BAILEY FLAT CULVERT REPLACEMENT

WIN 26156.00

City of Monmouth
Kennebec County
Maine

GEOTECHNICAL DESIGN REPORT

August 2025

PREPARED FOR

Maine Department of Transportation
16 State House Station
Augusta, Maine 04333

PREPARED BY

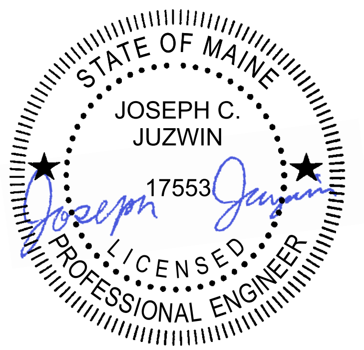
HNTB Corporation
9 Entin Road, Suite 202
Parsippany, NJ 07054

HNTB

Bailey Flat Culvert Replacement

Monmouth, Maine

Geotechnical Design Report
August 15, 2025



Joseph C. Juzwin, PE

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1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Project Background

The following summarizes the preliminary geotechnical assessment completed by HNTB for the replacement of the Bailey Flat Culvert carrying Cobbossee Road over Mud Mills Stream in Monmouth, Kennebec County, Maine. A Project Location Map is included as Figure 1.

The existing structure consists of a three-cell corrugated steel pipe culvert buried in the embankment below the roadway to accommodate the stream crossing. It is proposed that the existing pipes will be replaced with a single-cell four-sided box culvert. The roadway will maintain the existing alignment.

1.2 Scope of Services

HNTB's Geotechnical and Foundation Services group is providing geotechnical design services for the replacement of the Bailey Flat culvert. The overall objective of this study is to characterize the subsurface conditions within the project limits and to develop geotechnical design criteria and preliminary foundation recommendations for support of the proposed replacement structure and embankments.

A subsurface exploration program was executed by HNTB's partner, Schonewald Engineering Associates, Inc. (Schonewald), in coordination with HNTB. The preliminary assessment completed by HNTB included the following:

- Reviewed historical geotechnical data for the project site.
- Implemented a subsurface investigation and laboratory testing program to gather additional information where needed.
- Analyzed the resulting data collected to identify subsurface conditions that impact the design and construction of the project.
- Established engineering design parameters based on the available borings.
- Conducted geotechnical analyses and provided recommendations and design parameters for the culvert replacement.
- Established seismic site classification.

1.3 Existing Site Conditions

At the culvert location, Cobbossee Road is generally oriented in a northeast/southwest direction and is gradually elevated relative to the surrounding terrain. The roadway consists of two lanes, with one lane of travel in each direction and unpaved shoulders on either side. Mud Mills Stream generally flows from south to north, bending to approximately a southwest/northeast orientation to cross generally perpendicular Cobbossee Road. The area surrounding the stream is vegetated with woodland immediately adjacent to the project location. Areas along the Mud Mills Stream near the project site are indicated as marsh per the Project Location Map included as Figure 1.

The existing culvert is a three-cell corrugated steel pipe with approximate diameters of 6 feet each, extending 77 feet long transverse to the road. The total span of the culvert between outer edges of outside pipes is approximately 22 feet measured longitudinal to the road.

1.4 Proposed Improvements

The existing three-cell steel pipe culvert will be replaced with a new single-cell culvert, to be slightly offset from the existing stream alignment to allow for improved flow and to accommodate construction without blocking the flow of the stream. The proposed culvert is anticipated to consist of a four-sided rectangular concrete box with a span length of 16 feet between stem walls. The precast concrete box has a proposed length of 68'-6" between headwalls, with in-line wingwalls extending beyond the headwalls 16'-3" to the southwest and 17'-3" to the northeast. Negligible changes are anticipated in the existing roadway alignment, profile, or cross-section with repaving and resetting of guardrails.

1.5 Survey Control

All horizontal coordinates presented in this report are provided in feet and reference the North American Datum of 1983 (NAD 83), Maine West State Plane coordinate system. Elevations are provided in feet and reference the North American Vertical Datum of 1988 (NAVD 88).

2.0 GEOLOGY AND SITE CONDITIONS

2.1 General Site Geology

The project is located within the New England physiographic province, a region characteristically composed of gneiss, schist, marble, quartzite, and slate, with frequent folding, faulting, and igneous intrusions. The region has been subject to glaciation, resulting in a large number of lakes and streams, and surficial geology composed primarily of glacial deposits (glacial till, glaciofluvial deposits and glacial lake deposits).

Existing geologic mapping available for the project site includes Soil Survey data provided by the USDA Natural Resource Conservation Service (NRCS) and bedrock and surficial geology mapping prepared by the Maine Geological Survey (MGS) for the Monmouth quadrangle. Excerpts from this mapping are included in Figure 2 and Figure 3, respectively.

NRCS mapping indicates that the project site consists of Biddeford mucky peat sand, originating from glacial meltwaters through the site. MGS surficial geology mapping identifies soil overburden in the area of the project as the Presumpscot Formation, reported to consist of primarily of silty clay with minor sand deposited on the sea floor during the late-glacial marine submergence, underlain by till. Areas directly north and south of the project location are characterized as freshwater wetland consisting of organic materials including peat, silt, and sand often with standing water. Bedrock geology mapping shows the site is within the Sangerville Formation, consisting of medium-grained, medium-gray biotite-muscovite-garnet-sillimanite schist interlayered with light gray biotite-muscovite-quartz-feldspar granofels or a greenish-gray calc-silicate granofels.

3.0 SUBSURFACE EXPLORATION AND TESTING

3.1 Subsurface Exploration

A subsurface exploration program was performed for this project by New England Boring Contractors of Derry, NH under the supervision of Schonewald on behalf of HNTB. A series of two borings were performed at the project site, one at each side of the existing culvert. The borings were advanced by cased wash boring methods, using 4.0-inch (HW-size) and 3.0-inch (NW-size) inside diameter steel casing. Standard Penetration Test (SPT) sampling was conducted in general accordance with ASTM D1586 by driving a 1-3/8 inch ID split spoon sampler with a 140-pound hammer dropped 30 inches to obtain samples at 5 foot intervals. Each sample was removed from the sampler in the field, examined, and classified in accordance with the Burmister Soil Identification System. Sampling was advanced to top of rock, and a minimum of 10 feet of NQ2-sized rock core was collected from each boring location. Where Presumpscot Formation cohesive soils were encountered, SPT sampling was supplemented with in-situ vane shear testing to provide an estimate of undisturbed and remolded shear strength. The Boring Location Plan is included as Figure 4. Boring logs prepared by Schonewald are included in Appendix 2.

3.2 Laboratory Testing

A geotechnical laboratory testing program was performed by Geotesting Express of Acton, Massachusetts to verify the visual-manual field classifications and to aid in determination of the engineering design parameters. Testing included index tests to aid in identification and classification of soils, and corrosion testing for use in evaluating corrosivity of steel substructure elements. Complete laboratory results are presented in Appendix 2. Laboratory testing consisted of twelve (12) tests for natural moisture content, five (5) standard grain size analyses with natural water content, four (4) tests for fines content, seven (7) tests for Atterberg limits, one (1) tests for organic content, three (3) undisturbed samples for consolidation and two (2) undisturbed samples for consolidated-undrained triaxial testing. The soil testing was performed in accordance with the following ASTM Standards:

Moisture Content	ASTM D2216
Grain Size Analysis	ASTM D6913
Percent Passing No. 200 Sieve	ASTM D1140
Atterberg Limits	ASTM D4318
Organic Content	ASTM D2974
One-Dimensional Consolidation	ASTM D4767
Consolidated-Undrained Triaxial	ASTM D4767

Select soil samples were tested for pH, minimum laboratory resistivity, chlorides content, and sulfate content by GeoTesting Express, Inc. of Acton, Massachusetts for determination of site subsurface corrosion potential. The corrosively testing was performed in accordance with the following Standards:

pH	AASHTO T289
Sulfates	AASHTO T290
Chlorides	AASHTO T291
Minimum Laboratory Resistivity	AASHTO T288

Corrosion testing was performed as original replacement solutions included pile-supported options. A summary of the laboratory corrosion tests is presented in Table 3.2. The below results are not indicative of aggressive environmental conditions for corrosion of steel or concrete structure and foundation elements.

Table 3.1: Summary of Corrosion Test Results

Boring No.	Sample No.	Depth (ft)	pH	Resistivity (ohm-cm)	Sulfate (ppm)	Chloride (ppm)
BB-MMS-101	1D, 2D	2 – 6	8.37	51,652	24	<10

4.0 SUBSURFACE CONDITIONS

4.1 Stratigraphy

Based on the subsurface investigation, the following general subsurface strata were identified:

- **Fill:** The culvert site is overlain with up to 8 feet of medium dense to dense granular fill consisting of fine to coarse sand, with secondary components consisting of varying amounts of gravel, and fines. Fines were generally identified to be non-plastic, based on field classifications.
- **Stream Alluvium:** Beneath the fill, a stream alluvium stratum was encountered consisting of a very loose to very dense mix of sand, gravel, and organic silt with wood pieces. Boring BB-MMMS-102 encountered a 3-inch wood fragment within the spoon. The thickness of the stratum 5 to 9.5 feet.
- **Marine Silt & Clay Crust:** Beneath the stream alluvium, a Marine Silt and Clay desiccated "crust" stratum was encountered in boring BB-MMMS-102 only. The stiff material is comprised of a slightly mottled Silt with some clay and numerous partings consisting of a fine sandy silt. The layer was observed to be 5 feet in thickness.
- **Marine Silt & Clay:** The Marine Silt and Clay stratum below the upper crust generally consists of dark grey to olive grey Clay with some silt. This stratum was observed to have a thickness of approximately 12 to 13 feet. The stratum ranged from soft to medium stiff.
- **Glacial Till:** A generally very dense Glacial Till layer followed the Marine Silt and Clay stratum consisting of a grey fine to medium Sandy Gravel to Gravel with some fine to coarse sand with little silt. This stratum had a thickness ranging from approximately 2.5 to 5 feet.
- **Granofels Bedrock:** Top of rock was encountered in both borings at depths of 32.9 to 36 feet below ground surface. The bedrock encountered generally consists of hard, fresh, fine to medium grained, greenish grey Granofels bedrock. Rock Quality Designation (RQD) values ranged from 72 to 84 percent and averaged approximately 78 percent.

An interpretive subsurface profile is included in Figure 5.

4.2 Subsurface Material Properties

Geotechnical design parameters for soil were developed for each stratum based on material descriptions, standard published correlations, and engineering judgment. A summary of existing soil design properties at the site, as interpreted from available borings and laboratory testing, are presented in Table 4.2 below.

Table 4.1: Engineering Properties of Soil

Layer	$\overline{N_{60}}$ (bpf)	$\overline{N1_{60}}$ (bpf)	γ (pcf)	ϕ'(deg.)	S_u (psf)	E (ksi)	k_a	k_o	δ (deg.)
1 – Fill	18	30	122	37	-	587	0.23	0.40	19
2 – Stream Alluvium	7	8	110	31	-	355	0.29	0.48	14
3 – Marine Silt & Clay Crust	8	8	115	32	700	391	0.28	0.47	14
4 – Marine Silt & Clay	1	1	110	32	645-426	164	0.28	0.47	14
5 – Glacial Till	81	59	128	41	-	1245	0.19	0.34	22

Where: $\overline{N_{60}}$= Average SPT-N value of stratum, corrected for hammer efficiency, in blows per foot.
$\overline{N1_{60}}$= Average SPT-N value of stratum, corrected for hammer efficiency and effective overburden pressure, in blows per foot.
γ = Total unit weight of soil, based on grain size and relative density per Bowles 4th Edition, Table 3-4.
ϕ' = Internal friction angle of soil, per multiple SPT-N value correlations for cohesionless material. Drained friction angle for Marine Silt and Clay from laboratory triaxial testing.
S_u= Undrained shear strength of soil, per in-situ vane shear testing.
E= Elastic modulus, based on grain size and relative density as presented in AASHTO LRFD 9th Ed. Table C10.4.6.3-1.
k_a= Coulomb active earth pressure coefficient, for drained condition.
k_o= At-rest earth pressure coefficient, 1-sinϕ', for drained condition.
δ= Interface friction angle for soil to concrete interface as presented in AASHTO LRFD 9th Ed. Table C3.11.5.3-1.

Earth pressure coefficients provided above are for drained condition only. For undrained condition of cohesive soils, lateral earth pressure coefficient shall be taken as 1.0. Undrained shear strengths of the Marine Silt & Clay layer from vane shear testing performed on site were found to vary from stiff closer to the desiccated crust layer, to soft towards the bottom of the layer and is listed as such in the table above. The soil envelope surrounding the proposed culvert shall be backfilled with MaineDOT Soil Type 4, Granular Borrow, as indicated in MaineDOT Bridge Design Guide (BDG) Section 8.3.3. Design soil parameters for Soil Type 4 shall be as indicated in BDG Section 3.6, Table 3-3, an active earth pressure coefficient (k_a) of 0.27, and at-rest earth pressure coefficient (k_o) of 0.47.

5.0 DESIGN OF CULVERT

5.1 General Design Considerations

As discussed above, a new culvert is proposed to replace the three existing buried steel pipes. Three alternatives were initially considered including an integral abutment bridge, a 3-sided box culvert, and a 4-sided box culvert. A rectangular four-sided concrete box culvert was selected. The box culvert may consist of prefabricated components or a combination of prefabricated and cast-in-place components (i.e. cast-in-place bottom mat foundation), which would be placed or constructed within an excavation adjacent to or slightly overlapping the existing pipe culvert. The single-cell culvert would allow for greater flow capacity than the current pipe culverts and construction could be relatively simple at the project site.

5.2 Box Culvert Design and Recommendations

A minimum clear span length of 16 feet was specified for the proposed concrete box culvert, with a clear interior height of 8 feet between bottom and top slabs. This results in anticipated exterior dimensions of 18 feet wide by 10 feet high, assuming a thickness of 1 foot for top slab, bottom slab, and vertical stem walls. The base of the opening should be set approximately 12.5 feet below existing roadway surface, with 3.5 feet of embankment and pavement on top of the box and approximately 2 feet of Special Fill inside the box at the channel bottom. It is recommended that the bottom slab be placed or constructed atop a minimum 16 inch layer of culvert bedding stone placed above the Presumpscot formation Marine Silt and Clay. Bedding stone should be wrapped in a separation geotextile per Specification Section 722. A layer of geogrid reinforcement is recommended through the middle of the bedding stone layer to create a stable subgrade for construction and limit differential movement of precast box units.

A check of the average net bearing pressure at bottom of box was performed by comparing the existing stress at a point below proposed box against the stress induced at the same point in the proposed condition. It was concluded that installing the box will result in a negative net average bearing pressure (a decrease in applied pressure) and should not present any concern for settlement. Bearing resistance of the proposed condition was checked in accordance with AASHTO LRFD Bridge Design Specifications and appropriate load factors and shown to be satisfactory. Due to variability of fines present in the upper soil layer, bearing resistance was checked for both a cohesionless and cohesive material with applicable assumptions made to soil properties. Refer to Appendix 3 for bearing pressure and bearing resistance calculations. A nominal bearing resistance of 3.48 ksf and a strength limit state factored bearing resistance of 1.74 ksf is recommended for the box culvert foundation having a width of 18 feet and a length of 68.5 feet between headwalls.

The precast culvert walls, including short inlet/outlet headwalls and toewalls, should be designed with at-rest lateral earth pressures as the walls will be restrained. Walls that extend beyond the box culvert may be designed with active earth pressures. Temporary support of excavation walls may also be designed with active earth pressures.

Based on BDG Figure 5-1, the freezing index for Monmouth, ME is approximately 1600. The frost depth for granular soils at the project site is estimated as 84.8 inches based on BDG section 5.2.1. As the foundation may bear on either Stream Alluvium or the Marine Silt-Clay, the frost depth representing the more conservative assumption is provided. Per BDG section 5.2.1, shallow foundations should bear at a minimum depth equal to or exceeding the frost depth. Excavating and replacing with non-frost-susceptible material such as bedding stone for the foundations to bear upon is an acceptable means of providing frost protection. Riprap is not to be considered as contributing to the overburden thickness of soils required for frost protection. Accommodating the frost depth will likely control the bearing depth at the toe walls.

5.3 Global Stability Assessment

As the proposed box culvert construction will include minor changes with similar inclinations to the existing side slopes, a slope stability assessment was performed for the existing embankment. Limit equilibrium analysis was performed using the Slope/W module of GeoStudio 2021, distributed by Geo-Slope International Ltd. Subsurface conditions for global stability analysis were selected based on conditions at the nearest boring and stability was evaluated transverse to the roadway centerline. Spencer's method of analysis has been used to perform global stability analysis and satisfies both force and moment equilibrium which meets the requirements prescribed by AASHTO LRFD Article C11.6.2.2 for slope stability analysis. A 250 psf uniform live load surcharge was applied within roadway limits. Global stability analysis was performed in the Service-I loading condition. AASHTO LRFD requires a resistance factor of 0.75 for slopes not supporting structures to satisfy global stability, which approximately equates to a 1.3 factor of safety. The analysis found that the existing embankment has a minimum Factor of Safety of 1.8 meeting minimum requirements and does not require any stabilization. Refer to Appendix 3 for global stability calculations.

5.4 Construction Considerations

It is expected that the box culvert will be placed on top of the Presumpscot formation Marine Silt and Clay. As this is a soft cohesive material, proper care will need to be taken to ensure the box is founded on a prepared subgrade. The area is to be excavated to 16 inches below the bottom elevation of proposed box culvert, taking care to avoid disturbance of subgrade to remain, for which a smooth-edged bucket is recommended. Dewatering is recommended to perform bearing pad construction in the dry. Careful grade control should be maintained to avoid over excavation.

Excavation slope inclinations should be selected considering the potential for global stability failure, given the relatively low strength of the underlying silt and clay. Temporary support of excavations such as sheet piling should be designed to prevent basal instability. The loose stream alluvium may "flow" when disturbed and the marine silt and clay may lose strength. Subsidence may occur with the extraction of temporary sheeting.

A separation geotextile should be placed on the subgrade, followed by 16 inches of compacted culvert bedding stone with a layer of geogrid installed at the mid-height of the bedding stone layer. The geogrid shall have an opening size between 0.75 and 1 inch and follow MaineDOT Special Provision 620. The culvert can then be constructed or placed atop the compacted bedding stone.

Streamflow will need to be controlled to construct foundations in the dry. This may require damming and diversion, maintaining flow through the northernmost corrugated plate pipe. Temporary dewatering may be necessary in addition to the diversion depending on permitting and on the water level in relation to the capacity of the single corrugated pipe. Dewatering discharge should be handled in accordance with MaineDOT Best Management Practices.

6.0 SEISMIC CONDITIONS

6.1 Seismic Activity

Unlike the seismically active regions in the western United States where the North American and the Pacific plates meet, earthquakes in the northeast occur less frequently, are typically smaller in magnitude, more complex and less understood than plate boundary activity. The project site is situated nearly halfway between the plate boundaries to the west and the Mid-Atlantic Ridge to the east where the North American Plate diverges from the Eurasian Plate. Seismic events occurring deep within these boundaries are known as intraplate earthquakes. In the last few decades a common explanation for the cause of these earthquakes is that ancient zones of weakness are being reactivated in the present day stress field. Due to these uncertainties, the level of seismic hazard in the northeast, as presented by USGS mapping, is based primarily on the past records of seismic activity rather than the location of geologically mapped faults.

According to USGS earthquake history, several significant earthquake epicenters have been recorded in the Northeast region. Table 6.1 summarizes some of the notable earthquakes of magnitude 4.0 or greater centered within 200 miles of the project site over the last 100 years, as reported by USGS earthquake archives.

Table 6.1: Historic Nearby Earthquakes

Approximate Epicenter Location	Date (month/day/year)	Magnitude	Approximate Distance from Project Site (miles)
Waterboro, Maine	10/16/2012	4.7	40
Black Brook, New York	4/20/2002	5.3	180
Peru, Maine	5/29/1983	4.2	27
Sanbornton, New Hampshire	1/19/1982	4.5	92
Altona, New York	6/9/1975	4.2	185
Saint-Augustin-de-Woburn, Quebec	6/15/1973	4.8	187
Scarborough, Maine	4/26/1957	4.4	47
Sangerville, Maine	12/28/1947	4.5	70
Tamworth, New Hampshire	12/24/1940	5.6	66
Dannemora, New York	12/20/1940	5.3	185
Warrensburg, New York	4/15/1934	4.5	193
Ossipee, New Hampshire	4/20/1931	4.7	164
South Paris, Maine	10/9/1925	4.0	23

6.2 Seismic Evaluation

Seismic design of all proposed structures shall be in accordance with the AASHTO LRFD, as supplemented and modified by the MaineDOT BDG. For determining seismic loads and liquefaction criteria, values for the peak ground acceleration coefficient (PGA) and the short- and long-period spectral acceleration coefficients (S_S and S_1, respectively) were obtained from the USGS "U.S. Seismic Design Maps" online system. Values obtained are based on a 7% probability of exceedance over a 75-year period (1033-year return period) per 2002 USGS seismic data and 2009 AASHTO design criteria, with the project latitude and longitude in Monmouth, Maine used as the location of interest. These values were compared and found to be consistent with the corresponding values provided in the 1000-year return period seismic response maps in AASHTO LRFD Figures 3.10.2.1-1 through 3.10.2.1-3.

The reported base acceleration coefficients correspond to the peak ground acceleration at the top of rock (Site Class B). Given the soft soil, the project site meets the criteria given for Site Class E. The recommended design base acceleration coefficients, site factors, and maximum ground acceleration coefficients are presented below in Table 6.2.

Table 6.2: Seismic Response Spectrum

Acceleration Coefficient	At Top of Rock	Site Factor	At Ground Surface
Peak Ground Acceleration	PGA= 0.084g	F_{pga}= 2.5	A_S= 0.209g
0.2 Second Period	S_S= 0.170g	F_a= 2.5	S_{DA}= 0.426g
1.0 Second Period	S_1= 0.046g	F_v= 3.5	S_{D1}= 0.162g

7.0 LIMITATIONS OF REPORT

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. The validity of the conclusions and recommendations contained in this report are necessarily limited by, among other things, the scope of field investigation and by the number of borings. Therefore, given the nature of this subsurface study, there is a possibility that actual conditions encountered will differ from those discussed in this report. Should conditions arise which differ from those described in this report, HNTB should be notified immediately and provided with all information when available regarding subsurface conditions.

As part of the geotechnical recommendations presented in this report, HNTB makes no warranty as to the absence or presence of any environmental hazard or waste present on any property evaluated hereunder and all reports generated here to are qualified as being based upon existing data reasonably available to HNTB and not subject to independent verification. HNTB is not responsible for any latent defects that could not be reasonably discovered during the performance of its services and makes no legal representations whatsoever concerning any matter, including but not limited to, the ownership of any property or the interpretation of any law. These limitations form a material part of this report and are considered incorporated by reference therein. No warranty for the contents of this report, neither expressed nor implied, is made except that professional services were performed in accordance with generally accepted principles and practices.

