



Vermont Agency of Transportation
Program Development Division
Materials and Research Section

To: Joshua Schultz, Project Manager – VTrans' Highway Safety & Design Section

From: Thomas D. Eliassen, P.G., Transportation Geologist and Chad A. Allen, P.E., Geotechnical Engineer via Christopher C. Benda, P.E., Soils and Foundations Engineer

Date: September 19, 2012

Subject: COLCHESTER HES NH 5600(14), US 2 & 7, I-89 EXIT 16 REQUEST FOR BORINGS & WALL RECOMMENDATIONS

1.0 INTRODUCTION

We have completed our initial geotechnical investigation for the Colchester HES NH 5600(14) project. The project is located along Route US 2 & US 7 between the intersection of Highpoint Center /South Park Drive Intersection and the Rathe Road/Champlain Drive Intersection in Colchester. The project will consist of the construction of a double diamond interchange with I-89 and the installation of mast arms for controlling traffic along the project route. In addition, the construction of three retaining walls is proposed. One wall will be located along Lower Mountain View Drive and the other two walls will be constructed adjacent to shared use paths on either side of US 2 & US 7, beneath I-89, at Interchange 16. This report summarizes the boring and lab testing information, additional subsurface investigation recommendations for three retaining wall foundations, and contains geotechnical parameters to be used by the mast arm foundation designer. In addition, we have provided recommendations for ledge removal in areas depicted on the plans.

2.0 BORING INVESTIGATIONS

The field investigation was conducted between June 6th and July 24th, 2012. Twenty-eight wash-bore and seven solid stem auger borings were drilled and three hand steel probes were conducted to determine the subsurface profile for design and construction of the mast arm and overhead sign bridge foundations, roadway improvements, and retaining wall foundations at the locations shown in Table 2.1. In keeping with the Soils & Foundations convention for labeling subsurface explorations, borings labeled FB in the boring request (FB-1, FB-2 FB-3 ...) were given numbers starting with B-101 and ending with sequential numbers. As an example, boring FB-5 in the request has been re-labeled B-105. Due to the presence of underground utilities and other limiting site

conditions, many of the borings were drilled at locations offset from those depicted on the request-for-borings plans.

Table 2.1 Boring Locations

BORING ID	STATION	OFFSET (ft.)	NORTHING (VSPG Survey Feet)	EASTING (VSPG Survey Feet)	ELEVATION (ft.)	BORING TYPE
B-101	4+16	37 LT	731095.68	1462467.81	326.52	WASH BORE
B-102	4+17	58 RT	731069.44	1462559.12	324.59	WASH BORE
B-103	5+14	43 LT	731191.52	1462490.85	325.00	WASH BORE
B-104	5+19	50 RT	731168.78	1462581.18	324.79	WASH BORE
B-105	5+98	50 LT	731274.17	1462509.62	327.76	WASH BORE
B-106	5+96	43 RT	731243.87	1462597.56	326.03	WASH BORE
B-107	8+87	64 LT	731553.69	1462584.21	325.07	WASH BORE
B-108	9+50	38 LT	731605.46	1462627.28	327.25	WASH BORE
B-109	10+06	37 LT	731658.62	1462644.29	327.44	WASH BORE
B-110	A 0+67	30 RT	731683.62	1462492.52	327.23	WASH BORE
B-111	A 0+66	25 LT	731732.13	1462518.45	329.14	WASH BORE
B-112	12+09	58 RT	731826.12	1462793.19	330.96	WASH BORE
B-113	12+69	32 RT	731891.04	1462785.36	332.08	WASH BORE
B-114	13+23	41 RT	731940.46	1462809.22	333.22	WASH BORE
B-115	13+77	65 RT	731985.62	1462847.17	329.46	WASH BORE
B-116	D 2+29	32 RT	731784.15	1462933.25	325.70	WASH BORE
B-117	D 2+29	37 LT	731842.4	1462970.27	322.77	WASH BORE
B-118	15+44	43 RT	732153.02	1462871.32	341.17	WASH BORE
B-119	15+53	66 LT	732191.19	1462768.87	351.80	HAND STEEL
B-120	17+10	43 LT	732336.34	1462835.75	346.79	AUGER
B-121	17+28	52 LT	732326.01	1462931.92	348.74	AUGER
B-122	18+18	52 RT	732411.45	1462958.5	349.11	WASH BORE
B-123	18+45	37 RT	732441.29	1462951.82	--	NOT DRILLED
B-124	31+85	47 LT	733755.59	1463171.24	334.40	WASH BORE
B-125	31+85	46 RT	733751.43	1463264.15	333.30	WASH BORE
B-126	32+50	56 LT	733820.07	1463164.77	334.45	WASH BORE
B-127	32+72	42 RT	733839.26	1463263.34	332.29	WASH BORE
B-128	43+60	34 LT	734927.6	1463191.14	319.73	WASH BORE
B-129	43+84	48 LT	734951.36	1463176.73	319.19	WASH BORE
B-130	44+65	66 RT	735034.31	1463289.59	315.75	WASH BORE
B-131	44+67	37 RT	735035.81	1463260.58	318.12	WASH BORE
B-132	11+63	57 LT	731814.79	1462669.85	341.30	HAND STEEL
B-133	11+42	56 RT	731762.46	1462772.18	337.27	HAND STEEL
B-134	17+00	50 RT	732299.8	1462921.85	348.40	WASH BORE
C-101	8+00	4 LT	731452.48	1462615.23	326.90	AUGER
C-102	14+50	CL	732074.17	1462804.49	339.14	AUGER
C-103	28+00	5 LT	733371.92	1463171.2	342.14	AUGER
C-104	37+00	4 LT	734268.35	1463229.09	327.82	AUGER
C-105	49+00	CL	735467.6	1463233.58	311.95	AUGER

Generally, the actual boring locations were within an approximate 10-foot radius of the requested locations. Boring B-119 was not drilled due to the presence of shallow bedrock and a tree directly over the proposed location, however a hand steel probe was performed to assess the probable depth to bedrock. Three additional boring requests were made while the drilling operations were being conducted.

Additional borings B-132 and B-133 were requested in the areas of the proposed retaining walls beneath the median area between the northbound and southbound lanes of

the Interstate and boring B-134 was requested at a planned retaining wall location near the corner of US-2/7 and Lower Mountain View Drive (this retaining wall is no longer necessary). The locations for B-132 and B-133 were too steep and inaccessible for drilling equipment and therefore, hand steel probes were taken in these areas. Boring B-123 was not drilled due to the presence of a large number of underground utilities.

During the wash bore operations, split spoon samples and standard penetration tests (SPT) were taken continuously for the first 12 feet, followed by 5-foot intervals to depths of 25 feet below the ground surface or refusal. Soil samples were visually classified in the field and STP blow counts were recorded on the boring logs. Bedrock was cored in select borings using double walled core barrels. Pavement borings were advanced to a depth of 5-feet below ground surface. Soil samples were taken for each varying soil layer within the 5 foot depth of the boring. Samples were preserved and returned to the Materials and Research Laboratory for testing and further evaluation. Undisturbed samples (Shelby Tube samples) were collected from silt/clay layers in four borings. Upon completion of the laboratory testing, the field boring logs were revised to reflect the results of the laboratory classification results. The attached boring logs and auger notes display the types of soils and strata encountered and include the laboratory test results, SPT data, rock descriptions and properties and any pertinent observations made by the boring crew.

3.0 FIELD AND LABORATORY SOIL TESTS

The standard penetration resistance of the in-situ soil is determined by the number of blows required to drive a 2 inch OD split barrel sampler into the soil with a 140 pound hammer dropped from a height of 30 inches, in accordance with procedures specified in AASHTO T206 – Penetration Test and Split-Barrel Sampling of Soils. During the standard penetration test (SPT), the sampler is driven for a total length of 2.0 feet, while counting the blows for each 6 inch increment. The SPT N-value, which is defined as the sum of the number of blows required to drive the sampler through the second and third increments, is commonly used with established correlations to estimate a number of soil parameters, particularly the shear strength and density of cohesionless soils. The N values provided on the boring logs are raw values and have not been corrected for energy, borehole diameter, rod length or overburden pressure. The VT Agency of Transportation has determined a hammer correction value, C_E , to account for the efficiency of the SPT hammer on the drill rig. For this project, a CME 45C Track Rig was used, with a $C_E=1.34$. This value, included on the boring logs, was used in calculations to determine soil parameters. Selected specimens obtained from the standard penetration borings were tested in the laboratory to assess their physical properties. Moisture contents were determined, as well as the percent of each soil type.

Auger borings B-120 and B-121 were performed by advancing 4.5-inch diameter solid stem augers to refusal. Auger borings in the roadway (borings C-101 – C-105) were advanced to depths of 5-feet below top of pavement. Soil samples were collected from the auger flights at approximately 2-foot intervals and submitted to the laboratory for analysis.

Rock cores were collected at eight boring locations (Borings B-107, B-108, B-109, B-110, B-111, B-127, B-130 and B-134). Coring consisted of advancing a double-barrel coring device while noting drilling rates (minutes/foot). Rock cores were carefully placed in sturdy core boxes and delivered to the Materials & Research laboratory for identification by the Agency's Geologist.

Clayey samples from three shelly tubes were extracted and consolidated-undrained triaxial shear testing was conducted in accordance with AASHTO T-297 – Consolidated, Undrained Triaxial Compression Test on Cohesive Soils to determine the soil properties of the cohesive soil layers. Physical testing and determination of the Atterburg limits was also conducted for these soils. These index tests were used to relate the triaxial test results from one location to similar clay layers at other locations within the project site.

Table 3.1 Laboratory Test Results – CU (AASHTO T-297) Triaxial Testing

Boring	Classification	LL	PI	c', psf	ϕ'
B102	A-4; ClSi	34	8	0	38°
B117	A-7-6; Cl	67	38	207	31.6°
B134	A-7-5; Cl	54	23	231	23.6°

4.0 SOIL PROFILES

The subsurface soils observed throughout the project can be characterized as sand and gravel overlying silt and clay deposits with generally shallow bedrock on the north side of US 7. Groundwater was encountered sporadically throughout the project area ranging from 3.5 feet to 17 feet below ground surface. Due to traffic and pedestrian safety concerns, borings were backfilled upon completion preventing the measurement of equilibrated water levels in a number of borings.

The groundwater information in Tables 4.1.1 and 4.1.2 represents the subsurface water elevation at the time of the drilling. This summer has been particularly dry and the water table at the time of drilling is anticipated to be lower than normal. In addition, water table measurements obtained during the summer months can be expected to be lower than the water table measurements during extended periods of precipitation – especially during the spring (winter snow melt) season. The Designer shall account for groundwater fluctuations in his/her designs and not assume that the groundwater depth reported on the boring logs represents the design groundwater depth.

4.1 MAST ARM & SIGN BRIDGE FOUNDATIONS

Review of laboratory data and boring logs revealed the following information outlined in Tables 4.1.1 and 4.1.2 and pertain to the soil strata encountered during the drilling operations. The Designer and Contractor should be aware that actual conditions may vary from what was encountered during the subsurface investigation.

Table 4.1.1 Mast Arm & Sign Bridge Soil Profile and Design Parameters (1 of 2)

Location	Boring	Depth, ft	Soil Stratum Description	Groundwater Depth, ft	Possible Bedrock Elevation, ft	Friction Angle, degrees, ϕ'	Cohesion, psf - c'	Unit Weight, γ pcf	Soil Modulus, k (pci) ¹	Required Foundation Type ²
Highpoint Center / South Park Drive Intersection Mast Arms	B101	0 – 6	loose to medium dense SaSi ³	GNE ⁴	319.42	30	-----	110	25	CYL
		6 – 7.1	very dense SiSaGr			use upper layer				
	B102	0 – 7	dense to very dense Sa	12.5	298.99	35	-----	125	225	CYL
		7 – 10	medium dense Si			32	-----	120	90	
		10 – 17.5	loose ClSi			27	-----	90	20	
		17.5 – 25.6	very soft to soft Cl			23.6	231	120	200	
	B103	0 – 3.7	loose to dense SaGr	GNE	321.30	30	-----	115	25	CYL
	B104	0 – 8	medium to dense GrSa / SaSi	17.0	300.09	32	-----	120	100	CYL
		8 – 12.5	medium dense Si / ClSi			30	-----	110	90	
		12.5 – 17.5	loose Si			27	-----	90	25	
		17.5 – 24.7	Cl			23.6	231	120	200	
	Whitcomb Drive Sign Bridge	B105	0 – 10	dense to very dense SaGr	GNE	316.76	30	-----	110	225
10 – 11.0			weathered rock	use upper layer						
B106		0 – 6	medium to dense SaSi w/Gr	17.0	298.99	31	-----	115	100	CYL or SPR
		6 – 13	medium to dense ClSi & Si			31	-----	115	100	
		13 – 17.5	loose ClSi			23.6	231	120	25	
		17.5 – 21.2	soft Cl			to be determined				
Double Diamond Interchange - <u>West</u> Mast Arms	B107	0 – 4	loose to medium dense SaSi	GNE	319.07	32	-----	120	25	CYL or SPR
		4 – 6	SaGr w/weathered bedrock			use upper layer				
	B108	0 – 10.0	medium dense SaGr	GNE	317.25	31	-----	115	90	CYL
	B109	0 – 6	dense to very dense SaGr	GNE	319.24	35	-----	125	225	CYL
6 – 8.2		possible zone of weathered rock	use upper layer							
Ramp A Sign Bridge	B110	0 – 4	dense to very dense SaGr	5.3	322.23	35	-----	125	225	CYL
		4 – 5.0	possible zone of weathered rock			use upper layer				
	B111	0 – 7.2	dense to very dense SaGr	5.9	321.94	35	-----	125	225/125	CYL
Double Diamond Interchange - <u>East</u> Mast Arms	B113	0 – 4.9	very dense SaGr / GrSa	GNE	327.18	37	-----	130	225	CYL
	B114	0 – 4	very dense SaGr	GNE	323.02	37	-----	130	225	CYL
		4 – 9	soft to hard SaCl			to be determined				
		9 – 10.2	dense to very dense SaSiGr			37	-----	130	225	
	B115	0 – 4	medium to dense SiSaGr/SaClSi	7.1	320.06	30	-----	115	90	CYL
		4 – 8	medium to very stiff Cl			to be determined				
		8 – 9.4	very dense SaGr			37	-----	130	125	

Note 1: Where the value for k is split (i.e., 90 / 60) it indicates the soil modulus for use above / below the water table.

Note 2: CYL – cylindrical / shaft footing – diameter to be determined by designer

SPR – square or rectangular spread footing with dimensions determined by designer

Note 3: Gr = Gravel, Sa = Sand, Si = Silt, and Cl = Clay

Note 4: GNE = Groundwater Not Encountered

Table 4.1.2 Mast Arm & Sign Bridge Soil Profile and Design Parameters (2 of 2)

Location	Boring	Depth, ft	Soil Stratum Description	Groundwater Depth, ft	Possible Bedrock Elevation, ft	Friction Angle, degrees, ϕ'	Cohesion, psf - c'	Unit Weight, γ pcf	Soil Modulus, k (pci) ¹	Required Foundation Type ²
Ramp D Sign Bridge	B116	0 – 4	loose to medium dense Sa ³	3.5	311.80	30	-----	110	20	CYL or SPR
		4 – 13.9	medium to very stiff Cl			23.6	231	120	200	
	B117	0 – 3	soft SaSiCl	GNE ⁴	308.57	to be determined				CYL or SPR
		3 – 6	very soft Cl			to be determined				
		6 – 10	stiff Cl			to be determined				
		10 – 12	stiff Cl			31.6	207	106	1000	
		12 – 14.2	stiff Cl			to be determined				
STA 15+52 Sign Bridge	B118	0 – 4.8	medium to dense GrSa / SaGr	GNE	336.37	32	-----	120	90	CYL or SPR
	B119	Hand steel probe indicated 4.1 ft to top of ledge or boulder								
Mountain View Dr. Intersection Mast Arms	B120	0 – 5.5	auger boring – No SPT: GrSa	GNE	341.29	32	-----	120	90	CYL
	B121	0 – 4.2	auger boring – No SPT: GrSa	GNE	344.54	32	-----	120	90	CYL
	B122	0 – 4	very dense SaGr / GrSa	GNE	340.11	37	-----	130	225	CYL
		4 – 9.0	stiff to very stiff Cl			to be determined				
	B123	Not drilled to large number of underground utilities - use Boring B122 design parameters								CYL
Hercules Dr. Intersection Mast Arms	B124	0 – 4	medium dense sands & gravels	4.0	321.6	31	-----	115	90	CYL
		4 – 6	medium SaSiCl			to be determined				
		6 – 10	stiff Cl			23.6	231	120	1000	
		10 – 12.8	stiff to very stiff GrSaCl			to be determined				
	B125	0 – 6.0	medium dense GrSa	GNE	326.1	31	-----	115	90	CYL
		6.0 – 7.2	medium SaSiCl			to be determined				
	B126	0 – 4	dense to very dense Sa	GNE	323.75	32	-----	120	225	CYL
		4 - 10	medium to very stiff Cl			23.6	231	120	750	
		10 – 10.7	SaSi			32	-----	120	225	
	B127	0 – 6	medium dense GrSa w/some Si	3.5	319.09	31	-----	115	90	CYL
		6 – 8	stiff SaSiCl			to be determined				
		8 – 13.2	stiff to very stiff Cl			23.6	231	120	1000	
Rathe Rd / Champlain Drive Intersection Mast Arms	B128	0 – 7.2	medium to dense Sa & Gr	GNE	312.53	32	-----	120	150	CYL
	B129	0 – 3.5	medium to dense Sa & Gr	GNE	315.69	32	-----	120	150	CYL
	B130	0 – 8	medim to dense Si & Sa	5.0	300.25	32	-----	120	90 / 60	CYL
		8 – 12.5	stiff to very stiff Cl			23.6	231	120	1000	
		12.5 – 15.5	very dense SaGrSi			37	-----	130	125	
	B131	0 – 4	dense SaGr	5.0	307.22	35	-----	125	225	CYL
		4 – 8	medium dense SaSi / SiSa			30	-----	110	90 / 60	
8 – 10.9		medium SaSiCl	to be determined							

Note 1: Where the value for k is split (i.e., 90 / 60) it indicates the soil modulus for use above / below the water table.

Note 2: CYL – cylindrical / shaft footing – diameter to be determined by designer
 SPR – square or rectangular spread footing with dimensions determined by designer

Note 3: Gr = Gravel, Sa = Sand, Si = Silt, and Cl = Clay

Note 4: GNE = Groundwater Not Encountered

4.2 RETAINING WALLS

There are three retaining walls proposed for this project. Two of the retaining walls are proposed to retain embankment material which will accommodate the construction of sidewalks and safety improvements associated with the double diamond intersection. These retaining walls are intended to support each pair of interstate abutments, and are expected to be between 10 and 15 feet in height. The existing piers will remain but will be located between the proposed retaining walls and the proposed sidewalk/bike path and the roadway.

Table 4.2 depicts a summary of the information obtained from the subsurface investigation. However, hand steel soundings alone are insufficient to allow for the proper design of the retaining walls at the Exit 16 interchange. It is recommended that a minimum of 3 to 4 wall borings be obtained for each abutment retaining wall. These walls are anticipated to be constructed using a top down construction method. Three types of wall systems that should be considered include a soldier pile and lagging wall, soil nail wall, and an anchored wall system. Two of the four wall borings should be obtained a distance of 0.7 to 1.0 times the wall height behind the face of the wall. Limitations include shallow bedrock and limited vertical clearance for construction equipment.

The as-built plans depict the existing northern abutments to be spread footings placed directly on bedrock. Therefore, the wall in front of the northern abutments is likely to encounter bedrock, thus necessitating the development of a thorough bedrock profile to determine the amount of soil and/or rock removal and to ascertain the available resistance for ground anchors and soil nails. The follow-up investigation should determine whether or not it is feasible to have an engineered rock cut in the vicinity of the northern abutments which may depend equally on the line and grade of the wall and the subsurface information.

The retaining wall located in front of the southern abutments is not expected to encounter bedrock however a review of the original plans indicates that the southern abutments are supported by steel H-piles which could potentially conflict with drilled-in structural inclusions such as ground anchors or soil nails.

The third retaining wall is located along Lower Mountain View Drive from Station 502+37 to Station 503+64, LT. No borings have been drilled for this wall; Boring B-134 of Table 4.2, was drilled in the immediate vicinity of a wall originally proposed to be constructed in the southwest corner of Lower Mountain View Drive and US 7. B-134 could provide some geotechnical information relative to the anticipated soil conditions for the third structure but should not be used for design purposes until additional borings can confirm the applicability of B-134 to the structure location. Two additional wall borings are anticipated to a depth of 25 ft or bedrock – whichever comes first. This wall is anticipated to be a maximum of 5 feet high and does not represent a large engineering concern, however, the presence of soft marine clays requires a couple of borings to investigate the competency of the foundation soil, to determine the necessity of a foundation undercut and to ensure accurate project quantities.

It is recommended that an accurate survey be conducted for the beginning and end of wall sections along with wall sections every 10 feet and sent to the Soils & Foundations Unit so that appropriate subsurface investigation can be planned which will facilitate design recommendations for the preferred wall type(s) for this project.

Table 4.2 Retaining Wall Subsurface Information

Location	Boring	Depth, ft	Soil Stratum Description	Groundwater Depth, ft	Possible Bedrock Elevation, ft	Friction Angle, ϕ , °	Cohesion, psf -c'	Unit Weight, γ pcf	Anticipated Wall Type ²
North Abutment	B132	Hand steel probe indicated 5.5 ft to top of ledge or boulder							TBD
South Abutment	B133	Hand steel probe indicated 11.5 ft to top of ledge or boulder							TBD
Lower Mtn View Drive	B134	0 – 2	medium to stiff SaSiCl	None	339.90	unknown			PMB
		2 – 8.5	stiff to very stiff Cl			23.6	231	120	

Note 2: TBD – to be determined PMB – precast modular block wall

4.3 EXISTING PAVEMENT CROSS SECTION

Solid stem augers were drilled at 5 different locations along the project alignment. The generalized pavement profile beneath the ground surface consists of 0 to 9.5 inches of asphalt pavement followed by 24 inches of a subbase (SaGr) material. The augers extended to a depth of 5 ft and were terminated in a silty-sand (SiSa) material that contained various amounts of gravel. The SaGr and SiSa layers averaged 13.9% and 24.0% fines content (material finer than the #200 sieve), respectively.

5.0 BEDROCK CONDITIONS

Confirmed bedrock encountered across the project varies in depth from exposures at the surface to depths of 15.5-feet below ground surface. Borings B-102, B-104 and B-106 at the southern end of the project (near the intersection of US2/US7 and S. Park Drive) encountered auger refusal at depths of 25.6, 24.7 and 21.2 respectively. The dip of the top of bedrock surface is from northwest to southeast with numerous surface exposures on the northwest side of US-2/US7 and along the northbound on-ramp and southbound off-ramp of I-89 Interchange 16. Bedrock consists of light gray dolomite (dolostone) with closely spaced jointing. The 2011 Vermont State Bedrock Geologic map reports that the area of this project is underlain by the Winooski Dolostone Formation described as “*Well-bedded dolostone weathering beige, cream, and buff, with green, red, or gray phyllite, siliceous partings, and thin beds of blue-quartz-pebble conglomerate and quartzite*”.

Karst features in the form of solution cavity horizons (along bedding) were noted in some of the rock core samples. These karst features are relatively small in scale (little or no drilling breaks were reported). Figure 1 shows an excavated face adjacent to the Price Chopper supermarket parking lot located about 500-feet northwest of the intersection of US2/US7 and Mountain View Drive. A solution cavity can be seen about 1/3 of the way

below the top of the exposure. Observations made of the exposed rock in roadway cuts and two large excavated faces at nearby businesses show that the rock breaks along the closely spaced jointing resulting in exposures that have a broken-up appearance. This condition leads to raveling failures on slope faces and the development of overhangs (Figure 2). Core logs developed by the AOT geologist are attached. These logs include a photograph of the cores taken, lithologic descriptions, pertinent information such as depth of sample, percent recovery, RQD and RMR (Rock Mass Rating).



Figure 1: Photograph of rock exposure at Price Chopper parking lot northwest of the intersection of US2/US7 and Mountain View Drive. Solution cavity can be seen as horizontal zone about 1/3 of the way from the top of the exposure.



Figure 2: Photograph of westward facing rock cut along I-89 Interchange 16 northbound on-ramp. Note the presence of overhangs resulting from the deterioration along closely spaced jointing in the rock.

6.0 RECOMMENDATIONS

6.1. LEDGE REMOVAL

As indicated in the previous section of this report, bedrock consists of dolomite that contains numerous closely spaced joints. Dilation along these joint surfaces has led to slopes that are susceptible to raveling failures and the development of overhanging masses of rock. The presence of closely spaced jointing and the small amount of burden (distance between the existing slope face and the newly planned face), may make traditional presplit blasting difficult as the joint surfaces will provide avenues for the blast energy to propagate through the openings resulting in poor controlled fracture of the rock.

We recommend that ledge removal be conducted as follows:

Mechanical Excavation

Mechanical methods would include the use of a medium size hydraulic excavator. Closely spaced jointing within the slope may allow for this type of removal as the small blocks bound by the joint sets in the rock may make it easier to pluck them from the slope. Care should be taken to transition into adjacent rock exposures and structures (retaining wall, bridge footings and pile foundations).

Trim (Cushion) Blasting

Along Ramps A and B and from Station 13+50 to 17+00 trim blasting should be conducted. Trim blasting is similar to presplit blasting except one of the primary differences is that the final row of blast holes is fired after all production holes are fired. The charge is typically reduced in the final row of holes to protect the final cut face from blowback damage.

Line Drilling and Blasting

Blasting in close proximity to the bridge abutment footings should be conducted utilizing line drilling techniques. Line drilling consists of drilling a line of unloaded (not loaded with explosives) closely spaced holes parallel to one another, along the final neat line of the excavation. This technique produces a plane of weakness which forms a breakage plane when the production shots are fired. This acts as a barrier to stress waves from the production blast holes. Line drilling can be very effective in areas where close-by infrastructure such as bridge foundations need to be protected or where the character of the rock would promote venting of gas back into the final excavation wall.

Line drilling holes generally have a diameter of 2 to 3-inches. Hole diameters greater than 3-inches tend to be ineffective and therefore are seldom used. The row of production blasting holes closest to the line of empty holes should be fired last and have a closer spacing (50-75%) and around 50% less explosive charge than the other production shots. The charge should be spread down the hole using detonating cord as the initiator. Line drilling is more costly than presplit blasting methods due to the large number of drill holes that would need to be performed.

For the reasons discussed above, traditional presplit blasting should not be permitted. Any blasting performed on the project will require a pre-blast survey be performed and all blasts will be required to utilize protective matting over the blast area to protect from possible fly-rock. We have comprehensive blasting specifications for some recent projects covering these requirements. Upon your request we can develop similar specifications for this project.

6.2 Mast Arm and Sign Bridge Foundations

Due to site constraints the foundations for the mast arms are required to be cylindrical footings while the sign bridges are required to be either a spread footing or a cylindrical footing as noted in Tables 4.1.1 and 4.1.2. The cylindrical footings shall be installed as described by the designer and may be formed from driven casing, formed casing, or drilled. The type of construction methods utilized will affect the structure's ability to resist torque. The foundations shall be designed in accordance with VTrans' MREI 10-01. Earth pressure coefficients can be calculated using the soil's internal friction angle. Friction factors can be determined from published values in the NAVFAC design manual; DM 7.02.

6.3 Retaining Walls

It is recommended that a survey be conducted for each retaining wall. Cross sections should be provided that document the existing project conditions (wall sections) along the wall at 10 feet increments including the beginning and end of wall sections. These cross sections should be delivered to the Soils & Foundations Unit so that an appropriate subsurface investigation can be planned to facilitate design recommendations for the preferred wall type(s) for this project.

A minimum of 3 to 4 wall borings are recommended to be drilled for each abutment retaining wall. These walls are anticipated to be constructed using a top down construction method. Top down construction methods include the following three wall systems or types; a "modified") soldier pile and lagging wall (possibly utilizing drilled in-place H-piles), soil nail wall, and an anchored wall system. Two of the four wall borings should be obtained a distance of 0.7 to 1.0 times the wall height behind the face of the wall. Known project limitations include shallow bedrock and limited vertical clearance for construction equipment.

Two additional wall borings are recommended to be drilled for the retaining wall along Lower Mountain View Drive from Station 502+37 to Station 503+64, LT. The borings should be drilled to a depth of 25 ft or bedrock, whichever comes first.

6.4 Additional Laboratory Testing

It is recommended that triaxial tests be conducted on material classified as A6; SaSiCl to identify pertinent soil strength parameters.

6.5 Construction Considerations

6.5.1 Construction Dewatering: The construction of spread footings will require a minimum embedment of 5 feet and may encounter groundwater. Therefore, temporary construction dewatering may be required to construct spread and/or cylindrical foundations. Temporary dewatering may also be necessary to limit disturbance to and maintain the integrity of the bearing surface.

Temporary dewatering can likely be accomplished by open pumping from shallow sumps, temporary ditches, and trenches within and around the excavation limits. Sumps should be provided with filters suitable to prevent pumping of fine-grained soil particles. The water trapped by the temporary dewatering controls should be discharged to settling basins or an approved filter “sock” so that the fine particles suspended in the discharge have adequate time to “settle out” prior to discharge. All effluent, or discharge, should comply with all applicable permits and regulations.

Sumps and trenches should lie outside a 1V:1H line extending downward and outward from the edge of the footing. Installation and operation of the Contractor’s dewatering system should be integrated with other earthwork operations and sequence of cutting, filling, foundation construction, and backfilling.

6.5.2 Subgrade Preparation: Areas exhibiting excessive weaving, soft, or unstable soils should be excavated a minimum of 1 foot and replaced with compacted Granular Backfill for Structures (VTrans’ pay item 704.08).

6.5.3 Placement and Compaction of Backfill Material: Select fill material, such as Granular Backfill for Structures, should be placed systematically in horizontal layers not more than 12 inches in thickness, prior to compaction. Cobbles larger than 8 inches should be removed from the fill prior to placement. Where hand-guided compaction equipment, such as a small vibratory plate compactor, is used the loose lift thickness shall not exceed 6 inches. Cobbles larger than 4 inches should be removed from the fill prior to placement. Granular Backfill for Structures, or other select materials placed shall be compacted to a dry density of 95% of the maximum dry density determined in accordance with AASHTO T-99 – Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12 in.) Drop.

6.6 Design Guidelines

The Materials and Research Section of VTrans has developed *Materials and Research Engineering Instructions (MREI) 10-01*, which “standardizes VTrans’ foundation designs for overhead structures such as signal or sign bridges, mast arms, and strain poles during plan (preliminary and final) development or construction.” This document should be referenced in the project plans and specifications for the contractor’s use. The document is available on the Agency’s website at the following address:

<http://www.aot.state.vt.us/progdev/Sections/M&R%20Info/DocumentsM&RPages/M&R%20SoilEI%20-%20Overhead%20Structures%20030910.pdf>

In addition, it is highly recommended that this geotechnical report be included in the project's bid documents and referenced in the general notes on the project plan documents.

7.0 CONCLUSIONS

If any further analysis is needed or you would like to discuss this report, please contact us at (802) 828-2561. Typed boring logs are attached and are available in the CADD design files: M:\Projects\12d046\Materials&Research.

Attachments: Boring Logs (35 pages)
Rock Core Logs (3 pages)

cc: Read File/WEA
Project File



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-101**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW, SALISBURY**

Date Started: **7/20/12** Date Finished: **7/20/12**

VTSPG NAD83: **N 731095.68 ft E 1462467.81 ft**

Station: **4+16** Offset: **-37.00**

Ground Elevation: **326.52 ft**

	Casing	Sampler
Type:	H.S.A.	SS
I.D.:	3.5 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:	Auto/AWJ	
Rig:	CME 45C TRACK	C _E = 1.34

Groundwater Observations

Date	Depth (ft)	Notes
		Same day drilling.
		No water to death.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		A-4, SaSi, brn, MTW, Rec. = 1.5 ft	2-2-1-3 (3)	13.6	9.1	35.1	55.8
		A-4, SaSi, brn, MTW, Rec. = 1.7 ft		17.9	3.1	42.7	54.2
		A-4, SaSi, brn, MTW, Rec. = 1.6 ft	2-2-2-5 (4)	22.2	7.9	30.3	61.8
		Visual Description: SiSaGr, brn, MTW, Rec. = 0.1 ft, Insufficient sample for testing.	4-3-R@1.0"	26.3			
10		Hole stopped @ 7.1 ft CNPF-TLOB					
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-102**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY	Type: H.S.A.	Sampler: SS	Groundwater Observations		
Date Started: 7/20/12 Date Finished: 7/20/12	I.D.: 3.25 in	1.5 in	Date	Depth (ft)	Notes
VTSPG NAD83: N 731069.44 ft E 1462559.12 ft	Hammer Wt: N.A.	140 lb.	07/20/12	12.5	After 1/2 hr. lunch.
Station: 4+17 Offset: 58.00	Hammer Fall: N.A.	30 in.			
Ground Elevation: 324.59 ft	Hammer/Rod Type: Auto/AWJ				
	Rig: CME 45C TRACK	C _E = 1.34			

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-2-4, Sa, brn, MTW, Rec. = 1.8 ft	3-4-6-9 (10)	4.1	18.8	68.3	12.9		
		A-1-b, Sa, brn, MTW, Rec. = 1.8 ft	5-10-11-15 (21)	4.8	19.6	70.3	10.1		
		A-2-4, Sa, brn, MTW, Rec. = 2.0 ft	7-11-10-10 (21)	8.1	16.8	70.5	12.7		
		A-1-b, GrSa, brn, MTW, Rec. = 1.0 ft	8-7-5-7 (12)	11.3	21.1	65.8	13.1		
10		A-4, Si, brn, MTW, Rec. = 1.0 ft		22.0	1.3	8.4	90.3		
		A-4, Si, brn, MTW, Rec. = 1.9 ft	3-4-6-5 (10)	25.5		2.3	97.7	30	4
		A-4, ClSi, brn, MTW, Rec. = 2.0 ft, Material from Triaxial "B" Test Sample.		28.9		0.9	99.1	34	8
		Visual Description: ClSi, brn, MTW, Rec. = 2.0 ft, Similar material as 14-16 ft.	1-2-2-3 (4)	33.0					
15		A-4, ClSi, brn, MTW, Rec. = 2.0 ft	1-1-2-1 (3)	32.2		1.7	98.3	34	7
20		A-7-6, Cl, gry, MTW, Rec. = 2.0 ft	WH-WH-WH-2 (WH)	45.6	0.6	4.1	95.3	52	30
25		Visual Description: Cl, gry, MTW, Rec. = 1.7 ft, Similar material as 19-21 ft.	WH-WH-2-R@1.5" (2)	34.2					
Hole stopped @ 25.6 ft CNPF-TLOB									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_e is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG 2 COLCHESTER HES NH 5600(14).GPJ VERMONT AOT.GDT 9/11/12



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-103**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/19/12 Date Finished: 7/19/12
VTSPG NAD83: N 731191.52 ft E 1462490.85 ft
Station: 5+14 Offset: -43.00
Ground Elevation: 325.0 ft

Casing H.S.A. Sampler SS
Type: H.S.A. SS
I.D.: 3.5 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-b, SaGr, brn, MTW, Rec. = 1.2 ft	3-5-9-3 (14)	8.7	50.0	33.3	16.7
		A-1-b, GrSa, brn, MTW, Rec. = 1.0 ft	4-2-2-R@2.5"	16.1	36.3	46.6	17.1
5		Hole stopped @ 3.7 ft CNPF-TLOB					
10		Remarks: 1. At Station 5+14: Electrical caution tape was within the 2.0'- 3.7' sample. 2. Moved Hole to 5+19 and advanced casing to 3.7 feet, but could not penetrate further.					
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-104**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/20/12 Date Finished: 7/23/12
VTSPG NAD83: N 731168.78 ft E 1462581.18 ft
Station: 5+19 Offset: 50.00
Ground Elevation: 324.79 ft

Casing H.S.A. Sampler SS
Type: I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_F = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
07/23/12	17.0	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-2-4, GrSiSa, brn, MTW, Rec. = 1.0 ft	1-2-3-4 (5)	13.5	21.0	46.8	32.2		
		A-1-b, SiGrSa, brn, MTW, Rec. = 1.6 ft	2-4-5-6 (9)	8.0	27.4	52.4	20.2		
		A-1-b, GrSa, brn, MTW, Rec. = 1.4 ft	3-5-5-3 (10)	9.0	24.4	59.1	16.5		
		A-4, SaSi, brn, MTW, Rec. = 2.0 ft	2-5-5-6 (10)	22.3	5.0	23.9	71.1		
10		A-4, ClSi, brn, MTW, Rec. = 2.0 ft	2-3-3-2 (6)	29.9	0.1	4.8	95.1	33	7
		Visual Description: Si, brn, MTW, Rec. = 2.0 ft, Similar material as 14-16 ft.	4-3-3-3 (6)	31.9					
15		A-4, Si, gry, MTW, Rec. = 2.0 ft	1-1-1-1 (2)	31.5		0.9	99.1	30	6
20		A-7-6, Cl, gry, MTW, Sample from middle of tube.		43.8	10.3	7.4	82.3	56	33
25		Visual Description: Si with stones, gry, MTW, Rec. = 0.2 ft, Similar material as 14-16 ft.	3-R@2.5"	16.4					
		Hole stopped @ 24.7 ft CNPF-TLOB							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7


Boring No.: **B-105**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/19/12 Date Finished: 7/19/12
VTSPG NAD83: N 731274.17 ft E 1462509.62 ft
Station: 5+98 Offset: -50.40
Ground Elevation: 327.76 ft

Casing H.S.A. Sampler SS
Type: H.S.A. SS
I.D.: 3.5 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		Collapsed at 6.2 ft.
		None taken.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		A-2-4, SiGrSa, brn, MTW, Rec. = 1.5 ft, Broken Rock was within sample.	1-3-13-18 (16)	9.1	31.0	43.9	25.1
		A-1-b, SaGr, brn, MTW, Rec. = 0.8 ft	22-7-6-6 (13)	6.3	56.1	27.0	16.9
		A-1-b, SaGr, brn, MTW, Rec. = 0.6 ft	6-4-4-6 (8)	7.2	59.8	25.6	14.6
		Visual Description:, SaGr, brn, MTW, Rec. = 0.2 ft	4-9-10-11 (19)	13.9			
		A-1-b, SaGr, brn, MTW, Rec. = 1.2 ft	3-4-5-7 (9)	12.1	58.8	27.5	13.7
10		Visual Description:, Broken Rock, gry, MTW, Rec. = 1.0 ft	31-R@5.0"	6.4			
Hole stopped @ 11.0 ft CNPF-TLOB							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-106**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW, SALISBURY**

Date Started: **7/23/12** Date Finished: **7/23/12**

VTSPG NAD83: **N 731243.87 ft E 1462597.56 ft**

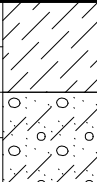









Station: **5+96** Offset: **43.00**

Ground Elevation: **326.03 ft**

Casing **H.S.A.** Sampler **SS**
Type: **H.S.A.** I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

Groundwater Observations

Date	Depth (ft)	Notes
07/23/12	17.0	Same Day.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %		
5		A-4, SaSi, brn, MTW, Rec. = 1.0 ft	2-2-3-22 (5)	16.6	15.4	39.5	45.1				
		A-2-4, SiSaGr, gry, MTW, Rec. = 0.7 ft, Broken Rock was within sample.	5-3-4-4 (7)	12.0	39.8	30.4	29.8				
		A-4, SaSi, brn, MTW, Rec. = 1.8 ft	3-3-2-2 (5)	21.8	11.7	38.9	49.4				
		A-4, Si, brn, MTW, Rec. = 2.0 ft	3-5-4-7 (9)	26.0	0.7	3.2	96.1			29	4
		Visual Description:, CiSi, gry, MTW, Rec. = 1.8 ft, Similar material as 10-12 ft.	3-4-5-4 (9)	30.1							
10		A-4, CiSi, gry, MTW, Rec. = 1.7 ft	4-4-3-3 (7)	32.1		3.8	96.2	34	7		
15		Visual Description:, CiSi, gry, MTW, Rec. = 1.8 ft, Similar material as 10-12 ft.	WH-1-1-2 (2)	34.5							
											
											
20		A-7-6, Cl, gry, MTW, Rec. = 2.0 ft	WH-1-1-2 (2)	34.8	10.5	24.0	65.5	47	27		
25		Hole stopped @ 21.2 ft CNPf-TLOB									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG 2 COLCHESTER HES NH 5600(14).GPJ VERMONT AOT.GDT 9/11/12



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-107**
Page No.: **1 of 1**
Pin No.: **12D046**
Checked By: **TDE**

Boring Crew: <u>PORTER, GARROW, SALISBURY</u>	Type: <u>H.S.A.</u>	Sampler: <u>SS</u>	Groundwater Observations		
Date Started: <u>7/11/12</u> Date Finished: <u>7/12/12</u>	I.D.: <u>3.25 in</u>	<u>1.5 in</u>	Date	Depth (ft)	Notes
VTSPG NAD83: <u>N 731553.69 ft E 1462584.21 ft</u>	Hammer Wt: <u>N.A.</u>	<u>140 lb.</u>			No water to depth.
Station: <u>8+87</u> Offset: <u>-64.20</u>	Hammer Fall: <u>N.A.</u>	<u>30 in.</u>			
Ground Elevation: <u>325.07 ft</u>	Hammer/Rod Type: <u>Auto/AWJ</u>				
	Rig: <u>CME 45C TRACK</u>	<u>C_E = 1.34</u>			

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		A-1-a, SaGr, brn, MTW, Rec. = 0.6 ft				2-3-3-9 (6)	4.4	54.8	31.7	13.5
		A-1-a, SaGr, brn, Moist, Rec. = 0.6 ft				9-13-10-10 (23)	3.8	55.0	32.0	13.0
		Visual Description: SaGr with Broken Rock, gry, MTW, Rec. = 0.2 ft, Possible Voids were in this area. Insufficient sample for testing.				3-1-WH-1 (1)	6.1			
10		6.0 ft - 9.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Poor rock, BXMDC, Closely space jointing. RMR = 38	1 (10)	100 (22)	9	Top of Bedrock @ 6.0 ft				
					5					
					6					
15		9.2 ft - 14.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BXMDC, Closely space jointing. RMR = 48	2 (10)	94 (54)	4					
					4					
					3					
					4					
20					5					
25										

Hole stopped @ 14.2 ft

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

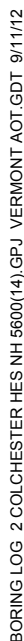
COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-108**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY	Type: WB	Casing: SS	Groundwater Observations		
Date Started: 7/18/12 Date Finished: 7/18/12	I.D.: 3 in	1.5 in	Date	Depth (ft)	Notes
VTSPG NAD83: N 731605.46 ft E 1462627.28 ft	Hammer Wt: N.A.	140 lb.			None Taken.
Station: 9+50 Offset: -38.00	Hammer Fall: N.A.	30 in.			Same day drilling.
Ground Elevation: 327.25 ft	Hammer/Rod Type: Auto/AWJ				
	Rig: CME 45C TRACK	C _E = 1.34			

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		Asphalt Pavement, 0.0 ft - 0.8 ft								
		A-1-a, SaGr, brn, MTW, Rec. = 0.8 ft				9-12	7.6	62.2	28.3	9.5
		A-1-a, SaGr, brn, MTW, Rec. = 1.0 ft				11-8-5-7 (13)	6.2	68.2	23.8	8.0
		Visual Description: SaGr with 1.5" stones, brn, MTW, Rec. = 0.2 ft, Insufficient sample for testing.				4-3-2-2 (5)	9.5			
		Visual Description: SaGr with 1.5" stones, brn, MTW, Rec. = 0.2 ft, Insufficient sample for testing.				5-4-3-3 (7)	7.6			
10		A-1-a, SaGr, brn, MTW, Rec. = 1.0 ft, Broken Rock was within sample.	1 (10)	100 (52)	6	6-20-R@2.5"	12.8	58.7	32.6	8.7
		10.0 ft - 15.0 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BXMD, Close to moderately closely spaced jointing. RMR = 53				Top of Bedrock @ 10.0 ft				
15		Hole stopped @ 15.0 ft								
20										
25										

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.





STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-110**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW, SALISBURY**

Date Started: **7/11/12** Date Finished: **7/16/12**

VTSPG NAD83: **N 731683.62 ft E 1462492.52 ft**



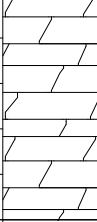
Station: **A 0+67** Offset: **30.00**

Ground Elevation: **327.23 ft**

Casing **H.S.A.** Sampler **SS**
Type: **H.S.A.** I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

Groundwater Observations

Date	Depth (ft)	Notes
07/17/12	5.3	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-a, SaGr, brn, Moist, Rec. = 1.0 ft				1-3-9-29 (12)	5.8	58.4	31.1	10.5
		A-1-a, Gr, gry, Moist, Rec. = 1.6 ft				25-33- 26-21 (59)	0.7	73.3	19.2	7.5
5	 	4.0 ft - 5.0 ft, Broken Rock. Not Competent.. BXDC, Possible Bedrock.	1 (10)	90 (36)	4	Top of Bedrock @ 5.0 ft				
		5.0 ft - 10.0 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BXMDC, Closely spaced jointing. RMR = 43								
10					3					
					4					
					4					
					4					
					4					
15										
20										
25										
		Hole stopped @ 10.0 ft CNPF-TLOB								

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-111**

Page No.: 1 of 1

Pin No.: 12D046

Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY

Date Started: 7/11/12 Date Finished: 7/18/12

VTSPG NAD83: N 731732.13 ft E 1462518.45 ft

Station: A 0+66 Offset: -24.80

Ground Elevation: 329.14 ft

Casing H.S.A. Sampler SS
I.D.: 3.5 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_F = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
07/19/12	5.9	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		A-1-a, SaGr, gry, Moist, Rec. = 1.0 ft				2-9-31-R (40)	3.5	65.4	23.4	11.2
		Field Note:, Cobbles								
		A-1-a, Gr with Broken Rock, gry, MTW, Rec. = 0.4 ft				4-R@5.0"	4.3	73.6	18.9	7.5
		7.2 ft - 8.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Poor rock, BX, Closely spaced jointing. RMR = 38	1 (10)	100 (0)	6	Top of Bedrock @ 7.2 ft				
10		8.2 ft - 10.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Poor rock, BX, Closely spaced jointing. RMR = 38	2 (10)	100 (0)	3					
					5					
		10.2 ft - 12.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Poor rock, BX, Closely spaced jointing. RMR = 38	3 (10)	100 (0)	5					
					7					
15		12.2 ft - 17.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BX, Closely spaced jointing. RMR = 48	4 (10)	98 (58)	4					
					5					
					7					
					7					
					7					
20		Hole stopped @ 17.2 ft								
25										

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7







Boring No.: **B-112**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/11/12 Date Finished: 7/11/12
VTSPG NAD83: N 731825.72 ft E 1462793.35 ft
Station: 12+09 Offset: 58.30
Ground Elevation: 330.96 ft

Casing: H.S.A. Sampler: SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %		
5		A-2-4, SiGrSa, brn, Moist, Rec. = 0.8 ft	2-3-1-2 (4)	7.8	24.3	54.1	21.6				
		A-1-b, Sa, brn, Moist, Rec. = 1.3 ft	1-2-1-1 (3)	1.9	17.3	73.5	9.2				
		A-2-4, Sa, brn, Moist, Rec. = 0.9 ft	3-1-2-4 (3)	5.5	17.5	66.2	16.3				
		A-2-4, SiSa, brn, MTW, Rec. = 0.9 ft	5-3-3-4 (6)	10.1	12.7	56.8	30.5				
10		A-6, SaCl, brn, MTW, Rec. = 0.6 ft	4-2-4-4 (6)	24.6	11.1	28.3	60.6			39	21
		A-7-6, Cl, gry, MTW, Rec. = 1.1 ft	2-3-5-7 (8)	29.2	0.3	4.3	95.4			50	24
		Hole stopped @ 12.5 ft CNPF-TLOB									
15											
20											
25											

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-113**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY	Casing: H.S.A.	Sampler: SS	Groundwater Observations		
Date Started: 7/11/12 Date Finished: 7/11/12	Type: I.D.: 3.25 in	SS 1.5 in	Date	Depth (ft)	Notes
VTSPG NAD83: N 731890.94 ft E 1462785.32 ft	Hammer Wt: N.A.	140 lb.			No water to depth.
Station: 12+69 Offset: 32.00	Hammer Fall: N.A.	30 in.			
Ground Elevation: 332.08 ft	Hammer/Rod Type: Auto/AWJ				
	Rig: CME 45C TRACK	C _E = 1.34			

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.7 ft					
		A-1-a, SaGr, brn, Moist, Sample from auger flights.	11-R	3.1	63.3	28.7	8.0
		A-1-b, SiGrSa, brn, Moist, Rec. = 1.4 ft	8-32-44-R (76)	5.1	28.6	50.2	21.2
		A-1-a, Gr, brn, Moist, Rec. = 0.8 ft, Lots of Broken Rock was within sample.	12-25-R (R)	4.2	70.2	17.5	12.3
5		Hole stopped @ 4.9 ft CNPf-TLOB					
10							
15							
20							
25							

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-114**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/10/12 Date Finished: 7/10/12
VTSPG NAD83: N 731940.46 ft E 1462809.22 ft
Station: 13+23 Offset: 41.00
Ground Elevation: 333.22 ft

Casing H.S.A. Sampler SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		No water to depth.
		Same day drilling.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-1-b, SaGr, brn, Moist, Rec. = 1.3 ft	7-10-7-7 (17)	5.1	49.8	35.0	15.2		
		A-1-b, SaGr, brn, Moist, Rec. = 0.9 ft	5-11-19-6 (30)	7.4	52.1	32.8	15.1		
		A-6, SaCl, brn, MTW, Rec. = 0.8 ft	1-2-1-5 (3)	16.8	18.5	42.4	39.1	28	17
		Visual Description:., SaCl, brn, MTW, Rec. = 1.3 ft, Similar material as 4.0-6.0 ft.	1-2-4-6 (6)	18.8					
		A-6, GrSaCl, brn, MTW, Rec. = 0.7 ft	1-2-23-20 (25)	17.2	24.8	32.4	42.8	32	20
10		A-2-4, SaSiGr, brn, MTW, Rec. = 0.7 ft		11.6	40.9	29.3	29.8		
		Visual Description:., SaSiGr, brn, MTW, Rec. = 0.2 ft, Insufficient sample for testing.	R@2.5"	15.1					
Hole stopped @ 10.2 ft CNPf-TLOB									
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7







Boring No.: **B-115**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/09/12 Date Finished: 7/09/12
VTSPG NAD83: N 731985.65 ft E 1462847.31 ft
Station: 13+77 Offset: 65.10
Ground Elevation: 329.46 ft

Casing H.S.A. Sampler SS
Type: I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
07/10/12	7.1	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-2-4, SiGrSa, brn, MTW, Rec. = 1.0 ft	1-3-3-3 (6)	10.3	26.7	49.5	23.8	47	22
		A-4, SaClSi, brn, MTW, Rec. = 0.9 ft	2-2-2-2 (4)	23.3	2.1	27.4	70.5		
		Visual Description:, Cl, brn, MTW, Rec. = 0.9 ft, Similar material as 6.0-8.0 ft.	1-3-1-3 (4)	23.8	0.2	6.5	93.3		
		A-7-6, Cl, brn, MTW, Rec. = 0.9 ft	4-6-8-9 (14)	29.5					
		Visual Description:, SiCl with stones, brn, MTW, Rec. = 0.9 ft		18.4					
10		A-1-b, SaGr, brn, MTW, Rec. = 0.9 ft	7-24-50- R (74)	13.6	44.1	38.5	17.4		
10		Hole stopped @ 9.4 ft CNPf-TLOB							
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-116**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW, SALISBURY**

Date Started: **7/10/12** Date Finished: **7/10/12**

VTSPG NAD83: **N 731773.45 ft E 1462943.51 ft**

Station: **D 2+29** Offset: **32.30**

Ground Elevation: **325.7 ft**

Casing **H.S.A.** Sampler **SS**
Type: **H.S.A.** I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

Groundwater Observations

Date	Depth (ft)	Notes
07/11/12	3.5	Auger left overnight.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-1-b, Sa, brn, Moist, Rec. = 1.1 ft	1-1-1-3 (2)	7.9	15.5	77.0	7.5		
		A-2-4, Sa, brn, MTW, Rec. = 1.8 ft	3-4-5-10 (9)	14.4	19.3	67.1	13.6		
		A-7-6, Cl, brn, MTW, Rec. = 0.5 ft	2-7-5-8 (12)	45.9		2.7	97.3	52	28
		A-2-4, SiGrSa, gry, MTW, Rec. = 0.5 ft		16.4	22.7	56.6	20.7		
		A-7-6, Cl, gry, MTW, Rec. = 1.4 ft	3-2-3-4 (5)	30.1	2.4	15.4	82.2	43	22
10		Visual Description: Cl, gry, MTW, Rec. = 1.9 ft, Similar material as 10.0 - 12.0 ft.	1-3-5-7 (8)	33.9					
		A-7-6, Cl, gry, MTW, Rec. = 2.0 ft	8-8-8-8 (16)	37.6	0.5	6.3	93.2	51	24
		Visual Description: Cl, gry, MTW, Rec. = 0.9 ft, Similar material as 10.0 - 12.0 ft.	1-R@5.0"	33.7					
15		Hole stopped @ 13.9 ft CNPF-TLOB							
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-117**

Page No.: 1 of 1

Pin No.: 12D046

Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY

Date Started: 7/10/12 Date Finished: 7/10/12

VTSPG NAD83: N 731837.02 ft E 1462977.32 ft

Station: D 2+29 Offset: -36.70

Ground Elevation: 322.77 ft

Casing: H.S.A. Sampler: SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		Same day drilling.
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-6, SaSiCl, brn, MTW, Rec. = 0.6 ft	1-1-1-18 (2)	26.2	11.3	22.4	66.3	40	16
		Visual Description: SaSiCl, brn, MTW, Rec. = 0.6 ft, Similar material as 0.0 - 2.0 ft.	1-2-1-2 (3)	23.1					
		A-7-6, Cl, gry, MTW, Rec. = 0.4 ft		25.7	0.6	16.0	83.4	45	23
		Visual Description: Cl, gry, MTW, Rec. = 0.8 ft, Similar material as 3.0 - 4.0 ft.	WH-1-WH-1 (1)	27.1					
		Visual Description: Cl with Stones, gry, MTW, Rec. = 2.0 ft, Similar material as 8.0 - 10.0 ft.	3-4-6-9 (10)	28.2					
10		A-7-6, Cl, brn, MTW, Rec. = 1.0 ft	3-4-6-6 (10)	31.3	12.9	8.5	78.6	46	22
		A-7-6, Cl, brn, MTW, Rec. = 1.85 ft, Material from Triaxial "B" sample.		46.1		2.3	97.7	67	38
		Visual Description: Cl, brn, MTW, Rec. = 1.2 ft, Similar material as 8.0 - 10.0 ft.	2-3-R@2.5"	32.3					
15		Hole stopped @ 14.2 ft CNPFF-TLOB							
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-118**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/09/12 Date Finished: 7/09/12
VTSPG NAD83: N 732153.02 ft E 1462871.32 ft
Station: 15+44 Offset: 43.00
Ground Elevation: 341.17 ft

Casing H.S.A. Sampler SS
Type: H.S.A. I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_F = 1.34$

Groundwater Observations

Date	Depth (ft)	Notes
		Same day drilling.
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-1-b, GrSa, brn, MTW, Rec. = 0.9 ft	1-3-3-2 (6)	9.6	35.6	46.4	18.0		
		A-2-4, SiSaGr, brn, MTW, Rec. = 0.6 ft	2-4-4-5 (8)	12.4	42.7	31.1	26.2		
		A-4, ClSi, brn, MTW, Rec. = 0.5 ft	1-R (R)	16.1	11.6	14.2	74.2	27	10
		Hole stopped @ 4.8 ft CNPF-TLOB							
10									
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-120**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 732336.34 ft E 1462835.75 ft
Station: 17+10 Offset: -43.00
Ground Elevation: 346.79 ft

Casing AUGER Sampler AUGER
Type: I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK $C_F =$

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		Field Note: Asphalt Pavement		0.7			
		Visual Description: Gr with 1-3" stones					
		A-1-b, GrSa, brn, Moist		4.7	35.8	54.2	10.0
		Hole stopped @ 5.5 ft CNPF-TLOB					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-121**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 732326.01 ft E 1462931.92 ft
Station: 17+28 Offset: -52.00
Ground Elevation: 348.74 ft

Casing AUGER Sampler AUGER
Type: I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK C_E =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note: Asphalt Pavement Visual Description: Gr with 1-3" stones, brn, Moist		0.3			
		A-1-a, SaGr, brn, Moist		5.9	54.3	37.9	7.8
5		Hole stopped @ 4.2 ft CNPF-TLOB					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-122**
Page No.: **1 of 1**
Pin No.: **12D046**
Checked By: **TDE**

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/09/12 Date Finished: 7/09/12
VTSPG NAD83: N 732411.45 ft E 1462958.50 ft
Station: 18+18 Offset: 52.00
Ground Elevation: 349.11 ft

Casing H.S.A. Sampler SS
Type: H.S.A. I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK C_E = 1.34

Groundwater Observations

Date	Depth (ft)	Notes
		Same day drilling.
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-6, SaSiCl, brn, MTW, Rec. = 0.9 ft	2-3-4-8 (7)	20.6	2.0	24.4	73.6	28	11
		A-6, SiCl, brn, MTW, Rec. = 1.5 ft	5-6-8-13 (14)	22.5		10.5	89.5	37	17
		Visual Description:, Cl, brn, MTW, Rec. = 1.9 ft, Similar material as 6.0-8.0 ft.	4-5-5-8 (10)	24.1					
		A-7-6, Cl, brn, MTW, Rec. = 1.7 ft	9-10-13-13 (23)	26.0	1.7	7.4	90.9	47	24
		Visual Description:, Cl with stones, brn, MTW, Rec. = 1.0 ft, Similar material as 6.0-8.0 ft.	2-6-R (R)	17.2					
10		Hole stopped @ 9.0 ft CNPF-TLOB							
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-124**

Page No.: 1 of 1

Pin No.: 12D046

Checked By: TDE

Boring Crew: PORTER, GARROW
Date Started: 7/02/12 Date Finished: 7/02/12
VTSPG NAD83: N 733755.59 ft E 1463171.24 ft
Station: 31+85 Offset: -47.00
Ground Elevation: 334.4 ft

Casing H.S.A. Sampler SS
Type: I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations		
Date	Depth (ft)	Notes
07/02/12	4.0	1 hr. after drilled.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-1-b, SaGr, brn, Moist, Rec. = 0.9 ft	2-4-4-3 (8)	5.3	56.7	32.2	11.1		
		A-2-4, Sa, brn, MTW, Rec. = 0.9 ft, 1 1/2 inch crushed stone came off auger flights.	2-1-2-2 (3)	21.8	19.1	65.4	15.5		
		A-6, SaSiCl, brn, MTW, Rec. = 1.6 ft	2-2-2-2 (4)	22.7	16.6	30.4	53.0	31	12
		Visual Description:., Cl, brn, Moist, Rec. = 1.6 ft, Similar material as 8.0-9.6 ft.	2-4-5-8 (9)	30.3					
		A-7-6, Cl, brn, Moist, Rec. = 1.3 ft	1-3-5-12 (8)	29.1	0.8	3.8	95.4	52	27
10		Visual Description:., GrSaCl, gry, Moist, Rec. = 0.4 ft, Similar material as 10.0-12.0 ft. A-6, GrSaCl, gry-brn, Moist, Rec. = 0.4 ft	5-5-8-7 (13)	24.0 29.1	20.6	21.5	57.9	28	11
Hole stopped @ 12.8 ft CNPf-TLOB									
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-125**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, WHITLOCK
Date Started: 7/05/12 Date Finished: 7/05/12
VTSPG NAD83: N 733751.43 ft E 1463264.15 ft
Station: 31+85 Offset: 46.00
Ground Elevation: 333.3 ft

Casing: H.S.A. Sampler: SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_E = 1.34$

Groundwater Observations		
Date	Depth (ft)	Notes
		Same day drilling.
		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-2-4, GrSa, brn, Moist, Rec. = 1.3 ft	2-3-5-4 (8)	14.2	29.8	51.5	18.7		
		A-1-b, SaGr, brn, Moist, Rec. = 1.0 ft	2-3-2-2 (5)	13.3	50.6	38.5	10.9		
		A-2-4, GrSa, brn, Moist, Rec. = 0.8 ft	2-2-4-4 (6)	20.1	29.4	51.1	19.5		
		A-6, SaSiCl, brn, Moist, Rec. = 1.2 ft	5-5-R@2.5"	20.9	12.9	22.7	64.4	38	17
10		Hole stopped @ 7.2 ft CNPF-TLOB							
15									
20									
25									

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-126**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW**
Date Started: **6/27/12** Date Finished: **6/27/12**
VTSPG NAD83: **N 733820.07 ft E 1463164.77 ft**
Station: **32+50** Offset: **-56.00**
Ground Elevation: **334.45 ft**

Casing **H.S.A.** Sampler **SS**
Type: **H.S.A.** I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

Groundwater Observations

Date	Depth (ft)	Notes
		None Taken.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-2-4, GrSiSa, brn, Moist, Rec. = 0.4 ft	2-5-4-2 (9)	13.1	20.7	51.4	27.9		
		Visual Description:, GrSa, brn, Moist, Rec. = 0.3 ft, Insufficient sample for testing.	2-3-3-3 (6)	7.4					
5		Visual Description:, Cl, brn, Moist, Rec. = 1.4 ft, Similar material as 6-8 ft.	2-1-3-4 (4)	27.7					
		A-7-6, Cl, brn, Moist, Rec. = 2.0 ft	6-8-10-10 (18)	31.6	0.7	5.8	93.5	52	24
		Visual Description:, Cl, brn, Moist, Rec. = 1.6 ft, Similar material as 6-8 ft.	3-3-7-15 (10)	27.3					
10		A-4, SaSi, brn, Moist, Rec. = 0.7 ft	12-R@2.5"	12.9	19.9	31.8	48.3	21	6
		Hole stopped @ 10.7 ft CNPFF-TLOB							
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-127**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW
Date Started: 7/02/12 Date Finished: 7/05/12
VTSPG NAD83: N 733839.26 ft E 1463263.34 ft
Station: 32+72 Offset: 42.00
Ground Elevation: 332.29 ft

Casing: H.S.A. Sampler: SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 45C TRACK $C_F = 1.34$

Groundwater Observations		
Date	Depth (ft)	Notes
07/05/12	3.5	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RGD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		A-2-4, GrSa, brn, Moist, Rec. = 1.0 ft				1-3-3-3 (6)	7.2	31.2	52.3	16.5		
		A-3, Sa, brn, Moist, Rec. = 1.0 ft				1-2-1-2 (3)	5.4	12.6	81.8	5.6		
		A-4, GrSiSa, gry-brn, Moist, Rec. = 1.5 ft				3-3-3-4 (6)	18.5	23.5	39.4	37.1	31	2
		A-6, SaSiCl, gry-brn, Moist, Rec. = 1.5 ft				6-5-5-7 (10)	25.5	11.3	22.4	66.3	40	18
10		Visual Description: Cl, gry-brn, Moist, Rec. = 1.7 ft, Similar material as 10.0-12.0 ft.				3-4-4-5 (8)	32.2					
		A-7-6, Cl, gry-brn, Moist, Rec. = 1.9 ft				5-7-7-8 (14)	32.2	0.4	4.7	94.9	50	24
15		13.2 ft - 18.2 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BXMD, Closely spaced jointing. RMR = 52	1 (10)	94 (84)	6	Top of Bedrock @ 13.2 ft						
					7							
					7							
					6							
20					4							
						Hole stopped @ 18.2 ft						
25												

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-128**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW

Date Started: 6/27/12 Date Finished: 6/27/12

VTSPG NAD83: N 734927.60 ft E 1463191.14 ft

Station: 43+60 Offset: -34.00

Ground Elevation: 319.73 ft

Casing	Sampler
Type: H.S.A.	SS
I.D.: 3.25 in	1.5 in
Hammer Wt: N.A.	140 lb.
Hammer Fall: N.A.	30 in.
Hammer/Rod Type: Auto/AWJ	
Rig: CME 45C TRACK	C _E = 1.34

Groundwater Observations

Date	Depth (ft)	Notes
		None Taken.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		A-1-b, GrSa, brn, Moist, Rec. = 1.3 ft	2-6-6-4 (12)	9.4	40.5	43.3	16.2
		A-2-4, GrSa, brn, Moist, Rec. = 0.8 ft	3-3-3-3 (6)	8.2	37.2	51.3	11.5
		A-1-b, SaGr, brn, Moist, Rec. = 0.7 ft, Lab Note: Broken Rock was within sample.	4-3-3-4 (6)	12.1	55.5	33.5	11.0
		A-1-a, Gr, brn-white, Moist, Rec. = 1.2 ft, Lab Note: Mostly Broken/Crushed Rock.	8-25-R@2.5"	8.5	76.0	17.9	6.1
10		Hole stopped @ 7.2 ft CNPF-TLOB					
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-129**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW

Date Started: 6/27/12 Date Finished: 6/27/12

VTSPG NAD83: N 734951.36 ft E 1463176.73 ft


Station: 43+84 Offset: -48.00

Ground Elevation: 319.19 ft

Casing	Sampler
Type: H.S.A.	SS
I.D.: 3.25 in	1.5 in
Hammer Wt: N.A.	140 lb.
Hammer Fall: N.A.	30 in.
Hammer/Rod Type: Auto/AWJ	
Rig: CME 45C TRACK	C _E = 1.34

Groundwater Observations

Date	Depth (ft)	Notes
		None Taken.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-b, GrSa, brn, Moist, Rec. = 1.1 ft	1-2-3-5 (5)	11.6	38.1	45.0	16.9
		A-1-a, SaGr, brn-white, Moist, Rec. = 1.0 ft, Lab Note: Mostly Broken/Crushed Rock.	4-34-R@6.0"	3.4	69.7	21.6	8.7
5		Hole stopped @ 3.5 ft CNPF-TLOB					
10		Remarks: 1. Ledge crop in area.					
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-130**
Page No.: **1 of 1**
Pin No.: **12D046**
Checked By: **TDE**

Boring Crew: **PORTER, GARROW, HOLT**
Date Started: **6/20/12** Date Finished: **6/25/12**
VTSPG NAD83: **N 735034.31 ft E 1463289.59 ft**
Station: **44+65** Offset: **66.00**
Ground Elevation: **315.75 ft**

Casing **H.S.A.** Sampler **SS**
Type: **H.S.A.** I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

Groundwater Observations

Date	Depth (ft)	Notes
06/25/12	5.0	AM

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %					
5		A-2-4, SiSa, brn, Moist, Rec. = 1.1 ft				2-4-4-5 (8)	10.3	12.3	59.5	28.2							
		A-2-4, SiSa, brn, Moist, Rec. = 2.0 ft				4-4-4-3 (8)	18.1	0.5	69.1	30.4							
		A-2-4, Sa, brn, Wet, Rec. = 2.0 ft				3-4-3-3 (7)	20.8	1.1	83.2	15.7							
		A-2-4, Sa, brn, Wet, Rec. = 1.0 ft				4-4-6-6 (10)	20.6	1.2	87.9	10.9							
10		A-4, Si, gry-brn, Wet, Rec. = 1.0 ft					22.5		10.0	90.0			29	5			
						A-7-6, Cl, gry-brn, Moist, Rec. = 2.0 ft	4-4-5-7 (9)	30.3	3.8	14.9			81.3	54	25		
						Visual Description: Cl, brn, Moist, Rec. = 2.0 ft, Similar material as 8-10 ft.	7-9-5-7 (14)	33.1									
15		A-4, SaGrSi, brn, Moist, Rec. = 1.1 ft							2-12-25-20 (37)	13.9			26.5	20.1	53.4	22	6
20		15.5 ft - 20.5 ft, Light gray, Dolomite, Moderately hard, Unweathered, Fair rock, BXDC, Close to moderately closely spaced jointing. RMR = 57	1 (10)	100 (84)	4		Top of Bedrock @ 15.5 ft										
					5												
					6												
					7												
					6												
25		Hole stopped @ 20.5 ft															

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_e is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-131**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **TDE**

Boring Crew: **PORTER, GARROW**

Date Started: **6/26/12** Date Finished: **6/26/12**

VTSPG NAD83: **N 735035.81 ft E 1463260.58 ft**


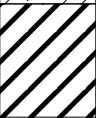
Station: **44+67** Offset: **37.00**

Ground Elevation: **318.12 ft**

Casing **H.S.A.** Sampler **SS**
I.D.: **3.25 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 45C TRACK** **C_E = 1.34**

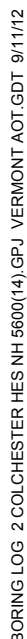
Groundwater Observations

Date	Depth (ft)	Notes
06/26/12	5.0	While Drilling.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
5		Topsoil, 0.0 ft - 0.3 ft							
		A-1-b, SaGr, brn, Moist, Rec. = 1.3 ft	3-4-5-5 (9)	4.8	54.0	32.4	13.6		
		A-1-b, SaGr, brn, Moist, Rec. = 0.9 ft	6-6-8-7 (14)	6.9	44.2	39.9	15.9		
		A-2-4, SiSa, brn, Moist, Rec. = 0.3 ft	2-3-2-2 (5)	11.9	17.9	61.7	20.4		
		A-4, SaSi, brn, Moist, Rec. = 0.5 ft	1-2-2-3 (4)	19.4	7.4	45.2	47.4	22	5
10		A-6, SaSiCl, brn, Moist, Rec. = 1.7 ft	2-2-4-7 (6)	24.8	7.0	20.6	72.4	38	18
		A-6, SaSiCl, brn, Moist, Rec. = 0.5 ft	4-R@6.0"	22.3	15.6	22.0	62.4	35	17
		Hole stopped @ 10.9 ft CNPF-TLOB							
15									
20									
25									

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_e is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.





STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: C-101
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 731452.48 ft E 1462615.23 ft
Station: 8+00 Offset: -4.00
Ground Elevation: 326.9 ft

Casing AUGER Sampler AUGER
Type: AUGER
I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK C_E =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt Pavement					
		A-1-b, SaGr, brn, Moist		3.3	43.3	37.8	18.9
		A-1-b, SiGrSa, brn, Moist		6.0	32.4	42.7	24.9
5		Hole stopped @ 5.0 ft					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: C-102
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 732074.17 ft E 1462804.49 ft
Station: 14+50 Offset: 0.00
Ground Elevation: 339.14 ft

Casing AUGER Sampler AUGER
Type: AUGER
I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK C_F =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt Pavement					
		A-1-b, SaGr, brn, Moist		3.6	48.9	35.5	15.6
		A-2-4, SiSa, brn, Moist		10.7	11.9	59.8	28.3
5		Hole stopped @ 5.0 ft					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: C-103
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 733371.92 ft E 1463171.20 ft
Station: 28+00 Offset: -5.00
Ground Elevation: 342.14 ft

Casing AUGER Sampler AUGER
Type: AUGER
I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK C_E =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt Pavement					
		A-1-a, SaGr, brn, Moist		1.7	58.9	29.4	11.7
		A-2-4, GrSiSa, brn, Moist		8.0	20.8	44.3	34.9
5		Hole stopped @ 5.0 ft					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **C-104**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 734268.35 ft E 1463229.09 ft
Station: 37+00 Offset: -4.00
Ground Elevation: 327.82 ft

Casing AUGER Sampler AUGER
Type: I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK $C_F =$

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt Pavement					
		A-1-a, SaGr, brn, Moist		1.3	65.4	25.3	9.3
		A-2-4, Sa, brn, Moist		6.6	6.2	76.7	17.1
5		Hole stopped @ 5.0 ft					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **C-105**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: TDE

Boring Crew: PORTER, GARROW, SALISBURY
Date Started: 7/24/12 Date Finished: 7/24/12
VTSPG NAD83: N 735467.60 ft E 1463233.58 ft
Station: 49+00 Offset: 0.00
Ground Elevation: 311.95 ft

Casing AUGER Sampler AUGER
Type: I.D.:
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 45C TRACK C_E =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note: Asphalt Pavement					
		A-1-b, SaGr, brn, Moist		3.1	46.2	39.9	13.9
		A-2-4, Sa, brn, Moist		6.5	5.3	80.0	14.7
5		Hole stopped @ 5.0 ft					
10							
15							
20							
25							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

COLCHESTER HES NH 5600(14)

CORE BOX NUMBER 12-019-01

Logged By: T. Eliassen

Date: JULY 19, 2012



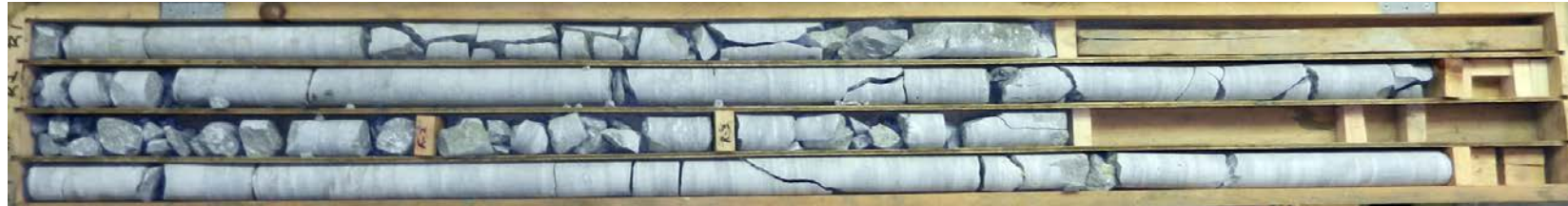
BORING	RUN NO.	CORE SIZE	DEPTH (ft.)	RECOVERY %	RQD %	DIP °	LITHOLOGIC DESCRIPTION	RMR RATING
B-130	1	BXDC	15.5 - 20.5	100	84	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 57 FAIR ROCK
B-127	1	BXDC	13.2 - 18.2	94	84	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 52 FAIR ROCK
B-134	1	BXDC	8.5 - 13.5	100	50	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. MOSTLY UNWEATHERED. SOME SLIGHT WEATHERING (YELLOW DISCOLORATION AT 10.5').	RMR = 48 FAIR ROCK
B-108	1	BXDC	10.0 - 15.0	100	52	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 53 FAIR ROCK

COLCHESTER HES NH 5600(14)

CORE BOX NUMBER 12-019-02

Logged By: T. Eliassen

Date: JULY 19, 2012



BORING	RUN NO.	CORE SIZE	DEPTH (ft.)	RECOVERY %	RQD %	DIP °	LITHOLOGIC DESCRIPTION	RMR RATING
B-107	1	BX	6.0 - 9.2	100	22	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACE JOINTING. UNWEATHERED.	RMR = 38 POOR ROCK
	2	BX	9.2 - 14.2	94	54	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACE JOINTING. UNWEATHERED.	RMR = 48 FAIR ROCK
B-109	1	BX	8.2 - 9.9	70	N/A	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. MECHANICAL BREAKAGE. UNWEATHERED.	RMR = 38 POOR ROCK
	2	BX	9.9 - 10.7	100	N/A	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. MECHANICAL BREAKAGE. UNWEATHERED.	RMR = 38 POOR ROCK
	3	BX	10.7 - 11.7	100	N/A	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. MECHANICAL BREAKAGE. UNWEATHERED.	RMR = 38 POOR ROCK
	4	BX	11.7 - 16.7	96	56	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 48 FAIR ROCK

COLCHESTER HES NH 5600(14)

CORE BOX NUMBER 12-019-03

Logged By: T. Eliassen

Date: AUGUST 13, 2012



BORING	RUN NO.	CORE SIZE	DEPTH (ft.)	RECOVERY %	RQD %	DIP °	LITHOLOGIC DESCRIPTION	RMR RATING
B-110	1	BXMDC	5.0 - 10.0	90	36	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 43 FAIR ROCK
B-111	1	BX	7.2 - 8.2	100	0	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 38 POOR ROCK
	2	BX	8.2 - 10.2	100	0	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 38 POOR ROCK
	3	BX	10.2 - 12.2	100	0	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 38 POOR ROCK
	4	BX	12.2 - 17.2	98	58	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSELY SPACED JOINTING. UNWEATHERED.	RMR = 48 FAIR ROCK



Vermont Agency of Transportation
Program Development Division
Materials and Research Section

To: Joshua Schultz, Project Manager – VTrans’ Highway Safety & Design Section
From: Chad A. Allen, P.E., Geotechnical Engineer via Christopher C. Benda, P.E., Soils and Foundations Engineer
Date: February 6, 2013
Subject: Geotechnical Report Addendum:
COLCHESTER HES NH 5600(14) – US 2 & 7, I-89 EXIT 16

1.0 INTRODUCTION

This report is issued as an addendum to the project’s initial geotechnical report dated September 19, 2012. Included herein are feasibility and foundation design recommendations for the retaining walls and mast arm foundations to be constructed for this project. This addendum includes additions and revisions to the following tables included in the initial geotechnical report;

Table 2.1	Boring Locations
Table 3.1	Laboratory Test Results – CU (AASHTO T-297) Triaxial Testing
Table 4.1.1	Mast Arm & Sign Bridge Soil Profile and Design Parameters (1 of 2)
Table 4.1.2	Mast Arm & Sign Bridge Soil Profile and Design Parameters (2 of 2)

This project, Colchester HES NH 5600(14) project, is located along Route US 2 & US 7 between the intersection of Highpoint Center /South Park Drive Intersection and the Rathe Road/Champlain Drive Intersection in Colchester. The project will consist of the construction of a double diamond interchange with I-89 and the installation of mast arms for controlling traffic along the project route. In addition, the construction of four retaining walls is proposed. One wall is proposed to be located along Lower Mountain View Drive and another in front of the Hampton Inn along US 2 & US 7. The other two walls will be constructed adjacent to shared use paths on either side of US 2 & US 7, beneath I-89, at Interchange 16.

2.0 SUBSURFACE INVESTIGATIONS

The initial field investigation is documented in the initial geotechnical report. The most recent follow-up investigation was conducted between November 5th and November 15th, 2012 and includes 7 wash-bore and 3 hollow stem auger borings in addition to 5 bedrock probes. The results of these borings are provided as an attachment to this report. The follow-up investigation was conducted to fill in data

gaps relating to soil properties for the design of the mast arm and overhead sign bridge foundations and to improve the soils and bedrock information for the proposed retaining wall locations. Table 2.1 depicts the boring locations for the follow-up field investigation only.

BORING ID	STATION	OFFSET (ft.)	NORTHING (VSPG Survey Feet)	EASTING (VSPG Survey Feet)	ELEVATION (ft.) ¹	BORING TYPE
B-201	D2+37.49	40.98 LT	731840.512	1462980.796	324.1	HSA ²
B-202	14+66.84	48.07 RT	732080.721	1462856.067	336.0	HSA
B-203	32+84.88	41.83 RT	733852.141	1463263.587	331.8	HSA
B-204	Boring was determined not to be necessary due to limited height of the proposed retaining wall.					
B-205	10+48.70	77.10 LT	731710.957	1462618.011	338.7	WASH BORE
B-206	10+59.98	66.08 LT	731718.633	1462631.787	338.1	WASH BORE
B-207	10+73.43	55.83 LT	731728.604	1462645.45	337.9	WASH BORE
B-208	10+93.41	54.23 LT	731747.297	1462652.675	339.5	WASH BORE
B-209	11+46.78	59.88 LT	731800.07	1462662.47	342.8	WASH BORE
B-210	11+69.93	57.25 LT	731816.712	1462670.158	341.3	WASH BORE
B-211	12+16.00	58.11 LT	731865.917	1462683.889	341.8	WASH BORE
B-212	12+36.28	69.48 LT	731888.596	1462678.769	342.1	WASH BORE
B-213	12+45.42	74.41 LT	731898.847	1462676.36	342.2	WASH BORE
B-214	12+53.83	78.48 LT	731907.979	1462675.139	341.2	WASH BORE
B-215	12+59.69	83.75 LT	731915.094	1462671.759	339.7	WASH BORE

¹estimated from existing contours to nearest 0.1 ft

²HSA = Hollow Stem Auger

Table 2.1R Secondary Field Investigation Boring Locations

During the wash bore operations, split spoon samples and standard penetration tests (SPT) were taken continuously to the top of bedrock elevation. Soil samples were visually classified in the field and SPT blow counts were recorded on the boring logs. Soil samples were preserved and returned to the Materials and Research Laboratory for testing and further evaluation.

Rock cores were collected at six boring locations (Borings B-206, B-208, B-209, B-210, B-211, and B-213). Coring consisted of advancing a double-barrel coring device while noting drilling rates (minutes/foot). Rock cores were carefully placed in core boxes and delivered to the M&R laboratory for identification by the Agency's Geologist. Bedrock was cored in select borings using double walled core barrels.

Undisturbed samples (Shelby Tube samples) were collected from silt/clay layers as requested in the geotechnical field work order. Upon completion of the laboratory testing, the field boring logs were revised to reflect the results of the laboratory classification results. The attached boring logs and auger notes display the types of soils and strata encountered and include the laboratory test results, SPT data, rock descriptions and properties and any pertinent observations made by the boring crew.

3.0 FIELD AND LABORATORY SOIL TESTS

The standard penetration resistance of the in-situ soil is determined by the number of blows required to drive a 2 inch OD split barrel sampler into the soil with a 140 pound hammer dropped from a height of 30 inches, in accordance with procedures specified in AASHTO T206 – Penetration Test and Split-Barrel Sampling of Soils. During the standard penetration test (SPT), the sampler is driven for a total length of 2.0 feet,

while counting the blows for each 6 inch increment. The SPT N-value, which is defined as the sum of the number of blows required to drive the sampler through the second and third increments, is commonly used with established correlations to estimate a number of soil parameters, particularly the shear strength and density of cohesionless soils. The N values provided on the boring logs are raw values and have not been corrected for energy, borehole diameter, rod length or overburden pressure. VTrans has determined a hammer correction value, C_E , to account for the efficiency of the SPT hammer on the drill rig. For the second investigation, a CME 55 Track Rig was used, with a $C_E=1.46$. Selected specimens obtained from the standard penetration borings were tested in the laboratory to assess their physical properties. Moisture contents were determined, as well as the percent of each soil type.

Clayey samples from two shelly tubes were extracted and tested in accordance with AASHTO T-297 – Consolidated, Undrained Triaxial Compression Test on Cohesive Soils and AASHTO T-216 – One-Dimensional Consolidation Properties of Soils. Physical testing was performed for these samples and included particle size analysis with hydrometer testing to determine the clay fraction. Atterburg limits were also evaluated for these samples. These index tests were used to relate the triaxial test results from one location to similar clay layers at other locations within the project site. Table 3.1 documents the triaxial testing conducted for this project and includes the laboratory test results from the initial investigation.

Boring	Classification	LL	PI	c', psf	ϕ'
B102	A-4; ClSi	34	8	0	38°
B117	A-7-6; Cl	67	38	207	31.6°
B134	A-7-5; Cl	54	23	231	23.6°
B201	A-7-6; Cl	48	22	215	27
B203	A6; SaSiCl	39	18	20	36

Table 3.1R Laboratory CU (AASHTO T-297) Triaxial Test Results

4.0 SOIL PROFILES

The subsurface soils observed throughout the project can be characterized as sand and gravel overlying silt and clay deposits with generally shallow bedrock on the north side of US 7. Groundwater was encountered sporadically throughout the project area ranging from 3.5 feet to 17 feet below ground surface. Due to traffic and pedestrian safety concerns, borings were backfilled upon completion preventing the measurement of equilibrated water levels in a number of borings.

The groundwater information in Tables 4.1.1R and 4.1.2R represents the subsurface water elevation at the time of the drilling. The summer of 2012 was particularly dry and the water table at the time of drilling is anticipated to be lower than normal. In addition, water table measurements obtained during the summer months can be expected to be lower than the water table measurements during extended periods of precipitation – especially during the spring (winter snow melt) season. The Designer shall account for groundwater fluctuations in his/her designs and not unilaterally assume that the groundwater depth reported on the boring logs represents the design groundwater depth.

4.1 MAST ARM & SIGN BRIDGE FOUNDATIONS

The soil strata encountered during the drilling operations is provided below in Tables 4.1.1 and 4.1.2. These charts were revised based on the results of the second investigation. Undrained shear strengths were based on 4 “p-q plots” with a limiting value of 575 psf. The Designer and Contractor should be aware that actual conditions may vary from what was encountered during the subsurface investigation.

Location	Boring	Depth, ft	Soil Stratum Description	Groundwater Depth, ft	Possible Bedrock Elevation, ft	Friction Angle, degrees, ϕ'	Cohesion, c' psf	Undrained Shear Strength, S_u , psf	Unit Weight, γ pcf	Soil Modulus, k (pci) ¹	Required Foundation Type ²
Highpoint Center / South Park Drive Intersection Mast Arms	B101	0 – 6	loose to medium dense SaSi ³	GNE ⁴	319.42	30	-----	-----	110	25	CYL use
		6 – 7.1	very dense SiSaGr			use upper layer					
	B102	0 – 7	dense to very dense Sa	12.5	298.99	35	-----	-----	125	225	CYL
		7 – 10	medium dense Si			32	-----	-----	120	90	
		10 – 17.5	loose ClSi			27	-----	-----	90	20	
		17.5 – 25.6	very soft to soft Cl			23.6	231	489	120	20	
	B103	0 – 3.7	loose to dense SaGr	GNE	321.30	30	-----	-----	115	25	CYL
	B104	0 – 8	medium to dense GrSa / SaSi	17.0	300.09	32	-----	-----	120	100	CYL
		8 – 12.5	medium dense Si / ClSi			30	-----	-----	110	90	
		12.5 – 17.5	loose Si			27	-----	-----	90	25	
		17.5 – 24.7	Cl			23.6	231	518	120	20	
Whitcomb Drive Sign Bridge	B105	0 – 10	dense to very dense SaGr	GNE	316.76	30	-----	-----	110	225	CYL / SPR
		10 – 11.0	weathered rock			use upper layer					use
	B106	0 – 6	medium to dense SaSi w/Gr	17.0	298.99	31	-----	-----	115	100	CYL / SPR
		6 – 13	medium to dense ClSi & Si			31	-----	-----	115	100	
		13 – 17.5	loose ClSi			27	-----	-----	90	20	
DD Interchange West – Mast Arms	B107	0 – 4	loose to medium dense SaSi	GNE	319.07	32	-----	-----	120	25	CYL / SPR
		4 – 6	SaGr w/weathered bedrock			use upper layer					
	B108	0 – 10.0	medium dense SaGr	GNE	317.25	31	-----	-----	115	90	CYL
	B109	0 – 6	dense to very dense SaGr	GNE	319.24	35	-----	-----	125	225	CYL use
		6 – 8.2	possible zone of weathered rock			use upper layer					
Ramp A Sign Bridge	B110	0 – 4	dense to very dense SaGr	5.3	322.23	35	-----	-----	125	225	CYL use
		4 – 5.0	possible zone of weathered rock			use upper layer					
	B111	0 – 7.2	dense to very dense SaGr	5.9	321.94	35	-----	-----	125	125	CYL
Double Diamond Interchange - East Mast Arms	B113	0 – 4.9	very dense SaGr / GrSa	GNE	327.18	37	-----	-----	130	225	CYL
		0 – 4	very dense SaGr			37	-----	-----	130	225	
	B114	4 – 9	soft to hard SaCl	GNE	323.02	36	20	567	110	100	CYL
		9 – 10.2	dense to very dense SaSiGr			37	-----	-----	130	225	
	B115	0 – 4	medium to dense SiSaGr/SaClSi	7.1	320.06	30	-----	-----	115	90	CYL
		4 – 8	medium to very stiff Cl			27	215	518	110	30	
		8 – 9.4	very dense SaGr			37	-----	-----	130	125	

Note 1: Where the value for k is split (i.e., 90 / 60) it indicates the soil modulus for use above / below the water table.

Note 2: CYL – cylindrical / shaft footing – diameter to be determined by designer

SPR – square or rectangular spread footing with dimensions determined by designer

Note 3: Gr = Gravel, Sa = Sand, Si = Silt, and Cl = Clay

Note 4: GNE = Groundwater Not Encountered

Table 4.1.1R Mast Arm & Sign Bridge Soil Profile and Design Parameters (1 of 2)

Location	Boring	Depth, ft		Soil Stratum Description	Groundwater Depth, ft	Possible Bedrock Elevation, ft	Friction Angle, degrees, ϕ'	Cohesion, psf - c'	Undrained Shear Strength, S_u , psf	Unit Weight, γ pcf	Soil Modulus, k (pci) ¹	Required Foundation Type ²
Ramp D Sign Bridge	B116	0 – 4		loose to medium dense Sa ³	3.5	311.80	30	-----	-----	110	20	CYL or SPR
		4 – 13.9		medium to very stiff Cl			23.6	231	425	120	200	
	B117/ B201	0 – 3		soft SaSiCl	GNE ⁴	308.57	27	215	396	110	30	CYL or SPR
		3 – 6		very soft Cl			27	215	469	110	30	
		6 – 10		stiff Cl			27	215	558	110	500	
		10 – 14.2		stiff Cl			31.6	207	367	106	500	
STA 15+52 Sign Bridge	B118	0 – 4.8		medium to dense GrSa / SaGr	GNE	336.37	32	-----	-----	120	90	CYL or SPR
	B119		Hand steel probe indicated 4.1 ft to top of ledge or boulder									
Mountain View Dr. Intersection Mast Arms	B120	0 – 5.5		auger boring – No SPT: GrSa	GNE	341.29	32	-----	-----	120	90	CYL
	B121	0 – 4.2		auger boring – No SPT: GrSa	GNE	344.54	32	-----	-----	120	90	CYL
	B122	0 – 4		very dense SaGr / GrSa	GNE	340.11	37	-----	-----	130	225	CYL
		4 – 9.0		stiff to very stiff Cl			27	215	518	110	500	
	B123		Not drilled to large number of underground utilities - use Boring B122 design									
Hercules Dr. Intersection Mast Arms	B124	0 – 4		medium dense sands & gravels	4.0	321.6	31	-----	-----	115	90	CYL
		4 – 6		medium SaSiCl			27	215	485	110	100	
		6 – 10		stiff Cl			23.6	231	424	120	500	
		10 – 12.8		stiff to very stiff GrSaCl			36	20	575	110	500	
	B125	0 – 6.0		medium dense GrSa	GNE	326.1	31	-----	-----	115	90	CYL
		6.0 – 7.2		medium SaSiCl			36	20	562	110	500	
	B126	0 – 4		dense to very dense Sa	GNE	323.75	32	-----	-----	120	225	CYL
		4 - 10		medium to very stiff Cl			23.6	231	433	120	500	
		10 – 10.7		SaSi			32	-----	-----	120	225	
	B127/ B203	0 – 6		medium dense GrSa w/some Si	3.5	319.09	31	-----	-----	115	90	CYL
		6 – 8		stiff SaSiCl			27	215	510	110	100	
		8 – 13.2		stiff to very stiff Cl			23.6	231	432	120	500	
Rathe Rd / Champlain Drive Intersection Mast Arms	B128	0 – 7.2		medium to dense Sa & Gr	GNE	312.53	32	-----	-----	120	150	CYL
	B129	0 – 3.5		medium to dense Sa & Gr	GNE	315.69	32	-----	-----	120	150	CYL
	B130	0 – 8		medim to dense Si & Sa	5.0	300.25	32	-----	-----	120	90 /	CYL
		8 – 12.5		stiff to very stiff Cl			23.6	231	438	120	500	
		12.5 – 15.5		very dense SaGrSi			37	-----	-----	130	125	
	B131	0 – 4		dense SaGr	5.0	307.22	35	-----	-----	125	225	CYL
		4 – 8		medium dense SaSi / SiSa			30	-----	-----	110	90 /	
		8 – 10.9		medium SaSiCl			27	215	555	110	100	

Note 1: Where the value for k is split (i.e., 90 / 60) it indicates the soil modulus for use above / below the water table.

Note 2: CYL – cylindrical / shaft footing – diameter to be determined by designer

SPR – square or rectangular spread footing with dimensions determined by designer

Note 3: Gr = Gravel, Sa = Sand, Si = Silt, and Cl = Clay

Note 4: GNE = Groundwater Not Encountered

Table 4.1.2R Mast Arm & Sign Bridge Soil Profile and Design Parameters (2 of 2)

4.2 RETAINING WALLS

4.2.1 Retaining Walls Less Than 8 ft in Overall Height: There are three (3) proposed retaining walls to be constructed with overall heights less than 8 ft. The first wall is the retaining wall located in front of the southern abutments and within the double diamond intersection. The other two walls are located along Lower Mountain View Drive (Station 502+50 LT) and along US 7 in front of the Hampton Inn (Station 14+20 to 15+25 RT).

It is recommended that the structure type for these three wall systems be a non-reinforced precast modular block retaining wall. While other walls are feasible these wall systems are recommended based on past experience and performance including recognition as consistently being the most cost effective solution for limited height retaining walls. The plans currently show a rectangular block wall at these locations, however, it is recommended that a general note be included on the plans indicating that the blocks are shown for conceptual purposes only. For instance a T-wall could also be an effective wall system. The plans and specifications provided for this project shall require that the selected wall system be one of the approved retaining wall systems identified on the "VAOT Earth Retaining System Selection Chart" which can be accessed from the following web site:

http://vtransengineering.vermont.gov/sites/aot_program_development/files/documents/materialsandresearch/MandRSoilAPPROVED_Retaining_Walls_8-2012_Final.pdf

Each of the three low height retaining walls can be designed using a calculated nominal bearing resistance of 2.5 ksf which computes to a factored bearing resistance of 1.1 ksf for the undrained condition; $S_u = 400$ psf. The maximum applied bearing pressure at the base of the leveling pad should not be greater than the factored bearing resistance. The bearing resistance is dependent upon the shear strength of the clay and remains unchanged with an increase in footing width. If additional bearing resistance is required to support the retaining wall blocks then a thicker leveling pad may be required in order to control the bearing pressure applied to the clay foundation material.

Due to the clayey soils on-site the groundwater should be controlled using drainage aggregate complying with VTrans Spec. 704.16 and placed directly behind the wall elements. The drainage stone should be kept separated from the existing soils by using a geotextile separator fabric meeting the material requirements for VTrans pay item 649.11. Geotextile fabric should also be placed under a leveling pad, if utilized. A leveling pad is currently shown with a 6 inch thickness; this value should be increased to 12 inches. Underdrain elements should be placed outside the leveling pad. The bottom of the leveling pad shall be located 3 feet below the ground surface resulting in a 2 foot minimum embedment depth for the retaining wall.

If an area of loose silt or soft clayey soil is encountered at the foundation elevation (bottom of the leveling pad) then the foundation soil should be undercut 1 foot and the stone subbase compacted. A geotextile fabric should be installed around the perimeter of the leveling pad material to prevent intrusion of fines into the clean structural fill material.

The proposed wall in front of the Hampton Inn is scheduled to be constructed on existing soil and is proposed to retain new fill material approximately 4 to 5 feet in depth. This load will cause minor settlement of approximately 1 to 2 inches for the structure. This degree of settlement and the limited corresponding differential settlement will not negatively impact a precast modular block wall system. Although it is anticipated that the fill area will settle uniformly the settlement could adversely affect the transitions between the cut and fill sections along the shared use path. Therefore it is recommended that the retaining wall structure be built including the subbase lying directly under the shared use path and then allowed to settle for 30 days to reduce or limit the settlement effects. The plans should note that after the provision of a 30 day settlement period the additional subbase material can be placed and graded and the concrete for the shared use path can be placed.

4.2.2 US 7 – North Abutments for I-89 SB & NB Bridges: The as-built plans depict the existing northern abutments to be spread footings placed directly on bedrock at an elevation of 339.00. Borings from the initial and secondary investigations were reviewed, along with as-built plan information including the original subsurface investigation conducted in the 1950s, to determine the existing bedrock profile.

These borings were plotted manually on the cross sections provided with the original request for geotechnical services. The borings and historic records indicate that the bedrock profile is sufficiently high alleviating the need for a retaining wall structure. It is highly likely that bedrock will need to be removed to install the pedestrian path, see Section 6.1 of the initial geotechnical report for recommendations regarding ledge removal.

A 1V:2H slope is recommended to be installed at the edge of the pedestrian path and extending upward until it intersects the abutments. Depending upon the depth to the bedrock this may include some exposed bedrock surfaces. The placement of some rock fill material may be necessary to fill in pockets or voids. In addition, consideration should be given to ensuring that drainage concerns are managed alongside the shared use path – especially if exposed bedrock is prevalent. It is recommended that a fence be installed to keep pedestrians from walking up the 1V:2H slope in front of the northern abutments.

5.0 BEDROCK CONDITIONS

Refer to the initial report for an in-depth discussion on the bedrock conditions. Core logs for the secondary subsurface investigation were developed by the AOT geologist and are attached for reference purposes. The core logs include a photograph of the cores taken, lithologic descriptions, pertinent information such as depth of sample, percent recovery, RQD and RMR (Rock Mass Rating).

6.0 RECOMMENDATIONS

6.1 LEDGE REMOVAL

The recommendations for ledge removal provided in the initial geotechnical report remain applicable.

6.2 Mast Arm and Sign Bridge Foundations

Due to the urban setting of this project and the presence and location of multiple utilities the foundations for the mast arms are required to be cylindrical footings while the sign bridges are required to be either a spread footing or a cylindrical footing as noted in Tables 4.1.1R and 4.1.2R. These tables were revised based on the results of the secondary subsurface investigation and further consideration of the soil parameters and include both drained and undrained strength parameters. The revised tables should be used for design purposes. Tables 4.1.1 and 4.1.2 from the initial report should be disregarded and not used for design. The cylindrical footings shall be installed as described by the designer and may be constructed using various techniques or methods such as driving or drilling casing and/or excavating and using steel casing as formwork. However, of utmost importance is the understanding that the selected construction method will affect the structure's ability to resist the design loads such as torque. The foundations shall be designed in accordance with VTrans' MREI 10-01. Earth pressure coefficients can be calculated using the soil's internal friction angle. Friction factors can be determined from published values in the NAVFAC design manual; DM 7.02.

6.3 Retaining Walls

Refer to Section 4.2 for specific recommendations for the four proposed retaining walls for this project. Recommendations are incorporated into the design discussion for these structures.

6.4 Construction Considerations

Refer to Section 6.5 of the initial geotechnical report for specific recommendations relating to construction considerations.

6.5 Design Guidelines

The Materials and Research Section of VTrans has developed *Materials and Research Engineering Instructions (MREI) 10-01*, which "standardizes VTrans' foundation designs for overhead structures such as signal or sign bridges, mast arms, and strain poles during plan (preliminary and final) development or construction." This document should be referenced in the project plans and specifications for the contractor's use. The document is available on the Agency's website at the following address: <http://www.aot.state.vt.us/progdev/Sections/M&R%20Info/DocumentsM&RPages/M&R%20SoilEI%20-%20Overhead%20Structures%20030910.pdf>

In addition, it is highly recommended that this addendum to the initial geotechnical report be included in the project's bid documents and referenced in the general notes on the project plan documents.

7.0 CONCLUSIONS

If any further analysis is needed or you would like to discuss this report, please contact us at (802) 828-2561. Typed boring logs are attached and are available in the CADD design files: M:\Projects\12d046\Materials&Research.

Attachments: Boring Logs - 9 pages
Auger Drilling Notes (Bedrock Probes) – 1 page
Rock Core Logs - 2 pages

cc: Read File/WEA
Project File



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-201**

Page No.: 1 of 1

Pin No.: 12D046

Checked By: CAA

Boring Crew: GARROW, WHITLOCK

Date Started: 11/05/12 Date Finished: 11/05/12

VTSPG NAD83: N 731840.51 ft E 1462980.79 ft

Station: D2+37.49 Offset: -40.98

Ground Elevation: 324.1 ft

Casing: H.S.A. Sampler: TUBE
I.D.: 3.25 in 3 in
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type:
Rig: CME 55 TRACK C_F =

Groundwater Observations

Date	Depth (ft)	Notes
11/15/12		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
2.5		SaSi Shelby Tube, brn, Moist, Rec. = 0.8 ft, 1.0 ft - 3.0 ft							
		ClSaSi Shelby Tube, brn, Moist, Rec. = 0.9 ft, 3.0 ft - 5.0 ft							
5.0		SaSiCl Shelby Tube, brn, Moist, Rec. = 1.1 ft, 5.0 ft - 7.0 ft							
7.5		A-7-6, Cl with angular stones, brn, Moist, Rec. = 1.3 ft, Material from Triaxial "A" sample. Sample "B" was similar material.		24.5	8.0	9.2	82.8	48	22
		Cl Shelby Tube, brn, Moist, Rec. = 2.0 ft, 9.0 ft - 11.0 ft							
10.0									
12.5		Hole stopped @ 11.0 ft NLTD							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_e is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG 2 COLCHESTER HES NH 5600(14).GPJ VERMONT AOT.GDT 1/29/13



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-202**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: CAA

Boring Crew: GARROW, JUDKINS
Date Started: 11/06/12 Date Finished: 11/06/12
VTSPG NAD83: N 732080.72 ft E 1462856.06 ft
Station: 14+66.84 Offset: 48.07
Ground Elevation: 336.0 ft

Casing: H.S.A. Sampler: SS
I.D.: 3.25 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 55 TRACK $C_F = 1.46$

Groundwater Observations		
Date	Depth (ft)	Notes
11/06/12	4.0	Poss. water table.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-1-b, SiGrSa, Dk/brn, Moist, Rec. = 0.7 ft	WH-2-3-2 (5)	13.8	34.2	44.6	21.2		
2.5		A-6, SaSiCl, Dk/brn, Moist, Rec. = 1.4 ft	WH-2-2-3 (4)	28.6	11.0	29.6	59.4	40	16
5.0		A-6, SaSiCl, brn, MTW, Rec. = 1.5 ft	3-3-3-3 (6)	26.7	9.4	29.7	60.9	35	15
		Visual Description: SaSiCl with some Broken Rock, brn, MTW, Rec. = 0.1 ft, Material similar to 4-6 ft., Insufficient sample for testing.	(R)	23.4					
7.5		Hole stopped @ 6.1 ft CNPF-TLOB							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-203**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: CAA

Boring Crew: GARROW, JUDKINS
Date Started: 11/06/12 Date Finished: 11/06/12
VTSPG NAD83: N 733852.14 ft E 1463263.58 ft
Station: 32+84.88 Offset: 41.83
Ground Elevation: 331.8 ft

Casing H.S.A. Sampler TUBE
Type: H.S.A. I.D.: 3.25 in 3 in
Hammer Wt: N.A. N.A.
Hammer Fall: N.A. N.A.
Hammer/Rod Type: CME 55 TRACK C_F =

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
2.5									
5.0		Sa Shelby Tube, brn, Moist, Rec. = 1.0 ft, 4.0 ft - 5.7 ft							
		A-6, GrSaCl, Dk/brn, Moist, Rec. = 1.3 ft, Possible Fill material.		21.4	31.4	32.3	36.3	30	13
7.5		A-6, SaSiCl with angular stones, Dk/brn, Moist		28.3	17.0	25.1	57.9	39	18
		A-6, SiCl with angular stones, gry, Moist, Rec. = 1.3 ft, Material from Triaxial "A" sample. Sample "B" was similar material.		27.6	20.7	22.7	56.6	34	15
10.0		Hole stopped @ 10.0 ft							
12.5		Remarks: 1. Moved Hole 8 feet from B-127, because of underground utilities.							

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_e is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG 2 COLCHESTER HES NH 5600(14).GPJ VERMONT AOT.GDT 1/29/13



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-206**
Page No.: 1 of 1
Pin No.: 12D046
Checked By: CAA

Boring Crew: GARROW, JUDKINS, WHITLOCK
Date Started: 11/07/12 Date Finished: 11/07/12
VTSPG NAD83: N 731718.63 ft E 1462631.78 ft
Station: 10+59.98 Offset: -66.08
Ground Elevation: 338.1 ft

Casing: WB Sampler: SS
Type: WB
I.D.: 4 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 55 TRACK $C_F = 1.46$

Groundwater Observations

Date	Depth (ft)	Notes
11/07/12		No water to depth

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-b, SaGr, brn, Moist, Rec. = 0.9 ft, Broken Rock was within sample.				WH-5-8-8 (13)	11.3	55.1	29.6	15.3
2.5		A-2-4, SaSiGr, brn, Moist, Rec. = 1.0 ft, Broken Rock was within sample.				9-8-7-R (15)	10.0	38.3	30.0	31.7
		Field Note: Possible top of bedrock. Not Competent								
5.0		5.0 ft - 10.0 ft, Light gray, Dolomite, with close to moderately closely spaced jointing. Karst horizons along some bedding surfaces. Moderately hard, Unweathered, Fair rock, NXMDC, RMR = 48	1 (10)	100 (34)	3	Top of Bedrock @ 5.0 ft				
7.5					3					
					3					
					3					
					3					
10.0										
		Hole stopped @ 10.0 ft								
12.5										

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-208**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **CAA**

Boring Crew: **GARROW, JUDKINS, WHITLOCK**

Date Started: **11/07/12** Date Finished: **11/08/12**

VTSPG NAD83: **N 731747.29 ft E 1462652.67 ft**

Station: **10+93.11** Offset: **-54.23**

Ground Elevation: **339.5 ft**

Casing **WB** Sampler **SS**
Type: **WB** I.D.: **4 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 55 TRACK** **C_E = 1.46**

Groundwater Observations

Date	Depth (ft)	Notes
11/08/12		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RGD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-1-b, GrSa, brn, Moist, Rec. = 0.8 ft				WH-WH-2-6 (2)	8.3	28.3	52.2	19.5		
2.5		A-6, GrSaCl, brn, Moist, Rec. = 1.0 ft				4-5-6-6 (11)	18.8	28.4	32.1	39.5	33	13
5.0		A-4, SaSiGr, rust-brn, Moist, Rec. = 1.2 ft				4-10-6-10 (16)	23.9	37.4	26.9	35.7		
		Visual Description: SiGr, tan, Moist, Rec. = 0.2 ft, Insufficient sample for testing.				5-R						
7.5		Field Note: NXDC, Possible bedrock. Not Competent										
10.0		8.9 ft - 13.9 ft, Light gray, Dolomite, with close to closely moderately spaced jointing. Karst horizons along some bedding surfaces. Moderately hard, Unweathered, Fair rock, NXMDC, RMR = 48	1 (10)	90 (40)	4							
12.5					4							
					4							
					4							
					5							
		Hole stopped @ 13.9 ft										

BORING LOG 2 COLCHESTER HES NH 5600(14).GPJ VERMONT AOT.GDT 1/29/13

- Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
 2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
 3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-209**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **CAA**

Boring Crew: **GARROW, JUDKINS**
Date Started: **11/09/12** Date Finished: **11/09/12**
VTSPG NAD83: **N 731800.07 ft E 1462662.47 ft**
Station: **11+46.78** Offset: **-59.88**
Ground Elevation: **342.8 ft**

Casing: **WB** Sampler: **SS**
Type: **WB** I.D.: **4 in** 1.5 in
Hammer Wt: **N.A.** 140 lb.
Hammer Fall: **N.A.** 30 in.
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 55 TRACK** $C_F = 1.46$

Groundwater Observations

Date	Depth (ft)	Notes
11/09/12		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RGD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-1-b, SiGrSa, brn, Moist, Rec. = 1.2 ft				WH-2-3-4 (5)	12.0	30.4	48.3	21.3		
2.5		A-6, SaGrCl, brn, Moist, Rec. = 0.9 ft				4-5-8-8 (13)	16.3	26.2	21.0	52.8	35	14
5.0		A-6, SaSiCl, rust-brn, Moist, Rec. = 1.2 ft				5-9-9-R (18)	19.2	15.9	26.7	57.4	29	11
		Field Note: NXDC										
		Visual Description: SaSiCl with Broken Rock, rust, Moist, Rec. = 0.2 ft, Insufficient sample for testing.				R	18.7					
		Field Note: NXDC, Possible top of bedrock, Not Competent										
7.5		7.7 ft - 12.7 ft, Light gray, Dolomite, with close to moderately closely spaced jointing. Karst horizons along some bedding surfaces. Moderately hard, Unweathered, Fair rock, NXMDC, RMR = 53	1 (10)	98 (68)	3							
10.0					3							
					3							
					3							
					3							
12.5												
		Hole stopped @ 12.7 ft										

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_F is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-210**

Page No.: 1 of 1

Pin No.: 12D046

Checked By: CAA

Boring Crew: GARROW, JUDKINS
Date Started: 11/14/12 Date Finished: 11/14/12
VTSPG NAD83: N 731816.71 ft E 1462670.15 ft
Station: 11+69.93 Offset: -57.25
Ground Elevation: 341.3 ft

Casing: WB
Sampler: SS
Type: WB
I.D.: 4 in
1.5 in
Hammer Wt: N.A.
140 lb.
Hammer Fall: N.A.
30 in.
Hammer/Rod Type: Auto/AWJ
Rig: CME 55 TRACK
C_E = 1.46

Groundwater Observations

Date	Depth (ft)	Notes
11/14/12		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-4, GrSaSi, Dk/brn, Moist, Rec. = 0.8 ft				WH-2-2-3 (4)	24.3	23.5	35.5	41.0	30	4
2.5		Visual Description: SiSa with one large stone, brn-rust, Moist, Rec. = 0.2 ft, Insufficient sample for testing.				3-2-3-6 (5)						
		A-2-4, SaSiGr, brn, Moist, Rec. = 0.6 ft, Two large stones = 27% of total sample weight.				8-R	16.3	41.8	23.7	34.5	25	6
5.0		Field Note: Possible top of bedrock, Not Competent.										
		5.0 ft - 10.0 ft, Light gray, Dolomite, with close to moderately closely spaced jointing. Karst horizons along some bedding surfaces. Moderately hard, Unweathered, Fair rock, NXMDC, RMR = 53	1 (10)	94 (52)	4		Top of Bedrock @ 5.0 ft					
7.5					3							
					4							
					4							
					5							
10.0		Hole stopped @ 10.0 ft										
12.5												

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

COLCHESTER
HES NH 5600(14)
US2 & US7

Boring No.: **B-211**

Page No.: **1 of 1**

Pin No.: **12D046**

Checked By: **CAA**

Boring Crew: **GARROW, JUDKINS**
Date Started: **11/15/12** Date Finished: **11/15/12**
VTSPG NAD83: **N 731865.91 ft E 1462683.88 ft**
Station: **12+16.00** Offset: **-58.11**
Ground Elevation: **341.8 ft**

Casing **WB** Sampler **SS**
Type: **WB** I.D.: **4 in** **1.5 in**
Hammer Wt: **N.A.** **140 lb.**
Hammer Fall: **N.A.** **30 in.**
Hammer/Rod Type: **Auto/AWJ**
Rig: **CME 55 TRACK** **C_E = 1.46**

Groundwater Observations

Date	Depth (ft)	Notes
11/15/12		No water to depth.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RGD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		A-4, GrSaSi, Dk/brn, Moist, Rec. = 1.0 ft				WH-1-2-4 (3)	18.4	27.4	35.0	37.6	27	4
2.5		A-2-4, SaSiGr, brn, Moist, Rec. = 1.3 ft				2-5-15-8 (20)	16.7	41.7	26.4	31.9	24	4
5.0		A-4, SaSi, brn, Moist, Rec. = 1.0 ft				2-2-2-2 (4)	27.9	13.9	39.8	46.3		
		Field Note:., NXDC, Cobbles										
7.5		6.5 ft - 11.5 ft, Light gray, Dolomite, with close to moderately closely spaced jointing. Karst horizons along some bedding surfaces. Moderately hard, Unweathered, Good rock, NXMDC, RMR = 62	1 (10)	84 (70)	2							
10.0					2							
					3							
					3							
					2							
12.5		Hole stopped @ 11.5 ft										

Notes:

1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.



STATE OF VERMONT
AGENCY OF TRANSPORTATION
SOILS & FOUNDATIONS UNIT
AGUER DRILLING NOTES

COLCHESTER HES NH 5600(14) CORE BOX NUMBER 12-019-05

Logged By: T. Eliassen

Date: NOVEMBER 27, 2012



BORING	RUN NO.	CORE SIZE	DEPTH (ft.)	RECOVERY %	RQD %	DIP °	LITHOLOGIC DESCRIPTION	RMR RATING
B-206	1	NXMDC	5.0 - 10.0	100	34	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 48 FAIR ROCK
B-208	1	NXMDC	8.9 - 13.9	90	40	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 48 FAIR ROCK
B-209	1	NXMDC	7.7 - 12.7	98	68	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 53 FAIR ROCK
B-210	1	NXMDC	5.0 - 10.0	94	52	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 53 FAIR ROCK

COLCHESTER HES NH 5600(14) CORE BOX NUMBER 12-019-04

Logged By: T. Eliassen

Date: NOVEMBER 27, 2012



BORING	RUN NO.	CORE SIZE	DEPTH (ft.)	RECOVERY %	RQD %	DIP °	LITHOLOGIC DESCRIPTION	RMR RATING
B-213	1	NXMDC	1.8 - 6.8	98	54	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 58 FAIR ROCK
B-211	1	NXMDC	6.5 - 11.5	84	70	10	LIGHT GRAY DOLOMITE. MODERATELY HARD. CLOSE TO MODERATELY CLOSELY SPACED JOINTING. KARST HORIZONS ALONG SOME BEDDING SURFACES. UNWEATHERED.	RMR = 62 GOOD ROCK