

**MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE**

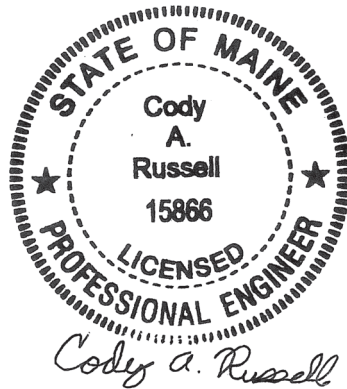
GEOTECHNICAL DESIGN REPORT

For the Replacement of

**LARGE CULVERT #137691
ROUTE 171
DREW PLANTATION, MAINE**

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Penobscot County
WIN 25521.00

Soils Report 2026-02
January 22, 2026

PROJECT DETAILS

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical design and construction recommendations for the replacement of an existing cross culvert (#137691) consisting of an approximately 36-inch diameter, 42-foot long corrugated metal pipe (CMP) on Route 171 in Drew Plantation, Maine. The existing culvert is in poor condition and needs replacement both from an infrastructure and environmental standpoint. The culvert is located approximately 0.1 of a mile north of Cemetery Road Intersection as shown in the attached Location Map. Route 171 is a Highway Corridor Priority 4 road.

The proposed replacement structure will be an 84-inch diameter, 65-foot long polymer coated corrugated steel pipe culvert on a skew of approximately 17.0 degrees. The invert of the proposed culvert is approximately 9.5 feet below the existing road grade at the roadway centerline. The roadway embankment slopes at the proposed culvert inlet and outlet shall be no steeper than 2H:1V to protect against erosion.

SUBSURFACE INVESTIGATION

One (1) boring (HB-DRE-101) and one (1) probe (HB-DRE-102) were drilled for this project on July 28, 2021 by the MaineDOT drill crew using a trailer-mounted drill rig. Exploration locations are shown on the attached Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are shown on the attached Boring Logs.

Boring HB-DRE-101 and probe HB-DRE-102 were drilled using solid stem auger drilling techniques. Soil samples were obtained in boring HB-DRE-101 at 5-foot intervals using Standard Penetration Test (SPT) methods. The MaineDOT drill rig is equipped with an automatic hammer to drive the split spoon. The MaineDOT calibrated automatic hammer delivers approximately 48 percent more energy during driving than the standard rope and cathead system. All N-values discussed in this report are corrected values (N_{60}) computed by applying an average energy transfer factor of 0.890 to the raw field N-values. No soil samples were obtained in the probe.

The MaineDOT Geotechnical Team member selected the boring and probe locations, drilling methods, designated type and depth of sampling, reviewed field logs for accuracy and identified field and laboratory testing requirements. A NorthEast Transportation Training and Certification (NETTCP) certified Subsurface Investigator logged the subsurface conditions encountered. The boring and probe were located in the field by taping to surveyed site features after completion of the drilling program.

LABORATORY TESTING

A laboratory testing program was conducted to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of one (1) standard grain size analyses with natural water content, and three (3) grain size analyses with hydrometer and natural water content. The results of the laboratory testing

program are discussed in the following section and are shown on the attached Boring Logs, Laboratory Testing Summary Sheet, and Grain Size Distribution Curve sheet.

SUBSURFACE CONDITIONS

Subsurface conditions encountered in the test boring and probe were generally fill consisting of sandy gravel underlain by native silt. An interpretive subsurface profile depicting the generalized soil stratigraphy at the boring location is shown on the attached Boring Location Plan & Interpretive Subsurface Profile with Boring Logs.

Boring HB-DRE-101 was drilled to a depth of approximately 17.0 feet below ground surface (bgs) without encountering a refusal surface. Probe HB-DRE-102 was drilled to a depth of approximately 15.5 feet bgs without encountering a refusal surface.

The table below summarizes the field and laboratory information obtained in boring HB-DRE-101:

Approx. Depth BGS ¹ (feet)	Soil Description	AASHTO ² Classification	USCS ³	WC% ⁴
0.0 – 0.5	HMA Pavement	--	--	--
0.5 – 4.5	Fill: Brown, damp, fine to coarse sandy gravel, little silt, occasional cobbles.	A-1-a	SW-SM	3.1
4.5 – 17.0	Brown and grey, wet, silt, little to some clay, trace to little fine to coarse sand, trace gravel, trace organics, wood.	A-4	CL	19.8 to 58.1

¹BGS = below ground surface

²AASHTO = American Association of State Highway and Transportation Officials

³USCS = Unified Soil Classification System

⁴WC% = Water content in percent

One (1) corrected N-value obtained in the fill was 64 blows per foot (bpf), indicating that the fill is very dense in consistency. Three (3) corrected N-values obtained in the silt ranged from 7 to 33 bpf, indicating that the silt is medium stiff to hard in consistency.

Groundwater was recorded at depth 9.6 feet bgs in boring HB-DRE-101. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

The following sections discuss geotechnical recommendations for the design and construction of the proposed polymer-coated corrugated steel pipe culvert.

Polymer-Coated Corrugated Steel Pipe Culvert Design and Construction – The proposed replacement structure will consist of an 84-inch diameter, 65-foot long polymer-coated corrugated steel pipe culvert on a skew of approximately 17.0 degrees. The proposed structure inlet and outlet slopes shall be riprapped with slopes no steeper than 2H:1V to protect against erosion. The proposed polymer-coated corrugated steel pipe culvert shall be designed and constructed in accordance with MaineDOT Standard Specification 603. The invert of the proposed polymer-coated corrugated steel pipe culvert ranges from approximately 333.04 feet at the inlet end to approximately 332.06 feet at the outlet end with a slope of approximately 1.5%.

The full nature of the proposed culvert bearing surface will not become evident until the culvert excavation is made. Any cobbles or boulders encountered in excess of 6 inches shall be removed and replaced with compacted Granular Borrow Material for Underwater Backfill or Crushed Stone $\frac{3}{4}$ -Inch. The prepared subgrade shall be proof-rolled using a static roller to visually confirm the prepared subgrade is firm and stable. The exposed subgrade shall be free of ponded water so that bedding material placement and compaction can be completed in the dry.

The proposed structure shall be bedded on a 1-foot thick layer of Granular Borrow, Material for Underwater Backfill meeting the requirements of MaineDOT Standard Specification 703.19. The soil envelope and backfill shall consist of Standard Specification 703.19 - Granular Borrow with a maximum particle size of 4 inches. The granular borrow bedding and backfill material shall be placed in lifts of 6 to 8 inches loose measure and compacted to the manufacturer's specifications or, in the absence of manufacturer's specifications. The bedding and backfill soil shall be compacted to at least 92 percent of the AASHTO T-180 maximum dry density. All subgrade surfaces should be protected from construction traffic in order to limit disturbance.

Settlement – No settlement issues are anticipated at the site. The proposed polymer-coated corrugated steel pipe culvert is larger than the existing culvert and will result in a net unloading of the site soils at the proposed structure location. Placement of fill soils at the location of the existing structure is not anticipated to exceed the past loading condition of the site soils. Any settlement due to elastic compression of the bedding material will be immediate and negligible.

Scour and Riprap – Both the inlet and outlet of the polymer-coated corrugated steel pipe culvert shall be protected against scour with riprap conforming to MaineDOT Standard Specification Section 703.26 Plain and Hand Laid Riprap. The roadway embankment slopes at the proposed culvert inlet and outlet shall be no steeper than 2H:1V. No specific scour protection recommendations are needed other than armoring with riprap. The riprap on the slopes shall be underlain by a 1-foot layer of protective aggregate cushion consisting of Granular Borrow Material for Underwater Backfill (703.19) that is underlain by a non-woven, Class 1 Erosion Control Geotextile meeting the requirements of MaineDOT Standard Specification 722.03. The toe of the riprap sections shall be keyed into the existing soils 1 foot below the streambed elevation.

Construction Considerations – Construction activities will include construction of cofferdams and earth support systems to control stream flow during construction. Construction activities will also include common earth excavation. Construction of the polymer-coated corrugated steel pipe culvert will require soil excavation. Earth support systems shall be implemented if laying back slopes is not feasible. It is likely that the use of complex (four-sided) braced excavations with

dewatering will be necessary due to the depth of the excavation. If this is the case, adequate embedment into the native soils will be necessary to allow for the excavation and maintenance of a stable excavation bottom. All earth support systems shall be designed by a Professional Engineer licensed in the State of Maine. Regardless of the method of excavation, all excavations and earth support systems shall meet all applicable OSHA regulations.

The Contractor shall control groundwater and surface water infiltration using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert groundwater and surface water as needed to maintain a stable excavation and allow work in the dry.

Using the excavated native soils as backfill around the culvert shall not be permitted. The native soils may only be used as Common Borrow in accordance with MaineDOT Standard Specifications 203 and 703.

The Contractor will have to excavate the existing subbase and subgrade fill soils in the vicinity of the culvert. These materials should not be used to re-base the roadway. Excavated subbase sand and gravel may be used as fill below roadway subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program and their project design consultant for specific application to the proposed replacement of a cross culvert (#137691) under Route 171 in Drew Plantation, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory location completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

It is recommended that a geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Attachments:

Location Map

Boring Location Plan & Interpretive Subsurface Profile with Boring Logs

Key to Soil and Rock Descriptions and Terms

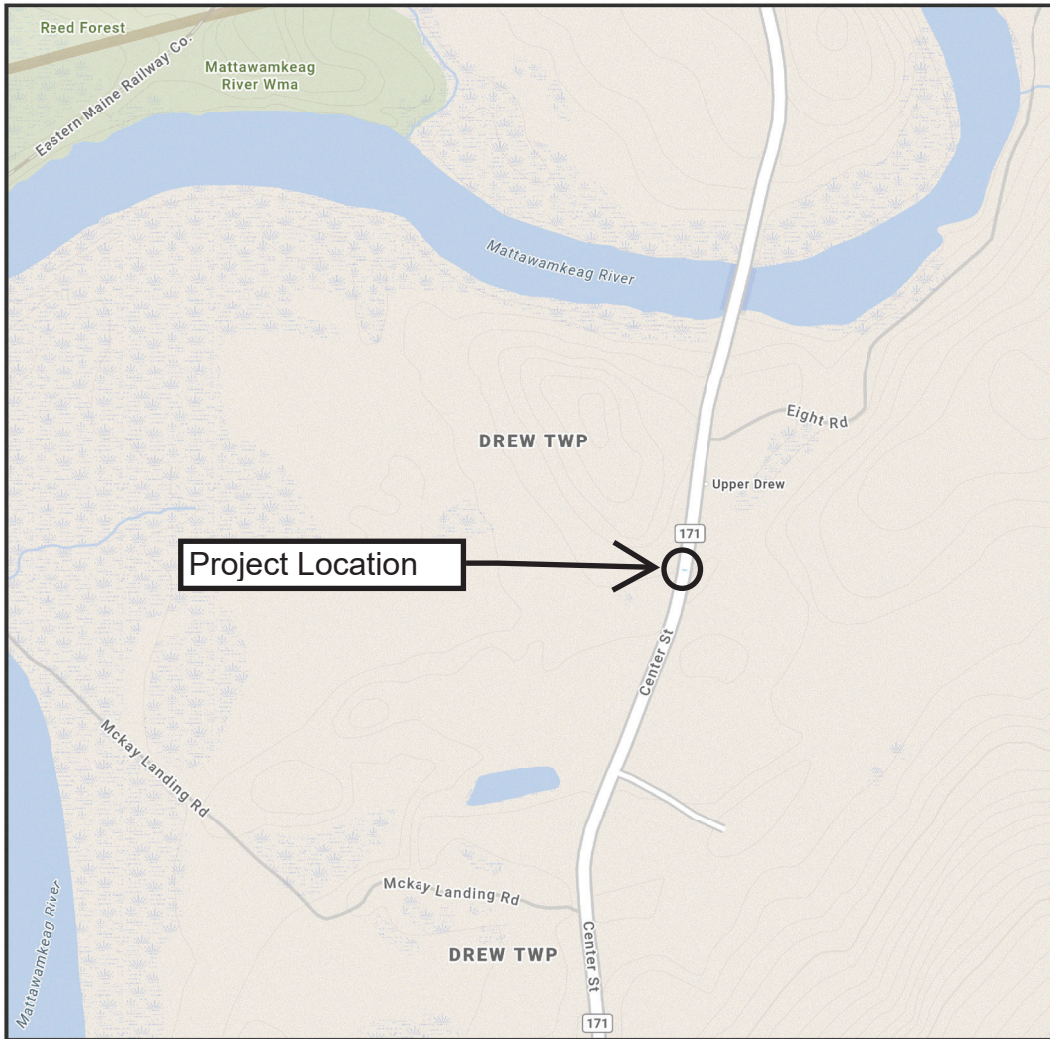
Boring Logs

Laboratory Testing Summary Sheet

Grain Size Distribution Curve Sheet



DREW PLANTATION, MAINE



The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

0.15 Miles
1 inch = 0.18 miles

Date: 6/24/2025
Time: 2:01:31 PM

<p>SHEET NUMBER</p> <p style="font-size: 2em; text-align: center;">1</p> <p>OF 2</p>	<p style="text-align: center;">DREW PLANTATION</p> <p style="text-align: center;">ROUTE 171</p> <hr/> <p style="text-align: center;">LOCATION MAP</p>	<p style="text-align: center;">STATE OF MAINE DEPARTMENT OF TRANSPORTATION</p> <hr/> <p style="text-align: center;">25521.00</p> <hr/> <p style="text-align: center;">WIN 25521.00</p> <p style="text-align: right; font-size: 0.8em;">HIGHWAY PLANS</p>
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Route 171 Large Culvert Replacement Location: Drew Pt.	Boring No.: HB-DRE-101 WIN: 25521.00
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Driller: MaineDOT	Elevation (ft.): 341.0	Auger ID/OD: 5" Dia.
Operator: Daggett/Jay	Datum: NAVD88	Sampler: Standard Split Spoon
Logged By: B. Wilder	Rig Type: CME 45C	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 7/28/2021; 09:30-10:30	Drilling Method: Solid Stem Auger	Core Barrel: N/A
Boring Location: 11+64.6, 8.6 ft Lt.	Casing ID/OD: N/A	Water Level*: 9.6 ft bgs.

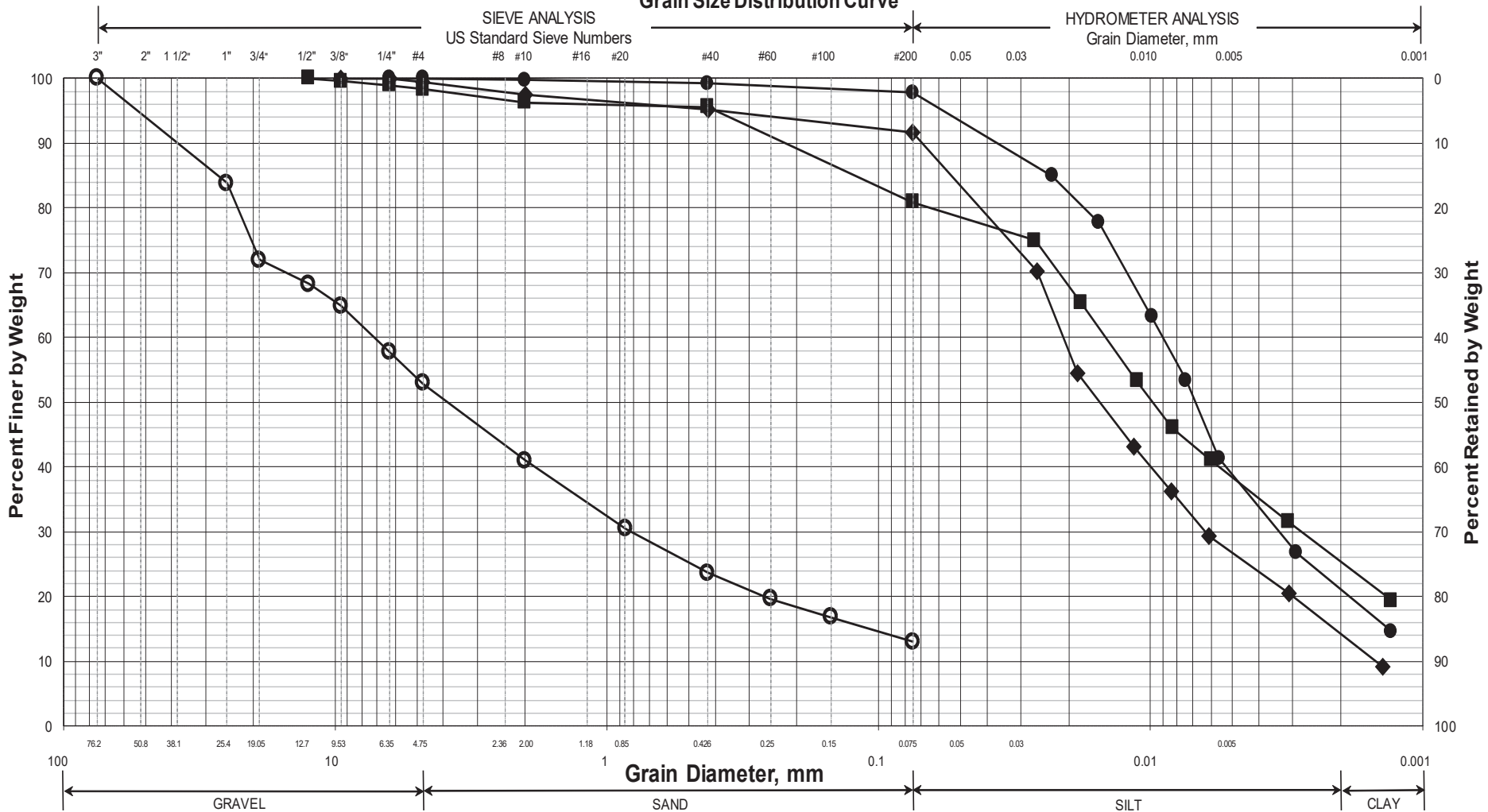
Hammer Efficiency Factor: 0.89	Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>	
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Definitions:
 D = Split Spoon Sample
 MD = Unsuccessful Split Spoon Sample Attempt
 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								340.5	5 1/2" HMA.		
	1D	24/17	1.50 - 3.50	10/10/33/33	43	64			Brown, damp, very dense, fine to coarse Sandy GRAVEL, little silt, occasional cobbles, (Fill).	G#340981 A-1-a, SW-SM WC=3.1%	
5								336.5	Brown, wet, medium stiff, SILT, little clay, trace fine to coarse sand, trace gravel, trace organics, with wood.	G#340982 A-4, CL WC=58.1%	
	2D	24/19	5.00 - 7.00	2/2/3/2	5	7			Grey, wet, very stiff, SILT, some clay, little fine to coarse sand, trace gravel.	G#340983 A-4, CL WC=19.8%	
10								333.5	Grey, wet, hard, SILT, some clay, trace fine to medium sand.	G#340984 A-4, CL WC=24.3%	
	3D	24/20	10.00 - 12.00	3/8/9/9	17	25			Bottom of Exploration at 17.0 feet below ground surface. NO REFUSAL		
15								324.0			
	4D	24/18	15.00 - 17.00	8/11/11/15	22	33					
20											
25											

Remarks:

Maine Department of Transportation Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-DRE-101/1D	11+64.6	8.6 LT	1.5-3.5	Sandy GRAVEL, little silt.	3.1			
◆	HB-DRE-101/2D	11+64.6	8.6 LT	5.0-7.0	SILT, little clay, trace sand, trace gravel.	58.1			
■	HB-DRE-101/3D	11+64.6	8.6 LT	10.0-12.0	SILT, some clay, little sand, trace gravel.	19.8			
●	HB-DRE-101/4D	11+64.6	8.6 LT	15.0-17.0	SILT, some clay, trace sand.	24.3			
▲									
X									

WIN
025521.00
Town
Drew Plt
Reported by/Date
WHITE, TERRY A 6/23/2025