

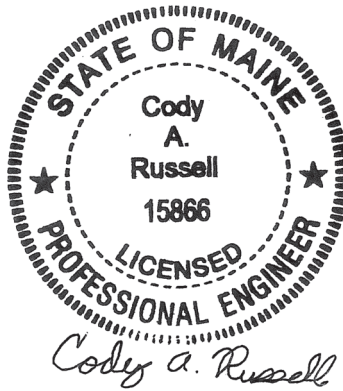
**MAINE DEPARTMENT OF TRANSPORTATION  
HIGHWAY PROGRAM  
GEOTECHNICAL SECTION  
AUGUSTA, MAINE**

**GEOTECHNICAL DESIGN REPORT**

*For the Rehabilitation of*

**LARGE CULVERT #188337  
ROUTE 202  
DIXMONT, MAINE**

*Prepared by:*  
Yueh-Ti Lee  
Assistant Geotechnical Engineer



*Reviewed by:*  
Cody Russell, P.E.  
Senior Geotechnical Engineer

Penobscot County  
WIN 26358.00

February 02, 2026

Soils Report 2026-08  
Federal Project No. 2635800

## **PROJECT DETAILS**

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical recommendations for the proposed rehabilitation of twin 60-inch diameter, approximately 72-foot long precast concrete pipe culverts (Large culvert #188337) on Route 202 in Dixmont. A subsurface investigation has been completed at the site to evaluate subsurface conditions and to develop geotechnical design and construction recommendations for the rehabilitation structure. This report presents the subsurface information obtained during the subsurface investigation and soil laboratory testing programs and provides design and construction recommendations and geotechnical design parameters for the culvert rehabilitation.

Large Culvert #188337 is located on Route 202, approximately 0.41 of a mile west of Route 143, as shown in the attached Location Map. Route 202 is a Highway Corridor Priority 3 road. The proposed rehabilitation involves replacement of the culvert end sections and slope stabilization at both the inlet and outlet. The slopes shall be reconstructed with a slope no steeper than 1.5H:1V armored with 4 feet of heavy riprap.

## **SUBSURFACE INVESTIGATION**

One (1) boring (HB-DIX-101) and one (1) probe (HB-DIX-102) were drilled for this project on October 2, 2024 by the MaineDOT drill crew using a trailer mounted drill rig. Exploration locations are shown on the attached Boring Location Plan with Boring Logs. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented on the attached Boring Logs.

Boring HB-DIX-101 was drilled using solid stem auger, cased wash boring, open hole, and roller coned drilling techniques. Soil samples were obtained in the boring 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 44 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 0.862 to the raw field N-values. Probe HB-DIX-102 was drilled using solid stem auger drilling techniques. 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. An experienced Northeast Transportation Training and Certification Program (NETTCP) certified subsurface inspector logged the subsurface conditions encountered. The boring and probes 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 four (4) standard grain size analyses with natural water content, and two (2) standard 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 in 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 generally consisted of fill consisting of sand, silty sand, and sandy silt, underlain by native silt and silty clay, underlain by glacial till consisting of sand.

Boring HB-DIX-101 was drilled to a depth of approximately 30.7 feet below ground surface (bgs) where a refusal surface was encountered. Probe HB-DIX-102 was drilled to a depth of approximately 25.5 feet bgs where a refusal surface was encountered. The exact nature of the refusal surface was not determined in the probe. Boulders were encountered in the boring and the probe.

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

Approx. Depth BGS <sup>1</sup> (feet)	Soil Description	AASHTO <sup>2</sup> Classification	USCS <sup>3</sup>	WC% <sup>4</sup>
0.0 – 0.1	HMA Pavement	--	--	--
0.1 – 15.0	Fill: Brown, dry, fine to coarse sand, some gravel, little silt.	A-1-b	SM	4.0
	Brown, damp, silty fine to coarse sand, little gravel.	A-4	SM	8.1
	Reddish brown, damp, fine to coarse sandy silt, trace gravel.	A-4	SM	11.9
15.0 – 26.8	Grey, wet, silty clay, wood. Grey, wet, silt, little fine to coarse sand, little clay, trace gravel. Boulder from 20.5 to 24.5 feet bgs.	A-4	CL	24.5 to 60.0
26.8 – 30.7	Till: Grey, wet, fine to coarse sand, some gravel, some silt. Boulder from 29.1 to 30.0 feet bgs.	A-1-b	SM	12.0

<sup>1</sup>BGS = below ground surface

<sup>2</sup>AASHTO = American Association of State Highway and Transportation Officials

<sup>3</sup>USCS = Unified Soil Classification System

<sup>4</sup>WC% = Water content in percent

Two (2) N<sub>60</sub>-values obtained in the sand and silty sand fill were 27 blows per foot (bpf) and 59 bpf, indicating that the fill is medium dense to very dense in consistency. One (1) N<sub>60</sub>-value obtained in the sandy silt fill was 19 bpf, indicating that the fill is very stiff in consistency. One (1) N<sub>60</sub>-value obtained in the native silt was 7 bpf, indicating that the silt is very stiff in consistency. One (1) N<sub>60</sub>-value obtained in the sand till was 102 bpf, indicating that the till is very dense in consistency.

The ignition loss of the native silt from sample 4D, boring HB-DIX-101 is 9.5%.

Groundwater was recorded at depth 14.0 feet bgs in boring HB-DIX-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 proposed culvert rehabilitation.

**Precast Concrete Pipe Culvert Rehabilitation** – The proposed culvert end sections 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.

**Oversteepened Slopes at Culvert Inlet and Outlet** – 1.5H:1V slopes are proposed at culvert inlet and outlet. In accordance with AASHTO LRFD Bridge Design Specifications 10<sup>th</sup> Edition 2024 (LRFD) Article 11.6.3.7 evaluation of earth slopes where geotechnical parameters are well-defined shall achieve a factor of safety of 1.3 (equivalent to a resistance factor of 0.75). Analysis of the proposed 1.5H:1V slopes using Geostudio Slope/W software determined that riprap armor was necessary for the slopes to achieve a factor of safety of 1.3 or greater. The critical slopes were analyzed assuming 4-feet of heavy riprap will armor the full height of the slope. The analysis of the proposed slopes resulted in an acceptable factor of safety of 1.307 at culvert inlet and 1.309 at culvert outlet. The stability results from this analysis are shown in the attached Slope Stability Analyses. The stability analyses were based on subsurface conditions encountered in borings drilled in the vicinity of the slopes.

The slopes shall be armored with 4 feet of riprap conforming to MaineDOT Standard Specification Section 703.28 Heavy Riprap underlain by a 1-foot layer of protective aggregate cushion conforming to MaineDOT Standard Specification 703.19 Granular Borrow Material for Underwater Backfill that is underlain by a non-woven Class 1 erosion control geotextile that meets the requirements for MaineDOT Standard Specification 722.03.

**Settlement** – No settlement issues are anticipated at the site. No changes to the existing vertical or horizontal alignment are currently planned for this project. 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 precast concrete pipe culvert shall be protected against scour with riprap conforming to MaineDOT Standard Specification Section 703.28 Heavy

Riprap. Slopes shall be no steeper than 1.5H:1V. No specific scour protection recommendations are needed other than armoring with riprap. The riprap on the slopes shall be underlain by a non-woven, Class 1 Erosion Control Geotextile meeting the requirements of MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion consisting of Granular Borrow Material for Underwater Backfill (Standard Specification Section 703.19). The toe of the riprap sections shall be keyed into the existing soils 1 foot below the streambed elevation.

**Seismic Design Considerations** – In conformance with LRFD Article 3.10.1, seismic analysis is not required for buried structures, except where they cross active faults. There are no known active faults in Maine; therefore, seismic analysis is not required.

**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 precast concrete pipe culvert will require soil excavation. Earth support systems shall be implemented if laying back slopes is not feasible. 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 for specific application to the proposed rehabilitation of an existing large culvert (#188337) under Route 202 in Dixmont, 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 with Boring Logs

Key to Soil and Rock Descriptions and Terms

Boring Logs

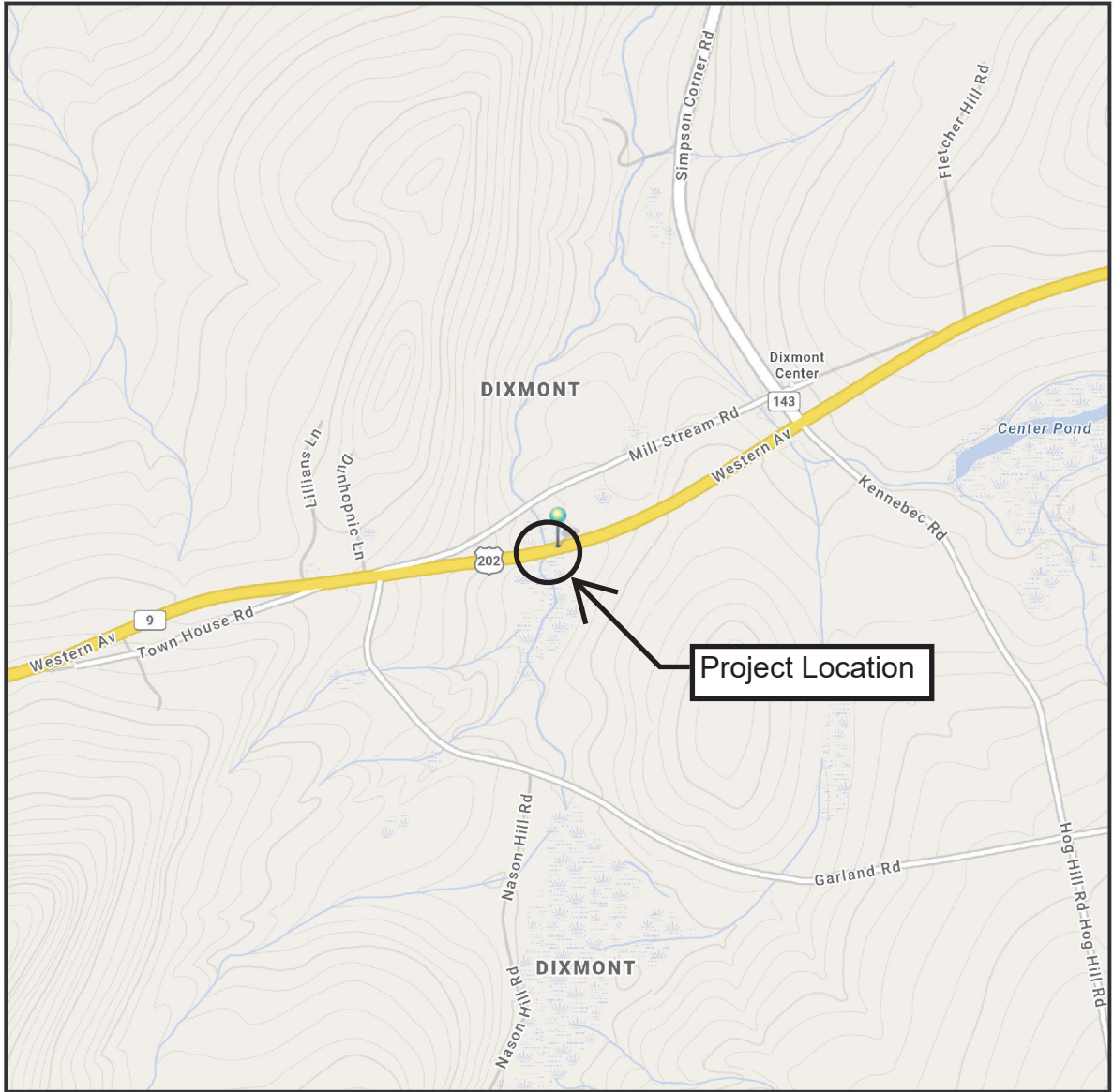
Laboratory Testing Summary Sheet

Grain Size Distribution Curve Sheet

Slope Stability Analyses



# DIXMONT, 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.

**0.25** Miles  
1 inch = 0.28 miles

Date: 1/29/2026  
Time: 11:48:51 AM

SHEET NUMBER	DIXMONT US ROUTE 202	STATE OF MAINE DEPARTMENT OF TRANSPORTATION	
		1	2635800
OF 2	LOCATION MAP	WIN	HIGHWAY PLANS
		26358.00	





<b>Maine Department of Transportation</b> Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Route 9 Large Culvert Replacement Location: Dixmont, Maine	Boring No.: HB -DIX-101 WIN: 26358.00
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Driller: MaineDOT	Elevation (ft.): 447.6	Auger ID/OD: 5" Solid Stem
Operator: Daggett/Andrle	Datum: NAVD88	Sampler: Standard Split Spoon
Logged By: C. Russell	Rig Type: CME 45C	Hammer Wt./Fall: 140#/30"
Date Start/Finish: 10/2/2024; 09:10-13:14	Drilling Method: Cased Wash Boring	Core Barrel: NQ-2"
Boring Location: 13+30.1, 12.6 ft Lt.	Casing ID/OD: NW-3"	Water Level*: 14.0 ft bgs.

Hammer Efficiency Factor: 0.862      Hammer Type: Automatic     Hydraulic     Rope & Cathead

Definitions:  
D = Split Spoon Sample      R = Rock Core Sample      S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)      T<sub>v</sub> = Pocket Torvane Shear Strength (psf)  
MD = Unsuccessful Split Spoon Sample Attempt      SSA = Solid Stem Auger      S<sub>u(lab)</sub> = Lab Vane Undrained Shear Strength (psf)      WC = Water Content, percent  
U = Thin Wall Tube Sample      HSA = Hollow Stem Auger      q<sub>p</sub> = Unconfined Compressive Strength (ksf)      LL = Liquid Limit  
MU = Unsuccessful Thin Wall Tube Sample Attempt      RC = Roller Cone      N-uncorrected = Raw Field SPT N-value      PL = Plastic Limit  
V = Field Vane Shear Test, PP = Pocket Penetrometer      WOH = Weight of 140lb. Hammer      Hammer Efficiency Factor = Rig Specific Annual Calibration Value      PI = Plasticity Index  
MV = Unsuccessful Field Vane Shear Test Attempt      WOR/C = Weight of Rods or Casing      N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency      G = Grain Size Analysis  
WO1P = Weight of One Person      N<sub>60</sub> = (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 <sub>60</sub>	Casing Blows					
0								447.5		1" HMA. ————0.1-		
	1D	24/14	1.00 - 3.00	10/10/9/10	19	27				Brown, dry, medium dense, fine to coarse SAND, some gravel, little silt, layer of HMA, (Fill).	G#379204 A-1-b, SM WC=4.0%	
5	2D	24/16	5.00 - 7.00	7/23/18/11	41	59				Brown, damp, very dense, Silty fine to coarse SAND, little gravel, (Fill).	G#379205 A-4, SM WC=8.1%	
10	3D	24/18	10.00 - 12.00	10/7/6/13	13	19	19			Reddish brown, damp, very stiff, fine to coarse Sandy SILT, trace gravel, (Fill).  Cobble in tip of spoon.	G#379206 A-4, SM WC=11.9%	
15	4D	24/14	15.00 - 17.00	3/2/3/4	5	7	OPEN HOLE	432.6		Grey, moist, medium stiff, SILT, little clay, trace fine to coarse sand, trace gravel, trace organics. ————15.0-	G#379207 A-4, CL WC=60.0% Loss on Ignition 9.5%	
20	MD R1	6/0 48/48	20.00 - 20.50 20.50 - 24.50	20	---			427.6		Spoon Refusal, grey, wet, Silty CLAY and wood in tip of spoon. R1: Boulder. R1: Core Times (min:sec) 20.5-21.5 ft (2:07) 21.5-22.5 ft(1:52) 22.5-23.5 ft (2:47) 23.5-24.5 ft (3:23) ————20.0-		
25												

**Remarks:**

<b>Maine Department of Transportation</b> Soil/Rock Exploration Log US CUSTOMARY UNITS		<b>Project:</b> Route 9 Large Culvert Replacement	<b>Boring No.:</b> HB -DIX-101
		<b>Location:</b> Dixmont, Maine	<b>WIN:</b> 26358.00
<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 447.6	<b>Auger ID/OD:</b> 5" Solid Stem	
<b>Operator:</b> Daggett/Andrle	<b>Datum:</b> NAVD88	<b>Sampler:</b> Standard Split Spoon	
<b>Logged By:</b> C. Russell	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> 140#/30"	
<b>Date Start/Finish:</b> 10/2/2024; 09:10-13:14	<b>Drilling Method:</b> Cased Wash Boring	<b>Core Barrel:</b> NQ-2"	
<b>Boring Location:</b> 13+30.1, 12.6 ft Lt.	<b>Casing ID/OD:</b> NW-3"	<b>Water Level*:</b> 14.0 ft bgs.	

**Hammer Efficiency Factor:** 0.862      **Hammer Type:** Automatic  Hydraulic  Rope & Cathead

Definitions: R = Rock Core Sample      S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)      T<sub>v</sub> = Pocket Torvane Shear Strength (psf)  
 D = Split Spoon Sample      SSA = Solid Stem Auger      S<sub>u(lab)</sub> = Lab Vane Undrained Shear Strength (psf)      W<sub>c</sub> = Water Content, percent  
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 U = Thin Wall Tube Sample      RC = Roller Cone      N-uncorrected = Raw Field SPT N-value      PL = Plastic Limit  
 MU = Unsuccessful Thin Wall Tube Sample Attempt      WOH = Weight of 140 lb. Hammer      Hammer Efficiency Factor = Rig Specific Annual Calibration Value      PI = Plasticity Index  
 V = Field Vane Shear Test, PP = Pocket Penetrometer      WOR/C = Weight of Rods or Casing      N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency      G = Grain Size Analysis  
 MV = Unsuccessful Field Vane Shear Test Attempt      WO1P = Weight of One Person      N<sub>60</sub> = (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 <sub>60</sub>	Casing Blows				
25											
	5D/A	21.6/14	26.30 - 28.10	15/36/35/50(3.6)	71	102	421.3 420.8		26.3-26.8 ft bgs) Grey, wet, SILT, little fine to coarse sand, little clay, trace gravel. 26.8-28.1 ft bgs) 5D/A (26.8-28.1 ft bgs) Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Till). Boulder from 29.1-30.0 ft bgs.	G#379208 A-4, CL WC=24.5% G#379209 A-1-b, SM WC=12.0%	
30							416.9		<b>Bottom of Exploration at 30.7 feet below ground surface.</b> Possible Boulder at 30.7 ft bgs.		
35											
40											
45											
50											

