

Maine Department of Transportation  
Highway Program

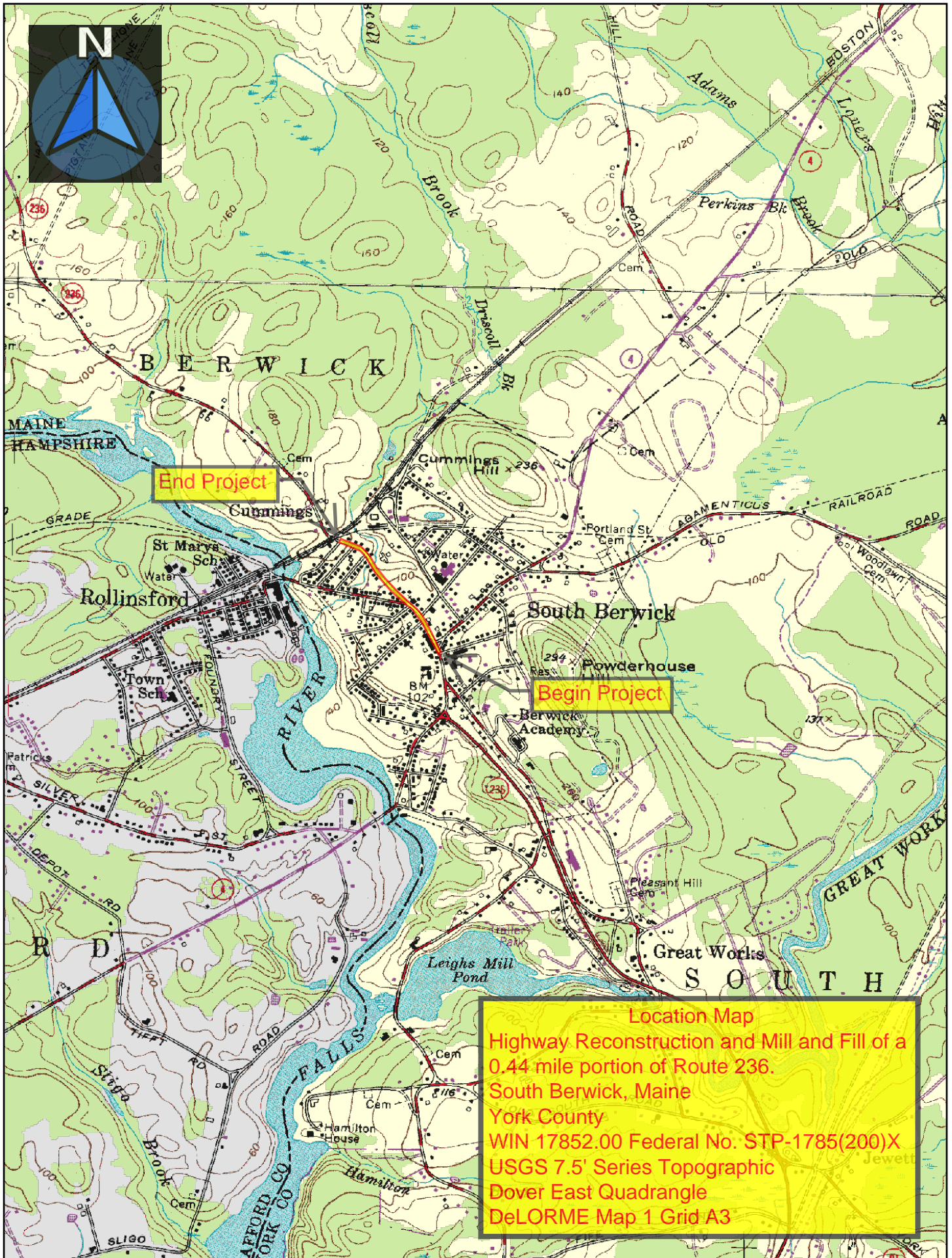
**GEOTECHNICAL REPORT**  
**Highway Reconstruction**  
**Route 236,**  
**South Berwick, Maine**

Prepared by:  
Karen Gross  
Geotechnical Design Engineer

York County

Soils Report No. 2012-132

WIN 17852.00  
Fed. Project STP-1785(200)x  
September 14, 2012



Map Scale 1:24000

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. Road names used on this map may not match official road names.

**Brad Foley, Program Manager**  
**Rich Crawford & Heath Cowan, Assistant Program Managers**  
**Phone: 624-3480 Fax: 624-3481**

---

## **Memorandum**

To: Sarah LeBlanc  
From: Karen Gross  
Date: 9/10/2012  
Subject: So. Berwick, PIN 17852.00  
Soils Report No. 2012-132

I have completed the subsurface investigations for the reconstruction of Route 236 in South Berwick. The following is a summary of the existing conditions, subsurface investigations, and my recommendations for the pavement structure design.

### **Project Background**

MaineDOT proposes to reconstruct and overlay a section of Route 236 in the town of South Berwick. This section of Route 236 is classified as a minor arterial. The reconstruction project begins at the intersection with Main Street (RLM 12.24) and continues 0.29 miles to the north to the Pan Am Railroad tracks (RLM 12.53). The scope of work for the reconstruction section will include drainage improvements, sidewalks, curbing, and a new pavement structure. The mill and overlay section begins at the intersection with Portland Street (RLM 12.09) and extends 0.15 miles northerly to the intersection with Main Street (RLM 12.24) and the start of the reconstruction project. This preliminary report will focus on the existing types of pavement structure materials and how it was constructed, subgrade types and strengths, existing surface and subsurface drainage conditions, and frost considerations in the reconstruction section.

### **Existing Pavement Assessment**

The existing roadway consists of two 11-foot travel lanes and variable width gravel shoulders. The current pavement distresses are considered to be low to moderate in severity, however there are a few locations where pavement distress can be considered severe (wide cracks). The primary distresses included rutting of the outer 1/3 of the travel lanes (structural distress), longitudinal cracking (structural and functional distress), block cracking (functional distress), and transverse cracking (functional distress). The cause of pavement distress is predominately due to frost action (heaving), poor pavement structure drainage, and lack of paved shoulders.

Ditching is non-existent or shallow along most of the project. There also appears to be storm water erosion of the gravel shoulders in some locations. In addition to saturating the subbase and subgrade, water running in the gravel shoulder can cause undermining of the gravel underneath the asphalt surface course and the subsequent loss of support when traffic loads are applied. This shows up as rutting in the right wheel path.



## Highway Program

### **As-Built Plans**

No as-built plans for the original construction of this roadway were located. MaineDOT records indicate there were maintenance overlays placed in 1996, 2001, and 2004.

### **Subsurface Investigations and Lab Testing Information**

Preliminary investigations included a Falling Weight Deflectometer (FWD) field analysis to determine pavement weaknesses and resilient modulus values for design, a GPR analysis to determine existing pavement structure material thicknesses, and 5 power auger borings to determine pavement structure materials thicknesses and properties.

Existing information, including surficial geology and agricultural maps, was analyzed to determine what the pavement foundation soils may consist of and where possible surface and subsurface drainage problems may exist.

All borings were drilled to a depth of 5 (+/-) feet using solid stem augers, unless refusal was encountered shallower than that depth. Subbase and subgrade soil samples were taken directly off the auger flights, and representative samples were tested by the MaineDOT testing lab in Bangor to determine the gradation and water content. The following summarizes the pavement structure materials thicknesses as found in the borings and soil properties from the lab testing data. A Boring Summary Sheet, boring logs, and Laboratory Testing Summary Sheet, and Grain Size distribution curves are attached at the end of this memo for your reference.

#### Existing HMA

The boring information indicates that the existing asphalt (HMA) ranges from 5" inches to 6" thick. No bituminous treated material or macadam was encountered beneath the HMA layer in any of the borings.

#### Existing Base/Subbase

The subsurface information indicates that the existing granular base/subbase thickness ranges from 19" to 24" in thickness. Lab testing data indicates that the existing granular material does not meet the requirements of Aggregate Subbase Course Gravel. All samples significantly exceed the specification requirements on the percentage passing the #200 sieve.

#### Subgrade Soils

The subsurface information indicates that the existing subgrade soils (24" below the existing roadway surface) consist predominately of a mix of sand and silt. This soil type is considered moderately to highly frost susceptible, with the susceptibility increasing with increasing silt contents. An old roadway surface approximately 5" thick was encountered at 24" below the existing surface at station 10+00. This old roadway consists of a material known as penetrated gravel; a process used in the 1940's and 1950's where liquid asphalt was sprayed onto the existing gravel to make a more stable wearing surface.

The Dover East Quadrangle Surficial Geology map and the SCS maps indicate that there is a change in soil type approximately at Station 17+00. According to all maps, the subgrade soils should consist predominately of sand and gravel from the start of the project to Station 17+00, and have a higher silt content from Station 17+00 to the end of the project. We encountered the opposite in the borings where the subgrade soils have higher silt content from the start of the project to Station 17+00.



### Bedrock

Shallow refusal (5' below the ground surface or less) was encountered in a boring at station 18+00. Additional investigations were conducted at this location and no obstructions, boulders, or refusal were encountered. Based on the information on the geology maps, shallow bedrock is not expected at this location, so hitting shallow refusal at this location is unexplained.

### Groundwater

Shallow groundwater was not noted in any of the borings, however wet subbase and subgrade soils were encountered from Station 18+00 to the end of the project. These wet soils can be due to a high groundwater table, but it is more likely that it is a result of poor pavement structure drainage due to a "bathtub" pavement section. This area is also located in a sag section of the roadway, and with poor drainage, there is a strong possibility that water is collecting here. The Soil Conservation Survey for York County indicates that seasonal shallow groundwater is probable from 18+00 to the project end. Since the soils are considered frost susceptible, the significance of the shallow groundwater table is that it can supply the water needed to produce large frost heaves.

### Frost Penetration

The anticipated depth of frost penetration and as interpolated from the Maine Design Freezing Index charts for this location is 42".

### **FWD Results**

FWD data was collected at 100 foot intervals in the right wheel path of the northbound travel lane. This field data was then processed to give us deflection data plots and an analysis of the existing pavement structures strengths and modulus values. Deflection data is very valuable because it provides information on where the existing pavement may have high deflections (weakness within the pavement or subgrade) and locations with low deflections where bedrock may be close to the surface. Sections with high deflections can also help identify areas that may need to be reconstructed.

The FWD deflection data shows there are higher deflections predominately in the top 12" to 24" of the pavement structure, therefore the deflections are occurring in the asphalt and subbase layers and not in the subgrade. This indicates that the pavement structure is probably not adequate to support traffic loadings either because of material deterioration, or lack of structural support. The section with the highest deflections in the top 12" to 24" is from station 13+00 to 17+00.

The FWD deflection data can also show where there are areas with a weak subgrade. The deflections in the subgrade are consistent, therefore the subgrade is probably providing a good foundation for the pavement structure.

The subgrade resilient moduli ( $M_r$ ) values as calculated from the FWD data range from 3058 psi to 8721 psi. Typically,  $M_r$  values over 8500 psi indicate the presence of shallow bedrock or stone base sections. A  $M_r$  value over 8500 psi was calculated at station 11+00. I do not think that there is shallow bedrock location, but there is a possibility that a stone base was placed during the original construction.  $M_r$  values under 3000 psi can indicate weak, wet, or soft subgrade soils. Deflection testing over existing culverts can also produce very low modulus values. A  $M_r$  value

of approximately 3000 psi was calculated at station 16+00. Values are between 3000 psi and 3500 psi from station 15+00 to 18+00. From the boring information, I am assuming these low values are due to wet and weak soils.

The resilient modulus values calculated from the FWD data can also be used to determine the appropriate Mr value to use in the pavement design. For design purposes, the Mr value as calculated as of per Chapter 13 of the Highway Design Guide (the 75<sup>th</sup> percentile of all values between 3000 psi and 8500 psi) is 3700 psi. Mr values will increase once positive drainage is provided, therefore a value of 4000 psi is recommended for the pavement design.

**Recommendations**

The following are recommendations for the reconstruction of Route 236:

- The existing subbase material does not meet the MaineDOT specification requirements for subbase or base gravel and should be removed and replaced with new aggregate.
- Drainage improvements are recommended on the entire project length. These improvements should include provisions to remove both groundwater and surface water. Daylighting the subbase gravel to ditches or side slopes, or underdrain if daylighting is not possible will promote drainage of the pavement structure. Ditching or a closed drainage system will remove surface water and help to lower the groundwater table.
- Since the subgrade soils are frost susceptible, new subbase aggregate and drainage improvements will reduce the detrimental effects of frost on the pavement structure.
- The recommended resilient modulus to use for the pavement design based on drainage improvements and the FWD analysis values is 4000 psi.

Attachments

Pavement Management Data  
Boring Summary Sheet  
Boring Logs  
Laboratory Summary Sheet  
Grain Size Curves  
Geoplans  
Geology Maps  
Frost Charts  
FWD Analysis  
GPR Data

Node count: 7



**MaineDOT**

**Route Log Mile Detail Report**

Tide Load date: 10/14/2011  
Tide year: 2011  
Instance: TIDEPDOD

**Filter Elements**

Selected Town	Selected ROUTE	Milepoint	Offset
South Berwick	0236X	12.09	.7

Open Error Form

VisiWeb™

Back

**NOTE:** The end of this road in South Berwick is at milepoint 12.55.

\*\* Clicking on NODE ID will query and return Connecting Node information. \*\*

EXPAND

**Filter Results**

Node ID	Node Desc	Node MP	Fed. Func. Class	Pavement Data						PIN
				Surface	IRI	PCR	Inv Year	Rut Left	Rut Right	
<a href="#">56698</a>	3107199 S.BER,MAIN,PORTLAND ST.	12.09	Minor arterial	Flexible	185	2.74	2009	.1	.2	<a href="#">004250.00</a> (1997)
<a href="#">56012</a>	3106476 S.BER,MAIN,YOUNG ST.	12.17	Minor arterial	Flexible	185	2.74	2009	.1	.2	<a href="#">011018.10</a> (2004)
<a href="#">55799</a>	3106245 S.BER,MAIN,NORTON ST.	12.19	Minor arterial	Flexible	185	2.74	2009	.1	.2	<a href="#">011018.10</a> (2004) <a href="#">011018.10</a> (2004) <a href="#">011018.21</a> (2004) <a href="#">008143.00</a> (2003)
<a href="#">55800</a>	Int of BERWICK RD, BUTLER ST, MAIN ST	12.24	Minor arterial	Flexible	185	2.74	2009	.1	.2	<a href="#">000625.00</a> (1994) <a href="#">011018.10</a> (2004) <a href="#">007234.10</a> (1996)
<a href="#">55801</a>	Int of BERWICK RD, TIBBETTS ST	12.44	Minor arterial	Flexible	156	3.46	2009	.1	.2	<a href="#">000625.00</a> (1994) <a href="#">011018.10</a> (2004) <a href="#">007234.10</a> (1996)
<a href="#">55802</a>	Int of BERWICK RD, HIGH ST	12.49	Minor arterial	Flexible	205	3.09	2009	.1	.3	<a href="#">000625.00</a> (1994) <a href="#">011018.10</a> (2004) <a href="#">007234.10</a> (1996)
<a href="#">55803</a>	TL - Berwick, South Berwick	12.55	Minor arterial	Flexible	236	2.65	2009	.1	.4	<a href="#">000625.00</a> (1994)

**BORING SUMMARY (Preliminary)**  
**South Berwick, Route 236 - - WIN 17852.00**

Boring No.	Design Station	Offset (ft)*	Exploration Depth (ft)	Refusal Depth (ft)	Depth to water (ft)	Pavement Thickness			Subbase Classification (USCS & AASHTO)	Subgrade Type	Frost susceptibility rating
						HMA (in)	Subbase (in)	Total (in)			
HB-SOBE-101	10+00	9.0 L	5.0			5	19.0	24.0	SM/A-1-b	silty SAND	III
HB-SOBE-102	12+00	7.0 L	5.0			5	19.0	24.0	SM/A-1-b	silty SAND	III
HB-SOBE-103	15+00					<b>OVERHEAD WIRES - - SKIPPED</b>					
HB-SOBE-104	18+00	7.0 L	2.5	2.5	WET SOILS @1.0	5.5	19.5	25.0	SM/A-2-4	SAND, some silt	II
HB-SOBE-105	21+00	7.0 L	5.0		WET SOILS @2.3	5.5	20.8	26.3	SM/A-2-4	SAND, some silt	II
HB-SOBE-106	23+00	7.0 L	5.0		WET SOILS @2.5	6	24.0	30.0	SM/A-2-4	SAND, some silt	II

\*Offsets from existing Roadway Centerline



<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 110.2	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 10+00, 9.0 ft Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: S <sub>u</sub> = Insitu Field Vane Shear Strength (psf) T <sub>v</sub> = Pocket Torvane Shear Strength (psf) q <sub>p</sub> = Unconfined Compressive Strength (ksf) S <sub>u</sub> (lab) = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	---	--

Depth (ft.)	Sample Information										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-value	Casing Blows	Elevation (ft.)	Graphic Log				
0						SSA	109.78		5" PAVEMENT.	0.42		
							108.20		Brown, moist, fine to coarse SAND, some silt, little gravel. ≈S4	2.00		
	S6		2.40 - 5.00				107.80		Old Roadway, (Oil Odor).	2.40		
									Light brown, damp, silty SAND, trace gravel. ≈S5	2.40		
5							105.20		<b>Bottom of Exploration at 5.00 feet below ground surface.</b> NO REFUSAL	5.00		
10												
15												
20												
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.

<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 102.3	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 12+00, 7.0 ft Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: S <sub>u</sub> = Insitu Field Vane Shear Strength (psf) T <sub>v</sub> = Pocket Torvane Shear Strength (psf) q <sub>p</sub> = Unconfined Compressive Strength (ksf) S <sub>u</sub> (lab) = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	---	--

Depth (ft.)	Sample Information										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-value	Casing Blows	Elevation (ft.)	Graphic Log				
0	S4		0.42 - 2.00			SSA	101.88		5" PAVEMENT.		G#239996 A-1-b, SM WC=6.9%	
							100.30		Brown, moist, fine to coarse SAND, some silt, little gravel.			
	S5		2.00 - 5.00							Light brown, moist, silty SAND, trace gravel.		G#239997 A-4, SM WC=6.9%
5							97.30	<b>Bottom of Exploration at 5.00 feet below ground surface.</b> NO REFUSAL				
10												
15												
20												
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.

<b>Maine Department of Transportation</b> Soil/Rock Exploration Log US CUSTOMARY UNITS		<b>Project:</b> A portion of Route 236 (Berwick Road) <b>Location:</b> South Berwick, Maine	<b>Boring No.:</b> HB-SOBE-103 <b>PIN:</b> 17852.00
--	--	--	--

<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b>	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 15+00, Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: $S_u$ = Insitu Field Vane Shear Strength (psf) $T_v$ = Pocket Torvane Shear Strength (psf) $q_p$ = Unconfined Compressive Strength (ksf) $S_u(lab)$ = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	--	--

Depth (ft.)	Sample Information										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-value	Casing Blows	Elevation (ft.)	Graphic Log				
0											<b>Bottom of Exploration at 0.00 feet below ground surface.</b> Overhead wires and utilities, skipped boring.	
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.

<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 78.2	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 18+00, 7.0 ft Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: S <sub>u</sub> = Insitu Field Vane Shear Strength (psf) T <sub>v</sub> = Pocket Torvane Shear Strength (psf) q <sub>p</sub> = Unconfined Compressive Strength (ksf) S <sub>u</sub> (lab) = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	---	--

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows						
0						SSA		77.74		5 1/2" PAVEMENT.		
								77.20		Brown, wet, fine to coarse SAND, some silt, little gravel. ≈S2	-0.46	
										Light brown, wet, fine to coarse SAND, some silt, little gravel. ≈S3	-1.00	
								75.70		Bottom of Exploration at 2.50 feet below ground surface. REFUSAL	-2.50	
5												
10												
15												
20												
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.

<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 95.8	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 21+00, 7.0 ft Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: S <sub>u</sub> = Insitu Field Vane Shear Strength (psf) T <sub>v</sub> = Pocket Torvane Shear Strength (psf) q <sub>p</sub> = Unconfined Compressive Strength (ksf) S <sub>u</sub> (lab) = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	---	--

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows						
0								95.34		5 1/2" PAVEMENT.		
										0.46	Brown, moist, fine to coarse SAND, soem silt, little gravel. ≈S1	
	S3		2.20 - 5.00					93.60		2.20	Light brown, wet, fine to coarse SAND, some silt, little gravel.	G#239998 A-2-4, SM WC=9.1%
5								90.80		Bottom of Exploration at 5.00 feet below ground surface. NO REFUSAL	5.00	
10												
15												
20												
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.



<b>Driller:</b> MaineDOT	<b>Elevation (ft.):</b> 105.8	<b>Auger ID/OD:</b> 5" Dia.
<b>Operator:</b> Giguere/Giles/Daggett	<b>Datum:</b> NAVD88	<b>Sampler:</b> Off Flights
<b>Logged By:</b> B. Wilder	<b>Rig Type:</b> CME 45C	<b>Hammer Wt./Fall:</b> N/A
<b>Date Start/Finish:</b> 9/22/11-9/22/11	<b>Drilling Method:</b> Solid Stem Auger	<b>Core Barrel:</b> N/A
<b>Boring Location:</b> 23+00, 7.0 ft Lt.	<b>Casing ID/OD:</b> N/A	<b>Water Level*:</b> None Observed

Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample attempt U = Thin Wall Tube Sample R = Rock Core Sample V = Insitu Vane Shear Test SSA = Solid Stem Auger	Definitions: S <sub>U</sub> = Insitu Field Vane Shear Strength (psf) T <sub>V</sub> = Pocket Torvane Shear Strength (psf) q <sub>p</sub> = Unconfined Compressive Strength (ksf) S <sub>U</sub> (lab) = Lab Vane Shear Strength (psf) WOH = weight of 140lb. hammer WOR = weight of rods WOC = weight of casing	Definitions: WC = water content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test
---	---	--

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows ((6 in.) Shear Strength (psf) or RQD (%))	N-value	Casing Blows						
0	S1		0.50 - 2.50					105.30		6" PAVEMENT.		
										Brown, moist, fine to coarse SAND, some silt, little gravel.	G#239999 A-2-4, SM WC=6.8%	
	S2		2.50 - 5.00					103.30		Brown, wet, fine to coarse SAND, some silt, little gravel.	G#240000 A-2-4, SM WC=11.4%	
5								100.80		<b>Bottom of Exploration at 5.00 feet below ground surface.</b> NO REFUSAL		
10												
15												
20												
25												

**Remarks:**  
 Offsets are from CL Existing Roadway.

State of Maine - Department of Transportation  
**Laboratory Testing Summary Sheet**

**Town(s): South Berwick**

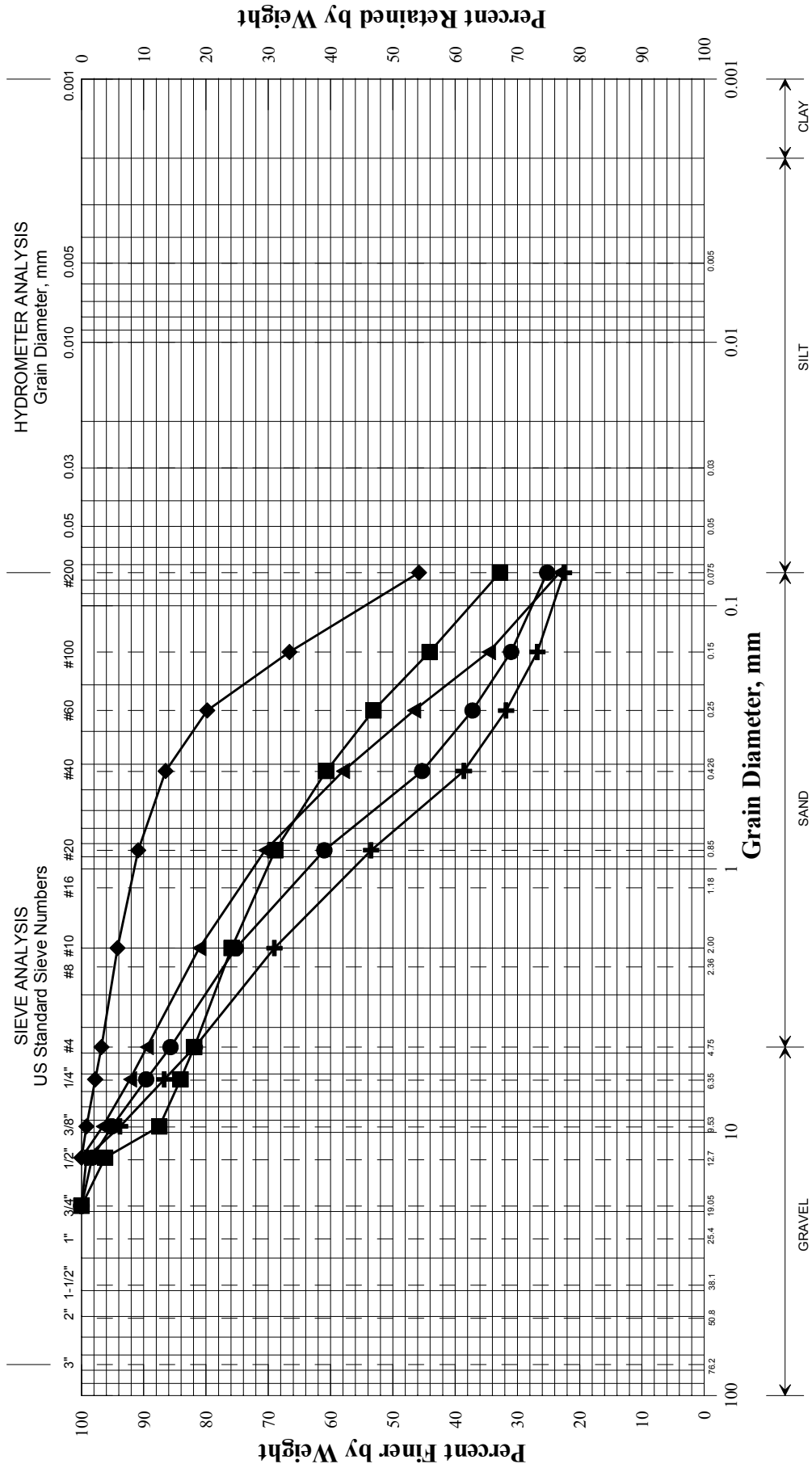
**Work Number: 17852.00**

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-SOBE-102, S4	12+00	7.0 Lt.	0.42-2.0	239996	1	6.9			SM	A-1-b	II
HB-SOBE-102, S5	12+00	7.0 Lt.	2.0-5.0	239997	1	6.9			SM	A-4	III
HB-SOBE-105, S3	21+00	7.0 Lt.	2.2-5.0	239998	1	9.1			SM	A-2-4	II
HB-SOBE-106, S1	23+00	7.0 Lt.	0.5-2.5	239999	1	6.8			SM	A-2-4	II
HB-SOBE-106, S2	23+00	7.0 Lt.	2.5-5.0	240000	1	11.4			SM	A-2-4	II

Classification of these soil samples is in accordance with **AASHTO Classification System M-145-40**. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the **MaineDOT and Corps of Engineers Classification Systems**.

GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)  
 WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98  
 LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98  
 PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

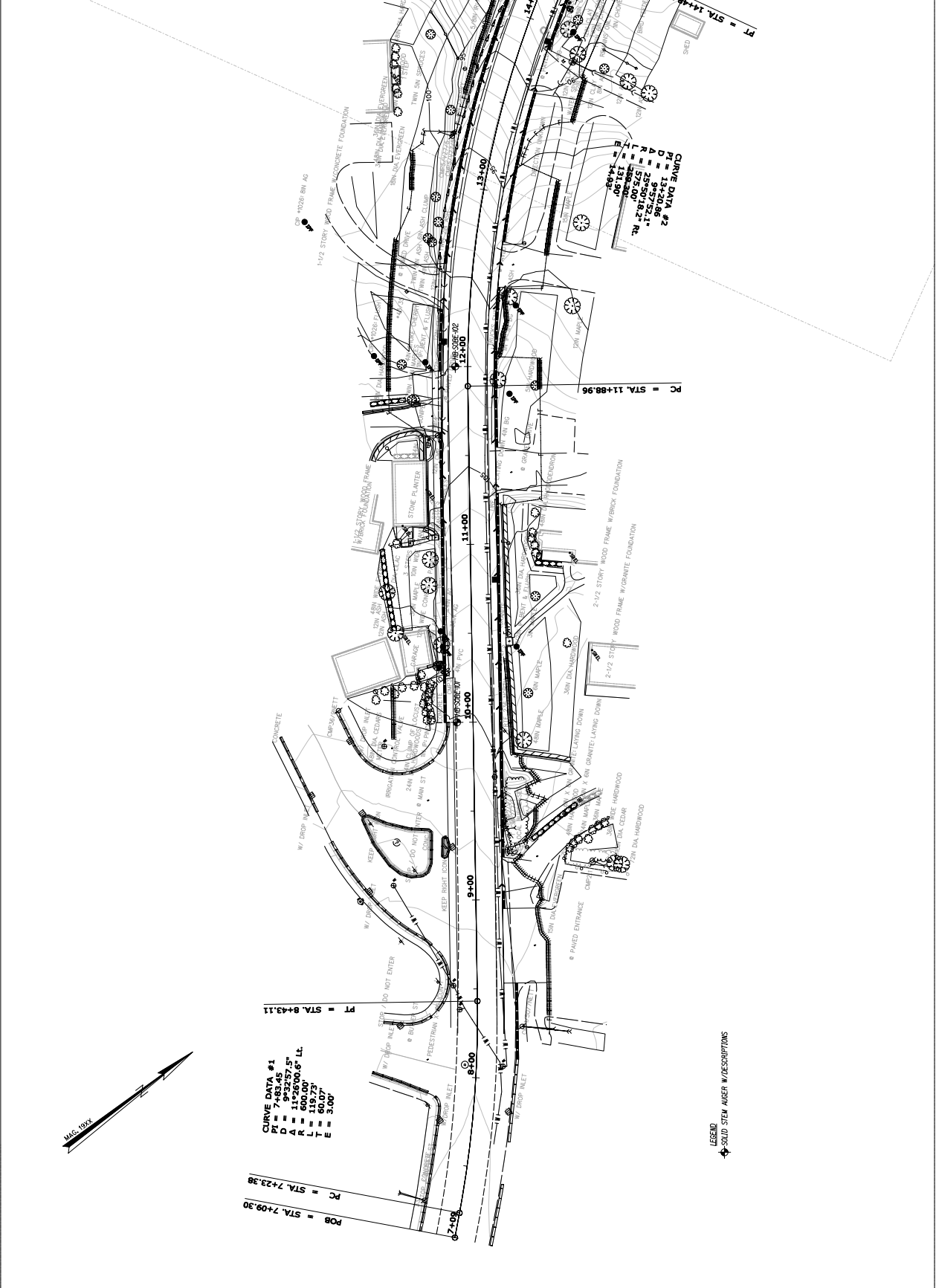
*State of Maine Department of Transportation*  
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

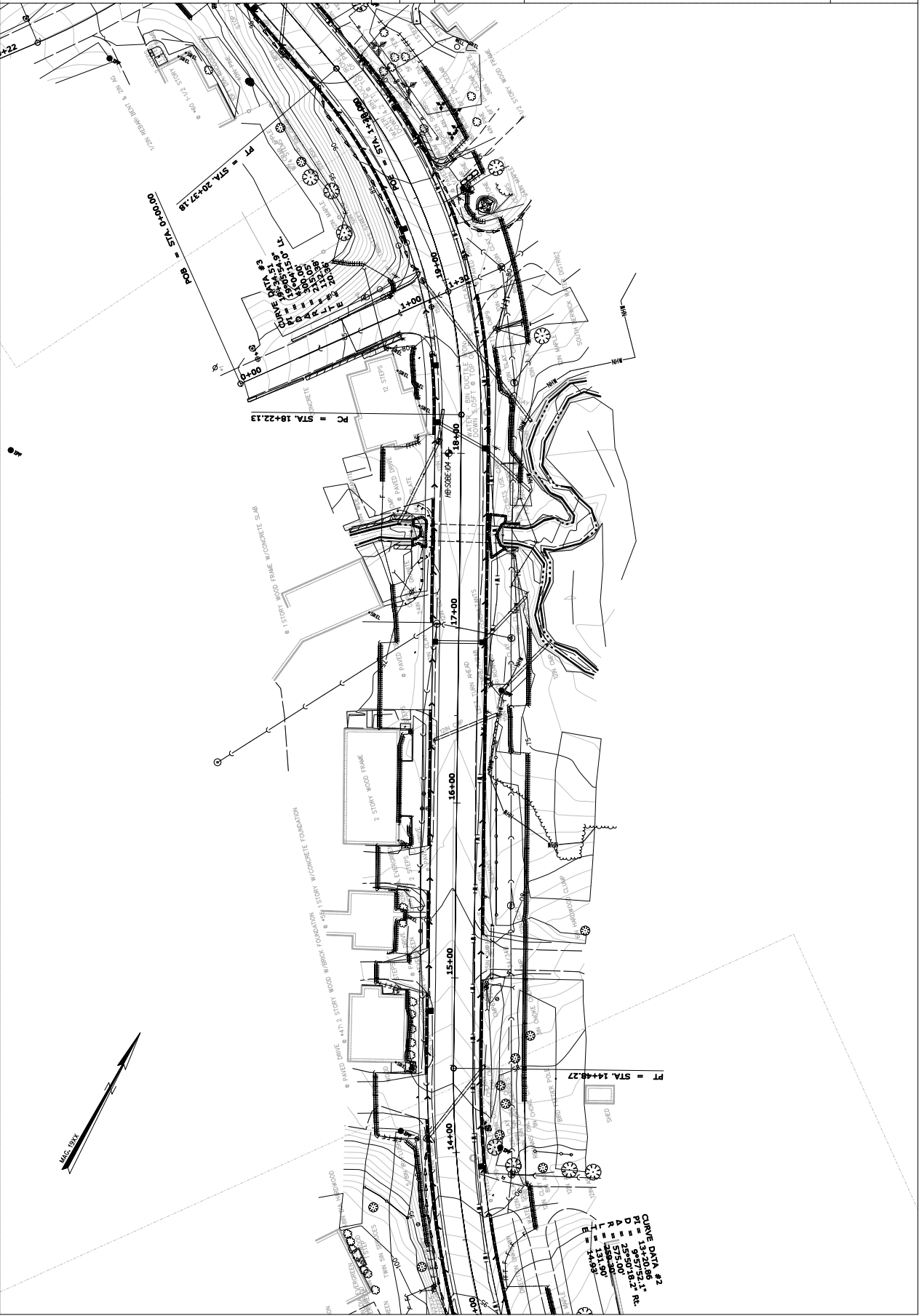
WIN
017852.00
Town
South Berwick
Reported by/Date
WHITE, TERRY A 9/30/2011

Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	12+00	7.0 LT	0.42-2.0	SAND, some silt, little gravel.	6.9			
◆	12+00	7.0 LT	2.0-5.0	Silty SAND, trace gravel.	6.9			
■	21+00	7.0 LT	2.2-5.0	SAND, some silt, little gravel.	9.1			
●	23+00	7.0 LT	0.5-2.5	SAND, some silt, little gravel.	6.8			
▲	23+00	7.0 LT	2.5-5.0	SAND, some silt, little gravel.	11.4			
×								



SO. BERRICK  
ROUTE 236 (BERRICK ROAD)  
GEOP LANS

STATE OF MAINE DEPARTMENT OF TRANSPORTATION STP-173(900)X PIN 1782.00 HIGHWAY PLANS			
PROJ. NUMBER	BY	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE
DESIGN-TEAM	DATE	DATE	DATE





FIELD CHANGES	REVISIONS	DATE
REVISIONS 4		
REVISIONS 3		
REVISIONS 2		
REVISIONS 1		
DESIGN (FIELD)		
DESIGN (OFFICE)		

PROJ. MANAGER	DATE
E. MARTIN	

DESIGN-REVIEWED	DATE
K. GROSS	

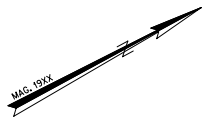
  

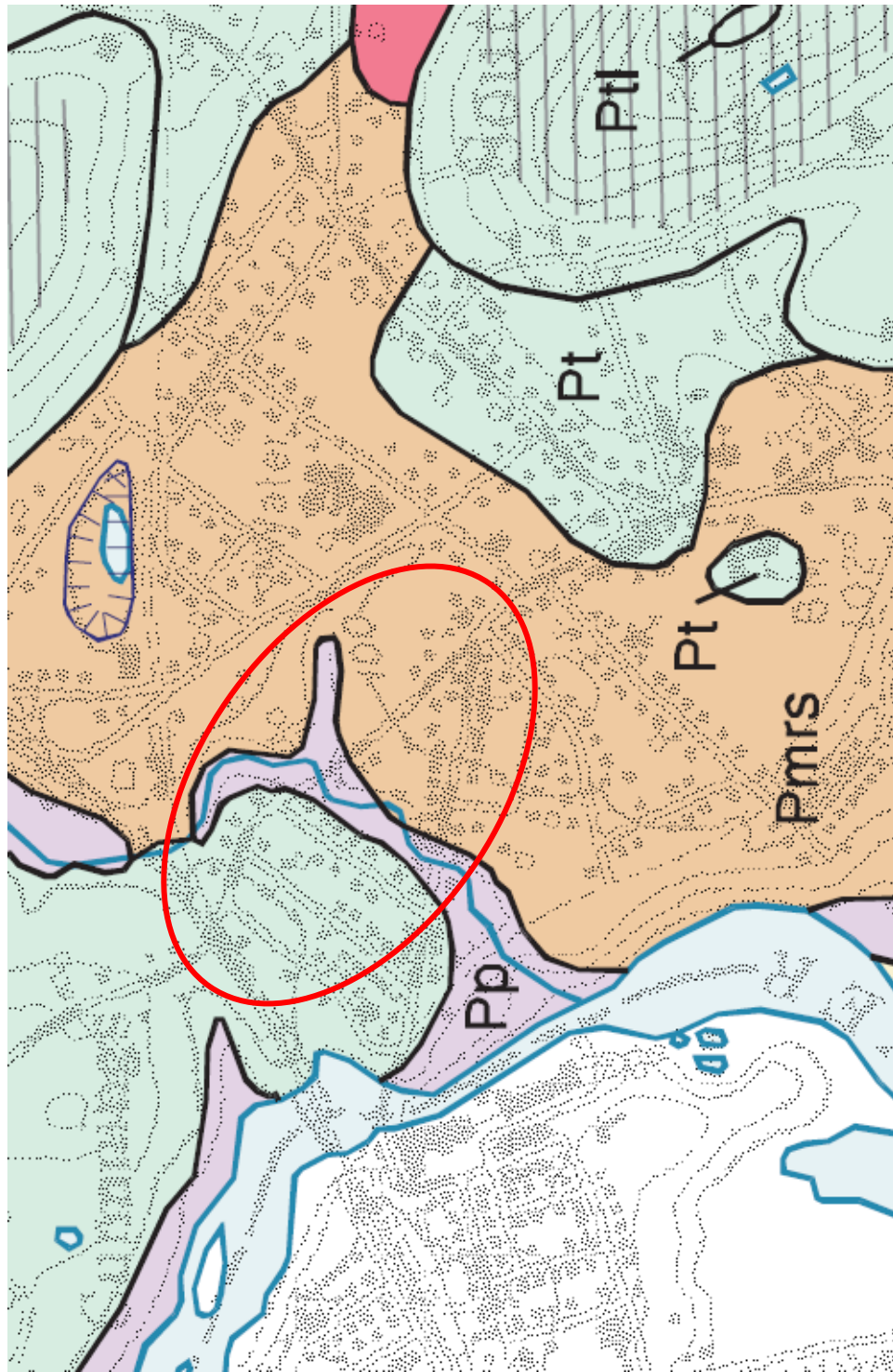
DATE	BY
SEPT 2011	

SIGNATURES	P.I. NUMBER

STATE OF MAINE DEPARTMENT OF TRANSPORTATION STP-1723(900)X PIN 1782.00 HIGHWAY PLANS
---





**Pms** - Marine shoreline deposit - Predominantly sand with minor gravel. Consists of beach deposits formed during stillstand of relative sea level in regressive phase of marine submergence. Thickness variable, from less than 3 m in beach ridges to more than 10 m in aprons around eroded drumlins.

**Pt** - Till - Gray to gray-brown poorly sorted mixture of silt, sand, pebbles, cobbles, and boulders. Forms a blanket deposit over younger sediments where not exposed at surface. Thin over topographic highs; thickens in topographic lows. May occur in and over end moraines (Pence). Averages 3 to 5 m in thickness.

**Pp** - Presumpscot Formation - Massive to laminated, gray and blue-gray (weathering brown) silt and silty clay. Locally may contain boulders, sand, and gravel. Occurs as blanket deposit over bedrock and older glacial sediments. Variable thickness, from less than 1 m to more than 50 m. Deposited during period of late-glacial marine submergence.

## Dover East Quadrangle, Maine

Digital cartography by:  
Susan S. Tolman

Cartographic design and editing by:  
Robert D. Tucker

Geographic design and editing by:  
Robert D. Tucker

Original geologic mapping by:  
Geoffrey W. Smith  
Cynthia C. Cameron

Working for the Department of Geological Engineering and Geosciences, Colorado State University, Fort Collins, Colorado 80523

Produced for the Department of Geological Engineering and Geosciences, Colorado State University, Fort Collins, Colorado 80523

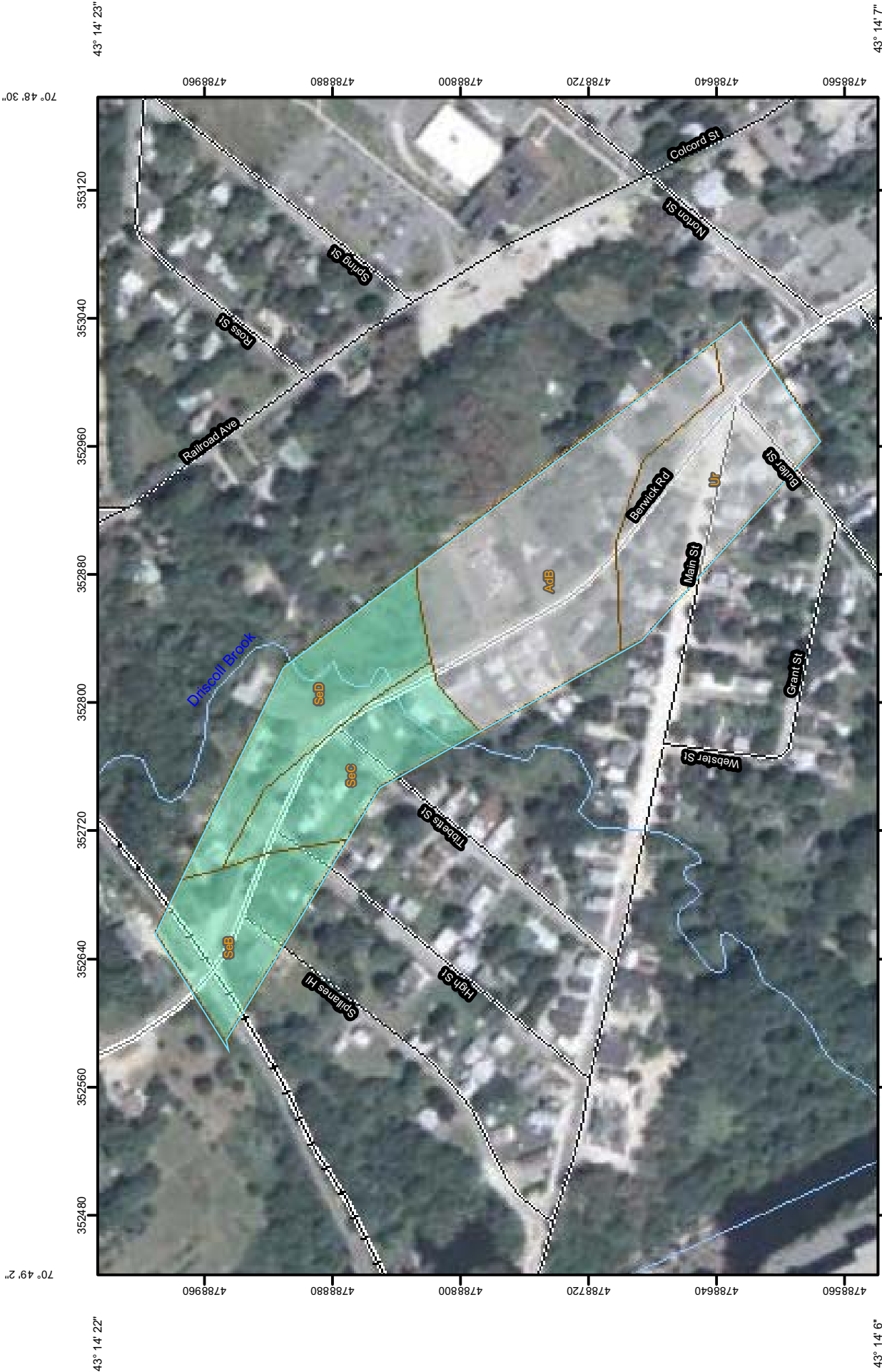


Open-file No. 07-80  
2007

Address: 23 State House Station, Augusta, Maine 04333  
Telephone: 207-287-2801 Email: [info@mainegeo.state.me.us](mailto:info@mainegeo.state.me.us)  
Internet Page: <http://www.mainegeo.state.me.us>

This map incorporates Open-File No. 06-02.

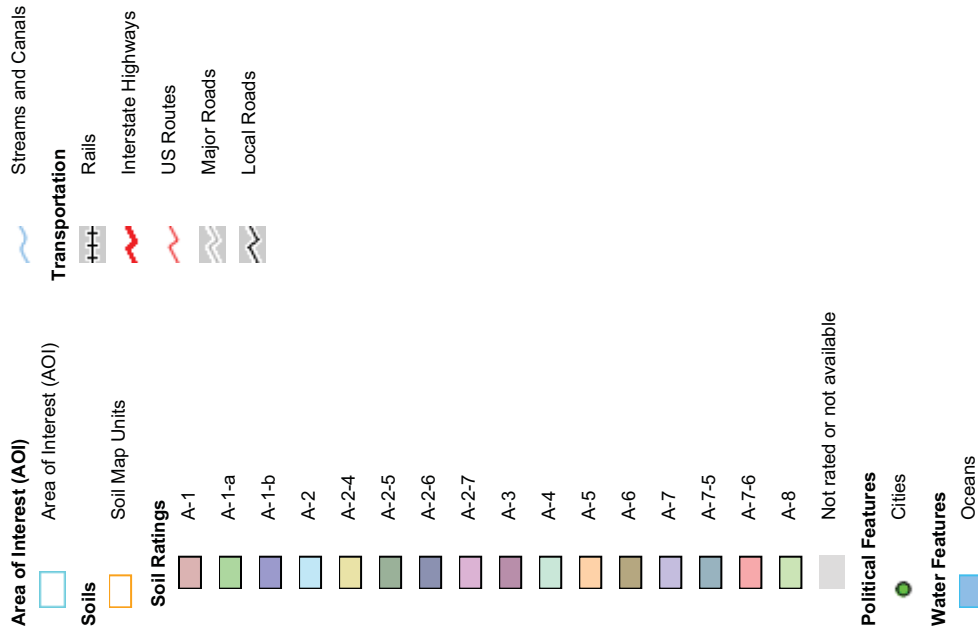
AASHTO Group Classification (Surface)—York County, Maine  
 (Rt. 236, South Berwick PIN 17852.00)



Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.



## MAP LEGEND



## MAP INFORMATION

Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.  
 The soil surveys that comprise your AOI were mapped at 1:20,000.  
 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.

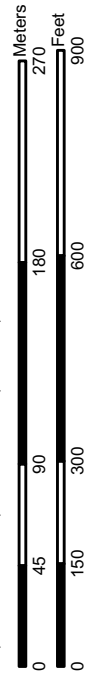
Soil Survey Area: York County, Maine  
 Survey Area Data: Version 11, Jan 7, 2009  
 Date(s) aerial images were photographed: 8/24/2003

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.

Depth to Any Soil Restrictive Layer—York County, Maine  
(Rt. 236, South Berwick PIN 17852.00)













































Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.





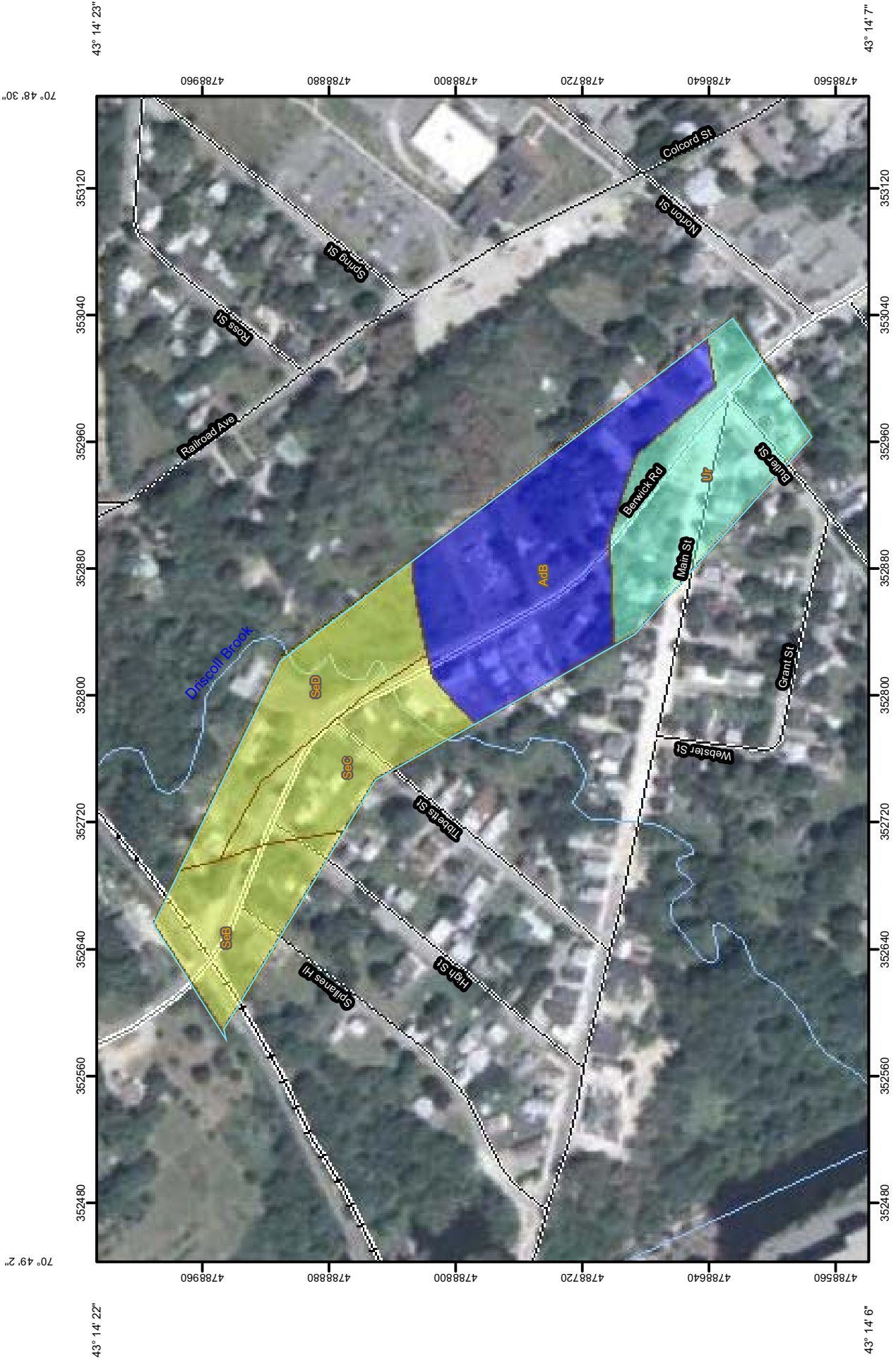
## MAP LEGEND

<b>Area of Interest (AOI)</b>	 Area of Interest (AOI)												
<b>Soils</b>	 Soil Map Units												
<b>Soil Ratings</b>	<table border="0"> <tr> <td></td> <td>0 - 25</td> </tr> <tr> <td></td> <td>25 - 50</td> </tr> <tr> <td></td> <td>50 - 100</td> </tr> <tr> <td></td> <td>100 - 150</td> </tr> <tr> <td></td> <td>150 - 200</td> </tr> <tr> <td></td> <td>&gt; 200</td> </tr> </table>		0 - 25		25 - 50		50 - 100		100 - 150		150 - 200		> 200
	0 - 25												
	25 - 50												
	50 - 100												
	100 - 150												
	150 - 200												
	> 200												
<b>Political Features</b>	 Cities												
<b>Water Features</b>	<table border="0"> <tr> <td></td> <td>Oceans</td> </tr> <tr> <td></td> <td>Streams and Canals</td> </tr> </table>		Oceans		Streams and Canals								
	Oceans												
	Streams and Canals												
<b>Transportation</b>	<table border="0"> <tr> <td></td> <td>Rails</td> </tr> <tr> <td></td> <td>Interstate Highways</td> </tr> <tr> <td></td> <td>US Routes</td> </tr> <tr> <td></td> <td>Major Roads</td> </tr> <tr> <td></td> <td>Local Roads</td> </tr> </table>		Rails		Interstate Highways		US Routes		Major Roads		Local Roads		
	Rails												
	Interstate Highways												
	US Routes												
	Major Roads												
	Local Roads												

## MAP INFORMATION

Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.  
 The soil surveys that comprise your AOI were mapped at 1:20,000.  
 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: York County, Maine  
 Survey Area Data: Version 11, Jan 7, 2009  
 Date(s) aerial images were photographed: 8/24/2003  
 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.











































Depth to Water Table—York County, Maine  
 (Rt. 236, South Berwick PIN 17852.00)



Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.



## MAP LEGEND

<b>Area of Interest (AOI)</b>	 Area of Interest (AOI)												
<b>Soils</b>	 Soil Map Units												
<b>Soil Ratings</b>	<table border="0"> <tr> <td></td> <td>0 - 25</td> </tr> <tr> <td></td> <td>25 - 50</td> </tr> <tr> <td></td> <td>50 - 100</td> </tr> <tr> <td></td> <td>100 - 150</td> </tr> <tr> <td></td> <td>150 - 200</td> </tr> <tr> <td></td> <td>&gt; 200</td> </tr> </table>		0 - 25		25 - 50		50 - 100		100 - 150		150 - 200		> 200
	0 - 25												
	25 - 50												
	50 - 100												
	100 - 150												
	150 - 200												
	> 200												
<b>Political Features</b>	 Cities												
<b>Water Features</b>	<table border="0"> <tr> <td></td> <td>Oceans</td> </tr> <tr> <td></td> <td>Streams and Canals</td> </tr> </table>		Oceans		Streams and Canals								
	Oceans												
	Streams and Canals												
<b>Transportation</b>	<table border="0"> <tr> <td></td> <td>Rails</td> </tr> <tr> <td></td> <td>Interstate Highways</td> </tr> <tr> <td></td> <td>US Routes</td> </tr> <tr> <td></td> <td>Major Roads</td> </tr> <tr> <td></td> <td>Local Roads</td> </tr> </table>		Rails		Interstate Highways		US Routes		Major Roads		Local Roads		
	Rails												
	Interstate Highways												
	US Routes												
	Major Roads												
	Local Roads												

## MAP INFORMATION

Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.  
 The soil surveys that comprise your AOI were mapped at 1:20,000.  
 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: York County, Maine  
 Survey Area Data: Version 11, Jan 7, 2009  
 Date(s) aerial images were photographed: 8/24/2003  
 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.








































Frost Action—York County, Maine  
 (Rt. 236, South Berwick PIN 17852.00)



Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.



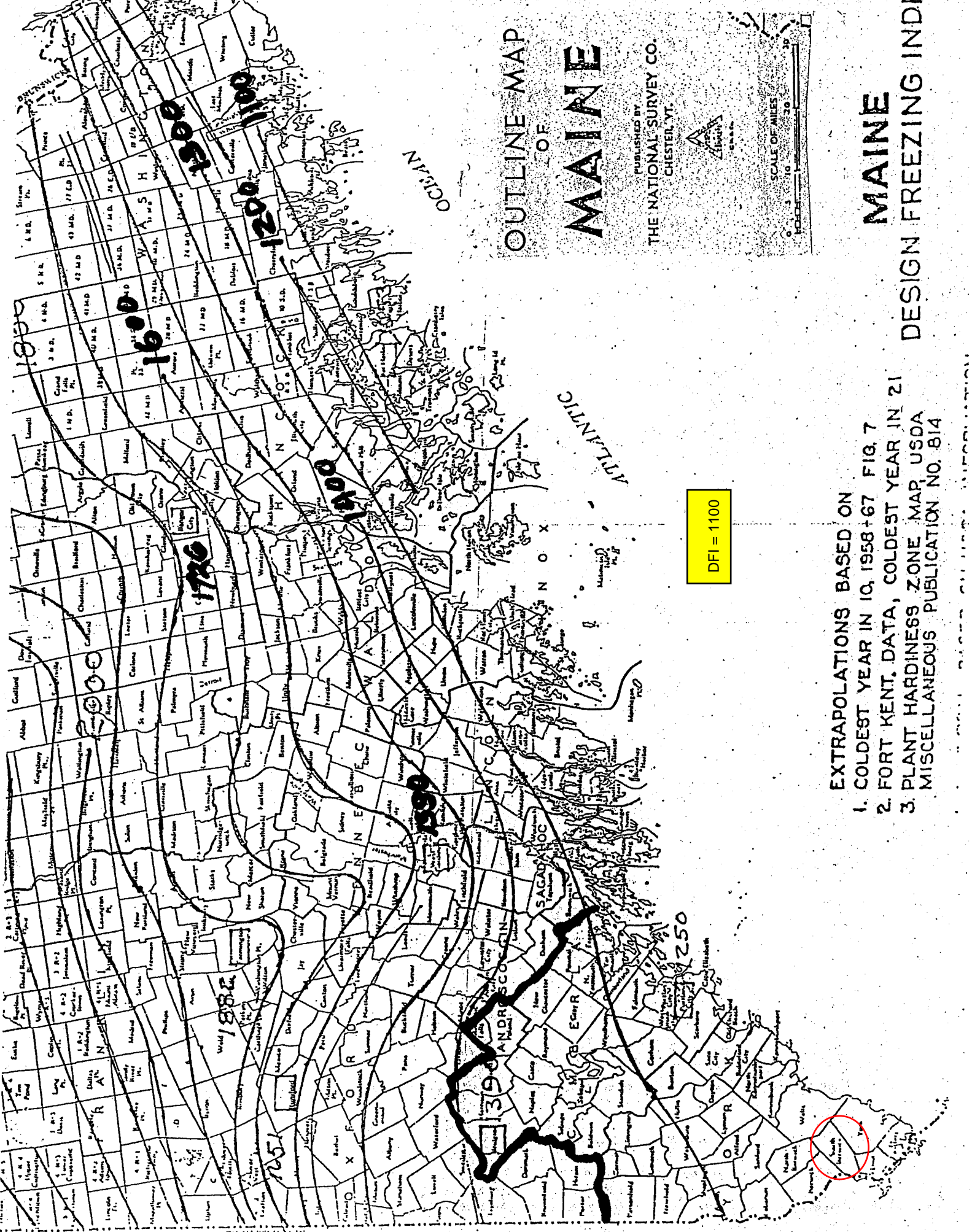
## MAP LEGEND

<b>Area of Interest (AOI)</b>	 Area of Interest (AOI)										
<b>Soils</b>	 Soil Map Units										
<b>Soil Ratings</b>	<table border="0"> <tr> <td></td> <td>High</td> </tr> <tr> <td></td> <td>Moderate</td> </tr> <tr> <td></td> <td>Low</td> </tr> <tr> <td></td> <td>None</td> </tr> <tr> <td></td> <td>Not rated or not available</td> </tr> </table>		High		Moderate		Low		None		Not rated or not available
	High										
	Moderate										
	Low										
	None										
	Not rated or not available										
<b>Political Features</b>	 Cities										
<b>Water Features</b>	<table border="0"> <tr> <td></td> <td>Oceans</td> </tr> <tr> <td></td> <td>Streams and Canals</td> </tr> </table>		Oceans		Streams and Canals						
	Oceans										
	Streams and Canals										
<b>Transportation</b>	<table border="0"> <tr> <td></td> <td>Rails</td> </tr> <tr> <td></td> <td>Interstate Highways</td> </tr> <tr> <td></td> <td>US Routes</td> </tr> <tr> <td></td> <td>Major Roads</td> </tr> <tr> <td></td> <td>Local Roads</td> </tr> </table>		Rails		Interstate Highways		US Routes		Major Roads		Local Roads
	Rails										
	Interstate Highways										
	US Routes										
	Major Roads										
	Local Roads										

## MAP INFORMATION

Map Scale: 1:3,490 if printed on A size (8.5" x 11") sheet.  
 The soil surveys that comprise your AOI were mapped at 1:20,000.  
 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: York County, Maine  
 Survey Area Data: Version 11, Jan 7, 2009  
 Date(s) aerial images were photographed: 8/24/2003  
 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.





OUTLINE MAP  
OF  
**MAINE**

PUBLISHED BY  
THE NATIONAL SURVEY CO.  
CHESTER, VT.



SCALE OF MILES  
0 5 10 20 30

**MAINE**  
DESIGN FREEZING INDEX

EXTRAPOLATIONS BASED ON

1. COLDEST YEAR IN 10, 1958+67 FIG. 7
2. FORT KENT DATA, COLDEST YEAR IN 21
3. PLANT HARDINESS ZONE MAP, USDA MISCELLANEOUS PUBLICATION NO. 814

DFI = 1100



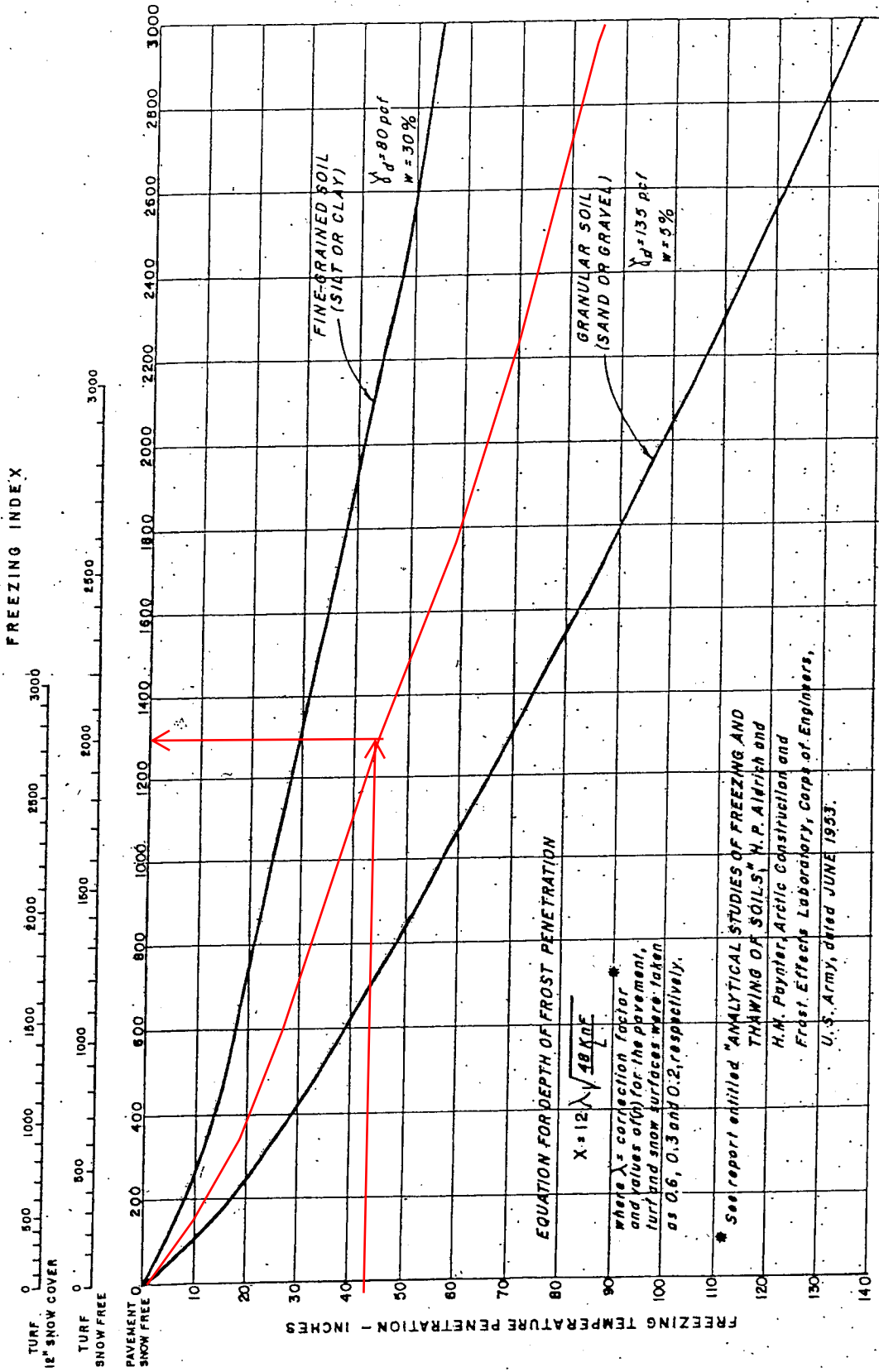


Figure 13-3 RELATIONSHIP BETWEEN FREEZING INDEX AND FREEZING TEMPERATURE PENETRATION FOR VARIOUS SURFACE CONDITIONS FOR GRANULAR AND FINE-GRAINED SOILS.

October 20, 2011

## Falling Weight Deflectometer (FWD) Summary Sheet

Project #: 17852.00  
Town(s): South Berwick  
Route(s): #232  
Date Tested: 06/29/2011  
Requested By: K. Gross  
Direction of Testing: South to North

# Of FWD tests: 17	# Of Power Augers/Spoons - 5
Design Life: N/A	Future 18-kip ESALs (Design Life): See Below
Initial Serviceability: N/A	Terminal Serviceability: N/A
Reliability Level: N/A	Overall Standard Deviation: N/A

Locations

Station (Feet)

Description

Used Project Stationing

**Comments:**

Subgrade Modulus values only.

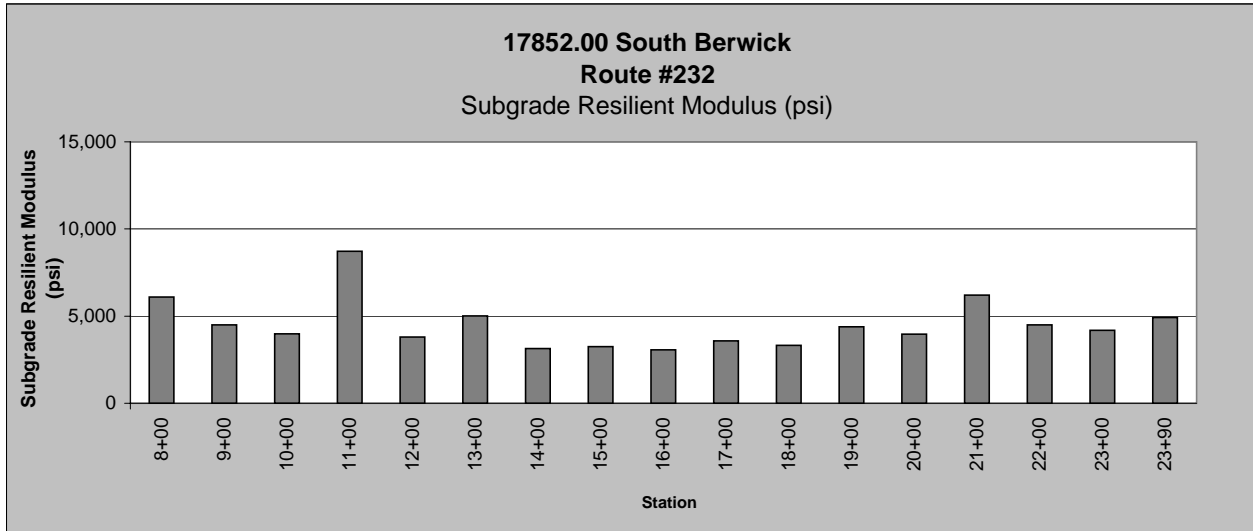
Pavement depths used for FWD analysis were taken from Ground Penetrating Radar (GPR) Estimated Pavement Depth Summary Sheet. Please see "Explanation of GPR Data Collection and Analysis" located at the top of the Sheet for details on how the estimated pavement depths were developed.

17852.00  
South Berwick  
Route #232

October 20, 2011

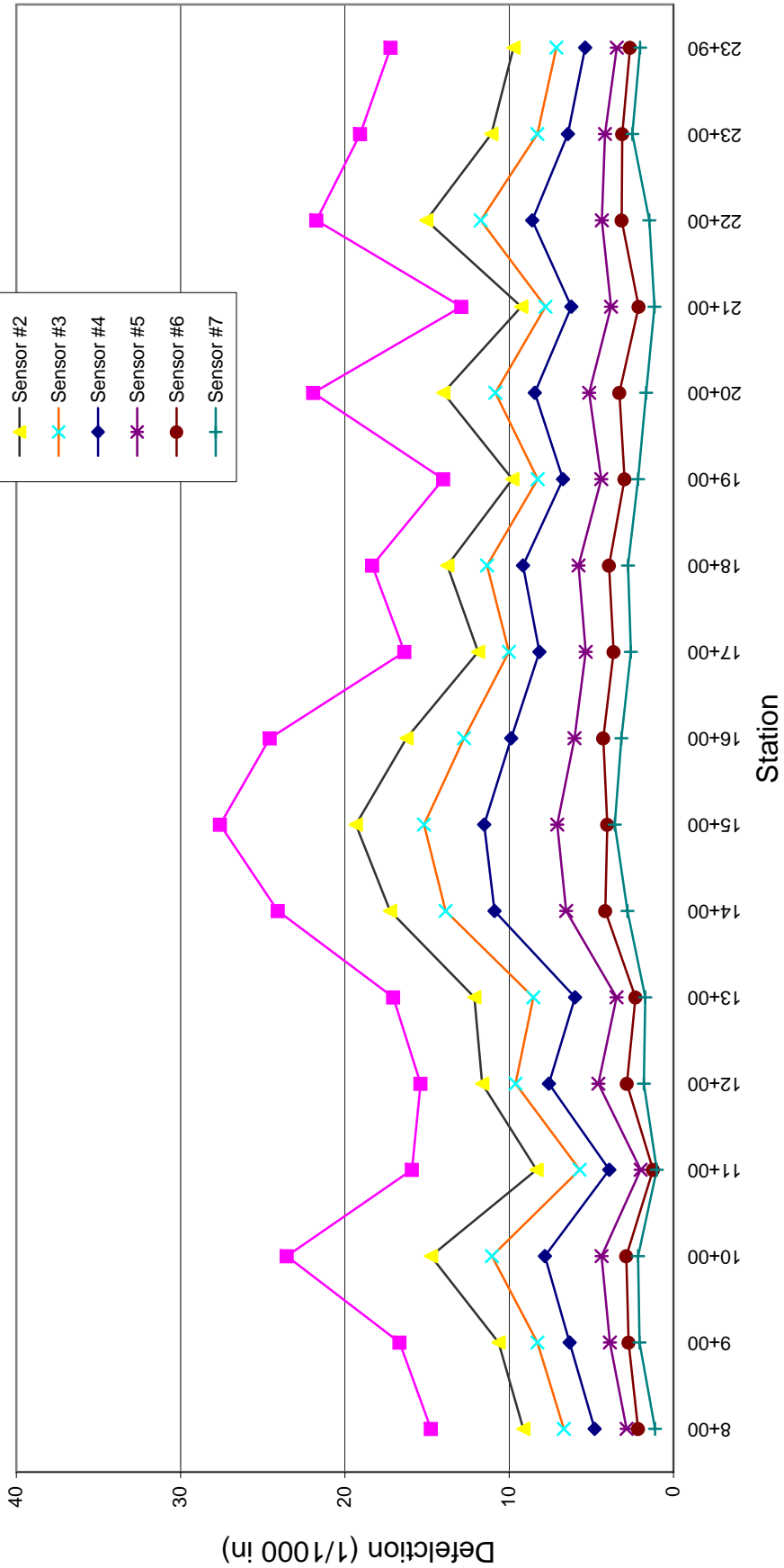
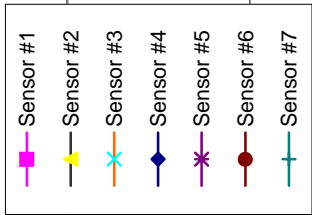
Station (Feet)	Subgrade Resilient Modulus (psi)	Pavement Depth (in.) From GPR Estimate	* Combined Pavement/Gravel Depth Used for Calculation (in.)
8+00	6,092	6.5	25.5
9+00	4,499	6.5	25.5
10+00	3,977	6	25
11+00	8,721	7.1	26.1
12+00	3,809	6.7	25.7
13+00	5,014	7.1	26.1
14+00	3,148	6.9	27.9
15+00	3,242	6.7	27.7
16+00	3,058	6.7	27.7
17+00	3,575	7.1	28.1
18+00	3,330	7.5	28.5
19+00	4,387	7.6	28.6
20+00	3,959	7.2	28.2
21+00	6,210	7.2	28.2
22+00	4,498	7.2	30
23+00	4,177	7	30
23+90	4,925	7	30

\* For actual Gravel Depths, see attached logdraft forms



WIN 17852.00  
South Berwick  
Route #236

6/29/11



**17852.00 South Berwick - Route #236**  
**Estimated Pavement Thickness**  
**Ground Penetrating Radar (GPR)**

**Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:**

For Project 17852.00 (South Berwick), GPR data was collected in the right and left wheel path in both the North and South bound lanes. Data was collected at ½ foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from geotechnical borings collected by MaineDOT personnel were used in developing the estimated GPR pavement thicknesses.

**GPR pavement thickness averages are to be considered for estimating purposes only.**  
**Actual pavement thickness may vary.**

Analysis Distance (ft) - 100

**17852.00 South Berwick - Route #236**

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
8+00	9+00	6.5	23+00	23+99	7.0			
9+00	10+00	6.0						
10+00	11+00	6.8						
11+00	12+00	7.1						
12+00	13+00	6.7						
13+00	14+00	7.1						
14+00	15+00	6.9						
15+00	16+00	6.7						
16+00	17+00	7.1						
17+00	18+00	7.5						
18+00	19+00	7.6						
19+00	20+00	7.2						
20+00	21+00	7.2						
21+00	22+00	7.5						
22+00	23+00	7.2						