

APPENDIX H

Preliminary Geotechnical Report



R. W. Gillespie & Associates, Inc.

Geotechnical Engineering • Geohydrology • Materials Testing Services

08 October 2009

Stephen R. Bushey, P.E.
DeLuca-Hoffman Associates, Inc.
778 Main Street, Suite 8
South Portland, ME 04106

Subject: Data Report of Geotechnical Explorations and Preliminary Evaluations
Eastern Trail U.S. Route 1 Crossing Project
Saco, Maine
RWG&A Project No. 303-195

Dear Mr. Bushey:

R. W. Gillespie & Associates, Inc., (RWG&A) has prepared this data report summarizing the results of geotechnical explorations and preliminary evaluations of soil and foundation design considerations for the Eastern Trail Route 1 Crossing Project in Saco, Maine. In accordance with our proposal to DeLuca-Hoffman Associates, Inc. (Note: RWG&A Proposal No. P-7095GI dated 06 February 2009), this data report provides information suitable for planning, but not for design or construction. Geotechnical recommendations for use in final design and construction would be prepared based on design information including selected foundation type, structural loads, alignment and grading to be provided by the project design team, and design phase geotechnical explorations.

Conceptual Pedestrian Bridge Location and Design Information

The project location is shown on Figure 1, *Locus Map*. Preliminary geotechnical evaluations were based on current and proposed grading and layout depicted on the plan marked "Draft Eastern Trail Alignment 9/24/09" and a profile sketch, both prepared by DeLuca-Hoffman Associates, Inc. (DHA). As requested, RWG&A conducted geotechnical evaluations for abutment location Option 2 depicted on the profile titled "U.S. Route 1 Cross Section" and dated 21 September 2009. It is understood Option 2 considers a future U.S. Route 1 road widening to 82-feet from the current 50-foot width. (Note: Option 1 was based on the current road width.) Proposed grading indicates that up to 6 feet of new fill will be needed at each abutment location. Furthermore, it is understood that vertical bridge loads acting on the abutments will be on the order of 80 kips.

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General Subsurface Conditions

Subsurface explorations were conducted during 08 August 2009, and consisted of two test borings designated B-1 and B-2. The borings were drilled near initially proposed abutment locations, which were subsequently revised based on site layout considerations after the explorations were made. Figure 2, *Exploration Location Plan*, shows the as-drilled test boring locations relative to the currently proposed alignment and logs of the explorations are provided in Appendix A. The test boring locations were marked by RWG&A prior to drilling using taping and pacing methods with reference to visible site features.

Subsurface conditions encountered at both boring locations consisted of silty clay marine deposits which extend to depths more than 106 feet below local ground surface. The total thickness of the deposits could not be determined in the time available for drilling. Silty clay encountered in the borings is typically stiff to medium stiff near the top of the deposits, becoming soft to very soft with increasing depth; seams and layers of sand were also encountered in the marine deposits. Depth to free water observed at boring B-2 was approximately 7 feet below current ground surface.

Preliminary Geotechnical Evaluations

Subsurface conditions at the boring locations consist of thick marine deposits of silty clay with layers of sand. The silty clay is expected to compress in response to loads imposed by new fill above current site grades and bridge foundations, resulting in foundation settlement. Based on the subsurface information from the test borings, conceptual grading and bridge design information provided, and RWG&A's experience with similar marine deposits in the site vicinity, total settlements on the order of 1 to 1 1/2 inches are expected at abutments with soil-supported spread footing foundations. If this settlement about is tolerable (Note: determined by the bridge designers) then soil-supported spread footing foundations appear feasible to support the proposed bridge abutments. An allowable bearing pressure of 1,000 pounds per square foot may be used for planning purposes. The seismic site class based on the National Earthquake Hazard Reduction Program Recommended Provisions and encountered subsurface soils is "E".

Alternatives to reduce post construction settlements include use of lightweight fills or supporting abutments on a pile-supported mat foundation. Friction piles consisting of either timber, steel pipe piles, or precast concrete bearing in the marine deposits appear feasible but would require further evaluation. RWG&A can evaluate support alternatives, if requested. The abutment footings should be located a minimum 6 feet below and adjacent to the nearest ground surface exposed to freezing temperatures. Foundation drains will be needed at the base of abutment foundations and at the back of the retained fill zone behind abutments.

Preliminary evaluation of global slope stability at abutment locations indicate that the factor of safety for static conditions is about 1.5 for the proposed new, higher ground surface grades, U.S. Route 1 roadway grades at current levels, and embankment slope pitch of 2 horizontal to 1 vertical. Final abutment design and location should consider future construction including roadways and utilities.

Recommendations for Additional Subsurface Investigation and Laboratory Testing

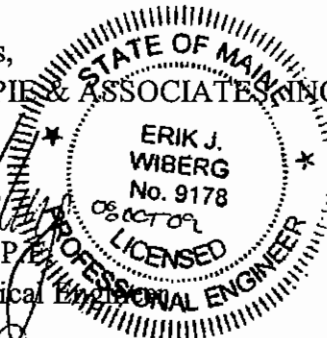
Prior to final design, RWG&A recommends that an additional soil boring be performed at the proposed western abutment location for use in evaluating existing fill composition associated with the former railroad embankment and to evaluate compressibility of silty clay deposits of the site. Laboratory testing consisting of one-dimensional consolidation and undrained shear strength determinations will be important components for design of foundation systems.

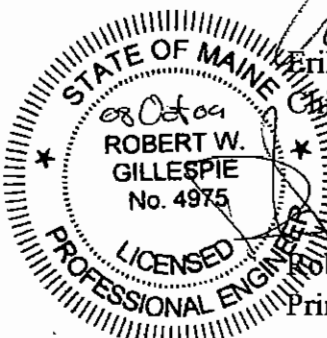
Closure

This report has been prepared for specific application to the proposed Eastern Trail U.S. Route 1 Crossing Project in Saco, Maine, for the exclusive use of DeLuca-Hoffman Associates, Inc. This work has been completed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

We trust the above information meets the project's current needs. Please do not hesitate to contact us if you have any questions or if we may be of further service.

Very truly yours,
R. W. GILLESPIE & ASSOCIATES, INC.


Erik J. Wiberg, P.E.
Chief Geotechnical Engineer


Robert W. Gillespie, P.E.
Principal Geotechnical Engineer

SRD/EJW/RWG:md

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Attachments: Figure 1. *Locus Map*

Figure 2. *Exploration Location Plan*

Appendix A. Boring Logs B-1 and B-2

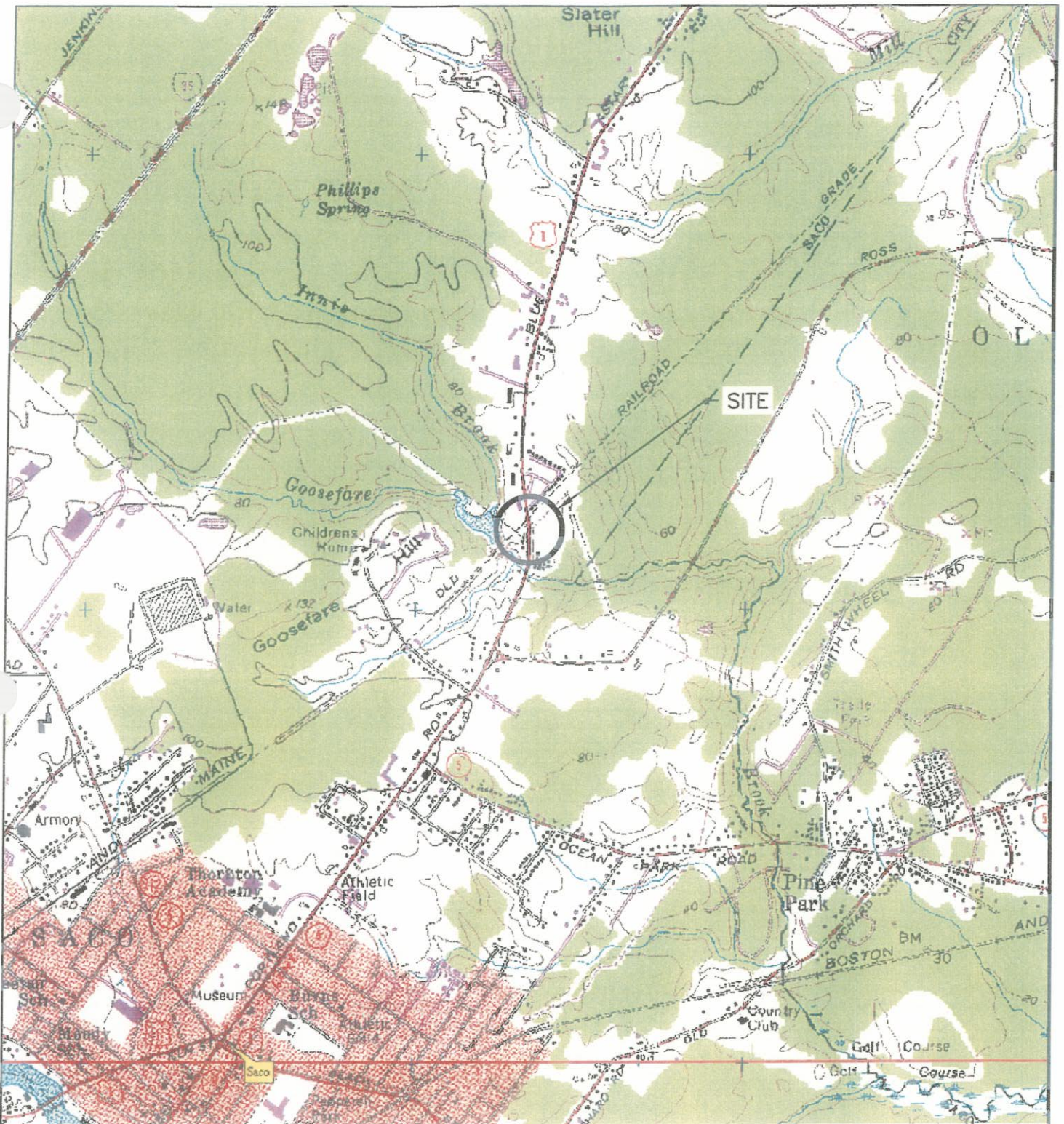
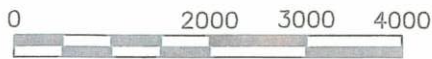


FIGURE 1
 LOCUS MAP
 EASTERN TRAIL PROJECT –
 ROUTE 1 CROSSING
 SACO, MAINE



SCALE, FEET

SOURCE:
 USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE
 OF OLD ORCHARD BEACH, DATED 1990.

OCTOBER 2009


PROJECT NO. 303-195



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 CONSULTING GEOTECHNICAL & ENVIRONMENTAL SPECIALISTS

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LEGEND:

 B-1 TEST BORING LOCATION BY RWG&A AUGUST 2009

SOURCE:

ELECTRONIC FILE IN PDF FORMAT TITLED "US ROUTE 1" PROVIDED BY DELUCCA-HOFFMAN ASSOCIATES, INC. ON 19 OCTOBER 2009

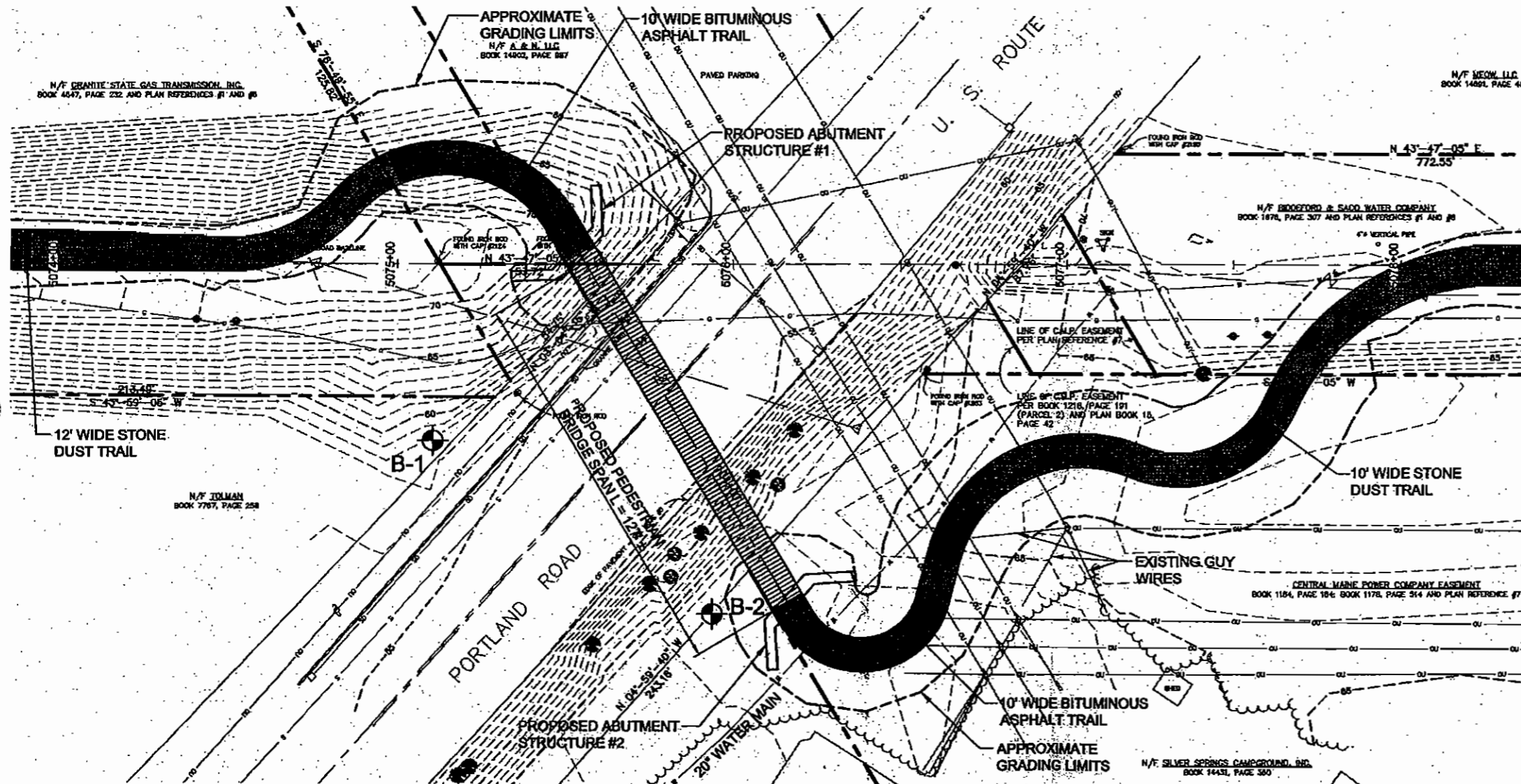



FIGURE 2
 EXPLORATION LOCATION PLAN
 PRELIMINARY GEOTECHNICAL EVALUATION
 EASTERN TRAIL PROJECT -
 ROUTE 1 CROSSING
 SACO, MAINE

08 OCTOBER 2009 PROJECT NO. 303-195
 REVISED 20 OCTOBER 2009

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APPENDIX A

BORING LOGS B-1 AND B-2

**Data Report of Geotechnical Explorations and Preliminary Evaluations
Eastern Trail U.S. Route 1 Crossing Project
Saco, Maine**

RWG&A, Inc. soil descriptions are based on the following criteria. Descriptive terminology is used to denote the grain size and percentage of each component. The soil descriptions are based on visual-manual classification procedures, Standard Penetration Test results, and the results of laboratory testing on selected soil samples, where available. The Unified Soil Classification Group Symbol will be indicated in capital letters.

COMPONENT DEFINITIONS BY GRADATION

SIEVE LIMITS

Materials	Definitions	Fractions	Sieve Limits	
			Upper	Lower
Boulders	Material too large to pass through an opening 12 in. square.			
Cobbles	Material passing through a 12 in. opening and retained on the 3 in. sieve.			
Gravel	Material passing the 3 in. sieve and retained on 1/4" (No. 4 sieve).	Coarse Fine	3 in. 3/4 in.	3/4 in. 1/4 in.
Sand	Material passing the No. 4 sieve and retained on the No. 200 sieve.	Coarse Medium Fine	No. 4 (1/4") No. 10 (1/8") No. 40 (1/32")	No. 10 (1/8") No. 40 (1/32") No. 200
Silt	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		No. 200	
Clay	Material passing the No. 200 sieve which can also be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		No. 200	

SOIL DESCRIPTION

General

Soils are described as to the Unified Soil Classification Systems Group Symbol, density or consistency, color, grain size distribution and other pertinent properties such as plasticity and dry strength. The RWG&A order of descriptors is as follows:

1. USCS Group Name and Symbol, or Fill
2. Density of Consistency
3. Moisture
4. Grain Size & Constituent percentages
5. Other pertinent descriptors
6. Color

DESCRIPTIVE TERMINOLOGY DENOTING COMPONENT PROPORTIONS

Descriptive Terms	Range of Proportions
Noun (major component)	≥50%
Adjective (secondary component)	20 - 50%
Some (third component)	25 - 45%
Little (second or third component)	15 - 25%
Few (second or third component)	5 - 15%
Trace	0 - 5%
With	Amount of component not determined. Used as a conjunction only. Does not indicate component percentile

OTHER DESCRIPTIVE TERMS

Where appropriate, geological classifications are also used (Glacial Till, etc.)

TYPICAL DESCRIPTIONS

SANDWITH SILT (SP-SM) Medium dense, moist, coarse to medium sand, few silt, brown (Fill) Loose, dry, fine sand, some gravel and silt, with brick and concrete fragments, dark brown
SILTY CLAY (CL) Very stiff, moist, silty clay, olive-brown

DENSITY OR CONSISTENCY OF SOILS

COHESIVE SOILS

Consistency of Cohesive Soils	Standard Penetration Test (Blows Per Foot) (N)	Undrained Shear Strength (TSF)
Very Soft	0 - 2	Below 0.13 (250 psf)
Soft	2 - 4	0.13 to 0.25 (to 500 psf)
Medium	4 - 8	0.25 to 0.5 (to 1,000 psf)
Stiff	8 - 15	0.5 to 1.0 (to 2,000 psf)
Very Stiff	15 - 30	1.0 to 2.0 (to 4,000 psf)
Hard	Over 30	over 2.0 (over 4,000 psf)

Consistency of cohesive soils is based upon field vane shear, torvane, or pocket penetrometer, or laboratory vane shear or Unconsolidated-Undrained Triaxial Compression tests. Consistency of cohesive soils is based upon the Standard Penetration test when no other data is available.

COHESIONLESS SOILS

Density of Cohesionless Soils	Standard Penetration Test (Blows per Foot) (in)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	over 50

PENETRATION RESISTANCE

STANDARD PENETRATION TEST (ASTM D1586) - a 2.0-inch diameter, 1-3/8 inch inside diameter split barrel sample is driven into soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The total number of blows required for penetration from 6 to 18 inches is the Standard Penetration Resistance (N).

COBBLES AND BOULDERS

The percentage of cobbles and boulders is estimated visually where possible.

Descriptive Term	Estimated Percentage
Very Few	0 - 10%
Few	10 - 25%
Common	25 - 40%
Numerous	40 - 50%

If the percentage cannot be determined, as in a typical test boring, then use "with" to indicate the presence of cobbles and/or boulders. (i.e., gravelly sand with cobbles and boulders).

FILLS

The following terminology is used to denote size range of man-made materials within fill deposits:

Size Range	Comparative Soil Terms
<No. 200 Sieve	Silt - size
No. 200 to 1/4 in.	Sand - size
1/4 in. to 3 in.	Gravel - size
3 in. to 12 in.	Cobble - size
>12 in.	Boulder - size

SUPPLEMENTAL SOIL DESCRIPTION TERMINOLOGY

Term	Example
Seam	Typically 1/16 to 1/2 inch thick 1/4 inch sand seams
Layer	Greater than 1/2 inch thick 2-inch sand layers
Occasional	One or less per foot of thickness
Frequent	More than one per foot of thickness
Interbedded	Alternating soil layers of different composition
Varved	Alternating thin seams of silt and clay
Mottled	Variations in color



Project Name: Eastern Trail Project Route 1 Crossing
 RWG&A Project No. 303-195
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 RWG&A Representative: G. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: Not Obs.

Drilling Contractor: Great Works Test Boring
 Drill Rig: B 53 Rubber Track
 Driller Rep.: Will Aikman
 Date Started: 08/07/09
 Date Completed: 08/07/09
 Surface Elevation: (-)
 Drilling Method: 4-inch Wash Rotary
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0	S-1	SILTY CLAY (CL); Soft, wet, silt and clay, trace fine sand, gray to bluish gray, with fine sand seams and layers.	6	2 1 2 2	3		
5	S-2	Field Vane: Undrained Shear Strength: $S_u=1.0$ ksf, Residual=0.11 ksf. Field Vane: could not advance field vane to next sample interval near 12' due to possible sand layer.	24	1 1 1 2	2		
15	S-3	Fine sand layer. (16.0' to 17.0')	24	2 10 17 18	27		
20	S-4	Field Vane: Undrained Shear Strength: $S_u=0.74$ ksf, Residual=0.09 ksf. Field Vane: Undrained Shear Strength: $S_u=0.65$ ksf, Residual=0.04 ksf.	18	3 2 3 1	5		
25							
30							

Notes:



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Boring Log: B-1
 Total Depth: 106
 Sheet 2 of 4

Project Name: Eastern Trail Project Route 1 Crossing
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 Observed Water Depth: Not Obs.