8.0 REFERENCES

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FIGURE 1

PROJECT LOCATION MAP

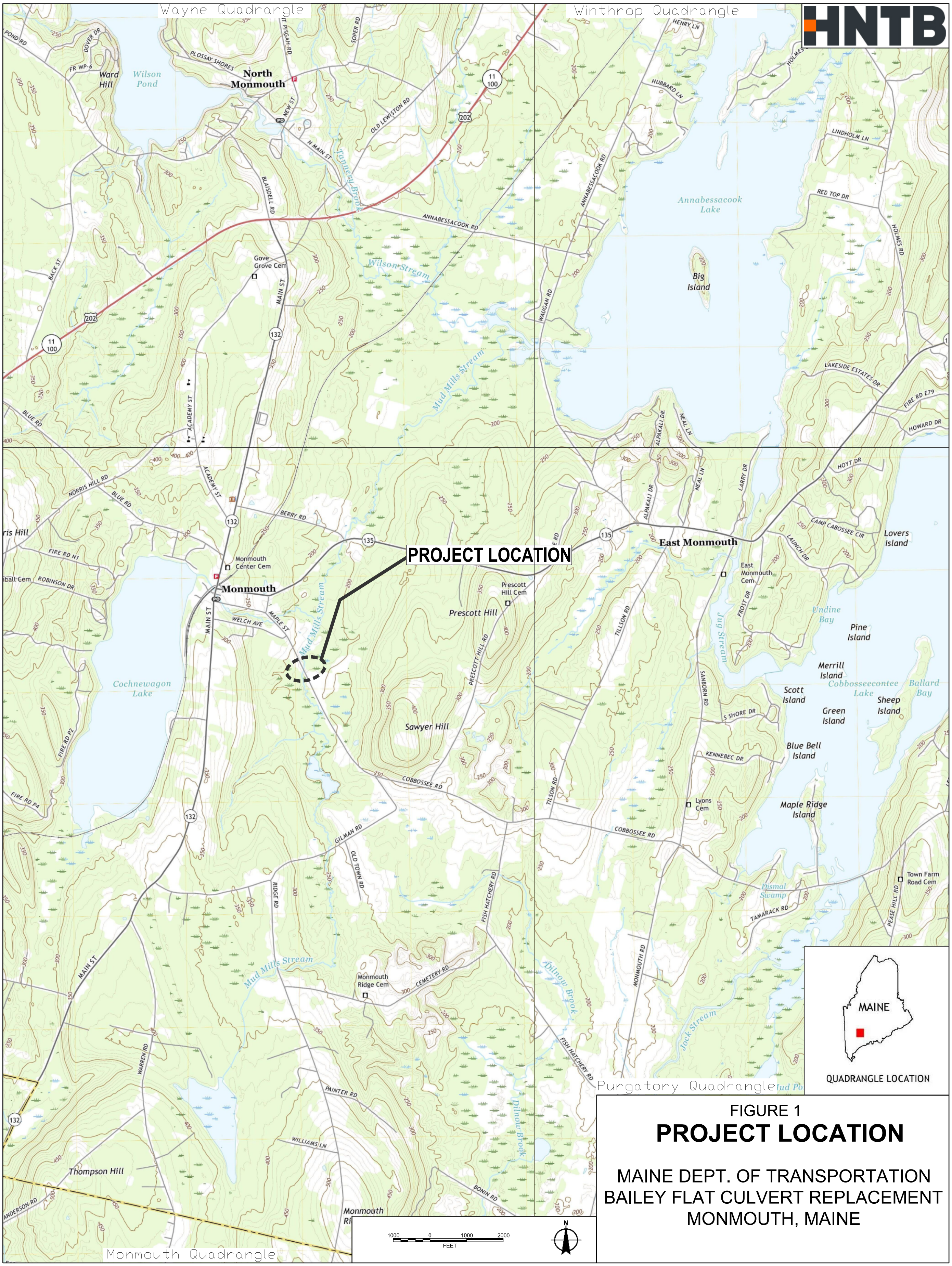


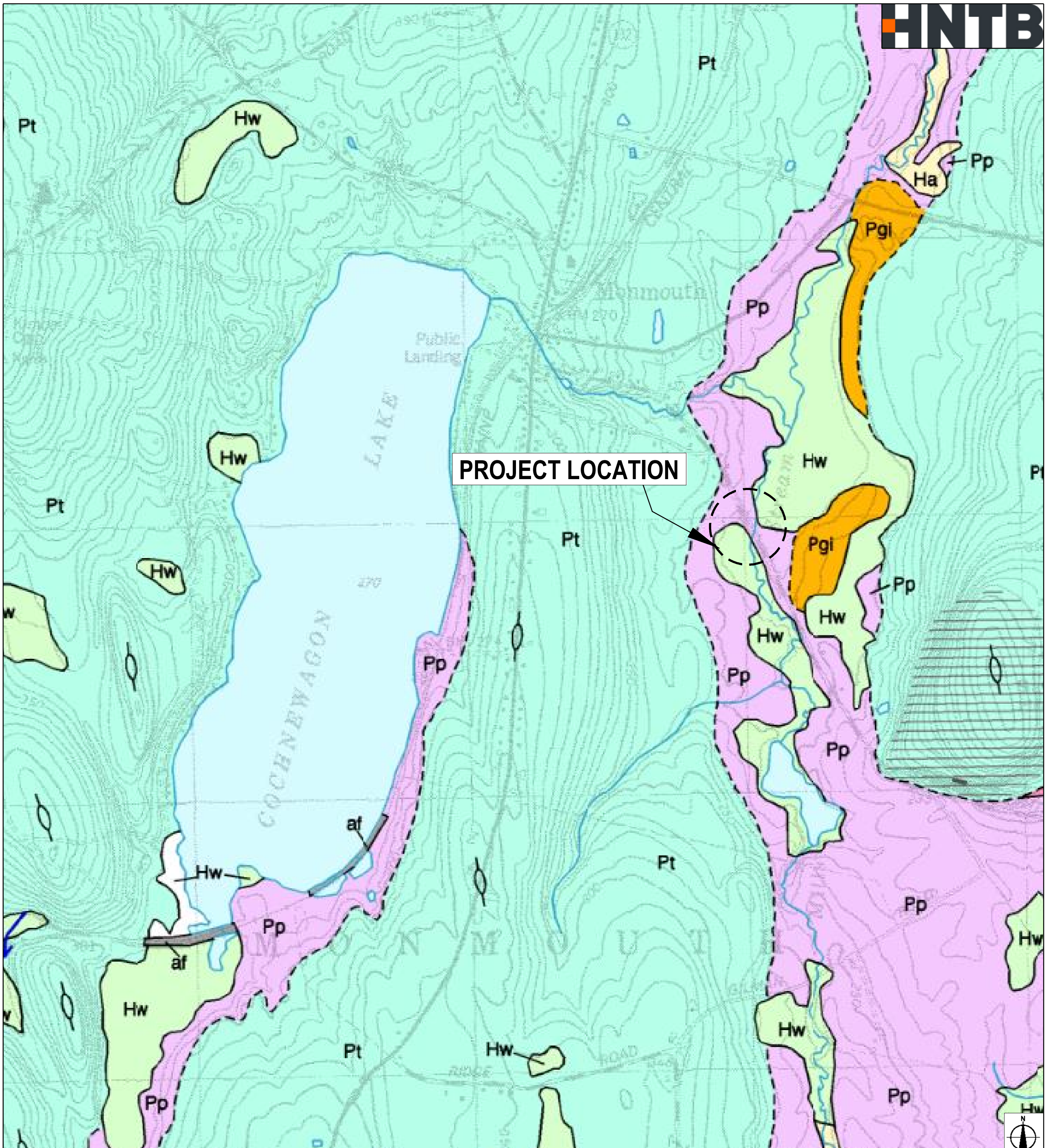
FIGURE 1
PROJECT LOCATION

MAINE DEPT. OF TRANSPORTATION
BAILEY FLAT CULVERT REPLACEMENT
MONMOUTH, MAINE

Basemaps: U.S.G.S. Monmouth, Wayne, Winthrop, and Purgatory, ME Quadrangles US Topo, 2021

FIGURE 2

SURFICIAL GEOLOGY MAP



LEGEND

Ha	Stream alluvium - Gray to brown fine sand silt with some gravel. Comprises flood plains along present streams and rivers. Extent of alluvium approximates areas of potential flooding.
Hw	Freshwater wetlands - Muck, peat, silt, and sand. Poorly drained areas, often with standing water.
Pp	Presumpscot Formation - Massive to laminated silty clay with rare dropstones and occasional shelly horizons, which overlie rock and till, and are interbedded with and overlie end morianes and marine fan deposits; includes sand deposited as a distal unit of submarine fans.
Pgi	Ice-contact deposits - Sand and gravel deposited against remnant masses of glacial ice; massive to well stratified; commonly has collapse features and irregular topography.

1000 0 1000 2000

FEET

FIGURE 2

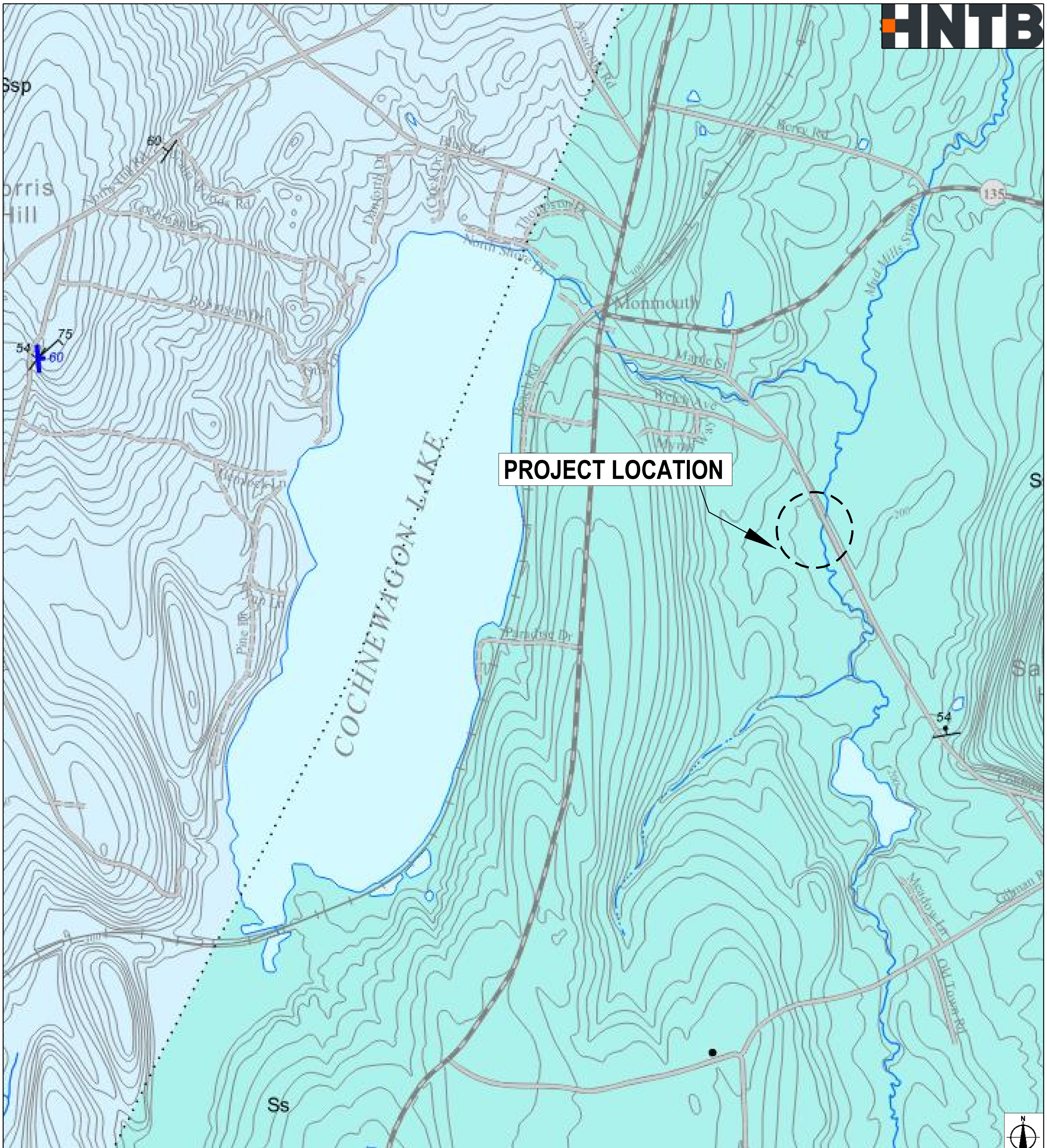
SURFICIAL GEOLOGY MAP

MAINE DEPT. OF TRANSPORTATION
BAILEY FLAT CULVERT REPLACEMENT
MONMOUTH, MAINE

Basemap: U.S.G.S. Surficial Geology Map - Monmouth Quadrangle, Maine - 2008

FIGURE 3

BEDROCK GEOLOGY MAP



LEGEND

Ss	Sangerville Fornation - Medium gray, medium-grained, non-rusty-weathering, biotite-muscovite-garnet-sillimanite schist with subordinate amounts of interlayered light gray biotite-muscovite-quartz-fledspar granofels or greenish-gray calc-silicate granofels. Light gray to white prismatic sillimanite in the darker colored schistose rocks commonly occurs as clumps up to 3 cm in length. Schistose layers range in thickness from 5 to 50 cm with the granofels layers generally thinner (<20 cm thick). Both massive and graded schistose layers are found within the unit.	
Ssp	Patch Mountain Member - Interlayered light greenish-gray, medium-grained, diopside-bearing, calc-silicate granofels and medium gray, medium-grained, biotite-quartz-feldspar granofels. Subordinate amounts of punky-weathering, light gray, medium-grained impure marble or light graymuscovite-biotite schist may be present. Layer thicknesses generally range from 3-10 cm.	

1000 0 1000 2000
FEET

FIGURE 3

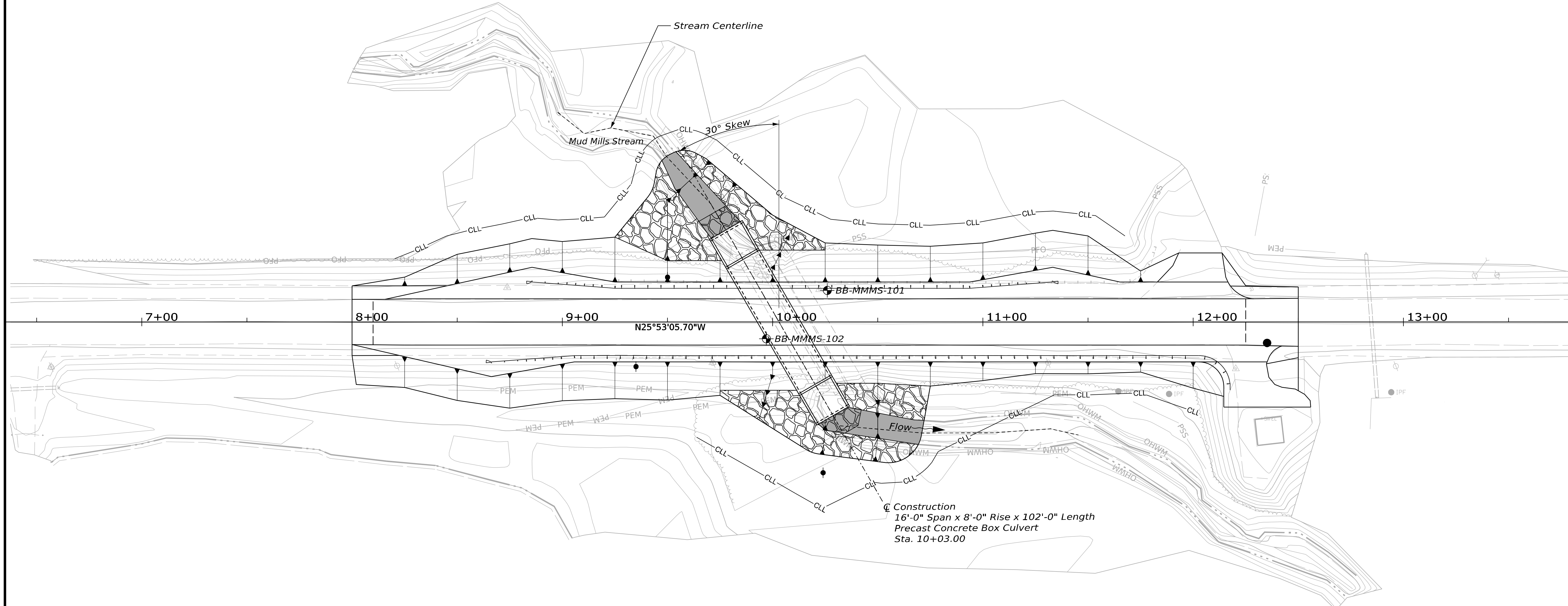
BEDROCK GEOLOGY MAP

MAINE DEPT. OF TRANSPORTATION
BAILEY FLAT CULVERT REPLACEMENT
MONMOUTH, MAINE

Basemap: U.S.G.S. Bedrock Geology Map - Monmouth Quadrangle, Maine - 2021

FIGURE 4

BORING LOCATION PLAN



LEGEND

BB-MMM-XXX — Indicates borings performed by New England Boring Contractors of Hermon, Maine between October 10, and October 11, 2022 and observed by Schonewald Engineering Associates.

PLAN

25 0 25 50

Scale of Feet

98% PS&E
May 2, 2025

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2615600

WIN
026156.00

BRIDGE PLANS

BRIDGE NO. 3671

SIGNATURE

P.E. NUMBER

DATE

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

MONMOUTH
BAILEY FLAT BRIDGE
BORING LOCATION PLAN

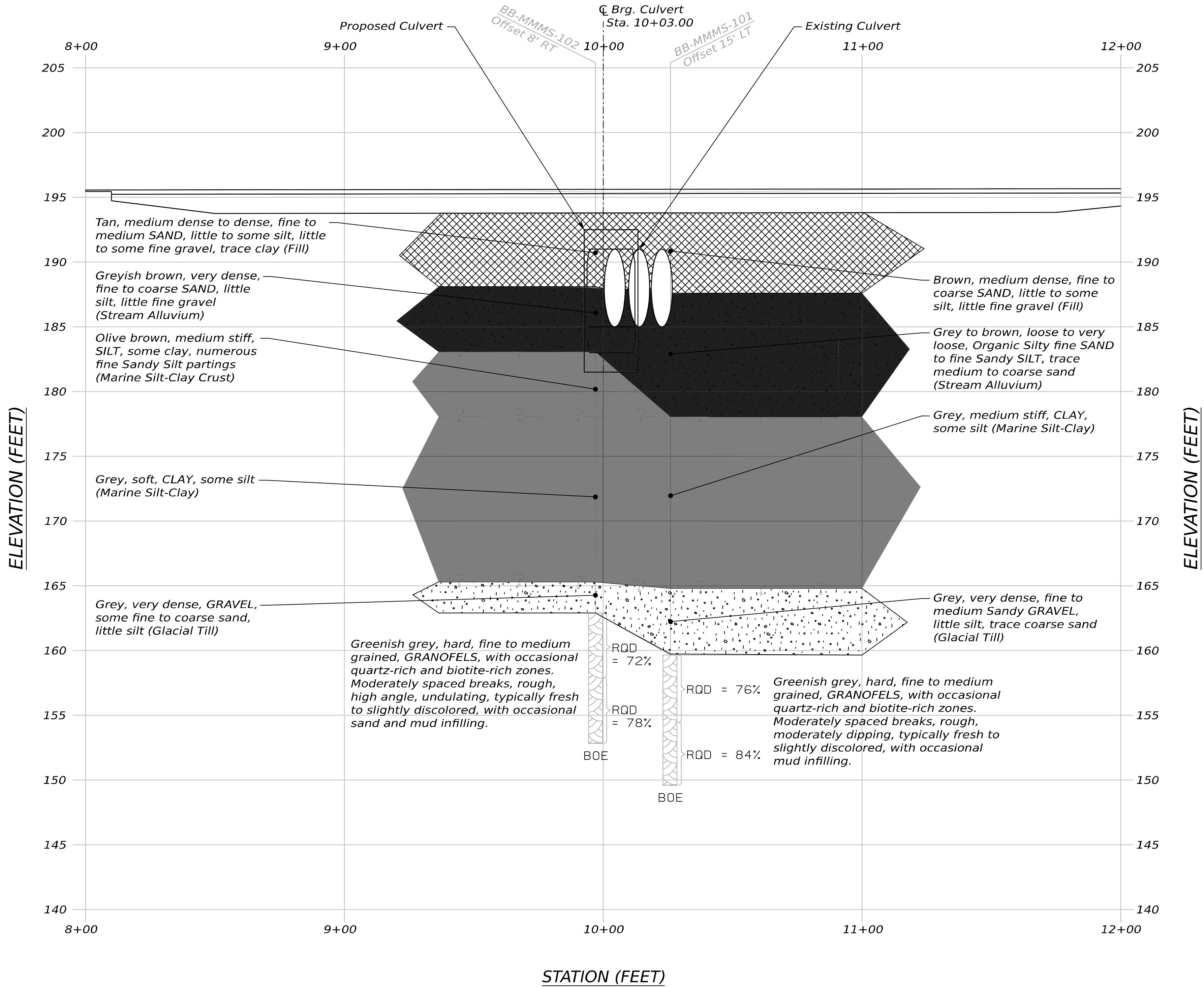
SHEET NUMBER
5
OF 21

Date: 4/28/2025

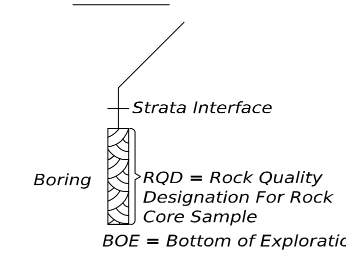
Username: ctobin

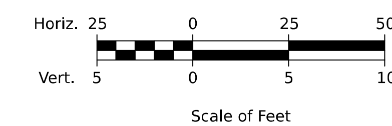
FIGURE 5

SUBSURFACE PROFILE



LEGEND





NOTES:

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

98% PS&E
May 2, 2025

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
2615600
WIN 026156.00
BRIDGE PLANS
BRIDGE NO. 3671

	BY	DATE
PROJ. MANAGER	Trevor Olsson	
DESIGN-DETAILED	M. Rowicki	05/25
CHECKED-REVIEWED	D. Buzza	05/25
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE
P.E. NUMBER
DATE

MONMOUTH
BAILEY FLAT BRIDGE
INTERPRETIVE
SUBSURFACE PROFILE

SHEET NUMBER
6
OF 21

Username: ctobin
Date: 4/28/2025
Filename: z_Interpretive Subsurface Profile.dgn

APPENDIX 1

GEOTECHNICAL DATA REPORT

SCHONEWALD ENGINEERING ASSOCIATES, INC.
■ www.SchonewaldEngineering.com ■

GEOTECHNICAL DATA REPORT
BAILEY FLAT BRIDGE #3671 REPLACEMENT
COBBOSSEECONTEE ROAD OVER MUD MILL STREAM
MONMOUTH, MAINE
MAINEDOT WIN 26156.00

PREPARED FOR:

HNTB Corporation
South Portland, Maine

PREPARED BY:

Schonewald Engineering Associates, Inc. (SchonewaldEA)
Cumberland, Maine

July 23, 2023 – UPDATED to include MaineDOT Key to Soil Descriptions (Attachments Pg 4) and Station and Offset to Boring Logs (Attachments Pgs 5 through 8)
December 2022

SchonewaldEA Project No. 22-017

SCHONEWALD ENGINEERING ASSOCIATES, INC.
■ www.SchonewaldEngineering.com ■

129 MIDDLE ROAD, CUMBERLAND, MAINE 04021
phone 207/829-5226
cell 207/272-9879

VIA EMAIL

December 29, 2022
Project No. 22-017 (Bailey Flat)

Mr. Joe Juzwin, P.E.
Mr. Josh Olund, P.E.
HNTB Corporation
82 Running Hill Road, Suite 201
South Portland, ME 04106

Re: Geotechnical Data Report
Bailey Flat Bridge #3671 Replacement
Cobbosseecontee Road over Mud Mill Stream
Monmouth, Maine
MaineDOT WIN 26156.00

Dear Joe and Josh:

Schonewald Engineering Associates, Inc. (SchonewaldEA) has prepared this geotechnical data report to transmit field- and laboratory-generated data to support HNTB's design work associated with the replacement of Bailey Flat Bridge that carries Cobbosseecontee Road over Mud Mill Stream in Monmouth, Maine (MaineDOT WIN 26156.00). SchonewaldEA's work on this project has been completed under Subconsultant Task Order Agreement No. 581.01 with HNTB that is dated September 9, 2022.

