

MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL GROUP
AUGUSTA, MAINE

**SUBSURFACE INVESTIGATION FOR
RECONSTRUCTION OF ROUTE 302
FOREST AVENUE, PORTLAND**

Prepared by:

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Reviewed by:

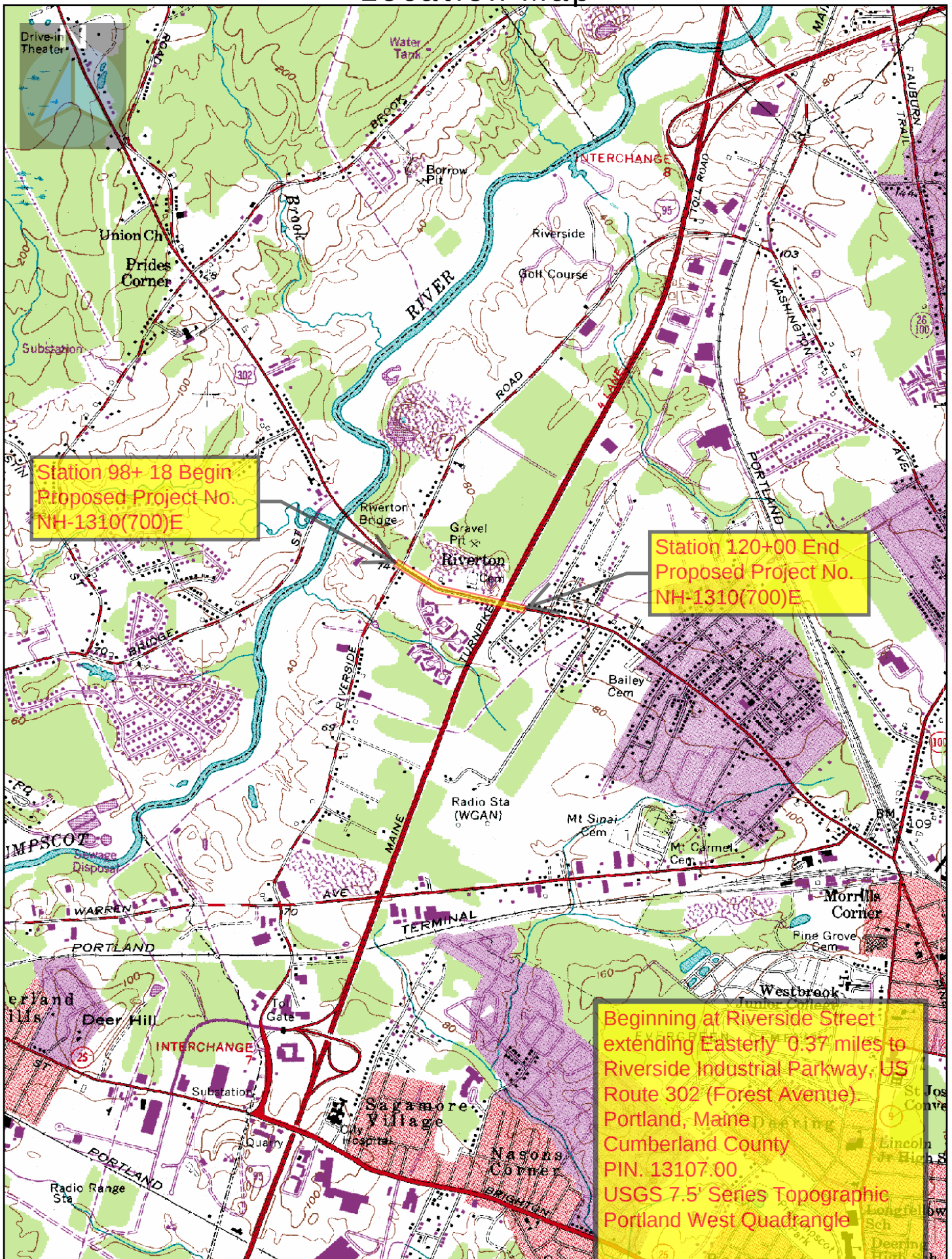
Karen Gross
Geotechnical Design Engineer

Cumberland County
PIN 13107.00

Soils Report No. 2011-04

Federal NH-1310(700)E
March 1, 2011

Location Map



Map Scale 1:24000

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1.0 Introduction

1.1 Project Overview

Maine DOT proposes to rebuild a portion of US Route 302 (Forest Avenue) in Portland. This section of roadway extends from the intersection of Riverside Street easterly for 0.41 miles to Castine Avenue. Only minimal changes to the horizontal alignment will be made, but the vertical alignment will be dropped to increase the available height under the I-95 bridges.

This report describes existing conditions for this project.

1.2 Summary of Recommendations

- Full depth reconstruction is recommended at the beginning and end of the project, but partial depth construction will be appropriate for the section from Station 104+00 to 114+00 where existing subbase and subgrade soils meet MDOT Standard Specification 703.06, Aggregate for Base and Subbase.
- A low gravity retaining wall will be constructed from approximately Station 105+00 to 106+60 to support a lawn area in front of a business set back from the roadway. A “Cobblestone” face pattern should be required for an appropriate appearance in this mixed residential-commercial area.
- Shallow groundwater in the area around the Maine Turnpike overpass may require construction of underdrains in saturated clay-silt soils.

2.0 Site and Subsurface Conditions

2.1 General Site Conditions

This portion of Route 302 (Forest Ave) serves an area of residential and commercial development. The area is fully developed. A large supermarket is built on land behind abutting properties with an entrance on this project. The road passes under bridges supporting I-95, and in this area the roadway surface will be lowered by 1.6 feet. The existing drainage system is inadequate and has no good outlet. As-built plans do not exist for this highway and no records were found from the original construction.

2.2 Mapped Data

The Maine Geologic Survey Surficial Geology map for the Portland West Quadrangle shows two soil types along this project. From the beginning of the project to the Turnpike overpass the map indicates Marine fan deposits of sand and gravel. The soils for the eastern area of the project are shown as Presumpscot formation clay-silt.

NRCS maps include information on soils for the five feet below the surface; deeper soils are not discussed. NRCS mapping for this area shows Windsor loamy sand from Riverside Street to approximately Station 112+00, Belgrade very fine sands in the area of the overpass, and Scantic silt-loam at the end of the project. These eastern soils are poorly graded silty sands, silts and clay-silts, but the soils for the western part of the project should be well-drained sandy materials. The area currently occupied by Hannaford supermarket is shown as a gravel pit on the old photograph in the soils survey.

The National Wetland Inventory map of the area does not show areas of wetlands within the project limits. Portions of the Surficial Geology and NRCS maps are included in Appendix A.

2.3 Subsurface Investigation

The subsurface investigation for this project was conducted in March, 2010. A total of 23 borings were done and four pavement cores were taken. Borings were extended to depths of between five and twenty feet. No FWD analysis was done due to the expected disturbance of subsurface soils from utility projects during the life of the project. Table 1 gives a summary of boring data.

2.4 Native Soils

According to geologic mapping by Maine Geologic Survey and NRCS, native soils in this area are predominantly sand, silty sand, and clay-silt. Our borings indicated different limits of these soils than were shown on the soils maps, but in general the maps were correct. The boring log data is attached in Appendix C. The native soils are described below.

Station 99+00 to Station 103+50: Clay-silt soils were found from the beginning of the project to approximately Station 103+50. The soils below the pavement structure but near the surface were stiff, with very wet clay-silt at a depth of 7.5 feet at Station 103+32.

Station 104+00 to Station 115+00: Soils in this area were generally described as medium dense SAND with small amounts of gravel and silt. Most of these soil samples meet the requirements of MaineDOT Standard Specification 703.06 Type E, Subbase Gravel.

Station 116+00 to Station 120+00: Soils in this area were generally described as SILT, some sand, or SAND some silt, and had higher silt contents than soils in the middle of the project. These soils were also loose and wet.

2.5 Subsurface Bedrock

No bedrock was encountered in our borings and no bedrock outcrops are shown on the plans.

2.6 Existing Pavement

The existing Hot Mix Asphalt is in fair to poor condition. A pavement core taken at Station 101+50 contains 9 inches of hot mix asphalt, with 6 inches of what appears to be 19 mm mix and a surface course with smaller stones. This section of pavement appears to have been built as part of an earlier project that included widening the intersection with Riverside Street. Cores at Stations 103+80 and 117+50 include a macadam course at the bottom covered by approximately 4 inches of HMA in layers. Borings from Station 102+00 to 114+75 show the gravel to be substantially thicker than would have been required when this road was built. It appears that pavement was placed directly on the native soils in this area. There is little difference between the gravel and subgrade in many tests, and a gravel pit very close in the area of the present Hannaford facility was the probable source of soils other than the native soils.

2.7 Groundwater

Shallow groundwater or wet soils appear in borings from Station 111+25 to the end of the project. Ground water was encountered at elevations between 69 to 75 feet between Station 111+25 to 116+60, and wet soils were mentioned in visual descriptions to the end of the project. We do not have data to establish whether the groundwater drops during the summer and fall, however the spring had been unusually dry when borings were done.

3.0 Design Recommendations

3.1 Pavement Design

Full depth reconstruction is recommended for the ends of this project where the subgrade soils are clay silt or silty sands. From Station 104 +00 to Station 114+00, the native soils generally meet the requirements of MaineDOT Standard Specification 703.06, Subbase Gravel type E; partial depth reconstruction is recommended. A Resilient Modulus of 5500 psi should be used to determine the pavement section for this project.

3.2 Retaining Wall

A low retaining wall will be needed in the area from Station 105+00 to 107+00, Left, to allow the construction of a sidewalk. This wall will support the grassed lawn between a restaurant and the sidewalk, but no structural loads will be required in design of the wall. Soils in this area were consistently medium dense to dense sand with little to some gravel and trace silt. A Precast Concrete Block Gravity Wall should be built according to the Special Provision. A value of 34° should be used for ϕ in the wall design; this is conservative for these soils. A factored bearing resistance of 4.5 ksf should be used in design, and a minimum embedment of one foot will be adequate. A "cobblestone" face pattern should be used to match the scale of structures in this mixed residential-commercial area.

3.3 Surface Water Drainage

Surface water drainage is presently inadequate, and a new surface water drainage system is needed to protect the pavement structure.

3.4 Groundwater

Shallow groundwater may cause problems during construction in the area of the turnpike, where the profile is to be lowered. Underdrain construction should be anticipated to be in wet soils, but groundwater should be below the new subgrade elevation. The underdrain system should be designed to be low enough to keep groundwater out of the pavement structure.

3.5 Frost Action

Frost depth below a roadway depends on grain size of the subgrade soils and the thickness of the pavement section. The design depth of frost in Hampden for a 24 inch total pavement section is as follows:

Granular subgrade	84 inches
Silt or Clay-Silt subgrade	48 inches

Any lenses of water trapped above these depths will freeze and potentially distort the pavement section. A gradual 20:1 transition zone may be needed between granular and fine subgrade areas to minimize damage that differential frost heaves would cause to the HMA in these areas. The areas of partial depth construction for this project appear to be within the area of granular subgrade soils, and transitions zones are not anticipated. If fine soils are encountered in areas of partial depth construction, full depth construction may need to be extended or a transition zone constructed.

Appendix A
Resource Maps
Surficial Geology
NRCS Soils Map

Portland West Quadrangle, Maine

Surficial geologic mapping by
Woodrow B. Thompson

Cartographic design and editing by:
Robert D. Tucker

Robert G. Marvinney
State Geologist

Digital cartography by:
Robert A. Johnston

Funding for the preparation of this map was provided in part by the U.S. Geological Survey
Cooperative Geologic Mapping (COGEMAP) Program, Cooperative Agreement No. 14-08-0001-A0520.



Maine Geological Survey

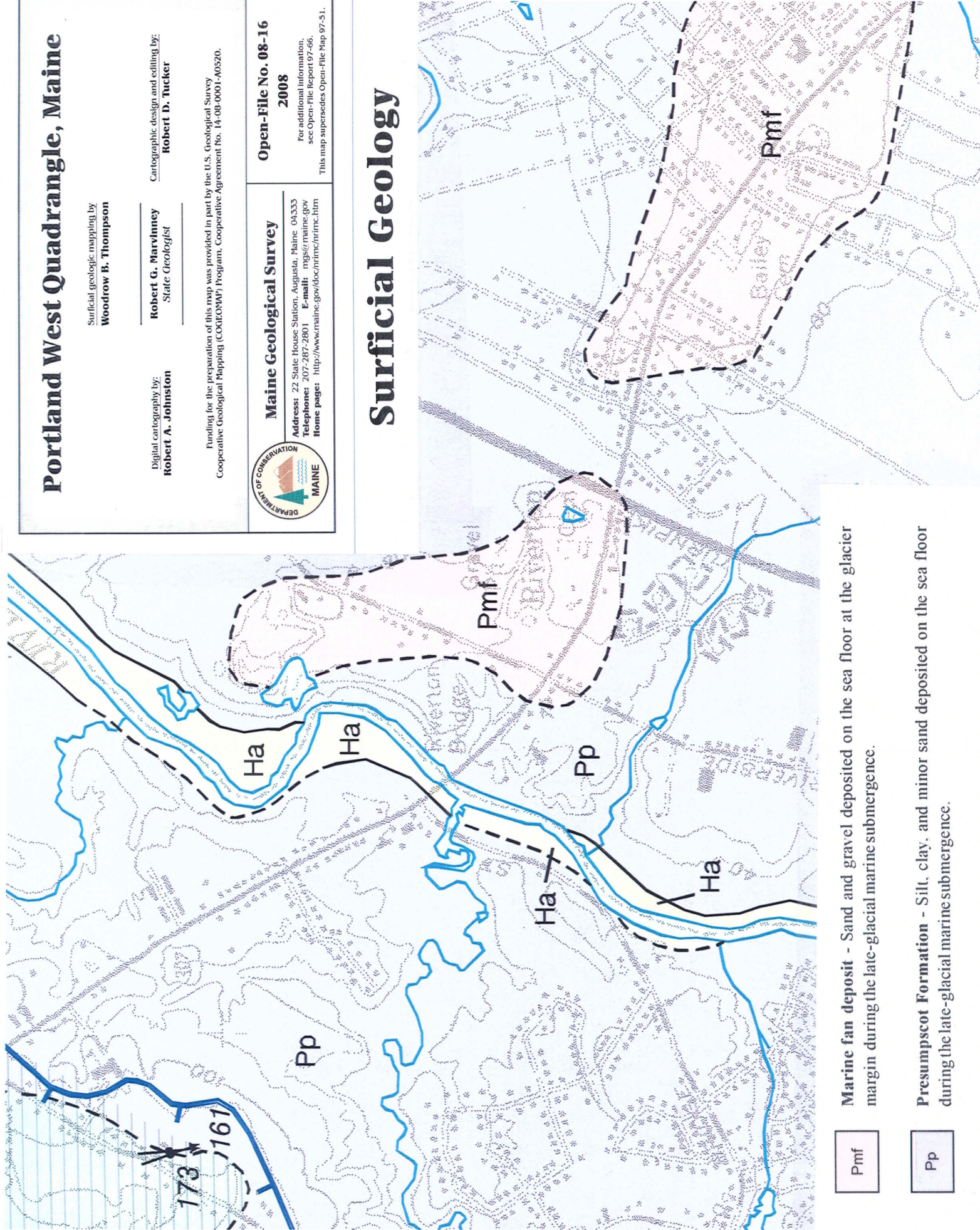
Address: 22 State House Station, Augusta, Maine 04333
Telephone: 207-287-2801 E-mail: mgs@maine.gov
Home page: <http://www.maine.gov/doc/nimc/nimc.htm>

Open-File No. 08-16

2008

For additional information,
see Open-File Report 97-66.
This map supersedes Open-File Map 97-51.

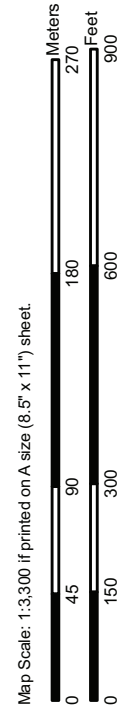
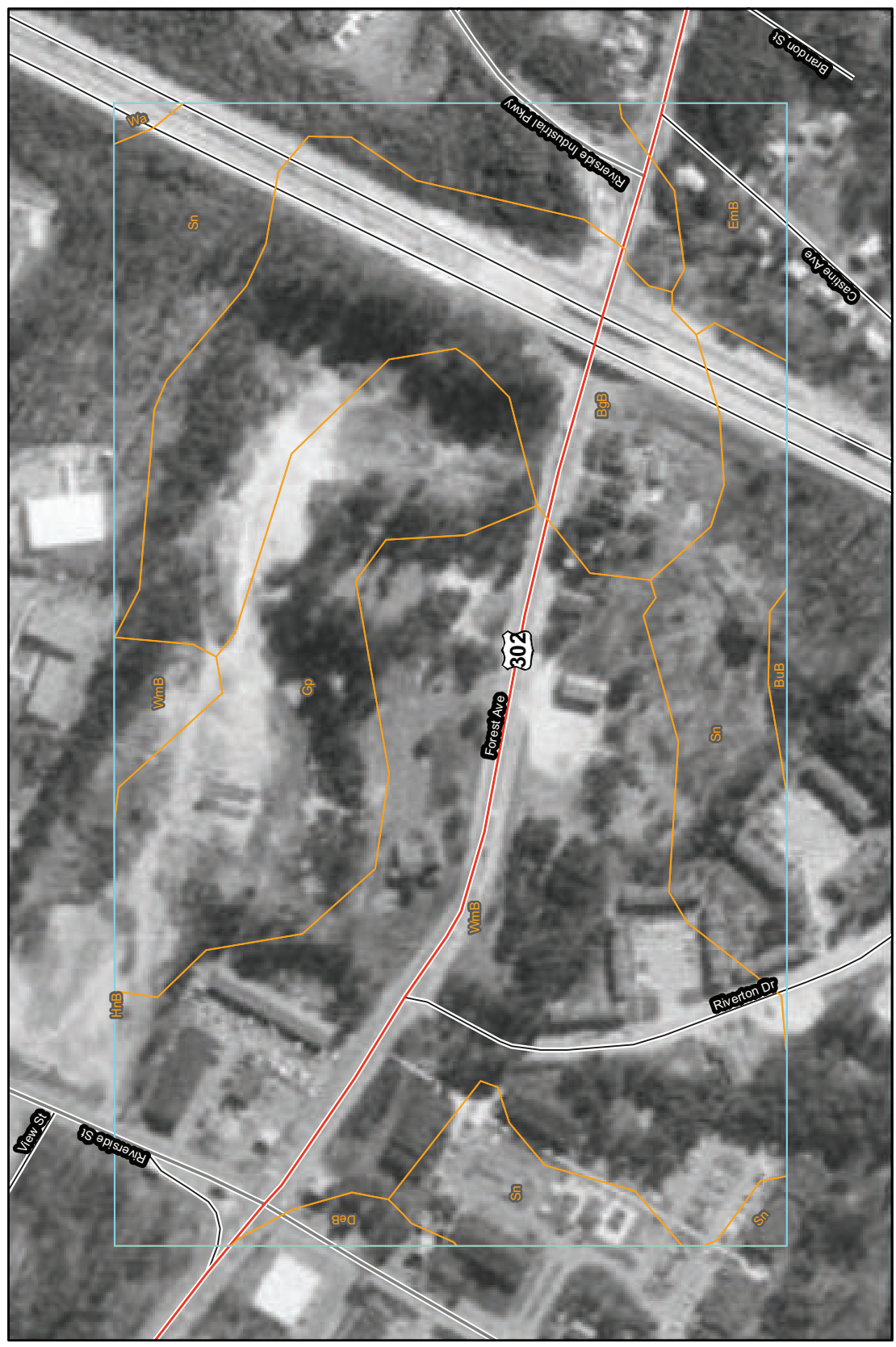
Surficial Geology



Pmf Marine fan deposit - Sand and gravel deposited on the sea floor at the glacier margin during the late-glacial marine submergence.

Pp Presumpscot Formation - Silt, clay, and minor sand deposited on the sea floor during the late-glacial marine submergence.

43° 42' 8" 70° 18' 50" 43° 41' 53" 70° 18' 49"



MAP LEGEND

Area of Interest (AOI)			Area of Interest (AOI)
Soils			Soil Map Units
Special Point Features			Blowout
			Borrow Pit
			Clay Spot
			Closed Depression
			Gravel Pit
			Gravelly Spot
			Landfill
			Lava Flow
			Marsh or swamp
			Mine or Quarry
			Miscellaneous Water
			Perennial Water
			Rock Outcrop
			Saline Spot
			Sandy Spot
			Severely Eroded Spot
			Sinkhole
			Slide or Slip
			Sodic Spot
			Spoil Area
			Stony Spot
Special Line Features			Gully
			Short Steep Slope
			Other
Political Features			Cities
Water Features			Oceans
			Streams and Canals
Transportation			Rails
			Interstate Highways
			US Routes
			Major Roads
			Local Roads
			Very Stony Spot
			Wet Spot
			Other

MAP INFORMATION

Map Scale: 1:3,300 if printed on A size (8.5" x 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000. Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cumberland County and Part of Oxford County, Maine
Survey Area Data: Version 7, Jan 8, 2009
Date(s) aerial images were photographed: 6/7/1997

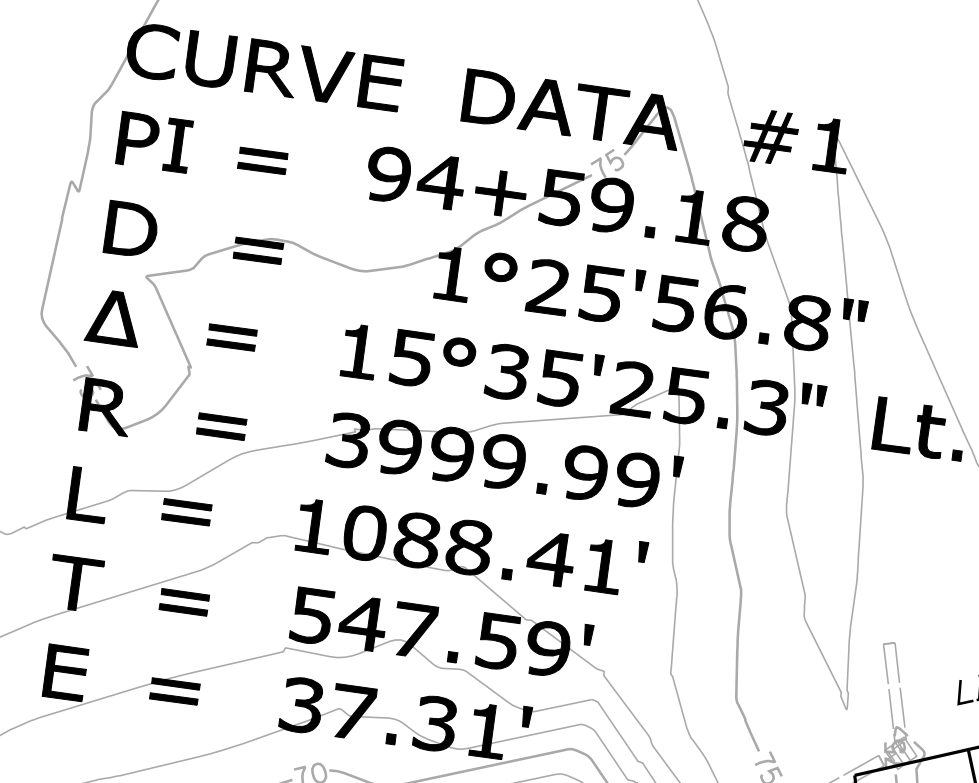
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

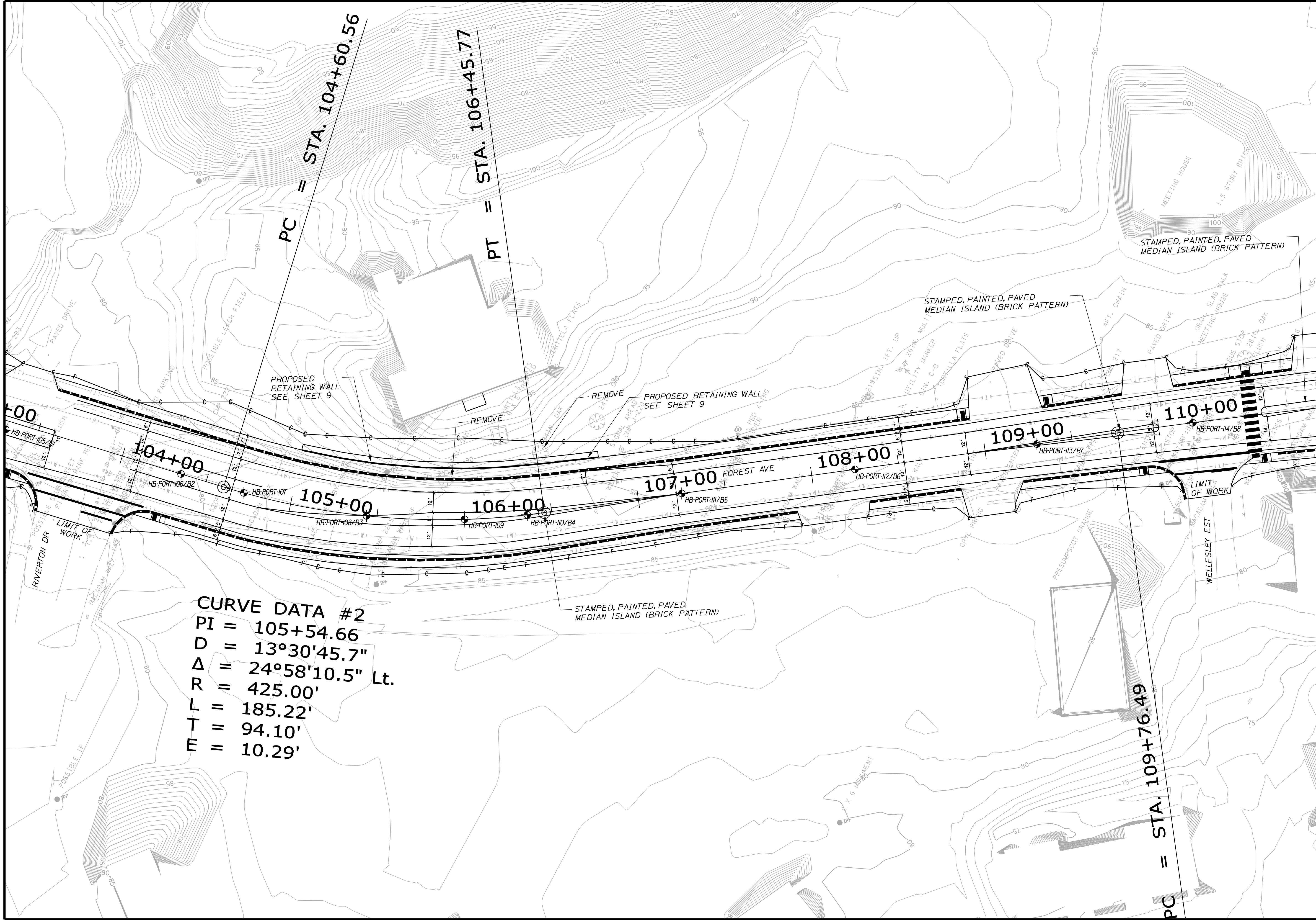
Cumberland County and Part of Oxford County, Maine (ME005)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BgB	Belgrade very fine sandy loam, 0 to 8 percent slopes	10.1	19.5%
BuB	Buxton silt loam, 3 to 8 percent slopes	0.2	0.3%
DeB	Deerfield loamy sand, 3 to 8 percent slopes	0.5	0.9%
EmB	Elmwood fine sandy loam, 0 to 8 percent slopes	1.9	3.7%
Gp	Gravel pits	7.9	15.3%
HnB	Hinckley-Suffield complex, 3 to 8 percent slopes	0.0	0.0%
Sn	Scantic silt loam	11.2	21.7%
Wa	Walpole fine sandy loam	0.1	0.2%
WmB	Windsor loamy sand, 0 to 8 percent slopes	19.8	38.3%
Totals for Area of Interest		51.7	100.0%

Appendix B

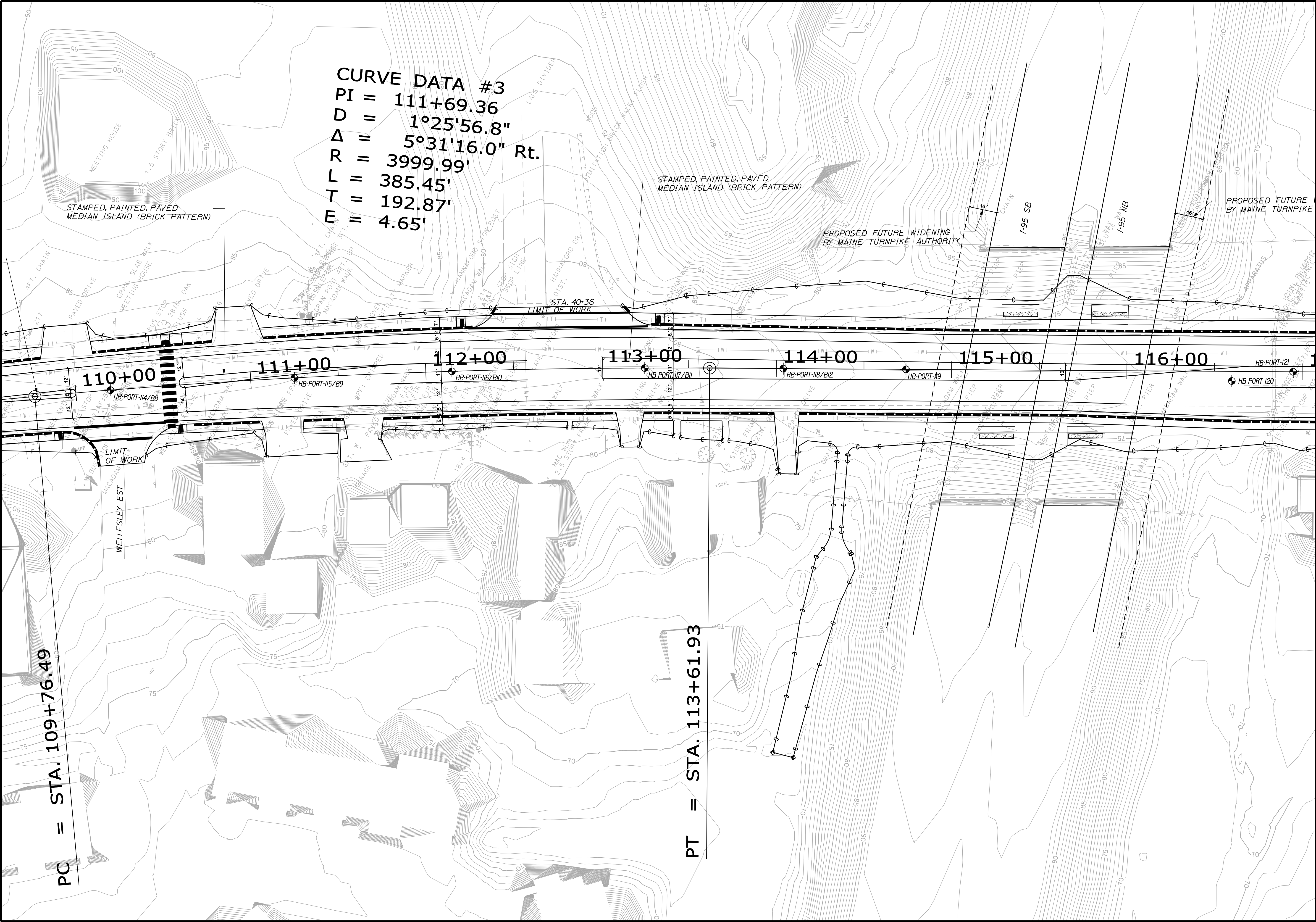
Geoplans



SHEET NUMBER 1 OF 4	PORTLAND FOREST AVENUE GEOPLANS	PROJ. MANAGER	BY	DATE
		DESIGN-DETAILED	K.BRESKIN	FEB. 2011
		CHECKED-REVISED		
		DESIGN2-DETAILED2		SIGNATURE
		DESIGN3-DETAILED3		P.E. NUMBER
		REVISIONS 1		
		REVISIONS 2		
		REVISIONS 3		
		REVISIONS 4		DATE
		FIELD CHANGES		
STATE OF MAINE DEPARTMENT OF TRANSPORTATION NH-1310(700)E PIN 13107.00 HIGHWAY PLANS				



SHEET NUMBER 2	PORTLAND FOREST AVENUE		PROJ. MANAGER	BY	DATE	STATE OF MAINE DEPARTMENT OF TRANSPORTATION NH-1310(700)E
			DESIGN-DETAILED	K.BRESKIN	FEB. 2011	
			CHECKED-REVISED			
			DESIGN2-DETAILED2		SIGNATURE	
			DESIGN3-DETAILED3		P.E. NUMBER	
			REVISIONS 1			
OF 4	GEOPLANS		REVISIONS 2			PIN 13107.00 HIGHWAY PLANS
			REVISIONS 3			
			REVISIONS 4		DATE	
			FIELD CHANGES			



STATE OF MAINE

DEPARTMENT OF TRANSPORTATION

NH-1310(700)E

PIN 13107.00

HIGHWAY PLANS

PORTLAND
FOREST AVENUE

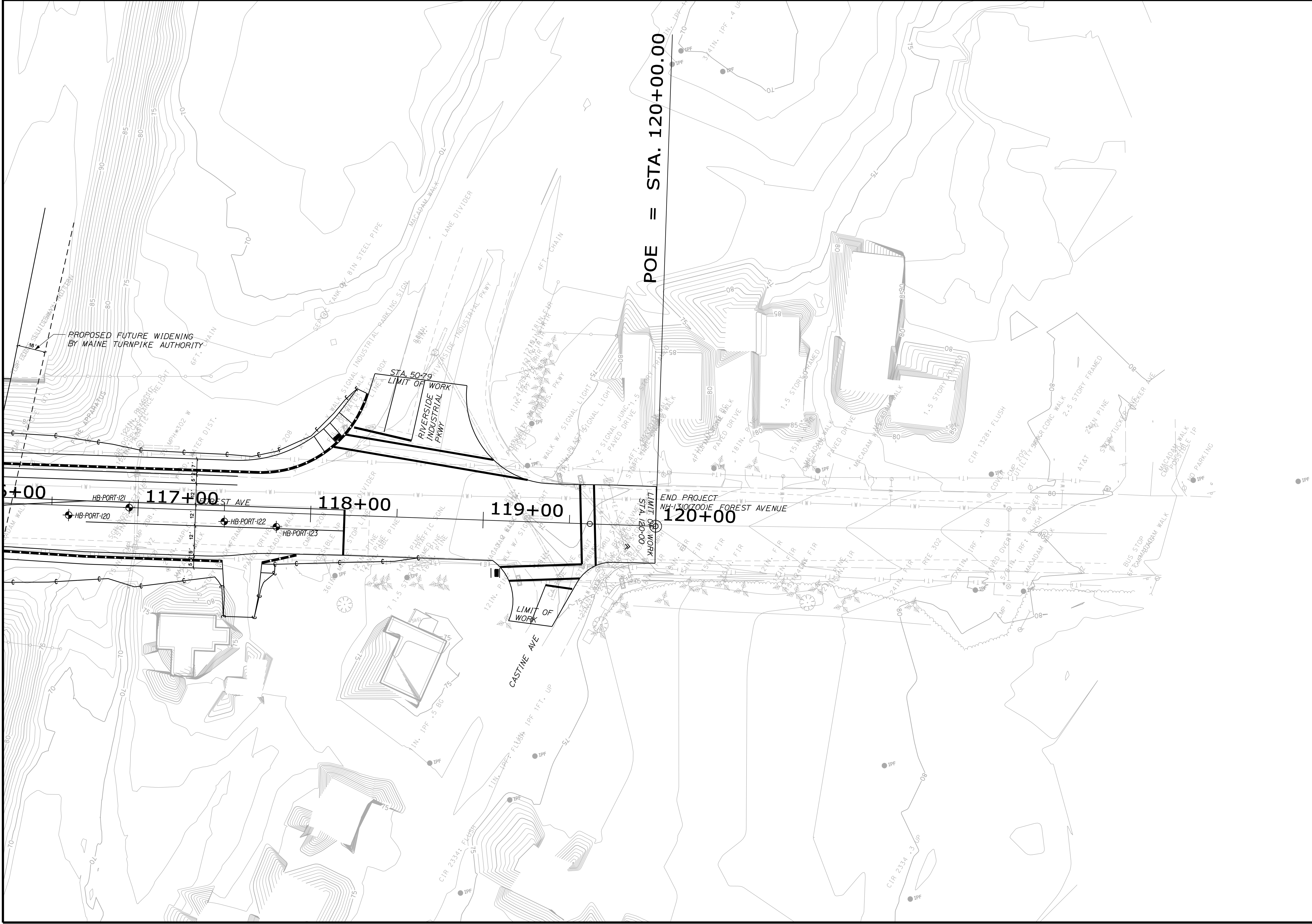
GEOPLANS

SHEET NUMBER

3

OF 4

PROJ. MANAGER	BY	DATE	SIGNATURE
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CHECKED-REVIEWED			
DESIGNS-DETAILED			
REVISIONS 1			P.E. NUMBER
REVISIONS 2			
REVISIONS 3			DATE
REVISIONS 4			
FIELD CHANGES			

[illegible]

Appendix C
Field Exploration Data
Soils Descriptions\ Key
Boring Logs
Pavement Core Photos

UNIFIED SOIL CLASSIFICATION SYSTEM					TERMS DESCRIBING DENSITY/CONSISTENCY																														
MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES																															
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	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. Consistency is rated according to standard penetration resistance. Modified Burmister System <table><tr><th><u>Descriptive Term</u></th><th><u>Portion of Total</u></th></tr><tr><td>trace</td><td>0% - 10%</td></tr><tr><td>little</td><td>11% - 20%</td></tr><tr><td>some</td><td>21% - 35%</td></tr><tr><td>adjective (e.g. sandy, clayey)</td><td>36% - 50%</td></tr></table> <table><tr><th><u>Density of Cohesionless Soils</u></th><th><u>Standard Penetration Resistance N-Value (blows per foot)</u></th></tr><tr><td>Very loose</td><td>0 - 4</td></tr><tr><td>Loose</td><td>5 - 10</td></tr><tr><td>Medium Dense</td><td>11 - 30</td></tr><tr><td>Dense</td><td>31 - 50</td></tr><tr><td>Very Dense</td><td>> 50</td></tr></table>				<u>Descriptive Term</u>	<u>Portion of Total</u>	trace	0% - 10%	little	11% - 20%	some	21% - 35%	adjective (e.g. sandy, clayey)	36% - 50%	<u>Density of Cohesionless Soils</u>	<u>Standard Penetration Resistance N-Value (blows per foot)</u>	Very loose	0 - 4	Loose	5 - 10	Medium Dense	11 - 30	Dense	31 - 50	Very Dense	> 50					
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(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	SW	Well-graded sands, gravelly sands, little or no fines																																
	(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.	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 shear strength as indicated. <table><tr><th><u>Consistency of Cohesive soils</u></th><th><u>SPT N-Value blows per foot</u></th><th><u>Approximate Undrained Shear Strength (psf)</u></th><th><u>Field Guidelines</u></th></tr><tr><td>Very Soft</td><td>WOH, WOR, WOP, <2</td><td>0 - 250</td><td>Fist easily Penetrates</td></tr><tr><td>Soft</td><td>2 - 4</td><td>250 - 500</td><td>Thumb easily penetrates</td></tr><tr><td>Medium Stiff</td><td>5 - 8</td><td>500 - 1000</td><td>Thumb penetrates with moderate effort</td></tr><tr><td>Stiff</td><td>9 - 15</td><td>1000 - 2000</td><td>Indented by thumb with great effort</td></tr><tr><td>Very Stiff</td><td>16 - 30</td><td>2000 - 4000</td><td>Indented by thumbnail</td></tr><tr><td>Hard</td><td>>30</td><td>over 4000</td><td>Indented by thumbnail with difficulty</td></tr></table>				<u>Consistency of Cohesive soils</u>	<u>SPT N-Value blows per foot</u>	<u>Approximate Undrained Shear Strength (psf)</u>	<u>Field Guidelines</u>	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
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Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail																																
Hard	>30	over 4000	Indented by thumbnail with difficulty																																
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) Color (Munsell color chart) Moisture (dry, damp, moist, wet, saturated) Density/Consistency (from above right hand side) 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., if applicable) Cementation (weak, moderate, or strong, if applicable, ASTM D 2488) Geologic Origin (till, marine clay, alluvium, etc.) Unified Soil Classification Designation Groundwater level					Rock Quality Designation (RQD): RQD = $\frac{\text{sum of the lengths of intact pieces of core}^* > 100 \text{ mm}}{\text{length of core advance}}$ *Minimum NQ rock core (1.88 in. OD of core) Correlation of RQD to Rock Mass Quality <table><tr><th><u>Rock Mass Quality</u></th><th><u>RQD</u></th></tr><tr><td>Very Poor</td><td><25%</td></tr><tr><td>Poor</td><td>26% - 50%</td></tr><tr><td>Fair</td><td>51% - 75%</td></tr><tr><td>Good</td><td>76% - 90%</td></tr><tr><td>Excellent</td><td>91% - 100%</td></tr></table> Desired Rock Observations: (in this order) Color (Munsell color chart) Texture (aphanitic, fine-grained, etc.) Lithology (igneous, sedimentary, metamorphic, 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, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90) -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m) -tightness (tight, open or healed) -infilling (grain size, color, etc.) Formation (Waterville, Ellsworth, Cape Elizabeth, etc.) RQD and correlation to rock mass quality (very poor, poor, etc.) ref: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A Recovery				<u>Rock Mass Quality</u>	<u>RQD</u>	Very Poor	<25%	Poor	26% - 50%	Fair	51% - 75%	Good	76% - 90%	Excellent	91% - 100%															
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Good	76% - 90%																																		
Excellent	91% - 100%																																		
Maine Department of Transportation Geotechnical Section Key to Soil and Rock Descriptions and Terms Field Identification Information					Sample Container Labeling Requirements: <table><tr><td>PIN</td><td>Blow Counts</td></tr><tr><td>Bridge Name / Town</td><td>Sample Recovery</td></tr><tr><td>Boring Number</td><td>Date</td></tr><tr><td>Sample Number</td><td>Personnel Initials</td></tr><tr><td>Sample Depth</td><td></td></tr></table>				PIN	Blow Counts	Bridge Name / Town	Sample Recovery	Boring Number	Date	Sample Number	Personnel Initials	Sample Depth																		
PIN	Blow Counts																																		
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Boring Number	Date																																		
Sample Number	Personnel Initials																																		
Sample Depth																																			

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-101 PIN: 13107.00																																																																																																																																																																																																			
Driller: MaineDOT			Elevation (ft.) 75.1		Auger ID/OD: 5" Dia.																																																																																																																																																																																																				
Operator: Gigurere/Giles			Datum: NAVD88		Sampler: Standard Split Spoon																																																																																																																																																																																																				
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-102 PIN: 13107.00																																																																																																																																																																																																																																																																																																																										
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Boring No.: HB-PORT-102

Maine Department of Transportation						Project: Forest Ave. Route 302							Boring No.: HB-PORT-103																																																																																																																																																																																																																																																																																																																																																																																
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This layer contains two split spoon samples labeled 1D and 2D. - Below ~11.5 feet: Olive, damp, very stiff, SILT, some clay, trace fine sand. 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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine				Boring No.: HB-PORT-106/B2 PIN: 13107.00																																																																																																																																																																																																																																																																																																																																																																																																													
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Maine Department of Transportation <u>Soil/Rock Exploration Log</u> US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine				Boring No.: HB-PORT-107 PIN: 13107.00									
Driller: MaineDOT				Elevation (ft.) 80.6				Auger ID/OD: 5" Dia.									
Operator: Gigurere/Giles				Datum: NAVD88				Sampler: Standard Split Spoon									
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 130#/30"									
Date Start/Finish: 3/2/10-3/2/10				Drilling Method: Solid Stem Auger				Core Barrel: N/A									
Boring Location: 104+72, CL				Casing ID/OD: N/A				Water Level*: None Observed									
Hammer Efficiency Factor: 0.84				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 = Insitu Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf) T _v = Pocket Torvane Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw field SPT N-value Hammer Efficiency Factor = Annual Calibration Value N ₆₀ = SPT N-uncorrected corrected for hammer efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected									
								S _{u(lab)} = Lab Vane Shear Strength (psf) WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									
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0							SSA	80.10			PAVEMENT. Light brown, damp, medium dense, fine to coarse SAND, trace gravel, trace silt. Similar to above. Similar to above, except moist. Bottom of Exploration at 12.00 feet below ground surface. NO REFUSAL		G#238193 A-1-b, SW-SM WC=2.7%				
	1D	24/20	1.00 - 3.00	12/9/8/7	17	24											
5	2D	24/19	5.00 - 7.00	9/8/7/7	15	21											
10	3D	24/18	10.00 - 12.00	3/10/11/12	21	29											
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Page 1 of 1												Boring No.: HB-PORT-107					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-108/B3 PIN: 13107.00																																																																																																																																																																																																																																																							
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Forest Ave. Route 302 Location: Portland, Maine				Boring No.: HB-PORT-111/B5 PIN: 13107.00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-112/B6 PIN: 13107.00																																																																																																																																																							
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Forest Ave. Route 302 Location: Portland, Maine				Boring No.: HB-PORT-115/B9 PIN: 13107.00																																																																																					
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Maine Department of Transportation						Project: Forest Ave. Route 302				Boring No.: HB-PORT-116B10																																																																																																																																																																																																																																																															
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Maine Department of Transportation						Project: Forest Ave. Route 302				Boring No.: HB-PORT-117B11																																																																																																																																																																																																			
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Forest Ave. Route 302				Boring No.: HB-PORT-119			
						Location: Portland, Maine				PIN: 13107.00			
Driller: MaineDOT						Elevation (ft.) 77.1				Auger ID/OD: 5" Dia.			
Operator: Gigurere/Giles						Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: B. Wilder						Rig Type: CME 45C				Hammer Wt./Fall: 130#/30"			
Date Start/Finish: 3/5/10-3/5/10						Drilling Method: Solid Stem Auger				Core Barrel: N/A			
Boring Location: 114+74, CL						Casing ID/OD: N/A				Water Level*: 7.0' bgs.			
Hammer Efficiency Factor: 0.84						Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
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Page 1 of 1													
Boring No.: HB-PORT-119													

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-120 PIN: 13107.00																																																																																																																																																																																																																																																																																																						
Driller: MaineDOT			Elevation (ft.) 73.5		Auger ID/OD: 5" Dia.																																																																																																																																																																																																																																																																																																							
Operator: Gigurere/Giles			Datum: NAVD88		Sampler: Standard Split Spon																																																																																																																																																																																																																																																																																																							
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: 130#/30"																																																																																																																																																																																																																																																																																																							
Date Start/Finish: 3/2/10-3/2/10			Drilling Method: Solid Stem Auger		Core Barrel: N/A																																																																																																																																																																																																																																																																																																							
Boring Location: 116+60, 55 Rt.			Casing ID/OD: N/A		Water Level*: 4.1' bgs.																																																																																																																																																																																																																																																																																																							
Hammer Efficiency Factor: 0.84			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 = Insitu Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw field SPT N-value Hammer Efficiency Factor = Annual Calibration Value N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected S_{u(lab)} = Lab Vane Shear Strength (psf) WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																																																																																																																																																												
<table><tr><th rowspan="2">Depth (ft.)</th><th colspan="8">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/ AASHTO and Unified Class.</th></tr><tr><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N₆₀</th><th>Casing Blows</th></tr><tr><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>73.20</td><td rowspan="2"></td><td>TOPSOIL, Sod.</td><td rowspan="2">G#238187 A-2-4, SM WC=16.9%</td></tr><tr><td></td><td>1D</td><td>24/14</td><td>1.00 - 3.00</td><td>1/3/6/7</td><td>9</td><td>13</td><td></td><td></td><td></td><td></td><td>Brown, moist, loose, silty fine to medium SAND, little silt, trace gravel.</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>69.40</td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="2"></td><td></td><td rowspan="2">G#238188 A-4, CL-ML WC=30.2%</td></tr><tr><td></td><td>2D</td><td>24/15</td><td>5.00 - 7.00</td><td>1/1/3/4</td><td>4</td><td>6</td><td></td><td></td><td></td><td></td><td>Grey, wet, loose, SILT, some sand trace gravel.</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>66.50</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL</td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>								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									73.20		TOPSOIL, Sod.	G#238187 A-2-4, SM WC=16.9%		1D	24/14	1.00 - 3.00	1/3/6/7	9	13					Brown, moist, loose, silty fine to medium SAND, little silt, trace gravel.										69.40					5												G#238188 A-4, CL-ML WC=30.2%		2D	24/15	5.00 - 7.00	1/1/3/4	4	6					Grey, wet, loose, SILT, some sand trace gravel.										66.50																Bottom of Exploration at 7.00 feet below ground surface. NO REFUSAL		10																																																								15																																																								20																																																								25													
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Page 1 of 1											Boring No.: HB-PORT-120																																																																																																																																																																																																																																																																																																	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-121 PIN: 13107.00					
Driller: MaineDOT			Elevation (ft.) 73.5		Auger ID/OD: 5" Dia.						
Operator: Gigurere/Giles			Datum: NAVD88		Sampler: Standard Split Spoon						
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: 130#/30"						
Date Start/Finish: 3/5/10-3/5/10			Drilling Method: Solid Stem Auger		Core Barrel: N/A						
Boring Location: 116+95, CL			Casing ID/OD: N/A		Water Level*: 7.0' bgs.						
Hammer Efficiency Factor: 0.84			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 = Insitu Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf) T_v = Pocket Torvane Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw field SPT N-value Hammer Efficiency Factor = Annual Calibration Value N₆₀ = SPT N-uncorrected corrected for hammer efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected S_{u(lab)} = Lab Vane 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								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	Elevation (ft.)			
0							SSA	73.00	PAVEMENT.		
	1D	24/20	1.00 - 3.00	11/26/17/18	43	60			Brown, damp, dense, fine to coarse SAND, some gravel, little silt.		
								71.00			
5											
	2D	24/22	5.00 - 7.00	1/2/4/7	6	8			Light brown, wet, loose, fine to medium SAND, some silt.		
								66.50			
10											
	3D	24/20	10.00 - 12.00	7/7/7/9	14	20			Light brown, wet, medium dense, fine to coarse SAND, little gravel, trace silt.		
								61.50			
									Bottom of Exploration at 12.00 feet below ground surface. NO REFUSAL		
15											
20											
25											
Remarks:											
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.											
Page 1 of 1											
Boring No.: HB-PORT-121											

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Forest Ave. Route 302 Location: Portland, Maine		Boring No.: HB-PORT-123 PIN: 13107.00					
Driller: MaineDOT			Elevation (ft.) 73.5		Auger ID/OD: 5" Dia.						
Operator: Gigurere/Giles			Datum: NAVD88		Sampler: Off Flights						
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A						
Date Start/Finish: 3/5/10-3/5/10			Drilling Method: Solid Stem Auger		Core Barrel: N/A						
Boring Location: 117+80, 80 Rt.			Casing ID/OD: N/A		Water Level*: None Observed						
Hammer Efficiency Factor:			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 = Insitu Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf) T _v = Pocket Torvane Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw field SPT N-value Hammer Efficiency Factor = Annual Calibration Value N ₆₀ = SPT N-uncorrected corrected for hammer efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected		S _u (lab) = Lab Vane 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								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	Elevation (ft.)			
0	A1		0.40 - 5.00				SSA	73.10		TOPSOLI, Sod. Olive-Brown, moist, silty fine to medium SAND, some silt, trace gravel. Brown, wet, fine to medium SAND, little silt, trace gravel. Bottom of Exploration at 9.00 feet below ground surface. NO REFUSAL	G#238197 A-2-4, SM WC=19.6% G#238198 A-2-4, SM WC=17.7%
5	A2		5.00 - 9.00					68.50			
10								64.50			
15											
20											
25											
Remarks: A=Auger sample											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1	
* 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.										Boring No.: HB-PORT-123	

Post land
13167.00

117450
L'RT



13 3:03PM

1846nd
130700
103480



13 3:03PM

Perone 13107.06
101750 S, R2
3-5-10



13 3:04PM

CONTENTS:

Portland
13107100
119400



13 3:04 PM

Appendix D

Lab Test Data

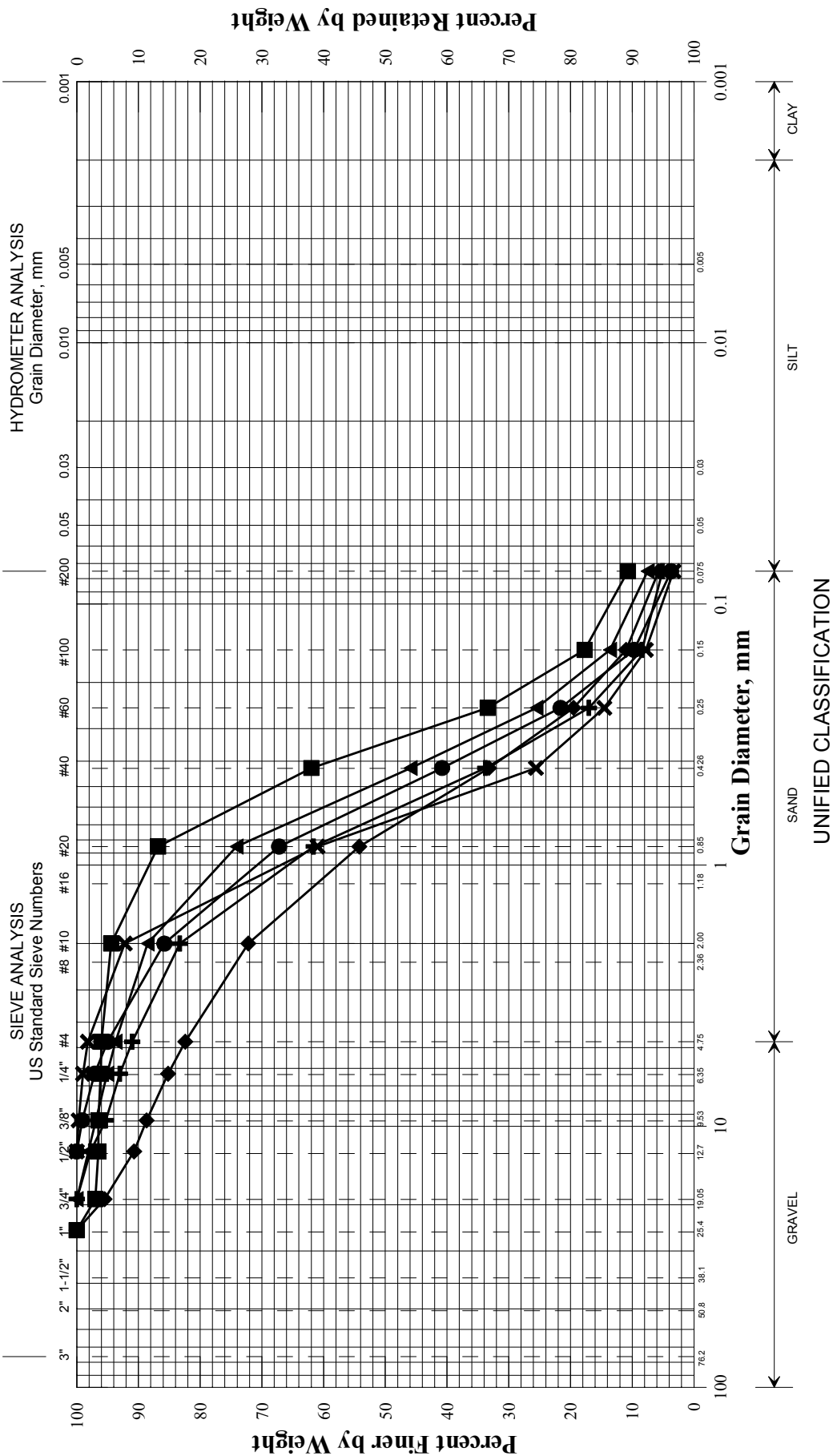
Lab Testing Summary Sheet
Grain Size Curves

GRAIN SIZE DISTRIBUTION CURVE



PIN
013107.00
Town
Portland
Reported by/Date
WHITE, TERRY A 5/5/2010

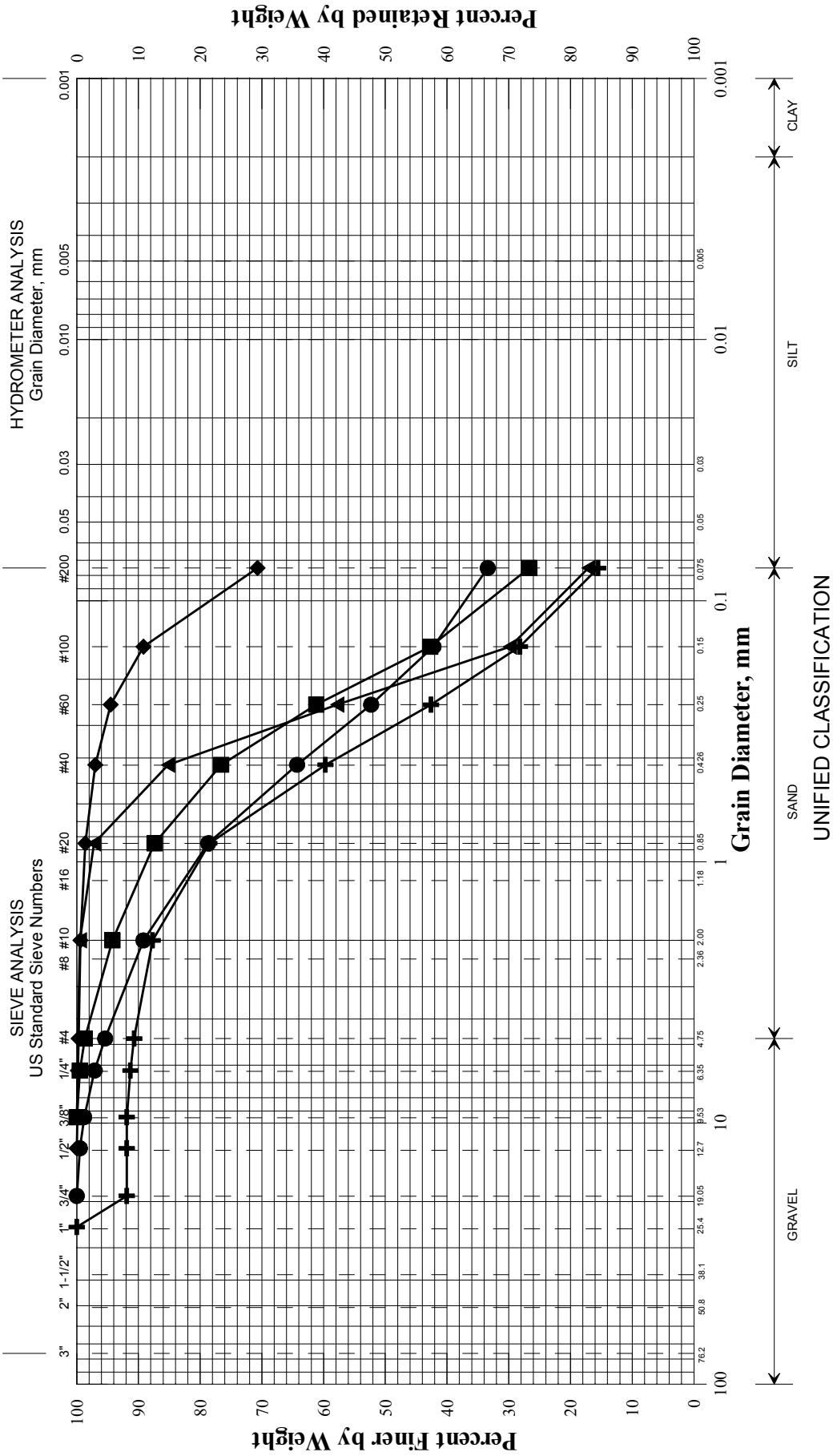
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	HB-PORT-110/B4/1D	106+36	CL	1.0-3.0	SAND, trace gravel, trace silt.	5.6			
◆	HB-PORT-110/B4/2D	106+36	CL	5.0-7.0	SAND, little gravel, trace silt.	4.7			
■	HB-PORT-112/B6/1D	108+25	CL	1.0-3.0	SAND, little silt, trace gravel.	9.2			
●	HB-PORT-112/B6/2D	108+25	CL	5.0-7.0	SAND, trace silt, trace gravel.	3.8			
▲	HB-PORT-116/B10/1D	112+15	CL	1.0-3.0	SAND, trace silt, trace gravel.	6.6			
✕	HB-PORT-116/B10/2D	112+15	CL	5.0-7.0	SAND, trace silt, trace gravel.	14.2			

PIN	013107.00
Town	Portland
Reported by/Date	WHITE, TERRY A 5/5/2010

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
HB-PORT-120/1D	116+60	5.5 RT	1.0-3.0	SAND, little silt, trace gravel.	16.9			
HB-PORT-120/2D	116+60	5.5 RT	5.0-7.0	SILT, some sand, trace gravel.	30.2			
HB-PORT-122/1D	117+50	6.0 RT	5.0-7.0	SAND, some silt, trace gravel.	31.3			
HB-PORT-123/A1	117+80	8.0 RT	0.4-5.0	SAND, some silt, trace gravel.	19.6			
HB-PORT-123/A2	117+80	8.0 RT	5.0-9.0	SAND, little silt, trace gravel.	17.7			

PIN	
013107.00	
Town	
Portland	
Reported by/Date	
WHITE, TERRY A	5/5/2010