AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Ken Upmal, P.E., Project Manager, Roadway Design

ZMH CEE

From: Zachary Haffenreffer, Technician Apprentice IV, via Callie Ewald, P. E., Geotechnical Engineering Manager

Date: July 28, 2016

Subject: Cabot-Danville FEGC-F 028-3(26) C/2 Retaining Wall Geotechnical Data Report

1.0 INTRODUCTION

We have completed our geotechnical investigation for the proposed retaining wall as part of the Cabot-Danville FEGC-F 028-3(26) C2 project located approximately 1900' north of Bridge No. 87 (Hooker Brook Bridge) on US 2 in Cabot, Vermont. This memo documents the investigation and recommendations for the construction of a new retaining wall running parallel to the proposed widened Route 2. Previous geotechnical reports for Bridge No. 87 and Bridge No. 88 prepared by Eric Denardo were provided on January 13, 2016 and May 23, 2016, respectively. Contained herein are the results of our subsurface investigation and geotechnical foundation recommendations for the retaining wall design as determined using the *2014 AASHTO LRFD Bridge Design Specifications*.

2.0 FIELD INVESTIGATION

The field investigation was conducted between May 24, 2016 and May 26, 2016. Two standard penetration borings were drilled to determine the subsurface profile in order to aid in design and construction of the retaining wall. A summary of the location of each boring and corresponding ground surface elevation can be found in Table 2.1. The values for the Northings and Eastings are based on the Vermont State Plane Grid Coordinate System NAD 83, and were located by a handheld GPS. Elevations for the borings were then taken off a VTrans survey file. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used to determine them. A boring location plan the retaining wall is attached.

Table 2.1 Boring Locations

Boring Number	Station	Offset (ft)	Northing (ft)	Easting (ft)	Elevation (ft)
B-301	61+50	43.0 RT	685007.22	1703547.22	1471.1
B-301B	61+51. 7	43.0 RT	685008.92	1703547.23	1471.1
B-302	62+25	43.0 RT	685078.87	1703569.87	1469.9

The borings were performed in general accordance with AASHTO T206, *Standard Method of Test for Penetration Test and Split-Barrel Sampling of Soils*. During boring operations, split spoon samples and standard penetration tests (SPT) were taken continuously to 20 feet then at 5 foot intervals thereafter until a depth of 27 feet. Boring B-301 encountered auger refusal conditions at 12.4 feet. Because of this, the station of B-301B was moved 1.7 feet towards B-302 with the offset remaining the same. Borehole B-301B was able to be drilled and sampled down to the full depth of 27 feet. Bedrock was not encountered. Soil samples were visually identified in the field and SPT blow counts were recorded on the boring logs. Soil samples were preserved and returned to the Construction and Materials Bureau Central Laboratory for testing and further evaluation. Upon completion of the laboratory testing, the boring logs were revised to reflect the results of the laboratory classification analysis.

3.0 FIELD AND LABORATORY TESTING

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. During the standard penetration test (SPT), the sampler is driven for a total length of 2 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 VTrans drill rigs. For this project, a brand new Diedrich D-25 drill rig was used. Because the rig is brand new, an energy correction factor has not yet been determined for the hammer. Therefore, a hammer energy factor of 1.3 was used in design calculations based on a standard practice value for an automatic hammer. Laboratory tests were conducted on all samples to evaluate grain size, moisture content, and percent finer than No. 200 sieve. Results from this testing can be found on the attached boring logs.

4.0 SOIL PROFILE

Review of laboratory data and boring logs revealed the following information pertaining to the soil strata. It should be noted that groundwater elevations are subject to change given the fact that boreholes were generally left open for a short period of time. Because groundwater elevations can fluctuate seasonally and are affected by temperature and precipitation, groundwater may be encountered during construction when not previously noted in the logs

B-301 & B-301B. The ground surface elevation at B-301 and B-301B was approximately 1471.1 feet. The groundwater was measured at a depth of 8.4 feet before drilling began on the second day and at a depth of 3.8 feet after drilling operations were completed. No bedrock was encountered to a depth of 27 feet.

Depth (Below Ground Surface Elevation)	Soil Profile
0 – 10 feet	Medium Dense Sandy Silt
10 – 27 feet	Dense Silty Sand

B-302. The ground surface elevation at B-302 was approximately 1469.9 feet. The groundwater was measured before drilling at a depth of 5.3 feet below the ground surface. No bedrock was encountered to a depth of 27 feet.

Depth (Below Ground Surface Elevation)	Soil Profile
0 – 27 feet	Medium Dense Sandy Silt

5.0 ANALYSIS

5.1 Retaining Wall

AASHTO's LRFD Bridge Design Specifications Manual (2014) was used as the reference for settlement and bearing resistance equations. Section 10.6.3.1.2 contains the equation used for bearing capacity. Neither depth factors nor load inclination factors were used in analysis as they were not considered pertinent. Hough's Method, used to calculate settlement in normally consolidated cohesionless soils, can be found in section 10.6.2.4.2.

We recommend the bottom of footing to be 4 feet below the ground based on frost susceptibility and the sandy silt/silty sand bearing stratum at this site. However, a conservative embedment of 3 feet was assumed for analysis because some wall systems use a stone leveling pad for foundation support, minimizing the overall embedment of the wall itself. A wall length of 225 feet was assumed for analysis as provided on the Preliminary Plans dated January 29, 2016. A conservative groundwater depth at the bottom of footing was used in the analysis.

As per section 10.5.5.1 of the 2014 AASHTO LRFD Bridge Design Specifications, a resistance factor of 1.0 should be applied to the unfactored bearing resistance for use in service limit state design. Service limit state design includes, but is not limited to, settlement and scour. Section 10.5.5.2.2 specifies that a resistance factor of 0.45 should be applied to the nominal bearing resistance for use in strength limit state design for spread footings on rock and soil.

Strength limit state design includes, but is not limited to, checks for bearing resistance, sliding and constructability. Potential for overturning is limited by controlling the location of the resultant of the reaction forces (eccentricity). Eccentricity, e, shall be limited as follows:

Foundations on soil:	$\|e\| < b/3$
Foundations on rock:	$\|e\| < 0.45b$

Eccentricity should be considered for settlement and bearing resistance design of spread footings by using effective footing widths based on AASHTO Section 10.6.1.3. All footing widths presented in this report are <u>effective</u> footing widths.

5.1.1 Bearing Resistance

Based on the more conservative profile in Boring B-302, an assumed bottom of footing elevation located in the medium dense sandy silt stratum as well as empirical relationships, it was determined the soil has a friction angle, $\varphi = 33°$ and density, $\gamma = 110$ lbs/ft^3. Figure 5.1 below displays the minimum effective footing width per maximum bearing resistance, factored due to LRFD strength limit. Bearing resistance for service limit state is not provided as strength limit state governs in regards to bearing resistance. For footing widths of 2, 4, 6 and 8 feet, the maximum factored bearing resistance is 10.6, 12.6, 14.5, and 16.4 kips/ft^2 (ksf), respectively.

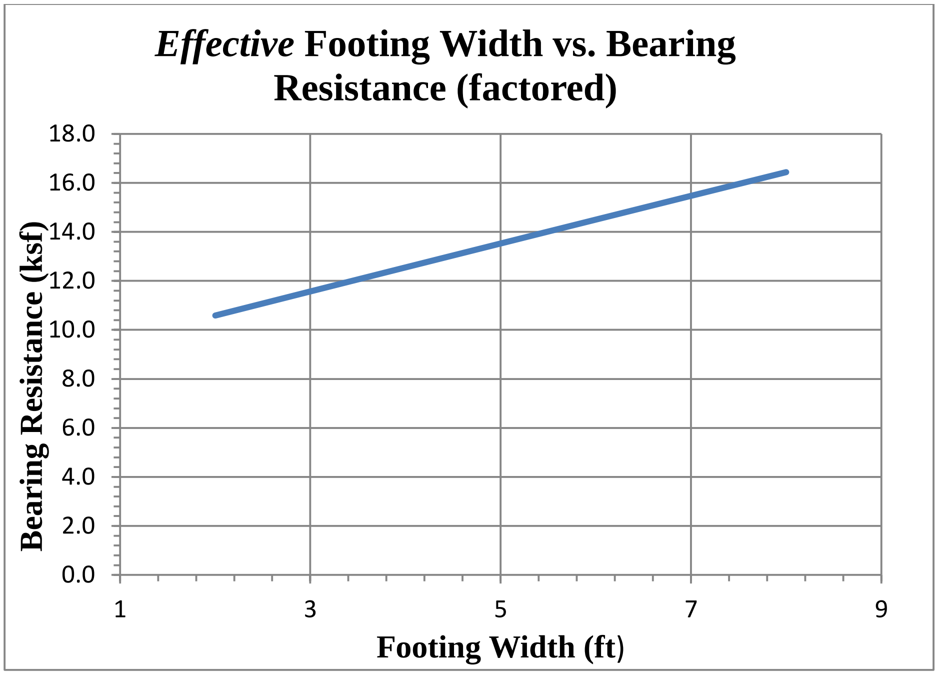


Figure 5.1 Factored bearing resistance. Load resistance factor, Φ=0.45

Soil settlement values were calculated for various footing widths based on the nominal bearing pressure. Bearing pressures of up to 3 ksf result in settlements up to 1.2 inches for effective footing widths of 7 feet or less. Smaller effective footing widths correspond with less settlement of the retaining wall. Due to the more granular nature of the soils at the footing elevation, this settlement is expected to occur during or immediately after construction.

These calculations are based on the geotechnical assumptions outlined above. Sections 10.5.2 and 10.5.3 of AASHTO outline all design states relevant to spread footing design and their respective resistance factors. Table 5.1 shows the appropriate resistance factors for various design states.

Table 5.1. Summary of Resistance Factors

Design State	Resistance Factor, φ
Settlement	1.0
Scour	1.0
Bearing Resistance	0.45
Sliding	0.80

5.1.2 Global Stability Analysis

A global stability analysis was conducted to evaluate the overall stability of the soil slope and proposed retaining wall using the geotechnical parameters stated above. Using Slide version 6.0 developed by Rocscience, a slope stability analysis was performed which evaluated both compound and deep-seated failures for a 7-foot-tall section of wall with a conservative groundwater table at the bottom of footing. According to the VTrans Slope Stability Investigation and Evaluation Manual, GEI 14-01, the Spencer Method is recommended to be used for slope stability analyses of failure surfaces of any shape and a minimum factor of safety of 1.3 shall be used for slopes adjacent to but not directly supporting structures. As a result, the Spencer Method produced a factor of safety against slope failure of 1.404. Figure 5.3 below shows an image of the retaining wall with the most critical failure surface using the Spencer Method.

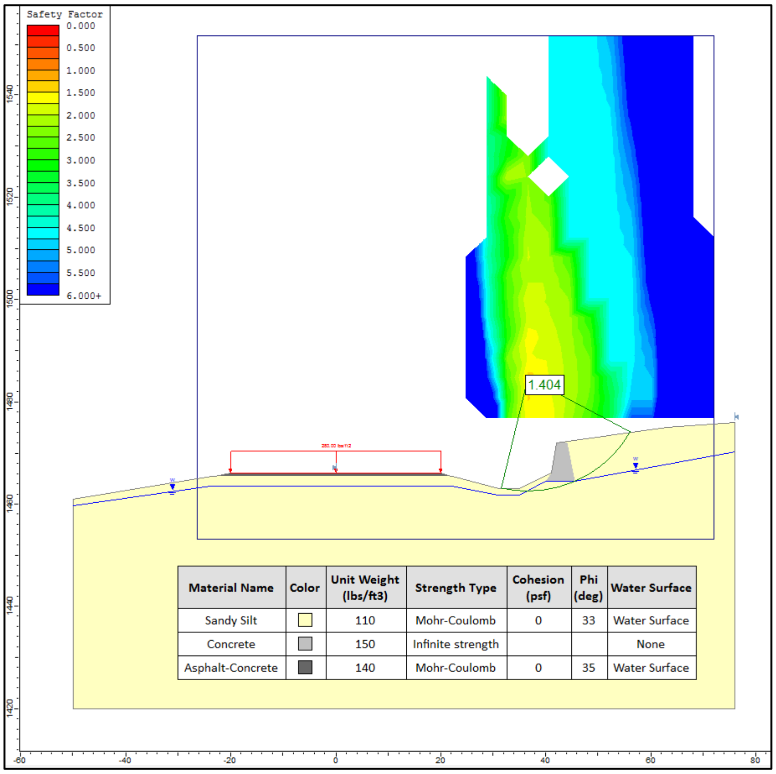


Figure 5.3 Retaining wall at Sta. 62+25 modeled in slide 6.0

5.2 Retaining Wall Selection: A conceptual plan (end result) approach to retaining wall solicitation is recommended for all wall systems except conventional reinforced concrete walls and bin walls in which case detailed plans should be included in the bidding documents.

In accordance with the Agency standard practice, projects containing earth retaining structures (except conventionally reinforced concrete and bin walls) shall use a concept drawing approach, i.e. fully detailed set of retaining wall plans will not be contained in the bidding documents. The design shall meet the requirements the 2014 LRFD Bridge Design Specifications. The concept drawing, furnished in the bidding documents will contain the following geometric and design project specific information:

A. Geometric

1. Beginning and end of wall stations.
2. Elevations on top of wall at beginning and end of wall station as well as all profile break points.
3. Original and proposed ground line profiles in front of and behind the retaining wall.
4. Cross sections at the retaining wall location at 24 foot intervals.
5. Horizontal wall alignment.
6. Details of wall appurtenances such as traffic barriers, coping, fencing, drainage, location and configurations of signs and lighting including conduit locations.
7. Right of way limits.
8. Construction sequence requirements if applicable, including traffic control, access, and stage construction sequences.
9. Elevation of highest permissible level for foundation construction. Location, depth and extent of any unsuitable material to be removed and replaced.

10. Quantities table showing estimated square feet of wall area, and quantity of appurtenances and traffic barriers.

B. Design

1. Shear strength and consolidation properties of foundation soils.
2. Shear strength and unit weight of select backfill.
3. Shear strength of random fill or in-situ soil behind the wall.
4. Required design life of the structure (example: permanent mechanically stabilized earth walls are commonly designed, based on corrosion, for minimum service lives of 75 years).
5. Nominal bearing resistance for the foundation soil and minimum footing embedment depth.
6. Maximum tolerable total and differential settlement.
7. Magnitude, location and direction of external loads due to bridges, overhead signs and lights, traffic surcharge and rapid groundwater draw down.
8. Limits and requirements for drainage features beneath, behind, or through the retaining structure.
9. Backfill requirements for both within and behind the retaining structure. (Both material and placement requirements should be specified, i.e., gradation, plasticity index, electrochemical, soundness, maximum loose lift thickness, minimum density and allowable moisture content).
10. Special facing panel and module finishes or colors.

Geometric, geotechnical and structural considerations must be complementary for the conceptual plan to convey the desired end product to the bidders. In general, the specifications should refer to the Agency's list of Approved Wall Systems in following link.
https://outside.vermont.gov/agency/vtrans/external/docs/construction/03GeotechEng/Engineering/Mast%20Arm%20and%20Overhead%20Sign%20Support%20Foundations%20MREI%2010-01%20Engineering.pdf

5.3 Design Parameters

Based on the soil profiles above, laboratory testing, and attached boring logs, the in-situ soil properties as well as engineering values for common construction materials can be found in Table 5.4. These values should be used in the design of the retaining wall foundation.

The table below highlights the geotechnical design parameters of the in-situ soils as well as regularly specified aggregates. These values should be used when designing any substructure units. It is recommended that values of K_0 be used for calculating earth pressures where the structure is not allowed to deflect longitudinally, away from or into the retained soil mass. Values for K_a should be utilized for an active earth pressure condition where the structure is moving away from the soil mass and K_p where the structure is moving toward the soil mass. K_a and K_p values are based on a vertical back of wall and a horizontal ground surface behind the wall or structure.

	703.01A - Granular Borrow	**704.08 - Granular Backfill for Structures**	**In-Situ M. Dense Sandy Silt**
Density (lb/ft^3):	130	140	110
Internal Friction Angle, ϕ (degrees)	32	34	33
Coefficient of Friction, f			
- mass concrete cast against soil:	0.45	0.55	0.32
- soil against precast/ formed concrete	0.40	0.48	0.25
Active Earth Pressure Coefficient, K_a:	0.31	0.28	0.30
Passive Earth Pressure Coefficient, K_p:	3.25	3.54	3.39
At-Rest Earth Pressure Coefficient, K_o:	0.47	0.44	0.46

Figure 5.4 Engineering Properties for Construction and In-Situ Materials

If a non-horizontal ground surface behind the wall or structure is used in design, the following equations should be used to determine the active earth pressure coefficient, K_a (AASHTO LRFD Section 3.11.5.3).

$$k_a = \frac{sin^2(\theta + \emptyset'_f)}{\Gamma[sin^2\theta \sin(\theta+\beta)]} \qquad (3.11.5.3\text{-}1)$$

in which

$$\Gamma = [1 + \sqrt{\frac{\sin(\emptyset'_f + \delta)\sin(\emptyset'_f - \beta)}{\sin(\theta-\delta)\sin(\theta+\beta)}}]^2 \qquad (3.11.5.3\text{-}2)$$

Where:
δ = friction angle between fill and wall taken as specified in Table 3.11.5.3-1 (degrees)
β = angle of fill to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
θ = angle of back face of wall to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
ϕ'_f = effective angle of internal friction (degrees)

Refer to AASHTO LRFD Section 3.11.5.4 to determine the passive earth pressure coefficient, K_p for a non-horizontal ground surface.

5.4 Construction Considerations

5.4.1 Construction Dewatering

Temporary construction dewatering may be required to install the retaining wall, which 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.

5.4.2 Placement and Compaction of Soils

Fills 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. Compaction equipment should preferably consist of large, self-propelled vibratory rollers. Where hand-guided 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.

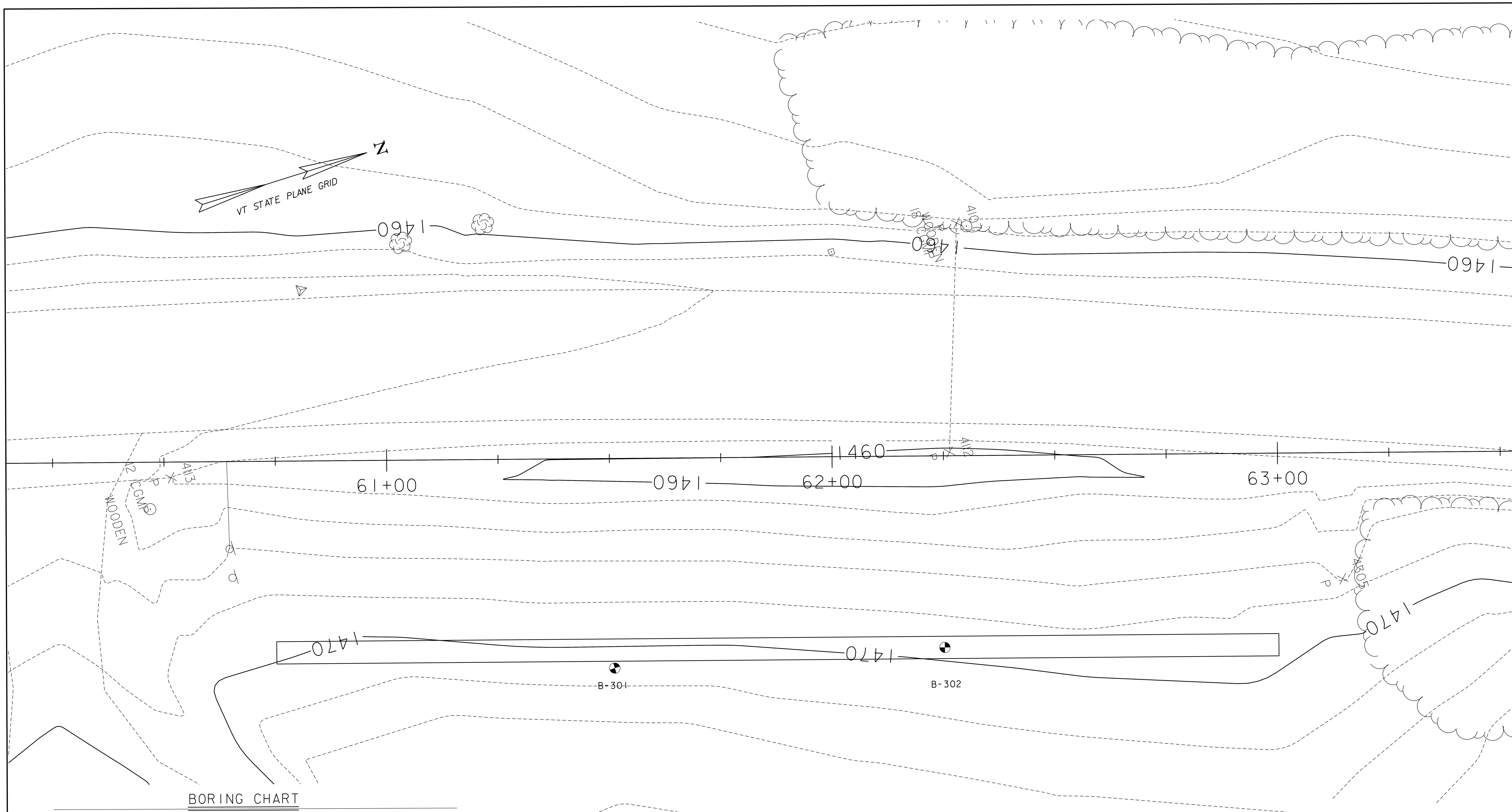
Embankment fills should be compacted to a dry density of at least 95% of the maximum dry density determined in accordance with AASHTO T-99. The current specification calls for 90%, however we are in the process of revising it to be 95% as recommended above. Granular Backfill for Structures, or other select materials placed within the roadway base section shall be compacted to a dry density of 95% of the maximum dry density determined in accordance with AASHTO T-99.

6.0 CONCLUSION

If any further analysis is needed or you would like to discuss this report, please contact us at (802) 828-2561. Computer generated boring logs are attached and available in the *M:\Projects\78d347\MaterialsResearch* folder.

Attachments: Boring Location Plan (1 page)
Boring Logs (3 pages)

cc: Casey Leach, VTrans Roadway
Electronic Read File/DJH
Project File/CEE
ZMH



BORING CHART

HOLE NO.	STATION	OFFSET (ft)	GROUND ELEV.	NORTHING	EASTING
B-301	61+50.00	43.00 RT	1471.1	685007.22	1703547.22
B-302	62+25.00	43.00 RT	1469.9	685078.88	1703547.22

SCALE 1" = 10'-0"
10 0 10

PROJECT NAME:	
PROJECT NUMBER:	
FILE NAME:	PLOT DATE: $$$$DATE$$$
PROJECT LEADER:	DRAWN BY: Zach Haffenreffer
DESIGNED BY:	CHECKED BY:
	SHEET OF

STATE OF VERMONT AGENCY OF TRANSPORTATION CONSTRUCTION AND MATERIALS BUREAU CENTRAL LABORATORY	BORING LOG **CABOT-DANVILLE** **FEGC-F 028-3(26) C/2** **US-2 BR-87**	Boring No.: **B-301** Page No.: 1 of 1 Pin No.: 78d347 Checked By: ZMH

Boring Crew: Judkins, Garrow, Coletti
Date Started: 5/24/16 Date Finished: 5/24/16
VTSPG NAD83: N 685007.22 ft E 1703547.22 ft
Station: 61+50 Offset: 43.00
Ground Elevation: 1471.1 ft

	Casing	Sampler
Type:	H.S.A.	SS
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: Diedrich 25 C_E = Unknown

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-4, SaSi, brn, Moist, Rec. = 1.9 ft, Lab Note: Wood fibers and pieces of wood were within sample	WH-2-3-7 (5)	25.7	7.1	43.1	49.8
2.5		A-4, SaSi, brn, Moist, Rec. = 1.9 ft	5-5-6-7 (11)	23.1	13.1	33.9	53.0
5.0		A-4, SaSi, brn, Moist, Rec. = 2.0 ft	3-3-4-4 (7)	18.9	7.1	37.7	55.2
7.5		A-4, SaSi, brn-gry, Moist, Rec. = 2.0 ft	2-2-4-7 (6)	20.7	5.9	42.1	52.0
		A-4, SaSi, brn, Moist, Rec. = 1.9 ft	2-4-5-5 (9)	20.2	7.6	39.4	53.0
10.0		A-4, SaSi, brn-gry, Moist, Rec. = 0.8 ft	5-R@3.5" (R)	14.5	14.0	39.5	46.5
		A-4, SiSa, brn, Moist, Rec. = 0.4 ft, Lab Note: Roots and plant material were within sample	R@5" (R)	20.3	16.7	49.9	33.4
12.5		Hole stopped @ 12.4 ft					
15.0							

Remarks:
Refusal with auger at 12.4 feet.

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 may occur due to other factors than those present at the time measurements were made.

STATE OF VERMONT AGENCY OF TRANSPORTATION CONSTRUCTION AND MATERIALS BUREAU CENTRAL LABORATORY	**BORING LOG** **CABOT-DANVILLE** **FEGC-F 028-3(26) C/2** **US-2 BR-87**	Boring No.: **B-301B** Page No.: 1 of 1 Pin No.: 78d347 Checked By: ZMH

Boring Crew: Judkins, Garrow, Coletti

Date Started: 5/24/16 Date Finished: 5/25/16

VTSPG NAD83:

Station: 61+51.7 Offset: 43.00

Ground Elevation:

	Casing	Sampler
Type:	WB	SS
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:	Diedrich 25	C_E = Unknown

Groundwater Observations

Date	Depth (ft)	Notes
05/25/16	3.8	W.T. after drilling
05/25/16	8.4	W.T. before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
12.7		Field Note:, NXDC, cleaned out casing, cobbles and boulders					
14		A-2-4, SiSa, gry-brn, Moist, Rec. = 1.4 ft	10-11-21-16 (32)	16.2	19.6	45.3	35.1
		Field Note:, Rollercone, cleaned out casing					
16		A-4, SiSa, gry, Moist, Rec. = 1.5 ft	8-11-12-17 (23)	17.9	10.6	47.7	41.7
18		A-2-4, SiSa, gry, Moist, Rec. = 1.5 ft	13-16-12-15 (28)	21.0	14.4	55.1	30.5
25		A-4, SaSi, gry, Moist, Rec. = 2.0 ft	10-15-19-23 (34)	26.6	0.6	39.2	60.2

Hole stopped @ 27.0 ft

Remarks:
Hole Collapsed at 20.3 feet.

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 may occur due to other factors than those present at the time measurements were made.

STATE OF VERMONT AGENCY OF TRANSPORTATION CONSTRUCTION AND MATERIALS BUREAU CENTRAL LABORATORY	BORING LOG **CABOT-DANVILLE** **FEGC-F 028-3(26) C/2** **US-2 BR-87**	Boring No.: **B-302** Page No.: 1 of 1 Pin No.: 78d347 Checked By: ZMH

Boring Crew: Judkins, Garrow, Coletti
Date Started: 5/25/16 Date Finished: 5/26/16
VTSPG NAD83: N 685078.87 ft E 1703569.87 ft
Station: 62+25 Offset: 43.00
Ground Elevation: 1469.9 ft

	Casing	Sampler
Type:	WB	SS
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: Diedrich 25 C_E = Unknown

Groundwater Observations

Date	Depth (ft)	Notes
05/26/16	5.3	W.T. before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-4, SaSi, brn, Moist, Rec. = 1.7 ft, Lab Note: Grass and grass roots were within sample	1-1-3-2 (4)	22.4	11.5	42.0	46.5
		A-4, SaSi, gry, Moist, Rec. = 1.8 ft, Lab Note: A lot of wood fibers and pieces of wood were within sample	2-3-2-2 (5)	29.9	6.9	46.3	46.8
5		A-4, SaSi, gry, Moist, Rec. = 1.8 ft	3-3-3-3 (6)	22.4	6.2	43.8	50.0
		Field Note:, Rollercone, cleaned out casing A-4, SaSi, gry-brn, Moist, Rec. = 2.0 ft	8-7-5-6 (12)	18.1	7.0	45.3	47.7
		A-2-4, SiSa, gry-brn, Moist, Rec. = 1.1 ft	6-6-7-7 (13)	18.1	10.7	55.1	34.2
10		A-2-4, SiSa, brn, Moist, Rec. = 1.3 ft	4-6-7-6 (13)	18.5	8.8	66.5	24.7
		A-4, SaSi, brn, Moist, Rec. = 1.3 ft	6-8-8-9 (16)	20.4	2.5	45.4	52.1
15		A-4, SaSi, gry, Moist, Rec. = 1.2 ft	6-5-7-9 (12)	26.1	0.4	35.6	64.0
		A-4, SaSi, gry, Moist, Rec. = 1.3 ft	5-4-6-9 (10)	27.0	3.4	41.9	54.7
		A-4, SaSi, gry, Moist, Rec. = 1.7 ft	6-8-10-12 (18)	25.9	1.1	45.4	53.5
20							
25		A-4, SiSa, gry, Moist, Rec. = 1.3 ft	8-10-11-14 (21)	22.5	4.7	50.2	45.1
		Hole stopped @ 27.0 ft					
30		Remarks: Hole collapsed at 13.2 feet.					

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 may occur due to other factors than those present at the time measurements were made.