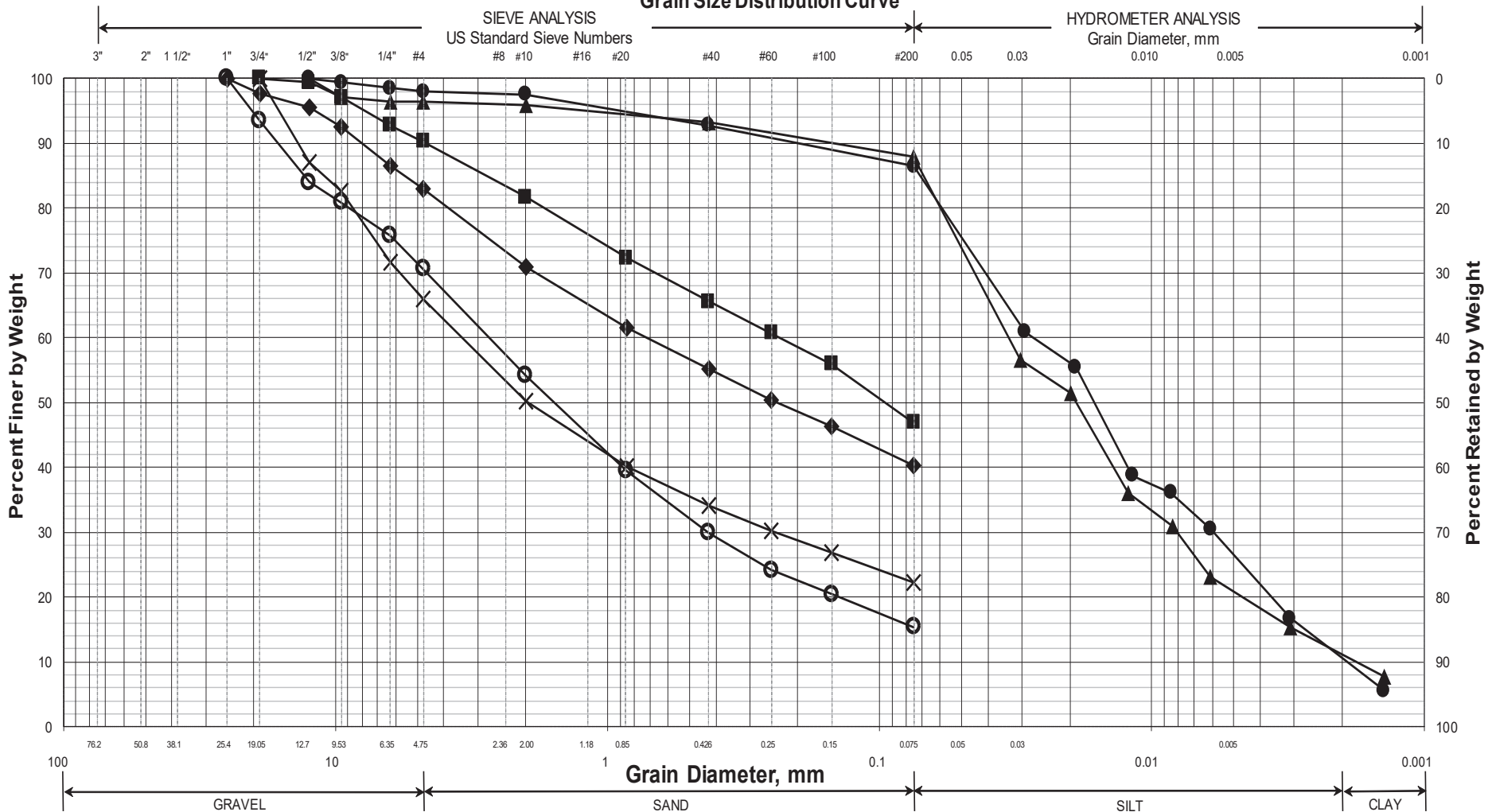
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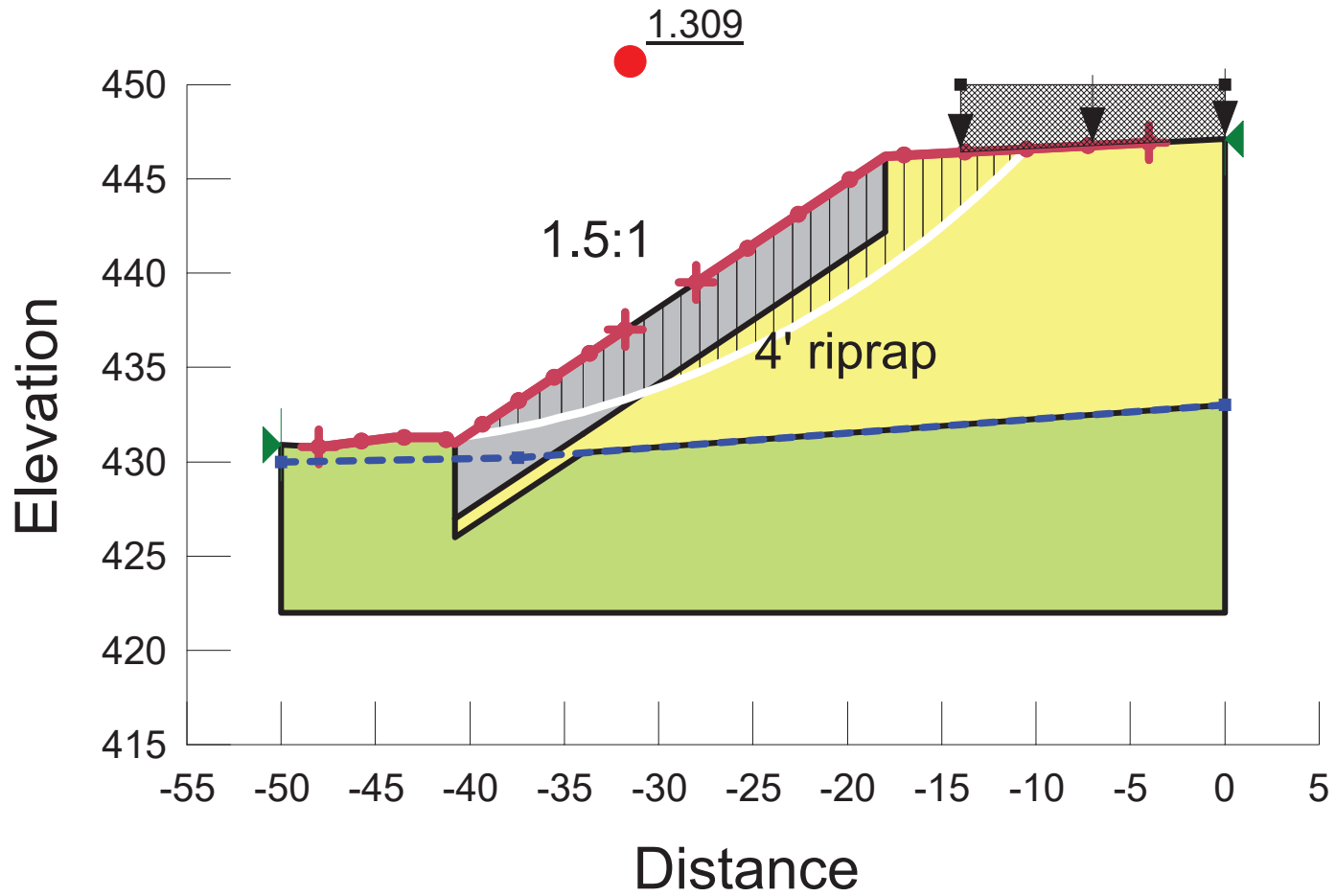
## Maine Department of Transportation Grain Size Distribution Curve






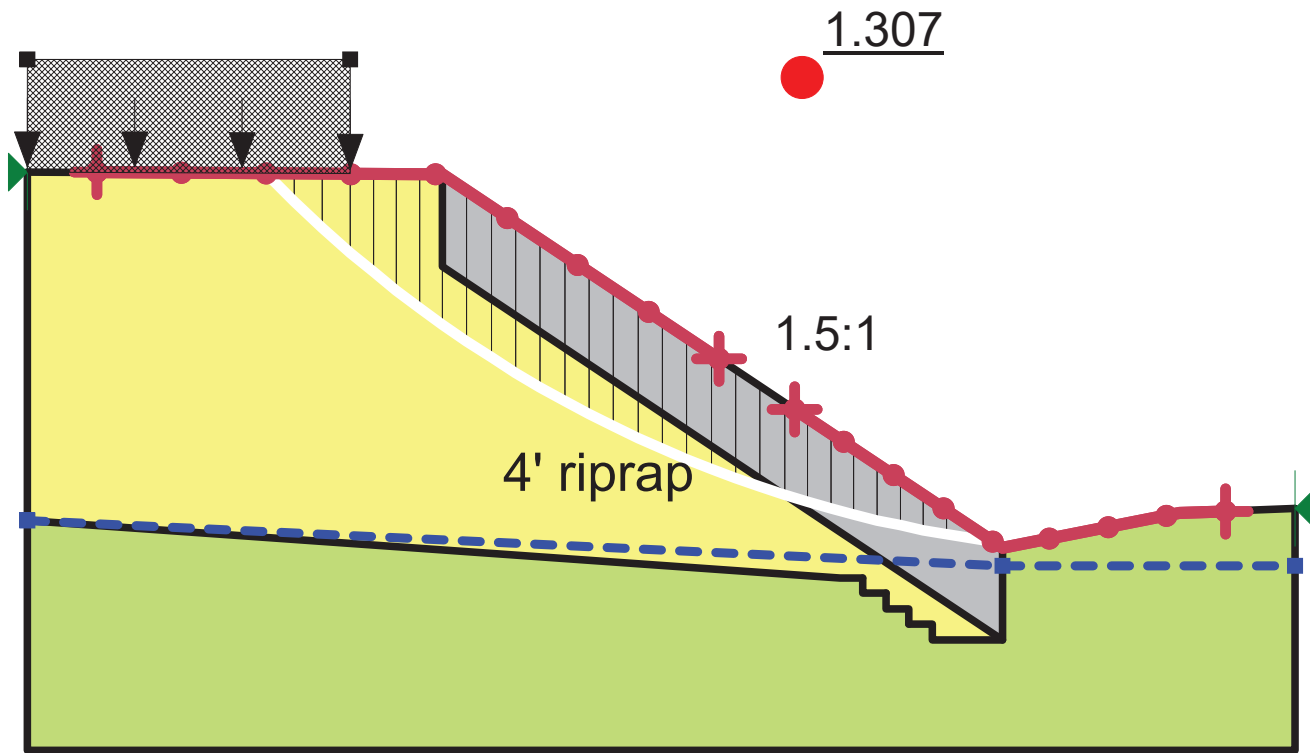
### UNIFIED CLASSIFICATION




	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-DIX-101/1D	13+30.1	12.6 LT	1.0-3.0	SAND, some gravel, little silt.	4.0			
◆	HB-DIX-101/2D	13+30.1	12.6 LT	5.0-7.0	Silty SAND, little gravel.	8.1			
■	HB-DIX-101/3D	13+30.1	12.6 LT	10.0-12.0	Sandy SILT, trace gravel.	11.9			
●	HB-DIX-101/4D	13+30.1	12.6 LT	15.0-17.0	SILT, little clay, trace sand, trace gravel.	60.0			
▲	HB-DIX-101/5D	13+30.1	12.6 LT	26.3-26.8	SILT, little sand, little clay, trace gravel.	24.5			
X	HB-DIX-101/5D(A)	13+30.1	12.6 LT	26.8-28.1	SAND, some gravel, some silt.	12.0			

WIN
026358.00
Town
Dixmont
Reported by/Date
WHITE, TERRY A      1/29/2026



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Fill	Mohr-Coulomb	125	0	34
	Riprap	Mohr-Coulomb	145	0	42
	Silt	Mohr-Coulomb	115	1,000	0



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Fill	Mohr-Coulomb	125	0	34
	Riprap	Mohr-Coulomb	145	0	45
	Silt	Mohr-Coulomb	115	1,000	0