Maine Department of Transportation
Highway Program

GEOTECHNICAL 100 SERIES REPORT

Route 197
Richmond, Maine

Prepared by:
Scott A. Hayden, C.G.
Soils Research Scientist

Sagadahoc County | WIN 19138.00 | Soils Report # 2012-117

March 9, 2012

Highway Program

Brad Foley, Program Manager

Memorandum

DATE: March 9, 2012

TO: Shawn Smith **DEPT:** Region 2

FROM: Scott A. Hayden **DEPT:** Highway Program

SUBJECT: Final Soils: Richmond, Route 197, WIN 19138.00
Report # 2012-117

Project Description

A subsurface investigation has been completed for a 2.83 mile portion of Route 197 in the town of Richmond. The project begins at the intersection of Ridge Road (RLM 12.05) and extends 2.83 miles southeast.

The investigation included the use of a drill rig, ground penetrating radar (GPR) and falling weight deflectometer (FWD). No stationing was available at the time of the field work so a starting station of 0+00 was designated. All station reference used for data collection was determined using a distance measuring instrument (DMI). All offsets were measured from the centerline of the existing roadway.

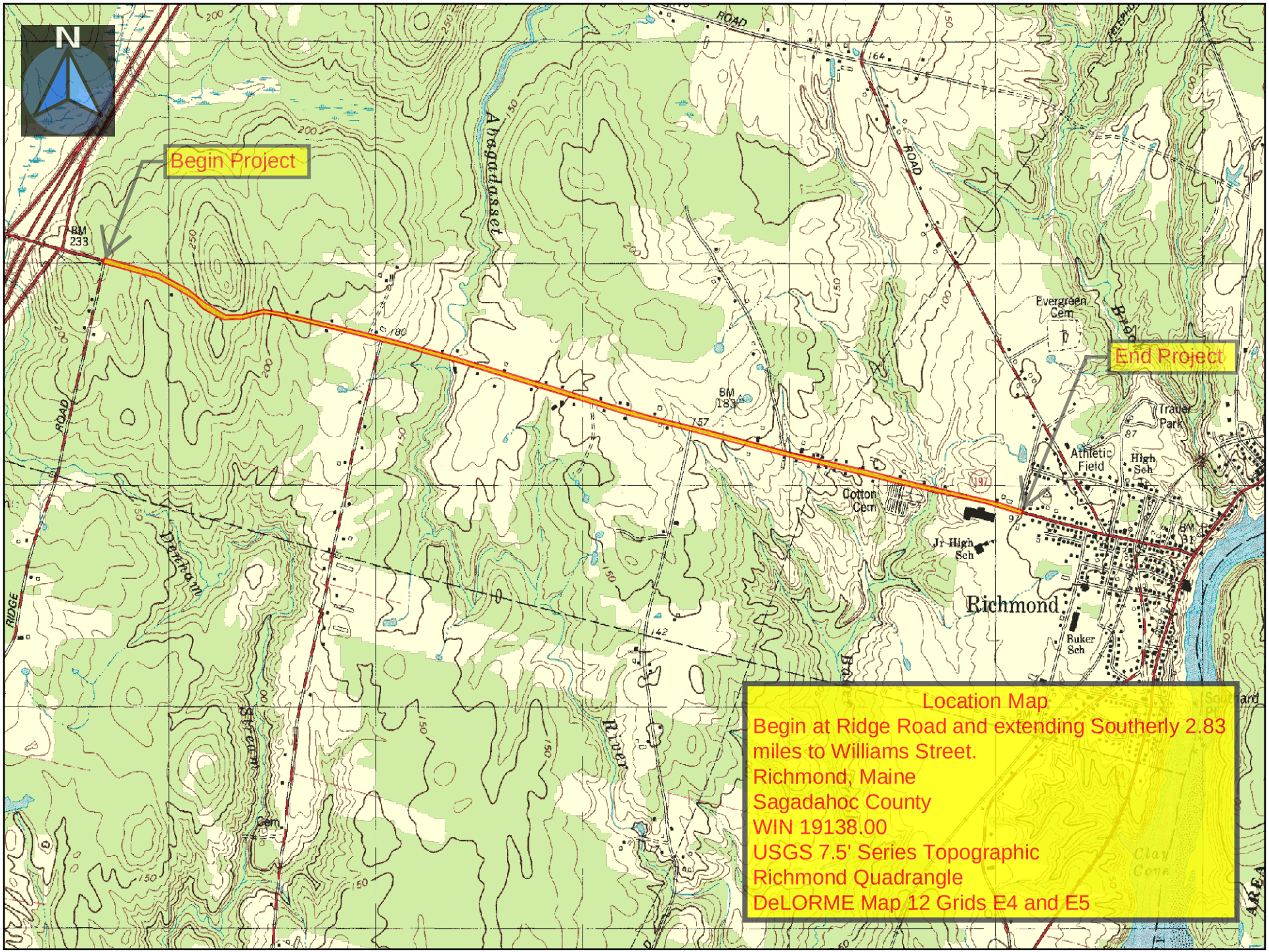
Existing Pavement Conditions

The existing roadway consists of two 11-foot travel lanes painted at 10.5 feet. Ten-foot paved shoulders are present for the first 700' of the project and then transition to 3-4 foot overgrown gravel shoulders. These gravel shoulders are uneven and drop off. Pavement conditions have been masked by extensive shimming. These shims extend from the edge of pavement to the inside wheel path in both lanes. The shimmed areas are located between stations 47+00 and 150+00 (See attached Shim Locations Listing). Based on the 2011 ARAN data these shims were necessarily due to severe rutting and cracking. Poor pavement conditions are likely due to poor drainage, inadequate base thickness, moist to wet subgrade soil conditions, truck / traffic loading, fatigue, frost effects, and the lack of paved shoulders.

ARAN data was collected for this project in 2011 prior to shimming activity. A summary of this data is presented in Table 1. A complete listing of the ARAN data has been attached on the following page.

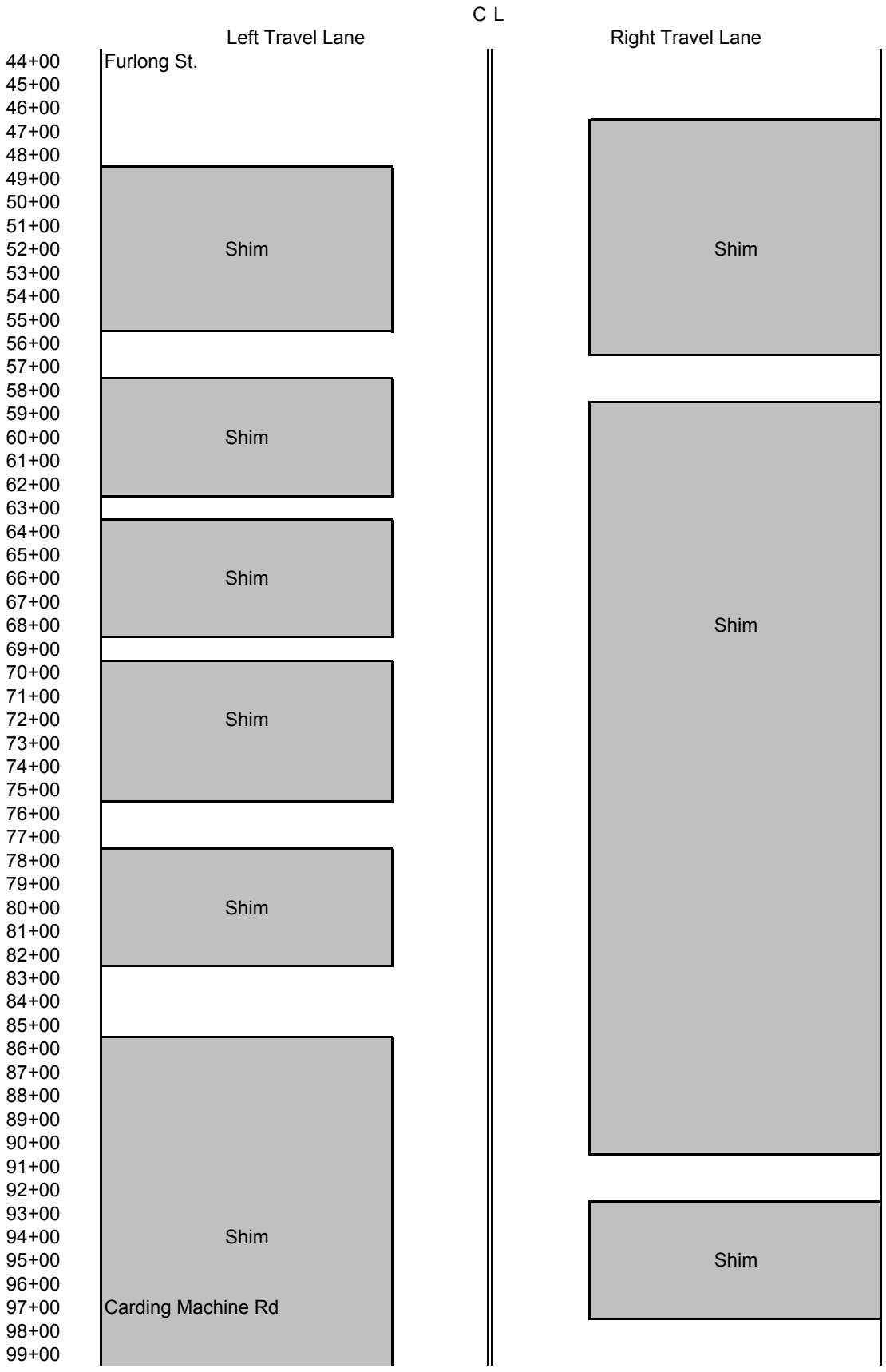
Table 1: Summary of 2010 ARAN Pavement Data

ARAN Pavement Data	Range	Average
Pavement Condition Rating (PCR)	2.34 – 3.59	2.97
International Roughness Index (IRI)	148 - 315	251
Rut Depth (right)	0.3" – 0.8"	0.5"
Rut Depth (left)	0.1" – 0.2"	0.13"

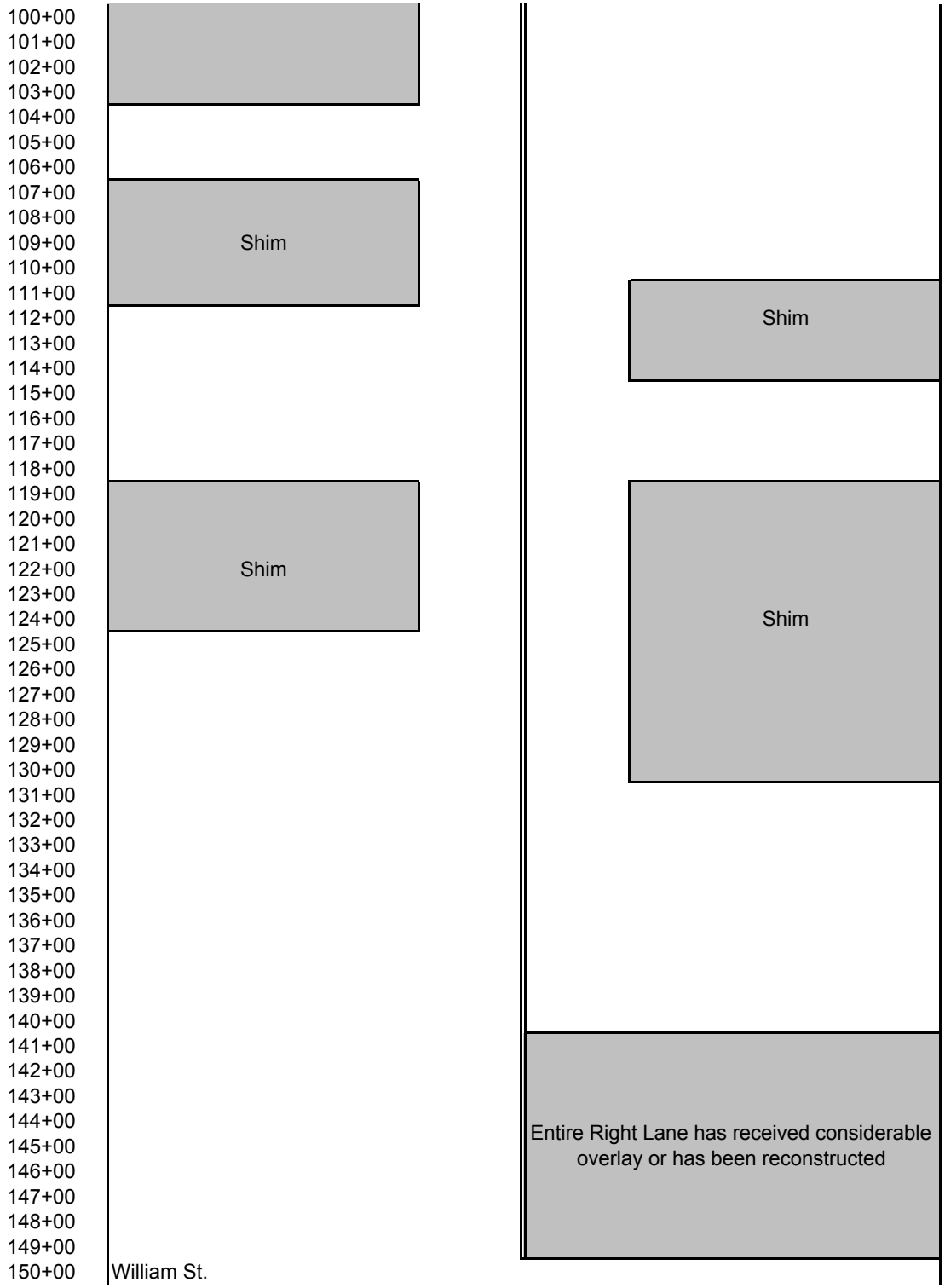


Map Scale 1:24000

Richmond Rte. 197
19138
Shimmed Locations



Richmond Rte. 197
19138
Shimmed Locations



ARAN DATA

Richmond Rte 197
19138.00

				ARAN DATA			
Station	**RLM**	**Inv Yr**	**Def**	**PCR < 3.5**	**IRI > 150**	**Rut Depth > 0.5"**	
						Left	**Right**
						(in.)	(in.)
0+00	12.05	2011	0	3.59	148	0.2	0.3
3+70	12.12	2011	0	3.59	148	0.2	0.3
4+22	12.13	2011	2	2.76	273	0.1	0.3
4+75	12.14	2011	2	2.76	273	0.1	0.3
5+28	12.15	2011	2	2.76	273	0.1	0.3
20+06	12.43	2011	2	2.76	273	0.1	0.3
34+85	12.71	2011	3	2.34	315	0.1	0.8
38+54	12.78	2011	3	2.34	315	0.1	0.8
43+82	12.88	2011	3	2.34	315	0.1	0.8
45+94	12.92	2011	3	2.34	315	0.1	0.8
56+50	13.12	2011	3	2.34	315	0.1	0.8
57+02	13.13	2011	3	2.34	315	0.1	0.8
65+47	13.29	2011	3	2.7	267	0.1	0.7
68+64	13.35	2011	3	2.7	267	0.1	0.7
96+62	13.88	2011	2	3.36	206	0.1	0.3
109+82	14.13	2011	2	3.36	206	0.1	0.3
111+41	14.16	2011	2	3.36	206	0.1	0.3
116+69	14.26	2011	3	3.17	239	0.1	0.5
123+55	14.39	2011	3	3.17	239	0.1	0.5
135+70	14.62	2011	3	3.17	239	0.1	0.5
136+22	14.63	2011	2	3.29	233	0.2	0.4
137+28	14.65	2011	2	3.29	233	0.2	0.4
137+81	14.66	2011	2	3.29	233	0.2	0.4
146+26	14.82	2011	2	3.29	233	0.2	0.4
147+84	14.85	2011	2	3.29	233	0.2	0.4
148+37	14.86	2011	2	3.29	233	0.2	0.4
149+42	14.88	2011	2	3.29	233	0.2	0.4
AVERAGE				**2.97**	**251**	**0.13**	**0.49**

Pavement Condition Rating (PCR)

PCR is defined as the composite condition of the pavement on a roadway. The PCR is compiled from the severity and extent of pavement distresses such as cracking, rutting, and ride quality. The rating system uses a scale of 5.00 (perfect) to 0.00 (fully deteriorated). The PCR is the condition of the pavement only, not necessarily a reflection of the condition of the roadway base structure (See Table 2).

Table 2: Pavement Condition Rating (PCR) Description

Scale Value	Scale Rating	Description
5	Excellent	New or nearly new pavements. Free of cracks, patches or rutting.
4	Good	Pavements exhibit little to no visible signs of surface deterioration. Evidence of initial cracking or rutting.
3	Fair	Visible defects including moderate cracking, distortion and rutting. Some patching may now be present.
2	Poor	Pavement deterioration consisting of advanced cracking and severe distortion. Extensive patching and rutting also present.
1	Very Poor	Extremely deteriorated pavements. Defects include severe cracking, distortion, rutting and typically very extensive patching.

The PCR rating for this project ranges from 2.34 – 3.59 with an average PCR of 2.97. The lowest PCR values (2.34) were encountered between stations 34+00 – 57+00.

International Roughness Index (IRI)

Ride quality is expressed in terms of International Roughness Index (IRI) and is measured in inches per mile. IRI is a measurement of the inches of vertical displacement experienced by a vehicle in a mile of roadway. The lower the IRI, the smoother the ride will be (See Table 3).

Table 3: IRI Rating Scale

IRI Value (In./mile)	**Ride Rating**
< 100	Good Ride
100 - 170	Fair Ride
> 170	Poor Ride

The IRI value for this project ranged between 148 - 315 in/mile with an average IRI value of 251 in/mile. The poorest IRI values were encountered between stations 34+00 – 57+00

Wheel Path Rutting Values

Wheel path rutting values are measured in inches and are presented in the ARAN pavement data every 50 feet. Rutting depths ranged between 0.1” – 0.2” in the inside wheel path and 0.3” – 0.8” in the outside wheel path. The worse rutting was encountered in the outside wheel path between stations 34+00 – 69+00 and 116+00 – 136+00.

FWD Analysis

Existing pavement performance and subgrade soil conditions are poor throughout much of this project. This is especially apparent beyond station 35+00 (See attached FWD Analysis and Performance Data Summary).

No project specific traffic data was available for this project at the time of the FWD analysis. Traffic data from a location west of High School Drive (bridge #3519) was considered the best available representative information. The FWD analysis was conducted using an 18-kip P2.5 value of 139 and a future ESAL's of 608,820 for a 12 year design. Pavement depths used for DARWin analysis were taken from Ground Penetrating Radar Summary sheets. A summary of the FWD analysis is shown in Table 4.

Table 4: Summary of FWD Analysis

Design Variables	% Fail	Range	Average	75 Percentile
Existing SN Fails to Meet Future SN	49%			
Pavement Modulus (psi)		36,095 – 522,225	161,160	96,800
Subgrade Resilient Modulus (psi)		1,876 – 7,574	3,935	2,930

Note: Mr Values > 8000psi were not included in the above calculations

Structural Number - The existing structural number fails to meet the future traffic structural number for 49% of this project (See attached FWD summary sheets).

Subgrade Resilient Modulus – Subgrade Resilient Modulus values range between 1,876 psi and 7,574 psi. A subgrade resilient modulus of 2,930 psi represents the 75th percentile. A 75th percentile value of 2,930 is very low.

Very low (<3000psi) subgrade resilient modulus values (Mr) were encountered throughout 28% of this project. It is anticipated that these low values are due to moist to wet, moisture sensitive, clay silt subgrade soils. These low Mr values could create long term challenges in meeting future pavement performance expectations and could result in short term construction issues. Depending on the subgrade conditions at the time of construction, the roadway in these low Mr areas may be at high risk of failure, due to the pumping of subgrade soils, if the pavement is removed as part of the PMRAP process and the unpaved roadway is subjected to traffic loading. As a result, additional base material would be necessary throughout extended portions of this project in order to support traffic while the roadway remains unpaved. The areas of greatest concern are listed in Table 5 below.

Table 5: Areas of Low Subgrade Resilient Modulus Values

41+50 – 43+50	94+00 – 96+00
51+50 – 73+50	120+00 – 133+50
86+50 – 88+50	

Boring/Coring/GPR Information

Subsurface explorations were conducted by Maine DOT using a CME 45C truck mounted drill rig. Bore hole logging was performed by Maine DOT. The purpose of the subsurface investigation is to obtain subsurface soil, bedrock, and ground water information.

A total of 8 power augers borings were conducted along the project (See Boring Logs). Power auger borings were conducted using 5" solid stem augers. Boring locations were determined based upon FWD deflection results and visual observations made during an on-site visit. Soils were described and sampled from the auger flights.

A total of 10 soil samples were collected from the power auger borings and tested at the Maine DOT Materials and Testing laboratory, located in Bangor Maine. Grain size and water content testing was conducted on each sample. Based upon laboratory test results, soil samples were classified according to the Unified Classification System, AASHTO Soil Classification and Maine DOT Frost Susceptibility Rating. Testing results are summarized on the attached Laboratory Testing Summary Sheet.

Existing HMA Thickness

Existing pavement thickness estimates have been provided using pavement core data, power auger boring data, and ground penetrating radar (GPR) data. See Table 6 for a summary comparison of existing pavement thickness estimates derived from coring/boring data and the GPR data.

Coring/Auger Data – Twenty-nine pavement cores and 8 power auger borings were used to physically measure the existing pavement thickness. Pictures of the pavement cores have been included at the back of this report.

GPR Data – Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores were used in developing the estimated GPR pavement thicknesses. GPR data was collected in the left and right wheel path of both the East and West bound lanes. Data was collected at high speed using an air launch antenna at 1 foot intervals along the entire project. This information was then consolidated to provide an average pavement thickness estimate every 100 feet (See attached GPR Pavement Thickness Estimates).

Table 6: Pavement Thickness Summary/Comparison

	Left Lane	**Right Lane**
Pavement Core/Auger Data		
Range of Thickness	4.5" – 11.0"	4.0" – 11.0"
Average Thickness	8.0"	7.3"
Ground Penetrating Radar Data		
Range of Thickness	5.6" – 9.9"	
Average Thickness	7.5"	

Existing Roadway Base

Existing Base Material Type:	silty gravelly SAND, A-1-b
Percent Passing #200:	3% - 17%
Range of Base Material Thickness:	4" – 29"
Average Thickness:	13.4"
Quality of Drainage (AASHTO):	poor to good
Permeability:	4' – 113' per day

The existing roadway base generally consists of silty gravelly SAND classified as (AAASHTO) an A-1-b soil. Percent passing the #200 sieve ranged from 3% - 29%. The estimated permeability of the base material has been calculated to be 4' – 113' per day using grain size distribution curves from obtained samples. These permeability values equate to a poor to good quality of drainage rating (1993, AASHTO Guide for Design of Pavement Structures). As a comparison, a base material meeting the "excellent quality of drainage" criteria provides a minimum permeability of 1000 ft/day.

The average thickness of the existing base is 13.4". However, this value is misleading. Within the most venerable portion of this project (35+00 – 139+00) where the underlying subgrade soils consist of moisture sensitive clay SILT soils, the existing base thickness ranged between 3.6" and 9.8" with an average thickness of only 7.0". The existing base thickness in this area is seriously inadequate. Design and construction decisions should consider this when developing performance expectations related to strength.

Subgrade Soils

Based upon power auger boring data, subgrade soils consist of silty SAND (glacial till) and clay SILT (glaciolacustrine).

Silty SANDS

These soils are derived from glacial till and are classified (AASHTO) as A-1-b and A-4 soils. These soils can perform adequately as a subgrade soils if they are properly compacted and drained. However, as the silt content in the sands exceeds 35% passing the #200 sieve, (A-4) these soils can lose stability if they are not properly compacted and drained. These silty SAND subgrade soils are anticipated to be encountered between stations 0+00 – 35+00 and 139+00 – 149+00.

Clay SILTS

These fine soils were deposited as lake bottom sediments during the last glaciation. These soils are very silty with 81% – 97% passing the # 200 sieve and are highly frost susceptible. These plastic soils are very sensitive to moisture and have high volume changes between wet and dry states. They have a high dry strength but lose much of this strength upon absorbing water. These soils are poorly drained and were found to be wet in October when the power auger borings were conducted.

FWD testing indicates that these soils have a very low (<3000 psi) subgrade resilient modulus value (See FWD Data). If these soils are not well drained long term pavement performance expectations may not be realized. In addition, these soils could create construction issues due to their moisture sensitivity. Depending on subgrade soil conditions at the time of construction there is a high risk that the existing roadway could fail due to the pumping of these subgrade soils if the pavement surface is removed

during the PMRAP process and the unpaved roadway is subjected to traffic loading. Additional base material would then be required to support traffic loading.

It is anticipated that these clay SILT subgrade soils will be encountered between stations 35+00 – 139+00. The areas of greatest concern are between the following stations:

41+50 – 43+50
51+50 – 73+50
86+50 – 88+50
94+00 – 96+00
120+00 – 133+50

It is critical that these subgrade soils be well drained. This will require the construction or reconstruction of deep (3' below the top of pavement) ditches.

Bedrock

Limited power auger borings were conducted along this project. Borings generally penetrated 5' without encountering any refusals. FWD testing was conducted every 250' along the project. Low FWD deflections and high Mr values can indicate the potential presence of shallow bedrock. Based on FWD data bedrock may be potentially shallow (< 6') at the following locations:

Station	Source	Comment
9+00 – 21+00	FWD	High Mr values, low deflections
16+75 – 18+00	Visual	Bedrock outcrop on left
69+00 – 71+00	FWD	Low deflections
97+00 – 101+00	FWD	Low deflections
106+50 – 108+50	FWD	High Mr values, low deflections

Drainage

Existing ditching is inadequate and overgrown throughout the project area. As previously detailed in the subgrade soil discussion drainage to remove surface and subsurface water is critical for the short term and long term success of this project. Ditch construction to a minimum depth of 3' below top of pavement is recommended.

Performance Data Summary

Based upon the attached Performance Data Summary sheets, 54 % of the project fails to meet 2 or more of the four minimum performance data criteria. Pavement performance in these areas is likely to be low and the risk of failure is likely to be higher. The areas of greatest concern are listed below:

41+50 – 43+50	94+00 – 96+00
51+50 – 73+50	120+00 – 133+50
86+50 – 88+50	

Please refer to the Performance Data Summary (PDS) sheets on the following pages.

The purpose of the PDS is to identify potential performance differences station by station based on 4 minimal performance criteria obtained from subsurface exploration data and falling weight deflectometer (FWD) data.

The PDS sheets are color coded and should be printed in color to fully utilize the information. Green indicates the minimum performance criteria have been met. Red indicates the minimum performance criteria have failed to be met. The total number of failed performance criteria is presented in the deficient column (DEF) for each FWD test station.

If an area fails to meet 2 or more of the minimal performance criteria the area is shaded in the deficiency column (DEF). It is anticipated that existing pavement performance will be less in these shaded areas. In addition, the risk of future pavement failure could also be higher.

Performance Data Summary

Richmond Rte. 197
19138.00

Station (FWD)	D E F	Minimum Performance Data Criteria				Boring Location (Plan View)	Base Material		Subgrade Soils	
							AASHTO Class	% #200	AASHTO Class	% #200
						KEY				
Station		Red – Fail Green - Met				Solid Pave Thick Unbound Pave - UP Base Thickness (inches)	Soil Type AASHTO Sample #	% 200 Frost Moisture	Soil Type AASHTO Sample #	% 200 Frost Moisture
						CL				
2+50	0	Pavement Thickness (4 inches)	Base Thickness (18 inches)	Subgrade Modulus (3000 psi)	Structural Number					
5+00	0									
7+51	0					5.0 SP - 22.6	SiGSa A-1-b S1	12 0 Damp	SiSa A-4 S2	41 III Moist
10+00	0									
12+50	0						Possible Shallow Bedrock Bedrock Outcrop 16+75 – 18+00			
15+00	0									
17+50	0									
20+00	0					7.0 SP - 20.6	SiGSa A-1-b S1	12 0 Damp	GSiSa A-1-b S3	21 II Damp
22+51	0									
25+01	0									
27+54	0									
30+01	0									
32+50	0									
35+00	1									
37+50	2									
40+05	2					4.6 SP - 9.8	SiGSa A-1-b S1	12 0 Damp	ClSi A-6 S4	82 IV Wet 1.2’
42+51	3									
45+00	2									
47+50	2									
50+01	2									
52+51	3									
55+00	3									
58+10	2									
60+00	3					6.0 SP - 3.6	SiGSa A-1-b S5	3 0 Damp	ClSi A-6 S6	97 IV Wet 0.8’

* SP = Solid Pavement Layer
* UP = Unbound Pavement Layer
SP+UP = Total Pavement Thickness
* Base Thickness = Red indicates presence of “treated base”

Performance Data Summary

Richmond Rte. 197
19138.00

Station (FWD)	D E F	Minimum Performance Data Criteria				Boring Location (Plan View)	Base Material		Subgrade Soils	
							AASHTO Class	% #200	AASHTO Class	% #200
						KEY				
Station		Red – Fail Green - Met				Solid Pave Thick Unbound Pave - UP Base Thickness (inches)	Soil Type AASHTO Sample #	% 200 Frost Moisture	Soil Type AASHTO Sample #	% 200 Frost Moisture
		Pavement Thickness (4 inches)	Base Thickness (18 inches)	Subgrade Modulus (3000 psi)	Structural Number	**CL**				
60+00	3					6.0 SP - 3.6	SiGSa A-1-b S5	3 0 Damp	ClSi A-6 S6	97 IV Wet 0.8’
62+54	3									
65+02	3									
67+50	3									
70+01	3						Possible Shallow Bedrock (FWD Deflections)			
72+50	3									
75+00	1									
77+54	1									
80+00	2					8.0 SP - 8.8	SiGSa A-1-b S1	12 0 Damp	ClSi A-6 S6	97 IV Moist
82+66	2									
85+05	2									
87+50	3									
90+00	2									
92+50	1									
95+01	3					7.0 SP - 7.4	SiGSa A-1-b S7	6 0 Damp	ClSi A-6 S8	81 IV Moist
97+52	1						Possible Shallow Bedrock (FWD Deflections)			
100+00	2									
102+80	1									
105+00	1									
107+53	1						Possible Shallow Bedrock (FWD Deflections)			
110+00	2									
112+51	2									
115+02	2									
117+50	1									
120+00	2					7.6 SP - 5.6	SiGSa A-1-b S7	6 0 Damp	ClSi A-6 S8	81 IV Moist

* SP = Solid Pavement Layer
* UP = Unbound Pavement Layer
SP+UP = Total Pavement Thickness
* Base Thickness = Red indicates presence of “treated base”

Performance Data Summary

Richmond Rte. 197
19138.00

Station (FWD)	D E F	Minimum Performance Data Criteria				Boring Location (Plan View)	Base Material		Subgrade Soils	
							AASHTO Class	% #200	AASHTO Class	% #200
						KEY				
Station		Red – Fail Green - Met				Solid Pave Thick Unbound Pave - UP Base Thickness (inches)	Soil Type AASHTO Sample #	% 200 Frost Moisture	Soil Type AASHTO Sample #	% 200 Frost Moisture
						CL				
120+00	2	Pavement Thickness (4 inches)	Base Thickness (18 inches)	Subgrade Modulus (3000 psi)	Structural Number	7.6 SP - 5.6	SiGSa A-1-b S7	6 0 Damp	ClSi A-6 S8	81 IV Moist
122+50	3									
125+05	3									
128+14	2									
130+01	3									
132+50	3									
134+98	1									
137+73	1									
140+01	0									
142+59	0									
145+26	0					9.5 SP - 28.9	SiGSa A-1-b S9	17 II Damp	GSaSi A-4 S10	54 IV Wet 3.2’
147+50	0									

* SP = Solid Pavement Layer
* UP = Unbound Pavement Layer
SP+UP = Total Pavement Thickness
* Base Thickness = Red indicates presence of “treated base”

Conclusions

1. Poor pavement performance is primarily due to inadequate existing base thickness, moisture sensitive clay silt subgrade soils, and inadequate drainage.

2. Drainage to remove surface and subsurface water is critical to the long term success of this project. Ditch construction to a minimum depth of 3' below top of pavement is recommended.

3. The Performance Data Summary (PDS) indicates that 54 % of the project fails to meet 2 or more of the four minimum performance data criteria. Inadequate base thickness, low subgrade resilient modulus and a low existing structural number are the primary performance deficiencies identified on the PDS. Refer to the PDS for those areas failing to meet 2 or more of the performance data criteria.

4. ARAN data indicates that existing pavement conditions are poor with moderate to severe fatigue/longitudinal cracking and rutting. The poorest ARAN results were encountered between stations 35+00 and 136+00.

5. A FWD analysis indicates very low (<3000psi) subgrade resilient modulus values (Mr) were encountered throughout 28% of this project. These low Mr areas could represent long term challenges in meeting future pavement performance expectations giving the current scope of this project. In addition, short term construction issues could arise in these low Mr areas if the existing pavement is removed during the PMRAP process. Low Mr values were encountered between the following stations:

41+50 – 43+50	94+00 – 96+00
51+50 – 73+50	120+00 – 133+50
86+50 – 88+50	

   Depending on the subgrade conditions at the time of construction, these areas could be at high risk of failure during construction if the existing pavement surface is removed during the PMRAP process and the unpaved roadway is subjected to traffic loading.

February 9, 2012

Falling Weight Deflectometer (FWD)
Summary Sheet

Project #: 19138.00
Town(s): Richmond
Route(s): #197
Date Tested: 08/19/2011
Requested By: S Hayden
Direction of Testing: West to East

Of FWD tests: 59 # Of Power Augers/Spoons - 8
Design Life: 12 Future 18-kip ESALs (Design Life): 608,820
Initial Serviceability: 4.5 Terminal Serviceability: 2.5
Reliability Level: 90% Overall Standard Deviation: .45

Locations

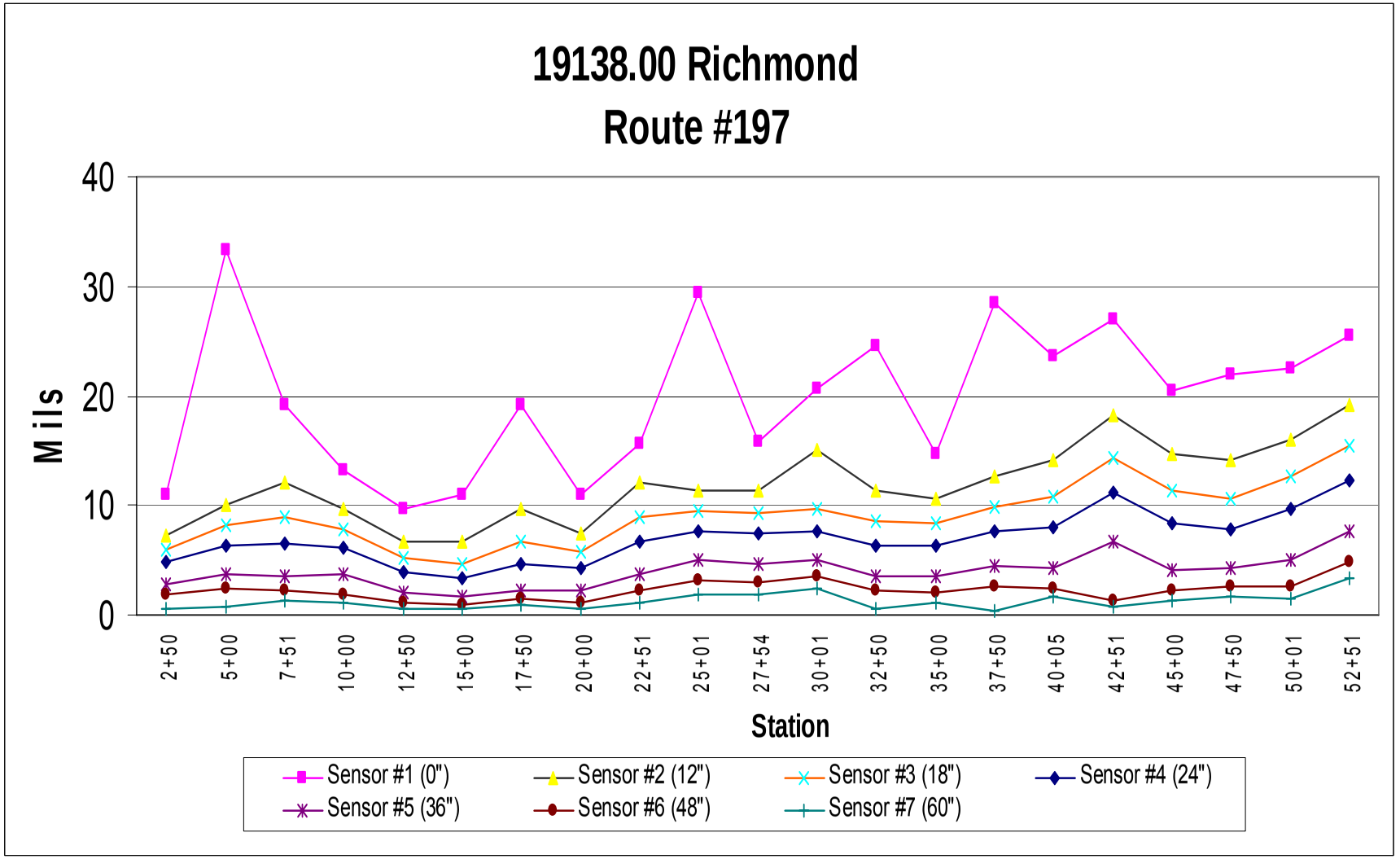
Station (Feet)	Description

Comments:

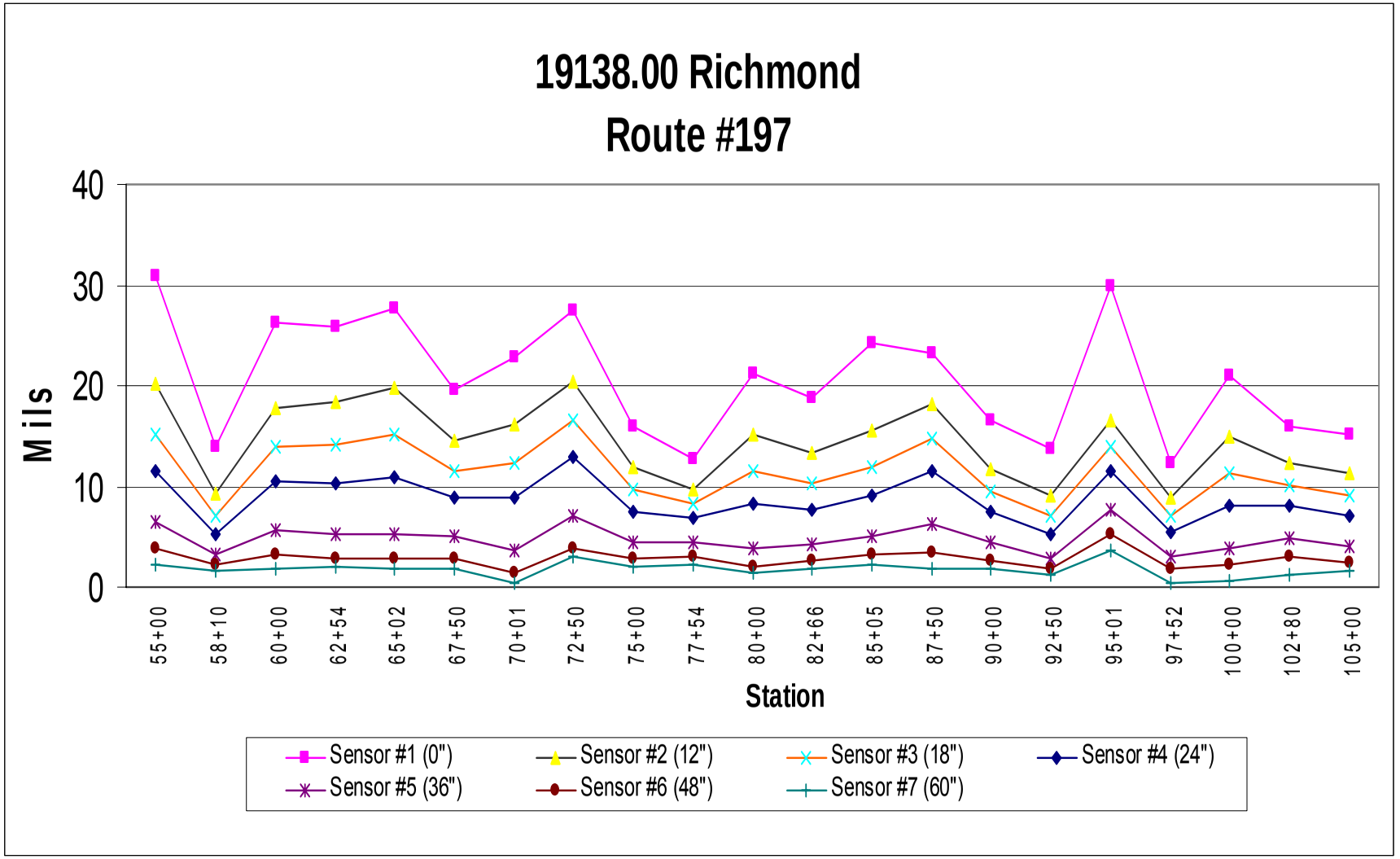
No project specific traffic data was available for this project at the time of the FWD analysis. Traffic data from a location west of High School Drive (bridge #3519) was considered the best available representative information. The 18-kip P2.5 value was 139. Future ESAL's were calculated for a 12 year design (608,820).

Pavement depths used for DARWin analysis were taken from Ground Penetrating Radar Summary sheets.

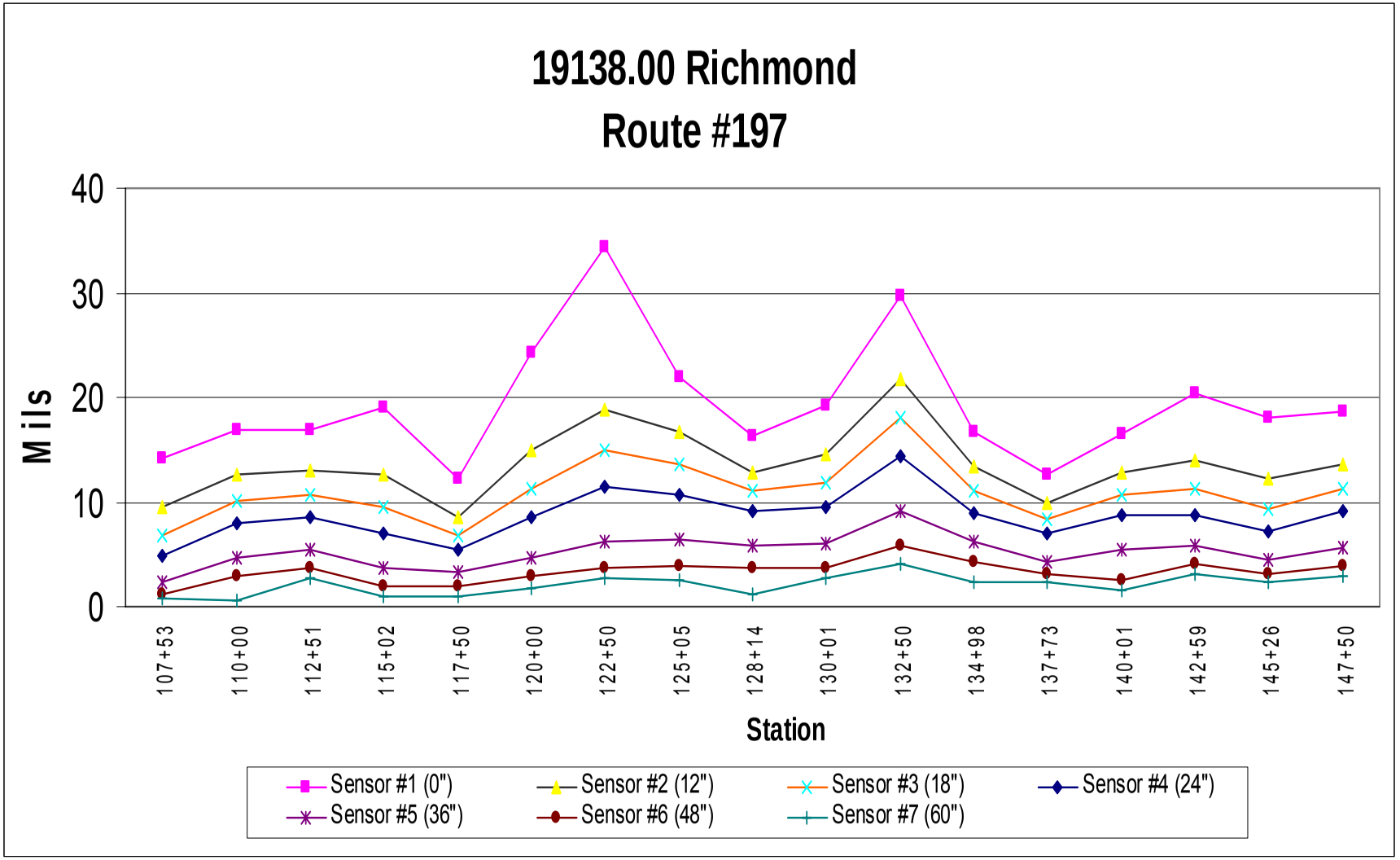
FWD Deflection Plots



FWD Deflection Plots



FWD Deflection Plots

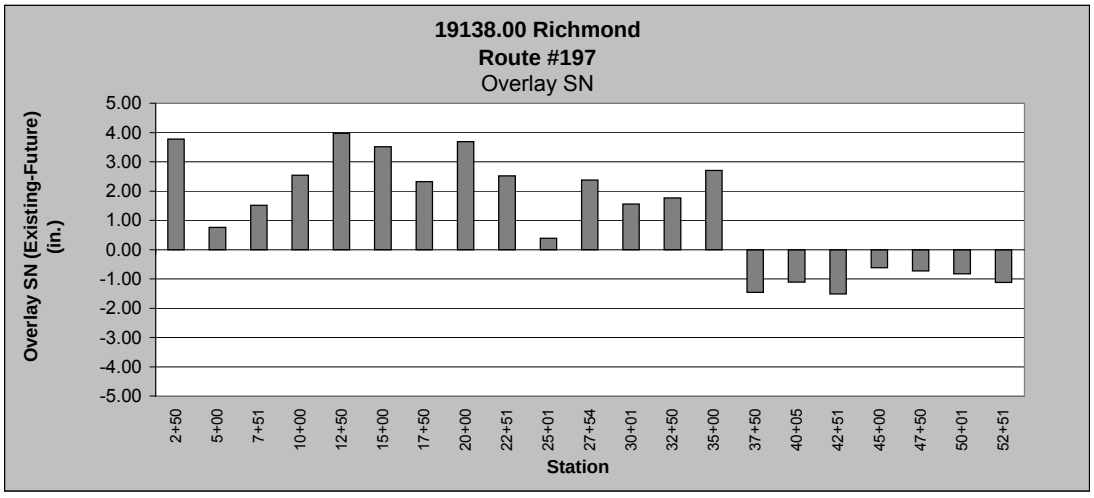


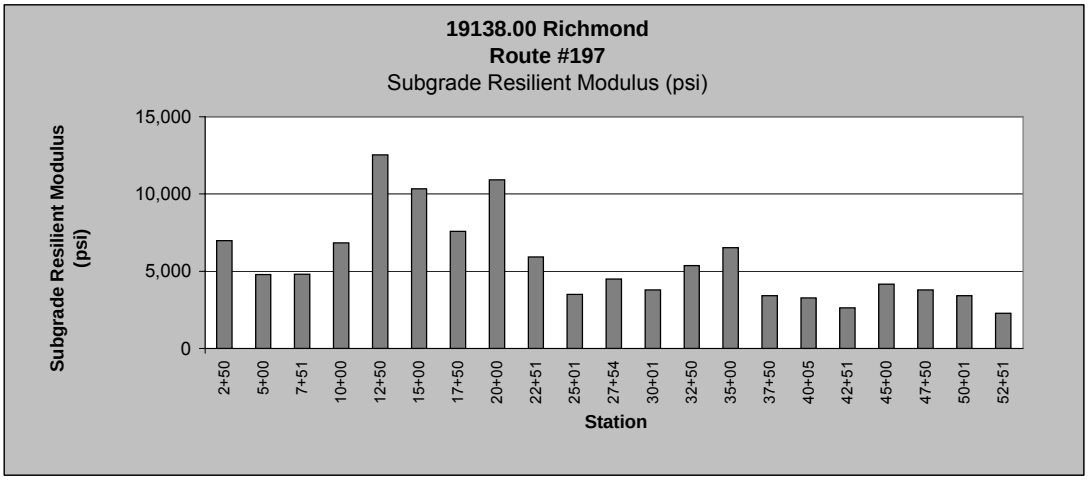
19138.00 Richmond
Route #197

Station (Feet)	Existing Structural Number (in.)	Future Traffic Structural Number (in.)	Overlay Structural Number (Existing - Future)	Recommended Pavement Thickness (in.)	Pavement Modulus (psi)	Subgrade Resilient Modulus (psi)	Pavement Depth (in)	Combined Pavement/Gravel Depth Used for Calculation (in)
2+50	6.98	3.20	3.78	-	138,284	6,991	9.8	30.0
5+00	4.43	3.67	0.76	-	36,095	4,788	9.5	29.8
7+51	5.17	3.66	1.51	-	70,760	4,813	7.5	27.8
10+00	5.77	3.23	2.54	-	98,116	6,839	6.9	27.2
12+50	6.56	2.59	3.97	-	114,877	**12,526**	6.8	30.0
15+00	6.29	2.78	3.51	-	101,055	**10,343**	6.5	30.0
17+50	5.43	3.11	2.32	-	64,911	7,574	7.2	30.0
20+00	6.41	2.72	3.69	-	107,099	**10,923**	7.1	30.0
22+51	5.92	3.40	2.52	-	84,222	5,935	7.0	30.0
25+01	4.48	4.09	0.39	-	36,627	3,492	8.0	30.0
27+54	6.13	3.75	2.38	-	93,819	4,503	7.9	30.0
30+01	5.54	3.98	1.56	-	69,135	3,782	7.1	30.0
32+50	5.28	3.52	1.76	-	59,953	5,363	7.2	30.0
35+00	6.00	3.29	2.71	-	87,727	6,518	6.7	30.0
37+50	2.67	4.13	**-1.46**	**3.32**	66,090	3,411	5.9	14.7
40+05	3.07	4.18	**-1.11**	**2.52**	92,433	3,280	6.3	15.1
42+51	3.00	4.51	**-1.51**	**3.43**	89,597	**2,621**	6.1	14.9
45+00	3.23	3.85	**-0.62**	**1.41**	101,108	4,171	6.6	15.4
47+50	3.25	3.98	**-0.73**	**1.66**	102,811	3,792	6.6	15.4
50+01	3.29	4.12	**-0.83**	**1.89**	111,526	3,425	6.4	15.2
52+51	3.60	4.72	**-1.12**	**2.55**	134,533	**2,275**	6.8	15.6

Possible Weak Soils (<3000)
Possible Shallow Bedrock (>8000)

For actual Gravel Depths, see logdraft forms - Pavement depths were taken from Ground Penetrating Radar Summary Sheet.



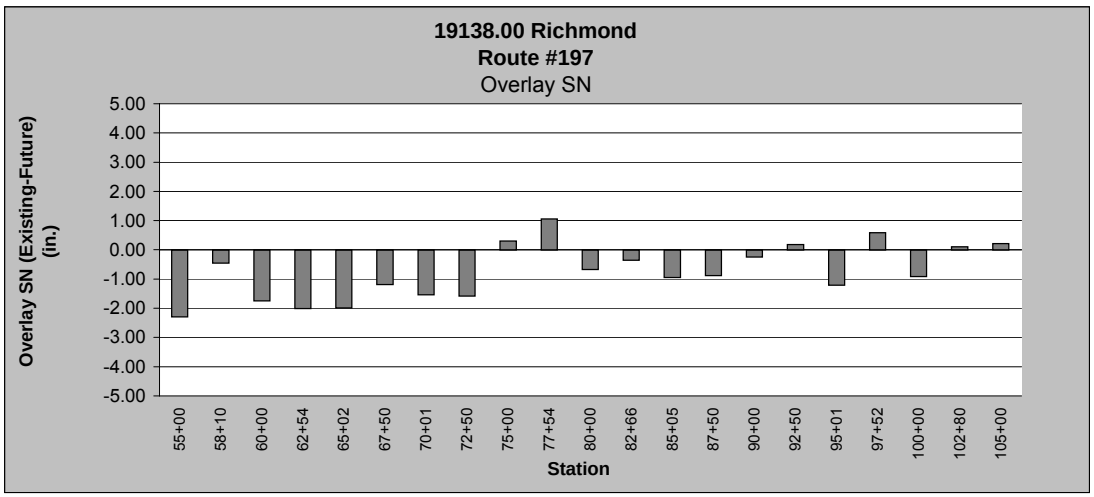


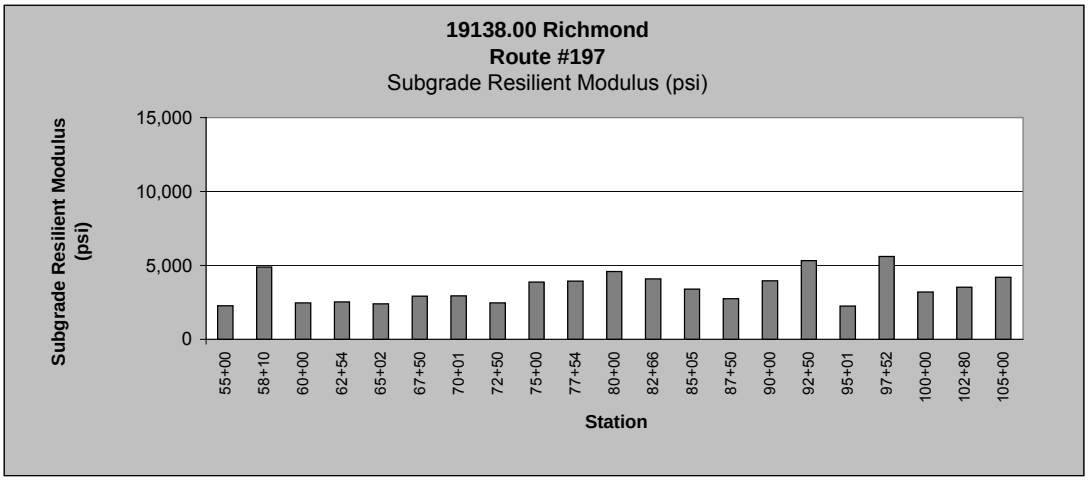
19138.00 Richmond
Route #197

Station (Feet)	Existing Structural Number (in.)	Future Traffic Structural Number (in.)	Overlay Structural Number (Existing - Future)	Recommended Pavement Thickness (in.)	Pavement Modulus (psi)	Subgrade Resilient Modulus (psi)	Pavement Depth (in)	Combined Pavement/Gravel Depth Used for Calculation (in)
55+00	2.43	4.72	**-2.29**	**5.20**	162,712	**2,273**	6.7	9.9
58+10	3.19	3.64	**-0.45**	**1.02**	378,819	4,898	6.6	9.8
60+00	2.85	4.60	**-1.75**	**3.98**	181,371	**2,467**	8.0	11.2
62+54	2.55	4.56	**-2.01**	**4.57**	200,162	**2,525**	6.7	9.9
65+02	2.64	4.63	**-1.99**	**4.52**	221,719	**2,411**	6.5	9.7
67+50	3.16	4.35	**-1.19**	**2.70**	378,796	**2,916**	6.6	9.8
70+01	2.80	4.34	**-1.54**	**3.50**	240,056	**2,934**	6.8	10.0
72+50	3.02	4.60	**-1.58**	**3.59**	178,721	**2,463**	8.7	11.9
75+00	4.25	3.95	0.30	-	191,551	3,868	8.5	16.4
77+54	4.99	3.93	1.06	-	308,909	3,945	8.5	16.4
80+00	3.05	3.72	**-0.67**	**1.52**	94,475	4,599	7.0	14.9
82+66	3.52	3.88	**-0.36**	**0.82**	136,751	4,087	7.3	15.2
85+05	3.18	4.13	**-0.95**	**2.16**	102,367	3,406	7.2	15.1
87+50	3.56	4.44	**-0.88**	**2.00**	135,082	**2,739**	7.5	15.4
90+00	3.67	3.92	**-0.25**	**0.57**	193,949	3,970	6.2	14.1
92+50	3.71	3.53	0.18	-	228,569	5,321	6.8	13.5
95+01	3.53	4.74	**-1.21**	**2.75**	143,185	**2,243**	8.3	15.0
97+52	4.06	3.47	0.59	-	267,378	5,596	7.3	14.0
100+00	3.30	4.21	**-0.91**	**2.07**	164,153	3,211	6.7	13.4
102+80	4.18	4.08	0.10	-	267,560	3,519	7.7	14.4
105+00	4.05	3.84	0.21	-	239,831	4,207	7.8	14.5

Possible Weak Soils (<3000)
Possible Shallow Bedrock (>8000)

For actual Gravel Depths, see logdraft forms - Pavement depths were taken from Ground Penetrating Radar Summary Sheet.





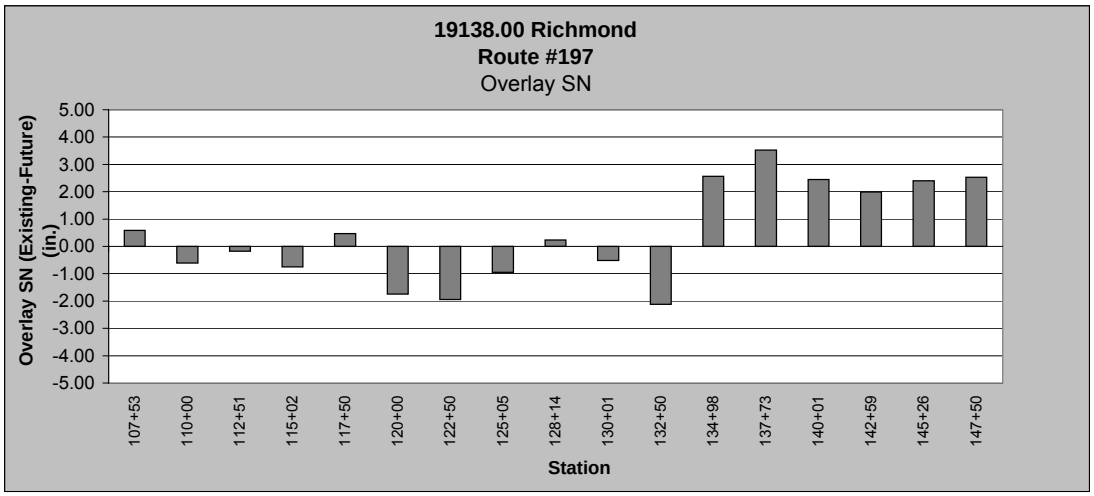
19138.00 Richmond
Route #197

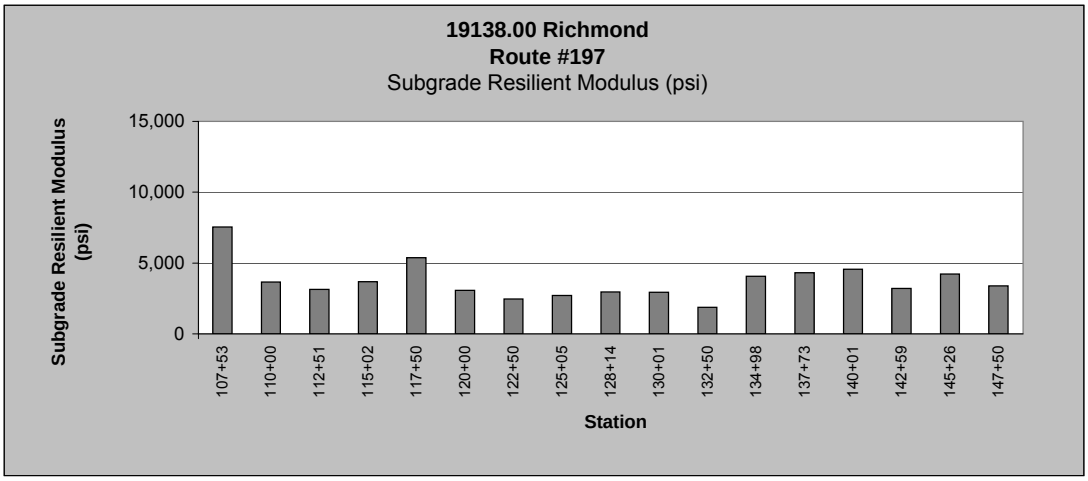
Station (Feet)	Existing Structural Number (in.)	Future Traffic Structural Number (in.)	Overlay Structural Number (Existing - Future)	Recommended Pavement Thickness (in.)	Pavement Modulus (psi)	Subgrade Resilient Modulus (psi)	Pavement Depth (in)	Combined Pavement/Gravel Depth Used for Calculation (in)
107+53	3.71	3.12	0.59	-	148,010	7,543	8.9	15.6
110+00	3.42	4.03	**-0.61**	**1.39**	230,144	3,666	5.7	12.4
112+51	4.06	4.24	**-0.18**	**0.41**	304,863	3,147	6.7	13.4
115+02	3.27	4.02	**-0.75**	**1.70**	167,384	3,688	6.5	13.2
117+50	3.99	3.52	0.47	-	311,198	5,374	6.4	13.1
120+00	2.53	4.27	**-1.74**	**3.95**	102,614	3,077	7.0	12.0
122+50	2.66	4.60	**-1.94**	**4.41**	96,553	**2,456**	7.9	12.9
125+05	3.51	4.46	**-0.95**	**2.16**	231,886	**2,703**	7.7	12.7
128+14	4.57	4.33	0.24	-	522,225	**2,950**	7.6	12.6
130+01	3.82	4.34	**-0.52**	**1.18**	299,533	**2,926**	7.7	12.7
132+50	2.90	5.02	**-2.12**	**4.82**	136,829	**1,876**	7.5	12.5
134+98	6.44	3.88	2.56	-	108,344	4,065	8.5	30.0
137+73	7.33	3.80	3.53	-	159,914	4,324	8.2	30.0
140+01	6.18	3.73	2.45	-	96,101	4,563	7.2	30.0
142+59	6.20	4.21	1.99	-	97,045	3,209	7.7	30.0
145+26	6.23	3.83	2.40	-	98,156	4,228	8.1	30.0
147+50	6.67	4.14	2.53	-	120,759	3,385	9.4	30.0

Possible Weak Soils (<3000)

Possible Shallow Bedrock (>8000)

For actual Gravel Depths, see logdraft forms - Pavement depths were taken from Ground Penetrating Radar Summary Sheet.





State of Maine - Department of Transportation

Pavement Core Summary Sheet

Town(s): Richmond Work Number: 19138.00

Station (Feet)	Offset (Feet)	Pavement Depth (Inches)	Unbound Pavement	PC-Number	Saved Core	Comments / Date 10/28/2011
20+00	9.0 Rt.	7.0				off auger
20+00	3.0 Rt.	7.5		1	yes	
20+00	6.0 Lt.	8.0		2	yes	
20+00	9.0 Lt.	8.0		3	yes	
40+00	3.0 Rt.	4.0		4	yes	
40+00	9.0 Rt.	4.5				off auger
40+00	3.0 Lt.	9.5		5	yes	
40+00	9.0 Lt.	8.0		6	yes	
60+00	9.0 Rt.	5.0				off auger
60+00	3.0 Rt.	8.0		7	yes	
60+00	CL	13.0		8	yes	
60+00	3.0 Lt.	9.5		9	yes	
60+00	9.0 Lt.	11.0		10	yes	
80+00	9.0 Rt.	8.0				off auger
80+00	3.0 Rt.	6.0		11	yes	
80+00	CL	9.5		12	yes	
80+00	3.0 Lt.	7.5		13	yes	
80+00	9.0 Lt.	7.0		14	yes	
95+00	8.0 Rt.	7.0				off auger
100+00	9.0 Rt.	7.5		15	yes	
100+00	3.0 Rt.	7.5		16	yes	
100+00	CL	7.5		17	yes	
100+00	3.0 Lt.	7.5		18	yes	
100+00	9.0 Lt.	4.5		19	yes	
120+00	9.0 Rt.	7.0		20	yes	
120+00	3.0 Rt.	10.0		21	yes	
120+00	CL	9.5		22	yes	
120+00	3.0 Lt.	8.5		23	yes	
120+00	9.5 Lt.	5.5		24	yes	
122+50	8.0 Rt.	7.5				off auger
135+66	9.0 Rt.	11.0		25	yes	
135+66	3.0 Rt.	9.5		26	yes	
135+66	CL	10.5		27	yes	
135+66	3.0 Lt.	9.5		28	yes	
135+66	9.5 Lt.	7.0		29	yes	
145+00	9.0 Lt.	9.5				off auger

Shaded Area = Shimmed Areas

19138.00 Richmond - Route #197
Estimated Pavement Thickness
Ground Penetrating Radar (GPR)

Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:
For Project 19138.00 (Richmond), GPR data was collected in the left and right wheel path of both the East and West bound lanes. Data was collected at 1 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 pavement cores and 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

Overall Average Thickness (in.)	7.5

Overall Minimum Thickness (in.)	5.6

Overall Maximum Thickness (in.)	9.9

19138.00 Richmond - Route #197

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
0+00	1+00	8.8	15+00	16+00	7.4	30+00	31+00	7.1	45+00	46+00	6.6
1+00	2+00	9.1	16+00	17+00	7.5	31+00	32+00	7.2	46+00	47+00	6.8
2+00	3+00	9.8	17+00	18+00	7.2	32+00	33+00	7.2	47+00	48+00	6.6
3+00	4+00	9.7	18+00	19+00	7.7	33+00	34+00	6.9	48+00	49+00	6.7
4+00	5+00	9.5	19+00	20+00	7.8	34+00	35+00	6.8	49+00	50+00	7.0
5+00	6+00	9.9	20+00	21+00	7.1	35+00	36+00	6.7	50+00	51+00	6.4
6+00	7+00	9.3	21+00	22+00	6.5	36+00	37+00	6.4	51+00	52+00	6.5
7+00	8+00	7.5	22+00	23+00	7.0	37+00	38+00	5.9	52+00	53+00	6.8
8+00	9+00	7.5	23+00	24+00	7.9	38+00	39+00	6.0	53+00	54+00	7.4
9+00	10+00	7.3	24+00	25+00	8.0	39+00	40+00	6.7	54+00	55+00	7.2
10+00	11+00	6.9	25+00	26+00	8.4	40+00	41+00	6.3	55+00	56+00	6.7
11+00	12+00	7.5	26+00	27+00	8.6	41+00	42+00	6.5	56+00	57+00	6.7
12+00	13+00	6.8	27+00	28+00	7.9	42+00	43+00	6.1	57+00	58+00	6.3
13+00	14+00	6.3	28+00	29+00	8.9	43+00	44+00	6.3	58+00	59+00	6.6
14+00	15+00	6.5	29+00	30+00	8.4	44+00	45+00	6.7	59+00	60+00	8.6

Station Limits		Average Depth (in)
60+00	61+00	8.0
61+00	62+00	7.5
62+00	63+00	6.7
63+00	64+00	6.4
64+00	65+00	6.6
65+00	66+00	6.5
66+00	67+00	6.8
67+00	68+00	6.6
68+00	69+00	6.5
69+00	70+00	6.8
70+00	71+00	8.2
71+00	72+00	8.0
72+00	73+00	8.7
73+00	74+00	8.4
74+00	75+00	9.1
75+00	76+00	8.5
76+00	77+00	8.0
77+00	78+00	8.5
78+00	79+00	7.2
79+00	80+00	7.0
80+00	81+00	7.7
81+00	82+00	7.3
82+00	83+00	7.3
83+00	84+00	6.6
84+00	85+00	7.1
85+00	86+00	7.2
86+00	87+00	7.8
87+00	88+00	7.5
88+00	89+00	6.7
89+00	90+00	6.2
90+00	91+00	6.3
91+00	92+00	6.4
92+00	93+00	6.8
93+00	94+00	7.3
94+00	95+00	7.5

Station Limits		Average Depth (in)
95+00	96+00	8.3
96+00	97+00	8.3
97+00	98+00	7.3
98+00	99+00	6.9
99+00	100+00	6.7
100+00	101+00	6.7
101+00	102+00	7.9
102+00	103+00	7.7
103+00	104+00	7.5
104+00	105+00	7.8
105+00	106+00	7.9
106+00	107+00	8.4
107+00	108+00	8.9
108+00	109+00	9.1
109+00	110+00	8.0
110+00	111+00	5.7
111+00	112+00	5.6
112+00	113+00	6.7
113+00	114+00	7.3
114+00	115+00	6.9
115+00	116+00	6.5
116+00	117+00	6.9
117+00	118+00	6.4
118+00	119+00	6.9
119+00	120+00	7.0
120+00	121+00	7.8
121+00	122+00	8.3
122+00	123+00	7.9
123+00	124+00	7.8
124+00	125+00	7.7
125+00	126+00	7.7
126+00	127+00	8.2
127+00	128+00	7.8
128+00	129+00	7.6
129+00	130+00	7.7

Station Limits		Average Depth (in)
130+00	131+00	8.5
131+00	132+00	8.0
132+00	133+00	7.5
133+00	134+00	7.4
134+00	135+00	8.5
135+00	136+00	9.0
136+00	137+00	8.5
137+00	138+00	8.2
138+00	139+00	7.4
139+00	140+00	7.2
140+00	141+00	7.5
141+00	142+00	7.2
142+00	143+00	7.7
143+00	144+00	7.7
144+00	145+00	8.1
145+00	146+00	8.1
146+00	147+00	9.7
147+00	148+00	9.4
148+00	149+00	9.0
149+00	150+00	8.3
150+00	150+38	8.7

Station Limits		Average Depth (in)

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Richmond Work Number: 19138.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C.	% Passing 200 Sieve	Classification		
								Unified	AASHTO	Frost
HB-RICH-101, S1	7+50	9.0 Rt.	0.42-2.3	261854	1	5.2	11.9	SW-SM	A-1-b	0
HB-RICH-101, S2	7+50	9.0 Rt.	2.3-4.5	261855	1	15.5	41.2	SM	A-4	III
HB-RICH-102, S3	20+00	9.0 Rt.	2.3-4.5	261856	1	6.8	21.2	SM	A-1-b	II
HB-RICH-103, S4	40+00	9.0 Rt.	1.2-4.5	261857	1	22.3	81.7	CL	A-6	IV
HB-RICH-104, S5	60+00	9.0 Rt.	0.5-0.8	261858	1	7.7	2.9	SW	A-1-b	0
HB-RICH-104, S6	60+00	9.0 Rt.	0.8-4.5	261859	1	27.9	97.1	CL	A-6	IV
HB-RICH-106, S7	95+00	8.0 Rt.	0.58-1.2	261860	2	3.5	6.3	SW-SM	A-1-b	0
HB-RICH-106, S8	95+00	8.0 Rt.	1.2-6.5	261861	2	48.3	80.9	CL	A-6	IV
HB-RICH-108, S9	145+00	9.0 Rt.	0.79-3.2	261862	2	3.7	17.4	SM	A-1-b	II
HB-RICH-108, S10	145+00	9.0 Rt.	3.2-4.0	261863	2	18.9	53.6	CL-ML	A-4	IV

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 MDOT 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)

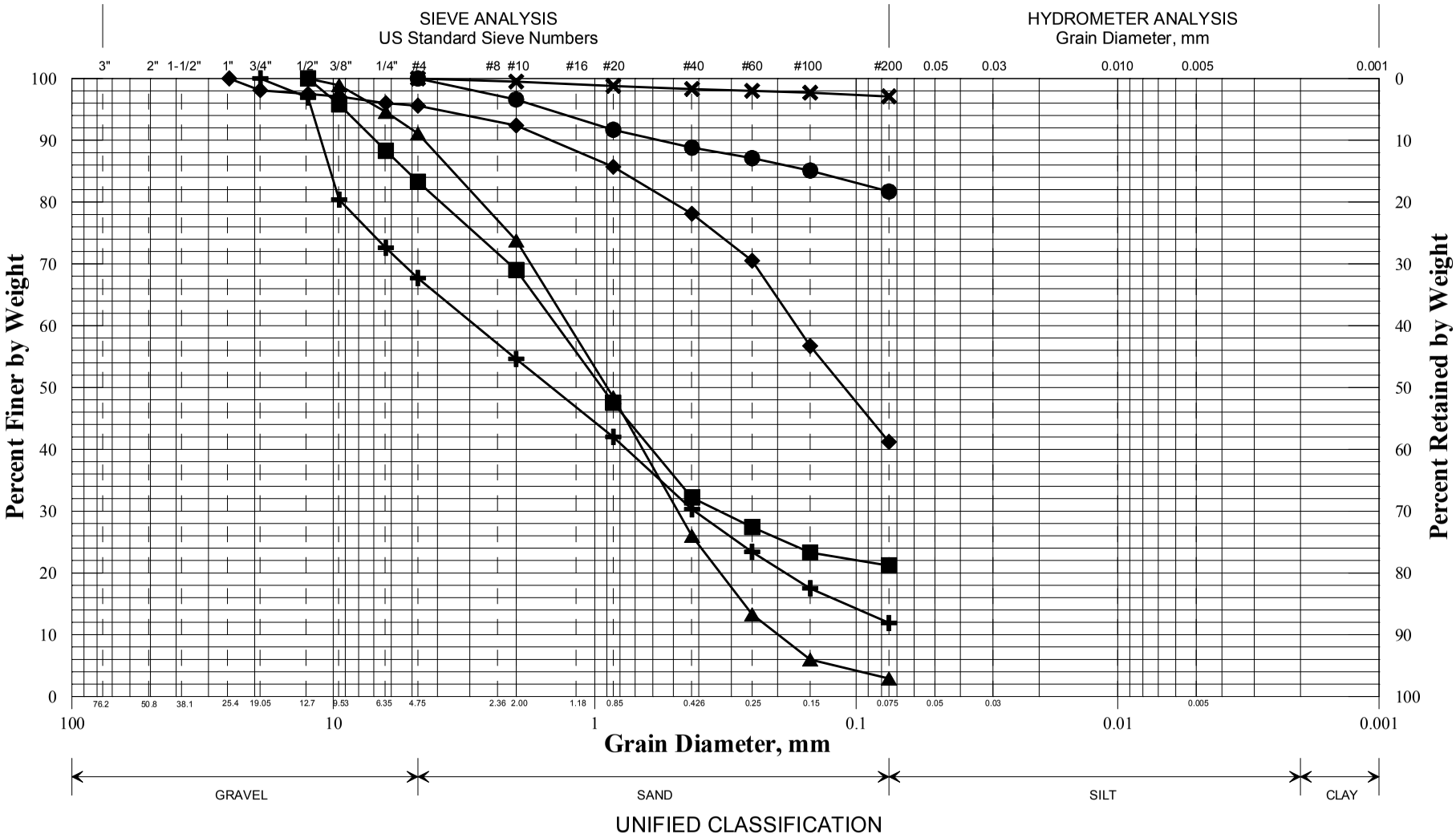
WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

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

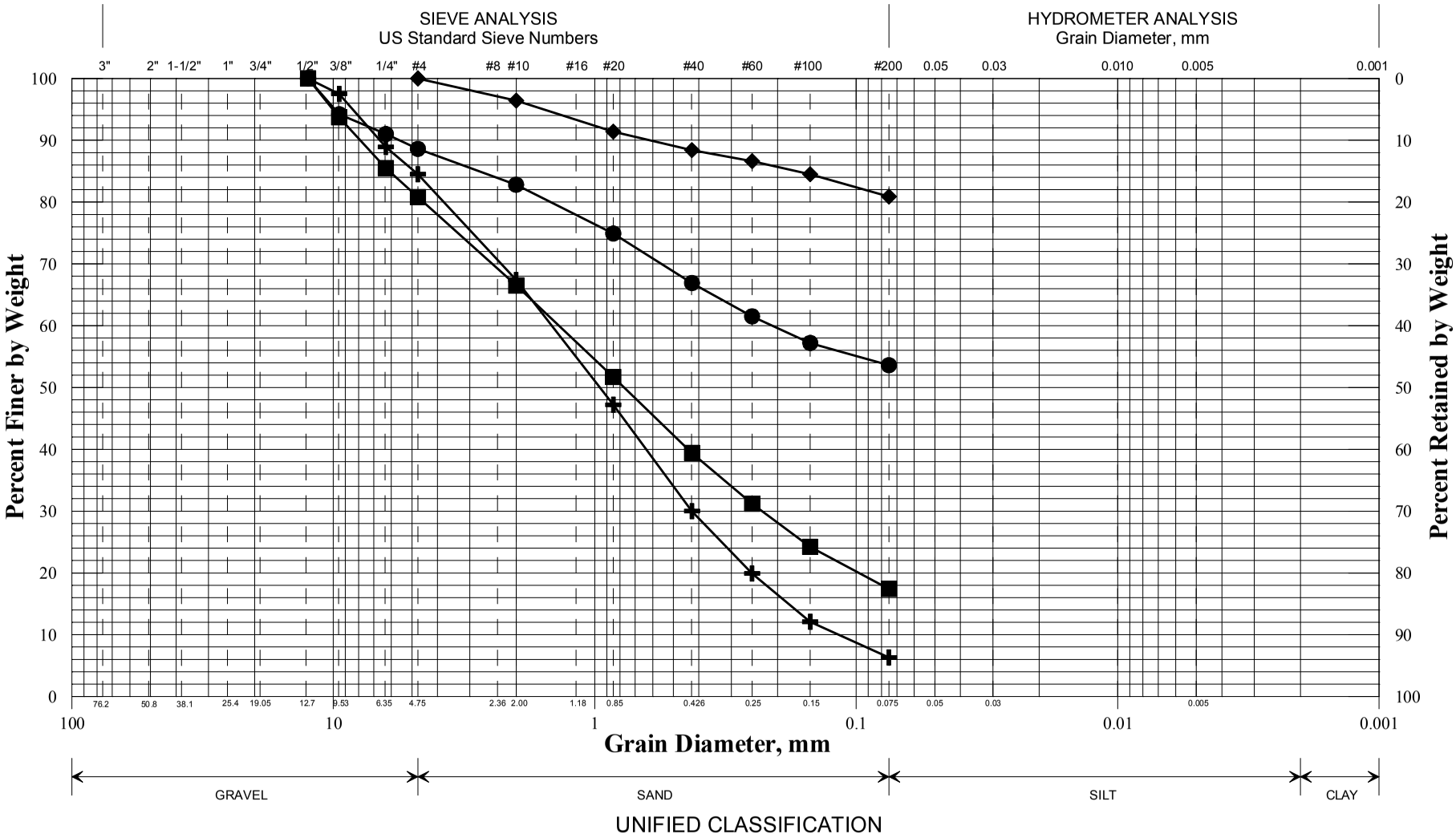


	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-RICH-101/S1	750	9.0 RT	0.42-2.3	SAND, some gravel, little silt.	5.2			
◆	HB-RICH-101/S2	750	9.0 RT	2.3-4.5	Silty SAND, trace gravel.	15.5			
■	HB-RICH-102/S3	2000	9.0 RT	2.3-4.5	SAND, some silt, little gravel.	6.8			
●	HB-RICH-103/S4	4000	9.0 RT	1.2-4.5	Clayey SILT, little sand.	22.3			
▲	HB-RICH-104/S5	6000	9.0 RT	0.5-0.8	SAND, trace gravel, trace silt.	7.7			
✖	HB-RICH-104/S6	6000	9.0 RT	0.8-4.5	Clayey SILT, trace sand.	27.9			

WIN
019138.00
Town
Richmond
Reported by/Date
WHITE, TERRY A 11/23/2011

State of Maine Department of Transportation

GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-RICH-106/S7	9500	8.0 RT	0.58-1.2	SAND, little gravel, trace silt.	3.5			
◆	HB-RICH-106/S8	9500	8.0 RT	1.2-6.5	Clayey SILT, little sand.	48.3			
■	HB-RICH-108/S9	14500	9.0 RT	0.79-3.2	SAND, little gravel, little silt.	3.7			
●	HB-RICH-108/S10	14500	9.0 RT	3.2-4.0	Sandy, clay SILT, little gravel.	18.9			
▲									
✖									

WIN
019138.00
Town
Richmond
Reported by/Date
WHITE, TERRY A 11/23/2011

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-101
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/20/11-10/20/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	7+50 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S1		0.42 - 2.30			SSA	-0.42		5" PAVEMENT.	
									0.42 — Brown, damp, fine to coarse SAND, some gravel, trace silt.	G#261854 A-1-b, SW-SM WC=5.2%
	S2		2.30 - 4.50				-2.30		2.30 — Olive, moist, silty, fine to medium SAND.	G#261855 A-4, SM WC=15.5%
							-4.50		4.50 — **Bottom of Exploration at 4.50 feet below ground surface.** NO REFUSAL	
5										
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-102
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/20/11-10/20/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	20+00 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	-0.58		7" PAVEMENT.	
									0.58 — Brown, damp, fine to coarse SAND, some gravel, trace silt. ≅S1	
	S3		2.30 - 4.50				-2.30		2.30 — Brown, moist, fine to coarse SAND, little gravel, trace silt.	G#261856 A-1-b, SM WC=6.8%
							-4.50		4.50 — **Bottom of Exploration at 4.50 feet below ground surface.** REFUSAL	
5										
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-103
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/20/11-10/20/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	40+00 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	-0.38		4½" PAVEMENT.	
									0.38	
	S4		1.20 - 4.50				-1.20		Brown, damp, fine to coarse SAND, some gravel, trace silt. ≅S1	G#261857 A-6, CL WC=22.3%
									1.20 Olive-brown, wet, clayey-SILT, trace fine sand.	
							-4.50		4.50	
5									**Bottom of Exploration at 4.50 feet below ground surface.** NO REFUSAL	
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-104
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/20/11-10/20/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	60+00 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S5		0.50 - 0.80			SSA	-0.50		6" PAVEMENT.	
	S6		0.80 - 4.50				-0.80		0.50	G#261858 A-1-b, SW WC=7.7%
									Black, damp, fine to coarse SAND.	
									0.80	G#261859 A-6, CL WC=97.1%
									Olive, moist, clayey-SILT.	
							-4.50		4.50	
5									**Bottom of Exploration at 4.50 feet below ground surface.** NO REFUSAL	
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-105
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/28/11-10/28/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	80+00 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	-0.67		8" PAVEMENT.	
							-1.40		Brown, damp, fine to coarse SAND, some gravel, trace silt. ≅S1	
									Olive, moist, clayey-SILT. ≅S6	
5							-5.00		**Bottom of Exploration at 5.00 feet below ground surface.** NO REFUSAL	
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-106
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/28/11-10/28/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	95+00 ft, 8.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S7		0.58 - 1.20			SSA	-0.58		7" PAVEMENT.	
									0.58	G#261860
	S8		1.20 - 6.50				-1.20		Black, damp, fine to coarse SAND, some gravel, trace silt.	A-1-b, SW-SM
									1.20	WC=3.5%
									Olive, moist, clayey-SILT, little fine sand.	G#261861
										A-4, CL
5										WC=48.3%
							-6.50		6.50	
									Bottom of Exploration at 6.50 feet below ground surface.	
									NO REFUSAL	
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-107
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/28/11-10/28/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	122+50 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	-0.63		7½" PAVEMENT.	
									0.63	
							-1.10		Black, damp, fine to coarse SAND, some gravel, trace silt. ≅S7	
									1.10	
									Olive, moist, clayey-SILT, little fine sand. ≅S8	
							-4.00		4.00	
5									**Bottom of Exploration at 4.00 feet below ground surface.** NO REFUSAL	
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 197
Location: Richmond, Maine

Boring No.: HB-RICH-108
WIN: 19138.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	10/28/11-10/28/11	**Drilling Method:**	Solid Stem	**Core Barrel:**	N/A
Boring Location:	145+00 ft, 9.0 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	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 No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S9		0.79 - 3.20			SSA	-0.79		9½" PAVEMENT.	
									0.79 Brown, damp, fine to coarse SAND, little gravel, trace silt.	G#261862 A-1-b, SM WC=3.7%
	S10		3.20 - 4.00				-3.20		3.20 Olive-grey, wet, clayey-SILT, little fine sand.	G#261863 A-4, CL-ML WC=18.9%
							-4.00		4.00 **Bottom of Exploration at 4.00 feet below ground surface.** NO REFUSAL	
5										
10										
15										
20										
25										

Remarks:

Offsets are from Existing Roadway CL.

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.

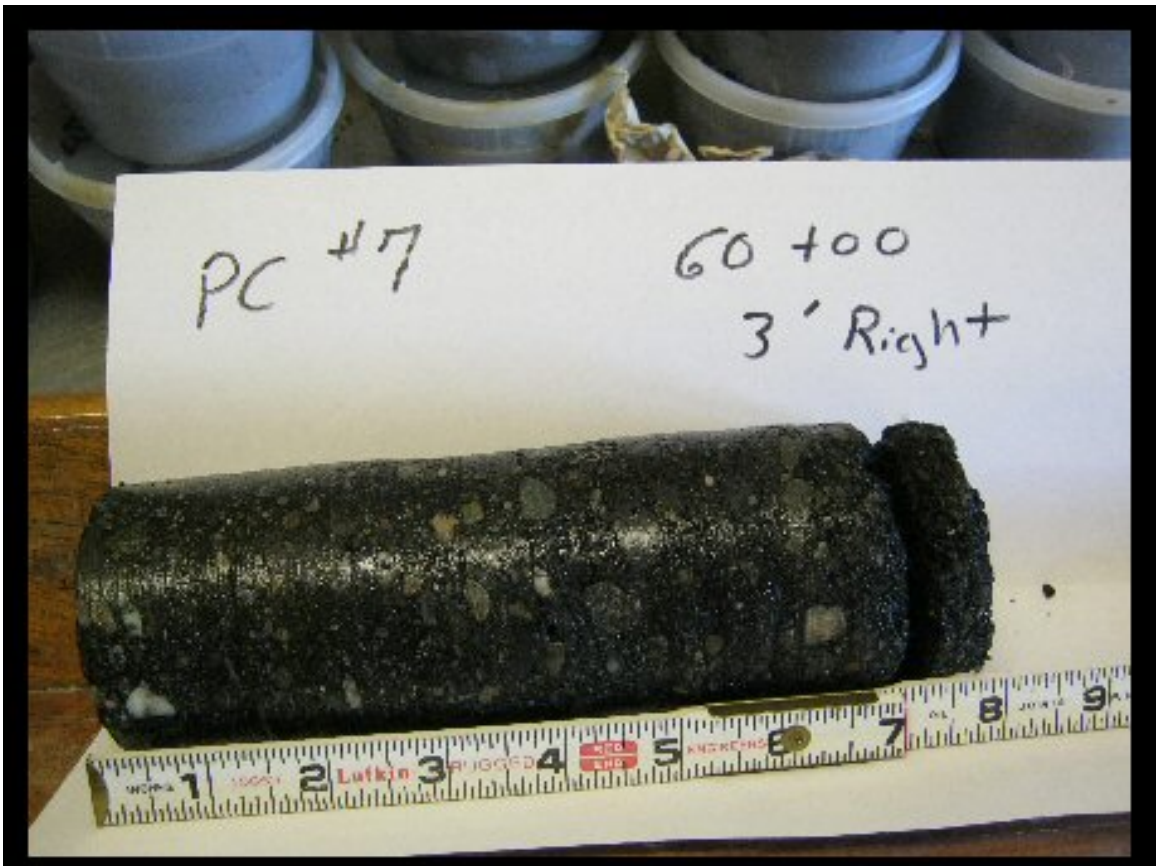
Boring No.: HB-RICH-108

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

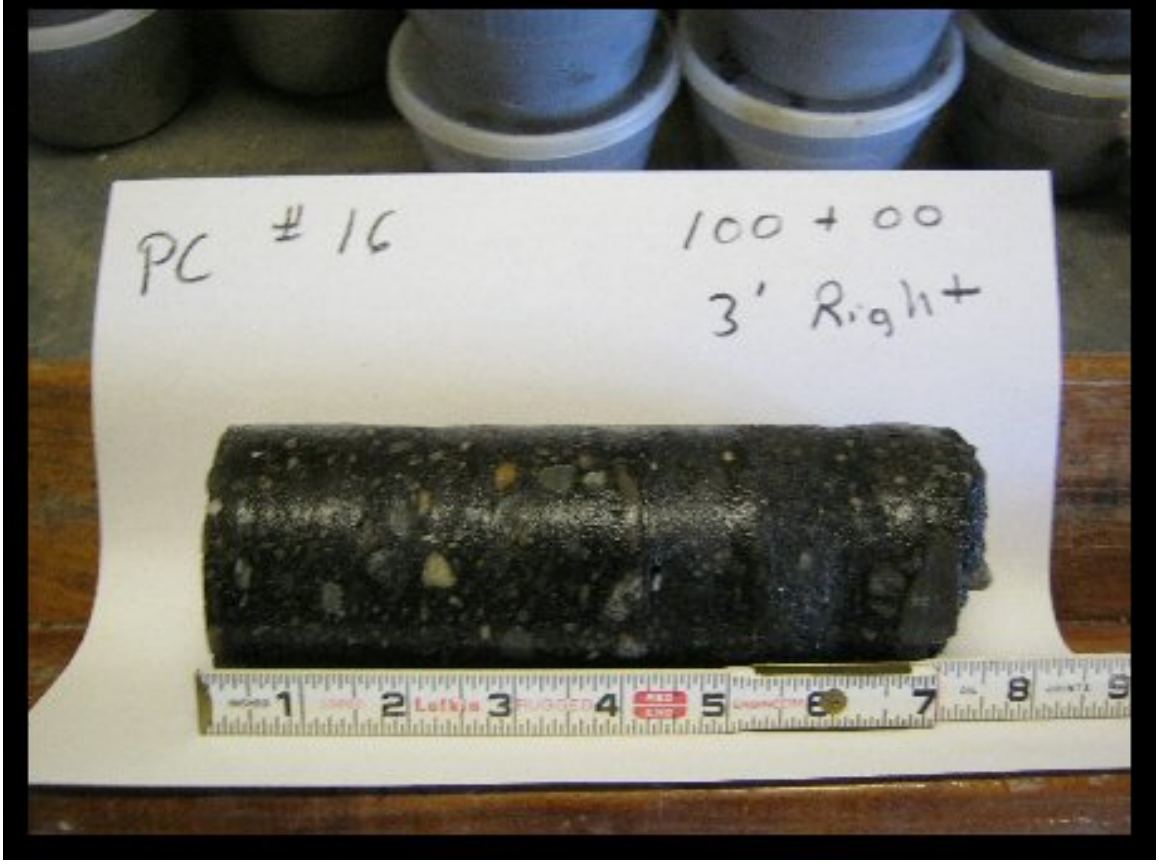


19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos



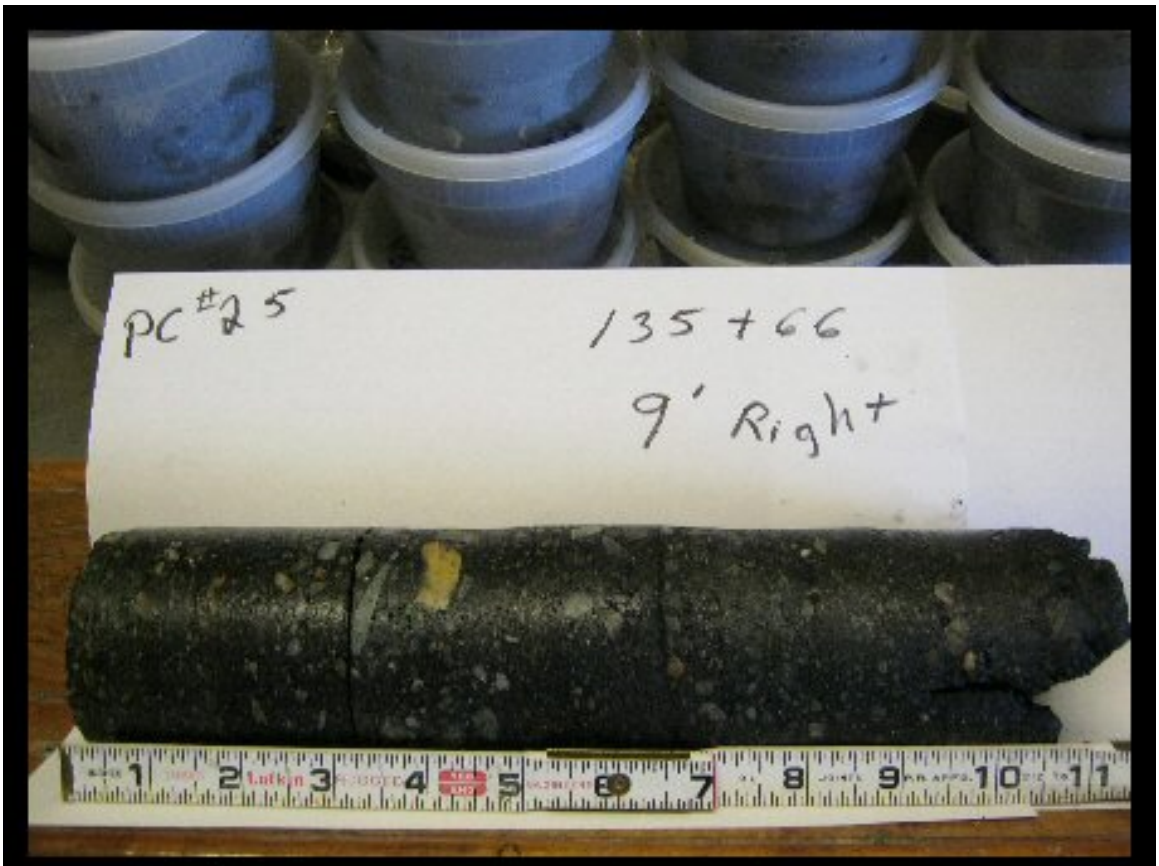
19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

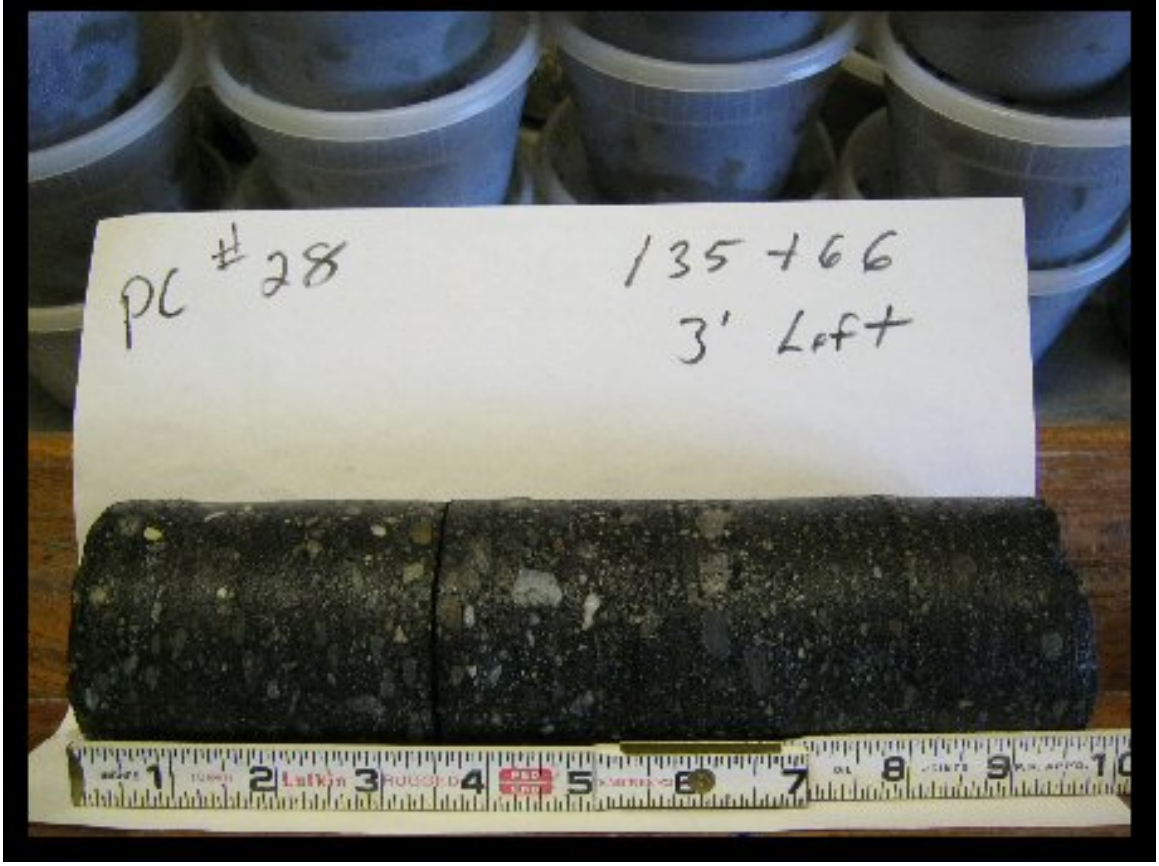
19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

19138.00
Richmond
Pavement Core Photos

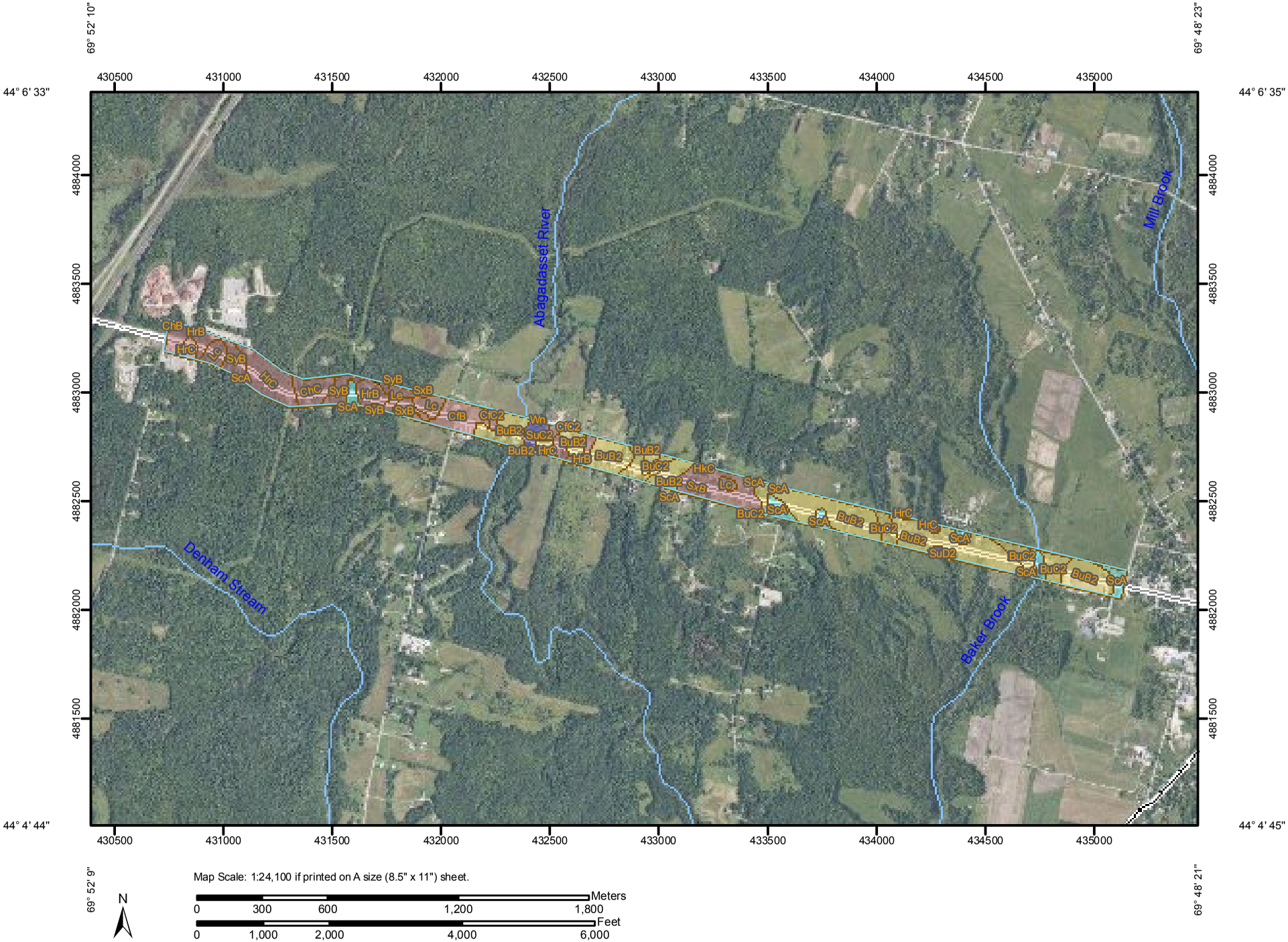


19138.00
Richmond
Pavement Core Photos



19138.00
Richmond
Pavement Core Photos

Parent Material Name—Androscoggin and Sagadahoc Counties, Maine
(19138.00 Richmond Rte. 197)



Map Scale: 1:24,100 if printed on A size (8.5" x 11") sheet.

N

Meters
0 300 600 1,200 1,800

Feet
0 1,000 2,000 4,000 6,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- coarse-loamy supraglacial meltout till derived from mica schist
- coarse-silty alluvium derived from mica schist
- fine glaciolacustrine deposits
- fine glaciolacustrine deposits and/or fine-silty marine deposits
- glaciolacustrine deposits derived from siltstone and/or fine-silty marine deposits
- sandy-skeletal glaciofluvial deposits derived from granite and gneiss
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:24,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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: Androscoggin and Sagadahoc Counties, Maine
Survey Area Data: Version 13, Jul 27, 2009

Date(s) aerial images were photographed: Data not available.

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.

Parent Material Name

Parent Material Name— Summary by Map Unit — Androscoggin and Sagadahoc Counties, Maine (ME606)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BuB2	Buxton silt loam, 0 to 8 percent slopes, eroded	glaciolacustrine deposits derived from siltstone and/or fine-silty marine deposits	60.6	38.9%
BuC2	Buxton silt loam, 8 to 15 percent slopes, eroded	glaciolacustrine deposits derived from siltstone and/or fine-silty marine deposits	12.9	8.3%
CfB	Charlton fine sandy loam, 0 to 8 percent slopes	coarse-loamy supraglacial meltout till derived from mica schist	7.3	4.7%
CfC2	Charlton fine sandy loam, 8 to 15 percent slopes, erode d	coarse-loamy supraglacial meltout till derived from mica schist	2.0	1.3%
ChB	Charlton very stony fine sandy loam, 0 to 8 percent slo pes	coarse-loamy supraglacial meltout till derived from mica schist	0.3	0.2%
ChC	Charlton very stony fine sandy loam, 8 to 15 percent sl opes	coarse-loamy supraglacial meltout till derived from mica schist	5.1	3.3%
HkC	Hinckley gravelly sandy loam, 8 to 15 percent slopes	sandy-skeletal glaciofluvial deposits derived from granite and gneiss	0.2	0.1%
HrB	Hollis fine sandy loam, 0 to 8 percent slopes	coarse-loamy supraglacial meltout till derived from mica schist	5.4	3.4%
HrC	Hollis fine sandy loam, 8 to 15 percent slopes	coarse-loamy supraglacial meltout till derived from mica schist	13.7	8.8%
Lc	Leicester fine sandy loam	coarse-loamy supraglacial meltout till derived from mica schist	6.2	4.0%
Le	Leicester very stony fine sandy loam	coarse-loamy supraglacial meltout till derived from mica schist	2.5	1.6%
ScA	Scantic silt loam, 0 to 3 percent slopes	fine glaciolacustrine deposits and/or fine-silty marine deposits	11.1	7.1%
SuC2	Suffield silt loam, 8 to 15 percent slopes, eroded	fine glaciolacustrine deposits	2.5	1.6%
SuD2	Suffield silt loam, 15 to 30 percent slopes, eroded	fine glaciolacustrine deposits	0.9	0.6%
SxB	Sutton loam, 0 to 8 percent slopes	coarse-loamy supraglacial meltout till derived from mica schist	13.8	8.8%
SyB	Sutton very stony loam, 0 to 8 percent slopes	coarse-loamy supraglacial meltout till derived from mica schist	11.4	7.3%
Wn	Winooski silt loam	coarse-silty alluvium derived from mica schist	0.1	0.1%
Totals for Area of Interest			**155.9**	**100.0%**

Rating Options

Aggregation Method: Dominant Condition