GEOTECHNICAL DESIGN REPORT
STRUT REPLACEMENT
MEADOW BROOK ROUTE 232 CROSSING
WOODSTOCK, MAINE
MaineDOT WIN 17538.00

PREPARED FOR:

Maine Department of Transportation
Western Region Highway Program
Dixfield, Maine

PREPARED BY:

Isabel V. (Be) Schonewald, P.E.
Schonewald Engineering Associates, Inc. (SchonewaldEA)
129 Middle Road
Cumberland, Maine 04021
Be@SchonewaldEngineering.com

September 17, 2012

SchonewaldEA Project No. 12-010

SCHONEWALD ENGINEERING ASSOCIATES, INC.

129 MIDDLE ROAD, CUMBERLAND, MAINE 04021
phone 207/829-5226
cell 207/272-9879

Geotechnical ■ Solid Waste ■ Stormwater/E&SC Engineering

VIA EMAIL

September 17, 2012
Project No. 12-010

Mr. John E. Rodrigue
Maine Department of Transportation
Western Region Highway Program
PO Box 817, Route 2
Dixfield, Maine 04224

Re: Geotechnical Design Report
Strut Replacement
Meadow Brook Route 232 Crossing
Woodstock, Maine
MaineDOT WIN 17538.00

Dear John:

Schonewald Engineering Associates, Inc. (SchonewaldEA) is pleased to provide the Maine Department of Transportation (MaineDOT) with this report that provides geotechnical engineering recommendations for the proposed replacement of the culvert that carries Meadow Brook beneath Route 232 in Woodstock, Maine. Specifically, this report is intended to summarize the findings of the geotechnical field and laboratory programs completed by MaineDOT, transmit the results of a geophysical survey of the project site that was completed by Hager-Richter Geoscience, Inc. (HRG) under contract to MaineDOT, and provide geotechnical engineering recommendations for the design of the replacement strut. The design parameters are intended for use by MaineDOT and CMA Engineers, Inc., SchonewaldEA's structural subconsultant on this project.

This work was completed in accordance with the agreement between SchonewaldEA and MaineDOT that was executed on May 24, 2012. This report is subject to the limitations contained in Appendix A. A quality assurance review of the technical aspects of SchonewaldEA's work has been completed by Kalia Breskin, P.E., Senior Geotechnical Engineer, MaineDOT Highway Program.

PROJECT UNDERSTANDING AND EXECUTIVE SUMMARY

We understand that MaineDOT intends to replace an existing 72-inch corrugated metal pipe (CMP) culvert with a structural plate arch culvert (strut) having a 12-foot span and 4-foot rise to maintain flow of Meadow Brook under Route 232 in Woodstock, Maine. The project site is located approximately 125 feet south of the intersection of Route 232 and Cushman Hill Road. MaineDOT's site location map is provided as Figure 1.

Subsurface conditions underlying the project site consist of a thin veneer of soil overlying shallow bedrock. In addition to completing limited test borings and auger probes, MaineDOT retained HRG to complete a geophysical survey to assess the bedrock topography in the vicinity of the culvert. The culvert will be founded on cast-in-place concrete footings that are keyed into bedrock. In consideration of the shallow bedrock conditions and in order for the designers to meet current rules regarding hydraulic capacity, the Route 232 profile has been raised approximately 2 feet over the proposed strut. No changes are proposed to the horizontal alignment.

REGIONAL GEOLOGY

The surficial geology in the project area is mapped as a broad area of glacial till that is characterized as a dense mixture of silt, sand, gravel, cobbles, and boulders. The project area is located in the vicinity of the mapped contact between the Songo Granodiorite intrusive rock and a pelitic sedimentary rock that has been subjected to moderate metamorphism resulting in a quartz biotite gneiss showing strong foliation.

SUBSURFACE EXPLORATION PROGRAM

MaineDOT drilled two test borings (HB-WOOD-101 and SB-WOOD-201) and four auger probes (HB-WOOD-102, -102A, -103, and -104) in the vicinity of the existing CMP culvert. Test boring HB-WOOD-101 and the four auger probes were drilled on December 8, 2011, with all the explorations advanced to practicable auger refusal. A second test boring, designated SB-WOOD-201, was drilled on May 9, 2012 and included 5 feet of rock core. The locations of the test borings and auger probes are depicted on MaineDOT's project geoplan that is included as Figure 2. Logs of the subsurface explorations that were prepared by MaineDOT are included as Appendix B.

Standard Penetration Tests (SPTs) were completed and split-spoon soil samples were obtained at roughly 5-foot intervals through the overburden soils in HB-WOOD-101. A five-foot rock core was completed in SB-WOOD-201. The auger probes were advanced to refusal without testing or sampling.

LABORATORY TESTING PROGRAM

The two samples of the overburden soils that were obtained in test boring HB-WOOD-101 were submitted for index testing as summarized on the following table.

BORING NO.	SAMPLE NO.	SAMPLE DEPTH (feet BGS)	MATERIAL TYPE	TESTING COMPLETED
HB-WOOD-101	1D	2 to 4	Till	sieve including moisture content
	2D	5 to 7	Till	sieve including moisture content

Tests were completed by the MaineDOT laboratory in Bangor, Maine in general accordance with the AASHTO and ASTM test procedures listed in the laboratory testing summary sheet included in Appendix C. Test results are noted on the test boring logs included as Appendix B. The laboratory test report (gradation curves) is also included in Appendix C.

GEOPHYSICAL SURVEY

MaineDOT retained Hager-Richter Geoscience, Inc. (HRG) to complete a geophysical survey to assess the bedrock surface topography in the vicinity of the proposed replacement strut. The geophysical report prepared by HRG entitled "Geophysical Survey, Route 232, Woodstock, Maine, PIN 17538.00" and dated May 25, 2012 is transmitted with this geotechnical report as Appendix D.

SUBSURFACE CONDITIONS

The generalized stratigraphy encountered in the subsurface explorations consisted of glacial till overlying bedrock. Descriptions of the materials encountered in each subsurface exploration are provided on the logs included as Appendix B. In general, the subsurface conditions encountered in the test borings are consistent with the published geological information presented above.

The GLACIAL TILL was observed to be up to 12.2 feet thick and was characterized as brown, moist, medium dense to dense, fine to coarse SAND, with approximately 15 to 25 percent Silt and 20 to 30 percent Gravel. Cobbles were noted in test boring HB-WOOD-101. The shallow (5.5 feet below ground surface (BGS)) in auger probe HB-WOOD-102 was likely on an obstruction (boulder).

The bedrock cored in test boring SB-WOOD-102 was described as a hard, fresh, white to gray, medium grained, Quartz Biotite GNEISS, having foliation typically dipping at 20 to 30 degrees. Close, low angle joints predominately parallel to foliation with a few of the joints showing slight weathering (biotite discoloration) were noted. The RQD of the core was 73 percent, with most of the breaks occurring along foliation. The rock mass quality is fair based upon the RQD value. Photographs of the rock core are included in Appendix B. Based upon the geophysical report prepared by HRG, specifically Figure 5 included in the report, the top of bedrock at the proposed strut location is anticipated to range between elevation 795 and 797 feet.

IMPLICATIONS OF SUBSURFACE CONDITIONS

Based upon the subsurface information obtained by MaineDOT, the two primary geotechnical concerns are: 1) shallow bedrock; and 2) the low angle foliation of the bedrock.

GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

SchonewaldEA provides the following geotechnical recommendations for the design of the replacement strut based upon the limited available information. These recommendations are based upon MaineDOT's Bridge Design Guide dated August 2003 (MaineDOT BDG) and the AASHTO LRFD Bridge Design Specifications, 5th Edition, 2010 with 2010 Interims (LRFD manual).

FOOTINGS: The footings for the strut should be cast in place and should bear directly on rock. The contractor should remove any overburden soil and weathered rock that can be removed using ordinary excavation equipment to expose competent bedrock at the required elevation. In accordance with MaineDOT's BDG, the bedrock surface should be clean and free of debris, soil, or loose rock. To increase sliding resistance, consideration should be given to keying the footing into the rock approximately six (6) inches.

Using the rock core description provided by MaineDOT, laboratory unconfined compression test data from similar rock, and correlations between RQD and rock mass compressive strength by Kulhawy and Goodman, a nominal bearing resistance (q_n) on rock equal to 315 ksf is reasonable. Using a bearing resistance factor (φ_b) of 0.45, a factored bearing resistance (q_r) of 140 ksf is recommended for designing footings bearing on rock. Regardless of the calculated bearing pressure, the minimum footing dimension should not be less than two feet.

For evaluation of sliding on the base of the footings and to avoid installing rock anchors, the bearing material should be treated as a soil with the friction angle (δ) between the cast-in-place concrete footing and the soil taken as 30 degrees. This is in accordance with Table 3.11.5.3-1 in the LRFD Manual. A resistance factor ($\varphi\tau$) for sliding, based upon the footing bearing on sandy soil is 0.80, in accordance with Table 10.5.5.2.2-1 of the LRFD Manual.

FOOTING STEM AND WALLS: The footing stems and other walls should be designed based upon a free-draining backfill material such as MaineDOT's Gravel Borrow (703.20) having limited fines content and the following design parameters:

- Internal friction angle (φ) equal to 34 degrees;
- Total unit weight (γ_t) equal to 0.125 kips per cubic foot (kcf);
- Coulomb active earth pressure coefficient (K_a) equal to 0.254; and
- At-rest earth pressure coefficient (K_0) equal to 0.441.

Weep holes and drainage/strip drains tied into footing drains or french drains should be provided to limit hydrostatic pressures. For the purpose of wall design, groundwater should be set at a level three feet up the stem in accordance with the MaineDOT BDG regardless of the groundwater controls provided.

The contractor should control surface water and groundwater to allow fill placement to be completed in the dry. Likewise, OSHA guidelines for trenching and excavating should be strictly observed by the contractor.

CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program and CMA Engineers, Inc. as a subconsultant for specific application to the design of the proposed replacement strut located on Route 232 at the Meadow Brook crossing in Woodstock, Maine (MaineDOT WIN 17538.00). No other intended use or warranty is implied. In the event that any changes in the nature, design or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. Further, the analyses and recommendations are based in part upon limited soil explorations at discrete locations at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

SchonewaldEA appreciates the opportunity to work with MaineDOT and CMA Engineers, Inc. on the Meadow Brook Route 232 strut. If you have any questions regarding this report or would like to discuss the geotechnical issues presented, please call me at your convenience.

Sincerely,
Schonewald Engineering Associates, Inc.

STATE OF MAINE
ISABEL V. SCHONEWALD
No. 7528
LICENSED
PROFESSIONAL ENGINEER

9/17/12

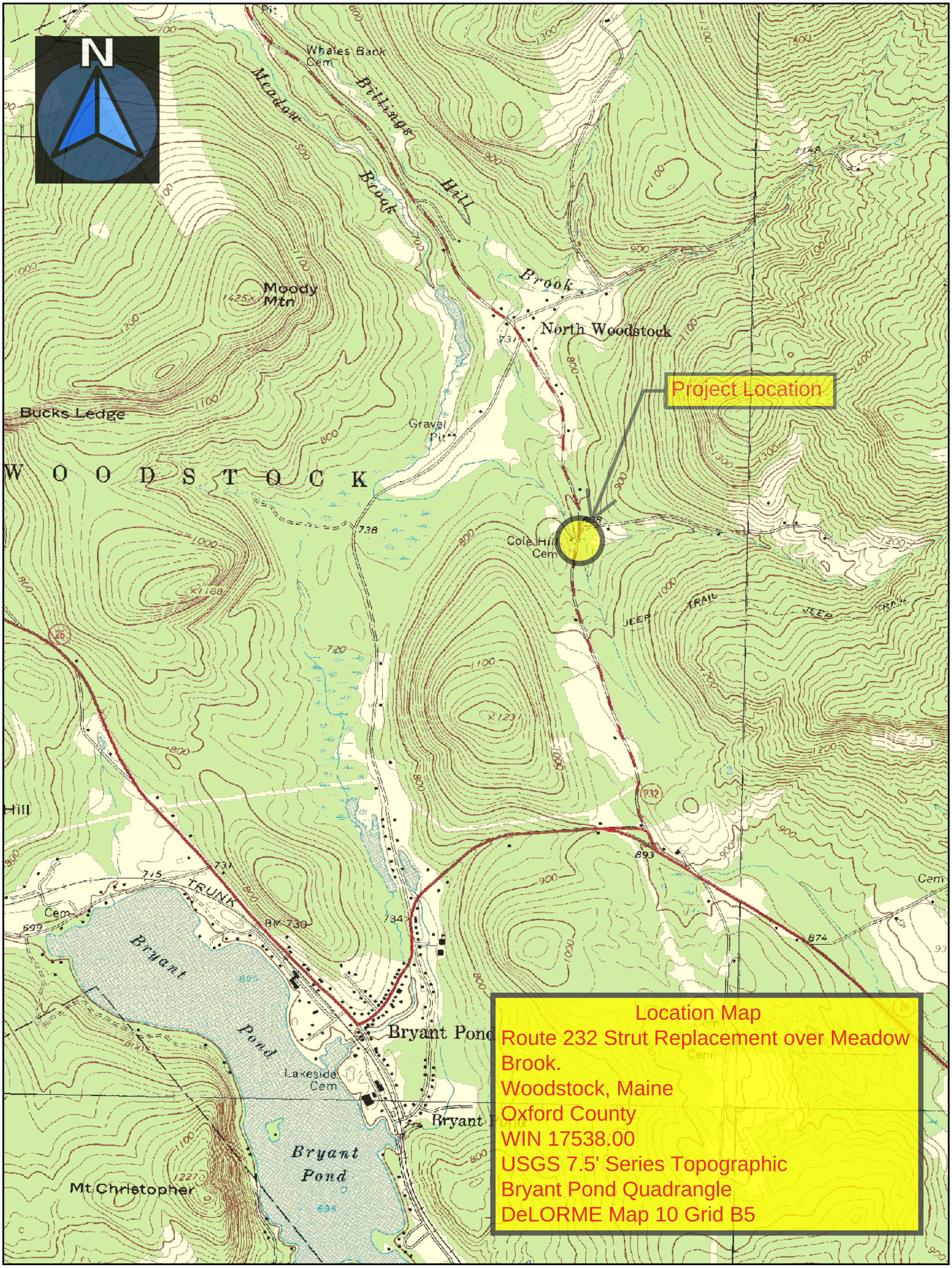
Isabel V. Schonewald, P.E.
President

cc: Jason Gallant, P.E., CMA Engineers, Inc.
Kitty Breskin, P.E. MaineDOT Highway Program

Attachments: Figures
- Appendix A: Limitations
- Appendix B: Subsurface Exploration Logs
- Appendix C: Laboratory Test Results
- Appendix D Project Geophysical Report

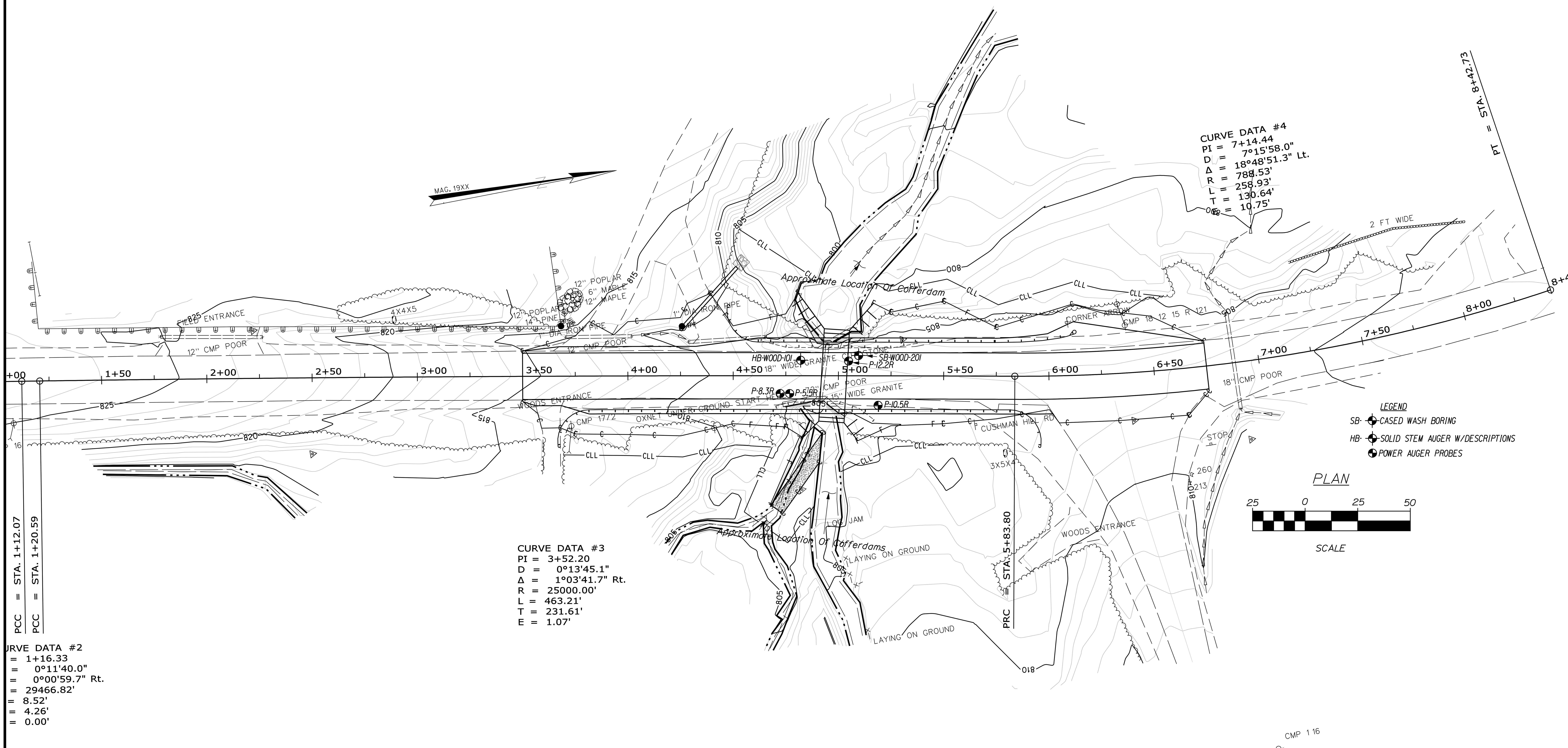
SCHONEWALD ENGINEERING ASSOCIATES, INC.

