93.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	572220.	0.00
94.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	575280.	0.00
94.5000	0.00	-1.10E-12	0.00	0.00	15962.	9.45E+09	0.00	578340.	0.00
95.0000	0.00	-1.28E-12	0.00	0.00	15962.	9.45E+09	0.00	581400.	0.00
95.5000	0.00	-1.27E-12	0.00	0.00	15962.	9.45E+09	0.00	584460.	0.00
96.0000	0.00	-1.16E-12	0.00	0.00	15962.	9.45E+09	0.00	587520.	0.00
96.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	590580.	0.00
97.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	593640.	0.00
97.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	596700.	0.00
98.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1128960.	0.00
98.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1134720.	0.00
99.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1140480.	0.00
99.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1146240.	0.00
100.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1152000.	0.00
100.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1157760.	0.00
101.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1163520.	0.00
101.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1169280.	0.00
102.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1175040.	0.00
102.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1180800.	0.00
103.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1186560.	0.00
103.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1192320.	0.00
104.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1198080.	0.00
104.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1203840.	0.00
105.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1209600.	0.00
105.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1215360.	0.00
106.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1221120.	0.00
106.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1226880.	0.00
107.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1232640.	0.00
107.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1238400.	0.00
108.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1244160.	0.00
108.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1249920.	0.00
109.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1255680.	0.00
109.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1261440.	0.00
110.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1267200.	0.00
110.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1272960.	0.00
111.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1278720.	0.00
111.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1284480.	0.00
112.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1290240.	0.00
112.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1296000.	0.00
113.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1301760.	0.00
113.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1307520.	0.00
114.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1313280.	0.00
114.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1319040.	0.00
115.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1324800.	0.00
115.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1330560.	0.00
116.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1336320.	0.00
116.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1342080.	0.00
117.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1347840.	0.00
117.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1353600.	0.00
118.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1359360.	0.00
118.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1365120.	0.00
119.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1370880.	0.00
119.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1376640.	0.00
120.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1382400.	0.00

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Capell Bridge Lpile 14 x 89.lp90									
120.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1388160.	0.00
121.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1393920.	0.00
121.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1399680.	0.00
122.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1405440.	0.00
122.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1411200.	0.00
123.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1416960.	0.00
123.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1422720.	0.00
124.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1428480.	0.00
124.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1434240.	0.00
125.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1440000.	0.00
125.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1445760.	0.00
126.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1451520.	0.00
126.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1457280.	0.00
127.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1463040.	0.00
127.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1468800.	0.00
128.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1474560.	0.00
128.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1480320.	0.00
129.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1486080.	0.00
129.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1491840.	0.00
130.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1497600.	0.00
130.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1503360.	0.00
131.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1509120.	0.00
131.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1514880.	0.00
132.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1520640.	0.00
132.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1526400.	0.00
133.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1532160.	0.00
133.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1537920.	0.00
134.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1543680.	0.00
134.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1549440.	0.00
135.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1555200.	0.00
135.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1560960.	0.00
136.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1566720.	0.00
136.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1572480.	0.00
137.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1578240.	0.00
137.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1584000.	0.00
138.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1589760.	0.00
138.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1595520.	0.00
139.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1601280.	0.00
139.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1607040.	0.00
140.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1612800.	0.00
140.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1618560.	0.00
141.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1624320.	0.00
141.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1630080.	0.00
142.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1635840.	0.00
142.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1641600.	0.00
143.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1647360.	0.00
143.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1653120.	0.00
144.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1658880.	0.00
144.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1664640.	0.00
145.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1670400.	0.00
145.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1676160.	0.00
146.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1681920.	0.00
146.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1687680.	0.00
147.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1693440.	0.00
147.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1699200.	0.00
148.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1704960.	0.00
148.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1710720.	0.00
149.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1716480.	0.00
149.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1722240.	0.00
150.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1728000.	0.00
150.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1733760.	0.00
151.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00	1739520.	0.00

Capell Bridge Lpile 14 x 89.lp90							
151.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
152.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
152.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
153.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
153.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
154.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
154.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
155.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
155.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
156.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
156.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
157.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
157.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
158.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
158.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
159.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
159.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
160.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
160.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
161.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
161.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
162.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
162.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
163.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
163.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
164.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
164.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
165.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
165.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
166.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
166.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
167.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
167.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
168.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
168.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
169.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
169.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
170.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
170.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
171.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
171.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
172.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
172.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
173.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
173.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
174.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
174.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
175.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
175.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
176.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
176.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
177.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
177.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
178.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
178.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
179.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
179.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
180.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
180.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
181.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
181.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
182.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00

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Capell Bridge Lpile 14 x 89.lp90							
182.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
183.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
183.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
184.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
184.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
185.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
185.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
186.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
186.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
187.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
187.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
188.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
188.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
189.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
189.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
190.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
190.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
191.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
191.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
192.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
192.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
193.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
193.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
194.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
194.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
195.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
195.5000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00
196.0000	0.00	0.00	0.00	0.00	15962.	9.45E+09	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.50287814 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -1510911. inch-lbs
 Maximum shear force = 28552. 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 = 21
 Number of zero deflection points = 33

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	0.5000	S, rad	0.00	412000.	0.5029	0.00	28552.	-1510911.

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Maximum pile-head deflection = 0.5028781444 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

Lateral Earth Pressure Evaluation



GZA
GeoEnvironmental, Inc
 477 Congress Street
 Suite 700
 Portland, Maine 04101
 207-879-9190
 Fax 207-879-0099

Engineers and
 Scientists

JOB: 09.0025946.00 Wells Capell Bridge
 SUBJECT: Lateral Earth Pressures
 SHEET: 1 OF 4
 CALCULATED BY A. Blaisdell 11/29/17
 CHECKED BY C.Snow 11/30/17

Subject: Evaluate lateral earth pressure coefficients

References:

1. MaineDOT Bridge Design Guide, Chapter 3
2. AASHTO LRFD Bridge Design Specifications, 7th Edition (2014, with 2015 and 2016 Interims)

Input Parameters:

$\beta := 0\text{deg}$ Angle of backfill to the horizontal

$\theta := 90\text{deg}$ Angle of backface of wall to the horizontal

$\phi := 32\text{deg}$ Effective angle of internal friction (*Granular borrow, Soil Type 4, BDG Table 3-3*)

$\delta_f := 19.5\text{deg}$ Average value, precast concrete against clean sand/silty sand-gravel mixture (*AASHTO LRFD Table 3.11.5.3-1*)

Earth Pressure Coefficients:

Coloumb Passive Earth Pressure Coefficient

$$K_{pc} := \frac{(\sin(\theta - \phi))^2}{\left[(\sin(\theta))^2 \cdot \sin(\theta + \delta_f) \cdot \left[1 - \sqrt{\frac{(\sin(\phi + \delta_f) \cdot \sin(\phi + \beta))}{(\sin(\theta + \delta_f) \cdot \sin(\theta + \beta))}} \right]^2 \right]}$$

$K_{pc} = 6.73$