SchonewaldEA completed the following items to support HNTB's design effort:

- Retained New England Boring Contractors (NEBC) to provide drilling and traffic control services, and completed two (2) test borings;
- Coordinated the above field effort, including site reconnaissance; utility clearance; retaining the drilling subcontractor; and coordinating field logistics;
- Observed and logged the test borings on a full-time basis;
- Retained and coordinated a qualified geotechnical laboratory to complete a soils testing program appropriate for the subsurface conditions encountered and proposed design of the replacement bridge;
- Provided draft boring logs and laboratory test results as the project progressed;
- Prepared a boring location plan, boring logs, and photo sheets of the bedrock core;
- Prepared this data report to transmit the boring location plan, boring logs, bedrock core photo sheets, and the laboratory test report; and
- Delivered the remaining soil samples and rock core obtained in the borings to HNTB.

SUBSURFACE EXPLORATION PROGRAM

SchonewaldEA retained New England Boring Contractors of Hermon, Maine to provide drilling and traffic control services for this project. Two test borings were drilled at the bridge site to evaluate subsurface conditions. The test borings were designated BB-MMMS-101 and -102 and were located at opposite corners of the existing bridge. The test borings were drilled on October 10 and 11, 2022 and were observed and logged by SchonewaldEA.

The approximate locations of the test borings are depicted on the Boring Location Plan that is included as Attachment 1. The base plan for the Boring Location Plan was taken from a plan entitled "Bailey Flat Bridge, Mud Mills Stream, Monmouth, Kennebec [County], General Plan," prepared by HNTB, progress print dated November 2022; original scale 1 inch = 50 feet. The borings were located in the field by taping from prominent site features depicted on the survey base plan; the locations should be considered only as accurate as the method implies. The ground surface elevation at each borehole that is noted on the boring log was approximated from the ground surface topography depicted on the base plan.

The test borings were advanced using standard cased wash boring techniques. Each boring was extended through overburden to refusal and approximately 10 feet of NQ2 (N-size, double-barrel core barrel) bedrock core was obtained. The logs of the test borings are included as Attachment 2. Photographs of the bedrock core obtained in the test borings are included as Attachment 3.

Standard Penetration Tests (SPTs) were completed and split-spoon soil samples were obtained near the ground surface and then typically at five-foot intervals to the bottom of each boring. SPTs were performed using an auto hammer that had been calibrated in general conformance with MaineDOT policy. The hammer efficiency factor is recorded on the boring logs. In lieu of SPT'ing / split-spoon sampling, vane shear tests were completed in soft marine silt-clay soils where encountered in the test borings. Vane shear tests were completed using MaineDOT's Geonor vane (65 mm by 130 mm) and the associated soil shear strength was determined using a vane constant developed by MaineDOT. Vane shear testing was completed in accordance with MaineDOT's standard field procedures that conform to the ASTM standard. Thin-walled undisturbed tube samples of the soft marine silt-clay were obtained using a fixed-piston sampler and were obtained, packed/ sealed, and handled/ transported in accordance with generally accepted best field practices.

Groundwater levels observed within the borings are noted on the boring logs, along with the conditions (e.g., stabilization times) under which the groundwater measurements were obtained. The boreholes were backfilled using drill cuttings, supplemented by manufactured sand and gravel.

GEOTECHNICAL LABORATORY TESTING PROGRAM

Representative soil samples obtained in the test borings were submitted to the GeoTesting Express (GTX) geotechnical laboratory in Acton, Massachusetts for a soil testing program to support the design for the new structure. The actual testing program was developed by HNTB's geotechnical group based on draft logs of the test borings provided by SchonewaldEA. The laboratory testing program is summarized in the following table.

Boring No.	Sample No.	Sample Depth (ft, BGS)	Tests Performed
UNDISTURBED TUBE SAMPLES			
BB-MMMS-101	U1	24-26	tube opening, Atterberg limits, moisture content, % -#200, consolidation (CRS)
BB-MMMS102	U1	19-21	tube opening, Atterberg limits, moisture content, % -#200, consolidation (CRS), 3-point CIU shear strength
BB-MMMS-102	U2	28-30	tube opening, Atterberg limits, moisture content, % -#200, consolidation (CRS), 3-point CIU shear strength
SPLIT-SPOON JAR SAMPLES			
BB-MMMS-101	1D & 2D	2-6	AASHTO corrosion series (see Note 1)
BB-MMMS-101	3D	9-11	grain size, organic content
BB-MMMS-101	4D	14-16	Atterberg limits, moisture content
BB-MMMS-101	5D	19-21	%-#200, moisture content
BB-MMMS-101	6D	29-31	Atterberg limits, moisture content
BB-MMMS-101	7D	34-35.8	grain size

Boring No.	Sample No.	Sample Depth (ft, BGS)	Tests Performed
SPLIT-SPOON JAR SAMPLES (cont'd)			
BB-MMMS-102	3D	9-11	grain size, moisture content
BB-MMMS-102	4D	14-16	Atterberg limits, moisture content, grain size
BB-MMMS-102	5D	24-26	Atterberg limits, moisture content
BB-MMMS-102	5D	30-32	grain size

Note 1: Corrosion series was performed on a composite sample of BB-MMMS-101 1D (2-4 ft) and 2D (4-6 ft). There was insufficient sample volume to complete the resistivity test by AASHTO Method T288, therefore, SchonewaldEA directed GTX to proceed with resistivity test by ASTM Method G57; pH, sulfates, and chlorides were determined by AASHTO method.

Laboratory test results are summarized on the test boring logs included as Attachment 2. The laboratory test report that includes methodology/ test standards is included as Attachment 4.

SchonewaldEA appreciates the opportunity to be of service to HNTB and MaineDOT. If you have any questions regarding the work completed by SchonewaldEA or the attached data, please call/reply at your convenience.

Sincerely,
Schonewald Engineering Associates, Inc.

Isabel V. (Be) Schonewald, P.E.
President

Attachments

SCHONEWALD ENGINEERING ASSOCIATES, INC.
www.SchonewaldEngineering.com

GEOTECHNICAL DATA REPORT
BAILEY FLAT BRIDGE #3671 REPLACEMENT
COBBOSSEECONTEE ROAD OVER MUD MILL STREAM
MONMOUTH, MAINE
MAINEDOT WIN 26156.00

ATTACHMENTS

ATTACHMENT 1

BORING LOCATION PLAN

BASE PLAN TAKEN FROM PLAN ENTITLED "BAILEY FLAT BRIDGE, MUD MILLS STREAM, MONMOUTH, KENNEBEC, GENERAL PLAN," PREPARED BY HNTB, DATED 11/22, ORIGINAL SCALE 1" = 50'

SCHONEWALD ENGINEERING ASSOCIATES, INC.

PROJECT NO.:	22-017
DATE:	DEC 2022
DRAWN BY:	IVS
APPROX. SCALE:	1" = 25'

BORING LOCATION PLAN
BAILEY FLAT BRIDGE #3671
COBBOSSEESONTEE ROAD OVER MUD MILL STREAM
MONMOUTH, MAINE
MAINEDOT WIN 26156.00

Figure No.:

1

SCHONEWALD ENGINEERING ASSOCIATES, INC.
■ www.SchonewaldEngineering.com ■

ATTACHMENT 2

MAINEDOT KEY TO SOIL DESCRIPTIONS
&
BORING LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

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

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

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

MODIFIED BURMISTER SYSTEM

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

TERMS DESCRIBING DENSITY/CONSISTENCY

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

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

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

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

Rock Quality Designation (RQD):

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

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

Rock Quality Based on RQD

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

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

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

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

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

Sample Container Labeling Requirements:

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

January 2020

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Bailey Flat Bridge #3671
Cobbosseecontee Rd o Mud Mill Stream
Location: Monmouth, ME

Boring No.: BB-MMMS-101

WIN: 26156.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	194.5	**Auger ID/OD:**	n/a
Operator:	Enos/ Gomm	**Datum:**	NAVD88	**Sampler:**	Standard Split-Spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 track (NEBC-23)	**Hammer Wt./Fall:**	140 lbs/ 30 in
Date Start/Finish:	10/10/22; 0830-1345	**Drilling Method:**	cased wash boring	**Core Barrel:**	NQ2
Boring Location:	Station 10+26, 15 ft LT	**Casing ID/OD:**	HW(4.0/4.5) 34.0' /NW(3.0/3.5) 36.2'	**Water Level*:**	6.6 ft (open, end)
Hammer Efficiency Factor:	0.859	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							PUSH			GRAVEL SHOULDER	
	1D	24/13	2.0 - 4.0	5-5-5-8	10	14				Brown, damp to moist, medium dense, fine to coarse SAND, little fine gravel, little silt, (Fill).	NO GTX# CORROSION SERIES (COMPOSITE W 2D)
	2D	24/16	4.0 - 6.0	10-12-9-7	21	30	RC			Brown, moist, medium dense, fine to coarse SAND, little to some silt, little fine gravel, (Fill).	REFER TO 1D
5											
								186.5		8.0	
	3D	24/14	9.0 - 11.0	3-1-2-1	3	4	19			Grey grading to brown-grey, very loose, Organic Silty fine SAND, trace medium to coarse sand, with occasional wood, (Stream Alluvium).	GTX#693305 ORG CONTENT 4.1% GTX#693300 G=A-4(0)
10							27				
							46				
							69				
							65				
	4D	24/17	14.0 - 16.0	3-2-3-3	5	7	RC			Grey, loose, fine Sandy SILT, trace clay. Grading to grey, medium stiff, SILT, some clay, little fine sand with numerous partings Silty fine SAND, (Stream Alluvium/ transition to Marine Silt-Clay Crust).	GTX#693284 WC=24.9% GTX#693278 LL=25 PL=18 PI=7
15											
								177.0		17.5	
	5D	24/22	19.0 - 21.0	PUSH THRU VANE			OPEN			Dark grey with black, medium stiff, CLAY, some silt, (Marine Silt-Clay).	GTX#693284 WC=35.7% GTX#693293 %-#200=99.3
20	V1		19.6 - 20.0	Su=769 /82 psf						V1: 28 / 3 ft-lbs (65 mm x 130 mm vane raw torque readings)	
	V2		20.6 - 21.0	Su=522 /41 psf						V2: 19 / 1.5 ft-lbs (65 mm x 130 mm vane raw torque readings)	
	U1	24/14	24.0 - 26.0	PISTON SAMPLER						Olive grey, CLAY, some silt, (Marine Silt-Clay).	GTX#693284 WC=44.4% GTX#693275
25											

Remarks:

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Bailey Flat Bridge #3671 Cobbosseecontee Rd o Mud Mill Stream
Location: Monmouth, ME

Boring No.: BB-MMMS-101
WIN: 26156.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	194.5	**Auger ID/OD:**	n/a
Operator:	Enos/ Gomm	**Datum:**	NAVD88	**Sampler:**	Standard Split-Spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 track (NEBC-23)	**Hammer Wt./Fall:**	140 lbs/ 30 in
Date Start/Finish:	10/10/22; 0830-1345	**Drilling Method:**	cased wash boring	**Core Barrel:**	NQ2
Boring Location:	Station 10+26, 15 ft LT	**Casing ID/OD:**	HW(4.0/4.5) 34.0' /NW(3.0/3.5) 36.2'	**Water Level*:**	6.6 ft (open, end)
Hammer Efficiency Factor:	0.859	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
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WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25											LL=44 PL=21 PI=23 GTX#693293 %-#200=99.9 GTX#CRC-2 CRS CONSOL
	6D	24/24	29.0 - 31.0	PUSH THRU VANE			RC			Olive grey, medium stiff, CLAY, some silt, (Marine Silt-Clay). V3: 23 / 3 ft-lbs (65 mm x 130 mm vane raw torque readings)	GTX#693284 WC=31.7% GTX#693279 LL=27 PL=17 PI=10
30	V3		29.6 - 30.0	Su=632 /82 psf							
	MV		30.6 - 31.0	--				163.7		MV: Grit noted during push. 30.8	
										30.8 ft: Granular material encountered.	
	7D	21/13	34.0 - 35.8	15-30-43-50/3"	73	105				Light grey, very dense, fine to medium Sandy GRAVEL, little silt, trace coarse sand; bottom 4 inches appears to be decomposed rock, (Glacial Till).	GTX#693301 G=A-1-b(0)
35								158.5		36.0	
	R1	60/60	36.2 - 41.2	RQD = 76%			NQ2			Top of bedrock at Elev. 158.5 ft. R1: Bedrock: Greenish grey, fine to medium grained, GRANOFELS, with occasional quartz-rich and biotite-rich zones; moderately dipping, thinly laminated remnant bedding visible; hard, typically fresh. Typically moderately dipping, moderately spaced breaks; undulating, rough, typically fresh to slightly discolored, and open to wide, with occasional mud infilling. (PATCH MOUNTAIN MEMBER) Core times: 1:55/ 2:00/ 2:05/ 2:05/ 2:15 min:sec/ft. ROCK QUALITY = GOOD	
40											
	R2	58/58	41.2 - 46.0	RQD = 84%						R2: Similar to R1, except very close breaks 41.2 to 42.0 ft. Core times: 1:45/ 1:25/ 1:35/ 1:35/ -- min:sec/ft. ROCK QUALITY = GOOD	
45								148.5		46.0	
										Bottom of Exploration at 46.0 feet below ground surface.	
50											

Remarks:

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

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

Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: Bailey Flat Bridge #3671 Cobbosseecontee Rd o Mud Mill Stream
Location: Monmouth, ME

Boring No.: BB-MMMS-102

WIN: 26156.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	195	**Auger ID/OD:**	SSA (4.5") 4'
Operator:	Enos/ Gomm	**Datum:**	NAVD88	**Sampler:**	Standard Split-Spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 track (NEBC-23)	**Hammer Wt./Fall:**	140 lbs/ 30 in
Date Start/Finish:	10/11/22; 0755-1400	**Drilling Method:**	cased wash boring	**Core Barrel:**	NQ2
Boring Location:	Station 9+97, 8 ft RT	**Casing ID/OD:**	HW(4.0/4.5) 19.0' /NW(3.0/3.5) 32.7'	**Water Level*:**	7.3 ft (open, end)
Hammer Efficiency Factor:	0.859	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			7 inches HMA	
	1D	24/19	2.0 - 4.0	11-11-10-21	21	30				Tan, damp, medium dense, fine to medium SAND, little fine gravel, little silt, trace clay, (Fill).	
	2D	24/16	4.0 - 6.0	18-15-8-10	23	33	25			Tan, damp to moist, dense, fine to coarse SAND, little to some gravel, little to some silt, (Fill).	
5							32				
							30				
							25	187.5		7.5	
							22				
	3D	24/9	9.0 - 11.0	4-6-63-53	--		RC			Dark greyish brown, fine to coarse SAND, little silt, little fine gravel; 3-inch layer wood in bottom of sample, likely skewed blow counts, (Stream Alluvium).	GTX#693284 WC=14.8% GTX#693302 G=A-1-b(0)
10											
								182.5		12.5	
	MV									MV: Unable to push vane at 14. 0 ft.	
	4D	24/19	14.0 - 16.0	7-4-4-8	8	11	71			Olive brown, slightly mottled, stiff, SILT, some clay, with numerous partings fine Sandy SILT, (Marine Silt-Clay Crust).	GTX#693284 WC=27.2% GTX#693280 LL=28 PL=21 PI=7 GTX#693303 G=A-4(7)
15							63				
							72				
							73	177.5		17.5	
							74				
	U1	24/21	19.0 - 21.0	PISTON SAMPLER			OPEN			Dark grey black, CLAY, some silt, (Marine Silt-Clay).	GTX#693284 WC=33.2% GTX#693276 LL=36 PL=22 PI=14 GTX#693293 %-#200=99.3 GTX#-- 3-pt CIU GTX#CRC-3 CRS CONSOL
20											
	5D	24/10	24.0 - 26.0	PUSH THRU VANE						Grey, soft, CLAY, some silt, (Marine Silt-Clay). V1: 5* / 2 ft-lbs (65 mm x 130 mm vane raw torque readings); * gritty	GTX#693284 WC=44.4% GTX#693281
25											

Remarks:

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Bailey Flat Bridge #3671 Cobbosseecontee Rd o Mud Mill Stream
Location: Monmouth, ME

Boring No.: BB-MMMS-102
WIN: 26156.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	195	**Auger ID/OD:**	SSA (4.5") 4'
Operator:	Enos/ Gomm	**Datum:**	NAVD88	**Sampler:**	Standard Split-Spoon
Logged By:	Schonewald	**Rig Type:**	Mobile Drill B-53 track (NEBC-23)	**Hammer Wt./Fall:**	140 lbs/ 30 in
Date Start/Finish:	10/11/22; 0755-1400	**Drilling Method:**	cased wash boring	**Core Barrel:**	NQ2
Boring Location:	Station 9+97, 8 ft RT	**Casing ID/OD:**	HW(4.0/4.5) 19.0' /NW(3.0/3.5) 32.7'	**Water Level*:**	7.3 ft (open, end)
Hammer Efficiency Factor:	0.859	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	V1 V2		24.6 - 25.0 25.6 - 26.0	-- Su=426 /41 psf						during shear, likely skewed reading V2: 15.5 / 1.5 ft-lbs (65 mm x 130 mm vane raw torque readings)	LL=42 PL=23 PI=19
	U2	24/17	28.0 - 30.0	PISTON SAMPLER						Grey, CLAY, some silt; fine sand on bottom of sample, (Marine Silt-Clay).	GTX#693284 WC=25.1% GTX#693277 LL=26 PL=19 PI=7
30	6D	24/9	30.0 - 32.0	4-30-10-18	40	57	RC	164.7		Grey, CLAY, some silt, (Marine Silt-Clay). Changing at 30.3 ft to: 30.3 6D: Grey, very dense, GRAVEL, some fine to coarse sand, little silt, (Glacial Till).	GTX#693293 %-#200=99.4 GTX#-- 3-pt CIU GTX#CRC-1 CRS CONSOL GTX#693304 G=A-1-b(0)
	R1	58/58	32.9 - 37.7	RQD = 72%			NQ2	162.3		32.7 Top of bedrock at Elev. 162.3 ft. R1: Bedrock: Greenish grey, fine to medium grained, GRANOFELS, with quartz-rich and biotite-rich zones; high-angle and undulating remnant bedding visible; hard, typically fresh. Typically low angle to moderately dipping, moderately spaced breaks; undulating, rough, fresh to slightly discolored, and open to wide, with occasional fine sand and mud infilling. (PATCH MOUNTAIN MEMBER) Core times: 4:05/ 2:55/ 2:45/ 3:15/ -- min:sec/ft. ROCK QUALITY = FAIR	
35											
	R2	60/60	37.7 - 42.7	RQD = 78%						R2: Similar to R1, except open fractures 39.3 to 39.4 and 41.1 to 41.2 ft. Core times: 3:15/ 2:45/ 2:20/ 2:10/ 2:00 min:sec ft. ROCK QUALITY = GOOD	
40											
								152.3		42.7 **Bottom of Exploration at 42.7 feet below ground surface.**	
45											
50											

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.

ATTACHMENT 3

BEDROCK CORE PHOTOGRAPHS

Core box containing wetted core from test boring BB-MMMS-101 (Box 1 of 1); left side of core box (top portion of cores). Slots from top to bottom:
1) BB-MMMS-101, R1;
2) BB-MMMS-101, R2;
3) empty;
4) empty.

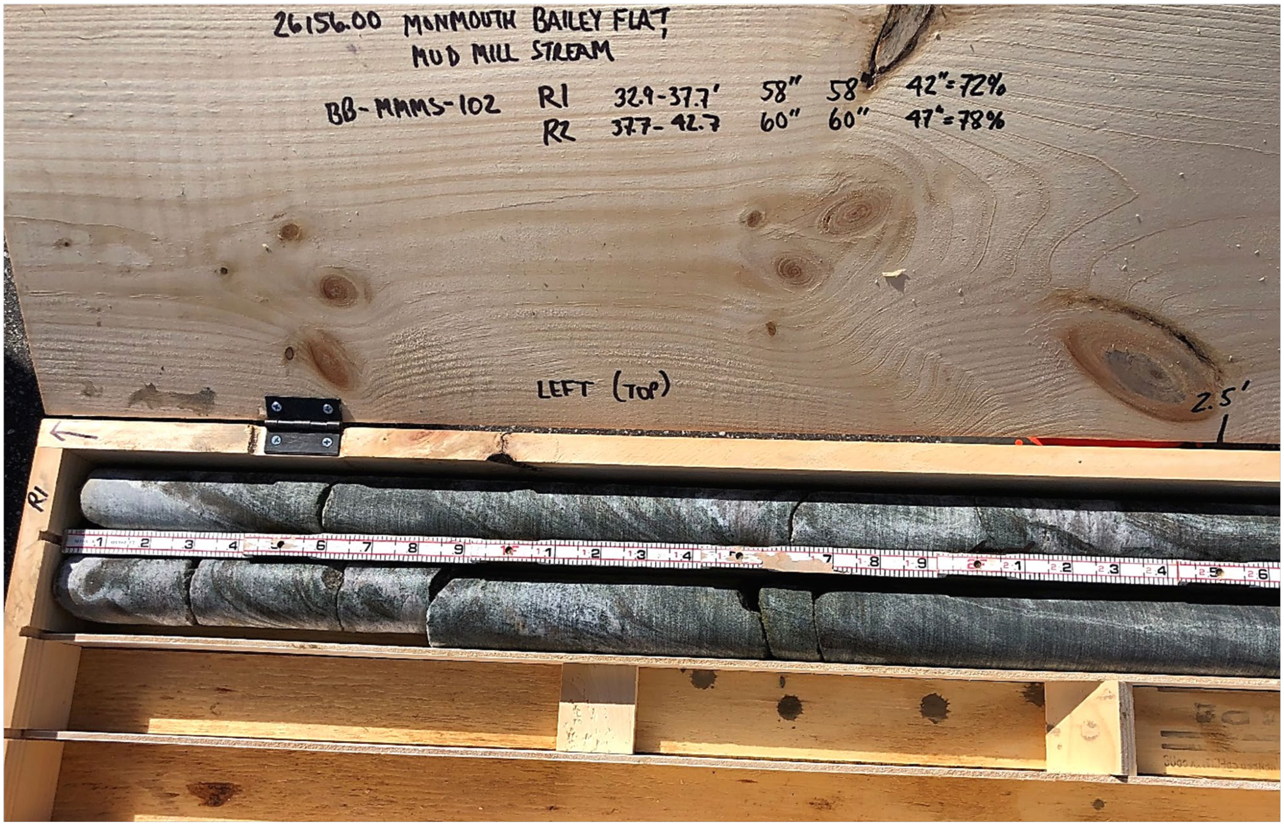
Core box containing wetted core from test boring BB-MMMS-101 (Box 1 of 1); right side of core box (bottom portion of cores). Slots from top to bottom:
1) BB-MMMS-101, R1;
2) BB-MMMS-101, R2;
3) empty;
4) empty.

SCHONEWALD ENGINEERING ASSOCIATES, INC.

ROCK CORE PHOTOGRAPHS
BAILEY FLAT BRIDGE #3671
COBBOSSEESONTEE ROAD OVER MUD MILL STREAM
MONMOUTH, MAINE
MAINEDOT WIN 26156.00

Sheet No.:

1 of 2



Core box containing wetted core from test boring BB-MMMS-102 (Box 1 of 1); left side of core box (top portion of cores). Slots from top to bottom:

1) BB-MMMS-102, R1;
2) BB-MMMS-102, R2;
3) empty;
4) empty.

Core box containing wetted core from test boring BB-MMMS-102 (Box 1 of 1); right side of core box (bottom portion of cores). Slots from top to bottom:

1) BB-MMMS-102, R1;
2) BB-MMMS-102, R2;
3) empty;
4) empty.

SCHONEWALD ENGINEERING ASSOCIATES, INC.

ROCK CORE PHOTOGRAPHS
BAILEY FLAT BRIDGE #3671
COBBOSSEESONTEE ROAD OVER MUD MILL STREAM
MONMOUTH, MAINE
MAINEDOT WIN 26156.00

Sheet No.:

2 of 2

ATTACHMENT 4

RESULTS OF LABORATORY TESTS ON SOIL SAMPLES

TABULATION OF SOIL TESTING (GTX PROJECT NO. 316328) (listed in order of test report presentation)				
Boring No.	Sample No.	Sample Depth (ft., BGS)	GTX TEST ID / NO.	Tests Completed (Method)
BB-MMMS-101	4D	14-16	693284	moisture content (ASTM D2216)
BB-MMMS-101	5D	19-21	693284	moisture content (ASTM D2216)
BB-MMMS-101	6D	29-31	693284	moisture content (ASTM D2216)
BB-MMMS-101	U1	24-26	693284	moisture content (ASTM D2216)
BB-MMMS-102	3D	9-11	693284	moisture content (ASTM D2216)
BB-MMMS-102	4D	14-16	693284	moisture content (ASTM D2216)
BB-MMMS-102	5D	24-26	693284	moisture content (ASTM D2216)
BB-MMMS-102	U1	19-21	693284	moisture content (ASTM D2216)
BB-MMMS-102	U2	28-30	693284	moisture content (ASTM D2216)
BB-MMMS-101	3D	9-11	693305	moisture, ash, organic matter (ASTM D2974)
BB-MMMS-101	1D, 2D	2-6	not provided	ph (AASHTO T289)
BB-MMMS-101	1D, 2D	2-6	not provided	lab soil resistivity (ASTM G57)
BB-MMMS-101	5D	19-21	693293	fines content [% passing #200 sieve] (ASTM D1140)
BB-MMMS-101	U1	24-26	693293	fines content [% passing #200 sieve] (ASTM D1140)
BB-MMMS-102	U1	19-21	693293	fines content [% passing #200 sieve] (ASTM D1140)
BB-MMMS-102	U2	28-30	693293	fines content [% passing #200 sieve] (ASTM D1140)
BB-MMMS-101	3D	9-11	693300	grain size w/o hydrometer (ASTM D6913)
BB-MMMS-101	7D	34-35.8	693301	grain size w/o hydrometer (ASTM D6913)
BB-MMMS-102	3D	9-11	693302	grain size w/o hydrometer (ASTM D6913)
BB-MMMS-102	4D	14-16	693303	grain size w/o hydrometer (ASTM D6913)
BB-MMMS-102	6D	30-32	693304	grain size w/o hydrometer (ASTM D6913)
BB-MMMS-101	4D	14-16	693278	Atterberg Limits (ASTM D4318)
BB-MMMS-101	6D	29-31	693279	Atterberg Limits (ASTM D4318)
BB-MMMS-101	U1	24-26	693275	Atterberg Limits (ASTM D4318)
BB-MMMS-102	4D	14-16	693280	Atterberg Limits (ASTM D4318)
BB-MMMS-102	5D	24-26	693281	Atterberg Limits (ASTM D4318)
BB-MMMS-102	U1	19-21	693276	Atterberg Limits (ASTM D4318)
BB-MMMS-102	U2	28-30	693277	Atterberg Limits (ASTM D4318)
BB-MMMS-102	U2	28-30	not provided	3-point CIU triaxial test (ASTM D4767)
BB-MMMS-102	U1	19-21	not provided	3-point CIU triaxial test (ASTM D4767)
BB-MMMS-101	U1	24-26	CRC-2	constant rate of strain consolidation (ASTM D4186)
BB-MMMS-102	U1	19-21	CRC-3	constant rate of strain consolidation (ASTM D4186)
BB-MMMS-102	U2	28-30	CRC-1	constant rate of strain consolidation (ASTM D4186)
BB-MMMS-101	1D, 2D	2-6	TEi-Testing Services	Chloride Method B (AASHTO T291)
BB-MMMS-101	1D, 2D	2-6	TEi-Testing Services	Sulfates [Soluble] (AASHTO T290)

Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID:	---	Sample Type: ---	Tested By: ckg
Sample ID:	---	Test Date: 11/10/22	Checked By: bfs
Depth :	---	Test Id: 693284	

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BB-MMMS-101	4D	14-16'	Moist, olive gray silty clay	24.9
BB-MMMS-101	5D	19-21'	Moist, dark gray clay	35.7
BB-MMMS-101	6D	29-31'	Wet, olive gray clay	31.7
BB-MMMS-101	U1	24-26'	Moist, gray clay	44.4
BB-MMMS-102	3D	9-11'	Moist, dark olive brown silty sand with gravel	14.8
BB-MMMS-102	4D	14-16'	Moist, olive gray silty clay	27.2
BB-MMMS-102	5D	24-26'	Moist, olive gray clay	44.4
BB-MMMS-102	U1	19-21'	Moist, gray clay	33.2
BB-MMMS-102	U2	28-30'	Moist, gray silty clay	25.1

Notes: Temperature of Drying : 110º Celsius

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Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID: BB-MMMS-101	Sample Type: jar	Tested By:	cam
Sample ID: 3D	Test Date: 11/19/22	Checked By:	bfs
Depth : 9-11'	Test Id: 693305		
Test Comment:	---		
Visual Description:	Moist, grayish brown silty sand		
Sample Comment:	---		

Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content,%	Ash Content,%	Organic Matter,%
BB-MMMS-101	3D	9-11'	Moist, grayish brown silty sand	49	95.9	4.1

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

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Client:	Schonewald Engineering Associates, Inc.
Project Name:	Bailey Flat Bridge, Mud Mill Stream
Project Location:	Monmouth, ME
GTX #:	316328
Test Date:	11/15/22
Tested By:	NLB
Checked By:	bfs

pH by AASHTO T 289

Boring ID	Sample ID	Depth, ft	Description	pH
BB-MMS-101	1D, 2D	2-6	Moist, yellowish brown silty sand	8.37

GeoTesting EXPRESS

Client:	Schonewald Engineering Associates, Inc.
Project:	Bailey Flat Bridge, Mud Mill Stream
Location:	Monmouth, ME
GTX#:	316328
Test Date:	11/15/22
Tested By:	nlb
Checked By:	bfs

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, $(ohm\text{-}cm)^{-1}$
BB-MMS-101	1D, 2D	2-6	Moist, yellowish brown silty sand	51,652	1.94E-05

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

Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	11/11/22	Checked By:	bfs
Depth :	---	Test Id:	693293		

Amount of Material Passing #200 Sieve - ASTM D1140

Boring ID	Sample ID	Depth	Visual Description	Fines, %
BB-MMMS-101	5D	19-21'	Moist, dark gray clay	99.3
BB-MMMS-101	U1	24-26'	Moist, gray clay	99.9
BB-MMMS-102	U1	19-21'	Moist, gray clay	99.3
BB-MMMS-102	U2	28-30'	Moist, gray silty clay	99.4

Notes: Tests performed using Method B - washing using a wetting agent
Dry mass of test specimen was determined directly

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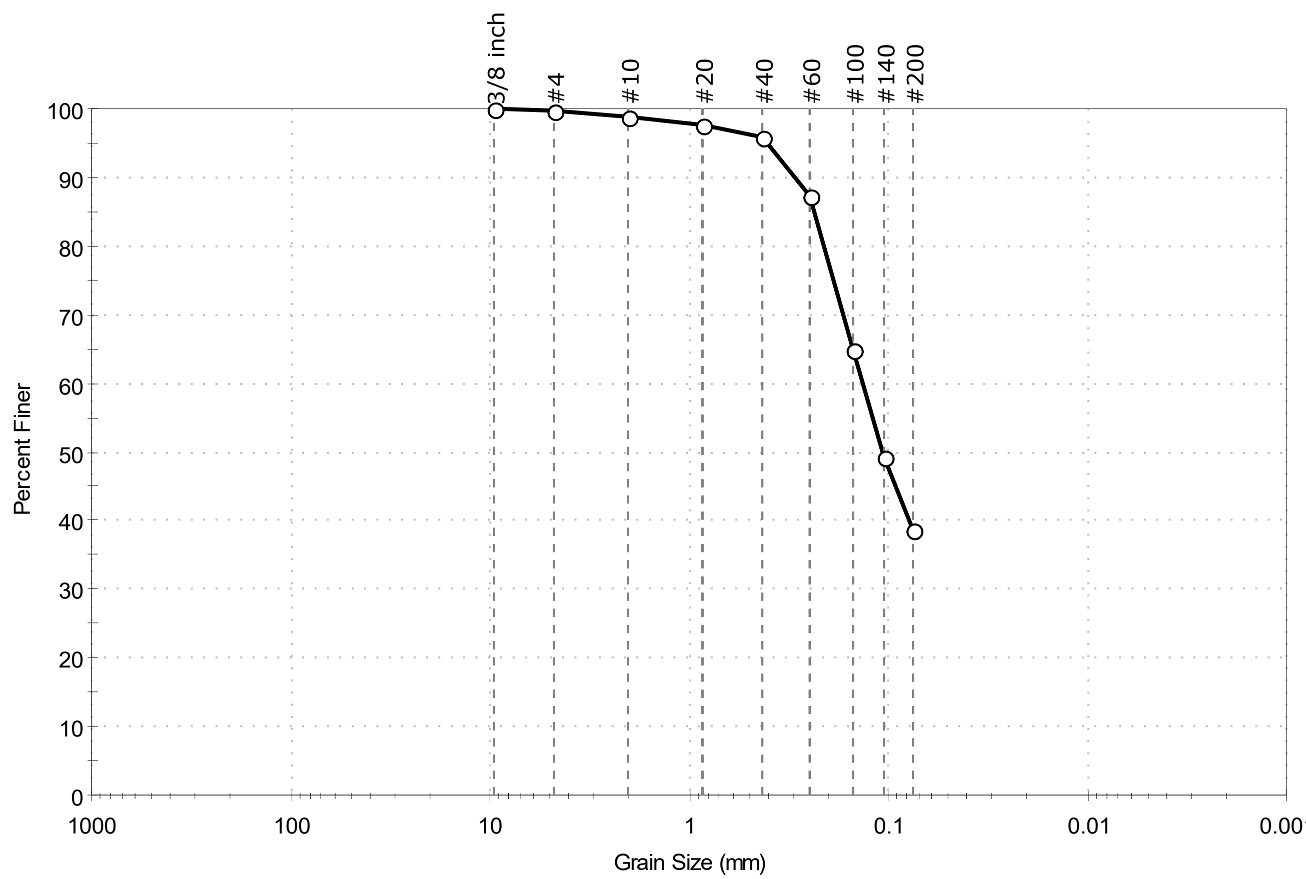
Client:	Schonewald Engineering Associates, Inc.			
Project:	Bailey Flat Bridge, Mud Mill Stream			
Location:	Monmouth, ME		Project No:	GTX-316328
Boring ID:	BB-MMMS-101	Sample Type: jar	Tested By:	ckg
Sample ID:	3D	Test Date: 11/11/22	Checked By:	bfs
Depth :	9-11'	Test Id: 693300		

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

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.3	61.1	38.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	96		
#60	0.25	87		
#100	0.15	65		
#140	0.11	49		
#200	0.075	39		

Coefficients

D_{85} =0.2373 mm
D_{30} =N/A
D_{60} =0.1345 mm
D_{15} =N/A
D_{50} =0.1077 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 : ---

Sand/Gravel Hardness : ---

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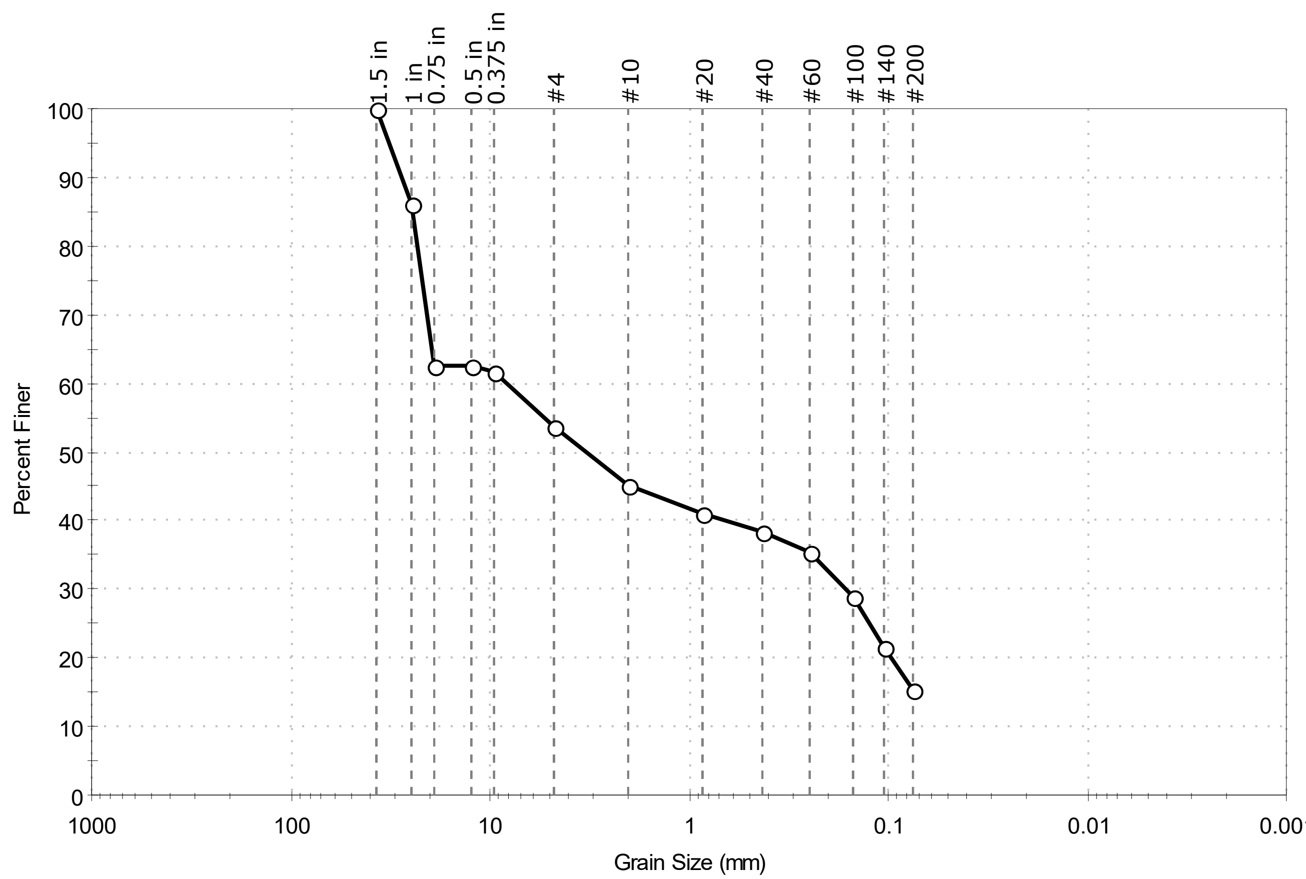
GeoTesting EXPRESS

Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	BB-MMMS-101	Sample Type:	jar	Tested By:	ckg
Sample ID:	7D	Test Date:	11/11/22	Checked By:	bfs
Depth :	34-35.8'	Test Id:	693301		

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

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	46.3	38.2	15.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	86		
0.75 in	19.00	63		
0.5 in	12.50	63		
0.375 in	9.50	62		
#4	4.75	54		
#10	2.00	45		
#20	0.85	41		
#40	0.42	38		
#60	0.25	35		
#100	0.15	29		
#140	0.11	21		
#200	0.075	15		

Coefficients

D_{85} =24.7043 mm
D_{30} =0.1645 mm
D_{60} =8.2826 mm
D_{15} =N/A
D_{50} =3.2793 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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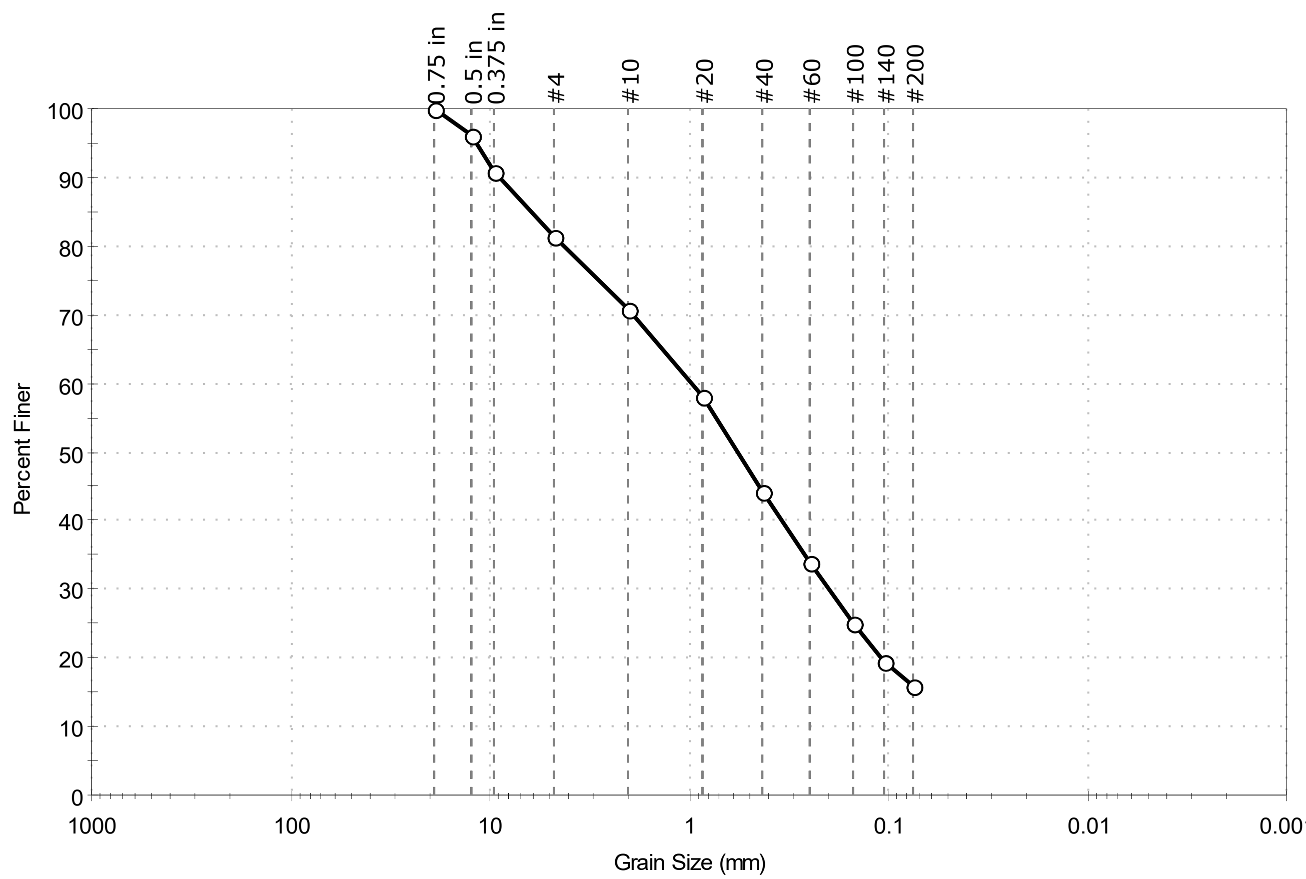
Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID:	BB-MMMS-102	Sample Type: jar	Tested By: ckg
Sample ID:	3D	Test Date: 11/11/22	Checked By: bfs
Depth :	9-11'	Test Id: 693302	
Test Comment:	---		
Visual Description:	Moist, dark olive brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	18.6	65.5	15.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	96		
0.375 in	9.50	91		
#4	4.75	81		
#10	2.00	71		
#20	0.85	58		
#40	0.42	44		
#60	0.25	34		
#100	0.15	25		
#140	0.11	20		
#200	0.075	16		

Coefficients

D_{85} =6.1775 mm | D_{30} =0.1998 mm

D_{60} =0.9704 mm | D_{15} =N/A

D_{50} =0.5677 mm | D_{10} =N/A

C_u =N/A | C_c =N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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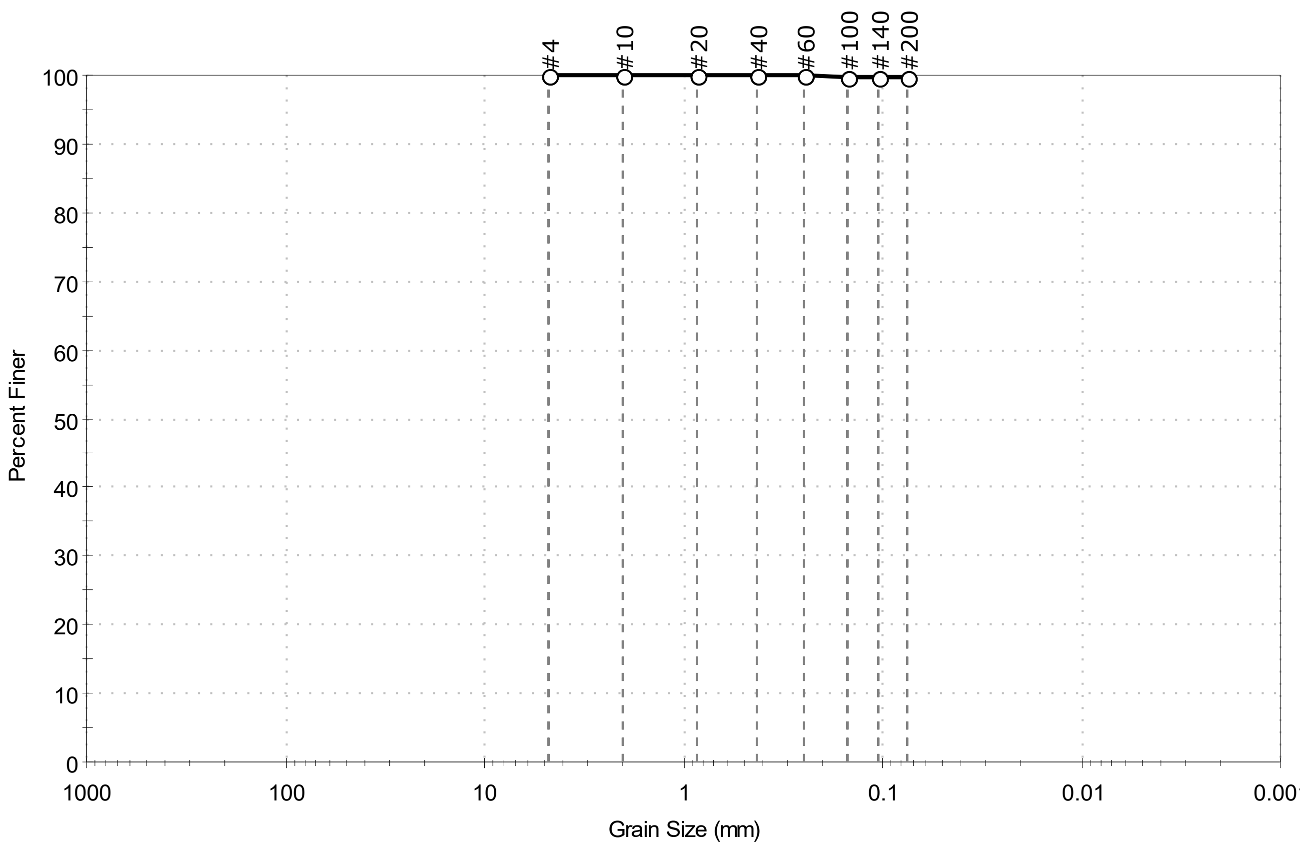
Client: Schonewald Engineering Associates, Inc.
Project: Bailey Flat Bridge, Mud Mill Stream
Location: Monmouth, ME
Project No: GTX-316328

Boring ID:	BB-MMMS-102	Sample Type:	jar	Tested By:	ckg
Sample ID:	4D	Test Date:	11/11/22	Checked By:	bfs
Depth :	14-16'	Test Id:	693303		

Test Comment: ---
Visual Description: Moist, olive gray silty clay
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.4	99.6

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	100		
#60	0.25	100		
#100	0.15	100		
#140	0.11	100		
#200	0.075	100		

Coefficients

D_{85} =N/A
D_{30} =N/A
D_{60} =N/A
D_{15} =N/A
D_{50} =N/A
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM Silty CLAY (CL-ML)

AASHTO Silty Soils (A-4 (7))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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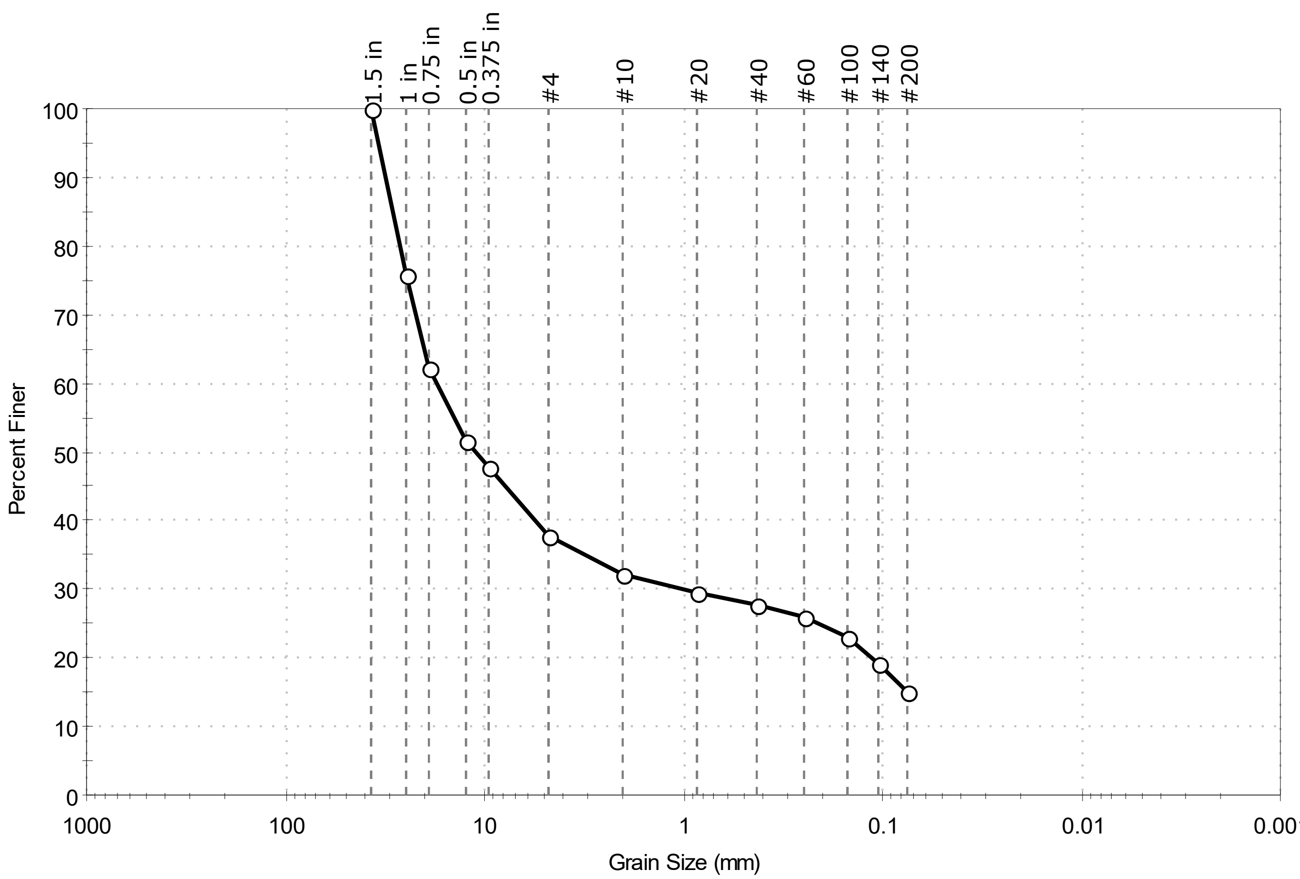
GeoTesting EXPRESS

Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	BB-MMMS-102	Sample Type:	jar	Tested By:	ckg
Sample ID:	6D	Test Date:	11/11/22	Checked By:	bfs
Depth :	30-32'	Test Id:	693304		

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

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	62.1	22.9	15.0

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	62		
0.5 in	12.50	52		
0.375 in	9.50	48		
#4	4.75	38		
#10	2.00	32		
#20	0.85	29		
#40	0.42	28		
#60	0.25	26		
#100	0.15	23		
#140	0.11	19		
#200	0.075	15		

Coefficients

D_{85} =29.1411 mm
D_{30} =1.0256 mm
D_{60} =17.4791 mm
D_{15} =N/A
D_{50} =11.1552 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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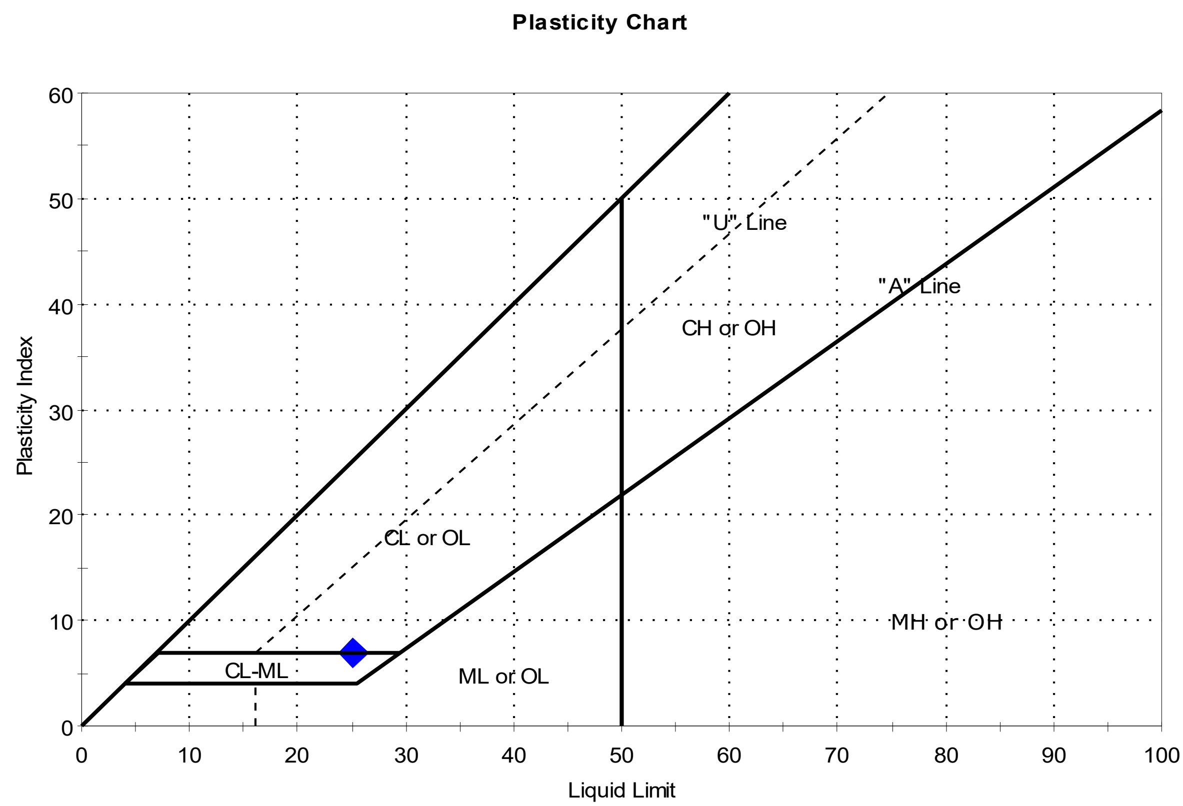
Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID: BB-MMMS-101	Sample Type: jar	Tested By:	cam
Sample ID: 4D	Test Date: 11/15/22	Checked By:	bfs
Depth : 14-16'	Test Id: 693278		
Test Comment:	---		
Visual Description:	Moist, olive gray silty 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
◆	4D	-MMMS-1	14-16'	25	25	18	7	1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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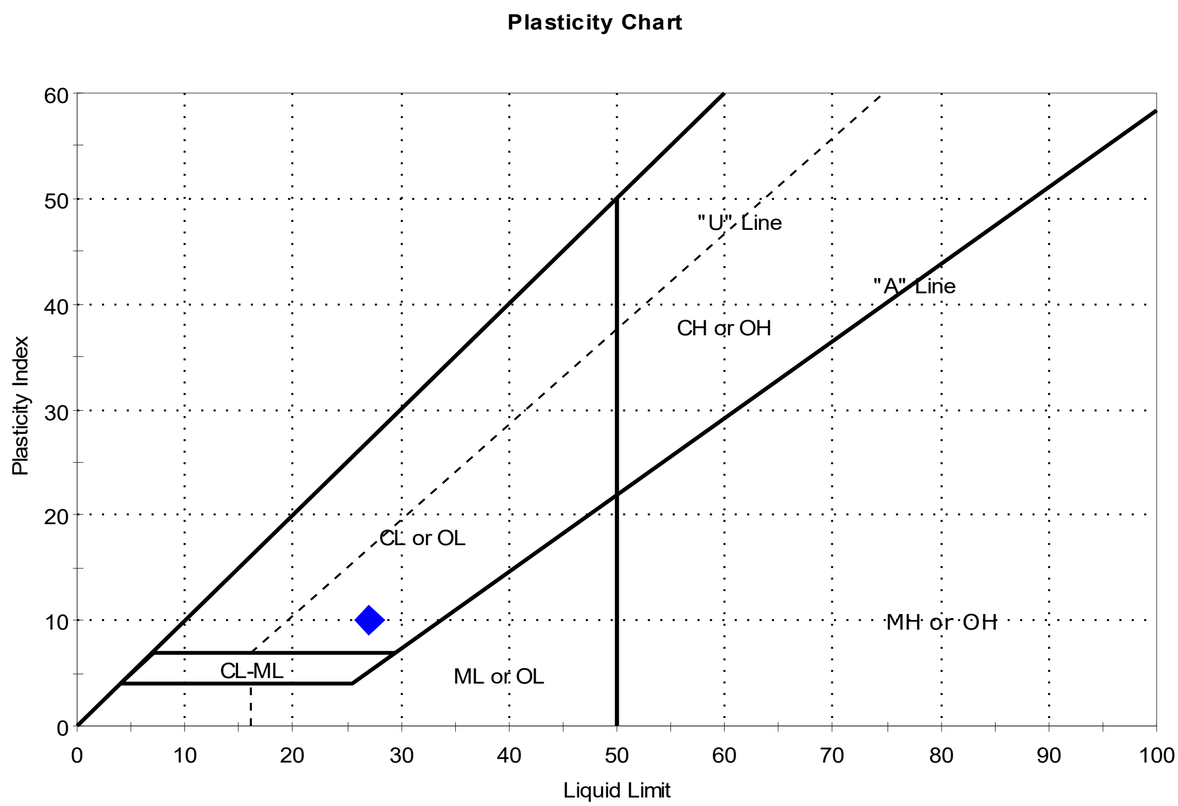
Client:	Schonewald Engineering Associates, Inc.
Project:	Bailey Flat Bridge, Mud Mill Stream
Location:	Monmouth, ME

Project No: GTX-316328

Boring ID:	BB-MMMS-101	Sample Type:	jar	Tested By:	cam
Sample ID:	6D	Test Date:	11/15/22	Checked By:	bfs
Depth :	29-31'	Test Id:	693279		

Test Comment:	---
Visual Description:	Wet, olive 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
◆	6D	-MMMS-1	29-31'	32	27	17	10	1.5	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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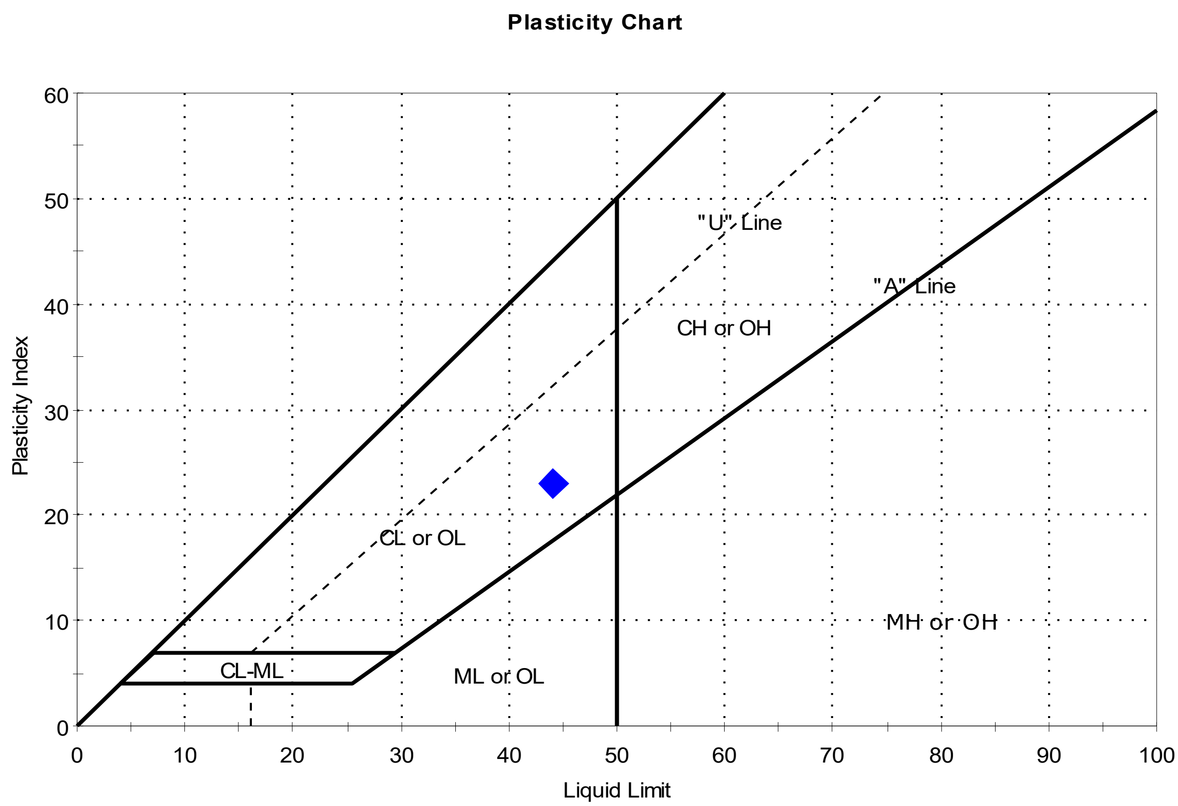
Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID: BB-MMMS-101	Sample Type: tube	Tested By:	cam
Sample ID: U1	Test Date: 11/15/22	Checked By:	bfs
Depth : 24-26'	Test Id: 693275		
Test Comment:	---		
Visual Description:	Moist, 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
◆	U1	-MMMS-1	24-26'	44	44	21	23	1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

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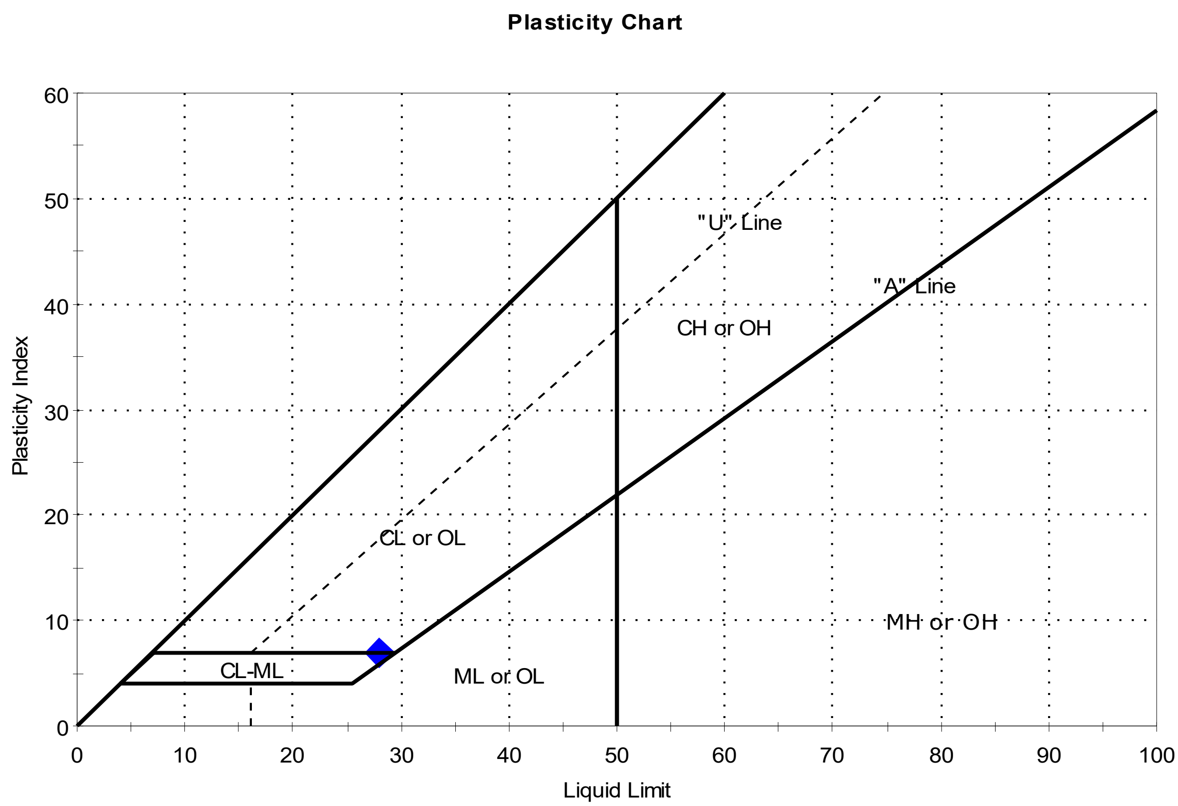
Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	BB-MMMS-102	Sample Type:	jar	Tested By:	cam
Sample ID:	4D	Test Date:	11/15/22	Checked By:	bfs
Depth :	14-16'	Test Id:	693280		
Test Comment:	---				
Visual Description:	Moist, olive gray silty 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
◆	4D	-MMMS-1	14-16'	27	28	21	7	0.9	Silty CLAY (CL-ML)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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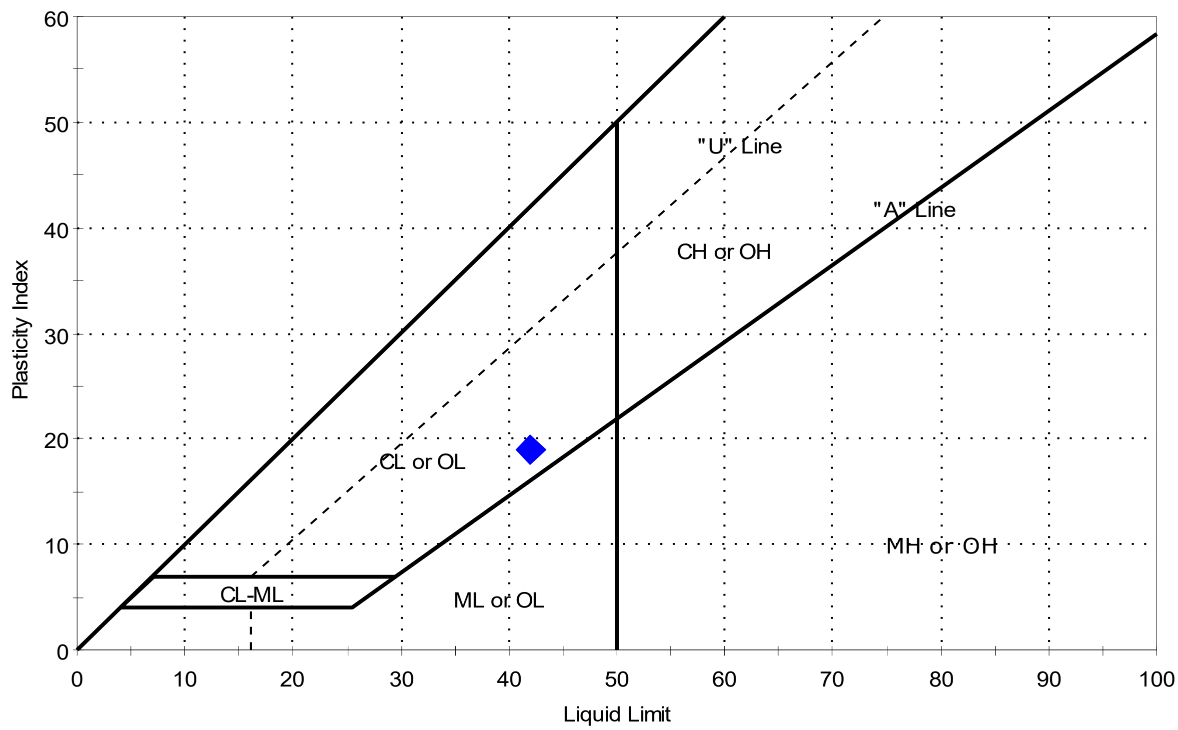
GeoTesting EXPRESS

Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	BB-MMMS-102	Sample Type:	jar	Tested By:	cam
Sample ID:	5D	Test Date:	11/15/22	Checked By:	bfs
Depth :	24-26'	Test Id:	693281		

Test Comment: ---
Visual Description: Moist, olive gray clay
Sample Comment: ---

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	5D	-MMMS-1	24-26'	44	42	23	19	1.1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

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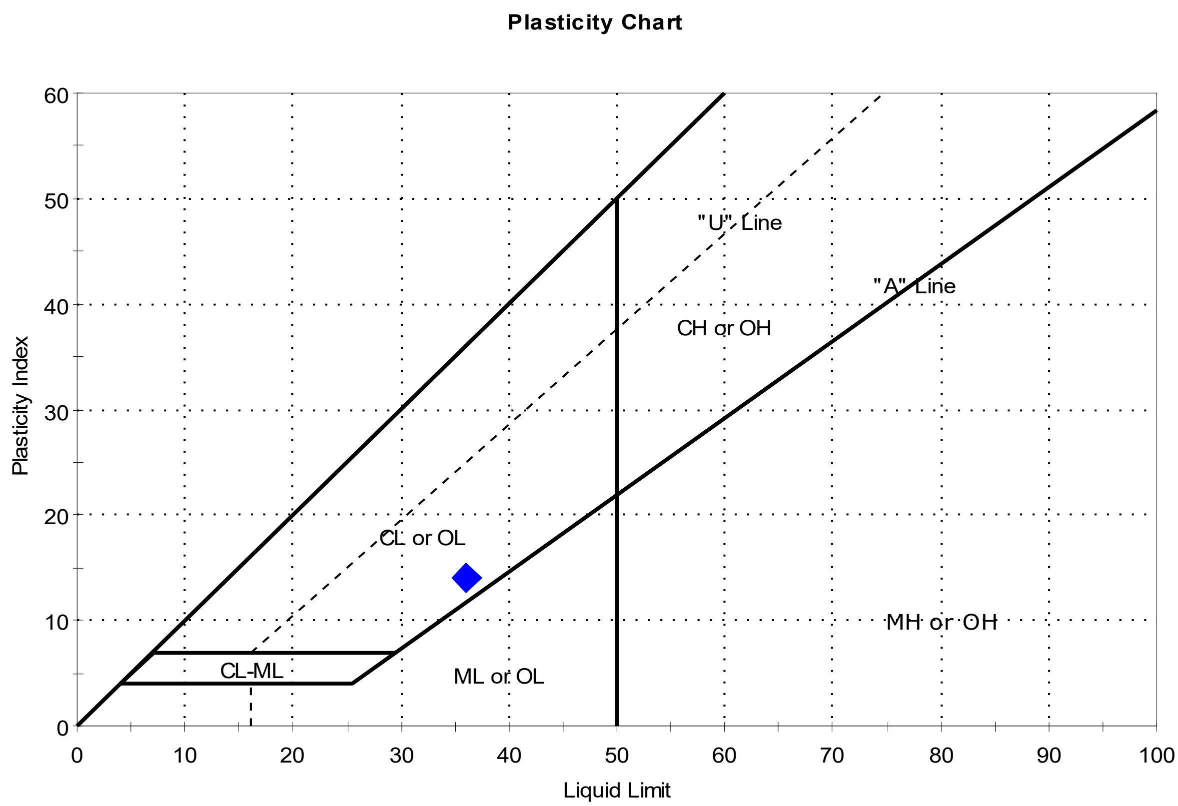
GeoTesting EXPRESS

Client:	Schonewald Engineering Associates, Inc.				
Project:	Bailey Flat Bridge, Mud Mill Stream				
Location:	Monmouth, ME			Project No:	GTX-316328
Boring ID:	BB-MMMS-102	Sample Type:	tube	Tested By:	cam
Sample ID:	U1	Test Date:	11/15/22	Checked By:	bfs
Depth :	19-21'	Test Id:	693276		
Test Comment:	---				
Visual Description:	Moist, 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
◆	U1	-MMMS-1	19-21'	33	36	22	14	0.8	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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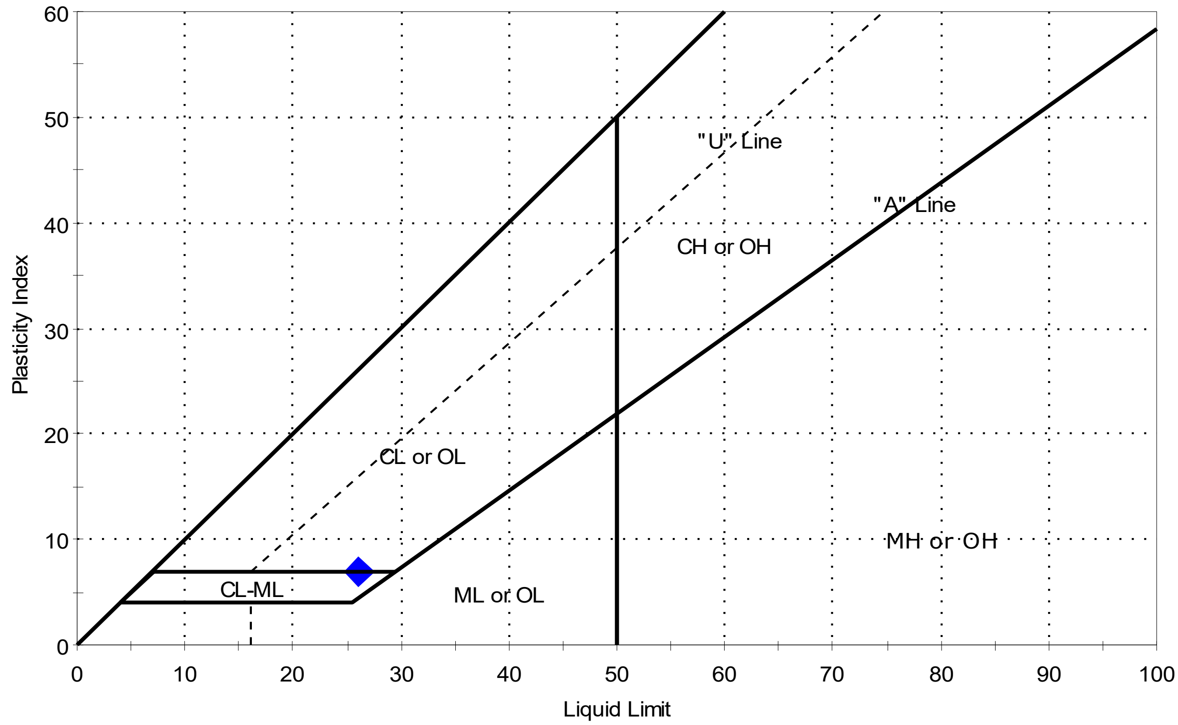
Client:	Schonewald Engineering Associates, Inc.		
Project:	Bailey Flat Bridge, Mud Mill Stream		
Location:	Monmouth, ME	Project No:	GTX-316328
Boring ID: BB-MMMS-102	Sample Type: tube	Tested By:	cam
Sample ID: U2	Test Date: 11/15/22	Checked By:	bfs
Depth : 28-30'	Test Id: 693277		
Test Comment:	---		
Visual Description:	Moist, gray silty 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
◆	U2	-MMMS-1	28-30'	25	26	19	7	0.9	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

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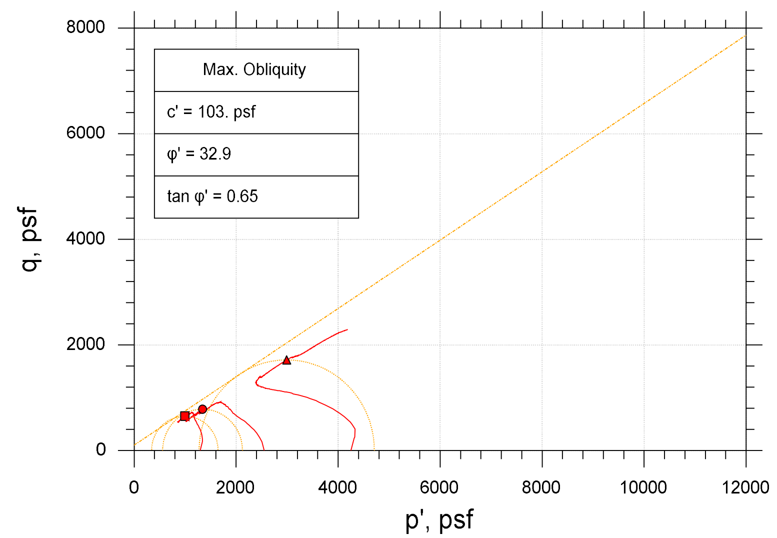
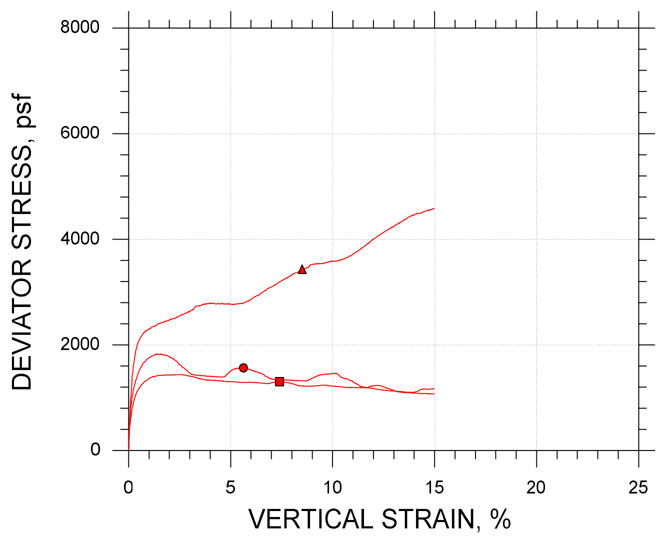
Client: Schonewald Engineering Associates, Inc.	
Project Name: Bailey Flat Bridge Mud Mill Str	
Project Location: Monmouth, ME	
Project Number: GTX-316328	
Tested By: trm	Checked By: njh
Boring ID: BB-MMMS-102	
Preparation: intact	
Description: Moist, gray silty clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: 26	Plastic Limit: 19
Plasticity Index: 7	Estimated Specific Gravity: 2.7

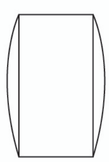
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

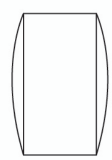


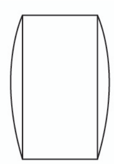


Symbol		■	●	▲	
Sample ID		U2	U2	U2	
Depth, ft		28-30'	28-30'	28-30'	
Test Number		CU-1-1	CU-1-2	CU-1-3	
Initial	Height, in	4.250	4.450	4.100	
	Diameter, in	2.000	2.010	2.030	
	Moisture Content (from Cuttings), %	28.3	31.1	27.9	
	Dry Density, pcf	95.4	91.5	93.3	
	Saturation (Wet Method), %	99.6	99.7	93.2	
	Void Ratio	0.766	0.843	0.807	
Before Shear	Moisture Content, %	25.3	29.7	26.6	
	Dry Density, pcf	100.	93.6	98.2	
	Cross-sectional Area (Method A), in²	3.044	3.127	3.153	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.684	0.801	0.717	
	Back Pressure, psf	9652.	2.171e+004	2.170e+004	
Vertical Effective Consolidation Stress, psf		1291.	2539.	4225.	
Horizontal Effective Consolidation Stress, psf		1297.	2546.	4251.	
Vertical Strain after Consolidation, %		0.7208	0.7300	2.196	
Volumetric Strain after Consolidation, %		2.085	2.039	4.204	
Time to 50% Consolidation, min		---	---	4.000	
Shear Strength, psf		652.2	783.3	1717.	
Strain at Failure, %		7.40	5.63	8.51	
Strain Rate, %/min		0.01600	0.01600	0.01600	
Deviator Stress at Failure, psf		1304.	1567.	3434.	
Effective Minor Principal Stress at Failure, psf		341.2	557.7	1274.	
Effective Major Principal Stress at Failure, psf		1646.	2124.	4709.	
B-Value		1.00	0.97	0.99	

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.





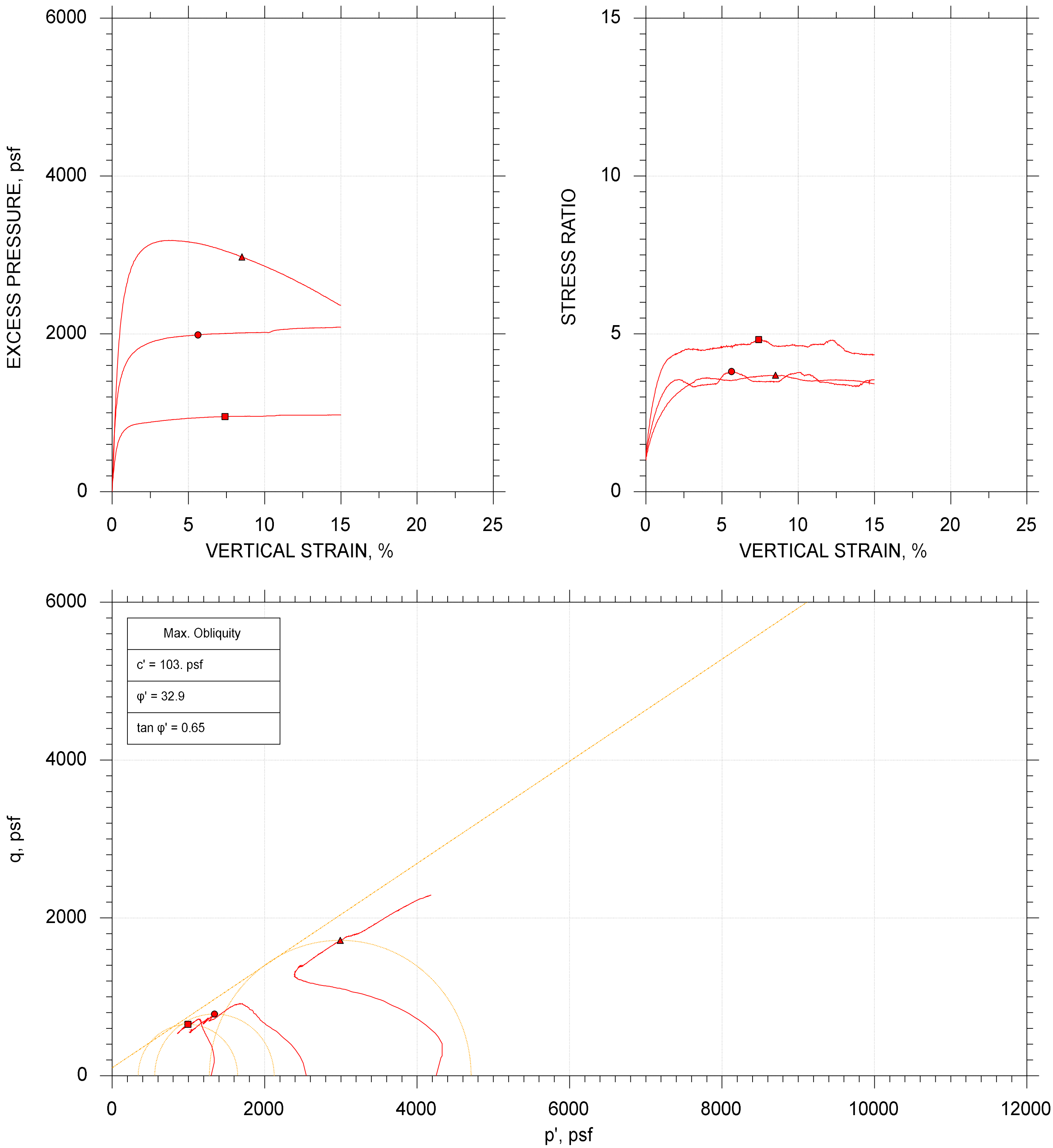


Remarks:

TX-009

Attachments 31

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	U2	CU-1-1	28-30'	trm	11/9/22	njh	11/21/22	316328-CU-1-1n.dat
●	U2	CU-1-2	28-30'	trm	11/7/22	njh	11/21/22	316328-CU-1-2n.dat
▲	U2	CU-1-3	28-30'	trm	11/9/22	njh	11/21/22	316328-CU-1-3n.dat

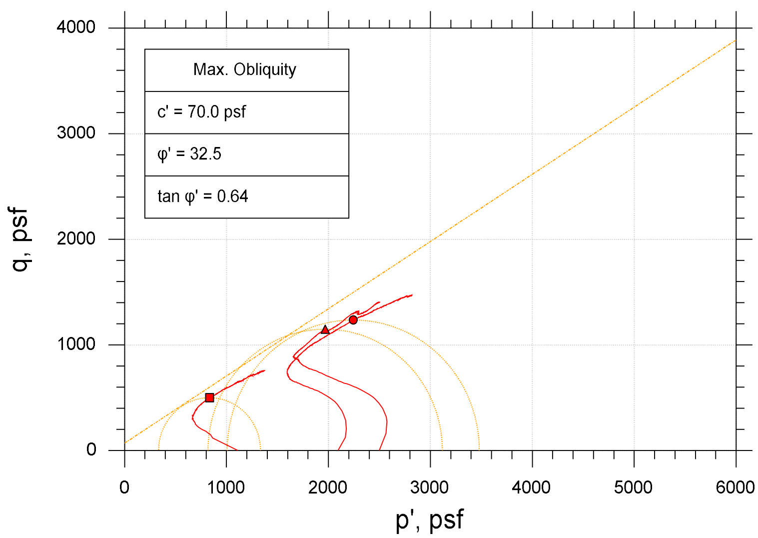
GeoTesting EXPRESS

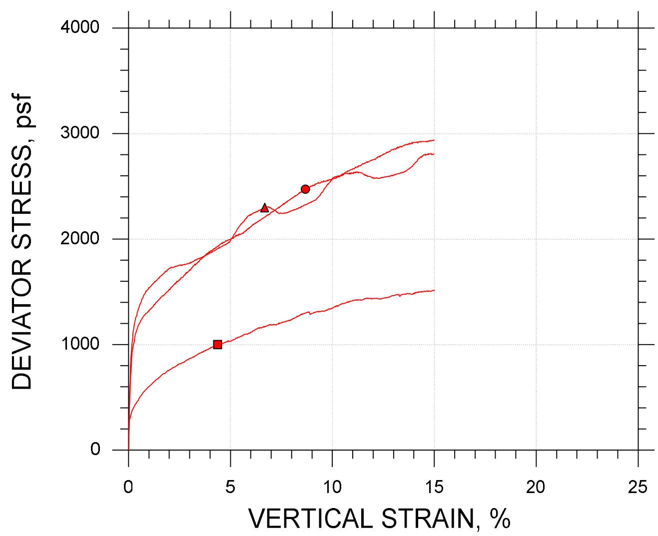
Project: Bailey Flat Bridge Mud Mill Str	Location: Monmouth, ME	Project No.: GTX-316328
Boring No.: BB-MMMS-102	Sample Type: intact	
Description: Moist, gray silty clay		
Remarks: TX-009		

GeoTesting EXPRESS

Client: Schonewald Engineering Associates, Inc.	
Project Name: Bailey Flat Bridge Mud Mill Str	
Project Location: Monmouth, ME	
Project Number: GTX-316328	
Tested By: trm	Checked By: njh
Boring ID: BB-MMMS-102	
Preparation: intact	
Description: Moist, gray clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: 36	Plastic Limit: 22
Plasticity Index: 14	Estimated Specific Gravity: 2.7

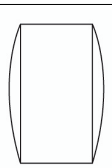
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

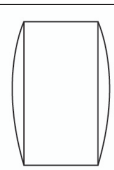


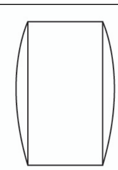


		■	●	▲	
Symbol		■	●	▲	
Sample ID		U1	U1	U1	
Depth, ft		19-21'	19-21'	19-21'	
Test Number		CU-2-1	CU-2-2	CU-2-3	
Initial	Height, in	4.490	4.400	4.450	
	Diameter, in	2.030	2.030	2.030	
	Moisture Content (from Cuttings), %	33.2	33.9	33.5	
	Dry Density, pcf	87.0	87.5	87.1	
	Saturation (Wet Method), %	95.6	98.7	96.6	
	Void Ratio	0.938	0.926	0.935	
Before Shear	Moisture Content, %	34.3	29.7	30.3	
	Dry Density, pcf	87.6	93.5	92.7	
	Cross-sectional Area (Method A), in²	3.244	3.101	3.109	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.925	0.802	0.819	
	Back Pressure, psf	2.175e+004	2.175e+004	9647.	
Vertical Effective Consolidation Stress, psf		1102.	2082.	2478.	
Horizontal Effective Consolidation Stress, psf		1113.	2093.	2499.	
Vertical Strain after Consolidation, %		0.9513	1.235	1.874	
Volumetric Strain after Consolidation, %		0.7680	3.096	5.215	
Time to 50% Consolidation, min		---	---	156.0	
Shear Strength, psf		500.1	1236.	1149.	
Strain at Failure, %		4.37	8.68	6.68	
Strain Rate, %/min		0.01600	0.01600	0.01600	
Deviator Stress at Failure, psf		1000.	2473.	2299.	
Effective Minor Principal Stress at Failure, psf		333.6	1007.	818.3	
Effective Major Principal Stress at Failure, psf		1334.	3480.	3117.	
B-Value		0.98	0.98	0.95	

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

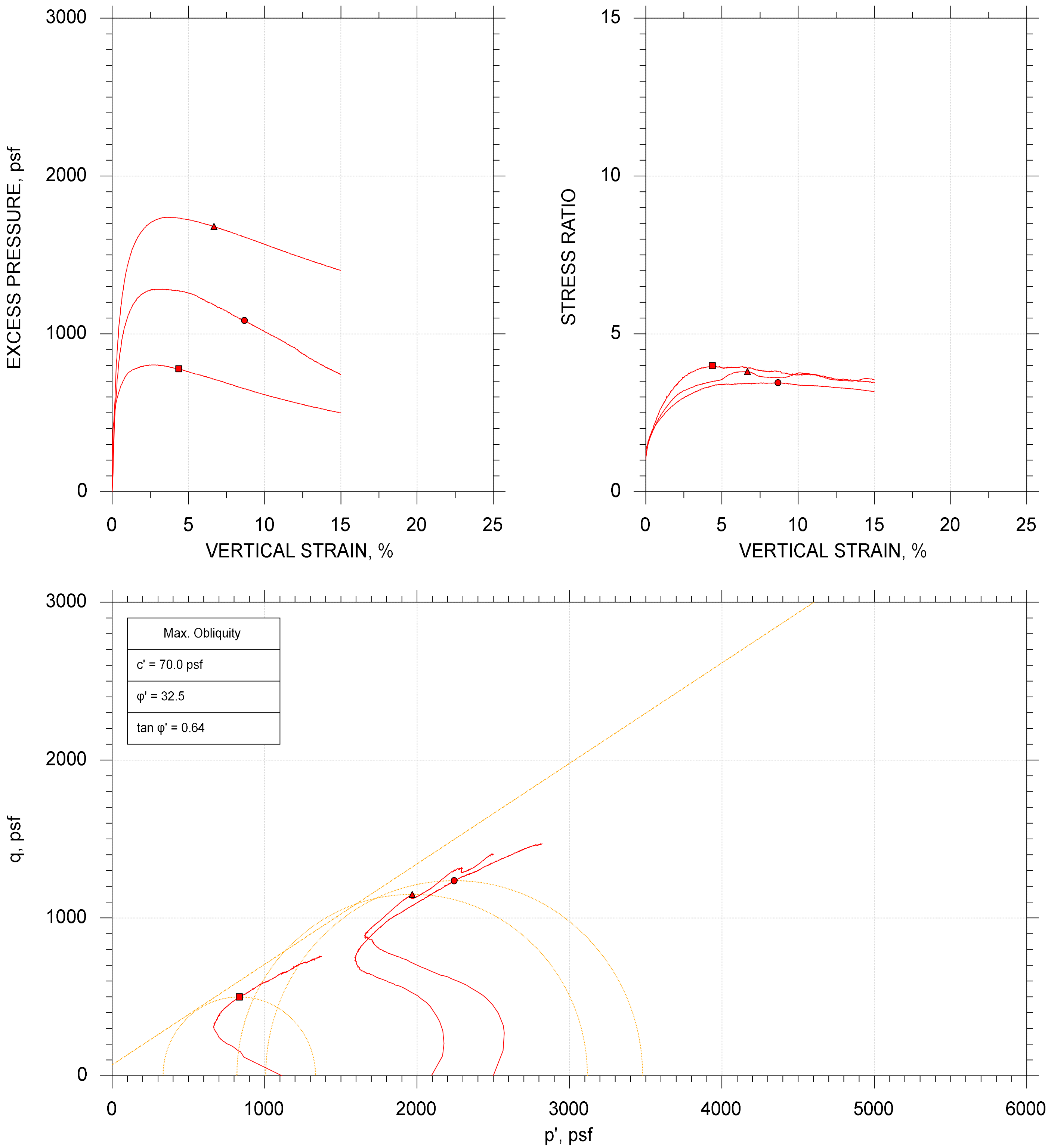






Remarks:

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

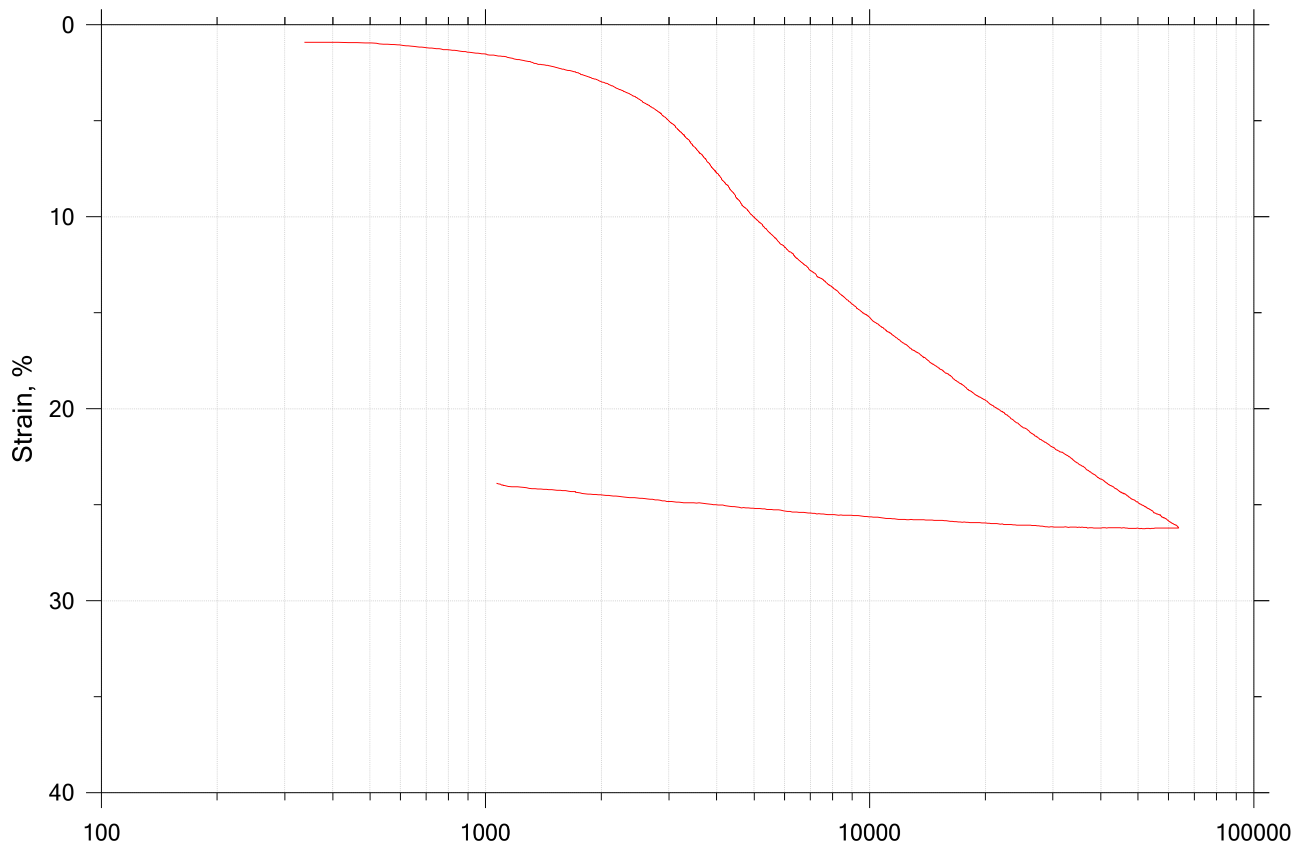


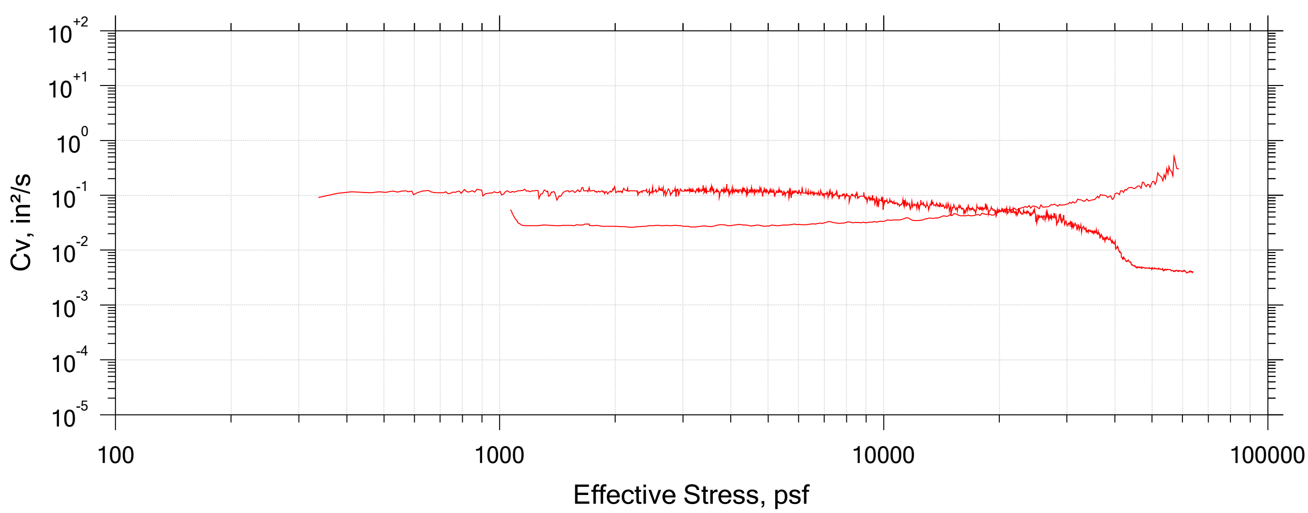
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	U1	CU-2-1	19-21'	trm	11/7/22	njh	11/21/22	316328-CU-2-1n.dat
●	U1	CU-2-2	19-21'	trm	11/7/22	njh	11/21/22	316328-CU-2-2n.dat
▲	U1	CU-2-3	19-21'	trm	11/7/22	njh	11/21/22	316328-CU-2-3n.dat

GeoTesting EXPRESS			
	Project: Bailey Flat Bridge Mud Mill Str	Location: Monmouth, ME	Project No.: GTX-316328
	Boring No.: BB-MMMS-102	Sample Type: intact	
	Description: Moist, gray clay		
	Remarks: TX-001		Attachments 34

CRC Test

Summary

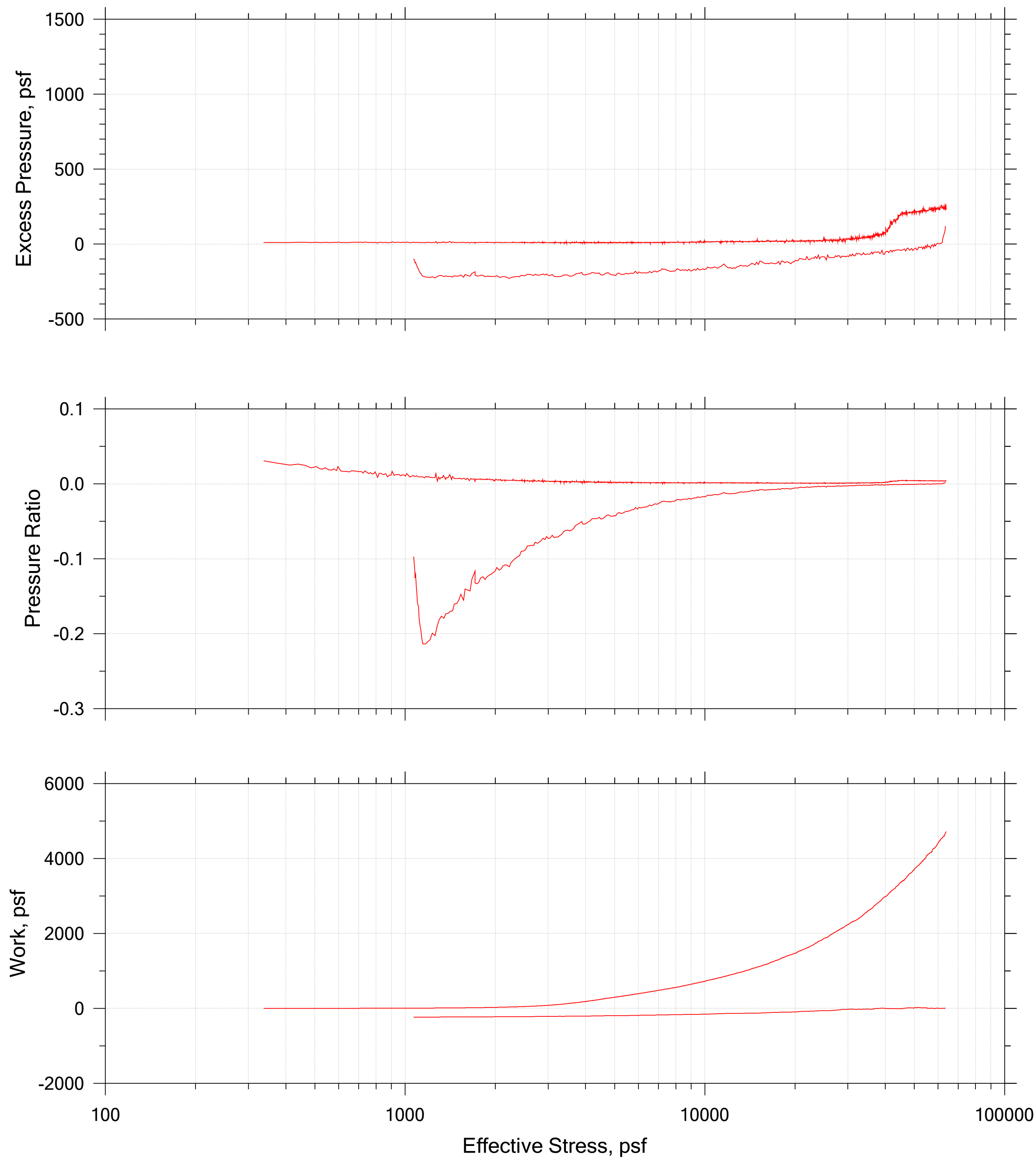




GeoTesting EXPRESS	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-101	Tester: trm	Checker: njh
	Sample Number: U1	Test Date: 11/7/22	Depth: 24-26'
	Test Number: CRC-2	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-008		

CRC Test

Pressure Curves



GeoTesting EXPRESS	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-101	Tester: trm	Checker: njh
	Sample Number: U1	Test Date: 11/7/22	Depth: 24-26'
	Test Number: CRC-2	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-008		

CRC Test

Specimen Diameter, in: 2.50	Specific Gravity: 2.70 (Estimated)	Liquid Limit: 44
Specimen Height, in: 1.00	Initial Void Ratio: 1.09	Plastic Limit: 21
Final Height, in: 0.73	Final Void Ratio: 0.529	Plasticity Index: 23

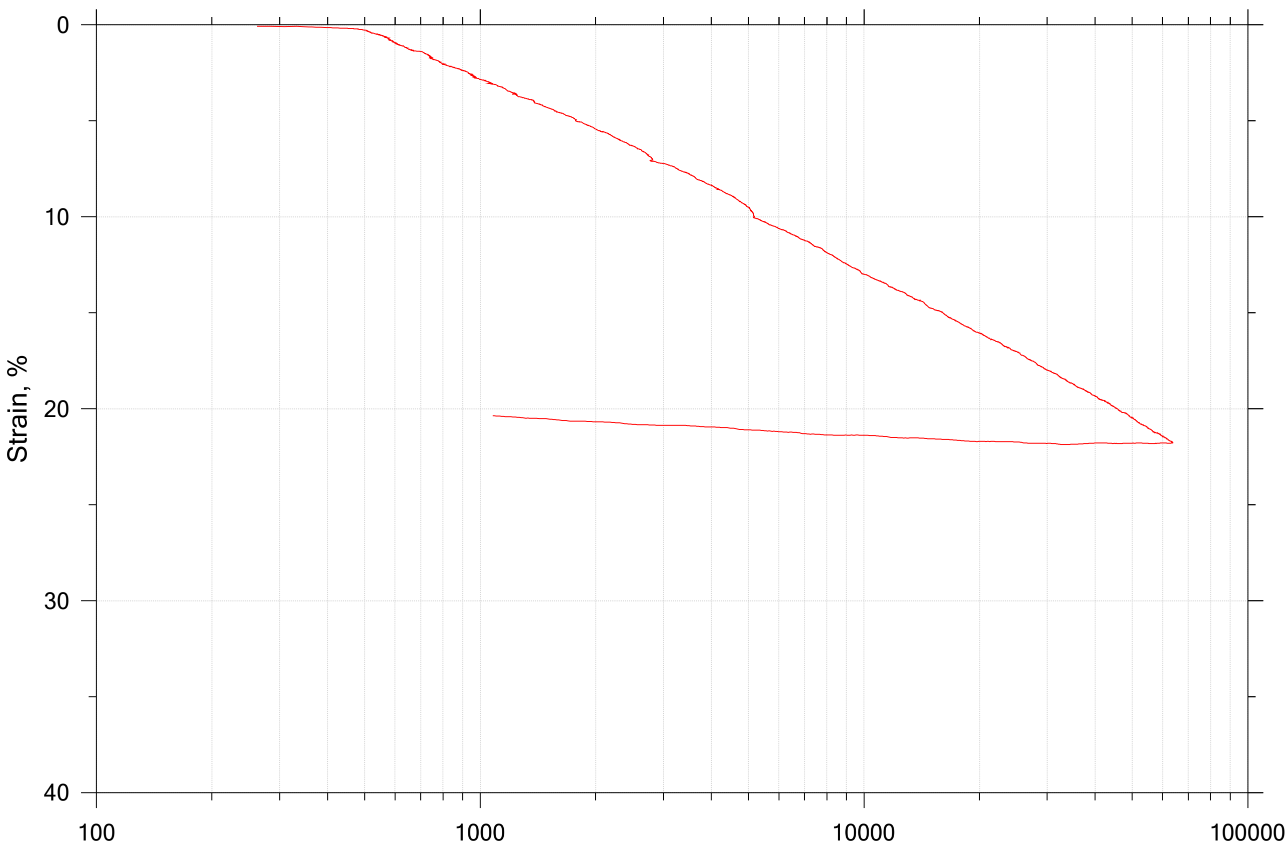
	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	A1648	---		E1684
Mass Container, gm	8.38	110.38	110.38	8.31
Mass Container + Wet Soil, gm	184.35	255.84	234.6	135.26
Mass Container + Dry Soil, gm	130.2	214.3	214.3	114.51
Mass Dry Soil, gm	121.82	103.92	103.92	106.2
Water Content, %	44.45	39.98	19.54	19.54
Void Ratio	---	1.09	0.53	---
Degree of Saturation, %	---	98.86	100.00	---
Dry Unit Weight, pcf	---	80.648	110.48	---

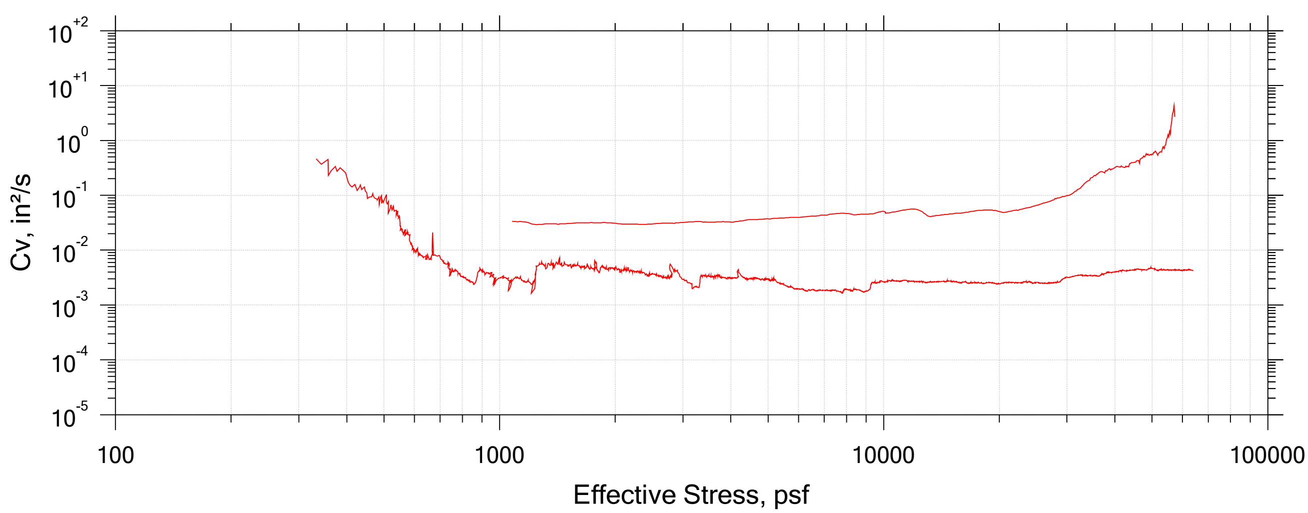
Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

GeoTesting EXPRESS			
	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-101	Tester: trm	Checker: njh
	Sample Number: U1	Test Date: 11/7/22	Depth: 24-26'
	Test Number: CRC-2	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: TX-008		

CRC Test

Summary

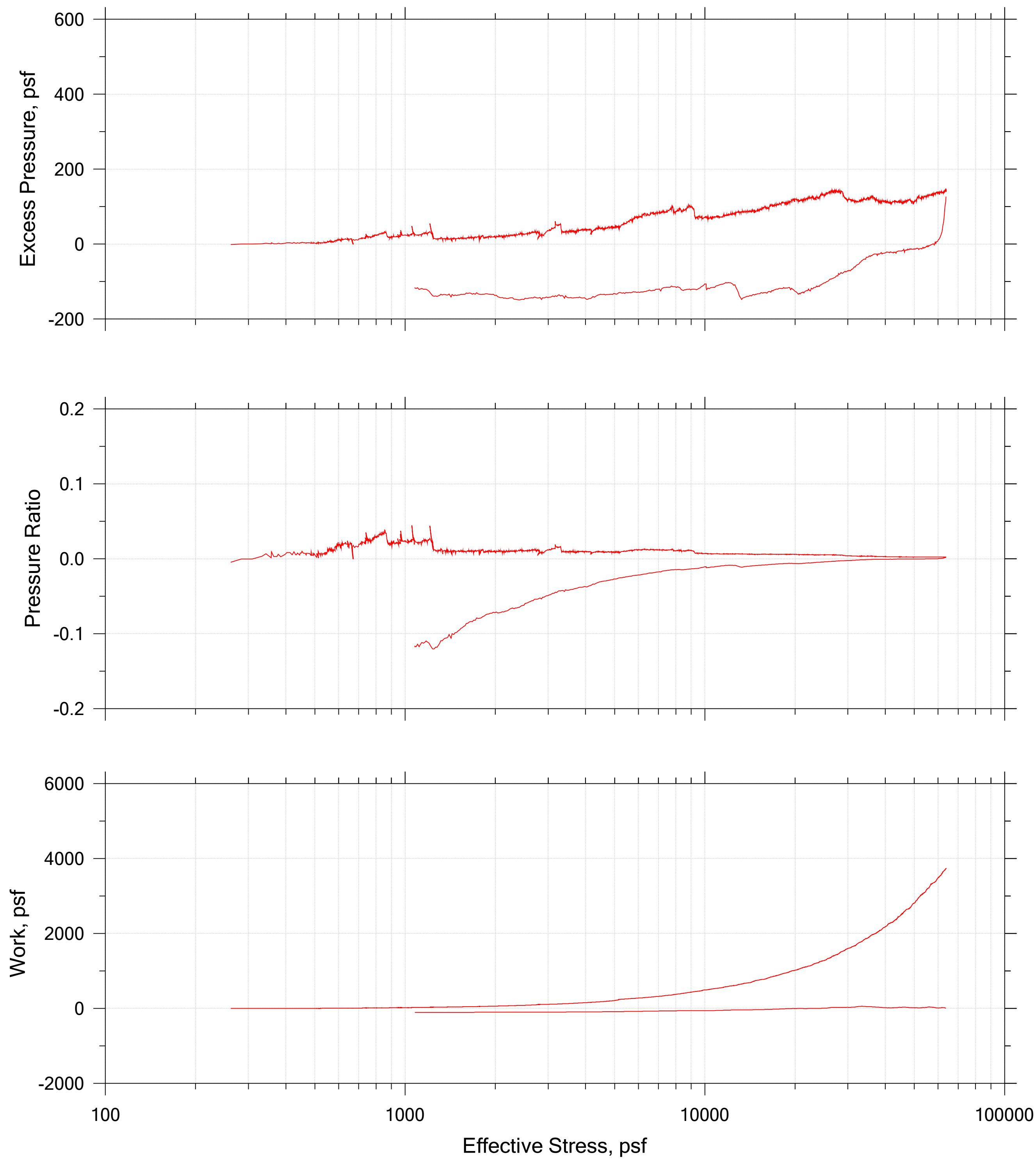




	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
GeoTesting EXPRESS	Sample Number: U1	Test Date: 11/07/22	Depth: 19-21'
	Test Number: CRC-3	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System JJ		

CRC Test

Pressure Curves



GeoTesting EXPRESS	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
	Sample Number: U1	Test Date: 11/07/22	Depth: 19-21'
	Test Number: CRC-3	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System JJ		

CRC Test

Specimen Diameter, in: 2.50	Specific Gravity: 2.74 (Estimated)	Liquid Limit: 36
Specimen Height, in: 1.00	Initial Void Ratio: 0.881	Plastic Limit: 22
Final Height, in: 0.80	Final Void Ratio: 0.505	Plasticity Index: 14

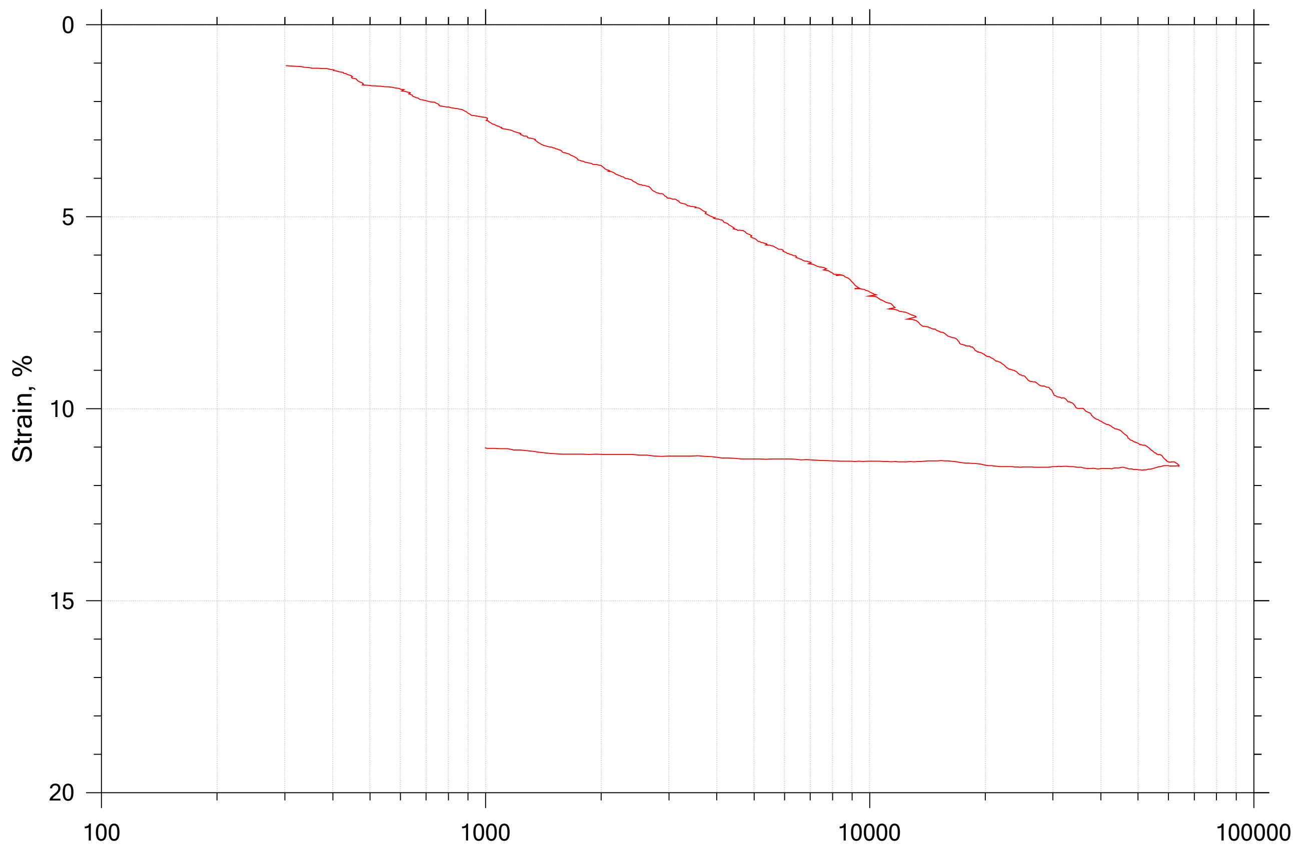
	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E7022	---		E2908
Mass Container, gm	8.85	108.9	108.9	8.21
Mass Container + Wet Soil, gm	293.64	262.94	247.73	147.64
Mass Container + Dry Soil, gm	221.66	226.13	226.13	125.95
Mass Dry Soil, gm	212.81	117.23	117.23	117.74
Water Content, %	33.82	31.40	18.42	18.42
Void Ratio	---	0.88	0.51	---
Degree of Saturation, %	---	97.67	100.00	---
Dry Unit Weight, pcf	---	90.983	113.73	---

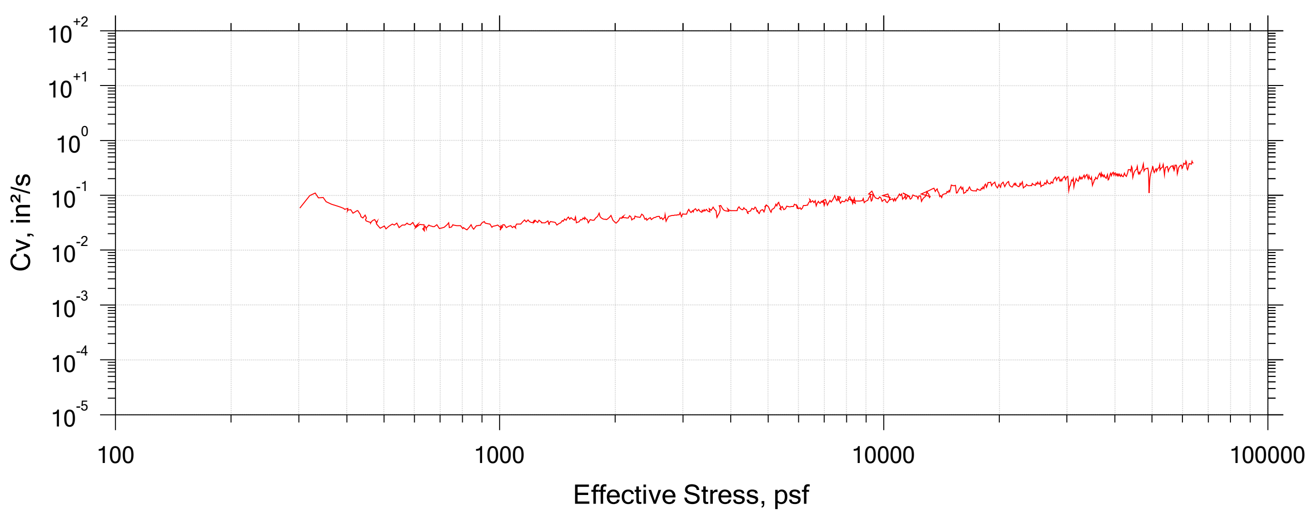
Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.
Therefore, values may not represent actual values for the specimen.

GeoTesting EXPRESS			
	Project Name: Bailey Flat Bridge	Location: Monmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
	Sample Number: U1	Test Date: 11/07/22	Depth: 19-21'
	Test Number: CRC-3	Preparation: intact	Elevation: ---
	Description: Moist, gray clay		
	Remarks: System JJ		

CRC Test

Summary

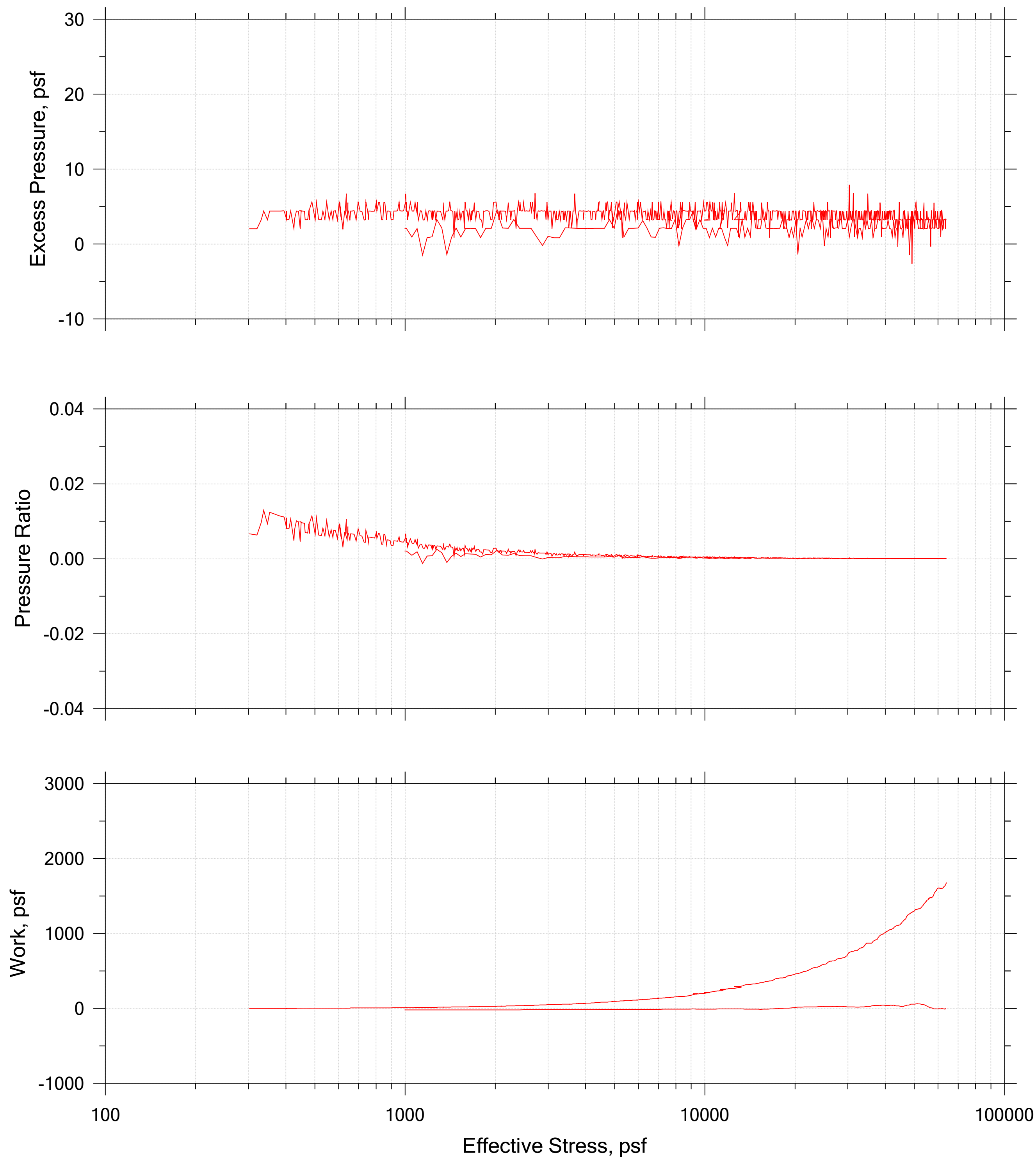




GeoTesting EXPRESS	Project Name: Bailey Flat Bridge	Location: Manmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
	Sample Number: U2	Test Date: 11/7/22	Depth: 28-30'
	Test Number: CRC-1	Preparation: intact	Elevation: ---
	Description: Moist, gray silty clay		
	Remarks: System TX-003		

CRC Test

Pressure Curves



GeoTesting EXPRESS			
	Project Name: Bailey Flat Bridge	Location: Manmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
	Sample Number: U2	Test Date: 11/7/22	Depth: 28-30'
	Test Number: CRC-1	Preparation: intact	Elevation: ---
	Description: Moist, gray silty clay		
	Remarks: System TX-003		

CRC Test

Specimen Diameter, in: 2.50	Specific Gravity: 2.74 (Estimated)	Liquid Limit: 26
Specimen Height, in: 1.00	Initial Void Ratio: 0.752	Plastic Limit: 19
Final Height, in: 0.84	Final Void Ratio: 0.472	Plasticity Index: 7

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	E2739	---		E3572
Mass Container, gm	8.74	111.04	111.04	8.22
Mass Container + Wet Soil, gm	184.86	270.52	258.29	156.93
Mass Container + Dry Soil, gm	149.86	236.63	236.63	135.06
Mass Dry Soil, gm	141.12	125.59	125.59	126.84
Water Content, %	24.80	26.98	17.24	17.24
Void Ratio	---	0.75	0.47	---
Degree of Saturation, %	---	98.15	100.00	---
Dry Unit Weight, pcf	---	97.472	116.04	---

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

GeoTesting EXPRESS			
	Project Name: Bailey Flat Bridge	Location: Manmouth, ME	Project Number: GTX-316328
	Boring Number: BB-MMMS-102	Tester: trm	Checker: njh
	Sample Number: U2	Test Date: 11/7/22	Depth: 28-30'
	Test Number: CRC-1	Preparation: intact	Elevation: ---
	Description: Moist, gray silty clay		
	Remarks: System TX-003		

testing services sm

PO Box 572455 / Salt Lake City UT 84157-2455 / USA
TEL +1 801 262 2448 · FAX +1 801 262 9870 · www.TEi-TS.com

GEOTESTING EPXRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2210694
Report Date	15 November 2022
Date Sampled	02 November 2022
Date Received	10 November 2022
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil: Project: Bailey Flat Bridge, Mud Mill Stream; Site Location: - — -; Job Number: GTX-316328

When examined to the applicable requirements of:

AASHTO T-291-18	"Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil" Method B
AASHTO T 290-20	"Standard Method of Test for Determining Water-Soluble Sulfate Ion Content in Soil"

Results:

AASHTO T 291 - Chloride Method B

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
BB-MMMS-101		< 10.	< 0.0010	10.
1D, 2D	2 – 6'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

AASHTO T 290 – Sulfates (Soluble)

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
BB-MMMS-101		24.	0.0024	10.
1D, 2D	2 – 6'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

APPENDIX 2

CALCULATIONS

SOIL PARAMETERS

HNTB	For	Maine DOT- Bailey Flat Culvert Replacement	Job No	72998	Sheet No	
	Made by	MLR	Check	JZ	Backchk	MLR
	Date	10/31/2022	Date	11/23/2022	Date	11/23/2022

Soil Properties

Layer	Top of Layer Elevation (ft)	Bottom of Layer Elevation (ft)	Depth to Top of Layer (ft)	Depth to Bot. of Layer (ft)	N (bpf)	N_{60} (bpf)	$N1_{60}$ (bpf)	γ (pcf)	φ' (deg)	c* (psf)	K(aw) (pci)	K(bw) (pci)	G(ksf)	E(ksf)
Layer 1 - Fill	193.5	186.5	0	7	19	18	30	122	37		196	102	232	587
Layer 2 - Alluvium	186.5	180.0	7.0	13.5	7	7	8	110	31		71	48	146	355
Layer 3 -Marine Silt and Clay Crust	180.0	175.5	13.5	18	7	8	8	115	-	600	-	-	161	391
Layer 4a - Marine Silt and Clay	175.5	163.0	18.0	30.5	1	1	1	110	-	426-645	-	-	69	164
Layer 5 - Glacial Till	163.0	159.0	30.5	34.5	57	81	59	128	41		275	155	446	1245

*Cohesion estimated from Vane Shear Test performed on New Borings.

LATERAL EARTH PRESSURE COEFFICIENTS

Calculations for:	MaineDOT Bailey Flats	Job No.:	67328
Made by:	JDZ	Date:	4/10/2025
Checked by:	MLR	Date:	4/15/2025
Backchecked by:	JDZ	Date:	4/15/2025

HNTB

Coulomb's Active Earth Pressure Coefficient, K_a

Reference: AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020

Structure material:	Precast Concrete				
Soil:	Dense Sand Fill	Alluvium	Marine Silt&Clay	Glacial Till	New Backfill, MEDOT Soil type 4
ϕ'	37	31	32	41	32
θ	90	90	90	90	90
δ	19	14	14	22	24
β'	0	0	0	0	0

$\sin^2(\theta+\phi)$	B	0.6	0.7	0.7	0.6	0.7
$\sin(\theta+\beta')$	C	1.0	1.0	1.0	1.0	1.0
$\sin^2(\theta)$	D	1.0	1.0	1.0	1.0	1.0
$\sin(\phi-\beta')$	E	0.6	0.5	0.5	0.7	0.5
$\sin(\phi+\delta)$	F	0.8	0.7	0.7	0.9	0.8
$\sin(\theta-\delta)$	G	0.9	1.0	1.0	0.9	0.9
$[1+(F*E/G*C)^{0.5}]^2$	A	2.98	2.60	2.65	3.22	2.87
K_a	B/(A*D*G)	**0.23**	**0.29**	**0.28**	**0.19**	**0.27**

where:

δ = friction angle between fill and wall (degrees)
β = angle of fill to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
θ = angle of back face of wall to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
ϕ'_f = effective angle of internal friction (degrees)

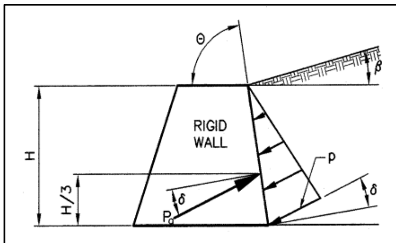


Figure 3.11.5.3-1—Notation for Coulomb Active Earth Pressure

Calculations for:	MaineDOT Bailey Flats	Job No.:	67328
Made by:	JDZ	Date:	4/10/2025
Checked by:	MLR	Date:	4/15/2025
Backchecked by:	JDZ	Date:	4/15/2025

HNTB

At-Rest Earth Pressure Coefficient, K_o

	Soil:	Dense Sand Fill	Alluvium	Marine Silt&Clay	Glacial Till	New Backfill, MEDOT Soil type 4
	ϕ'	37	31	32	41	32
K_o	=1-sin(ϕ')	**0.40**	**0.48**	**0.47**	**0.34**	**0.47**

BEARING PRESSURE AND CAPACITY CHECK

For:	MaineDOT - Monmouth Bridges	Job Number:	67328	Sheet No.		HNTB
By:	MLR	Check By:	JDZ	Check by:	MLR	
Date:	4/4/2025	Date:	4/4/2025	Date:	4/4/2025	

Bailey Flat Culvert Box - Pressure Check

Objective:

Calculate the stress increase/decrease of proposed box culvert from the existing conditions. The point of interest will be 13.5' below existing grade. Soil parameters of existing materials retrieved from calculated soil propoerties spreadsheet for Bailey Flat.

Assumptions:

1) Surcharge/Live Load ignored
2) Weight taken over a 1 ft strip perpendicular through the culvert
3) Water in culvert at Q1.1 elevation.
4) Loading assumed to be uniform along bottom of culvert

Existing Conditions

A) Subsurface Details

Layer	Depth to Top (ft)	Depth to Bot (ft)	Unit Weight
1 - Fill	0	7	122
2 - Alluvium	7	13.5	110

6.95	GWT depth - Average from borings

B) Stress at point of Interest - Depth 13.5'

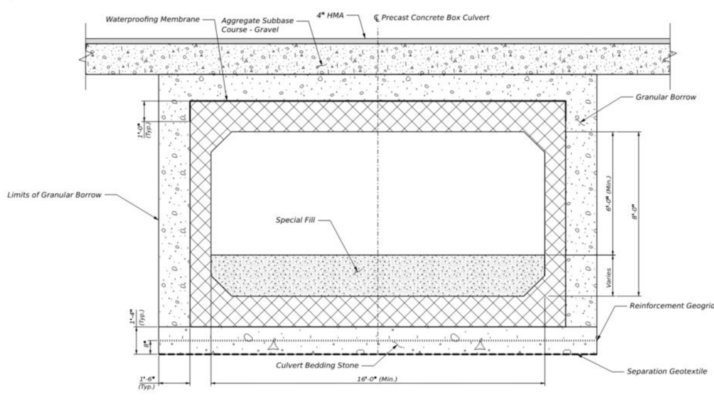
1569	Total Stress (psf)
408.7	Pore Water Pressure (psf)
1160.3	Effective Stress (psf)

Proposed Conditions

C) Subsurface and Culvert Details

150	Culvert Unit Weight (pcf)
1	Width of Culvert Box Sides (ft)
10	Total Box Depth (ft)
18	Total Box Width (ft)
7800	Total Box Weight (lb/ft)
3.5	Depth of Soil Above Box (ft)
2	Depth of Soil within Box (ft)
130	Unit Weight of Fill Soil, saturated (pcf)
3	Depth (ft) of Water in Culvert,above fill soil[3]
8190	Weight of Soil above Box (lb/ft)
4160	Weight of Soil within Box (lb/ft)
2995.2	Weight of Water within Box (lb/ft)
23145.2	Total Weight of Soil and Box Culvert (lb/ft)
964.4	Total Pressure of Proposed Culvert at POI (psf)

Sketch of Proposed Box Culvert



PROPOSED PRECAST CONCRETE BOX CULVERT TRANSVERSE SECTION
(Not To Scale)

D) Net Pressure Check

964	Applied Presure of Proposed Condition (psf)
1160	Initial Effective Stress (psf)

TRUE No Pressure Increase from Proposed Condition

For:	MaineDOT - Monmouth Bridges	Job Number:	67328	Sheet No.		HNTB
By:	MLR	Check By:	JDZ	Check by:	MLR	
Date:	4/4/2025	Date:	4/4/2025	Date:	4/4/2025	

Bailey Flat Culvert Box - Bearing on Cohesive Material

Assumptions:

1) 500 psf clay
2) GWT at 7 ft depth
3) Assumed 0.5 for bearing resistance factor as clay cohesion is assumed here

A) Bearing Capacity

13.5	Depth of Bearing Material (ft)
115	Unit Weight of Bearing Material (pcf)
0	Friction Angle of Bearing Material
500	Cohesion of Bearing Material (psf)
18	Width of Culvert (ft)
68.5	Length of Culvert (ft)

Factors (Per AASHTO 10.6.3.1)

5.14	Nc	1	ic
1	Nq	1	iq
0	Ny	1	iy
1.05	sc	0.5	Cwq
1.00	sq	0.5	Cwy
1.00	sy	1	dq

3481	Nominal Bearing Capacity (psf) (AASHTO 10.6.3.1.2a-1)
0.5	Bearing Capacity Factor for Strength (AASHTO 10.5.5.2.2)
1741	Factored Bearing Capacity (psf) (AASHTO 10.6.3.1.1-1)

B) Loads - Unfactored & Factored

Factors based on Ref 1 - Table 3.4.1-2

Factor		Pressure (psf)	Factored Pressure	
1.75	x	250	437.5	LS - Live Load Surcharge
1.25	x	325	406.25	DC - Box Culvert
1.3	x	514.5833333	668.9583333	EV - Earth Pressure
		Total	1512.708333	Factored Pressure Demand (psf)

B) Bearing Resistance Check

TRUE	Check Factored Pressure < Factored Bearing Capacity

References:

1) AASHTO LRFD Bridge Design Specifications - Ninth Edition, 2020

For:	MaineDOT - Monmouth Bridges	Job Number:	67328	Sheet No.	
By:	MLR	Check By:	JDZ	Check by:	MLR
Date:	4/4/2025	Date:	4/4/2025	Date:	4/4/2025

Bailey Flat Culvert Box - Bearing on Cohesionless Alluvial

Assumptions:

1) 31 deg. Sand material

2) GWT at 7 ft depth

A) Bearing Capacity

13.5	Depth of Bearing Material (ft)
110	Unit Weight of Bearing Material (pcf)
31	Friction Angle of Bearing Material
0	Cohesion of Bearing Material (psf)
18	Width of Culvert (ft)
68.5	Length of Culvert (ft)

Factors (Per AASHTO 10.6.3.1)

32.7	Nc	1	ic
20.6	Nq	1	iq
26	Ny	1	iy
1.05	sc	0.5	Cwq
1.16	sq	0.5	Cwy
0.89	sy	1.00	dq

29228	Nominal Bearing Capacity (psf) (AASHTO 10.6.3.1.2a-1)
0.45	Bearing Capacity Factor for Strength (AASHTO 10.5.5.2.2)
13152	Factored Bearing Capacity (psf) (AASHTO 10.6.3.1.1-1)

B) Loads - Unfactored & Factored

Factors based on Ref 1 - Table 3.4.1-2

Factor		Pressure (psf)	Factored Pressure	
1.75	x	250	437.5	LS - Live Load Surcharge
1.25	x	325	406.25	DC - Box Culvert
1.3	x	514.5833333	668.9583333	EV - Earth Pressure
		Total	1512.708333	Factored Pressure Demand (psf)

B) Bearing Resistance Check

TRUE	Check Factored Pressure < Factored Bearing Capacity

References:

1) AASHTO LRFD - 9th Edition

GLOBAL STABILITY

Project: Bailey Flat Culvert Replacement	**Job No: 67328**	**Design Criteria Document:**
Client: MaineDOT	**Discipline: Geotech**	**Calculation No:**

Name or Description of Calculation: Stability Assessment

Calc. Rev. No.	Originator	Checker	Senior Technical Reviewer (if required)	Confirmation Required (Y/N)
1	M. Rowicki			

Calculation Objective:

Perform a slope stability checks of existing embankment. Use Slope/W to perform assessment.

Calculation Methodology/List of Assumptions:

General

- Slope/W was utilized to assess settlement using the Spencer analysis type.
- Soil parameters and strata elevations were taken from previously summarized parameter sheet.
- Slope through the roadway (longitudinal) was checked.
- For the side slope condition, Section 10+50.00 was run as the governing condition. Geometric working coordinates were extracted from the cross section and input into the program.
- Piezometric line was placed at EL. 188.7’
- A live load surcharge of 250 psf is applied to the entire roadway.
- Only the undrained condition was assessed at this stage.

References/Inputs:

- See above

Attachments: (List each attachment following the subject calculation)

Attachment 1: Slope/W Models
- Assessment

Attachment 2: Bailey Flat Cross Sections

Conclusions:

Minimum Factor of Safety calculated: 1.8

Document Check:	Name	Signature	Date
Originator:	M.Rowicki	Mateusz Rowicki	11/22/22
Checker:	J. Zwetchkenbaum	Joseph Zwetchkenbaum	11/23/22
BackChecker:	M.Rowicki	Mateusz Rowicki	11/23/22
Updater:	M.Rowicki	Mateusz Rowicki	11/23/22
Verifier:	J. Zwetchkenbaum	Joseph Zwetchkenbaum	11/28/22

Color	Name	Material Model	Unit Weight (pcf)	Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	Alluvium	Mohr-Coulomb	110		0	31	0	1
	Existing Fill	Mohr-Coulomb	122		0	37	0	1
	Glacial Till	Mohr-Coulomb	126		0	40	0	1
	Marine Silt and Clay	Undrained (Phi=0)	110	600				1
	Marine Silt and Clay Crust	Mohr-Coulomb	115		600	0	0	1

Name: SLOPE/W Analysis -Right
File Name: Transverse Section 10+50.00_Original.gsz