Maine Department of Transportation
Highway Program
Geotechnical Group

Report of

SUBSURFACE INVESTIGATION FOR RECONSTRUCTION OF ROUTE 2 IN THE TOWN OF GILEAD, OXFORD COUNTY

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Oxford County PIN 9184.50 Soils Report 2008-18
Federal NH-9184(500)E
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Table of Contents

1.0 Introduction

1.1 Project Overview

Maine DOT proposes to rebuild Route 2 in the Town of Gilead. The project scope includes substantial horizontal and vertical realignment and full depth reconstruction. This report describes conditions from Station 6+240, 1.41 km west of the Bog Brook Bridge extending 3.22 km easterly to Station 9+460, 1.81 km east of the same bridge. A separate report discusses conditions at Bog Brook Bridge, to be replaced as part of this project.

1.2 Summary of Recommendations

Where the roadway subgrade will consist of blasted rock, the subgrade should be fractured to a depth of 1.2 meters surface to ensure pavement structure drainage.

The Contractor is likely to encounter groundwater seeps in cut slopes. A riprap downspout should be placed from the seep to the ditchline to allow drainage and prevent erosion of the slope.

All cut slopes must be stabilized during construction. We recommend that permanent stabilization include Erosion Control mix seeded with a mixture of small native plants to encourage rapid revegetation of the slopes.

Existing pavement should be removed in all fill areas where the proposed subgrade elevation will be less than 1.4 meters above the existing pavement surface. This will minimize the problems of trapped water between the existing and new pavement sections.

Large cobbles and boulders may be encountered in cuts at subgrade and in sideslopes. Cobbles and boulders should not be left projecting more than 150 mm from sideslopes or into the subbase soils.

2.0 Site and Subsurface Conditions

2.1 General Site Conditions

The existing roadway was designed in 1927 and 1931 as State Highway "O". It was designed to have 2.74 m (9 ft) travel lanes with 0.9 m (3 ft) unbased shoulders. The surface gravel was 100 mm to 150mm (4 to 6 inches) thick over a 125 mm to 200 mm (5 to 8 inch) base course. Maine DOT has no records of improvements since original construction, but the roadway has been widened and paved with hot mix asphalt.

Land use along the project is mostly woodland with a few residences and small businesses. The White Mountain National Forest occupies land south of the highway in the area of Bog Brook. A US Department of Defense training facility occupies a large tract of abutting land, as does a gravel pit operated by Pike Industries.

The topography is generally hilly but not mountainous, and slopes in most areas are moderately steep but not severe. Several significant drainage swales and small streams cross the highway in addition to Bog Brook. Existing ditches are inadequate, and subsurface drainage problems add to the pavement damage along this road. The existing pavement section includes approximately 150 mm of HMA over sandy soils of varying thickness. It is in poor condition.

2.2 Mapped Data

Geologic mapping by the National Wetlands Inventory indicates that the only significant areas of wetland soils at the highway may be near Bog Brook and the other major drainage swales at Stations 6+940 and 7+270.

NRCS mapping is incomplete or not available in this area.

The Surficial Geology Map, Gilead Quadrangle, by Maine Geologic Survey shows that most of the land area surrounding the road was once deposited by rivers or under glacial lakes. In addition to till in the steeper parts of the project, most soils were deposited by glacial streams or by streams flowing into the Androscogggin River. From the beginning of the current project to the small stream at Station 6+940, ice-contact deposits of sand and gravel surround the road. From this stream to Wheeler Brook at Station 7+270 the deposit is called the Wheeler Brook Fan, and consists of sands and gravels. From Wheeler Brook to Bog Brook, silty sand deposits from the Androscoggin as well as from Wheeler Brook and Bog Brook surround the highway. This map indicates that from Wheeler Brook to the end of the project, soils north of the road are glacial lake deposits with glacial Till on the steep hillsides to the south. A section of the Surficial Geology map is included as Appendix A.

2.3 Subsurface Investigation

The subsurface investigation for this project was started by Haley and Aldrich in 2002. Their report covers the original project from the Pleasant River to the NH State line. Limits of the individual segments of this project have changed several times, and additional investigations have been done. The initial investigation included 11 borings within the limits of the current project. Probes in seven locations from Station 8+120 to 8+360 and an additional 5 borings were completed in February, 2008, additional borings, and cores were completed in April, 2008 and seismic refraction lines were completed in June, 2008. Boring and core locations are shown on the Geoplans, Appendix B.

2.4 Native soils

Much of the existing roadway was constructed as a sidehill fill, and soils under the travelway and shoulders are embankment fill similar to the native soils but less dense. Native soils are generally poorly graded sands with trace to little silt, and include areas with many cobbles and boulders. In general these soils do not meet Standard Specification 703.06 for Type D or E gravel. Table 1 describes the soils encountered.

Table 1

Station	Depth (m)	Description
6+300	0.14 – 1.31	Brown, moist, gravelly SAND
	1.31 – 2.44	Gold, damp SAND
6+500	0.14 – 6.1	Lt Brown, damp to moist SAND, trace Silt, trace Gravel
6+660	to 4.57 m	Lt Brown, dry to moist, med. Dense SAND, trace to some Gravel, trace Silt
6+940	0.14 – 3.05	Brown damp to moist SAND, little Gravel, trace Silt
6+950	0.82 TO 4.57	Brown, wet, dense SAND, little to some Gravel, trace Silt
7+050	0 – 5.18	Brown, damp, medium dense to dense SAND, trace Gravel
7+258	1.52 – 2.47	Brown, medium dense Silty SAND, trace Gravel, trace Silt, Cobbles
7+268	0.3 – 1.89	Brown, dry SAND with cobbles and boulders
7+631	0.76 – 6.61	Brown, dry, very dense Gravelly SAND trace Silt to wet SAND, little Silt, trace Gravel
	6.61 – 8.23	Red-orange, wet, medium dense silty fine SAND
7+663	1.01 – 3.05	Gray-brown, moist, loose Silty fine SAND with Sandy Silt Layers
	3.05 – 8.23	Lt Brown to yellow, wet, dense SAND, trace to little Gravel
7+900	0.15 to 0.91	Brown, damp SAND, some Gravel
	0.91 to 3.05	Lt brown,damp SAND some Gravel
8+200	0.09 – 1.71	Silty SAND to bedrock refusal
8+300	0.09 – 0.91	Silty SAND to bedrock refusal
8+496	2.44 – 4.88	Orange to gray-brown medium dense sandy GRAVEL, trace Silt
	4.88 – 8.23	Tan medium dense SAND, trace to little Gravel
9+200	0.14 – 0.98	Brown, damp Gravelly SAND
	0.98 – 3.05	Lt brown, damp SAND, trace Gravel, trace Silt (This is a glacial boulder pile with the voids filled.)

Maine DOT soils descriptions are included in Appendix C.

2.5 Existing Pavement
Pavement cores were taken at Stations 6+500, 6+940, 7+500, 8+000, 8+600 and 9+200, on the centerline and in the left and right wheel paths. These cores showed the existing Hot Mix Asphalt thickness to be 150 mm in most locations except at Station 9+200 the pavement was only 100 mm thick. The pavement is in poor condition with areas of cracking and potholes. The soils under the highway are generally sand. These sands could be either embankment fill or native material; soils under the roadway are very similar to native soils in the area. Although encountered soils under the HMA pavement suface do not meet the Maine DOT standard specification for Type D or Type E subbase gravel, many samples meet standard criteria for well-graded sands.

2.6 Subsurface Ledge
Subsurface Ledge was encountered in several borings, and outcrops are common along this project. Controlled blasting will be required on all ledge cut slopes where the height of the cut exceeds 2.4 meters and/or the overburden slope will be steeper than 1v:3h. Ledge cuts will be required on the right from Station 8+140 to 8+340.

3.0 Design Recommendations

3.1 Pavement Design
Very little of the new highway will be on the existing horizontal and vertical alignment, and complete reconstruction of the pavement structure is needed. A single pavement structure should be used throughout the project. A Soil Support Value of 4.5 is appropriate for most of the native soils on this project, and is reasonable for use in deep fills. A Resilient Modulus of 35,000 kPa should be used.

This project will include two alternates for the pavement structural section, as follows:

160 mm HMA	150 mm HMA
280 mm Type B gravel	250 mm dense graded base course
365 mm ASC-G	405 mm ASC-G

These sections produce a similar pavement structural number, and are adequate to support projected loadings along this highway.

Transition zones will be required where the subgrade changes to and from bedrock, with a typical 20:1 transition. A detail for this transition is given in Appendix D.

We do not anticipate that soft or silty soils will be encountered under the roadway unless areas of silt are found near the Bog Brook Bridge. If pockets of soft soils are found, a non-woven geotextile meeting MaineDOT Standard Specification 722, Stabilization/Reinforcement geotextile may be used to help support the subbase soils and construction traffic.

3.2 Embankment fills
High embankment fills will be required to correct the horizontal and vertical alignment. We do not anticipate slope stability problems in any of these areas if the surface soils are adequately prepared and the embankments are properly constructed.

We anticipate that the soils used in embankment construction will be primarily sand with low fines content. It will be difficult to get vegetation established on the native soils in this climate on the north side of the hills. These soils will be quite erodible, and the slopes must be stabilized during construction. We recommend a finished slope treatment of erosion control mix seeded with native plant material to prevent erosion of the soil slopes.

Between Station 6+860 and 7+020 the embankment fills will be as much as 8 ½ meters high. The native soils underlying the new alignment consist of brown, damp, medium dense to very dense sand. Fill slopes designed for this area vary from 1v:5h to a maximum of 1v:2h. The design slopes should be stable over these subsoils.

A fill between Station 7+400 and 7+720 is required for the relocation and reconstruction of the Bog Brook Bridge, with a maximum height of approximately 2 ½ meters except in the area immediately surrounding the bridge at Station 7+650. Design slopes in this area are generally 1v:2h or 1v:3h. Soils right at the bridge include an alluvial deposit of loose sand with silt layers overlying deposit of dense sand or gravelly sand. Low embankment fills should not cause any stability problems on these soils. A separate report discusses geotechnical design for the bridge foundation.

The new alignment crosses through an active gravel pit operated by Pike Industries between Station 8+450 and 8+880. The final height of the embankment will depend on the amount of material that is removed from the construction area by the time ROW is acquired for the project. The deepest fill shown on the current plans is approximately 7 meters high with a 1v:2h slope on the left at Station 8+560. A boring at Station 8+500, 10 RT through the edge of the existing roadway embankment, shows a 1.6 m thick layer of loose sand fill underlain by a 0.85 m stratum of medium dense sandy topsoil, a 2.44 m stratum of very dense sandy Gravel, and medium dense Sand extending to a depth of 8.23 m. The design slopes should be stable over these subsoils.

3.3 Soil Cut Slopes

Deep cuts will be required for the construction of this project. Most are cuts into the side of the hill on the Right side of the highway, but a few are cuts through the existing embankment to correct the vertical alignment. Rounded stones should not be used as riprap on cut slopes, due to the length of the slopes, the possibility of ice action surrounding groundwater seeps, and large amounts of spring runoff in some parts of the project. A Special Provision for large stone materials is included in the appendices to better define the materials that will be acceptable. All cut slopes must receive temporary stabilization during construction.

Between Station 6+460 and 6+540, a 9 meter cut will be made in a small, steep hill on the right. A boring at Station 6+500 encountered only sand for 2.44 meters under the existing roadway and there is no evidence of shallow ledge in the area. This appears to be a glacial deposit of sand. A 1v:2h cut slope is proposed for this area, with a maximum slope length of 18 meters. Erosion from wind and water is likely with this type of soil, and we recommend that erosion control mix be placed and seeded with a mixture of small native plants to speed the restoration of vegetation on this slope.

From Station 6+620 to 6+760, cuts of as much as 6 meters will be needed on the right. A boring at Station 6+660, 15 m right in the existing hill, encountered medium dense sand and gravel to a depth of 4.56 m. Side slopes of 1v:1.5h and as long as 20 meters are proposed, and riprap facing will be needed to prevent surficial erosion. The underlying soils should be stable at these slopes.

Between Station 7+020 and Station 7+100, the new alignment cuts through a small sand hill. The north and west sides of this hill have existing slopes of nearly 1v:3h. A boring at Station 7+050 through the top of this hill encountered only sand to a depth of 5.18 meters. Cut slopes of 1v:2h are proposed both left and right. The underlying soils should be adequately stable at these slopes, but a cover of erosion control mix seeded with small native plants is recommended to control surface erosion.

The new alignment is close to the existing roadway from Station 7+320 to 7+400, but cuts of 3 m and less are needed to create a ditch on the right. Riprap will be required to protect the finished 1v:1.5h slopes.

The new vertical alignment will flatten a hill in the existing fill between Stations 7+780 and 7+900. A boring at Station 7+900 encountered only sand in the existing fill. Erosion control mix should be used on the sideslopes, as above.

Shallow bedrock between Stations 10+140 and 10+340 Right will require a 4v:1h ledge cut with overburden at slopes of 1v:3h or flatter.

From Station 9+140 and 9+320, construction of a shoulder and ditch require excavation into the hill on the right. A boring at Station 9+200, 11m right found that the hill in this location is a pile of boulders; voids between the boulders are filled with soil. A boring through the existing roadway at 9+200, 0.2m left, found only sand under the HMA to a depth of 3.05 m. We anticipate that boulders of varying size will be found within the soil matrix in throughout this slope. Finished slopes will be 1v:2h as much as 21.5 m long should be covered with erosion control mix and seeded. No boulders should be allowed to project into the cut slope more than 150 mm; any voids in the slope left by boulder removal should be filled with borrow.

3.4 Ledge Cut Slopes

Ledge cut slopes will be required in the area between Station 8+140 and Station 8+380, although we do not anticipate that the cut depths will be consistent in this area. Ledge was encountered 1.6 to 6.2 meters below the existing roadway in this area.

Rock cores in this area indicate a moderately hard to hard, fresh, light gray to gray and white, medium grained Diorite to Gneiss with joints dipping at low to moderate angles. RQD values range from 44 to 100. A toe drain may be needed to control seepage if a soil rock interface is needed in the cut face.

Between Station 10+140 and 10+340 ledge cuts may be as high as 7 meters, and controlled blasting will be required for any cut higher than 2.4 meters. The typical DOT ledge cut slope of 4v:1h will be acceptable in this area. Ledge cuts of up to 10 meters are anticipated, and presplitting and controlled blasting should be required to ensure that the finished cut slope is clean and stable. Any section where the ledge cut will be more than 2.4 meters tall will require an adequate rockfall zone. If the overburden slope is steep above the ledge cut, rockfall fencing should be considered. Tracks of the St. Lawrence and Atlantic Railroad are at the toe of slope approximately 25 meters left of the existing highway.

We recommend fracture blasting in all cuts where ledge will form the new subgrade to promote subsurface drainage. Rock presplit holes should be extended to a depth of 1.2 meters below the bottom of the subbase to prevent formation of water pockets. After detonation, any rock extending into the subbase should be removed, and compaction will be needed to ensure that the fractured rock material forms a stable base for the roadway.

3.5 Surface Water Drainage

Surface water on the right will be collected in ditches in all areas of the project except from Station 9+345 and 9+410, right, where a curb and underdrain will be used to minimize impacts to the abutting property. Because the soils in these ditches will be highly erodible sands, the ditches must be lined with a less erodible material.

Groundwater seeps are difficult to detect during a subsurface investigation program. If seeps are encountered in cut slopes during construction, a downspout should be constructed to carry the water to the ditch without damage to the underlying slope.

3.6 Frost Action

Mean frost depth for these soils is estimated as 1370 mm, with a design frost depth of 1700 mm. Frost penetration into granular subgrade is estimated as 865 mm, with a design frost penetration of 1400 mm.

Soils in this area are granular materials with low fines content, and are not seriously frost susceptible, however pockets of soils with higher fines may be encountered during construction. Any water trapped in the upper subgrade will freeze. A transition zone as shown in Appendix X Figure Y. should be used if frost susceptible soils are encountered in ledge cut areas.

Existing pavement should be removed in all fill areas where the proposed subgrade elevation will be less than 1.4 meters above the existing pavement surface. This will minimize the problems of trapped water between the existing and new pavement sections.

Appendix A
Resource Maps
Surficial Geology

Gilead Quadrangle, Maine

Surficial geologic mapping by
Woodrow B. Thompson

Digital cartography by:
John B. Poisson

Robert G. Marvinney
State Geologist

Cartographic design and editing by:
Robert D. Tucker

Funding for the preparation of this map was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 02HQAG0032.

DEPARTMENT OF CONSERVATION MAINE

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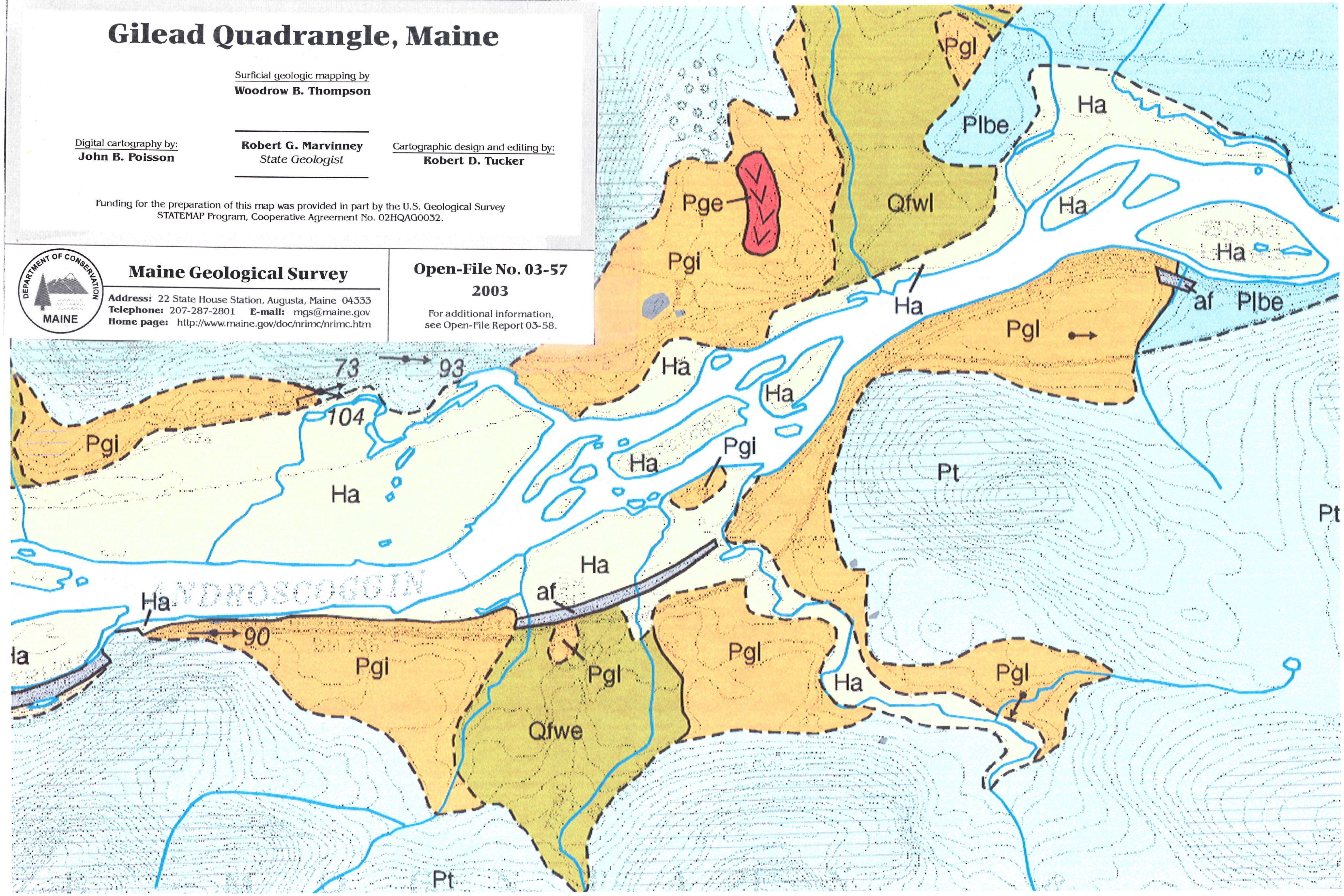
Open-File No. 03-57
2003

For additional information, see Open-File Report 03-58.



Appendix B
Geoplans

METRIC

1. All dimensions are in millimeters unless otherwise noted.
2. All elevations and stations are in meters.

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	AC-NH-9184(50)	1	

009184.50

LEGEND

HB- HOLLOW STEM AUGER W/DESCRIPTIONS

P- POWER AUGER PROBE

PC- PAVEMENT CORE

KEY

R = Refusal of augers (actual nature of refusal surface unknown)

NR = No Refusal surface encountered

W = Weathered Rock, top of

	BY	DATE
PROJECT DESIGN ENGINEER	K. Breskin	
DESIGN-DETAILED	T. White	
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F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
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CURVE DATA

PI = 8+485.617
Δ = 39°25'22.0" RT
R = 340.000m
L = 233.939m
T = 121.814m
E = 21.163m

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PLANS

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Rte.2

GEOPLANS

SHEET OF

AUGUSTA, MAINE

Filename: ...\geotech\msta\015_Geoplan15.dgn Division: GEOTECH Username: terry.white Date:12/8/2008

	BY	DATE
PROJECT DESIGN ENGINEER	K. Breskin	
DESIGN-DETAILED	T. White	
CHECKED		
REVISIONS		
FIELD CHANGES		

PLANS

METRIC

1. All dimensions are in millimeters unless otherwise noted.
2. All elevations and stations are in meters.

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	AC-NH-9184(50)	15	

009184.50

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PLANS

GILEAD

Rte.2

GEOPLANS

SHEET OF AUGUSTA, MAINE

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	AC-NH-9184(50)	16	-

009184.50

METRIC

1. All dimensions are in millimeters unless otherwise noted.
2. All elevations and stations are in meters.

Filename: ...\geotech\msta\016_Geoplan16.dgn
Division: GEOTECH
Username: terry.white
Date:12/8/2008

PLANS		BY	DATE
	PROJECT DESIGN ENGINEER	K. Breskin	
	DESIGN-DETAILED	T. White	
	CHECKED		
	REVISIONS		
	FIELD CHANGES		

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PLANS

GILEAD

Rte.2

GEOPLANS

SHEET OF

AUGUSTA, MAINE

METRIC
1. All dimensions are in millimeters unless otherwise noted.
2. All elevations and stations are in meters.

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	AC-NH-9184(50)	17	

009184.50

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PLANS

GILEAD

Rte.2

GEOPLANS

SHEET OF AUGUSTA, MAINE

PLANS		BY	DATE
PROJECT DESIGN ENGINEER			
DESIGN-DETAILED	K. Breskin	T. White	
CHECKED			
REVISIONS			
FIELD CHANGES			

Date: 12/8/2008
Username: terry.white
Division: GEOTECH
Filename: ...\geotech\msta\017_Geoplan17.dgn

METRIC
1. All dimensions are in millimeters unless otherwise noted.
2. All elevations and stations are in meters.

F.H.W.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE	AC-NH-9184(50)	18	

009184.50

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

PLANS

GILEAD

Rte.2

GEOPLANS

SHEET OF

AUGUSTA, MAINE

PLANS		BY	DATE
PROJECT DESIGN ENGINEER		K. Breskin	
DESIGN-DETAILED		T. White	
CHECKED			
REVISIONS			
FIELD CHANGES			

Filename: ...\geotech\msta\018_Geoplan18.dgn Division: GEOTECH Username: terry.white Date:12/8/2008

Appendix C
Field Exploration Data
Soils Descriptions
Boring Logs
Probe Summary Sheet
Seismic Refraction Survey report
Lab Test Data

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Moisture (dry, damp, moist, wet, saturated)
Density/Consistency (from above right hand side)
Name (sand, silty sand, clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc., if applicable)
Cementation (weak, moderate, or strong, if applicable, ASTM D 2488)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation
Groundwater level

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Consistency is rated according to standard penetration resistance.

Modified Burmister System

Descriptive Term	Portion of Total
trace	0% - 10%
little	11% - 20%
some	21% - 35%
adjective (e.g. sandy, clayey)	36% - 50%

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value blows per foot	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily Penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* > 100 mm}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Correlation of RQD to Rock Mass Quality

Rock Mass Quality	RQD
Very Poor	<25%
Poor	26% - 50%
Fair	51% - 75%
Good	76% - 90%
Excellent	91% - 100%

Desired Rock Observations: (in this order)

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Lithology (igneous, sedimentary, metamorphic, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -tightness (tight, open or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A
Recovery

Sample Container Labeling Requirements:

PIN
Bridge Name / Town
Boring Number
Sample Number
Sample Depth
Blow Counts
Sample Recovery
Date
Personnel Initials

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project:	Routes 2	**Location:**	Gilead, Maine	**Boring No.:**	HB-GILE-201
				PIN:	9184.50
Driller:	MaineDOT	**Elevation (m):**	216.90	**Auger ID/OD:**	5" Dia
Operator:	E. Giguere	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	2/25/08	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	6+300, 3.5 m 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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S1		0.14 - 1.31			SSA	216.76		PAVEMENT. 0.14	
									Brown, moist, gravelly fine to coarse SAND.	
1	S2		1.31 - 2.44				215.59		1.31 Gold, damp, fine to medium SAND, trace silt.	
2							214.46		2.44 **Bottom of Exploration at 2.44 m below ground surface.** NO REFUSAL	
3										
4										
5										
6										
7										
8										

Remarks:

Offsets are from Proposed 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
METRIC UNITS

Project: Routes 2
Location: Gilead, Maine

Boring No.: HB-GILE-202
PIN: 9184.50

Driller:	MaineDOT	**Elevation (m):**	214.80	**Auger ID/OD:**	5" Dia
Operator:	E. Giguere	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	2/25/08	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	6+500, 2.2 m Lt.	**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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S3		0.14 - 1.98			SSA	214.66		PAVEMENT. 0.14	
									Brown, damp, gravelly fine to medium SAND, trace silt.	
2	S4		1.98 - 3.96				212.82		1.98 Light brown, damp, fine to medium SAND, trace silt, trace gravel.	
4	S5		3.96 - 6.10				210.84		3.96 Light brown, moist, fine to medium SAND, little gravel, trace silt.	
6							208.70		6.10 **Bottom of Exploration at 6.10 m below ground surface.** NO REFUSAL	

Remarks:

Offsets are from Proposed 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-GILE-202

Haley & Aldrich, Inc.

Soil/Rock Exploration Log
METRIC UNITS

Project: Reconstruction of Route 2	Location: Bethel-Gilead, Maine	File No. 28816-000	Boring No.: B-6 + 660 R
			PIN: 009184.20

Driller:	Mike Porter	Elevation (m):	221.50	Auger ID/OD:	10.2 cm / 17.8 cm
Operator:	Maine Test Borings	Datum:	NGVD	Sampler:	Split Spoon / Cuttings
Logged By:	Matt Dodson	Rig Type:	Mobile Track	Hammer Wt./Fall:	63.3 kg / 76.2 cm
Date Start/Finish:	7/24/02 / 7/24/02	Drilling Method:	HS Auger	Core Barrel:	
Boring Location:	Sta. 6 + 660, 15 RT	Casing ID/OD:		Water Level*:	Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	139.7/139.7	0.12 - 1.52	N/A	N/A		221.38		-TOPSOIL- 0.12	
									Light brown to tan dry SAND, trace gravel, trace silt, poorly-graded (fine to medium), little gravel with depth -GLACIO FLUVIAL DEPOSIT-(SP)	
1							220.43		1.07	
									Note: drill action indicates occasional coarse gravel, cuttings are well-graded SAND (SW)	WC=2.4
	D2	61.0/17.8	1.52 - 2.13	4/13/15/17	28				Light brown damp medium dense SAND, little/some gravel, well-graded, no structure -GLACIO FLUVIAL DEPOSIT-(SW)	
2										
							218.75		2.74	
3	D3	61.0/35.6	3.05 - 3.66	3/5/6/6	11				Brown damp medium dense SAND, poorly-graded (fine to medium), no structure -GLACIO FLUVIAL DEPOSIT-	
4	D4	61.0/40.6	3.96 - 4.57	7/13/14/19	27				Light brown to tan damp medium dense SAND, little to trace silty poorly-graded (fine) very thinly bedded -GLACIO FLUVIAL DEPOSIT-	WC=4.6
							216.93		4.57	
									Bottom of Exploration at 4.57 m below ground surface.	
5										
6										
7										

Remarks:

Drilled 0.30 m higher, new location. Boring drilled 2.1 m S of original location.

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
METRIC UNITS

Project:	Routes 2	**Location:**	Gilead, Maine	**Boring No.:**	HB-GILE-203
				PIN:	9184.50
Driller:	MaineDOT	**Elevation (m):**	207.40	**Auger ID/OD:**	5" Dia
Operator:	E. Giguere	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	2/25/08	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	6+940, 17.2 m Lt.	**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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA	207.25		PAVEMENT. 0.15	
									Brown, damp, gravelly fine to medium SAND, trace silt. ≅S3	
1	S6		0.98 - 1.95				206.43		0.98 Gold, damp, fine to medium SAND, little gravel, trace silt.	
2	S7		1.95 - 3.05				205.45		1.95 Brown, moist, fine to coarse SAND, some gravel, trace silt.	
3							204.35		3.05 **Bottom of Exploration at 3.05 m below ground surface.** NO REFUSAL	
4										
5										
6										
7										
8										

Remarks:

Offsets are from Proposed 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-GILE-203

Haley & Aldrich, Inc.

Soil/Rock Exploration Log
METRIC UNITS

Project: Reconstruction of Route 2
Location: Bethel-Gilead, Maine
File No. 28816-000

Boring No.: B-6 + 950 R
PIN: 009184.20

Driller:	Mike Porter	**Elevation (m):**	205.14	**Auger ID/OD:**	10.2 cm / 17.8 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon
Logged By:	Matt Dodson	**Rig Type:**	Mobile Track	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/25/02 / 7/25/02	**Drilling Method:**	HS Auger	**Core Barrel:**	
Boring Location:	Sta. 6 + 948, 5 RT	**Casing ID/OD:**		**Water Level*:**	1.6 m

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	81.3/81.3	0.00 - 0.81	N/A	N/A				-TOPSOIL-	
							204.31		0.82	
1										
	D2	61.0/43.2	1.52 - 2.13	12/46/53/40	99				Brown wet very dense SAND, trace silt, some gravel, well-graded -GLACIO FLUVIAL DEPOSIT-(SW)	
2										
3	D3	61.0/38.1	3.05 - 3.66	32/39/36/26	75				Brown wet very dense SAND, little gravel, well-graded -GLACIO FLUVIAL DEPOSIT-(SW)	
4										
							200.57		4.57	
									Bottom of Exploration at 4.57 m below ground surface.	
5										
6										
7										

Remarks:

Hole to open 1.73 m, water at 1.49 m
Pulled casing, hole caved to 1.89 m, water at 1.58 m, sand running 1.16 m into casing at 4.57 m

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.: B-6 + 950 R

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	**Project:** Reconstruction of Route 2 **Location:** Bethel-Gilead, Maine **File No.** 28816-000	**Boring No.:** B-7 + 050 CL **PIN:** 009184.20

Driller:	Mike Porter	**Elevation (m):**	214.67	**Auger ID/OD:**	6.4 cm / 10.2 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon / Cuttings
Logged By:	Matt Dodson	**Rig Type:**	Mobile Track	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/25/02 / 7/25/02	**Drilling Method:**	HS Auger	**Core Barrel:**	
Boring Location:	Sta. 7 + 050, CL	**Casing ID/OD:**		**Water Level*:**	Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pe /Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Gr ic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/27.9	0.00 - 0.61	2/8/6/9	14		214.58		-TOPSOIL-	
									0.09	
									Brown damp medium dense fine SAND, trace silt, trace gravel, poorly-graded -GLACIO FLUVIAL DEPOSIT-(SP)	WC=3.6
1										
	D2	61.0/35.6	1.52 - 2.13	10/24/28/25	52				Light brown damp very dense SAND, trace to little gravel, well-graded -GLACIO FLUVIAL DEPOSIT-(SW)	
2							212.47		2.19	
									Note: drill action indicates no gravel below 2.19 m	
3	D3	61.0/43.2	3.05 - 3.66	9/14/17/18	31				Light brown to tan damp dense SAND, trace silt, very thinly bedded, poorly graded, trace silt in occasional sandy silt zones, layers at low angles -GLACIO FLUVIAL DEPOSIT-(SP)	WC=3.8
4										
	D4	61.0/30.5	4.57 - 5.18	6/10/12/13	22				Light brown damp medium dense SAND, poorly-graded (fine to medium) -GLACIO FLUVIAL DEPOSIT-(SP)	
5							209.49		5.18	
									Bottom of Exploration at 5.18 m below ground surface.	
6										
7										

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

Boring No.: B-7 + 050 CL

Haley & Aldrich, Inc.

Soil/Rock Exploration Log
METRIC UNITS

Project:	Reconstruction of Route 2	**Location:**	Bethel-Gilead, Maine	**Boring No.:**	B-7 + 260 L
File No.	28816-000			**PIN:**	009184.20
Driller:	Mike Porter	**Elevation (m):**	205.72	**Auger ID/OD:**	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon
Logged By:	W. Graham	**Rig Type:**	Mobile Drill Bomb	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/31/02 / 7/31/02	**Drilling Method:**	HSA	**Core Barrel:**	
Boring Location:	Sta. 7 + 258, 11 LT	**Casing ID/OD:**		**Water Level*:**	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/0.0	0.00 - 0.61	3/3/1/2	4				From auger cuttings Brown loose coarse to fine SAND (SP), little silt, little gravel -FILL-	
							205.11		0.61	
1									-FILL-	
							204.19		1.52	
	D2	61.0/22.9	1.52 - 2.13	2/1/19/33	20				Brown medium dense silty medium to fine SAND, trace gravel (SM) -GLACIO FLUVIAL DEPOSIT-	
2							203.89		1.83	
									Light brown very dense gravelly SAND (SW), trace silt, wet from 1.83-2.13 m -GLACIO FLUVIAL DEPOSIT-	
	D3	0.0/0.0	2.47 - 2.47	100 for 0	100		203.25		Drill action indicates cobble or bedrock	
									2.47	
3									**Bottom of Exploration at 2.47 m below ground surface.** Sampler refusal	
4										
5										
6										
7										

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.

Boring No.: B-7 + 260 L

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	Project: Reconstruction of Route 2 Location: Bethel-Gilead, Maine File No. 28816-000	Boring No.: B-7 + 264 R PIN: 009184.20
Driller: Mike Porter	Elevation (m): 205.64	Auger ID/OD: 6.4 cm / 14.0 cm
Operator: Maine Test Borings	Datum: NGVD	Sampler: Split Spoon
Logged By: W. Graham	Rig Type: Mobile Drill Bomb	Hammer Wt./Fall: 63.3 kg / 76.2 cm
Date Start/Finish: 7/31/02 / 7/31/02	Drilling Method: HSA	Core Barrel:
Boring Location: Sta. 7 + 268, 11 RT	Casing ID/OD:	Water Level*:

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S2	61.0/17.8	0.00 - 0.61	1/2/21/18	23		205.34		Brown medium dense silty SAND (SM) dry, little roots, poorly-graded, no structure, no odors -TOPSOIL-	
									0.30	
									Drill action indicates cobbles and boulders	
1										
	D2	61.0/27.9	1.52 - 2.13	89 / 100 (140 mm)	100				Brown dry dense medium fine SAND -GLACIO FLUVIAL DEPOSIT-(SP)	
2							203.75		Auger refusal at 1.90 m boulders or bedrock	
									1.89	
									Bottom of Exploration at 1.89 m below ground surface. Auger Refusal	
3										
4										
5										
6										
7										

Remarks:

Moved test boring location 4.88 m E SE of original location

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.

Haley & Aldrich, Inc.	Project: Reconstruction of Route 2	Boring No.: B-7 + 639 L
Soil/Rock Exploration Log METRIC UNITS	Location: Bethel-Gilead, Maine File No. 28816-000	PIN: 009184.20

Driller:	Mike Porter	Elevation (m):	203.10	Auger ID/OD:	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	Datum:	NGVD	Sampler:	Split Spoon
Logged By:	W. Graham	Rig Type:	Mobile Drill Bomb	Hammer Wt./Fall:	63.3 kg / 76.2 cm
Date Start/Finish:	7/31/02 / 7/31/02	Drilling Method:	HSA	Core Barrel:	
Boring Location:	Sta. 7 + 631, 4 LT	Casing ID/OD:		Water Level*:	Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/15.2	0.00 - 0.61	6/14/7/4	21				Brown dry loose to medium dense, silty medium to fine SAND (SM) poorly-graded, little roots, little gravel -TOPSOIL-	
							202.34		0.76 Drill action indicates strata change	
1										
	D2	25.3/15.2	1.52 - 1.78	42 / 100 for 10 cm	100				Light brown dry, dense, gravelly medium to fine SAND (SP), poorly-graded, trace silt -GLACIO FLUVIAL DEPOSIT- Gravel is increasing in size as depth increases, up to 10 cm (cobbles)	
2										
									Note: soil wet below 3.00 m	
3	D3	61.0/27.9	3.20 - 3.81	56/32/24/23	56				Brown, wet, dense, coarse to medium SAND (SP), little silt and gravel	
4										
	D4	61.0/22.9	4.57 - 5.18	9/24/38/30	62				Brown wet very dense medium to fine SAND (SP), little coarse sand, trace gravel, poorly-graded, some silt from 4.57-4.63 m -GLACIO FLUVIAL DEPOSIT-	
5									Brown to yellow-brown, wet, dense, medium to fine SAND (SP), trace silt	
6	D5	61.0/22.9	6.10 - 6.71	17/30/27/18	57				Brown wet very dense coarse to fine SAND (SP), poorly-graded, little silt, little gravel	
							196.48		6.61 Orange to red, wet SILT (ML), trace fine sandd -GLACIAL LACUSTRINE DEPOSIT-	
7										
	D6	61.0/40.6	7.62 - 8.23	4/8/9/12	17		195.48		7.62 Gray wet medium dense silty fine sand, poorly-graded, trace coarse sand to fine gravel	

Remarks:

Test boring moved 1.31 m SW from original location

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.

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	Project: Reconstruction of Route 2 Location: Bethel-Gilead, Maine File No. 28816-000	Boring No.: B-7 + 639 L PIN: 009184.20

Driller:	Mike Porter	Elevation (m):	203.10	Auger ID/OD:	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	Datum:	NGVD	Sampler:	Split Spoon
Logged By:	W. Graham	Rig Type:	Mobile Drill Bomb	Hammer Wt./Fall:	63.3 kg / 76.2 cm
Date Start/Finish:	7/31/02 / 7/31/02	Drilling Method:	HSA	Core Barrel:	
Boring Location:	Sta. 7 + 631, 4 LT	Casing ID/OD:		Water Level*:	Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
8									-GLACIAL LACUSTRINE DEPOSIT-	
							194.87		8.23 **Bottom of Exploration at 8.23 m below ground surface.**	
9										
10										
11										
12										
13										
14										
15										

Remarks:

Test boring moved 1.31 m SW from original location

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.

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	Project: Reconstruction of Route 2 Location: Bethel-Gilead, Maine File No. 28816-000	Boring No.: B-7 + 663 L PIN: 009184.20

Driller:	Mike Porter	Elevation (m):	202.21	Auger ID/OD:	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	Datum:	NGVD	Sampler:	Split Spoon
Logged By:	W. Graham	Rig Type:	Mobile Drill Bomb	Hammer Wt./Fall:	63.3 kg / 76.2 cm
Date Start/Finish:	7/31/02 / 7/31/02	Drilling Method:	HSA	Core Barrel:	
Boring Location:	Sta. 7 + 663, 4 LT	Casing ID/OD:		Water Level*:	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/15.2	0.00 - 0.61	1/2/3/4	5				Tan to yellow-brown loose dry, medium to fine SAND, trace silt, trace gravel -TOPSOIL-	
1							201.20		1.01	
	D2	61.0/35.6	1.52 - 2.13	2/2/2/2	4				Gray-brown, loose, moist silty fine SAND (SM), trace roots, coarse sand layer at 1.89 m 6 cm thick, occasional organic sandy SILT layers 1.27 cm thick, for the last 15 cm of the spoon -ALLUVIAL DEPOSIT-	
2										
3							199.16		3.05	
	D3	61.0/17.8	3.05 - 3.66	21/14/16/17	30				Drill action indicates strata change Tan to light brown wet medium SAND (SP), little coarse sand, little fine SAND, trace fine gravel -GLACIO FLUVIAL DEPOSIT-	
4										
	D4	61.0/17.8	4.57 - 5.18	46/44/16/22	60				Tan to light brown, wet, medium SAND (SP), trace coarse sand, some fine SAND, trace gravel	
5										
6	D5	61.0/27.9	6.10 - 6.71	15/25/28/31	53					
									Yellow dense to very dense medium to fine SAND (SW), well-graded, no structure, wet, trace gravel -GLACIO FLUVIAL DEPOSIT-	
7										
	D6	61.0/25.4	7.62 - 8.23	10/34/58/111	92				Brown dense to very dense medium to fine SAND (SW), well-graded, no structure, wet, little gravel, little coarse sand	

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.

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	**Project:** Reconstruction of Route 2 **Location:** Bethel-Gilead, Maine **File No.** 28816-000	**Boring No.:** B-7 + 663 L **PIN:** 009184.20

Driller:	Mike Porter	**Elevation (m):**	202.21	**Auger ID/OD:**	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon
Logged By:	W. Graham	**Rig Type:**	Mobile Drill Bomb	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/31/02 / 7/31/02	**Drilling Method:**	HSA	**Core Barrel:**	
Boring Location:	Sta. 7 + 663, 4 LT	**Casing ID/OD:**		**Water Level*:**	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pe /R c ( )	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic L g	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
8									-GLACIO FLUVIAL DEPOSIT-	
							193.98		8.23	
									Bottom of Exploration at 8.23 m below ground surface.	
9										
10										
11										
12										
13										
14										
15										

Remarks:

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* 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.: B-7 + 663 L

Maine Department of Transportation

Soil/Rock Exploration Log
METRIC UNITS

Project: Routes 2
Location: Gilead, Maine

Boring No.: HB-GILE-204
PIN: 9184.50

Driller:	MaineDOT	**Elevation (m):**	212.40	**Auger ID/OD:**	5" Dia
Operator:	E. Giguere	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	2/25/08	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	7+900, 4.3 m Lt.	**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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA			PAVEMENT.	
	S8		0.15 - 0.91				212.25		0.15 Brown, damp, fine to coarse SAND, some gravel.	
1	S9		0.91 - 3.05				211.49		0.91 Light brown, damp, fine to medium SAND, some gravel, trace silt.	
2										
3							209.35		3.05 **Bottom of Exploration at 3.05 m below ground surface.** NO REFUSAL	
4										
5										
6										
7										
8										

Remarks:

Offsets are from Proposed 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-GILE-204

Haley & Aldrich, Inc.

Soil/Rock Exploration Log
METRIC UNITS

Project: Reconstruction of Route 2
Location: Bethel-Gilead, Maine
File No. 28816-000

Boring No.: B-8 + 200 R
PIN: 009184.20

Driller:	Mike Porter	**Elevation (m):**	226.10	**Auger ID/OD:**	
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon / Cuttings
Logged By:	Matt Dodson	**Rig Type:**	Mobile Track	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/26/02 / 7/29/02	**Drilling Method:**	NW	**Core Barrel:**	NV 2
Boring Location:	Sta. 8 + 200, 16 RT	**Casing ID/OD:**	7.62 cm	**Water Level*:**	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pe /Rc (cm)	Sample Depth (m)	Blows (150 mm Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	111.8/111.8	0.09 - 1.21	N/A	N/A		226.01	-TOPSOIL- (0.09)	
								Orange-brown damp silty SAND, trace roots -SUBSOIL-(SM)	WC=4.9
1							224.73	(1.37)	
	D2	15.2/15.2	1.52 - 1.68	N/A	N/A			Brown, wet SAND, trace silt, horizontally stratified, poorly-graded (fine) -GLACIO FLUVIAL DEPOSIT-(SP)	
	R1	40.6/33.0	1.71 - 2.11	RQD = 75%			224.39	TOP OF BEDROCK at 1.71 m (1.71)	
2	R2	137.2/109.2	2.10 - 3.47	RQD = 96%				Moderately hard, dark gray-brown, slightly weathered QUARTZ/ BIOTITE GNEISS, foliation at high angles, but various joints closely spaced undulating, rough, discolored, tight to open	
							223.42	(2.68) Hard fresh light gray white GRANODIORITE, GNEISS changes into GRANITE over 10.2 cm	
3							223.05	(3.05) Back into GNEISS, joint at 3.05 m, rough, undulating, highly fractured, highly weathered, open 7.62 cm wide, separating 2 rock types, joint at 3.35 m, rough/smooth, planar, discolored	
	R3	157.5/149.9	3.47 - 5.05	RQD = 68%				Hard to moderately hard, fresh, light gray, medium grained, DIORITE no bedding present, joints are at low angles, extremely close to close, rough	
4									
5	R4	152.4/152.4	5.06 - 6.58	RQD = 100%				Hard to moderately hard, fresh, light gray, medium grained, DIORITE no bedding present, joints are at low angles, extremely close to close, rough.	
6	R5	61.0/61.0	6.58 - 7.19	RQD = 78%				Hard to moderately hard, fresh, light gray, medium grained DIORITE, no bedding present. Joints are at horizontal to low angles, extremely close to close, rough, planar to undulating, partly open to open.	
7							218.90	(7.19) **Bottom of Exploration at 7.19 m below ground surface.**	

Remarks:

Boring drilled 4.9 m SE of original location

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.

Haley & Aldrich, Inc.

Soil/Rock Exploration Log

METRIC UNITS

Project: Reconstruction of Route 2

Location: Bethel-Gilead, Maine

File No. 28816-000

Boring No.: B-8 + 300 R

PIN: 009184.20

Driller:	Mike Porter	**Elevation (m):**	230.20	**Auger ID/OD:**	5.1 cm / 8.9 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon
Logged By:	Matt Dodson	**Rig Type:**	Mobile Track	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/30/02 / 7/30/02	**Drilling Method:**	HSA / Wash coring	**Core Barrel:**	NV 2
Boring Location:	Sta. 8 + 300, 8 RT	**Casing ID/OD:**	7.6 cm / 8.3 cm	**Water Level*:**	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pe /R c (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic L g	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/53.3	0.00 - 0.61	N/A			230.11		-TOPSOIL- (0.09) Yellow-brown, silty SAND, no structure, no odor, dry -SUBSOIL-(SM)	
1							229.28		(0.91) TOP OF BEDROCK at 0.91 m Begin NV2 core at 1.22 m	
	R1	30.5/15.2	1.22 - 1.52	RQD = 50%			228.98		(1.22) Hard, fresh, light gray to white, medium-grained, dioritic GNIESS, extremely thin bedding, joints are at low angles to moderately dipping, rough, open, border of the pluton intrusion into the Carrabassett formation	
	R2	91.4/61.0	1.52 - 2.44	RQD = 44%			228.67		(1.52) Appears to begin 20 cm space between joints, both sides are smooth, moderately dipping to high angle at the bottom.	
2										
	R3	152.4/152.4	2.44 - 3.96	RQD = 100%					Hard, fresh, light gray to white, medium-grained, dioritic GNIESS, extremely thin bedding, joints are at low angles to moderately dipping, rough, open	
3										
4	R4	152.4/149.9	3.96 - 5.49	RQD = 98%					Hard, fresh, light gray to white, medium-grained, dioritic GNIESS, extremely thin bedding, joints are at low angles to moderately dipping, rough, open	
5										
	R5	121.9/121.9	5.49 - 6.71	RQD = 100%					Hard, fresh, light gray to white, medium-grained, dioritic GNIESS, extremely thin bedding, joints are at low angles to moderately dipping, rough, open	
6										
							223.49		(6.71) **Bottom of Exploration at 6.71 m below ground surface.**	
7										

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.

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	**Project:** Reconstruction of Route 2 **Location:** Bethel-Gilead, Maine **File No.** 28816-000	**Boring No.:** B-8 + 500 R **PIN:** 009184.20

Driller:	Mike Porter	**Elevation (m):**	230.38	**Auger ID/OD:**	7.6 cm
Operator:	Maine Test Borings	**Datum:**	NGVD	**Sampler:**	Split Spoon
Logged By:	Matt Dodson	**Rig Type:**	Mobile Track	**Hammer Wt./Fall:**	63.3 kg / 76.2 cm
Date Start/Finish:	7/11/02 / 7/11/02	**Drilling Method:**	HSA	**Core Barrel:**	
Boring Location:	Sta. 8 + 496, 10 RT	**Casing ID/OD:**		**Water Level*:**	Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/12.7	0.00 - 0.61	2/5/3/4	8				Gray-brown damp loose SAND, well-graded, no structure -FILL-(SW)	WC=2.1
1									Trace black ash and cinders at top of recovery	
	D2	61.0/15.2	1.60 - 2.21	1/3/8/10	11		228.78		1.60 Orange-brown moist medium dense silty SAND, some gravel, some roots, no structure, burnt organics/organic odor -OLD TOPSOIL-(SM)	
2							227.94		2.44	
3	D3	61.0/27.9	3.05 - 3.66	36/110/84/24	194				Gray-brown damp very dense sandy GRAVEL, trace silt, no structure -ALLUVIAL DEPOSIT-(GP)	WC=2.7
4										
	D4	61.0/30.5	4.57 - 5.18	15/32/24/29	56		225.50		Gray-brown damp very dense sandy GRAVEL, trace silt, no structure -ALLUVIAL DEPOSIT-(GP) 4.88 Tan damp SAND, trace gravel, poorly-graded, weakly layered -GLACIO FLUVIAL DEPOSIT-(SP)	WC=3.0
5										
6	D5	61.0/33.0	6.10 - 6.71	1/10/13/24/22	22				Tan damp SAND, trace little gravel, poorly-graded, weakly layered -GLACIO FLUVIAL DEPOSIT-(SP)	WC=2.2
7	D6	61.0/33.0	7.62 - 8.23	20/37/25/18	52				Tan to brown damp very dense SAND, little gravel, poorly-graded -GLACIO FLUVIAL DEPOSIT-(SP)	

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.

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	Project: Reconstruction of Route 2 Location: Bethel-Gilead, Maine File No. 28816-000	Boring No.: B-8 + 500 R PIN: 009184.20
Driller: Mike Porter	Elevation (m): 230.38	Auger ID/OD: 7.6 cm
Operator: Maine Test Borings	Datum: NGVD	Sampler: Split Spoon
Logged By: Matt Dodson	Rig Type: Mobile Track	Hammer Wt./Fall: 63.3 kg / 76.2 cm
Date Start/Finish: 7/11/02 / 7/11/02	Drilling Method: HSA	Core Barrel:
Boring Location: Sta. 8 + 496, 10 RT	Casing ID/OD:	Water Level*: Dry

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
8							222.15		8.23 **Bottom of Exploration at 8.23 m below ground surface.**	
9										
10										
11										
12										
13										
14										
15										

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 METRIC UNITS	**Project:** Routes 2 **Location:** Gilead, Maine	**Boring No.:** HB-GILE-205 **PIN:** 9184.50

Driller:	MaineDOT	**Elevation (m):**	222.60	**Auger ID/OD:**	5" Dia
Operator:	E. Giguere	**Datum:**	NAVD 88	**Sampler:**	Off Flights
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	2/25/08	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	9+200, 0.2 m Lt.	**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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	S10		0.14 - 0.98			SSA			PAVEMENT.	
							222.46		0.14 Brown, damp, gravelly, fine to coarse SAND.	
1	S11		0.98 - 3.05				221.62		0.98 Light brown, damp, fine to medium SAND, trace gravel, trace silt.	
2										
3							219.55		3.05 **Bottom of Exploration at 3.05 m below ground surface.** NO REFUSAL	
4										
5										
6										
7										
8										

Remarks:

Offsets are from Proposed 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-GILE-205

Haley & Aldrich, Inc. Soil/Rock Exploration Log METRIC UNITS	Project: Reconstruction of Route 2 Location: Bethel-Gilead, Maine File No. 28816-000	Boring No.: B-9 + 200 R PIN: 009184.20

Driller:	Mike Porter	Elevation (m):	226.34	Auger ID/OD:	6.4 cm / 14.0 cm
Operator:	Maine Test Borings	Datum:	NGVD	Sampler:	Split Spoon
Logged By:	W. Graham	Rig Type:	Mobile Drill Bomb	Hammer Wt./Fall:	63.3 kg / 91.4 cm
Date Start/Finish:	8/1/02 / 8/1/02	Drilling Method:	HSA	Core Barrel:	
Boring Location:	Sta. 9 + 200, 11 RT	Casing ID/OD:		Water Level*:	

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 (kPa)
T_v = Pocket Torvane Shear Strength (kPa)
q_p = Unconfined Compressive Strength (Pa)
$S_{u(lab)}$ = Lab Vane Shear Strength (kPa)
WOH = weight of 64 kg hammer
WOR = weight of rods

Definitions:
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (m)	Sample No.	Pen/Rec (cm)	Sample Depth (m)	Blows (150 mm) Shear Strength (kPa) or RQD (%)	N-value	Casing Blows	Elevation (m)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	D1	61.0/61.0	0.00 - 0.61	3 / 100 for 5	100				Yellow brown, dry, loose, silty SAND (SM), poorly-graded, no structure, little roots, little gravel -TOPSOIL-(SM)	
							226.13		0.20	
1									Drilling indicates boulders, cobbles, or bedrock, moving borehole 0.91 m SE to avoid boulder. Driller will begin the core at 0.30 m bgs. While attempting to auger into rock to set casing at 0.98 m the auger advanced very rapidly to 1.43 m. Augured through cobble 1.43 to 1.83 m. Gravel material at 1.83 m -GLACIO FLUVIAL DEPOSIT-	
2										
							223.66		2.68	
3									Drill action indicates another boulder. Through boulder at 3.51 m	
							222.83		3.51	
									Material coming off the augers is a light brown, silty fine SAND (SP) This is a glacial boulder pile with the voids filled	
4							222.22		4.11	
									Bottom of Exploration at 4.11 m below ground surface.	
5										
6										
7										

Remarks:

Boring drilled 1.6 m N of original location

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.: B-9 + 200 R

State of Maine - Department of Transportation

Power Auger Probe Summary Sheet

Town(s): Gilead Project Number: 9184.50

Station (Meter)	Offset (Meter)	Weathered Rock (Meter)	Refusal (Meter)	No Refusal (Meter)	Water Depth (m)	Comments Date: 2/25/08
8+120						overhead wires
8+125	2.7 Rt.		0.49			
8+160	2.0 Rt.		0.79			
8+200	CL		0.94			
8+240	4.1 Lt.		1.89			
8+280	8.9 Lt.		1.71			
8+320	12.5 Lt.		1.52			
8+350	12.7 Lt.		0.98			
8+360						overhead wires

MaineDOT
Drill Rig: CME 45C
5" Solid Stem Auger

BW, EG, CG

HAGER-RICHTER
GEOSCIENCE, INC.

SEISMIC REFRACTION SURVEY
US ROUTE 2 REALIGNMENT
GILEAD, MAINE

PIN 9184.50

Prepared for:

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

Prepared by:

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

File 08J35
July, 2008

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. conducted a seismic refraction survey along the south side of US Route 2 in Gilead, Maine for the Maine Department of Transportation (MaineDOT) in June, 2008. The geophysical survey was performed in support of a geotechnical investigation of the Site by MaineDOT.

MaineDOT is undertaking a geotechnical design for the realignment of US Route 2 in Gilead, Maine. As part of the geotechnical design, MaineDOT required information on the depth of bedrock for a slope stability analysis along a section of the roadway between stations 8+090 and 8+370.

MaineDOT specified that seismic refraction data be acquired along traverses located approximately 11 meters right of centerline, and at 22 meters right of centerline. The slope in this area is relatively steep and wooded. Surface elevation in the area survey varies from about 215 meters to about 236 meters. The locations of the lines were staked by MaineDOT.

Based on the results of the seismic refraction survey conducted for the MaineDOT along Route 2 in Gilead, Maine, we conclude:

- The depth of competent bedrock along the seismic lines between Stations 8+090 and 8+370 varies between about 0.6 and 4.4 meters below ground surface.
- The elevation of competent bedrock in the locations surveyed between Stations 8+090 and 8+370 varies from 210.6 to 233.8 meters for a total relief of 23.2 meters.
- The bedrock surface is gently undulating and generally follows topography.

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Seismic Refraction Survey
US Route 2 Realignment
Gilead, Maine
PIN 9184.50
File 08J35 July, 2008

1. INTRODUCTION

Hager-Richter Geoscience, Inc. conducted a seismic refraction survey along the south side of US Route 2 in Gilead, Maine for the Maine Department of Transportation (MaineDOT) in June, 2008. The geophysical survey was performed in support of a geotechnical investigation of the Site by MaineDOT.

MaineDOT is undertaking a geotechnical design for the realignment of US Route 2 in Gilead, Maine. As part of the geotechnical design, MaineDOT required information on the depth of bedrock for a slope stability analysis along a section of the roadway between stations 8+090 and 8+370. Hager-Richter conducted a similar study between stations 10+160 and 10+320 on the south side of the roadway and between stations 10+360 and 10+540 on the north side of the roadway in July, 2006.[1]

MaineDOT specified that seismic refraction data be acquired along traverses located approximately 11 meters right of centerline, and at 22 meters right of centerline. The slope in this area is relatively steep and wooded. Surface elevation in the area survey varies from about 215 meters to about 236 meters. The locations of the lines were staked by MaineDOT.

The objective of the seismic refraction survey was to determine the depth of the bedrock surface along the two traverses specified by MaineDOT.

Hager-Richter personnel were on-site on June 17-18, 2008. Jeffrey Reid, P.G., and Vanja Dezelic, Ph.D., conducted the seismic refraction survey. The fieldwork was coordinated with Ms. Kitty Breskin, PE., of MaineDOT. Site plans were received by Hager-Richter on July 14, 2008. 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.

1. Hager-Richter Geoscience, Inc. report entitled "Seismic Refraction Survey, Route 2 Realignment, Gilead, Maine, PIN 9184.00," dated September, 2006.

2. EQUIPMENT AND PROCEDURES

2.1 General. The general equipment and procedures for seismic refraction surveys as conducted by Hager-Richter are described in the Appendix. Details specific to this site are given below in section 2.3, Site Specific.

2.2 Limitations of the Method. 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 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 at the surface and/or where the interfaces have apparent dips greater than about 20°.

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. In such cases, the depth determined by seismic refraction is the depth of *competent* bedrock, which might be located at some depth below the geologic contact.

The depth relations of the water table and bedrock may constitute a significant problem for the seismic refraction technique. This problem is that of a "blind layer." A blind layer occurs where the thickness of the saturated overburden is less than about half the depth of bedrock. In such cases, the water-saturated material immediately above bedrock is "blind" in the sense that no refracted seismic energy from it will be received as a first arrival of seismic energy, and all methods used to reduce the seismic data to determine the depth of bedrock, the objective of this survey, use *only* first arrivals. Thus, the saturated layer will not be detected where it is close to bedrock, and most methods of seismic data reduction will indicate that bedrock is considerably deeper than it actually is. Although GRM, the method used by Hager-Richter to reduce the seismic refraction data, does not use first arrivals through the water saturated zone (because there is none to use) in such cases, GRM determines the depth of bedrock correctly by using the *average* velocity of the saturated and unsaturated zones.

A "hidden layer" occurs where a lower velocity material underlies a higher velocity material, a common situation in stratified sediments. An example is where sands are present under layers of clay or till. As in the case of a "blind layer," most methods of seismic refraction data reduction will indicate that bedrock is considerably shallower than it actually is, if a hidden layer is present but not detected. Internal tests in the seismic refraction data reduction software that we use (GREMIX by Interpex) indicate that such layers might be present, and an average velocity of the two layers is used to determine the depth of bedrock.

2.3 Site Specific. The approximate locations of the seismic refraction lines were specified by MaineDOT. The seismic refraction survey consisted of two seismic lines totaling about 720 meters. A geophone spacing of 2 meters was used for all seismic lines. The seismic source was a 12-pound sledge hammer striking a steel plate. At least six shot points were used per spread -- two located internal to the spread, one at each end of the spread, and two off-end shots were used where access allowed. The elevations of the seismic lines were taken from plans provided to Hager-Richter by MaineDOT.

3. RESULTS AND DISCUSSION

3.1 General. The seismic refraction survey consisted of two seismic lines designated as Seismic Lines 11R and 22R. The locations of the seismic lines are shown in Figure 2. The results of the survey are shown in profile form in Figures 3 and 4 and are listed in Table 1.

3.2 Data Quality. The quality of the seismic refraction data ranges from good to very good. The data were impacted slightly by traffic noise in some areas. A measure of the accuracy of the data can be obtained by comparing the depths determined seismically with depths from borings that intersect bedrock, and the internal consistency of the data can be assessed by comparison of the depths determined at intersecting seismic lines. The locations of borings and depth of rock were provided by MaineDOT. The differences between the seismically determined bedrock depths and the depths of bedrock from nearby borings are generally 0.5 meters or less.

Based on these results, and on the results from other similar seismic refraction surveys, we estimate the accuracy (standard deviation) of the *depths* of competent bedrock determined by the seismic refraction survey to be about ± 10% of the depth of bedrock, or ± 0.75 meters), whichever is greater.

3.3 Interpretation of Velocities. Materials with two distinct velocity ranges were detected at the Site. The upper material exhibits a velocity range of 300 meters per second (m/s) to 375 m/s and is interpreted to consist of unsaturated soils and sediments.

The lower material exhibits a velocity range of 3600 m/s to 4600 m/s 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.

3.4 Bedrock Depths. Figures 3 and 4 indicate that the bedrock surface is gently undulating and generally follows topography. The depth of competent bedrock along the seismic lines between Stations 8+090 and 8+370 varies between about 0.6 meters and 4.4 meters below ground surface. The elevation of competent bedrock in the locations surveyed between Stations 8+090 and 8+370 varies from 210.6 meters to 233.8 meters for a total relief of 23.2 meters.

4. LIMITATIONS

This report was prepared for the exclusive use of the 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 preparation of this Report 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 are 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.

TABLE 1
SEISMIC REFRACTION SURVEY RESULTS
ROUTE 2 REALIGNMENT
GILEAD, MAINE
PIN 9184.50

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 11 R			
8076	215.4	4.4	210.9
8078	215.6	4.3	211.3
8080	215.9	4.3	211.5
8082	216.1	4.2	211.9
8084	216.3	4.2	212.1
8086	216.5	4.1	212.4
8088	216.7	4.1	212.6
8090	216.9	4.0	212.9
8092	217.1	3.9	213.2
8094	217.4	3.9	213.5
8096	217.7	3.9	213.8
8098	217.9	3.9	214.0
8100	218.1	3.9	214.2
8102	218.4	3.9	214.5
8104	218.6	3.9	214.7
8106	218.8	3.9	214.9
8108	218.9	3.8	215.1
8110	219.2	3.9	215.3
8112	219.4	3.8	215.6
8114	219.6	3.8	215.9
8116	219.9	3.8	216.1
8118	220.1	3.7	216.4
8120	220.3	3.7	216.6
8122	220.5	3.6	216.9
8124	220.7	3.6	217.1
8126	220.9	3.6	217.3
8128	221.1	3.6	217.5
8130	221.4	3.5	217.9
8132	221.6	3.2	218.4
8134	221.9	3.2	218.7
8136	222.2	3.0	219.2
8138	222.4	2.8	219.6
8140	222.6	2.5	220.1
8142	222.7	2.0	220.7
8144	222.7	1.8	220.9
8146	222.7	1.7	221.1
8148	222.8	1.6	221.2
8150	222.6	1.5	221.1
8152	222.9	1.2	221.7
8154	223.4	1.1	222.3

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 11 R (cont.)			
8156	223.5	1.0	222.6
8158	223.7	0.8	222.9
8160	223.8	0.6	223.2
8162	223.9	0.6	223.4
8164	224.1	0.6	223.5
8166	224.2	1.0	223.2
8168	224.3	1.1	223.1
8170	224.4	1.2	223.1
8172	224.5	1.3	223.2
8174	224.6	1.3	223.2
8176	224.7	1.4	223.2
8178	224.8	1.5	223.3
8180	224.9	1.5	223.4
8182	224.9	1.5	223.4
8184	225.0	1.6	223.4
8186	225.1	1.8	223.3
8188	225.2	1.9	223.3
8190	225.3	1.9	223.4
8192	225.4	2.0	223.4
8194	225.4	1.9	223.5
8196	225.4	1.9	223.5
8198	225.4	1.8	223.6
8200	225.4	1.8	223.6
8202	225.4	1.8	223.6
8204	225.5	1.8	223.7
8206	225.5	1.7	223.8
8208	225.6	1.7	223.9
8210	225.6	1.7	223.9
8212	225.5	1.6	223.9
8214	225.4	1.6	223.9
8216	225.4	1.6	223.8
8218	225.5	1.6	223.9
8220	225.5	1.5	224.0
8222	225.6	1.5	224.0
8224	225.6	1.5	224.1
8226	225.9	1.5	224.4
8228	226.1	1.4	224.7
8230	226.4	1.4	225.0
8232	226.5	1.5	225.0
8234	226.6	1.5	225.1

Estimated standard deviation of depth of bedrock is 10% or .75 meters, whichever is greater. Depths of bedrock determined here are depths of competent bedrock. Weathered or highly fractured bedrock may occur at shallower depths. Elevations for seismic lines taken from plans provided by Maine DOT.

TABLE 1 (cont.)
SEISMIC REFRACTION SURVEY RESULTS

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 11 R (cont.)			
8236	226.7	1.5	225.3
8238	226.8	1.7	225.2
8240	226.8	1.7	225.1
8242	226.9	1.7	225.1
8244	226.9	1.7	225.2
8246	226.9	1.7	225.2
8248	226.9	1.7	225.3
8250	227.0	1.6	225.4
8252	227.0	1.5	225.4
8254	227.1	1.5	225.6
8256	227.2	1.4	225.9
8258	227.4	1.4	226.0
8260	227.4	1.2	226.2
8262	227.4	1.3	226.1
8264	227.4	1.2	226.2
8266	227.9	1.2	226.7
8268	228.2	1.2	227.0
8270	228.4	1.1	227.2
8272	228.6	1.1	227.5
8274	228.8	1.1	227.8
8276	229.1	1.1	227.9
8278	229.3	1.1	228.2
8280	229.6	1.1	228.5
8282	229.8	1.2	228.6
8284	229.9	1.2	228.7
8286	230.0	1.3	228.7
8288	230.2	1.3	228.9
8290	230.3	1.3	229.0
8292	230.5	1.4	229.2
8294	230.7	1.3	229.4
8296	230.8	1.3	229.5
8298	230.9	1.2	229.7
8300	230.9	1.1	229.8
8302	231.0	1.2	229.9
8304	231.2	1.1	230.1
8306	231.4	1.2	230.2
8308	231.6	1.2	230.4
8310	231.7	1.1	230.6
8312	231.9	1.1	230.9
8314	232.1	1.1	231.0
8316	232.2	1.0	231.2
8318	232.3	1.0	231.3
8320	232.3	1.0	231.3

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 11 R (cont.)			
8322	232.2	1.2	231.0
8324	232.1	1.3	230.8
8326	232.0	1.3	230.7
8328	231.8	1.3	230.5
8330	231.7	1.2	230.5
8332	231.6	1.2	230.3
8334	231.4	1.2	230.2
8336	231.3	1.4	229.9
8338	231.2	1.4	229.8
8340	231.0	1.4	229.6
8342	230.9	1.4	229.5
8344	230.7	1.3	229.4
8346	230.6	1.3	229.2
8348	230.4	1.3	229.1
8350	230.2	1.2	229.0
8352	230.1	1.2	228.9
8354	230.0	1.2	228.8
8356	230.0	1.2	228.8
8358	230.0	1.2	228.8
Line 22 R			
8+090	218.8	3.5	215.3
8+092	218.9	3.5	215.5
8+094	219.2	3.4	215.7
8+096	219.5	3.4	216.1
8+098	219.8	3.1	216.7
8+100	220.1	3.2	216.9
8+102	220.6	3.3	217.3
8+104	221.0	3.7	217.3
8+106	221.4	3.7	217.7
8+108	221.8	3.9	217.9
8+110	222.1	4.0	218.1
8+112	222.3	4.0	218.3
8+114	222.5	3.8	218.8
8+116	222.7	3.7	219.0
8+118	222.9	3.6	219.3
8+120	223.2	3.6	219.6
8+122	223.4	3.5	219.8
8+124	223.6	3.7	219.9
8+126	223.8	3.8	220.0
8+128	223.8	3.7	220.2
8+130	223.9	3.5	220.4
8+132	223.9	3.4	220.6
8+134	224.0	3.3	220.7

Estimated standard deviation of depth of bedrock is 10% or .75 meters, whichever is greater. Depths of bedrock determined here are depths of competent bedrock. Weathered or highly fractured bedrock may occur at shallower depths. Elevations for seismic lines taken from plans provided by Maine DOT.

TABLE 1 (cont.)
SEISMIC REFRACTION SURVEY RESULTS

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 22 R (cont.)			
8+136	224.1	3.2	220.9
8+138	224.1	3.1	221.0
8+140	224.1	3.0	221.1
8+142	224.0	2.9	221.2
8+144	224.0	2.8	221.2
8+146	224.0	2.6	221.5
8+148	224.7	2.5	222.3
8+150	226.2	2.3	223.9
8+152	226.0	2.1	223.9
8+154	225.8	2.1	223.7
8+156	225.6	1.9	223.7
8+158	225.4	1.9	223.5
8+160	225.2	1.9	223.3
8+162	225.0	1.9	223.1
8+164	225.1	1.9	223.2
8+166	225.3	1.9	223.4
8+168	225.5	1.9	223.6
8+170	225.6	2.0	223.6
8+172	225.8	1.9	223.9
8+174	225.9	2.0	224.0
8+176	226.1	2.4	223.7
8+178	226.2	2.5	223.7
8+180	226.4	2.6	223.8
8+182	226.5	2.6	223.9
8+184	226.7	2.7	224.0
8+186	226.8	2.7	224.2
8+188	227.0	2.7	224.3
8+190	227.2	2.7	224.5
8+192	227.4	2.7	224.7
8+194	227.6	2.7	224.9
8+196	227.8	2.7	225.1
8+198	227.8	2.7	225.1
8+200	227.8	2.6	225.2
8+202	227.7	2.6	225.1
8+204	227.7	2.5	225.1
8+206	227.6	2.5	225.1
8+208	227.9	2.5	225.4
8+210	228.1	2.5	225.6
8+212	228.4	2.5	225.9
8+214	228.3	2.4	225.9
8+216	228.2	2.4	225.8
8+218	228.1	2.4	225.8
8+220	228.1	2.4	225.7

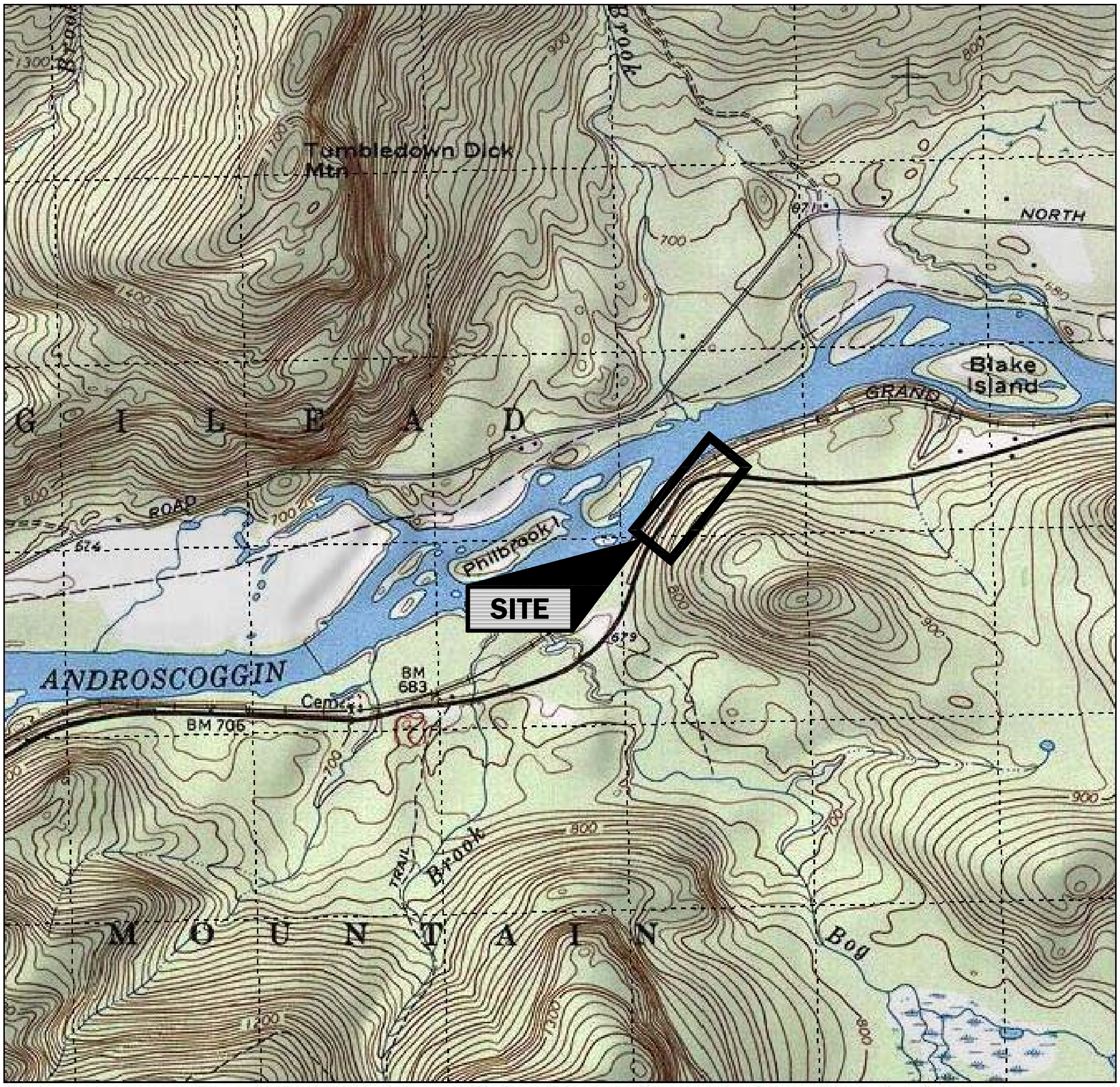
Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 22 R (cont.)			
8+222	228.0	2.3	225.7
8+224	227.9	2.3	225.6
8+226	227.8	2.3	225.5
8+228	228.0	2.3	225.7
8+230	228.3	2.3	226.0
8+232	228.5	2.3	226.3
8+234	228.8	2.3	226.5
8+236	229.0	2.3	226.7
8+238	229.3	2.3	227.0
8+240	229.5	2.3	227.2
8+242	229.8	2.1	227.7
8+244	230.0	2.0	228.0
8+246	230.3	2.0	228.3
8+248	230.4	2.0	228.4
8+250	230.4	1.9	228.5
8+252	230.4	1.8	228.6
8+254	230.4	1.9	228.5
8+256	230.5	1.7	228.8
8+258	230.7	2.0	228.8
8+260	231.0	1.9	229.1
8+262	231.2	2.0	229.2
8+264	231.5	2.0	229.5
8+266	231.9	2.0	229.9
8+268	232.2	2.1	230.1
8+270	232.6	2.2	230.4
8+272	232.8	2.1	230.7
8+274	233.0	2.2	230.8
8+276	233.2	2.2	231.0
8+278	233.4	2.3	231.2
8+280	233.6	2.3	231.3
8+282	233.8	2.4	231.4
8+284	234.0	2.4	231.7
8+286	234.2	2.3	232.0
8+288	234.4	2.1	232.3
8+290	234.4	2.1	232.3
8+292	234.4	2.1	232.3
8+294	234.4	2.0	232.4
8+296	234.4	1.9	232.5
8+298	234.5	2.0	232.5
8+300	234.6	2.1	232.5
8+302	234.7	2.1	232.6
8+304	234.8	2.1	232.7
8+306	234.9	2.0	232.9

Estimated standard deviation of depth of bedrock is 10% or .75 meters, whichever is greater. Depths of bedrock determined here are depths of competent bedrock. Weathered or highly fractured bedrock may occur at shallower depths. Elevations for seismic lines taken from plans provided by Maine DOT.

TABLE 1 (cont.)
SEISMIC REFRACTION SURVEY RESULTS

Station (meters)	Surface Elevation (meters)	Bedrock Depth (meters)	Bedrock Elevation (meters)
Seismic Line 22 R (cont.)			
8+308	235.0	2.2	232.7
8+310	235.2	2.1	233.0
8+312	235.4	2.1	233.2
8+314	235.6	2.0	233.6
8+316	235.8	2.0	233.8
8+318	235.7	2.1	233.6
8+320	235.6	2.1	233.5
8+322	235.5	2.1	233.4
8+324	235.4	2.0	233.4
8+326	235.5	2.1	233.4
8+328	235.6	2.1	233.6
8+330	235.8	2.0	233.7
8+332	235.8	2.4	233.4
8+334	235.8	2.4	233.4
8+336	235.8	2.2	233.6
8+338	235.8	2.2	233.6
8+340	235.8	2.1	233.7
8+342	235.8	2.0	233.8
8+344	235.6	1.9	233.7
8+346	235.4	1.8	233.6
8+348	235.2	1.7	233.5
8+350	235.0	1.7	233.3
8+352	234.8	1.8	233.1
8+354	234.6	1.8	232.8
8+356	234.7	1.9	232.8
8+358	234.8	1.9	232.9

Estimated standard deviation of depth of bedrock is 10% or .75 meters, whichever is greater. Depths of bedrock determined here are depths of competent bedrock. Weathered or highly fractured bedrock may occur at shallower depths. Elevations for seismic lines taken from plans provided by Maine DOT.



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

N

H-R

LOCATION

SCALE (meters)

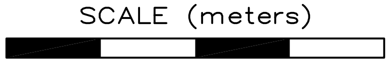
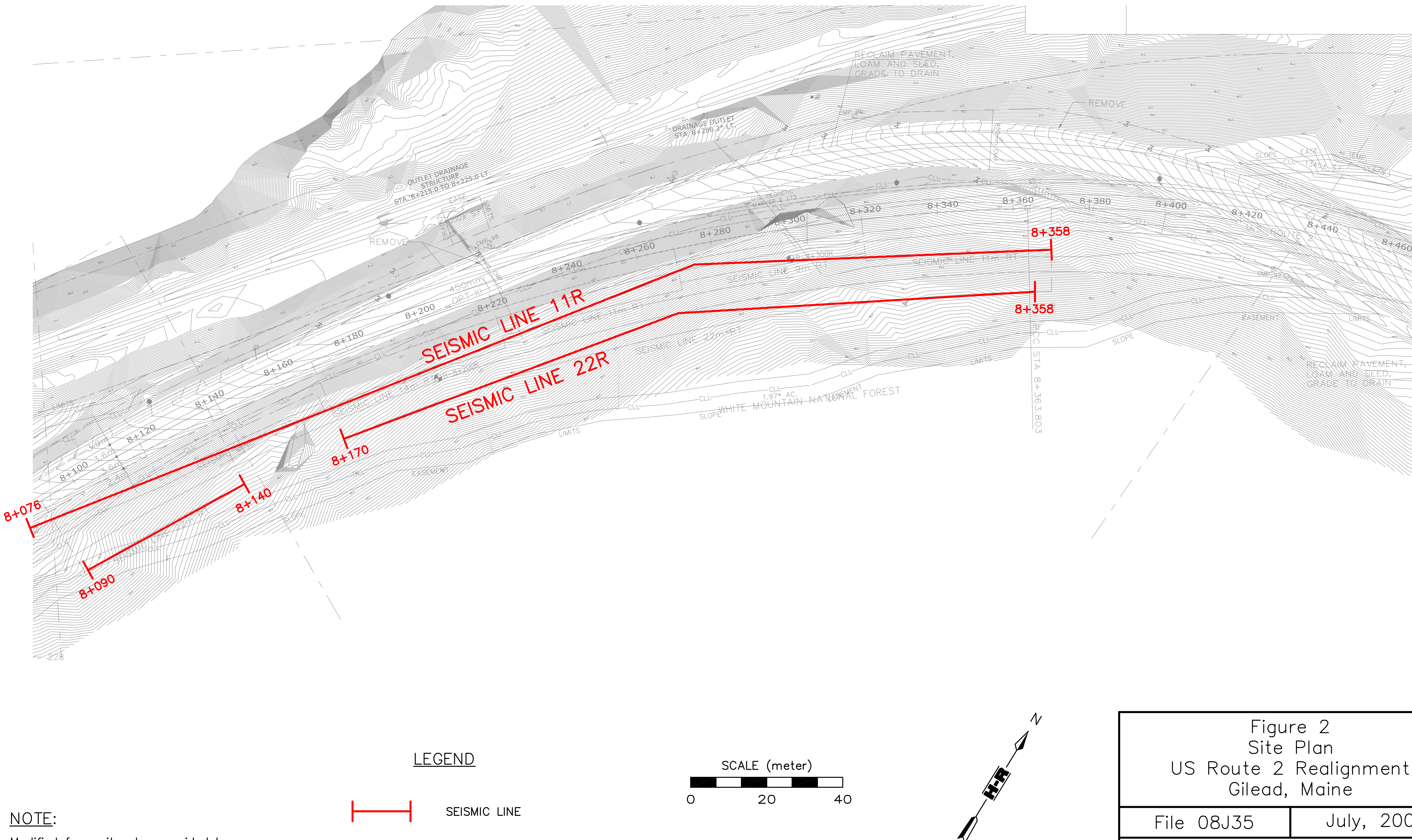


Figure 1
General Site Location
US Route 2 Realignment
Gilead, Maine

File 08J35	July, 2008

HAGER–RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



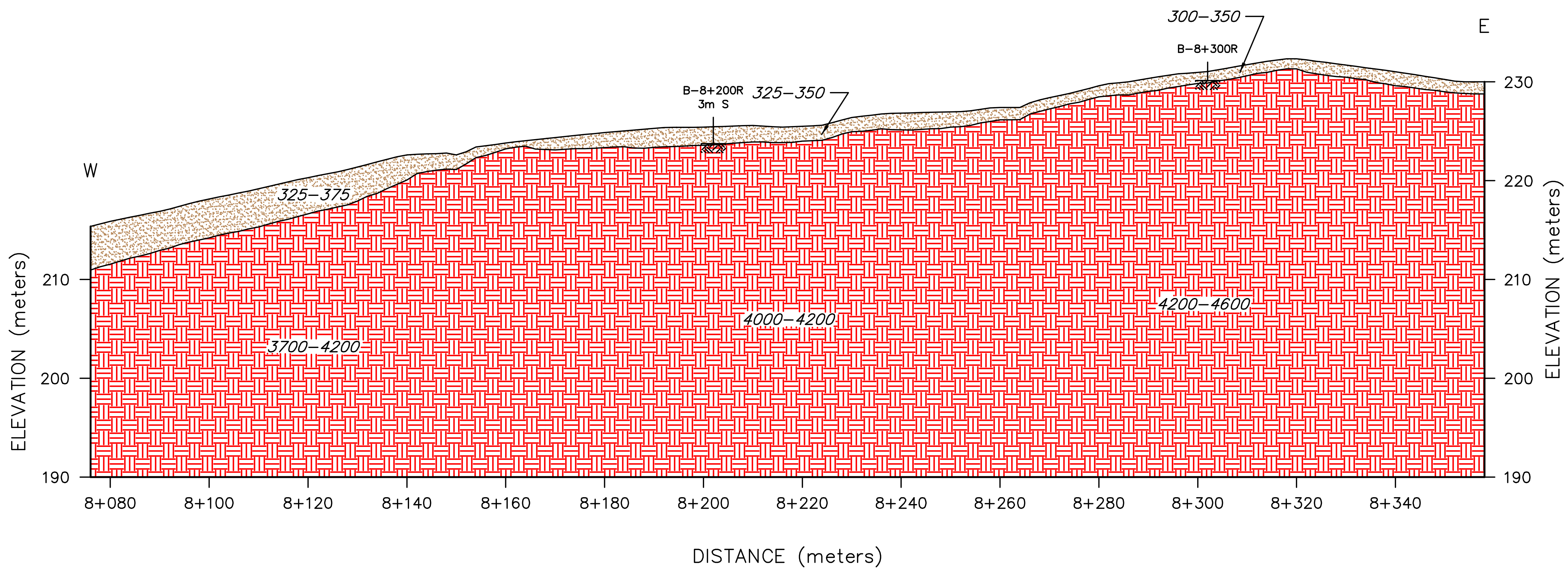
NOTE:

Modified from site plan provided by Maine DOT.

Figure 2
Site Plan
US Route 2 Realignment
Gilead, Maine

File 08J35	July, 2008

HAGER–RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



NOTES:

1. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or .75 m, 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 determined from plans provided by Maine DOT.
4. Data were analyzed using the Generalized Reciprocal Method.

LEGEND

	Unsaturated soils
	Competent bedrock
325–375	Velocity (m/sec)
	Interface determined from seismic refraction data
B–8+200R 3m S	Boring with identification and depth of bedrock based on logs provided by Maine DOT.

HORIZONTAL SCALE (meter)

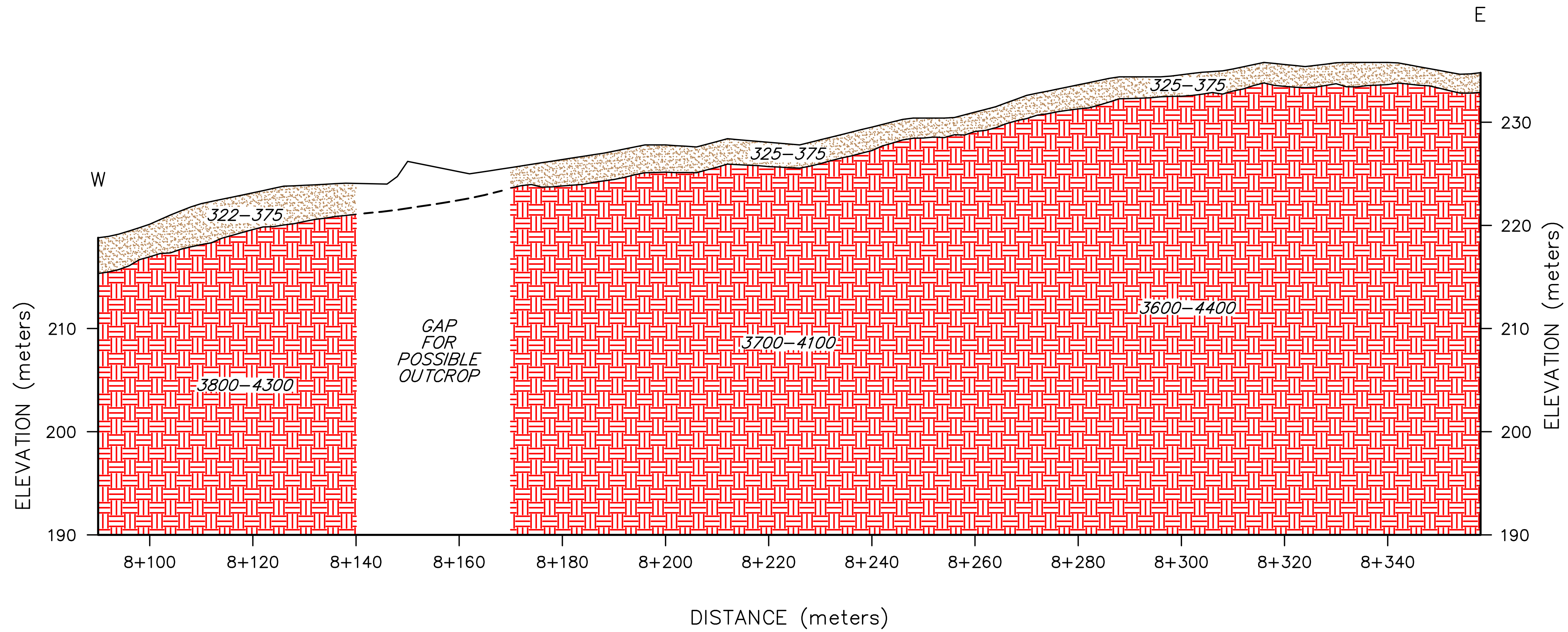
0 20 40

Vertical Exaggeration = 2X

Figure 3
Seismic Line 11R
US Route 2 Realignment
Gilead, Maine

File 08J35 | July, 2008

HAGER–RICHTER GEOSCIENCE, INC.
Salem, New Hampshire



LEGEND

- Unsaturated soils
- Competent bedrock
- *325–375* Velocity (m/sec)
- Interface determined from seismic refraction data (Dashed were inferred)
- B–8+200R 3m S — Boring with identification and depth of bedrock based on logs provided by Maine DOT.

HORIZONTAL SCALE (meter)

0 20 40

Vertical Exaggeration = 2X

NOTES:

1. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or .75 m, 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 determined from plans provided by Maine DOT.
4. Data were analyzed using the Generalized Reciprocal Method.

Figure 4 Seismic Line 22R US Route 2 Realignment Gilead, Maine	
File 08J35	July, 2008
HAGER–RICHTER GEOSCIENCE, INC. Salem, New Hampshire	

APPENDIX

SEISMIC REFRACTION METHOD

Equipment. We used two Geometrics Geode units connected to, and controlled by, a notebook PC computer. The software provides for the acquisition, display, plotting, filtering and storage of seismic data. The seismogram image presented in real time on the notebook screen allows the operator to verify the quality of the data. The stored digital data are transferred to floppy disks or CDs at the end of the field day for storage, backup, and future data processing.

The Geodes were coupled to two 24-element seismic spread cables for a total of 48 geophones. The geophones measure only the vertical component, and their resonant frequency is 12 Hz.

Seismic energy is provided by a 12-lb sledge hammer striking a steel base plate, an EWG, or a Betsy seisgun. The Betsy seisgun uses a shotgun blank as the seismic source and is not classified as a weapon or explosive under Federal regulations. The EWG is an accelerated weight drop, using industrial elastics to accelerate the weight. The number of stacks per shot point is variable, and the quality of the stacked seismic signal for each shot point was verified in the field with the paper record. Five shot points were used for each 48-geophone spread -- one off each end of the cable, one at each end of the cable, and one at the 24^{th} geophone. This configuration provides reversed profiles. Shot points (and geophone locations, if necessary) were flagged in the field.

Data Analysis and Interpretation. The seismic data were analyzed using the Generalized Reciprocal Method (GRM) of seismic refraction interpretation. The method is described in detail in Palmer (1980).[1] GRM allows for some variation in the surface topography as well as lateral variation in the seismic velocity of the upper layers. The method uses the principle of migration whereby the refractor need only be planar over a short distance, thus allowing the calculation of depth to an undulating interface. In addition, GRM is relatively insensitive to dip angles as high as 20°, unlike most other methods that can be sensitive to dips as low as 5°. GRM also allows for the calculation of depth below each geophone instead of below only the shot points as in the Time-Intercept and Crossover Distance methods. The GRM software that we use for data analysis (GREMIX by Interpex) contains several internal tests for data consistency.

The results are used to construct an interpreted velocity profile of the subsurface for each seismic line. The velocities of seismic waves are functions of the types of geologic material through which they pass. One can thus infer the general subsurface stratigraphy from the velocities determined. Seismic velocities are expressed in feet per second (fps).

A widespread misconception about the seismic refraction method is that one cannot detect velocity inversions (layers of lower velocity material underlying higher velocity material) or hidden layers (layers of intermediate velocity too thin to produce first arrival signals), common

[1] Palmer, Derecke (1980) The Generalized Reciprocal Method of Seismic Refraction Interpretation, Society of Exploration Geophysicists, 104 p.

conditions in stratified sediments. If present and undetected, such layers can cause large errors in the depths calculated for the various layers. However, using GRM, the presence of such layers can be inferred readily, and more importantly, the method uses average velocities for the detected and undetected layers to determine accurate depths to the refractors that are detected. Typical uncertainties in depths determined seismically are 10% or 2 feet, whichever is larger.

Limitations of the Method. 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 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°.

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. In such cases, the depth determined by seismic refraction is the depth of *sound* bedrock, which might be located at some depth below the geologic contact.

The depth relations of the water table and bedrock may constitute a significant problem for the seismic refraction technique. This problem is that of a "blind layer." A blind layer occurs where the thickness of the saturated overburden is less than about half the depth of bedrock. In such cases, the water-saturated material immediately above bedrock is "blind" in the sense that no refracted seismic energy from it will be received as a first arrival of seismic energy, and all methods used to reduce the seismic data to determine the depth of bedrock, the objective of this survey, use *only* first arrivals. Thus, the saturated layer will not be detected where it is close to bedrock, and most methods of seismic data reduction will indicate that bedrock is considerably deeper than it actually is. Although GRM, the method used by Hager-Richter to reduce the seismic refraction data, does not use first arrivals through the water saturated zone (because there is none to use) in such cases, GRM determines the depth of bedrock correctly by using the *average* velocity of the saturated and unsaturated zones.

A "hidden layer" occurs where a lower velocity material underlies a higher velocity material, a common situation in stratified sediments. An example is where sands are present under layers of clay or till. As in the case of a "blind layer," most methods of seismic refraction data reduction will indicate that bedrock is shallower than it actually is, if a hidden layer is present but not detected. Internal tests in the seismic refraction data reduction software that we use (GREMIX by Interpex) indicate that such layers might be present, and an average velocity of the two layers is used to determine the depth of bedrock.

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Gilead   Project Number: 9184.50

Boring & Sample Identification Number	Station (Meter)	Offset (Meter)	Depth (Meter)	Reference Number	G.S.D.C. Sheet	W.C.	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-GILE-201, S1	6+300	3.5 Rt.	0.14-1.31	210123	1	6.0			SW-SM	A-1-b	0
HB-GILE-202, S3	6+500	2.2 Lt.	0.14-1.98	210124	1	3.9			SM	A-1-b	II
HB-GILE-202, S4	6+500	2.2 Lt.	1.98-3.96	210125	1	8.1			SM	A-2-4	II
HB-GILE-203, S6	6+940	17.2 Lt.	0.98-1.95	210202	1	3.5			SW-SM	A-1-b	0
HB-GILE-204, S8	7+900	4.3 Lt.	0.15-0.91	210203	2	6.0			SW-SM	A-1-b	0
HB-GILE-204, S9	7+900	4.3 Lt.	0.91-3.05	210204	2	3.2			SW-SM	A-1-b	0
HB-GILE-205, S10	9+200	0.2 Lt.	0.14-0.98	210205	2	2.7			SW-SM	A-1-a	0
HB-GILE-205, S11	9+200	0.2 Lt.	0.98-3.05	210206	2	6.3			SM	A-2-4	II

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

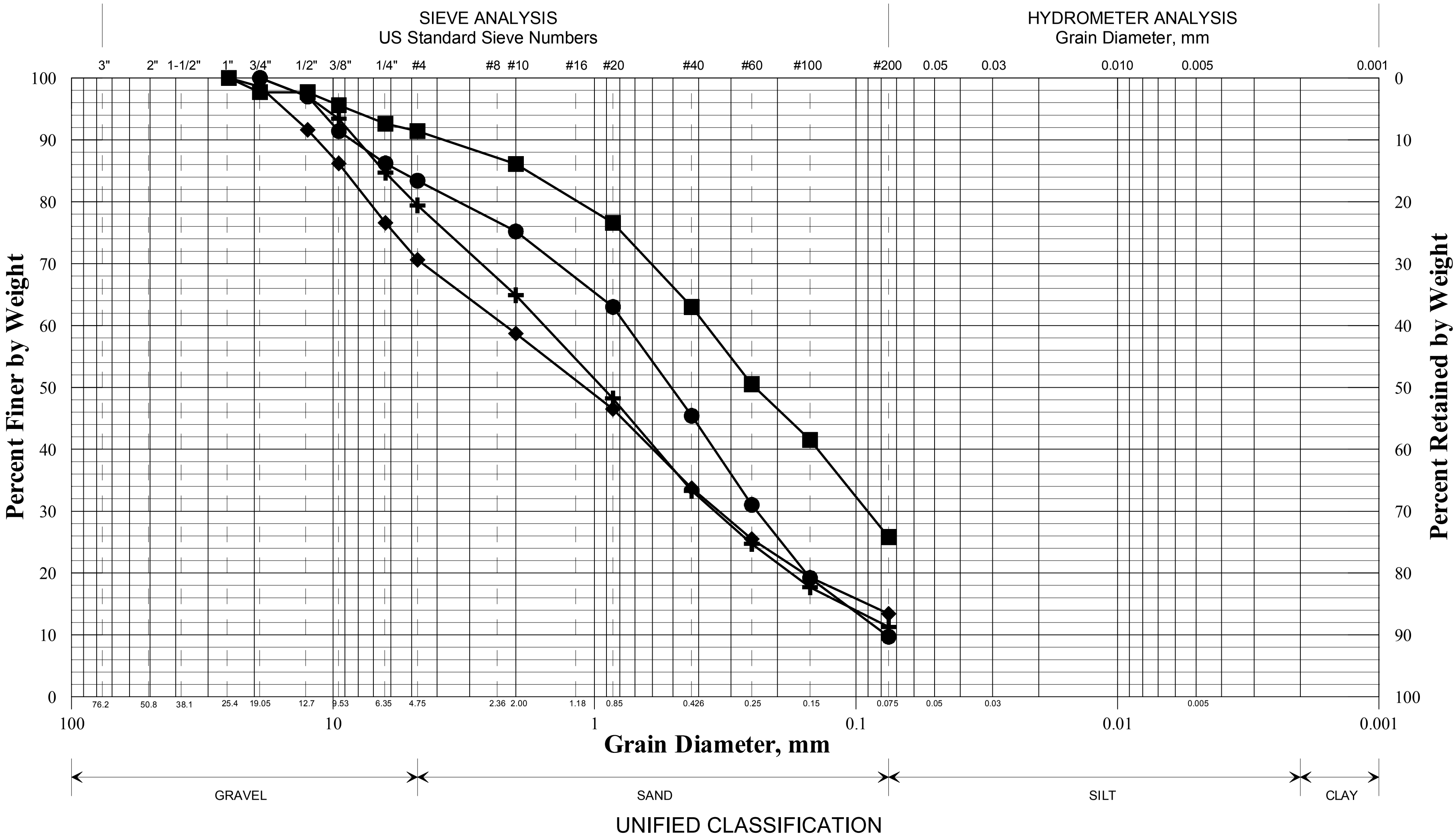
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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

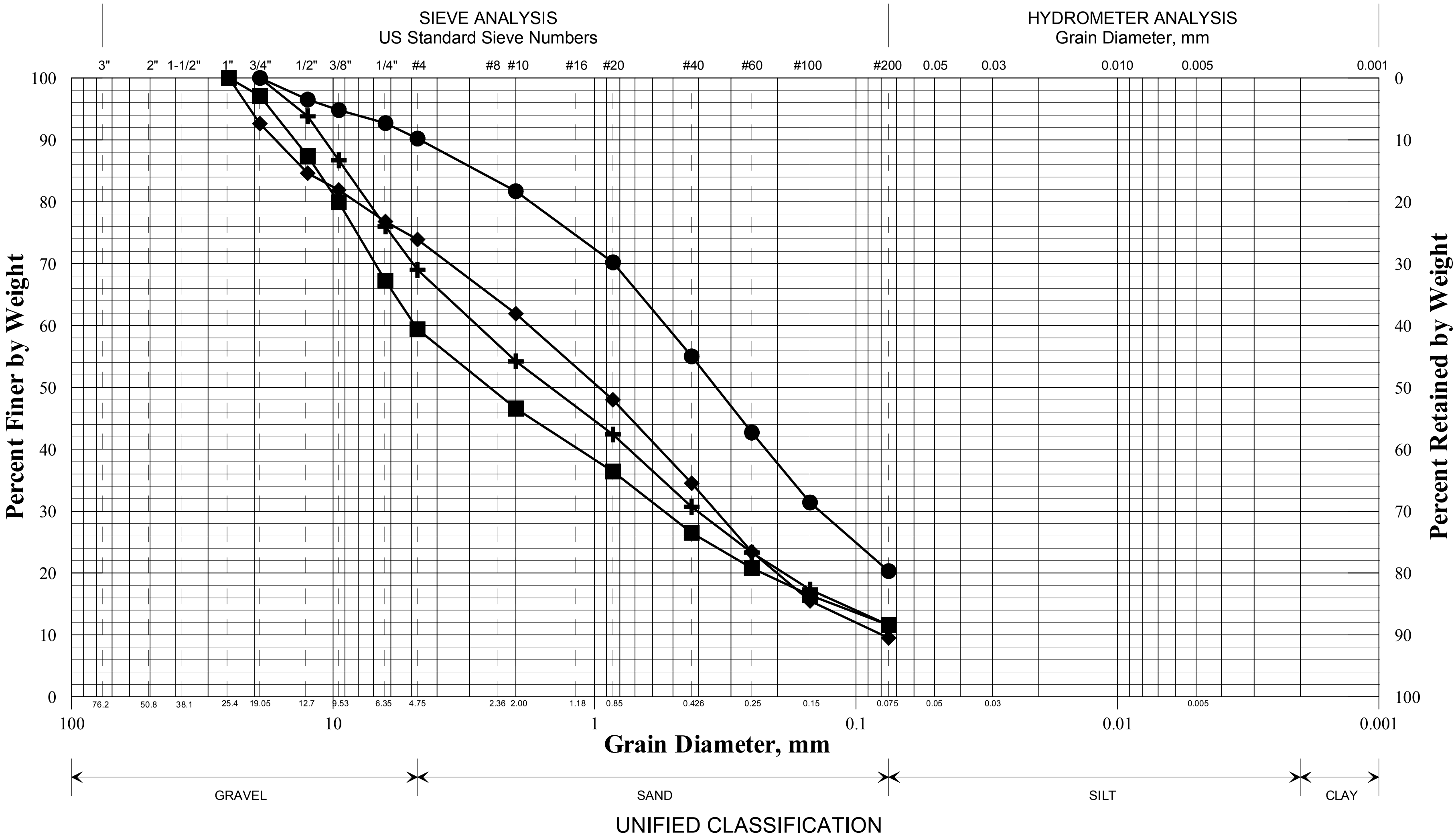


	Boring/Sample No.	Station	Offset, m	Depth, m	Description	W, %	LL	PL	PI
✚	HB-GILE-201/S1	6+300	3.5 RT	0.14-1.31	SAND, some gravel, little silt.	6.0			
◆	HB-GILE-202/S3	6+500	2.2 LT	0.14-1.98	SAND, some gravel, little silt.	3.9			
■	HB-GILE-202/S4	6+500	2.2 LT	1.98-3.96	SAND, some silt, trace gravel.	8.1			
●	HB-GILE-203/S6	6+940	17.2 LT	0.98-1.95	SAND, little gravel, trace silt.	3.5			
▲									
✖									

PIN	
009184.20	
Town	
Gilead	
Reported by/Date	
WHITE, TERRY A	4/1/2008

SHEET 1

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, m	Depth, m	Description	W, %	LL	PL	PI
✚	HB-GILE-204/S8	7+900	4.3 LT	0.15-0.91	SAND, some gravel, little silt.	6.0			
◆	HB-GILE-204/S9	7+900	4.3	0.91-3.05	SAND, some gravel, trace silt.	3.2			
■	HB-GILE-205/S10	9+200	0.2 LT	0.14-0.98	Gravelly SAND, little silt.	2.7			
●	HB-GILE-205/S11	9+200	0.2 LT	0.98-3.05	SAND, little silt, trace gravel.	6.3			
▲									
✖									

PIN
009184.20
Town
Gilead
Reported by/Date
WHITE, TERRY A 4/1/2008

SHEET 2

Appendix D
Pavement Design

Core Summary Sheet
Soil Support and Modulus Charts
Ledge cut transition detail

State of Maine - Department of Transportation

Pavement Core Summary Sheet

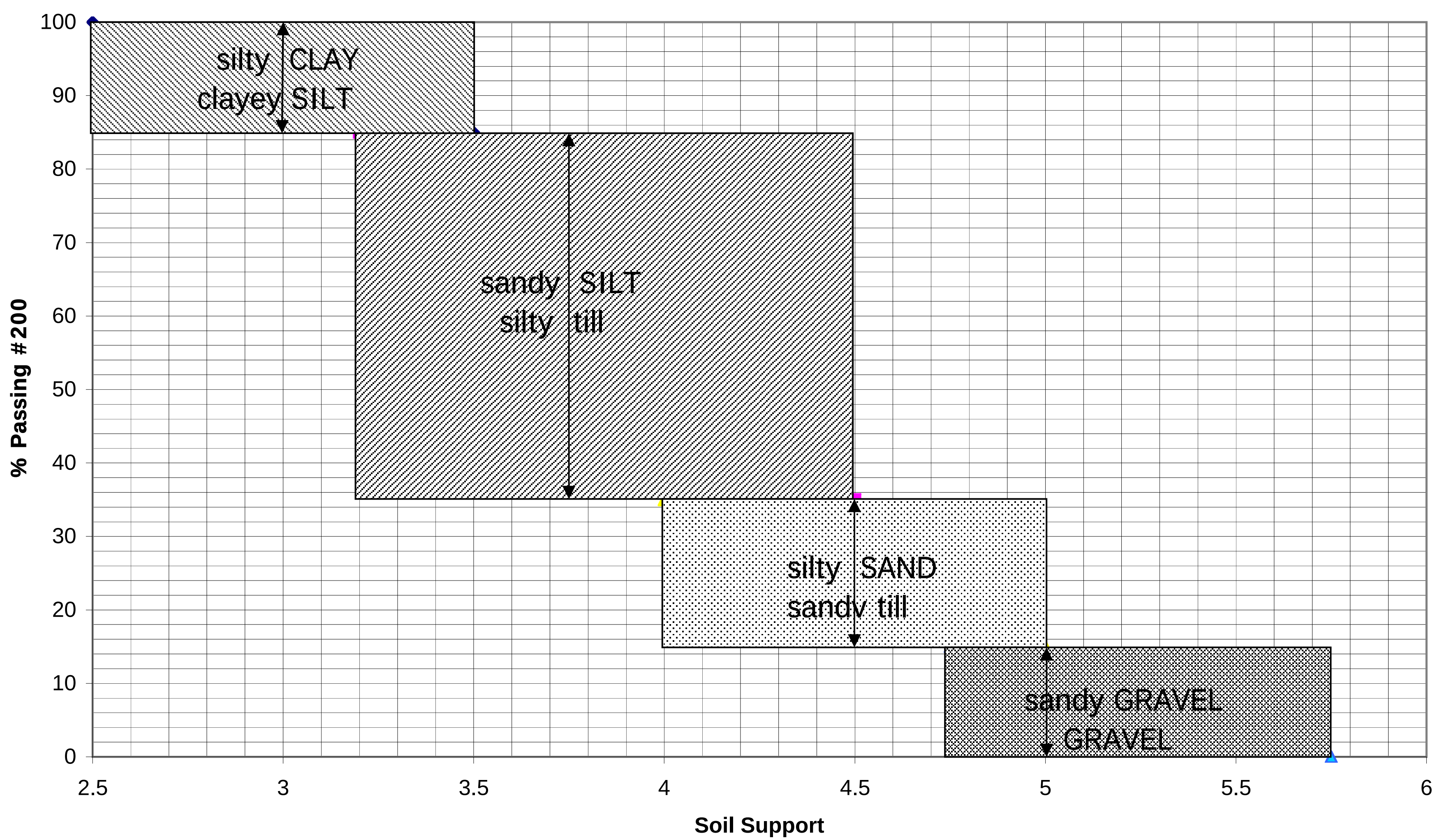
Town(s): Gilead Project Number: 9184.00

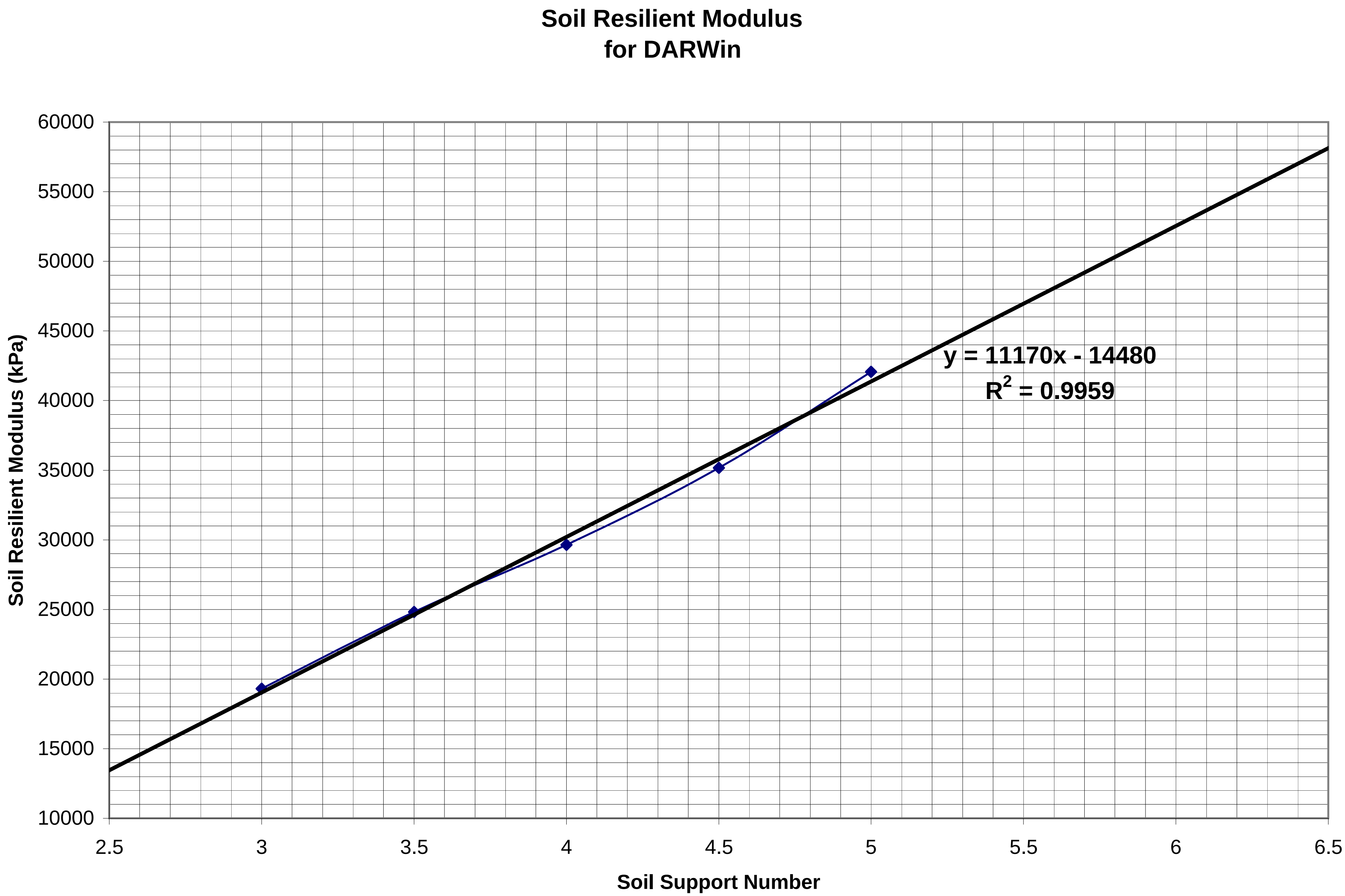
Station (Meter)	Offset (Meter)	Pavement Depth (mm)	Unbound Pavement	PC-Number	Saved Core	Comments / Date 4/9/2008
6+500	1.52 Lt.	152.4				
6+500	CL	152.4				
6+500	1.52 Rt.	152.4				
6+940	1.52 Lt.	152.4				
6+940	CL	127.0				
6+940	1.52 Rt.	127.0				
7+500	1.52 Lt.	152.4				
7+500	CL	152.4				
7+500	1.52 Rt.	152.4				
8+000	CL	101.6				recovered only 63.5 mm
8+600	1.52 Lt.	152.4				
8+600	CL	152.4				
8+600	1.52 Rt.	152.4				
9+200	1.52 Lt.	101.6				
9+200	CL	101.6				
9+200	1.52 Rt.	101.6				

Logged By: E. Giguere

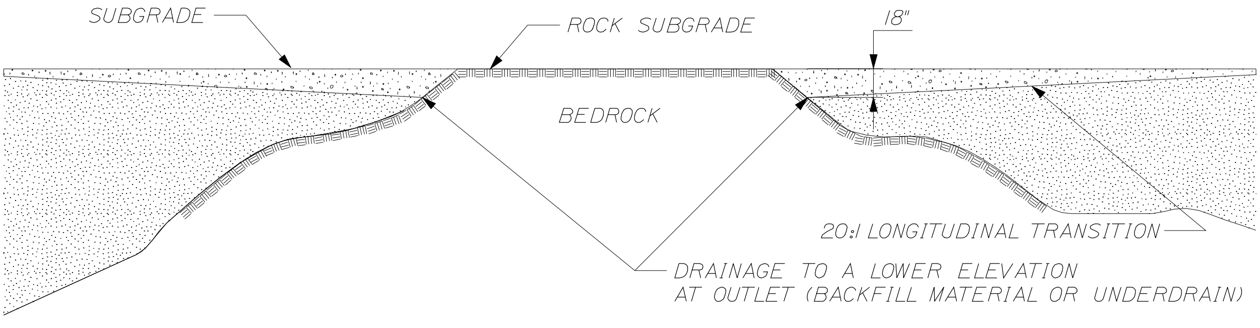
50 mm Thinwall Core

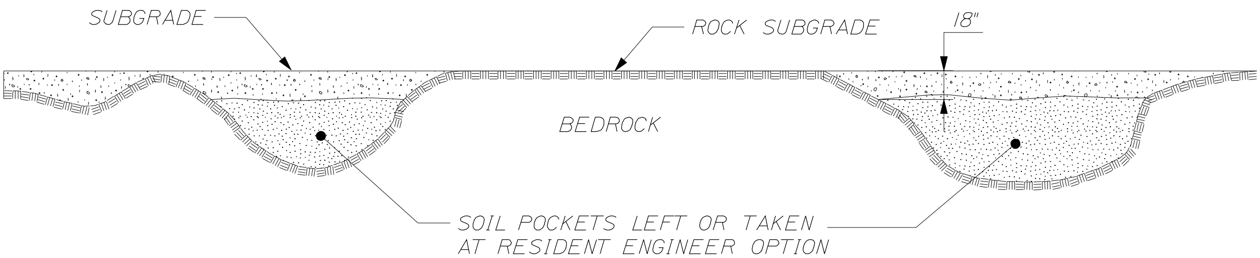
Guidelines for Selection of Soil Support Values for Pavement Design

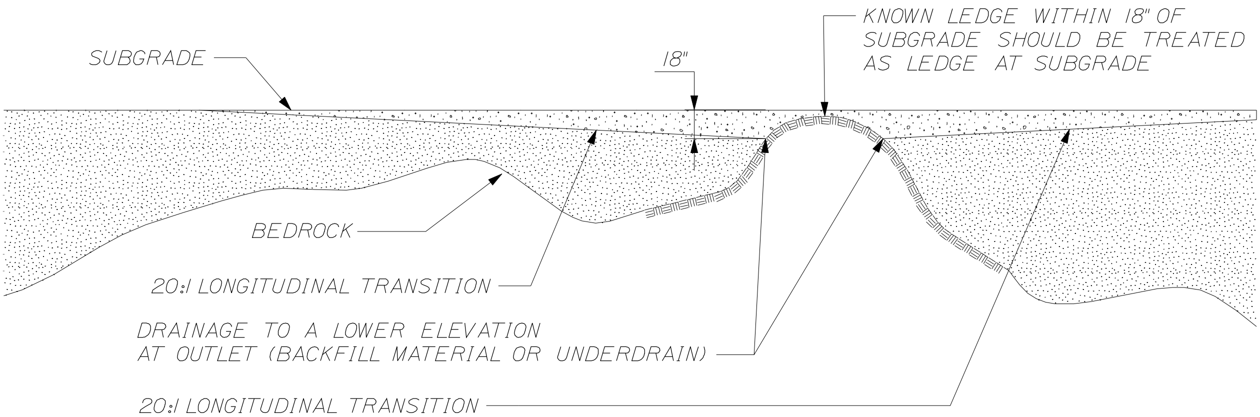


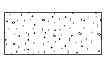

Soil Resilient Modulus
for DARWin
Soil Resilient Modulus (kPa)
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
2.5
3
3.5
4
4.5
5
5.5
6
6.5
Soil Support Number
y = 11170x - 14480
R2 = 0.9959

PROFILE OF UNDERCUT OF FROST SUSCEPTIBLE SOILS OVER LEDGE







 FROST SUSCEPTIBLE SOIL TO BE UNDERCUT AND REPLACED WITH NON FROST SUSCEPTIBLE MATERIAL

IF A SOIL SECTION BETWEEN LEDGE SUBGRADE IS OF SUCH LENGTH THAT THE TRANSITION FROM EACH EDGE WOULD MEET, IT SHOULD BE TREATED AS AN EARTH POCKET