Geotechnical Engineering Report

Northfield BF 0241 (58)
Replacement of VT-12 over the Dog River

PIN 19J223

Town of Northfield

Washington County, Vermont

Submitted to:

Vermont Agency of Transportation (VTrans)

Submitted by:

Hardesty & Hanover, LLC

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Vermont Agency of Transportation (VTrans)
Geotechnical and Foundation Report

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Northfield, Vermont

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1.0 Introduction

1.1 Project Scope

The following presents the Geotechnical and Foundation Report for the Replacement of Bridge 60 over Dog River in Northfield, Vermont. This report has been prepared by Hardesty & Hanover, LLC (H&H) in accordance with the terms of the project agreement and based on the current Vermont Agency of Transportation (VTrans) and AASHTO LRFD Bridge Design Specification guidelines.

The scope of work for this report included:

- General description of the project, its elements, and a project background.
- Review of the current site conditions.
- Review and description of the regional and site geology.
- Review and summary of historic records for the project site.
- Summary of the field explorations conducted.
- Summary of the laboratory testing program conducted.
- Description of the project soil/rock conditions, including any geological hazards.
- Geotechnical recommendations for the bridge and wingwall foundations.
- Discussion of construction related considerations.

1.2 Project Description

The existing bridge runs north-south carrying Vermont State Route 12 through Northfield, Vermont. It was constructed in 1926 and consists of a 3-span T-beam cast in place concrete deck bridge approximately 111 feet in length, supported on spread footings. In 1958, the bridge underwent widening. The bridge currently carries 1 lane of traffic in each direction, as well as a shoulder and sidewalk on both sides. It is located approximately 1.1 miles north of the intersection of VT Route 12 and VT Route 12A. A site location map and aerial photography of the site can be seen in Figure 1-1 and Figure 1-2 below.

Overall, the existing structure was determined to require replacement to meet project goals. The proposed structure will consist of a single span bridge 140 feet in length supported by integral abutments.

Figure 1-1: Site Location Map
Source: U.S. Geological Survey, 1:24000

Figure 1-2: Site Location Aerial Imagery
Source: Google Earth

2.0 Subsurface Exploration

Existing subsurface information for the project site was limited, and not considered reliable for design. Therefore, a subsurface exploration program was developed to obtain soil and rock design parameters for engineering analyses at the locations of the proposed substructure foundations. The subsurface exploration program included borings and laboratory testing of the collected samples, as well as geophysical testing to further understand the top of rock profile at the areas of interest.

2.1 Subsurface Exploration Program

In total, 10 borings were conducted over 7 working days. New England Boring Company was retained to perform all the borings. Six (6) of the conducted borings (differentiated by the "B-" prefix) followed the sampling procedure Standard Penetration Test (SPT), using techniques and equipment specified in ASTM Standard D1586. All split spoon samples were classified in the field by a qualified inspector according to the Burmeister Classification System. The remaining four (4) borings (differentiated by the "H-" prefix) were conducted for environmental sampling. The environmental sampling was supervised by representative of Atlas Technical Consultants, LLC. Refer to the Subsurface Investigation Report for further details regarding the environmental sampling procedures.

Borings B-101, B-102, and B-103 were advanced on VT Route 12 (Main St.) behind the existing south abutment. Boring B-105 was advanced on VT Route 12 behind the existing north abutment, boring B-104 was advanced at the nearby gas station parking lot north of the existing north abutment, and B-106 was advanced off the road on unpaved ground behind the existing north abutment. All the borings, with the exception of B-101, were terminated after 10 feet of rock coring. B-101 was abandoned prior to termination due to broken casing at the bottom of the hole. B-101A was terminated after the required environmental samples were collected. All rock coring was conducted using an NX size core barrel.

Borings advanced within VT Route 12 and the nearby parking lot were restored to original conditions and patched with concrete upon backfilling. A boring location plan, boring logs, and associated subsurface profiles can be found in Appendix A.

2.2 Geophysical Testing

Geophysical testing was also conducted in order to gain additional information related to the subsurface conditions at the project site. Seismic Refraction Testing, performed by Hager Richter Geoscience, was conducted at four (4) locations within the project site in order to obtain a better understanding of the depth and slope of the bedrock behind each abutment. Figure 2-1 shows the

locations of the 4 testing locations. Refer to Appendix C for the testing techniques and associated report from Hager Richter Geoscience.

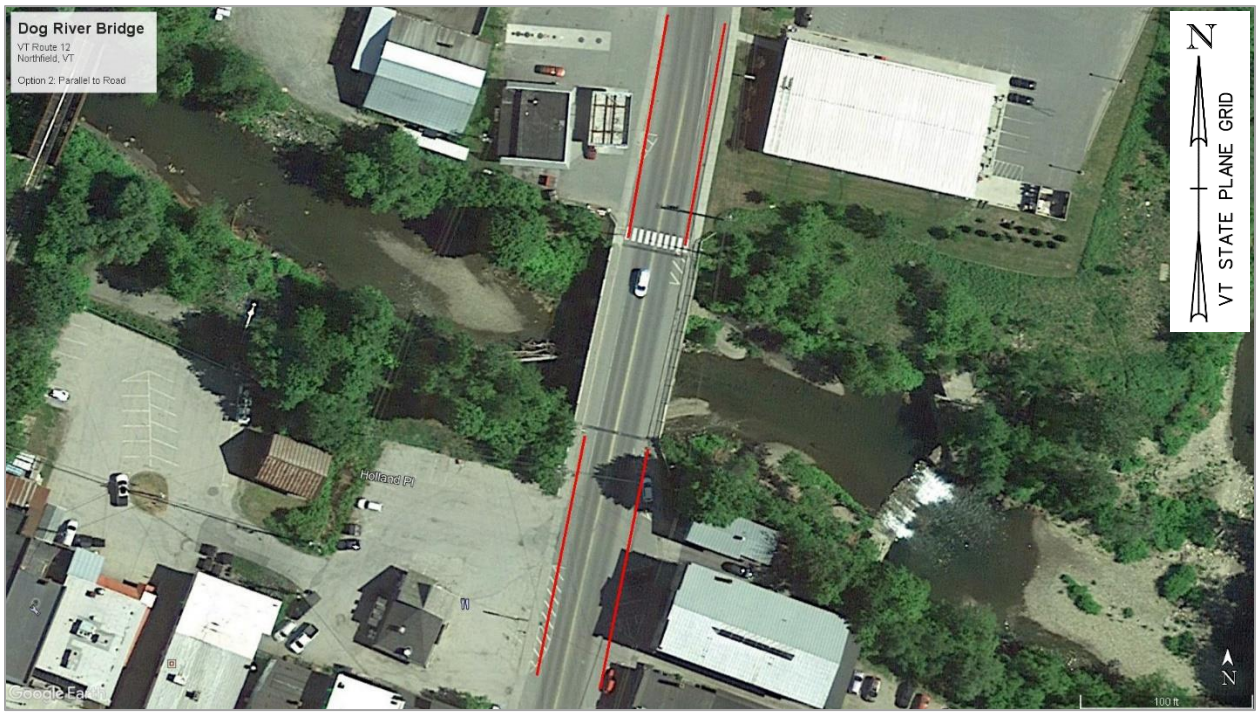


Figure 2-1: Seismic Refraction Testing Locations
Source: Google Earth

2.3 Laboratory Testing

Twenty-one (21) soil samples representative of the soil layers observed were selected for additional geotechnical laboratory testing to provide soil classification/identification and/or geotechnical engineering property data. Additionally, five (5) rock cores were selected for testing to provide the necessary geotechnical engineering properties for design.

The laboratory testing program included:

- Moisture Content (ASTM D2216)
- Atterberg Limits (ASTM D4318)
- Grain Size Analysis (ASTM D6913)
- Grain Size Analysis with Hydrometer (ASTM D6913/D7928)
- Unconfined Compressive Strength (ASTM D7012)
- pH (ASTM G51)
- Sulfate Content (ASTM D516)
- Chloride Content (ASTM D512)
- Resistivity (ASTM G57)

GeoTesting Express of Acton, Massachusetts performed the laboratory testing program on the selected samples. The results of the testing program can be found in Appendix B.

3.0 Subsurface Conditions

3.1 Regional Geology

According to the Bedrock Geologic Map of Vermont published in 2011, prepared by the United States Geological Survey (USGS), the project site lies within the Cram Hill Formation – Undivided (Ochu). The Cram Hill Formation consists of dark-gray to grayish-green quartz-chlorite-(biotite)-muscovite phyllite. It contains 1 to 2 centimeter thick beds of dark-gray metasiltstone and quartzite, as well as thicker beds of dark-bluish-gray vitreous quartzite, grayish-green to light-yellowish-green sericite phyllite, and cobble to boulder conglomerate and greenstone. Refer to Figure 3-1.

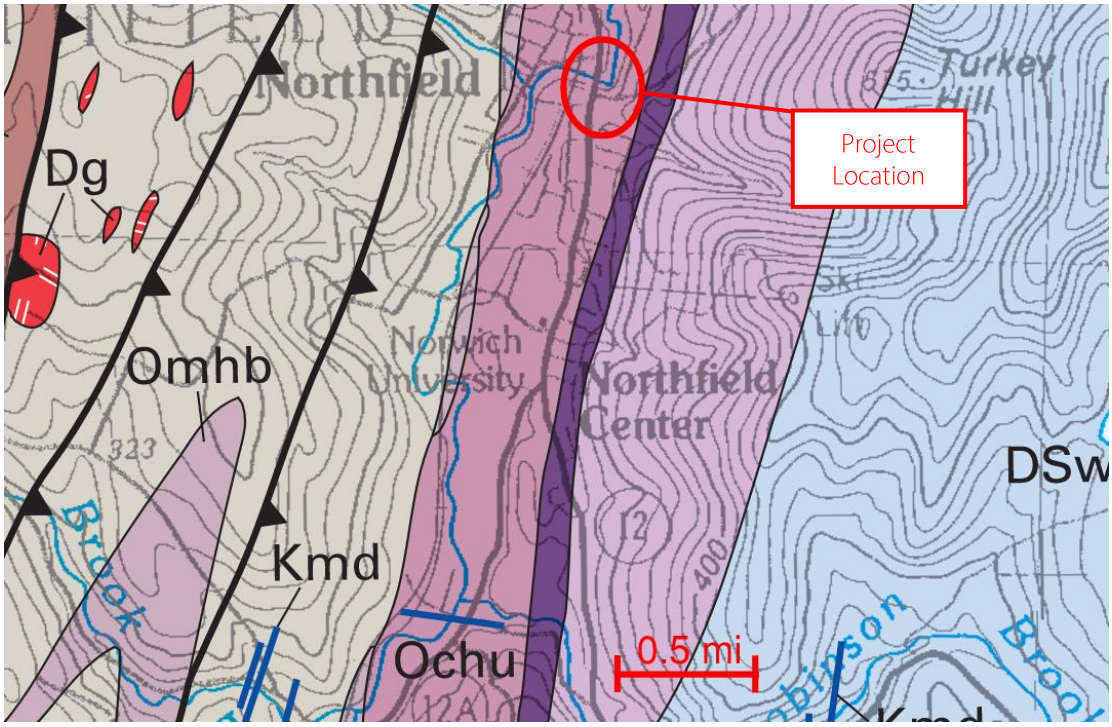


Figure 3-1: Regional Bedrock Geology
Source: United States Geologic Survey, VTrans

According to the Surficial Geologic Map of Vermont, published in 1970, the soils at the project site generally consist of Postglacial Fluvial deposits. These deposits contain fluvial sands and gravels and are generally found along the banks of the Dog River, bounded by Route 12A to the South and Northfield Falls to the North. Refer to Figure 3-2.

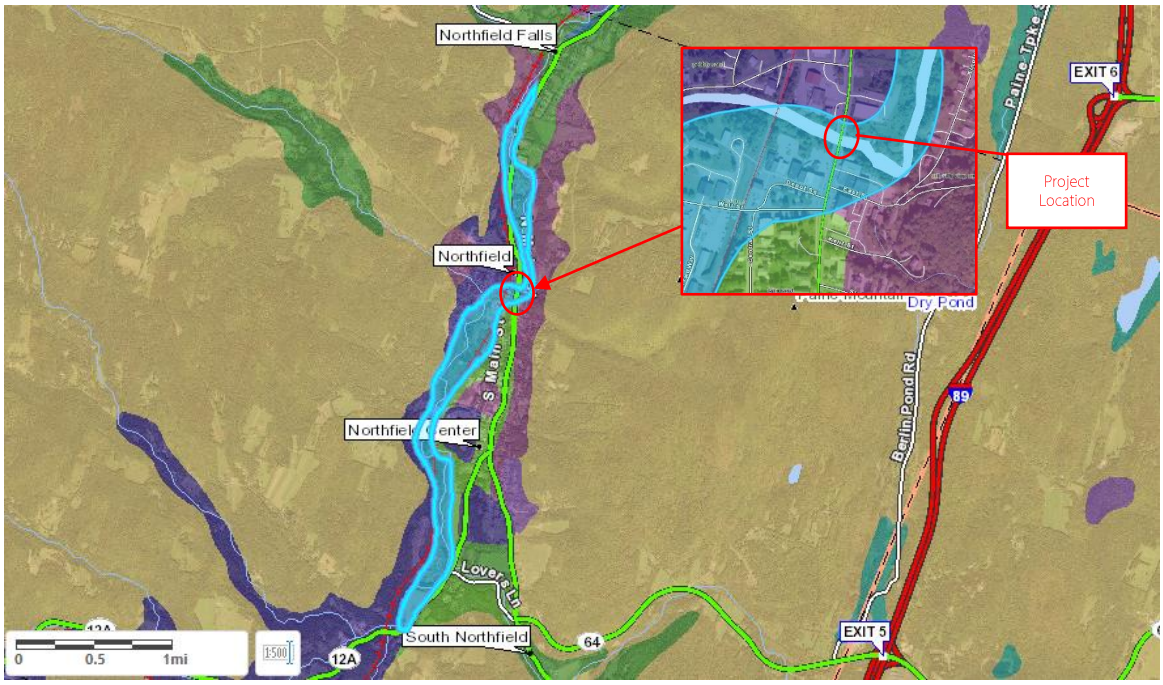


Figure 3-2: Regional Surficial Geology
Source: United States Geologic Survey, VTrans

3.2 Stratigraphy

This section summarizes the general subsurface conditions within the project limits. The subsurface stratigraphy determined from the borings along the project alignment is consistent with the regional geology. Due to the complex nature of the subsurface soil, the boundaries between different soil strata are not clearly defined, and the soil properties and thickness of each stratum are anticipated to vary. The general strata descriptions are summarized in the order they were encountered.

For engineering purposes, the subsurface stratigraphy has been generalized into two (2) distinct soil strata overlying bedrock based on soil classification, index properties, and engineering design properties.

All borings advanced through VT Route 12 encountered a surficial layer of asphalt approximately 6 inches thick. B-102 and B-103 on the southern end of the project site encountered an additional 1.5 feet of reinforced concrete immediately following the asphaltic pavement layer.

COHESIONLESS FILL – At the ground surface, or immediately following the asphalt/concrete, a heterogeneous layer of man-made fill was encountered. According to the Burmeister Soil Classification System, the fill material consists of coarse-to-fine sands with varying percentages of coarse-to-fine gravel and fine-grained material. Wood and cobbles were also encountered at some

locations. This stratum varies in relative density from loose to very dense, and generally varies from 6 feet to 20 feet in thickness throughout the project site.

FLUVIAL DEPOSITS – Underlying the Fill layer, a layer of Fluvial Deposits consisting of coarse-to-fine grained sands and medium-to-fine grained gravels, with varying percentages of fine-grained material, was encountered throughout the project site. The relative density of this layer generally varies from loose to very dense, per field SPT data. The thickness of this stratum varies in thickness from 8 feet to 15 feet throughout the project site.

BEDROCK – Bedrock was encountered throughout the project site, ranging in depth from 25 feet to 30 feet below the road surface. Generally, the bedrock is shallower behind the North abutment and deeper behind the South abutment. Bedrock depth and slope was confirmed with the geophysical testing described in Section 2.2. The bedrock samples retrieved indicate the rock type as Grey Phyllite. Some cores included small pockets of quartzite as well. The bedrock can generally be described as slightly to highly weathered, intensely to slightly fractured, moderately soft to moderately hard rock with coarse-to-fine grains, and a dip angle between 0° and 90° with respect to the vertical axis of the cores. The majority of the samples were classified as moderately weathered, moderately fractured, moderately soft rock. Recovery varied from 87% to 100% and RQD varied from 13% to 95%, with most being between 45% and 67%.

3.3 Engineering Parameters

The geotechnical engineering parameters required for design and analysis have been developed based on the SPT data and/or laboratory testing results collected across the project site, along with our professional engineering judgement. These parameters are presented in Table 3-1 below.

Table 3-1: Estimated Geotechnical Engineering Parameters

Stratum	Total Unit Weight (pcf)	Friction Angle (degrees)	Unconfined Compressive Strength (ksf)
Fill	120 – 125	32 – 35	--
Fluvial Deposits	125 – 130	34 – 38	--
Bedrock	167 – 176	--	400 – 3,075

3.4 Groundwater Observations

Two (2) monitoring wells were installed at the project site for environmental testing of the groundwater. The wells were installed in B-104MW, located adjacent to B-104, and H-101MW, located adjacent to H-101 on September 24, 2021 and September 28, 2021, respectively. Water depth was measured in B-104MW at a depth of 18.6 feet (EL. 710.96) approximately 96 hours after well installation.

Groundwater depth is expected to roughly coincide with the water level of the Dog River, as well as vary with seasonal changes and annual variations in precipitation. The location of the monitoring wells can be seen on the Boring Location Plan in Appendix A.

3.5 Corrosion Potential

AASHTO Section 10.7.5 outlines the below guidelines for soil conditions that indicate potential pile deterioration or corrosion.

- Resistivity less than 2,000 ohm-cm
- pH less than 5.5
- pH between 5.5 and 8.5 in soils with high organic content
- Sulfate concentrations greater than 1,000 ppm

Laboratory test results indicate pH values ranging from 6.29 to 6.37, resistivity values ranging from 3,926 to 4,959 ohm-cm, sulfate concentration ranging from 16 to 48 ppm, and chloride content ranging from <10 to 10 ppm. **Per the AASHTO guidelines above, the laboratory corrosivity test results indicate that the soils on site exhibit negligible corrosivity.**

3.6 Scour

As instructed from the VTrans project team, the scour depth shall be considered to top of bedrock such that there is no overburden soil present at the abutment pile locations.

As for the wingwalls, no scour losses were considered as scour countermeasures are proposed in front of each wingwall, meeting VTrans Structures Design Manual Section 10.2.2.

4.0 Site Seismicity

Per the VTrans Structure Design Manual Section 3.8.2, as well as AASHTO Section 4.7.4.3, a single span bridge does not require a seismic analysis.

4.1 Site Class Characterization

Following the current AASHTO seismic site characterization guidelines in Section 3.10.3.1, the seismic site class of the project site was determined to be Site Class D, based on the soil characteristics determined through the subsurface investigation program, subsequent laboratory testing program and proposed foundation type.

4.2 Liquefaction Analysis

A screening procedure was initiated to evaluate whether a liquefaction analysis was necessary for the project site, following FHWA-NHI-11-032. The need to perform a liquefaction evaluation is a function of the Seismic Hazard Level of the bridge, which depends on the spectral acceleration adjusted per the Site Class at both 1 second (S_{D1}) and 0.2 second (S_{DS}).

Horizontal acceleration coefficients for the project location were determined using resources provided by the United States Geological Survey. Using the ASCE-7 Hazard Tool, endorsed on the USGS website, site class adjusted spectral acceleration at 0.2s (S_{DS}) and 1s (S_{D1}) were referenced as 0.22 and 0.091, respectively. A full report from the ASCE-7 Hazard Tool is available in Appendix D. These seismic parameters reflect Hazard Level 2 per FHWA-NHI-11-032 Table 6-1. Therefore, as per Section 6.3.1 of the FHWA publication, evaluation of the liquefaction potential is not required.

5.0 Bridge Foundations

This section summarizes the geotechnical analysis and provides foundation recommendations for use during design of the proposed VT Route 12 Bridge over Dog River and are based on the available subsurface investigation. The design philosophy follows the 2020 AASHTO LRFD Bridge Design Specifications 9th Edition and VTrans guidelines.

5.1 Design Procedures and Assumptions

The design of the integral abutment pile foundations is based on the following procedures and assumptions:

- Design pile axial capacity considering only skin friction from the grouted socket embedded in bedrock while neglecting end bearing and skin friction along the pile above the rock socket.
- Design pile axial capacity considering a resistance factor of 0.50 for side resistance in rock.
- Establish a minimum pile tip elevation such that the pile satisfies the requirements of AASHTO Section 10.7.6 and the VTrans Integral Abutment Bridge Design Guideline Section 10.2.2.3.
- Piles will be spaced at least 3 diameter-widths apart, center-to-center. Apply P-multipliers for evaluation of lateral capacity of pile groups.
- Consider a pile thickness loss of 1/16" to account for potential effects of corrosion to the web/flange thicknesses and flange width of the non-grouted pile sections. The full pile section was used for the grouted portion of the pile.
- Estimate rock socket length to meet the required nominal capacity by using the O'Neill and Reese, 1999 (AASHTO LRFD 10.8.3.5.4b) method to compute the unit side resistance of the grouted rock socket.
- Scour depth considered to top of bedrock due to the design flood.

The design of Wingwalls 2 & 3 as Soldier Pile & Lagging Walls is based on the following procedures and assumptions:

- Piles will be spaced at least 2.5 diameter-widths apart, center-to-center. Apply P-multipliers for evaluation of lateral capacity of pile groups.
- Consider a pile thickness loss of 1/16" to account for potential effects of corrosion to the web/flange thicknesses and flange width of the non-grouted pile sections. The full pile section was used for the grouted portion of the pile.
- Top of rock was assumed to be the elevation it was encountered in the nearest boring to each wingwall.
- No scour considered due to the presence of stone fill keyed into the riverbed as scour protection.

- Subsurface Information at the proposed wingwall locations was limited; the nearest bridge boring to the proposed wingwall was utilized for design purposes.

The bearing capacity calculations for the locations of Wingwalls 1 & 4 are based on the following procedures and assumptions:

- Bearing capacity calculations follow the procedure outlined in AASHTO LRFD BDS Section 10.6.3.1.2a – Basic Formulation.
- A factored bearing resistance factor of 0.45 was applied to the ultimate unit bearing capacities, per AASHTO LRFD Table 10.5.5.2.2.1.
- No scour was considered for the wingwalls along the Dog River due to the presence of stone fill keyed into the riverbed as scour protection.

5.2 Foundation Design and Recommendations

5.2.1 Bridge Abutments

The replacement structure will be supported on 2 integral abutments. The piles will be placed such that the webs of the piles are perpendicular to the centerline of the girders to allow for a flexible foundation system to accommodate the daily and annual thermal expansion/contraction of the superstructure.

Per the VTrans Integral Abutment Bridge Design Guidelines, the design methodology of the integral abutments will follow the "simplified method". This approach is commonly used for VTrans integral abutments, and typically leads to a slightly more conservative design than a more detailed and rigorous design process.

Lateral load analyses on a single pile were performed using the L-Pile software program. L-Pile utilizes the "p-y" method for single pile analyses. This method computes the lateral response of the foundation due to the design loads. The reaction of the soil surrounding the pile is replaced with a series of discrete non-linear springs. The forces created due to soil resistance develops as a function of lateral deflection, which determines behavior of the pile under loading. The development of the p-y curves was selected based on the information gathered from the subsurface exploration program.

Across the project site, bedrock is encountered at a shallow depth relative to the proposed foundation elevation. Driving the piles to the top of bedrock does not provide the necessary penetration into the bearing soils to obtain fixity for resisting the applied lateral loads to the foundation as described in AASHTO LRFD Section 10.7.6, especially when potential scour losses are considered. In order for these piles to obtain fixity, they will need to be installed into 24-inch predrilled holes that extend into bedrock. After the pile is seated in the pre-bored hole, the rock socket, up to the required socket length, will be backfilled with non-shrink grout, and the rest of the hole will be backfilled with cushion sand.

Since the piles will be placed in a pre-excavated hole and the rock socket will be grouted, the pile capacity will be controlled by the skin friction of the grouted socket. The skin friction along the pile

above the rock socket and the end bearing of the socket will be ignored. Per AASHTO LRFD Equation 10.8.3.5.4b-2, the nominal skin friction of the grouted socket in fractured rock is calculated using the following equation. Based on the subsurface conditions encountered at the project site, a nominal unit side resistance value of 15 ksf was used for the rock sockets.

$$\frac{q_s}{p_a} = 0.65 * \alpha_E * \sqrt{\frac{q_u}{p_a}}$$

Where:

$$q_s = unit\ side\ resistance\ (ksf)$$
$$p_a = atmospheric\ pressure = 2.12\ (ksf)$$
$$\alpha_E = joint\ modification\ factor\ \textit{(AASHTO LRFD Table 10.8.3.5.4b-1)}$$
$$q_u = uniaxial\ compressive\ strength\ of\ rock\ (ksf)$$

Following the guidelines in the VTrans Integral Abutment Design Manual (2nd Edition), Section 4.5.2.1.4, fixity of these piles is achieved at a depth of 18 feet below the pile cap (EL 699.5) at the South Abutment, and a depth of 13 feet below the pile cap (EL 703.5) at the North Abutment. The recommended pile size, axial load recommendations, and estimated tip elevations can be seen in Table 5-1 below.

Table 5-1: Integral Abutment Pile Recommendations

Substructure Unit	Pile Size	Rock Socket Diameter (in)	Max. Factored Axial Load (kips)	Axial Resistance of Grouted Socket (kips)		Minimum Rock Socket Length (ft)	Estimated Pile Tip Elevation (ft)	Assumed Top of Rock Elevation	Estimated Pile Length (ft)
				Nominal	Factored				
South Abutment	HP 12x84	24	319	655	325	7	691.5 - 693.5	698.5 - 700.3	26.0 – 28.0
North Abutment	HP 12x84	24	320	655	325	7	694.6 - 699.0	701.6 – 706.0	19.5 – 23.95
Notes: Per the VTrans Integral Abutment Design Manual (2nd Edition) Section 10.2.2.3, a minimum pile length of 16 feet shall be maintained.									

The factored axial resistance in the table above corresponds to a factor of 0.50 for side resistance in rock, following Carter and Kulhawy. in AASHTO LRFD Table 10.5.5.2.4-1. Detailed geotechnical analysis of the abutment piles can be found in the Geotechnical Calculation Package submitted under a separate cover.

5.2.2 Wingwalls 2 & 3

Due to a variety of site constraints including, but not limited to, access difficulty, proximity to vibration-sensitive structures, and nearby utilities, Wingwalls 2 & 3 are proposed to consist of a Soldier Pile & Lagging Walls installed in predrilled holes socketed in bedrock with a cast-in-place concrete facing along the exposed portion of the wall.

Throughout the project site, bedrock is encountered at relatively shallow depths relative to the bottom of the proposed wall face. For this reason, driving the piles to the top of bedrock does not provide the necessary penetration to support the exposed portion of the wall or for the piles to obtain fixity. The portion of the predrilled socket in bedrock will be backfilled with non-shrink grout, and the rest of the hole will be backfilled with cushion sand. See table 5-2 below for the soldier pile and lagging wall recommendations. If bedrock is encountered 5-ft or greater below the estimated top of rock elevation and above the maximum pile tip elevation in soil shown values in Table 5-2 below, the contractor shall notify the engineer. Drilling operations shall cease if rock is not encountered upon reaching the maximum pile tip elevation in soil value shown in Table 5-2, and the pile may be terminated at that elevation.

Table 5-2: WW2 & WW3 Soldier Pile & Lagging Wall Recommendations

Wall Location	Recommended Pile Section	Minimum Required Moment of Inertia[(1)] (in^4)	Minimum Required Section Modulus[(1)] (in^3)	Minimum Drill Hole Diameter (in)	Estimated Top of Rock Elevation (ft)[(2)]	Required Rock Socket Length (ft)	Estimated Pile Tip Elevation in Rock (ft)	Maximum Pile Tip Elevation in Soil (ft)
WW2	HP14X102 50 ksi	1050	150	30	700.3	7	693.3	690.0
WW3	HP14X102 50 ksi	1050	150	30	701.6	7	694.6	690.0

Notes:

1. *Minimum Required Moment of Inertia and Section are related to the steel section only, and not the composite section of the soldier pile and grout.*
2. *Estimated depth of bedrock taken from nearest boring conducted for the proposed bridge abutments and is subject to variations. Due to the length of WW3, it is recommended that additional subsurface exploration along the length of the wall be conducted prior to construction.*

5.2.3 Wingwalls 1 & 4

Wingwalls 1 and 4, on the Southwestern and Northeastern corners of the bridge respectively, are proposed to be 13 feet in length. These wingwalls are proposed to be comprised of prefabricated retaining wall elements designed by the Contractor. Estimated unit bearing capacities have been calculated for these structures following the guidelines for the general bearing capacity equation outlined in AASHTO LRFD Section 10.6.3.1.2. Calculations detailing the determination of the unit bearing capacities can be found in the Geotechnical Calculation Package submitted under a separate cover. Per AASHTO LRFD Table 10.5.5.2.2.1, a resistance factor of 0.45 was used. A range of nominal unit bearing and factored unit bearing capacities for Wingwalls 1 and 4 can be seen in Figure 5-1 below.

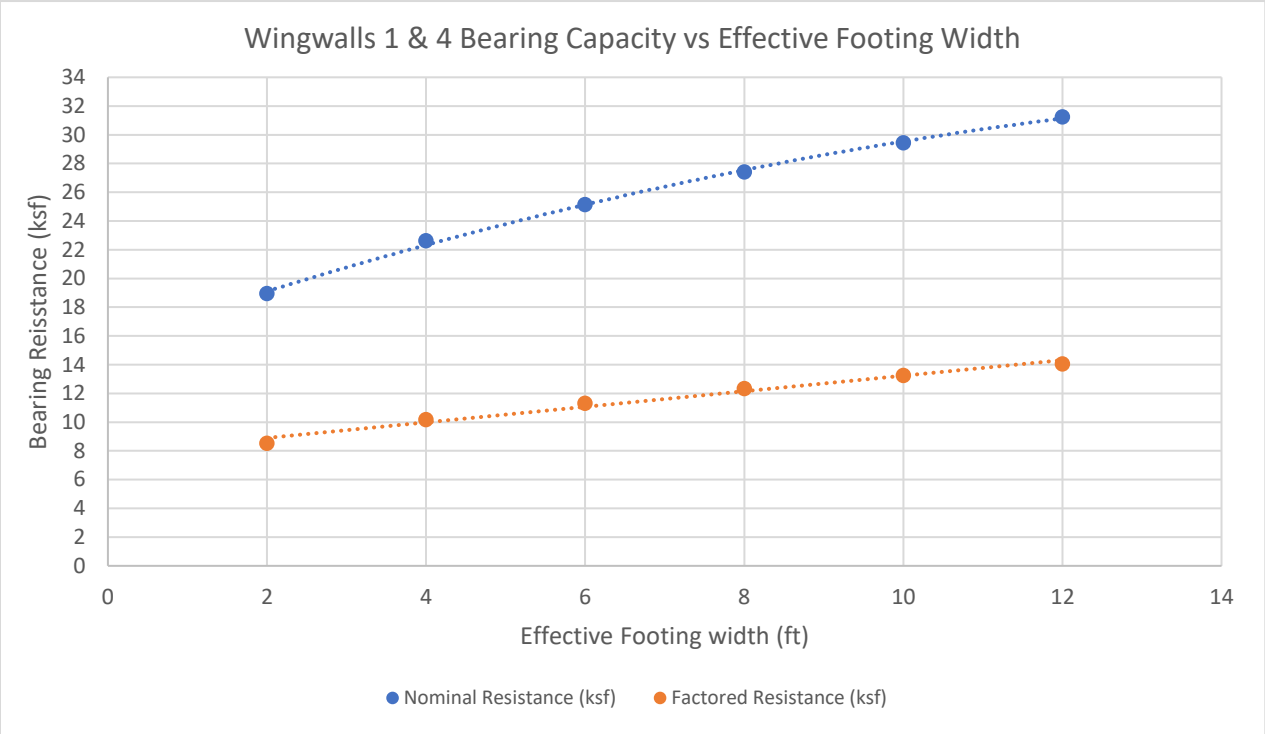


Figure 5-1: Wingwalls 1 & 4 Effective Bearing Capacities

Given the favorable site soil conditions, as summarized in Sections 3.2 and 3.3, geotechnical settlement or instability of the wingwalls is not a concern. Additionally, global stability of the wingwalls was determined not to be a design concern as the spread footings will be bearing on soil overlying bedrock at relatively shallow depths below the foundation. The following material properties described in Table 5-3 should be utilized for the design of a prefabricated retaining wall system:

Table 5-3: Prefabricated Retaining Wall System Recommended Material Properties

Material/Location	Unit Weight (psf)	Friction Angle (degrees)
Backfill behind wingwalls	120	30
Infill between precast units & foundation soil	125	34

5.2.4 Sign Structure Foundation

At the northwestern corner of the proposed structure, there is an existing sign for the business adjacent to the bridge that will be required to be relocated temporarily during construction. The temporary sign will be supported on a spread footing to be designed by the Contractor. The design of the proposed spread footing should meet the following criteria:

- The bottom of the spread footing shall be a minimum of five (5) feet below the ground surface, per VTrans requirements for frost susceptible soils.
- Due to the close proximity to the existing water main, the contractor shall verify its depth and location in the field prior to installation of the sign structure foundation. If the location or depth of the water main is found to differ from the location shown on the project plans, notify the Engineer of Record before proceeding with construction of the spread footing.
- It is assumed that the adjacent Wingwall 3 will be constructed prior to the proposed sign structure spread footing.
- The proposed footing should be positioned such that a minimum of two (2) feet clear distance is maintained between the footing and the adjacent water main.
- It is assumed that the material above and below the spread footing will have a unit weight of 120 pounds-per-square-foot (psf) and a friction angle of 30°.
- The spread footing is assumed to be three (3) feet wide. The contractor shall design the length of the footing as necessary for the bearing resistance provided below and to resist sliding and overturning forces.
- If any deviations from the above criteria/assumptions are determined to be required by the contractor, the proposed deviation(s) should be submitted to the Engineer of Record for approval.
- Following AASHTO Table C10.6.2.5.1-1, an allowable bearing resistance of 4 kips per square foot should be considered for the proposed sign structure spread footing.

6.0 Construction Considerations

6.1 Potential Obstructions

Based on the subsurface conditions described in Section 3.2, obstructions may be encountered during excavation and foundation construction. These obstructions may include, but are not limited to, unclassified fill, timber, and construction debris, including but not limited to concrete remnants of previous construction, and existing bridge foundation elements. Boulders and cobbles may be encountered as well during excavation and foundation construction. Construction procedures should consider such obstructions and develop contingencies if obstructions are encountered.

6.2 Pre-Bored Pile Installation

Due to the shallow depth to bedrock across the project site, all piles supporting the abutments and soldier piles are to be installed into pre-bored holes sunk into bedrock to achieve the required minimum tip elevation. The pre-bored holes should be constructed with temporary casing. The casing shall have a smooth wall and sufficient strength to resist damage and deformation from installation, and all pressures acting on the casing. Additionally, it should be noted that the bedrock within the project limits exhibits vertical joints/vertical plating. Appropriate means and methods of construction to successfully excavate the rock socket and keep the rock socket from caving and/or sloughing shall be considered.

The following notes shall be considered for the pre-bored pile installation:

1. Frequent checks of the plumbness, alignment, and dimensions of the hole should be taken during drilling.
2. The interior of the pre-bored hole should be thoroughly clean of soil and debris prior to the lowering of the pile. A weighted tape should be used to inspect the bottom of the hole for cleanliness.
3. The piles shall be lowered into the hole oriented such that the web of the pile is perpendicular to the centerline of the girders for the abutment piles, and perpendicular to the face of the wingwall for the soldier piles.
4. Following the placement of the pile, the annulus around the pile tip within the rock socket should be filled with non-shrink grout using tremie to place grout underwater from the pile tip elevation to 2 feet above the top of the rock socket (tip of the casing). The remainder of the annulus can be filled with cushion sand.

6.3 Construction Monitoring

The proposed foundation construction generates a low level and short duration of vibration, however some vibration/displacement is unavoidable. Therefore, prior to commencing any construction activities, it is recommended that a pre-construction survey of all adjacent facilities within 100 feet of the existing bridge take place, using photographs, videos, and sketches to

document the existing condition of the structures. The scope and detail of the survey should be enough to serve as a reference for comparison should evidence of damage be observed during and/or after construction has taken place.

At least 2 weeks prior to the start of any construction operations, baseline displacement and vibration readings will be required at any existing structures, including the existing bridge substructures, and utilities within 100 feet of planned construction activities. The baseline survey shall be carried out by a qualified Vibration Specialist. Per the baseline survey, the Vibration Specialist will establish safe vibration and displacement limits for any existing structures and utilities within 100 feet of planned construction activities throughout the project duration. If these thresholds are exceeded, the contractor shall be immediately alerted to stop work and adjust/reevaluate their means and methods to prevent damage of any existing structure(s).

Instruments anticipated to be employed include, but are not limited to, the following:

- Vibration Monitors
- Deformation Monitoring Points
- Tilt Monitors
- Grid Crack Gages

6.4 Temporary Excavations

Depending on spatial limitations, support of excavation may be required for the demolition of the existing structure and/or the construction of the proposed abutments, wingwalls, and sign structure. If the spatial constraints permit, the contractor may slope back the excavation. However, any excavation deeper than 5 feet where this is not possible will require a temporary support of excavation system. The contractor will be responsible for the design of the excavation support systems, and the design and detailing of the systems shall be performed by a licensed Professional Engineer in the State of Vermont.

Prior to commencing any excavation activities, the contractor shall locate all adjacent foundations and utilities. During excavation, all adjacent utilities must be protected from damage. Table 3-1 in Section 3.3 of this report shows the recommended soil parameters for the design of the temporary support of excavation elements.

7.0 Geotechnical Limitations

This final report has been prepared on behalf of and for the exclusive use of VTrans for specific application to the named project as described herein. If this report is provided to prospective contractors, it should be made clear that the information is provided for factual data only and not as a warranty of subsurface conditions included in this report.

Hardesty & Hanover, LLC has attempted to conduct the services reported herein in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. The recommendations and conclusions contained in this report are professional opinions. No other representation, expressed or implied, is included or intended in this document.

The conclusions and recommendations given in this report are based on: a) available as-built foundation information and b) interpretation of subsurface exploration data and c) Hardesty & Hanover's experience. It must be recognized that there are uncertainties on the current condition of the existing substructure since they are unable to be inspected and that variations may occur from conditions observed in the borings, particularly within existing fills or previously developed areas. Design recommendations are based on data from borings, sampling, and related procedures. Actual subsurface conditions may vary from those encountered in the borings. Therefore, design recommendations are subject to adjustment in the field based on subsurface conditions encountered during construction. Hardesty & Hanover, LLC is not responsible for the conclusions, opinions or recommendations made by others based on these data.

The analyses, conclusions and recommendations contained in this report are based on, data obtained from the subsurface exploration. The field exploration methods used indicate subsurface conditions only at specific locations where samples were obtained, only at the time they were obtained and only to the depths penetrated. Discrete sampling cannot be relied on to accurately reflect natural variations in stratigraphy that may exist between sample locations. The recommendations included in this report have been based in part on assumptions about natural variations in site stratigraphy that may only be completely evaluated during earthwork and foundation construction. Unanticipated soil or rock conditions may require that additional expense be incurred to attain a properly constructed project.

The conclusions or recommendations in this report should not be used if the nature, design or location of the facilities are changed or if there is a substantial lapse in time between the submittal of this report and the start of work at the site. If changes are contemplated, or if significant time lapse occurs, Hardesty & Hanover, LLC must review them to assess their impact on this report's findings, conclusions, and/or design recommendations. Hardesty & Hanover, LLC will not be responsible for any claims, damages, or liability associated with any other party's interpretations of this report's subsurface data or reuse of this report's subsurface data or engineering analyses.

Hardesty & Hanover's scope of geotechnical services for this phase of the project did not include any environmental assessment or investigation for the presence of wetlands or hazardous or toxic material in the soil, surface water, groundwater, or air on, below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

8.0 References

- *AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.*
- *VTrans Integral Abutment Bridge Design Guidelines, 2nd Edition, 2008.*
- *VTrans Structures Design Manual, 5th Edition, 2010.*
- *Federal Highway Administration, "Design and Construction of Driven Pile Foundations – Volume 1" NHI Courses 132021 and 132022, Geotechnical Engineering Circular 12 (FHWA-NHI-16-009), July 2016.*
- *Federal Highway Administration, "Drilled Shafts: Construction Procedures and Design Methods" NHI Course 132014, Geotechnical Engineering Circular No. 10 (FHWA-NHI-18-024), September 2018.*
- *Federal Highway Administration, "Shallow Foundations" Geotechnical Engineering Circular No. 6 (FHWA-SA-02-054), September 2002.*
- *VTrans MREI 11-01 – Geotechnical Guidelines for the Subsurface Investigation Process, 2011.*
- *U.S. seismic design maps. U.S. Geological Survey. (n.d.), from https://earthquake.usgs.gov/hazards/designmaps/usdesign.php*
- *Federal Highway Administration, "LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations" Reference Manual for NHI Course 130094, Geotechnical Engineering Circular No. 3 (FHWA-NHI-11-032), August 2011.*
- *ASCE-7 Hazard Tool, asce7hazardtool.online, 2021.*
- *Ratcliffe, N.M., Stanley, R.S., Gale., M.H., Thompson, P.J., and Walsh, G.J., 2011, Bedrock geologic map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 sheets, scale 1:100,000.*
- *Doll, C. G., 1970, Surficial Geologic Map of Vermont, Vermont Geological Survey, Montpelier, VT.*

Appendix A: Boring Location Plan, Boring Logs, & Subsurface Profiles

SOIL CLASSIFICATION

AASHTO	
A1	Gravel and Sand
A3	Fine Sand
A2	Silty or Clayey Gravel and Sand
A4	Silty Soil - Low Compressibility
A5	Silty Soil - Highly Compressible
A6	Clayey Soil - Low Compressibility
A7	Clayey Soil - Highly Compressible

ROCK QUALITY DESIGNATION

R.Q.D. (%)	ROCK DESCRIPTION
<25	Very Poor
25 to 50	Poor
51 to 75	Fair
76 to 90	Good
>90	Excellent

SHEAR STRENGTH

UNDRAINED SHEAR STRENGTH IN P.S.F.	CONSISTENCY
<250	Very Soft
250-500	Soft
500-1000	Med. Stiff
1000-2000	Stiff
2000-4000	Very Stiff
>4000	Hard

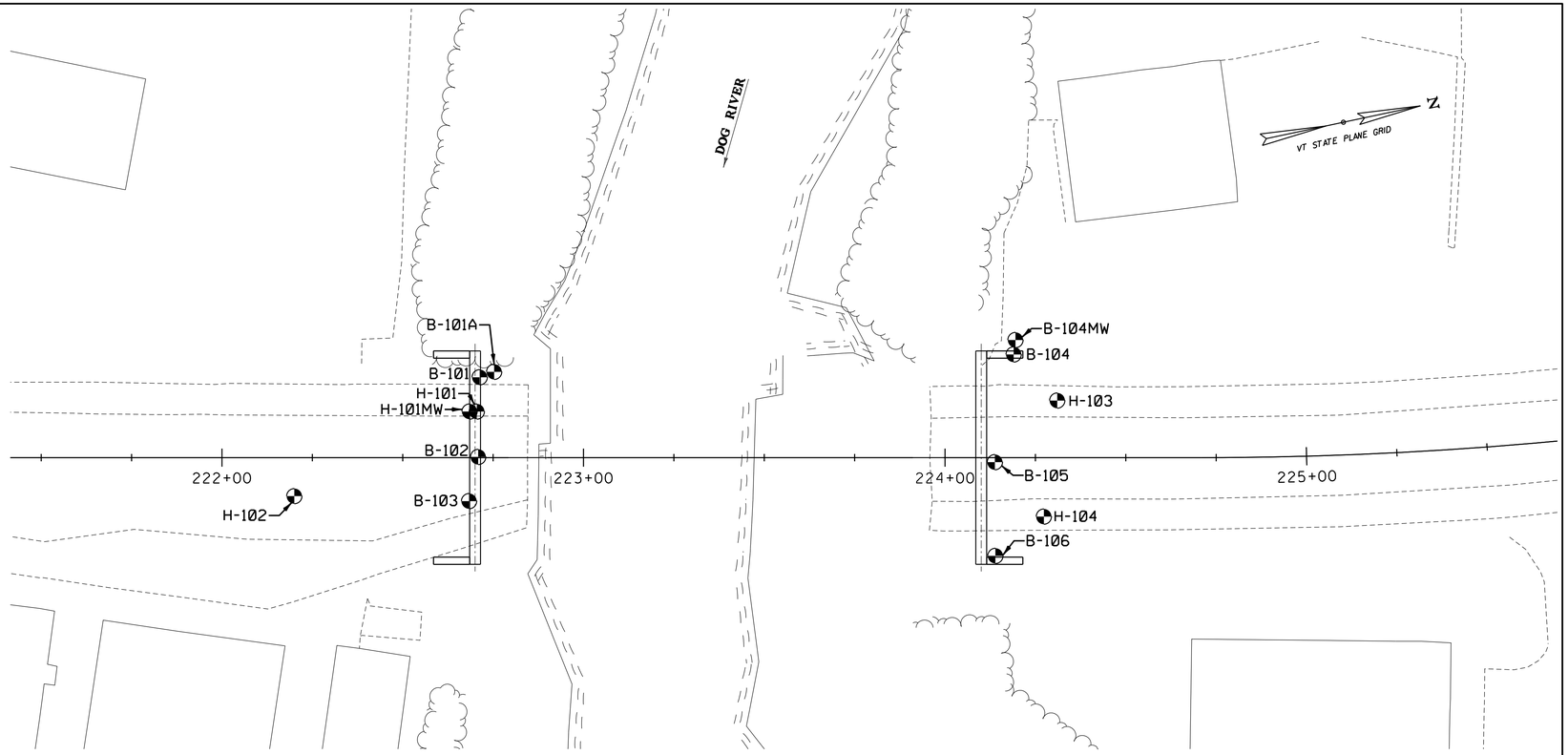
CORRELATION GUIDE OF "N" TO DENSITY/CONSISTENCY

DENSITY (GRANULAR SOILS)		CONSISTENCY (COHESIVE SOILS)	
N	DESCRIPTIVE TERM	N	DESCRIPTIVE TERM
<5	Very Loose	<2	Very Soft
5-10	Loose	2-4	Soft
11-24	Med. Dense	5-8	Med. Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

COMMONLY USED SYMBOLS

▼	Water Elevation
⊕	Standard Penetration Boring
⊕	Auger Boring
⊙	Rod Sounding
S	Sample
N	Standard Penetration Test Blow Count Per Foot For: 2" O.D. Sampler 1 3/8" I.D. Sampler Hammer Weight Of 140 Lbs. Hammer Fall Of 30"
VS	Field Vane Shear Test
US	Undisturbed Soil Sample
B	Blast
DC	Diamond Core
MD	Mud Drill
WA	Wash Ahead
HSA	Hollow Stem Auger
AX	Core Size 1 1/8"
BX	Core Size 1 5/8"
NX	Core Size 2 1/8"
M	Double Tube Core Barrel Used
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non Plastic
w	Moisture Content (Dry Wgt. Basis)
D	Dry
M	Moist
MTW	Moist To Wet
W	Wet
Sat	Saturated
Bo	Boulder
Gr	Gravel
Sa	Sand
Si	Silt
Cl	Clay
HP	Hardpan
Le	Ledge
NLTD	No Ledge To Depth
CNPF	Can Not Penetrate Further
TLOB	Top of Ledge Or Boulder
NR	No Recovery
Rec.	Recovery
%Rec.	Percent Recovery
ROD	Rock Quality Designation
CBR	California Bearing Ratio
<	Less Than
>	Greater Than
R	Refusal (N > 100)
VTSPG	NAD83 - See Note 7

COLOR			
blk	Black	pnk	Pink
bl	Blue	pu	Purple
brn	Brown	rd	Red
dk	Dark	tn	Tan
gry	Gray	wh	White
gn	Green	yel	Yellow
lt	Light	mltc	Multicolored
or	Orange		



20 0 20

SCALE: 1" = 20'-0"

BORING CHART

HOLE NO.	NORTHING	EASTING	STATION	OFFSET	ELEV TLOB
B-101	601218.43	1599459.36	222+71.29	22.2' LT	------
B-101A	601222.65	1599458.73	222+75.29	23.7' LT	------
B-102	601213.45	1599480.83	222+70.87	0.2' LT	698.5
B-103	601208.44	1599492.27	222+68.35	12.0' RT	700.3
B-104	601364.21	1599483.86	224+18.98	28.5' LT	701.6
B-104MW	601365.53	1599480.06	224+19.48	32.5' LT	------
B-105	601352.94	1599511.91	224+13.78	1.2' RT	704.7
B-106	601347.71	1599537.30	224+13.93	27.2' RT	706.0

HOLE NO.	NORTHING	EASTING	STATION	OFFSET
H-101	601215.68	1599468.47	222+70.49	12.8' LT
H-101MW	601213.73	1599468.06	222+68.49	12.8' LT
H-102	601161.44	1599480.88	222+20.01	10.6' RT
H-103	601373.36	1599498.83	224+31.03	15.8' LT
H-104	601363.07	1599529.46	224+27.33	16.3' RT

DEFINITIONS (AASHTO)

BEDROCK (LEDGE) - Rock in its native location of indefinite thickness.

BOULDER - A rock fragment with an average dimension > 12 inches.

COBBLE - Rock fragments with an average dimension between 3 and 12 inches.

GRAVEL - Rounded particles of rock < 3" and > 0.0787" (#10 sieve).

SAND - Particles of rock < 0.0787" (#10 sieve) and > 0.0029" (#200 sieve).

SILT - Soil < 0.0029" (#200 sieve), non or slightly plastic and exhibits no strength when air-dried.

CLAY - Fine grained soil, exhibits plasticity when moist and considerable strength when air-dried.

VARVED - Alternate layers of silt and clay.

HARDPAN - Extremely dense soil, cemented layer, not softened when wet.

MUCK - Soft organic soil (containing > 10% organic material.

MOISTURE CONTENT - Weight of water divided by dry weight of soil.

FLOWING SAND - Granular soil so saturated (loose) that it flows into drill casing during extraction of wash rod.

STRIKE - Angle from magnetic north to line of intersection of bed with a horizontal plane.

DIP - Inclination of bed with a horizontal plane.

1. The subsurface explorations shown herein were made between 9/20/2021 and 9/28/2021 by New England Boring Contractors.

2. Soil and rock classifications, properties and descriptions are based on engineering interpretation from available subsurface information by the Agency and may not necessarily reflect actual variations in subsurface conditions that may be encountered between individual boring or sample locations.

3. Observed water levels and/or conditions indicated are as recorded at the time of exploration and may vary according to the prevailing rainfall, methods of exploration and other factors.

GENERAL NOTES

4. Engineering judgment was exercised in preparing the subsurface information presented herein. Analysis and interpretation of subsurface data was performed and interpreted for Agency design and estimating purposes. Presentation of the information in the Contract is intended to provide the Contractor access to the same data available to the Agency. The subsurface information is presented in good faith and is not intended as a substitute for personal investigation, independent interpretation, independent analysis or judgment by the Contractor.

5. Pictorial structure details shown on the boring plan layout or soils profile are for illustrative purposes only and may not accurately portray final contract details.

6. Terminology used on boring logs to describe the hardness, degree of weathering, and spacing of fractures, joints and other discontinuities in the bedrock is defined in the AASHTO Manual on Subsurface Investigations, 1988.

7. Northing and Easting coordinates are shown in Vermont State Plane Grid North American Datum 1983 in meters and survey feet.

Hardesty & Hanover

PROJECT NAME: NORTHFIELD

PROJECT NUMBER: BF 0241(58)

FILE NAME: z19j223bor.dgn
PROJECT LEADER: C. BAKER
DESIGNED BY: S. BROWN
BORING LAYOUT SHEET

PLOT DATE: 3/30/2022
DRAWN BY: S. BROWN
CHECKED BY: K. SMITH
SHEET 18 OF 46

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-101**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/28/21 Date Finished: 9/28/21
VTSPG NAD83: N 601218.43 ft E 1599459.36 ft
Station: 222+71.29 Offset: 22.2' LT
Ground Elevation: 730.47 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Grey c(+)mf SAND, and mf Gravel, some (-) Silt, Rec. = 0.75 ft, 0.5 ft - 2.0 ft, Environmental Sample - No sample collected	5-7-7-8 (14)				
		S-2: Grey c(+)mf SAND, and mf Gravel, some (-) Silt, Rec. = 0.83 ft, 2.0 ft - 4.0 ft	7-6-7-6 (13)	4.5	39.0	39.0	22.0
5		S-3: Brown cmf SAND, some cmf Gravel (crushed rock), Rec. = 0.92 ft, 4.0 ft - 6.0 ft	8-9-11-9 (20)				
		S-4: No Recovery, Rec. = 0.0 ft, 6.0 ft - 8.0 ft	13-12-22-13 (34)				
		S-5: Brown cmf SAND, little Silt, little c(-)mf Gravel, Rec. = 0.75 ft, 8.0 ft - 10.0 ft	11-7-7-12 (14)				
10		S-6: Brown mf Gravel, and cm(-)f Sand, little Silt, Rec. = 1.08 ft, 10.0 ft - 12.0 ft	24-19-15-14 (34)	11.2	25.0	41.0	16.0
15		S-7: Top 6": Grey mf GRAVEL, and c(+)mf Sand, trace (+) Silt, Rec. = 0.67 ft, 15.0 ft - 16.5 ft, Small green glass fragments throughout	9-16-8-4 (24)	15.1	50.0	41.2	8.8
		S-7: Bott 2": Grey SILT, little mf Sand, 16.5 ft - 17.0 ft, Small green glass fragments throughout					
		Hole stopped @ 17.0 ft					
20		Casing snapped at approximately 15ft. Hole abandoned with 5ft of casing left in the hole.					
		Remarks:					
		1. Mud Rotary drill used. Groundwater not recorded.					
		2. Hole located 1ft North, 1ft East of survey-marked location.					
		3. Boulder 8ft - 13ft, very hard drilling					
25							
30							
35							
40							
45							

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.

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CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-101A**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/28/21 Date Finished: 9/28/21
VTSPG NAD83: N 601222.65 ft E 1599458.73 ft
Station: 222+75.29 Offset: 23.7' LT
Ground Elevation: 730.47 ft

	Casing	Sampler
Type:	AUGER	
I.D.:		
Hammer Wt:	N.A.	N.A.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	AWJ	
Rig:	MOBILE	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 %
		0.0 ft - 0.5 ft, Asphalt					
5							
		Visual Description:, Brown cmf SAND, little cmf Gravel, trace Silt, Solid-Stem Auger, no sample taken - spoils visually classified					
10							
15							
		Field Note:, Solid-Stem Auger, drilling becomes hard - no samples taken					
20		Field Note:, Mud Rotary, Very Hard drilling - no samples taken					
25		Hole stopped @ 25.0 ft					

Remarks:
1. Mud Rotary drill used. Groundwater not recorded.
2. Hole located 4ft North, 1.5ft West of B-101 as-drilled location.
3. For soil samples 0ft - 20ft, see B-101.

30
35
40
45

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.

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-102**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/22/21 Date Finished: 9/23/21
VTSPG NAD83: N 601213.45 ft E 1599480.83 ft
Station: 222+70.87 Offset: 0.2' LT
Ground Elevation: 730.48 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		0.5 ft - 2.0 ft, Concrete/Rebar								
		S-1: Brown cmf SAND, little mf Gravel, little (-) Silt, Rec. = 0.83 ft, 2.0 ft - 4.0 ft, Environmental Sample - No sample collected				10-10-11-11 (21)				
5		S-2: Grey cmf SAND, little (+) cmf Gravel, Rec. = 0.67 ft, 4.0 ft - 6.0 ft				22-17-9-4 (26)				
		S-3: Brown cmf SAND, little c(-)mf Gravel, Rec. = 0.58 ft, 6.0 ft - 8.0 ft, Environmental Sample - No sample collected				3-3-3-4 (6)				
		S-4: Brown/Grey cmf SAND, little cmf Gravel, Rec. = 1.0 ft, 8.0 ft - 10.0 ft, Environmental Sample - No sample collected				10-9-6-7 (15)				
10		S-5: Black/Brown c(+)m(-)f SAND, some (-) Silt, little (+) mf(+) Gravel, Rec. = 1.0 ft, 10.0 ft - 12.0 ft				9-3-6-6 (9)	6.9	15.0	59.0	21.0
15		S-6: Dark Brown cmf SAND, some cm(+)f Gravel, Rec. = 0.5 ft, 15.0 ft - 17.0 ft, Wood fragments present in sample				3-3-4-7 (7)				
		18.0 ft - 20.0 ft, Drilled through large piece of wood (Confirmed by wood stuck to casing upon removal)								
20		S-7: Grey/Black cm SAND, Rec. = 0.17 ft, 20.0 ft - 21.0 ft, Wood in tip of spoon.				50/2" (100)				
		S-8: SAME, Rec. = 0.58 ft, 21.0 ft - 23.0 ft				9-7-12-16 (19)				
25		S-9: Grey mf GRAVEL, little cmf Sand, Rec. = 1.33 ft, 25.0 ft - 27.0 ft, Wood fragments present in sample				6-6-3-4 (9)				
30		S-10: J1 (Top 8"): Grey-Brown mf(+) SAND, some Silt, Rec. = 1.17 ft, 30.0 ft - 31.0 ft				14-16-16-15 (32)	31.3	1.0	2.0	97.0
		S-10: J2 (Bott. 6"): Grey SILT trace (-), f Sand, trace (-) f Gravel [NP], 31.0 ft - 32.0 ft								
		32.0 ft, Approximate Top of Rock	C-1 (5-90)	91.7 (45)	6					
35		33.0 ft - 38.0 ft, Grey PHYLLITE, moderately to highly weathered, moderately to slightly fractured, moderately soft to moderately hard rock, cmf grains, 5+ pieces			4 4.5 12 3.5					
40		38.0 ft - 43.0 ft, Grey PHYLLITE, moderately weathered, intensely to moderately fractured, moderately soft to moderately hard rock, cmf grains, 7+ pieces	C-2 (5-90)	91.7 (33.3)	7 6 6 6 16					
		Hole stopped @ 43.0 ft								
45		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 0.5ft South, 2.5ft West of survey-marked location. 3. Lost water in casing at approximately 14ft and 19ft.								

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.

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B-102 Rock Cores

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AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-103**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/21/21 Date Finished: 9/21/21
VTSPG NAD83: N 601208.44 ft E 1599492.27 ft
Station: 222+68.35 Offset: 12.0' RT
Ground Elevation: 730.3 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		0.5 ft - 2.0 ft, Concrete/Rebar								
		S-1: J1 (Top 7"): Brown mf SAND, little Silt, Rec. = 0.92 ft, 2.0 ft - 3.0 ft, Environmental Sample - No sample collected				14-12-10-9 (22)				
		S-1: J2 (Bott. 4"): Grey cmf(-) SAND, little (+) Gravel, 3.0 ft - 4.0 ft								
5		S-2: Grey-Brown cm GRAVEL, some (+) Sand, some Silt, Rec. = 0.92 ft, 4.0 ft - 6.0 ft				31-25-18-8 (43)	6.6	39.0	31.0	30.0
		S-3: Grey-Brown cm Gravel, some (+) Sand, some Silt, Rec. = 1.0 ft, 6.0 ft - 8.0 ft				10-8-10-13 (18)				
10		S-4: Grey-Brown cmf SAND, some (+) cmf(+) Gravel, Rec. = 0.83 ft, 8.0 ft - 10.0 ft				14-6-5-5 (11)				
		S-5: Grey-Brown cmf SAND, little (+) mf Gravel, Rec. = 1.17 ft, 10.0 ft - 12.0 ft, Highly decomposed shale/phyllite				12-19-40-50 (59)				
15		S-6: Brown cmf SAND, little c(-)mf Gravel, Rec. = 1.08 ft, 15.0 ft - 17.0 ft				4-6-7-7 (13)				
20		S-7: Dark Grey CLAY & SILT some (+), c(-)f Sand, trace (-) f Gravel [PI=15], Rec. = 2.0 ft, 20.0 ft - 22.0 ft, Wood fragments in top 6" of sample				3-4-4-4 (8)	91.8	1.0	34.0	65.0
25		S-8: Grey m(+)f Gravel and cm(-)f Sand, little Silt, