

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

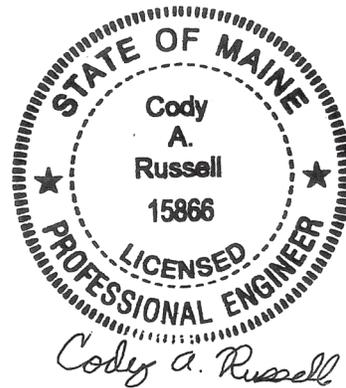
GEOTECHNICAL DESIGN REPORT

For the Replacement of

**LARGE CULVERT #181630
ROUTE 162
T17R4 (SINCLAIR), MAINE**

Prepared by:

Yueh-Ti Lee
Assistant Geotechnical Engineer



Reviewed by:

Cody Russell, P.E.
Senior Geotechnical Engineer

Aroostook County
WIN 23781.00

Soils Report 2026-01
January 2, 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 (#181630) consisting of an approximately 42-inch diameter, 48-foot long corrugated metal pipe (CMP) on Route 162 in T17R4 (Sinclair), Maine. The existing culvert is in poor condition and needs replacement both from an infrastructure and environmental standpoint. The culvert is located approximately 1.46 of a mile northeast of Shore Road as shown in the attached Location Map. Route 162 is a Highway Corridor Priority 4 road.

The proposed replacement structure will be an 87-inch span by 63-inch rise by 68-foot long polymer coated corrugated steel pipe arch culvert on a skew of approximately 19.0 degrees. The invert of the proposed culvert is approximately 8.4 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 1.75H:1V armored with 3 feet of plain riprap to protect against erosion.

SUBSURFACE INVESTIGATION

One (1) boring (HB-SIN-101) and one (1) probe (HB-SIN-102) were drilled for this project on October 16, 2018 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-SIN-101 was drilled using solid stem auger drilling techniques. Soil samples were obtained in boring HB-SIN-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 55 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 0.928 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 two (2) standard grain size analyses with natural water content, and two (2) 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 sand underlain by glacial till consisting of silt and sand. 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-SIN-101 was drilled to a depth of approximately 17.0 feet below ground surface (bgs) without encountering a refusal surface. Probe HB-SIN-102 was drilled to a depth of approximately 15.5 feet bgs where a refusal surface was encountered. The exact nature of the refusal surface was not determined in the probe.

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

Approx. Depth BGS ¹ (feet)	Soil Description	AASHTO ² Classification	USCS ³	WC% ⁴
0.0 – 9.0	Fill: Brown, moist to wet, fine to coarse sand, some gravel, little silt, wood.	A-1-b	SM	8.4 to 23.1
9.0 – 17.0	Till: Grey, wet, silt, some gravel, some fine to coarse sand, little clay. Grey, wet, fine to coarse sand, some silt, little gravel, little clay.	A-4	SC-SM	9.1 to 9.8

¹BGS = below ground surface

²AASHTO = American Association of State Highway and Transportation Officials

³USCS = Unified Soil Classification System

⁴WC% = Water content in percent

Two (2) corrected N-values obtained in the fill were both 12 blows per foot (bpf), indicating that the fill is medium dense in consistency. One (1) corrected N-value obtained in the silt till was 40 bpf, indicating that the silt is hard in consistency. One (1) corrected N-value obtained in the sand till was 56 bpf, indicating that the sand is very dense in consistency.

Groundwater was recorded at depth 4.5 feet bgs in boring HB-SIN-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 arch culvert.

Polymer-Coated Corrugated Steel Pipe Arch Culvert Design and Construction – The proposed replacement structure will consist of an 87-inch span by 63-inch rise by 68-foot polymer-coated corrugated steel pipe arch culvert on a skew of approximately 19.0 degrees. The proposed structure inlet and outlet slopes shall be riprapped with slopes no steeper than 1.75H:1V to protect against erosion. The proposed polymer-coated corrugated steel pipe arch culvert shall be designed and constructed in accordance with MaineDOT Standard Specification 603. The approximate invert of the proposed polymer-coated corrugated steel pipe arch culvert will be set at an elevation of 579.00 feet with a 0% slope.

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 arch 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 arch 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 1.75H:1V. All slopes steeper than 2H:1V shall be armored with 3 feet of plain riprap. 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 corrugated metal pipe arch 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 (#181630) under Route 162 in T17R4 (Sinclair), 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



SINCLAIR TWP., MAINE

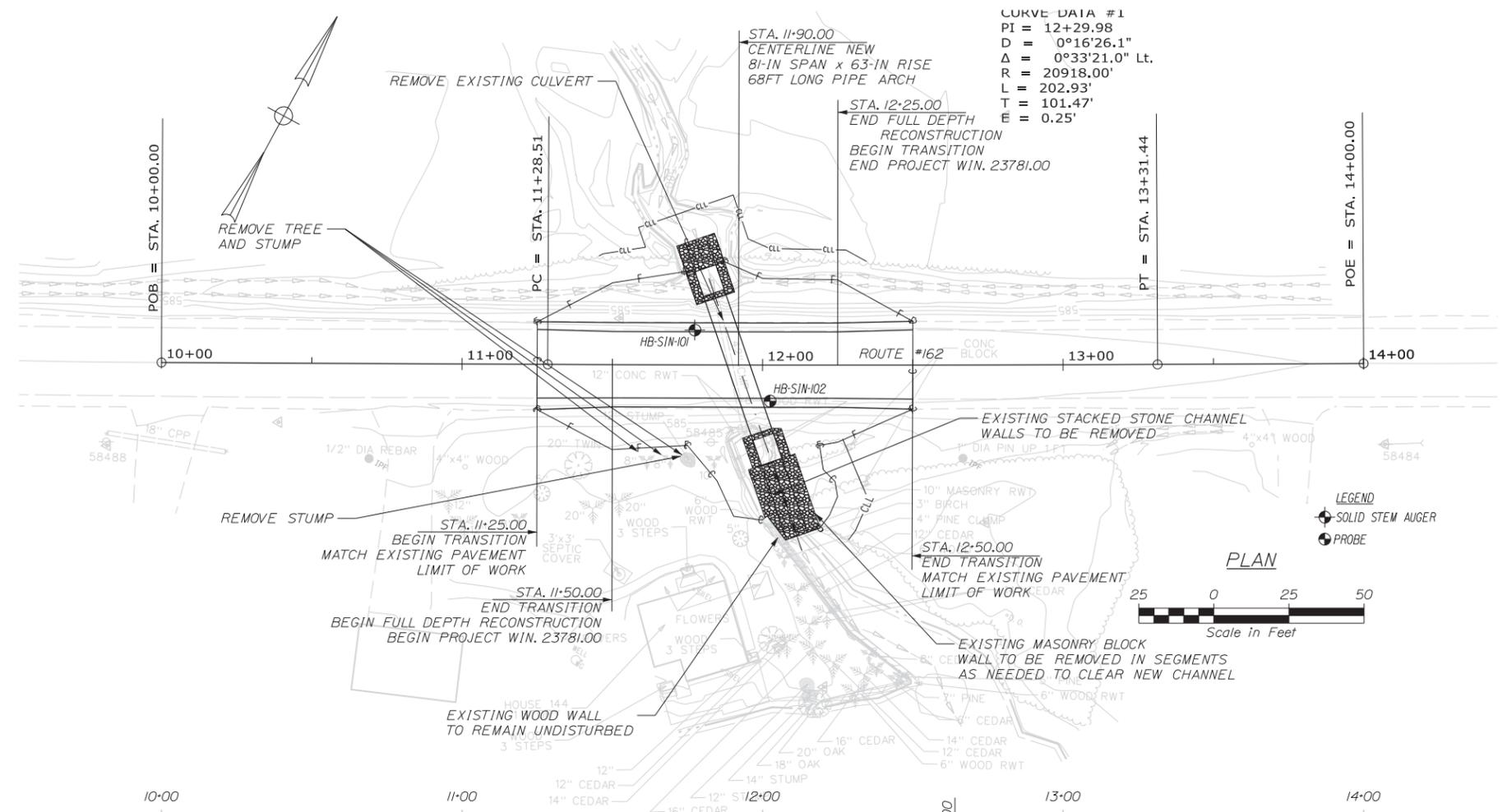


The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information.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

0.35 Miles
1 inch = 0.42 miles

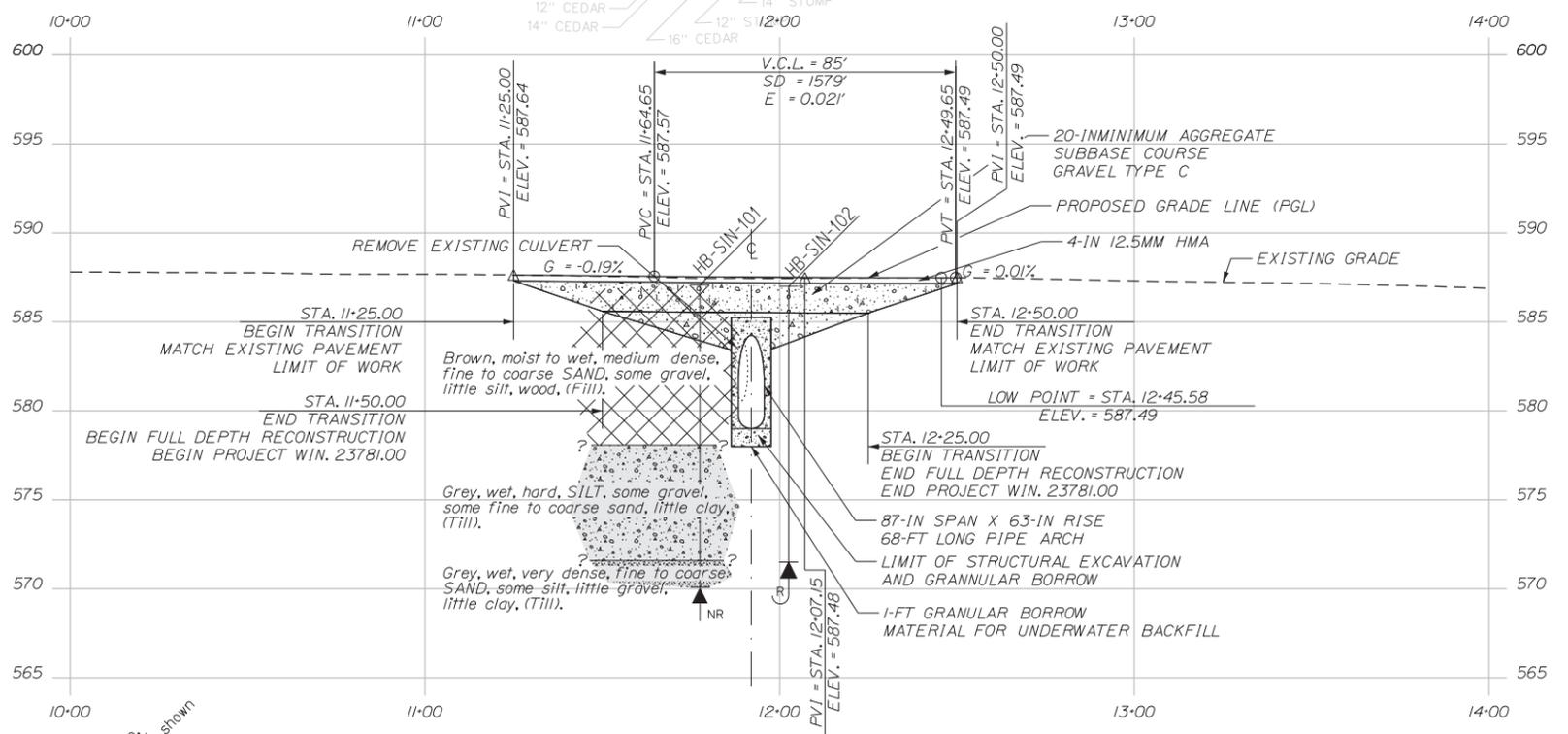
Date: 6/9/2025
Time: 2:27:26 PM

SHEET NUMBER 1	T17R4(SINCLAIR) ROUTE 162	STATE OF MAINE DEPARTMENT OF TRANSPORTATION	
		CAPITAL PROJECTS	
OF 2	LOCATION MAP	WIN 23781.00	HIGHWAY PLANS



CURVE DATA #1
 PI = 12+29.98
 D = 0°16'26.1"
 Δ = 0°33'21.0" Lt.
 R = 20918.00'
 L = 202.93'
 E = 101.47'
 T = 0.25'

Maine Department of Transportation Sullivan, Escalation, LLC AS CONSULTANTS		Project: Large Culvert #181630 Replacement on Route 162 Locations: Sinclair, Maine		Boring No.: HB-SIN-101 WIN: 23781.00																																																								
Drilling Contractor: MainDOT	Elevation (ft.): 587.1	Drill Bit: 5/8"	Auger ID (in): 5" O.D.	Operator: Duggan/Finley	Soil Type: N/A																																																							
Logged By: B. White	Drilling Method: CME-45C	Core Barrels: N/A	Water Level: 4.5 ft bgs.	Date Start/Finish: 10/16/2018-10/16/2018	Drilling Method: Solid Stem Auger																																																							
<p>Soil Test Results</p> <table border="1"> <thead> <tr> <th>Depth (ft.)</th> <th>Sample No.</th> <th>Pen./Rec. (in)</th> <th>Sample Depth (ft.)</th> <th>Moisture (%)</th> <th>Specific Gravity (G_s)</th> <th>Unit Weight (pcf)</th> <th>Void Ratio (e)</th> <th>Classification</th> <th>Visual Description and Remarks</th> <th>Laboratory Test Results / ASHTO and Unified Class</th> </tr> </thead> <tbody> <tr> <td>0-5</td> <td>10</td> <td>24/15</td> <td>0.00 - 2.00</td> <td>24/4/4</td> <td>8</td> <td>12</td> <td>58</td> <td>GM-10</td> <td>Brown, moist, medium dense, fine to coarse SAND, some gravel, little silt, wood, (FIII).</td> <td>GM-10 4-10, 58 MC-45</td> </tr> <tr> <td>5-10</td> <td>20</td> <td>24/16</td> <td>5.00 - 7.00</td> <td>5/6/2/2</td> <td>8</td> <td>12</td> <td>58</td> <td>GM-10</td> <td>Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, wood, (FIII).</td> <td>GM-10 4-10, 58 MC-45</td> </tr> <tr> <td>10-15</td> <td>30</td> <td>24/18</td> <td>10.00 - 12.00</td> <td>10/13/13/20</td> <td>26</td> <td>40</td> <td>40</td> <td>GM-10</td> <td>Grey, wet, hard, SILT, some gravel, some fine to coarse sand, little clay, (TIII).</td> <td>GM-10 4-10, 58 MC-45</td> </tr> <tr> <td>15-20</td> <td>40</td> <td>24/15</td> <td>15.00 - 17.00</td> <td>7/14/22/13</td> <td>36</td> <td>56</td> <td>56</td> <td>GM-10</td> <td>Grey, wet, very dense, fine to coarse SAND, some silt, little gravel, little clay, (TIII).</td> <td>GM-10 4-10, 58 MC-45</td> </tr> </tbody> </table>						Depth (ft.)	Sample No.	Pen./Rec. (in)	Sample Depth (ft.)	Moisture (%)	Specific Gravity (G _s)	Unit Weight (pcf)	Void Ratio (e)	Classification	Visual Description and Remarks	Laboratory Test Results / ASHTO and Unified Class	0-5	10	24/15	0.00 - 2.00	24/4/4	8	12	58	GM-10	Brown, moist, medium dense, fine to coarse SAND, some gravel, little silt, wood, (FIII).	GM-10 4-10, 58 MC-45	5-10	20	24/16	5.00 - 7.00	5/6/2/2	8	12	58	GM-10	Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, wood, (FIII).	GM-10 4-10, 58 MC-45	10-15	30	24/18	10.00 - 12.00	10/13/13/20	26	40	40	GM-10	Grey, wet, hard, SILT, some gravel, some fine to coarse sand, little clay, (TIII).	GM-10 4-10, 58 MC-45	15-20	40	24/15	15.00 - 17.00	7/14/22/13	36	56	56	GM-10	Grey, wet, very dense, fine to coarse SAND, some silt, little gravel, little clay, (TIII).	GM-10 4-10, 58 MC-45
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Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

Maine Department of Transportation Sullivan, Escalation, LLC AS CONSULTANTS		Project: Large Culvert #181630 Replacement on Route 162 Locations: Sinclair, Maine		Boring No.: HB-SIN-102 WIN: 23781.00																																																								
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**STATE OF MAINE
DEPARTMENT OF TRANSPORTATION**

**T17R4 (SINCLAIR)
ROUTE 162**

**BORING LOCATION PLAN &
INTERPRETIVE SUBSURFACE PROFILE
WITH BORING LOGS**

23781.00

**WIN
23781.00**

HIGHWAY PLANS

PROJ. MANAGER: ROGER SOUCY
 CHECKED-REVIEWED: T. WHITE
 DESIGNED-DETAILED: Y. T. LEE
 DESIGNED-DETAILED: T. WHITE

DATE: DEC 2025

SIGNATURE: _____
 P.E. NUMBER: _____
 DATE: _____

SHEET NUMBER

2

OF 2

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Large Culvert #181630 Replacemnt on Route 162 Location: Sinclair, Maine	Boring No.: HB-SIN-101 WIN: 23781.00
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Driller: MaineDOT	Elevation (ft.): 587.1	Auger ID/OD: 5" Dia.
Operator: Daggett/Niles	Datum: NAVD88	Sampler: Standard Split Spoon
Logged By: B. Wilder	Rig Type: CME 45C	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 10/16/2018; 12:30-15:00	Drilling Method: Solid Stem Auger	Core Barrel: N/A
Boring Location: 11+77.5, 11.3 ft Lt.	Casing ID/OD: N/A	Water Level*: 4.5 ft bgs.

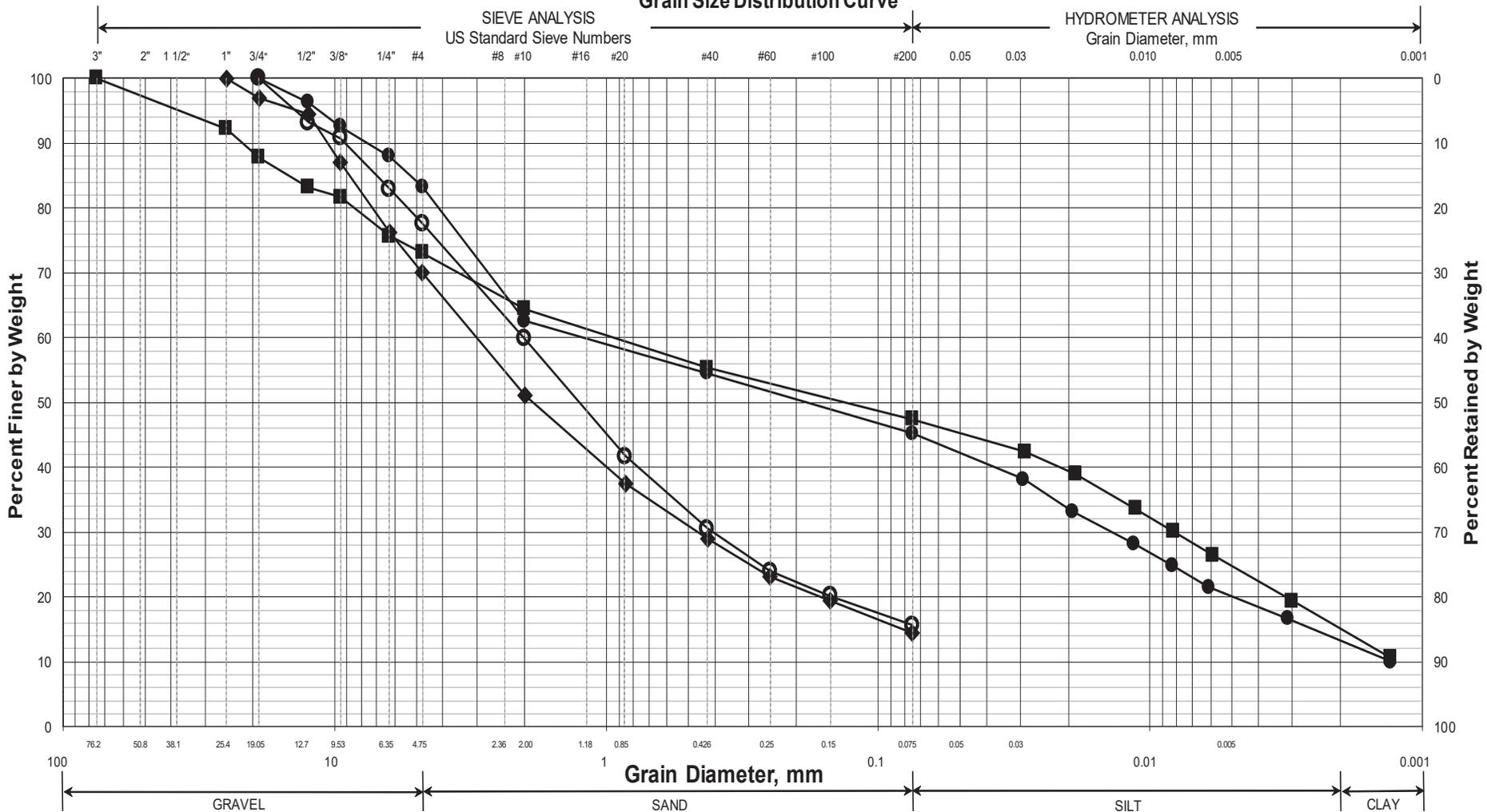
Hammer Efficiency Factor: 0.928 **Hammer Type:** Automatic Hydraulic Rope & Cathead

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

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows						
0	1D	24/15	0.00 - 2.00	2/4/4/4	8	12	SSA			Brown, moist, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#342730 A-1-b, SM WC=8.4%		
5	2D	24/16	5.00 - 7.00	5/6/2/2	8	12						Brown, wet, medium dense, fine to coarse SAND, some gravel, little silt, wood, (Fill).	G#342731 A-1-b, SM WC=23.1%
10	3D	24/18	10.00 - 12.00	10/13/13/20	26	40		578.1				Grey, wet, hard, SILT, some gravel, some fine to coarse sand, little clay, (Till).	G#342732 A-4, SC-SM WC=9.1%
15	4D	24/15	15.00 - 17.00	7/14/22/13	36	56		571.6				Grey, wet, very dense, fine to coarse SAND, some silt, little gravel, little clay, (Till).	G#342733 A-4, SC-SM WC=9.8%
								570.1		Bottom of Exploration at 17.0 feet below ground surface. NO REFUSAL			
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-SIN-101/1D	11+77.5	11.3 LT	0.0-2.0	SAND, some gravel, little silt.	8.4			
◆	HB-SIN-101/2D	11+77.5	11.3 LT	5.0-7.0	SAND, some gravel, little silt.	23.1			
■	HB-SIN-101/3D	11+77.5	11.3 LT	10.0-12.0	SILT, some gravel, some sand, little clay.	9.1			
●	HB-SIN-101/4D	11+77.5	11.3 LT	15.5-17.0	SAND, some silt, little gravel, little clay.	9.8			
▲									
X									

WIN
023781.00
Town
Sinclair Twp
Reported by/Date
WHITE, TERRY A 6/9/2025