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707 Sable Oaks Drive
Suite 150
South Portland, ME 04106
T: 207.879.9190
F: 207.536.1173
www.gza.com

MEMORANDUM (via email)

To: Nathaniel Benoit
Maine Department of Transportation
16 State House Station
Augusta, ME 04333-0016

From: Nicholas Williams, P.E.
Christopher L. Snow, P.E.
Andrew R. Blaisdell, P.E., Consultant Reviewer
GZA GeoEnvironmental, Inc. (GZA)

File No.: 09.0025953.00

Date: January 9, 2019

Re: Geotechnical Evaluation
Gagnon Brook Culvert Replacement
MaineDOT WIN 21776.00 & 23565.00
Frenchville, Maine



This memorandum presents the results of the geotechnical evaluation for the Gagnon Brook culvert beneath Railroad Bridge #7831 and Route 1 Bridge #2303 in Frenchville, Maine. Our work was completed in accordance with the General Contract Agreement (CTM# 2015060800000000793) between MaineDOT and GZA GeoEnvironmental, Inc. (GZA) dated May 20, 2015 which incorporates GZA's proposal No. 09.P000044.18, dated August 3, 2017, GZA's proposal No. 09.P000071.20 dated September 18, 2019, Contract Modifications 1 through 4, and the *Limitations* included in **Appendix A** of this report.

BACKGROUND

The Gagnon Brook Culvert has two segments. The upstream segment passes beneath Route 1 (Bridge #2303), there is a short open reach of the brook, then the downstream segment passes beneath the Madawaska Subdivision of Maine Northern Railway (MNR) at M.P. 259.11 (Railroad Bridge #7831). Gagnon Brook flows east to west through the existing four-sided concrete box culverts and discharges to the St. John River approximately 100 feet west of the railroad bridge.

The existing culverts are 12-foot wide by 8-foot tall cast-in-place concrete structures with concrete floor slabs and flared concrete wing walls at the inlets and outlets. The MNR has a single track with an approximately 15-foot height of fill above between the culvert and the railbed. We understand this culvert is in serious condition with the southwest outlet wing wall having completely failed, leaving a 15-foot diameter scour hole on the St. John riverbank where the wing wall once stood.

A complete replacement is proposed for the two culvert segments. The replacement culvert will be a continuous reach beneath Rt. 1 and the MNR embankment, constructed on a new alignment



approximately south of the current culverts. New wing walls and a splash pad are proposed at the St. John River where the culvert outlets. The splash pad will consist of heavy riprap and be set as much as 5 feet below the outlet. The existing culverts will be filled in place.

SUBSURFACE EXPLORATIONS FOR THE CURRENT PROJECT

GZA completed a preliminary design exploration program in 2017 consisting of three test borings and a supplementary exploration program in 2019 consisting of one test boring. The as-drilled boring locations were surveyed by MaineDOT, and are shown on **Figure 2**.

New England Boring Contractors of Hermon, Maine provided drilling services and coordinated utility clearance. All borings were drilled using 3- or 4-inch driven casing and drive-and-wash drilling techniques. Standard penetration testing (SPT) and split-spoon sampling were performed at 5- to 10-foot typical intervals in the overburden using a 24-inch-long, 1-3/8-inch inside-diameter sampler, driven with a 140-lb hammer with a 30-inch drop. Bedrock cores were obtained using NQ2 wire-line coring equipment. GZA personnel monitored the drilling work and prepared logs of each boring that are included in **Appendix B**. Elevations referenced in this report are in feet and refer to the National American Vertical Datum of 1988 (NAVD88). The borings were backfilled with cuttings and crushed stone upon completion. Additional details of each program are described below.

PRELIMINARY TEST BORINGS

GZA completed three (3) test borings (BB-FGB-101, -102 and -103) between August 22 and August 28, 2017. Two borings (BB-FGB-101 and -102) were drilled within the railroad bed using a hi-rail mounted drill rig on either side of the existing railroad culvert. BB-FGB-103 was drilled between Route 1 and the railroad along the proposed culvert alignment using an ATV-mounted drill rig. The borings were drilled to depths of approximately 67.3 to 87.5 feet below ground surface (bgs) and terminated approximately 6.7 to 11.5 feet into bedrock. SPT sampling was conducted using a safety hammer operated by a rope and cathead or calibrated automatic hammer.

SUPPLEMENTARY TEST BORING

GZA completed one (1) supplemental test boring (BB-FGB-201) on October 2, 2019. The boring was drilled east of Route 1 in the existing residential driveway on the upstream end of the Route 1 culvert. The boring was drilled using a truck-mounted drill rig, and SPT sampling was conducted using a calibrated automatic hammer. The boring was drilled to a depth of 42 feet and was terminated in dense soils prior to reaching bedrock.

LABORATORY TESTING

GZA retained GeoTesting Express of Acton, Massachusetts to complete a testing program to assess the gradation and engineering characteristics of the soil and to evaluate the strength of the bedrock. The program included: eight (8) gradation analysis / AASHTO Classification / Unified Soil Classification System / Frost Classifications, one (1) Atterberg Limit Test, and two (2) unconfined compressive strength / secant modulus tests on bedrock core samples. Results of the testing are included in **Appendix C**.



GENERALIZED SUBSURFACE CONDITIONS

Two soil units were encountered in the borings: Fill and Glacial Till. Approximately 18 inches of ballast was encountered in the borings drilled through the railbed (BB-FGB-101 and -102). The approximate thicknesses and generalized descriptions of the subsurface units are presented in the following table, in descending order from existing ground surface. Detailed descriptions of the materials encountered at specific locations are provided in the boring logs in **Appendix B**. An interpreted subsurface profile showing the soil and rock conditions along the proposed culvert alignment is presented on **Figure 3**.

GENERALIZED SUBSURFACE CONDITIONS		
Subsurface Unit	Approximate Encountered Thickness (ft)	Generalized Description
Fill	12 to 23	Variable ranging <u>from</u> : Brown, medium dense, fine to coarse SAND, with varying amounts of Silt and Gravel <u>to</u> : Grey, soft to very stiff, Sandy SILT, trace Gravel, with some wood and roots. (USCS: SM, ML). <ul style="list-style-type: none"> • Encountered in all borings • Approximately 18 inches of ballast was present above the fill in borings BB-FGB-101 and -102
Glacial Till	44 to 54	Variable ranging <u>from</u> : Brown, very dense, fine to coarse SAND, with varying amounts of Silt and Gravel <u>to</u> : Grey, hard, SILT, with varying amounts of Sand and Gravel <u>to</u> : Grey, hard, Silty CLAY. (USCS: SM, SC, ML, CL). <ul style="list-style-type: none"> • Encountered in all borings
Encountered Top of Bedrock Elevation		BB-FGB-101: El. 416.0 BB-FGB-102: El. 415.1 BB-FGB-103: El. 422.5

BEDROCK

Bedrock encountered in the test borings and was described as hard, fresh to slightly weathered, aphanitic, grey, Slate. Primary joints are extremely close to widely spaced, high angle to moderately dipping, planar, smooth to rough, fresh, partially open to open, some silt infilling. Secondary joints are close to moderately spaced, low angle to moderately dipping, planar, smooth to rough, fresh, partially open to open. A few highly fractured zones were observed. The Rock Quality Designation (RQD) ranged from 0 to 95 percent with a weighted average RQD based run lengths of 36 percent, indicating poor Rock Mass Quality.

Unconfined compressive strength (UCS) testing was conducted on two samples of rock, the results of which are summarized in the following table.

SUMMARY OF BEDROCK STRENGTH TEST RESULTS							
Boring	Depth below Existing Grade (ft)	Depth below Top of Rock (ft)	Elevation (ft NAVD 88)	Unconfined Compressive Strength (psi)	Secant Modulus @ 50% of Failure Stress (ksi)	Unit Weight (pcf)	Rock Type
BB-FGB-102	83.8	7.8	407.3	7,243	9,180	170	SLATE
BB-FGB-103	65.7	8.7	413.8	10,995	9,820	169	SLATE



GROUNDWATER

Groundwater was encountered at depths of approximately 24.7 feet and 11 feet below ground surface at borings BB-FGB-101 and -103 respectively, corresponding to approximately El. 466.7 and 468.5 respectively. Water levels were measured in completed boreholes within approximately 20 minutes of completion of drilling and may not have stabilized. Fluctuations in groundwater levels will occur due to variations in season, precipitation, river level and other factors. Consequently, water levels during and after constructions are likely to vary from those encountered in the borings at the time the observations were made.

ENGINEERING EVALUATIONS & RECOMMENDATIONS

SITE SEISMIC CLASSIFICATION

Seismic site class was determined in general accordance with LRFD Table C3.10.3.1. The average SPT N-value is between 15 and 50 blows per foot, Therefore, the bridge should be assigned to Site Class D. Based on the site coordinates, the recommended AASHTO Response Spectra (Site Class D) for a 7 percent probability of exceedance in 75 years are summarized for the site are as follows:

SITE CLASS D SEISMIC DESIGN PARAMETERS	
Parameter	Design Value
Fpga	1.6
Fa	1.6
Fv	2.4
As (Period = 0.0 sec)	0.148 g
SDs (Period = 0.2 sec)	0.329 g
SD1 (Period = 1.0 sec)	0.149 g

FROST DEPTH

Based on the MaineDOT BDG, Section 5.2.1, the Freezing Index for the site is 2600, and with high-moisture content soils at the proposed foundation elevations (approximately at creek level), the estimated depth of frost penetration is approximately 6.5 feet. Consequently, new foundation levels should be set at least 6.5 feet below ground surfaces exposed to freezing temperatures.

PROPOSED CULVERT

The proposed new culvert will have a reinforced concrete base that will also serve as its foundation. The borings indicate that the proposed bearing elevation of the culvert is within glacial till stratum. Bearing resistance values were developed for the culvert foundation based on the method of Munfakh et al., 2001. Bearing resistances were evaluated in accordance with Articles 10.6.3.1.1 and 10.6.3.1.2a of AASHTO LRFD.

We recommend that the culvert bear on undisturbed glacial till deposits and that the design be checked assuming a maximum allowable bearing pressure of 8 ksf for the service condition. If the bearing pressure is limited as recommended,



we estimate the post construction settlement of the culvert to be less than approximately ½ inch. Although not anticipated, if encountered in the culvert subgrade excavation, all organic, or otherwise unsuitable soils should be removed beneath the culvert bearing zone and replaced with lean concrete, compacted Gravel Borrow, or crushed stone.

We recommend that the culvert and associated wing walls be backfilled with compacted Maine DOT 703.19 Granular Borrow for Underwater Backfill which is considered to be Type 4 soil in accordance with the Maine DOT Bridge Design Guide (BDG). Recommended soil properties for Type 4 soils to be used as backfill are as follows:

Soil Type	Friction Angle	Soil Total Unit Weight (pcf)
Maine DOT Granular Borrow	32	125

Because the culvert side walls are not allowed to rotate at the top, they should be designed based on at-rest earth pressure (Ko). The side walls should be designed using Ko equal to 0.47 and a unit weight of 125 pounds per cubic foot (pcf) for the backfill.

WINGWALLS/TOE WALLS

We recommend that the upstream wing walls bear on undisturbed glacial till deposits and that the design be checked assuming a maximum allowable bearing pressure of 8 ksf for the service condition. If the bearing pressure is limited as recommended, we estimate the post construction of the culvert to be less than approximately ½ inch. Although not anticipated, if encountered in the wall subgrade excavations, all organic, or otherwise unsuitable soils should be removed beneath the bearing zone and replaced with lean concrete, compacted Gravel Borrow, or crushed stone. The footings should be founded at least 6.5 feet below ground surface for frost protection.

The downstream wing walls are proposed to have a top of wall elevation of approximately El. 479 and an exposed height of approximately 20 feet at the outlet and an effective embankment height of 32 feet. Given the height of the walls and the depth of excavation required into the base of the railroad embankment, spread footing foundations are considered impractical for support of the downstream wing walls.

Due to the height, constructability concerns previously noted, and the considerable loads imposed by the railroad and embankment, GZA evaluated three alternative wall types for the downstream wing walls, including cantilevered soldier beam and lagging, anchored soldier beam and lagging, and soil nail. Due to the large imposed loads, the moment demand on a cantilevered system would require an excessively large soldier beam section, so the cantilevered system was judged to be impractical. Although feasible, the use of a soil nail wall at this site was expected to require significantly more near-horizontal drilling than an anchored soldier beam and lagging system and was therefore judged to be less efficient for construction. Given the above constraints, an anchored soldier beam and lagging system is considered the preferred alternative for the downstream wing walls.

We recommend that the permanent downstream wing walls consist of anchored soldier beam and lagging walls. GZA evaluated a technically feasible wall configuration as follows:

- ASTM A572 Grade 50 double W16x100 soldier beams drilled and grouted into place at 12 feet on-center maximum and at least 10 feet below the lowest adjacent grade;



- Galvanized 1-3/4-inch diameter, ASTM A722 steel (150 ksi ultimate strength) All-Thread Bars, one per soldier pile;
- A single-level wale system to distribute the tieback force into the piles;
- A 8-foot long row of sheet piles, serving as a dead man installed at least 30 feet behind the back of the lagging at the downstream end;
- A wale system to distribute the tieback force into the deadman;
- Temporary timber lagging for the construction condition; and
- A Permanent, 12-inch minimum thickness, cast-in-place, reinforced concrete facing.

Foundation drainage should be provided for the wing walls in accordance with Section 5.4.1.9 of the Maine DOT BDG.

Live load surcharge on the upstream wing walls should be applied as a uniform lateral surcharge pressure using the equivalent fill height (Heq) values developed in accordance with AASHTO Article 3.11.6.4 based on the culvert height and distance from the wall back face to the edge of traffic.

CONSTRUCTION CONSIDERATIONS

Construction considerations are intended to identify geotechnical-related issues that have the potential to impact design and cost considerations for bridge construction. These items are provided in the bullets that follow.

EXCAVATION

It is anticipated that the proposed culvert excavations could be accomplished using sloped open cut techniques, however, if it is desirable to limit the extent of excavations a temporary support of excavation system may be used.

DEWATERING

Based on the measured groundwater levels, little or no construction dewatering is anticipated to be necessary. If localized water or surface runoff water is encountered in an excavation, we anticipate that pumping from localized sumps should be sufficient. Dewatering efforts must meet the requirements of local, State and federal environmental and conservation authorities.

SOLDIER BEAM AND LAGGING

Given the high density of the soils, and the cobbles/boulders observed along the bank, it is anticipated that directly driving the soldier beams would be problematic. If the piles could be driven past these potential obstructions, it is likely that they would kick out of alignment and create issues for the lagging installation. We therefore recommend that the soldier beams be installed in pre-drilled holes and backfilled with concrete. We recommend a minimum predrill depth of 10 feet below the lowest planned grade (temporary or permanent).

We anticipate that it will be necessary to use temporary casing to keep the holes open through the overburden soil. Once the socket drilling is completed, the bases should be cleaned out using an auger, cleanout bucket, air lift, vacuum truck or other suitable means to remove loose material in the base.



A temporary template or frame may be employed to establish the pile top locations.

The Contractor should be required to submit the proposed installation equipment and a narrative describing the installation sequence for review by the geotechnical engineer prior to mobilizing the equipment and materials to the site.

GEOTECHNICAL SPECIFICATIONS, BID SUPPORT, AND CONSTRUCTION OBSERVATION

Although not part of the base scope of work, GZA is available to provide geotechnical services to support subsequent phases of the project including: geotechnical design of walls or piles; technical specification preparation; bid support and construction services including submittal review and observation; and documentation of foundation construction. GZA can develop a scope and estimated costs for these services once the initial geotechnical evaluation has been reviewed by the owner and the design team.

CLOSURE

We trust this information meets current project needs. Please feel free to call Nicholas Williams at (207) 358-5129 if you have any questions or if we can be of further service.

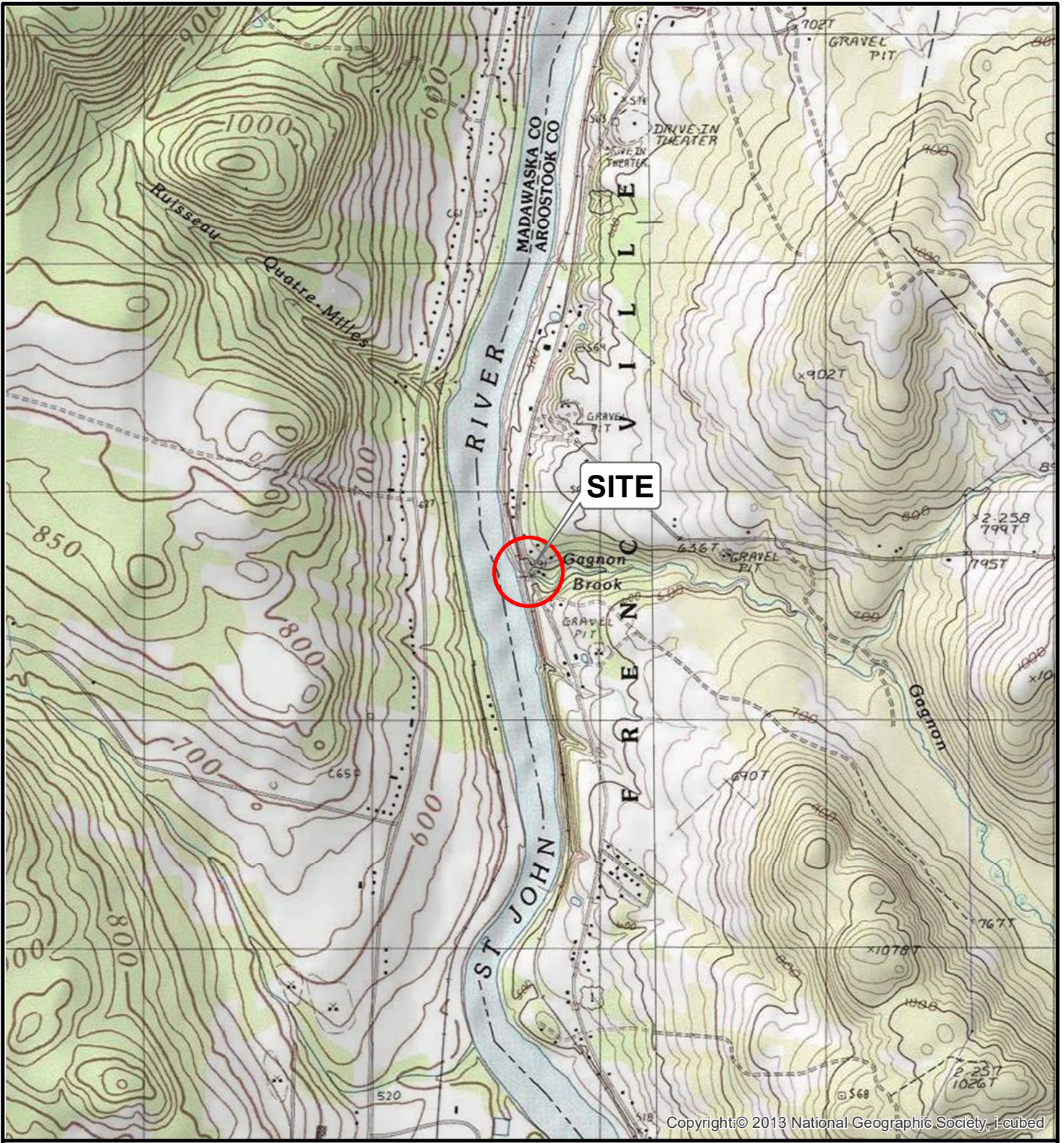
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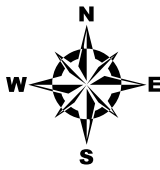
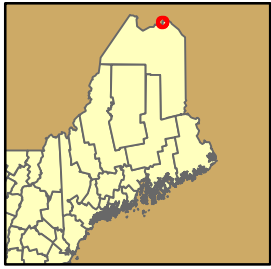
Attachments: Figure 1 – Site Locus
Figure 2 – Boring Location Plan
Figure 3 – Interpretive Subsurface Profile
Appendix A - Limitations
Appendix B - Test Boring Logs
Appendix C – Laboratory Test Results



FIGURES



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USGS
QUADRANGLE
LOCATION

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

Data Supplied by :



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

SCALE IN FEET



PROJ. MGR.: NVW
DESIGNED BY: BLW
REVIEWED BY: CLS
OPERATOR: BLW

DATE: 12-06-2019

LOCUS PLAN

**GAGNON BROOK BRIDGE
FRENCHVILLE, MAINE**

JOB NO.
09.0025953.00

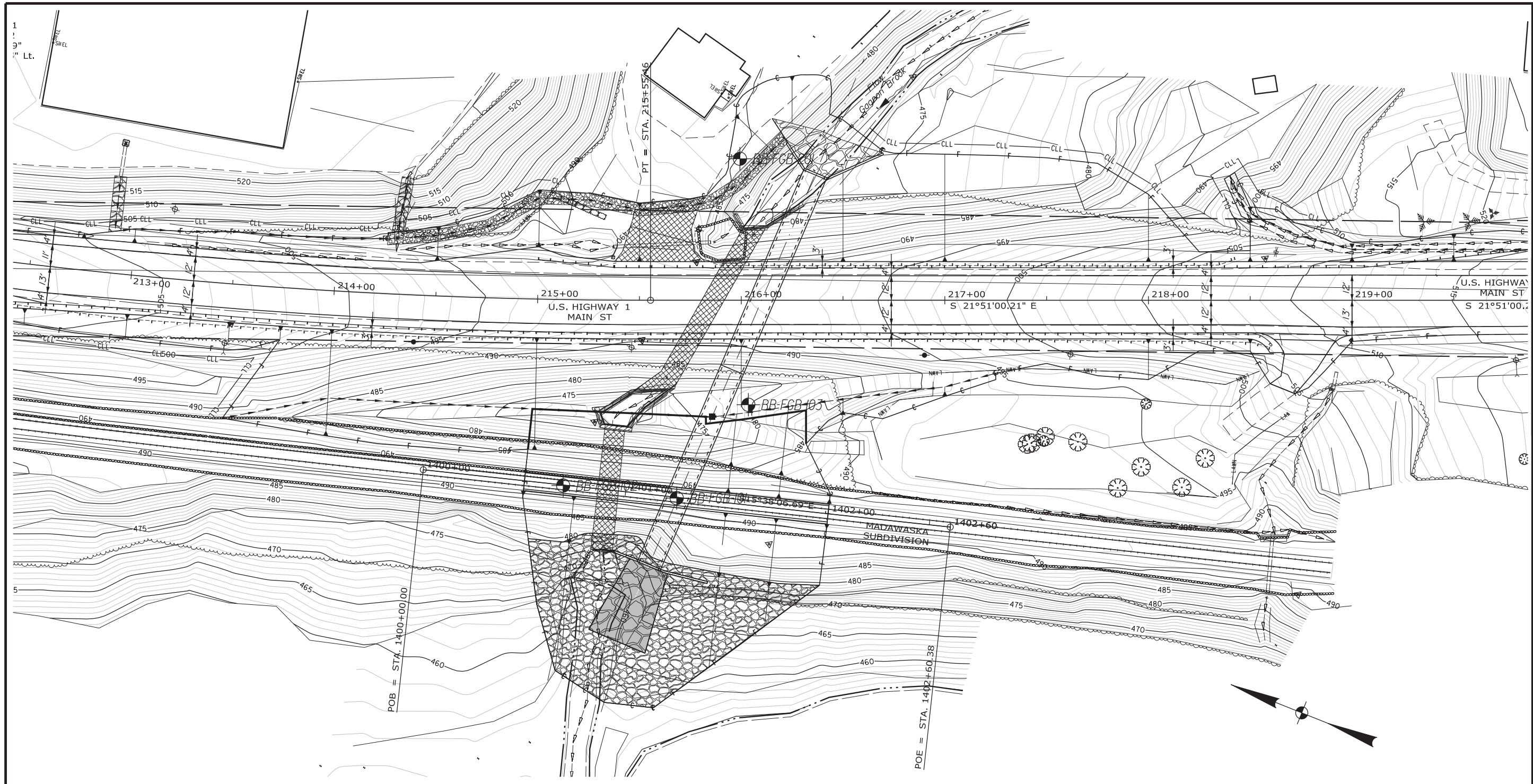
FIGURE NO.
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Date: 1/8/2020

Username: common

Division: MULTIMODAL


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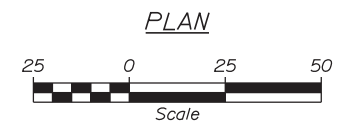


NOTES

- 1) Base map developed from electronic files (Alignments.dgn, Alignments_Rail.dgn, Bridge.dgn, Conours.dgn, Highway.dgn, RWPlan.dgn, Text.dgn, and Topo.dgn) provided by VHB on September 11, 2019 and January 8, 2020.
- 2) The as-drilled locations of the test borings were surveyed by MaineDOT and provided to GZA in an electronic file (borings.dgn) on October 4, 2019.
- 3) BB-FGB-100 and BB-FGB-200 series bridge borings were performed by New England Boring Contractors and observed by GZA personnel between August 7 and 11, 2017, and on October 2, 2019.

BORING LOCATION PLAN LEGEND

 BB-FGB-201 Location and designation of cased wash boring



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
CAPITAL PROJECTS
BRIDGE NO. 7831 & 2303
WIN 21776.00 & 23565.00
BRIDGE PLANS



Christopher L.
SIGNATURE
7275
P.E. NUMBER
1-8-2020
DATE

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

GAGNON BROOK BRIDGE
OVER GAGNON BROOK
FRENCHVILLE
AROOSTOOK COUNTY
BORING LOCATION PLAN

SHEET NUMBER
11
OF 43

GZA FIGURE 2



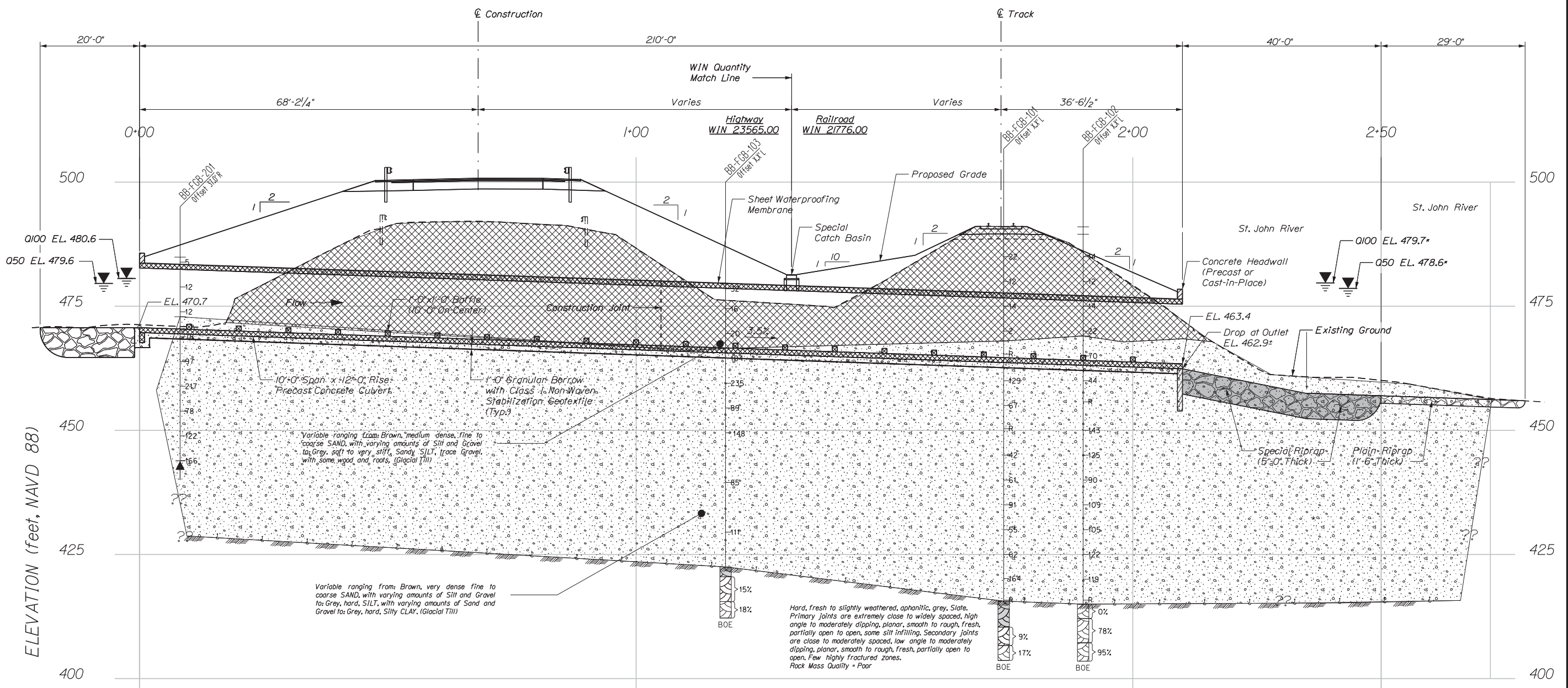
PREPARED BY:

Date: 1/8/2020

Username: common

Division: MULTIMODAL

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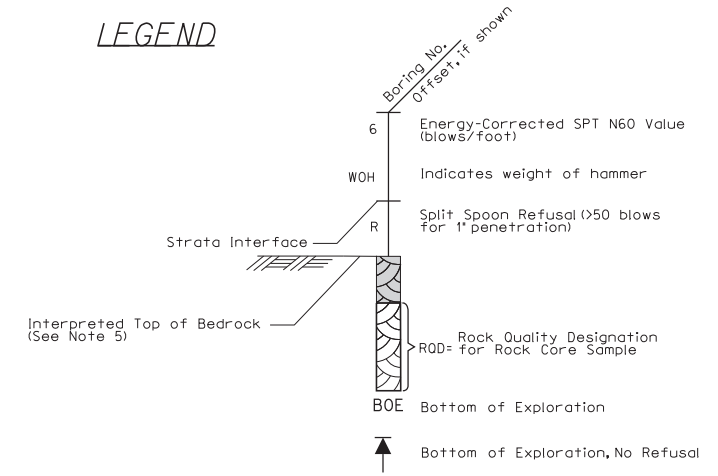


* Water surface elevations provided are based on gage data for St. John River and are not in conjunction with controlling headwater elevations for Gagnon Brook. See hydraulic memo.