RWG&A Project No. 303-195
 Surface Elevation: (-)
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		S-5	Change to very soft consistency. Probed with wash rotary bit from 30' to 106' in probable marine deposits.	24	wor wor wor wor	0		
35								
40								
45								
50								
55								
60								

Preliminary

Notes:



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Boring Log: B-1
Total Depth: 106
Sheet 3 of 4

Project Name: Eastern Trail Project Route 1 Crossing
Location: Saco, Maine
Client: DeLuca-Hoffman Associates, Inc.
Observed Water Depth: Not Obs.

RWG&A Project No. 303-195
Surface Elevation: (-)
Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Probed with wash rotary bit from 30' to 106' in probable marine deposits.					
65								
70								
75								
80								
85								
90								

Preliminary

Notes:



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Boring Log: B-1
 Total Depth: 106
 Sheet 4 of 4

Project Name: Eastern Trail Project Route 1 Crossing
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 Observed Water Depth: Not Obs.

RWG&A Project No. 303-195
 Surface Elevation: (-)
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
90	[Hatched pattern]		Probed with wash rotary bit from 30' to 106' in probable marine deposits.					
95								
100								
105								
110			Bottom of exploration at 106 ft; not refusal.					
115								
120								

Notes:

Preliminary



Project Name: Eastern Trail Project Route 1 Crossing
 RWG&A Project No. 303-195
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 RWG&A Representative: G. Morrell
 Boring Location: See Exploration Location Plan
 Boring Abandonment Method: Backfilled with cuttings
 Observed Water Depth: 7.0'

Drilling Contractor: Great Works Test Boring
 Drill Rig: B 53 Rubber Track
 Driller Rep.: Will Aikman
 Date Started: 08/07/09
 Date Completed: 08/07/09
 Surface Elevation: (-)
 Drilling Method: 4-inch Wash Rotary
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
0		S-1	TOPSOIL AND ORGANICS. SILTY CLAY (CL); Medium stiff to very soft, moist to wet, silt and clay, trace fine sand, mottled, brownish olive to blueish gray. Pocket Penetrometer: Undrained Shear Strength: Su=2.5 kfs. Pocket Penetrometer: Undrained Shear Strength: Su=2.25 kfs.	6	5 7 7 7	14		
5		S-2		24	2 3 5 6	8		
10		S-3	Fine sand layer. (11.5' to 11.7')	18	3 2 2 1	4		
15		S-4		12	1 1/12 1/12 1	2		
20			Field Vane: Undrained Shear Strength: Su=0.73 ksf, Residual=0.05 ksf. Field Vane: Undrained Shear Strength: Su=0.73 ksf, Residual=0.07 ksf.					
25		S-5	Fine sand seam. (26.5' to 26.6') Fine sand layer. (27.5' to 28.5')	6	1/24			
30								

Notes:



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Boring Log: B-2
 Total Depth: 106
 Sheet 2 of 4

Project Name: Eastern Trail Project Route 1 Crossing
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 Observed Water Depth: 7.0'

RWG&A Project No. 303-195
 Surface Elevation: (-)
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
30		S-6	Field Vane: could not advance field vane into sample interval near 33' due to possible sand seam/layer. Probed with wash rotary bit from 35' to 106' in probable marine deposits.	24	wor	0		
35								
40								
45								
50								
55								
60								

Preliminary

Notes:



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Boring Log: B-2

Total Depth: 106

Sheet 3 of 4

Project Name: Eastern Trail Project Route 1 Crossing

Location: Saco, Maine

Client: DeLuca-Hoffman Associates, Inc.

Observed Water Depth: 7.0'

RWG&A Project No. 303-195

Surface Elevation: (-)

Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
60			Probed with wash rotary bit from 35' to 106' in probable marine deposits.					
65								
70								
75								
80								
85								
90								

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Notes:



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Boring Log: B-2
 Total Depth: 106
 Sheet 4 of 4

Project Name: Eastern Trail Project Route 1 Crossing
 Location: Saco, Maine
 Client: DeLuca-Hoffman Associates, Inc.
 Observed Water Depth: 7.0'

RWG&A Project No. 303-195
 Surface Elevation: (-)
 Casing Type: 4" Casing

DEPTH, FT.	SYMBOL	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT %	LAB TESTS
90			Probed with wash rotary bit from 35' to 106' in probable marine deposits.					
95 100 105 110 115 120			Bottom of exploration at 106 ft; not refusal.					

Preliminary

Notes: