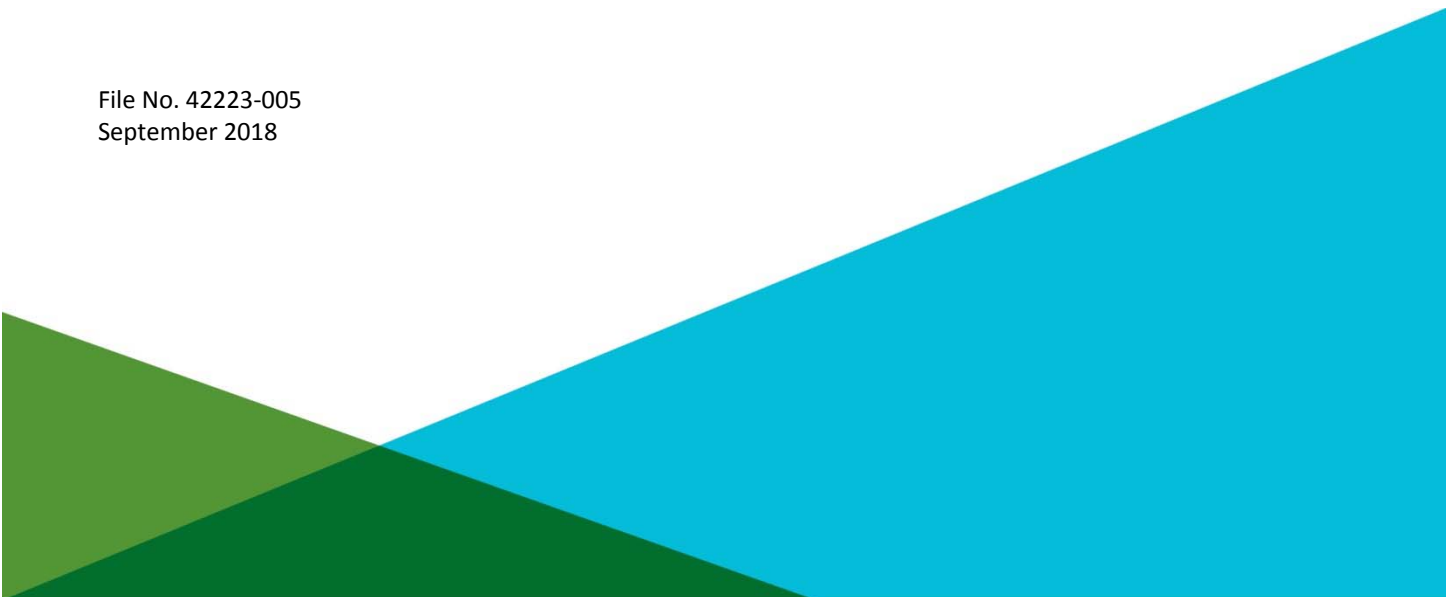


**GEOTECHNICAL DESIGN REPORT – 100% SUBMISSION
MAINE AVENUE BRIDGE
ROUTE 24 OVER COBBOSSEECONTEE STREAM
GARDINER, MAINE
MAINEDOT WIN 18736.00, BRIDGE NO. 3098**

by Haley & Aldrich, Inc.
Portland, Maine

for Stantec
Scarborough, Maine

File No. 42223-005
September 2018





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Attention: Tim Merritt, P.E.
Senior Project Manager

Subject: Geotechnical Design Report – 100% Submission
Maine Avenue Bridge
Route 24 over Cobbosseecontee Stream
Gardiner, Maine
MaineDOT WIN 18736.00, Bridge No. 3098

Ladies and Gentlemen:

This geotechnical design report (GDR) presents the results of subsurface investigation and geotechnical laboratory testing programs, and also provides geotechnical design recommendations and construction considerations for the proposed bridge replacement. This GDR has been prepared in support of Stantec's 100 percent submission to the Maine Department of Transportation (MaineDOT).

This work has been completed in accordance with our proposal dated 27 June 2017, and your subsequent authorization.

Project Understanding

The existing bridge carries Maine Avenue/Route 24 over the Cobbosseecontee Stream, as shown on Figure 1, Project Locus. Based on our review of the historic bridge plans dated 1925 and 1933 (Appendix E), we understand that the existing bridge consists of an approximately 50-ft long, approximately 40-ft wide, single-span structure. The existing bridge abutments consist of stacked granite blocks bearing between approximately El. -3 and El. 0. Timber cribbing may be present beneath the abutments (it is shown schematically below the north abutment on the historic bridge plans).

The proposed replacement bridge will be located approximately along the same alignment as the existing bridge. The replacement bridge is proposed to be a 78-ft single span structure with integral abutments located approximately 10 ft outside of the existing abutments (i.e., farther away from the stream).

Horizontal Coordinate System and Elevation Datum

Plan locations of test borings are reported as northing and easting coordinates relative to the Maine State Plane Coordinate System, North American Datum of 1983 (NAD 83), Maine 2000 West Zone (refer to Table I and boring logs in Appendix A). Elevations referenced herein are in feet and reference the North American Vertical Datum of 1988 (NAVD 88).

Geologic Setting

According to Maine Geological Survey's Gardiner Quadrangle, Maine (2009), surficial geologic units mapped within the site vicinity consist largely of stream alluvium from both the Kennebec River and the Cobbosseecontee Stream. The recent test borings drilled at the site encountered man-placed fill overlying these alluvial deposits. Underlying the alluvial deposits is a glaciomarine deposit consisting of sand, silt and clay typical of the Presumpscot Formation. Deposition of this formation occurred as a result of melting glacial ice in conjunction with sea level rise during deglaciation in Late Wisconsinan time. Below the marine deposit is a very dense glacial till deposit consisting of a heterogeneous mix of sand, silt, gravel, cobbles and boulders which directly overlies bedrock.

According to Maine Geological Survey's Bedrock Geology of the Gardiner Quadrangle, Maine (1982), bedrock at the site is mapped as Silurian-Ordovician age rocks of the Vassalboro Formation. Bedrock core samples collected for this site investigation consisted of metamorphic rocks composed of schist with occasional veins of quartzite. The above referenced map indicates a fault zone located south of the Maine Avenue bridge site. The presence of the fault zone has been evaluated and, in our opinion, will not impact the design of the new bridge foundations or superstructure.

Subsurface Explorations

HISTORIC EXPLORATIONS BY OTHERS

Limited subsurface information at the existing bridge is shown on the historic drawings included in Appendix E.

PRELIMINARY PHASE EXPLORATIONS

Haley & Aldrich conducted a preliminary geotechnical exploration program at the site. Two phases of drilling took place for the preliminary investigation. The first phase consisted of drilling two test borings (BB-GCS-104 and BB-GCS-105) to identify general subsurface conditions along the proposed bridge alignment. During the same phase, two additional test borings (BB-GCS-203 and BB-GCS-204) were performed for environmental purposes and those test boring logs are also included in this report. For more information on the environmental exploratory borings performed by Haley & Aldrich, refer to the environmental report entitled "Environmental Investigation Report, Route 24 over Cobbosseecontee Stream, Gardiner, Maine, MaineDOT WIN 18736.00, Bridge No. 3098," dated 8 June 2017 (Environmental Report).

The second phase of field work consisted of drilling explorations at four locations within the roadway behind both abutments in an effort to determine the plan limits of the existing foundations as well as the condition of the foundation bearing materials. At each of the following locations a boring and a series of auger probes were performed: south abutment NB lane, south abutment SB lane, north abutment NB lane, and north abutment SB lane. Additionally, and for the same general purpose, borings and probes were conducted at one location behind the existing concrete retaining wall east of the north abutment.

Boring locations were laid out in the field by Haley & Aldrich by taping from existing site features. “As-drilled” locations and ground surface elevation at boring locations were surveyed by Maine DOT and the locations of the borings are shown on Figure 2. Coordinate location data and ground surface elevations at exploration locations are provided on individual test boring logs provided in Appendix A and are summarized in Table I.

All test borings were drilled by New England Boring Contractors of Hermon, Maine using a truck-mounted Mobile B53 drill rig. Test borings were drilled to depths ranging from 1.5 ft to 85.0 ft below ground surface (BGS).

Geotechnical test borings were typically performed by advancing a 4.0-in. (HW-size) inside diameter (ID) steel casing to a certain depth and then telescoping a 3.0-in. (NW-size) ID steel casing within the HW casing. Borings were advanced using cased-wash methods by either driving or spinning the casing. Soil samples were generally collected continuously through the man-placed fill and then typically at 5-ft intervals once native soils were encountered. The first phase of test borings were extended to bedrock and sampled 10 ft of rock core. The second phase of test borings were typically terminated once naturally deposited soils were encountered. Auger probes were typically drilled using solid stem augers and were terminated on refusal surfaces.

Environmental explorations were typically performed using 2.0-in. ID hollow-stem augers (HSA). Soil samples were generally collected continuously through the man-placed fill. Environmental test borings were terminated below the groundwater table or in natural soil, whichever was shallower.

Soils samples were collected by driving a 1-3/8-in. ID split-spoon sampler with a 140-lb hammer dropped from a height of 30 in., as indicated on the test boring logs. Drilling and sampling were performed in accordance with MaineDOT specifications. The drill rig was equipped with either a standard rope and cathead and safety hammer or a winch driven automatic hammer calibrated annually per MaineDOT requirements (Appendix A of MaineDOT Geotechnical Drilling Contract Specifications, revised June 2007). A theoretical hammer efficiency factor of 0.6 was assumed for the rope and cathead/safety hammer system and a calculated hammer efficiency of 0.569 for the calibrated winch and automatic hammer system.

The number of hammer blows required to advance the sampler through each 6 in. interval was recorded and is provided on the test boring logs. The uncorrected SPT N-value is defined as the total number of blows required to advance the sampler through the middle 12 in. of the 24-in. sampling interval. The

energy-corrected SPT N-value (N₆₀) is equal to the uncorrected N-value multiplied by the hammer efficiency factor divided by 0.6 (i.e., 60 percent theoretical hammer efficiency). Both the raw blow count data and the corrected N-values are shown on the boring logs.

Soil samples obtained during both the geotechnical and environmental explorations were screened with a photoionization detector (PID) to assess the presence of volatile organic compounds (VOCs). There were several instances of elevated PID readings for this subsurface exploration program. Refer to individual boring logs provided in Appendix A for PID readings. PID readings are discussed further in the Environmental Report.

The two geotechnical borings performed during the first phase sampled 10 ft of bedrock each using a 2.0-in. (NQ-size) ID diamond-tipped core barrel.

All soil and bedrock samples were classified in accordance with the MaineDOT classification system and were preserved in glass sample jars and wooden core boxes. The samples that were not submitted for laboratory testing are available for review upon request. Soil and bedrock samples will be stored at the Haley & Aldrich laboratory facility in Portland, Maine until the construction phase of the project is completed.

FINAL PHASE EXPLORATIONS

Based on the extent and quality of the subsurface data collected during the preliminary design phase and because the proposed vertical and horizontal alignment did not change significantly after the preliminary design phase, Haley & Aldrich determined that additional, design phase field work was not needed to finalize geotechnical and foundation support requirements for the proposed bridge.

Generalized Subsurface Conditions

The subsurface conditions encountered at the site consist of the following geologic units presented in order of increasing depth below ground surface: man-placed fill, alluvial deposits, marine deposits, glacial till, weathered bedrock and bedrock. Refer to Table II for a summary of the soil units and encountered thicknesses at each test boring location. Refer to Figures 3 through 5 for a graphical representation of the subsurface conditions along the bridge alignment. A description of each soil unit is provided separately, below. Detailed soil descriptions are provided on the test boring logs in Appendix A.

Please note that the soil descriptions provided on the test boring logs and summarized below do not represent actual field conditions other than at the specific test boring locations. The actual conditions will vary from those described and shown herein.

SOIL

Unit	Approximate Range in Encountered Thickness (ft)	Generalized Description
Fill	13.9 to 34.0	Loose to very dense silty SAND, trace to little gravel (SM); SAND, trace to some silt and gravel (SP, SP-SM, SW-SM, SW); silty GRAVEL, trace sand (GM); sandy GRAVEL, little to trace silt (GP-GM); GRAVEL, trace to some silt and sand (GP, GW, GW-GM) Soft to hard SILT, little clay, trace to little sand and gravel (ML); sandy SILT, trace gravel (ML); silty CLAY (CL); silty CLAY, little sand, little gravel (CL) <u>The fill contained frequent cobbles, boulders, granite and wood;</u> occasionally contained glass, asphalt, felt, sawdust, plastic, brick, concrete and shell fragments <i>(encountered in all test borings)</i>
Alluvial Deposit	5.5 to 8.2	Loose to very dense, SAND, trace to little silt and gravel (SP); GRAVEL, little sand, trace silt (GP) <i>(encountered in borings BB-GCS-104 and BB-GCS-105)</i>
Marine Deposit	19.5 to 24.2	<i>Marine Sand:</i> Very loose to medium dense, silty SAND (SM); SAND, little silt and clay (SP, SP-SM) 9.4 to 15.0 ft thick <i>Marine Silt/Clay:</i> Very soft to stiff silty CLAY (CL); loose sandy SILT (ML) 4.5 to 14.8 ft thick (thickest in BB-104, on the south side of the bridge) Attempted to collect tubes but were unable to push tube, and attempted to perform in situ vane shear tests but were unable to turn vane The full thickness of deposit was not penetrated in the 200 and 300 series borings <i>(encountered in borings BB-GCS-104, BB-GCS-105, BB-GCS-204, BB-GCS-302, BB-GCS-303, BB-GCS-304, BB-GCS-305, BB-GCS-306B)</i>
Glacial Till	12.0 to 19.6	Dense to very dense gravelly SAND, trace silt (SP); SAND, some to trace silt and gravel (SW, SW-SM) The glacial till was moderately bonded and contained frequent cobbles and boulders <i>(encountered in borings BB-GCS-104 and BB-GCS-105)</i>
Weathered Bedrock	2.5	weathered bedrock was encountered in one boring only <i>(encountered in BB-GCS-104)</i>

BEDROCK

Bedrock was cored in boring BB-GCS-104 and BB-GCS-105. The top of the bedrock surface ranged from approximately 67.0 to 71.5 ft BGS (El. -55.8 to El. -52.5). A summary of top of bedrock elevations is provided below.

Substructure	Test Boring	Approx. Elev. Top of Bedrock (ft, NAVD 88)	Horizontal Distance between Test Borings (ft)	Approx. Slope of Rock Surface
Abutment 1	BB-GCS-104	-55.8	106	1V:32H
Abutment 2	BB-GCS-105	-52.5		

Bedrock encountered at the site consisted of soft to very hard SCHIST with occasional veins of quartzite. Highly fractured zones were encountered within the sampled bedrock.

Rock quality designation (RQD) is a common parameter that is used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the core run. RQD values for bedrock encountered at the site ranged between 20 and 72 percent, this correlates to a Rock Mass Quality rating of very poor to fair.

Substructure	Test Boring	Length of Rock Core Sampled (ft)	Range in RQD (%)	Average RQD (%) ¹
Abutment 1	BB-GCS-104	10.0	62 to 72	67
Abutment 2	BB-GCS-105	10.0	20 to 35	28

¹ Average RQD is the mean of RQDs recorded for each test boring.

Photographs showing the visual condition of the sampled bedrock core are included in Appendix B.

WATER ELEVATIONS

The following tidal data was provided by Stantec for the Cobbosseecontee Stream at the project site in their 40 percent PIC submission plans dated 1 September 2017:

Q1.1 (MLW): El. 0.9
Q1.1 (MHW): El. 3.9
Q50: El. 6.8
Q100: El. 7.6

Laboratory Testing Program

PRELIMINARY DESIGN PHASE TESTING PROGRAM

A preliminary laboratory testing program was undertaken on soil samples collected during the field investigations to assist in soil classification/identification and scour evaluations. A supplemental laboratory testing program was undertaken during the final design phase on soil samples collected during the preliminary field investigations to determine the corrosive potential of the fill soils surrounding the piles. In general, laboratory testing was performed on disturbed soil samples collected during SPT sampling. All laboratory soil testing was performed by GeoTesting Express of Acton, Massachusetts. Geotechnical laboratory testing was performed in accordance with applicable American Society for Testing Materials (ASTM) testing procedures.

The preliminary phase testing program included ten grain size analyses (sieve only, no hydrometer) and two Atterberg limits. A summary of laboratory test results is provided below.

Test Boring No.	Soil Sample No.	Sample Depth (ft)	Strata	Percent Finer than #200 Sieve (%)	USCS Classification
BB-GCS-104	2D	2.0 to 4.0	Fill	40.9	SM
BB-GCS-104	3D	4.0 to 6.0	Fill	46.6	SM
BB-GCS-104	15D	40.0 to 42.0	Marine Sand	14.0	SP-SM
BB-GCS-105	2D	2.5 to 4.5	Fill	31.2	SM
BB-GCS-105	3D	4.5 to 6.5	Fill	11.8	SW-SM
BB-GCS-105	14D	35.5 to 37.5	Marine Sand	62.5	ML
BB-GCS-302	3D	9.0 to 11.0	Fill	66.4	ML
BB-GCS-303	5D	19.0 to 21.0	Fill	9.2	GW
BB-GCS-304	7D	24.0 to 26.0	Fill	11.6	GW-GM
BB-GCS-305	7D	34.0 to 36.0	Marine Sand	29.6	SM

Test Boring No.	Soil Sample No.	Sample Depth (ft)	Strata	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification
BB-GCS-104	11D	28.0 to 30.0	Marine Clay	33	38	18	20	CL
BB-GCS-104	13D	32.0 to 34.0	Marine Clay	29	36	17	19	CL

In addition, one compressive strength rock test was conducted. Elastic moduli measurements were also planned, but both axial strain devices failed to record meaningful data, so young's modulus and poisson's ratio could not be determined. A summary of the rock test results is provided below.

Test Boring No.	Rock Core No.	Sample Depth (ft)	Peak Compressive Stress (psi)	Young's Modulus (ksi)
BB-GCS-104	R6	80.3 to 80.6	4,721	6,330 to 7,310

FINAL DESIGN PHASE TESTING PROGRAM

The final design phase testing program included four series of tests to determine the corrosive potential of the fill soils that will be present adjacent to the new piles. A summary of laboratory test results is provided below.

Test Boring No.	Soil Sample No.	Sample Depth (ft)	Strata	Organic Content, %	pH of soil in water/CaCl	Electrical Resistivity, ohm-cm	Sulfates, Soluble, mg/kg	Chloride, Soluble, mg/kg
BB-GCS-104	5D, 6D and 7D	10.8 to 17.0	Fill	0.3	6.1 / 5.8	3,306	250	< 100
BB-GCS-105	11D, 12D and 13D	20.0 to 29.0	Fill	0.3	6.3 / 6.1	3,822	912	< 100
BB-GCS-303	2D and 3D	5.0 to 12.0	Fill	1.2	7.7 / 6.9	744	115	< 100
BB-GCS-304	4D, 5D and 6D	12.5 to 21.0	Fill	1.2	6.6 / 6.2	3,306	173	500

Additional geotechnical laboratory testing was not conducted during the design phase of the project.

Laboratory test results are provided in Appendix C.

Ground Penetrating Radar Survey

As part of the second phase of explorations during preliminary design, a ground penetrating radar (GPR) survey was performed. The GPR survey was conducted behind each abutment and adjacent to the existing concrete retaining wall at the northeast corner of the bridge to attempt to define the existing foundation limits.

Hager-Richter Geoscience, Inc. of Salem, New Hampshire performed the GPR survey on 9 November 2016, under contract with MaineDOT and under the direction of Haley & Aldrich. Their report outlining the details of the procedures, equipment used to complete the study, and results of the survey is included in Appendix D.

As described in the report in Appendix D, the GPR signal penetration depth was limited, and is estimated to have been about 2 to 5 ft. As shown in Figure 2 of the GPR report, the GPR survey identified the tops of possible abutment structures at a depth of 3 to 5 ft immediately behind the bridge on both the north and south side of the bridge. These structures were located approximately 4 to 5 ft from the end of the bridge deck as shown in Appendix D, Figure 2. The GPR survey also identified various flat-topped structures in the approaches to the bridge at a depth of 1 to 3 ft and several utilities.

Channel Retaining Wall

Borings and GPR survey were performed behind the existing concrete retaining wall located along the stream to the east of the north abutment. Refer to Figure 2 for boring locations, Figure 6 for a graphical representation of the conditions encountered and Appendix D for GPR survey results. Borings encountered frequent concrete and granite structures and wood.

The borings were conducted at various distances from the back of the retaining wall, in an attempt to define the geometry of the retaining wall. Please note that boring BB-GCS-306 was drilled as close to the back of the retaining wall as possible (approximately 3 ft) based on site conditions, equipment and safety. However concrete was encountered at various depths and thicknesses, and did not provide conclusive information on the geometry of the existing wall. However, the following observations can be made:

- The stem of the existing wall is thinner than 3 to 4 ft close to the ground surface.
- The footing is composed of concrete.
- Based on conditions encountered in BB-GCS-306, it is possible that the retaining wall footing bears at approximately El. -2 to El. -3.
- Footing width is likely less than 9 to 10 ft wide at footing bearing level.

We have schematically shown the possible section limits of the retaining wall on Figure 6.

Geotechnical Design Recommendations

Geotechnical design recommendations for the subject project, as discussed and provided herein, were developed in accordance with the following documents:

- AASHTO Load and Resistance Factor Design Bridge Design Specifications, Seventh Edition, 2014 with Interim Revisions through 2016, referred to herein as AASHTO LRFD,
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, Second Edition, 2011, referred to herein as Guide Specification; and
- MaineDOT Bridge Design Guide, August 2003, with Interim Revisions through March 2014, referred to herein as the BDG.

We coordinated our technical evaluations with Stantec, the bridge designer, throughout the preliminary and final design phases of the project. Engineering calculations that support the recommendations outlined in this section are provided for reference in Appendix F.

We understand that this report will be included as a reference document in the package that will be provided to the prospective Contractors for bidding. Please note that the recommendations included herein are superseded by the information contained in the Contract Documents (CDs; plans, standard specifications and special provisions) and that the information contained in the CDs takes precedence over the information provided in this report.

SCOUR

Scour effects at the abutments were not considered due to the presence of heavy riprap that will be placed along the edges of the river as part of the proposed project improvements. The lateral and vertical extent of heavy riprap needed to protect the bridge foundations was determined by Stantec.

FROST PROTECTION

The minimum depth of embedment/cover for footings or other below grade structures was evaluated in accordance with Section 5.2.1 of the MaineDOT BDG. Based on a design freezing index equal to 1,500 freezing degree-days, we recommend that the footings and walls bear a minimum of 5.5 ft below the lowest adjacent ground surface exposed to freezing. Refer to Appendix F, Calculations, for supporting documentation.

APPROACH EMBANKMENTS

Settlement

Minimal (less than 6 in.) raises-in-grade are planned at the approach embankments. Given the proposed raises-in-grade, and the nature and consistency of the fill and naturally-deposited soils that are present at the site, we anticipate that the resulting magnitude of settlement will be minimal, will result from elastic compression of in-situ soils, and will likely occur rapidly during construction, soon after new site fills are placed and prior to final paving. We anticipate post-construction settlement to be negligible (i.e., < ½ in.). Based on subsurface conditions at the site, specifically the “stiff” nature of the marine clay, we do not anticipate that long-term, consolidation settlements of the in-situ soils will occur as a result of the planned raises-in-grade.

Global Stability

Computer-assisted, two-dimensional global stability evaluations were performed using the computer program Slide 6.0 by Rocscience Inc. to evaluate global stability of the bridge approach embankments. Evaluations were performed perpendicular to the face of Abutment 1. Abutment 2 is slightly shorter with a more gradual slope in front of the abutment, so the Abutment 1 geometry was considered the critical design case. In addition, the soil conditions at Abutment 2 do not include the clay present at Abutment 1. For these reasons, evaluations at Abutment 2 were not conducted. The proposed abutment piles were included in the evaluations. Please note that the piles are needed to develop acceptable global stability factors of safety.

Soil and rock material and strength properties used in the Abutment 1 global stability evaluations are summarized below.

	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)
RipRap	140	45	0
Granular Borrow	125	32	0
Existing Fill	115	30	0
Alluvial Deposits	115	30	0
Marine Deposits (clay)	115	0	500
Marine Deposits (granular)	115	29	0
Glacial Till/ Weathered Bedrock	130	36	0

The minimum calculated static factor of safety from our evaluations is 1.9. The minimum factor of safety required for static stability evaluations is 1.5 where the slope does support or contain a structural element, based on the requirements of LRFD Article 11.6.2.3. The calculated factor of safety under pseudo-static earthquake loading from our evaluations is 1.3, using a horizontal coefficient of 0.097 (i.e., one half of the peak ground acceleration coefficient, A_s). Values ranging from $A_s/3$ to $A_s/2$ are recommended in literature (Melo and Sharma, 2004); the reduction from A_s is due to soil slope flexibility and the fact that the peak ground acceleration during an earthquake lasts only for a very short period of time. The minimum factor of safety required for pseudo-static stability evaluations is 1.0 based on the requirements of LRFD. The factor of safety for both the static case and under pseudo-static earthquake loading exceed the minimum required.

SEISMIC DESIGN

Due to the nature and thickness of the overburden soils encountered in the test borings, we recommend the site be considered "Site Class E." Based on the site location and the assignment of "Site Class E," the United States Geological Survey (USGS) software application Seismic Design Parameters v. 2.0 provided the recommended AASHTO response spectra for a 7 percent probability of exceedance in 75 years. The recommended values are summarized below.

Parameter	Design Value
Mapped Peak Ground Acceleration, PGA =	0.077
Mapped Short (0.2-second) Period, S_s =	0.160
Mapped Long (1.0-second) Period, S_1 =	0.045
Site Factor, F_{pga} =	2.5
Site Factor, F_a =	2.5
Site Factor, F_v =	3.5
Acceleration Coefficient, A_s (0 second period) =	0.193
Horizontal Response Spectral Acceleration, S_{DS} (0.2 second period) =	0.400
Horizontal Response Spectral Acceleration, S_{D1} (1 second period) =	0.157
Seismic Performance Zone =	2
Seismic Performance Category =	B

LIQUEFACTION CONSIDERATIONS

The liquefaction susceptibility of the granular soils at the site was evaluated by calculating the ratio between the cyclic resistance ratio (CRR) of the in-situ soils at each sample location and equivalent uniform cyclic stress ratio (CSR) imposed by the design earthquake. This ratio was modified using a magnitude scaling factor (MSF) to account for earthquake magnitudes different from M 7.5 to obtain the factor of safety against liquefaction. Liquefaction of the in-situ granular soils will likely occur when the factor of safety is less than 1.0.

The CRR is a function of clean sand-corrected SPT N-value, $(N_1)_{60-CS}$ following the simplified methodology outlined by Youd and Idriss (2001). The CRR was estimated using raw SPT N-values that were corrected for various effects including overburden pressure, hammer energy, borehole diameter, drill rod length, sampling method and fines content (estimated from field samples or obtained from the laboratory test results, as available). In cases where laboratory grain size analyses were available, that data was used in lieu of field observations/soil classifications made during drilling. Since the CRR calculated from $(N_1)_{60-CS}$ using the simplified methodology is based on a M 7.5 earthquake, the CRR was corrected to the design earthquake magnitude (M 5.1; see below) using the MSF (equal to 2.68, based on Youd & Idriss, 2001).

The magnitude (M) for the design earthquake used to assess liquefaction susceptibility at the site was determined from earthquake deaggregation data obtained from the USGS in accordance with AASHTO Guide Specification Section 6.8. This data is based on a seismic event (earthquake) having a seven percent probability of exceedance in 75 years (approximate 1,000-year return period). Based on our review of the USGS deaggregation data, we judged that the modal magnitude earthquake (M 5.1) is appropriate for use in assessing liquefaction susceptibility for this site based on the large number of earthquakes that are significant to the deaggregation (Dickenson, 2005).

In accordance with AASHTO Guide Specifications Section 6.8, the “seasonally averaged groundwater elevation” should be used when determining the extent of soils that are adequately saturated for liquefaction to occur. The liquefaction analyses summarized herein are based on a water level equal to El. 3.9 (Q1.1), which we judged to be representative of the “seasonally averaged groundwater elevation.”

Since liquefaction is considered at the Extreme Event Limit State and AASHTO LRFD specifies that the overall goal in designing for any extreme event is to prevent structure collapse and protect life safety, calculated factors of safety greater than 1.0 are considered acceptable.

The factor of safety in the samples from all the borings ranged from 1.2 to 7.0. Based on the results of the simplified liquefaction evaluation using the data from the recent borings, it is our opinion that the site soils are not liquefaction susceptible. Refer to calculations in Appendix F for plots of factor of safety.

FOUNDATION SUPPORT ALTERNATIVES

As shown on the interpretive subsurface profile (Figure 3), the subsurface conditions primarily consist of, in order of increasing depth below ground surface, man-placed fill, alluvial deposits, marine deposits, glacial till, weathered bedrock, and bedrock. Based on the loading information provided by Stantec, it is our opinion that the glacial till and bedrock are considered suitable for support of the bridge superstructure. Based on the depth to the suitable foundation bearing strata and the subsurface data available at this time, we consider both of the following foundation alternatives to be technically feasible for support of the new bridge:

- Micropiles socketed into bedrock: A wide range of axial micropile capacities are achievable, depending on the micropile diameter (7 to 9 in. is typical) and rock socket length. A permanent steel casing is typically extended to bedrock (El. -55.8 to El. -52.5) and the micropile rock socket is constructed to the length needed to provide the necessary axial and lateral resistance. Lateral resistance of plumb/vertical micropiles is typically relatively small, but rock sockets may slightly increase lateral load resistance. If additional lateral resistance is required, battered micropiles could be considered to resist lateral loads.
- Piles driven to refusal on bedrock: Piles would be approximately 65 to 75 ft long (from existing ground surface) and driven through the overburden soils, including 14 to 34 ft of existing fill (see construction considerations below) and 12 to 20 ft dense glacial till.

Based on several discussions with Stantec and MaineDOT during the preliminary design phase, driven piles were selected to support the new bridge abutments, and micropiles were selected to support the northeast retaining wall connection from Abutment 2 to the existing channel retaining wall. Geotechnical engineering evaluations and design recommendations for piles driven to refusal in/on bedrock are summarized in the following sections of this report. Additional evaluations for rock-socketed micropiles to support the bridge were not conducted during final design phase. Stantec performed evaluations for rock-socketed micropiles to support the northeast retaining wall.

DRIVEN PILES

Corrosion and Deterioration

The design of steel H-piles should include consideration of corrosion in accordance with AASHTO LRFD Section 10.7.5. As discussed in previous sections of this report, a chemical laboratory testing program (i.e., pH, electrical resistivity, sulfates, chlorides) was undertaken to assess the corrosion potential of in-situ soils that will be present directly adjacent to the new piles.

Criteria provided by the Federal Highway Administration (FHWA) National Highway Institute (publication no. FHWA HI 97-013) suggests that an “aggressive” corrosive environment for steel piles can generally be identified as follows:

- $\text{pH} \leq 4.5$
- electrical resistivity $< 2,000 \text{ ohm-cm}$
- $2,000 \text{ ohm-cm} < \text{electrical resistivity} < 5,000 \text{ ohm-cm}$ and chloride ion content $> 100 \text{ ppm}$ and/or sulfate ion content $> 200 \text{ ppm}$

In addition, electrical resistivity values greater than 5,000 ohm-cm are considered “non-aggressive.”

The results of the laboratory chemical testing that are summarized above were compared to this criteria. Based on this comparison, it is our opinion that the existing fill should be considered “aggressive.” Although chemical testing was not completed on samples of the naturally deposited soils, it is our opinion that these soils should be considered “non-aggressive.”

Based on the results of laboratory chemical testing, it is our opinion that the abutment piles should be designed to account for section loss due to corrosion. We recommend that the design axial compressive pile resistance and lateral capacity of steel H-piles consider a 1/16-in. reduction in cross-sectional area over the planned design life of the bridge (75 years) to account for corrosion.

Bridge Loads

Stantec provided maximum lateral deflection of the integral bridge abutments caused by contraction and expansion of the bridge due to temperature movements, and loads for the Service I and Strength I Limit States on 27 November 2017. Based on this information and discussions with Stantec, the following load cases were used in our evaluations:

Contraction Displacement 0.51 in.

Load Case	Axial Load (kips)
No Axial	0
Service I	210.86
Strength I	323.66

Expansion Displacement 0.32 in.

Load Case	Axial Load (kips)
No Axial	0
Service I	210.86
Strength I	323.66

We understand that the axial design loads changed slightly after 27 November 2017. However based on information provided by Stantec, the revised loads resulted in less than a 5 percent change in the pile stresses; therefore our evaluations were not updated.

Lateral Pile Evaluations – Abutment 1

Using the displacements and axial loads provided by Stantec, Haley & Aldrich conducted lateral pile evaluations at Abutment 1 and Abutment 2 using the software program LPILE by Ensoft, Inc. The shear

forces and moments caused by the imposed displacements were provided to Stantec to perform the structural design of the pile. Based on the results of the initial round of lateral load evaluations and the structural evaluation using an HP12x74 pile, Stantec increased the pile size to HP14x117. This pile size selection was controlled by lateral pile demands (not axial demands).

We modeled a single, vertical HP14x117 pile, with a fixed head condition at the top of the pile. Lateral group effects (pile-soil interaction) were not significant given the pile spacing to pile size ratio.

A summary of the maximum shear force and maximum moments as determined by the lateral pile evaluations is provided below. The load case resulting in the highest shear force and moment is reported. LPile results of deflection, moment and shear with depth are included in Appendix F.

Case	Deflection (in.)	Axial Load (kips)	Max. Shear Force at Top of Pile (kips) ¹	Max. Moment (kip-ft) ^{1,2}
Abutment 1 – Contraction	0.51	0	24.2	122.5
Abutment 2 – Contraction	0.51	0	24.2	122.5
Abutment 1 – Expansion	0.32	0	101.5	223.7
Abutment 2 – Expansion	0.32	0	101.5	223.9

¹ Lateral pile evaluations included 1/16-in. reduction in cross-sectional area

² Moment at top of pile.

Scour effects were not considered due to the presence of heavy riprap placed to protect the piles along the edges of the river.

Axial Compression Pile Resistance

In accordance with AASHTO LRFD, a distinction is made between piles driven to “soft” rock and piles driven to “hard rock.” Based on our experience on similar projects with similar bedrock conditions, we consider the bedrock at the site on which piles will bear to be “hard.” Therefore, the geotechnical resistance of the piles is controlled by their structural resistance, as discussed in AASHTO LRFD Section 10.7.3.2.3. The structural resistance factor (Article 6.5.4.2) for axial resistance of piles in compression and subject to damage due to severe driving (“hard” rock bearing stratum) is 0.5. In addition, resistance factors for Service and Extreme Limit State loading are 1.0. Therefore, the nominal and factored structural resistance of the steel H-pile sections (with $f_y = 50$ ksi) at the Service, Strength and Extreme Event Limit States is summarized below.

Substructure	Steel H-pile Section	Nominal Structural Resistance ¹ (kips)	Factored Structural Resistance (kips) ¹		
			Service Limit State ($\phi=1.0$)	Strength Limit State ($\phi=0.5$)	Extreme Limit State ($\phi=1.0$)
Abutment 1	HP14x117	1,436	1,436	718	1,436
Abutment 2	HP14x117	1,436	1,436	718	1,436

¹ Nominal and factored structural resistance based on area of HP14x117 H-pile including 1/16-in. reduction in cross-sectional area.

Based on the loads provided by Stantec, the maximum factored compressive pile load is 323.66 kips in the Strength Limit State. Please note that this load is lower than the factored structural resistance.

Axial Uplift Pile Resistance

We understand that abutment piles will not be subjected to uplift.

Nominal Pile Driving Resistance and Pile Tip Elevations

We recommend that the piles be driven to refusal in/on rock to the minimum required nominal resistances shown in the table below in accordance with AASHTO LRFD Section 10.7.3.7. The minimum required nominal resistances shown below are calculated using a resistance factor of 0.65 based on the assumption that dynamic testing will be performed to verify nominal axial compressive resistances during pile installation.

Substructure	Max. Factored Strength Limit State Load ¹ (kips)	Nominal Resistance Required to Resist Factored Loads ² (kips)
Abutment 1	323.66	498
Abutment 2	323.66	498

¹ Maximum factored strength limit state compressive loads from Stantec.

² Based on a resistance factor equal to 0.65 applied to the total factored load (for dynamic field verification testing).

Pile Tip Elevations

As discussed previously, the piles will develop their axial compressive resistance through end bearing in/on rock. Therefore, the recommended tip elevations for estimating pile lengths are based on the depths to rock observed in test borings. For estimating bid quantities, we recommend the following pile tip elevations be used at each substructure:

Substructure	Representative Test Boring	Estimated Pile Tip Elevation (ft, NAVD 88) ¹
Abutment 1	BB-GCS-104	El. -57
Abutment 2	BB-GCS-105	El. -54

¹ Estimated pile tip elevation assumes piles will bear 1 to 2 ft below the observed top of bedrock surface in the borings.

Pile Settlement and Elastic Pile Compression

Pile settlement due to elastic shortening of the steel H-piles as well as pile tip settlement was evaluated based on the maximum factored Service Limit State loads provided by Stantec. Estimates of elastic pile compression for individual piles at each substructure are summarized below.

Substructure	Maximum Factored Service Limit State Load (kips) ¹	Approximate Elastic Pile Compression (in.)
Abutment 1	210.86	< ¼
Abutment 2	210.86	< ¼

¹ – Maximum factored service limit state compressive loads from Stantec.

The values summarized above do not include pile tip settlement, which is considered to be negligible for two primary reasons: 1) the relatively small load transmitted to the pile tip during service limit state loading and 2) the piles will be driven to rock. The elastic shortening of the piles is anticipated to occur primarily during construction, soon after the superstructure loads are applied.

Pile Embedment, Spacing, Clearance and Pile Material

We recommend that minimum pile spacing, clearance and embedment (into the pile cap) meet the requirements of AASHTO LRFD Section 10.7.1.2. We also recommend that the piles be equipped with a pile tip in accordance with MaineDOT Standard Specification 501.048. Based on the potential for hard driving and sloping bedrock, we recommend the pile tip consist of a HP-77750-B manufactured by Associated Pipe & Fitting, or equivalent, fabricated from minimum 50 ksi steel.

ABUTMENT AND WINGWALL LATERAL EARTH PRESSURE RECOMMENDATIONS

For structural design of integral abutments, we recommend use of passive earth pressures, using a Coulomb passive earth pressure coefficient, K_p , of 6.6. Developing full passive pressure assumes that the ratio of lateral abutment movement to abutment height (y/H) exceeds 0.005 (where H is measured from bottom of pile cap to top of abutment). If the calculated displacements are significantly less than that required to develop full passive pressure (i.e., y/H less than 0.005), the Rankine passive earth pressure coefficient, 3.25, should be used.

Soil properties of Soil Type 4, granular borrow, should be used for abutment backfill material. The backfill properties per BDG Section 3.6.1 are as follows:

- Friction Angle, ϕ , 32 degrees
- Total Unit Weight, γ , 125 pcf
- Soil-Concrete Interface Friction Angle, δ , 24 degrees

In addition, walls should be designed for a live load surcharge equivalent to the earthfill height summarized in LRFD Tables 3.11.6.4-1 and 3.11.6.4-2. A uniform lateral load equal to the surcharge

times the lateral earth pressure coefficient should be applied to abutments and walls to account for the live load surcharge.

If determined applicable by Stantec, the walls and abutments should be designed for a uniform lateral load to account for seismic soil loading in accordance with LRFD Article A.11.3.1 (Mononobe-Okabe Method). Based on the seismic site class (Site Class "E"), we recommend a seismic active earth pressure coefficient, K_{AE} , of 0.42 be used for design. Note that this soil pressure includes both the static and seismic lateral earth loads.

CONNECTION BETWEEN NEW ABUTMENT 2 AND EXISTING CHANNEL RETAINING WALL

Based on several discussions with Stantec and MaineDOT during the preliminary design phase, micropiles were selected to support the wall that will connect the new Abutment 2 and the existing channel retaining wall (northeast closure wall).

Lateral micropile evaluations for the northeast closure wall were performed by Stantec using soil stratigraphy and soil properties (physical and strength) provided by Haley & Aldrich for Abutment 2 (refer to Appendix F).

For micropile axial compression and uplift design, we recommend that a strength limit factored unit frictional resistance of 10.9 ksf in bedrock be used to resist axial loads. This design resistance value is based on a resistance factor of 0.5, assuming load tests will not be performed.

The micropiles will develop their axial compressive resistance through side friction in the bedrock. Therefore, the recommended tip elevations for estimating micropile lengths are based on the depths to rock observed in test borings and the maximum axial loads as determined by Stantec. For estimating bid quantities, we recommend using an estimated bedrock elevation of El. -52.5. Final socket lengths will be determined by Stantec based on the unit resistance provided above and the final design loads.

Construction Considerations

Based on the subsurface conditions encountered and our understanding of the proposed bridge replacement, we offer the following general geotechnical observations regarding the planned bridge construction:

TEMPORARY EARTH SUPPORT

Based on the proposed elevation of the bottom of the foundations, temporary earth support systems will likely be needed to construct the abutment substructures. Based on the subsurface soil, rock and groundwater conditions at the site, we anticipate that the most cost-effective excavation support systems for construction of the substructures will consist of steel sheeting.

Design of temporary works, including temporary earth support system(s) are typically the responsibility of the Contractor and should be conducted by a Licensed Professional Engineer in the State of Maine

hired by the Contractor. We recommend that temporary earth support system(s) be designed to support all appropriate combinations of earth, water and surcharge loads (from traffic, construction equipment, material stockpiles and other sources) imposed on the system(s) during all phases of the construction period. The Contractor is responsible for choosing an applicable factor of safety for the earth support system(s). The Contractor's design should also consider the means and methods and construction sequencing proposed. We recommend that design calculations and shop drawings be prepared by the Contractor, stamped by a Licensed Professional Engineer in the State of Maine and submitted to MaineDOT for review prior to construction.

DYNAMIC PILE LOAD TESTING PROGRAM

The Contractor will be required to confirm the minimum required nominal pile resistances in the field using dynamic testing methods. The piles should be driven to a nominal resistance equal to the maximum factored axial compressive pile load divided by a resistance factor equal to 0.65 in accordance with AASHTO LRFD Table 10.5.5.2.3-1 (498 kips for Abutment 1 and 2). We recommend that Contractor perform two dynamic pile load tests with 24-hour (minimum) restrike tests at each substructure location (4 total) to evaluate hammer system efficiencies, driving stresses in the pile, and the nominal resistance of the piles. We recommend that the dynamic testing be completed prior to production pile driving and that CAPWAP analysis be performed on each pile installed during the dynamic test program (4 total). The CAPWAP results will be used to finalize driving criteria for the production piles to assure that the piles achieve the necessary resistance without being overstressed.

REUSE OF EXCAVATED ON-SITE SOILS

Based on the test borings drilled at the site we anticipate that the excavated material will consist primarily of in-situ fill. The in-situ fill includes both granular zones (typically near ground surface) and fine-grained zones (with depth). If excavated soils are reused, the Contractor will need to segregate the granular and fine-grained soils.

We understand that MaineDOT has reviewed the anticipated excavation quantities and results of environmental testing to determine soil reuse options and prepared a soil management special provision.

PRE-CONSTRUCTION CONDITION SURVEY

Due to proximity of the existing channel retaining wall to the existing/replacement bridge and new northeast closure wall, we recommend that MaineDOT conduct a pre-construction condition survey of the channel retaining wall to document the exterior condition of this structure prior to the start of construction activities.

INSTRUMENTATION

We recommend that an instrumentation program be developed that will allow MaineDOT to monitor vertical movement and vibrations of the existing channel retaining wall during construction. Threshold

and limiting values for settlement and vibrations would be developed by the design team and incorporated into the contract documents. The Contractor would need to consider these movement criteria when determining construction means and methods and sequencing of the work in the vicinity of the existing channel retaining wall. However, based on recent discussions with MaineDOT it is our understanding that MaineDOT has decided not to implement an instrumentation program for the project.

SUBMITTAL REVIEWS

The Contract Drawings and Specifications should be written so that the requirements of the documents are consistent with the design intent of the geotechnical recommendations outlined herein. The Specifications require that the Contractor and the Contractor's engineer perform analyses and submit results to MaineDOT for review. We recommend that Haley & Aldrich be allowed to review the geotechnical-related submittals to ensure that the Contractor's analyses/submittals are in accordance with the intent of the design as summarized herein. This will enable us to observe compliance with the design concepts, assumptions and specifications, and to facilitate design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

CONSTRUCTION MONITORING

The geotechnical design and earthwork recommendations contained herein are based on the known and predictable behavior of a properly engineered and constructed foundation. Monitoring of the foundation construction activities is required to enable the geotechnical engineer to confirm that procedures and techniques used by the contractor during construction are appropriate and will not impact the design of the bridge. Therefore, we recommend that an individual representing MaineDOT, qualified by geotechnical training and experience be present at the site to provide monitoring during the foundation construction activities listed below.

- Dynamic testing of indicator driven piles.
- Installation of production driven piles and micropiles.
- Placement and compaction of compacted fills.

Limitations and Closure

This report is prepared for the exclusive use of Stantec relative to the Replacement of Maine Avenue Bridge in Gardiner, Maine. There are no intended beneficiaries other than Stantec. Haley & Aldrich shall owe no duty whatsoever to any other person or entity on account of the Agreement or the report. Use of this report by any person or entity other than Stantec for any purpose whatsoever is expressly forbidden unless such other person or entity obtains written authorization from Stantec and from Haley & Aldrich indicating that the Report is adequate for such other use. Use of this report by such other person or entity without the written authorization of Stantec and Haley & Aldrich shall be at such other person's or entities sole risk, and shall be without legal exposure or liability to Haley & Aldrich.

The analyses and recommendations are based, in part, upon the data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations then appear, it may be necessary to reevaluate the recommendations of this report.

We understand that this report will be included as a reference document in the package that will be provided to the prospective Contractors for bidding. Please note that the recommendations included herein are superseded by the information contained in the Contract Documents (CDs; plans and specifications) and that the information contained in the CDs takes precedence over the information provided in this report.

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to call if you have any questions or comments.

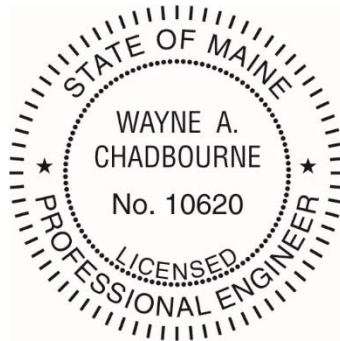
Sincerely yours,
HALEY & ALDRICH, INC.



Erin A. Force, P.E.
Project Manager



Wayne A. Chadbourne, P.E.
Senior Associate



Enclosures:

- Table I – Summary of Subsurface Explorations – Location Data
- Table II – Summary of Subsurface Explorations – Subsurface Data
- Figure 1 – Project Locus
- Figure 2 – Site and Subsurface Exploration Location Plan
- Figure 3 – Interpretive Subsurface Profile
- Figure 4 – Abutment Profile A-A Southbound Lane
- Figure 5 – Abutment Profile B-B Northbound Lane
- Figure 6 – Retaining Wall Profile C-C
- Appendix A – Test Boring Logs
- Appendix B – Rock Core Photographs
- Appendix C – Laboratory Test Results
- Appendix D – Geophysical Survey
- Appendix E – Historic Bridge Drawings
- Appendix F - Calculations

References

1. Newburg, Donald W, *Bedrock Geology of the Gardiner 15' Quadrangle, Maine*, Maine Geological Survey, Department of Conservation, Augusta, Maine, 1984.
2. Thompson, Woodrow B, *Surficial Geology Gardiner Quadrangle, Maine*, Maine Geological Survey, Department of Conservation, Augusta, Maine, Open File Report No. 09-8, 2009.
3. Melo, Cristiano and Sharma, Sunil, *Seismic Coefficients for Pseudostatic Slope Analysis*, 13th World Conference on Earthquake Engineering, Vancouver, B.C., Canada, August 1-6, 2004.

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TABLE I
Summary of Subsurface Explorations - Location Data

Maine Avenue Bridge

Route 24 over Cobbosseecontee Stream

Gardiner, Maine

MaineDOT WIN 18736.00, Bridge No. 3098

Test Boring No. ¹	Coordinates ²	
	Easting	Northing
BB-GCS-104	1,142,507	509,800
BB-GCS-105	1,142,490	509,905
BB-GCS-203	1,142,394	509,896
BB-GCS-204	1,142,454	509,782
BB-GCS-302	1,142,472	509,826
BB-GCS-302A	1,142,472	509,828
BB-GCS-302B	1,142,471	509,829
BB-GCS-303	1,142,486	509,828
BB-GCS-303A	1,142,486	509,834
BB-GCS-303B	1,142,485	509,834
BB-GCS-303C	1,142,485	509,833
BB-GCS-303D	1,142,486	509,831
BB-GCS-304	1,142,457	509,889
BB-GCS-304A	1,142,458	509,886
BB-GCS-304B	1,142,458	509,888
BB-GCS-305	1,142,472	509,893
BB-GCS-305A	1,142,473	509,891
BB-GCS-305B	1,142,473	509,890
BB-GCS-306	1,142,501	509,900
BB-GCS-306A	1,142,503	509,903
BB-GCS-306B	1,142,502	509,905
BB-GCS-306C	1,142,504	509,908

Notes:

1. As-drilled test boring locations are shown on Figure 2, Site and Subsurface Exploration Plan.
2. As-drilled coordinates of test borings were determined by MaineDOT using GPS survey equipment and reference NAD83, Maine 2000 West Zone coordinate system.

Prepared By:	MLS	2/3/2017
Checked By:	EAF	3/21/2017
Reviewed By:	WAC	5/4/2017

TABLE II
Summary of Subsurface Explorations - Subsurface Data

Maine Avenue Bridge
 Route 24 over Cobbosseecontee Stream
 Gardiner, Maine
 MaineDOT WIN 18736.00, Bridge No. 3098

Test Boring No. ¹	Ground Surface Elevation ^{2,3}	Approximate Strata Thickness ^{5,6} (ft)						Approximate Auger Probe Refusal Depth (ft)	Approximate Elevation of Top of Bedrock ^{2,3}	Approximate Elevation of Bottom of Exploration ^{2,3}
		Fill	Alluvial Deposit	Marine Silt/Clay	Marine Sand	Glacial Till	Weathered Bedrock			
BB-GCS-104	15.7	17.0	8.2	14.8	9.4	19.6	2.5	NA	-55.8	-69.3
BB-GCS-105	14.5	30.0	5.5	4.5	15.0	12.0	NE	NA	-52.5	-64.5
BB-GCS-203	14.3	>18.0	--	--	--	--	--	NA	--	-3.7
BB-GCS-204	14.1	13.9	NE	NE	>0.6	--	--	NA	--	-0.4
BB-GCS-302	15.4	30.0	NE	NE	>2.0	--	--	NA	--	-16.6
BB-GCS-302A	15.5	>20.1	--	--	--	--	--	20.1	--	-4.6
BB-GCS-302B	15.5	>6.2	--	--	--	--	--	6.2	--	9.3
BB-GCS-303	15.3	27.0	NE	>4.0	--	--	--	NA	--	-15.7
BB-GCS-303A	15.3	>15.0	--	--	--	--	--	--	--	0.3
BB-GCS-303B	15.4	>1.5	--	--	--	--	--	1.5	--	13.9
BB-GCS-303C	15.4	>9.3	--	--	--	--	--	9.3	--	6.1
BB-GCS-303D	15.3	>23.7	--	--	--	--	--	23.7	--	-8.4
BB-GCS-304	15.3	29.5	NE	NE	>5.5	--	--	NA	--	-19.7
BB-GCS-304A	15.3	>6.6	--	--	--	--	--	6.6	--	8.7
BB-GCS-304B	15.3	>20.5	--	--	--	--	--	20.5	--	-5.2
BB-GCS-305	15.3	34.0	NE	NE	>2.0	--	--	NA	--	-20.7
BB-GCS-305A	15.4	>20.0	--	--	--	--	--	20.0	--	-4.6
BB-GCS-305B	15.4	>6.0	--	--	--	--	--	6.0	--	9.4
BB-GCS-306	13.8	>18.4	--	--	--	--	--	NA	--	-4.6
BB-GCS-306A	13.7	>6.9	--	--	--	--	--	NA	--	6.8
BB-GCS-306B	13.6	25.0	NE	>1.0	--	--	--	NA	--	-12.4
BB-GCS-306C	13.5	>16.5	--	--	--	--	--	16.5	--	-3.0

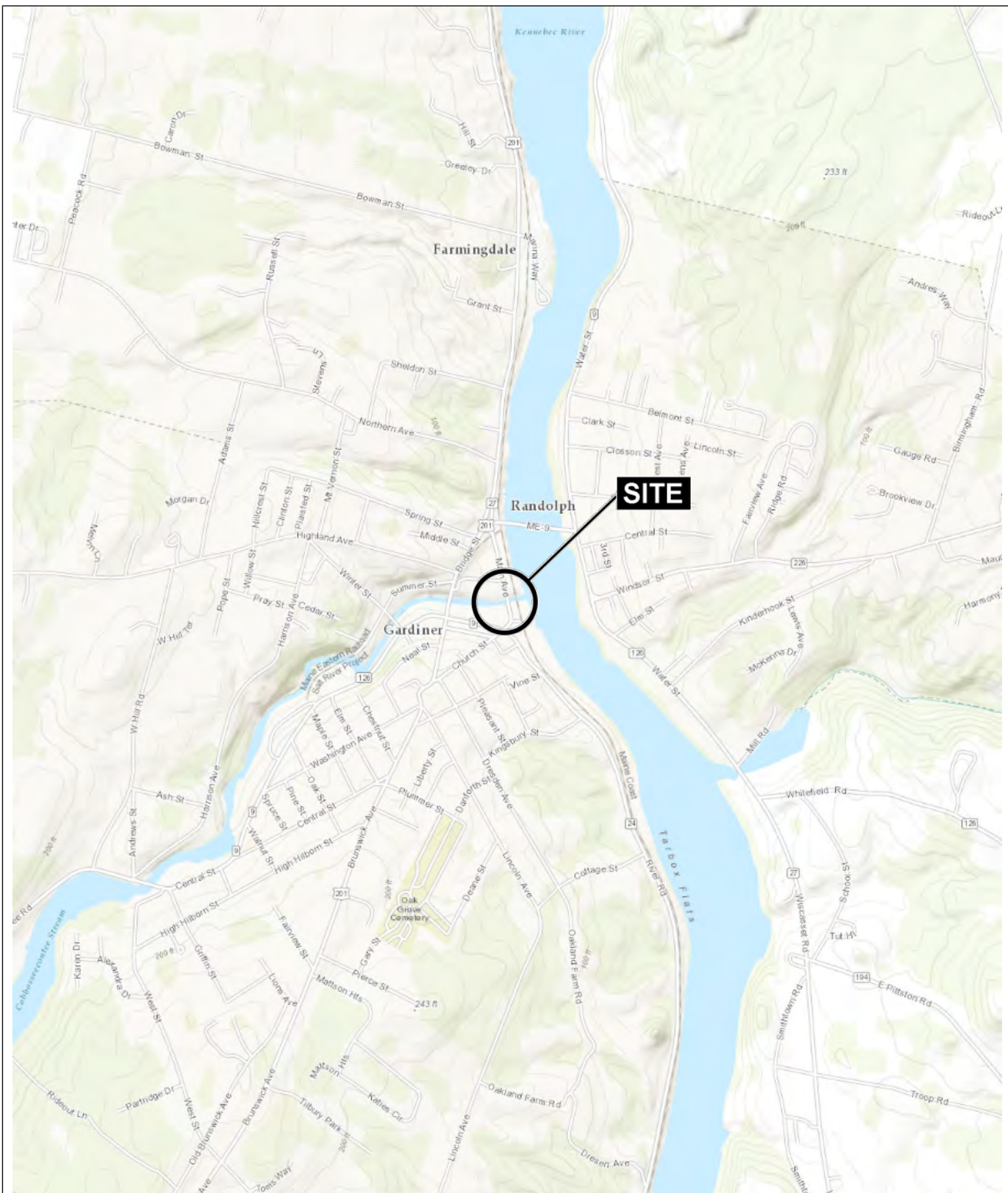
Notes:

1. As-drilled test boring locations are shown on Figure 2, Site and Subsurface Exploration Plan.
2. Ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment.
4. Elevations are in feet and reference the North American Vertical Datum of 1988 (NAVD 88).
5. "NE" indicates stratum was not encountered in test boring.
6. "--" indicates test boring was not drilled deep enough to determine presence of stratum.

Haley & Aldrich, Inc.

\\haleyaldrich.com\share\por_common\PROJECTS\42223 - gardiner bridges\000\Deliverables\Maine Ave\2017-0504-HAI-Maine Ave Tables-F.xlsx

Prepared By:	MLS	2/3/2017
Checked By:	EAF	3/21/2017
Reviewed By:	WAC	5/4/2017



MAP SOURCE: ESRI

SITE COORDINATES: 44°13'50"N, 69°46'17"W



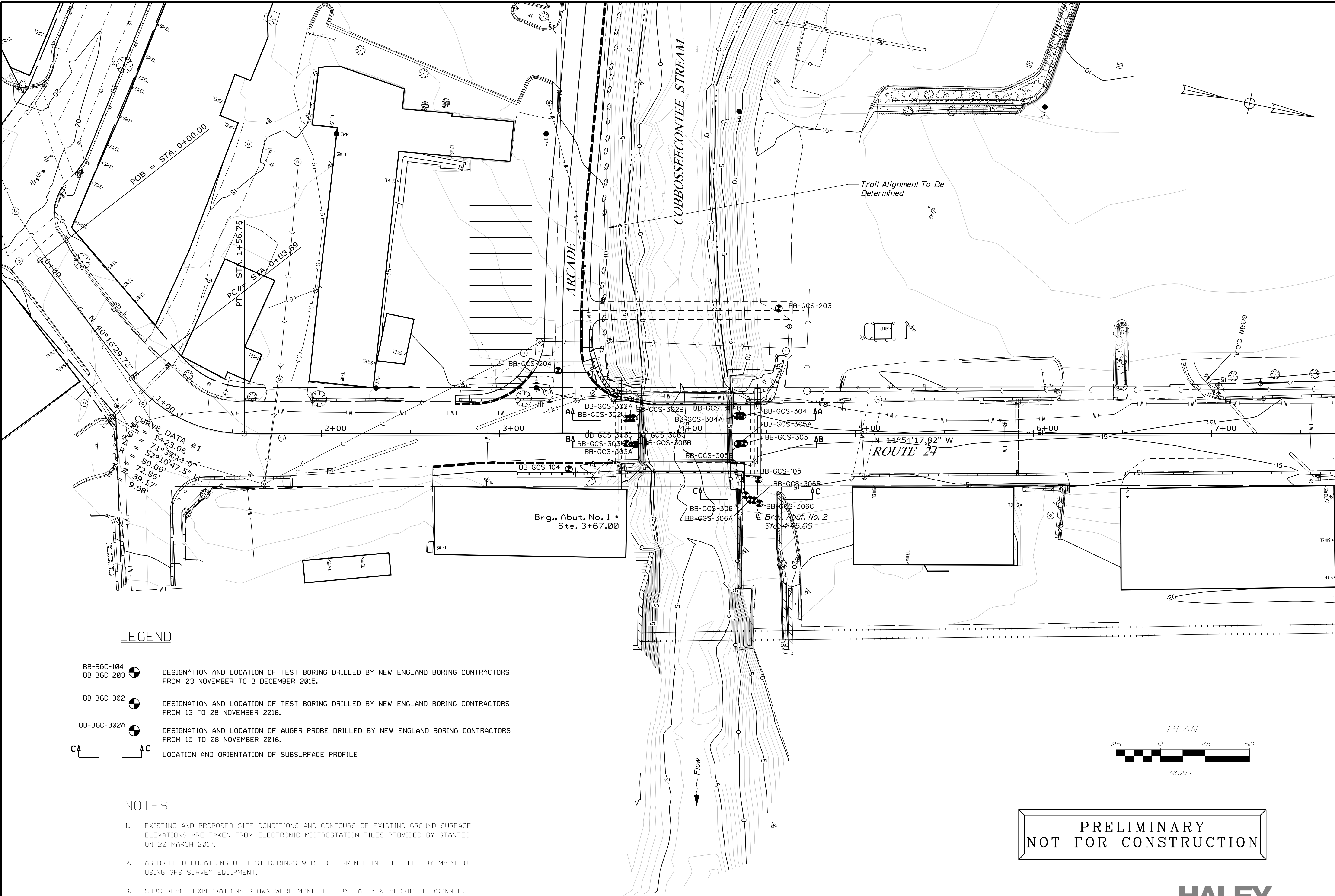
**HALEY
ALDRICH**

MAINE AVENUE BRIDGE
ROUTE 24 OVER COBBOSSEECONTEE STREAM
GARDINER, MAINE
MAINEDOT WIN 18736.00, BRIDGE NO. 3098

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
APRIL 2018

FIGURE 1



LEGEND

- BB-BGC-104 DESIGNATION AND LOCATION OF TEST BORING DRILLED BY NEW ENGLAND BORING CONTRACTORS FROM 23 NOVEMBER TO 3 DECEMBER 2015.
- BB-BGC-203 DESIGNATION AND LOCATION OF TEST BORING DRILLED BY NEW ENGLAND BORING CONTRACTORS FROM 13 TO 28 NOVEMBER 2016.
- BB-BGC-302 DESIGNATION AND LOCATION OF TEST BORING DRILLED BY NEW ENGLAND BORING CONTRACTORS FROM 13 TO 28 NOVEMBER 2016.
- BB-BGC-302A DESIGNATION AND LOCATION OF AUGER PROBE DRILLED BY NEW ENGLAND BORING CONTRACTORS FROM 15 TO 28 NOVEMBER 2016.
- CA LOCATION AND ORIENTATION OF SUBSURFACE PROFILE

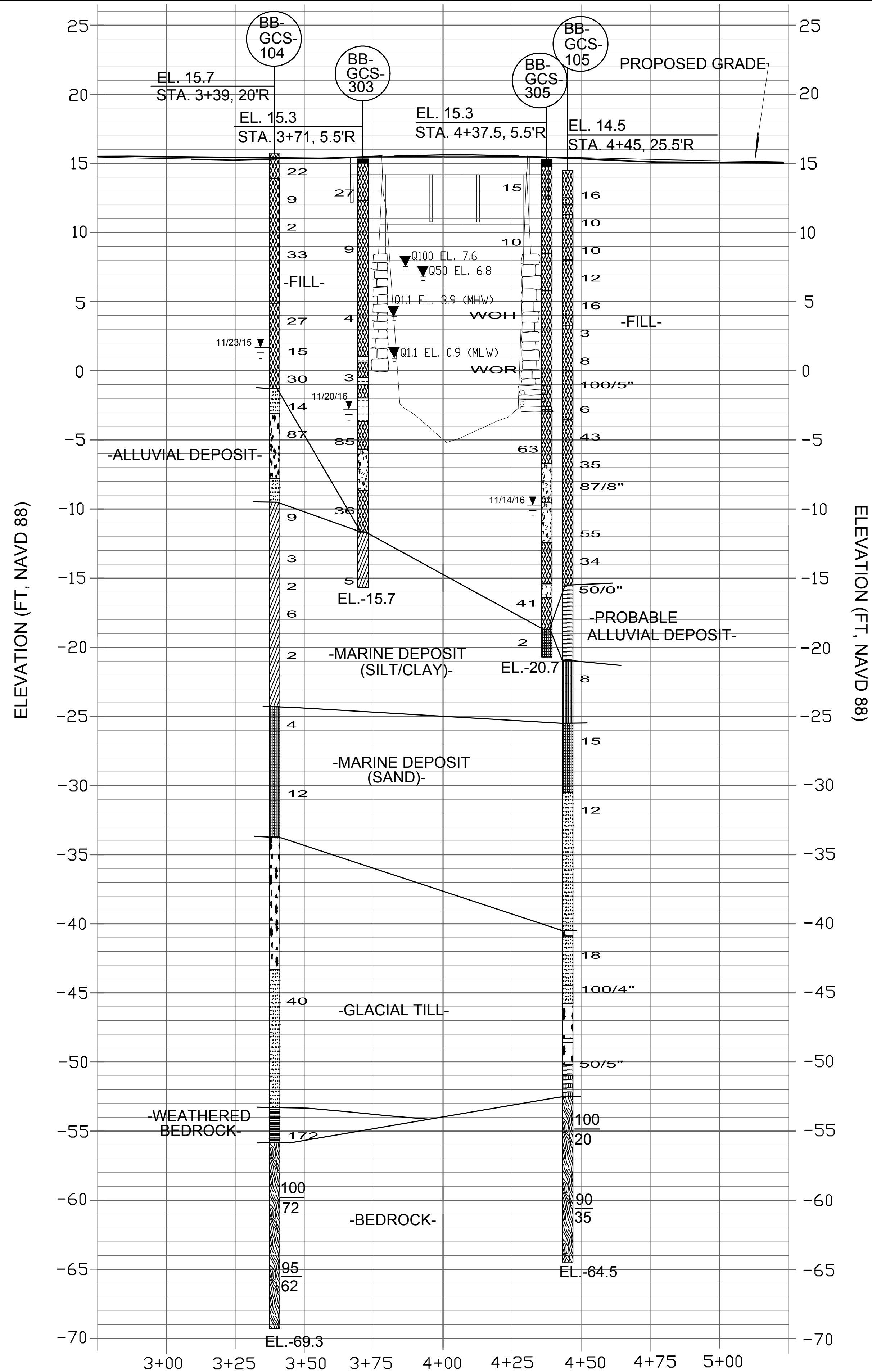
NOTES

- EXISTING AND PROPOSED SITE CONDITIONS AND CONTOURS OF EXISTING GROUND SURFACE ELEVATIONS ARE TAKEN FROM ELECTRONIC MICROSTATION FILES PROVIDED BY STANTEC ON 22 MARCH 2017.
- AS-DRILLED LOCATIONS OF TEST BORINGS WERE DETERMINED IN THE FIELD BY MAINEDOT USING GPS SURVEY EQUIPMENT.
- SUBSURFACE EXPLORATIONS SHOWN WERE MONITORED BY HALEY & ALDRICH PERSONNEL.
- ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV83).

PRELIMINARY
NOT FOR CONSTRUCTION



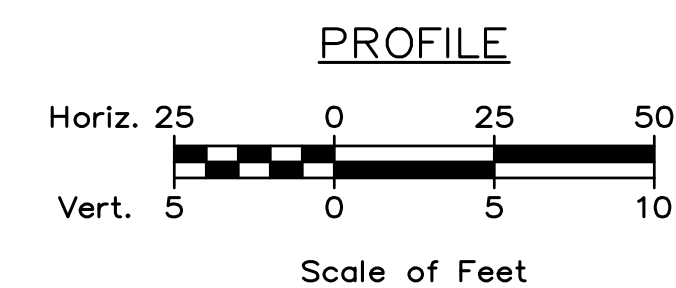
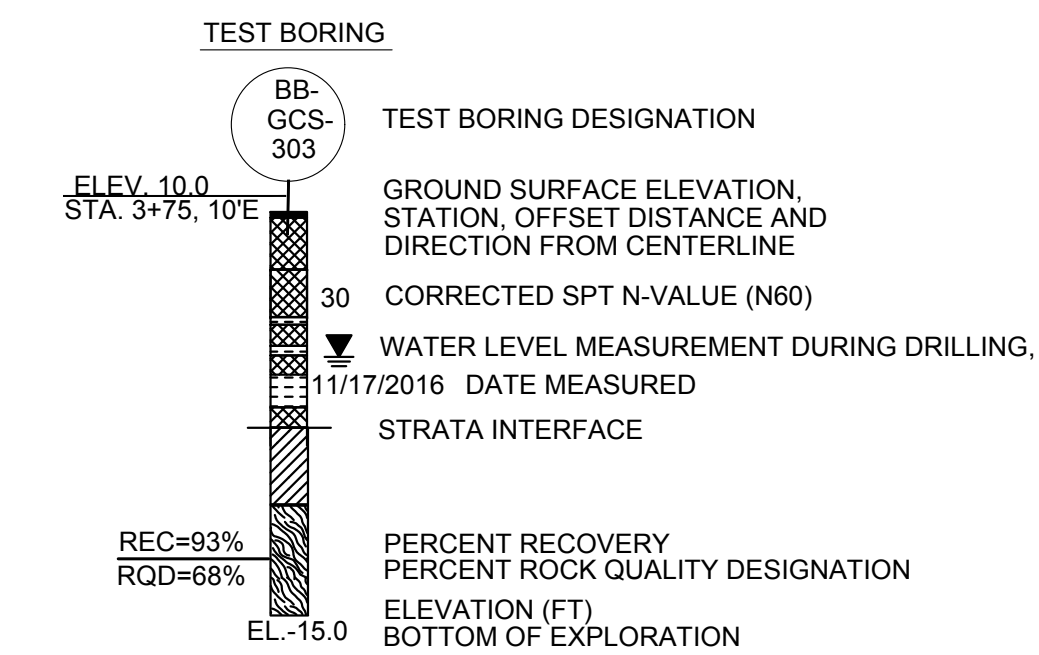
STATE OF MAINE DEPARTMENT OF TRANSPORTATION STP-1873(600)X	DATE		SIGNATURE		P.E. NUMBER	DATE
	MAR 2017		[Signature]			
	[Signature]		[Signature]			
MAIN AVE. BRIDGE COBBOSSECONTEE STREAM KENNEBEC COUNTY GARDINER		PROJ. MANAGER	L. TIMBERLAKE	BY	DATE	SHEET NUMBER 2 OF 6
SITE & SUBSURFACE EXPLORATION LOCATION PLAN		DESIGN-DETAILED	KFP	EAF	MAR 2017	
		CHECKED-REVIEWED	KFP	EAF		
		DESIGN-DETAILED	KFP	EAF		
		DESIGN-DETAILED	KFP	EAF		
		REVISIONS 1				BRIDGE NO. 3098 WIN 18736.00 BRIDGE PLANS
		REVISIONS 2				
		REVISIONS 3				
		REVISIONS 4				
		FIELD CHANGES				



NOTES

1. THE SUBSURFACE PROFILE IS LOCATED ALONG THE EAST SIDE OF THE PROPOSED BRIDGE. STATION AND OFFSET REFERENCE BASELINE STATIONING ALONG THE CENTERLINE OF THE MAINE AVENUE BRIDGE.
2. EXISTING AND PROPOSED GROUND SURFACE ELEVATIONS AND BRIDGE STRUCTURE/SUBSTRUCTURE GEOMETRY WERE TAKEN FROM THE ELECTRONIC FILES PROVIDED BY STANTEC, INC. ON 10 JANUARY 2017.
3. THE "AS DRILLED" TEST BORING LOCATIONS AND ELEVATIONS WERE DETERMINED BY MAINEDOT USING GPS SURVEY EQUIPMENT.
4. LINES REPRESENTING CHANGES IN STRATA ARE BASED ON LINEAR INTERPOLATION BETWEEN SUBSURFACE EXPLORATIONS. THESE INTERPRETED STRATA LINES DO NOT REPRESENT ACTUAL FIELD CONDITIONS OTHER THAN AT SPECIFIC EXPLORATION LOCATIONS. ACTUAL FIELD CONDITIONS ALONG THE SUBSURFACE PROFILE WILL VARY FROM THOSE SHOWN.
5. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
6. TEST BORINGS WERE ADVANCED USING CASSED WASH METHODS BY A COMBINATION OF DRIVING AND SPINNING CASING.

LEGEND



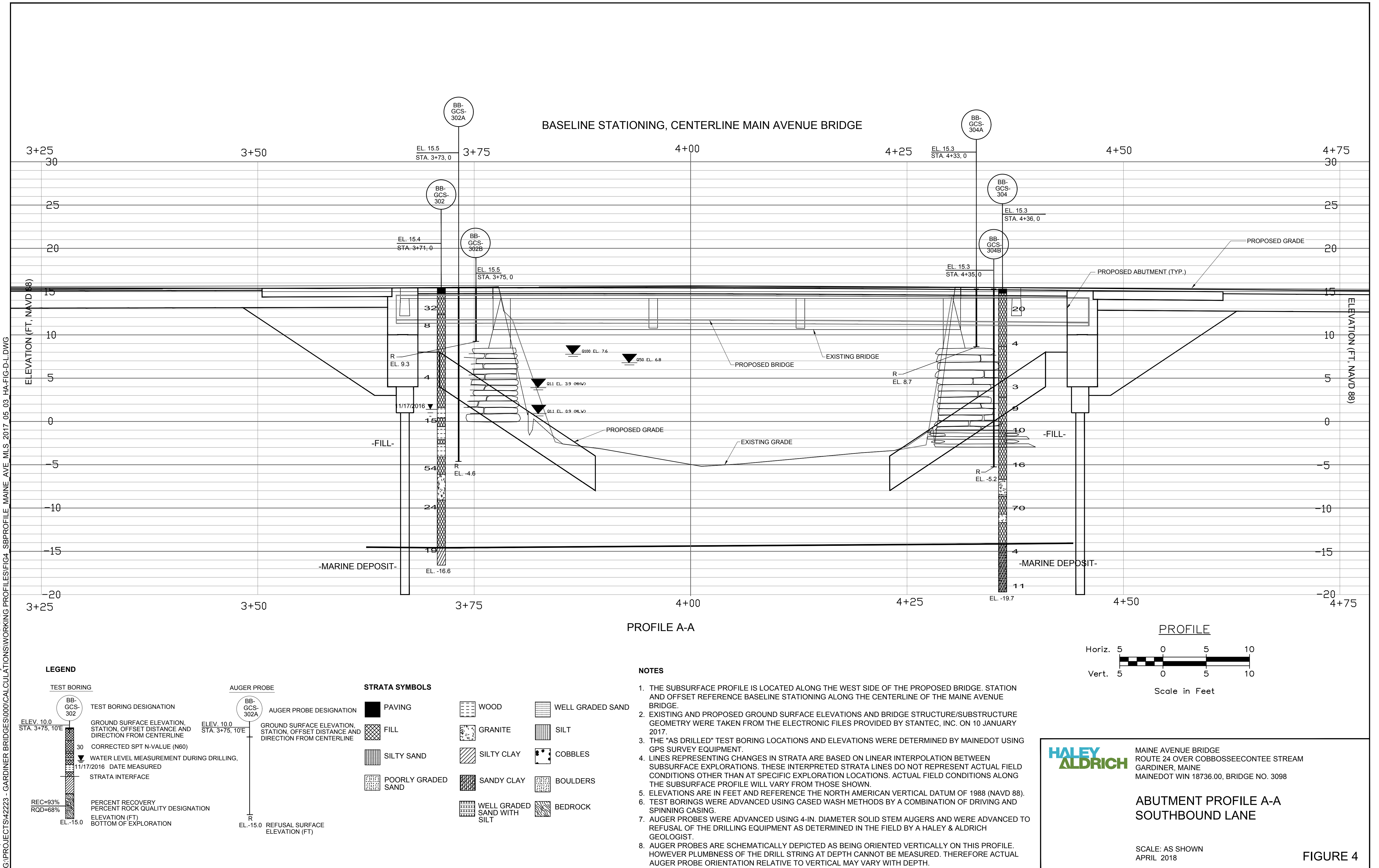
HALEY ALDRICH MAINE AVENUE BRIDGE
ROUTE 24 OVER COBBOSSECONTEE STREAM
GARDINER, MAINE
MAINEDOT WIN 18736.00, BRIDGE NO. 3098

INTERPRETIVE SUBSURFACE PROFILE

SCALE: AS SHOWN
APRIL 2018

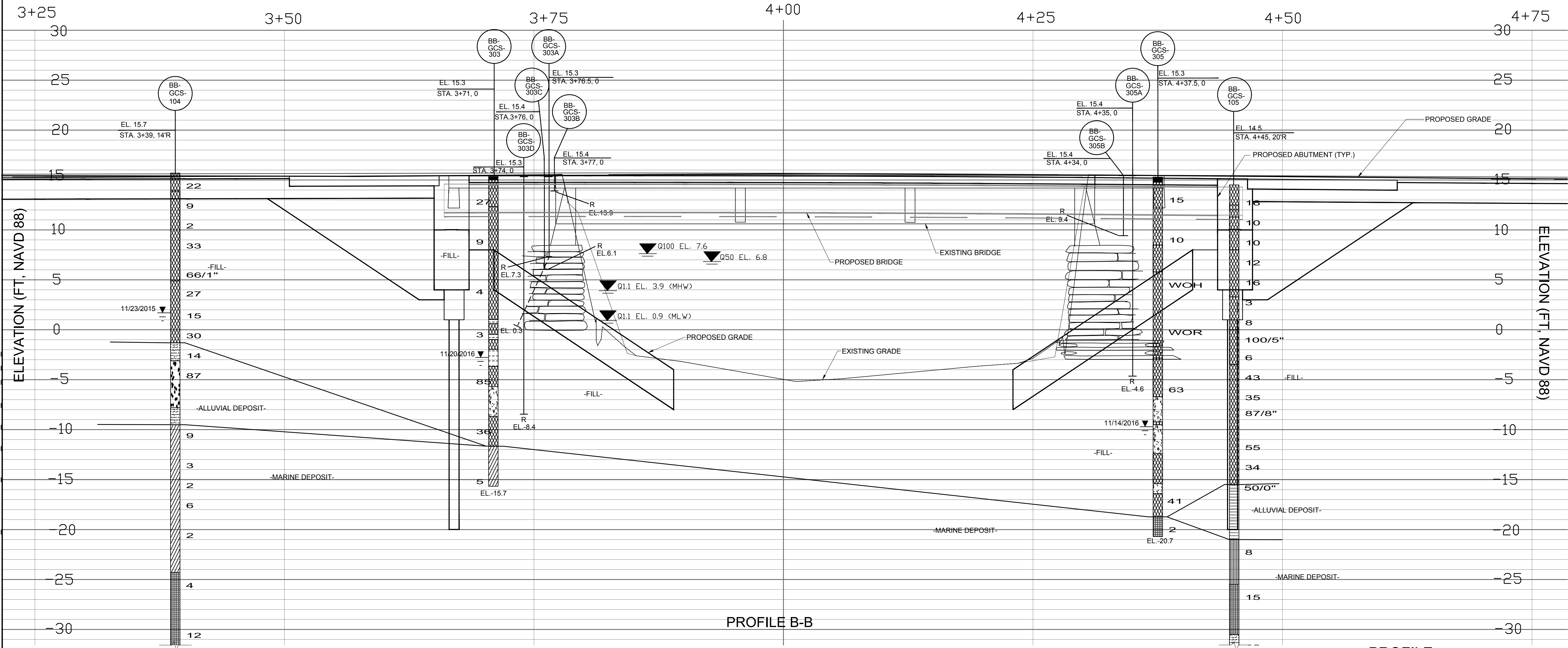
FIGURE 3

SNOW, MARLEIGH
G:\PROJECTS\42223 - GARDINER BRIDGES\000\CALCULATIONS\WORKING PROFILES\FIG4 - SBPROFILE MAINE AVE.MLS.2017.05.03.HA-FIG-D-L.DWG
Printed: 5/4/2017 3:35 PM
Layout: HA-FIG-D-L



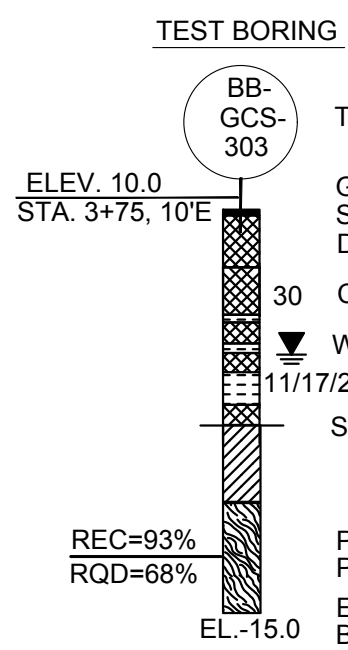
SNOW, MARLEIGH
G:\PROJECTS\42223 - GARDINER BRIDGES\000\CALCULATIONS\WORKING PROFILES\FIG5 - NBPROFILE MAINE AVE MILS 2017 05 04 HA-FIG-D-L.DWG
Layout: 5/4/2017 3:52 PM
Printed: 5/4/2017 3:52 PM

BASELINE STATIONING CENTERLINE MAIN AVENUE BRIDGE



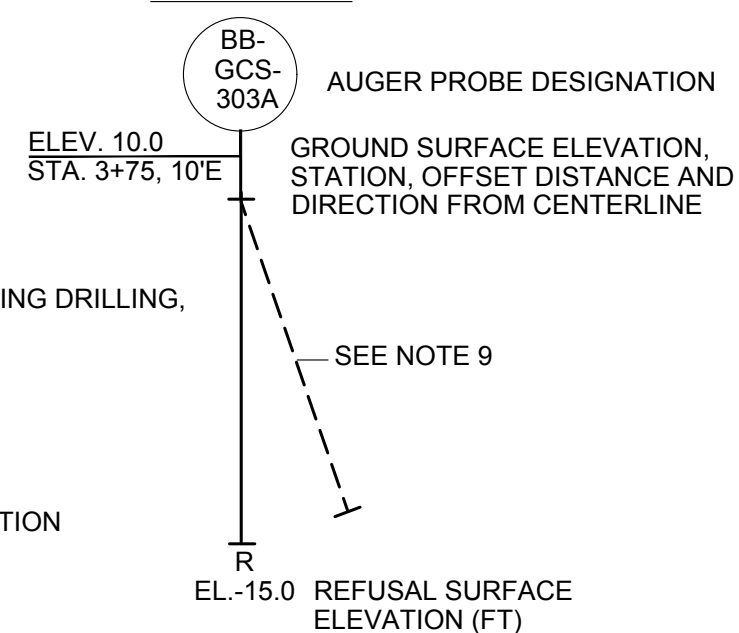
PROFILE B-B

LEGEND

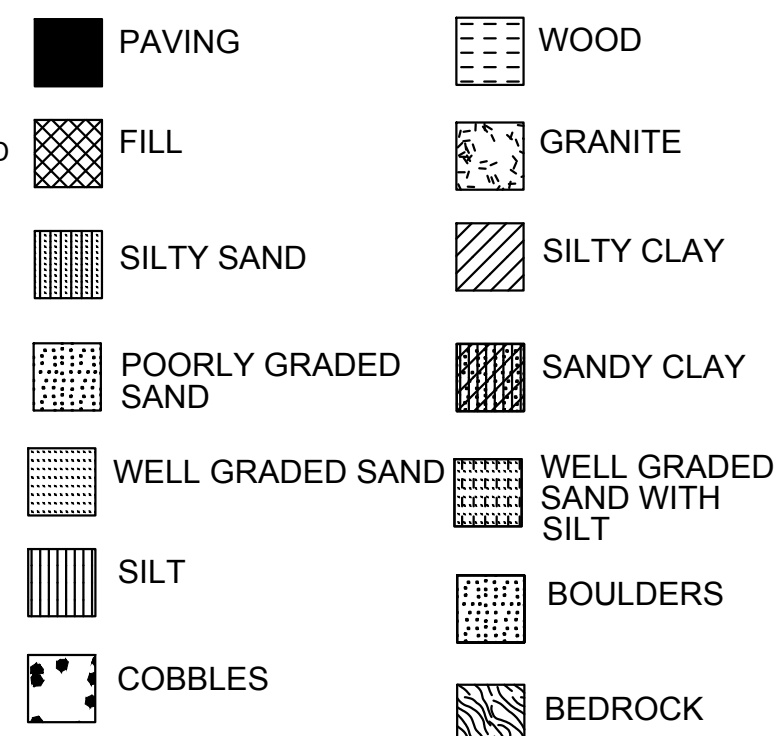


TEST BORING DESIGNATION
GROUND SURFACE ELEVATION, STATION, OFFSET DISTANCE AND DIRECTION FROM CENTERLINE
CORRECTED SPT N-VALUE (N60)
WATER LEVEL MEASUREMENT DURING DRILLING, DATE MEASURED
STRATA INTERFACE
PERCENT RECOVERY
PERCENT ROCK QUALITY DESIGNATION
ELEVATION (FT)
BOTTOM OF EXPLORATION

AUGER PROBE



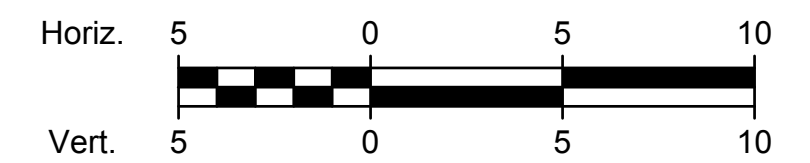
STRATA SYMBOLS



NOTES

1. THE SUBSURFACE PROFILE IS LOCATED ALONG THE EAST SIDE OF THE PROPOSED BRIDGE. STATION AND OFFSET REFERENCE BASELINE STATIONING ALONG THE CENTERLINE OF THE MAINE AVENUE BRIDGE.
2. EXISTING AND PROPOSED GROUND SURFACE ELEVATIONS AND BRIDGE STRUCTURE/SUBSTRUCTURE GEOMETRY WERE TAKEN FROM THE ELECTRONIC FILES PROVIDED BY STANTEC, INC. ON 10 JANUARY 2017.
3. THE "AS DRILLED" TEST BORING LOCATIONS AND ELEVATIONS WERE DETERMINED BY MAINEDOT USING GPS SURVEY EQUIPMENT.
4. LINES REPRESENTING CHANGES IN STRATA ARE BASED ON LINEAR INTERPOLATION BETWEEN SUBSURFACE EXPLORATIONS. THESE INTERPRETED STRATA LINES DO NOT REPRESENT ACTUAL FIELD CONDITIONS OTHER THAN AT SPECIFIC EXPLORATION LOCATIONS. ACTUAL FIELD CONDITIONS ALONG THE SUBSURFACE PROFILE WILL VARY FROM THOSE SHOWN.
5. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
6. TEST BORINGS WERE ADVANCED USING CASED WASH METHODS BY A COMBINATION OF DRIVING AND SPINNING CASING.
7. AUGER PROBES WERE ADVANCED USING 4-IN. DIAMETER SOLID STEM AUGERS AND WERE ADVANCED TO REFUSAL OF THE DRILLING EQUIPMENT AS DETERMINED IN THE FIELD BY A HALEY & ALDRICH GEOLOGIST.
8. AUGER PROBES ARE SCHEMATICALLY DEPICTED AS BEING ORIENTED VERTICALLY ON THIS PROFILE. HOWEVER PLUMBNESS OF THE DRILL STRING AT DEPTH CANNOT BE MEASURED. THEREFORE ACTUAL AUGER PROBE ORIENTATION RELATIVE TO VERTICAL MAY VARY WITH DEPTH.
9. AUGER PROBE BB-GCS-303A ENCOUNTERED AN INCREASE IN RESISTANCE AT A DEPTH OF APPROXIMATELY 8 FT BELOW GROUND SURFACE. BASED ON OBSERVATIONS OF THE DRILL STEM UPON INCREASING DRILL HEAD PRESSURE IT APPEARED THAT THE BOTTOM OF THE AUGER DEFLECTED TO THE SOUTH (AWAY FROM THE ABUTMENT). THE AUGER ADVANCED ALONG THE EDGE OF AN APPARENT STRUCTURE AT AN ANGLE BASED ON OBSERVATIONS OF DRILLING ACTION AND WAS TERMINATED AT A DEPTH OF 15 FT BELOW GROUND SURFACE (NO REFUSAL).

PROFILE



Scale in Feet

HALEY
ALDRICH

MAINE AVENUE BRIDGE
ROUTE 24 OVER COBBOSSEECONTEE STREAM
GARDINER, MAINE
MAINEDOT WIN 18736.00, BRIDGE NO. 3098

ABUTMENT PROFILE B-B NORTHBOUND LANE

SCALE: AS SHOWN
APRIL 2018

FIGURE 5



FIGURE 6

APPENDIX A

Test Boring Logs

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-104 WIN: 18736				
Driller: New England Boring Contractors				Elevation (ft.): 15.7				Auger ID/OD: --				
Operator: M. Porter				Datum: NAVD 88				Sampler: Split Spoon-1.375 in. ID				
Logged By: K. Russ/H. Hollauer				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30-HW/NW300#/24				
Date Start/Finish: 11-23-2015/11-23-2015				Drilling Method: HW/NW Drive				Core Barrel: NQ-2.0 in. ID				
Boring Location: E1142507; N509800				Casing ID/OD: HW-4 in. ID/NW-3 in. ID				Water Level*: 14.0				
Hammer Efficiency Factor: 0.6				Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒								
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample 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				
0	1D	24/15	0.00 - 2.00	4/12/10/6	22	22	HW		13.9	Dark brown, moist, medium dense, fine SAND, little medium sand, trace coarse sand and gravel, poorly graded -FILL-(SP) PID=0.4ppm		
	2D	24/9	2.00 - 4.00	6/6/3/2	9	9				Dark brown, moist, medium dense, silty fine SAND, trace medium to coarse sand -FILL-(SM) PID=0.0ppm	G#365358 (2.0'-4.0') A-4, SM	
5	3D	24/14	4.00 - 6.00	1/1/1/3	2	2				Dark brown, wet, loose, silty fine to coarse SAND, little gravel, contains brick, shells and plastic -FILL-(SM) PID=0.0ppm	G#365329 (4.0'-6.0') A-4, SM	
	4D	24/12	6.00 - 8.00	21/24/9/9	33	33				Dark brown, wet, soft, fine sandy SILT, trace fine gravel, contains brick, coal, ash and roots -FILL-(ML) PID=0.3ppm		
										Brown, wet, hard, fine sandy SILT, trace medium to coarse sand and gravel, contains brick, concrete, wood, roots -FILL-(ML) PID=0.3ppm		
10	MD 5D	1/0 24/7	10.00 - 10.08 10.80 - 12.80	66(1.0") 15/17/10/9	27	27			4.9	Note: Split spoon refusal at 10.0 ft. Advanced roller bit to 10.8 ft. PID=0.0ppm		
										Dark brown, wet, medium dense, fine sandy GRAVEL, little silt, trace medium to coarse sand, loosely bonded -FILL-(GP-GM) PID=0.0ppm	(10.8-17.0'); WC=6.4% ER=3,306 ohm-cm pH=6.1/5.8 Sulfate=250 mg/kg Chloride=<100 mg/kg OC=.3%	
	6D	24/8	13.00 - 15.00	9/9/6/9	15	15				Dark brown, wet, medium dense, silty GRAVEL, trace fine to coarse sand, loosely bonded -FILL-(GM) PID=0.0ppm		
15	7D	24/5	15.00 - 17.00	7/12/18/8	30	30				Dark brown, wet, medium dense, coarse GRAVEL, little silt, trace fine to coarse sand and fine gravel, loosely bonded -FILL-(GM) PID=0.0ppm		
	8D	24/10	17.00 - 19.00	11/4/10/26	14	14			-1.3	Gray, wet, medium dense, medium to fine SAND, little coarse sand, silt and fine gravel, layers of wood chips throughout sample -ALLUVIAL DEPOSIT-(SP) PID=0.0ppm		
	9D	24/12	19.00 - 21.00	18/35/52/60	87	87			-3.1	Note: Rock in tip of split spoon sampler.		
20										Gray, wet, very dense, coarse GRAVEL, little fine sand, trace silt, trace medium to coarse sand, loosely bonded -ALLUVIAL DEPOSIT-(GP) PID=0.0ppm		
25									-7.8			
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 4		
* 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-GCS-104		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-104 WIN: 18736						
Driller: New England Boring Contractors		Elevation (ft.): 15.7		Auger ID/OD: --								
Operator: M. Porter		Datum: NAVD 88		Sampler: Split Spoon-1.375 in. ID								
Logged By: K. Russ/H. Hollauer		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30-HW/NW300#/24								
Date Start/Finish: 11-23-2015/11-23-2015		Drilling Method: HW/NW Drive		Core Barrel: NQ-2.0 in. ID								
Boring Location: E1142507; N509800		Casing ID/OD: HW-4 in. ID/NW-3 in. ID		Water Level*: 14.0								
Hammer Efficiency Factor: 0.6		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒										
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_u = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information							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					
25	10D	24/10	25.00 - 27.00	17/5/4/5	9	9	HW	-9.5		Note: Attempted 3 in. diameter tube sample at 28.0 ft, no penetration or recovery. Olive-gray, wet, soft, silty CLAY -MARINE DEPOSIT-(CL) Note: Attempted 3 in. diameter tube sample at 30.0 ft, no penetration or recovery. Vane shear test attempted at 31.0 ft, no penetration, vane refusal. Gray, wet, very soft, silty CLAY, trace organic seams -MARINE DEPOSIT-(CL) Note: Attempted 3 in. diameter tube sample at 32.0 ft, no penetration. Gray, wet, medium stiff, silty CLAY -MARINE DEPOSIT-(CL) Gray, wet, very soft to soft, silty CLAY, little fine sand at approximately 36.5 ft. -MARINE DEPOSIT-(CL)	#365355 (28.0'-30.0') WC=33% LL=38, PL=18 PI=20 #365356 (32.0'-34.0') WC=29% LL=36, PL=17 PI=19	
	MU	0/0	27.99 - 27.99									
	11D	24/24	28.00 - 30.00	1/1/2/3	3	3						
	MU	0/0	29.95 - 29.95									
30	12D	24/24	30.00 - 32.00	1/1/1/2	2	2						
	MU	0/0	31.95 - 31.95									
	13D	24/24	32.00 - 34.00	2/3/3/4	6	6						
35	14D	24/24	35.00 - 37.00	2/WOH/2/2	2	2						
40	15D	24/24	40.00 - 42.00	4/2/2/2	4	4	NW	-24.3				
45	16D	24/12	45.00 - 47.00	5/7/5/5	12	12						
50								-33.7				
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content												
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 4 Boring No.: BB-GCS-104		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-104 WIN: 18736																							
Driller: New England Boring Contractors				Elevation (ft.): 15.7				Auger ID/OD: --																							
Operator: M. Porter				Datum: NAVD 88				Sampler: Split Spoon-1.375 in. ID																							
Logged By: K. Russ/H. Hollauer				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30-HW/NW300#/24																							
Date Start/Finish: 11-23-2015/11-23-2015				Drilling Method: HW/NW Drive				Core Barrel: NQ-2.0 in. ID																							
Boring Location: E1142507; N509800				Casing ID/OD: HW-4 in. ID/NW-3 in. ID				Water Level*: 14.0																							
Hammer Efficiency Factor: 0.6				Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒																											
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt				R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person				S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected																							
				T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																											
<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																								
50	R1	60/36	50.00 - 55.00				NW				through boulders from 50.0 to 57.0 ft.																				
55	R2	24/14	55.00 - 57.00																												
60	17D	24/10	60.00 - 62.00	26/22/16/17	40	40	NW SPUN																								
65	R3	18/18	65.00 - 66.50																												
	R4	6/6	67.00 - 67.50																												
	R5	12/12	68.00 - 69.00																												
70	18D	18/12	70.00 - 71.50	26/54/118	172	172	NQ																								
75																															

Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 3 of 4	
* 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-GCS-104	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-104 WIN: 18736			
Driller: New England Boring Contractors				Elevation (ft.): 15.7				Auger ID/OD: --			
Operator: M. Porter				Datum: NAVD 88				Sampler: Split Spoon-1.375 in. ID			
Logged By: K. Russ/H. Hollauer				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30-HW/NW300#/24			
Date Start/Finish: 11-23-2015/11-23-2015				Drilling Method: HW/NW Drive				Core Barrel: NQ-2.0 in. ID			
Boring Location: E1142507; N509800				Casing ID/OD: HW-4 in. ID/NW-3 in. ID				Water Level*: 14.0			
Hammer Efficiency Factor: 0.6				Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _{u(lab)} = Lab Vane Undrained Shear Strength (psf) q _u = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							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				
75	R6	60/60	75.00 - 80.00	RQD = 72%						Gray to light gray, fine to medium grained, very hard, slightly weathered SCHIST. Joints dipping at low angles, very close to moderately close, tight to open. Occasional silt infillings and chlorite deposits on joint surfaces, occasional plagioclase/quartz zones. Recovery=100% Rock Mass Quality=Fair R6 Core Times (min:sec): 75.0-76.0' (2:00); 76.0-77.0' (2:15); 77.0-78.0' (2:00); 78.0-79.0'(3:00); 79.0-80.0' (2:30)	UC qp=4,721psi
80	R7	60/57	80.00 - 85.00	RQD = 62%							
85									-69.3	Bottom of Exploration at 85.0 feet below ground surface. Note: 20.0 ft of HW casing abandoned in borehole from approximately 20.0 to 40.0 ft depth.	
90											
95											
100											
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content											
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 4 of 4 Boring No.: BB-GCS-104	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-105 WIN: 18736	
Driller: New England Boring Contractors		Elevation (ft.): 14.5		Auger ID/OD: --			
Operator: M. Porter		Datum: NAVD 88		Sampler: Split Spoon-1.375 in. ID			
Logged By: K. Russ/H. Hollauer		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30-HW/NW300#/24			
Date Start/Finish: 12-01-2015/12-03-2015		Drilling Method: HW/NW Drive		Core Barrel: NQ-2.0 in. ID			
Boring Location: E1142490; N509905		Casing ID/OD: HW-4 in. ID/NW-3 in. ID		Water Level*: Not Observed			
Hammer Efficiency Factor: 0.6		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒					
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt						R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person	
S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected						T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test	

Depth (ft.)	Sample 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				
0	1D	24/21	0.50 - 2.50	10/8/8/5	16	16	HW	14.3		-BITUMINOUS CONCRETE-	
								12.5		Dark brown, dry, medium dense, fine to medium SAND, little coarse sand and gravel, little silt, contains brick fragments	
	2D	24/18	2.50 - 4.50	7/6/4/4	10	10		12.0		-FILL-(SP) PID=0.4ppm	G#365341 (2.5'-4.5') A-2-4, SM
								11.3		Light brown dry, medium dense, fine SAND, little medium SAND, trace coarse sand, little silt	
5	3D	24/10	4.50 - 6.50	5/6/4/3	10	10				-FILL-(SP-SM) PID=0.0ppm	G#365342 (4.5'-6.5') A-1-b, SW-SM
										Brown to dark brown, dry, loose, silty SAND, little fine gravel	
	4D	24/5	6.50 - 8.50	5/6/6/8	12	12		8.0		-FILL-(SM) PID=0.3ppm	
										Light brown, dry, loose, poorly graded SAND, little silt, little fine gravel	
	5D	24/10	8.50 - 10.50	12/10/6/9	16	16				-FILL-(SP-SM) PID=0.4ppm	
										Light brown, dry, loose, well graded SAND, some fine to coarse gravel, little silt	
10	6D	24/16	10.50 - 12.50	2/1/2/2	3	3		4.0		-FILL-(SW-SM) PID=0.3ppm	
								3.3		Light brown, dry, medium dense, fine to coarse SAND, little silt, trace fine gravel	
	7D	24/20	12.50 - 14.50	2/3/5/7	8	8				-FILL-(SM) PID=0.8ppm	
										Brown, dry, medium dense, fine to coarse SAND, some silt, trace fine to coarse gravel	
	8D	5/1	14.50 - 14.92	100(5.0")				0.0		-FILL-(SM)	
15										Olive-gray, wet, soft, silty CLAY	
								-1.5		-FILL-(CL) PID=48.0 ppm	
	9D	24/5	16.00 - 18.00	3/4/2/4	6	6				Gray, wet, soft, fine sandy SILT	
								-3.5		-FILL-(ML) PID=53.2ppm	
	10D	24/9	18.00 - 20.00	10/12/31/19	43	43				Gray, wet, soft, fine sandy SILT	
									-FILL-(ML) PID=47.0ppm		
20									Wood, 1-in. recovery of gray silty CLAY, some gravel		
	11D	24/7	20.00 - 22.00	36/20/15/22	35	35			-FILL-(CL) PID=9.7ppm	(20.0-29.0'); WC=2.7% ER=3,822 pH=6.3/6.1 Sulfate=912 mg/kg Chloride=<100 mg/kg OC=.3%	
									Note: Advanced roller bit through wood 14.5 to 16.0 ft.		
									Olive-gray, wet, medium stiff, silty CLAY, petroleum-like odor, contains saw dust		
	12D	14/7	22.00 - 23.17	46/37/50(2.0")	87	87			-FILL-(CL) PID=5.6ppm		
25									Brownish-gray, wet, dense, gravelly fine to coarse SAND, trace silt		
									-FILL-(SW)		

Remarks:

 Notes:
 1. ER = Electrical Resistivity
 2. OC = Organic Content

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 4

Boring No.: BB-GCS-105

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobscookseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-105 WIN: 18736					
Driller: New England Boring Contractors		Elevation (ft.): 14.5		Auger ID/OD: --							
Operator: M. Porter		Datum: NAVD 88		Sampler: Split Spoon-1.375 in. ID							
Logged By: K. Russ/H. Hollauer		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30-HW/NW300#/24							
Date Start/Finish: 12-01-2015/12-03-2015		Drilling Method: HW/NW Drive		Core Barrel: NQ-2.0 in. ID							
Boring Location: E1142490; N509905		Casing ID/OD: HW-4 in. ID/NW-3 in. ID		Water Level*: Not Observed							
Hammer Efficiency Factor: 0.6		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _u = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							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				
25	MD	24/0	25.00 - 27.00	27/23/32/19	55	55	HW			PID=3.3ppm Brownish-gray, wet, dense, fine to coarse SAND, some gravel, trace silt -FILL-(SW) PID=1.6ppm Brownish-gray, wet, very dense, coarse GRAVEL, little medium to coarse sand and fine gravel, trace silt, poorly graded -FILL-(GP) No recovery, probable cobbles -FILL- Brownish-gray, wet, dense, fine to coarse SAND and GRAVEL, trace silt, well graded -FILL-(SW/GW) Note: Drill action and driller observations indicate strata change at 30.0 ft. -PROBABLE ALLUVIAL DEPOSIT- (Based on drill action)	G#365343 A-4, ML
	13D	24/8	27.00 - 29.00	15/13/21/44	34	34					
30	MD	0/0	30.00 - 30.00	50(0")				-15.5			
35	14D	24/24	35.50 - 37.50	5/5/3/4	8	8		-21.0	Gray, wet, loose, sandy SILT -MARINE DEPOSIT-(ML)		
40	15D	24/9	40.00 - 42.00	9/6/9/7	15	15		-25.5	Gray, wet, medium dense, silty fine SAND -MARINE DEPOSIT-(SM)		
45	16D	24/8	45.00 - 47.00	14/9/3/3	12	12		-30.5	Gray, wet, medium dense, fine SAND, trace silt -MARINE DEPOSIT-(SP)		
50											
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content											
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 4 Boring No.: BB-GCS-105	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-105 WIN: 18736					
Driller: New England Boring Contractors		Elevation (ft.) 14.5		Auger ID/OD: --							
Operator: M. Porter		Datum: NAVD 88		Sampler: Split Spoon-1.375 in. ID							
Logged By: K. Russ/H. Hollauer		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30-HW/NW300#/24							
Date Start/Finish: 12-01-2015/12-03-2015		Drilling Method: HW/NW Drive		Core Barrel: NQ-2.0 in. ID							
Boring Location: E1142490; N509905		Casing ID/OD: HW-4 in. ID/NW-3 in. ID		Water Level*: Not Observed							
Hammer Efficiency Factor: 0.6		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _u = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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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				
50							HW				
55	MD	24/0	55.50 - 57.50	15/9/9/4	18	18		-40.5 -40.9		-COBBLE- Note: Drill action indicates cobble. No recovery	
60	17D	4/4	60.00 - 60.33	100(4.0")			NW SPUN	-44.5 -45.8		Note: Drill action indicates strata change at 59.0 ft. Gray, wet, very dense, gravelly fine SAND, little medium to coarse sand, trace silt, moderately bonded -GLACIAL TILL-(SP)	
65	18D	5/2	65.50 - 65.92	50(5.0")				-48.3 -48.6 -50.2 -51.0		-BOULDER- Note: Drill action indicates boulders from approximately 60.3 to 62.8 ft and 63.1 to 64.7 ft. -GLACIAL TILL- -BOULDER- -GLACIAL TILL-	
70	R1	60/60	69.00 - 74.00	RQD = 20%			NQ	-52.5		Gray, wet, very dense, fine to coarse SAND, some gravel, little silt, moderately bonded -GLACIAL TILL-(SW-SM) Advanced roller bit to 69.0 ft, begin NQ rock core Top of Bedrock at El. -52.5	
75	R2	60/54	74.00 - 79.00	RQD = 35%						Gray, fine to coarse grained SCHIST, soft to hard, fresh to severely weathered. Joints very close, horizontal to moderately dipping, tight. Light gray-white-green, quartz veins 1 to 3 in. thickness. Highly weathered zone at approximately 71.3 to 71.8 ft. Recovery=100% Rock Mass Quality=Very Poor R1 Core Times (min:sec): 69.0-70.0' (1:30); 70-71.0' (1:30); 71.0-72.0' (1:40); 72.0-73.0'(1:50); 73.0-74.0' (1:40) Dark gray, fine to coarse grained SCHIST, soft to hard, fresh to moderately severely weathered. Joints very close to close, dipping at	
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content											
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 4 Boring No.: BB-GCS-105	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Bridges Over Cobbosseecontee Stream			Boring No.: BB-GCS-105																																																																																																																																																																																	
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-203 WIN: 18736	
Driller: New England Boring Contractors		Elevation (ft.): 14.3		Auger ID/OD: HSA-2-1/4 in. ID			
Operator: M. Porter		Datum: NAVD 88		Sampler: Split Spoon-1.375 in. ID			
Logged By: K. Russ		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30			
Date Start/Finish: 11-30-2015/11-30-2015		Drilling Method: Auger		Core Barrel: --			
Boring Location: E1142394; N509896		Casing ID/OD: --		Water Level*: 13.5			
Hammer Efficiency Factor: 0.6		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒					
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt						R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person	
S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected						T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test	

Depth (ft.)	Sample 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				
0	1D	24/12	0.00 - 2.00	5/6/8/6	14	14	HSA		12.5	Olive-brown, moist, medium dense, fine SAND, little silt, trace medium sand, trace fine gravel, poorly graded -FILL-(SP-SM) PID=0.1ppm		
	2D	24/13	2.00 - 4.00	3/8/6/4	14	14			10.7	Olive-brown, dry, medium dense, fine SAND, some medium to coarse sand and gravel, little silt -FILL-(SW-SM) PID=0.1ppm		
5	3D	24/13	4.00 - 6.00	10/8/6/4	14	14			10.3	Olive-brown, dry, stiff, fine sandy SILT -FILL-(ML) PID=0.1ppm		
	4D	24/2	6.00 - 8.00	5/4/3/5	7	7			5.8	Olive-brown, dry, medium dense, silty fine SAND, little medium to coarse sand, trace fine gravel -FILL-(SM) PID=0.1ppm		
	5D	24/9	8.00 - 10.00	9/11/3/3	14	14			4.3	Olive-brown, dry, loose, silty fine SAND, little medium sand, trace coarse sand, trace fine gravel -FILL-(SM) PID=0.4ppm		
10	6D	24/6	10.00 - 12.00	1/2/69/43	71	71			2.3	Olive-brown, dry, medium dense, silty fine SAND, little medium to coarse sand, trace coarse gravel -FILL-(SM) PID=0.5ppm		
	MD	24/0	12.00 - 14.00	4/4/5/4	9	9			10.0	Olive-brown, dry, medium dense, fine to coarse sandy GRAVEL, trace silt -FILL-(GW) PID=2.4ppm		
15	7D	24/16	14.00 - 16.00	3/5/5/6	10	10			12.0	Black, moist, very dense, gravelly fine to coarse SAND, little silt, contains cardboard fabric -FILL-(SW-SM) PID=0.1ppm		
	8D	24/10	16.00 - 18.00	11/17/10/33	27	27			-3.7	No recovery, wet(split spoon sampler), wood fragment in spoon tip -FILL- Recovered 16 in. wood, strong gasoline-like odor PID=382.0ppm Similar to above PID=8.0ppm		
20										Bottom of Exploration at 18.0 feet below ground surface.		
25												

Remarks:

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

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

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Boring No.: BB-GCS-203

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Bridges Over Cobbosseecontee Stream Location: Gardiner, Maine			Boring No.: BB-GCS-204 WIN: 18736																																																																																																																																																																																																				
Driller: New England Boring Contractors			Elevation (ft.): 14.1			Auger ID/OD: HSA-2-1/4 in. ID																																																																																																																																																																																																							
Operator: M. Porter			Datum: NAVD 88			Sampler: Split Spoon-1.375 in. ID																																																																																																																																																																																																							
Logged By: K. Russ			Rig Type: Mobile B53 Truck			Hammer Wt./Fall: SS-140#/30																																																																																																																																																																																																							
Date Start/Finish: 11-30-2015/11-30-2015			Drilling Method: Auger			Core Barrel: --																																																																																																																																																																																																							
Boring Location: E1142454; N509782			Casing ID/OD: --			Water Level*: 12.0																																																																																																																																																																																																							
Hammer Efficiency Factor: 0.6			Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☒																																																																																																																																																																																																										
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-302 WIN: 18736.00					
Driller: New England Boring Contractors		Elevation (ft.): 15.4		Auger ID/OD: --							
Operator: C. Dupuis		Datum: NAVD 88		Sampler: Split Spoon-1.375 in.ID							
Logged By: M. Snow		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30;HW/NW-300#/24							
Date Start/Finish: 11-17-16/11-17-16		Drilling Method: NW Drive		Core Barrel: NQ-2.0 in.ID							
Boring Location: E1142472; N509826		Casing ID/OD: NW-3.0 in.ID		Water Level*: 14.0							
Hammer Efficiency Factor: 0.569		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐									
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0							SSA	14.8		-BITUMINOUS CONCRETE-	
	1D	24/14	1.00 - 3.00	24/16/18/12	34	32				Brown, dry, dense, fine to coarse SAND and GRAVEL, trace silt, well graded -FILL-(SW/GW) PID=0.0 ppm	
	2D	24/15	3.00 - 5.00	4/4/4/5	8	8				Brown, dry to moist, medium stiff, SILT, little fine to coarse sand, trace gravel, contains ash, coal -FILL-(ML) PID=0.0 ppm	
5							NW Spun				
	3D	24/16	9.00 - 11.00	4/2/2/5	4	4				Brown, moist, soft, SILT, some fine to coarse sand, trace gravel -FILL-(ML) PID=0.6 ppm	G#406888 (9.0'-11.0') A-4(0) ML
	4D	24/7	14.00 - 16.00	43/12/4/5	16	15				Note: Wood in wash water and high resistance at approximately 13.8 ft. -WOOD- PID=37 ppm Light brown, wet, medium dense, WOOD (5 in.) Dark brown SILT (2 in.), trace organics in spoon tip -FILL-(ML)	
15											
	5D	24/12	19.50 - 21.50	40/28/29/29	57	54				Note: Increased resistance remains constant to approximately 17.5 ft. Note: Less resistance from 17.5 to 18.0 ft - probable soil. Note: Increased resistance from 18.0 to 19.5 ft. Wood observed in wash water.	
20											
	6D	24/4	24.00 - 26.00	49/16/9/10	25	24				Gray-brown, wet, very dense, GRAVEL, some fine to coarse sand, trace silt, granite pieces, well graded -FILL-(GW) PID=0.0 ppm Note: High resistance on drill head from 21.5 to 24.5 ft.	
25										-PROBABLE GRANITE-	
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 2	
* 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-GCS-302	

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-303 WIN: 18736.00			
Driller: New England Boring Contractors				Elevation (ft.): 15.3				Auger ID/OD: --			
Operator: C. Dupuis				Datum: NAVD 88				Sampler: Split Spoon-1.375 in.ID			
Logged By: M. Snow				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30;NW-300#/24			
Date Start/Finish: 11-20-16/11-20-16				Drilling Method: NW Drive				Core Barrel: NQ-2.0 in.ID			
Boring Location: E1142486; N509828				Casing ID/OD: NW-3.0 in.ID				Water Level*: 18.1 ft			
Hammer Efficiency Factor: 0.569				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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0								15.0		-BITUMINOUS CONCRETE-	
	1D	24/18	1.00 - 3.00	19/19/9/8	28	27				Note: Brown, dry, fine to medium SAND, little coarse sand and gravel (SW) observed in auger cuttings from 0.5 to 1.0 ft. Brown, dry, medium dense, fine to coarse SAND, little silt, little gravel	
								12.3		-FILL-(SW-SM) -PID=0.0 ppm	
										- - - - - 3.0	
5	2D	24/22	5.00 - 7.00	4/5/4/7	9	9				Note: Dark gray-brown sandy SILT (ML) observed in auger cuttings from 3.0 to 4.0 ft. Brown-gray, dry to moist, stiff, SILT, little clay, trace fine sand	(5-12'); WC=22.0% ER=744 ohm-cm pH=7.7/6.9 Sulfate=115 mg/kg Chloride=<100 mg/kg OC=1.2%
										-FILL-(ML) (reworked native soil) PID=0.0 ppm	
10	3D	24/22	10.00 - 12.00	WOH/2/2/2	4	4				Brown, moist, soft, silty CLAY, little fine sand	
										-FILL-(CL) (reworked native soil) PID=0.0 ppm	
15	4D	24/22	14.30 - 16.30	4/1/2/5	3	3			1.0	-WOOD-	
								0.6		-WOOD-	
										Dark brown, wet, soft, SILT, trace organics, organic odor	
								-0.5		-FILL-(ML)	
								-1.0		-PID=0.0 ppm	
										- - - - - 15.8	
								-2.0		-WOOD-	
										Note: Drill action indicates easy penetration from 16.3 to 17.3 ft.	
										- - - - - 16.3	
										- - - - - 17.3	
20	5D	24/12	19.00 - 21.00	18/50/40/37	90	85			-3.7	Note: Increased resistance from 17.3 to 18.5 ft. Washed ahead of casing from 18.5 to 19.0 ft. Wood in wash water from 18.5 to 19.0 ft.	G#406889 (19.0'-21.0') (A-1-a(1)), GW-GM
										-WOOD-	
										- - - - - 19.0	
										Gray, wet, very dense, GRAVEL, some fine to coarse sand, trace silt, granite pieces	
								-5.7		-FILL-(GW-GM) PID=0.0 ppm	
										- - - - - 21.0	
										Note: High resistance from 21.0 to 24.0 ft, granite chips in wash water.	
25	6D	24/7	24.00 - 26.00	25/29/9/8	38	36			-8.7	-GRANITE-	
										- - - - - 24.0	
Remarks: Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content 2. OC = Organic Content											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 2	
* 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-GCS-303	

Maine Department of Transportation <u>Soil/Rock Exploration Log</u> <u>US CUSTOMARY UNITS</u>				Project: Bridges over Cobbosseecontee Stream		Boring No.: BB-GCS-303					
				Location: Gardiner, Maine		WIN: 18736.00					
Driller: New England Boring Contractors		Elevation (ft.) 15.3		Auger ID/OD: --							
Operator: C. Dupuis		Datum: NAVD 88		Sampler: Split Spoon-1.375 in.ID							
Logged By: M. Snow		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30;NW-300#/24							
Date Start/Finish: 11-20-16/11-20-16		Drilling Method: NW Drive		Core Barrel: NQ-2.0 in.ID							
Boring Location: E1142486; N509828		Casing ID/OD: NW-3.0 in.ID		Water Level*: 18.1 ft							
Hammer Efficiency Factor: 0.569		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐									
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25							SSA	-11.7		Gray, wet, dense, GRAVEL, little fine to coarse sand, little silt, trace clay in spoon tip -FILL-(GW-GM) PID=0.0 ppm Note: Drill action indicates less resistance at 27.0 ft. Gray, wet, medium stiff, silty CLAY -MARINE DEPOSIT-(CL) Bottom of Exploration at 31.0 feet below ground surface. No Refusal	
30	7D	24/24	29.00 - 31.00	4/2/3/2	5	5		-15.7			
35											
40											
45											
50											
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-303D WIN: 18736.00																																																																																																																																																																																																																																																																																																																																																																																								
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	0							SSA	14.8	-BITUMINOUS CONCRETE-			1D	24/12	1.00 - 3.00	4/11/10/13	21	20			Brown, dry, medium dense, fine to coarse SAND, some gravel, trace silt, well graded -FILL-(SW-SM) PID=51.9 ppm	(12.5-21.0'); WC=16.1% ER=3,306 ohm-cm pH=6.6/6.2 Sulfate=173 mg/kg Chloride=500 mg/kg OC=1.2%	5												2D	24/12	5.00 - 7.00	7/2/2/2	4	4		8.7	Brown, dry, loose, fine to coarse SAND, some gravel, trace silt, well graded -FILL-(SW) PID=4.1 ppm											Light brown, moist, soft, sandy SILT, trace clay, strong petroleum-like odor -FILL-(ML)		10									No Recovery			3D	24/0	10.00 - 12.00	2/1/2/8	3	3	HW Drive																4D	24/14	12.50 - 14.50	10/5/5/5	10	9		2.8	Brown-gray, wet, stiff, mottled, silty CLAY, little coarse sand and gravel, slight petroleum-like odor -FILL-(CL) (reworked native soil) PID=2.3 ppm Note: 5 ft of casing broke off in hole (10.0 to 15.0 ft). Relocate boring 1.0 ft north. 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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-304 WIN: 18736.00																							
Driller: New England Boring Contractors				Elevation (ft.): 15.3				Auger ID/OD: --																							
Operator: C. Dupuis				Datum: NAVD 88				Sampler: Split Spoon-1.375 in.ID																							
Logged By: M. Snow				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30;HW/NW-300#/24																							
Date Start/Finish: 11-15-16/11-16-16				Drilling Method: HW/NW Drive				Core Barrel: NQ-2.0 in.ID																							
Boring Location: E1142457; N509889				Casing ID/OD: HW-4.0 in.ID/NW-3.0 in.ID				Water Level*: Not observed																							
Hammer Efficiency Factor: 0.569				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐																											
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt				R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person				S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected																							
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25							NW Spun	-10.7		Gray, wet, very dense, sandy GRAVEL, little silt, granite pieces, wood fragments -FILL-(GW-GM) PID=0.0 ppm	G#406890 (24.0'-26.0') (A-1-a(0)), GW-GM																				
								-11.7		Note: Granite chips in wash water. -PROBABLE GRANITE-																					
												Note: Probable granular fill based on drill action from 27.0 to 29.0 ft.																			
	8D	24/0	29.00 - 31.00	9/3/1/2	4	4		-14.2		Trace gray, wet, very loose, silty fine SAND, in spoon tip -FILL-(SM) PID=0.0 ppm																					
30												Note: Change at 29.5 ft based on driller observations.																			
	9D	24/18	33.00 - 35.00	2/3/9/11	12	11						Gray, wet, medium dense, silty fine SAND with clayey sand layers, occasional silt lenses -MARINE DEPOSIT-(SM/SC) PID=0.0 ppm																			
35								-19.7				Bottom of Exploration at 35.0 feet below ground surface. No Refusal																			
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Notes: 1. ER = Electrical Resistivity 2. OC = Organic Content																															
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-304A WIN: 18736.00																																																																																																																																						
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-304B WIN: 18736.00																																																																																																																																																			
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Operator: C. Dupuis		Datum: NAVD 88		Sampler: --																																																																																																																																																					
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Date Start/Finish: 11-15-16/11-15-16		Drilling Method: Solid Stem Auger		Core Barrel: --																																																																																																																																																					
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-305 WIN: 18736.00			
Driller: New England Boring Contractors				Elevation (ft.): 15.3				Auger ID/OD: --			
Operator: C. Dupuis				Datum: NAVD 88				Sampler: Split Spoon-1.375 in.ID			
Logged By: M. Snow				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30;HW/NW-300#/24			
Date Start/Finish: 11-13/16/11-14/16				Drilling Method: HW/NW Drive				Core Barrel: NQ-2.0 in.ID			
Boring Location: E1142472; N509893				Casing ID/OD: HW-4.0 in.ID/NW-3.0 in.ID				Water Level*: 25.0			
Hammer Efficiency Factor: 0.569				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											

Depth (ft.)	Sample 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				
0							SSA	14.8		-BITUMINOUS CONCRETE-	
	1D	24/10	1.00 - 3.00	16/8/8/8	16	15				Brown, dry, medium dense, fine to coarse SAND, some gravel, trace silt, well graded -FILL-(SW) PID=0.9 ppm	0.5
5	2D	24/12	5.00 - 7.00	6/6/5/3	11	10	23			Brown, dry, loose, fine to coarse SAND, some gravel, trace silt, well graded -FILL-(SW) PID=0.5 ppm	8.5
10	3D	24/18	10.00 - 12.00	WOH/WOH/WOH/2			8		Note: Brown silty CLAY with sand and gravel observed in wash water at 9.5 ft. Olive-brown, wet, very soft, silty CLAY, trace fine sand -FILL-(CL) PID=0.0 ppm	9.5	
							7				
							7				
							6				
							5				
15	4D	24/18	15.00 - 17.00	WOR/WOR/WOR/ WOH			4		Gray, wet, very soft, silty CLAY, trace fine sand -FILL-(CL) PID=0.0 ppm		
							6				
							6				
							6				
							10		Note: Drill action indicates change at 18.1 ft - clay with gravel in wash water, wood pieces.	18.1	
20	5D	24/16	20.00 - 22.00	30/27/39/33	66	63	35		Brown-gray, very dense, GRAVEL, some fine to coarse sand, trace silt, well graded, contains 2 to 3 in. wood pieces -FILL-(SW) PID=2.7 ppm		
							95				
							130		Note: Granite chips observed in wash water from 22.0 to 24.5 ft. Advanced roller bit ahead of casing to 25.0 ft. Drill action indicates probable granular fill from 24.5 to 24.8 ft. Probable granite from 24.8 to 25.1 ft.	22.0	
							108				
25							47			24.5	

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 1 of 2
Boring No.: BB-GCS-305

[illegible]

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-305B WIN: 18736.00					
Driller: New England Boring Contractors		Elevation (ft.): 15.4		Auger ID/OD: --							
Operator: C. Dupuis		Datum: NAVD 88		Sampler: --							
Logged By: M. Snow		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: --							
Date Start/Finish: 11-15-16/11-15-16		Drilling Method: Solid Stem Auger		Core Barrel: --							
Boring Location: E1142473; N509890		Casing ID/OD: --		Water Level*: Dry							
Hammer Efficiency Factor: --		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☐									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt		R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person		S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected							
		T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
Depth (ft.)	Sample 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	15.0	-BITUMINOUS CONCRETE- Note: Observations below based on auger cuttings and drill action. Brown, granular -FILL-(SW) -----4.5 Brown -PROBABLE COHESIVE FILL-(ML) -----5.5 Brown -PROBABLE GRANULAR FILL-(SW) -----6.0 Bottom of Exploration at 6.0 feet below ground surface. Auger refusal at 6.0 ft. Square granite corner piece in auger tip. Refusal on granite.		
5											
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											
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Page 1 of 1											
Boring No.: BB-GCS-305B											

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-306 WIN: 18736.00			
Driller: New England Boring Contractors				Elevation (ft.): 13.8				Auger ID/OD: --			
Operator: C. Dupuis				Datum: NAVD 88				Sampler: Split Spoon-1.375 in.ID			
Logged By: M. Snow				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30;NW-300#/24			
Date Start/Finish: 11-21-16/11-21-16				Drilling Method: NW Spun				Core Barrel: NQ-2.0 in.ID			
Boring Location: E1142501; N509900				Casing ID/OD: NW-3.0 in.ID				Water Level*: 16.4			
Hammer Efficiency Factor: 0.569				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample 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				
0							SSA	13.6		0.2	
	1D	24/8	1.00 - 3.00	3/2/1/1	3	3			Dark brown, dry, very loose, firm to medium SAND, some gravel, trace coarse sand, trace silt, contains coal and ash -FILL-(SW) PID=0.0 ppm		
5							NW Spun	8.8		5.0	
	2D	24/7	5.00 - 7.00	9/10/14/17	24	23			Dark brown, dry, medium dense, fine to coarse SAND, some gravel, trace silt, contains wood pieces (1 to 3-in. thick) -FILL-(SW)/-WOOD- PID=0.0 ppm Note: Spin NW casing through wood from 5.0 to 6.5 ft.		
								7.3		6.5	
									-GRANULAR FILL-		
10							NQ Core	3.8		10.0	
	R1	55/55	10.00 - 14.58						-CONCRETE-(Granite Aggregate 0.25 to 1-in. diameter)		
15									-CONCRETE-		
	R2	22/22	14.60 - 16.43								
	3D	24/6	16.40 - 18.40	WOH(10.0)/1(9.0) /50(5.0)				-2.6	Gray, wet, very dense, GRAVEL, some silt, little fine to coarse sand -FILL-(GM) PID=0.0 ppm	16.4	
								-4.6		18.4	
									Bottom of Exploration at 18.4 feet below ground surface. Refusal at 18.4 ft		
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 1 Boring No.: BB-GCS-306	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-306A WIN: 18736.00					
Driller: New England Boring Contractors		Elevation (ft.): 13.7		Auger ID/OD: --							
Operator: C. Dupuis		Datum: NAVD 88		Sampler: --							
Logged By: M. Snow		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: --							
Date Start/Finish: 11-28-16/11-28-16		Drilling Method: NW Drive		Core Barrel: --							
Boring Location: E1142503; N509903		Casing ID/OD: NW-3.0 in.ID		Water Level*: Dry							
Hammer Efficiency Factor: --		Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☐									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt		R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person		S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected							
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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.)			
0							SSA	13.5	BITUMINOUS CONCRETE- Note: Observations below based on auger cuttings and drill action. Dark brown, dry, fine to coarse SAND, some gravel, trace silt, contains coal pieces	0.2	
5							NW Spun	8.0			
								6.8	Note: Increased resistance at 5.7 ft. Advance rollerbit ahead of casing. Losing water at 6.4 ft. Water returned at 6.9 ft. Granite and concrete chips observed in wash water -CONCRETE-(Granite Aggregate)	5.7	
									Bottom of Exploration at 6.9 feet below ground surface. Boring terminated in concrete	6.9	
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.											
Page 1 of 1										Boring No.: BB-GCS-306A	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine		Boring No.: BB-GCS-306B WIN: 18736.00	
Driller: New England Boring Contractors		Elevation (ft.): 13.6		Auger ID/OD: --			
Operator: C. Dupuis		Datum: NAVD 88		Sampler: Split Spoon-1.375 in.ID			
Logged By: M. Snow		Rig Type: Mobile B53 Truck		Hammer Wt./Fall: SS-140#/30;NW-300#/24			
Date Start/Finish: 11-28-16/11-28-16		Drilling Method: NW Drive/NW Spun		Core Barrel: NQ-2.0 in.ID			
Boring Location: E1142502; N509905		Casing ID/OD: NW-3.0 in.ID		Water Level*: 10.1			
Hammer Efficiency Factor: 0.569		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐					
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test							

Depth (ft.)	Sample 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				
0							SSA	13.4		-BITUMINOUS CONCRETE-	0.2
								10.1		Note: Observed from auger cuttings from 0 to 5.0 ft. Dark brown, dry, fine to coarse SAND, some gravel, trace silt, contains coal and brick pieces	
5							NW Spun			Note: Increased resistance at 3.5 ft. Spin NW casing to 4.0 ft. Advance roller bit to 5.0 ft. Observed granite chips and sand in wash water.	-3.5
								6.8		-CONCRETE-(Granite Aggregate)	
								6.6		Note: Advanced through concrete at 6.8 ft. Soil encountered from 6.8 to 7.0 ft.	-6.8
								7.0		-CONCRETE-(Granite Aggregate)	
10								3.6		Note: Probable soil from 10.0 to 11.6 ft based on drill action.	-10.0
								2.0		-CONCRETE-(Granite Aggregate)	
15	1D	24/5	14.00 - 16.00	41/33/18/14	51	48		0.1		Note: Drill action indicates change at 13.5 ft to soil.	-13.5
								-0.4		Brown, wet, very dense -WOOD-	-14.0
	2D	24/10	16.00 - 18.00	6/5/46/14	51	48		-2.4		Gray-brown, wet, very dense, weathered rock pieces, some fine to medium sand, trace coarse sand, trace silt	-16.0
										-FILL-(GW)	
20	3D	24/10	19.00 - 21.00	33/25/32/32	57	54				Gray-brown, wet, very dense, GRAVEL, little fine to coarse sand, trace silt	-21.5
										-FILL-(GW)	
								-7.9		Note: Increased resistance from 21.5 to 24.0 ft. Granite chips observed in wash water.	-21.5
								-10.4		Gray, wet, dense, silty GRAVEL, little fine to coarse sand	-24.0
25	4D	24/13	24.00 - 26.00	29/18/3/4	21	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 1 of 2

Boring No.: BB-GCS-306B

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-306B WIN: 18736.00							
Driller: New England Boring Contractors				Elevation (ft.): 13.6				Auger ID/OD: --									
Operator: C. Dupuis				Datum: NAVD 88				Sampler: Split Spoon-1.375 in.ID									
Logged By: M. Snow				Rig Type: Mobile B53 Truck				Hammer Wt./Fall: SS-140#/30;NW-300#/24									
Date Start/Finish: 11-28-16/11-28-16				Drilling Method: NW Drive/NW Spun				Core Barrel: NQ-2.0 in.ID									
Boring Location: E1142502; N509905				Casing ID/OD: NW-3.0 in.ID				Water Level*: 10.1									
Hammer Efficiency Factor: 0.569						Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐											
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt						R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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.			
25								-11.4		-FILL-(GM) 25.0							
								-12.4		Gray, wet, medium stiff, silty CLAY							
										-MARINE DEPOSIT-(CL) 26.0							
										Bottom of Exploration at 26.0 feet below ground surface. No Refusal							
30																	
45																	
50																	
Remarks:																	
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.																	
Page 2 of 2																	
* 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-GCS-306B																	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Bridges over Cobbosseecontee Stream Location: Gardiner, Maine				Boring No.: BB-GCS-306C WIN: 18736.00																																																																																																																																																																																																																																																																																																																																														
Driller: New England Boring Contractors				Elevation (ft.): 13.5				Auger ID/OD: --																																																																																																																																																																																																																																																																																																																																														
Operator: C. Dupuis				Datum: NAVD 88				Sampler: --																																																																																																																																																																																																																																																																																																																																														
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Date Start/Finish: 11-28-16/11-28-16				Drilling Method: Solid Stem Auger				Core Barrel: --																																																																																																																																																																																																																																																																																																																																														
Boring Location: E1142504; N509908				Casing ID/OD: --				Water Level*: Not observed																																																																																																																																																																																																																																																																																																																																														
Hammer Efficiency Factor: --				Hammer Type: Automatic ☐ Hydraulic ☐ Rope & Cathead ☐																																																																																																																																																																																																																																																																																																																																																		
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<table><thead><tr><th rowspan="2">Depth (ft.)</th><th colspan="7">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>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></thead><tbody><tr><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td>SSA</td><td>13.3</td><td rowspan="24"></td><td>-BITUMINOUS CONCRETE-</td><td rowspan="24"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Note: Descriptions below based on auger cuttings and drill action.</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Brown -GRANULAR FILL-(SW)</td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>3.5</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>												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	0							SSA	13.3		-BITUMINOUS CONCRETE-											Note: Descriptions below based on auger cuttings and drill action.										Brown -GRANULAR FILL-(SW)	5																																																		10								3.5																																																														15																																																																																										20																																																												25									
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APPENDIX B

Rock Core Photographs



BORING ID	RUN ID	RUN DEPTH (FT)	RUN EL. ^{NOTE 1}	RECOVERY		RQD ^{NOTE 2}	
				IN.	%	IN.	%
BB-GCS-104	R1	50.0 to 55.0	-34.3 to -39.3	BOULDER		BOULDER	
BB-GCS-104	R2	55.0 to 57.0	-39.3 to -41.3	BOULDER		BOULDER	
BB-GCS-104	R3	65.0 to 66.5	-49.3 to -50.8	BOULDER		BOULDER	
BB-GCS-104	R4	67.0 to 67.5	-51.3 to -51.8	BOULDER		BOULDER	
BB-GCS-104	R5	68.0 to 69.0	-52.3 to -53.3	BOULDER		BOULDER	
BB-GCS-104	R6	75.0 to 80.0	-59.3 to -64.3	60	100	43	72
BB-GCS-104	R7	80.0 to 85.0	-64.3 to -69.3	57	95	37	62

NOTES:

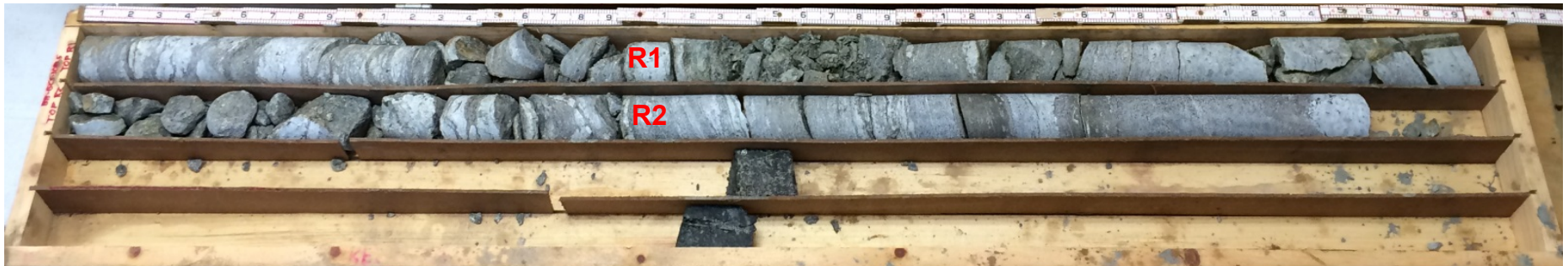
1. ELEVATIONS ARE MEASURED IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
2. "RQD" INDICATES ROCK QUALITY DESIGNATION (PERCENT OF ROCK PIECES RECOVERED EQUAL TO OR GREATER THAN 4 IN. IN LENGTH).

**HALEY
ALDRICH**

UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

MAINE AVENUE BRIDGE
MaineDOT WIN 18736.00, Bridge No. 3098
ROUTE 24 OVER COBBOSSEECONTEE STREAM
GARDINER MAINE

**PHOTOGRAPH OF
BEDROCK CORE
BORINGS: BB-GCS-104**



BORING ID	RUN ID	RUN DEPTH (FT)	RUN EL. ^{NOTE 1}	RECOVERY		RQD ^{NOTE 2}	
				IN.	%	IN.	%
BB-GCS-105	R1	69.0 to 74.0	-54.5 to -59.5	60	100	12	20
BB-GCS-105	R2	74.0 to 79.0	-59.5 to -64.5	54	90	21	35

NOTES:

1. ELEVATIONS ARE MEASURED IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
2. "RQD" INDICATES ROCK QUALITY DESIGNATION (PERCENT OF ROCK PIECES RECOVERED EQUAL TO OR GREATER THAN 4 IN. IN LENGTH).



UNDERGROUND
ENGINEERING &
ENVIRONMENTAL
SOLUTIONS

MAINE AVENUE BRIDGE
MaineDOT WIN 18736.00, Bridge No. 3098
ROUTE 24 OVER COBBOSSECONTEE STREAM
GARDINER MAINE

**PHOTOGRAPH OF
BEDROCK CORE
BORING: BB-GCS-105**

FILE NO. 42223-005

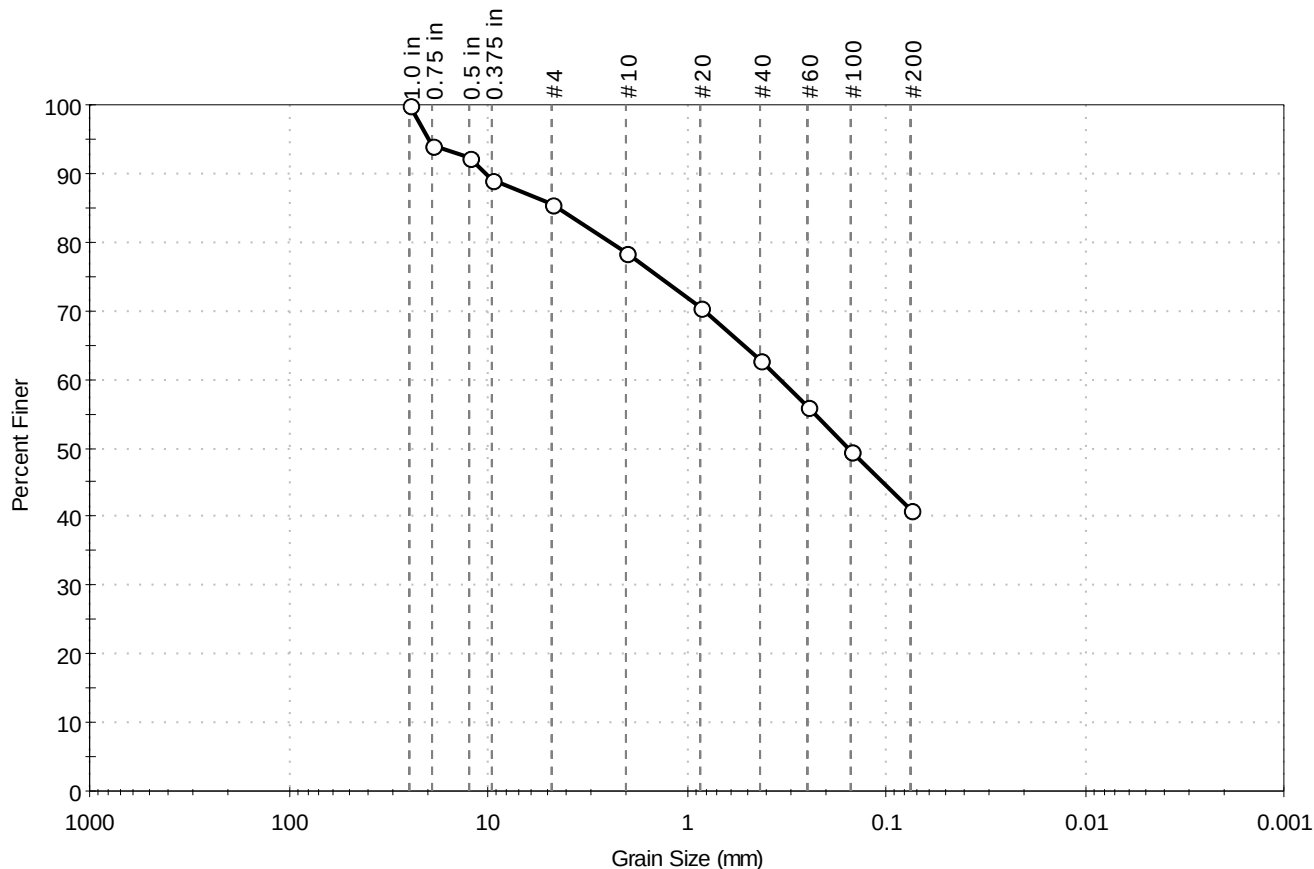
March 2018

Appendix C

Laboratory Test Results

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-104	Sample Type:	bag
Sample ID:	2D	Test Date:	02/18/16
Depth :	2.0-4.0	Test Id:	365338
Test Comment:	---		
Visual Description:	Moist, dark olive brown clayey sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	14.4	44.7	40.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	94		
0.5 in	12.50	92		
0.375 in	9.50	89		
#4	4.75	86		
#10	2.00	79		
#20	0.85	70		
#40	0.42	63		
#60	0.25	56		
#100	0.15	50		
#200	0.075	41		

Coefficients

D ₈₅ = 4.4055 mm	D ₃₀ = N/A
D ₆₀ = 0.3440 mm	D ₁₅ = N/A
D ₅₀ = 0.1550 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

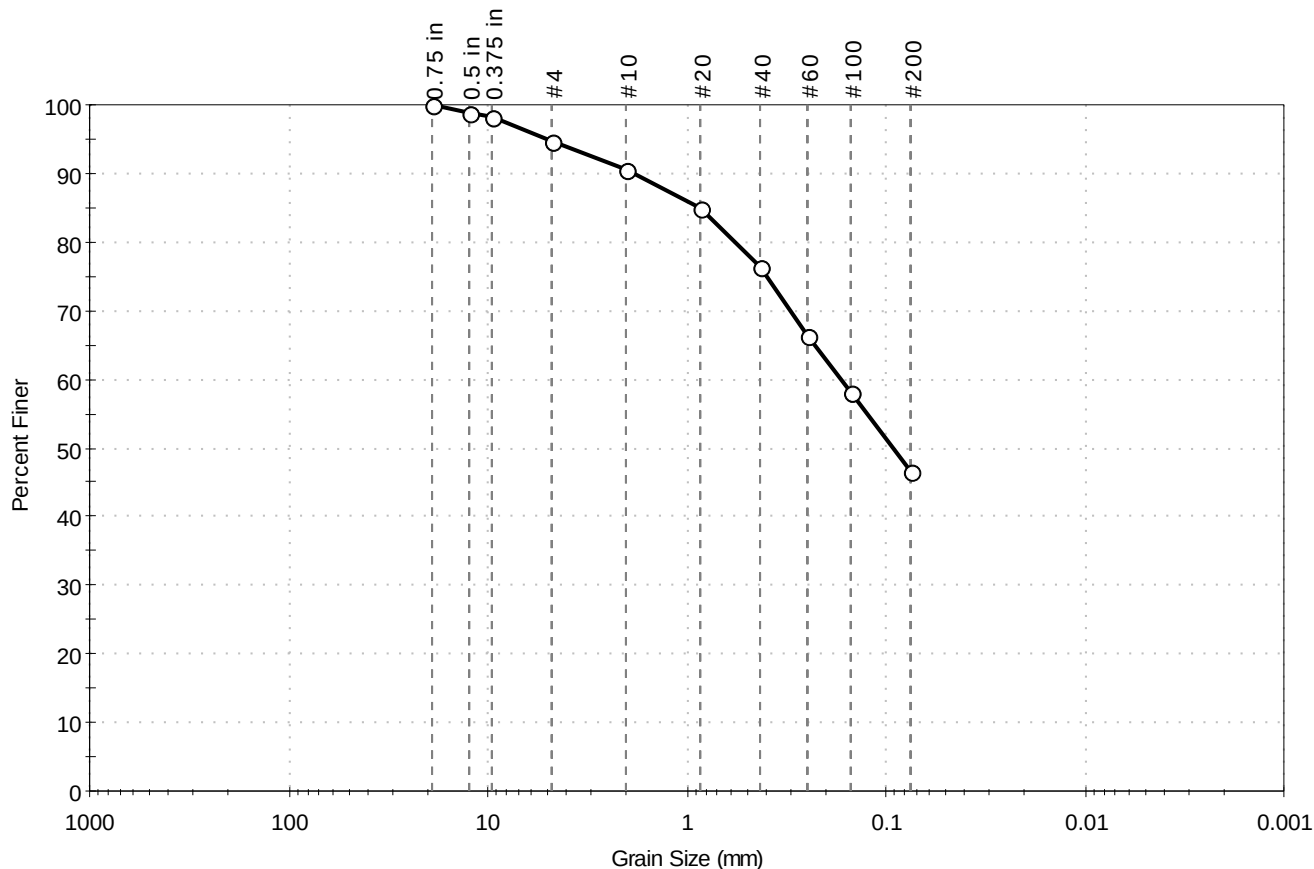
AASHTO Silty Soils (A-4 (0))

Sample / Test Description

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

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-104	Sample Type:	bag
Sample ID:	3D	Test Date:	02/18/16
Depth :	4.0-6.0	Test Id:	365339
Test Comment:	---		
Visual Description:	Moist, brown clayey sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	5.2	48.2	46.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	99		
0.375 in	9.50	98		
#4	4.75	95		
#10	2.00	90		
#20	0.85	85		
#40	0.42	76		
#60	0.25	67		
#100	0.15	58		
#200	0.075	47		

Coefficients

D ₈₅ = 0.8564 mm	D ₃₀ = N/A
D ₆₀ = 0.1688 mm	D ₁₅ = N/A
D ₅₀ = 0.0921 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

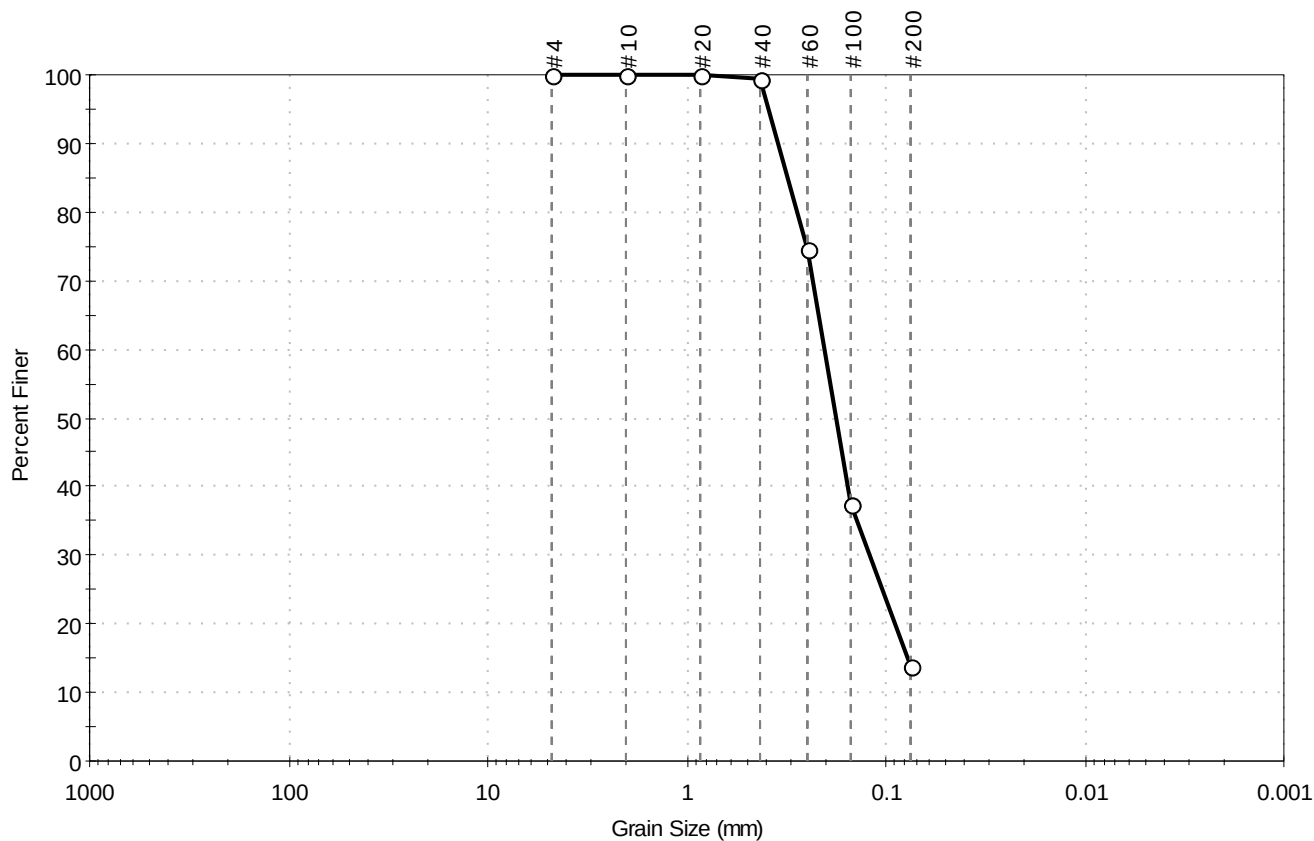
AASHTO Silty Soils (A-4 (0))

Sample / Test Description

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

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-104	Sample Type:	bag
Sample ID:	15D	Test Date:	02/18/16
Depth :	40.0-42.0	Test Id:	365340
Test Comment:	---		
Visual Description:	Moist, dark gray silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	86.0	14.0

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	75		
#100	0.15	38		
#200	0.075	14		

Coefficients

D ₈₅ = 0.3116 mm	D ₃₀ = 0.1202 mm
D ₆₀ = 0.2042 mm	D ₁₅ = 0.0773 mm
D ₅₀ = 0.1780 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))

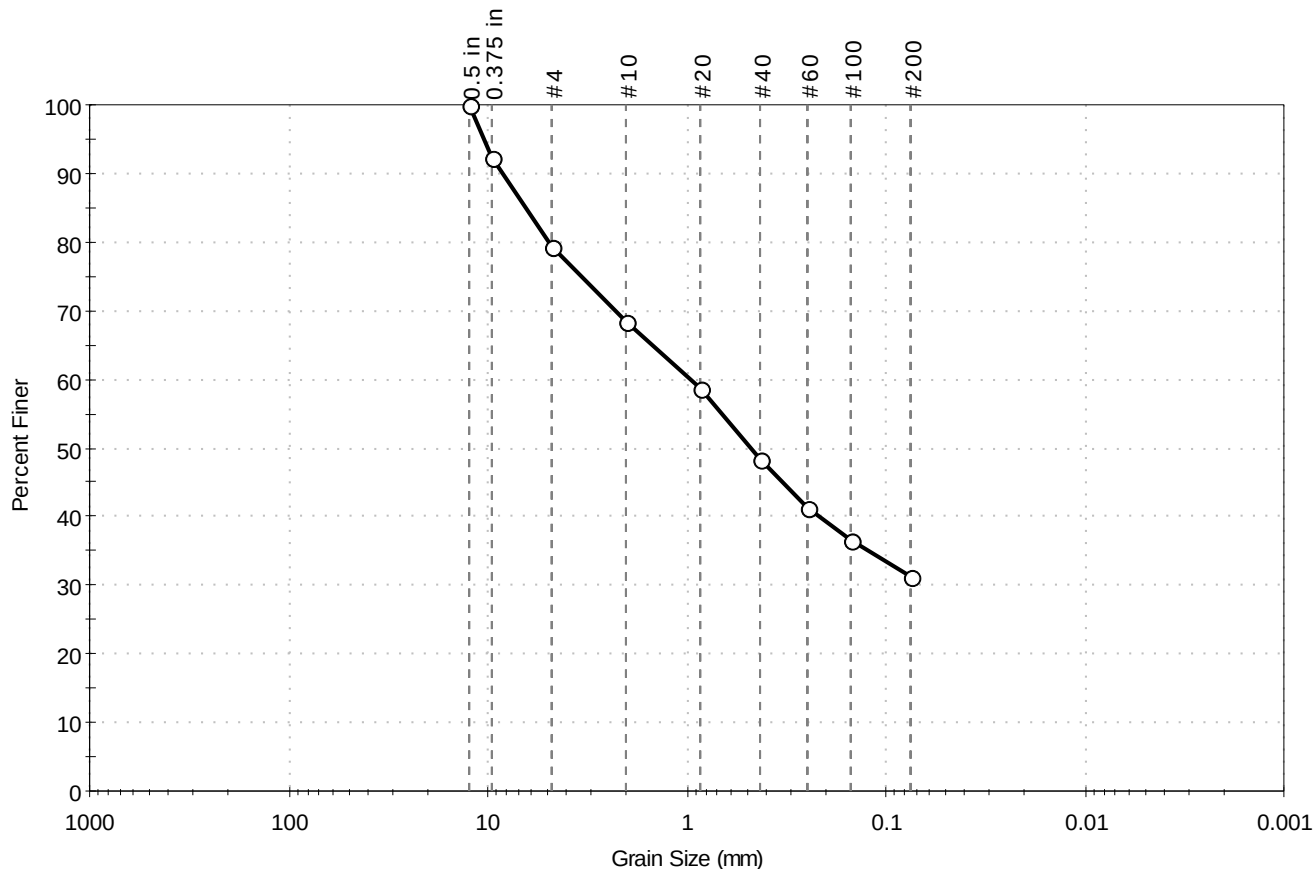
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-105	Sample Type:	bag
Sample ID:	2D	Test Date:	02/18/16
Depth :	2.5-4.5	Test Id:	365341
Test Comment:	---		
Visual Description:	Moist, olive brown clayey sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	20.7	48.1	31.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	92		
#4	4.75	79		
#10	2.00	68		
#20	0.85	59		
#40	0.42	48		
#60	0.25	41		
#100	0.15	37		
#200	0.075	31		

Coefficients

D ₈₅ = 6.4389 mm	D ₃₀ = N/A
D ₆₀ = 0.9551 mm	D ₁₅ = N/A
D ₅₀ = 0.4719 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

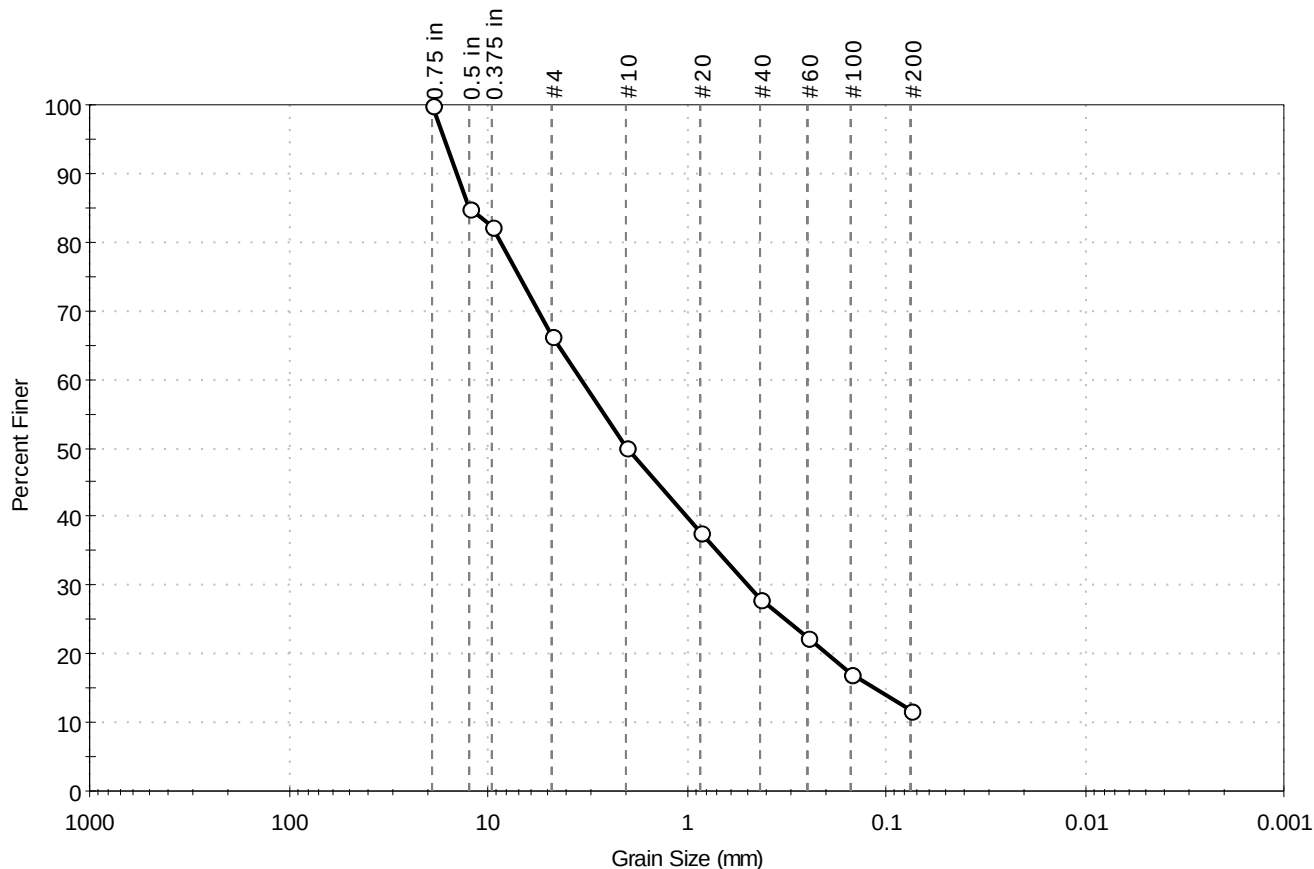
AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample / Test Description

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

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-105	Sample Type:	bag
Sample ID:	3D	Test Date:	02/18/16
Depth :	4.5-6.5	Test Id:	365342
Test Comment:	---		
Visual Description:	Moist, brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	33.7	54.5	11.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	85		
0.375 in	9.50	82		
#4	4.75	66		
#10	2.00	50		
#20	0.85	38		
#40	0.42	28		
#60	0.25	22		
#100	0.15	17		
#200	0.075	12		

Coefficients

D ₈₅ = 12.5175 mm	D ₃₀ = 0.4890 mm
D ₆₀ = 3.3922 mm	D ₁₅ = 0.1134 mm
D ₅₀ = 1.9879 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

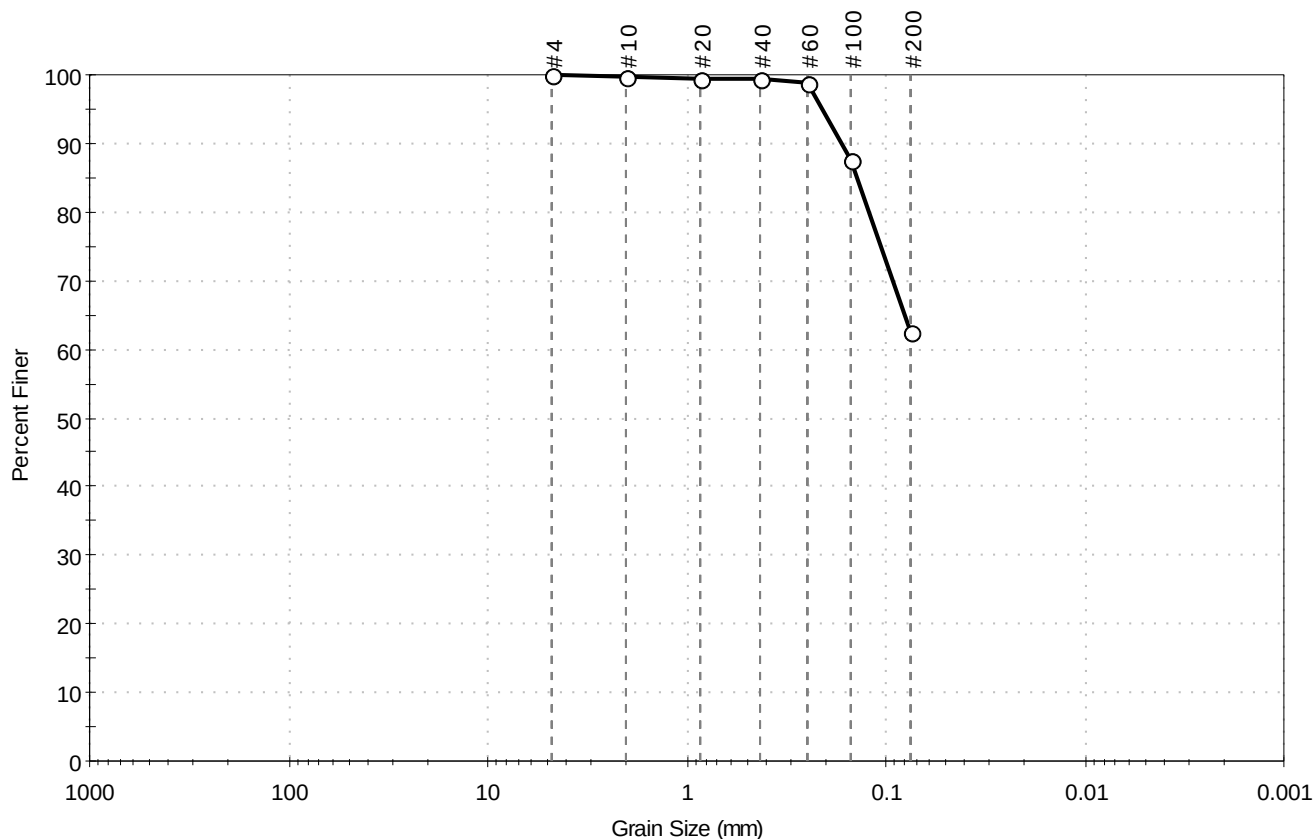
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample / Test Description

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

Client:	Haley & Aldrich, Inc.		
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine	Project No:	GTX-304381
Boring ID:	BB-GCS-105	Sample Type:	bag
Sample ID:	14D	Test Date:	02/18/16
Depth :	35.5-37.5	Test Id:	365343
Test Comment:	---		
Visual Description:	Moist, dark gray sandy clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	37.5	62.5

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	99		
#100	0.15	88		
#200	0.075	62		

Coefficients

$D_{85} = 0.1396 \text{ mm}$ $D_{30} = \text{N/A}$
 $D_{60} = \text{N/A}$ $D_{15} = \text{N/A}$
 $D_{50} = \text{N/A}$ $D_{10} = \text{N/A}$
 $C_u = \text{N/A}$ $C_c = \text{N/A}$

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

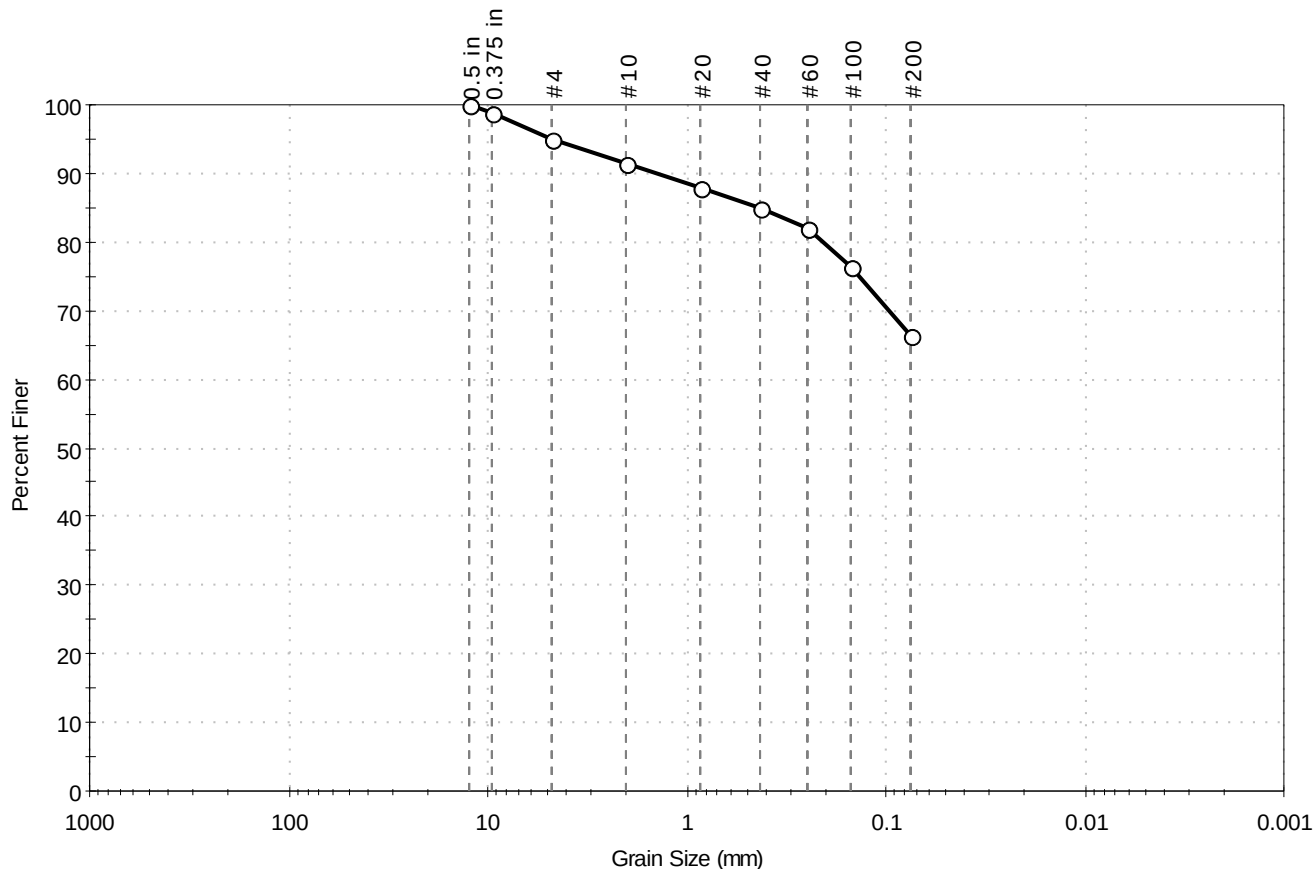
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client: Haley & Aldrich, Inc.	Project No: GTX-306172	
Project: Maine Avenue Bridge		
Location: Gardiner, ME		
Boring ID: BB-GCS-302	Sample Type: bag	Tested By: jbr
Sample ID: 3D	Test Date: 03/22/17	Checked By: emm
Depth: 9-11	Test Id: 406888	
Test Comment: ---		
Visual Description: Moist, light olive gray sandy clay		
Sample Comment: ---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	5.0	28.6	66.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	95		
#10	2.00	92		
#20	0.85	88		
#40	0.42	85		
#60	0.25	82		
#100	0.15	76		
#200	0.075	66		

Coefficients

$D_{85} = 0.4309$ mm $D_{30} = \text{N/A}$
 $D_{60} = \text{N/A}$ $D_{15} = \text{N/A}$
 $D_{50} = \text{N/A}$ $D_{10} = \text{N/A}$
 $C_u = \text{N/A}$ $C_c = \text{N/A}$

Classification

ASTM N/A

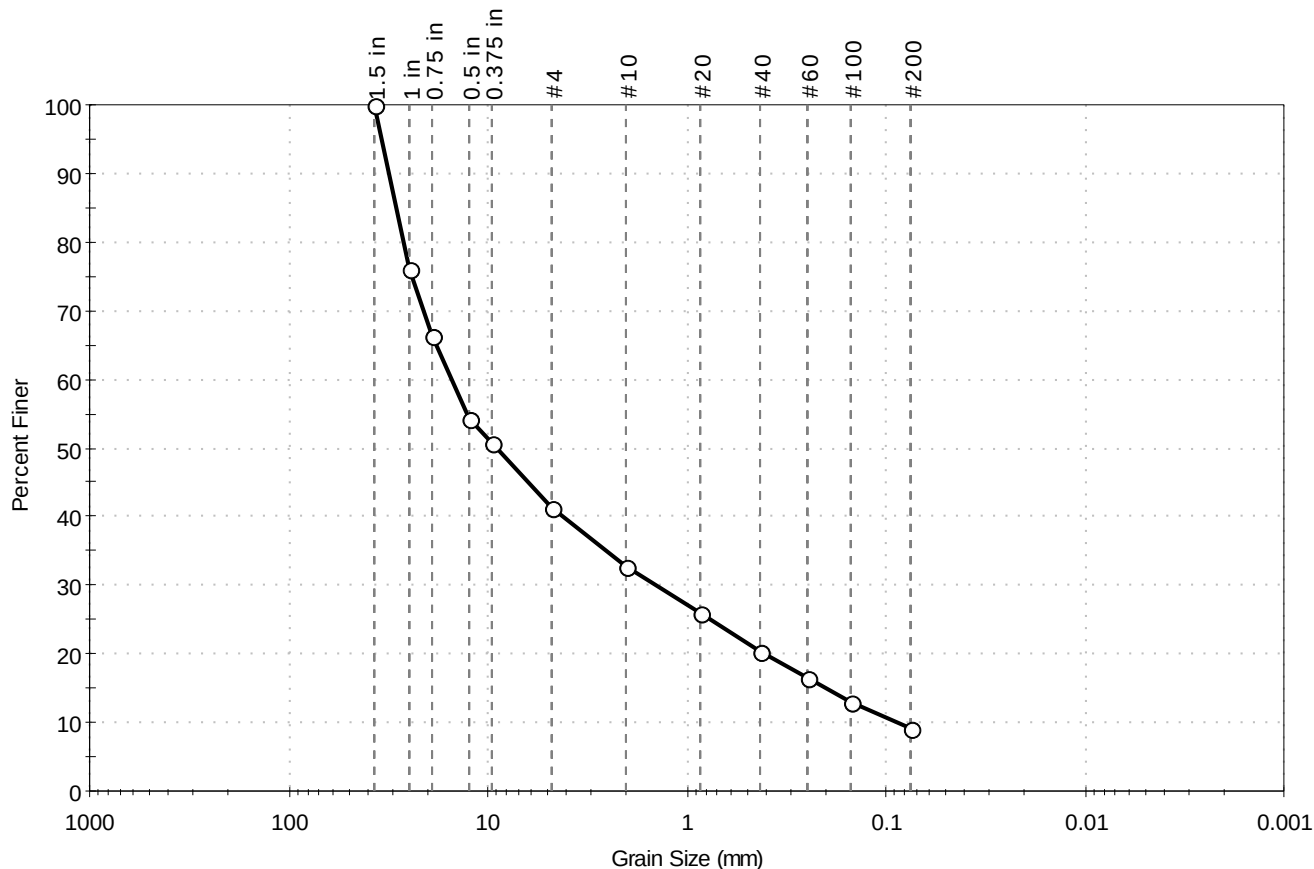
AASHTO Silty Soils (A-4 (0))

Sample / Test Description

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

Client:	Haley & Aldrich, Inc.		
Project:	Maine Avenue Bridge		
Location:	Gardiner, ME	Project No:	GTX-306172
Boring ID:	BB-GCS-303	Sample Type:	bag
Sample ID:	5D	Test Date:	03/22/17
Depth:	19-21	Test Id:	406889
Test Comment:	---		
Visual Description:	Moist, dark olive gray gravel with silt and sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	58.7	32.1	9.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	76		
0.75 in	19.00	66		
0.5 in	12.50	54		
0.375 in	9.50	51		
#4	4.75	41		
#10	2.00	33		
#20	0.85	26		
#40	0.42	20		
#60	0.25	16		
#100	0.15	13		
#200	0.075	9.2		

Coefficients

D ₈₅ = 29.1057 mm	D ₃₀ = 1.4087 mm
D ₆₀ = 15.2061 mm	D ₁₅ = 0.2027 mm
D ₅₀ = 8.9837 mm	D ₁₀ = 0.0867 mm
C _u = 175.388	C _c = 1.505

Classification

ASTM N/A

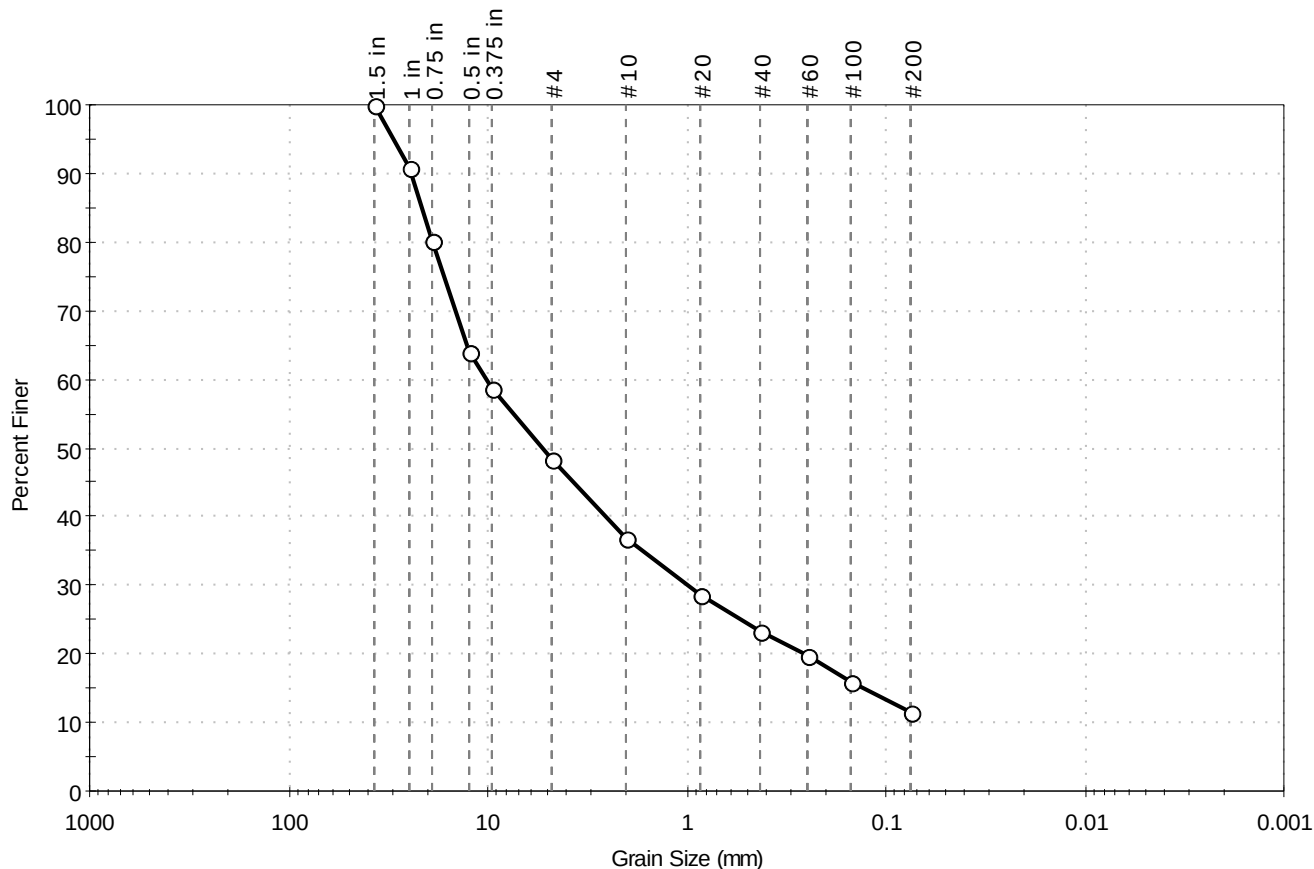
AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample / Test Description

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

Client: Haley & Aldrich, Inc.	Project No: GTX-306172
Project: Maine Avenue Bridge	
Location: Gardiner, ME	
Boring ID: BB-GCS-304	Sample Type: bag
Sample ID: 7D	Tested By: jbr
Depth: 24-26	Test Date: 03/22/17
	Checked By: emm
	Test Id: 406890
Test Comment: ---	
Visual Description: Moist, dark olive gray gravel with silt and sand	
Sample Comment: ---	

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	51.5	36.9	11.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	91		
0.75 in	19.00	80		
0.5 in	12.50	64		
0.375 in	9.50	59		
#4	4.75	49		
#10	2.00	37		
#20	0.85	29		
#40	0.42	23		
#60	0.25	20		
#100	0.15	16		
#200	0.075	12		

Coefficients

D ₈₅ = 21.5215 mm	D ₃₀ = 0.9829 mm
D ₆₀ = 10.1435 mm	D ₁₅ = 0.1307 mm
D ₅₀ = 5.2548 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification

ASTM N/A

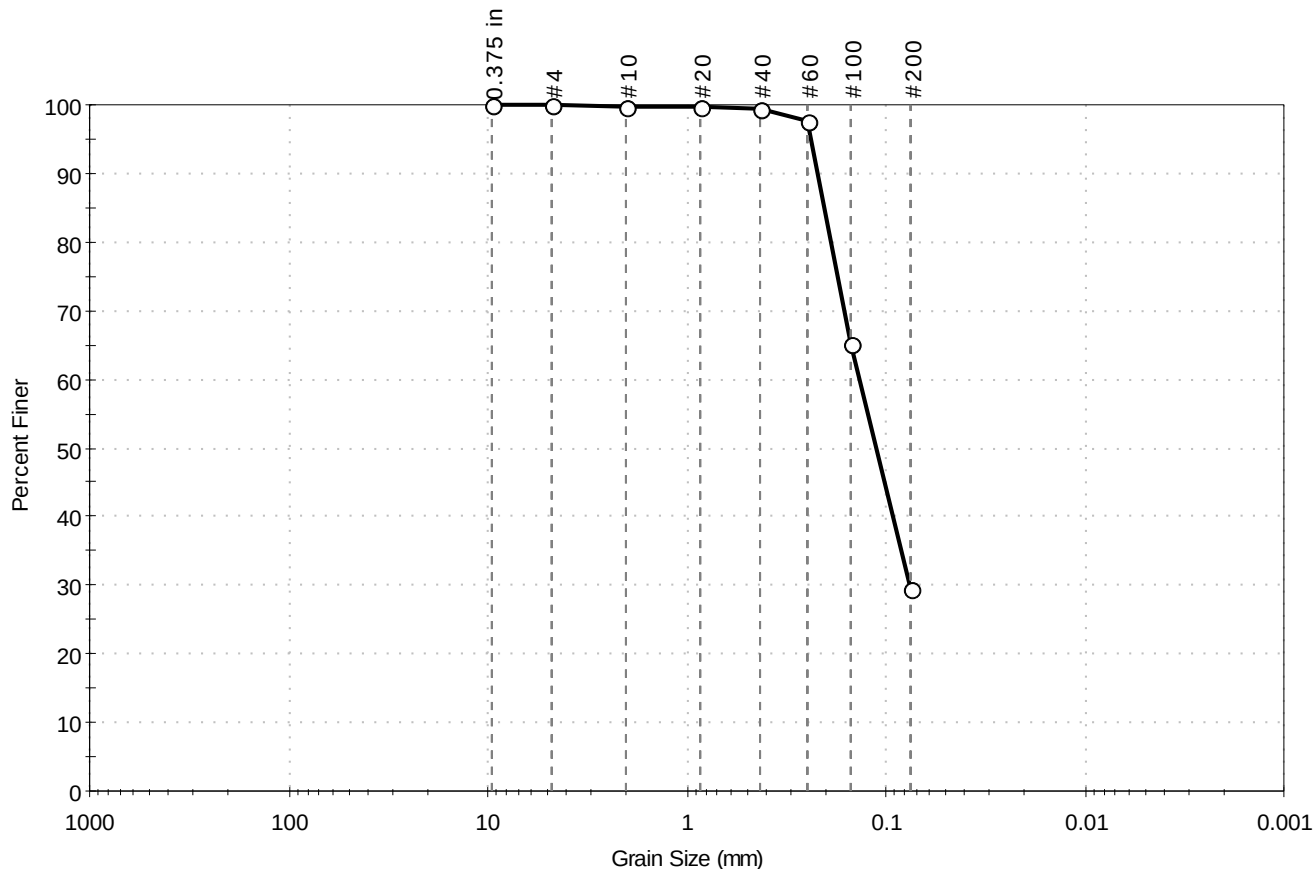
AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample / Test Description

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

Client: Haley & Aldrich, Inc.	Project No: GTX-306172	
Project: Maine Avenue Bridge		
Location: Gardiner, ME		
Boring ID: BB-GCS-305	Sample Type: bag	Tested By: jbr
Sample ID: 7D	Test Date: 03/22/17	Checked By: emm
Depth: 34-36	Test Id: 406891	
Test Comment: ---		
Visual Description: Moist, greenish gray silty sand		
Sample Comment: ---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.2	70.2	29.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	98		
#100	0.15	65		
#200	0.075	30		

Coefficients

$D_{85} = 0.2050$ mm $D_{30} = 0.0755$ mm
 $D_{60} = 0.1357$ mm $D_{15} = \text{N/A}$
 $D_{50} = 0.1116$ mm $D_{10} = \text{N/A}$
 $C_u = \text{N/A}$ $C_c = \text{N/A}$

Classification

ASTM N/A

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

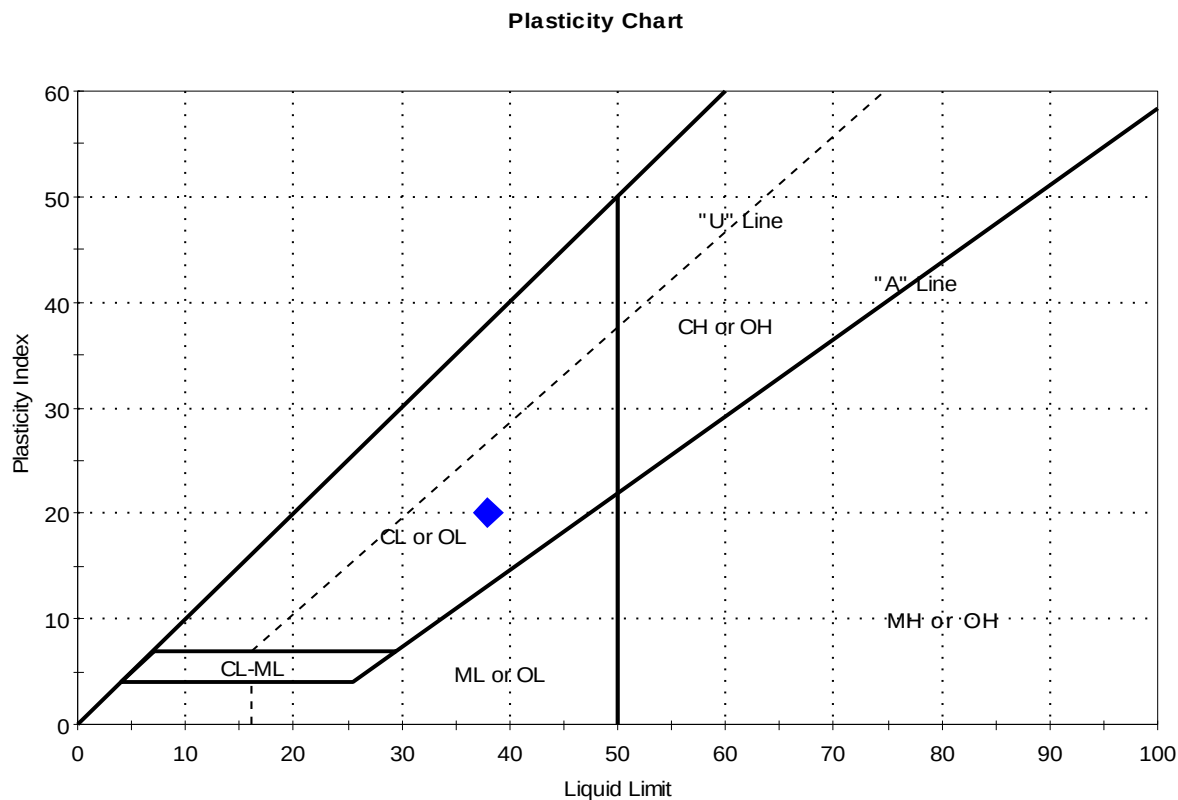
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Haley & Aldrich, Inc.	Project No:	GTX-304381
Project:	U.S. 24 over the Cobbossee Stream		
Location:	Gardiner, Maine		
Boring ID:	BB-GCS-104	Sample Type:	bag
Sample ID:	11D	Test Date:	02/18/16
Depth :	28.0-30.0	Test Id:	365355
Test Comment:	---		
Visual Description:	Moist, dark gray 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
◆	11D	B-GCS-10	28.0-30.0	33	38	18	20	0.7	

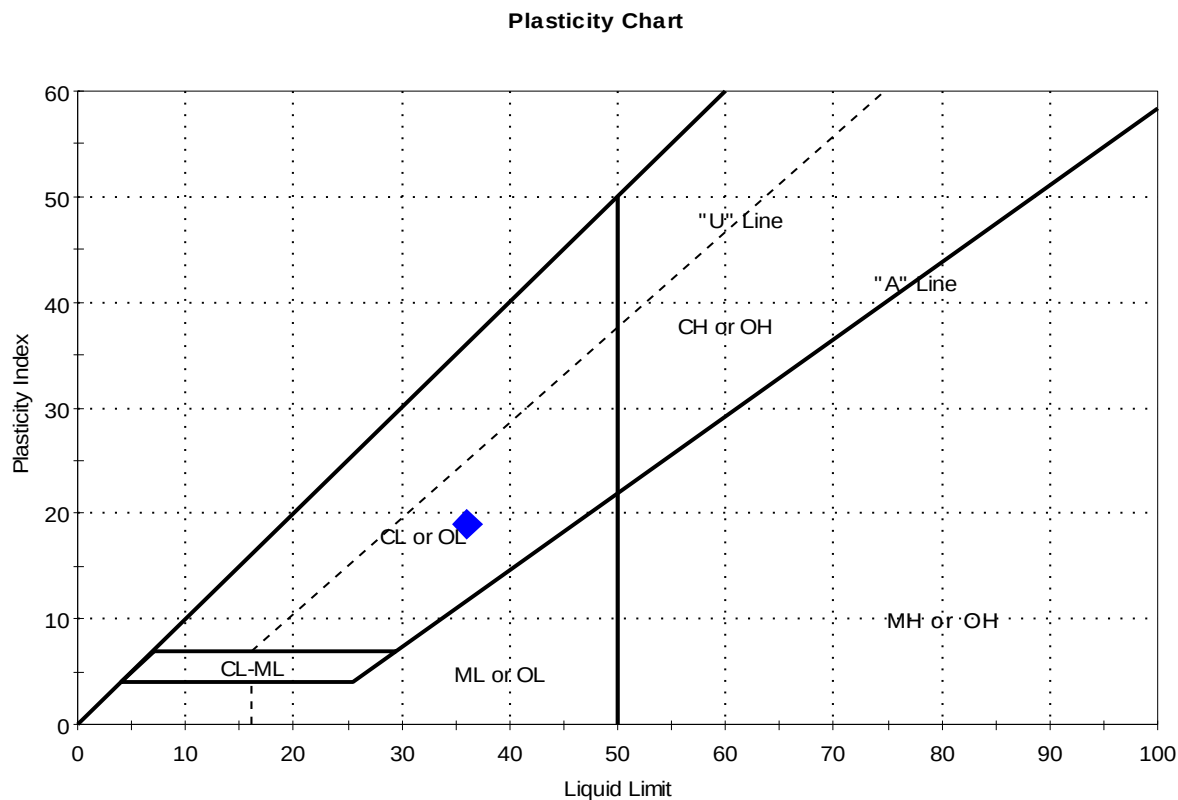
Sample Prepared using the WET method

Dry Strength: HIGH
Dilatancy: NONE
Toughness: MEDIUM



Client:	Haley & Aldrich, Inc.				
Project:	U.S. 24 over the Cobbossee Stream				
Location:	Gardiner, Maine			Project No:	GTX-304381
Boring ID:	BB-GCS-104	Sample Type:	bag	Tested By:	GA
Sample ID:	13D	Test Date:	02/18/16	Checked By:	jdt
Depth :	32.0-34.0	Test Id:	365356		
Test Comment:	---				
Visual Description:	Moist, dark gray 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
◆	13D	B-GCS-104	32.0-34.0	29	36	17	19	0.6	

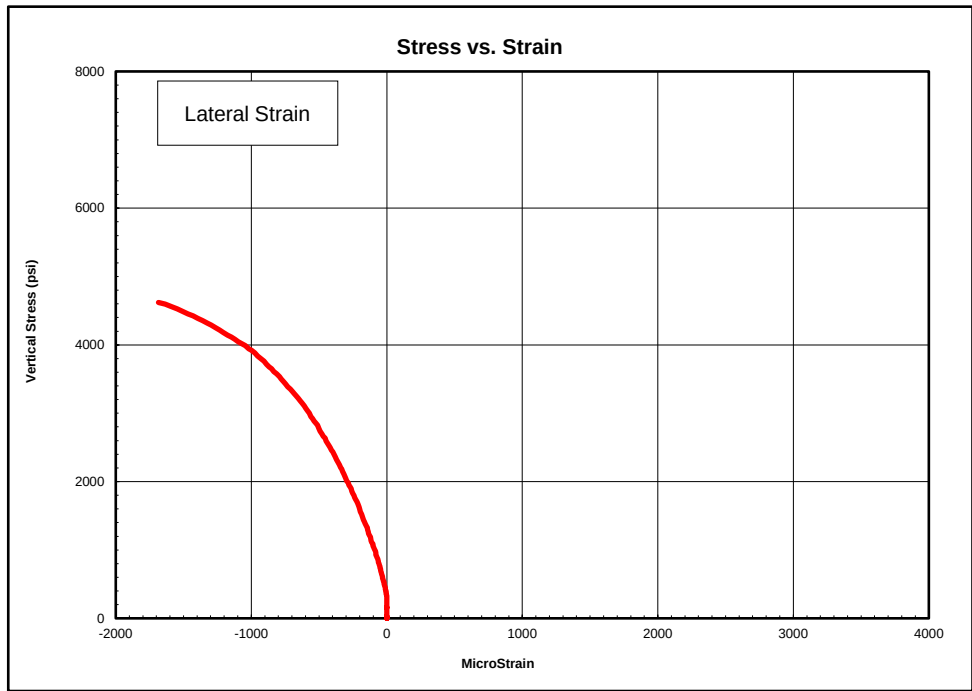
Sample Prepared using the WET method

Dry Strength: HIGH
Dilatancy: NONE
Toughness: MEDIUM



Client:	Haley & Aldrich, Inc.
Project Name:	U.S. 24 over the Cobbossee Stream
Project Location:	Gardiner, Maine
GTX #:	304381
Test Date:	2/15/2016
Tested By:	rlc
Checked By:	jsc
Boring ID:	BB-GCS-104
Sample ID:	R6
Depth, ft:	80.25-80.62
Sample Type:	rock core
Sample Description:	See photographs Discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 4,721 psi

Both axial strain devices failed to record meaningful data. Young's Modulus and Poisson's Ratio could not be determined.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
500-1700	---	---
1700-3000	---	---
3000-4200	---	---

Notes: Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
 The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
 Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
 Calculations assume samples are isotropic, which is not necessarily the case.

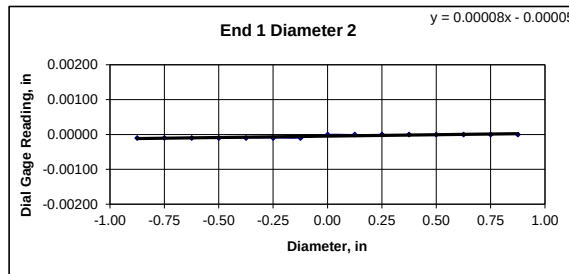
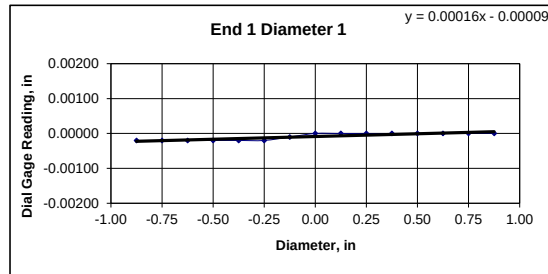


Client:	Haley & Aldrich, Inc.	Test Date:	2/12/2016
Project Name:	U.S. 24 over the Cobbossee Stream	Tested By:	daa/rlc
Project Location:	Gardiner, Maine	Checked By:	jsc
GTX #:	304381		
Boring ID:	BB-GCS-104		
Sample ID:	R6		
Depth:	80.25-80.62 ft		
Visual Description:	See photographs		

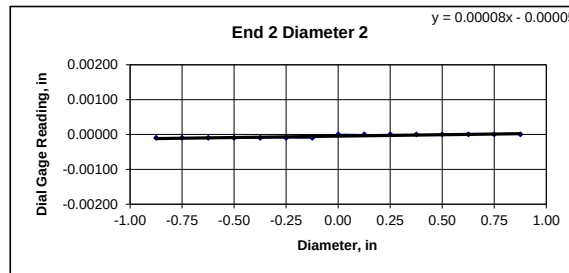
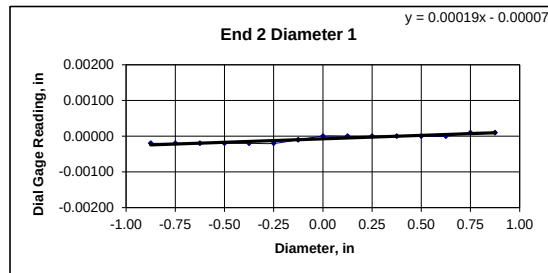
UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY				DEVIATION FROM STRAIGHTNESS (Procedure S1)	
	1	2	Average	Maximum gap between side of core and reference surface plate: Is the maximum gap $\leq$ 0.02 in.? YES	
Specimen Length, in:	4.33	4.33	4.33	Maximum difference must be $<$ 0.020 in.	
Specimen Diameter, in:	1.98	1.98	1.98	Straightness Tolerance Met? YES	
Specimen Mass, g:	572.99				
Bulk Density, lb/ft ³ :	163	Minimum Diameter Tolerance Met? YES			
Length to Diameter Ratio:	2.2	Length to Diameter Ratio Tolerance Met? YES			

END FLATNESS AND PARALLELISM (Procedure FP1)															
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00020	-0.00020	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Difference between max and min readings, in: 0° = 0.00020 90° = 0.00010															
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00020	-0.00020	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Difference between max and min readings, in: 0° = 0.0003 90° = 0.0001 Maximum difference must be < 0.0020 in. Difference = ± 0.00015															
Flatness Tolerance Met? YES															



DIAMETER 1	
End 1:	
Slope of Best Fit Line	0.00016
Angle of Best Fit Line:	0.00917
End 2:	
Slope of Best Fit Line	0.00019
Angle of Best Fit Line:	0.01089
Maximum Angular Difference:	0.00172
Parallelism Tolerance Met? Spherically Seated	YES



DIAMETER 2	
End 1:	
Slope of Best Fit Line	0.00008
Angle of Best Fit Line:	0.00458
End 2:	
Slope of Best Fit Line	0.00008
Angle of Best Fit Line:	0.00458
Maximum Angular Difference:	0.00000
Parallelism Tolerance Met? Spherically Seated	YES

PERPENDICULARITY (Procedure P1)						Maximum angle of departure must be $\leq$ 0.25°	
END 1	(Calculated from End Flatness and Parallelism measurements above)						
	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?		
Diameter 1, in	0.00020	1.980	0.00010	0.006	YES		
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES	Perpendicularity Tolerance Met?	YES
END 2							
Diameter 1, in	0.00030	1.980	0.00015	0.009	YES		
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES		

Client:	Haley & Aldrich, Inc.
Project Name:	U.S. 24 over the Cobbossee Stream
Project Location:	Gardiner, Maine
GTX #:	304381
Test Date:	2/15/2016
Tested By:	daa/rlc
Checked By:	jsc
Boring ID:	BB-GCS-104
Sample ID:	R6
Depth, ft:	80.25-80.62



After cutting and grinding



After break



Client:	Haley & Aldrich, Inc.		
Project:	US 201 & 9 over the Cobbossee Stream		
Location:		Project No:	GTX-307546
Boring ID: ---	Sample Type: ---	Tested By:	jbr
Sample ID: ---	Test Date: 01/22/18	Checked By:	emm
Depth : ---	Test Id: 439711		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BB-GCS-104	S5+S6+S7	10.8-17	Moist, very dark gray sand with gravel	6.4
BB-GCS-105	11D+12D+13D	20-29	Moist, dark gray sand with gravel	2.7
BB-GCS-303	2D+3D	5-12	Moist, gray clay	22.0
BB-GCS-304	4D+5D+6D	12.5-21	Moist, dark gray clay with gravel	16.1
BB-GCS-401	1D+3D+4D	0-8.2	Moist, dark brown sand with gravel	7.3

Notes: Temperature of Drying : 110° Celsius



Client:	Haley & Aldrich, Inc.		
Project:	US 201 & 9 over the Cobbossee Stream		
Location:		Project No:	GTX-307546
Boring ID: ---	Sample Type: ---	Tested By:	cam
Sample ID: ---	Test Date: 01/22/18	Checked By:	emm
Depth : ---	Test Id: 439716		

Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content, %	Ash Content, %	Organic Matter, %
BB-GCS-104	S5+S6+S7	10.8-17	Moist, very dark gray sand with gravel	6	99.7	.3
BB-GCS-105	11D+12D+13C	20-29	Moist, dark gray sand with gravel	3	99.7	.3
BB-GCS-303	2D+3D	5-12	Moist, gray clay	22	98.8	1.2
BB-GCS-304	4D+5D+6D	12.5-21	Moist, dark gray clay with gravel	16	98.8	1.2
BB-GCS-401	1D+3D+4D	0-8.2	Moist, dark brown sand with gravel	7	98.5	1.5

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass;
dried to a constant mass at temperature of 105° C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440° C



Client:	Haley & Aldrich, Inc.				
Project:	US 201 & 9 over the Cobbossee Stream				
Location:				Project No:	GTX-307546
Boring ID: ---	Sample Type: ---		Tested By:	jbr	
Sample ID: ---	Test Date: 01/22/18		Checked By:	emm	
Depth : ---	Test Id: 439721				

pH of Soil by ASTM D4972

Boring ID	Sample ID	Depth	Visual Description	pH of Soil in Distilled Water	pH of Soil in Calcium Chloride
BB-GCS-104	S5+S6+S7	10.8-17	Moist, very dark gray sand with gravel	6.1	5.8
BB-GCS-105	11D+12D+13C	20-29	Moist, dark gray sand with gravel	6.3	6.1
BB-GCS-303	2D+3D	5-12	Moist, gray clay	7.7	6.9
BB-GCS-304	4D+5D+6D	12.5-21	Moist, dark gray clay with gravel	6.6	6.2
BB-GCS-401	1D+3D+4D	0-8.2	Moist, dark brown sand with gravel	6.1	5.9

Notes: Sample Preparation: screened through #10 sieve
Method A, pH meter used



Client:	Haley & Aldrich, Inc.
Project:	US 201 & 9 over the Cobbossee Stream
Location:	---
GTX#:	307546
Test Date:	01/22/18
Tested By:	jbr
Checked By:	emm

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, (ohm-cm) ⁻¹
BB-GCS-104	S5+S6+S7	10.8-17	Moist, very dark gray sand with gravel	3,306	3.03E-04
BB-GCS-105	11D+12D+13D	20-29	Moist, dark gray sand with gravel	3,822	2.62E-04
BB-GCS-303	2D+3D	5-12	Moist, gray clay	744	1.34E-03
BB-GCS-304	4D+5D+6D	12.5-21	Moist, dark gray clay with gravel	3,306	3.03E-04
BB-GCS-401	1D+3D+4D	0-8.2	Moist, dark brown sand with gravel	992	1.01E-03

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
 Water added to sample to create a thick slurry prior to testing (saturated condition).
 Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
 Test conducted in standard laboratory atmosphere: 68-73 F



6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: US 201-9 COBBOSSEE STREAM (GTX 307546)
SAMPLE ID: BB-GCS-104, S5 + S6 + S7, 10.8 – 17

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0125039

REPORT DATE: 01-26-18

CLIENT NUMBER:

JOB NUMBER: 04.1115-0003

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 01-25-18

TIME RECEIVED: 1230

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	250 *	mg/kg	ASTM D-516 **	1200/01-26-18	SD
Chloride, Soluble	< 100 *	mg/kg	ASTM D-512 **	1230/01-26-18	SD

SO4CL 009-18

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT



6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: US 201-9 COBBOSSEE STREAM (GTX 307546)
SAMPLE ID: BB-GCS-105, 11D+12D+13D COMPOSITE

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0119022

REPORT DATE: 01-23-18

CLIENT NUMBER:

JOB NUMBER: 04.1115-0003

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 01-19-18

TIME RECEIVED: 1100

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	912 *	mg/kg	ASTM D-516 **	1200/01-22-18	SD
Chloride, Soluble	< 100 *	mg/kg	ASTM D-512 **	0700/001-23-18	SD

SO4CL 006-18

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT



6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: US 201-9 COBBOSSEE STREAM (GTX 307546)
SAMPLE ID: BB-GCS-303, 2D + 3D, 5 - 12

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0125040

REPORT DATE: 01-26-18

CLIENT NUMBER:

JOB NUMBER: 04.1115-0003

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 01-25-18

TIME RECEIVED: 1230

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	115 *	mg/kg	ASTM D-516 **	1200/01-26-18	SD
Chloride, Soluble	< 100 *	mg/kg	ASTM D-512 **	1230/01-26-18	SD

SO4CL 009-18

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT



6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: US 201-9 COBBOSSEE STREAM (GTX 307546)
SAMPLE ID: BB-GCS-304, 4D + 5D + 6D, 12.5 - 21

FOR: GEOTESTING EXPRESS, INC.
125 NAGOG PARK ACTION, MA 01720

REPORTED TO: ETHAN MARRO

LAB NUMBER: 0125041

REPORT DATE: 01-26-18

CLIENT NUMBER:

JOB NUMBER: 04.1115-0003

REPORT NUMBER:

DATE SAMPLED:

TIME SAMPLED:

SAMPLED BY: CLIENT

DATE RECEIVED: 01-25-18

TIME RECEIVED: 1230

RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
Sulfate, Soluble	173 *	mg/kg	ASTM D-516 **	1200/01-26-18	SD
Chloride, Soluble	500 *	mg/kg	ASTM D-512 **	1230/01-26-18	SD

SO4CL 009-18

Respectfully submitted,

* Dry weight basis

Steve DeGregorio
Chemist

SD

** WATER EXTRACTION PERFORMED BY USING A 1:10 RATIO OF SAMPLE AND REAGENT WATER FOLLOWED BY CENTRIFUGE AND VACUUME FILTRATION. THE WATER EXTRACT IS THEN ANALYZED USING THE ASTM D-512 AND D-516 METHODS.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

END OF REPORT

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$	S_r	Post cyclic undrained shear strength
B	pore pressure parameter for $\Delta\sigma_3$	T	temperature
CAI	CERCHAR Abrasiveness Index	t	time
CIU	isotropically consolidated undrained triaxial shear test	U, UC	unconfined compression test
CR	compression ratio for one dimensional consolidation	UU, Q	unconsolidated undrained triaxial test
CSR	cyclic stress ratio	u_a	pore gas pressure
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$	u_e	excess pore water pressure
C_u	coefficient of uniformity, D_{60}/D_{10}	u, u_w	pore water pressure
C_c	compression index for one dimensional consolidation	V	total volume
C_α	coefficient of secondary compression	V_g	volume of gas
c_v	coefficient of consolidation	V_s	volume of solids
c	cohesion intercept for total stresses	V_s	shear wave velocity
c'	cohesion intercept for effective stresses	V_v	volume of voids
D	diameter of specimen	V_w	volume of water
D	damping ratio	V_o	initial volume
D_{10}	diameter at which 10% of soil is finer	v	velocity
D_{15}	diameter at which 15% of soil is finer	W	total weight
D_{30}	diameter at which 30% of soil is finer	W_s	weight of solids
D_{50}	diameter at which 50% of soil is finer	W_w	weight of water
D_{60}	diameter at which 60% of soil is finer	w	water content
D_{85}	diameter at which 85% of soil is finer	w_c	water content at consolidation
d_{50}	displacement for 50% consolidation	w_f	final water content
d_{90}	displacement for 90% consolidation	w_l	liquid limit
d_{100}	displacement for 100% consolidation	w_n	natural water content
E	Young's modulus	w_p	plastic limit
e	void ratio	w_s	shrinkage limit
e_c	void ratio after consolidation	w_o, w_i	initial water content
e_o	initial void ratio	α	slope of q_f versus p_f
G	shear modulus	α'	slope of q_f versus p_f'
G_s	specific gravity of soil particles	γ_t	total unit weight
H	height of specimen	γ_d	dry unit weight
H_R	Rebound Hardness number	γ_s	unit weight of solids
i	gradient	γ_w	unit weight of water
I_s	Uncorrected point load strength	ϵ	strain
$I_{s(50)}$	Size corrected point load strength index	ϵ_{vol}	volume strain
H_A	Modified Taber Abrasion	ϵ_h, ϵ_v	horizontal strain, vertical strain
H_T	Total hardness	μ	Poisson's ratio, also viscosity
K_o	lateral stress ratio for one dimensional strain	σ	normal stress
k	permeability	σ'	effective normal stress
LI	Liquidity Index	σ_c, σ'_c	consolidation stress in isotropic stress system
m_v	coefficient of volume change	σ_h, σ'_h	horizontal normal stress
n	porosity	σ_v, σ'_v	vertical normal stress
PI	plasticity index	σ'_{vc}	Effective vertical consolidation stress
P_c	preconsolidation pressure	σ_1	major principal stress
p	$(\sigma_1 + \sigma_3) / 2, (\sigma_v + \sigma_h) / 2$	σ_2	intermediate principal stress
p'	$(\sigma'_1 + \sigma'_3) / 2, (\sigma'_v + \sigma'_h) / 2$	σ_3	minor principal stress
p'_c	p' at consolidation	τ	shear stress
Q	quantity of flow	ϕ	friction angle based on total stresses
q	$(\sigma_1 - \sigma_3) / 2$	ϕ'	friction angle based on effective stresses
q_f	q at failure	ϕ'_r	residual friction angle
q_o, q_i	initial q	ϕ_{ult}	ϕ for ultimate strength
q_c	q at consolidation		

APPENDIX D

Geophysical Survey

**GEOPHYSICAL SURVEY
MAINE AVENUE BRIDGE
GARDINER, MAINE
PIN 18736.00**

**MAINE DOT MULTI-PIN CONTRACT
NO. 2015070600000000015**

Prepared for:

Maine Department of Transportation
Bridge Program
16 State House Station
Augusta, Maine 04333-0016

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 16SG32
December, 2016

HAGER-RICHTER GEOSCIENCE, INC.

CONSULTANTS IN GEOLOGY AND GEOPHYSICS

8 INDUSTRIAL WAY - D10
SALEM, NEW HAMPSHIRE 03079-5820

TELEPHONE (603) 893-9944
FAX (603) 893-8313

December 5 2016
File 16SG32

Laura Krusinski, P.E.
Senior Geotechnical Engineer
Maine Department of Transportation
Bridge Program
State House Station 16
Augusta, Maine 04333-0016

Dir: 207-624-3441
Tel: 207-215-7641
Email: Laura.Krusinski@maine.gov

RE: **MaineDOT Multi-PIN Contract**
No. 20150706000000000015
Geophysical Survey
Maine Avenue Bridge - Bridge #3098
Gardiner, Maine
PIN 18736.00

Dear Ms. Krusinski:

In this letter, we report the results of a geophysical survey conducted by Hager-Richter Geoscience, Inc. (Hager-Richter) for the above referenced project located on State Route 24 in Gardiner, Maine. The scope of the project and area of interest were specified by the Maine Department of Transportation (MaineDOT) and its consultant, Haley & Aldrich, Inc. (H&A) of Portland, Maine. Preliminary results¹ for the survey were provided to MaineDOT and H&A on November 10, 2016.

INTRODUCTION

The Maine Avenue Bridge is a two-lane bridge that carries State Route 24 across the Cobbosseecontee Stream in Gardiner, Maine. Figure 1 shows the general location of the site. The existing Maine Avenue Bridge is approximately 50 feet long and 30 feet wide and is constructed of reinforced concrete. Exposed portions of the abutments facing the stream under the bridge are constructed of granite blocks, but it was not known how far the abutments extended under the approach roadways.

¹*Hager-Richter Letter, Entitled "Preliminary Results, MaineDOT Multi-PIN Project Contract No. 20150706000000000015, Maine Avenue Bridge - Bridge #3098, Gardiner, Maine, PIN 18736.00."*

MaineDOT Multi-PIN Contract No. 20150706000000000015

Geophysical Survey - Maine Avenue Bridge - Bridge #3098

Gardiner, Maine

PIN 18736.00

H-R File 16SG32

Page 2

According to information provided by MaineDOT, a replacement bridge structure is planned, including new abutments that will be located farther back from the stream. As part of a geotechnical investigation for this project, and to facilitate construction, MaineDOT requested a geophysical survey to determine the horizontal extent of the abutments under the approach roadways for the existing bridge. In addition, MaineDOT requested that an additional area located behind a retaining wall on the northeast side of the bridge be included in the survey area. Figure 2 is an aerial view of the Maine Avenue Bridge and its approaches. Photograph 1, below, show typical conditions at the site.



Photograph1. Maine Avenue Bridge over the Cobbosseecontee Stream, view to the south. The east concrete parapet for the bridge can be seen on the left side of the photograph.

OBJECTIVES

The objectives of the geophysical survey were to detect and, if detected, to determine the horizontal extent of the abutments under the approach roadways for the existing Maine Avenue Bridge and to detect possible structures or utilities behind a retaining wall above the north side of the Cobbosseecontee Stream on the east side of the bridge in Gardiner, Maine.

THE SURVEY

Steven Grant, P.G., and William Desmarais of Hager-Richter conducted the field operations on November 9, 2016. The project was coordinated with Ms. Laura Krusinski, P.E., of MaineDOT. Ms. Marleigh L. Snow of H&A was present for the fieldwork and specified the area of interest for the survey. Project Flaggers, Inc., of Brunswick, Maine provided flaggers who conducted the lane closures and traffic control.

The geophysical survey was conducted using the ground penetrating radar (GPR) method. GPR data on Maine Avenue were acquired along a series of traverses spaced 2 feet apart and oriented parallel to the roadway and along traverses spaced 5 feet apart and oriented perpendicular to the roadway. The traverses oriented perpendicular to the roadway were acquired on the approach roadways but not on the bridge deck itself. In addition, GPR data were acquired along the north side of the Cobbosseecontee Stream, east of the Maine Avenue Bridge. In this portion of the area of interest, GPR data were acquired along traverses spaced 2 feet apart and oriented parallel to the stream and along traverses spaced 5 feet apart and oriented perpendicular to the stream. This design is adequate to detect features within the exploration depth of the GPR signal with a horizontal dimension of 2 feet with a high degree of confidence.

GPR is useful for detecting and identifying both metallic and non-metallic objects as well as disturbed or excavated areas, such as may be presented by granite block abutments located below the roadway. Site plans with project stationing were not provided. The locations of the GPR traverses were tied to local site features, and their locations are shown in Figure 2.

EQUIPMENT

GPR. The GPR survey was conducted using a Geophysical Survey Systems, Inc. SIR-4000 high performance GPR data acquisition system using a 120 MHz antenna with a 230 ns time window. Data were acquired by pulling the GPR antenna along straight lines on the surface of the area(s) to be investigated. The system includes a survey wheel that provides data at a uniform horizontal scale, and the real time images of the data are immediately available for field use.

GPR uses a high-frequency electromagnetic pulse (referred to herein as "radar signal") transmitted from a radar antenna to probe the subsurface. The transmitted radar signals are reflected from subsurface interfaces of materials with contrasting electrical properties. Travel times of the radar signal can be converted to approximate depth below the surface by correlation with targets of known depths. GPR data acquisition is monitored in the field and the GPR data are digitally recorded for subsequent processing.

Data from the GPR survey were processed using RADAN 7.4 GPR processing software from Geophysical Survey Systems, Inc. We reviewed profile images and created plan view time slice maps of the GPR data. Interpretation of the records is based on the nature and intensity of the reflected signals and on the resulting patterns.

LIMITATIONS OF THE METHOD

HAGER-RICHTER GEOSCIENCE, INC. MAKES NO GUARANTEE THAT ALL TARGETS OF INTEREST WERE DETECTED IN THIS SURVEY. HAGER-RICHTER GEOSCIENCE, INC. IS NOT RESPONSIBLE FOR DETECTING TARGETS OF INTEREST THAT NORMALLY CANNOT BE DETECTED BY THE METHODS EMPLOYED OR THAT COULD NOT BE DETECTED BECAUSE OF SITE CONDITIONS.

There are limitations of the GPR technique as used to detect and/or locate targets such as those of the objectives of this survey. Limitations include: (1) surface conditions, (2) electrical conductivity of the ground, (3) contrast of the electrical properties of the target and the surrounding soil, and (4) spacing of the traverses. Of these restrictions, only the last is controllable by us.

The condition of the ground surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. Sites covered with snow piles, high grass, bushes, landscape structures, debris, obstacles, soil mounds, etc. limit the survey access and the coupling of the GPR antenna with the ground. In many cases, the GPR signal will not penetrate below concrete pavement, especially inside buildings, and a target may not be detectable. The GPR method also commonly does not provide useful data under canopies found at some facilities.

The electrical conductivity of the ground determines the attenuation of the GPR signal and thereby limits the maximum depth of exploration. For example, the GPR signal does not penetrate clay-rich soils, and targets buried in clay might not be detected.

A definite contrast in the electrical conductivities of the surrounding ground and the target material is required to obtain a reflection of the GPR signal. If the contrast is too small, possibly due to construction details or deeply corroded metal in the target, then the reflection may be too weak to recognize and the target can be missed.

Spacing of the traverses is limited by access at many sites, but where flexibility of traverse spacing is possible, the spacing is adjusted to the size of the target. The GPR operator controls the spacing between lines, and the design of the survey is based on the dimensions of the

smallest feature of interest. Targets with dimensions smaller than the spacing between GPR survey lines can be missed.

RESULTS

The geophysical survey was conducted using the ground penetrating radar (GPR) method across the accessible portions of the area of interest specified by the MaineDOT. Figure 2 shows the locations of the GPR traverses and the interpretation of the geophysical results. Figure 3 shows an example GPR profile.

General. Apparent GPR signal penetration was limited, with two-way traveltime reflections received from 20 to 50 ns of the 230 ns time window used for the 120 MHz antenna. Based upon site-specific velocity matching calibrations made for the site, the GPR signal penetration is estimated to have been about 2 - 5 feet. GPR signal penetration was typically lower in the central portion of the roadway.

Roadway Approach Area. GPR reflections consistent with approximately 4- to 6-foot wide, 3- to 5-foot deep structures were detected at each end of the bridge, and we interpret such structures to be the tops of the possible bridge abutments. The locations of tops of the possible abutments are shown as red cross-hatched areas in Figure 2. It was not possible to determine details of the possible abutment structure at depth because the top of the detected possible abutment was located very near to the limit of GPR signal penetration. The tops of the possible abutments were not detected in the central portion of the south side of the bridge because of low GPR signal penetration, but they may be present.

GPR reflections consistent with flat topped surfaces or structures at depths of 1 to 3 feet were detected in the vicinity of the bridge, at locations above or adjacent to the tops of the possible abutments discussed above, and extending between 8 and approximately 20 feet from the ends of the bridge. The locations of the flat-topped structures are shown as blue hatched areas on Figure 2. The identity of the flat-topped structures is unknown. It is possible that they represent apron structures adjacent to the bridge or are caused by fill layers from roadway repairs.

Water lines and unidentified utility segments or linear features were detected in the GPR records, and their locations are shown in Figure 2.

Area adjacent to Retaining Wall Northeast of Bridge. Significant subsurface structures or features were not detected in the area adjacent to the retaining wall, with the exception of a single north-south oriented utility, and its location is shown in Figure 2. Whether structures are present below the depth of GPR signal penetration cannot be determined on the basis of the GPR data.

CONCLUSIONS

Based upon the geophysical survey performed by Hager-Richter Geoscience at the Maine Avenue Bridge along State Route 24 in Gardiner, Maine, we conclude that:

- The tops of possible abutment structures were detected within 4 to 6 feet from the ends of the bridge at depths of 3 to 5 feet.
- Areas of flat-topped structures extend between approximately 8 and 20 feet from the ends of the bridge at depths of 1 to 3 feet.
- Water lines and unidentified utility segments or linear features were detected in the survey area.

LIMITATIONS ON THE USE OF THIS REPORT

This letter report was prepared for the exclusive use of the Maine Department of Transportation and its consultant, Haley & Aldrich, Inc. (collectively, Client). No other party shall be entitled to rely on this Report or any information, documents, records, data, interpretations, advice or opinions given to Client by Hager-Richter Geoscience, Inc. (Hager-Richter) in the performance of its work. The Report relates solely to the specific project for which Hager-Richter has been retained and shall not be used or relied upon by Client or any third party for any variation or extension of this project, any other project or any other purpose without the express written permission of Hager-Richter. Any unpermitted use by Client or any third party shall be at Client's or such third party's own risk and without any liability to Hager-Richter.

The detection of subsurface utilities and/or other subsurface objects was not an objective of this survey. However, some utilities and/or other subsurface objects were detected and their locations are provided as a courtesy. Other utilities and/or other subsurface objects may be present and the Client or any third party shall not rely on this report for information on such.

Hager-Richter has used reasonable care, skill, competence and judgment in the performance of its services for this project consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by Hager-Richter should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated

MaineDOT Multi-PIN Contract No. 20150706000000000015

Geophysical Survey - Maine Avenue Bridge - Bridge #3098

Gardiner, Maine

PIN 18736.00

H-R File 16SG32

Page 7

with additional subsurface exploration including, but not limited to, test pits, soil borings with collection of soil and water samples, and laboratory testing.

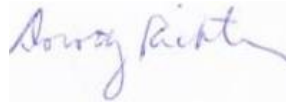
Except as expressly provided in this limitations section, Hager-Richter makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.

If you have any questions or comments on this letter report, please contact us at your convenience. We look forward to working with you again in the future.

Sincerely,
HAGER-RICHTER GEOSCIENCE, INC.

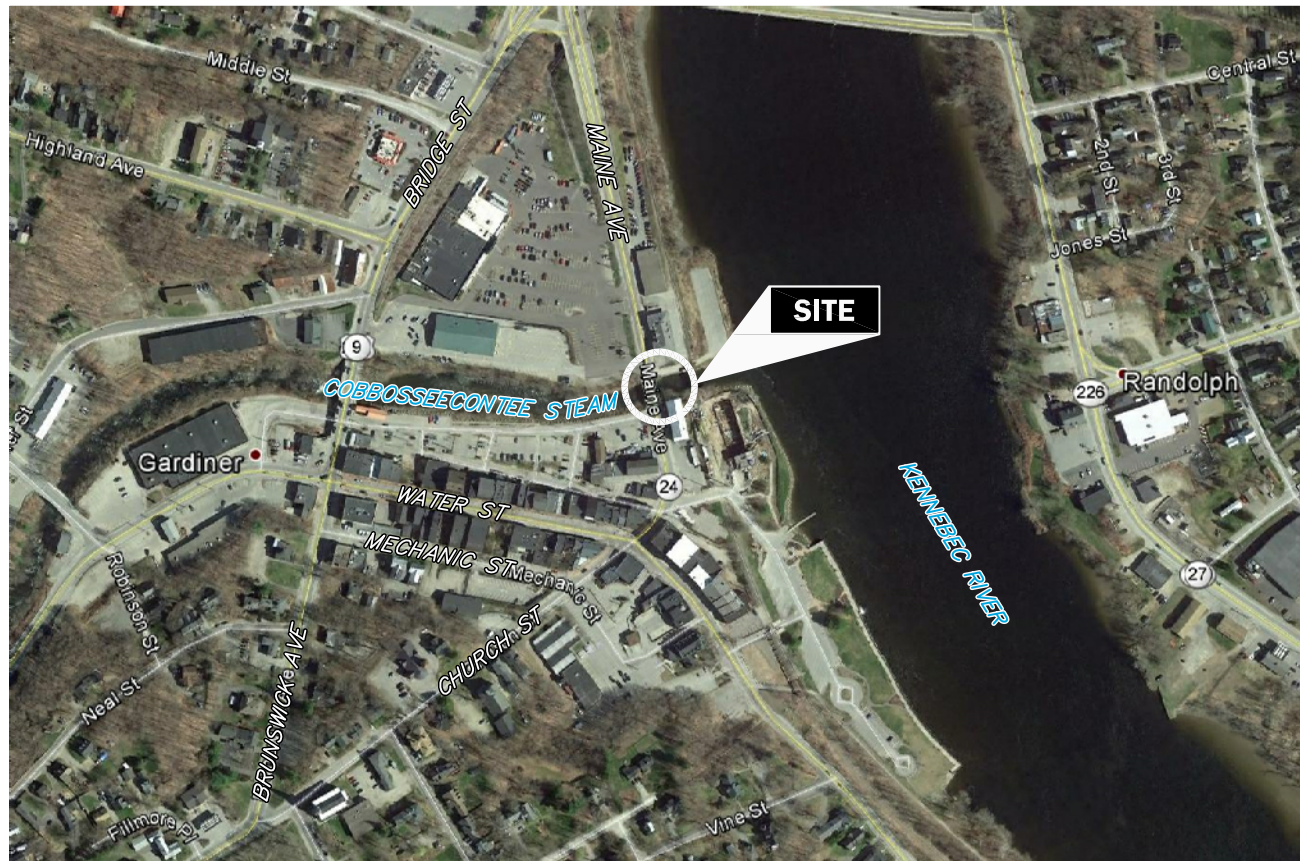


by Steven Grant, P.G.
Senior Geophysicist



Dorothy Richter, P.G.
President

Attachments: Figures 1-3



APPROXIMATE SCALE (feet)

0 500 1000



LOCATION

NOTE:

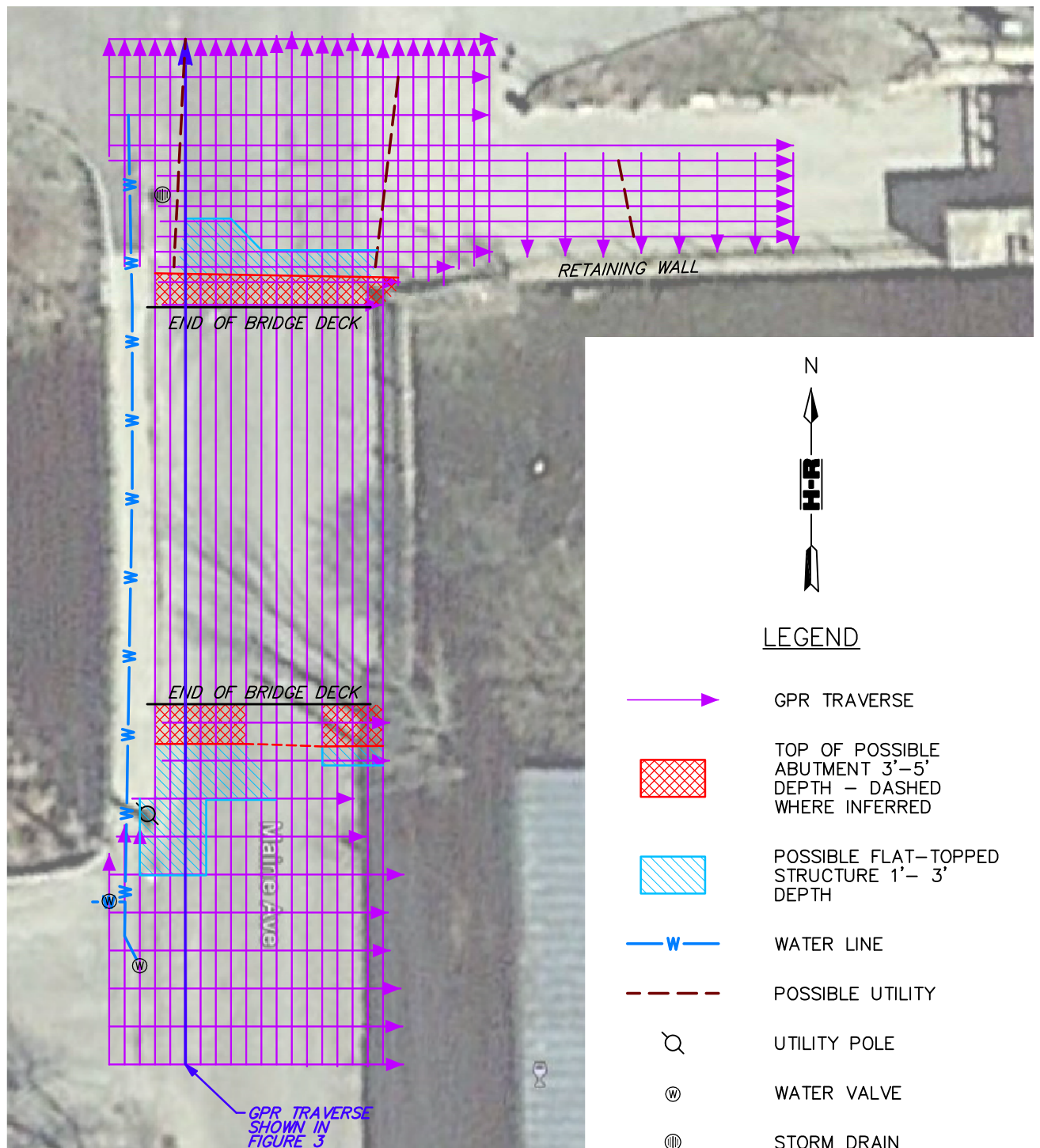
Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
Maine Avenue Bridge over
Cobbosseecontee Stream
Gardiner, Maine
PIN 18736.00

File 16SG32

November, 2016

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



NOTE:

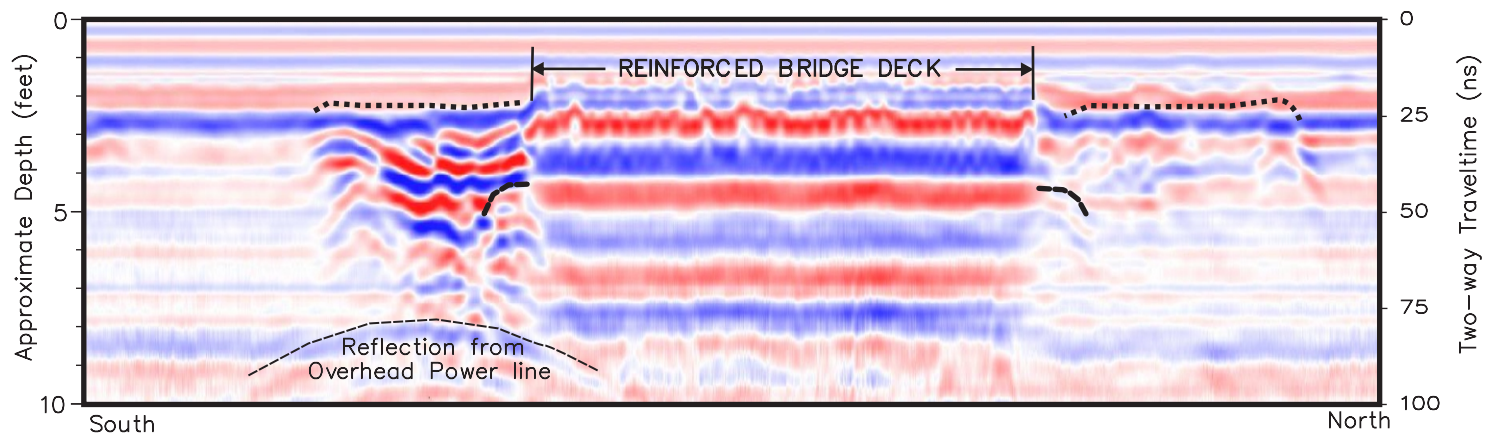
Modified from Google Earth Pro aerial photograph.

Figure 2
GPR Survey
Maine Avenue Bridge over
Cobbosseecontee Stream
Gardiner, Maine
PIN 18736.00

File 16SG32

November, 2016

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



LEGEND



Top of Possible Abutment



Possible Flat-Topped Structures

HORIZONTAL
SCALE (feet)



NOTES:

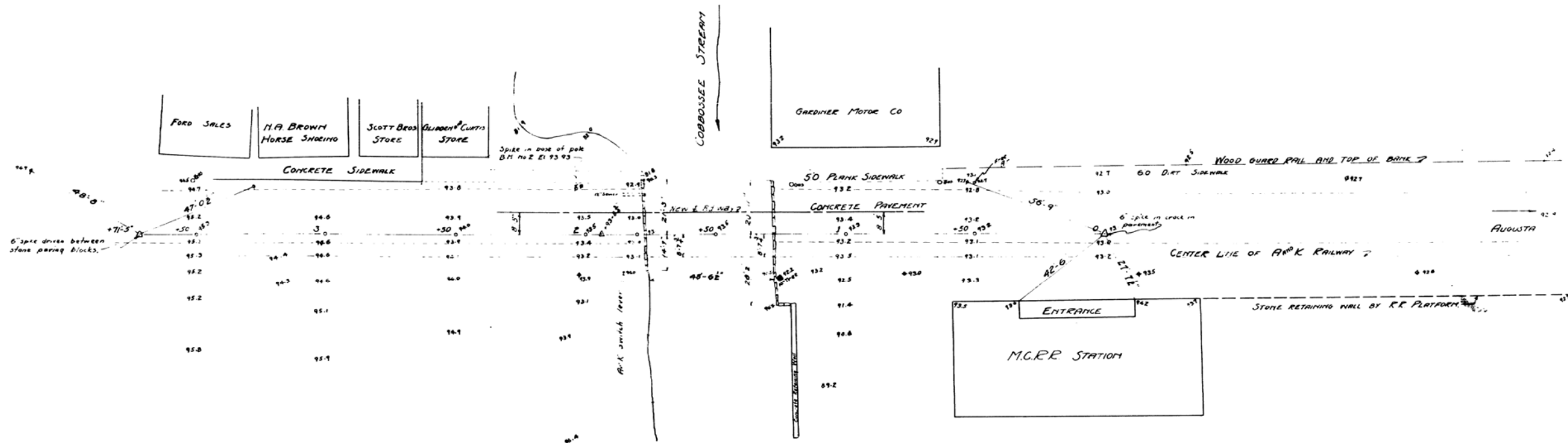
1. GPR records shown were acquired using a GSSI SIR 4000 GPR System and a 120 MHz antenna.
2. Estimated depths represent distance below ground surface.
3. Estimated depth scale shown on the GPR records was calculated using a GPR signal propagation velocity of 0.220 ft/ns, as calibrated from analyses of hyperbolic reflections.
4. Location of example profiles shown on Figure 2.

Figure 3
Example GPR Section
Maine Avenue Bridge
Gardiner, Maine
PIN 18736.00

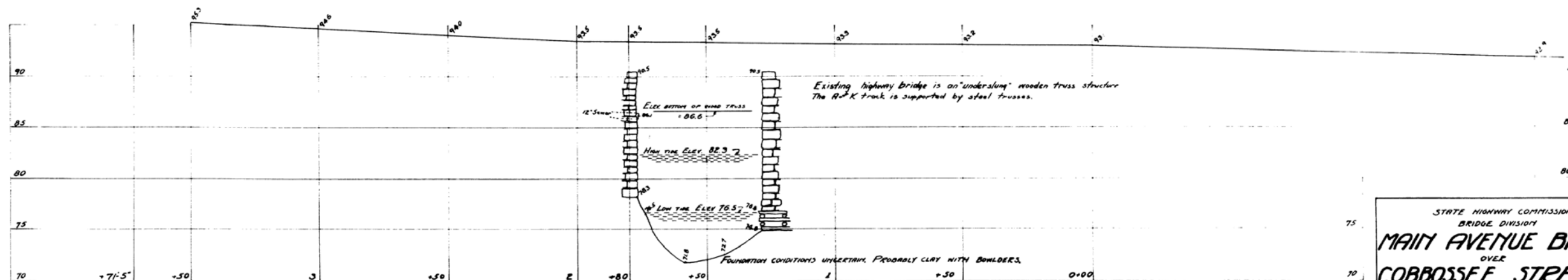
FILE 16SG32	December, 2016
HAGER-RICHTER GEOSCIENCE, INC.	
Salem, New Hampshire	

APPENDIX E

Historic Bridge Drawings



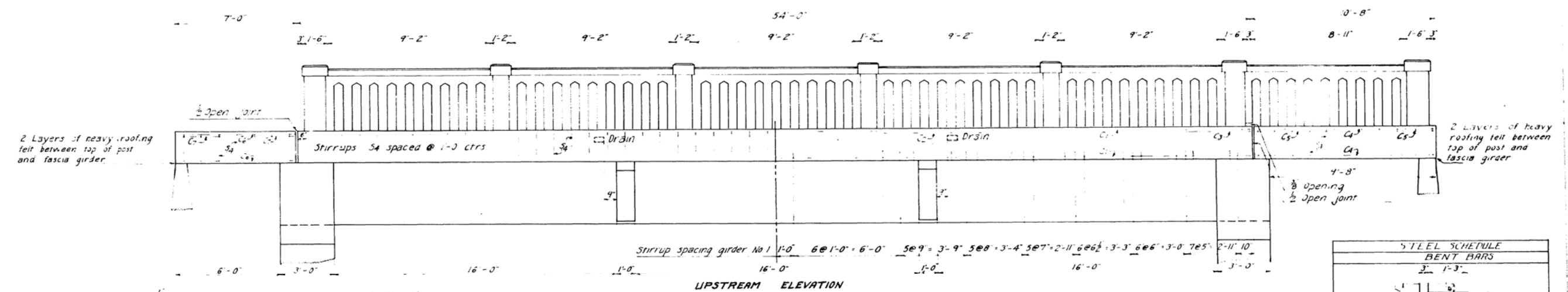
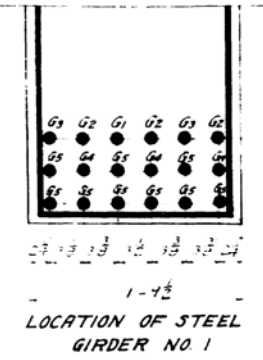
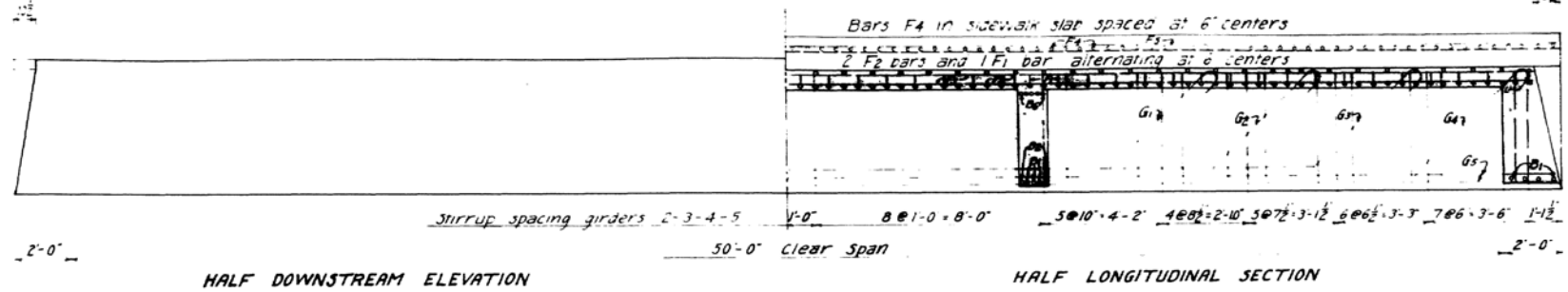
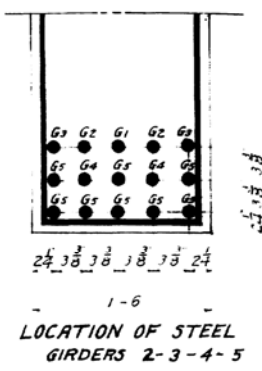
PLAN
Scale - 1" = 20'



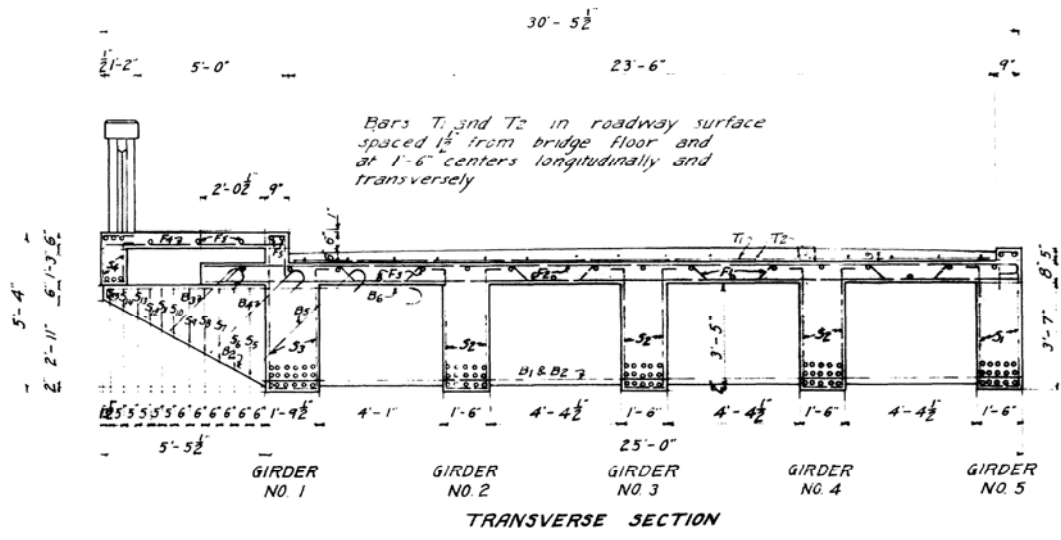
PROFILE
Scale H - 1" = 20'
V - 1" = 5'

STATE HIGHWAY COMMISSION
BRIDGE DIVISION
MAIN AVENUE BRIDGE
OVER
COBBOSSEE STREAM
IN THE CITY OF
GARDINER, KENNEBEC CO.
SURVEY PLAN
SHEET 1 OF 1
AUGUSTA, ME
APRIL 23, 1914

SURVEYED BY H.L.D.
PLOTTED BY H.L.D.
TITLED BY H.L.D.



Note: The 2" open joints in sidewalk curb and the 2" openings between end cross beams and bridge seats are to be covered with 2 layers of heavy roofing felt coat concrete and back side of each layer of felt as applied with hot tar or asphalt. The joints in curb to be covered to 3" above roadway surface.

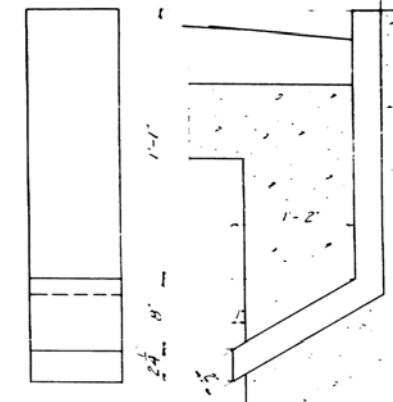
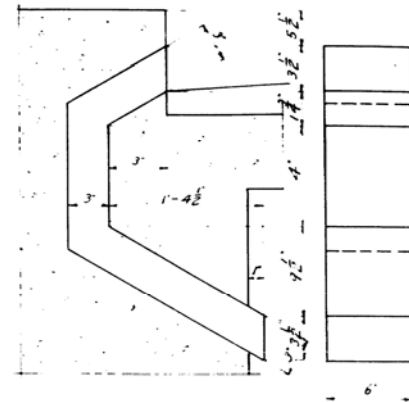
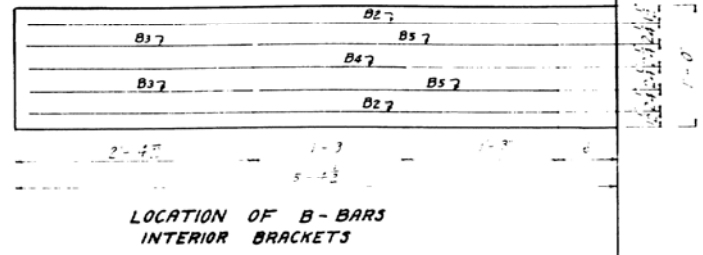
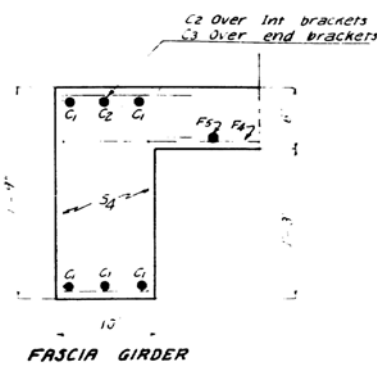


STEEL SCHEDULE						
BENT BARS						
Mark	Size	No. Req.	A	B	C	D
G1	1/2"	5	23'-6"	3'-5"	3'-0 1/2"	4'-7"
G2	"	11	30'-4"	3'-5"	3'-0 1/2"	4'-7"
G3	"	10	37'-2"	3'-5"	3'-0 1/2"	4'-7"
G4	"	11	44'-0"	3'-8 1/2"	3'-4"	4'-11 1/2"
Mark	Size	No. Req.	A	B	C	D
B1	3/8"	4	2'-0"	2'-11"	6'-2 1/2"	
B4	"	2	4'-0"	1'-4"	3'-7 1/2"	9'-1 1/2"
B5	"	4	2'-6"	1'-7 1/2"	4'-9 1/2"	8'-7"
Mark	Size	No. Req.	Total Length	Location		
B6	3/8"	10	13'-6 1/2"	Brackets		
Mark	Size	No. Req.	Total Length	Location		
B2	3/8"	4	30'-8 1/2"	Brackets		

STEEL SCHEDULE				
BENT BARS				
Mark	Size	No. Req.	Total Length	Location
F1	3/8"	52	24'-2 1/4"	Floor Slab
Mark	Size	No. Req.	Total Length	Location
S1	1/2"	73	11'-8"	Down Stream Girder
Mark	Size	No. Req.	Total Length	Location
S2	1/2"	219	10'-3"	Interior Girders
Mark	Size	No. Req.	Total Length	Location
S3	1/2"	83	13'-2 1/2"	Sidewalk Girder

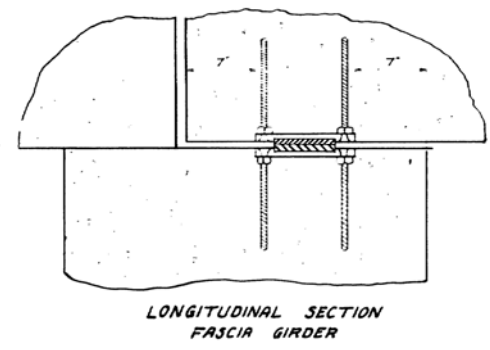
STEEL SCHEDULE				
BENT BARS				
Mark	Size	No. Req.	Total Length	Location
S4	1/2"	72	4'-11"	Fascia
Mark	Size	No. Req.	Total Length	Location
S5	1/2"	2	2'-10 1/2"	Brackets
S6	"	2	2'-7 1/2"	
S7	"	2	2'-4 1/2"	
S8	"	2	2'-1"	
S9	"	1	1'-9 1/2"	
S10	"	1	1'-6 1/2"	
S11	"	1	1'-3 1/2"	
S12	"	1	1'-1"	
S13	"	0	0'-10 1/2"	
S14	"	0	0'-7 1/2"	
S15	"	0	0'-4 1/2"	

MAINE HIGHWAY COMMISSION
BRIDGE DIVISION
MAIN AVENUE BRIDGE
OVER
COBBOSSEE STREAM
IN THE TOWN OF
GARDINER, KENNEBEC COUNTY
PART PLAN OF SUPERSTR.
SHEET 2 OF 4 AUGUSTA, ME MAY 18, 1925

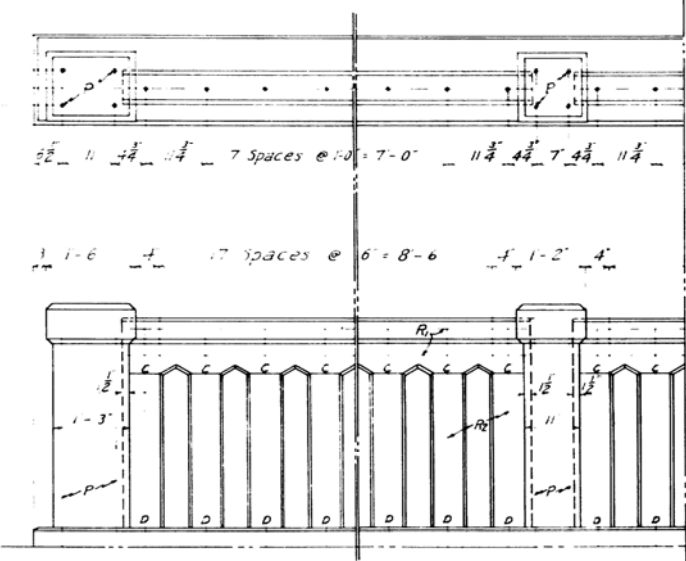
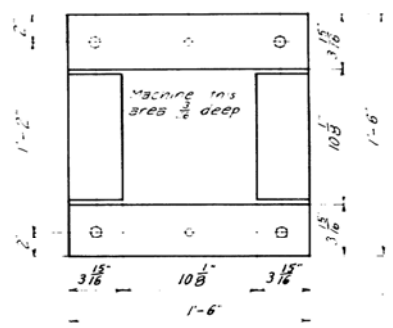
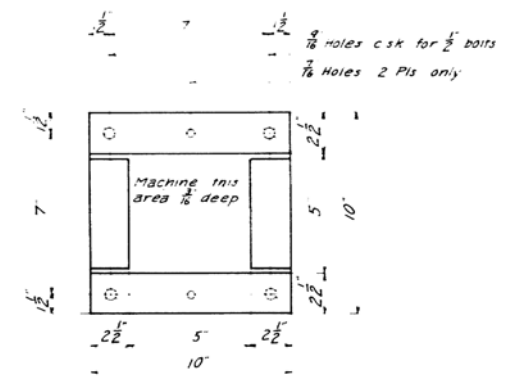


STEEL SCHEDULE			
Straight Bars			
Mark	Size	No. Req.	Length Location
Gs	1/2"	41	53'-6" Girders
C1	3/8"	5	53'-8" Fascia Girder
C2	1/2"	2	5'-0"
C3	1/2"	2	4'-0"
C4	1/2"	5	10'-4"
C5	1/2"	2	3'-0"
C6	1/2"	5	6'-8"
C7	1/2"	2	2'-9"
F2	3/8"	106	26'-9" Floor Slab
F3	1/2"	20	52'-0"
F4	1/2"	143	6'-0" Sidewalk Slab
F5	1/2"	5	53'-9"
B1	3/8"	14	24'-8" Cross Beams
P	1/2"	28	4'-6" Posts
R1	3/8"	3	4'-0" Railing
R2	1/2"	60	4'-3"
T1	1/2"	16	23'-5" Roadway Surface
T2	1/2"	30	52'-0"

All steel dimensions are to center line of bar
All steel to be plain round structural grade

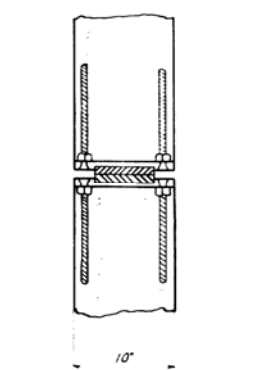


LONGITUDINAL SECTION
FASCIA GIRDER

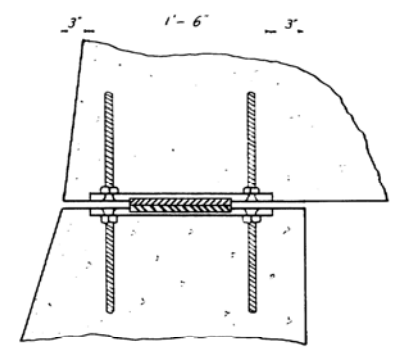


RAIL DETAILS

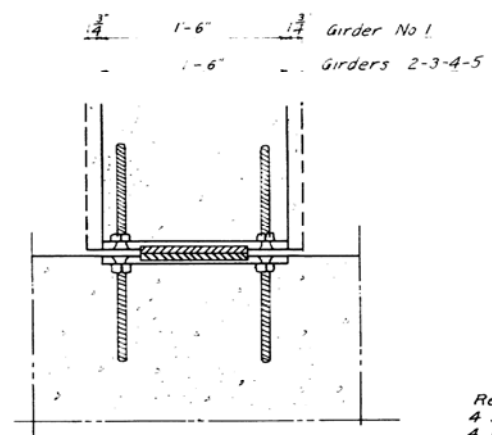
Curb to be cast with slab. Place vertical rods for posts and rails in fascia girder. Break the bond at points C and D top and bottom of each vertical section between openings and at ends, by placing there one layer of heavy roofing felt cut to fit form and slipped down over the reinforcing steel at the proper time. After the rail forms are removed wrap the end 6" of each rail with heavy roofing felt fold in the ends and build post forms so that rails project into posts 1 1/2". When post forms are removed cut away all felt left exposed. All exposed edges of concrete to be chamfered 1/2" unless otherwise indicated.



TRANSVERSE SECTION
FASCIA GIRDER



LONGITUDINAL SECTION
GIRDERS 1-2-3-4-5



TRANSVERSE SECTION
GIRDERS 1-2-3-4-5

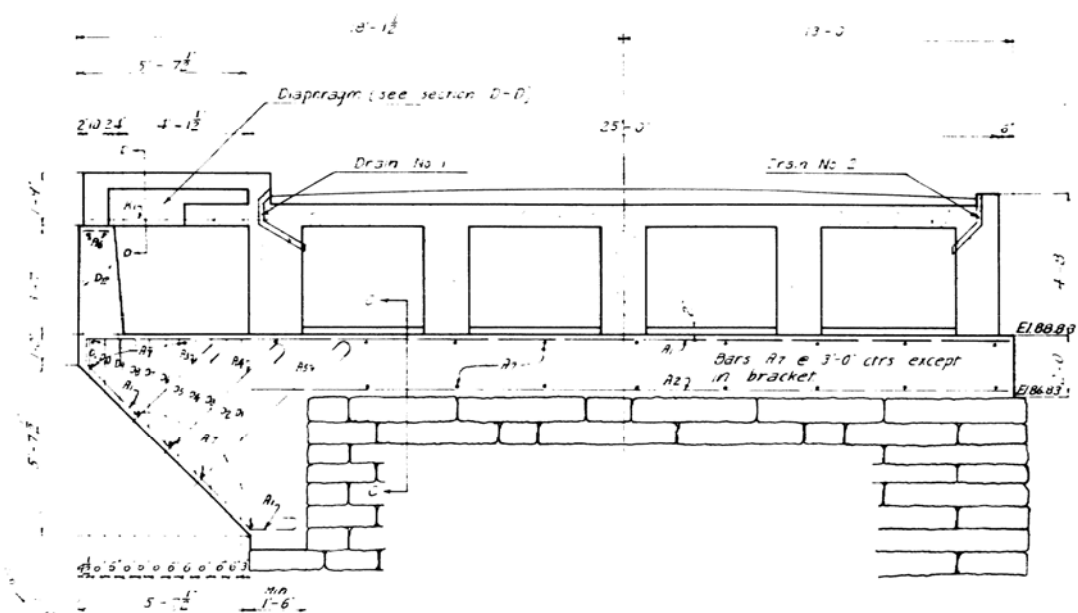
EXPANSION BEARING DETAILS

- Required:
- 4 Steel plates 10" x 4" x 10"
 - 4 Phosphor bronze plates 4 1/8" x 3" x 4 1/8"
 - 16 Bolts 3/8" x 10" with nuts, csk heads, threaded full length
 - 10 Steel plates 18" x 4" x 1'-6"
 - 10 Phosphor bronze plates 10" x 8" x 10"
 - 40 Bolts 3/4" x 1'-0" with nuts, csk heads, threaded full length

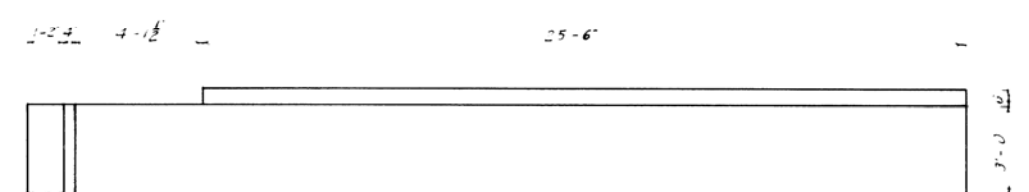
Note: Grooves in steel plates to be cut 3/8" to 1/2" deeper than bearing area to allow machining of bearing area. Bronze plates to be finished smooth and true either by rolling or by a final finishing cut.

Expansion plates will be furnished by the Highway Commission for nearest railroad station.

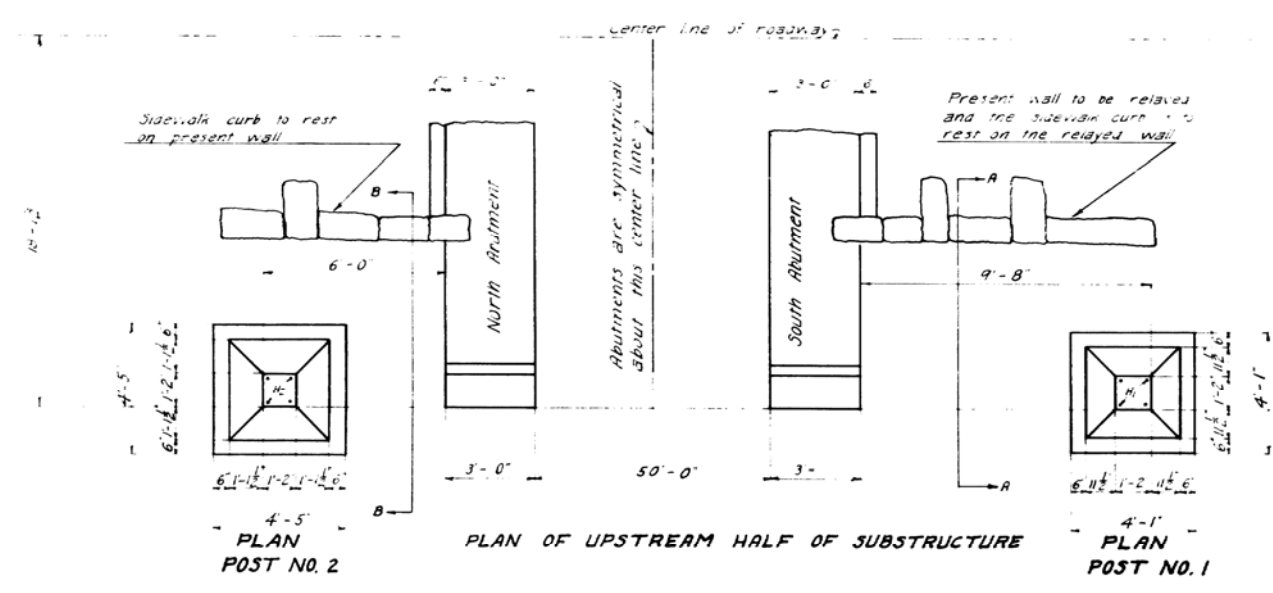
MAINE HIGHWAY COMMISSION
BRIDGE DIVISION
MAIN AVENUE BRIDGE
OVER
COBBOSSEE STREAM
IN THE TOWN OF
GARDINER KENNEBEC COUNTY
DETAILS
SHEET 3 OF 4 AUGUSTA, ME MAY 19, 1925



ELEVATION NORTH ABUTMENT



PLAN NORTH ABUTMENT

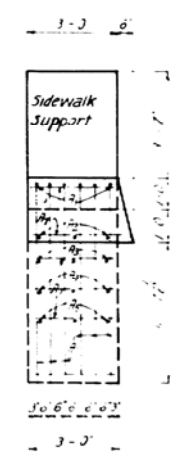


PLAN POST NO. 2

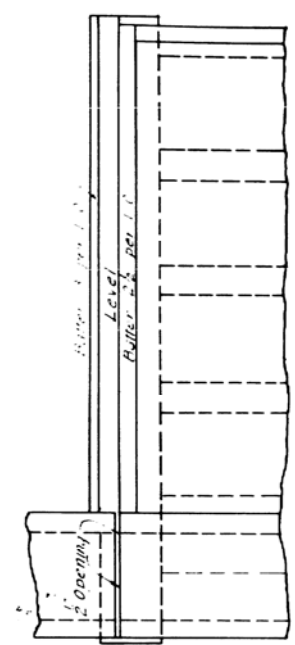
PLAN OF UPSTREAM HALF OF SUBSTRUCTURE

PLAN POST NO. 1

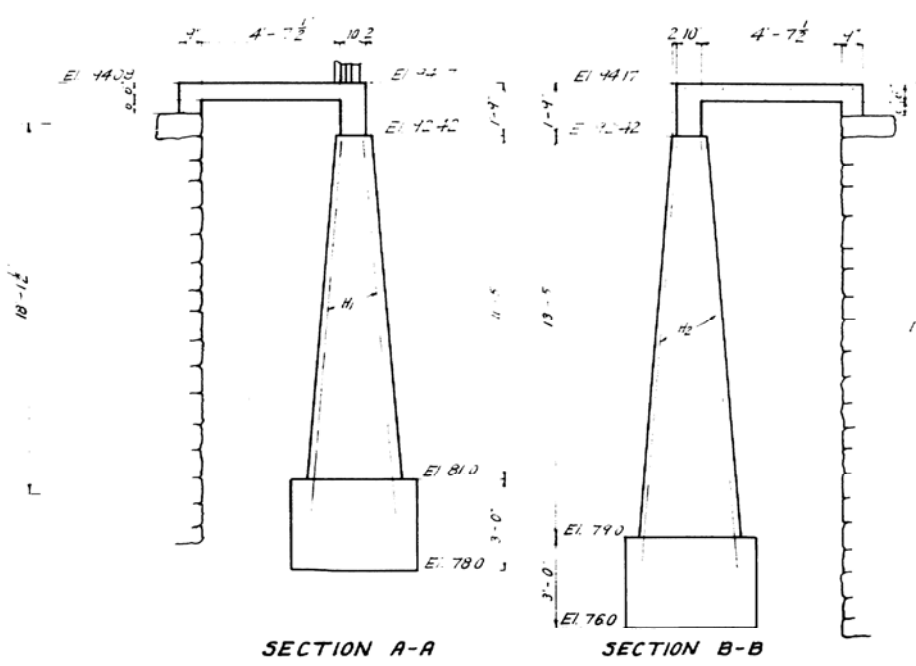
See sheet 2 for location of drains
See sheet 3 for drain details



SECTION C-C



PART PLAN VIEW OVER NORTH ABUTMENT

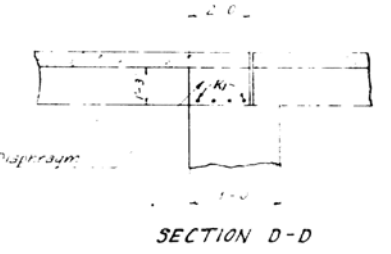


SECTION A-A

SECTION B-B

STEEL SCHEDULE

Mark	Size	No	Req	Length	Location
A1	3/4"	17	10 1/2	5'-5 1/2"	Abut Brackets
A2	3/4"	6	1'-6"	3'-6 1/2"	Abut Brackets
A3	3/4"	6	5'-0 1/2"	7'-10"	Abut Brackets
A4	3/4"	6	6'-6 1/2"	9'-4"	Abut Brackets
D1	1/2"	2	6'-1 1/4"	20'-1 1/4"	Abut Brackets
D2	1/2"	2	5'-7 1/4"	19'-1 1/4"	Abut Brackets
D3	1/2"	2	5'-1 1/4"	18'-1 1/4"	Abut Brackets
D4	1/2"	2	4'-7 1/4"	17'-1 1/4"	Abut Brackets
D5	1/2"	2	4'-1 1/4"	16'-1 1/4"	Abut Brackets
D6	1/2"	2	3'-7 1/4"	15'-1 1/4"	Abut Brackets
D7	1/2"	2	3'-1 1/4"	14'-1 1/4"	Abut Brackets
D8	1/2"	2	2'-7 1/4"	13'-1 1/4"	Abut Brackets
D9	1/2"	2	2'-1 1/4"	12'-1 1/4"	Abut Brackets
D10	1/2"	2	1'-7 1/4"	11'-1 1/4"	Abut Brackets
D11	1/2"	2	1'-1 1/4"	10'-1 1/4"	Abut Brackets
D12	1/2"	2	1'-1 1/4"	9'-7 1/4"	Abut Brackets
A5	3/4"	8	5'-7"	5'-7"	Diaphragms



SECTION D-D

MAINE HIGHWAY COMMISSION
BRIDGE DIVISION
MAIN AVENUE BRIDGE
OVER
COBBOSSEE STREAM
IN THE TOWN OF
GARDINER KENNEBEC COUNTY
SUBSTRUCTURE PLAN
SHEET 4 of 4 AUGUSTA, ME. MAY 22, 1925

NOTES

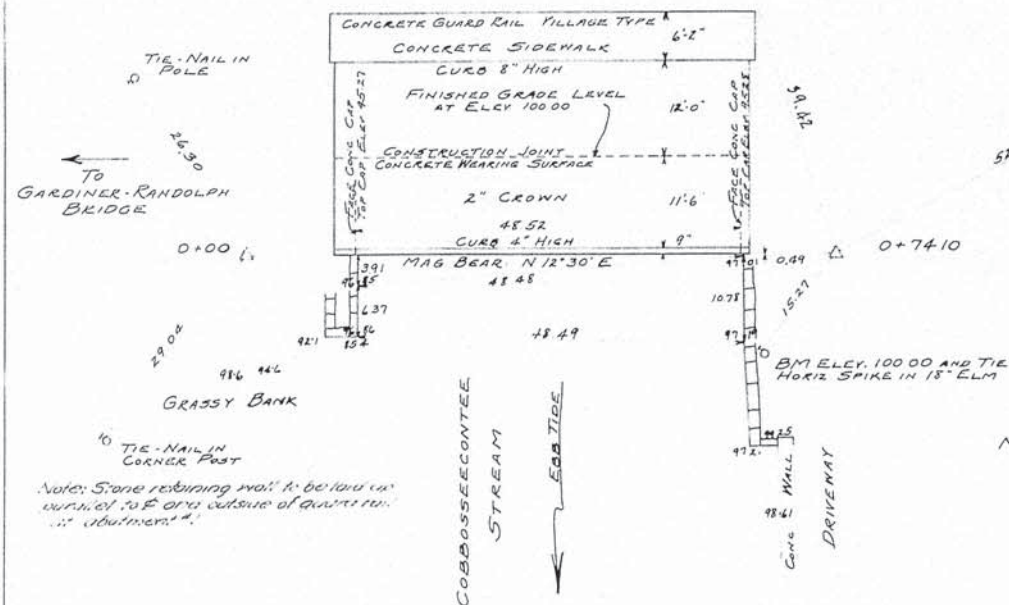
REINFORCING STEEL SHOWING ON TOP WEARING SURFACE NEXT TO DOWNSTREAM CURB
COVER PLATE AND UPPER FLANGES OF CHANNELS IN UPPER CHORD OF A.K. RY. TRUSSES RUSTED. FLANGES RUSTED OVER BEARINGS.

GARAGE

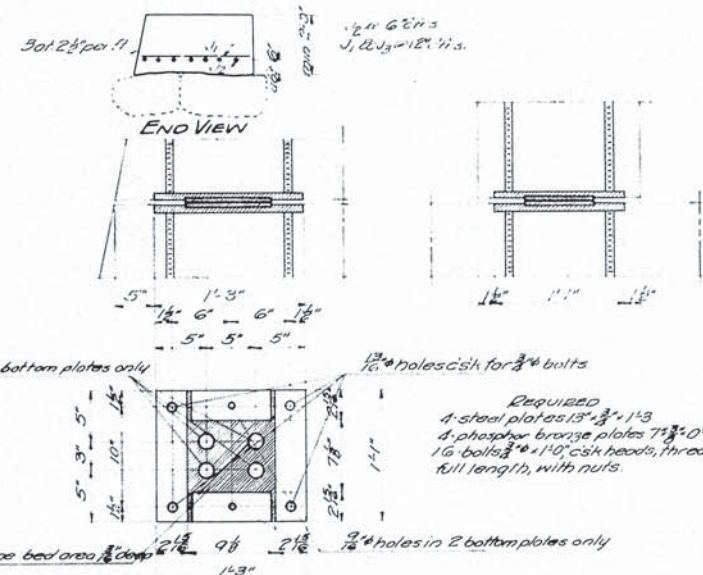
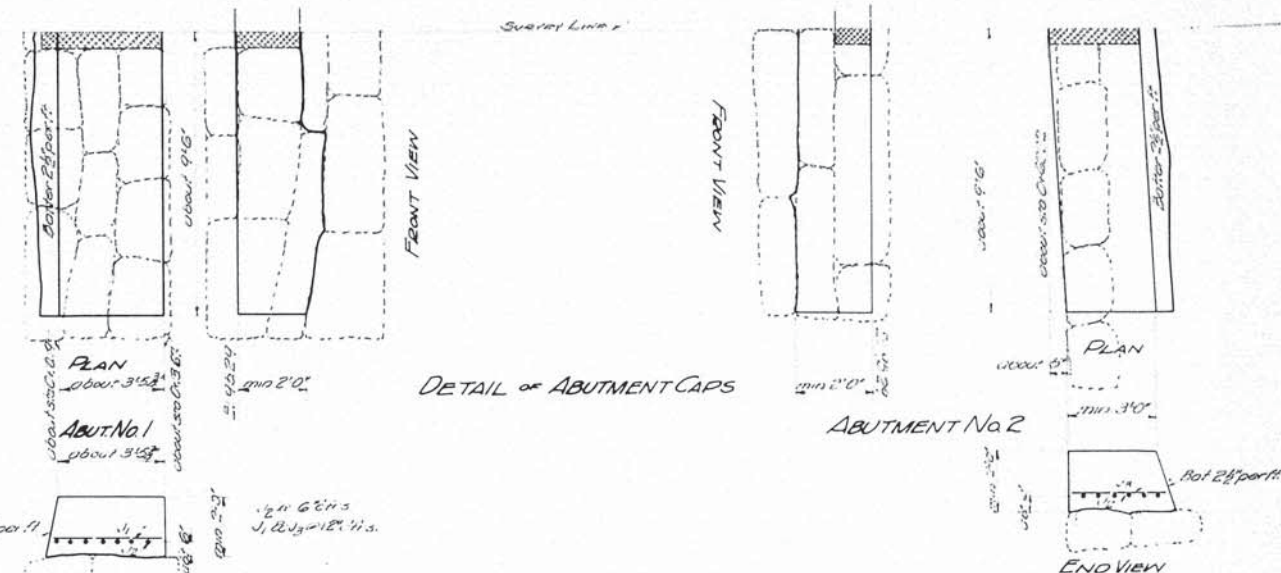
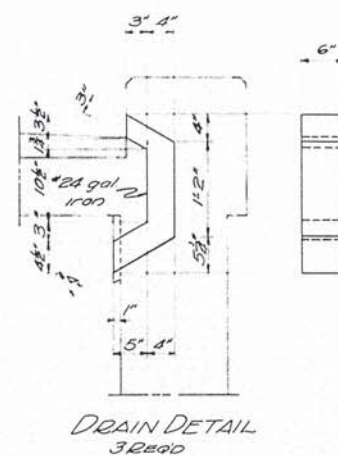
TIE-NAIL IN CORNER BLOS

TIE-NAIL IN POLE

Crosshatched areas of present abutment caps to be removed flush with present superstructure so that new beam will have full bearing on new concrete.



SURVEY PLAN
SCALE 1 INCH = 10 FEET



Grooves in steel plates to be cut $\frac{3}{8}$ " to $\frac{1}{2}$ " deeper than bed area to permit machining. Bronze plates to be finished smooth and true, either by rolling or by a final finishing cut. Expansion plates to be furnished by the Commission F.O.B. nearest R.R. station.

EXPANSION PLATE DETAILS

TOWN 06-10
BRIDGE 3098

MAINE HIGHWAY COMMISSION
BRIDGE DIVISION
EXTENSION OF
MAIN AVENUE BRIDGE
OVER
COBOSSEECONTEE STREAM
IN THE CITY OF
GARDINER
KENNEBEC COUNTY

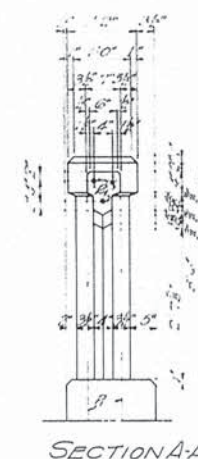
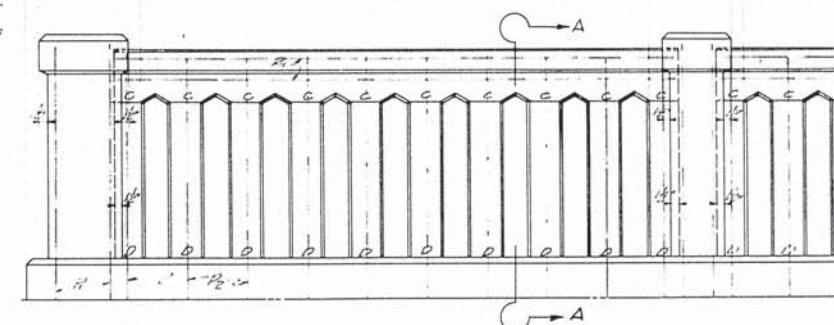
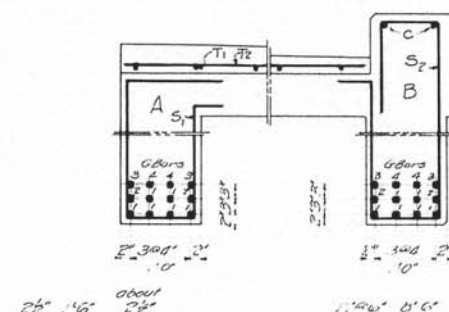
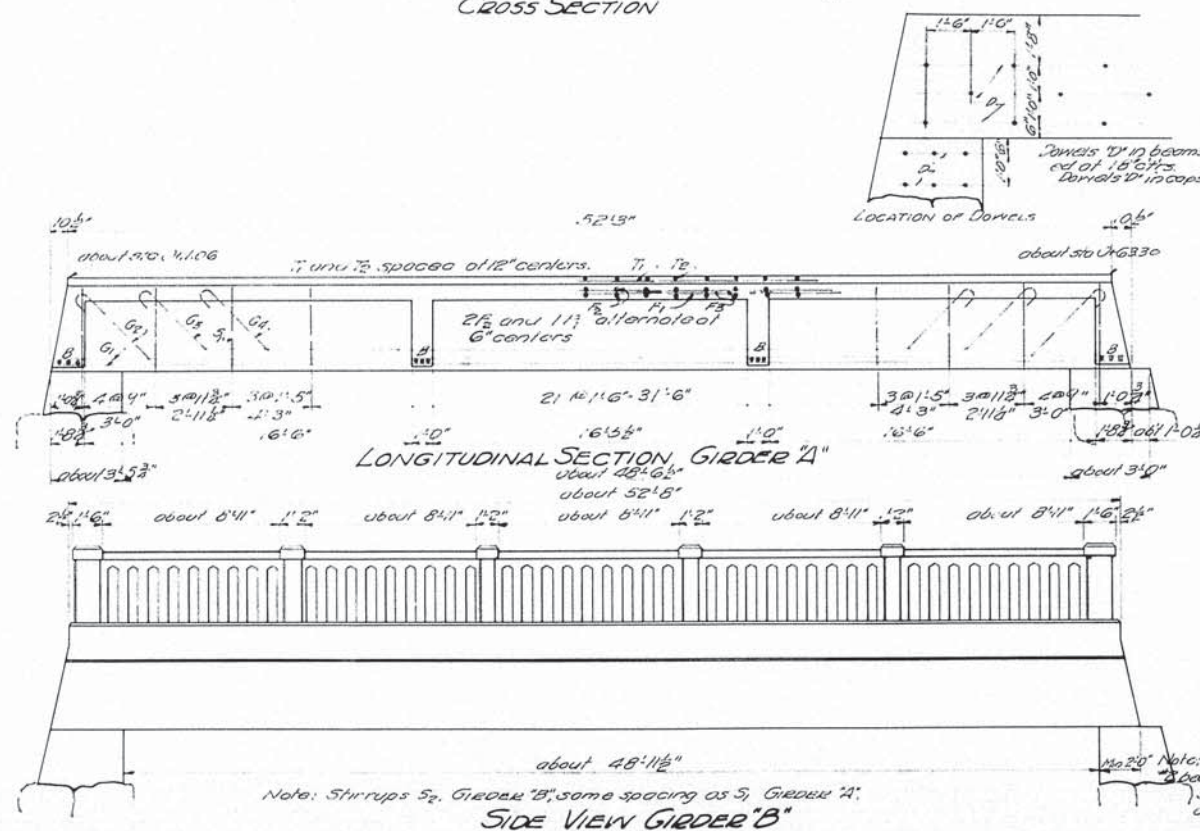
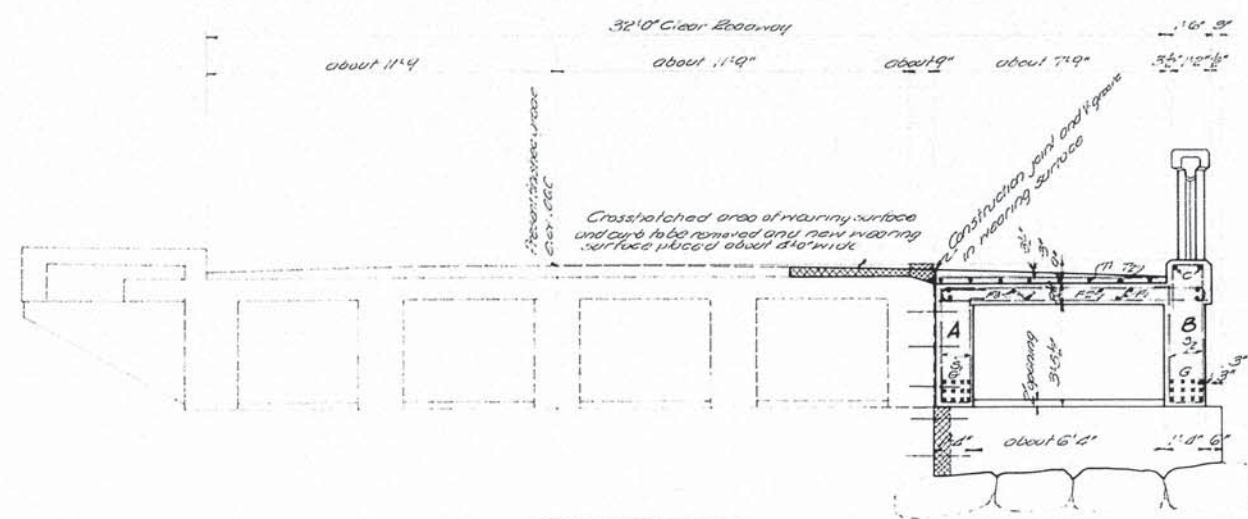
SHEET 1 OF 2 AUGUSTA, ME. JULY, 1933

26-46

SURVEYED & PLOTTED BY C. Beckman

Beckman

0 1 2 3 4 5 INCHES



STEEL SCHEDULE

Molt	Size	No.	Total length
F ₁	8 1/2"	106	92 1/2"
T ₂	8 1/2"	8	52 1/2"
G ₂	9 1/2"	52	71 1/2"
T ₁	1 1/2"	18	53 1/2"
C	3 1/4"	2	52 1/2"
D	3 3/4"	12	61 1/2"
J ₁	3 3/4"	10	31 1/2"
J ₂	2 1/4"	13	41 3/4"
J ₃	3 3/4"	10	21 1/4"
H	3 3/4"	20	41 1/2"
F ₂	8 1/2"	50	41 3/4"
L ₁	8 1/4"	15	9 3/4"
D ₂	6 1/4"	8	52 1/2"
M	3 1/2"	65	11 1/2"

Month	Size	No	A	B	C	D	Total length
G2	1 st	2	47:15"	3:8 1/2"	4:14 1/2"	3:4"	55:7 1/2"
G3	1 st	4	37:13"	3:5 1/2"	4:7 1/2"	3:4 1/2"	49:0 1/2"
G4	1 st	4	30:4 1/2"	3:5 1/2"	4:7 1/2"	3:1"	42:1 3/4"
F1	2 nd	52					11 1/2:5 1/2"
S1	2 nd	42					0:7 1/2"
S2	2 nd	42					13:3 1/2"

The steel to be plain
bars of structural grade
All dimensions are to
§ of bars.

Form	06-10
Number	3098

Maine Highway Commission
 Bridge Division
 EXTENSION OF
 MAIN AVENUE BRIDGE
 over
 COBBOSEECONTEE STREAM
 in the City of
 GARDNER - KENNEBEC CO.
 Sheet 2 of 2 Augusta, Me July 1933

26-47

APPENDIX F

Calculations

Table of Contents

- Frost Protection
- Global Stability
- Seismic Site Class
- Liquefaction Analysis
- Driven Pile Axial Resistance
- Lateral Pile Evaluation
- Driven Pile Elastic Compression
- Lateral Soil Pressures
- Axial Micropile Evaluations

Frost Protection

Client: MAINEDOT

Project: MAINE AVENUE BRIDGE, GARDINER, MAINE

Subject: FROST SUSCEPTIBILITY AND MAX. DEPTH OF FROST PENETRATION

OBJECTIVE:

Evaluate maximum depth of frost penetration based on soil and groundwater conditions, as well as geographic site location.

REFERENCES:

1. MaineDOT Bridge Design Guide, 2003 with interim revisions through 2017.
2. Preliminary Geotechnical Design Report prepared by Haley & Aldrich, Inc.
3. MaineDOT drawing set prepared by Stantec, dated August, 2017.

EVALUTATION:

1. Gather relevant information from test borings performed near proposed bridge abutment locations:

STRUCTURE	TEST BORING NO.	GROUND SURFACE	GROUND WATER	SAMPLE No. AND ELEVATION	AASHTO/USCS	FINES CONTENT
ABUTMENT NO. 1	BB-GCS-104	El. 15.7	El. 1.7	2D El. 11.7-13.7	A-4/ SM	40.9
				3D El. 9.7-11.7	A-4/ SM	46.6
ABUTMENT NO. 2	BB-GCS-105	El. 14.5	Not Observed	2D El. 10.5-12.5	A-2-4/ SM	31.2
				3D El. 8.5-10.5	A-1-b/ SW-SM	11.8

Note: Ground water elevations summarized above were determined in the field and may have been influenced by the drilling process. Ground water elevations may vary throughout the year due to seasonal variations and precipitation events.

2. Water levels at the site are as follows:

Q1.1 (MLW) El. 0.9

Q1.1 (MHW) El. 3.9

Q50 El. 6.8

Q100 El. 7.6

3. Proposed bottom of abutment elevations are as follows:

Abutment No. 1 El. 4.0

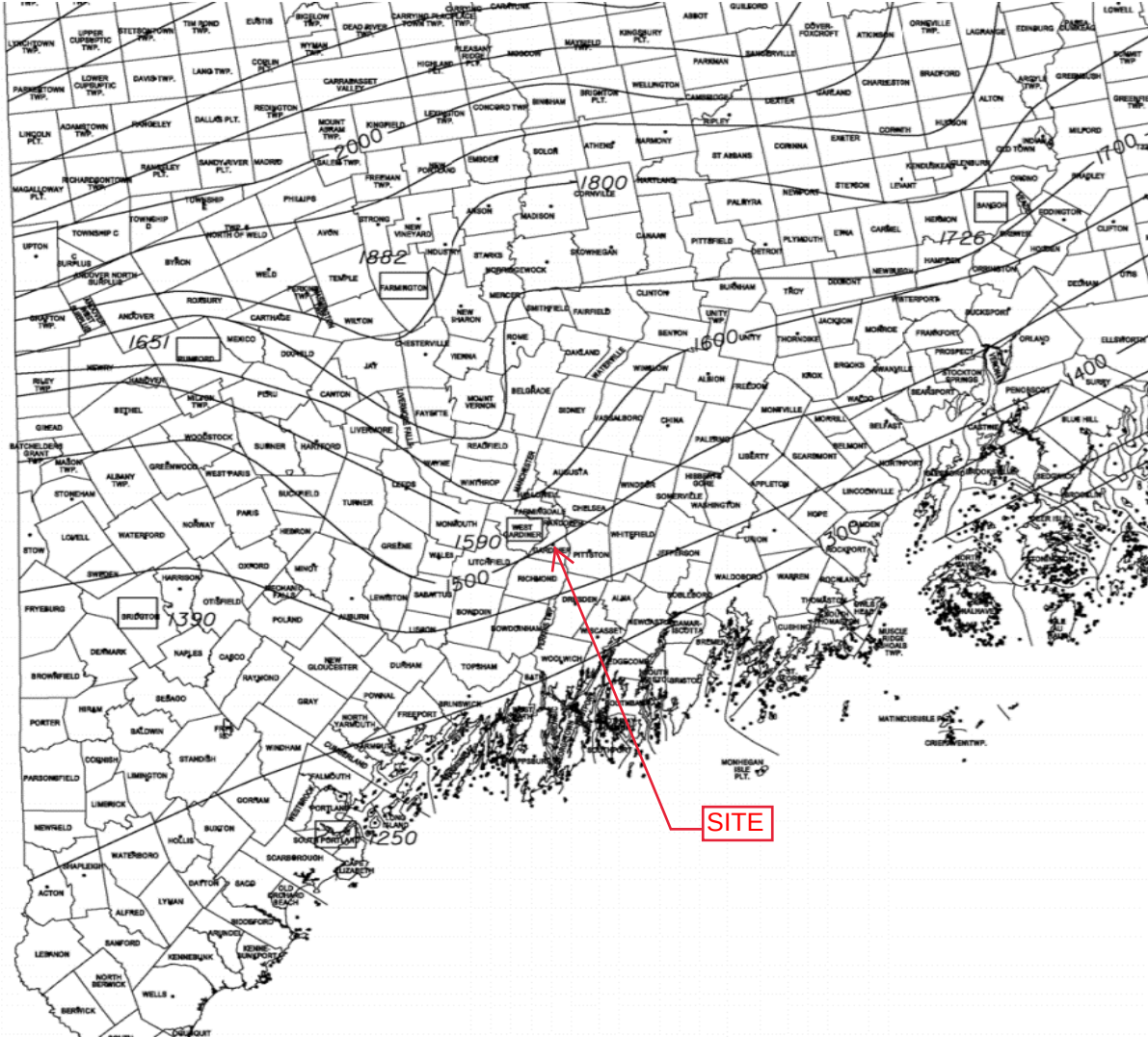
Abutment No. 2 El. 4.0

4. From MaineDOT Bridge Design Guide Figure 5-1, the design freezing index for the site is approximately 1500 °F - days

5. Estimate range in frost penetration using MaineDOT Bridge Design Guide Table 5-1, the design freezing index above and an assumed range in water content since site-specific laboratory test data does not exist

From Table 5-1, frost penetration depths vary between approximately 5 ft (w=30%), 5.5 ft (20%) and 7 ft (w=10%) for coarse-grained soils. Frost penetration depths vary between approximately 4 ft (w=30%) and 5 ft (w=10%).

Recommend 5.5 ft (w=20%)


Table 5-1 Depth of Frost Penetration

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

Global Stability

Client:	Maine Department of Transportation
Project:	Maine Avenue Bridge over Cobbosseecontee Stream, Gardiner, Maine
Subject:	Global Stability for Abutment 1

PROBLEM STATEMENT AND OBJECTIVE

Calculate the global stability minimum factor of safety for Abutment 1.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014.
2. Slide version 7.0 by RocScience.
3. FHWA-NHI-16-009 Design and Construction of Driven Pile Foundations - Volume 1.
4. American Institute of Steel Construction (AISC), 13th Edition, 2005.
5. Maine DOT Bridge Design Guide, 2003, with 2014 updates.

AVAILABLE INFORMATION

1. Plan set titled, "State of Maine Department of Transportation, Gardiner Kennebec County, Maine Avenue Bridge over Cobbosseecontee Stream," dated August 2017.

ASSUMPTIONS

1. Abutment 1 will be modeled as the "worse case."
2. Pile cap will be modeled as infinite strength with no weight.
3. Water level will be modeled at Q1.1 at El. 3.9 (MHW).
4. Seismic cases will have a seismic force of $A_s/2$ ($0.193g/2$) = 0.0965 g based on the seismic site class calculations .
5. Proposed HP14x117 will be modeled with a pile shear strength of 278 kips:
 $V_p = 0.58F_{yw}d_w t_w$ (from FHWA Equation 8-61)
 d_w = depth of web (assume 1/16 in. corrosion) = 0.68 in.
 t_w = thickness of web (assume 1/16 in. corrosion) = 14.085
 $F_{yw} = 50$ ksi
 $V_p = 278$ kips
 Piles will be modeled to top of bedrock with an out of plane spacing of 10 ft parallel to the surface.
6. A 250 psf traffic surcharge will be modeled.

SOIL PROPERTIES

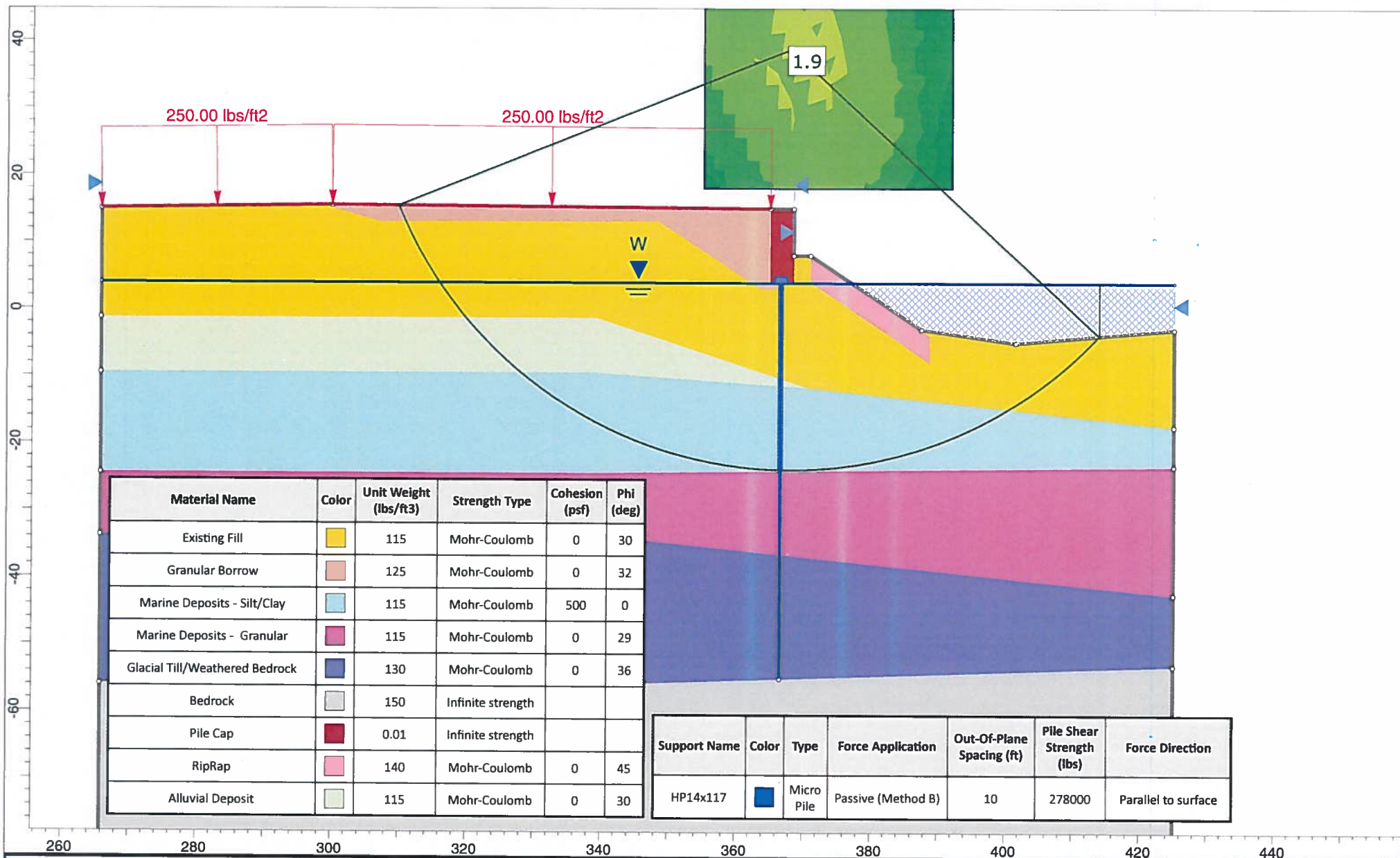
Material	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)
Riprap	140	45	0
Granular Borrow	125	32	0
Existing Fill	115	30	0
Alluvial Deposit	115	30	0
Marine Deposits - Silt/Clay	115	0	500
Marine Deposit - Granular	115	29	0
Glacial Till/Weathered Bedrock	130	36	0
Bedrock	infinite strength		

RESULTS AND CONCLUSIONS

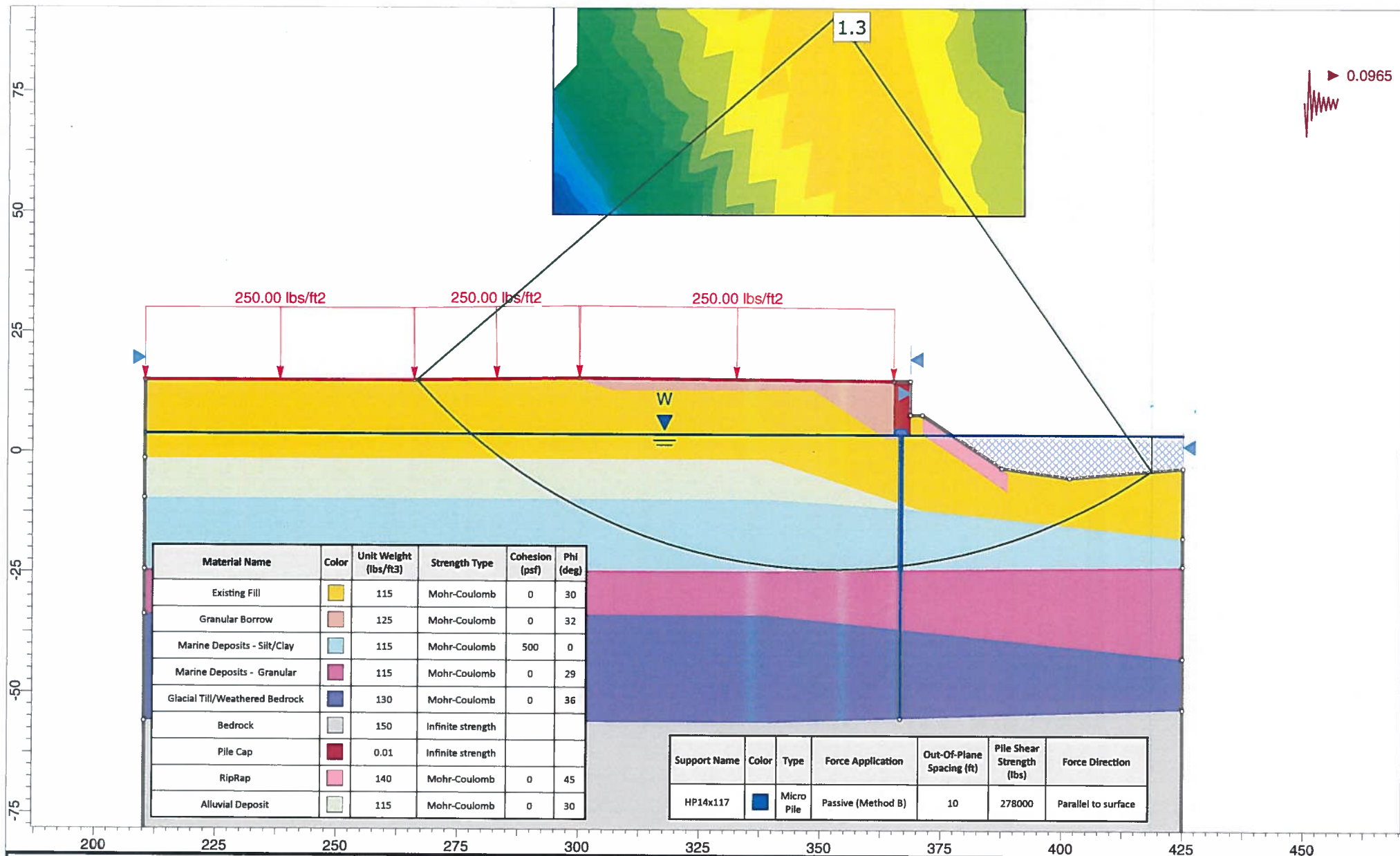
	F.S.
Abutment 1 - Static	1.9
Abutment 1 - Seismic	1.3

Based on AASHTO LRFD Section 11.6.2.3, an acceptable resistance factor for where the slope contains or supports a structure is 0.65 (F.S. = $1/0.65 = 1.5$).

Based on Maine DOT Bridge Design Guide Section 5.9.4, a minimum seismic factor of safety of 1.0 is acceptable for slope stability.



 SLIDEINTERPRET 7.023	Project Maine Avenue Bridge over Cobbosseecontee Stream, Gardiner, Maine					
	Analysis Description Global Stability for Abutment 1					
	Drawn By MMB		Scale 1:237		Company Haley & Aldrich, Inc.	
	Date April 2018			File Name 2018-0409-HA1-Maine Avenue Gardiner-Abutment 1-Global Stability-D1.slm		



 SLIDEINTERPRET 7.023	Project		
	Maine Avenue Bridge over Cobbosseecontee Stream, Gardiner, Maine		
	Analysis Description		
	Global Stability for Abutment 1		
	Drawn By		Company
	MMB	Haley & Aldrich, Inc.	
	Scale	1:330	
	Date	April 2018	
	File Name	2018-0409-HAI-Maine Avenue Gardiner-Abutment 1-Global Stability-Seismic-D1.slm	

Seismic Site Class

CALCULATIONS

File No.	42223-005
Sheet	1 of 3
Date	5/12/2016
Computed By	KAR
Checked By	MMB

Client	Maine Department of Transportation
Project	Route 24 over Cobbosseecontee Stream; WIN 18736.00 Bridge NO. 3098
Subject	Seismic Site Class & Design Parameters

OBJECTIVE:

Assess the seismic hazard at the bridge site in accordance with the AASHTO LRFD Bridge Design Specifications 7th Edition 2014 and the MaineDOT Bridge Design Guide 2003 with interim revisions through August 2008.

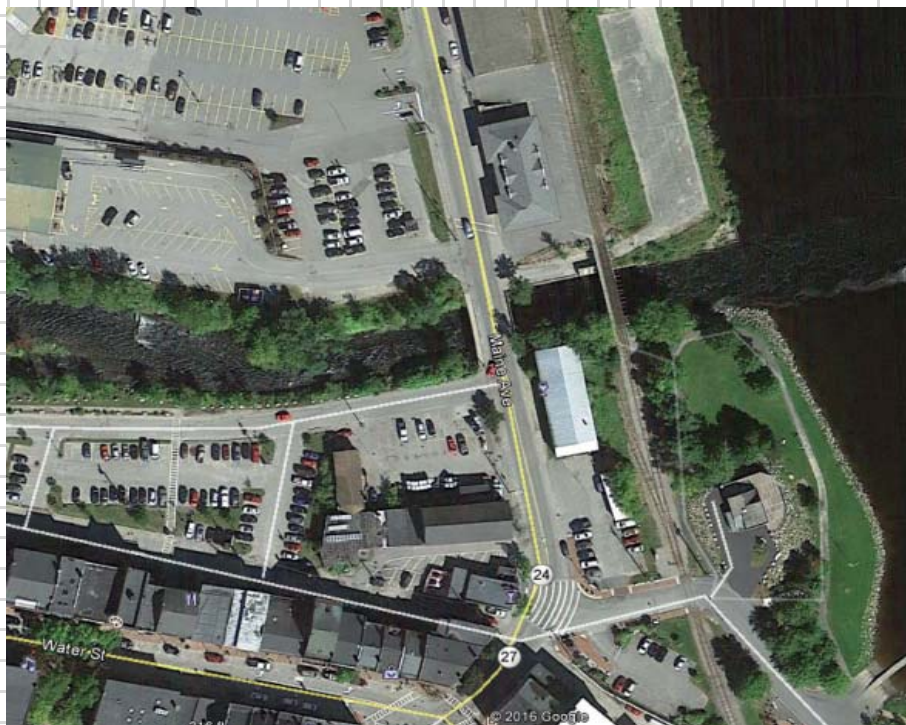
METHODOLOGY:

1. Determine geographic location of the bridge site (latitude-longitude coordinates).
2. Determine Site Class in accordance with Section 3.10.3.1 (N method for cohesionless soils) considering only test borings drilled at proposed substructure locations. These test borings were drilled into bedrock and/or penetrated a minimum of 100 ft below existing ground surface/mudline. For sublayers with an SPT N60 value equal to 0 bpf or in excess of 100 bpf, default values of 1 and 100 bpf were used, respectively.
3. Determine Site Factors and Elastic Seismic Response Coefficients based on (1) and (2) in accordance with Section 3.10.3.2. Factors are determined using the AASHTO earthquake ground motion parameters application v. 2.10 for a seismic event having a 7 percent probability of exceedance in 75 years.
4. Determine Seismic Design Category based on (3) in accordance with Section 3.5.

1. GEOGRAPHIC LOCATION:

Determine latitude-longitude site coordinates using Google Earth.

Latitude =	44° 13' 50" North	Convert to decimal degrees.	Latitude =	44.2306° North
Longitude =	69° 46' 17" West		Longitude =	69.7714° West





CALCULATIONS

Client Maine Department of Transportation

Project Route 24 over Cobbosseecontee Stream; WIN 18736.00 Bridge NO. 3098

Subject Seismic Site Class & Design Parameters

File No. 42223-005

Sheet 2 of 3

Date 5/12/2016

Computed By KAR

Checked By MMB

2. SITE CLASS:

BB-GCS-104:	15.7	(existing ground surface elevation)		
Elevation (ft, NAVD 88)	Depth (ft, BGS)	N ₆₀ (bpf)	Thickness (ft)	Weighted SPT N60 (bpf)
14.7	1	22	2	11
12.7	3	9	2	
10.7	5	2	2	
8.7	7	33	3.4	
3.9	11.8	27	3.5	
1.7	14	15	2.1	
-0.3	16	30	2	
-2.3	18	14	2	
-4.3	20	87	4	
-10.3	26	9	4.5	
-13.3	29	3	2.5	
-15.3	31	2	2	
-17.3	33	6	2.5	
-20.3	36	2	4	
-25.3	41	4	5	
-30.3	46	12	10	
-45.3	61	40	11.5	
-55.05	70.75	100	6.5	
-55.8	71.5	100	28.5	
Total =			100	

BB-GCS-105	14.5	(existing ground surface elevation)		
Elevation (ft, NAVD 88)	Depth (ft, BGS)	N ₆₀ (bpf)	Thickness (ft)	Weighted SPT N60 (bpf)
13	1.5	16	2.5	19
11	3.5	10	2	
9	5.5	10	2	
7	7.5	12	2	
5	9.5	16	2	
3	11.5	3	2	
1	13.5	8	2	
-0.2	14.7	100	1	
-2.5	17	6	2.5	
-4.5	19	43	2	
-6.5	21	35	2	
-8.1	22.6	87	2	
-11.5	26	55	3	
-13.5	28	34	5.3	
-22	36.5	8	6.5	
-26.5	41	15	4.7	
-31.5	46	12	7.8	
-42	56.5	18	7.5	
-45.65	60.15	100	8.2	
-52.5	67	100	33	
Total =			100	

Notes:

1. For test boring locations where bedrock was encountered within 100 ft of ground surface/mudline, the thickness of the rock layer was adjusted so that the total thickness of material encountered at each test boring location is equal to 100 ft.
2. For sublayers where the average SPT N60 value was in excess of 100 bpf a default value of 100 bpf was used in accordance with AASHTO LRFD.
3. For sublayers where the SPT N60 value was equal to 0 bpf a default value of 1 bpf was used.



CALCULATIONS

File No.	42223-005
Sheet	3 of 3
Date	5/12/2016
Computed By	KAR
Checked By	MMB

Client	Maine Department of Transportation
Project	Route 24 over Cobbosseecontee Stream; WIN 18736.00 Bridge NO. 3098
Subject	Seismic Site Class & Design Parameters

Summarize weighted SPT N60 values for each test boring....

Test Boring No.	Weighted SPT N60 (bpf)
BB-GCS-104	11
BB-GCS-105	19

In accordance with Table 3.10.3.1-1 for SPT 15 < N60 < 50 bpf the site should be considered Site Class D.
In accordance with Table 3.10.3.1-1 for SPT < 15 bpf the site should be considered Site Class E.

Recommend a Seismic Site Class E.

Determine site factors and elastic seismic response coefficients based on geographic location and Site Class

3. SITE FACTORS & ELASTIC SEISMIC RESPONSE COEFFICIENTS:

SITE CLASS E - "Soft Clay Soil"

Design Parameter	Design Value
Site Factor for short-period range of acceleration response spectrum, F_a =	2.500
Site Factor for long-period range of acceleration response spectrum, F_v =	3.500
Horizontal response spectral acceleration coefficient at 0.2-s period on rock, S_s =	0.160
Horizontal response spectral acceleration coefficient at 1.0-s period on rock, S_1 =	0.045
Peak seismic ground acceleration coefficient on rock, PGA =	0.077
Site factor at zero-period on acceleration response spectrum, F_{pga} =	2.500
Horizontal response spectral acceleration coefficient at 0.2-s period modified by F_a , S_{DS} =	0.400
Horizontal response sepctral acceleration coefficient at 1.0-s period modified by F_v , S_{D1} =	0.157

In accordance with Table 3.10.6-1, since $0.15 < SD1 \leq 0.30$, the bridge should be designed based on the requirements of **Seismic Zone 2 (AASHTO LRFD 2014).**

Equivalent to previously...

Seismic Design Category B (AASHTO LRFD 2011)

Liquefaction Analysis

PROBLEM STATEMENT & OBJECTIVE

Calculate factor of safety against liquefaction using the procedure in Youd and Idriss (2001) for SPT N data.

EXECUTIVE SUMMARY

All factors of safety are greater than 1.2, so liquefaction is unlikely. Most of the low factors of safety are within the clay layer so liquefaction is unlikely.

REFERENCES

- 1. Youd and Idriss, "Liquefaction Resistance of Soils: Summary Report for the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils," 2001.
- 2. AASHTO LRFD Bridge Design Specifications 7th Edition, 2014.

AVAILABLE INFORMATION

- 1. Maine Department of Transportation boring logs BB-GCS-104 and BB-GCS-105 from March 2016.
- 2. The Peak Ground Acceleration, A_s , is 0.193g from the seismic site class calculations completed by Haley & Aldrich (SITE CLASS E).
- 3. Deaggregation plot of the site from the United States Geological Survey (USGS) Earthquake Hazards website (<https://earthquake.usgs.gov/hazards/interactive/>) for 975-yr return period.
- 4. Geotechnical laboratory test results for sieve gradation by GeoTesting Express.

ASSUMPTIONS

- 1. Elevations reference the North American Vertical Datum of 1988 (NAVD88).
- 2. Fines content for samples from borings BB-cgs-104 and BB-cgs-105 were estimated based on field geologist log descriptions correlated to the Maine Department of Transportation key to soil and rock description and terms.
- 3. Fines content for following samples was determined from sieve gradation laboratory testing:

Boring No.	Sample	Depth	% Fines
BB-GCS-104	2D	2-4	40.9
BB-GCS-104	3D	4-6	46.6
BB-GCS-104	15D	40-42	14
BB-GCS-105	2D	2.5-4.5	31.2
BB-GCS-105	3D	4.5-6.5	11.8
BB-GCS-105	14D	35.5-37.5	62.5

- 4. Total unit weights used in the analysis were estimated as follows: Fill 115 pcf, Marine Clay 110 pcf, Marine Deposit 120 pcf, and Glacial Till 130 pcf.
- 5. SPT N_{60} values were provided on the boring logs. The SPT N_{60} values were used in the analysis.
- 6. An SPT value of "1" was assigned to samples with WOR or WOH. An SPT value of "100" was assigned to samples that encountered refusal.
- 7. Assume 90% fines for CL layer
- 8. Magnitude (mode) $M=5.1$ based on deaggregation data and corresponding $MSF=2.68$ based on equation (24) in Youd & Idriss (2001).
- 9. Groundwater assumed to be at El. +3.9 (equal to Q1.1).
- 10. Minimum required factor of safety against liquefaction is 1.2 (AASHTO LRFD Section 10.5.4.2).

PROCEDURE

1. Evaluate the Cyclic Stress Ratio:

The Cyclic Stress Ratio (CSR) is defined as $CSR = (\tau_{av}/\sigma'_{vo}) = 0.65(\frac{a_{max}}{g})(\frac{\sigma_{vo}}{\sigma'_{vo}})r_d$

a_{max} = peak horizontal acceleration at the ground surface generated by the earthquake (A_s*g)
g = acceleration of gravity
σ_{vo} = total vertical overburden stress
σ'_{vo} = effective vertical overburden stress
r_d = stress reduction coefficient
r_d = 1 - 0.00765z for z ≤ 9.15 m
r_d = 1.174 - 0.0267z for 9.15 m < z ≤ 23 m
z = depth below ground surface in meters

2. Evaluate the Cyclic Resistance Ratio:

The Cyclic Resistance Ratio for a magnitude 7.5 earthquake (CRR_{7.5}) is defined as $CRR_{7.5} = \frac{1}{34-(N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10*(N_1)_{60} + 45]^2} - \frac{1}{200}$ for clean sands

where (N₁)₆₀ = SPT blow count normalized to an overburden pressure of approximately 100 KPa (1 tsf) and a hammer energy ratio or hammer efficiency of 60%.

$(N_1)_{60} = C_N * N_{60}$

$C_N = \frac{P_a^{0.5}}{\sigma'_{vo}} (\leq 1.7)$

The above is valid for (N₁)₆₀ < 30
for (N₁)₆₀ ≥ 30, clean granular soils are too dense to liquefy and are classed as non-liquefiable (NL)

To consider the influence of fines content (FC), a correction to the (N₁)₆₀ to an equivalent clean sand is made (N₁)_{60 cs} = α + β(N₁)₆₀
where α and β are coefficients determined from the following relationships:

- α = 0 for FC ≤ 5%
- α = exp[1.76-(190/FC²)] for 5% < FC < 35%
- α = 5.0 for FC ≥ 35%
- β = 1.0 for FC ≤ 5%
- β = [0.99 + (FC^{1.5}/1000)] for 5% < FC < 35%
- β = 1.2 for FC ≥ 35%

3. Evaluate the Factor of Safety Against Liquefaction:

where $F.S. = \frac{CRR_{7.5}}{CSR} * MSF$

MSF = magnitude scaling factor (equation (24) in Youd & Idriss, 2001)
M_w = moment magnitude of earthquake

CALCULATIONS

Boring No.	BB-GCS-104	
Approximate Ground Surface Elevation (NAVD88)	15.7	
Depth of Groundwater	11.8	ft
Unit Weight of Seawater	64	pcf
$A_s = F_{PGA} * PGA$	0.193	g
Magnitude (based on modal magnitude from deaggregation plot)	5.1	
Magnitude Scaling Factor	2.68	

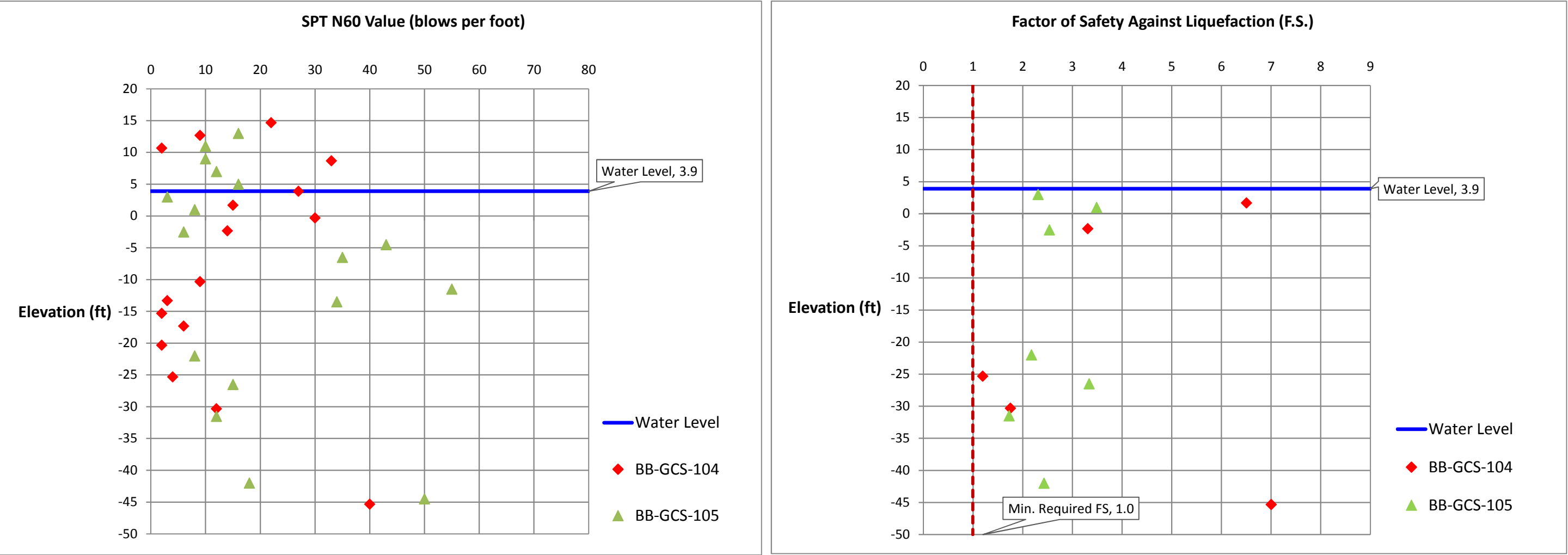
Sample No.	Depth (ft)	Elevation	Description	SPT N_{60}	γ_t (pcf)	σ_v (psf)	σ_w (psf)	σ'_v (psf)	C_N	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60CS}$	$CRR_{7.5}$	r_d	CSR	FS
1D	1	14.7	FILL	22	115	115	0	115	1.70	37	0	0.00	1.00	37	NL	1.00	0.125	#N/A
2D	3	12.7	FILL	9	115	345	0	345	1.70	15	40.9	5.00	1.20	23	0.263	0.99	0.125	5.7
3D	5	10.7	FILL	2	115	575	0	575	1.70	3	46.6	5.00	1.20	9	0.105	0.99	0.124	2.3
4D	7	8.7	FILL	33	115	805	0	805	1.61	53	60	5.00	1.20	69	NL	0.98	0.123	#N/A
5D	11.8	3.9	FILL	27	115	1,357	0	1357	1.24	33	15	2.50	1.05	38	NL	0.97	0.122	#N/A
6D	14	1.7	FILL	15	115	1,610	141	1469	1.19	18	35	4.98	1.20	26	0.322	0.97	0.133	6.5
7D	16	-0.3	FILL	30	115	1,840	269	1571	1.15	35	15	2.50	1.05	39	NL	0.96	0.141	#N/A
8D	18	-2.3	Alluvial	14	120	2,080	397	1683	1.11	16	11	1.21	1.03	17	0.183	0.96	0.149	3.3
9D	20	-4.3	Alluvial	87	120	2,320	525	1795	1.08	94	5	0.00	1.00	94	NL	0.95	0.155	#N/A
10D	26	-10.3	Marine Clay	9	110	2,980	909	2071	1.00	9	90	5.00	1.20	16	0.169	0.94	0.170	#N/A
11D	29	-13.3	Marine Clay	3	110	3,310	1101	2209	0.97	3	90	5.00	1.20	8	0.100	0.93	0.175	#N/A
12D	31	-15.3	Marine Clay	2	110	3,530	1229	2301	0.95	2	90	5.00	1.20	7	0.090	0.92	0.177	#N/A
13D	33	-17.3	Marine Clay	6	110	3,750	1357	2393	0.93	6	90	5.00	1.20	12	0.129	0.91	0.178	#N/A
14D	36	-20.3	Marine Clay	2	110	4,080	1549	2531	0.91	2	90	5.00	1.20	7	0.089	0.88	0.178	#N/A
15D	41	-25.3	Marine Sand	4	120	4,680	1869	2811	0.86	3	14	2.20	1.04	6	0.078	0.84	0.176	1.2
16D	46	-30.3	Marine Sand	12	120	5,280	2189	3091	0.82	10	5	0.00	1.00	10	0.112	0.80	0.171	1.8
17D	61	-45.3	Glacial Till	40	130	7,230	3149	4081	0.72	29	5	0.00	1.00	29	0.393	0.68	0.151	7.0

clay
clay
clay
clay

Boring No.	BB-GCS-105	
Approximate Ground Surface Elevation (NAVD88)	14.5	
Depth of Groundwater	10.6	ft
Unit Weight of Seawater	64	pcf
A ₅ = F _{PGA} *PGA	0.193	g
Magnitude (based on modal magnitude from deaggregation plot)	5.1	
Magnitude Scaling Factor	2.68	

Sample No.	Depth (ft)	Elevation	Description	SPT N_{60}	γ_t (pcf)	σ_v (psf)	σ_w (psf)	σ'_v (psf)	C_N	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60CS}$	$CRR_{7.5}$	r_d	CSR	FS
1D	1.5	13	FILL	16	115	173	0	173	1.70	27	15	2.50	1.05	31	NL	1.00	0.125	#N/A
2D	3.5	11	FILL	10	115	403	0	403	1.70	17	31.2	4.78	1.16	25	0.284	0.99	0.124	6.1
3D	5.5	9	FILL	10	115	633	0	633	1.70	17	11.8	1.49	1.03	19	0.203	0.99	0.124	4.4
4D	7.5	7	FILL	12	115	863	0	863	1.56	19	15	2.50	1.05	22	0.243	0.98	0.123	5.3
5D	9.5	5	FILL	16	115	1,093	0	1093	1.38	22	15	2.50	1.05	26	0.306	0.98	0.123	6.7
6D	11.5	3	FILL	3	115	1,323	58	1265	1.28	4	80	5.00	1.20	10	0.110	0.97	0.128	2.3
7D	13.5	1	FILL	8	115	1,553	186	1367	1.24	10	50	5.00	1.20	17	0.179	0.97	0.138	3.5
9D	17	-2.5	FILL	6	115	1,955	410	1545	1.16	7	80	5.00	1.20	13	0.144	0.96	0.152	2.5
10D	19	-4.5	FILL	43	115	2,185	538	1647	1.13	48	5	0.00	1.00	48	NL	0.96	0.159	#N/A
11D	21	-6.5	FILL	35	115	2,415	666	1749	1.09	38	5	0.00	1.00	38	NL	0.95	0.165	#N/A
12D	22.6	-8.1	FILL	87	115	2,599	768	1831	1.07	93	5	0.00	1.00	93	NL	0.95	0.169	#N/A
MD	26	-11.5	FILL	55	115	2,990	986	2004	1.02	56	5	0.00	1.00	56	NL	0.94	0.176	#N/A
13D	28	-13.5	FILL	34	115	3,220	1114	2106	1.00	34	5	0.00	1.00	34	NL	0.93	0.179	#N/A
14D	36.5	-22	Marine Deposit	8	120	4,240	1658	2582	0.90	7	62.5	5.00	1.20	14	0.147	0.88	0.181	2.2
15D	41	-26.5	Marine Deposit	15	120	4,780	1946	2834	0.86	13	50	5.00	1.20	20	0.221	0.84	0.178	3.3
16D	46	-31.5	Marine Sand	12	120	5,380	2266	3114	0.82	10	5	0.00	1.00	10	0.112	0.80	0.173	1.7
MD	56.5	-42	Marine Sand	18	120	6,640	2938	3702	0.75	14	5	0.00	1.00	14	0.145	0.71	0.161	2.4
	59	-44.5	Glacial Till	50	130	6,965	3098	3867	0.73	37	5	0.00	1.00	37	NL	0.69	0.157	#N/A

PLOTS



Note: Non-liquefied samples (NL) are not shown above.

CONCLUSIONS AND RECOMMENDATIONS

All factors of safety are greater than 1.2, so liquefaction is unlikely. Most of the low factors of safety (but still greater than 1.2) are within the clay layer so liquefaction is unlikely.

Driven Pile Axial Resistance

Client: Stantec

Date: 24SEP2018

Project: Maine Avenue Bridge, Gardiner maine

Computed by: JLL

Subject: Geotechnical and Structural Resistance of H-Piles

Checked by: EAF

ASSUMPTIONS

1. H-Piles (HP14x117) are driven to hard rock and the geotechnical axial compression resistance of the pile is limited by structural axial resistance of the pile section.
2. H-Piles are subject to damage due to severe driving conditions where use of a pile tip is necessary. Resistance factor for axial resistance of piles in compression is 0.5 (Section 6.5.4.2 AASHTO LRFD 2014).
3. Loss in section due to corrosion is assumed to be 0.0625 inch from all pile surfaces.
4. H-Piles are completely embedded in soil and there is no reduction in axial resistance due to buckling.
5. This calculation only addresses axial resistance, if the piles are subjected to lateral loads, the structural resistance under combined axial load and flexure should also be evaluated.
6. The pile section has $f_y = 50$ ksi.
7. Equations used herein are from AASHTO LRFD 2014.

CALCULATIONS P_n shall be determined as follows:**6.9.4.1.2—Elastic Flexural Buckling Resistance**

- If $\frac{P_e}{P_o} \geq 0.44$, then:

The elastic critical buckling resistance, P_e , based on flexural buckling shall be taken as:

$$P_n = \left[0.658^{\left(\frac{P_o}{P_e} \right)} \right] P_o \quad (6.9.4.1.1-1)$$

$$P_e = \frac{\pi^2 E}{\left(\frac{K \ell}{r_s} \right)^2} A_g \quad (6.9.4.1.2-1)$$

- If $\frac{P_e}{P_o} < 0.44$, then:

where:

$$P_n = 0.877 P_e \quad (6.9.4.1.1-2)$$

A_g = gross cross-sectional area of the member (in.²)
 K = effective length factor in the plane of buckling determined as specified in Article 4.6.2.5
 ℓ = unbraced length in the plane of buckling (in.)
 r_s = radius of gyration about the axis normal to the plane of buckling (in.)

where:

 A_g = gross cross-sectional area of the member (in.²) F_y = specified minimum yield strength (ksi) P_e = elastic critical buckling resistance determined as specified in Article 6.9.4.1.2 for flexural buckling, and as specified in Article 6.9.4.1.3 for torsional buckling or flexural-torsional buckling, as applicable (kips) P_o = equivalent nominal yield resistance = $Q F_y A_g$ (kips) Q = slender element reduction factor determined as specified in Article 6.9.4.2. Q shall be taken equal to 1.0 for bearing stiffeners.

Section	Corrosion (in)	A_s (in)	f_y (ksi)	Q	$P_o = Q \cdot f_y \cdot A_s$ (kip)	P_e (kip)	P_o/P_e	P_n (kip)	ϕP_n (kip)
HP14x117	0.0625	28.7	50	1.0	1436	∞	0	1436	718

Notes:

1. $Q \cdot f_y \cdot A_s$ from Section 6.9.4.1.1 of AASHTO LRFD, $Q=1$ for nonslender elements. Pile is considered nonslender because the unbraced length is zero (i.e., completely embedded in soil).
2. P_e from Eq. 6.9.4.1.2-1 (Elastic Flexural Buckling Resistance). With the unbraced length=0, $P_e = \infty$.
3. P_n from Eq. 6.9.4.1.1-1.
4. Resistance factor for axial resistance of piles in compression is 0.5 (Section 6.5.4.2 AASHTO LRFD 2014).

Lateral Pile Evaluation

**CALCULATIONS**

File No.:	42223-005
Sheet:	1 of 2
Date:	5-Apr-2018
Computed by:	MMB
Checked by:	JLL

Client:	Maine Department of Transportation
Project:	Maine Avenue Bridge over Cobbosseecontee Stream, Gardiner, Maine
Subject:	Lateral Analysis of Individual HP 14x117 Pile Foundation

PROBLEM STATEMENT & OBJECTIVE

Calculate the maximum shear and bending moment for a single pile (HP 14x117) under the loading conditions provided.

REFERENCES

1. LPILE 2016 manual by Ensoft
2. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014

AVAILABLE INFORMATION

1. Loads and top of pile conditions provided by Stantec in an email dated 27 November 2017.
2. Plan set titled "State of Maine Department of Transportation, Gardiner Kennebec County, Maine Avenue Bridge over Cobbosseecontee Stream," dated August 2017.
3. Plan sheet B5 showing Abutment 1 (South) at Station 3+67 and Abutment 2 (North) at Station 4+45.

ASSUMPTIONS

1. Piles oriented such that loads provided cause bending about the pile weak axis (i.e., pile weak axis is perpendicular to bridge alignment).
2. Pile section: HP14x117 based on email from Stantec dated 22 February 2018.
3. Water level assumed to be at Q1.1 (MHW) flood elevation, El. 3.9.
4. Borings BB-GCS-303 and BB-GCS-104 from plans will represent the south abutment profile (station 3+71).
5. Boring BB-GCS-105 will represent the north abutment profile (station 4+45).
6. Piles spacing to pile size ratio is such that group effects are not significant: 10 ft center-to-center spacing for Abutment 1 (South) and 8.5 ft center-to-center spacing for Abutment 2 (North).
7. Fixed head condition based on 11 December 2017 conference call with Stantec.
8. 1/16 in. corrosion loss based on the results of pH, resistivity, sulfates, and chlorides testing. We have assumed that the stream is not brackish based on information provided by Stantec on 15 March 2018.
9. For each abutment, two scenarios were considered:
Scenario 1 (Contraction Displacement): Top of pile at El. 4, ground surface modeled at El. 4. Tip of pile assumed at top of rock for lateral analysis.
Scenario 2 (Expansion Displacement): Top of pile at El. 4, ground surface modeled at El. 15. Tip of pile assumed at top of rock for lateral analysis.
10. Preaugering or precoring may be required. However, soil properties were not reduced, since this would reduce the stresses and moments in the piles.

LOADS**Scenario 1 - Contraction Displacement**

Case	Axial (kips)	Deflection (in)
Strength I	323.66	0.51
Service I	210.86	0.51
No Axial	0	0.51

Scenario 2 - Expansion Displacement

Case	Axial (kips)	Deflection (in)
Strength I	323.66	0.32
Service I	210.86	0.32
No Axial	0	0.32

SOIL PROFILE

Abutment (Borings)	LPile Model Elevations (ft)					
	Top of Fill	Top of Alluvial Deposit	Top of Marine Deposit (Clay)	Top of Marine Deposits (Granular)	Top of Glacial Till	Top of Bedrock
North (BB-GCS-105)	4	-15.5	--	-21	-44.5	-52.5
South (BB-GCS-303, BB-GCS-104)	4	--	-12	-24	-34	-56

SOIL PROPERTIES

Material	LPile Soil Model	Unit Weight (pcf)	Friction Angle (deg.)	Subgrade Modulus, k (pci)	Undrained Shear Strength (psf)	ϵ_{50}
Fill	Sand (Reese)	115	30	40	--	--
Alluvial Deposit	Sand (Reese)	120	32	30	--	--
Marine Deposit - Clay	Soft Clay (Matlock)	115	--	--	500	0.01
Marine Deposit - Granular	Sand (Reese)	115	29	20	--	--
Glacial Till	Sand (Reese)	130	36	125	--	--

PILE PROPERTIES

Pile Section	Corrosion Case	Weak Axis Moment of Inertia, I (in ⁴)	Area, A (in ²)	Modulus of Elasticity, E (lbs/in ²)
HP14x117	1/16 in.	365	28.7	29,000,000

Client: Maine Department of Transportation

Date: 5-Apr-2018

Project: Maine Avenue Bridge over Cobbosseecontee Stream, Gardiner, Maine

Computed by: MMB

Subject: Lateral Analysis of Individual Pile Foundation

Checked by: JLL

LPILE RESULTS**Scenario 1 - Contraction Displacement**

Case	Axial (kips)	Deflection (in)	Max Shear Force (kips) At Top of Pile	Max Moment (kip-ft)
North - Strength	323.66	0.51	23.1	122.0
North - Service	210.86	0.51	23.5	122.2
North - No Axial	0	0.51	24.2	122.5
South - Strength	323.66	0.51	23.1	122.0
South - Service	210.86	0.51	23.5	122.1
South - No Axial	0	0.51	24.2	122.5

Scenario 2 - Expansion Displacement

Case	Axial (kips)	Deflection (in)	Max Shear Force (kips) At Top of Pile	Max Moment (kip-ft)
North - Strength	323.66	0.32	100.6	223.9
North - Service	210.86	0.32	100.9	223.9
North - No Axial	0	0.32	101.5	223.9
South - Strength	323.66	0.32	100.5	223.6
South - Service	210.86	0.32	100.9	223.6
South - No Axial	0	0.32	101.5	223.7

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LPILE for Windows, Version 2018-10.003

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:

\\haleyaldrich.com\share\por_common\PROJECTS\42223 - gardiner bridges\005 - Maine
Ave\Calculations\Lateral Pile Evaluations\LPILE Files\

Name of input data file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.32 deflection.lp10

Name of output report file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.32 deflection.lp10

Name of plot output file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.32 deflection.lp10

Name of runtime message file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.32 deflection.lp10

Date and Time of Analysis

Date: April 5, 2018

Time: 10:08:15

Problem Title

Bridge over Cobbosseecontee Stream, Gardiner, Maine

Maine Department of Transportation

Haley & Aldrich, Inc.

Description:

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	=	100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- 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	=	60.000 ft

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Depth of ground surface below top of pile = -11.1000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.0850
2	60.000	14.0850

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	= 60.000000 ft
Flange Width	= 14.760000 in
Section Depth	= 14.085000 in
Flange Thickness	= 0.680000 in
Web Thickness	= 0.680000 in
Section Area	= 28.700000 sq. in
Moment of Inertia	= 365.000000 in^4
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 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	= -11.100000 ft
Distance from top of pile to bottom of layer	= 0.100000 ft
Effective unit weight at top of layer	= 115.000000 pcf
Effective unit weight at bottom of layer	= 115.000000 pcf
Friction angle at top of layer	= 30.000000 deg.
Friction angle at bottom of layer	= 30.000000 deg.
Subgrade k at top of layer	= 40.000000 pci
Subgrade k at bottom of layer	= 40.000000 pci

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 Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	0.100000	ft
Distance from top of pile to bottom of layer	=	16.000000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	30.000000	deg.
Friction angle at bottom of layer	=	30.000000	deg.
Subgrade k at top of layer	=	40.000000	pci
Subgrade k at bottom of layer	=	40.000000	pci

Layer 3 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	16.000000	ft
Distance from top of pile to bottom of layer	=	28.000000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Undrained cohesion at top of layer	=	500.000000	psf
Undrained cohesion at bottom of layer	=	500.000000	psf
Epsilon-50 at top of layer	=	0.010000	
Epsilon-50 at bottom of layer	=	0.010000	

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

Distance from top of pile to top of layer	=	28.000000	ft
Distance from top of pile to bottom of layer	=	38.000000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	29.000000	deg.
Friction angle at bottom of layer	=	29.000000	deg.
Subgrade k at top of layer	=	20.000000	pci
Subgrade k at bottom of layer	=	20.000000	pci

Layer 5 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	38.000000	ft
Distance from top of pile to bottom of layer	=	60.000000	ft
Effective unit weight at top of layer	=	67.600000	pcf
Effective unit weight at bottom of layer	=	67.600000	pcf
Friction angle at top of layer	=	36.000000	deg.
Friction angle at bottom of layer	=	36.000000	deg.
Subgrade k at top of layer	=	125.000000	pci
Subgrade k at bottom of layer	=	125.000000	pci

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

Summary of Input Soil Properties

Layer E50 Layer or Num. krm	Soil Type Name (p-y Curve Type) kpy pci	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.
-----	-----	-----	-----	-----	-----

1	Sand	-11.1000	115.0000	--	30.0000
--	40.0000				
--	(Reese, et al.)	0.10000	115.0000	--	30.0000
--	40.0000				
2	Sand	0.10000	52.6000	--	30.0000
--	40.0000				
--	(Reese, et al.)	16.0000	52.6000	--	30.0000
--	40.0000				
3	Soft	16.0000	52.6000	500.0000	--
0.01000	--				
	Clay	28.0000	52.6000	500.0000	--
0.01000	--				
4	Sand	28.0000	52.6000	--	29.0000
--	20.0000				
--	(Reese, et al.)	38.0000	52.6000	--	29.0000
--	20.0000				
5	Sand	38.0000	67.6000	--	36.0000
--	125.0000				
--	(Reese, et al.)	60.0000	67.6000	--	36.0000
--	125.0000				

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 = 3

Load Compute No.	Load Top y vs. Pile Length	Condition 1	Condition 2	Axial Thrust Force, lbs
1	5	y = 0.320000 in	S = 0.0000 in/in	323660.
N.A.				
2	5	y = 0.320000 in	S = 0.0000 in/in	210860.
N.A.				
3	5	y = 0.320000 in	S = 0.0000 in/in	0.0000000
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.

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	-11.1000	0.00	N.A.	No	0.00	113771.
2	0.1000	11.2001	Yes	No	113771.	326302.
3	16.0000	86.7494	No	No	440073.	63382.
4	28.0000	23.4356	No	No	503455.	594397.
5	38.0000	25.1881	Yes	No	1097853.	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 = 0.320000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 323660.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Load Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00		0.3200	-2683637.	100537.	0.00	63057.	1.06E+10	
-1581.		17787.	0.00					
0.6000		0.3134	-2001753.	88360.	-0.00159	49900.	1.06E+10	
-1681.		38611.	0.00					
1.2000		0.2971	-1403829.	76062.	-0.00275	38364.	1.06E+10	
-1735.		42059.	0.00					
1.8000		0.2738	-893635.	63712.	-0.00353	28520.	1.06E+10	
-1695.		44582.	0.00					

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2.4000	0.2462	-469913.	51866.	-0.00400	20344.	1.06E+10
-1595.	46656.	0.00				
3.0000	0.2162	-128143.	40854.	-0.00420	13750.	1.06E+10
-1464.	48730.	0.00				
3.6000	0.1857	137959.	30868.	-0.00420	13939.	1.06E+10
-1310.	50803.	0.00				
4.2000	0.1558	335920.	22032.	-0.00404	17759.	1.06E+10
-1144.	52877.	0.00				
4.8000	0.1276	474029.	14407.	-0.00376	20424.	1.06E+10
-973.6623	54950.	0.00				
5.4000	0.1017	560912.	8004.	-0.00341	22100.	1.06E+10
-805.1689	57024.	0.00				
6.0000	0.07850	605166.	2785.	-0.00301	22954.	1.06E+10
-644.2972	59098.	0.00				
6.6000	0.05829	615060.	-1317.	-0.00260	23145.	1.06E+10
-495.2621	61171.	0.00				
7.2000	0.04110	598305.	-4400.	-0.00218	22821.	1.06E+10
-361.0498	63245.	0.00				
7.8000	0.02684	561884.	-6576.	-0.00179	22119.	1.06E+10
-243.5185	65318.	0.00				
8.4000	0.01533	511949.	-7969.	-0.00142	21155.	1.06E+10
-143.5305	67392.	0.00				
9.0000	0.00633	453762.	-8706.	-0.00110	20032.	1.06E+10
-61.1037	69466.	0.00				
9.6000	-4.46E-04	391688.	-8910.	-8.08E-04	18835.	1.06E+10
4.4269	71539.	0.00				
10.2000	-0.00531	329223.	-8699.	-5.63E-04	17630.	1.06E+10
54.2496	73613.	0.00				
10.8000	-0.00855	269048.	-8180.	-3.60E-04	16468.	1.06E+10
89.9228	75686.	0.00				
11.4000	-0.01048	213108.	-7449.	-1.96E-04	15389.	1.06E+10
113.2361	77760.	0.00				
12.0000	-0.01137	162700.	-6587.	-6.78E-05	14417.	1.06E+10
126.0890	79834.	0.00				
12.6000	-0.01146	118571.	-5664.	2.78E-05	13565.	1.06E+10
130.3880	81907.	0.00				
13.2000	-0.01097	81014.	-4734.	9.57E-05	12840.	1.06E+10
127.9656	83981.	0.00				
13.8000	-0.01008	49962.	-3839.	1.40E-04	12241.	1.06E+10
120.5184	86054.	0.00				
14.4000	-0.00895	25078.	-3011.	1.66E-04	11761.	1.06E+10
109.5650	88128.	0.00				
15.0000	-0.00770	5834.	-2269.	1.76E-04	11390.	1.06E+10
96.4209	90202.	0.00				
15.6000	-0.00641	-8420.	-1626.	1.75E-04	11440.	1.06E+10
82.1877	92275.	0.00				
16.2000	-0.00517	-18401.	-1136.	1.66E-04	11632.	1.06E+10
53.9262	75091.	0.00				
16.8000	-0.00402	-25557.	-763.5324	1.51E-04	11770.	1.06E+10
49.5938	88859.	0.00				
17.4000	-0.00299	-30101.	-423.1161	1.32E-04	11858.	1.06E+10
44.9663	108228.	0.00				
18.0000	-0.00211	-32267.	-117.0007	1.11E-04	11900.	1.06E+10
40.0658	136599.	0.00				
18.6000	-0.00139	-32304.	152.8539	8.92E-05	11901.	1.06E+10
34.8938	180710.	0.00				
19.2000	-8.27E-04	-30482.	384.3405	6.79E-05	11865.	1.06E+10
29.4081	256057.	0.00				
19.8000	-4.13E-04	-27086.	574.6145	4.83E-05	11800.	1.06E+10
23.4458	408893.	0.00				
20.4000	-1.31E-04	-22432.	717.8210	3.15E-05	11710.	1.06E+10
16.3338	894802.	0.00				
21.0000	4.01E-05	-16896.	741.2010	1.81E-05	11603.	1.06E+10

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-9.8393	1765500.	0.00				
21.6000	1.29E-04	-11843.	650.3497	8.31E-06	11506.	1.06E+10
-15.3972	859817.	0.00				
22.2000	1.60E-04	-7570.	534.9223	1.70E-06	11423.	1.06E+10
-16.6660	751195.	0.00				
22.8000	1.53E-04	-4148.	415.5382	-2.28E-06	11357.	1.06E+10
-16.4962	773901.	0.00				
23.4000	1.27E-04	-1575.	300.3184	-4.23E-06	11308.	1.06E+10
-15.5093	880030.	0.00				
24.0000	9.26E-05	196.0879	194.1675	-4.70E-06	11281.	1.06E+10
-13.9770	1086857.	0.00				
24.6000	5.93E-05	1243.	100.4868	-4.21E-06	11301.	1.06E+10
-12.0454	1463613.	0.00				
25.2000	3.20E-05	1663.	21.9242	-3.22E-06	11309.	1.06E+10
-9.7776	2199721.	0.00				
25.8000	1.29E-05	1573.	-38.7600	-2.12E-06	11308.	1.06E+10
-7.0792	3952733.	0.00				
26.4000	1.49E-06	1114.	-66.6551	-1.20E-06	11299.	1.06E+10
-0.6695	3231652.	0.00				
27.0000	-4.45E-06	619.0939	-61.8687	-6.15E-07	11289.	1.06E+10
1.9990	3231652.	0.00				
27.6000	-7.37E-06	226.3972	-30.4945	-3.28E-07	11282.	1.06E+10
6.7160	6563705.	0.00				
28.2000	-9.17E-06	181.5005	-6.0053	-1.89E-07	11281.	1.06E+10
0.08651	67910.	0.00				
28.8000	-1.01E-05	140.8006	-5.3462	-7.93E-08	11280.	1.06E+10
0.09660	68947.	0.00				
29.4000	-1.03E-05	104.8850	-4.6376	4.27E-09	11279.	1.06E+10
0.1002	69984.	0.00				
30.0000	-1.00E-05	74.0000	-3.9206	6.51E-08	11279.	1.06E+10
0.09889	71021.	0.00				
30.6000	-9.38E-06	48.1242	-3.2268	1.07E-07	11278.	1.06E+10
0.09383	72058.	0.00				
31.2000	-8.49E-06	27.0365	-2.5788	1.32E-07	11278.	1.06E+10
0.08619	73094.	0.00				
31.8000	-7.47E-06	10.3740	-1.9915	1.45E-07	11278.	1.06E+10
0.07693	74131.	0.00				
32.4000	-6.40E-06	-2.3168	-1.4739	1.48E-07	11277.	1.06E+10
0.06685	75168.	0.00				
33.0000	-5.35E-06	-11.5387	-1.0296	1.43E-07	11278.	1.06E+10
0.05658	76205.	0.00				
33.6000	-4.34E-06	-17.8093	-0.6581	1.33E-07	11278.	1.06E+10
0.04661	77242.	0.00				
34.2000	-3.43E-06	-21.6357	-0.3561	1.20E-07	11278.	1.06E+10
0.03730	78278.	0.00				
34.8000	-2.62E-06	-23.4943	-0.1178	1.04E-07	11278.	1.06E+10
0.02889	79315.	0.00				
35.4000	-1.93E-06	-23.8180	0.06372	8.81E-08	11278.	1.06E+10
0.02154	80352.	0.00				
36.0000	-1.35E-06	-22.9875	0.1963	7.22E-08	11278.	1.06E+10
0.01530	81389.	0.00				
36.6000	-8.90E-07	-21.3273	0.2881	5.71E-08	11278.	1.06E+10
0.01019	82426.	0.00				
37.2000	-5.31E-07	-19.1052	0.3469	4.34E-08	11278.	1.06E+10
0.00615	83462.	0.00				
37.8000	-2.65E-07	-16.5337	0.3803	3.13E-08	11278.	1.06E+10
0.00311	84499.	0.00				
38.4000	-8.07E-08	-13.7747	0.4131	2.10E-08	11278.	1.06E+10
0.00599	534600.	0.00				
39.0000	3.64E-08	-10.6831	0.4248	1.26E-08	11278.	1.06E+10
-0.00274	541080.	0.00				
39.6000	1.01E-07	-7.7166	0.3872	6.38E-09	11278.	1.06E+10
-0.00770	547560.	0.00				

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40.2000	1.28E-07	-5.1371	0.3239	2.01E-09	11277.	1.06E+10
-0.00987	554040.	0.00				
40.8000	1.30E-07	-3.0612	0.2519	-7.82E-10	11277.	1.06E+10
-0.01013	560520.	0.00				
41.4000	1.17E-07	-1.5057	0.1823	-2.34E-09	11277.	1.06E+10
-0.00922	567000.	0.00				
42.0000	9.65E-08	-0.4255	0.1214	-2.99E-09	11277.	1.06E+10
-0.00769	573480.	0.00				
42.6000	7.39E-08	0.2568	0.07231	-3.05E-09	11277.	1.06E+10
-0.00596	579960.	0.00				
43.2000	5.26E-08	0.6299	0.03544	-2.75E-09	11277.	1.06E+10
-0.00429	586440.	0.00				
43.8000	3.44E-08	0.7799	0.00982	-2.27E-09	11277.	1.06E+10
-0.00283	592920.	0.00				
44.4000	2.00E-08	0.7818	-0.00636	-1.74E-09	11277.	1.06E+10
-0.00166	599400.	0.00				
45.0000	9.36E-09	0.6964	-0.01517	-1.23E-09	11277.	1.06E+10
-7.88E-04	605880.	0.00				
45.6000	2.18E-09	0.5691	-0.01868	-8.04E-10	11277.	1.06E+10
-1.86E-04	612360.	0.00				
46.2000	-2.21E-09	0.4312	-0.01866	-4.64E-10	11277.	1.06E+10
1.90E-04	618840.	0.00				
46.8000	-4.49E-09	0.3025	-0.01658	-2.14E-10	11277.	1.06E+10
3.90E-04	625320.	0.00				
47.4000	-5.29E-09	0.1935	-0.01350	-4.54E-11	11277.	1.06E+10
4.64E-04	631800.	0.00				
48.0000	-5.15E-09	0.1083	-0.01019	5.73E-11	11277.	1.06E+10
4.56E-04	638280.	0.00				
48.6000	-4.47E-09	0.04657	-0.00710	1.10E-10	11277.	1.06E+10
4.00E-04	644760.	0.00				
49.2000	-3.56E-09	0.00551	-0.00450	1.28E-10	11277.	1.06E+10
3.22E-04	651240.	0.00				
49.8000	-2.63E-09	-0.01887	-0.00248	1.23E-10	11277.	1.06E+10
2.40E-04	657720.	0.00				
50.4000	-1.79E-09	-0.03077	-0.00102	1.06E-10	11277.	1.06E+10
1.65E-04	664200.	0.00				
51.0000	-1.10E-09	-0.03406	-5.79E-05	8.42E-11	11277.	1.06E+10
1.02E-04	670680.	0.00				
51.6000	-5.76E-10	-0.03199	5.06E-04	6.17E-11	11277.	1.06E+10
5.42E-05	677160.	0.00				
52.2000	-2.10E-10	-0.02707	7.72E-04	4.17E-11	11277.	1.06E+10
1.99E-05	683640.	0.00				
52.8000	2.38E-11	-0.02106	8.36E-04	2.53E-11	11277.	1.06E+10
-2.28E-06	690120.	0.00				
53.4000	1.54E-10	-0.01515	7.74E-04	1.30E-11	11277.	1.06E+10
-1.49E-05	696600.	0.00				
54.0000	2.11E-10	-0.00998	6.46E-04	4.42E-12	11277.	1.06E+10
-2.06E-05	703080.	0.00				
54.6000	2.18E-10	-0.00586	4.95E-04	0.00	11277.	1.06E+10
-2.15E-05	709560.	0.00				
55.2000	1.97E-10	-0.00285	3.47E-04	-3.93E-12	11277.	1.06E+10
-1.96E-05	716040.	0.00				
55.8000	1.61E-10	-8.46E-04	2.18E-04	-5.18E-12	11277.	1.06E+10
-1.62E-05	722520.	0.00				
56.4000	1.22E-10	3.19E-04	1.16E-04	-5.36E-12	11277.	1.06E+10
-1.24E-05	729000.	0.00				
57.0000	8.42E-11	8.44E-04	4.02E-05	-4.97E-12	11277.	1.06E+10
-8.60E-06	735480.	0.00				
57.6000	5.05E-11	9.22E-04	-9.45E-06	-4.37E-12	11277.	1.06E+10
-5.20E-06	741960.	0.00				
58.2000	2.13E-11	7.28E-04	-3.61E-05	-3.81E-12	11277.	1.06E+10
-2.21E-06	748440.	0.00				
58.8000	-4.36E-12	4.19E-04	-4.24E-05	-3.42E-12	11277.	1.06E+10

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4.57E-07 754920. 0.00
59.4000 -2.79E-11 1.33E-04 -3.02E-05 -3.23E-12 11277. 1.06E+10
2.95E-06 761400. 0.00
60.0000 -5.08E-11 0.00 0.00 -3.18E-12 11277. 1.06E+10
5.42E-06 383940. 0.00

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

Output Summary for Load Case No. 1:

File-head deflection = 0.32000000 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -2683637. inch-lbs
Maximum shear force = 100537. 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 = 10
Number of zero deflection points = 7

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.320000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 210860.0 lbs

Depth Res.	Soil X	Deflect. Spr.	Bending Distrib.	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil p
	Es*h	y	Moment					
feet	inches	Lat. Load	in-lbs	lbs	radians	psi*	in-lb^2	
lb/inch	lb/inch	lb/inch	lb/inch					
0.00	0.3200	-2683745.	100880.	0.00	59129.	1.06E+10		
-1581.	17787.	0.00						
0.6000	0.3134	-1999942.	88729.	-0.00159	45935.	1.06E+10		
-1681.	38611.	0.00						
1.2000	0.2971	-1401207.	76431.	-0.00275	34383.	1.06E+10		
-1735.	42058.	0.00						
1.8000	0.2738	-890981.	64080.	-0.00353	24538.	1.06E+10		
-1696.	44582.	0.00						
2.4000	0.2462	-467734.	52232.	-0.00399	16372.	1.06E+10		
-1596.	46656.	0.00						
3.0000	0.2164	-126721.	41216.	-0.00419	9792.	1.06E+10		
-1464.	48730.	0.00						
3.6000	0.1859	138513.	31224.	-0.00419	10020.	1.06E+10		
-1311.	50803.	0.00						
4.2000	0.1560	335621.	22378.	-0.00403	13823.	1.06E+10		
-1146.	52877.	0.00						
4.8000	0.1278	472982.	14740.	-0.00375	16473.	1.06E+10		
-975.7197	54950.	0.00						
5.4000	0.1020	559273.	8320.	-0.00340	18138.	1.06E+10		
-807.6857	57024.	0.00						
6.0000	0.07885	603115.	3082.	-0.00301	18984.	1.06E+10		
-647.2353	59098.	0.00						
6.6000	0.05868	612783.	-1043.	-0.00259	19170.	1.06E+10		

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-498.5592	61171.	0.00				
7.2000	0.04151	595972.	-4150.	-0.00218	18846.	1.06E+10
-364.6254	63245.	0.00				
7.8000	0.02726	559644.	-6353.	-0.00179	18145.	1.06E+10
-247.2800	65318.	0.00				
8.4000	0.01575	509918.	-7774.	-0.00143	17186.	1.06E+10
-147.3793	67392.	0.00				
9.0000	0.00673	452026.	-8538.	-0.00110	16069.	1.06E+10
-64.9420	69466.	0.00				
9.6000	-6.96E-05	390300.	-8770.	-8.12E-04	14878.	1.06E+10
0.6913	71539.	0.00				
10.2000	-0.00496	328208.	-8585.	-5.67E-04	13680.	1.06E+10
50.6988	73613.	0.00				
10.8000	-0.00824	268404.	-8090.	-3.65E-04	12526.	1.06E+10
86.6255	75686.	0.00				
11.4000	-0.01021	212814.	-7382.	-2.01E-04	11453.	1.06E+10
110.2458	77760.	0.00				
12.0000	-0.01113	162720.	-6540.	-7.31E-05	10487.	1.06E+10
123.4428	79834.	0.00				
12.6000	-0.01126	118856.	-5635.	2.26E-05	9640.	1.06E+10
128.1069	81907.	0.00				
13.2000	-0.01081	81511.	-4720.	9.08E-05	8920.	1.06E+10
126.0551	83981.	0.00				
13.8000	-0.00995	50617.	-3838.	1.36E-04	8324.	1.06E+10
118.9707	86054.	0.00				
14.4000	-0.00885	25837.	-3019.	1.62E-04	7846.	1.06E+10
108.3605	88128.	0.00				
15.0000	-0.00763	6649.	-2285.	1.73E-04	7475.	1.06E+10
95.5309	90202.	0.00				
15.6000	-0.00637	-7594.	-1648.	1.72E-04	7494.	1.06E+10
81.5768	92275.	0.00				
16.2000	-0.00514	-17601.	-1160.	1.64E-04	7687.	1.06E+10
53.8233	75361.	0.00				
16.8000	-0.00401	-24799.	-788.1058	1.49E-04	7826.	1.06E+10
49.5347	89040.	0.00				
17.4000	-0.00299	-29403.	-447.9542	1.31E-04	7914.	1.06E+10
44.9519	108238.	0.00				
18.0000	-0.00212	-31647.	-141.7723	1.10E-04	7958.	1.06E+10
40.0987	136256.	0.00				
18.6000	-0.00140	-31779.	128.5087	8.87E-05	7960.	1.06E+10
34.9794	179565.	0.00				
19.2000	-8.42E-04	-30066.	360.8445	6.76E-05	7927.	1.06E+10
29.5583	252790.	0.00				
19.8000	-4.28E-04	-26789.	552.5445	4.83E-05	7864.	1.06E+10
23.6917	398131.	0.00				
20.4000	-1.46E-04	-22256.	698.3002	3.16E-05	7776.	1.06E+10
16.7960	827070.	0.00				
21.0000	2.70E-05	-16829.	728.2624	1.83E-05	7672.	1.06E+10
-8.4732	2257731.	0.00				
21.6000	1.18E-04	-11824.	643.8527	8.59E-06	7575.	1.06E+10
-14.9740	914919.	0.00				
22.2000	1.51E-04	-7584.	530.9825	1.99E-06	7493.	1.06E+10
-16.3789	782302.	0.00				
22.8000	1.47E-04	-4184.	413.4349	-2.01E-06	7428.	1.06E+10
-16.2732	799723.	0.00				
23.4000	1.22E-04	-1624.	299.6605	-3.99E-06	7378.	1.06E+10
-15.3308	906391.	0.00				
24.0000	8.91E-05	142.8297	194.6381	-4.49E-06	7350.	1.06E+10
-13.8421	1118572.	0.00				
24.6000	5.71E-05	1192.	101.7001	-4.04E-06	7370.	1.06E+10
-11.9740	1509457.	0.00				
25.2000	3.10E-05	1620.	23.1734	-3.08E-06	7378.	1.06E+10
-9.8389	2287353.	0.00				

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25.8000	1.28E-05	1535.	-39.3116	-2.01E-06	7377.	1.06E+10
-7.5180	4242935.	0.00				
26.4000	2.06E-06	1060.	-69.7108	-1.12E-06	7367.	1.06E+10
-0.9262	3231652.	0.00				
27.0000	-3.44E-06	534.8116	-58.6989	-5.83E-07	7357.	1.06E+10
3.9851	8337722.	0.00				
27.6000	-6.33E-06	216.0802	-25.1256	-3.27E-07	7351.	1.06E+10
5.3409	6077976.	0.00				
28.2000	-8.15E-06	173.9973	-5.6215	-1.95E-07	7350.	1.06E+10
0.07691	67910.	0.00				
28.8000	-9.13E-06	135.7218	-5.0299	-8.93E-08	7350.	1.06E+10
0.08742	68947.	0.00				
29.4000	-9.44E-06	101.8380	-4.3848	-8.49E-09	7349.	1.06E+10
0.09175	69984.	0.00				
30.0000	-9.25E-06	72.6057	-3.7260	5.08E-08	7348.	1.06E+10
0.09126	71021.	0.00				
30.6000	-8.71E-06	48.0292	-3.0838	9.19E-08	7348.	1.06E+10
0.08715	72058.	0.00				
31.2000	-7.93E-06	27.9207	-2.4803	1.18E-07	7348.	1.06E+10
0.08049	73094.	0.00				
31.8000	-7.01E-06	11.9561	-1.9306	1.31E-07	7347.	1.06E+10
0.07220	74131.	0.00				
32.4000	-6.04E-06	-0.2779	-1.4437	1.35E-07	7347.	1.06E+10
0.06304	75168.	0.00				
33.0000	-5.07E-06	-9.2436	-1.0237	1.32E-07	7347.	1.06E+10
0.05361	76205.	0.00				
33.6000	-4.14E-06	-15.4206	-0.6709	1.24E-07	7347.	1.06E+10
0.04439	77242.	0.00				
34.2000	-3.29E-06	-19.2805	-0.3826	1.12E-07	7347.	1.06E+10
0.03572	78278.	0.00				
34.8000	-2.53E-06	-21.2690	-0.1537	9.80E-08	7347.	1.06E+10
0.02784	79315.	0.00				
35.4000	-1.87E-06	-21.7920	0.02178	8.34E-08	7347.	1.06E+10
0.02091	80352.	0.00				
36.0000	-1.33E-06	-21.2085	0.1511	6.87E-08	7347.	1.06E+10
0.01500	81389.	0.00				
36.6000	-8.84E-07	-19.8254	0.2415	5.48E-08	7347.	1.06E+10
0.01012	82426.	0.00				
37.2000	-5.38E-07	-17.8973	0.3004	4.20E-08	7347.	1.06E+10
0.00624	83462.	0.00				
37.8000	-2.80E-07	-15.6274	0.3346	3.06E-08	7347.	1.06E+10
0.00328	84499.	0.00				
38.4000	-9.79E-08	-13.1712	0.3726	2.08E-08	7347.	1.06E+10
0.00727	534600.	0.00				
39.0000	1.93E-08	-10.3246	0.3936	1.28E-08	7347.	1.06E+10
-0.00145	541080.	0.00				
39.6000	8.60E-08	-7.5427	0.3648	6.70E-09	7347.	1.06E+10
-0.00654	547560.	0.00				
40.2000	1.16E-07	-5.0921	0.3091	2.40E-09	7347.	1.06E+10
-0.00891	554040.	0.00				
40.8000	1.21E-07	-3.0982	0.2433	-3.85E-10	7347.	1.06E+10
-0.00939	560520.	0.00				
41.4000	1.10E-07	-1.5879	0.1782	-1.98E-09	7347.	1.06E+10
-0.00868	567000.	0.00				
42.0000	9.21E-08	-0.5260	0.1205	-2.70E-09	7347.	1.06E+10
-0.00734	573480.	0.00				
42.6000	7.14E-08	0.1561	0.07343	-2.82E-09	7347.	1.06E+10
-0.00575	579960.	0.00				
43.2000	5.15E-08	0.5399	0.03764	-2.59E-09	7347.	1.06E+10
-0.00419	586440.	0.00				
43.8000	3.41E-08	0.7059	0.01243	-2.16E-09	7347.	1.06E+10
-0.00281	592920.	0.00				
44.4000	2.03E-08	0.7254	-0.00378	-1.68E-09	7347.	1.06E+10

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-0.00169	599400.	0.00				
45.0000	1.00E-08	0.6565	-0.01290	-1.21E-09	7347.	1.06E+10
-8.42E-04	605880.	0.00				
45.6000	2.93E-09	0.5433	-0.01683	-7.98E-10	7347.	1.06E+10
-2.49E-04	612360.	0.00				
46.2000	-1.49E-09	0.4166	-0.01727	-4.72E-10	7347.	1.06E+10
1.28E-04	618840.	0.00				
46.8000	-3.86E-09	0.2961	-0.01560	-2.29E-10	7347.	1.06E+10
3.35E-04	625320.	0.00				
47.4000	-4.79E-09	0.1927	-0.01288	-6.32E-11	7347.	1.06E+10
4.20E-04	631800.	0.00				
48.0000	-4.77E-09	0.1108	-0.00985	4.01E-11	7347.	1.06E+10
4.23E-04	638280.	0.00				
48.6000	-4.21E-09	0.05074	-0.00697	9.50E-11	7347.	1.06E+10
3.77E-04	644760.	0.00				
49.2000	-3.40E-09	0.01020	-0.00450	1.16E-10	7347.	1.06E+10
3.08E-04	651240.	0.00				
49.8000	-2.55E-09	-0.01441	-0.00255	1.14E-10	7347.	1.06E+10
2.32E-04	657720.	0.00				
50.4000	-1.76E-09	-0.02694	-0.00113	1.00E-10	7347.	1.06E+10
1.62E-04	664200.	0.00				
51.0000	-1.10E-09	-0.03104	-1.81E-04	8.05E-11	7347.	1.06E+10
1.03E-04	670680.	0.00				
51.6000	-5.98E-10	-0.02979	3.91E-04	5.98E-11	7347.	1.06E+10
5.63E-05	677160.	0.00				
52.2000	-2.41E-10	-0.02559	6.76E-04	4.10E-11	7347.	1.06E+10
2.29E-05	683640.	0.00				
52.8000	-8.37E-12	-0.02019	7.61E-04	2.54E-11	7347.	1.06E+10
8.02E-07	690120.	0.00				
53.4000	1.25E-10	-0.01471	7.20E-04	1.35E-11	7347.	1.06E+10
-1.21E-05	696600.	0.00				
54.0000	1.86E-10	-0.00985	6.11E-04	5.18E-12	7347.	1.06E+10
-1.82E-05	703080.	0.00				
54.6000	2.00E-10	-0.00593	4.75E-04	0.00	7347.	1.06E+10
-1.97E-05	709560.	0.00				
55.2000	1.84E-10	-0.00301	3.38E-04	-3.23E-12	7347.	1.06E+10
-1.83E-05	716040.	0.00				
55.8000	1.53E-10	-0.00105	2.17E-04	-4.61E-12	7347.	1.06E+10
-1.54E-05	722520.	0.00				
56.4000	1.17E-10	1.28E-04	1.19E-04	-4.92E-12	7347.	1.06E+10
-1.19E-05	729000.	0.00				
57.0000	8.22E-11	6.85E-04	4.61E-05	-4.65E-12	7347.	1.06E+10
-8.40E-06	735480.	0.00				
57.6000	5.04E-11	8.06E-04	-2.81E-06	-4.14E-12	7347.	1.06E+10
-5.19E-06	741960.	0.00				
58.2000	2.26E-11	6.57E-04	-3.00E-05	-3.64E-12	7347.	1.06E+10
-2.35E-06	748440.	0.00				
58.8000	-2.04E-12	3.86E-04	-3.76E-05	-3.29E-12	7347.	1.06E+10
2.14E-07	754920.	0.00				
59.4000	-2.48E-11	1.25E-04	-2.74E-05	-3.11E-12	7347.	1.06E+10
2.62E-06	761400.	0.00				
60.0000	-4.69E-11	0.00	0.00	-3.07E-12	7347.	1.06E+10
5.00E-06	383940.	0.00				

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.32000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-2683745. inch-lbs
Maximum shear force	=	100880. lbs

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 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 = 10
 Number of zero deflection points = 7

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 0.320000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 0.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00		0.3200	-2683951.	101519.	0.00	51786.	1.06E+10	
-1581.		17787.	0.00					
0.6000		0.3134	-1996579.	89417.	-0.00159	38523.	1.06E+10	
-1681.		38611.	0.00					
1.2000		0.2971	-1396341.	77119.	-0.00275	26942.	1.06E+10	
-1735.		42058.	0.00					
1.8000		0.2739	-886063.	64767.	-0.00352	17096.	1.06E+10	
-1696.		44582.	0.00					
2.4000		0.2464	-463701.	52914.	-0.00398	8947.	1.06E+10	
-1596.		46656.	0.00					
3.0000		0.2166	-124096.	41891.	-0.00418	2394.	1.06E+10	
-1466.		48730.	0.00					
3.6000		0.1862	139527.	31886.	-0.00418	2692.	1.06E+10	
-1313.		50803.	0.00					
4.2000		0.1564	335060.	23022.	-0.00401	6465.	1.06E+10	
-1149.		52877.	0.00					
4.8000		0.1283	471038.	15360.	-0.00374	9088.	1.06E+10	
-979.5313		54950.	0.00					
5.4000		0.1026	556237.	8909.	-0.00339	10732.	1.06E+10	
-812.3475		57024.	0.00					
6.0000		0.07952	599324.	3635.	-0.00300	11564.	1.06E+10	
-652.6766		59098.	0.00					
6.6000		0.05940	608576.	-531.7594	-0.00259	11742.	1.06E+10	
-504.6651		61171.	0.00					
7.2000		0.04226	591666.	-3685.	-0.00218	11416.	1.06E+10	
-371.2471		63245.	0.00					
7.8000		0.02803	555511.	-5937.	-0.00179	10718.	1.06E+10	
-254.2463		65318.	0.00					
8.4000		0.01651	506176.	-7408.	-0.00143	9766.	1.06E+10	
-154.5090		67392.	0.00					
9.0000		0.00747	448831.	-8224.	-0.00110	8660.	1.06E+10	
-72.0547		69466.	0.00					
9.6000		6.27E-04	387751.	-8506.	-8.18E-04	7481.	1.06E+10	
-6.2347		71539.	0.00					
10.2000		-0.00431	326348.	-8369.	-5.75E-04	6297.	1.06E+10	
44.1101		73613.	0.00					
10.8000		-0.00766	267231.	-7921.	-3.73E-04	5156.	1.06E+10	
80.5002		75686.	0.00					

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11.4000	-0.00969	212287.	-7254.	-2.10E-04	4096.	1.06E+10
104.6816	77760.	0.00				
12.0000	-0.01069	162770.	-6451.	-8.29E-05	3141.	1.06E+10
118.5071	79834.	0.00				
12.6000	-0.01089	119397.	-5578.	1.31E-05	2304.	1.06E+10
123.8373	81907.	0.00				
13.2000	-0.01050	82443.	-4692.	8.18E-05	1591.	1.06E+10
122.4609	83981.	0.00				
13.8000	-0.00971	51838.	-3833.	1.27E-04	1000.	1.06E+10
116.0360	86054.	0.00				
14.4000	-0.00866	27248.	-3034.	1.54E-04	525.7290	1.06E+10
106.0483	88128.	0.00				
15.0000	-0.00749	8155.	-2314.	1.66E-04	157.3471	1.06E+10
93.7873	90202.	0.00				
15.6000	-0.00627	-6076.	-1687.	1.67E-04	117.2262	1.06E+10
80.3359	92275.	0.00				
16.2000	-0.00508	-16142.	-1205.	1.60E-04	311.4453	1.06E+10
53.6326	76009.	0.00				
16.8000	-0.00397	-23427.	-833.9664	1.46E-04	452.0195	1.06E+10
49.4271	89611.	0.00				
17.4000	-0.00298	-28151.	-494.2844	1.29E-04	543.1554	1.06E+10
44.9290	108659.	0.00				
18.0000	-0.00212	-30545.	-187.9475	1.09E-04	589.3521	1.06E+10
40.1646	136363.	0.00				
18.6000	-0.00141	-30857.	83.1593	8.77E-05	595.3750	1.06E+10
35.1429	178959.	0.00				
19.2000	-8.58E-04	-29348.	317.0920	6.72E-05	566.2470	1.06E+10
29.8384	250330.	0.00				
19.8000	-4.46E-04	-26291.	511.4048	4.83E-05	507.2738	1.06E+10
24.1374	389429.	0.00				
20.4000	-1.63E-04	-21983.	661.6592	3.19E-05	424.1577	1.06E+10
17.6000	777047.	0.00				
21.0000	1.24E-05	-16763.	705.4930	1.87E-05	323.4377	1.06E+10
-5.4239	3137771.	0.00				
21.6000	1.06E-04	-11824.	634.6199	8.95E-06	228.1428	1.06E+10
-14.2630	969972.	0.00				
22.2000	1.41E-04	-7625.	525.9250	2.34E-06	147.1142	1.06E+10
-15.9300	811200.	0.00				
22.8000	1.40E-04	-4251.	411.1556	-1.70E-06	82.0192	1.06E+10
-15.9503	822850.	0.00				
23.4000	1.17E-04	-1704.	299.3970	-3.72E-06	32.8782	1.06E+10
-15.0937	929447.	0.00				
24.0000	8.59E-05	60.4104	195.8291	-4.28E-06	1.1656	1.06E+10
-13.6752	1145750.	0.00				
24.6000	5.52E-05	1116.	103.8603	-3.88E-06	21.5311	1.06E+10
-11.8717	1547263.	0.00				
25.2000	3.00E-05	1556.	25.8278	-2.97E-06	30.0222	1.06E+10
-9.8039	2351642.	0.00				
25.8000	1.24E-05	1488.	-36.7276	-1.94E-06	28.7072	1.06E+10
-7.5726	4393398.	0.00				
26.4000	2.09E-06	1027.	-67.3662	-1.08E-06	19.8178	1.06E+10
-0.9382	3231652.	0.00				
27.0000	-3.20E-06	517.7665	-57.0164	-5.59E-07	9.9901	1.06E+10
3.8131	8581305.	0.00				
27.6000	-5.95E-06	206.0848	-24.4486	-3.12E-07	3.9763	1.06E+10
5.2335	6329636.	0.00				
28.2000	-7.70E-06	165.7071	-5.3466	-1.86E-07	3.1972	1.06E+10
0.07260	67910.	0.00				
28.8000	-8.63E-06	129.0933	-4.7877	-8.57E-08	2.4908	1.06E+10
0.08265	68947.	0.00				
29.4000	-8.93E-06	96.7638	-4.1777	-8.85E-09	1.8670	1.06E+10
0.08681	69984.	0.00				
30.0000	-8.76E-06	68.9346	-3.5542	4.75E-08	1.3301	1.06E+10

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0.08639	71021.	0.00				
30.6000	-8.25E-06	45.5839	-2.9460	8.64E-08	0.8795	1.06E+10
0.08254	72058.	0.00				
31.2000	-7.51E-06	26.5120	-2.3743	1.11E-07	0.5115	1.06E+10
0.07627	73094.	0.00				
31.8000	-6.65E-06	11.3941	-1.8532	1.24E-07	0.2198	1.06E+10
0.06846	74131.	0.00				
32.4000	-5.73E-06	-0.1747	-1.3914	1.28E-07	0.00337	1.06E+10
0.05982	75168.	0.00				
33.0000	-4.81E-06	-8.6426	-0.9928	1.25E-07	0.1668	1.06E+10
0.05092	76205.	0.00				
33.6000	-3.93E-06	-14.4710	-0.6575	1.17E-07	0.2792	1.06E+10
0.04221	77242.	0.00				
34.2000	-3.13E-06	-18.1113	-0.3832	1.06E-07	0.3494	1.06E+10
0.03401	78278.	0.00				
34.8000	-2.41E-06	-19.9884	-0.1651	9.28E-08	0.3857	1.06E+10
0.02657	79315.	0.00				
35.4000	-1.79E-06	-20.4882	0.00260	7.90E-08	0.3953	1.06E+10
0.02001	80352.	0.00				
36.0000	-1.27E-06	-19.9509	0.1265	6.53E-08	0.3849	1.06E+10
0.01440	81389.	0.00				
36.6000	-8.53E-07	-18.6671	0.2135	5.21E-08	0.3602	1.06E+10
0.00976	82426.	0.00				
37.2000	-5.23E-07	-16.8770	0.2705	4.00E-08	0.3256	1.06E+10
0.00607	83462.	0.00				
37.8000	-2.76E-07	-14.7725	0.3040	2.93E-08	0.2850	1.06E+10
0.00324	84499.	0.00				
38.4000	-1.02E-07	-12.4998	0.3429	2.00E-08	0.2412	1.06E+10
0.00756	534600.	0.00				
39.0000	1.15E-08	-9.8350	0.3670	1.24E-08	0.1898	1.06E+10
-8.63E-04	541080.	0.00				
39.6000	7.67E-08	-7.2149	0.3429	6.60E-09	0.1392	1.06E+10
-0.00583	547560.	0.00				
40.2000	1.07E-07	-4.8970	0.2924	2.48E-09	0.09449	1.06E+10
-0.00820	554040.	0.00				
40.8000	1.12E-07	-3.0041	0.2314	-2.07E-10	0.05796	1.06E+10
-0.00875	560520.	0.00				
41.4000	1.04E-07	-1.5647	0.1706	-1.76E-09	0.03019	1.06E+10
-0.00815	567000.	0.00				
42.0000	8.70E-08	-0.5480	0.1162	-2.48E-09	0.01057	1.06E+10
-0.00693	573480.	0.00				
42.6000	6.78E-08	0.1092	0.07162	-2.63E-09	0.00211	1.06E+10
-0.00547	579960.	0.00				
43.2000	4.92E-08	0.4832	0.03752	-2.43E-09	0.00932	1.06E+10
-0.00401	586440.	0.00				
43.8000	3.29E-08	0.6495	0.01334	-2.04E-09	0.01253	1.06E+10
-0.00271	592920.	0.00				
44.4000	1.98E-08	0.6753	-0.00235	-1.59E-09	0.01303	1.06E+10
-0.00165	599400.	0.00				
45.0000	9.99E-09	0.6157	-0.01131	-1.15E-09	0.01188	1.06E+10
-8.41E-04	605880.	0.00				
45.6000	3.21E-09	0.5125	-0.01531	-7.68E-10	0.00989	1.06E+10
-2.73E-04	612360.	0.00				
46.2000	-1.07E-09	0.3952	-0.01597	-4.59E-10	0.00762	1.06E+10
9.19E-05	618840.	0.00				
46.8000	-3.41E-09	0.2826	-0.01457	-2.29E-10	0.00545	1.06E+10
2.96E-04	625320.	0.00				
47.4000	-4.37E-09	0.1854	-0.01212	-6.98E-11	0.00358	1.06E+10
3.83E-04	631800.	0.00				
48.0000	-4.41E-09	0.1080	-0.00934	3.00E-11	0.00208	1.06E+10
3.91E-04	638280.	0.00				
48.6000	-3.93E-09	0.05095	-0.00666	8.41E-11	9.83E-04	1.06E+10
3.52E-04	644760.	0.00				

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49.2000	-3.20E-09	0.01212	-0.00435	1.06E-10	2.34E-04	1.06E+10
2.90E-04	651240.	0.00				
49.8000	-2.41E-09	-0.01168	-0.00251	1.06E-10	2.25E-04	1.06E+10
2.20E-04	657720.	0.00				
50.4000	-1.68E-09	-0.02406	-0.00116	9.36E-11	4.64E-04	1.06E+10
1.55E-04	664200.	0.00				
51.0000	-1.07E-09	-0.02840	-2.45E-04	7.57E-11	5.48E-04	1.06E+10
9.93E-05	670680.	0.00				
51.6000	-5.90E-10	-0.02759	3.12E-04	5.67E-11	5.32E-04	1.06E+10
5.55E-05	677160.	0.00				
52.2000	-2.50E-10	-0.02391	5.97E-04	3.92E-11	4.61E-04	1.06E+10
2.37E-05	683640.	0.00				
52.8000	-2.64E-11	-0.01899	6.91E-04	2.46E-11	3.66E-04	1.06E+10
2.53E-06	690120.	0.00				
53.4000	1.04E-10	-0.01395	6.64E-04	1.34E-11	2.69E-04	1.06E+10
-1.01E-05	696600.	0.00				
54.0000	1.66E-10	-0.00943	5.70E-04	5.41E-12	1.82E-04	1.06E+10
-1.62E-05	703080.	0.00				
54.6000	1.82E-10	-0.00575	4.47E-04	0.00	1.11E-04	1.06E+10
-1.79E-05	709560.	0.00				
55.2000	1.70E-10	-0.00299	3.21E-04	-2.72E-12	5.78E-05	1.06E+10
-1.69E-05	716040.	0.00				
55.8000	1.43E-10	-0.00112	2.09E-04	-4.12E-12	2.15E-05	1.06E+10
-1.43E-05	722520.	0.00				
56.4000	1.10E-10	1.76E-05	1.17E-04	-4.49E-12	3.40E-07	1.06E+10
-1.12E-05	729000.	0.00				
57.0000	7.81E-11	5.72E-04	4.83E-05	-4.29E-12	1.10E-05	1.06E+10
-7.98E-06	735480.	0.00				
57.6000	4.86E-11	7.14E-04	1.59E-06	-3.85E-12	1.38E-05	1.06E+10
-5.01E-06	741960.	0.00				
58.2000	2.26E-11	5.95E-04	-2.49E-05	-3.41E-12	1.15E-05	1.06E+10
-2.35E-06	748440.	0.00				
58.8000	0.00	3.55E-04	-3.32E-05	-3.09E-12	6.85E-06	1.06E+10
5.12E-08	754920.	0.00				
59.4000	-2.18E-11	1.18E-04	-2.47E-05	-2.92E-12	2.27E-06	1.06E+10
2.31E-06	761400.	0.00				
60.0000	-4.26E-11	0.00	0.00	-2.88E-12	0.00	1.06E+10
4.54E-06	383940.	0.00				

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

Output Summary for Load Case No. 3:

Pile-head deflection	=	0.32000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-2683951. inch-lbs
Maximum shear force	=	101519. 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	=	9
Number of zero deflection points	=	7

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.

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 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	Load Type	Load 1	Load 2	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max in
No.		in-lbs		lbs	inches	radians	lbs
1	y, in	0.3200	S, rad	0.00	323660.	0.3200	0.00
100537.	-2683637.						
2	y, in	0.3200	S, rad	0.00	210860.	0.3200	0.00
100880.	-2683745.						
3	y, in	0.3200	S, rad	0.00	0.00	0.3200	0.00
101519.	-2683951.						

Maximum pile-head deflection = 0.3200000000 inches
 Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

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LPILE for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Ave\Calculations\Lateral Pile Evaluations\LPILE Files\

Name of input data file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.51 deflection.lp10

Name of output report file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.51 deflection.lp10

Name of plot output file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.51 deflection.lp10

Name of runtime message file:

2018-0405-HAI-HP 14 x 117-South-High Fill-116 Corrosion-0.51 deflection.lp10

Date and Time of Analysis

Date: April 5, 2018

Time: 10:06:07

Problem Title

Bridge over Cobbosseecontee Stream, Gardiner, Maine

Maine Department of Transportation

Haley & Aldrich, Inc.

Description:

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 | = | 100 |

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- 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	=	59.800 ft

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Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.0850
2	59.800	14.0850

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	= 59.800000 ft
Flange Width	= 14.760000 in
Section Depth	= 14.085000 in
Flange Thickness	= 0.680000 in
Web Thickness	= 0.680000 in
Section Area	= 28.700000 sq. in
Moment of Inertia	= 365.000000 in^4
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 sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	= 0.0000 ft
Distance from top of pile to bottom of layer	= 15.700000 ft
Effective unit weight at top of layer	= 52.600000 pcf
Effective unit weight at bottom of layer	= 52.600000 pcf
Friction angle at top of layer	= 30.000000 deg.
Friction angle at bottom of layer	= 30.000000 deg.
Subgrade k at top of layer	= 40.000000 pci
Subgrade k at bottom of layer	= 40.000000 pci

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 Layer 2 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	15.700000	ft
Distance from top of pile to bottom of layer	=	28.300000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Undrained cohesion at top of layer	=	500.000000	psf
Undrained cohesion at bottom of layer	=	500.000000	psf
Epsilon-50 at top of layer	=	0.010000	
Epsilon-50 at bottom of layer	=	0.010000	

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

Distance from top of pile to top of layer	=	28.300000	ft
Distance from top of pile to bottom of layer	=	37.700000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	29.000000	deg.
Friction angle at bottom of layer	=	29.000000	deg.
Subgrade k at top of layer	=	20.000000	pci
Subgrade k at bottom of layer	=	20.000000	pci

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

Distance from top of pile to top of layer	=	37.700000	ft
Distance from top of pile to bottom of layer	=	59.800000	ft
Effective unit weight at top of layer	=	67.600000	pcf
Effective unit weight at bottom of layer	=	67.600000	pcf
Friction angle at top of layer	=	36.000000	deg.
Friction angle at bottom of layer	=	36.000000	deg.
Subgrade k at top of layer	=	125.000000	pci
Subgrade k at bottom of layer	=	125.000000	pci

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

 Summary of Input Soil Properties

Layer E50 Layer or Num. krm	Soil Type Name kpy (p-y Curve Type) pci	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.
1	Sand	0.00	52.6000	--	30.0000
--	40.0000				
--	(Reese, et al.)	15.7000	52.6000	--	30.0000
--	40.0000				
2	Soft	15.7000	52.6000	500.0000	--
0.01000	--				
	Clay	28.3000	52.6000	500.0000	--
0.01000	--				
3	Sand	28.3000	52.6000	--	29.0000
--	20.0000				
--	(Reese, et al.)	37.7000	52.6000	--	29.0000

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```
--      20.0000
4      Sand      37.7000      67.6000      --      36.0000
--      125.0000
      (Reese, et al.)      59.8000      67.6000      --      36.0000
--      125.0000
```

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 = 3

Load Compute No.	Load Top y Type vs. Pile Length	Condition 1	Condition 2	Axial Thrust Force, lbs
1	5	y = 0.510000 in	S = 0.0000 in/in	323660.
N.A.				
2	5	y = 0.510000 in	S = 0.0000 in/in	210860.
N.A.				
3	5	y = 0.510000 in	S = 0.0000 in/in	0.0000000
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

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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	133513.
2	15.7000	29.0427	No	No	133513.	66552.
3	28.3000	18.6384	No	No	200064.	411791.
4	37.7000	22.3755	Yes	No	611855.	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 = 0.510000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 323660.0 lbs

Depth Res.	Soil X	Deflect. Spr. y	Bending Distrib. Load	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil p
feet	Es*h	inches	in-lbs	lbs	radians	psi*	in-lb^2	
lb/inch	lb/inch	lb/inch	lb/inch					
0.00	0.00	0.5100	-1463449.	23097.	0.00	39514.	1.06E+10	
0.00	0.00	0.00	0.00					
0.5980		0.5064	-1297386.	22883.	-9.36E-04	36310.	1.06E+10	
-27.1617		384.8677	0.00					
1.1960		0.4966	-1130678.	22579.	-0.00176	33093.	1.06E+10	
-57.8025	835.3143	0.00	0.00					
1.7940		0.4812	-965167.	22063.	-0.00247	29900.	1.06E+10	
-85.9448	1282.	0.00	0.00					
2.3920		0.4611	-802562.	21359.	-0.00307	26762.	1.06E+10	
-110.1464	1714.	0.00	0.00					
2.9900		0.4372	-644365.	20507.	-0.00356	23710.	1.06E+10	
-127.4953	2093.	0.00	0.00					
3.5880		0.4101	-491718.	19536.	-0.00394	20765.	1.06E+10	
-142.8916	2501.	0.00	0.00					
4.1860		0.3806	-345656.	18447.	-0.00423	17947.	1.06E+10	
-160.8769	3034.	0.00	0.00					
4.7840		0.3494	-207334.	17248.	-0.00442	15278.	1.06E+10	
-173.1261	3556.	0.00	0.00					
5.3820		0.3172	-77600.	15925.	-0.00451	12775.	1.06E+10	
-195.6448	4426.	0.00	0.00					
5.9800		0.2846	42181.	14450.	-0.00452	12091.	1.06E+10	
-215.5009	5433.	0.00	0.00					
6.5780		0.2523	150799.	12827.	-0.00446	14187.	1.06E+10	
-236.6835	6733.	0.00	0.00					
7.1760		0.2206	246991.	11063.	-0.00432	16043.	1.06E+10	

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-255.1712	8300.	0.00				
7.7740	0.1902	329654.	9179.	-0.00413	17638.	1.06E+10
-269.7253	10176.	0.00				
8.3720	0.1614	397908.	7208.	-0.00388	18955.	1.06E+10
-279.5563	12431.	0.00				
8.9700	0.1345	451140.	5186.	-0.00359	19982.	1.06E+10
-284.1257	15160.	0.00				
9.5680	0.1098	489031.	3151.	-0.00328	20713.	1.06E+10
-283.0067	18496.	0.00				
10.1660	0.08749	511579.	1146.	-0.00294	21148.	1.06E+10
-275.8807	22629.	0.00				
10.7640	0.06766	519114.	-785.9611	-0.00259	21293.	1.06E+10
-262.5186	27841.	0.00				
11.3620	0.05036	512314.	-2599.	-0.00224	21162.	1.06E+10
-242.7340	34585.	0.00				
11.9600	0.03556	492207.	-4202.	-0.00190	20774.	1.06E+10
-204.1316	41196.	0.00				
12.5580	0.02315	460813.	-5435.	-0.00157	20169.	1.06E+10
-139.5225	43256.	0.00				
13.1560	0.01298	421510.	-6230.	-0.00127	19410.	1.06E+10
-81.9448	45316.	0.00				
13.7540	0.00486	377323.	-6639.	-0.00100	18558.	1.06E+10
-32.0668	47375.	0.00				
14.3520	-0.00143	330890.	-6719.	-7.63E-04	17662.	1.06E+10
9.8267	49435.	0.00				
14.9500	-0.00610	284443.	-6526.	-5.55E-04	16766.	1.06E+10
43.7760	51495.	0.00				
15.5480	-0.00939	239801.	-6118.	-3.77E-04	15904.	1.06E+10
70.0812	53555.	0.00				
16.1460	-0.01151	198391.	-5614.	-2.29E-04	15105.	1.06E+10
70.3908	43871.	0.00				
16.7440	-0.01267	160294.	-5100.	-1.07E-04	14370.	1.06E+10
72.6771	41155.	0.00				
17.3420	-0.01305	125687.	-4576.	-1.01E-05	13702.	1.06E+10
73.3954	40357.	0.00				
17.9400	-0.01282	94661.	-4051.	6.45E-05	13104.	1.06E+10
72.9586	40845.	0.00				
18.5380	-0.01212	67243.	-3533.	1.19E-04	12575.	1.06E+10
71.6216	42390.	0.00				
19.1360	-0.01110	43407.	-3026.	1.57E-04	12115.	1.06E+10
69.5570	44952.	0.00				
19.7340	-0.00987	23085.	-2536.	1.79E-04	11723.	1.06E+10
66.8886	48621.	0.00				
20.3320	-0.00853	6171.	-2068.	1.89E-04	11396.	1.06E+10
63.7101	53609.	0.00				
20.9300	-0.00715	-7472.	-1624.	1.89E-04	11422.	1.06E+10
60.0939	60279.	0.00				
21.5280	-0.00582	-18009.	-1207.	1.80E-04	11625.	1.06E+10
56.0969	69211.	0.00				
22.1260	-0.00457	-25628.	-819.7164	1.66E-04	11772.	1.06E+10
51.7622	81347.	0.00				
22.7240	-0.00344	-30542.	-464.9302	1.46E-04	11867.	1.06E+10
47.1191	98272.	0.00				
23.3220	-0.00246	-32981.	-144.5325	1.25E-04	11914.	1.06E+10
42.1779	122842.	0.00				
23.9200	-0.00165	-33197.	139.2513	1.03E-04	11918.	1.06E+10
36.9146	160790.	0.00				
24.5180	-9.93E-04	-31459.	383.7514	8.06E-05	11884.	1.06E+10
31.2292	225773.	0.00				
25.1160	-4.91E-04	-28064.	584.7586	6.04E-05	11819.	1.06E+10
24.7928	362539.	0.00				
25.7140	-1.25E-04	-23347.	731.4471	4.30E-05	11728.	1.06E+10
16.0902	920620.	0.00				

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26.3120	1.26E-04	-17766.	734.5279	2.91E-05	11620.	1.06E+10
-15.2316	865257.	0.00				
26.9100	2.92E-04	-12940.	606.4680	1.87E-05	11527.	1.06E+10
-20.4596	503428.	0.00				
27.5080	3.94E-04	-9148.	451.6090	1.12E-05	11454.	1.06E+10
-22.7007	413454.	0.00				
28.1060	4.52E-04	-6511.	284.7568	5.86E-06	11403.	1.06E+10
-23.8022	378009.	0.00				
28.7040	4.78E-04	-5089.	187.5386	1.92E-06	11376.	1.06E+10
-3.2932	49435.	0.00				
29.3020	4.79E-04	-3828.	163.6248	-1.10E-06	11351.	1.06E+10
-3.3718	50465.	0.00				
29.9000	4.62E-04	-2735.	139.6246	-3.32E-06	11330.	1.06E+10
-3.3172	51495.	0.00				
30.4980	4.32E-04	-1809.	116.3834	-4.86E-06	11312.	1.06E+10
-3.1603	52525.	0.00				
31.0960	3.92E-04	-1042.	94.5353	-5.83E-06	11297.	1.06E+10
-2.9289	53555.	0.00				
31.6940	3.48E-04	-424.8832	74.5262	-6.33E-06	11286.	1.06E+10
-2.6477	54585.	0.00				
32.2920	3.02E-04	56.7752	56.6382	-6.45E-06	11278.	1.06E+10
-2.3378	55615.	0.00				
32.8900	2.55E-04	417.9605	41.0145	-6.29E-06	11285.	1.06E+10
-2.0167	56644.	0.00				
33.4880	2.11E-04	674.6391	27.6838	-5.92E-06	11290.	1.06E+10
-1.6987	57674.	0.00				
34.0860	1.71E-04	842.7832	16.5844	-5.41E-06	11294.	1.06E+10
-1.3948	58704.	0.00				
34.6840	1.34E-04	937.7736	7.5849	-4.80E-06	11295.	1.06E+10
-1.1134	59734.	0.00				
35.2820	1.02E-04	973.9530	0.5042	-4.16E-06	11296.	1.06E+10
-0.8601	60764.	0.00				
35.8800	7.41E-05	964.3103	-4.8719	-3.50E-06	11296.	1.06E+10
-0.6383	61794.	0.00				
36.4780	5.14E-05	920.2813	-8.7754	-2.86E-06	11295.	1.06E+10
-0.4497	62824.	0.00				
37.0760	3.31E-05	851.6468	-11.4452	-2.26E-06	11294.	1.06E+10
-0.2944	63854.	0.00				
37.6740	1.89E-05	766.5112	-13.1163	-1.71E-06	11292.	1.06E+10
-0.1713	64884.	0.00				
38.2720	8.54E-06	671.3458	-15.4904	-1.22E-06	11290.	1.06E+10
-0.4904	411960.	0.00				
38.8700	1.40E-06	549.8722	-17.5428	-8.09E-07	11288.	1.06E+10
-0.08165	418397.	0.00				
39.4680	-3.07E-06	423.3280	-17.1846	-4.79E-07	11286.	1.06E+10
0.1815	424834.	0.00				
40.0660	-5.47E-06	305.4636	-15.3533	-2.32E-07	11283.	1.06E+10
0.3289	431270.	0.00				
40.6640	-6.39E-06	204.0544	-12.7741	-5.91E-08	11281.	1.06E+10
0.3900	437707.	0.00				
41.2620	-6.32E-06	122.4048	-9.9711	5.15E-08	11280.	1.06E+10
0.3912	444144.	0.00				
41.8600	-5.65E-06	60.7092	-7.2937	1.14E-07	11279.	1.06E+10
0.3550	450581.	0.00				
42.4580	-4.69E-06	17.1984	-4.9480	1.40E-07	11278.	1.06E+10
0.2987	457018.	0.00				
43.0560	-3.64E-06	-10.9556	-3.0317	1.42E-07	11278.	1.06E+10
0.2354	463455.	0.00				
43.6540	-2.65E-06	-26.9722	-1.5643	1.29E-07	11278.	1.06E+10
0.1736	469892.	0.00				
44.2520	-1.79E-06	-34.0069	-0.5153	1.09E-07	11278.	1.06E+10
0.1188	476329.	0.00				
44.8500	-1.09E-06	-34.8727	0.1745	8.52E-08	11278.	1.06E+10

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0.07350	482765.	0.00				
45.4480	-5.66E-07	-31.8985	0.5766	6.26E-08	11278.	1.06E+10
0.03856	489202.	0.00				
46.0460	-1.94E-07	-26.8884	0.7630	4.27E-08	11278.	1.06E+10
0.01340	495639.	0.00				
46.6440	4.70E-08	-21.1462	0.7993	2.64E-08	11278.	1.06E+10
-0.00329	502076.	0.00				
47.2420	1.85E-07	-15.5398	0.7404	1.40E-08	11278.	1.06E+10
-0.01311	508513.	0.00				
47.8400	2.47E-07	-10.5842	0.6297	5.11E-09	11278.	1.06E+10
-0.01776	514950.	0.00				
48.4380	2.58E-07	-6.5262	0.4986	-6.87E-10	11277.	1.06E+10
-0.01877	521387.	0.00				
49.0360	2.38E-07	-3.4247	0.3686	-4.06E-09	11277.	1.06E+10
-0.01748	527824.	0.00				
49.6340	2.00E-07	-1.2177	0.2524	-5.63E-09	11277.	1.06E+10
-0.01490	534260.	0.00				
50.2320	1.57E-07	0.2239	0.1566	-5.97E-09	11277.	1.06E+10
-0.01181	540697.	0.00				
50.8300	1.14E-07	1.0571	0.08289	-5.54E-09	11277.	1.06E+10
-0.00872	547134.	0.00				
51.4280	7.73E-08	1.4393	0.03020	-4.69E-09	11277.	1.06E+10
-0.00596	553571.	0.00				
52.0260	4.71E-08	1.5123	-0.00438	-3.69E-09	11277.	1.06E+10
-0.00368	560008.	0.00				
52.6240	2.43E-08	1.3936	-0.02447	-2.70E-09	11277.	1.06E+10
-0.00192	566445.	0.00				
53.2220	8.31E-09	1.1738	-0.03373	-1.83E-09	11277.	1.06E+10
-6.63E-04	572882.	0.00				
53.8200	-2.00E-09	0.9179	-0.03553	-1.13E-09	11277.	1.06E+10
1.62E-04	579318.	0.00				
54.4180	-7.84E-09	0.6690	-0.03266	-5.87E-10	11277.	1.06E+10
6.40E-04	585755.	0.00				
55.0160	-1.04E-08	0.4520	-0.02727	-2.07E-10	11277.	1.06E+10
8.61E-04	592192.	0.00				
55.6140	-1.08E-08	0.2785	-0.02095	4.03E-11	11277.	1.06E+10
9.02E-04	598629.	0.00				
56.2120	-9.85E-09	0.1511	-0.01473	1.86E-10	11277.	1.06E+10
8.31E-04	605066.	0.00				
56.8100	-8.15E-09	0.06630	-0.00926	2.60E-10	11277.	1.06E+10
6.95E-04	611503.	0.00				
57.4080	-6.13E-09	0.01711	-0.00487	2.88E-10	11277.	1.06E+10
5.27E-04	617940.	0.00				
58.0060	-4.02E-09	-0.00494	-0.00172	2.92E-10	11277.	1.06E+10
3.50E-04	624377.	0.00				
58.6040	-1.93E-09	-0.00898	1.41E-04	2.87E-10	11277.	1.06E+10
1.70E-04	630813.	0.00				
59.2020	1.05E-10	-0.00425	7.17E-04	2.83E-10	11277.	1.06E+10
-9.37E-06	637250.	0.00				
59.8000	2.12E-09	0.00	0.00	2.81E-10	11277.	1.06E+10
-1.91E-04	321844.	0.00				

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

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1463449. inch-lbs
Maximum shear force	=	23097. lbs
Depth of maximum bending moment	=	0.000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head

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 Number of iterations = 15
 Number of zero deflection points = 6

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 0.510000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 210860.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. inches lb/inch	Bending Distrib. Load Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00	0.00	0.5100	-1465636.	23479.	0.00	35626.	1.06E+10	
0.00	0.00	0.00	0.00					
0.5980		0.5064	-1297182.	23272.	-9.37E-04	32376.	1.06E+10	
-27.1616	384.8699	0.00	0.00					
1.1960		0.4966	-1128795.	22968.	-0.00176	29127.	1.06E+10	
-57.8020	835.3229	0.00	0.00					
1.7940		0.4812	-962227.	22452.	-0.00247	25913.	1.06E+10	
-85.9444	1282.	0.00	0.00					
2.3920		0.4611	-799098.	21748.	-0.00306	22765.	1.06E+10	
-110.1481	1714.	0.00	0.00					
2.9900		0.4372	-640821.	20896.	-0.00355	19711.	1.06E+10	
-127.5027	2093.	0.00	0.00					
3.5880		0.4102	-488453.	19925.	-0.00394	16772.	1.06E+10	
-142.9111	2500.	0.00	0.00					
4.1860		0.3807	-342942.	18835.	-0.00422	13964.	1.06E+10	
-160.9204	3033.	0.00	0.00					
4.7840		0.3496	-205367.	17636.	-0.00440	11309.	1.06E+10	
-173.2090	3555.	0.00	0.00					
5.3820		0.3175	-76500.	16312.	-0.00450	8823.	1.06E+10	
-195.7854	4425.	0.00	0.00					
5.9800		0.2851	42363.	14836.	-0.00451	8164.	1.06E+10	
-215.7204	5430.	0.00	0.00					
6.5780		0.2528	150075.	13212.	-0.00445	10243.	1.06E+10	
-237.0015	6728.	0.00	0.00					
7.1760		0.2213	245428.	11444.	-0.00431	12082.	1.06E+10	
-255.6187	8290.	0.00	0.00					
7.7740		0.1909	327366.	9557.	-0.00412	13663.	1.06E+10	
-270.3488	10161.	0.00	0.00					
8.3720		0.1622	395047.	7581.	-0.00387	14969.	1.06E+10	
-280.3977	12407.	0.00	0.00					
8.9700		0.1354	447883.	5551.	-0.00359	15989.	1.06E+10	
-285.2310	15122.	0.00	0.00					
9.5680		0.1107	485572.	3507.	-0.00327	16716.	1.06E+10	
-284.4268	18436.	0.00	0.00					
10.1660		0.08842	508117.	1491.	-0.00293	17151.	1.06E+10	
-277.6732	22534.	0.00	0.00					
10.7640		0.06861	515841.	-455.6521	-0.00259	17300.	1.06E+10	
-264.7517	27690.	0.00	0.00					
11.3620		0.05131	509403.	-2286.	-0.00224	17176.	1.06E+10	
-245.4953	34334.	0.00	0.00					

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11.9600	0.03649	489801.	-3919.	-0.00190	16798.	1.06E+10
-209.4599	41196.	0.00				
12.5580	0.02405	458910.	-5190.	-0.00158	16201.	1.06E+10
-144.9402	43256.	0.00				
13.1560	0.01384	420084.	-6024.	-0.00128	15452.	1.06E+10
-87.3767	45316.	0.00				
13.7540	0.00567	376328.	-6472.	-0.00101	14608.	1.06E+10
-37.4447	47375.	0.00				
14.3520	-6.62E-04	330258.	-6590.	-7.71E-04	13719.	1.06E+10
4.5622	49435.	0.00				
14.9500	-0.00539	284084.	-6435.	-5.62E-04	12828.	1.06E+10
38.6758	51495.	0.00				
15.5480	-0.00873	239610.	-6062.	-3.85E-04	11970.	1.06E+10
65.1891	53555.	0.00				
16.1460	-0.01091	198248.	-5580.	-2.37E-04	11172.	1.06E+10
69.1496	45464.	0.00				
16.7440	-0.01213	160242.	-5075.	-1.15E-04	10439.	1.06E+10
71.6268	42375.	0.00				
17.3420	-0.01257	125761.	-4558.	-1.81E-05	9774.	1.06E+10
72.4759	41390.	0.00				
17.9400	-0.01239	94883.	-4039.	5.67E-05	9178.	1.06E+10
72.1382	41783.	0.00				
18.5380	-0.01175	67623.	-3526.	1.12E-04	8652.	1.06E+10
70.8819	43284.	0.00				
19.1360	-0.01078	43943.	-3024.	1.50E-04	8195.	1.06E+10
68.8866	45837.	0.00				
19.7340	-0.00960	23765.	-2539.	1.73E-04	7806.	1.06E+10
66.2808	49524.	0.00				
20.3320	-0.00831	6976.	-2075.	1.83E-04	7482.	1.06E+10
63.1606	54555.	0.00				
20.9300	-0.00698	-6567.	-1634.	1.83E-04	7474.	1.06E+10
59.6006	61293.	0.00				
21.5280	-0.00568	-17035.	-1221.	1.75E-04	7676.	1.06E+10
55.6589	70322.	0.00				
22.1260	-0.00446	-24619.	-836.8093	1.61E-04	7822.	1.06E+10
51.3803	82587.	0.00				
22.7240	-0.00337	-29532.	-484.5546	1.43E-04	7917.	1.06E+10
46.7955	99677.	0.00				
23.3220	-0.00242	-32005.	-166.2546	1.22E-04	7965.	1.06E+10
41.9169	124445.	0.00				
23.9200	-0.00162	-32287.	115.9123	1.00E-04	7970.	1.06E+10
36.7249	162580.	0.00				
24.5180	-9.82E-04	-30644.	359.3712	7.87E-05	7938.	1.06E+10
31.1287	227494.	0.00				
25.1160	-4.92E-04	-27367.	560.1442	5.90E-05	7875.	1.06E+10
24.8281	362168.	0.00				
25.7140	-1.35E-04	-22784.	708.4035	4.20E-05	7787.	1.06E+10
16.4928	875972.	0.00				
26.3120	1.11E-04	-17327.	715.5535	2.84E-05	7681.	1.06E+10
-14.5001	938394.	0.00				
26.9100	2.73E-04	-12600.	591.8621	1.83E-05	7590.	1.06E+10
-19.9736	525828.	0.00				
27.5080	3.73E-04	-8888.	440.2925	1.10E-05	7519.	1.06E+10
-22.2699	428465.	0.00				
28.1060	4.30E-04	-6314.	276.4295	5.82E-06	7469.	1.06E+10
-23.3999	390380.	0.00				
28.7040	4.57E-04	-4939.	181.1853	2.01E-06	7442.	1.06E+10
-3.1454	49435.	0.00				
29.3020	4.59E-04	-3720.	158.3182	-9.24E-07	7419.	1.06E+10
-3.2279	50465.	0.00				
29.9000	4.43E-04	-2664.	135.3225	-3.09E-06	7398.	1.06E+10
-3.1812	51495.	0.00				
30.4980	4.15E-04	-1768.	113.0181	-4.59E-06	7381.	1.06E+10

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-3.0352	52525.	0.00				
31.0960	3.77E-04	-1028.	92.0213	-5.54E-06	7367.	1.06E+10
-2.8168	53555.	0.00				
31.6940	3.35E-04	-430.9590	72.7668	-6.03E-06	7355.	1.06E+10
-2.5496	54585.	0.00				
32.2920	2.91E-04	34.9196	55.5313	-6.17E-06	7348.	1.06E+10
-2.2541	55615.	0.00				
32.8900	2.47E-04	384.6893	40.4573	-6.02E-06	7354.	1.06E+10
-1.9471	56644.	0.00				
33.4880	2.04E-04	633.7961	27.5773	-5.68E-06	7359.	1.06E+10
-1.6426	57674.	0.00				
34.0860	1.65E-04	797.6674	16.8359	-5.19E-06	7362.	1.06E+10
-1.3511	58704.	0.00				
34.6840	1.30E-04	891.1444	8.1105	-4.62E-06	7364.	1.06E+10
-1.0807	59734.	0.00				
35.2820	9.88E-05	928.0568	1.2304	-4.01E-06	7365.	1.06E+10
-0.8368	60764.	0.00				
35.8800	7.23E-05	920.9243	-4.0073	-3.38E-06	7365.	1.06E+10
-0.6230	61794.	0.00				
36.4780	5.03E-05	880.7677	-7.8238	-2.77E-06	7364.	1.06E+10
-0.4407	62824.	0.00				
37.0760	3.26E-05	817.0136	-10.4465	-2.19E-06	7363.	1.06E+10
-0.2903	63854.	0.00				
37.6740	1.89E-05	737.4743	-12.1003	-1.67E-06	7361.	1.06E+10
-0.1707	64884.	0.00				
38.2720	8.72E-06	648.3901	-14.5085	-1.20E-06	7360.	1.06E+10
-0.5005	411960.	0.00				
38.8700	1.72E-06	532.8662	-16.6635	-7.95E-07	7357.	1.06E+10
-0.1001	418397.	0.00				
39.4680	-2.69E-06	411.6425	-16.4503	-4.75E-07	7355.	1.06E+10
0.1595	424834.	0.00				
40.0660	-5.10E-06	298.2085	-14.7782	-2.34E-07	7353.	1.06E+10
0.3066	431270.	0.00				
40.6640	-6.06E-06	200.2555	-12.3524	-6.54E-08	7351.	1.06E+10
0.3695	437707.	0.00				
41.2620	-6.04E-06	121.1245	-9.6853	4.35E-08	7349.	1.06E+10
0.3739	444144.	0.00				
41.8600	-5.43E-06	61.1208	-7.1198	1.05E-07	7348.	1.06E+10
0.3412	450581.	0.00				
42.4580	-4.53E-06	18.6227	-4.8607	1.32E-07	7347.	1.06E+10
0.2885	457018.	0.00				
43.0560	-3.53E-06	-9.0402	-3.0066	1.36E-07	7347.	1.06E+10
0.2283	463455.	0.00				
43.6540	-2.58E-06	-24.9387	-1.5805	1.24E-07	7348.	1.06E+10
0.1692	469892.	0.00				
44.2520	-1.75E-06	-32.0992	-0.5556	1.05E-07	7348.	1.06E+10
0.1165	476329.	0.00				
44.8500	-1.08E-06	-33.2300	0.1232	8.26E-08	7348.	1.06E+10
0.07273	482765.	0.00				
45.4480	-5.69E-07	-30.5814	0.5234	6.09E-08	7348.	1.06E+10
0.03882	489202.	0.00				
46.0460	-2.07E-07	-25.9022	0.7139	4.18E-08	7348.	1.06E+10
0.01427	495639.	0.00				
46.6440	3.02E-08	-20.4614	0.7576	2.61E-08	7347.	1.06E+10
-0.00211	502076.	0.00				
47.2420	1.67E-07	-15.1085	0.7074	1.40E-08	7347.	1.06E+10
-0.01187	508513.	0.00				
47.8400	2.31E-07	-10.3511	0.6053	5.38E-09	7347.	1.06E+10
-0.01660	514950.	0.00				
48.4380	2.45E-07	-6.4377	0.4820	-3.11E-10	7347.	1.06E+10
-0.01778	521387.	0.00				
49.0360	2.27E-07	-3.4332	0.3583	-3.66E-09	7347.	1.06E+10
-0.01668	527824.	0.00				

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49.6340	1.92E-07	-1.2841	0.2471	-5.26E-09	7347.	1.06E+10
-0.01431	534260.	0.00				
50.2320	1.51E-07	0.1293	0.1548	-5.65E-09	7347.	1.06E+10
-0.01141	540697.	0.00				
50.8300	1.11E-07	0.9552	0.08351	-5.28E-09	7347.	1.06E+10
-0.00848	547134.	0.00				
51.4280	7.56E-08	1.3438	0.03217	-4.50E-09	7347.	1.06E+10
-0.00583	553571.	0.00				
52.0260	4.66E-08	1.4306	-0.00179	-3.56E-09	7347.	1.06E+10
-0.00363	560008.	0.00				
52.6240	2.45E-08	1.3288	-0.02178	-2.62E-09	7347.	1.06E+10
-0.00193	566445.	0.00				
53.2220	8.91E-09	1.1260	-0.03127	-1.79E-09	7347.	1.06E+10
-7.11E-04	572882.	0.00				
53.8200	-1.21E-09	0.8855	-0.03347	-1.11E-09	7347.	1.06E+10
9.78E-05	579318.	0.00				
54.4180	-7.03E-09	0.6490	-0.03106	-5.90E-10	7347.	1.06E+10
5.73E-04	585755.	0.00				
55.0160	-9.68E-09	0.4414	-0.02614	-2.21E-10	7347.	1.06E+10
7.99E-04	592192.	0.00				
55.6140	-1.02E-08	0.2745	-0.02022	2.20E-11	7347.	1.06E+10
8.50E-04	598629.	0.00				
56.2120	-9.37E-09	0.1511	-0.01434	1.66E-10	7347.	1.06E+10
7.90E-04	605066.	0.00				
56.8100	-7.81E-09	0.06824	-0.00912	2.41E-10	7347.	1.06E+10
6.65E-04	611503.	0.00				
57.4080	-5.91E-09	0.01953	-0.00490	2.70E-10	7347.	1.06E+10
5.09E-04	617940.	0.00				
58.0060	-3.92E-09	-0.00297	-0.00185	2.76E-10	7347.	1.06E+10
3.41E-04	624377.	0.00				
58.6040	-1.95E-09	-0.00790	-1.30E-05	2.72E-10	7347.	1.06E+10
1.71E-04	630813.	0.00				
59.2020	-1.51E-11	-0.00399	6.07E-04	2.68E-10	7347.	1.06E+10
1.34E-06	637250.	0.00				
59.8000	1.90E-09	0.00	0.00	2.67E-10	7347.	1.06E+10
-1.70E-04	321844.	0.00				

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1465636. inch-lbs
Maximum shear force	=	23479. 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	=	15
Number of zero deflection points	=	6

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)

Displacement of pile head	=	0.510000 inches
Rotation of pile head	=	0.0000E+00 radians
Axial load on pile head	=	0.0 lbs

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Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil	
Res. Soil	Spr. Distrib.							
X	y	Moment	Force	S	Stress	Stiffness	p	
Es*h	Lat. Load							
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2		
lb/inch	lb/inch	lb/inch						
0.00	0.5100	-1469697.	24190.	0.00	28357.	1.06E+10		
0.00	0.00	0.00						
0.5980	0.5064	-1296807.	23995.	-9.38E-04	25021.	1.06E+10		
-27.1613	384.8740	0.00						
1.1960	0.4965	-1125315.	23691.	-0.00176	21712.	1.06E+10		
-57.8010	835.3388	0.00						
1.7940	0.4812	-956800.	23175.	-0.00246	18461.	1.06E+10		
-85.9436	1282.	0.00						
2.3920	0.4612	-792710.	22471.	-0.00306	15295.	1.06E+10		
-110.1511	1714.	0.00						
2.9900	0.4373	-634293.	21618.	-0.00354	12238.	1.06E+10		
-127.5161	2093.	0.00						
3.5880	0.4103	-482442.	20648.	-0.00392	9308.	1.06E+10		
-142.9469	2500.	0.00						
4.1860	0.3810	-337952.	19557.	-0.00420	6521.	1.06E+10		
-161.0003	3032.	0.00						
4.7840	0.3501	-201753.	18358.	-0.00438	3893.	1.06E+10		
-173.3618	3553.	0.00						
5.3820	0.3182	-74481.	17032.	-0.00447	1437.	1.06E+10		
-196.0445	4422.	0.00						
5.9800	0.2859	42696.	15554.	-0.00449	823.7924	1.06E+10		
-216.1248	5425.	0.00						
6.5780	0.2538	148743.	13926.	-0.00442	2870.	1.06E+10		
-237.5871	6718.	0.00						
7.1760	0.2224	242556.	12153.	-0.00429	4680.	1.06E+10		
-256.4417	8273.	0.00						
7.7740	0.1923	323163.	10259.	-0.00410	6235.	1.06E+10		
-271.4949	10134.	0.00						
8.3720	0.1637	389790.	8273.	-0.00385	7521.	1.06E+10		
-281.9431	12363.	0.00						
8.9700	0.1369	441898.	6231.	-0.00357	8526.	1.06E+10		
-287.2596	15053.	0.00						
9.5680	0.1124	479213.	4170.	-0.00326	9246.	1.06E+10		
-287.0309	18328.	0.00						
10.1660	0.09015	501748.	2132.	-0.00293	9681.	1.06E+10		
-280.9565	22364.	0.00						
10.7640	0.07036	509815.	159.5895	-0.00258	9837.	1.06E+10		
-268.8356	27418.	0.00						
11.3620	0.05305	504038.	-1704.	-0.00224	9725.	1.06E+10		
-250.5331	33887.	0.00						
11.9600	0.03820	485361.	-3390.	-0.00191	9365.	1.06E+10		
-219.2820	41196.	0.00						
12.5580	0.02570	455391.	-4732.	-0.00159	8787.	1.06E+10		
-154.9287	43256.	0.00						
13.1560	0.01542	417443.	-5638.	-0.00129	8054.	1.06E+10		
-97.3925	45316.	0.00						
13.7540	0.00717	374480.	-6157.	-0.00102	7225.	1.06E+10		
-47.3624	47375.	0.00						
14.3520	7.47E-04	329078.	-6345.	-7.84E-04	6349.	1.06E+10		
-5.1472	49435.	0.00						
14.9500	-0.00408	283411.	-6259.	-5.76E-04	5468.	1.06E+10		
29.2692	51495.	0.00						
15.5480	-0.00753	239251.	-5952.	-3.99E-04	4616.	1.06E+10		
56.1663	53555.	0.00						
16.1460	-0.00981	197984.	-5511.	-2.51E-04	3820.	1.06E+10		

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66.7304	48817.	0.00				
16.7440	-0.01113	160153.	-5022.	-1.30E-04	3090.	1.06E+10
69.5990	44877.	0.00				
17.3420	-0.01167	125905.	-4519.	-3.27E-05	2429.	1.06E+10
70.7102	43480.	0.00				
17.9400	-0.01160	95299.	-4012.	4.23E-05	1839.	1.06E+10
70.5675	43660.	0.00				
18.5380	-0.01106	68327.	-3509.	9.77E-05	1318.	1.06E+10
69.4680	45059.	0.00				
19.1360	-0.01020	44932.	-3018.	1.36E-04	866.9473	1.06E+10
67.6062	47583.	0.00				
19.7340	-0.00911	25019.	-2541.	1.60E-04	482.7258	1.06E+10
65.1195	51298.	0.00				
20.3320	-0.00790	8459.	-2085.	1.71E-04	163.2053	1.06E+10
62.1098	56406.	0.00				
20.9300	-0.00665	-4903.	-1652.	1.72E-04	94.6049	1.06E+10
58.6552	63270.	0.00				
21.5280	-0.00543	-15245.	-1244.	1.66E-04	294.1369	1.06E+10
54.8169	72479.	0.00				
22.1260	-0.00428	-22763.	-866.0363	1.53E-04	439.2044	1.06E+10
50.6422	84982.	0.00				
22.7240	-0.00324	-27674.	-518.6928	1.36E-04	533.9553	1.06E+10
46.1647	102373.	0.00				
23.3220	-0.00233	-30207.	-204.5078	1.16E-04	582.8382	1.06E+10
41.4008	127491.	0.00				
23.9200	-0.00157	-30609.	74.4179	9.54E-05	590.5866	1.06E+10
36.3377	165922.	0.00				
24.5180	-9.62E-04	-29139.	315.6671	7.51E-05	562.2308	1.06E+10
30.9001	230555.	0.00				
25.1160	-4.94E-04	-26079.	515.6371	5.64E-05	503.1736	1.06E+10
24.8330	360943.	0.00				
25.7140	-1.53E-04	-21739.	665.9666	4.02E-05	419.4432	1.06E+10
17.0649	802856.	0.00				
26.3120	8.29E-05	-16521.	680.2958	2.72E-05	318.7575	1.06E+10
-13.0713	1131516.	0.00				
26.9100	2.38E-04	-11975.	564.9464	1.75E-05	231.0591	1.06E+10
-19.0774	575326.	0.00				
27.5080	3.35E-04	-8413.	419.4424	1.06E-05	162.3154	1.06E+10
-21.4756	460376.	0.00				
28.1060	3.91E-04	-5956.	261.1000	5.77E-06	114.9092	1.06E+10
-22.6555	416206.	0.00				
28.7040	4.18E-04	-4665.	169.4922	2.17E-06	90.0129	1.06E+10
-2.8762	49435.	0.00				
29.3020	4.22E-04	-3523.	148.5316	-6.09E-07	67.9743	1.06E+10
-2.9657	50465.	0.00				
29.9000	4.09E-04	-2533.	127.3660	-2.66E-06	48.8823	1.06E+10
-2.9333	51495.	0.00				
30.4980	3.84E-04	-1695.	106.7693	-4.10E-06	32.7048	1.06E+10
-2.8071	52525.	0.00				
31.0960	3.50E-04	-1001.	87.3256	-5.01E-06	19.3163	1.06E+10
-2.6120	53555.	0.00				
31.6940	3.12E-04	-441.7316	69.4489	-5.50E-06	8.5230	1.06E+10
-2.3703	54585.	0.00				
32.2920	2.71E-04	-4.3957	53.4061	-5.65E-06	0.08481	1.06E+10
-2.1009	55615.	0.00				
32.8900	2.31E-04	324.7530	39.3388	-5.54E-06	6.2660	1.06E+10
-1.8197	56644.	0.00				
33.4880	1.92E-04	560.1943	27.2854	-5.24E-06	10.8087	1.06E+10
-1.5396	57674.	0.00				
34.0860	1.55E-04	716.3535	17.2025	-4.81E-06	13.8217	1.06E+10
-1.2706	58704.	0.00				
34.6840	1.23E-04	807.0841	8.9833	-4.29E-06	15.5723	1.06E+10
-1.0202	59734.	0.00				

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35.2820	9.37E-05	845.2812	2.4755	-3.73E-06	16.3093	1.06E+10
-0.7936	60764.	0.00				
35.8800	6.90E-05	842.6123	-2.5037	-3.16E-06	16.2578	1.06E+10
-0.5942	61794.	0.00				
36.4780	4.84E-05	809.3474	-6.1551	-2.60E-06	15.6160	1.06E+10
-0.4235	62824.	0.00				
37.0760	3.17E-05	754.2742	-8.6864	-2.07E-06	14.5534	1.06E+10
-0.2820	63854.	0.00				
37.6740	1.87E-05	684.6807	-10.3038	-1.58E-06	13.2106	1.06E+10
-0.1688	64884.	0.00				
38.2720	8.99E-06	606.3934	-12.7607	-1.14E-06	11.7001	1.06E+10
-0.5159	411960.	0.00				
38.8700	2.25E-06	501.5391	-15.0828	-7.69E-07	9.6770	1.06E+10
-0.1313	418397.	0.00				
39.4680	-2.04E-06	389.9255	-15.1195	-4.66E-07	7.5234	1.06E+10
0.1210	424834.	0.00				
40.0660	-4.44E-06	284.5437	-13.7273	-2.38E-07	5.4901	1.06E+10
0.2670	431270.	0.00				
40.6640	-5.46E-06	192.9113	-11.5750	-7.60E-08	3.7221	1.06E+10
0.3329	437707.	0.00				
41.2620	-5.53E-06	118.4193	-9.1520	2.96E-08	2.2848	1.06E+10
0.3424	444144.	0.00				
41.8600	-5.03E-06	61.5612	-6.7896	9.06E-08	1.1878	1.06E+10
0.3160	450581.	0.00				
42.4580	-4.23E-06	20.9750	-4.6886	1.19E-07	0.4047	1.06E+10
0.2696	457018.	0.00				
43.0560	-3.33E-06	-5.7299	-2.9496	1.24E-07	0.1106	1.06E+10
0.2151	463455.	0.00				
43.6540	-2.46E-06	-21.3573	-1.6005	1.15E-07	0.4121	1.06E+10
0.1609	469892.	0.00				
44.2520	-1.69E-06	-28.7003	-0.6215	9.76E-08	0.5538	1.06E+10
0.1120	476329.	0.00				
44.8500	-1.06E-06	-30.2776	0.03517	7.76E-08	0.5842	1.06E+10
0.07107	482765.	0.00				
45.4480	-5.73E-07	-28.1955	0.4304	5.78E-08	0.5440	1.06E+10
0.03908	489202.	0.00				
46.0460	-2.27E-07	-24.1011	0.6269	4.00E-08	0.4650	1.06E+10
0.01569	495639.	0.00				
46.6440	1.52E-09	-19.1986	0.6828	2.54E-08	0.3704	1.06E+10
-1.06E-04	502076.	0.00				
47.2420	1.37E-07	-14.3016	0.6476	1.40E-08	0.2759	1.06E+10
-0.00970	508513.	0.00				
47.8400	2.03E-07	-9.9040	0.5607	5.81E-09	0.1911	1.06E+10
-0.01454	514950.	0.00				
48.4380	2.20E-07	-6.2550	0.4511	3.29E-10	0.1207	1.06E+10
-0.01600	521387.	0.00				
49.0360	2.07E-07	-3.4298	0.3390	-2.95E-09	0.06618	1.06E+10
-0.01525	527824.	0.00				
49.6340	1.78E-07	-1.3898	0.2368	-4.59E-09	0.02682	1.06E+10
-0.01324	534260.	0.00				
50.2320	1.41E-07	-0.03147	0.1510	-5.07E-09	6.07E-04	1.06E+10
-0.01066	540697.	0.00				
50.8300	1.05E-07	0.7780	0.08407	-4.82E-09	0.01501	1.06E+10
-0.00801	547134.	0.00				
51.4280	7.23E-08	1.1751	0.03532	-4.15E-09	0.02267	1.06E+10
-0.00558	553571.	0.00				
52.0260	4.54E-08	1.2849	0.00259	-3.32E-09	0.02479	1.06E+10
-0.00354	560008.	0.00				
52.6240	2.47E-08	1.2122	-0.01711	-2.47E-09	0.02339	1.06E+10
-0.00195	566445.	0.00				
53.2220	9.88E-09	1.0393	-0.02693	-1.71E-09	0.02005	1.06E+10
-7.88E-04	572882.	0.00				
53.8200	1.25E-10	0.8257	-0.02980	-1.08E-09	0.01593	1.06E+10

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-1.01E-05	579318.	0.00				
54.4180	-5.61E-09	0.6116	-0.02819	-5.92E-10	0.01180	1.06E+10
4.58E-04	585755.	0.00				
55.0160	-8.37E-09	0.4211	-0.02407	-2.42E-10	0.00812	1.06E+10
6.91E-04	592192.	0.00				
55.6140	-9.08E-09	0.2661	-0.01888	-8.73E-12	0.00514	1.06E+10
7.57E-04	598629.	0.00				
56.2120	-8.49E-09	0.1502	-0.01359	1.32E-10	0.00290	1.06E+10
7.16E-04	605066.	0.00				
56.8100	-7.18E-09	0.07109	-0.00883	2.07E-10	0.00137	1.06E+10
6.12E-04	611503.	0.00				
57.4080	-5.52E-09	0.02349	-0.00493	2.39E-10	4.53E-04	1.06E+10
4.75E-04	617940.	0.00				
58.0060	-3.74E-09	3.59E-04	-0.00206	2.48E-10	6.94E-06	1.06E+10
3.25E-04	624377.	0.00				
58.6040	-1.96E-09	-0.00601	-2.69E-04	2.46E-10	1.16E-04	1.06E+10
1.73E-04	630813.	0.00				
59.2020	-2.16E-10	-0.00350	4.19E-04	2.42E-10	6.75E-05	1.06E+10
1.91E-05	637250.	0.00				
59.8000	1.52E-09	0.00	0.00	2.41E-10	0.00	1.06E+10
-1.36E-04	321844.	0.00				

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

Output Summary for Load Case No. 3:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1469697. inch-lbs
Maximum shear force	=	24190. lbs
Depth of maximum bending moment	=	0.000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	16
Number of zero deflection points	=	6

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	Load 1	Load 2	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max in lbs
1	y, in	0.5100	S, rad	0.00	323660.	0.5100	0.00
23097.	-1463449.						
2	y, in	0.5100	S, rad	0.00	210860.	0.5100	0.00
23479.	-1465636.						
3	y, in	0.5100	S, rad	0.00	0.00	0.5100	0.00

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24190. -1469697.

Maximum pile-head deflection = 0.5100000000 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

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LPILE for Windows, Version 2018-10.003

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:

\\haleyaldrich.com\share\por_common\PROJECTS\42223 - gardiner bridges\005 - Maine
Ave\Calculations\Lateral Pile Evaluations\LPILE Files\

Name of input data file:

2018-0405-HAI-HP 14 x 117-North-High Fill-116 Corrosion-0.32 deflection.lp10

Name of output report file:

2018-0405-HAI-HP 14 x 117-North-High Fill-116 Corrosion-0.32 deflection.lp10

Name of plot output file:

2018-0405-HAI-HP 14 x 117-North-High Fill-116 Corrosion-0.32 deflection.lp10

Name of runtime message file:

2018-0405-HAI-HP 14 x 117-North-High Fill-116 Corrosion-0.32 deflection.lp10

Date and Time of Analysis

Date: April 5, 2018

Time: 10:14:49

Problem Title

Bridge over Cobbosseecontee Stream, Gardiner, Maine

Maine Department of Transportation

Haley & Aldrich, Inc.

Description:

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	=	100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- 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	=	56.500 ft

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Depth of ground surface below top of pile = -11.1000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.0850
2	56.500	14.0850

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	= 56.500000 ft
Flange Width	= 14.760000 in
Section Depth	= 14.085000 in
Flange Thickness	= 0.680000 in
Web Thickness	= 0.680000 in
Section Area	= 28.700000 sq. in
Moment of Inertia	= 365.000000 in^4
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 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	= -11.100000 ft
Distance from top of pile to bottom of layer	= 0.100000 ft
Effective unit weight at top of layer	= 115.000000 pcf
Effective unit weight at bottom of layer	= 115.000000 pcf
Friction angle at top of layer	= 30.000000 deg.
Friction angle at bottom of layer	= 30.000000 deg.
Subgrade k at top of layer	= 40.000000 pci
Subgrade k at bottom of layer	= 40.000000 pci

2018-0405-HAI-HP 14 x 117-North-High Fill-116 Corrosion-0.32 deflection.lp10o.txt
 Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	0.100000	ft
Distance from top of pile to bottom of layer	=	19.500000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	30.000000	deg.
Friction angle at bottom of layer	=	30.000000	deg.
Subgrade k at top of layer	=	40.000000	pci
Subgrade k at bottom of layer	=	40.000000	pci

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

Distance from top of pile to top of layer	=	19.500000	ft
Distance from top of pile to bottom of layer	=	25.000000	ft
Effective unit weight at top of layer	=	57.600000	pcf
Effective unit weight at bottom of layer	=	57.600000	pcf
Friction angle at top of layer	=	32.000000	deg.
Friction angle at bottom of layer	=	32.000000	deg.
Subgrade k at top of layer	=	30.000000	pci
Subgrade k at bottom of layer	=	30.000000	pci

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

Distance from top of pile to top of layer	=	25.000000	ft
Distance from top of pile to bottom of layer	=	48.500000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	29.000000	deg.
Friction angle at bottom of layer	=	29.000000	deg.
Subgrade k at top of layer	=	20.000000	pci
Subgrade k at bottom of layer	=	20.000000	pci

Layer 5 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	48.500000	ft
Distance from top of pile to bottom of layer	=	56.500000	ft
Effective unit weight at top of layer	=	67.600000	pcf
Effective unit weight at bottom of layer	=	67.600000	pcf
Friction angle at top of layer	=	36.000000	deg.
Friction angle at bottom of layer	=	36.000000	deg.
Subgrade k at top of layer	=	125.000000	pci
Subgrade k at bottom of layer	=	125.000000	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	Angle of Friction deg.	kpy pci
1	Sand	-11.1000	115.0000	30.0000	40.0000
	(Reese, et al.)	0.10000	115.0000	30.0000	40.0000
2	Sand	0.10000	52.6000	30.0000	40.0000

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	(Reese, et al.)	19.5000	52.6000	30.0000	40.0000
3	Sand	19.5000	57.6000	32.0000	30.0000
	(Reese, et al.)	25.0000	57.6000	32.0000	30.0000
4	Sand	25.0000	52.6000	29.0000	20.0000
	(Reese, et al.)	48.5000	52.6000	29.0000	20.0000
5	Sand	48.5000	67.6000	36.0000	125.0000
	(Reese, et al.)	56.5000	67.6000	36.0000	125.0000

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 = 3

Load Compute No.	Load Top y Type	Condition 1		Condition 2		Axial Thrust Force, lbs
vs. Pile Length						
1	5	y =	0.320000 in	S =	0.0000 in/in	323660.
N.A.						
2	5	y =	0.320000 in	S =	0.0000 in/in	210860.
N.A.						
3	5	y =	0.320000 in	S =	0.0000 in/in	0.0000000
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

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	-11.1000	0.00	N.A.	No	0.00	113771.
2	0.1000	11.2001	Yes	No	113771.	468767.
3	19.5000	21.8628	Yes	No	582537.	343777.
4	25.0000	32.0659	Yes	No	926315.	1539883.
5	48.5000	34.1959	Yes	No	2466198.	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 = 0.320000 inches
Rotation of pile head = 0.0000E+00 radians
Axial load on pile head = 323660.0 lbs

Depth Res.	Soil X	Deflect. Spr. y	Bending Distrib. Lat. Load	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil p
feet	Es*h	inches	lb/inch	lbs	radians	psi*	in-lb^2	
0.00		0.3200	-2686323.	100552.	0.00	63109.	1.06E+10	
-1581.		16749.	0.00					
0.5650		0.3142	-2041685.	89117.	-0.00151	50671.	1.06E+10	
-1677.		36185.	0.00					
1.1300		0.2995	-1471254.	77564.	-0.00264	39664.	1.06E+10	
-1731.		39192.	0.00					
1.6950		0.2784	-978330.	65900.	-0.00342	30154.	1.06E+10	
-1710.		41640.	0.00					
2.2600		0.2530	-562622.	54603.	-0.00392	22133.	1.06E+10	
-1623.		43479.	0.00					
2.8250		0.2253	-220716.	43998.	-0.00417	15536.	1.06E+10	
-1506.		45318.	0.00					
3.3900		0.1965	52289.	34261.	-0.00422	12286.	1.06E+10	
-1367.		47156.	0.00					
3.9550		0.1680	262389.	25511.	-0.00412	16340.	1.06E+10	
-1214.		48995.	0.00					
4.5200		0.1406	416310.	17821.	-0.00390	19310.	1.06E+10	
-1054.		50834.	0.00					
5.0850		0.1151	521176.	11216.	-0.00360	21333.	1.06E+10	
-893.9520		52672.	0.00					
5.6500		0.09177	584216.	5684.	-0.00325	22550.	1.06E+10	
-737.8134		54511.	0.00					

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6.2150	0.07100	612519.	1183.	-0.00287	23096.	1.06E+10
-590.1225	56350.	0.00				
6.7800	0.05290	612833.	-2357.	-0.00247	23102.	1.06E+10
-453.9984	58189.	0.00				
7.3450	0.03746	591417.	-5020.	-0.00209	22688.	1.06E+10
-331.6175	60027.	0.00				
7.9100	0.02458	553926.	-6905.	-0.00172	21965.	1.06E+10
-224.2964	61866.	0.00				
8.4750	0.01411	505345.	-8115.	-0.00138	21028.	1.06E+10
-132.5948	63705.	0.00				
9.0400	0.00584	449959.	-8755.	-0.00108	19959.	1.06E+10
-56.4305	65544.	0.00				
9.6050	-4.83E-04	391346.	-8930.	-8.07E-04	18828.	1.06E+10
4.8015	67382.	0.00				
10.1700	-0.00510	332405.	-8737.	-5.75E-04	17691.	1.06E+10
52.1102	69221.	0.00				
10.7350	-0.00828	275391.	-8267.	-3.80E-04	16591.	1.06E+10
86.7956	71060.	0.00				
11.3000	-0.01026	221980.	-7598.	-2.21E-04	15560.	1.06E+10
110.3453	72899.	0.00				
11.8650	-0.01128	173329.	-6803.	-9.45E-05	14622.	1.06E+10
124.3433	74737.	0.00				
12.4300	-0.01154	130151.	-5939.	2.65E-06	13789.	1.06E+10
130.3915	76576.	0.00				
12.9950	-0.01124	92784.	-5056.	7.40E-05	13068.	1.06E+10
130.0461	78415.	0.00				
13.5600	-0.01054	61264.	-4192.	1.23E-04	12459.	1.06E+10
124.7681	80254.	0.00				
14.1250	-0.00957	35393.	-3377.	1.54E-04	11960.	1.06E+10
115.8872	82092.	0.00				
14.6900	-0.00845	14800.	-2629.	1.70E-04	11563.	1.06E+10
104.5775	83931.	0.00				
15.2550	-0.00726	-1006.	-1963.	1.75E-04	11297.	1.06E+10
91.8456	85770.	0.00				
15.8200	-0.00608	-12590.	-1386.	1.70E-04	11520.	1.06E+10
78.5260	87608.	0.00				
16.3850	-0.00495	-20545.	-898.2330	1.60E-04	11674.	1.06E+10
65.2859	89447.	0.00				
16.9500	-0.00391	-25471.	-498.4812	1.45E-04	11769.	1.06E+10
52.6350	91286.	0.00				
17.5150	-0.00298	-27942.	-181.2626	1.28E-04	11816.	1.06E+10
40.9398	93125.	0.00				
18.0800	-0.00217	-28491.	60.7162	1.10E-04	11827.	1.06E+10
30.4404	94963.	0.00				
18.6450	-0.00149	-27601.	236.0137	9.20E-05	11810.	1.06E+10
21.2698	96802.	0.00				
19.2100	-9.26E-04	-25694.	353.7890	7.49E-05	11773.	1.06E+10
13.4722	98641.	0.00				
19.7750	-4.74E-04	-23132.	417.3147	5.93E-05	11724.	1.06E+10
5.2669	75360.	0.00				
20.3400	-1.22E-04	-20296.	439.8574	4.54E-05	11669.	1.06E+10
1.3828	76739.	0.00				
20.9050	1.41E-04	-17367.	439.0235	3.33E-05	11612.	1.06E+10
-1.6288	78118.	0.00				
21.4700	3.29E-04	-14489.	420.4051	2.31E-05	11557.	1.06E+10
-3.8633	79497.	0.00				
22.0350	4.55E-04	-11768.	388.9215	1.47E-05	11504.	1.06E+10
-5.4238	80876.	0.00				
22.6000	5.29E-04	-9280.	348.7871	7.96E-06	11456.	1.06E+10
-6.4152	82255.	0.00				
23.1650	5.63E-04	-7073.	303.5139	2.72E-06	11414.	1.06E+10
-6.9397	83634.	0.00				
23.7300	5.66E-04	-5176.	255.9440	-1.20E-06	11377.	1.06E+10

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-7.0927	85013.	0.00					
24.2950	5.46E-04	-3597.	208.3032	-4.01E-06	11347.	1.06E+10	
-6.9606	86392.	0.00					
24.8600	5.11E-04	-2334.	162.2704	-5.91E-06	11322.	1.06E+10	
-6.6184	87771.	0.00					
25.4250	4.66E-04	-1371.	125.9835	-7.10E-06	11304.	1.06E+10	
-4.0857	59433.	0.00					
25.9900	4.15E-04	-594.1106	99.6101	-7.73E-06	11289.	1.06E+10	
-3.6940	60353.	0.00					
26.5550	3.61E-04	13.7188	76.0188	-7.91E-06	11278.	1.06E+10	
-3.2651	61272.	0.00					
27.1200	3.08E-04	471.4381	55.3830	-7.76E-06	11286.	1.06E+10	
-2.8222	62192.	0.00					
27.6850	2.56E-04	798.7647	37.7350	-7.35E-06	11293.	1.06E+10	
-2.3837	63111.	0.00					
28.2500	2.08E-04	1015.	22.9959	-6.77E-06	11297.	1.06E+10	
-1.9641	64030.	0.00					
28.8150	1.64E-04	1140.	11.0030	-6.08E-06	11299.	1.06E+10	
-1.5736	64950.	0.00					
29.3800	1.26E-04	1191.	1.5345	-5.33E-06	11300.	1.06E+10	
-1.2194	65869.	0.00					
29.9450	9.19E-05	1185.	-5.6698	-4.57E-06	11300.	1.06E+10	
-0.9057	66788.	0.00					
30.5100	6.35E-05	1134.	-10.8901	-3.83E-06	11299.	1.06E+10	
-0.6342	67708.	0.00					
31.0750	4.00E-05	1054.	-14.4128	-3.13E-06	11298.	1.06E+10	
-0.4049	68627.	0.00					
31.6400	2.11E-05	952.7656	-16.5182	-2.49E-06	11296.	1.06E+10	
-0.2162	69547.	0.00					
32.2050	6.28E-06	840.5919	-17.4722	-1.91E-06	11294.	1.06E+10	
-0.06527	70466.	0.00					
32.7700	-4.86E-06	724.2366	-17.5199	-1.41E-06	11291.	1.06E+10	
0.05119	71385.	0.00					
33.3350	-1.29E-05	609.2166	-16.8815	-9.84E-07	11289.	1.06E+10	
0.1371	72305.	0.00					
33.9000	-1.82E-05	499.6442	-15.7498	-6.29E-07	11287.	1.06E+10	
0.1967	73224.	0.00					
34.4650	-2.14E-05	398.4104	-14.2901	-3.42E-07	11285.	1.06E+10	
0.2339	74143.	0.00					
35.0300	-2.28E-05	307.3702	-12.6397	-1.16E-07	11283.	1.06E+10	
0.2529	75063.	0.00					
35.5950	-2.30E-05	227.5235	-10.9101	5.57E-08	11282.	1.06E+10	
0.2573	75982.	0.00					
36.1600	-2.21E-05	159.1849	-9.1885	1.80E-07	11280.	1.06E+10	
0.2505	76901.	0.00					
36.7250	-2.05E-05	102.1389	-7.5406	2.63E-07	11279.	1.06E+10	
0.2356	77821.	0.00					
37.2900	-1.85E-05	55.7788	-6.0129	3.14E-07	11278.	1.06E+10	
0.2151	78740.	0.00					
37.8550	-1.63E-05	19.2265	-4.6358	3.38E-07	11278.	1.06E+10	
0.1912	79660.	0.00					
38.4200	-1.39E-05	-8.5658	-3.4263	3.41E-07	11278.	1.06E+10	
0.1656	80579.	0.00					
38.9850	-1.16E-05	-28.7319	-2.3904	3.29E-07	11278.	1.06E+10	
0.1399	81498.	0.00					
39.5500	-9.47E-06	-42.4246	-1.5257	3.07E-07	11278.	1.06E+10	
0.1151	82418.	0.00					
40.1150	-7.49E-06	-50.7651	-0.8234	2.77E-07	11278.	1.06E+10	
0.09201	83337.	0.00					
40.6800	-5.72E-06	-54.8046	-0.2705	2.43E-07	11278.	1.06E+10	
0.07108	84256.	0.00					
41.2450	-4.19E-06	-55.4995	0.1490	2.08E-07	11278.	1.06E+10	
0.05267	85176.	0.00					

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41.8100	-2.91E-06	-53.6954	0.4526	1.73E-07	11278.	1.06E+10
0.03690	86095.	0.00				
42.3750	-1.85E-06	-50.1197	0.6583	1.39E-07	11278.	1.06E+10
0.02377	87015.	0.00				
42.9400	-1.02E-06	-45.3808	0.7835	1.09E-07	11278.	1.06E+10
0.01318	87934.	0.00				
43.5050	-3.78E-07	-39.9721	0.8450	8.14E-08	11278.	1.06E+10
0.00495	88853.	0.00				
44.0700	8.73E-08	-34.2796	0.8579	5.76E-08	11278.	1.06E+10
-0.00116	89773.	0.00				
44.6350	4.04E-07	-28.5920	0.8357	3.75E-08	11278.	1.06E+10
-0.00540	90692.	0.00				
45.2000	5.96E-07	-23.1123	0.7901	2.09E-08	11278.	1.06E+10
-0.00805	91611.	0.00				
45.7650	6.87E-07	-17.9701	0.7310	7.77E-09	11278.	1.06E+10
-0.00938	92531.	0.00				
46.3300	7.01E-07	-13.2338	0.6665	-2.23E-09	11278.	1.06E+10
-0.00966	93450.	0.00				
46.8950	6.57E-07	-8.9230	0.6027	-9.32E-09	11278.	1.06E+10
-0.00915	94369.	0.00				
47.4600	5.75E-07	-5.0201	0.5443	-1.38E-08	11277.	1.06E+10
-0.00807	95289.	0.00				
48.0250	4.70E-07	-1.4813	0.4943	-1.59E-08	11277.	1.06E+10
-0.00667	96208.	0.00				
48.5900	3.59E-07	1.7529	0.3627	-1.58E-08	11277.	1.06E+10
-0.03217	607047.	0.00				
49.1550	2.56E-07	3.5057	0.1751	-1.41E-08	11277.	1.06E+10
-0.02315	612793.	0.00				
49.7200	1.68E-07	4.1895	0.04464	-1.16E-08	11277.	1.06E+10
-0.01534	618539.	0.00				
50.2850	9.84E-08	4.1621	-0.03808	-8.96E-09	11277.	1.06E+10
-0.00906	624285.	0.00				
50.8500	4.67E-08	3.7124	-0.08350	-6.44E-09	11277.	1.06E+10
-0.00434	630032.	0.00				
51.4150	1.11E-08	3.0581	-0.1017	-4.27E-09	11277.	1.06E+10
-0.00104	635778.	0.00				
51.9800	-1.12E-08	2.3516	-0.1017	-2.54E-09	11277.	1.06E+10
0.00106	641524.	0.00				
52.5450	-2.33E-08	1.6906	-0.09055	-1.24E-09	11277.	1.06E+10
0.00222	647270.	0.00				
53.1100	-2.80E-08	1.1293	-0.07386	-3.38E-10	11277.	1.06E+10
0.00270	653016.	0.00				
53.6750	-2.79E-08	0.6905	-0.05553	2.45E-10	11277.	1.06E+10
0.00271	658762.	0.00				
54.2400	-2.47E-08	0.3753	-0.03814	5.86E-10	11277.	1.06E+10
0.00242	664508.	0.00				
54.8050	-1.99E-08	0.1708	-0.02325	7.61E-10	11277.	1.06E+10
0.00197	670254.	0.00				
55.3700	-1.44E-08	0.05668	-0.01171	8.34E-10	11277.	1.06E+10
0.00144	676000.	0.00				
55.9350	-8.62E-09	0.00842	-0.00390	8.55E-10	11277.	1.06E+10
8.67E-04	681746.	0.00				
56.5000	-2.81E-09	0.00	0.00	8.57E-10	11277.	1.06E+10
2.85E-04	343746.	0.00				

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

Output Summary for Load Case No. 1:

Pile-head deflection = 0.32000000 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -2686323. inch-lbs

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Maximum shear force = 100552. 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 = 6
Number of zero deflection points = 6

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.320000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 210860.0 lbs

Depth Res. Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00	0.3200	-2686450.	100898.	0.00	59181.	1.06E+10	
-1581.	16749.	0.00					
0.5650	0.3142	-2039964.	89486.	-0.00151	46707.	1.06E+10	
-1677.	36185.	0.00					
1.1300	0.2995	-1468686.	77934.	-0.00264	35685.	1.06E+10	
-1731.	39192.	0.00					
1.6950	0.2784	-975639.	66269.	-0.00342	26172.	1.06E+10	
-1710.	41640.	0.00					
2.2600	0.2531	-560297.	54971.	-0.00391	18158.	1.06E+10	
-1623.	43479.	0.00					
2.8250	0.2254	-219052.	44362.	-0.00416	11574.	1.06E+10	
-1506.	45318.	0.00					
3.3900	0.1967	53154.	34619.	-0.00421	8373.	1.06E+10	
-1368.	47156.	0.00					
3.9550	0.1682	262433.	25862.	-0.00411	12411.	1.06E+10	
-1215.	48995.	0.00					
4.5200	0.1409	415598.	18160.	-0.00390	15366.	1.06E+10	
-1056.	50834.	0.00					
5.0850	0.1154	519828.	11541.	-0.00360	17377.	1.06E+10	
-896.2318	52672.	0.00					
5.6500	0.09210	582384.	5993.	-0.00324	18584.	1.06E+10	
-740.5134	54511.	0.00					
6.2150	0.07137	610366.	1471.	-0.00286	19124.	1.06E+10	
-593.1996	56350.	0.00					
6.7800	0.05329	610521.	-2090.	-0.00247	19127.	1.06E+10	
-457.3911	58189.	0.00					
7.3450	0.03787	589091.	-4777.	-0.00209	18713.	1.06E+10	
-335.2503	60027.	0.00					
7.9100	0.02500	551711.	-6687.	-0.00172	17992.	1.06E+10	
-228.0853	61866.	0.00					
8.4750	0.01452	503341.	-7923.	-0.00138	17059.	1.06E+10	
-136.4522	63705.	0.00					
9.0400	0.00623	448237.	-8589.	-0.00108	15996.	1.06E+10	
-60.2697	65544.	0.00					
9.6050	-1.07E-04	389953.	-8790.	-8.10E-04	14871.	1.06E+10	
1.0622	67382.	0.00					
10.1700	-0.00475	331360.	-8622.	-5.79E-04	13740.	1.06E+10	

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48.5438	69221.	0.00				
10.7350	-0.00796	274695.	-8174.	-3.85E-04	12647.	1.06E+10
83.4643	71060.	0.00				
11.3000	-0.00998	221615.	-7528.	-2.26E-04	11623.	1.06E+10
107.2988	72899.	0.00				
11.8650	-0.01103	173265.	-6752.	-9.99E-05	10690.	1.06E+10
121.6176	74737.	0.00				
12.4300	-0.01133	130347.	-5906.	-2.65E-06	9862.	1.06E+10
128.0093	76576.	0.00				
12.9950	-0.01107	93194.	-5038.	6.89E-05	9145.	1.06E+10
128.0174	78415.	0.00				
13.5600	-0.01040	61840.	-4186.	1.19E-04	8540.	1.06E+10
123.0910	80254.	0.00				
14.1250	-0.00946	36088.	-3381.	1.50E-04	8043.	1.06E+10
114.5497	82092.	0.00				
14.6900	-0.00837	15568.	-2641.	1.67E-04	7647.	1.06E+10
103.5593	83931.	0.00				
15.2550	-0.00720	-204.9409	-1981.	1.71E-04	7351.	1.06E+10
91.1196	85770.	0.00				
15.8200	-0.00604	-11789.	-1408.	1.68E-04	7575.	1.06E+10
78.0608	87608.	0.00				
16.3850	-0.00493	-19775.	-922.7349	1.57E-04	7729.	1.06E+10
65.0473	89447.	0.00				
16.9500	-0.00391	-24752.	-523.9523	1.43E-04	7825.	1.06E+10
52.5877	91286.	0.00				
17.5150	-0.00299	-27289.	-206.5251	1.27E-04	7874.	1.06E+10
41.0487	93125.	0.00				
18.0800	-0.00219	-27914.	36.6083	1.09E-04	7886.	1.06E+10
30.6721	94963.	0.00				
18.6450	-0.00151	-27104.	213.7872	9.12E-05	7870.	1.06E+10
21.5931	96802.	0.00				
19.2100	-9.53E-04	-25276.	333.9701	7.45E-05	7835.	1.06E+10
13.8591	98641.	0.00				
19.7750	-5.03E-04	-22788.	399.8897	5.91E-05	7787.	1.06E+10
5.5862	75360.	0.00				
20.3400	-1.52E-04	-20023.	424.6413	4.54E-05	7733.	1.06E+10
1.7151	76739.	0.00				
20.9050	1.13E-04	-17160.	426.0593	3.35E-05	7678.	1.06E+10
-1.2968	78118.	0.00				
21.4700	3.02E-04	-14341.	409.6539	2.34E-05	7624.	1.06E+10
-3.5425	79497.	0.00				
22.0350	4.29E-04	-11672.	380.2800	1.50E-05	7572.	1.06E+10
-5.1224	80876.	0.00				
22.6000	5.06E-04	-9227.	342.1038	8.34E-06	7525.	1.06E+10
-6.1391	82255.	0.00				
23.1650	5.43E-04	-7057.	298.6043	3.13E-06	7483.	1.06E+10
-6.6926	83634.	0.00				
23.7300	5.48E-04	-5187.	252.6041	-7.93E-07	7447.	1.06E+10
-6.8768	85013.	0.00				
24.2950	5.32E-04	-3629.	206.3202	-3.62E-06	7417.	1.06E+10
-6.7763	86392.	0.00				
24.8600	4.99E-04	-2379.	161.4323	-5.54E-06	7393.	1.06E+10
-6.4650	87771.	0.00				
25.4250	4.57E-04	-1424.	125.9454	-6.76E-06	7375.	1.06E+10
-4.0031	59433.	0.00				
25.9900	4.08E-04	-652.0041	100.0705	-7.42E-06	7360.	1.06E+10
-3.6296	60353.	0.00				
26.5550	3.56E-04	-46.0370	76.8599	-7.65E-06	7348.	1.06E+10
-3.2172	61272.	0.00				
27.1200	3.04E-04	412.0828	56.4991	-7.53E-06	7355.	1.06E+10
-2.7889	62192.	0.00				
27.6850	2.54E-04	741.6221	39.0332	-7.16E-06	7361.	1.06E+10
-2.3633	63111.	0.00				

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28.2500	2.07E-04	961.8471	24.3964	-6.62E-06	7366.	1.06E+10
-1.9544	64030.	0.00				
28.8150	1.64E-04	1091.	12.4392	-5.96E-06	7368.	1.06E+10
-1.5728	64950.	0.00				
29.3800	1.26E-04	1148.	2.9525	-5.24E-06	7369.	1.06E+10
-1.2257	65869.	0.00				
29.9450	9.31E-05	1146.	-4.3122	-4.51E-06	7369.	1.06E+10
-0.9173	66788.	0.00				
30.5100	6.51E-05	1102.	-9.6243	-3.79E-06	7368.	1.06E+10
-0.6497	67708.	0.00				
31.0750	4.18E-05	1027.	-13.2604	-3.10E-06	7367.	1.06E+10
-0.4229	68627.	0.00				
31.6400	2.30E-05	931.0323	-15.4927	-2.48E-06	7365.	1.06E+10
-0.2356	69547.	0.00				
32.2050	8.19E-06	823.6923	-16.5799	-1.92E-06	7363.	1.06E+10
-0.08514	70466.	0.00				
32.7700	-3.00E-06	711.6842	-16.7613	-1.42E-06	7361.	1.06E+10
0.03163	71385.	0.00				
33.3350	-1.11E-05	600.4786	-16.2525	-1.00E-06	7359.	1.06E+10
0.1185	72305.	0.00				
33.9000	-1.66E-05	494.1695	-15.2427	-6.53E-07	7357.	1.06E+10
0.1794	73224.	0.00				
34.4650	-2.00E-05	395.6531	-13.8947	-3.68E-07	7355.	1.06E+10
0.2183	74143.	0.00				
35.0300	-2.16E-05	306.8082	-12.3443	-1.43E-07	7353.	1.06E+10
0.2391	75063.	0.00				
35.5950	-2.19E-05	228.6719	-10.7021	2.88E-08	7351.	1.06E+10
0.2454	75982.	0.00				
36.1600	-2.12E-05	161.6056	-9.0550	1.54E-07	7350.	1.06E+10
0.2405	76901.	0.00				
36.7250	-1.98E-05	105.4465	-7.4689	2.39E-07	7349.	1.06E+10
0.2274	77821.	0.00				
37.2900	-1.80E-05	59.6429	-5.9911	2.92E-07	7348.	1.06E+10
0.2086	78740.	0.00				
37.8550	-1.58E-05	23.3717	-4.6529	3.19E-07	7347.	1.06E+10
0.1862	79660.	0.00				
38.4200	-1.36E-05	-4.3618	-3.4723	3.25E-07	7347.	1.06E+10
0.1621	80579.	0.00				
38.9850	-1.14E-05	-24.6419	-2.4567	3.16E-07	7348.	1.06E+10
0.1375	81498.	0.00				
39.5500	-9.36E-06	-38.5769	-1.6049	2.95E-07	7348.	1.06E+10
0.1137	82418.	0.00				
40.1150	-7.44E-06	-47.2485	-0.9094	2.68E-07	7348.	1.06E+10
0.09142	83337.	0.00				
40.6800	-5.72E-06	-51.6743	-0.3583	2.36E-07	7348.	1.06E+10
0.07114	84256.	0.00				
41.2450	-4.24E-06	-52.7828	0.06318	2.03E-07	7348.	1.06E+10
0.05321	85176.	0.00				
41.8100	-2.98E-06	-51.3972	0.3716	1.69E-07	7348.	1.06E+10
0.03778	86095.	0.00				
42.3750	-1.94E-06	-48.2276	0.5841	1.37E-07	7348.	1.06E+10
0.02488	87015.	0.00				
42.9400	-1.11E-06	-43.8699	0.7173	1.08E-07	7348.	1.06E+10
0.01442	87934.	0.00				
43.5050	-4.75E-07	-38.8092	0.7873	8.15E-08	7348.	1.06E+10
0.00623	88853.	0.00				
44.0700	-7.24E-09	-33.4266	0.8088	5.83E-08	7348.	1.06E+10
9.59E-05	89773.	0.00				
44.6350	3.16E-07	-28.0090	0.7948	3.87E-08	7348.	1.06E+10
-0.00422	90692.	0.00				
45.2000	5.17E-07	-22.7599	0.7568	2.24E-08	7347.	1.06E+10
-0.00698	91611.	0.00				
45.7650	6.19E-07	-17.8109	0.7045	9.40E-09	7347.	1.06E+10

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-0.00845	92531.	0.00				
46.3300	6.44E-07	-13.2341	0.6457	-5.44E-10	7347.	1.06E+10
-0.00888	93450.	0.00				
46.8950	6.12E-07	-9.0535	0.5867	-7.68E-09	7347.	1.06E+10
-0.00852	94369.	0.00				
47.4600	5.40E-07	-5.2561	0.5321	-1.23E-08	7347.	1.06E+10
-0.00759	95289.	0.00				
48.0250	4.46E-07	-1.8028	0.4850	-1.45E-08	7347.	1.06E+10
-0.00632	96208.	0.00				
48.5900	3.43E-07	1.3615	0.3594	-1.47E-08	7347.	1.06E+10
-0.03073	607047.	0.00				
49.1550	2.47E-07	3.1120	0.1796	-1.32E-08	7347.	1.06E+10
-0.02230	612793.	0.00				
49.7200	1.64E-07	3.8347	0.05337	-1.10E-08	7347.	1.06E+10
-0.01494	618539.	0.00				
50.2850	9.74E-08	3.8671	-0.02768	-8.54E-09	7347.	1.06E+10
-0.00897	624285.	0.00				
50.8500	4.79E-08	3.4837	-0.07318	-6.19E-09	7347.	1.06E+10
-0.00445	630032.	0.00				
51.4150	1.35E-08	2.8925	-0.09256	-4.15E-09	7347.	1.06E+10
-0.00127	635778.	0.00				
51.9800	-8.32E-09	2.2404	-0.09419	-2.50E-09	7347.	1.06E+10
7.88E-04	641524.	0.00				
52.5450	-2.04E-08	1.6225	-0.08491	-1.27E-09	7347.	1.06E+10
0.00195	647270.	0.00				
53.1100	-2.55E-08	1.0927	-0.06998	-3.96E-10	7347.	1.06E+10
0.00245	653016.	0.00				
53.6750	-2.58E-08	0.6747	-0.05316	1.70E-10	7347.	1.06E+10
0.00251	658762.	0.00				
54.2400	-2.32E-08	0.3714	-0.03697	5.05E-10	7347.	1.06E+10
0.00227	664508.	0.00				
54.8050	-1.89E-08	0.1720	-0.02292	6.79E-10	7347.	1.06E+10
0.00187	670254.	0.00				
55.3700	-1.40E-08	0.05864	-0.01185	7.53E-10	7347.	1.06E+10
0.00139	676000.	0.00				
55.9350	-8.73E-09	0.00916	-0.00416	7.75E-10	7347.	1.06E+10
8.77E-04	681746.	0.00				
56.5000	-3.45E-09	0.00	0.00	7.78E-10	7347.	1.06E+10
3.50E-04	343746.	0.00				

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.32000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-2686450. inch-lbs
Maximum shear force	=	100898. 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	=	6
Number of zero deflection points	=	6

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 0.320000 inches

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 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 0.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
-1581.	0.00	0.3200	-2686688.0.00	101543.	0.00	51838.	1.06E+10	
-1677.	0.5650	0.3142	-2036765.0.00	90175.	-0.00151	39298.	1.06E+10	
-1731.	1.1300	0.2995	-1463918.0.00	78622.	-0.00263	28246.	1.06E+10	
-1710.	1.6950	0.2785	-970649.0.00	66956.	-0.00341	18728.	1.06E+10	
-1624.	2.2600	0.2532	-555993.0.00	55654.	-0.00390	10728.	1.06E+10	
-1507.	2.8250	0.2255	-215976.0.00	45040.	-0.00415	4167.	1.06E+10	
-1370.	3.3900	0.1969	54746.0.00	35286.	-0.00420	1056.	1.06E+10	
-1218.	3.9550	0.1686	262507.0.00	26514.	-0.00410	5065.	1.06E+10	
-1060.	4.5200	0.1413	414273.0.00	18792.	-0.00388	7993.	1.06E+10	
-900.	5.0850	0.1159	517328.0.00	12147.	-0.00358	9982.	1.06E+10	
-745.	5.6500	0.09273	578991.0.00	6567.	-0.00323	11171.	1.06E+10	
-598.	6.2150	0.07206	606384.0.00	2010.	-0.00285	11700.	1.06E+10	
-463.	6.7800	0.05403	606246.0.00	-1592.	-0.00247	11697.	1.06E+10	
-341.	7.3450	0.03863	584793.0.00	-4323.	-0.00208	11283.	1.06E+10	
-235.	7.9100	0.02577	547620.0.00	-6280.	-0.00172	10566.	1.06E+10	
-143.	8.4750	0.01528	499640.0.00	-7564.	-0.00139	9640.	1.06E+10	
-67.	9.0400	0.00697	445058.0.00	-8279.	-0.00108	8587.	1.06E+10	
-5.	9.6050	5.91E-04	387379.0.00	-8527.	-8.17E-04	7474.	1.06E+10	
41.	10.1700	-0.00411	329430.0.00	-8405.	-5.87E-04	6356.	1.06E+10	
77.	10.7350	-0.00737	273409.0.00	-8001.	-3.94E-04	5275.	1.06E+10	
101.	11.3000	-0.00945	220939.0.00	-7394.	-2.36E-04	4263.	1.06E+10	
116.	11.8650	-0.01057	173142.0.00	-6655.	-1.10E-04	3341.	1.06E+10	
123.	12.4300	-0.01094	130703.0.00	-5841.	-1.24E-05	2522.	1.06E+10	
124.	12.9950	-0.01074	93944.0.00	-5001.	5.95E-05	1813.	1.06E+10	
119.	13.5600	-0.01013	62896.0.00	-4173.	1.10E-04	1214.	1.06E+10	
112.	14.1250	-0.00925	37362.0.00	-3386.	1.42E-04	720.8879	1.06E+10	
	112.0413	82092.	0.00					

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14.6900	-0.00821	16979.	-2662.	1.59E-04	327.5978	1.06E+10
101.6405	83931.	0.00				
15.2550	-0.00709	1268.	-2013.	1.65E-04	24.4565	1.06E+10
89.7412	85770.	0.00				
15.8200	-0.00597	-10318.	-1447.	1.62E-04	199.0899	1.06E+10
77.1651	87608.	0.00				
16.3850	-0.00489	-18357.	-966.7730	1.53E-04	354.1956	1.06E+10
64.5716	89447.	0.00				
16.9500	-0.00390	-23428.	-570.0119	1.40E-04	452.0302	1.06E+10
52.4671	91286.	0.00				
17.5150	-0.00300	-26087.	-252.4164	1.24E-04	503.3299	1.06E+10
41.2189	93125.	0.00				
18.0800	-0.00222	-26851.	-7.3515	1.07E-04	518.0709	1.06E+10
31.0716	94963.	0.00				
18.6450	-0.00155	-26186.	173.1194	8.98E-05	505.2533	1.06E+10
22.1647	96802.	0.00				
19.2100	-0.00100	-24503.	297.5857	7.36E-05	472.7770	1.06E+10
14.5510	98641.	0.00				
19.7750	-5.54E-04	-22151.	367.8000	5.87E-05	427.3948	1.06E+10
6.1612	75360.	0.00				
20.3400	-2.05E-04	-19516.	396.5392	4.53E-05	376.5481	1.06E+10
2.3165	76739.	0.00				
20.9050	6.02E-05	-16774.	402.0397	3.37E-05	323.6468	1.06E+10
-0.6939	78118.	0.00				
21.4700	2.52E-04	-14064.	389.6598	2.38E-05	271.3610	1.06E+10
-2.9580	79497.	0.00				
22.0350	3.83E-04	-11490.	364.1348	1.56E-05	221.6987	1.06E+10
-4.5715	80876.	0.00				
22.6000	4.64E-04	-9126.	329.5413	9.03E-06	176.0911	1.06E+10
-5.6330	82255.	0.00				
23.1650	5.06E-04	-7022.	289.2965	3.86E-06	135.4796	1.06E+10
-6.2386	83634.	0.00				
23.7300	5.17E-04	-5204.	246.1850	-5.28E-08	100.4014	1.06E+10
-6.4786	85013.	0.00				
24.2950	5.05E-04	-3683.	202.4071	-2.90E-06	71.0693	1.06E+10
-6.4352	86392.	0.00				
24.8600	4.77E-04	-2459.	159.6417	-4.87E-06	47.4448	1.06E+10
-6.1799	87771.	0.00				
25.4250	4.39E-04	-1519.	125.6447	-6.14E-06	29.3016	1.06E+10
-3.8487	59433.	0.00				
25.9900	3.94E-04	-755.2381	100.7046	-6.87E-06	14.5720	1.06E+10
-3.5083	60353.	0.00				
26.5550	3.46E-04	-153.0961	78.2141	-7.16E-06	2.9539	1.06E+10
-3.1261	61272.	0.00				
27.1200	2.97E-04	305.3453	58.3800	-7.11E-06	5.8915	1.06E+10
-2.7247	62192.	0.00				
27.6850	2.49E-04	638.5370	41.2704	-6.81E-06	12.3203	1.06E+10
-2.3224	63111.	0.00				
28.2500	2.05E-04	864.9722	26.8433	-6.33E-06	16.6892	1.06E+10
-1.9334	64030.	0.00				
28.8150	1.64E-04	1003.	14.9728	-5.73E-06	19.3434	1.06E+10
-1.5682	64950.	0.00				
29.3800	1.27E-04	1068.	5.4725	-5.07E-06	20.6066	1.06E+10
-1.2342	65869.	0.00				
29.9450	9.50E-05	1077.	-1.8847	-4.38E-06	20.7752	1.06E+10
-0.9360	66788.	0.00				
30.5100	6.77E-05	1042.	-7.3486	-3.70E-06	20.1135	1.06E+10
-0.6758	67708.	0.00				
31.0750	4.48E-05	977.0920	-11.1784	-3.05E-06	18.8525	1.06E+10
-0.4540	68627.	0.00				
31.6400	2.63E-05	890.8687	-13.6308	-2.45E-06	17.1889	1.06E+10
-0.2695	69547.	0.00				
32.2050	1.16E-05	792.2583	-14.9516	-1.92E-06	15.2862	1.06E+10

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-0.1202	70466.	0.00				
32.7700	2.93E-07	688.1245	-15.3694	-1.44E-06	13.2770	1.06E+10
-0.00308	71385.	0.00				
33.3350	-7.99E-06	583.8490	-15.0911	-1.03E-06	11.2651	1.06E+10
0.08518	72305.	0.00				
33.9000	-1.37E-05	483.4892	-14.2996	-6.92E-07	9.3287	1.06E+10
0.1483	73224.	0.00				
34.4650	-1.74E-05	389.9467	-13.1526	-4.13E-07	7.5238	1.06E+10
0.1900	74143.	0.00				
35.0300	-1.93E-05	305.1396	-11.7830	-1.90E-07	5.8875	1.06E+10
0.2140	75063.	0.00				
35.5950	-2.00E-05	230.1693	-10.2995	-1.87E-08	4.4410	1.06E+10
0.2236	75982.	0.00				
36.1600	-1.96E-05	165.4788	-8.7884	1.08E-07	3.1928	1.06E+10
0.2221	76901.	0.00				
36.7250	-1.85E-05	110.9980	-7.3161	1.97E-07	2.1417	1.06E+10
0.2122	77821.	0.00				
37.2900	-1.69E-05	66.2728	-5.9307	2.53E-07	1.2787	1.06E+10
0.1965	78740.	0.00				
37.8550	-1.51E-05	30.5782	-4.6651	2.84E-07	0.5900	1.06E+10
0.1769	79660.	0.00				
38.4200	-1.31E-05	3.0141	-3.5393	2.95E-07	0.05816	1.06E+10
0.1552	80579.	0.00				
38.9850	-1.11E-05	-17.4153	-2.5628	2.91E-07	0.3360	1.06E+10
0.1328	81498.	0.00				
39.5500	-9.12E-06	-31.7379	-1.7367	2.75E-07	0.6124	1.06E+10
0.1109	82418.	0.00				
40.1150	-7.33E-06	-40.9645	-1.0556	2.52E-07	0.7904	1.06E+10
0.09004	83337.	0.00				
40.6800	-5.71E-06	-46.0520	-0.5098	2.24E-07	0.8886	1.06E+10
0.07095	84256.	0.00				
41.2450	-4.29E-06	-47.8780	-0.08649	1.94E-07	0.9238	1.06E+10
0.05393	85176.	0.00				
41.8100	-3.08E-06	-47.2247	0.2291	1.63E-07	0.9112	1.06E+10
0.03917	86095.	0.00				
42.3750	-2.08E-06	-44.7709	0.4525	1.34E-07	0.8638	1.06E+10
0.02671	87015.	0.00				
42.9400	-1.27E-06	-41.0892	0.5990	1.06E-07	0.7928	1.06E+10
0.01650	87934.	0.00				
43.5050	-6.42E-07	-36.6487	0.6835	8.12E-08	0.7071	1.06E+10
0.00842	88853.	0.00				
44.0700	-1.71E-07	-31.8214	0.7197	5.93E-08	0.6140	1.06E+10
0.00226	89773.	0.00				
44.6350	1.62E-07	-26.8901	0.7200	4.05E-08	0.5188	1.06E+10
-0.00217	90692.	0.00				
45.2000	3.78E-07	-22.0584	0.6953	2.48E-08	0.4256	1.06E+10
-0.00511	91611.	0.00				
45.7650	4.99E-07	-17.4618	0.6549	1.22E-08	0.3369	1.06E+10
-0.00681	92531.	0.00				
46.3300	5.44E-07	-13.1781	0.6064	2.36E-09	0.2543	1.06E+10
-0.00749	93450.	0.00				
46.8950	5.31E-07	-9.2388	0.5560	-4.82E-09	0.1783	1.06E+10
-0.00739	94369.	0.00				
47.4600	4.78E-07	-5.6392	0.5081	-9.58E-09	0.1088	1.06E+10
-0.00672	95289.	0.00				
48.0250	4.01E-07	-2.3485	0.4661	-1.21E-08	0.04531	1.06E+10
-0.00569	96208.	0.00				
48.5900	3.14E-07	0.6806	0.3516	-1.27E-08	0.01313	1.06E+10
-0.02808	607047.	0.00				
49.1550	2.29E-07	2.4190	0.1862	-1.17E-08	0.04667	1.06E+10
-0.02071	612793.	0.00				
49.7200	1.55E-07	3.2053	0.06797	-9.88E-09	0.06184	1.06E+10
-0.01416	618539.	0.00				

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50.2850	9.52E-08	3.3406	-0.00975	-7.78E-09	0.06446	1.06E+10
-0.00877	624285.	0.00				
50.8500	4.97E-08	3.0730	-0.05512	-5.73E-09	0.05929	1.06E+10
-0.00462	630032.	0.00				
51.4150	1.75E-08	2.5931	-0.07635	-3.91E-09	0.05003	1.06E+10
-0.00164	635778.	0.00				
51.9800	-3.38E-09	2.0377	-0.08083	-2.43E-09	0.03932	1.06E+10
3.20E-04	641524.	0.00				
52.5450	-1.54E-08	1.4970	-0.07475	-1.30E-09	0.02888	1.06E+10
0.00147	647270.	0.00				
53.1100	-2.10E-08	1.0241	-0.06290	-4.91E-10	0.01976	1.06E+10
0.00202	653016.	0.00				
53.6750	-2.21E-08	0.6440	-0.04877	4.30E-11	0.01243	1.06E+10
0.00215	658762.	0.00				
54.2400	-2.04E-08	0.3627	-0.03471	3.65E-10	0.00700	1.06E+10
0.00200	664508.	0.00				
54.8050	-1.71E-08	0.1733	-0.02219	5.37E-10	0.00334	1.06E+10
0.00169	670254.	0.00				
55.3700	-1.31E-08	0.06184	-0.01201	6.12E-10	0.00119	1.06E+10
0.00131	676000.	0.00				
55.9350	-8.84E-09	0.01050	-0.00456	6.36E-10	2.03E-04	1.06E+10
8.89E-04	681746.	0.00				
56.5000	-4.50E-09	0.00	0.00	6.39E-10	0.00	1.06E+10
4.57E-04	343746.	0.00				

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

Output Summary for Load Case No. 3:

Pile-head deflection	=	0.32000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-2686688. inch-lbs
Maximum shear force	=	101543. 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	=	6
Number of zero deflection points	=	5

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	Load Type	Load 1	Load 2	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max in lbs
No.		in-lbs		lbs	inches	radians	
1	y, in	0.3200	S, rad	0.00	323660.	0.3200	0.00
100552.		-2686323.					

```

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  2 y, in      0.3200  S, rad      0.00      210860.      0.3200      0.00
100898. -2686450.
  3 y, in      0.3200  S, rad      0.00      0.00      0.3200      0.00
101543. -2686688.

```

```

Maximum pile-head deflection = 0.3200000000 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

```

The analysis ended normally.

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LPILE for Windows, Version 2018-10.003

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:

\\haleyaldrich.com\share\por_common\PROJECTS\42223 - gardiner bridges\005 - Maine
Ave\Calculations\Lateral Pile Evaluations\LPILE Files\

Name of input data file:

2018-0405-HAI-HP 14x117-North-High Fill-116 Corrosion-0.51 deflection.lp10

Name of output report file:

2018-0405-HAI-HP 14x117-North-High Fill-116 Corrosion-0.51 deflection.lp10

Name of plot output file:

2018-0405-HAI-HP 14x117-North-High Fill-116 Corrosion-0.51 deflection.lp10

Name of runtime message file:

2018-0405-HAI-HP 14x117-North-High Fill-116 Corrosion-0.51 deflection.lp10

Date and Time of Analysis

Date: April 5, 2018

Time: 10:00:55

Problem Title

Bridge over Cobbosseecontee Stream, Gardiner, Maine

Maine Department of Transportation

Haley & Aldrich, Inc.

Description:

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 | = | 100 |

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- 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	=	56.500 ft

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Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.0850
2	56.500	14.0850

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	= 56.500000 ft
Flange Width	= 14.760000 in
Section Depth	= 14.085000 in
Flange Thickness	= 0.680000 in
Web Thickness	= 0.680000 in
Section Area	= 28.700000 sq. in
Moment of Inertia	= 365.000000 in^4
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 sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	= 0.0000 ft
Distance from top of pile to bottom of layer	= 19.500000 ft
Effective unit weight at top of layer	= 52.600000 pcf
Effective unit weight at bottom of layer	= 52.600000 pcf
Friction angle at top of layer	= 30.000000 deg.
Friction angle at bottom of layer	= 30.000000 deg.
Subgrade k at top of layer	= 40.000000 pci
Subgrade k at bottom of layer	= 40.000000 pci

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 Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	19.500000	ft
Distance from top of pile to bottom of layer	=	25.000000	ft
Effective unit weight at top of layer	=	57.600000	pcf
Effective unit weight at bottom of layer	=	57.600000	pcf
Friction angle at top of layer	=	32.000000	deg.
Friction angle at bottom of layer	=	32.000000	deg.
Subgrade k at top of layer	=	30.000000	pci
Subgrade k at bottom of layer	=	30.000000	pci

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

Distance from top of pile to top of layer	=	25.000000	ft
Distance from top of pile to bottom of layer	=	48.500000	ft
Effective unit weight at top of layer	=	52.600000	pcf
Effective unit weight at bottom of layer	=	52.600000	pcf
Friction angle at top of layer	=	29.000000	deg.
Friction angle at bottom of layer	=	29.000000	deg.
Subgrade k at top of layer	=	20.000000	pci
Subgrade k at bottom of layer	=	20.000000	pci

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

Distance from top of pile to top of layer	=	48.500000	ft
Distance from top of pile to bottom of layer	=	56.500000	ft
Effective unit weight at top of layer	=	67.600000	pcf
Effective unit weight at bottom of layer	=	67.600000	pcf
Friction angle at top of layer	=	36.000000	deg.
Friction angle at bottom of layer	=	36.000000	deg.
Subgrade k at top of layer	=	125.000000	pci
Subgrade k at bottom of layer	=	125.000000	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	Angle of Friction deg.	kpy pci
1	Sand	0.00	52.6000	30.0000	40.0000
	(Reese, et al.)	19.5000	52.6000	30.0000	40.0000
2	Sand	19.5000	57.6000	32.0000	30.0000
	(Reese, et al.)	25.0000	57.6000	32.0000	30.0000
3	Sand	25.0000	52.6000	29.0000	20.0000
	(Reese, et al.)	48.5000	52.6000	29.0000	20.0000
4	Sand	48.5000	67.6000	36.0000	125.0000
	(Reese, et al.)	56.5000	67.6000	36.0000	125.0000

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 = 3

Load Compute No.	Load Top y Type vs. Pile Length	Condition 1	Condition 2	Axial Thrust Force, lbs
1	5	y = 0.510000 in	S = 0.0000 in/in	323660.
N.A.				
2	5	y = 0.510000 in	S = 0.0000 in/in	210860.
N.A.				
3	5	y = 0.510000 in	S = 0.0000 in/in	0.0000000
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	238155.
2	19.5000	18.1391	Yes	No	238155.	246974.
3	25.0000	27.5063	Yes	No	485128.	1213794.
4	48.5000	32.5361	Yes	No	1698922.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
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 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 = 0.510000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 323660.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00	0.00	0.5100	-1464498.	23124.	0.00	39534.	1.06E+10	
0.5650	0.5068	-1307385.	22935.	-8.88E-04	36503.	1.06E+10		
-25.4996	341.1215	0.00	22664.	-0.00167	33458.	1.06E+10		
1.1300	0.4980	-1149608.	22202.	-0.00236	30431.	1.06E+10		
-54.4573	741.4631	0.00	22202.	-0.00236	30431.	1.06E+10		
1.6950	0.4841	-992717.	21568.	-0.00295	27450.	1.06E+10		
-81.6062	1143.	0.00	21568.	-0.00295	27450.	1.06E+10		
2.2600	0.4660	-838183.	20793.	-0.00344	24539.	1.06E+10		
-105.4438	1534.	0.00	20793.	-0.00344	24539.	1.06E+10		
2.8250	0.4441	-687317.	19907.	-0.00383	21719.	1.06E+10		
-123.3190	1882.	0.00	19907.	-0.00383	21719.	1.06E+10		
3.3900	0.4194	-541154.	18914.	-0.00413	19006.	1.06E+10		
-138.0344	2232.	0.00	18914.	-0.00413	19006.	1.06E+10		
3.9550	0.3922	-400576.	17822.	-0.00434	16420.	1.06E+10		
-154.8081	2676.	0.00	17822.	-0.00434	16420.	1.06E+10		
4.5200	0.3634	-266551.	16628.	-0.00447	13976.	1.06E+10		
-167.3737	3123.	0.00	16628.	-0.00447	13976.	1.06E+10		
5.0850	0.3333	-139845.	15307.	-0.00453	11691.	1.06E+10		
-184.8779	3761.	0.00	15307.	-0.00453	11691.	1.06E+10		
5.6500	0.3027	-21442.	13854.	-0.00450	12967.	1.06E+10		
-204.6377	4584.	0.00	13854.	-0.00450	12967.	1.06E+10		
6.2150	0.2719	87585.	12269.	-0.00442	14870.	1.06E+10		
-224.1682	5589.	0.00	12269.	-0.00442	14870.	1.06E+10		
6.7800	0.2416	186185.	10563.	-0.00427	16551.	1.06E+10		
-243.3456	6829.	0.00	10563.	-0.00427	16551.	1.06E+10		
7.3450	0.2120	273336.	8758.	-0.00407	17995.	1.06E+10		
-259.8449	8308.	0.00	8758.	-0.00407	17995.	1.06E+10		
7.9100	0.1837	348158.	6881.	-0.00383	19187.	1.06E+10		
-272.5734	10061.	0.00	6881.	-0.00383	19187.	1.06E+10		
8.4750	0.1568	409962.	4964.	-0.00355	20119.	1.06E+10		
-280.9933	12147.	0.00	4964.	-0.00355	20119.	1.06E+10		
9.0400	0.1318	458272.	3038.	-0.00325	20787.	1.06E+10		
-284.6794	14647.	0.00	3038.	-0.00325	20787.	1.06E+10		
9.6050	0.1087	492852.	1140.	-0.00292	21189.	1.06E+10		
-283.3001	17671.	0.00	1140.	-0.00292	21189.	1.06E+10		
10.1700	0.08776	513716.						

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-276.6158	21370.	0.00				
10.7350	0.06906	521143.	-694.0536	-0.00259	21333.	1.06E+10
-264.4666	25965.	0.00				
11.3000	0.05262	515680.	-2427.	-0.00226	21227.	1.06E+10
-246.7433	31794.	0.00				
11.8650	0.03842	498150.	-4005.	-0.00194	20889.	1.06E+10
-218.7873	38613.	0.00				
12.4300	0.02638	469862.	-5280.	-0.00163	20343.	1.06E+10
-157.3813	40452.	0.00				
12.9950	0.01638	433680.	-6160.	-0.00134	19645.	1.06E+10
-102.1737	42291.	0.00				
13.5600	0.00827	392191.	-6689.	-0.00107	18844.	1.06E+10
-53.8019	44130.	0.00				
14.1250	0.00185	347677.	-6914.	-8.34E-04	17986.	1.06E+10
-12.5766	45968.	0.00				
14.6900	-0.00305	302097.	-6884.	-6.26E-04	17106.	1.06E+10
21.4795	47807.	0.00				
15.2550	-0.00664	257079.	-6646.	-4.47E-04	16238.	1.06E+10
48.5874	49646.	0.00				
15.8200	-0.00911	213934.	-6247.	-2.96E-04	15405.	1.06E+10
69.1643	51485.	0.00				
16.3850	-0.01065	173667.	-5729.	-1.72E-04	14628.	1.06E+10
83.7755	53323.	0.00				
16.9500	-0.01144	137008.	-5129.	-7.26E-05	13921.	1.06E+10
93.0878	55162.	0.00				
17.5150	-0.01164	104434.	-4482.	4.76E-06	13292.	1.06E+10
97.8262	57001.	0.00				
18.0800	-0.01138	76211.	-3816.	6.26E-05	12748.	1.06E+10
98.7340	58840.	0.00				
18.6450	-0.01079	52420.	-3154.	1.04E-04	12289.	1.06E+10
96.5394	60678.	0.00				
19.2100	-0.00997	32992.	-2515.	1.31E-04	11914.	1.06E+10
91.9256	62517.	0.00				
19.7750	-0.00901	17744.	-1986.	1.47E-04	11620.	1.06E+10
64.1313	48267.	0.00				
20.3400	-0.00797	5419.	-1570.	1.55E-04	11382.	1.06E+10
58.3632	49646.	0.00				
20.9050	-0.00691	-4231.	-1196.	1.55E-04	11359.	1.06E+10
51.9958	51025.	0.00				
21.4700	-0.00587	-11485.	-866.3875	1.50E-04	11499.	1.06E+10
45.3386	52404.	0.00				
22.0350	-0.00487	-16638.	-581.6572	1.41E-04	11598.	1.06E+10
38.6527	53783.	0.00				
22.6000	-0.00395	-19992.	-341.6342	1.29E-04	11663.	1.06E+10
32.1506	55162.	0.00				
23.1650	-0.00312	-21839.	-144.5109	1.16E-04	11699.	1.06E+10
25.9979	56541.	0.00				
23.7300	-0.00238	-22461.	12.4933	1.02E-04	11711.	1.06E+10
20.3161	57920.	0.00				
24.2950	-0.00174	-22117.	132.8473	8.76E-05	11704.	1.06E+10
15.1866	59299.	0.00				
24.8600	-0.00119	-21044.	220.4524	7.38E-05	11683.	1.06E+10
10.6556	60678.	0.00				
25.4250	-7.36E-04	-19451.	271.8054	6.08E-05	11653.	1.06E+10
4.4928	41372.	0.00				
25.9900	-3.66E-04	-17625.	294.7835	4.89E-05	11617.	1.06E+10
2.2854	42291.	0.00				
26.5550	-7.31E-05	-15668.	304.1097	3.82E-05	11580.	1.06E+10
0.4656	43210.	0.00				
27.1200	1.52E-04	-13669.	302.3291	2.89E-05	11541.	1.06E+10
-0.9909	44130.	0.00				
27.6850	3.18E-04	-11695.	291.8036	2.07E-05	11503.	1.06E+10
-2.1140	45049.	0.00				

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28.2500	4.33E-04	-9803.	274.6778	1.38E-05	11466.	1.06E+10
-2.9378	45968.	0.00				
28.8150	5.06E-04	-8032.	252.8588	8.13E-06	11432.	1.06E+10
-3.4985	46888.	0.00				
29.3800	5.44E-04	-6410.	228.0058	3.51E-06	11401.	1.06E+10
-3.8328	47807.	0.00				
29.9450	5.53E-04	-4955.	201.5293	-1.34E-07	11373.	1.06E+10
-3.9773	48727.	0.00				
30.5100	5.42E-04	-3676.	174.5980	-2.90E-06	11348.	1.06E+10
-3.9670	49646.	0.00				
31.0750	5.14E-04	-2575.	148.1515	-4.90E-06	11327.	1.06E+10
-3.8344	50565.	0.00				
31.6400	4.75E-04	-1646.	122.9173	-6.25E-06	11309.	1.06E+10
-3.6093	51485.	0.00				
32.2050	4.29E-04	-880.7457	99.4317	-7.06E-06	11294.	1.06E+10
-3.3185	52404.	0.00				
32.7700	3.80E-04	-266.7588	78.0620	-7.43E-06	11282.	1.06E+10
-2.9852	53323.	0.00				
33.3350	3.29E-04	210.3779	59.0295	-7.45E-06	11281.	1.06E+10
-2.6291	54243.	0.00				
33.9000	2.79E-04	566.3638	42.4332	-7.20E-06	11288.	1.06E+10
-2.2666	55162.	0.00				
34.4650	2.31E-04	817.3620	28.2715	-6.75E-06	11293.	1.06E+10
-1.9109	56081.	0.00				
35.0300	1.87E-04	979.3715	16.4643	-6.18E-06	11296.	1.06E+10
-1.5721	57001.	0.00				
35.5950	1.47E-04	1068.	6.8713	-5.52E-06	11298.	1.06E+10
-1.2577	57920.	0.00				
36.1600	1.12E-04	1097.	-0.6901	-4.83E-06	11299.	1.06E+10
-0.9728	58840.	0.00				
36.7250	8.17E-05	1080.	-6.4296	-4.13E-06	11298.	1.06E+10
-0.7203	59759.	0.00				
37.2900	5.60E-05	1028.	-10.5717	-3.46E-06	11297.	1.06E+10
-0.5016	60678.	0.00				
37.8550	3.48E-05	951.4081	-13.3445	-2.82E-06	11296.	1.06E+10
-0.3164	61598.	0.00				
38.4200	1.77E-05	859.1907	-14.9715	-2.24E-06	11294.	1.06E+10
-0.1636	62517.	0.00				
38.9850	4.38E-06	758.2471	-15.6650	-1.73E-06	11292.	1.06E+10
-0.04102	63436.	0.00				
39.5500	-5.68E-06	654.3522	-15.6213	-1.27E-06	11290.	1.06E+10
0.05390	64356.	0.00				
40.1150	-1.29E-05	552.0151	-15.0177	-8.88E-07	11288.	1.06E+10
0.1242	65275.	0.00				
40.6800	-1.77E-05	454.6101	-14.0102	-5.66E-07	11286.	1.06E+10
0.1730	66194.	0.00				
41.2450	-2.06E-05	364.5192	-12.7335	-3.03E-07	11284.	1.06E+10
0.2036	67114.	0.00				
41.8100	-2.18E-05	283.2754	-11.3005	-9.59E-08	11283.	1.06E+10
0.2191	68033.	0.00				
42.3750	-2.19E-05	211.7048	-9.8038	6.26E-08	11281.	1.06E+10
0.2224	68953.	0.00				
42.9400	-2.10E-05	150.0605	-8.3167	1.78E-07	11280.	1.06E+10
0.2163	69872.	0.00				
43.5050	-1.94E-05	98.1466	-6.8952	2.58E-07	11279.	1.06E+10
0.2031	70791.	0.00				
44.0700	-1.75E-05	55.4297	-5.5798	3.07E-07	11278.	1.06E+10
0.1850	71711.	0.00				
44.6350	-1.53E-05	21.1371	-4.3977	3.32E-07	11278.	1.06E+10
0.1637	72630.	0.00				
45.2000	-1.30E-05	-5.6589	-3.3650	3.37E-07	11277.	1.06E+10
0.1409	73549.	0.00				
45.7650	-1.07E-05	-25.9695	-2.4882	3.27E-07	11278.	1.06E+10

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0.1177	74469.	0.00				
46.3300	-8.56E-06	-40.8315	-1.7663	3.05E-07	11278.	1.06E+10
0.09520	75388.	0.00				
46.8950	-6.58E-06	-51.2597	-1.1924	2.76E-07	11278.	1.06E+10
0.07408	76308.	0.00				
47.4600	-4.82E-06	-58.2105	-0.7550	2.41E-07	11278.	1.06E+10
0.05495	77227.	0.00				
48.0250	-3.32E-06	-62.5534	-0.4390	2.02E-07	11279.	1.06E+10
0.03827	78146.	0.00				
48.5900	-2.09E-06	-65.0493	0.2064	1.61E-07	11279.	1.06E+10
0.1521	494160.	0.00				
49.1550	-1.14E-06	-60.4610	1.0062	1.21E-07	11279.	1.06E+10
0.08381	499906.	0.00				
49.7200	-4.49E-07	-51.9351	1.4038	8.48E-08	11278.	1.06E+10
0.03347	505652.	0.00				
50.2850	1.35E-08	-41.7976	1.5138	5.48E-08	11278.	1.06E+10
-0.00102	511398.	0.00				
50.8500	2.94E-07	-31.6482	1.4343	3.13E-08	11278.	1.06E+10
-0.02245	517144.	0.00				
51.4150	4.38E-07	-22.4863	1.2437	1.39E-08	11278.	1.06E+10
-0.03376	522891.	0.00				
51.9800	4.83E-07	-14.8446	1.0015	1.99E-09	11278.	1.06E+10
-0.03769	528637.	0.00				
52.5450	4.65E-07	-8.9147	0.7496	-5.62E-09	11278.	1.06E+10
-0.03662	534383.	0.00				
53.1100	4.07E-07	-4.6558	0.5154	-9.97E-09	11277.	1.06E+10
-0.03244	540129.	0.00				
53.6750	3.30E-07	-1.8815	0.3155	-1.21E-08	11277.	1.06E+10
-0.02653	545875.	0.00				
54.2400	2.44E-07	-0.3242	0.1584	-1.28E-08	11277.	1.06E+10
-0.01982	551621.	0.00				
54.8050	1.56E-07	0.3222	0.04759	-1.28E-08	11277.	1.06E+10
-0.01286	557367.	0.00				
55.3700	7.05E-08	0.3772	-0.01585	-1.25E-08	11277.	1.06E+10
-0.00586	563113.	0.00				
55.9350	-1.37E-08	0.1623	-0.03182	-1.24E-08	11277.	1.06E+10
0.00115	568859.	0.00				
56.5000	-9.72E-08	0.00	0.00	-1.23E-08	11277.	1.06E+10
0.00824	287302.	0.00				

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

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1464498. inch-lbs
Maximum shear force	=	23124. 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	=	7
Number of zero deflection points	=	5

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 0.510000 inches

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 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 210860.0 lbs

Depth Res.	Soil X Es*h feet lb/inch	Deflect. Spr. y Lat. Load inches lb/inch	Bending Distrib. Moment in-lbs lb/inch	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil p
0.00	0.00	0.5100	-1466614.	23504.	0.00	35645.	1.06E+10	
0.00	0.00	0.00	0.00					
0.5650	341.1232	0.5068	-1307244.	23320.	-8.88E-04	32570.	1.06E+10	
-25.4995	1.1300	0.4980	-1147849.	23049.	-0.00167	29494.	1.06E+10	
-54.4569	1.6950	0.4841	-989907.	22588.	-0.00236	26447.	1.06E+10	
-81.6058	2.2600	0.4660	-834809.	21954.	-0.00294	23454.	1.06E+10	
-105.4450	2.8250	0.4442	-683794.	21178.	-0.00343	20541.	1.06E+10	
-123.3247	3.3900	0.4195	-537821.	20292.	-0.00382	17724.	1.06E+10	
-138.0494	3.9550	0.3924	-397703.	19300.	-0.00412	15021.	1.06E+10	
-154.8414	4.5200	0.3636	-264337.	18207.	-0.00433	12447.	1.06E+10	
-167.4380	5.0850	0.3336	-138427.	17012.	-0.00446	10018.	1.06E+10	
-184.9882	5.6500	0.3031	-20893.	15691.	-0.00451	7750.	1.06E+10	
-204.8117	6.2150	0.2724	87244.	14236.	-0.00449	9030.	1.06E+10	
-224.4235	6.7800	0.2422	184986.	12649.	-0.00440	10916.	1.06E+10	
-243.6996	7.3450	0.2127	271356.	10940.	-0.00426	12583.	1.06E+10	
-260.3332	7.9100	0.1844	345510.	9131.	-0.00406	14013.	1.06E+10	
-273.2328	8.4750	0.1576	406787.	7250.	-0.00382	15196.	1.06E+10	
-281.8591	9.0400	0.1326	454736.	5325.	-0.00354	16121.	1.06E+10	
-285.7891	9.6050	0.1096	489131.	3391.	-0.00324	16785.	1.06E+10	
-284.6938	10.1700	0.08866	509991.	1483.	-0.00292	17187.	1.06E+10	
-278.3365	10.7350	0.06996	517589.	-364.5781	-0.00259	17334.	1.06E+10	
-266.5623	11.3000	0.05351	512460.	-2113.	-0.00226	17235.	1.06E+10	
-249.2713	11.8650	0.03928	495403.	-3717.	-0.00194	16906.	1.06E+10	
-223.7017	12.4300	0.02720	467609.	-5025.	-0.00163	16369.	1.06E+10	
-162.2988	12.9950	0.01716	431926.	-5938.	-0.00134	15681.	1.06E+10	
-107.0122	13.5600	0.00899	390929.	-6499.	-0.00108	14890.	1.06E+10	
-58.4857	14.1250	0.00251	346885.	-6755.	-8.44E-04	14040.	1.06E+10	
-17.0380	45968.	0.00	0.00					

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14.6900	-0.00245	301740.	-6754.	-6.36E-04	13169.	1.06E+10
17.2981	47807.	0.00				
15.2550	-0.00611	257114.	-6544.	-4.57E-04	12308.	1.06E+10
44.7327	49646.	0.00				
15.8200	-0.00865	214309.	-6170.	-3.06E-04	11482.	1.06E+10
65.6712	51485.	0.00				
16.3850	-0.01026	174327.	-5674.	-1.81E-04	10711.	1.06E+10
80.6673	53323.	0.00				
16.9500	-0.01111	137893.	-5094.	-8.14E-05	10008.	1.06E+10
90.3763	55162.	0.00				
17.5150	-0.01136	105487.	-4464.	-3.47E-06	9382.	1.06E+10
95.5125	57001.	0.00				
18.0800	-0.01116	77376.	-3812.	5.51E-05	8840.	1.06E+10
96.8101	58840.	0.00				
18.6450	-0.01061	53643.	-3162.	9.71E-05	8382.	1.06E+10
94.9890	60678.	0.00				
19.2100	-0.00984	34228.	-2532.	1.25E-04	8007.	1.06E+10
90.7260	62517.	0.00				
19.7750	-0.00892	18952.	-2009.	1.42E-04	7713.	1.06E+10
63.4740	48267.	0.00				
20.3400	-0.00791	6577.	-1598.	1.50E-04	7474.	1.06E+10
57.9253	49646.	0.00				
20.9050	-0.00688	-3142.	-1226.	1.52E-04	7408.	1.06E+10
51.7527	51025.	0.00				
21.4700	-0.00586	-10479.	-896.9513	1.47E-04	7549.	1.06E+10
45.2648	52404.	0.00				
22.0350	-0.00488	-15725.	-612.2328	1.39E-04	7650.	1.06E+10
38.7229	53783.	0.00				
22.6000	-0.00397	-19177.	-371.3294	1.28E-04	7717.	1.06E+10
32.3400	55162.	0.00				
23.1650	-0.00315	-21125.	-172.5975	1.15E-04	7755.	1.06E+10
26.2829	56541.	0.00				
23.7300	-0.00242	-21846.	-13.4114	1.01E-04	7769.	1.06E+10
20.6746	57920.	0.00				
24.2950	-0.00178	-21596.	109.5546	8.70E-05	7764.	1.06E+10
15.5985	59299.	0.00				
24.8600	-0.00124	-20609.	200.0718	7.35E-05	7745.	1.06E+10
11.1027	60678.	0.00				
25.4250	-7.87E-04	-19093.	253.9941	6.08E-05	7715.	1.06E+10
4.8035	41372.	0.00				
25.9900	-4.17E-04	-17338.	279.0904	4.91E-05	7682.	1.06E+10
2.5995	42291.	0.00				
26.5550	-1.22E-04	-15449.	290.5295	3.86E-05	7645.	1.06E+10
0.7749	43210.	0.00				
27.1200	1.06E-04	-13509.	290.8066	2.93E-05	7608.	1.06E+10
-0.6931	44130.	0.00				
27.6850	2.76E-04	-11589.	282.2424	2.13E-05	7571.	1.06E+10
-1.8332	45049.	0.00				
28.2500	3.95E-04	-9743.	266.9496	1.44E-05	7535.	1.06E+10
-2.6780	45968.	0.00				
28.8150	4.72E-04	-8011.	246.8118	8.76E-06	7502.	1.06E+10
-3.2624	46888.	0.00				
29.3800	5.14E-04	-6421.	223.4724	4.14E-06	7471.	1.06E+10
-3.6224	47807.	0.00				
29.9450	5.28E-04	-4992.	198.3331	4.80E-07	7443.	1.06E+10
-3.7933	48727.	0.00				
30.5100	5.20E-04	-3733.	172.5600	-2.31E-06	7419.	1.06E+10
-3.8094	49646.	0.00				
31.0750	4.96E-04	-2646.	147.0950	-4.36E-06	7398.	1.06E+10
-3.7024	50565.	0.00				
31.6400	4.61E-04	-1726.	122.6726	-5.76E-06	7380.	1.06E+10
-3.5018	51485.	0.00				
32.2050	4.18E-04	-965.6613	99.8393	-6.62E-06	7366.	1.06E+10

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-3.2337	52404.	0.00				
32.7700	3.71E-04	-353.1691	78.9751	-7.04E-06	7354.	1.06E+10
-2.9210	53323.	0.00				
33.3350	3.23E-04	125.3747	60.3159	-7.11E-06	7349.	1.06E+10
-2.5832	54243.	0.00				
33.9000	2.75E-04	485.0565	43.9760	-6.92E-06	7356.	1.06E+10
-2.2368	55162.	0.00				
34.4650	2.29E-04	741.4729	29.9702	-6.53E-06	7361.	1.06E+10
-1.8947	56081.	0.00				
35.0300	1.86E-04	910.1119	18.2337	-6.00E-06	7365.	1.06E+10
-1.5673	57001.	0.00				
35.5950	1.48E-04	1006.	8.6417	-5.38E-06	7366.	1.06E+10
-1.2621	57920.	0.00				
36.1600	1.13E-04	1043.	1.0260	-4.73E-06	7367.	1.06E+10
-0.9844	58840.	0.00				
36.7250	8.36E-05	1033.	-4.8101	-4.06E-06	7367.	1.06E+10
-0.7372	59759.	0.00				
37.2900	5.83E-05	989.0770	-9.0791	-3.41E-06	7366.	1.06E+10
-0.5221	60678.	0.00				
37.8550	3.73E-05	919.9499	-11.9988	-2.80E-06	7365.	1.06E+10
-0.3392	61598.	0.00				
38.4200	2.03E-05	834.3893	-13.7838	-2.24E-06	7363.	1.06E+10
-0.1874	62517.	0.00				
38.9850	6.93E-06	739.4511	-14.6390	-1.74E-06	7361.	1.06E+10
-0.06488	63436.	0.00				
39.5500	-3.24E-06	640.8535	-14.7546	-1.30E-06	7359.	1.06E+10
0.03077	64356.	0.00				
40.1150	-1.06E-05	543.0835	-14.3032	-9.16E-07	7358.	1.06E+10
0.1024	65275.	0.00				
40.6800	-1.57E-05	449.5225	-13.4375	-5.99E-07	7356.	1.06E+10
0.1530	66194.	0.00				
41.2450	-1.88E-05	362.5820	-12.2897	-3.38E-07	7354.	1.06E+10
0.1856	67114.	0.00				
41.8100	-2.03E-05	283.8416	-10.9714	-1.31E-07	7353.	1.06E+10
0.2033	68033.	0.00				
42.3750	-2.05E-05	214.1856	-9.5744	2.81E-08	7351.	1.06E+10
0.2088	68953.	0.00				
42.9400	-1.99E-05	153.9326	-8.1721	1.46E-07	7350.	1.06E+10
0.2048	69872.	0.00				
43.5050	-1.86E-05	102.9551	-6.8209	2.28E-07	7349.	1.06E+10
0.1937	70791.	0.00				
44.0700	-1.68E-05	60.7885	-5.5624	2.81E-07	7348.	1.06E+10
0.1775	71711.	0.00				
44.6350	-1.47E-05	26.7258	-4.4251	3.09E-07	7348.	1.06E+10
0.1580	72630.	0.00				
45.2000	-1.26E-05	-0.09916	-3.4264	3.17E-07	7347.	1.06E+10
0.1366	73549.	0.00				
45.7650	-1.04E-05	-20.6426	-2.5742	3.11E-07	7347.	1.06E+10
0.1147	74469.	0.00				
46.3300	-8.38E-06	-35.8931	-1.8692	2.92E-07	7348.	1.06E+10
0.09323	75388.	0.00				
46.8950	-6.48E-06	-46.8250	-1.3059	2.66E-07	7348.	1.06E+10
0.07293	76308.	0.00				
47.4600	-4.78E-06	-54.3615	-0.8742	2.34E-07	7348.	1.06E+10
0.05442	77227.	0.00				
48.0250	-3.31E-06	-59.3466	-0.5603	1.97E-07	7348.	1.06E+10
0.03818	78146.	0.00				
48.5900	-2.10E-06	-62.5224	0.08911	1.58E-07	7348.	1.06E+10
0.1534	494160.	0.00				
49.1550	-1.17E-06	-58.5904	0.9010	1.19E-07	7348.	1.06E+10
0.08611	499906.	0.00				
49.7200	-4.86E-07	-50.6463	1.3158	8.44E-08	7348.	1.06E+10
0.03624	505652.	0.00				

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50.2850	-2.39E-08	-40.9899	1.4447	5.50E-08	7348.	1.06E+10
0.00180	511398.	0.00				
50.8500	2.60E-07	-31.2130	1.3836	3.19E-08	7348.	1.06E+10
-0.01984	517144.	0.00				
51.4150	4.09E-07	-22.3196	1.2095	1.48E-08	7347.	1.06E+10
-0.03151	522891.	0.00				
51.9800	4.60E-07	-14.8544	0.9811	2.85E-09	7347.	1.06E+10
-0.03588	528637.	0.00				
52.5450	4.47E-07	-9.0247	0.7399	-4.80E-09	7347.	1.06E+10
-0.03525	534383.	0.00				
53.1100	3.95E-07	-4.8070	0.5138	-9.23E-09	7347.	1.06E+10
-0.03147	540129.	0.00				
53.6750	3.22E-07	-2.0315	0.3192	-1.14E-08	7347.	1.06E+10
-0.02592	545875.	0.00				
54.2400	2.40E-07	-0.4458	0.1651	-1.22E-08	7347.	1.06E+10
-0.01954	551621.	0.00				
54.8050	1.56E-07	0.2423	0.05530	-1.23E-08	7347.	1.06E+10
-0.01285	557367.	0.00				
55.3700	7.36E-08	0.3392	-0.00899	-1.21E-08	7347.	1.06E+10
-0.00611	563113.	0.00				
55.9350	-7.66E-09	0.1549	-0.02754	-1.19E-08	7347.	1.06E+10
6.43E-04	568859.	0.00				
56.5000	-8.83E-08	0.00	0.00	-1.19E-08	7347.	1.06E+10
0.00748	287302.	0.00				

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1466614. inch-lbs
Maximum shear force	=	23504. 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	=	7
Number of zero deflection points	=	5

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
 Displacement of pile head = 0.510000 inches
 Rotation of pile head = 0.000E+00 radians
 Axial load on pile head = 0.0 lbs

Depth Res.	Soil X	Deflect. Spr. y	Bending Distrib. Lat. Load	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil p
feet	Es*h	inches	in-lbs	lbs	radians	psi*	in-lb^2	
lb/inch		lb/inch	lb/inch					
0.00	0.00	0.5100	-1470522.	24210.	0.00	28373.	1.06E+10	
0.00	0.00	0.00	0.00					
0.5650	0.5650	0.5068	-1306964.	24037.	-8.90E-04	25217.	1.06E+10	
-25.4993		341.1263	0.00					

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1.1300	0.4979	-1144578.	23766.	-0.00167	22084.	1.06E+10
-54.4561	741.4823	0.00				
1.6950	0.4841	-984696.	23305.	-0.00236	18999.	1.06E+10
-81.6051	1143.	0.00				
2.2600	0.4660	-828564.	22671.	-0.00294	15987.	1.06E+10
-105.4473	1534.	0.00				
2.8250	0.4443	-677280.	21895.	-0.00342	13068.	1.06E+10
-123.3353	1882.	0.00				
3.3900	0.4196	-531665.	21009.	-0.00381	10258.	1.06E+10
-138.0775	2231.	0.00				
3.9550	0.3926	-392398.	20016.	-0.00410	7571.	1.06E+10
-154.9034	2675.	0.00				
4.5200	0.3640	-260251.	18923.	-0.00431	5021.	1.06E+10
-167.5573	3121.	0.00				
5.0850	0.3342	-135807.	17727.	-0.00444	2620.	1.06E+10
-185.1928	3757.	0.00				
5.6500	0.3038	-19875.	16404.	-0.00449	383.4798	1.06E+10
-205.1342	4578.	0.00				
6.2150	0.2733	86627.	14946.	-0.00447	1671.	1.06E+10
-224.8969	5579.	0.00				
6.7800	0.2432	182790.	13355.	-0.00438	3527.	1.06E+10
-244.3558	6812.	0.00				
7.3450	0.2139	267721.	11641.	-0.00424	5166.	1.06E+10
-261.2369	8280.	0.00				
7.9100	0.1858	340644.	9825.	-0.00404	6573.	1.06E+10
-274.4527	10017.	0.00				
8.4750	0.1591	400950.	7934.	-0.00380	7736.	1.06E+10
-283.4599	12079.	0.00				
9.0400	0.1342	448226.	5997.	-0.00353	8648.	1.06E+10
-287.8402	14543.	0.00				
9.6050	0.1112	482270.	4047.	-0.00323	9305.	1.06E+10
-287.2685	17513.	0.00				
10.1700	0.09033	503109.	2119.	-0.00292	9707.	1.06E+10
-281.5131	21129.	0.00				
10.7350	0.07164	511008.	248.2106	-0.00259	9860.	1.06E+10
-270.4274	25594.	0.00				
11.3000	0.05516	506475.	-1529.	-0.00227	9772.	1.06E+10
-253.9268	31211.	0.00				
11.8650	0.04088	490270.	-3176.	-0.00195	9460.	1.06E+10
-231.9399	38465.	0.00				
12.4300	0.02874	463402.	-4544.	-0.00164	8941.	1.06E+10
-171.4462	40452.	0.00				
12.9950	0.01860	428654.	-5518.	-0.00136	8271.	1.06E+10
-116.0186	42291.	0.00				
13.5600	0.01033	388573.	-6140.	-0.00110	7497.	1.06E+10
-67.2100	44130.	0.00				
14.1250	0.00374	345402.	-6453.	-8.61E-04	6664.	1.06E+10
-25.3549	45968.	0.00				
14.6900	-0.00135	301065.	-6507.	-6.54E-04	5809.	1.06E+10
9.4958	47807.	0.00				
15.2550	-0.00513	257165.	-6348.	-4.75E-04	4962.	1.06E+10
37.5316	49646.	0.00				
15.8200	-0.00779	214990.	-6020.	-3.24E-04	4148.	1.06E+10
59.1364	51485.	0.00				
16.3850	-0.00952	175534.	-5566.	-1.99E-04	3387.	1.06E+10
74.8422	53323.	0.00				
16.9500	-0.01048	139518.	-5023.	-9.78E-05	2692.	1.06E+10
85.2833	55162.	0.00				
17.5150	-0.01084	107422.	-4425.	-1.87E-05	2073.	1.06E+10
91.1545	57001.	0.00				
18.0800	-0.01074	79517.	-3800.	4.11E-05	1534.	1.06E+10
93.1726	58840.	0.00				
18.6450	-0.01028	55894.	-3172.	8.45E-05	1078.	1.06E+10

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92.0425	60678.	0.00				
19.2100	-0.00959	36503.	-2560.	1.14E-04	704.3036	1.06E+10
88.4292	62517.	0.00				
19.7750	-0.00874	21176.	-2050.	1.33E-04	408.5869	1.06E+10
62.2009	48267.	0.00				
20.3400	-0.00779	8709.	-1645.	1.42E-04	168.0386	1.06E+10
57.0596	49646.	0.00				
20.9050	-0.00681	-1135.	-1278.	1.45E-04	21.9013	1.06E+10
51.2493	51025.	0.00				
21.4700	-0.00583	-8623.	-951.6702	1.41E-04	166.3863	1.06E+10
45.0774	52404.	0.00				
22.0350	-0.00489	-14040.	-667.3095	1.34E-04	270.8903	1.06E+10
38.8048	53783.	0.00				
22.6000	-0.00401	-17672.	-425.0922	1.24E-04	340.9769	1.06E+10
32.6458	55162.	0.00				
23.1650	-0.00321	-19804.	-223.6761	1.12E-04	382.1088	1.06E+10
26.7690	56541.	0.00				
23.7300	-0.00249	-20705.	-60.7203	9.91E-05	399.4981	1.06E+10
21.3005	57920.	0.00				
24.2950	-0.00187	-20627.	66.8370	8.58E-05	397.9953	1.06E+10
16.3270	59299.	0.00				
24.8600	-0.00133	-19799.	162.5274	7.29E-05	382.0113	1.06E+10
11.9002	60678.	0.00				
25.4250	-8.79E-04	-18424.	221.0442	6.06E-05	355.4726	1.06E+10
5.3614	41372.	0.00				
25.9900	-5.08E-04	-16802.	249.9517	4.93E-05	324.1787	1.06E+10
3.1659	42291.	0.00				
26.5550	-2.09E-04	-15034.	265.2096	3.92E-05	290.0768	1.06E+10
1.3349	43210.	0.00				
27.1200	2.34E-05	-13205.	269.2197	3.01E-05	254.7910	1.06E+10
-0.1520	44130.	0.00				
27.6850	1.99E-04	-11384.	264.2264	2.22E-05	219.6399	1.06E+10
-1.3210	45049.	0.00				
28.2500	3.25E-04	-9622.	252.2821	1.55E-05	185.6604	1.06E+10
-2.2024	45968.	0.00				
28.8150	4.09E-04	-7963.	235.2257	9.87E-06	153.6344	1.06E+10
-2.8290	46888.	0.00				
29.3800	4.59E-04	-6433.	214.6702	5.26E-06	124.1175	1.06E+10
-3.2346	47807.	0.00				
29.9450	4.80E-04	-5052.	191.9996	1.59E-06	97.4694	1.06E+10
-3.4529	48727.	0.00				
30.5100	4.80E-04	-3829.	168.3735	-1.26E-06	73.8839	1.06E+10
-3.5165	49646.	0.00				
31.0750	4.63E-04	-2769.	144.7371	-3.37E-06	53.4172	1.06E+10
-3.4559	50565.	0.00				
31.6400	4.35E-04	-1867.	121.8361	-4.86E-06	36.0158	1.06E+10
-3.2995	51485.	0.00				
32.2050	3.98E-04	-1116.	100.2345	-5.81E-06	21.5408	1.06E+10
-3.0726	52404.	0.00				
32.7700	3.56E-04	-507.4537	80.3344	-6.33E-06	9.7911	1.06E+10
-2.7976	53323.	0.00				
33.3350	3.12E-04	-27.0874	62.3972	-6.50E-06	0.5226	1.06E+10
-2.4936	54243.	0.00				
33.9000	2.68E-04	338.6528	46.5651	-6.40E-06	6.5341	1.06E+10
-2.1767	55162.	0.00				
34.4650	2.25E-04	604.3350	32.8809	-6.10E-06	11.6604	1.06E+10
-1.8599	56081.	0.00				
35.0300	1.85E-04	784.5183	21.3086	-5.66E-06	15.1369	1.06E+10
-1.5537	57001.	0.00				
35.5950	1.48E-04	893.2798	11.7507	-5.12E-06	17.2354	1.06E+10
-1.2657	57920.	0.00				
36.1600	1.15E-04	943.8577	4.0649	-4.53E-06	18.2113	1.06E+10
-1.0015	58840.	0.00				

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36.7250	8.67E-05	948.3997	-1.9216	-3.92E-06	18.2989	1.06E+10
-0.7645	59759.	0.00				
37.2900	6.22E-05	917.8011	-6.3997	-3.33E-06	17.7085	1.06E+10
-0.5565	60678.	0.00				
37.8550	4.16E-05	861.6201	-9.5682	-2.76E-06	16.6245	1.06E+10
-0.3781	61598.	0.00				
38.4200	2.48E-05	788.0563	-11.6254	-2.23E-06	15.2052	1.06E+10
-0.2287	62517.	0.00				
38.9850	1.14E-05	703.9798	-12.7624	-1.75E-06	13.5830	1.06E+10
-0.1067	63436.	0.00				
39.5500	1.06E-06	614.9982	-13.1584	-1.33E-06	11.8661	1.06E+10
-0.01010	64356.	0.00				
40.1150	-6.61E-06	525.5523	-12.9770	-9.63E-07	10.1403	1.06E+10
0.06360	65275.	0.00				
40.6800	-1.20E-05	439.0298	-12.3645	-6.54E-07	8.4709	1.06E+10
0.1171	66194.	0.00				
41.2450	-1.55E-05	357.8896	-11.4483	-3.99E-07	6.9053	1.06E+10
0.1532	67114.	0.00				
41.8100	-1.74E-05	283.7903	-10.3372	-1.93E-07	5.4756	1.06E+10
0.1746	68033.	0.00				
42.3750	-1.81E-05	217.7168	-9.1215	-3.26E-08	4.2007	1.06E+10
0.1840	68953.	0.00				
42.9400	-1.78E-05	160.1022	-7.8744	8.84E-08	3.0891	1.06E+10
0.1839	69872.	0.00				
43.5050	-1.69E-05	110.9399	-6.6531	1.75E-07	2.1405	1.06E+10
0.1764	70791.	0.00				
44.0700	-1.55E-05	69.8867	-5.5005	2.33E-07	1.3484	1.06E+10
0.1636	71711.	0.00				
44.6350	-1.37E-05	36.3534	-4.4471	2.67E-07	0.7014	1.06E+10
0.1471	72630.	0.00				
45.2000	-1.18E-05	9.5834	-3.5128	2.82E-07	0.1849	1.06E+10
0.1285	73549.	0.00				
45.7650	-9.91E-06	-11.2802	-2.7081	2.81E-07	0.2176	1.06E+10
0.1089	74469.	0.00				
46.3300	-8.03E-06	-27.1389	-2.0363	2.69E-07	0.5236	1.06E+10
0.08929	75388.	0.00				
46.8950	-6.27E-06	-38.8930	-1.4946	2.48E-07	0.7504	1.06E+10
0.07052	76308.	0.00				
47.4600	-4.67E-06	-47.4057	-1.0752	2.20E-07	0.9147	1.06E+10
0.05319	77227.	0.00				
48.0250	-3.28E-06	-53.4734	-0.7668	1.88E-07	1.0317	1.06E+10
0.03780	78146.	0.00				
48.5900	-2.12E-06	-57.8035	-0.1144	1.52E-07	1.1153	1.06E+10
0.1546	494160.	0.00				
49.1550	-1.21E-06	-55.0251	0.7135	1.16E-07	1.0617	1.06E+10
0.08958	499906.	0.00				
49.7200	-5.47E-07	-48.1287	1.1555	8.31E-08	0.9286	1.06E+10
0.04081	505652.	0.00				
50.2850	-8.84E-08	-39.3565	1.3164	5.51E-08	0.7594	1.06E+10
0.00667	511398.	0.00				
50.8500	2.00E-07	-30.2780	1.2874	3.28E-08	0.5842	1.06E+10
-0.01522	517144.	0.00				
51.4150	3.56E-07	-21.8989	1.1428	1.61E-08	0.4225	1.06E+10
-0.02745	522891.	0.00				
51.9800	4.17E-07	-14.7815	0.9395	4.30E-09	0.2852	1.06E+10
-0.03253	528637.	0.00				
52.5450	4.14E-07	-9.1593	0.7186	-3.36E-09	0.1767	1.06E+10
-0.03265	534383.	0.00				
53.1100	3.72E-07	-5.0378	0.5075	-7.91E-09	0.09720	1.06E+10
-0.02960	540129.	0.00				
53.6750	3.07E-07	-2.2770	0.3234	-1.03E-08	0.04393	1.06E+10
-0.02471	545875.	0.00				
54.2400	2.33E-07	-0.6523	0.1755	-1.12E-08	0.01259	1.06E+10

2018-0405-HAI-HP 14x117-North-High Fill-116 Corrosion-0.51 deflection.lp10o.txt

-0.01892	551621.	0.00				
54.8050	1.55E-07	0.1029	0.06813	-1.14E-08	0.00199	1.06E+10
-0.01276	557367.	0.00				
55.3700	7.84E-08	0.2715	0.00281	-1.12E-08	0.00524	1.06E+10
-0.00651	563113.	0.00				
55.9350	2.70E-09	0.1410	-0.02002	-1.11E-08	0.00272	1.06E+10
-2.26E-04	568859.	0.00				
56.5000	-7.24E-08	0.00	0.00	-1.11E-08	0.00	1.06E+10
0.00613	287302.	0.00				

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

Output Summary for Load Case No. 3:

Pile-head deflection	=	0.51000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-1470522. inch-lbs
Maximum shear force	=	24210. 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	=	7
Number of zero deflection points	=	5

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	Load 1	Load 2	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max in lbs
		in-lbs		lbs	inches	radians	
1	y, in	0.5100	S, rad	0.00	323660.	0.5100	0.00
23124.	-1464498.						
2	y, in	0.5100	S, rad	0.00	210860.	0.5100	0.00
23504.	-1466614.						
3	y, in	0.5100	S, rad	0.00	0.00	0.5100	0.00
24210.	-1470522.						

Maximum pile-head deflection = 0.5100000000 inches
 Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

Driven Pile Elastic Compression

CALCULATIONS

File No.	42223-005
Sheet	1 of 1
Date	9-Apr-18
Computed by	EAF
Checked by	MMB

Client	Maine Department of Transportation
Project	Maine Avenue Bridge, Gardiner, Maine
Subject	Elastic Compression for Piles

PROBLEM STATEMENT & OBJECTIVE

Estimate the settlement under service vertical loads for the piles at Abutment 1 and 2.

EXECUTIVE SUMMARY

The total elastic settlement for a single pile at Abutment 1 and 2 is 0.18 in.

ASSUMPTIONS

1. The HPile section is HP14x117 with 1/16 in. corrosion loss.
2. Top of pile elevation will be taken as the elevation at the bottom of the pile cap (El. 4)
3. Use top of rock elevation from boring BB-GCS-104 (El. -55.8), which is lower elevation.

AVAILABLE INFORMATION:

1. Haley & Aldrich boring logs BB-GCS-104 and BB-GCS-105.
2. Email from Stantec dated 27 November 2017 with maximum service axial load for the abutments.
3. PIC plan set titled "Gardiner, Kennebec County, Maine Avenue Bridge over Cobbosseecontee Stream, Route 24, Federal Aid Project No. STP-1873(600), Project Length 0.05 mi., Bridge No. 3098."

PROCEDURE

$$\delta = PL/AE$$

δ = settlement
P = vertical service load on pile
L = length of pile
A = cross sectional area of pile
E = elastic modulus of pile

CALCULATIONS:

Max Vertical Service Load, P:	210.86	kips
Elevation of Top of Pile:	4	
Elevation of Tip of Pile:	-55.8	
Length, L:	59.8	ft
Area of Pile, A:	28.7	in ²
Elastic Modulus of Pile, E:	29,000	ksi

Total Settlement of Pile, δ_{Total} : 0.18 in.

Lateral Soil Pressures

Client: Stantec

Project: Maine Avenue Bridge, Gardiner, Maine

Computed by: JLL

Subject: Lateral Earth Pressures

Checked by: EAF

PASSIVE LATERAL EARTH PRESSURE COEFFICIENT

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 2014 with interim revisions. See plot below.

ϕ'_f (deg)	θ (deg)	δ (deg)	$-\delta/\phi'_f$	k_p	R	$R \cdot k_p$
32	90	24	-0.75	7.7	0.86	6.6

Note: $R \cdot k_p$ should only be applied to effective earth pressures (i.e., do not apply to hydrostatic pressures).

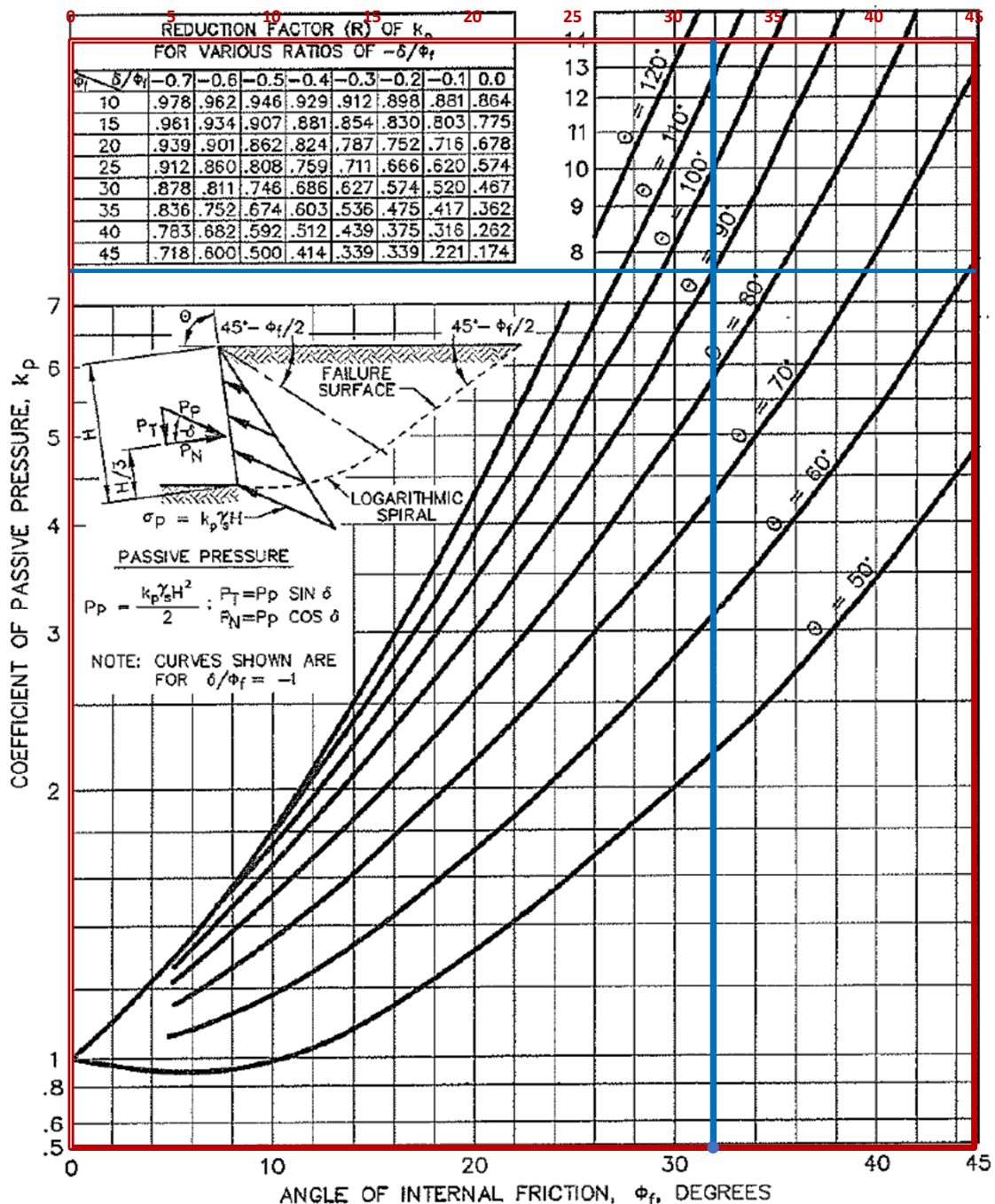


Figure 3.11.5.4-1—Computational Procedures for Passive Earth Pressures for Vertical and Sloping Walls with Horizontal Backfill (U.S. Department of the Navy, 1982a)

Client: Stantec

Date: 26-Sep-2018

Project: Maine Avenue Bridge, Gardiner, Maine

Computed by: JLL

Subject: Lateral Earth Pressures

Checked by: EAF

SEISMIC LATERAL EARTH PRESSURE COEFFICIENT
REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 2014 with interim revisions. Excerpts below.

$$K_{AE} = \frac{\cos^2(\phi - \theta_{MO} - \beta)}{\cos \theta_{MO} \cos^2 \beta \cos(\delta + \beta + \theta_{MO})} \times \left[1 + \frac{\sin(\phi + \delta) \sin(\phi - \theta_{MO} - i)}{\cos(\delta + \beta + \theta_{MO}) \cos(i - \beta)} \right]^{-2} \quad (A11.3.1-1)$$

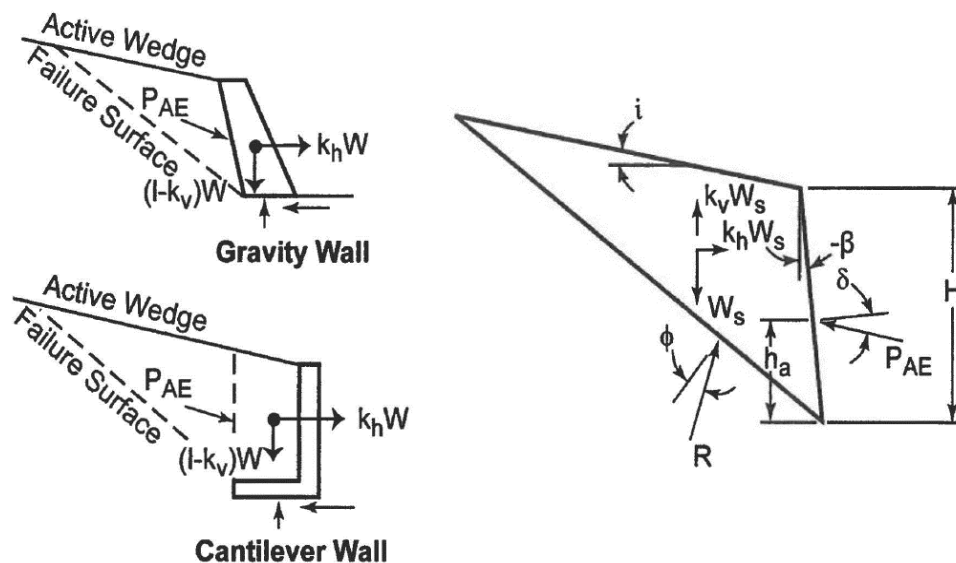
where:

- K_{AE} = seismic active earth pressure coefficient (dim)
 γ = unit weight of soil (kcf)
 H = height of wall (ft)
 h = height of wall at back of wall heel considering height of sloping surcharge, if present (ft)
 ϕ_f = friction angle of soil (degrees)
 θ_{MO} = arc tan [$k_h/(1 - k_v)$] (degrees)
 δ = wall backfill interface friction angle (degrees)
 k_h = horizontal seismic acceleration coefficient (dim.)
 k_v = vertical seismic acceleration coefficient (dim.)
 i = backfill slope angle (degrees)
 β = slope of wall to the vertical, negative as shown (degrees)

Note that K_{AE} includes the static (k_a) and dynamic (Δk_{AE}) components of the lateral soil pressure. According to Section A11.3.1 of AASHTO LRFD, a reasonable approach for routine walls is to apply the combined resultant of the static and seismic force at the same location as the static earth pressure but no less than $h/3$. Assuming hydrodynamic effects are negligible, total soil unit weight should be used when calculating the static+seismic force using K_{AE} .

CALCULATIONS

ϕ'_f (deg)	PGA (g)	F_{PGA}	k_h (g)	k_v (g)	θ_{MO} (deg)	δ (deg)	β (deg)	i (deg)	K_{AE}
32	0.077	2.50	0.19	0.00	10.9	24	0.0	0.00	0.42


Figure A11.3.1-1—Mononobe-Okabe Method Force Diagrams

Axial Micropile Evaluations

Client: Stantec

Date: 25-Sep-2018

Project: Bridge Street Bridge, Gardiner, Maine

Computed by: JLL

Subject: Micropile Geotechnical Resistance

Checked by: EAF

PROBLEM STATEMENT & OBJECTIVE

Determine the geotechnical resistance of drilled micropiles in bedrock.

EXECUTIVE SUMMARY

Refer to tables on sheet 4 and 5 for capacity for a range of embedment depths.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 7th Edition, with 2015 & 2016 Interim Revisions.

AVAILABLE INFORMATION

1. Test boring logs BB-GCS-104 and BB-GCS-105.
2. Draft plan set titled, "Gardiner, Kennebec County, Maine Avenue Bridge over Cobbosseecontee Stream" by Stantec, labeled 90% PS&E Submittal.

ASSUMPTIONS

1. Micropile diameter = 9.625 in (OD). Socket diameter below casing = 9.0 in.
2. Micropile diameter = 7.625 in (OD). Socket diameter below casing = 7.0 in.
3. Axial group effects are not considered.
4. Resistance from soils above bedrock are not considered. Micropile end-bearing resistance is assumed zero.

PROCEDURE

1. Determine nominal grout-to-ground resistance based on embedment within bedrock.
2. Determine the rock socket perimeter and calculate the factored geotechnical resistance per unit length.

Client: Stantec

Date: 25-Sep-2018

Project: Bridge Street Bridge, Gardiner, Maine

Computed by: JLL

Subject: Micropile Geotechnical Resistance

Checked by: EAF

CALCULATIONS

AASHTO LRFD Nominal Geotechnical Unit Resistance

Table C10.9.3.5.2-1—Summary of Typical α_u Values (Grout-to-Ground Bond) for Preliminary Micropile Design (modified after Sabatini, et al., 2005)

Soil/Rock Description	Typical Range of Grout-to-Ground Bond Nominal Resistance for Micropile Types ⁽¹⁾ (ksf)				
	Type A	Type B	Type C	Type D	Type E
Silt & Clay (some sand) (soft medium plastic)	0.7–1.4	0.7–2.0	0.7–2.5	0.7–3.0	0.7–2.0
Silt & Clay (some sand) (stiff, dense to very dense)	0.7–2.5	1.4–4.0	2.0–4.0	2.0–4.0	1.4–4.0
Sand (some silt) (fine, loose-medium dense)	1.4–3.0	1.4–4.0	2.0–4.0	2.0–5.0	1.4–5.0
Sand (some silt, gravel) (fine-coarse, medium-very dense)	2.0–4.5	2.5–7.5	3.0–7.5	3.0–8.0	2.5–7.5
Gravel (some sand) (medium-very dense)	2.0–5.5	2.5–7.5	3.0–7.5	3.0–8.0	2.5–7.5
Glacial Till (silt, sand, gravel) (medium-very dense, cemented)	2.0–4.0	2.0–6.5	2.5–6.5	2.5–7.0	2.0–6.5
Soft Shales (fresh-moderate fracturing, little to no weathering)	4.3–11.5	N/A	N/A	N/A	N/A
Slates and Hard Shales (fresh- moderate fracturing, little to no weathering)	10.8–28.8	N/A	N/A	N/A	N/A
Limestone (fresh-moderate fracturing, little to no weathering)	21.6–43.2	N/A	N/A	N/A	N/A
Sandstone (fresh-moderate fracturing, little to no weathering)	10.8–36.0	N/A	N/A	N/A	N/A
Granite and Basalt (fresh-moderate fracturing, little to no weathering)	28.8–87.7	N/A	N/A	N/A	N/A

⁽¹⁾ Refer to Article 10.9.1 for description of micropile types.

Bedrock Nominal Unit Resistance
19.8 ksf

- Type A micropiles are constructed by placing a sand-cement mortar or neat cement grout in the pile under a gravity head only;
- Type B micropiles are constructed by injecting a neat cement grout under pressure (typically 6–21 ksf) into the drilled hole while the temporary drill casing or auger is withdrawn;
- Type C micropiles are grouted as for Type A, followed 15–25 min after primary grouting by injection of additional grout under pressure (typically greater than 21 ksf) via a preplaced sleeved grout pipe.
- Type D micropiles are grouted similar to Type C, but the primary grout is allowed to harden before injecting the secondary grout under pressure (typically 42–170 ksf) with a packer to achieve treatment of specific pile intervals or material horizons; or
- Type E micropiles are constructed by drilling with grout injection through a continuous-thread, hollow-core steel bar. The grout injection serves to flush cuttings, achieve grout penetration into the ground and stabilize the drill hole. Often the initial grout has a high water to cement ratio and is then replaced with a thicker structural grout near the completion of drilling.

Client: Stantec
 Project: Bridge Street Bridge, Gardiner, Maine
 Subject: Micropile Geotechnical Resistance

CALCULATIONS

AASHTO LRFD STR Limit State Resistance Factors for Micropiles

Table 10.5.5.2.5-1—Resistance Factors for Geotechnical Resistance of Axially Loaded Micropiles

Limit State	Method/ Ground Condition	Resistance Factor
Compression Resistance of Single Micropile, ϕ_{stat}	Side Resistance (Bond Resistance): Presumptive Values	0.55 ⁽¹⁾
	Tip Resistance on Rock O'Neill and Reese (1999)	0.50
	Side Resistance and Tip Resistance Load Test	Values in Table 10.5.5.2.3-1, but no greater than 0.70
Block Failure, ϕ_{bl}	Clay	0.60
Uplift Resistance of Single Micropile, ϕ_{up}	Presumptive Values	0.55 ⁽¹⁾
	Tension Load Test	Values in Table 10.5.5.2.3-1, but no greater than 0.70
Group Uplift Resistance, ϕ_{ug}	Sand & Clay	0.50

⁽¹⁾ Apply to presumptive grout-to-ground bond values for preliminary design only in Article C10.9.3.5.2.

Resistance Factor (Presumptive)

0.55

Bedrock Factored Unit Resistance

10.9 ksf

Client: Stantec

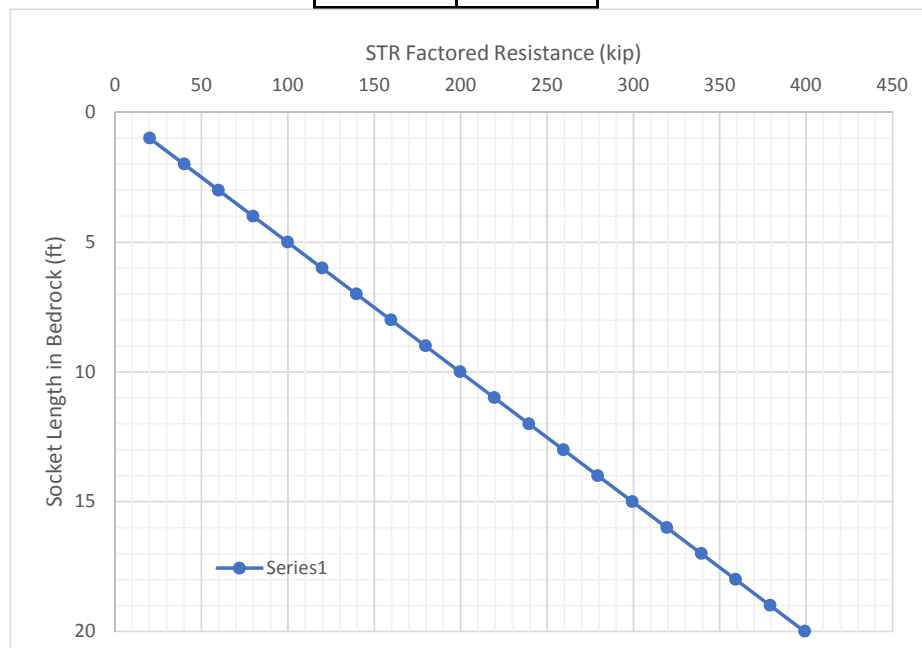
Project: Bridge Street Bridge, Gardiner, Maine

Subject: Micropile Geotechnical Resistance

CALCULATIONS

Rock Socket Diameter (in) = 7
 Rock Socket Perimeter (ft) = 1.8
 Rock Socket Side Area (ft²/ft) = 1.8
 Bedrock STR Factored Unit Side Resistance (ksf) = 10.9
 Bedrock STR Factored Resistance per foot (kip/ft) = 20.0

Rock Socket Length in Bedrock (ft)	Bedrock Factored Geotechnical Resistance (kip)
1	20
2	40
3	60
4	80
5	100
6	120
7	140
8	160
9	180
10	200
11	220
12	239
13	259
14	279
15	299
16	319
17	339
18	359
19	379
20	399



Client:	Stantec
Project:	Bridge Street Bridge, Gardiner, Maine
Subject:	Micropile Geotechnical Resistance

CALCULATIONS

Rock Socket Diameter (in) = 9
 Rock Socket Perimeter (ft) = 2.4
 Rock Socket Side Area (ft²/ft) = 2.4
 Bedrock STR Factored Unit Side Resistance (ksf) = 10.9
 Bedrock STR Factored Resistance per foot (kip/ft) = 25.7

Rock Socket Length in Bedrock (ft)	Bedrock Factored Geotechnical Resistance (kip)
1	26
2	51
3	77
4	103
5	128
6	154
7	180
8	205
9	231
10	257
11	282
12	308
13	334
14	359
15	385
16	411
17	436
18	462
19	488
20	513