NOTES

- 1) Base map developed from electronic files (032_details_01.dgn, Bridge Profile.dgn, and Rail_Profile.dgn) provided by VHB on September 11, 2019 and January 8, 2020.
- 2) Stationing is based on the culvert centerline. Station 0+00 is located at the inlet of the culvert (East edge).
- 3) This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

LEGEND



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
CAPITAL PROJECTS
WIN 21776.00 & 23565.00
BRIDGE NO. 7831 & 2303
BRIDGE PLANS

SIGNATURE: [Signature]
P.E. NUMBER: 7275
DATE: 1-8-2020

PROJ. MANAGER	DATE	BY	NAME	BENEFIT
DESIGN-DETAILED				
CHECKED-REVIEWED				
DESIGN-DETAILED				
DESIGN-DETAILED				
REVISIONS 1				
REVISIONS 2				
REVISIONS 3				
REVISIONS 4				
FIELD CHANGES				

GAGNON BROOK BRIDGE
OVER GAGNON BROOK
FRENCHVILLE
AROOSTOOK COUNTY
INTERPRETIVE SUBSURFACE PROFILE

PREPARED BY: [Signature]

GZA FIGURE 3



SHEET NUMBER

12

OF 43



APPENDIX A – LIMITATIONS



LIMITATIONS

Explorations

1. The analyses and recommendations in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.
2. The generalized soil profile described in the text 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 are probably more erratic. For specific information, refer to the boring logs.
3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design, or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by GZA GeoEnvironmental, Inc. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

5. It is recommended that this firm be retained to provide soil engineering services during construction of the foundation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

6. This design basis report has been prepared for this project by GZA GeoEnvironmental, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.
7. This report has been prepared for this project by GZA GeoEnvironmental, Inc. for the exclusive use of the TEC Associates and their project team for specific application to the repairs to SWPRR Bridge 7.26 in New Stanton, Pennsylvania in accordance with generally accepted soil and foundation engineering practices. No Warranty, express or implied, is made.

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APPENDIX B – TEST BORING LOGS

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

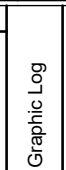
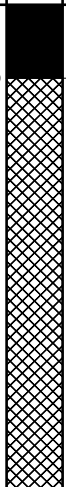
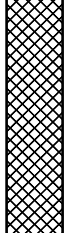
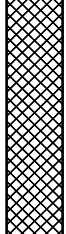
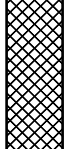

Boring No.: BB-FGB-101

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.4	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-23-17/8-24-17	Drilling Method: SPT / Drive & Wash	Core Barrel: NQ
Boring Location: N1271563.1, E2170832.3	Casing ID/OD: 4/4.5"	Water Level*: 24.7' bgs

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected C = Consolidation Test

Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
0								489.9		0'-1.5': Ballast	
5	1D	24/13	5.0 - 7.0	10-10-12-10	22	22	49			Olive-brown, moist, very stiff, Sandy SILT, trace gravel, (Fill).	
10	2D	24/8	10.0 - 12.0	18-7-5-3	12	12	15			Brown, moist, medium dense, fine to medium SAND, some silt, trace gravel, (Fill).	
15	3D	24/13	15.0 - 17.0	11-10-4-7	14	14	16			Top 11": Grey, moist, medium dense, fine to medium SAND, some silt, trace gravel, (Fill). Bottom 2": Brown, moist, Sandy SILT, trace gravel, (Fill).	
20	4D	24/15	20.0 - 22.0	3-1-1-7	2	2	11			Olive-brown, moist, soft, Sandy SILT, trace gravel, wood present, (Fill).	G#1 A-4, ML
25							45	468.4			

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Water level measurements were taken immediately after removal of casing.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine


Boring No.: BB-FGB-101

WIN: 21776.00

Driller:	New England Boring Contractors	Elevation (ft.)	491.4	Auger ID/OD:	4.5" SSA
Operator:	Mike Porter	Datum:	NAVD 88	Sampler:	Standard Splitspoon
Logged By:	B. Woodman	Rig Type:	High-Rail	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	8-23-17/8-24-17	Drilling Method:	SPT / Drive & Wash	Core Barrel:	NQ
Boring Location:	N1271563.1, E2170832.3	Casing ID/OD:	4/4.5"	Water Level*:	24.7' bgs

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140 lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
25	5D	16/10	25.0 - 26.3	22-34-50/3"	R		R/C	465.1		Olive-brown, wet, very dense, Silty fine to coarse SAND, little gravel, (Glacial Till).		
								464.4		26.3'-27.0': Apparent cobble		
30	6D	24/19	30.0 - 32.0	47-70-59-76	129	129				Grey, wet, hard, SILT, some fine sand, (Glacial Till).		
35	7D	24/18	35.0 - 37.0	16-26-41-68	67	67				Grey, wet, hard, SILT, some fine sand, (Glacial Till).		
40	8D	16/12	40.0 - 41.3	47-71-117/3"	R					Grey, wet, hard, SILT, some fine to medium sand, little gravel, (Glacial Till).	G#2 A-4, ML	
45	9D	24/13	45.0 - 47.0	43-23-19-32	42	42				Grey, wet, hard, Silty CLAY, little fine sand, trace gravel (Glacial Till).	G#3 A-4, CL	
50												

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Water level measurements were taken immediately after removal of casing.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-101

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.4	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-23-17/8-24-17	Drilling Method: SPT / Drive & Wash	Core Barrel: NQ
Boring Location: N1271563.1, E2170832.3	Casing ID/OD: 4/4.5"	Water Level*: 24.7' bgs

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140 lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
50	10D	24/20	50.0 - 52.0	15-20-41-50	61	61				Grey, wet, hard, Silty CLAY, trace fine sand, few fine sand lenses, (Glacial Till).		
55	11D	24/22	55.0 - 57.0	20-37-54-76	91	91				Grey, wet, hard, Silty CLAY, trace fine sand, few fine sand lenses, (Glacial Till).		
60	12D	24/21	60.0 - 62.0	20-24-31-42	55	55				Grey, wet, hard, Silty CLAY, trace fine sand, few fine sand lenses, (Glacial Till).		
65	13D	24/19	65.0 - 67.0	20-27-35-42	62	62				Grey, wet, hard, Silty CLAY, trace fine to medium sand, few fine sand lenses, one medium sand lens, (Glacial Till).		
70	14D	20/13	70.0 - 71.7	52-66-98-100	164	164				Grey, wet, very dense, Silty fine to coarse SAND, little gravel, (Glacial Till).		
75												

Remarks:

1. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Water level measurements were taken immediately after removal of casing.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-101

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.4	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-23-17/8-24-17	Drilling Method: SPT / Drive & Wash	Core Barrel: NQ
Boring Location: N1271563.1, E2170832.3	Casing ID/OD: 4/4.5"	Water Level*: 24.7' bgs

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140 lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor(60%)*N-uncorrected) C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in. Shear Strength (psf) or RQD (%))	N-uncorrected	N ₆₀	Casing Blows					
75	15D	5/0	75.4 - 75.8	100/4"					416.0		No recovery. Spoon head deformed during sampling. Attempted to extract spoon shoe with roller cone.	
80	R1	44/36	79.0 - 82.7	RQD = 9%					412.4		Extracted spoon shoe with core barrel, set up to core at 79.0'. R1: 79.0'-82.7' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Joints are extremely close to closely spaced, high angle, planar, smooth, fresh, with silt infilling. Highly fractured zone from 79.3'-81.7', resulting in angular gravel. Rock Mass Quality = Very Poor Recovery = 82% Rock Core Times (min:sec): 79.0-80.0' (4:05), 80.0-81.0' (4:43), 81.0-82.0' (4:15), 82.0-82.7' (3:13)	
85	R2	36/32	82.7 - 85.7	RQD = 17%					408.7		R2: 82.7'-85.7' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Primary joints are extremely close to closely spaced, high angle, planar, rough, fresh, open. Secondary joints are closely spaced, low angle to moderately dipping, planar, rough, fresh, open. Rock Mass Quality = Very Poor Recovery = 89% Rock Core Times (min:sec): 82.7-83.7' (1:21), 83.7-84.7' (2:02), 84.7-85.7' (2:47)	
									405.7		Bottom of Exploration at 85.7 feet below ground surface.	

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Water level measurements were taken immediately after removal of casing.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-102

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.1	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-22-17/8-23-17	Drilling Method: Drive & Wash	Core Barrel: NQ
Boring Location: N1271617.1, E2170817.3	Casing ID/OD: 4/4.5", 3/3.5"	Water Level*: Not measured

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: R = Rock Core Sample S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf)
 D = Split Spoon Sample SSA = Solid Stem Auger S_{u(lab)} = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent
 MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q_p = Unconfined Compressive Strength (ksf) LL = Liquid Limit
 U = Thin Wall Tube Sample RC = Roller Cone N-uncorrected = Raw Field SPT N-value PL = Plastic Limit
 MU = Unsuccessful Thin Wall Tube Sample Attempt WOH = Weight of 140 lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value PI = Plasticity Index
 V = Field Vane Shear Test, PP = Pocket Penetrometer WOR/C = Weight of Rods or Casing N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency G = Grain Size Analysis
 MV = Unsuccessful Field Vane Shear Test Attempt WO1P = Weight of One Person N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected C = Consolidation Test

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in. Shear Strength (psf) or RQD (%))	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
25	5D	24/4	25.0 - 27.0	20-39-31-34	70	70	20			Olive-brown, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till).		
							119					
							31					
							68					
							65					
30	6D	24/9	30.0 - 32.0	16-15-29-43	44	44	67			Olive-brown, wet, hard, Sandy CLAY, little gravel, (Glacial Till).		
							66					
							103 R/C					
35	7D	6/3	35.0 - 35.5	150/6"						Grey, wet, hard, Silty CLAY, some fine sand, trace gravel, (Glacial Till). Apparent boulder at 35.5'. Began advancement of 3" casing.	A-4, CL LL=40 PL=24 PI=16 WC=28	
40	8D	24/20	40.0 - 42.0	31-60-83-76	143	143				Grey, wet, hard, Silty CLAY, some sand, little gravel, (Glacial Till).	G#4 A-4, CL	
45	9D	21/13	45.0 - 46.8	35-42-83-74	125	125				Grey, wet, very dense, Clayey SAND, some gravel, (Glacial Till).	G#5 A-4, SC	
50												

Remarks:

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- Water level measurements were taken immediately after removal of casing.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-102

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.1	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-22-17/8-23-17	Drilling Method: Drive & Wash	Core Barrel: NQ
Boring Location: N1271617.1, E2170817.3	Casing ID/OD: 4/4.5", 3/3.5"	Water Level*: Not measured

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

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

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows					
50	10D	24/18	50.0 - 52.0	26-38-52-82	90	90				Grey, wet, hard, Silty CLAY, (Glacial Till).	G#6 A-4, CL	
55	11D	24/20	55.0 - 57.0	34-44-65-98	109	109				Grey, wet, hard, Silty CLAY, (Glacial Till).		
60	12D	24/19	60.0 - 62.0	29-51-54-89	105	105				Grey, wet, hard, Silty CLAY, trace fine sand, few fine sand lenses, (Glacial Till).		
65	13D	24/21	65.0 - 67.0	31-62-60-66	122	122				Grey, wet, hard, Silty CLAY, trace fine sand, (Glacial Till).		
70	14D	24/18	70.0 - 72.0	28-39-80-156	119	119				Grey, wet, hard, Silty CLAY, trace fine to medium sand, few fine sand lenses, one medium sand lens, (Glacial Till).		
75												

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Water level measurements were taken immediately after removal of casing.

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-102

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 491.1	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: High-Rail	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-22-17/8-23-17	Drilling Method: Drive & Wash	Core Barrel: NQ
Boring Location: N1271617.1, E2170817.3	Casing ID/OD: 4/4.5", 3/3.5"	Water Level*: Not measured

Hammer Efficiency Factor: 0.6 **Hammer Type:** Automatic Hydraulic Rope & Cathead

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt	R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person	S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _{u(lab)} = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor(60%)*N-uncorrected	T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
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Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in. Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
75	15D	4/4	75.0 - 75.3	118/3"					415.1		Grey, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till). Practical roller cone refusal at 76.0', set up to core at 76.0'. R1: 76.0'-78.9' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Joints are extremely close to closely spaced, high angle, planar, rough, fresh, silt infilling. Highly fractured from 77.0'-77.4' and 78.7'-78.9' resulting in angular gravel. Rock Mass Quality = Very Poor Recovery = 89% Rock Core Times (min:sec): 76.0-77.0' (6:05), 77.0-78.0' (6:06), 78.0-78.9' (6:07) R2: 78.9'-83.8' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Joints are widely spaced, moderately dipping, planar, smooth, discolored, partially open. Rock Mass Quality = Good Recovery = 89% Rock Core Times (min:sec): 78.9-79.0' (0:26), 79.0-80.0' (6:03), 80.0-81.0' (5:57), 81.0-82.0' (5:33), 82.0-83.0' (5:23), 83.0-83.8' (4:19) R3: 83.8'-87.5' Hard, fresh, aphanitic, grey, SLATE. Joints are close to moderately spaced, low angle to moderately dipping, planar, smooth, fresh, partially open. One high angle joint from 85.0'-85.2'. Rock Mass Quality = Excellent Recovery = 100% Rock Core Times (min:sec): 83.8-84.8' (3:19), 84.8-85.8' (4:43), 85.8-86.8' (4:02), 86.8-87.1' (3:53)	q _p =1,043 ksf
	R1	35/35	76.0 - 78.9	RQD = 0%								
	R2	59/53	78.9 - 83.8	RQD = 78%								
	R3	44/44	83.8 - 87.5	RQD = 95%								
80									403.6			
85												
90												
95												
100												

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Water level measurements were taken immediately after removal of casing.

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-103

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 479.5	Auger ID/OD: 4.5" SSA
Operator: Mike Porter	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: Mobile Drill B-53 (ATV)	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 8-28-17/8-28-17	Drilling Method: Drive & Wash	Core Barrel:
Boring Location: N1271547.5, E2170888.0	Casing ID/OD: 4/4.5"	Water Level*: 11.0' bgs

Hammer Efficiency Factor: 0.677

Hammer Type: Automatic Hydraulic Rope & Cathead

Definitions:
 D = Split Spoon Sample
 MD = Unsuccessful Split Spoon Sample Attempt
 U = Thin Wall Tube Sample
 MU = Unsuccessful Thin Wall Tube Sample Attempt
 V = Field Vane Shear Test, PP = Pocket Penetrometer
 MV = Unsuccessful Field Vane Shear Test Attempt
 R = Rock Core Sample
 SSA = Solid Stem Auger
 HSA = Hollow Stem Auger
 RC = Roller Cone
 WOH = Weight of 140 lb. Hammer
 WOR/C = Weight of Rods or Casing
 WO1P = Weight of One Person
 S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
 S_{u(lab)} = Lab Vane Undrained Shear Strength (psf)
 q_p = Unconfined Compressive Strength (ksf)
 N-uncorrected = Raw Field SPT N-value
 Hammer Efficiency Factor = Rig Specific Annual Calibration Value
 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency
 N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected
 T_v = Pocket Torvane Shear Strength (psf)
 WC = Water Content, percent
 LL = Liquid Limit
 PL = Plastic Limit
 PI = Plasticity Index
 G = Grain Size Analysis
 C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in. Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
50												
55												
60	R1	60/48	59.0 - 64.0	RQD = 15%					422.5		Practical refusal during roller cone advancement at 57.0'. Set up to core at 59.0'. R1: 59.0'-64.0' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Primary joints are extremely close to closely spaced, high angle, planar, rough, fresh, partially open to open, with trace silt infilling. Secondary joints are moderately spaced, low angle to moderately dipping, planar, rough, discolored, open. Rock Mass Quality = Very Poor Recovery = 80% Rock Core Times (min:sec): 59.0-60.0' (3:28), 60.0-61.0' (2:56), 61.0-62.0' (2:38), 62.0-63.0' (3:08), 63.0-64.0' (2:32)	
65	R2	40/39	64.0 - 67.3	RQD = 18%					412.2		R2: 64.0'-67.3' Hard, fresh to slightly weathered, aphanitic, grey, SLATE. Joints are extremely close to closely spaced, high angle, planar, rough, fresh, open, with trace silt infilling. Rock Mass Quality = Very Poor Recovery = 98% Rock Core Times (min:sec): 64.0-65.0' (1:59), 65.0-66.0' (3:03), 66.0-67.0' (2:54), 67.0-67.3' (1:27)	q _p =1,583 ksf
70												
75												

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Automatic Hammer NEBC #2 Energy Transfer Ratio = 0.677.
- Water level measurements were taken immediately after removal of casing.

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Gagnon Brook Railway Bridge #7831
Route 1 Bridge #2303
Location: Frenchville, Maine

Boring No.: BB-FGB-201

WIN: 21776.00

Driller: New England Boring Contractors	Elevation (ft.): 484.9	Auger ID/OD: 4.5" SSA
Operator: Brad Enos	Datum: NAVD 88	Sampler: Standard Splitspoon
Logged By: B. Woodman	Rig Type: Mobile Drill B-53 (Truck)	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 10-2-19/10-2-19	Drilling Method: Drive & Wash	Core Barrel:
Boring Location: N1271596.3, E2170998.6	Casing ID/OD: 4/4.5"	Water Level*: 15.3' bgs
Hammer Efficiency Factor: 0.937	Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>	

Definitions:
 D = Split Spoon Sample
 MD = Unsuccessful Split Spoon Sample Attempt
 U = Thin Wall Tube Sample
 MU = Unsuccessful Thin Wall Tube Sample Attempt
 V = Field Vane Shear Test, PP = Pocket Penetrometer
 MV = Unsuccessful Field Vane Shear Test Attempt
 R = Rock Core Sample
 SSA = Solid Stem Auger
 HSA = Hollow Stem Auger
 RC = Roller Cone
 WOH = Weight of 140lb. Hammer
 WOR/C = Weight of Rods or Casing
 WO1P = Weight of One Person
 S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
 S_u(lab) = Lab Vane Undrained Shear Strength (psf)
 q_p = Unconfined Compressive Strength (ksf)
 N-uncorrected = Raw Field SPT N-value
 Hammer Efficiency Factor = Rig Specific Annual Calibration Value
 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency
 N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected
 T_v = Pocket Torvane Shear Strength (psf)
 WC = Water Content, percent
 LL = Liquid Limit
 PL = Plastic Limit
 PI = Plasticity Index
 G = Grain Size Analysis
 C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0	1D	24/12	0.0 - 2.0	1-1-2-2	3	5					Brown, moist, loose, fine to coarse SAND, little silt, (Fill).	
5	2D	24/1	5.0 - 7.0	3-4-4-6	8	12					Brown, moist, medium dense, fine to coarse SAND, little silt, (Fill).	
10	3D	24/1	10.0 - 12.0	2-3-5-14	8	12					Brown, wet, medium dense, fine to medium SAND, some silt, (Fill). Attempted to recover material with 3" spoon, recovered cobble piece.	
15	4D	24/15	15.0 - 17.0	19-22-28-31	50	78					Grey, wet, very dense, fine to coarse SAND, little gravel, little silt, (Glacial Till).	
20	5D	24/17	20.0 - 22.0	27-29-33-30	62	97					Grey, wet, very dense, fine to coarse SAND, little gravel, little silt, (Glacial Till).	
25												

Remarks:

- Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterberg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
- Automatic Hammer NEBC #2 Energy Transfer Ratio = 0.937.
- Water level measured at 14.5' with casing in the ground Water level measured at 15.3' with casing removed.

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



APPENDIX C – LABORATORY TEST RESULTS



Client: GZA GeoEnvironmental, Inc.
 Project Name: Gagnon Brook Culvert Replacement
 Project Location: Frenchville, ME
 GTX #: 306979
 Date: 09/18/17

Soil Classification - AASHTO M 145

Boring ID	Sample ID	Depth, ft	Group Name	Group Symbol	Gravel, %	Sand, %	Fines, %
BB-FGB-101	4D	20-22	Silty Soils	A-4 (0)	4	37	59
BB-FGB-101	8D	40-41.3	Silty Soils	A-4 (0)	28	25	47
BB-FGB-101	9D	45-47	Silty Soils	A-4 (0)	8	14	78
BB-FGB-102	8D	40-42	Silty Soils	A-4 (0)	22	28	50
BB-FGB-102	9D	45-46.7	Silty Soils	A-4 (0)	34	30	36
BB-FGB-102	10D	50-52	Clayey Soils	A-6 (18)	0	0	100
BB-FGB-103	6D	24-26	Silty Soils	A-4 (0)	16	35	49
BB-FGB-103	7D	29-31	Stone Fragments, Gravel and Sand	(A-1-b (0)	20	61	19

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



Client: GZA GeoEnvironmental, Inc.
Project Name: Gagnon Brook Culvert Replacement
Project Location: Frenchville, ME
GTX #: 306979
Date: 09/18/17

Maine DOT - Frost Classifications

Boring ID	Sample ID	Depth, ft	% Finer than 0.02 mm	USCS Soil Classification	Maine DOT Frost Group
BB-FGB-102	10D	50-52	97.5	CL	FG-3

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-102	Sample Type:	bag
Sample ID:	10D	Test Date:	09/21/17
Depth :	50-52 ft	Test Id:	423884
Test Comment:	---		
Visual Description:	Moist, dark gray clay		
Sample Comment:	---		

USCS Classification - ASTM D2487

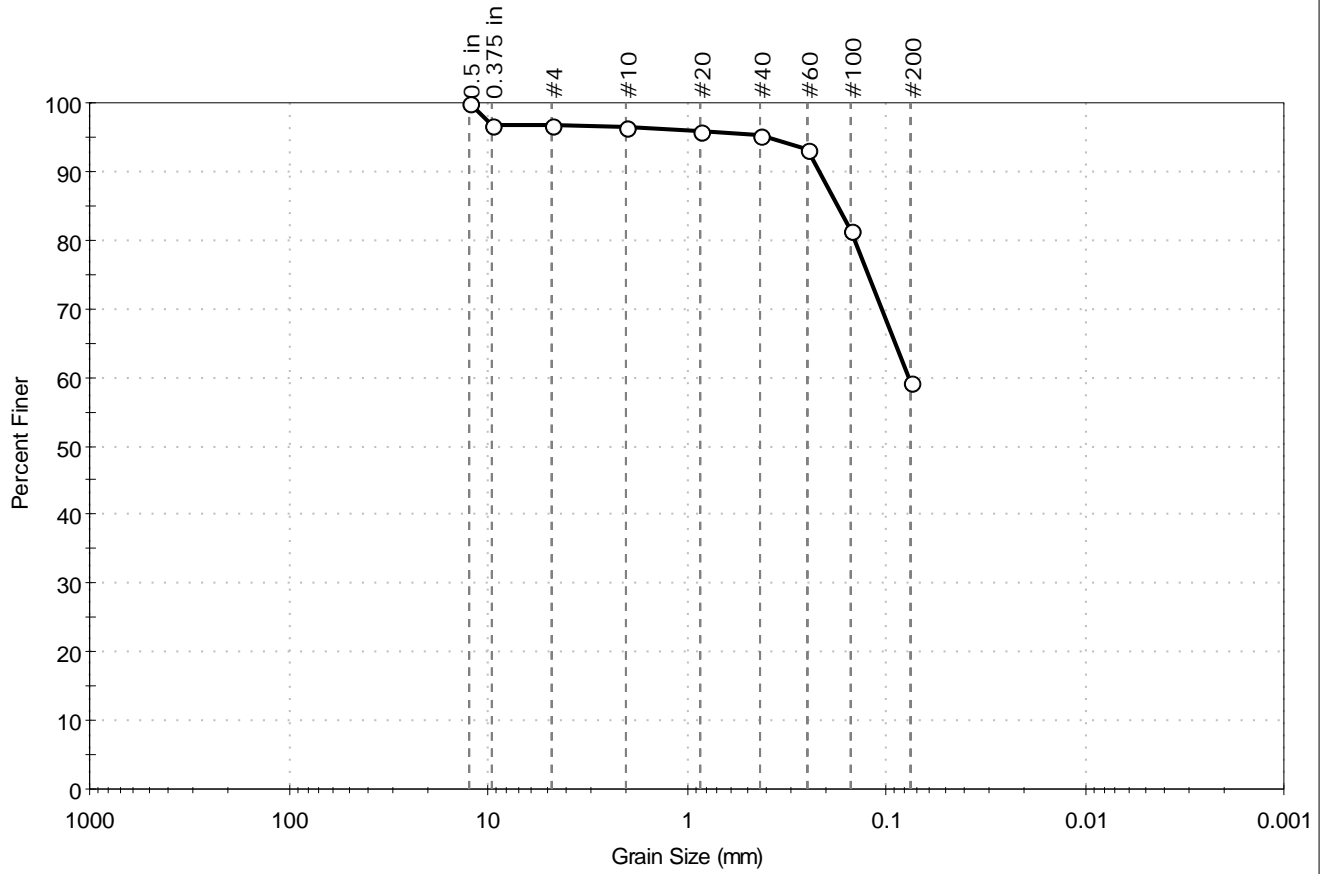
Boring ID	Sample ID	Depth	Group Name	Group Symbol	Gravel, %	Sand, %	Fines, %
BB-FGB-102	10D	50-52 ft	Lean clay	CL	0.0	0.3	99.7

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-101	Sample Type:	bag
Sample ID:	4D	Test Date:	09/15/17
Depth:	20-22 ft	Test Id:	423892
Test Comment:	---		
Visual Description:	Moist, olive gray sandy silt, trace gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.2	37.6	59.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	97		
#4	4.75	97		
#10	2.00	96		
#20	0.85	96		
#40	0.42	95		
#60	0.25	93		
#100	0.15	82		
#200	0.075	59		

<u>Coefficients</u>	
D ₈₅ = 0.1744 mm	D ₃₀ = N/A
D ₆₀ = 0.0769 mm	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

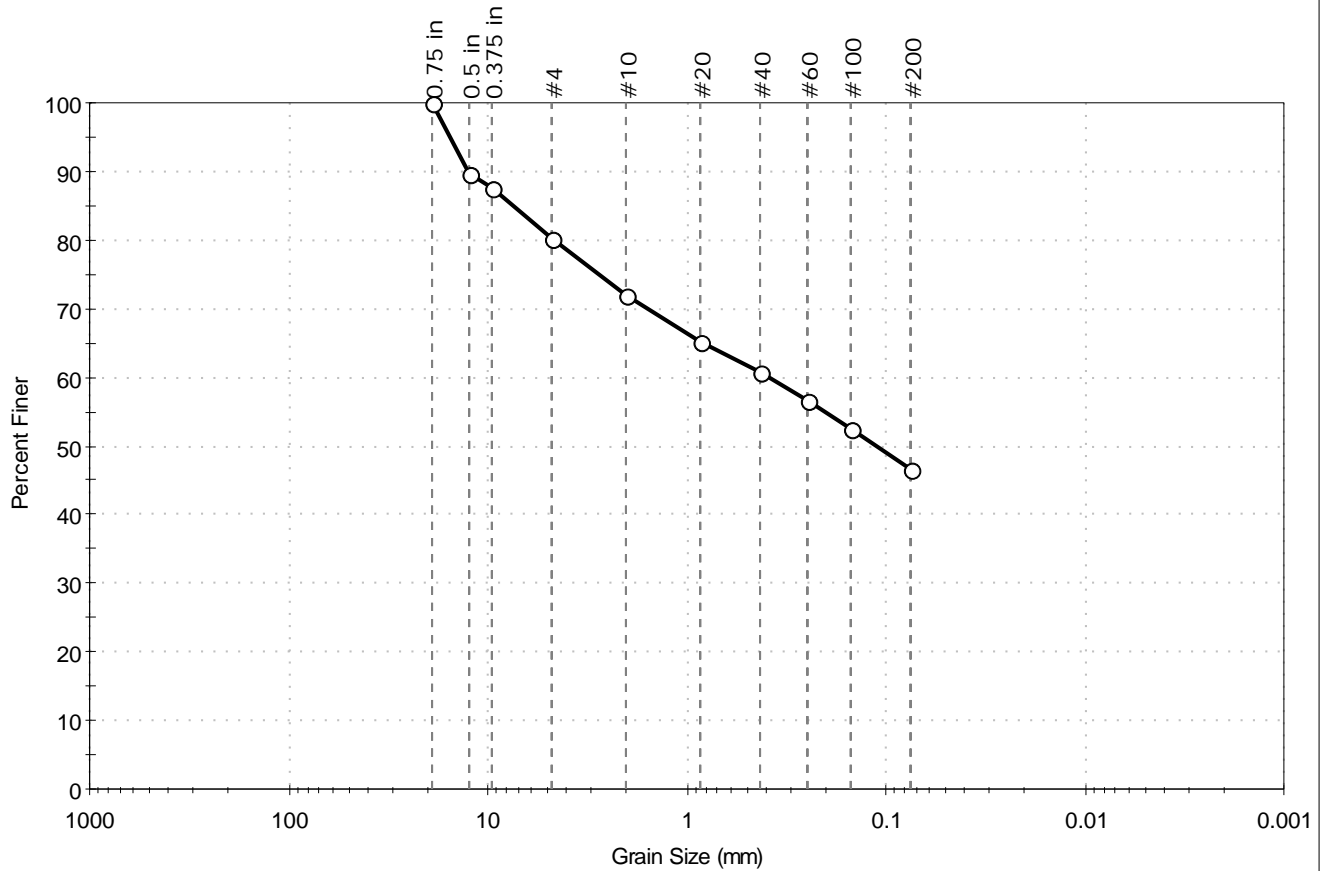
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-101	Sample Type:	bag
Sample ID:	8D	Test Date:	09/15/17
Depth :	40-41.3 ft	Test Id:	423893
Test Comment:	---		
Visual Description:	Moist, dark gray silt, some sand, little gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	19.9	33.6	46.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	90		
0.375 in	9.50	88		
#4	4.75	80		
#10	2.00	72		
#20	0.85	65		
#40	0.42	61		
#60	0.25	57		
#100	0.15	52		
#200	0.075	47		

<u>Coefficients</u>	
D ₈₅ = 7.4469 mm	D ₃₀ = N/A
D ₆₀ = 0.3860 mm	D ₁₅ = N/A
D ₅₀ = 0.1123 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

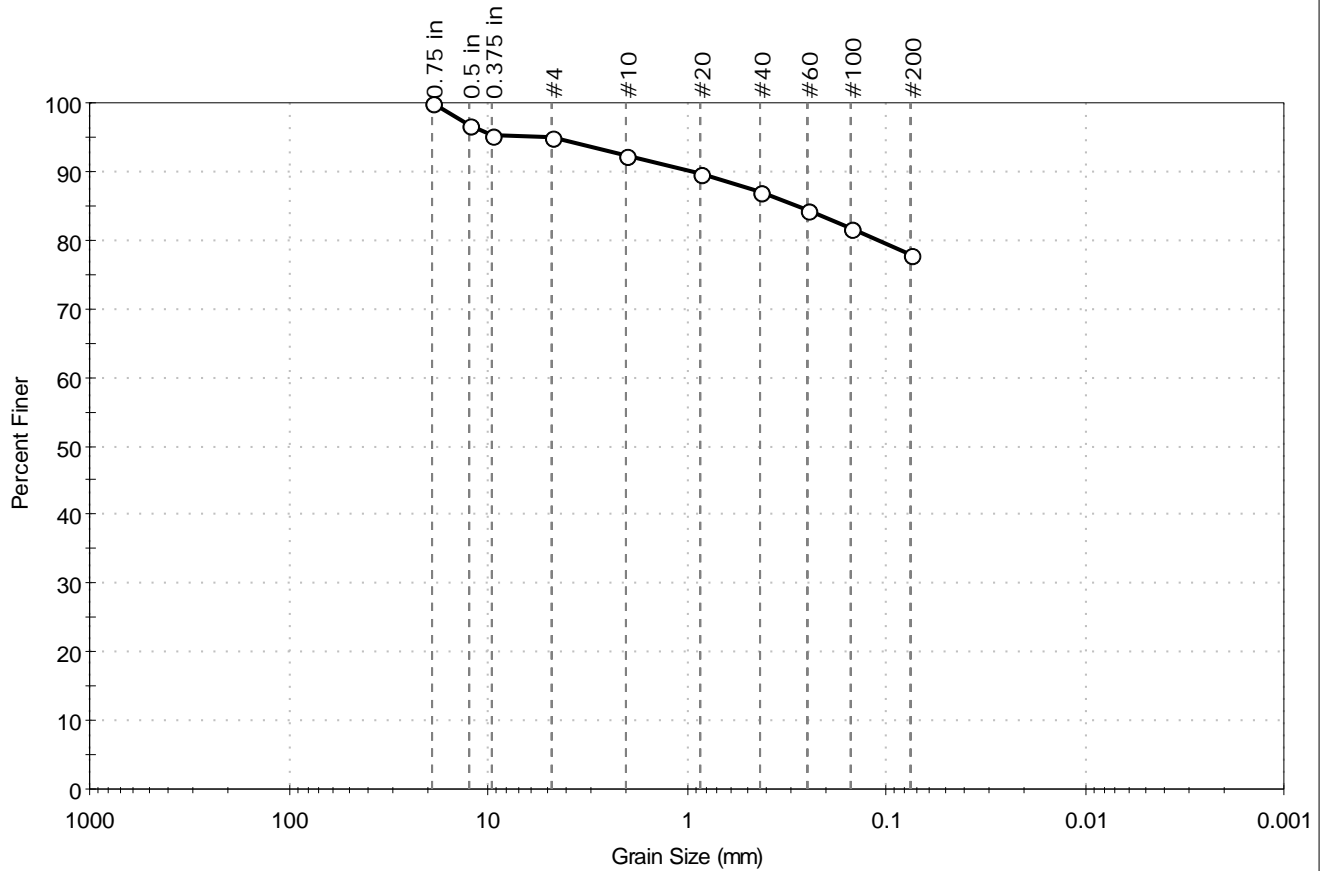
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-101	Sample Type:	bag
Sample ID:	9D	Test Date:	09/15/17
Depth:	45-47 ft	Test Id:	423873
Test Comment:	---		
Visual Description:	Moist, dark gray clay, little sand, trace gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	5.0	17.0	78.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	95		
#4	4.75	95		
#10	2.00	92		
#20	0.85	90		
#40	0.42	87		
#60	0.25	84		
#100	0.15	82		
#200	0.075	78		

<u>Coefficients</u>	
D ₈₅ = 0.2798 mm	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

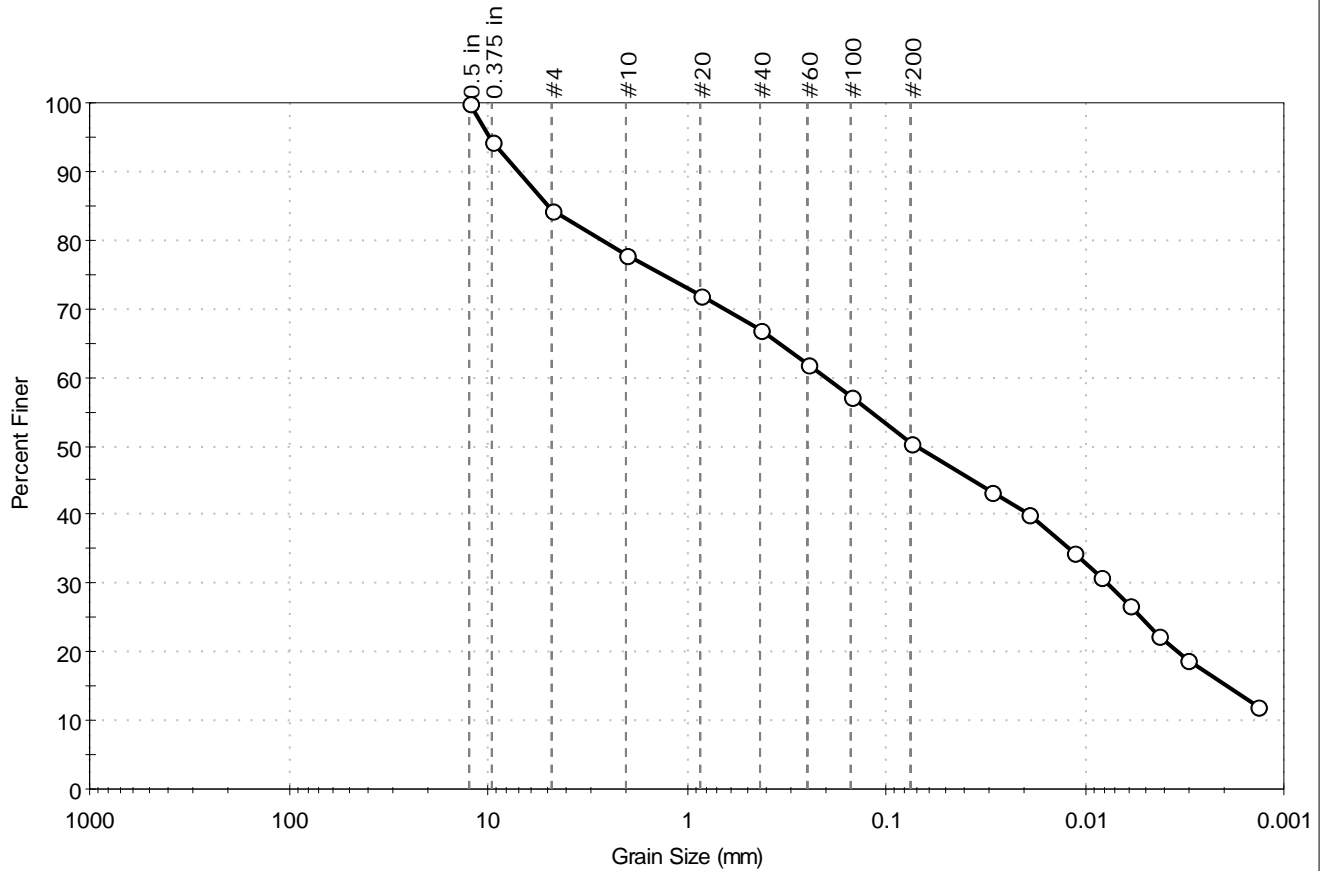
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-102	Sample Type:	bag
Sample ID:	8D	Test Date:	09/15/17
Depth:	40-42 ft	Test Id:	423874
Test Comment:	---		
Visual Description:	Moist, dark gray clay, some sand, little gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	15.5	34.2	50.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	95		
#4	4.75	84		
#10	2.00	78		
#20	0.85	72		
#40	0.42	67		
#60	0.25	62		
#100	0.15	57		
#200	0.075	50		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0297	43		
---	0.0193	40		
---	0.0115	34		
---	0.0083	31		
---	0.0060	27		
---	0.0043	23		
---	0.0031	19		
---	0.0014	12		

<u>Coefficients</u>	
D ₈₅ = 4.9270 mm	D ₃₀ = 0.0077 mm
D ₆₀ = 0.2012 mm	D ₁₅ = 0.0019 mm
D ₅₀ = 0.0720 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

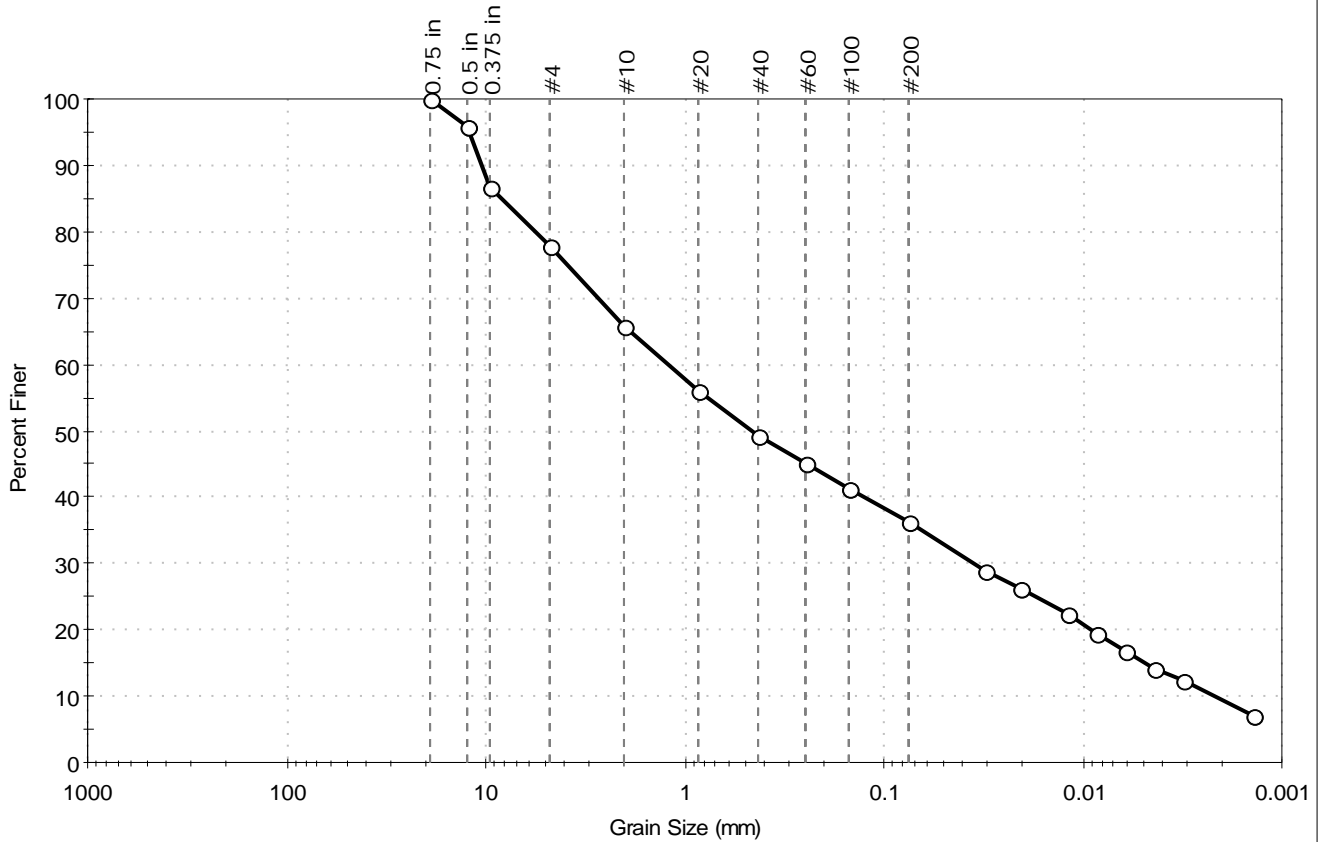
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-102	Sample Type:	bag
Sample ID:	9D	Test Date:	09/15/17
Depth:	45-46.7 ft	Checked By:	emm
Test Comment:	---		
Visual Description:	Moist, very dark gray clayey sand, some gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	21.9	41.7	36.4

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	87		
#4	4.75	78		
#10	2.00	66		
#20	0.85	56		
#40	0.42	49		
#60	0.25	45		
#100	0.15	41		
#200	0.075	36		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0313	29		
---	0.0205	26		
---	0.0120	23		
---	0.0086	19		
---	0.0062	17		
---	0.0044	14		
---	0.0032	12		
---	0.0014	7		

<u>Coefficients</u>	
D ₈₅ = 8.3166 mm	D ₃₀ = 0.0354 mm
D ₆₀ = 1.2055 mm	D ₁₅ = 0.0049 mm
D ₅₀ = 0.4523 mm	D ₁₀ = 0.0022 mm
C _u = 547.955	C _c = 0.473

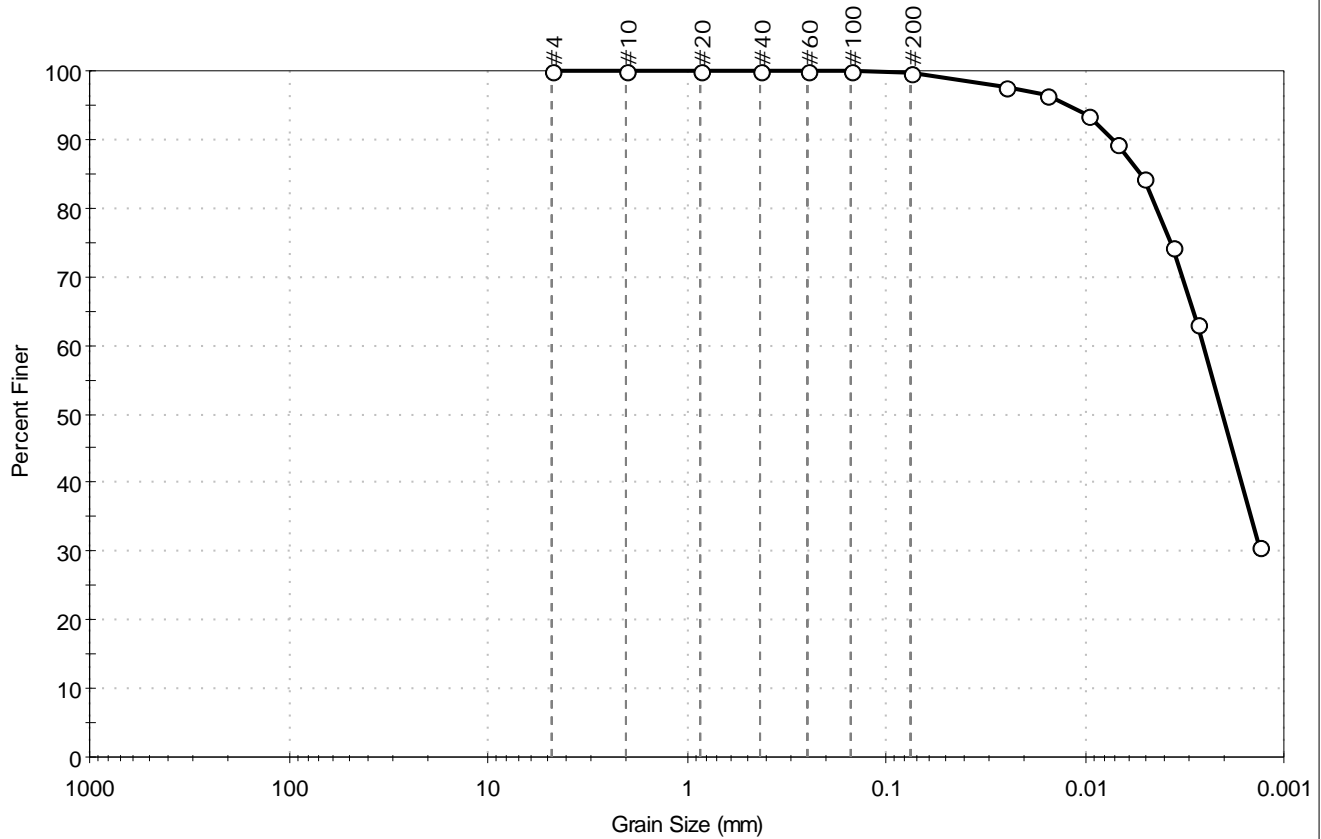
<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Silty Soils (A-4 (0))

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-102	Sample Type:	bag
Sample ID:	10D	Test Date:	09/15/17
Depth:	50-52 ft	Test Id:	423876
Tested By:	GA		
Checked By:	emm		
Test Comment:	---		
Visual Description:	Moist, dark gray clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	0.3	99.7

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		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0250	98		
---	0.0156	97		
---	0.0095	94		
---	0.0069	89		
---	0.0050	84		
---	0.0036	74		
---	0.0027	63		
---	0.0013	31		

<u>Coefficients</u>	
D ₈₅ = 0.0052 mm	D ₃₀ = N/A
D ₆₀ = 0.0026 mm	D ₁₅ = N/A
D ₅₀ = 0.0020 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

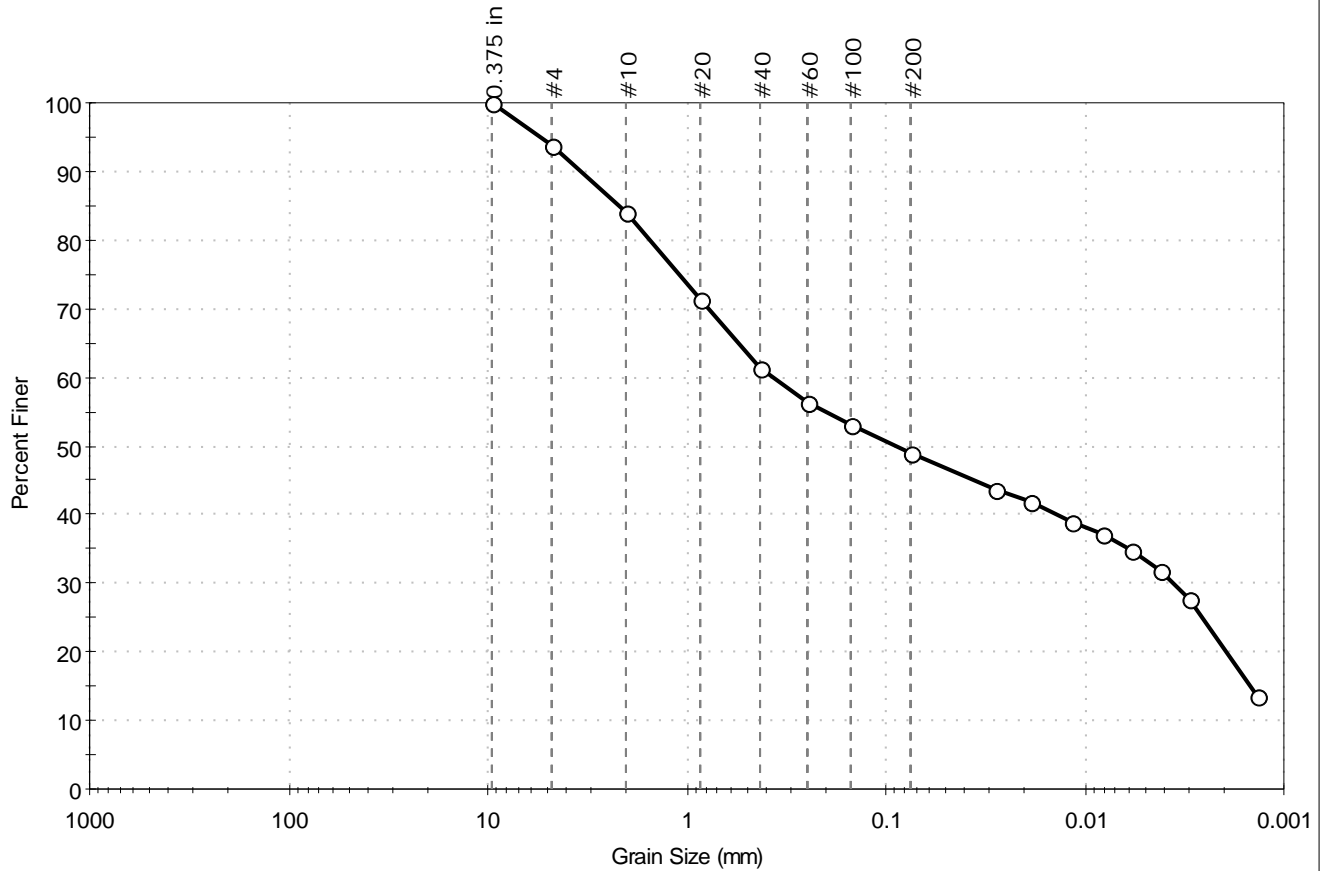
<u>Classification</u>	
<u>ASTM</u>	Lean clay (CL)
<u>AASHTO</u>	Clayey Soils (A-6 (18))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-103	Sample Type:	bag
Sample ID:	6D	Test Date:	09/15/17
Depth:	24-26 ft	Test Id:	423877
Test Comment:	---		
Visual Description:	Moist, dark gray sandy clay, trace gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	6.0	45.1	48.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	94		
#10	2.00	84		
#20	0.85	72		
#40	0.42	61		
#60	0.25	56		
#100	0.15	53		
#200	0.075	49		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0283	44		
---	0.0187	42		
---	0.0116	39		
---	0.0082	37		
---	0.0059	35		
---	0.0041	32		
---	0.0030	28		
---	0.0014	14		

<u>Coefficients</u>	
D ₈₅ = 2.1864 mm	D ₃₀ = 0.0036 mm
D ₆₀ = 0.3701 mm	D ₁₅ = 0.0015 mm
D ₅₀ = 0.0910 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

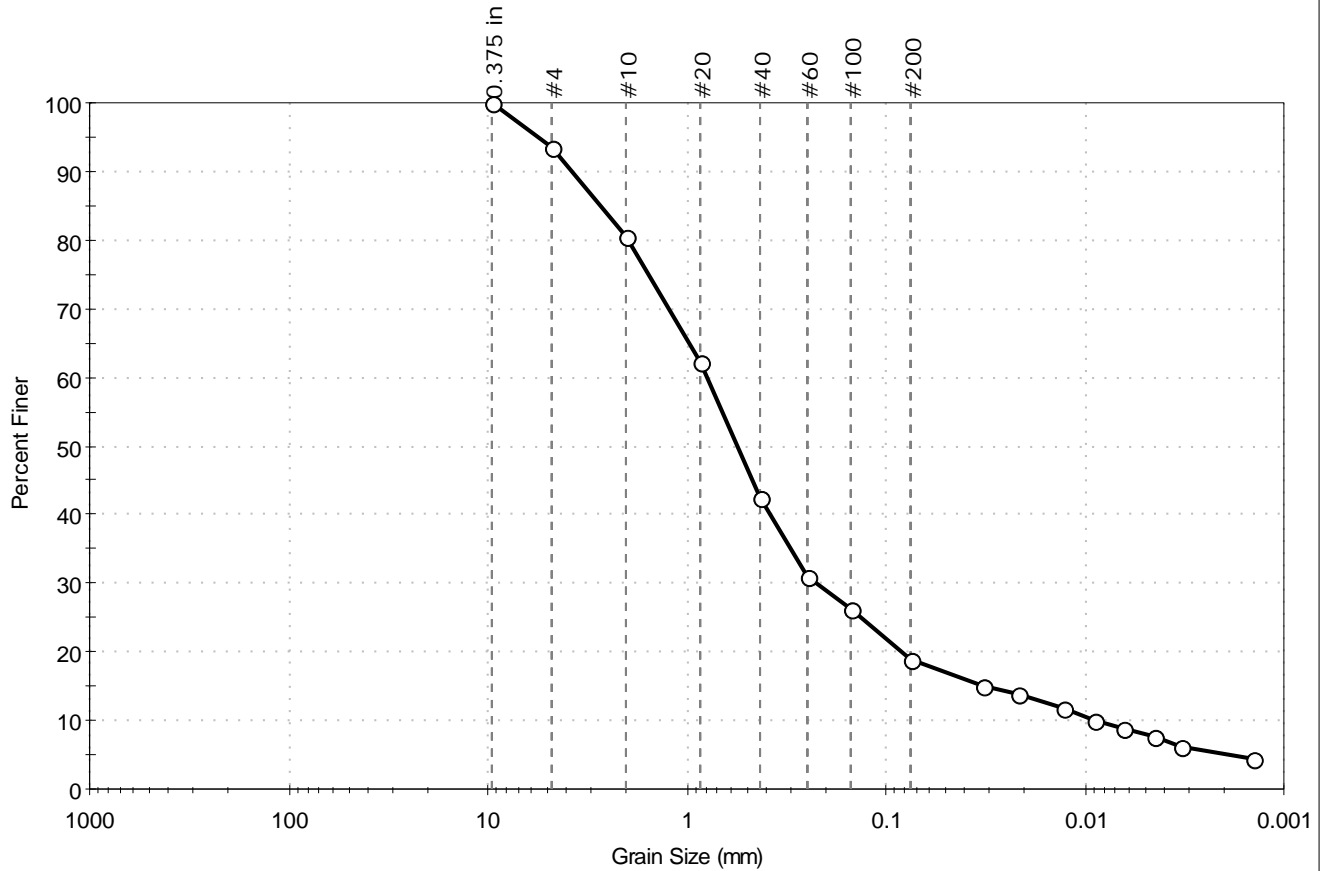
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-103	Sample Type:	bag
Sample ID:	7D	Test Date:	09/15/17
Depth:	29-31 ft	Test Id:	423878
Test Comment:	---		
Visual Description:	Moist, dark gray sand, little clay, trace gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	6.5	74.6	18.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	94		
#10	2.00	80		
#20	0.85	62		
#40	0.42	43		
#60	0.25	31		
#100	0.15	26		
#200	0.075	19		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0329	15		
---	0.0217	14		
---	0.0127	12		
---	0.0090	10		
---	0.0064	9		
---	0.0045	8		
---	0.0033	6		
---	0.0014	4		

<u>Coefficients</u>	
D ₈₅ = 2.6956 mm	D ₃₀ = 0.2272 mm
D ₆₀ = 0.7869 mm	D ₁₅ = 0.0332 mm
D ₅₀ = 0.5522 mm	D ₁₀ = 0.0090 mm
C _u = 87.433	C _c = 7.289

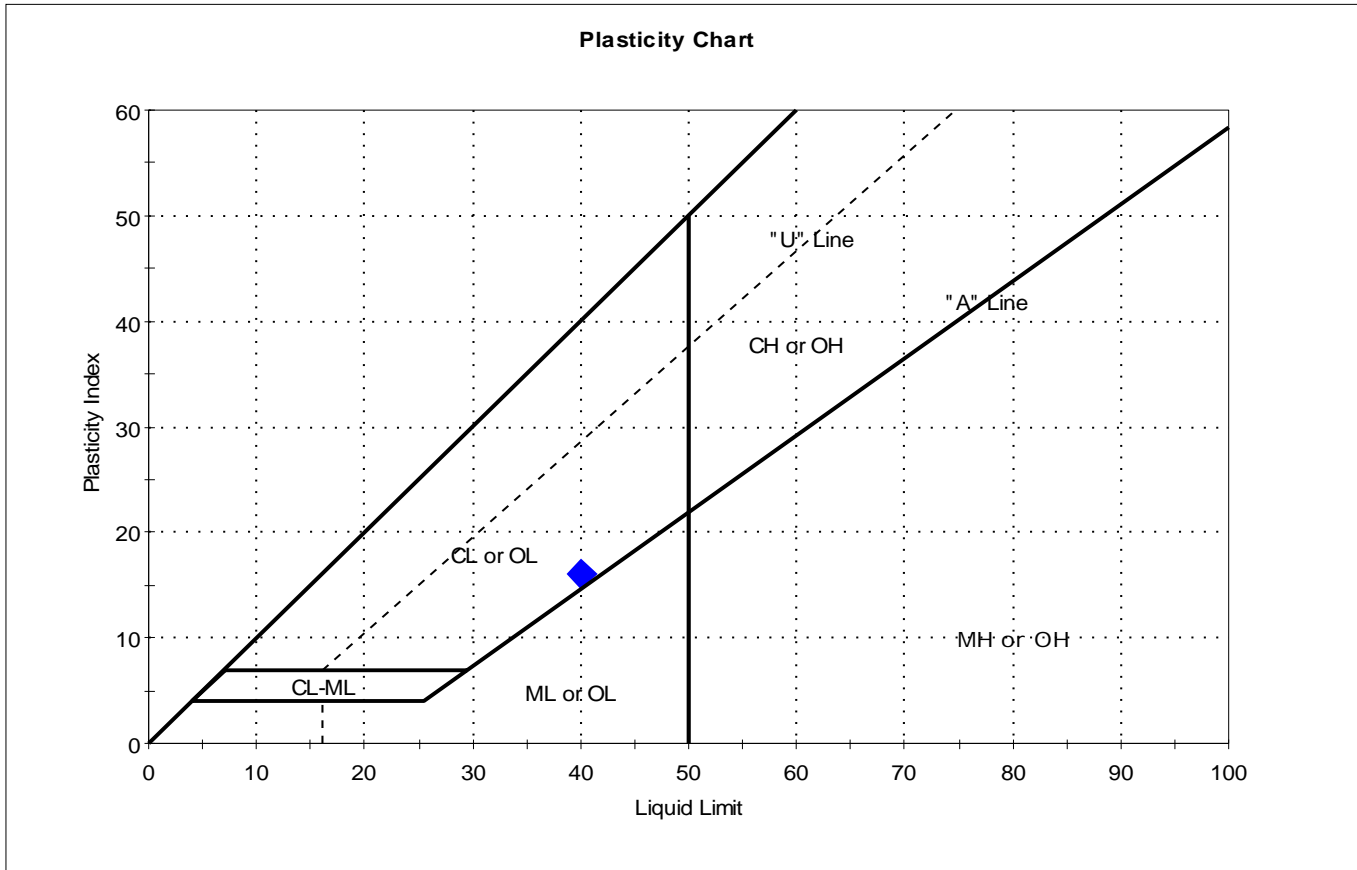
<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (0))

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-102	Sample Type:	bag
Sample ID:	10D	Test Date:	09/15/17
Depth:	50-52 ft	Test Id:	423868
Test Comment:	---		
Visual Description:	Moist, dark gray clay		
Sample Comment:	---		

Atterberg Limits - ASTM D4318



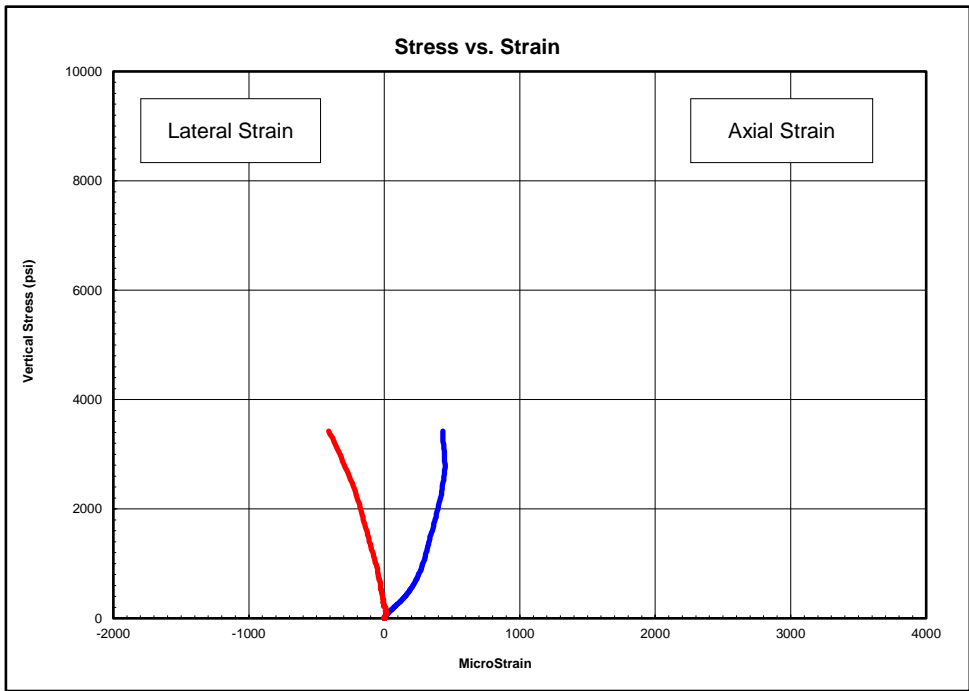
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	10D	B-FGB-10	50-52 ft	28	40	24	16	0.3	Lean clay (CL)

Sample Prepared using the WET method
 0% Retained on #40 Sieve
 Dry Strength: VERY HIGH
 Dilatancy: SLOW
 Toughness: MEDIUM



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Gagnon Brook Culvert Replacement
Project Location:	Frenchville, ME
GTX #:	306979
Test Date:	9/14/2017
Tested By:	rlc
Checked By:	jsc
Boring ID:	BB-FGB-102
Sample ID:	2
Depth, ft:	83.8-84.7
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

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



Peak Compressive Stress: 7,243 psi

The graph above does not include values up to the peak stress value. The strain gauges failed before the peak value was attained. Young's Modulus and Poisson's Ratio could not be determined for the second and third stress range.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
700-2700	9,180,000	---
2700-4600	---	---
4600-6500	---	---

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

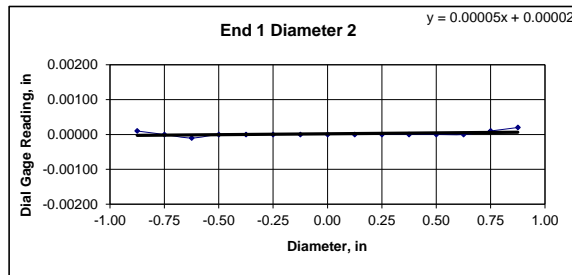
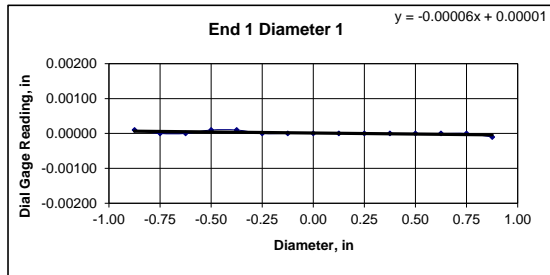


Client:	GZA GeoEnvironmental, Inc.	Test Date:	9/13/2017
Project Name:	Gagnon Brook Culvert Replacement	Tested By:	rlc
Project Location:	Frenchville, ME	Checked By:	jsc
GTX #:	306979		
Boring ID:	BB-FGB-102		
Sample ID:	2		
Depth:	83.8-84.7 ft		
Visual Description:	See photographs		

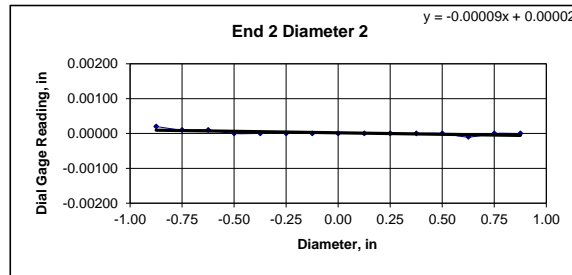
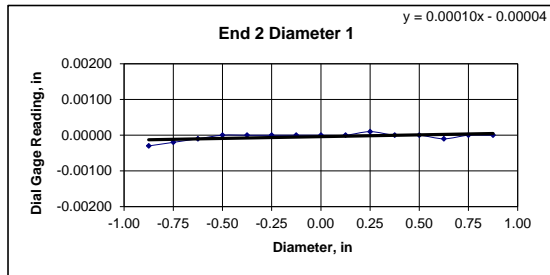
UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY				DEVIATION FROM STRAIGHTNESS (Procedure S1)			
	1	2	Average	Maximum gap between side of core and reference surface plate: Is the maximum gap \leq 0.02 in.? YES			
Specimen Length, in:	4.15	4.15	4.15	Maximum difference must be $<$ 0.020 in. Straightness Tolerance Met? YES			
Specimen Diameter, in:	1.99	1.99	1.99				
Specimen Mass, g:	577.66						
Bulk Density, lb/ft ³ :	170						
Length to Diameter Ratio:	2.1						
		Minimum Diameter Tolerance Met?	YES				
		Length to Diameter Ratio Tolerance Met?	YES				

END FLATNESS AND PARALLELISM (Procedure FP1)															
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00010	0.00000	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00020
	Difference between max and min readings, in: 0° = 0.00020 90° = 0.00030														
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000	0.00000	-0.00010	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	0.00000	0.00000
	Difference between max and min readings, in: 0° = 0.0004 90° = 0.0003 Maximum difference must be $<$ 0.0020 in. Difference = \pm 0.00020 Flatness Tolerance Met? YES														



DIAMETER 1	
End 1:	Slope of Best Fit Line: 0.00006 Angle of Best Fit Line: 0.00344
End 2:	Slope of Best Fit Line: 0.00010 Angle of Best Fit Line: 0.00573
Maximum Angular Difference:	0.00229
Parallelism Tolerance Met?	YES Spherically Seated



DIAMETER 2	
End 1:	Slope of Best Fit Line: 0.00005 Angle of Best Fit Line: 0.00286
End 2:	Slope of Best Fit Line: 0.00009 Angle of Best Fit Line: 0.00516
Maximum Angular Difference:	0.00229
Parallelism Tolerance Met?	YES Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)					
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00030	1.990	0.00015	0.009	YES
	Perpendicularity Tolerance Met? YES				
END 2					
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00030	1.990	0.00015	0.009	YES



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Gagnon Brook Culvert Replacement
Project Location:	Frenchville, ME
GTX #:	306979
Test Date:	9/14/2017
Tested By:	rlc
Checked By:	jsc
Boring ID:	BB-FGB-102
Sample ID:	2
Depth, ft:	83.8-84.7



After cutting and grinding

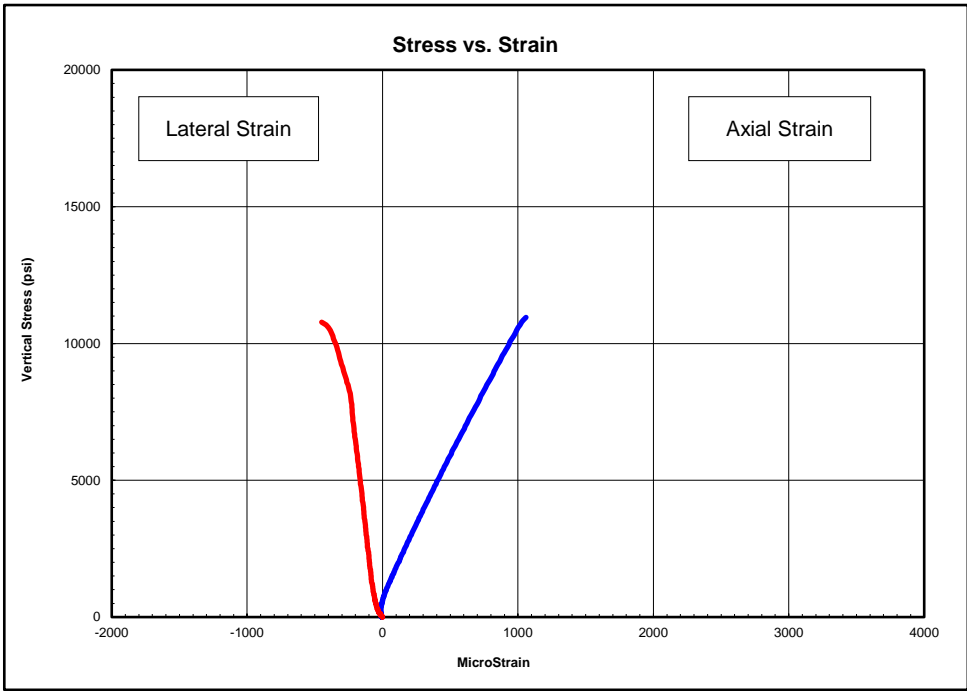


After break



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Gagnon Brook Culvert Replacement
Project Location:	Frenchville, ME
GTX #:	306979
Test Date:	9/14/2017
Tested By:	rlc
Checked By:	jsc
Boring ID:	BB-FGB-103
Sample ID:	3-5
Depth, ft:	65.67-66.05
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

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



Peak Compressive Stress: 10,995 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
1100-4000	10,700,000	0.25
4000-6900	9,820,000	0.24
6900-9900	9,310,000	0.44

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



Client:	GZA GeoEnvironmental, Inc.	Test Date:	9/13/2017
Project Name:	Gagnon Brook Culvert Replacement	Tested By:	rlc
Project Location:	Frenchville, ME	Checked By:	jsc
GTX #:	306979		
Boring ID:	BB-FGB-103		
Sample ID:	3-5		
Depth:	65.67-66.05 ft		
Visual Description:	See photographs		

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

BULK DENSITY				DEVIATION FROM STRAIGHTNESS (Procedure S1)			
	1	2	Average	Maximum gap between side of core and reference surface plate: Is the maximum gap \leq 0.02 in.? YES			
Specimen Length, in:	4.20	4.20	4.20	Maximum difference must be < 0.020 in.			
Specimen Diameter, in:	1.99	1.99	1.99	Straightness Tolerance Met? YES			
Specimen Mass, g:	581.21						
Bulk Density, lb/ft ³ :	169						
Length to Diameter Ratio:	2.1						
		Minimum Diameter Tolerance Met?	YES				
		Length to Diameter Ratio Tolerance Met?	YES				

END FLATNESS AND PARALLELISM (Procedure FP1)															
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00020	-0.00010	0.00000	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00000
Difference between max and min readings, in: 0° = 0.00020 90° = 0.00030															
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000
Difference between max and min readings, in: 0° = 0.0004 90° = 0.0004 Maximum difference must be < 0.0020 in. Difference = \pm 0.00020															
Flatness Tolerance Met? YES															

<div style="text-align: center;"> <p>End 1 Diameter 1 y = 0.00005x - 0.00005</p> </div> <div style="text-align: center;"> <p>End 2 Diameter 1 y = 0.00007x - 0.00005</p> </div>	<div style="text-align: center;"> <p>End 1 Diameter 2 y = 0.00011x - 0.00003</p> </div> <div style="text-align: center;"> <p>End 2 Diameter 2 y = 0.00016x - 0.00004</p> </div>	<p>DIAMETER 1</p> <p>End 1: Slope of Best Fit Line: 0.00005 Angle of Best Fit Line: 0.00286</p> <p>End 2: Slope of Best Fit Line: 0.00007 Angle of Best Fit Line: 0.00401</p> <p>Maximum Angular Difference: 0.00115</p> <p>Parallelism Tolerance Met? YES Spherically Seated</p>	<p>DIAMETER 2</p> <p>End 1: Slope of Best Fit Line: 0.00011 Angle of Best Fit Line: 0.00630</p> <p>End 2: Slope of Best Fit Line: 0.00016 Angle of Best Fit Line: 0.00917</p> <p>Maximum Angular Difference: 0.00286</p> <p>Parallelism Tolerance Met? YES Spherically Seated</p>
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PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)						<i>Maximum angle of departure must be \leq 0.25°</i>	
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?		
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES		
Diameter 2, in (rotated 90°)	0.00030	1.990	0.00015	0.009	YES	Perpendicularity Tolerance Met? YES	
END 2							
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES		
Diameter 2, in (rotated 90°)	0.00040	1.990	0.00020	0.012	YES		



Client:	GZA GeoEnvironmental, Inc.
Project Name:	Gagnon Brook Culvert Replacement
Project Location:	Frenchville, ME
GTX #:	306979
Test Date:	9/14/2017
Tested By:	rlc
Checked By:	jsc
Boring ID:	BB-FGB-103
Sample ID:	3-5
Depth, ft:	65.67-66.05



After cutting and grinding

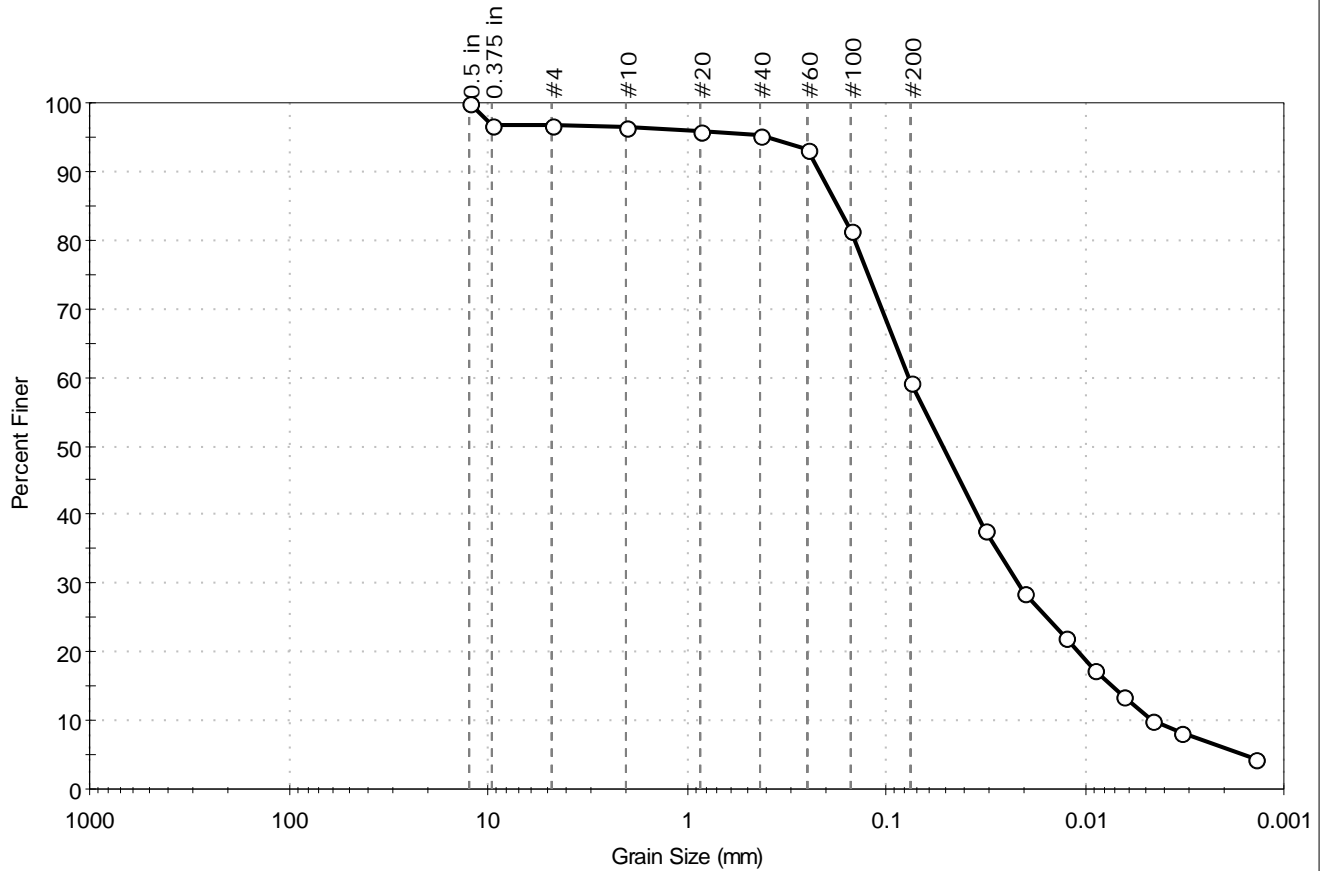


After break



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-101	Sample Type:	bag
Sample ID:	4D	Test Date:	09/15/17
Depth :	20-22 ft	Test Id:	423892
Test Comment:	---		
Visual Description:	Moist, olive gray sandy silt		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.2	37.6	59.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	97		
#4	4.75	97		
#10	2.00	96		
#20	0.85	96		
#40	0.42	95		
#60	0.25	93		
#100	0.15	82		
#200	0.075	59		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0316	38		
---	0.0202	29		
---	0.0127	22		
---	0.0090	17		
---	0.0065	14		
---	0.0047	10		
---	0.0033	8		
---	0.0014	4		

<u>Coefficients</u>	
D ₈₅ = 0.1744 mm	D ₃₀ = 0.0216 mm
D ₆₀ = 0.0769 mm	D ₁₅ = 0.0073 mm
D ₅₀ = 0.0516 mm	D ₁₀ = 0.0047 mm
C _u = 16.362	C _c = 1.291

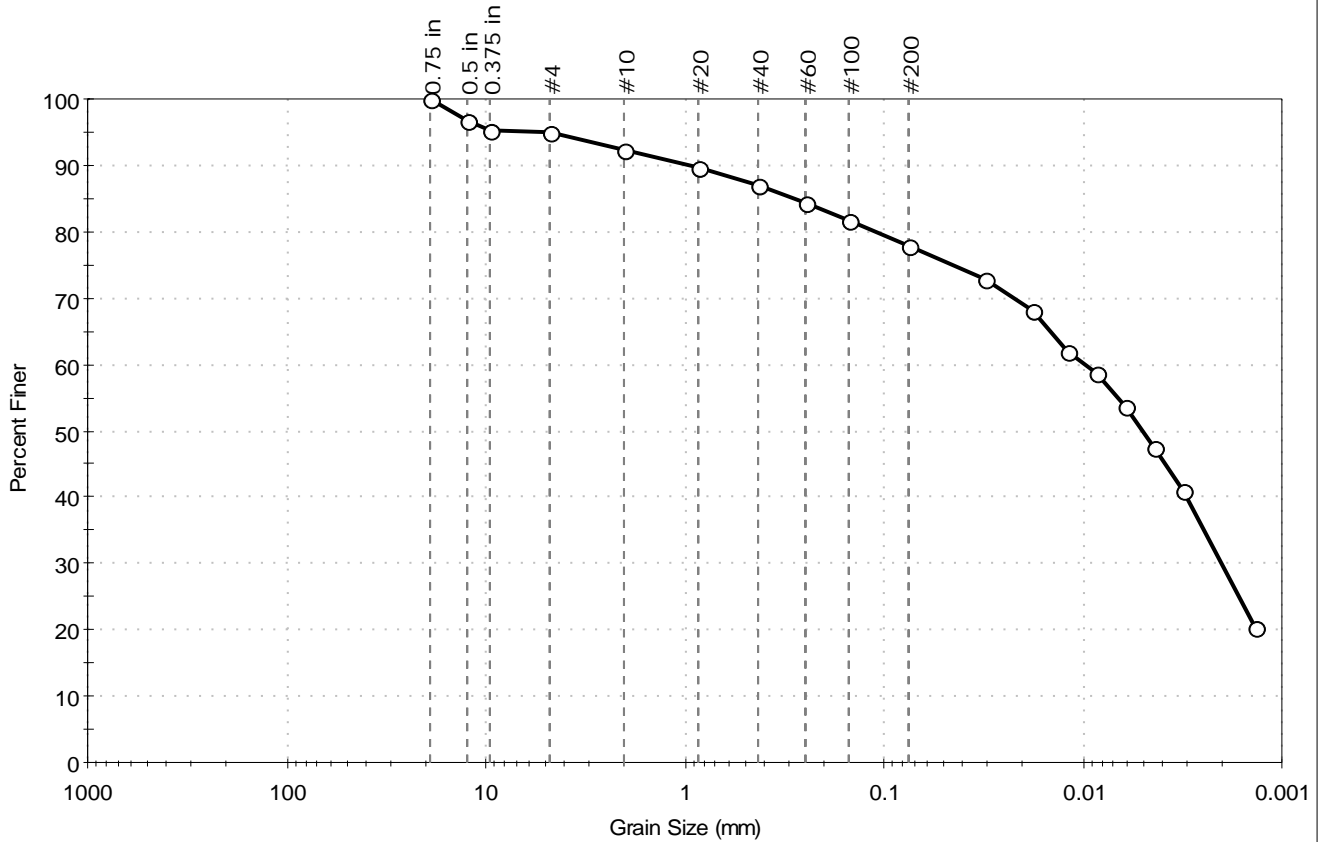
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

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



Client:	GZA GeoEnvironmental, Inc.		
Project:	Gagnon Brook Culvert Replacement		
Location:	Frenchville, ME	Project No:	GTX-306979
Boring ID:	BB-FGB-101	Sample Type:	bag
Sample ID:	9D	Test Date:	09/15/17
Depth:	45-47 ft	Test Id:	423873
Test Comment:	---		
Visual Description:	Moist, dark gray clay with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	5.0	17.0	78.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	95		
#4	4.75	95		
#10	2.00	92		
#20	0.85	90		
#40	0.42	87		
#60	0.25	84		
#100	0.15	82		
#200	0.075	78		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0312	73		
---	0.0177	68		
---	0.0120	62		
---	0.0086	59		
---	0.0061	54		
---	0.0044	47		
---	0.0031	41		
---	0.0014	20		

<u>Coefficients</u>	
D ₈₅ = 0.2798 mm	D ₃₀ = 0.0020 mm
D ₆₀ = 0.0099 mm	D ₁₅ = N/A
D ₅₀ = 0.0050 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Silty Soils (A-4 (0))

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