FIGURES



Map Scale 1:24000

Filename: ...\GEOTECH\MSTA\001_Geoplan1.dgn Division: GEOTECH Username: terry.white Date:9/12/2012



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

17538.00

PIN 17538.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	SHAWN SMITH	
DESIGN-DETAILED	JEFF WALLACE	APR 2012
CHECKED-REVIEWED	T. WHITE	
DESIGN2-DETAILED2	K. BRESKIN	
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

WOODSTOCK
ROUTE 232

GEOPLANS

SHEET NUMBER

2

OF 2

SCHONEWALD ENGINEERING ASSOCIATES, INC.

APPENDIX A

LIMITATIONS

SCHONEWALD ENGINEERING ASSOCIATES, INC.

LIMITATIONS

Explorations

The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time the measurements were made.

Review

In the event that any changes in the nature, design, or location of the proposed construction are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by SchonewaldEA. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that geotechnical design and construction recommendations may be properly interpreted and implemented in the design and specifications.

Construction

It is recommended that this firm be retained to provide geotechnical engineering support services during construction of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

This geotechnical engineering report has been prepared for this project by SchonewaldEA. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

This report has been prepared for this project by SchonewaldEA for the exclusive use of the MaineDOT Highway Program and CMA Engineers, Inc., as a subconsultant, for specific application to the design of the proposed replacement strut located on Route 232 at the Meadow Brook crossing in Woodstock, Maine (MaineDOT WIN 17538.00) in accordance with generally accepted soil and foundation engineering practices. No Warranty, express or implied, is made.

SCHONEWALD ENGINEERING ASSOCIATES, INC.

APPENDIX B

SUBSURFACE EXPLORATION LOGS

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 232 Strut
Location: Woodstock, Maine

Boring No.: HB-WOOD-101
WIN: 17538.00

Driller:	MaineDOT	**Elevation (ft.)**	807.6	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/8/11-12/8/11	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	4+82, 7.3 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	807.02		7" PAVEMENT. ——0.58	
										Cobble from 1.0-1.3 ft bgs.	
	1D	24/16	2.00 - 4.00	3/8/6/12	14	20				Brown, moist, medium dense, silty, fine to medium SAND, little gravel.	G#176418 A-2-4, SM WC=9.2%
								803.10		——4.50	
5	2D	24/15	5.00 - 7.00	6/26/14/13	40	56				Brown, moist, dense, fine to coarse SAND, some gravel, little silt, occasional cobble.	G#176419 A-1-b, SM WC=8.3%
										Solid drilling from 8.2-9.3 ft bgs.	
								798.30		——9.30	
10										**Bottom of Exploration at 9.30 feet below ground surface.** REFUSAL	
15											
20											
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project:	Route 232 Strut			**Boring No.:**	SB-WOOD-201
Location:	Woodstock, Maine			**WIN:**	17538.00
Driller:	MaineDOT	**Elevation (ft.)**	806.5	**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	300#/16"
Date Start/Finish:	5/9/12; 08:00-09:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	5+11, 8.0 ft Lt.	**Casing ID/OD:**	NW	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	805.96		6½" PAVEMENT. — 0.54	
										No descriptions given.	
5										Set in NW Casing at 5.0 ft bgs, then drove to 10.3 ft bgs.	
							30				
							36				
							57				
							68				
							77				
10	R1	60/60	10.30 - 15.30	RQD = 73%			a50 NQ-2	796.20		a50 blows for 0.3 ft. — 10.30 Top of Bedrock at Elev. 796.2 ft. R1:Bedrock: Hard, fresh, white to grey medium grained, Quartz Biotite GNEISS. Close, low angle joints predominately parallel to foliation, with a few of the joints showing slight weathering (biotite discoloration). Rock Mass Quality = Fair R1:Core Times (min:sec) 10.3-11.3 ft (2:50) 11.3-12.3 ft (1:50) 12.3-13.3 ft (1:10) 13.3-14.3 ft (1:20) 14.3-15.3 ft (1:45) 100% Recovery — 15.30	
15								791.20		**Bottom of Exploration at 15.30 feet below ground surface.**	
20											
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

State of Maine - Department of Transportation

Power Auger Probe Summary Sheet

Town(s): Woodstock Work Number: 17538.00

Station (Feet)	Offset (Feet)	Weathered Rock (Feet)	Refusal (Feet)	No Refusal (Feet)	Water Depth (Ft.)	Comments / Date 12/8/2011
4+77.3	8.5 Rt.		*5.5			HB-WOOD-102
4+72.3	8.5 Rt.		8.3			HB-WOOD-102A
5+18.9	14.0 Rt.		10.5			HB-WOOD-103
5+04.8	7.0 Lt.		12.2			HB-WOOD-104
The soils were very similar to HB-WOOD-101 in all probes.						
* Refusal possibly on Boulder; refer to Geophysical Report.						

MaineDOT Drill Crew
Logged By: B. Wilder
Drill Rig: CME 45C

5" Solid Stem Auger

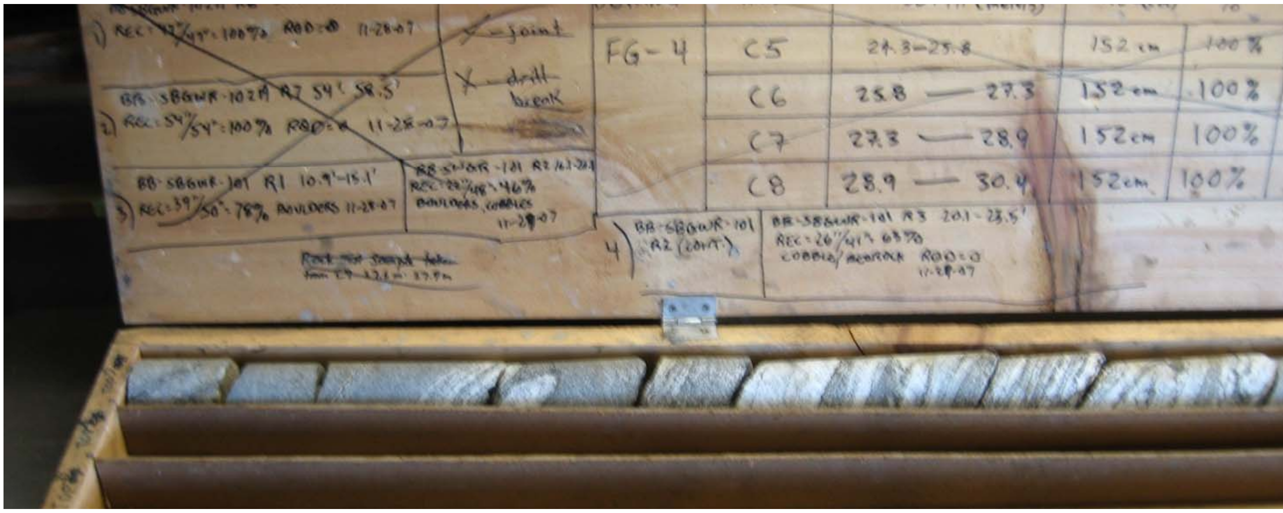


Photo 1: left side of core box (top portion of core)

Photo 2: right side of core box (bottom portion of core)

Photo 3: close-up of joint surface

SCHONEWALD ENGINEERING ASSOCIATES, INC.

ROCK CORE PHOTOGRAPHS

TEST BORING SB-WOOD-201
WOODSTOCK, MAINE
MaineDOT WIN 17538.00

Sheet No.:

1

SCHONEWALD ENGINEERING ASSOCIATES, INC.

APPENDIX C

LABORATORY TEST RESULTS

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Woodstock   Work Number: 17538.00

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-WOOD-101, 1D	4+82	7.3 Lt.	2.0-4.0	176418	1	9.2	22.7	SM	A-2-4	II
HB-WOOD-101, 2D	4+82	7.3 Lt.	5.0-7.0	176419	1	8.3	15.0	SM	A-1-b	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 MDOT and Corps of Engineers Classification Systems.

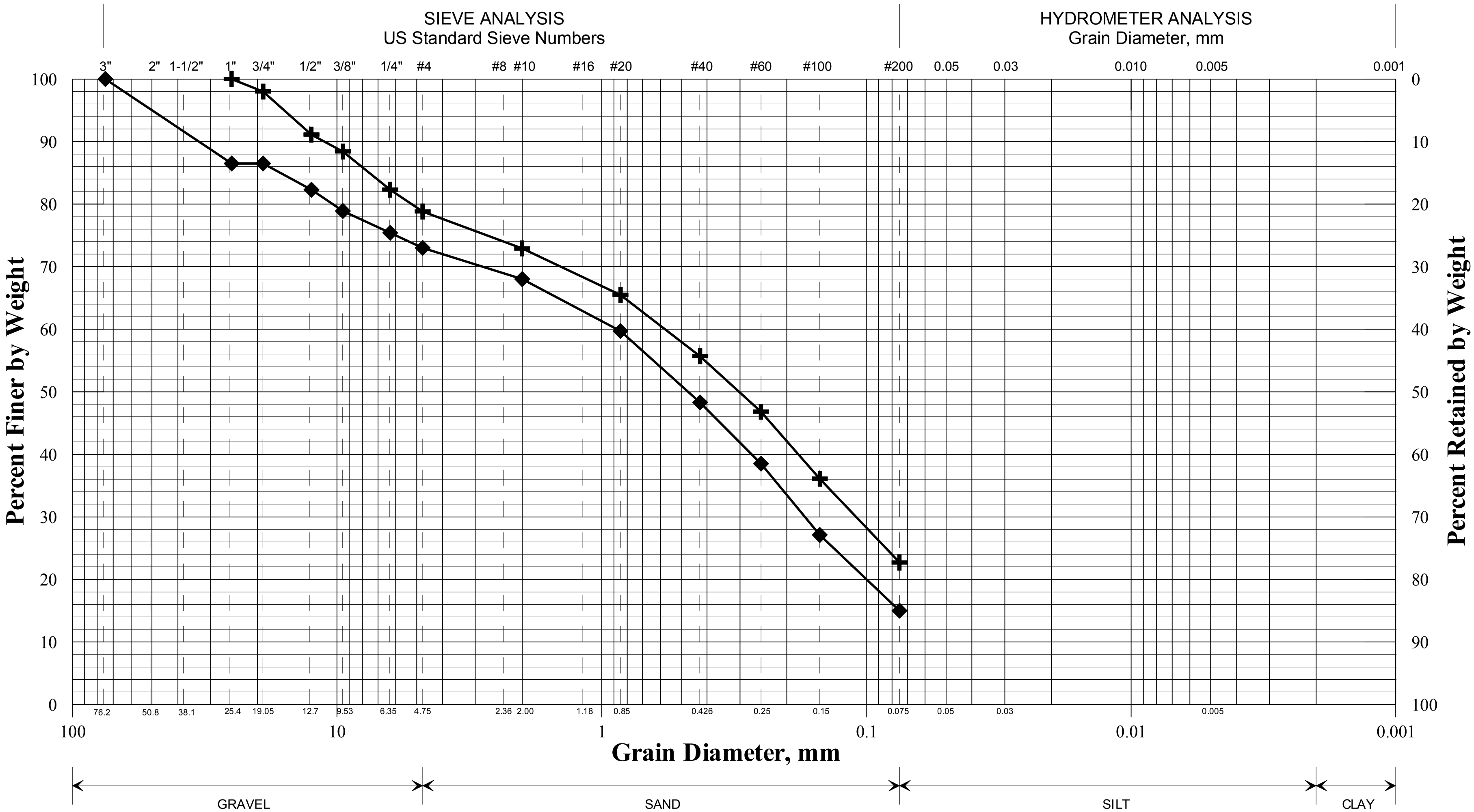
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-WOOD-101/1D	4+82	7.3 LT	2.0-4.0	SAND, some silt, some gravel.	9.2			
◆	HB-WOOD-101/2D	4+82	7.3 LT	5.0-7.0	SAND, some gravel, little silt.	8.3			
■									
●									
▲									
✖									

WIN	
017538.00	
Town	
Woodstock	
Reported by/Date	
WHITE, TERRY A	4/23/2012

SHEET 1

Schonewald Engineering Associates, Inc.

APPENDIX D

PROJECT GEOPHYSICAL REPORT

HAGER-RICHTER
GEOSCIENCE, INC.

GEOPHYSICAL SURVEY
ROUTE 232
WOODSTOCK, MAINE

PIN 17538.00
MAINE DOT CONTRACT
No. 20110613000000006486

Prepared for:

Maine Department of Transportation
Highway Program
16 State House Station
Augusta, Maine 04333-0016

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 12SG11
May, 2012

HAGER-RICHTER
GEOSCIENCE, INC.

CONSULTANTS IN GEOLOGY AND GEOPHYSICS
8 INDUSTRIAL WAY - D10
SALEM, NEW HAMPSHIRE 03079-5820
TELEPHONE (603) 893-9944
FAX (603) 893-8313

May 25, 2012
File 12SG11

Kitty Breskin, P.E.
Geotechnical Design Engineer
Maine Department of Transportation
Highway Program
16 State House Station
Augusta, Maine 04333-0016

Phn: 207.624.3000
Cell: 207.592.7605
Email Kitty.Breskin@maine.gov

RE: **Maine DOT Contract No. 20110613000000006486**
Geophysical Survey
Route 232
Woodstock, Maine
PIN 17538.00

Dear Ms. Breskin:

In this letter, we report the results of a geophysical survey conducted by Hager-Richter Geoscience, Inc. (H-R) along a portion of State Route 232 in Woodstock, Maine for the Maine Department of Transportation (MaineDOT) in May, 2011. The geophysical survey was performed in support of a geotechnical investigation by MaineDOT for the replacement of a corrugated steel culvert channeling Meadow Brook under State Route 232.

INTRODUCTION

The Site is a portion of State Route 232 located approximately 75 feet south of the junction of Cushman Hill Road and approximately 1 mile north of the junction of Routes 232 and 26. The general location of the Site is shown in Figure 1. A 5-foot diameter corrugated steel culvert channels Meadow Brook under Route 232 at this location, and according to information provided by MaineDOT, the steel culvert is to be replaced. State Route 232 is a two-lane road that is generally flat and level in the area of interest (AOI). The AOI measured approximately 100 feet by 25 feet. Figure 2 is a site plan showing the AOI.

In support of a geotechnical investigation of the site, MaineDOT required information on the depth and configuration of bedrock in the vicinity of the existing culvert, and the presence of weathered bedrock MaineDOT installed five auger borings and probes (HB-Wood-101, HB-Wood-102, HB-Wood-102A, HB-Wood-103, and HB-Wood-104) in the roadway near the existing culvert. Refusal on presumed bedrock was encountered at depths of approximately 5.5 feet to 12.2 feet below ground surface. Preliminary logs for the borings and probes provided by

MaineDOT are attached to this report in Appendix 1.

OBJECTIVE

The objective of the geophysical survey was to determine (1) the depth and configuration of the bedrock surface and (2) whether the upper portion of the bedrock is weathered in the vicinity of the proposed construction.

THE SURVEY

The geophysical survey was conducted using ground penetrating radar (GPR) and seismic refraction methods. Michael Howley and Eric Rickert of Hager-Richter conducted the geophysical survey on May 2, 2012. The fieldwork was coordinated with Ms. Kitty Breskin, P.E., of MaineDOT, who was on site for the initiation of the survey and specified the area of interest. Representatives of the MaineDOT were on site for the duration of the field work and coordinated traffic control services. Data analysis and interpretation were completed at the Hager-Richter offices. Original data and field notes will be retained in the Hager-Richter files for a minimum of three years.

GPR data were acquired along traverses spaced 2 feet apart oriented parallel to the travel lanes, and along traverses spaced 10 feet apart oriented perpendicular to the travel lanes. The area of interest extended approximately 50 feet north and south of the culvert along the paved roadway. In addition, seismic refraction profiling was conducted along two 94-foot long seismic lines, one line along each shoulder of the roadway. MaineDOT provided site plans showing site features, surface topography, and the locations of borings and probes. Figure 2 is a modified site plan showing the locations of the GPR traverses, seismic refraction lines, and other site features.

EQUIPMENT

GPR. The GPR survey was conducted using a Sensors and Software Noggin SmartCart Plus digital GPR system equipped with a survey wheel to trigger recording of data at equal horizontal distances. The GPR system was used with a 250 MHz antenna and a 60 nsec[1] time window. The GPR data were processed using EKKO_Mapper 4™ software licensed by Sensors and Software.

Seismic Refraction. For the seismic refraction survey, we used two 24-channel Geometrics Geode digital seismographs, coupled to 48 geophones spaced 2 feet apart. Five shot

[1]ns, abbreviation for nanosecond, 1/1,000,000,000 second. Light and the GPR signal require about 1 ns to travel 1 ft in air. The GPR signal requires about 3.5 ns to travel 1 ft in unsaturated sandy soil.

points were used per seismic spread - one located internal to the spread, one at each end of the spread, and two offset shots located in-line but outside of the spread of geophones. The seismic source was a sledgehammer striking a metal plate. The seismic refraction data were processed using IXRefraX™ software licensed by Interpex.

LIMITATIONS OF THE METHODS

HAGER-RICHTER GEOSCIENCE, INC. MAKES NO GUARANTEE THAT THE DEPTH OF BEDROCK WAS ACCURATELY DETERMINED IN THIS SURVEY. HAGER-RICHTER GEOSCIENCE, INC. IS NOT RESPONSIBLE FOR DETERMINING THE DEPTH OF BEDROCK WHERE THE INTERFACE CANNOT BE DETECTED BECAUSE OF SITE CONDITIONS. THE BEDROCK DEPTHS DETERMINED SHOULD NOT BE USED FOR CONTRACT BEDROCK REMOVAL QUANTITIES.

GPR. There are limitations of the GPR technique: (1) surface conditions, (2) electrical conductivity and thickness of the subsurface layers, (3) electrical properties of the target(s), and (4) spacing of the traverses. Of these restrictions, only the last is controllable by us in most cases.

The condition of the survey surface can affect the quality of the GPR data and the depth of penetration of the GPR signal. For exterior sites, a surface covered with obstacles such as automobiles, dumpsters, thick leaf debris, materials piles, etc. limit the survey access. Similarly, for interior sites, a surface covered with obstacles such as desks, benches, laboratory equipment, etc. also limit access. Some floor coverings may limit the coupling of the GPR antenna with the subsurface.

The electrical conductivity of the subsurface determines the attenuation of the GPR signals, and thereby limits the maximum depth of exploration. The GPR signal does not penetrate clay-rich soils or soils contaminated with road salt. In some cases, the GPR signal may not penetrate below concrete pavement, and some asphalts are electrically conducting.

A strong contrast in the electrical conductivities of the ground and the target (for examples, UST, pipe, void, dry well, drum, contaminant plume) is required to obtain a reflection of the GPR signal. If the contrast is too small, then the reflection may be too weak to recognize, and the target can be missed.

Spacing of the traverses is limited by access at many sites, but where flexibility of traverse spacing is possible, the spacing is adjusted on the basis of the size of the target.

Seismic Refraction. Like all geophysical methods, the seismic refraction method is based on the assumption that the local geology is uncomplicated. In particular, the seismic refraction method assumes that interfaces between geologic materials correlate with sharp increases in seismic velocity and that the interfaces between geologic units are relatively flat-lying. The method is not very sensitive to lateral variations within layers, and relatively subtle features such as fracture zones within bedrock are generally difficult to detect unless there is a topographic expression of the feature. The accuracy of the method is degraded in areas with strong topographic relief and/or where the interfaces have apparent dips greater than about 20°. *In general, the standard error of depths determined is about 10% or 2 feet, whichever is greater.*

Where two materials do not exhibit contrasting velocities, or where velocities gradually increase with depth, a clear refracted signal is not generated, and the seismic refraction method cannot be used to distinguish the two materials. In some cases, the "geophysical contact" between materials with contrasting velocities does not correlate exactly with the "geologic contact." For example, where a highly weathered bedrock is overlain by a dense material such as till, the velocity range of the weathered bedrock might overlap or approach the velocity range of the till, and the two materials cannot be distinguished seismically.

RESULTS

The geophysical survey of the roadway in the vicinity of the steel culvert consisted of a ground penetrating radar (GPR) survey across the area of interest and a seismic refraction survey along the road shoulders. The GPR survey was conducted in a 24-foot by 100-foot GPR survey area with traverses spaced 2 feet apart oriented parallel to the travel lanes, and along traverses spaced 10 feet apart oriented perpendicular to the travel lanes. The seismic refraction survey consisted of two 94-foot long seismic refraction survey lines located on the shoulders of the roadway. The locations of the GPR traverses and seismic refraction lines are shown in Figure 2, and an example GPR profile is shown in Figure 3. The results of the seismic refraction survey are shown in profile form in Figure 4, as a bedrock elevation contour plot in Figure 5, and are listed in Table 1.

GPR Survey. Apparent GPR signal penetration was generally fair to good across the area of interest, with two-way traveltime reflections received for 40 to 50 ns of the 60 ns records recorded. Based on site specific time-to-depth conversions for the GPR signal at the Site, the GPR signal penetration is estimated to have been approximately 5 to 8 feet.

GPR reflections consistent with those expected for the top of bedrock are not evident in any of the GPR records for the site. The depth of bedrock based on boring logs provided by MaineDOT ranges from 8.3 feet to 12.2 feet below ground surface. The bedrock depths indicated by borings in the area of interest is either greater than the effective penetration of the

GPR signal, or the contrast between the bedrock surface and the overlying soils is not sufficient to generate a detectable GPR reflection. An example GPR profile is shown in Figure 3 indicating the location of the 5-foot diameter steel culvert.

Seismic Refraction Survey. The seismic refraction survey consisted of two transects designated as Seismic Lines 1 and 2. The locations of the seismic lines are shown in Figure 2. The results of the seismic survey are shown in profile form in Figure 4, as a contour plot of bedrock elevations in Figure 5, and are listed in Table 1.

The quality of the seismic refraction data ranges from good to excellent. A measure of the accuracy of the data can be obtained by comparing the bedrock depths determined seismically with depths reported from nearby borings that encountered refusals on assumed bedrock, or comparing bedrock depths with results of other geophysical methods. For the present survey, five borings (HB-Wood-101, HB-Wood-102, HB-Wood-102A, HB-Wood-103, and HB-Wood-104) were drilled to refusal in the roadway within 25 feet north and south of the culvert. Boring HB-Wood-102 encountered refusal at 5.5 feet, and is interpreted to have encountered a boulder or other non-bedrock refusal. The remaining four borings encountered refusal at depths ranging from approximately 8.3 feet to 12.2 feet below the road surface.

Comparison with results from the GPR survey are not possible due to the lack of GPR reflections from bedrock, as stated above. Based on the good quality of the seismic data for this project and on the results from other similar seismic refraction surveys, we estimate the accuracy (standard deviation) of the apparent depths of competent bedrock determined by the seismic refraction survey in most locations to be about ± 10% of the depth of bedrock, or ± 2 feet), whichever is greater.

Seismic profiles for the two lines shown in Figure 3 do not show a prominent bedrock trough in the vicinity of the existing culvert. An examination of Figure 4 shows that depth of bedrock increases to the north and west. The depth of competent bedrock along the seismic lines varies between about 6 and 14 feet below ground surface. The elevation of competent bedrock in the locations surveyed varies between 793 and 801 feet for a total relief of 8 feet.

The elevation of the road at discreet points along the seismic profiles could not be determined from the plans supplied by MeDOT, therefore we use a surface elevation of 807 feet for the entire AOI, determined from the average elevation of the boring locations. Bedrock depths and elevations at station spacings of 5 feet along the two seismic lines are listed in Table 1.

The contours shown on Figure 4 represents interpolations based on the seismic data. The contours shown represent non-unique models for bedrock elevation, and the elevation of competent bedrock at any particular location between actual data points may differ from that shown. Bedrock elevations based on additional data, such as additional borings or seismic data, may differ significantly from those shown on the plates. **The bedrock model shown as profiles, bedrock elevation contour plot, or listed as tabular data should not be used for contract bedrock removal quantities.**

The presence of weathered bedrock at the site cannot be confirmed on the basis of seismic refraction data. The seismically determined depth of bedrock is greater than the depth of refusal for three of the four borings interpreted to have been terminated at bedrock. However, the difference between the seismic depth of bedrock and the depth of refusal in the three borings is less than the stated accuracy of the seismic refraction method (±10% or 2 feet, whichever is greater).

Materials with two distinct velocity ranges were detected at the Site. The upper material exhibits a velocity of 1,350 feet per second (fps) and is interpreted to consist of unsaturated and saturated soils and sediments. The lower material exhibits a velocity range of 11,000 fps to 14,300 fps and is interpreted to be competent bedrock. Where the top of bedrock is highly fractured and/or deeply weathered, it might exhibit lower velocities that cannot be detected as a distinct layer on the basis of the seismic refraction data. Thus, the top of rock determined on the basis of seismic refraction data generally is the top of competent bedrock, which might be located somewhat below the geologic contact between the overburden and bedrock.

CONCLUSIONS

Based on the results of the geophysical survey conducted by Hager-Richter Geoscience, Inc. along a portion of Route 232 at the Meadow Brook culvert crossing located in Woodstock, Maine in May, 2012, we conclude that the depth of bedrock below the surveyed portion of the roadway varies between about 6 and 14 feet and is deepest north of the location of the culvert along the western edge of the road.

LIMITATIONS

This letter report was prepared for the exclusive use of Maine Department of Transportation (Client). No other party shall be entitled to rely on this Report or any information, documents, records, data, interpretations, advice or opinions given to Client by Hager-Richter Geoscience, Inc. (H-R) in the performance of its work. The Report relates solely to the specific project for which H-R has been retained and shall not be used or relied upon by Client or any third party for any variation or extension of this project, any other project or any other purpose without the express written permission of H-R. Any unpermitted use by Client or any third party shall be at Client's or such third party's own risk and without any liability to H-R.

H-R has used reasonable care, skill, competence and judgment in the performance of' its services for this project consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by H-R should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, test pits, soil borings with collection of soil and water samples, and laboratory testing.

Except as expressly provided in this limitations section, H-R makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.

If you have any questions or comments on this letter report, please contact us at your convenience. It has been a pleasure to work with you on this project. We look forward to working with you again in the future.

Sincerely yours,
HAGER-RICHTER GEOSCIENCE, INC.

Michael W. Howley
Geophysicist

Dorothy Richter, P.G.
President

Attachments: Table 1, Figures 1-5, Appendix A

Table 1
Depth and Elevation of Bedrock from Seismic Refraction
State Route 232
Woodstock, Maine

Seismic Line 1				
Station (feet)	**Easting (feet)**	**Northing (feet)**	**Bedrock Depth (feet)**	**Approximate Bedrock Elevation (feet)**
4+45	916537.20	571032.73	7.0	800.3
4+50	916538.05	571037.66	7.2	800.1
4+55	916538.89	571042.58	7.1	800.2
4+60	916539.74	571047.51	8.1	799.3
4+65	916540.59	571052.43	8.4	798.9
4+70	916541.43	571057.36	10.2	797.2
4+75	916542.28	571062.28	10.9	796.4
4+80	916543.13	571067.21	11.3	796.0
4+85	916543.97	571072.13	11.4	795.9
4+90	916544.82	571077.06	11.3	796.1
4+95	916545.67	571081.98	11.4	795.9
5+00	916546.51	571086.91	11.4	795.9
5+05	916547.36	571091.83	11.8	795.5
5+10	916548.20	571096.76	12.1	795.3
5+15	916549.05	571101.68	12.5	794.8
5+20	916549.90	571106.61	13.6	793.7
5+25	916550.74	571111.53	13.9	793.4
5+30	916551.59	571116.46	13.9	793.4
5+35	916552.44	571121.38	13.9	793.4
5+39	916553.12	571125.31	13.9	793.4

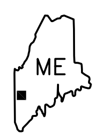
Seismic Line 2				
Station (feet)	**Easting (feet)**	**Northing (feet)**	**Bedrock Depth (feet)**	**Approximate Bedrock Elevation (feet)**
4+45	916560.86	571028.60	6.3	801.0
4+50	916561.71	571033.53	6.6	800.7
4+55	916562.55	571038.46	6.8	800.5
4+60	916563.40	571043.39	7.5	799.9
4+65	916564.25	571048.31	8.4	798.9
4+70	916565.09	571053.24	9.2	798.1
4+75	916565.94	571058.17	9.8	797.5
4+80	916566.79	571063.10	10.4	796.9
4+85	916567.63	571068.03	10.7	796.6
4+90	916568.48	571072.96	10.7	796.7
4+95	916569.33	571077.89	10.8	796.5
5+00	916570.17	571082.81	11.2	796.2
5+05	916571.02	571087.74	11.6	795.7
5+10	916571.86	571092.67	11.4	796.0
5+15	916572.71	571097.60	11.1	796.2
5+20	916573.56	571102.53	10.9	796.5
5+25	916574.40	571107.46	10.0	797.3
5+30	916575.25	571112.38	9.1	798.2
5+35	916576.10	571117.31	8.9	798.4
5+39	916576.78	571121.25	8.8	798.5

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Heavily weathered or highly fractured bedrock may occur at shallower depths. Easting and Northing coordinates for the seismic lines were determined from plans provided by MaineDOT. Elevations are relative to the average boring surface elevation of 807 feet indicated on plans provided by MaineDOT.

N

APPROXIMATE SCALE (feet)

0 1000 2000



LOCATION

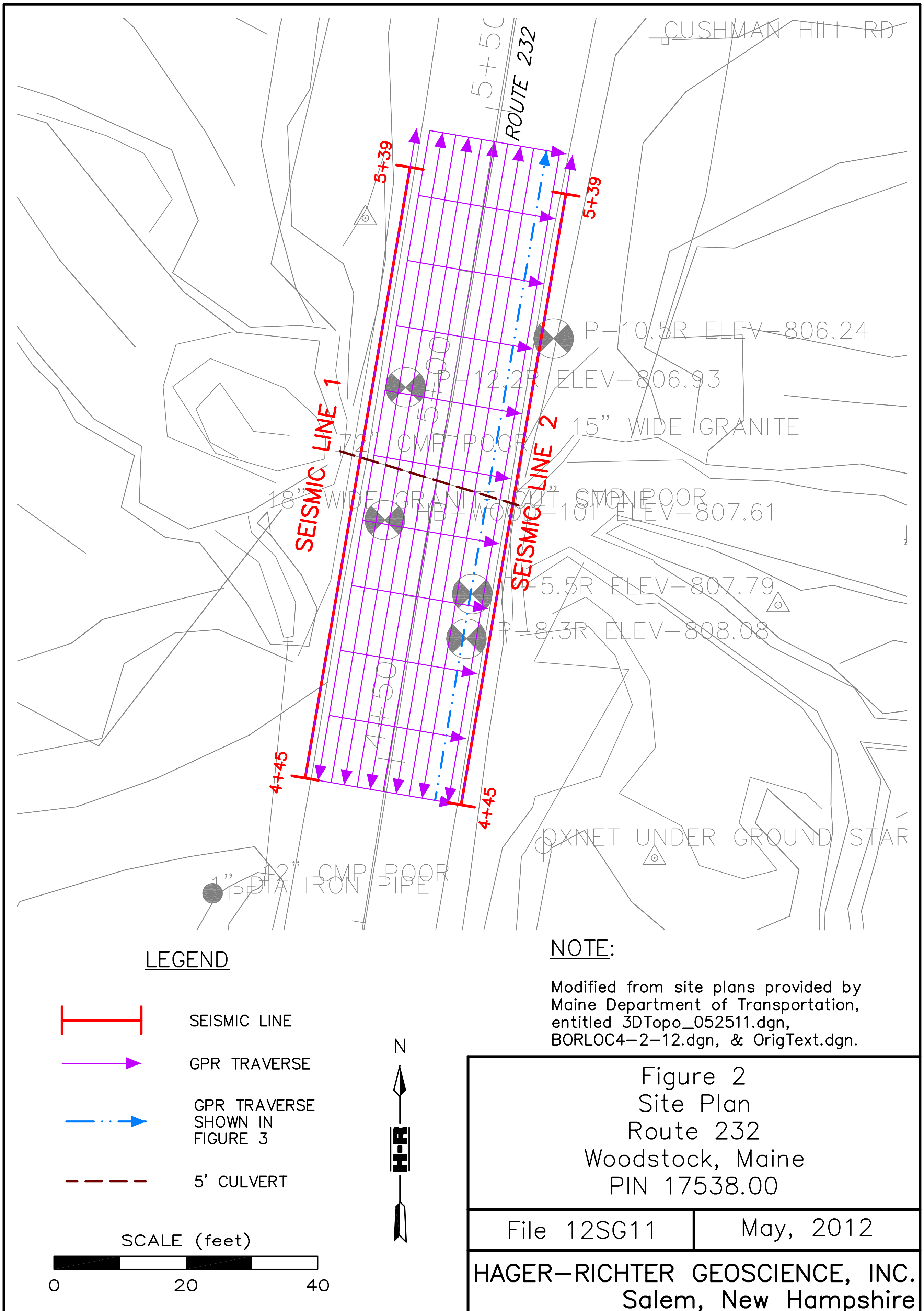
NOTE:

Modified from Google Earth aerial photograph.

Figure 1
General Site Location
Route 232
Woodstock, Maine
PIN 17538.00

File 12SG11	May, 2012

HAGER–RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



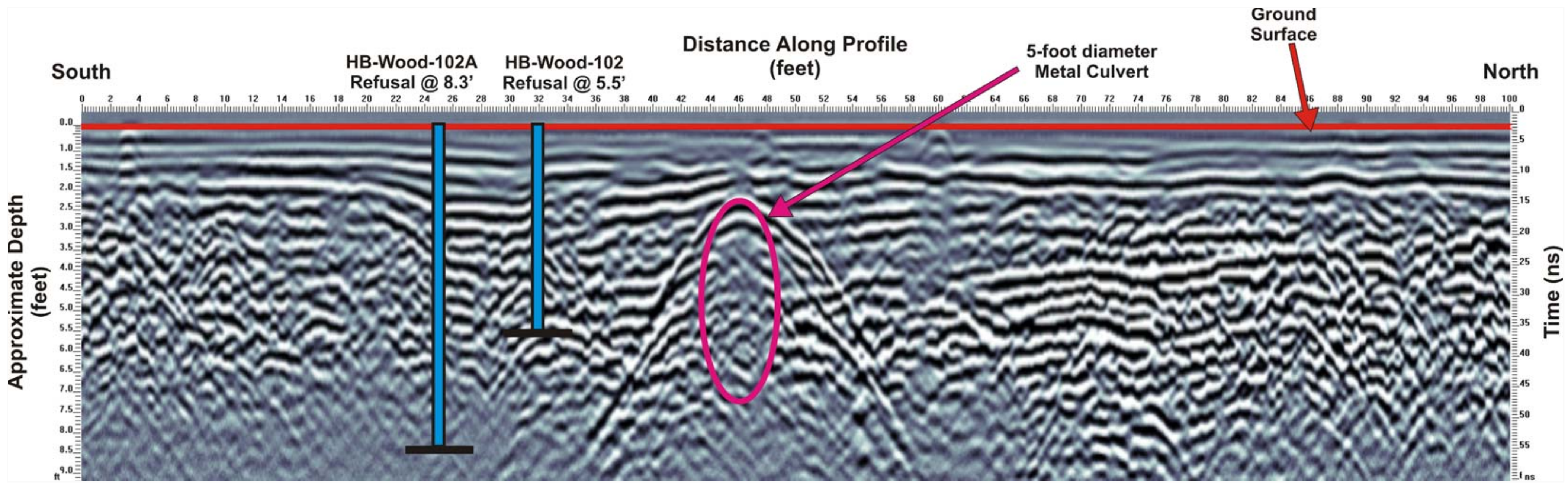
NOTE:

Modified from site plans provided by Maine Department of Transportation, entitled 3DTopo_052511.dgn, BORLOC4-2-12.dgn, & OrigText.dgn.

Figure 2
Site Plan
Route 232
Woodstock, Maine
PIN 17538.00

File 12SG11	May, 2012

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



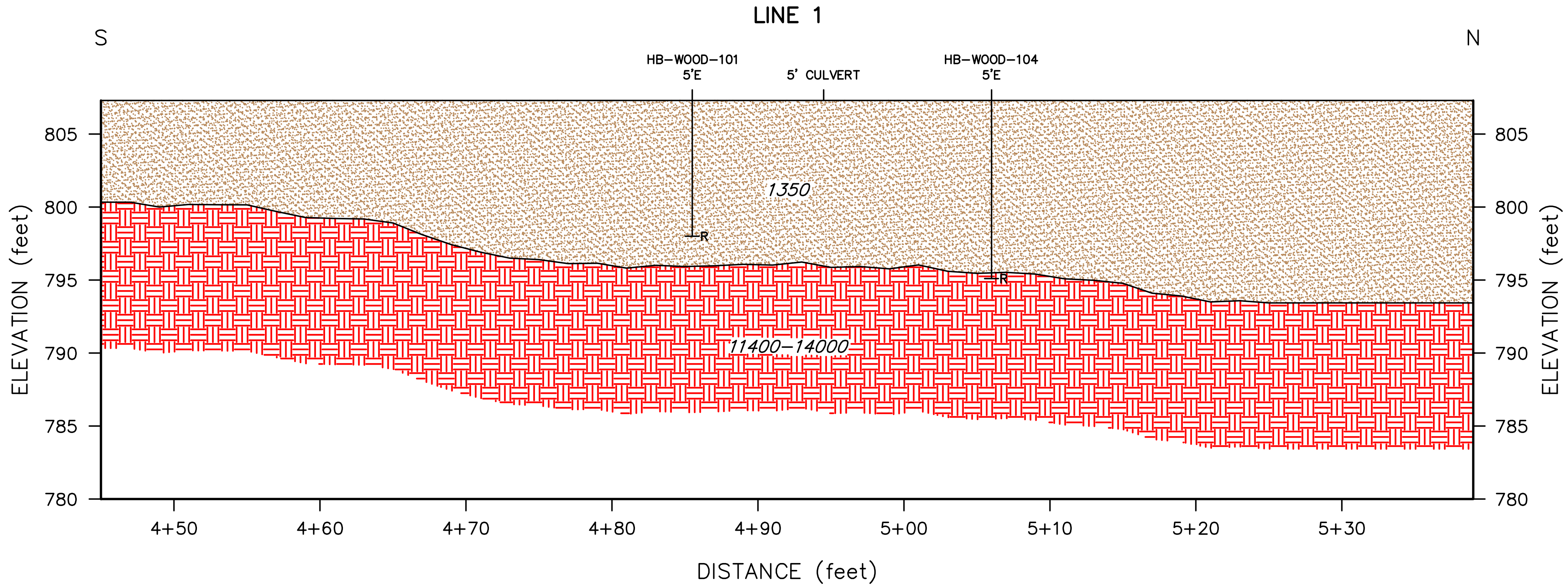
NOTES:

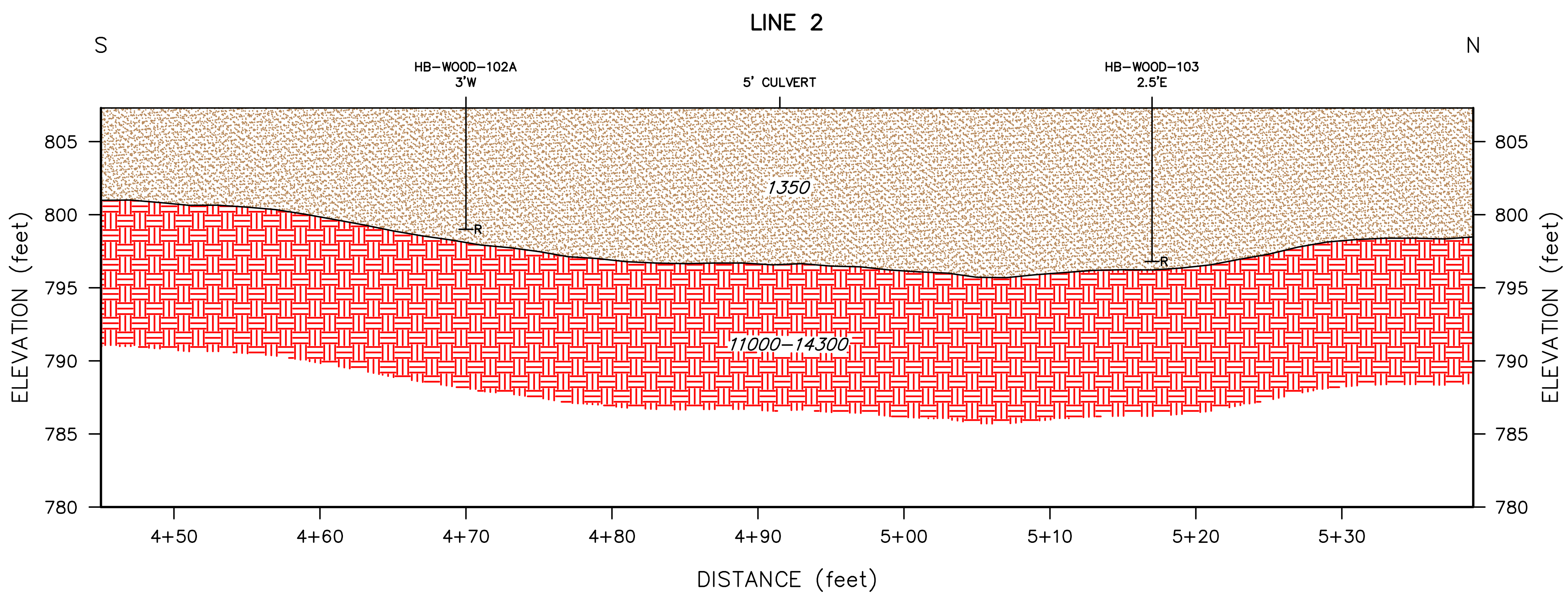
1. GPR data were acquired using a Sensors and Software Noggin Smart Cart digital GPR system with a 250 MHz antenna.
2. Estimated depths represent distance below ground surface
3. Locations of GPR records shown in Figure 2.

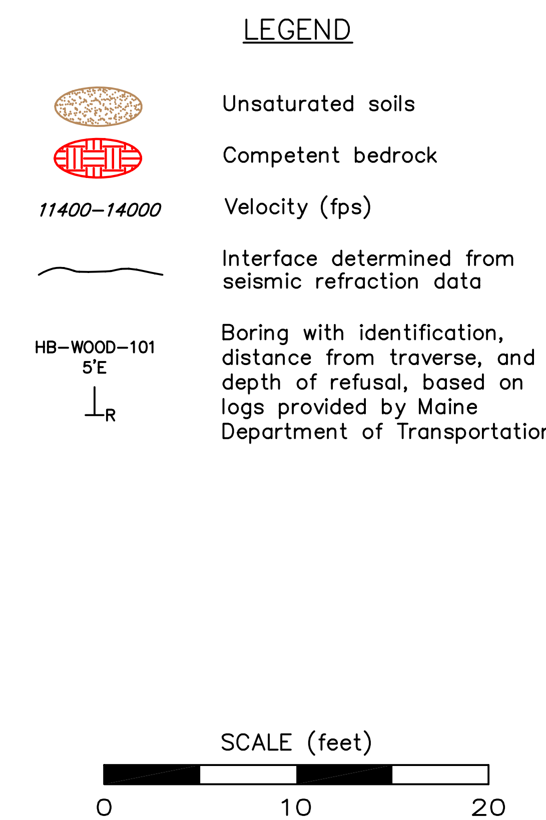
HORIZONTAL SCALE (feet)

0 10 20

Figure 3 Example GPR Record Route 232 Woodstock, Maine PIN 17538.00	
File 12SG11	May, 2012
HAGER–RICHTER GEOSCIENCE, INC. Salem, New Hampshire	







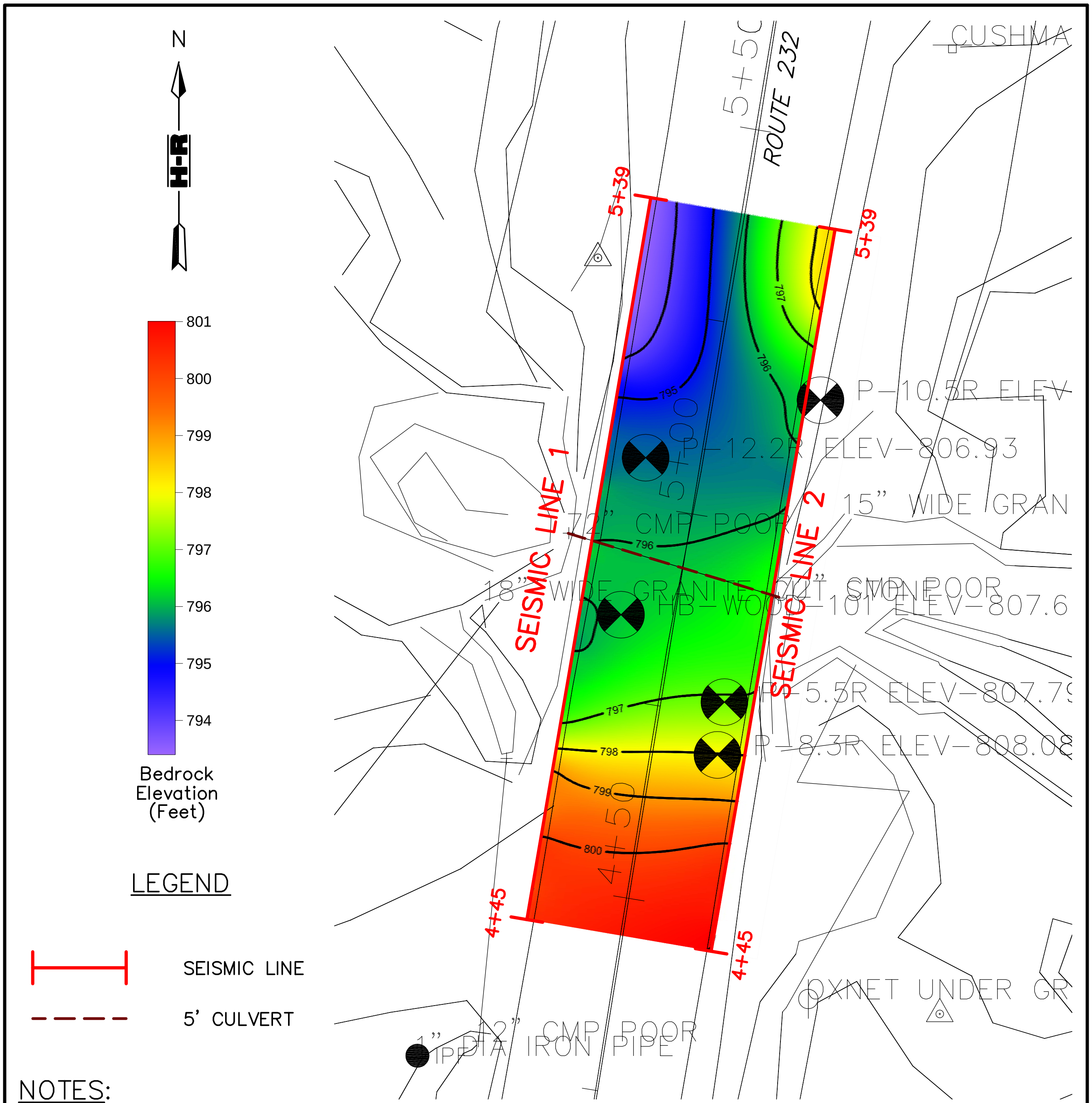
NOTES:

1. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or 2 feet, whichever is greater.
2. The depths determined for bedrock are depths of competent rock; weathered and/or fractured bedrock might occur at shallower depths.
3. Surface elevations estimated from average elevation of borings indicated on plan provided by Maine Maine Department of Transportation, entitled BORLOC4-2-12.dgn.
4. Data were analyzed using the Generalized Reciprocal Method.

Figure 4
Seismic Line 1 & 2
Route 232
Woodstock, Maine
PIN 17538.00

File 12SG11	May, 2012

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



NOTES:

1. Modified from site plans provided by Maine Department of Transportation, entitled 3DTopo_052511.dgn, BORLOC4-2-12.dgn, & OrigText.dgn.

2. Contour Interval = 1 Foot.

3. Surface elevations estimated from average elevation of borings indicated on plan provided by Maine Maine Department of Transportation, entitled BORLOC4-2-12.dgn.

4. The bedrock elevations shown on this plot are a non-unique model. The contours represent interpolations based on the available data, including seismic refraction data and boring information. The elevations of the bedrock surface at any particular location may differ from that shown. Bedrock elevations based on additional data may differ significantly.

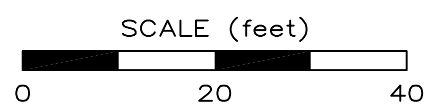


Figure 5
Bedrock Topography
Route 232
Woodstock, Maine
PIN 17538.00

File 12SG11	May, 2012

HAGER-RICHTER GEOSCIENCE, INC.
Salem, New Hampshire

APPENDIX A

Boring Logs

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Route 232 Strut
Location: Woodstock, Maine

Boring No.: HB-WOOD-101
PIN: 17538.00

Driller:	MaineDOT	**Elevation (ft.)**		**Auger ID/OD:**	5" Dia.
Operator:	Giguere/Giles	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	12/8/11-12/8/11	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	?????, 7.0 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	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	
										Cobble from 1.0-1.3 ft bgs.	
	1D	24/16	2.00 - 4.00	3/8/6/12	14	20				Brown, moist, medium dense, silty, fine to medium SAND, little gravel.	
								-4.50		—4.50	
5	2D	24/15	5.00 - 7.00	6/26/14/13	40	56				Brown, moist, dense, fine to coarse SAND, some gravel, little silt, occasional cobble.	
										Solid drilling from 8.2-9.3 ft bgs.	
								-9.30		—9.30	
10										**Bottom of Exploration at 9.30 feet below ground surface.** REFUSAL	
15											
20											
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

State of Maine - Department of Transportation

Power Auger Probe Summary Sheet

Town(s): Woodstock   Work Number: 17538.00

Station (Feet)	Offset (Feet)	Weathered Rock (Feet)	Refusal (Feet)	No Refusal (Feet)	Water Depth (Ft.)	Comments / Date 12/8/2011
	8.5 Rt.		5.5			HB-WOOD-102
	8.5 Rt.		8.3			HB-WOOD-102A
	7.0 Lt.		10.5			HB-WOOD-103
	14.0 Lt.		12.2			HB-WOOD-104
The soils were very similar to HB-WOOD-101 on all borings.						

MaineDOT Drill Crew
Logged By: B. Wilder
Drill Rig: CME 45C

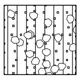
5" Solid Stem Auger

KEY TO SYMBOLS

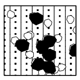
Symbol Description

Strata symbols

Paving



Description not given for: "Z:Y"



Description not given for: "OYB"

Misc. Symbols

Description not given for: "DOWNAROW"

Notes:

1. Exploratory borings were drilled on 12/8/11-12/8/11 using a 4-inch diameter continuous flight power auger.

2. No free water was encountered at the time of drilling or when re-checked the following day.

3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs.