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GEOTECHNICAL
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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

M E M O R A N D U M (*via email)*

To: Mr. Gregory Goodrich, PE, NBIS
VHB
2 Bedford Farms Drive, Suite 200
Bedford, New Hampshire 03110-6532

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

File No.: 09.0026129.00

Date: January 25, 2023

Re: Geotechnical Evaluation
MNR Culvert Replacement, Oakfield Yard over Thomas Brook
Oakfield, Maine

This memorandum presents the results of our geotechnical services for the MNR culvert replacement over Thomas Brook, in Oakfield, Maine. Our services were provided in accordance with the Subconsultant Agreement between VHB and GZA GeoEnvironmental, Inc. (GZA), signed on September 20, 2021, and the *Limitations* included in **Appendix A**.

BACKGROUND

An existing, 185-foot-long, single-box, concrete culvert carries Thomas Brook beneath a work road and three spur tracks in the MNR Oakfield Yard facility, at the approximate location shown on the **Locus Plan, Figure 1**. Approximately 12 to 18 feet of fill lies over the culvert and supports the existing railway.

We understand that VHB has been engaged by MaineDOT to design a replacement culvert alignment that will be offset 40 to 65 feet to the north and will consist of an approximately 170-foot-long precast concrete arch with a span of approximately 30 feet, supported on spread footing foundations. The primary geotechnical concerns are foundation requirements for the proposed precast arch alternative are bearing capacity and constructability.

SUBSURFACE EXPLORATIONS FOR THE CURRENT PROJECT

GZA completed an exploration program on September 27 to 29, 2021, consisting of six test borings drilled on the north and south sides of the existing culvert, at distances of approximately 16 to 36 feet laterally from the existing culvert centerline. Four test borings were performed over the west access road and two test borings were performed over to the eastern-most active rail line. The

as-drilled boring locations were surveyed by VHB and are shown on **Figure 2, Boring Location Plan.** The boring elevations were interpolated from existing contours and rounded to the nearest 0.5 feet. The test borings (GZ-1 to GZ-6) were drilled using a track-mounted drill rig to depths ranging from approximately 42 to 47 feet below ground surface (bgs) and were terminated after collecting approximately 10 feet of bedrock core at each location.

New England Boring Contractors of Hermon, Maine provided drilling services and coordinated utility clearance. The borings were drilled using 3- and 4-inch driven casing and drive-and-wash drilling techniques. Standard penetration testing (SPT) and split-spoon sampling were performed at 5-foot typical intervals using a 24-inch-long, 1-3/8-inch inside-diameter sampler. The sampler was driven with a 140-lb calibrated automatic hammer with a 30-inch drop from a truck-mounted drill rig. Approximately 10 feet of bedrock was cored in each of the borings using NQ2 coring equipment. The borings were backfilled with drill cuttings and gravel upon completion. GZA personnel monitored the drilling work and prepared test boring logs 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).

Streambed samples were taken by GZA personnel at locations selected by VHB for use in their scour analyses. Sampling was complete in-stream using a shovel while wading. The approximate sampling locations are shown on **Figure 2**.

LABORATORY TESTING

GZA retained Thielsch Engineering of Cranston, Rhode Island to complete a laboratory testing program to assess the gradation and engineering characteristics of the soil. The program included: eight (8) gradation analysis (including 5 with hydrometer tests) / AASHTO Classification / Unified Soil Classification System Classifications, six (6) water content test, and one (1) organic content test. Results of the testing are included in **Appendix C**.

In addition, GZA collected two (2) grab samples of the streambed materials by hand for VHB scour analysis. Laboratory data for scour considerations are presented in the table below and associated laboratory test results are included in **Appendix C.**

LABORATORY DATA FOR SCOUR CONSIDERATIONS					
Sample ID	**Depth (feet)**	**D_{50} (mm)**	**Classification**		
			USCS	**AASHTO**	**Burmister**
SS-1, 1D	0-0.5	6.5974	GW-GM	A-1-a	GRAVEL and fine to coarse Sand, trace Silt
SS-2, 1D	0-0.5	6.1277	GW	A-1-a	GRAVEL and fine to coarse Sand, trace Silt

GENERALIZED SUBSURFACE CONDITIONS

Three soil units were encountered in the borings: Fill, Alluvium, and Glacial Till. Approximately 24 inches of railroad ballast was encountered at the ground surface in GZ-5 and GZ-6. The approximate thicknesses and generalized descriptions of the underlying units are presented in the following table, in descending order beneath ground surface. Detailed descriptions of the materials encountered at specific locations are provided in the boring logs in **Appendix B**.

GENERALIZED SUBSURFACE CONDITIONS		
Subsurface Unit	**Approximate Encountered Thickness (ft)**	**Generalized Description**
Ballast	2	Gravel. (USCS:GP) *Encountered in GZ-5 and GZ-6*
Fill	12.5 to 17.5	Variable: Ranging from dark brown/black, very loose to dense, fine to coarse SAND, some to trace gravel, some to little silt to Dark brown, moist, dense, GRAVEL, some fine to coarse sand, little silt. (USCS: SM, GM). MaineDOT Frost Classification = I, II, III, and IV *Encountered in all borings.*
Alluvium	1.7 to 5.0	Dark brown to grey, moist to wet, medium dense, fine to coarse SAND, some to no gravel, some to trace silt, with organics and trace wood fragments. (USCS: SM). MaineDOT Frost Classification = II *Encountered in borings GZ-1, GZ-3, GZ-4.*
Glacial Till	16.4 to 22.2	Variable: Ranging from Olive-brown to grey, wet, medium dense to very dense, fine to coarse SAND, little Gravel, little to some Silt, to Sandy GRAVEL, little to some Silt. (USCS: SM, GM). MaineDOT Frost Classification = II, III *Encountered in all borings.*

GROUNDWATER

Groundwater was encountered at a depth of approximately 6 to 17 feet below ground surface, corresponding to approximately El. 559 to 546. The water level was measured in the completed borehole 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 construction are likely to vary from those encountered in the boring at the time the observations were made.

ENGINEERING EVALUATIONS & RECOMMENTATIONS

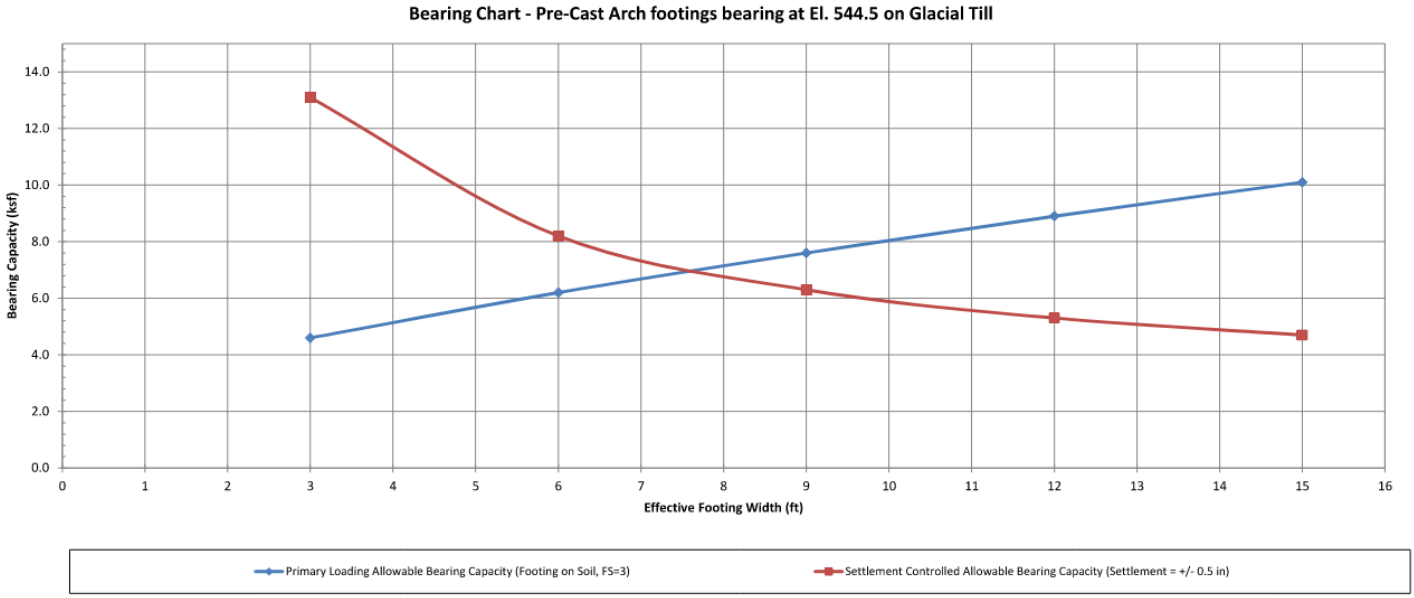
Geotechnical engineering evaluations have been conducted in general accordance with the *AREMA Manual for Railway Engineering, Chapter 8 Concrete Structures and Foundations,* and the *MaineDOT Bridge Design Guide.* Consistent with AREMA, recommendations are provided based on Allowable Stress Design (ASD).

PROPOSED REPLACEMENT CULVERT

The proposed culvert replacement will span beneath the existing access road and multiple lines of railroad tracks, north of the existing culvert, and will consist of a precast reinforced concrete arch bearing on spread footings consisting of precast concrete with cast in place cells. The borings indicate that the proposed bearing elevation of the culvert is located entirely within the medium dense to very dense Glacial Till which is judged to be able to provide suitable bearing for the culvert.

PROPOSED FOOTING DESIGN PARAMETERS

The proposed arch culvert foundations should be designed as spread footings bearing on medium dense to dense glacial till. The bearing capacity chart shown below demonstrates the allowable bearing capacity for various footing widths based on a factor of safety of 3.0 on ultimate bearing capacity, and the allowable bearing pressure needed to limit settlement to approximately ½-inch. We recommend the footings be sized such that the anticipated bearing pressures are below the lines plotted for both cases at the effective footing width. We note that the effective width concept creates a uniformly loaded "equivalent" footing width which accounts for eccentricity/moment on the footing and that the effective width is commonly narrower than the nominal footing dimension.



If bearing materials are disturbed during excavation, they should be densified as described in the Construction Considerations section of the memorandum.

RESISTANCE TO LATERAL LOADS

Resistance to lateral loads may be developed in sliding friction on the base of the footing. We recommend an ultimate friction coefficient, $\tan\delta$, equal to 0.5 for footings bearing on glacial till. A minimum factor of safety of 1.5 provided against sliding. In order to provide resistance to overturning, AREMA requires that the resultant of the loading on the footings be located in the central one-third of the footing base. Passive resistance on the stream side of the footings should be ignored in calculation of lateral resistance. However, since the arch is rigid, lateral forces at the arch level are reacted by passive pressures on the opposite leg of the arch.

FROST DEPTH

We recommend that footings that may exposed to dry ground conditions during the winter months be founded at least 6 feet below the nearest ground surface exposed to freezing.

BACKFILL MATERIALS AND CULVERT LOADING

Backfill within the anticipated depth of frost penetration (6 feet from nearest surface exposed to freezing temperatures), should consist of compacted Maine DOT 703.19 Granular Borrow for Underwater Backfill, otherwise it may consist of Granular Borrow. If necessary, limited areas may be founded on crushed stone fully wrapped in geotextile. However, installation of a continuous gravel layer between the upstream water body and the downstream water body may result in excessive seepage flow beneath the foundations, and should be avoided. Recommended soil properties for Granular Borrow to be used below bearing level and as backfill are as follows:

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

Because the arch culvert side walls are not able to rotate at the top, they should be designed using an at-rest earth pressure coefficient, Ko, equal to 0.47.

Design of the culvert and footing should incorporate a Cooper E80 railroad surcharge load.

SEISMIC CONSIDERATIONS

Culverts are presumed by AREMA to be of a design generally resistant to seismic forces. The evaluation of seismic site class and other design parameters is included for reference. 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 could be assigned to Site Class D. Based on the site coordinates, the corresponding 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)	0.110
SDs (Period = 0.2 sec)	0.254
SD1 (Period = 1.0 sec)	0.120

CONSTRUCTION CONSIDERATIONS

Construction considerations are intended to identify geotechnical-related issues that have the potential to impact design and construction of the culvert replacement. These items are provided in the sections that follow.

EXCAVATION AND DEWATERING

Since the proposed culvert will be constructed off-alignment, we anticipate that stream flow will be maintained in the existing culvert during construction of the new culvert, and that construction can be completed free of stream flow. In our opinion, the inflow of groundwater and surface water may be limited by temporary sheet piling or by distance from the surface water and the moderate permeability of the glacial till. Consequently, dewatering may be feasible by open pumping from sumps installed in the base of footing excavations. It will probably be necessary to use cantilever sheet pile cutoff walls to separate the upstream and downstream water bodies from the culvert excavation, depending on season and flow conditions.

It is important for the contractor be prepared to address lateral seepage that may occur through the subgrade and into the excavation. The contractor should be responsible for controlling groundwater, surface runoff, infiltration, and water from all other sources by methods which preserve the undisturbed condition of the subgrade and permit foundation construction in-the-dry. Discharge of pumped groundwater and river water should comply with all local, State, and federal regulations.

We anticipate that the new culvert can be constructed in segments to allow MNR service to be maintained on available sidings within the yard. We anticipate that excavations can be made using a combination of sloped open cut techniques, trench boxes and temporary sheet pile support, where necessary. Excavation for footing subgrade preparation is anticipated to extend on the order of 25 feet below existing railway grades, and as much as approximately 7 feet below the stream level noted on the base plan.

Temporary excavation slopes should be limited according to OSHA standards. Excavation safety is the responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. Excavation safety is the responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. Excavation planning should take into consideration the excavation and SOE requirements of Maine Northern Railway, available outage windows, and appropriate surcharge loading in accordance with the *AREMA Manual for Railway Engineering*. If excavation support systems are proposed, the contractor should be required to submit shop drawings and supporting calculations prepared by an engineer licensed in Maine.

FOOTING SUBGRADE PREPARATION

We recommend bearing surface preparation be conducted in the dry. Though not anticipated, unsuitable material such as fill or swamp deposits should be removed within the zone of influence beneath new foundations to expose undisturbed, naturally deposited glacial till. The zone of influence is defined as the area between a line that extends 1 foot horizontally away from the footing bearing level and then down at a 1H:1V inclination away from the footing. If the subgrade is loosened or disturbed during excavation, it should be recompacted using large plate or walk behind roller.

If needed beneath footings, Granular Borrow may be placed in lifts and compacted up to the bottom of footing level in accordance with Specification Section 203.13, except that the required dry density should be 95 percent of the maximum density in accordance with AASHTO T 180. If culvert bedding stone is used in lieu of Granular Borrow, the material should be densified in lifts not exceeding 1-foot thickness, and be fully encased in separation geotextile.

Effort should be made to prevent freezing of foundation subgrades. In the event that freezing occurs, the frozen material should be stripped and replaced with compacted Granular Borrow.

BACKFILLING

Excavations should be backfilled with Granular Borrow placed in lifts and compacted to at least 95 percent of the maximum density in accordance with ASTM D1557. Backfilling should proceed uniformly on both sides of the culvert in order to avoid unequal lateral forces that could result in displacement of the partially completed structure.

REUSE OF ON-SITE MATERIALS

Based on the test boring results, the onsite material typically does not meet MaineDOT gradation requirements for Granular Borrow for Underwater Backfill because it has more than 10 percent passing the No. 200 sieve. However, with the exception of fill soils, the material generally has less than 20 percent passing the No. 200 sieve, and is considered suitable for use as Granular Borrow in areas not exposed to frost.

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: technical specification preparation; bid phase support services; and design support during construction, including submittal review and limited field observation of critical geotechnical elements of the proposed construction.

CLOSURE

We trust this information meets current project needs. Please feel free to call Nicholas Williams at (207) 245-8444 if you have any questions or if we can be of further service.

NVW/CLS/ARB:erc
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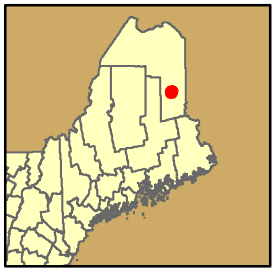
Attachments: Figure 1 – Site Locus
Figure 2 – Boring Location Plan
Appendix A - Limitations
Appendix B - Test Boring Log
Appendix C – Laboratory Test Results

FIGURES



USGS QUADRANGLE LOCATION

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

Data Supplied by : esri USGS science for a changing world

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

SCALE IN FEET

GZA

PROJ. MGR.: NVW
DESIGNED BY: ADM
REVIEWED BY: CLS
OPERATOR: LCN

DATE: 10-06-2021

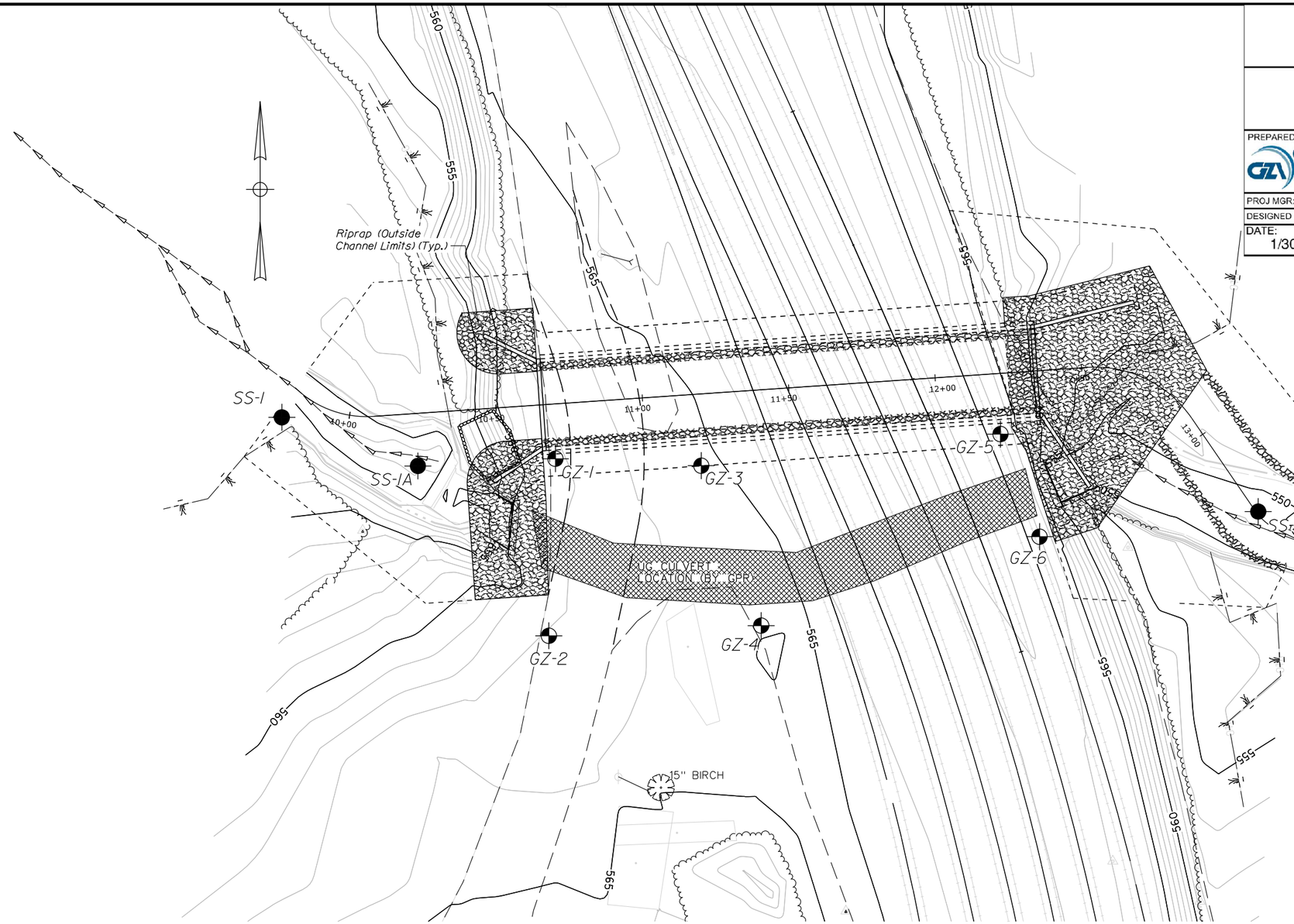
LOCUS PLAN

OAKFIELD YARD OVER THOMAS BROOK
OAKFIELD, MAINE

JOB NO.
09.0026129.00

FIGURE NO.
1

 P:\09 Jobs\0026100s\09.0026129.00 - VHB - MNRR Oakfield Culvert Replacement\Figures\GIS\09.0026129.00-Oakfield Figure1-Locus.mxd, 10/6/2021, 11:24:40 AM, Luis.Navarrete



THOMAS BROOK BRIDGE
MAINEDOT WIN 25177.00
OAKFIELD, MAINE

BORING LOCATION PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		VHB	
PROJ MGR: NVW	REVIEWED BY: CLS	CHECKED BY: ARB	FIG 2
DESIGNED BY: NVW	DRAWN BY: NVW	SCALE: AS SHOWN	
DATE: 1/30/23	PROJECT NO. 09.0026129.00	REVISION NO. 0	

NOTES

1) Base map developed from electronic files (Contours.dgn, points.dgn, Text.dgn, and Topo.dgn) provided by VHB on December 7, 2021 and January 13, 2023.

2) As-drilled locations of the test borings were surveyed and provided by VHB within the referenced .dgn files. As-drilled elevations of the test borings were interpolated based on the provided contours and are in feet and refer to the North American Vertical Datum of 1988 (NAVD88)

3) GZ-1 series borings were performed by New England Boring Contractors and observed by GZA personnel between September 27 and September 29, 2021.

4) SS-1 series stream samples were collected mid-stream by GZA using a shovel while wading, and the locations were estimated by taping to existing structural elements and s hould be considered approximate.

BORING LOCATION PLAN LEGEND

GZ-1 — *Location and designation of cased wash boring*

SS-1 — *Location and designation of Stream Sample*

PLAN

20 0 20 40
Scale of Feet

PREPARED BY:

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

1

WIN 025177.00 BRIDGE PLANS

BRIDGE NO. 7825

CHRISTOPHER L. SNOW No. 7825 LICENSED PROFESSIONAL ENGINEER STATE OF MAINE 01/30/2023

PROJ. MANAGER	M. KERSBERGEN		
DESIGN-DETAILED	N. WILLIAMS	JAN 2023	
CHECKED-REVIEWED	C. SNOW	JAN 2023	
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

THOMAS BROOK BRIDGE
MADAWASKA SUBDIVISION OVER THOMAS BROOK
OAKFIELD AROOSTOOK COUNTY, ME

BORING LOCATION PLAN

SHEET NUMBER 6 OF 18

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 VHB and their project team for specific application to the replacement of the Oakfield Railyard culvert in Oakfield, Maine in accordance with generally accepted soil and foundation engineering practices. No Warranty, express or implied, is made.

APPENDIX B – TEST BORING LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 4 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):

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

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

Rock Quality Based on RQD

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

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

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

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

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

Sample Container Labeling Requirements:

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-1
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	563.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/28/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 10 + 69.0, 18.6 RT	**Casing ID/OD:**	4"	**Water Level*:**	16.8'
Hammer Efficiency Factor: 0.863		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/10	0.0 - 2.0	5-10-11-11	21	30	SSA			Dark brown, moist, dense, GRAVEL, some fine to coarse sand, little silt, (Fill).	G#21-S-3931 A-1-a, GM WC=4.8
	2D	24/8	4.0 - 6.0	2-6-4-3	10	14				Brown, dry, medium dense, Silty fine to coarse SAND, little gravel, (Fill).	
5											
	3D	24/7	9.0 - 11.0	4-4-4-4	8	12	36			Brown, wet, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
10							39				
							44				
							25	550.5		12.5	
							53				
	4D	24/11	14.0 - 16.0	6-10-10-11	20	29	17	548.8		14.0'-14.2': Grey, Silty fine to coarse SAND, trace organic fibers. 14.2	
15							50			14.2'-16.0': Olive brown, wet, medium dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
							54				
							86				
							33				
	5D	24/14	19.0 - 21.0	7-6-13-25	19	27	88			Olive-brown, wet, medium dense, fine to coarse SAND, some gravel, some silt, (Glacial Till). Bottom 2": Gravel.	
20							65				
							44				
							90				
							90				
	6D	24/16	24.0 - 26.0	27-49-36-33	85	122	48			Olive brown, wet, very dense, Sandy GRAVEL, some silt, (Glacial Till).	
25											

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829669.7, E2227512.6). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-1
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	563.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/28/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 10 + 69.0, 18.6 RT	**Casing ID/OD:**	4"	**Water Level*:**	16.8'
Hammer Efficiency Factor: 0.863		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 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							104				
							28				
							89				
							120				
	7D	24/17	29.0 - 31.0	34-38-63-58	101	145	100			Olive-brown, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till).	G#21-S-3932 A-2-4(0), GM WC=12.9
30							83				
							95				
							112				
							183				
	8D	2/2	34.0 - 34.2	50/2"			NQ2	528.8		Grey, wet, very dense, GRAVEL (probable bedrock). Splitspoon refusal at 34.2'; set up to core at 34.2'.	
35	R1	58.8/57	34.2 - 39.1	RQD = 87%						34.2- R1: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Joints are close to moderately spaced, moderately dipping, planar to stepped, smooth, fresh, very tight to tight. Rock Quality = Good Recovery = 97% Rock Core Times (min:sec): 34.2-35.2' (1:48), 35.2-36.2' (3:08), 36.2-37.2' (2:46), 37.2-38.2' (3:32), 38.2-39.1' (3:30)	
	R2	54/52	39.1 - 43.6	RQD = 57%						R2: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. 39.1'-42.6': Joints are close to moderately spaced, moderately dipping, planar to undulating, smooth to rough, fresh, very tight to partially open. 41.6'-42.9': Rock is fractured to gravel-size pieces. 42.9'-43.6': One low angle joint, undulating, smooth, fresh, tight. Rock Quality = Fair Recovery = 96% Rock Core Times (min:sec): 39.1-40.1' (3:29), 40.1-41.1' (1:46), 41.1-42.1' (2:52), 42.1-43.1' (3:16), 43.1-43.6' (3:52)	
40											
								519.4		43.6- **Bottom of Exploration at 43.6 feet below ground surface.**	
45											
50											

Remarks:

1. Fine Grained Soil Descriptions on this log are based on plasticity estimated using visual manual classification techniques or laboratory Atterberg Limit Tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829669.7, E2227512.6). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-2
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	563.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/29/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 10 + 62.6, 78.7' RT	**Casing ID/OD:**	4"	**Water Level*:**	11.0'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/16	0.0 - 2.0	12-16-17-13	33	47	SSA			Brown, dry, dense, fine to coarse SAND, some gravel, some silt, (Fill).	
	2D	24/14	4.0 - 6.0	4-3-3-2	6	9				Brown, wet, loose, Silty fine to coarse SAND, some gravel, (Fill).	
5											
	3D	24/9	9.0 - 11.0	1-1-1-1	2	3	PUSH			Brown, wet, very loose, Silty fine to coarse SAND, little gravel, (Fill).	
10											
								550.0		13.0	
							15				
							42				
15	4D	24/10	15.0 - 17.0	7-7-8-12	15	22	83			Grey, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
							101				
							120				
							83				
	5D	24/14	19.0 - 21.0	15-15-20-17	35	50	RC			Grey, wet, dense, Sandy GRAVEL, some silt, (Glacial Till).	
20											
	6D	24/13	24.0 - 26.0	16-16-11-21	27	39	25			Grey, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
25											

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829609.3, E2227510.4). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-2
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	563.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/29/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 10 + 62.6, 78.7' RT	**Casing ID/OD:**	4"	**Water Level*:**	11.0'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 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.
							55				
							37				
							88				
							97				
	7D	24/13	29.0 - 31.0	28-27-23-20	50	72	RC			Grey, wet, very dense, Gravelly SAND, some silt, (Glacial Till).	
	8D	14/5	34.0 - 35.2	54-56-30/2.4"	-		NQ2			Grey, wet, very dense, Sandy GRAVEL, some silt, (Glacial Till).	
								527.8		35.2	
	R1	60/60	35.6 - 40.6	RQD = 60%						Splitspoon refusal at 35.2' indicates probable bedrock. Roller cone to 35.6'. Dark grey rock fragments observed in wash return. Set up to core at 35.6'. R1: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Joints are close to moderately spaced, moderately dipping, planar to undulating, smooth, fresh, very tight to partially open. Rock Quality = Fair Recovery = 100% Rock Core Times (min:sec): 35.6-36.6' (2:58), 36.6-37.6' (1:47), 37.6-38.6' (2:20), 38.6-39.6' (2:56), 39.6-40.6' (2:08)	
	R2	60/60	40.6 - 45.6	RQD = 54%						R2: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Joints are very close to moderately spaced, moderately dipping to high angle, planar, smooth to rough, fresh, very tight to partially open. Rock Quality = Fair Recovery = 100% Rock Core Times (min:sec): 40.6-41.6' (1:16), 41.6-42.6' (2:12), 42.6-43.6' (3:10), 43.6-44.6' (3:15), 44.6-45.6' (2:50)	
								517.4		45.6	
										Bottom of Exploration at 45.6 feet below ground surface.	

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829609.3, E2227510.4). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-3
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	565.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/28/21-9/28/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 11 + 18.4, 24.4' RT	**Casing ID/OD:**	4"	**Water Level*:**	14.0'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/15	0.0 - 2.0	5-5-4-5	9	13	SSA			Brown to black, dry, medium dense, fine to coarse SAND, some silt, little gravel, (Fill).	
	2D	24/14	4.0 - 6.0	2-3-3-2	6	9				Brown, dry, loose, Silty fine to coarse SAND, some gravel, (Fill).	
5											
	3D	24/13	9.0 - 11.0	2-5-3-3	8	12	35			Brown, dry, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
10							35				
							31				
							44	552.5		12.5	
							37				
	4D	24/12	14.0 - 16.0	4-2-6-10	8	12	29			Top 10": Dark brown, wet, medium dense, fine to coarse SAND, some gravel, trace silt, with organics, (Alluvium).	
15							35	549.2		15.8	
							31			Bottom 2": Grey, wet, fine to coarse SAND, some gravel, little silt, (Glacial Till).	
							42				
							40				
	5D	24/17	19.0 - 21.0	6-4-5-4	9	13	80			Olive-brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (Glacial Till).	
20							120				
							135				
							150				
							180				
	6D	24/14	24.0 - 26.0	24-20-61-51	81	117	RC			Grey, wet, very dense, Sandy GRAVEL, some silt, (Glacial Till).	
25											

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. West culvert head wall is 9.5' to top of water.
5. The as-drilled location ws surveyed by VHB (N829667.3, E2227562.3). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-3
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	565.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/28/21-9/28/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 11 + 18.4, 24.4' RT	**Casing ID/OD:**	4"	**Water Level*:**	14.0'
Hammer Efficiency Factor: 0.863		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
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											
	7D	24/16	29.0 - 31.0	36-43-42-61	85	122				Olive-brown, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till).	
30											
							NQ2	531.3		33.7	
	R1	60/60	34.0 - 39.0	RQD = 60%						Increase in resistance at 33.7' during roller cone advancement indicates probable top of rock. Advanced roller cone to 34.0' and set up to core. Dark grey rock fragments observed in wash return. R1: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Primary joints are very close to moderately spaced, low angle to moderately dipping, planar to undulating, smooth to rough, fresh to discolored, very tight to open, with silt infilling. Secondary joints are close to widely spaced, high angle, planar to undulating, smooth, fresh to discolored, open, with silt infilling. Rock Quality = Fair Recovery = 100% Rock Core Times (min:sec): 34.0-35.0' (3:17), 35.0-36.0' (3:30), 36.0-37.0' (2:08), 37.0-38.0' (3:32), 38.0-39.0' (3:45)	
35											
	R2	51.6/45	39.0 - 43.3	RQD = 20%						R2: 39.0'-39.6': Rock is fractured to gravel-size pieces. 39.6'-43.3': Hard, fresh, aphanitic, gray, CALCAREOUS METASILTSTONE. Joints are close to moderately spaced, moderately dipping to high angle, planar, smooth to rough, fresh, very tight to partially open, with silt infilling. Rock Quality = Poor Recovery = 87% Rock Core Times (min:sec): 39.0-40.0' (1:31), 40.0-41.0' (4:27), 41.0-42.0' (2:47), 42.0-43.0' (5:40), 43.0-43.3' (0:45)	
40											
								521.7		43.3	
										Bottom of Exploration at 43.3 feet below ground surface.	
45											
50											

Remarks:

1. Fine Grained Soil Descriptions on this log are based on plasticity estimated using visual manual classification techniques or laboratory Atterberg Limit Tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. West culvert head wall is 9.5' to top of water.
5. The as-drilled location ws surveyed by VHB (N829667.3, E2227562.3). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-4
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	565.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/29/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 11 + 35.0, 80.2' RT	**Casing ID/OD:**	4"	**Water Level*:**	6.0'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.0 - 2.0	3-5-4-3	9	13	SSA			Dark brown/black, dry, medium dense, fine to coarse SAND, little silt, trace gravel, (Fill).	
	2D	24/14	4.0 - 6.0	5-3-5-7	8	12		560.8		Top 2": Dark brown/black, dry, medium dense, fine to coarse SAND, little silt, trace gravel, (Fill).	G#21-S-3934 A-4(0), SM WC=11.3
5										4.2 Bottom 12": Brown, wet, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
	3D	24/12	9.0 - 11.0	8-8-9-10	17	24	RC			Brown, moist, medium dense, Silty fine to coarse SAND, trace gravel, (Fill).	
10								552.5		12.5	
	4D	24/11	14.0 - 16.0	7-5-3-7	8	12	30			Dark brown, moist, medium dense, fine to coarse SAND, some gravel, trace silt, with organics, trace wood fragments, (Alluvium).	G#21-S-3935 A-1-b, SM WC=50.6 OC=8.4
15							31				
							33				
							90	547.5		17.5	
							120				
	5D	24/13	19.0 - 21.0	11-10-27-33	60	86	46			Grey, wet, very dense, Silty fine to coarse SAND, little gravel, (Glacial Till).	
20							68				
							240				
							360				
							160				
	6D	24/14	24.0 - 26.0	23-22-34-30	56	81	RC			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	G#21-S-3936 A-1-b, SM WC=9.0
25											

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829612.8, E2227582.7). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-4
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	565.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/29/21-9/29/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 11 + 35.0, 80.2' RT	**Casing ID/OD:**	4"	**Water Level*:**	6.0'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
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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											
							▼				
	7D	24/14	29.0 - 31.0	22-12-21-14	33	47	57			Grey, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
30							100				
							180				
							142				
							120				
	8D	24/12	34.0 - 36.0	72-71-50-37	121	174	RC			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
35											
							▼	528.5		36.5	
	R1	60/60	37.0 - 42.0	RQD = 50%						Increase in resistance at 36.5' during roller cone advancement indicates probable top of rock. Advanced roller cone to 37.0' and set up to core. Dark grey rock fragments observed in wash return. R1: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Primary joints are close, high angle to vertical, planar, smooth, fresh, very tight to tight. Secondary joints are close, horizontal to low angle, planar, rough to smooth, tight to partially open. Rock Quality = Poor Recovery = 100% Rock Core Times (min:sec): 37.0-38.0' (3:19), 38.0-39.0' (3:21), 39.0-40.0' (1:02), 40.0-41.0' (2:43), 41.0-42.0' (3:09)	
							NQ2				
40											
	R2	60/60	42.0 - 47.0	RQD = 48%						R2: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Primary joints are close to moderately spaced, high angle, planar, smooth, fresh, very tight to tight. Secondary joints are very close to moderately spaced, horizontal to low angle, planar, smooth, fresh, tight to partially open. Rock Quality = Poor Recovery = 100% Rock Core Times (min:sec): 42.0-43.0' (1:50), 43.0-44.0' (1:37), 44.0-45.0' (3:55), 45.0-46.0' (1:32), 46.0-47.0' (3:55)	
45											
							▼	518.0		47.0	
										Bottom of Exploration at 47.0 feet below ground surface.	
50											

Remarks:

1. Fine Grained Soil Descriptions on this log are based on plasticity estimated using visual manual classification techniques or laboratory Atterberg Limit Tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829612.8, E2227582.7). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-5
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	566.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/27/21-9/27/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 12 + 20.9, 20.7' RT	**Casing ID/OD:**	4"/3"	**Water Level*:**	15.8'
Hammer Efficiency Factor: 0.863		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							RC			0'-2.0': Ballast, (Fill).	
	1D	24/14	2.5 - 4.5	11-9-8-5	17	24	52			Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#21-S-3933 A-1-b, SM WC=11.2
							45				
5	2D	24/8	5.0 - 7.0	6-5-6-14	11	16	19			Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	
							24				
							54				
							63				
							55				
10	3D	24/0	10.0 - 12.0	9-32-28-11	60	86	65			No recovery.	
							RC				
								552.5		13.5	
15	4D	24/10	15.0 - 17.0	13-12-20-22	32	46				Olive-brown, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
							55				
							60				
20	5D	24/16	20.0 - 22.0	10-6-6-5	12	17	86			Olive-brown, wet, medium dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
							56				
							72				
							73				
25							91				

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829678.1, E2227664.3). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-5
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	566.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/27/21-9/27/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 12 + 20.9, 20.7' RT	**Casing ID/OD:**	4"/3"	**Water Level*:**	15.8'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/14	25.0 - 27.0	10-13-14-19	27	39	58			Olive, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
							70				
							62				
							81				
							120				
30	7D	17/1	30.0 - 31.4	9-6-50/5"			65			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (GLACIAL TILL).	
							75	534.6		31.4	
	R1	60/60	32.0 - 37.0	RQD = 70%			91			Splitspoon refusal at 31.4' indicates probable bedrock. Advanced roller cone to 32.0' and set up to core. Dark grey rock fragments in wash return. R1: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Joints are extremely close to close, high angle, planar to undulating, smooth to rough, fresh, very tight to tight, with pyrite and silt infilling. One low angle joint is undulating, rough, fresh, tight. Rock Quality = Fair Recovery = 100% Rock Core Times (min:sec): 32.0-33.0' (1:50), 33.0-34.0' (2:30), 34.0-35.0' (2:23), 35.0-36.0' (1:16), 36.0-37.0' (2:13)	
35											
	R2	60/57	37.0 - 42.0	RQD = 87%						R2: Hard, fresh, aphanitic, grey, CALCAREOUS METASILTSTONE. Joints are close to moderately spaced, moderately dipping to high angle, planar, rough to smooth, fresh, very tight to tight, with pyrite infilling. Rock Quality = Good Recovery = 95% Rock Core Times (min:sec): 37.0-38.0' (3:14), 38.0-39.0' (2:32), 39.0-40.0' (3:19), 40.0-41.0' (2:11), 41.0-42.0' (2:05)	
40								524.0		42.0	
										Bottom of Exploration at 42.0 feet below ground surface.	
45											
50											

Remarks:

1. Fine Grained Soil Descriptions on this log are based on plasticity estimated using visual manual classification techniques or laboratory Atterberg Limit Tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829678.1, E2227664.3). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-6
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	566.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/27/21-9/27/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 12 + 31.8, 56.5' RT	**Casing ID/OD:**	4"	**Water Level*:**	12.6'
Hammer Efficiency Factor:	0.863	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: 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							RC			0'-2.0': Ballast, (Fill).	
	1D	18/12	2.5 - 4.0	7-7-5	12	17	22			Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	
							24				
	2D	24/9	4.0 - 6.0	7-7-4-3	11	16	35			Brown, wet, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
5							38				
							24				
							32				
	42										
	3D	24/11	9.0 - 11.0	8-5-4-4	9	13	48			Brown, wet, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
10							41				
							26				
							24				
							41				
	4D	24/10	14.0 - 16.0	12-10-6-8	16	23	26			Brown, wet, medium dense, Silty fine to coarse SAND, some gravel, (Fill).	
15							24				
							41				
							82	548.5		17.5	
							90				
	5D	24/11	19.0 - 21.0	10-11-17-23	28	40	97			Olive brown, wet, dense, fine to coarse SAND, some gravel, some silt, (Glacial Till).	
20							70				
							93				
							192				
							210				
	6D	24/15	24.0 - 26.0	70-68-61-67	129	186	142			Olive-brown, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till).	
25											

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. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829643.1, E2227677.6). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: MNR Culvert Replacement
Location: Oakfield, Maine

Boring No.: GZ-6
WIN: 25177.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	566.0	**Auger ID/OD:**	4.25
Operator:	Brad Enos	**Datum:**	NAVD88	**Sampler:**	Standard Splitspoon
Logged By:	L. Navarrete	**Rig Type:**	Track B-53 Mobile	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	9/27/21-9/27/21	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ2
Boring Location:	Sta. 12 + 31.8, 56.5' RT	**Casing ID/OD:**	4"	**Water Level*:**	12.6'
Hammer Efficiency Factor: 0.863		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 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											
	7D	23/17	29.0 - 30.9	75-60-32-59/5"	-					Olive-brown, wet, very dense, GRAVEL, some fine to coarse sand, some silt, (Glacial Till).	
30											
	R1	60/60	33.9 - 38.9	RQD = 63%				532.1		33.9 Increased resistance at 33.9' during roller cone advancement indicates probable bedrock. Dark grey rock fragments observed in wash return. Set up to core at 33.9'. R1: Hard, fresh, aphanitic to fine grained, CALCAREOUS METASILTSTONE with calcite veins. Primary joints are close to moderately spaced, moderately dipping, planar, smooth to rough, fresh, very tight to tight. Secondary joints are close, high angle to vertical, planar to undulating, smooth to rough, fresh, tight. One horizontal joint is planar, rough, fresh, tight. Rock Quality = Fair Recovery = 100% Rock Core Times (min:sec): 33.9-34.9' (4:30), 34.9-35.9' (1:51), 35.9-36.9' (1:54), 36.9-37.9' (1:52), 37.9-38.9' (1:48)	
35											
	R2	60/60	38.9 - 43.9	RQD = 80%						R2: Hard, fresh, aphanitic to fine grained, grey, CALCAREOUS METASILTSTONE with calcite veins. Primary joints are very close to close, moderately dipping to high angle, planar, smooth, fresh, very tight to tight. Secondary joints are moderately spaced, low angle to horizontal, planar to undulating, rough, fresh, tight to open. Rock Quality = Good Recovery = 100% Rock Core Times (min:sec): 38.9-39.9' (3:22), 39.9-40.9' (2:11), 40.9-41.9' (1:39), 41.9-42.9' (1:42), 42.9-43.9' (2:19)	
40								522.1		43.9 **Bottom of Exploration at 43.9 feet below ground surface.**	
45											
50											

Remarks:

1. Fine Grained Soil Descriptions on this log are based on plasticity estimated using visual manual classification techniques or laboratory Atterberg Limit Tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.
2. Automatic hammer NEB#D23 Energy transfer ratio = 0.863
3. Water level measured immediately after removal of casing.
4. The as-drilled location ws surveyed by VHB (N829643.1, E2227677.6). Elevation was interpolated from existing contours and estimated to the nearest 0.5'.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

APPENDIX C – LABORATORY TEST RESULTS

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

Client Information:
GZA GeoEnvironmental
South Portland, ME
PM: Nick Williams
Assigned By: LCN
Collected By: LCN

Project Information:
MNR Oakfield Culvert Replacement
Oakfield, ME
GZA Project Number:09.0026129.00
Summary Page: 1 of 1
Report Date: 10.20.21

LABORATORY TESTING DATA SHEET, Report No.: 7421-K-139

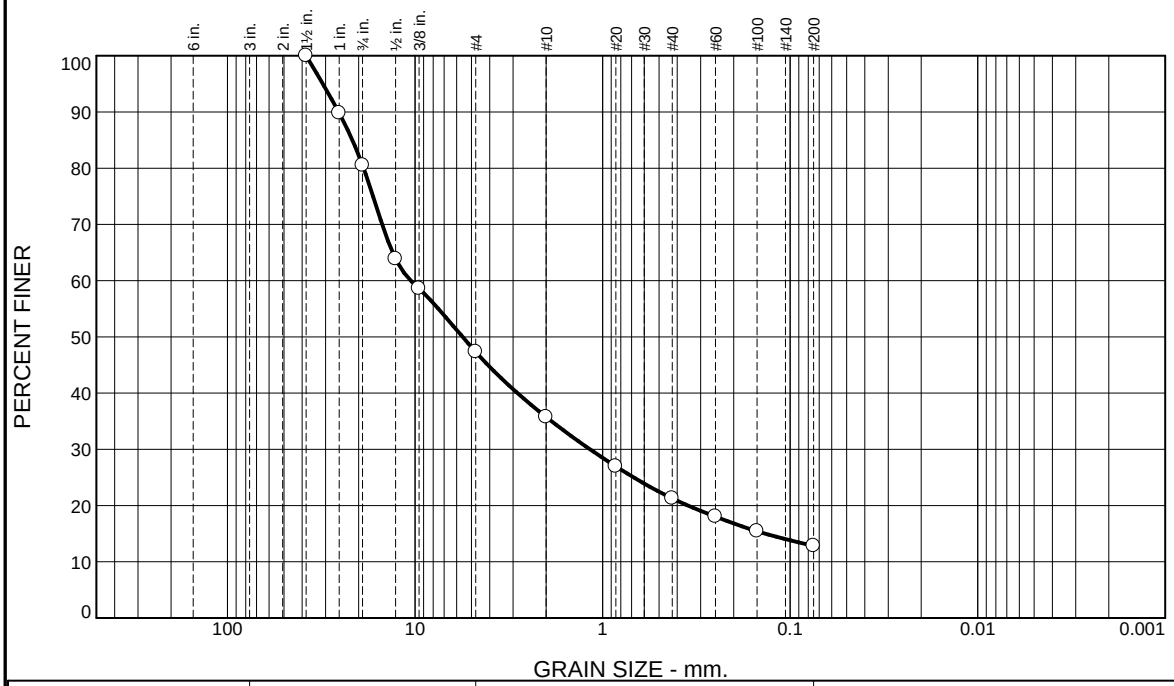
Boring No.	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Moisture Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Moisture Content %	γ_d MAX (pcf) / W_{opt} (%)	γ_d MAX (pcf) / W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D854			D1557						
GZ-1	1D	0-2	21-S-3931	4.8			52.7	34.5	12.8											Brown f-c GRAVEL, some f-c Sand, little Silt
GZ-1	7D	29-31	21-S-3932	12.9			42.0	31.3	26.7											Brown f-c GRAVEL, some f-c Sand, some Silt & Clay
GZ-5	1D	2.5-4.5	21-S-3933	11.2			32.2	52.5	15.3											Brown f-c SAND, some f-c Gravel, little Silt
GZ-4	2D	4-6	21-S-3934	11.3			24.9	36.9	38.2											Brown SILT and f-c SAND, some f-c Gravel
GZ-4	4D	14-16	21-S-3935	50.6			27.1	58.0	14.9	8.4										Brown f-c SAND, some fine Gravel, trace Silt
GZ-4	6D	24-26	21-S-3936	9.0			35.2	43.7	21.1											Grey f-c SAND and f-c GRAVEL, some Silt & Clay
SS-1		0-0.5	21-S-3937				55.3	37.5	7.2											Brown f-c GRAVEL and f-c SAND, trace Silt
SS-2		0-0.5	21-S-3938				57.4	38.4	4.2											Grey fine GRAVEL and f-c SAND, trace Silt

Date Received: *10.08.21*

Reviewed By:

Date Reviewed: *10.20.21*

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.5	33.2	11.6	14.4	8.5	12.8	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	89.8		
0.75"	80.5		
0.5"	63.9		
0.375"	58.6		
#4	47.3		
#10	35.7		
#20	27.0		
#40	21.3		
#60	18.0		
#100	15.4		
#200	12.8		

* (no specification provided)

Material Description

Brown f-c GRAVEL, some f-c Sand, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 25.5591 D_{85}= 21.5737 D_{60}= 10.5340
D_{50}= 5.5780 D_{30}= 1.1668 D_{15}= 0.1359
D_{10}= C_u= C_c=

Remarks

Date Received: 10.08.21 **Date Tested:** 10.13.21

Tested By: SL

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 0-2' **Date Sampled:**
Sample Number: GZ-1 / 1D

Thielsch Engineering Inc.

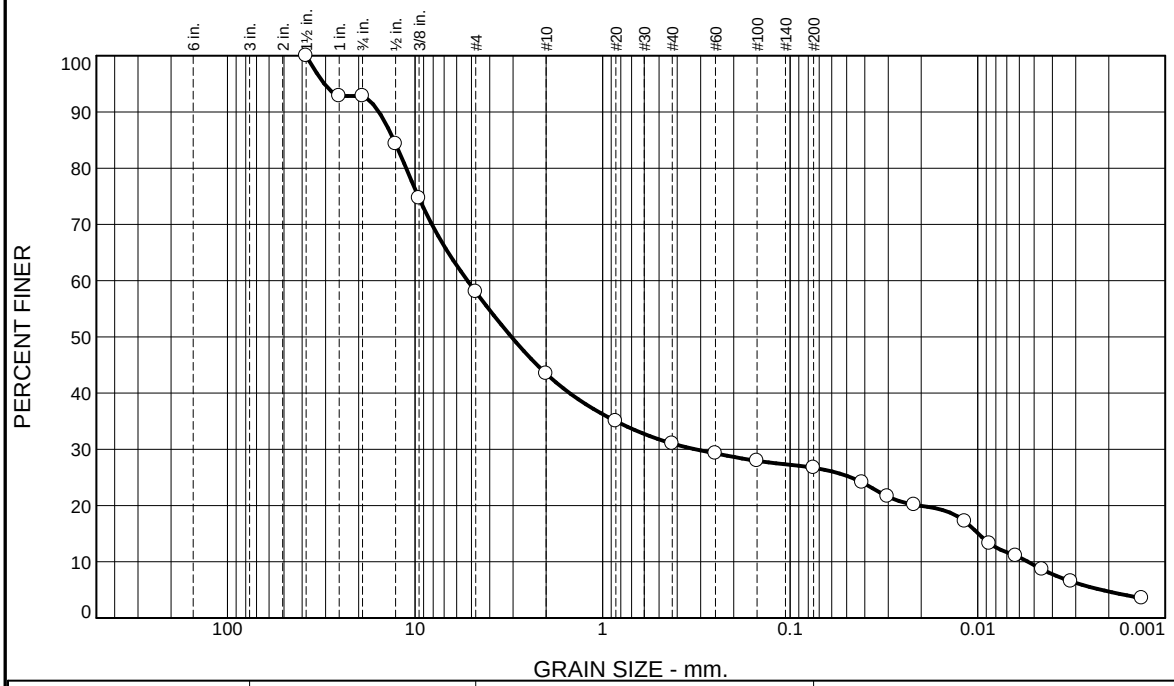
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3931

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.2	34.8	14.5	12.5	4.3	22.0	4.7

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	92.8		
0.75"	92.8		
0.5"	84.3		
0.375"	74.7		
#4	58.0		
#10	43.5		
#20	35.0		
#40	31.0		
#60	29.3		
#100	27.9		
#200	26.7		
0.0413 mm.	24.1		
0.0303 mm.	21.6		
0.0218 mm.	20.2		
0.0117 mm.	17.2		
0.0087 mm.	13.3		
0.0063 mm.	11.1		
0.0045 mm.	8.6		
0.0032 mm.	6.5		
0.0013 mm.	3.5		

* (no specification provided)

Material Description

Brown f-c GRAVEL, some f-c Sand, some Silt & Clay

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= GC **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 15.5801 D_{85}= 12.9682 D_{60}= 5.2539
D_{50}= 3.0640 D_{30}= 0.3187 D_{15}= 0.0099
D_{10}= 0.0054 C_u= 974.95 C_c= 3.59

Remarks

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

Date Received: 10.08.21 **Date Tested:** 10.15.21

Tested By: SL / RR

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 29-31' **Date Sampled:**
Sample Number: GZ-1 / 7D

Thielsch Engineering Inc.

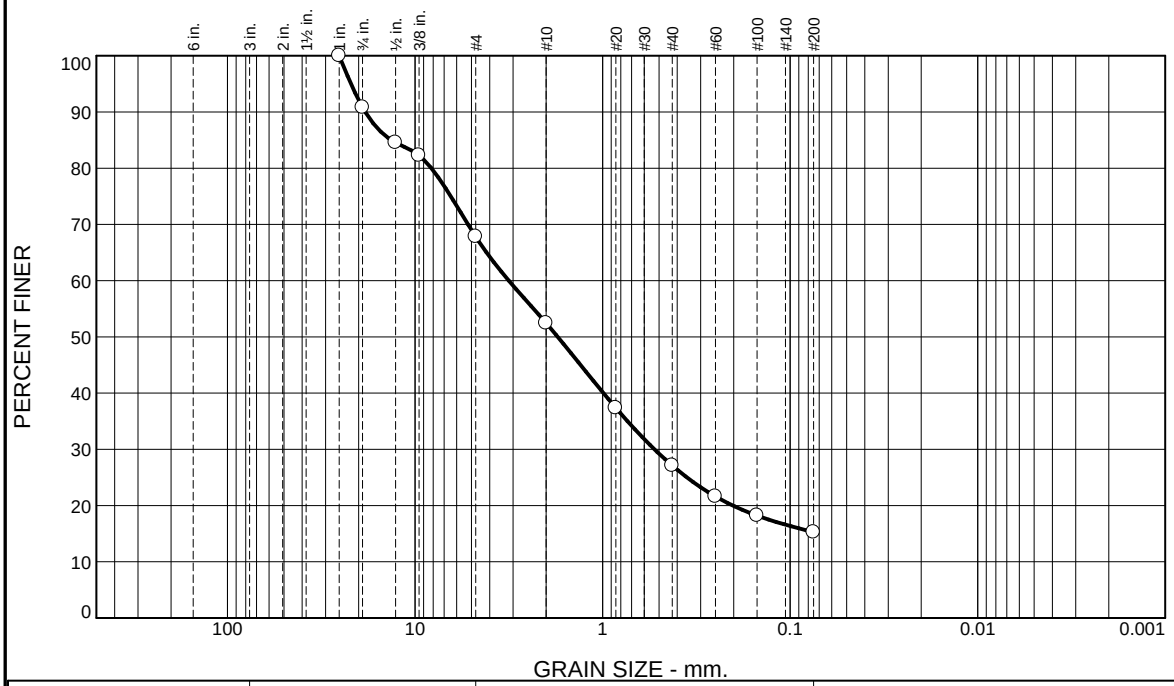
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3932

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.2	23.0	15.3	25.4	11.8	15.3	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	90.8		
0.5"	84.6		
0.375"	82.3		
#4	67.8		
#10	52.5		
#20	37.4		
#40	27.1		
#60	21.6		
#100	18.2		
#200	15.3		

* (no specification provided)

Material Description

Brown f-c SAND, some f-c Gravel, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 18.4324 D_{85}= 13.3677 D_{60}= 3.1638
D_{50}= 1.7335 D_{30}= 0.5288 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10.08.21 **Date Tested:** 10.13.21

Tested By: SL

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 2.5-4.5' **Date Sampled:**
Sample Number: GZ-5 / 1D

Thielsch Engineering Inc.

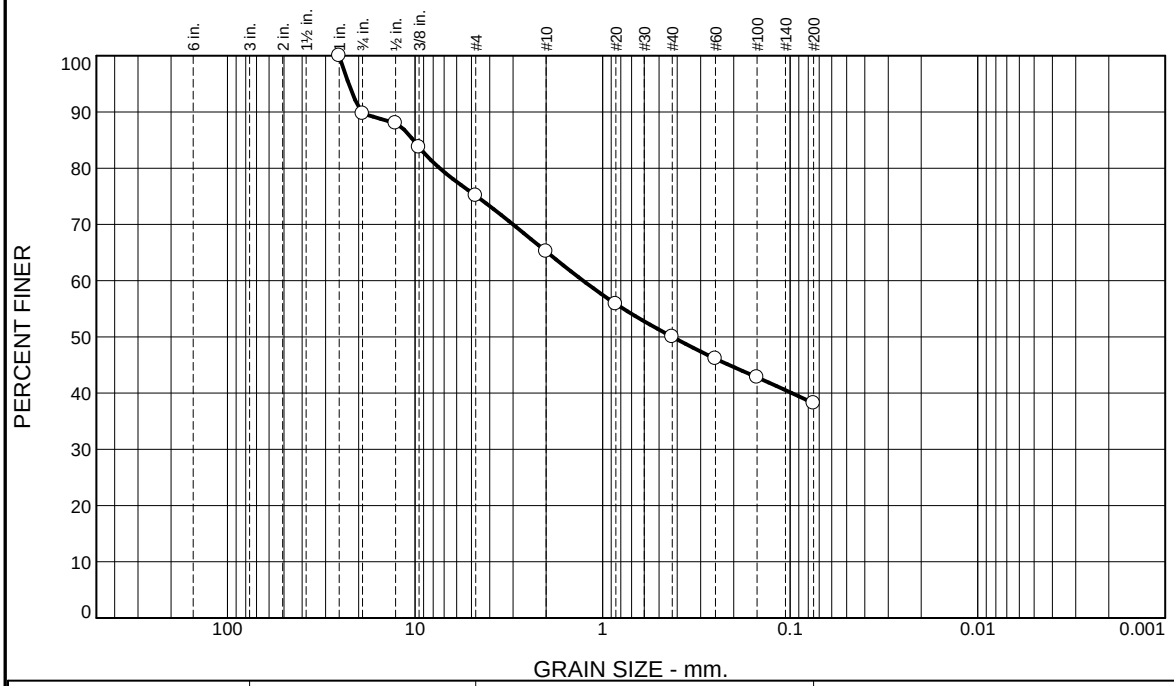
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3933

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	14.6	9.9	15.2	11.8	38.2	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	89.7		
0.5"	88.0		
0.375"	83.8		
#4	75.1		
#10	65.2		
#20	55.9		
#40	50.0		
#60	46.1		
#100	42.8		
#200	38.2		

* (no specification provided)

Material Description

Brown SILT and f-c SAND, some f-c Gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 19.3080 D_{85}= 10.2183 D_{60}= 1.2694
D_{50}= 0.4243 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 10.08.21 **Date Tested:** 10.13.21

Tested By: SL

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 4-6' **Date Sampled:**
Sample Number: GZ-4 / 2D

Thielsch Engineering Inc.

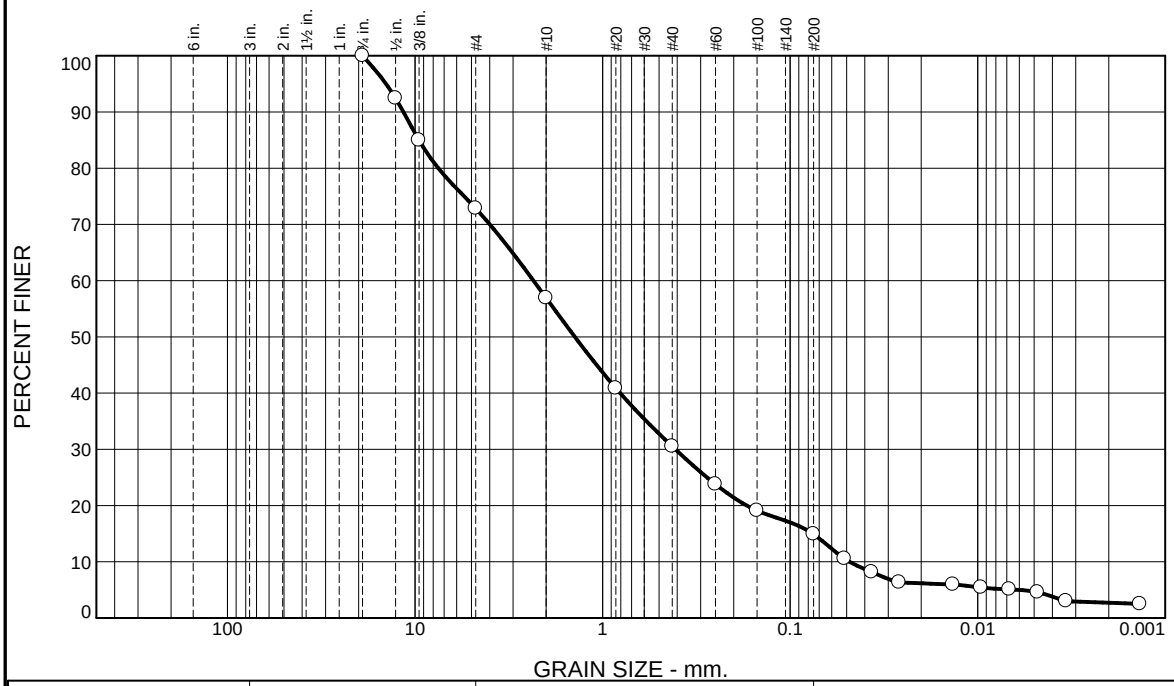
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3934

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	27.1	16.0	26.4	15.6	12.2	2.7

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	92.4		
0.375"	85.0		
#4	72.9		
#10	56.9		
#20	40.9		
#40	30.5		
#60	23.8		
#100	19.1		
#200	14.9		
0.0513 mm.	10.6		
0.0367 mm.	8.2		
0.0262 mm.	6.3		
0.0135 mm.	6.0		
0.0096 mm.	5.4		
0.0068 mm.	5.1		
0.0048 mm.	4.6		
0.0034 mm.	3.0		
0.0014 mm.	2.5		

* (no specification provided)

Material Description

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

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 11.5354 D_{85}= 9.5384 D_{60}= 2.3374
D_{50}= 1.4051 D_{30}= 0.4089 D_{15}= 0.0758
D_{10}= 0.0482 C_u= 48.47 C_c= 1.48

Remarks

Date Received: 10.08.21 **Date Tested:** 10.15.21

Tested By: SL / RR

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 14-16' **Date Sampled:**
Sample Number: GZ-4 / 4D

Thielsch Engineering Inc.

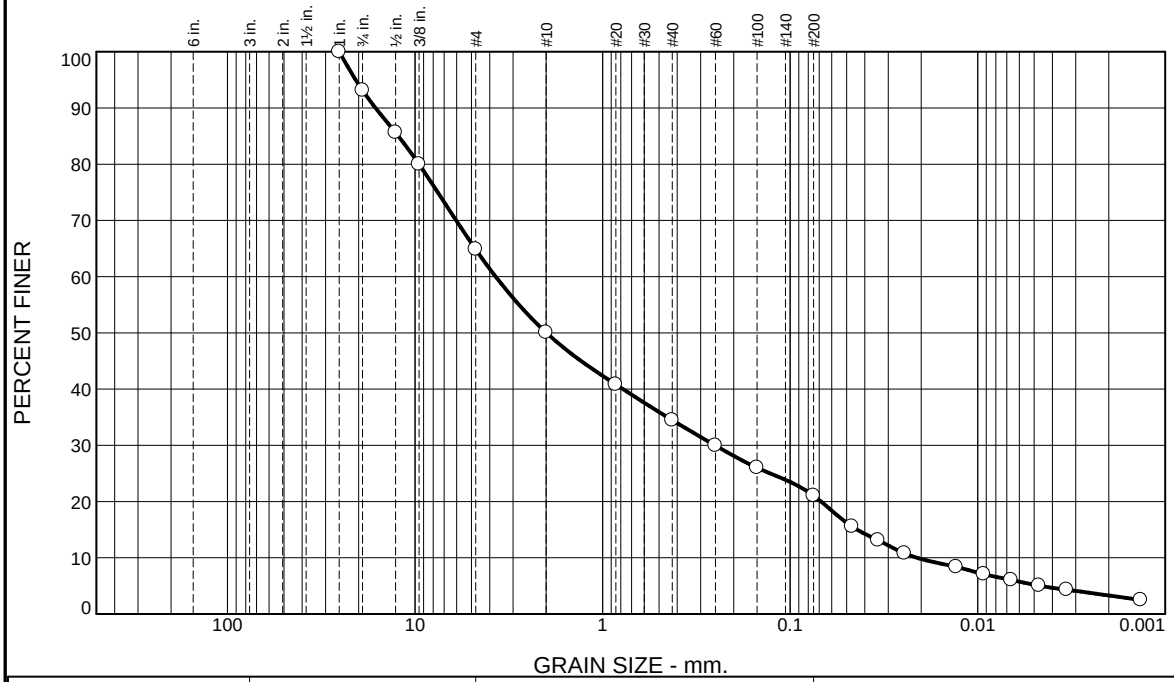
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3936

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	28.3	14.7	15.6	13.4	17.8	3.3

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	93.1		
0.5"	85.6		
0.375"	80.0		
#4	64.8		
#10	50.1		
#20	40.8		
#40	34.5		
#60	30.0		
#100	26.0		
#200	21.1		
0.0469 mm.	15.6		
0.0340 mm.	13.1		
0.0246 mm.	10.8		
0.0130 mm.	8.4		
0.0093 mm.	7.1		
0.0066 mm.	6.1		
0.0047 mm.	5.0		
0.0034 mm.	4.3		
0.0013 mm.	2.5		

* (no specification provided)

Material Description

Grey f-c SAND and f-c GRAVEL, some Silt & Clay

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SC **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 16.2551 D_{85}= 12.2774 D_{60}= 3.7162
D_{50}= 1.9906 D_{30}= 0.2512 D_{15}= 0.0440
D_{10}= 0.0211 C_u= 176.19 C_c= 0.81

Remarks

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

Date Received: 10.08.21 **Date Tested:** 10.15.21

Tested By: SL / RR

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 24-26' **Date Sampled:**
Sample Number: GZ-4 / 6D

Thielsch Engineering Inc.

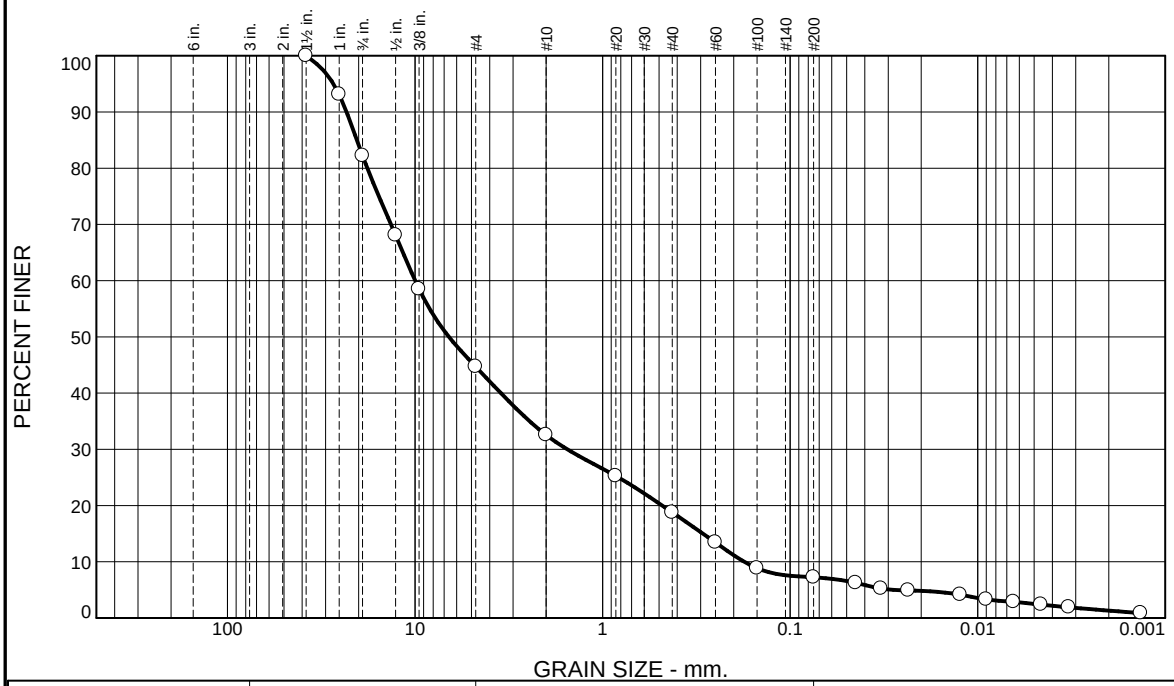
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3936

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	17.8	37.5	12.1	13.8	11.6	5.9	1.3

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	93.1		
0.75"	82.2		
0.5"	68.1		
0.375"	58.5		
#4	44.7		
#10	32.6		
#20	25.3		
#40	18.8		
#60	13.4		
#100	8.9		
#200	7.2		
0.0447 mm.	6.3		
0.0328 mm.	5.2		
0.0234 mm.	4.9		
0.0124 mm.	4.2		
0.0090 mm.	3.3		
0.0064 mm.	2.9		
0.0046 mm.	2.4		
0.0033 mm.	1.9		
0.0013 mm.	0.9		

* (no specification provided)

Material Description

Brown f-c GRAVEL and f-c SAND, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 23.1782 D_{85}= 20.4237 D_{60}= 9.9925
D_{50}= 6.5974 D_{30}= 1.5415 D_{15}= 0.2916
D_{10}= 0.1756 C_u= 56.92 C_c= 1.35

Remarks

Date Received: 10.08.21 **Date Tested:** 10.15.21

Tested By: SL / RR

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 0-0.5' **Date Sampled:**
Sample Number: SS-1

Thielsch Engineering Inc.

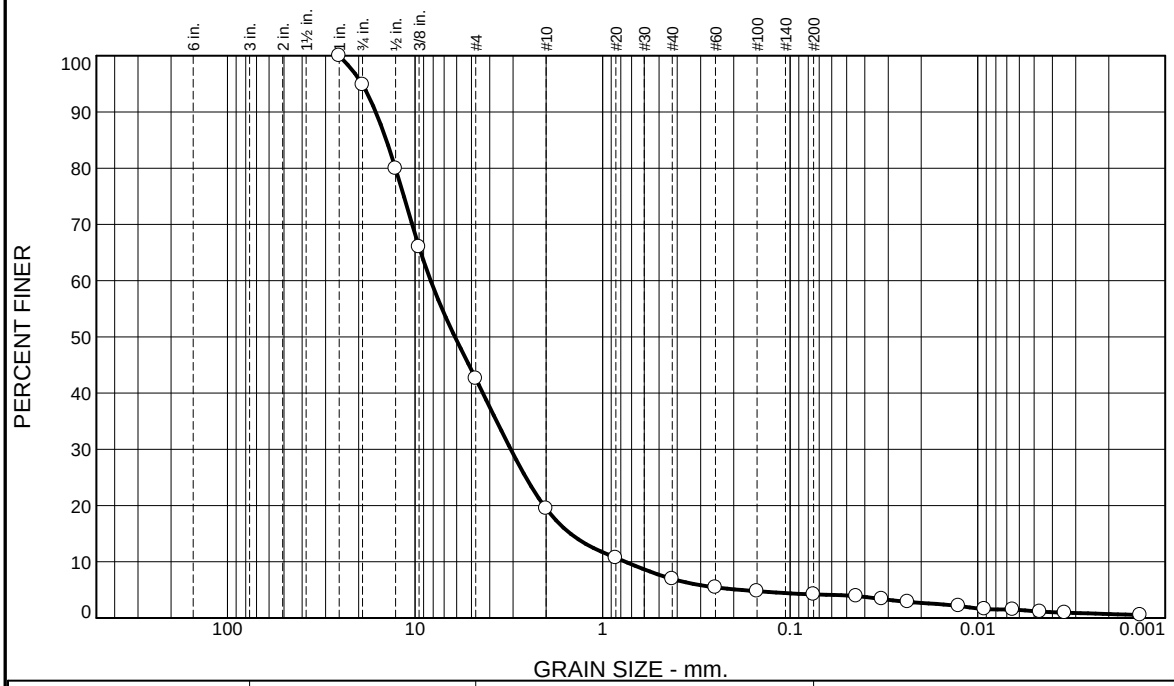
Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3937

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.2	52.2	23.1	12.6	2.7	3.5	0.7

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	94.8		
0.5"	79.9		
0.375"	66.0		
#4	42.6		
#10	19.5		
#20	10.7		
#40	6.9		
#60	5.5		
#100	4.8		
#200	4.2		
0.0445 mm.	3.9		
0.0324 mm.	3.4		
0.0236 mm.	2.9		
0.0126 mm.	2.1		
0.0092 mm.	1.6		
0.0065 mm.	1.5		
0.0047 mm.	1.1		
0.0034 mm.	0.9		
0.0014 mm.	0.5		

* (no specification provided)

Material Description

Grey fine GRAVEL and f-c SAND, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 16.2059 D_{85}= 14.2289 D_{60}= 8.2520
D_{50}= 6.1277 D_{30}= 3.0894 D_{15}= 1.4817
D_{10}= 0.7557 C_u= 10.92 C_c= 1.53

Remarks

Date Received: 10.08.21 **Date Tested:** 10.15.21

Tested By: SL / RR

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 0-0.5' **Date Sampled:**
Sample Number: SS-2

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental

Project: MNR Oakfield Culvert Replacement
Oakfield, ME

Project No: 09.0026129.00 **Figure** 21-S-3938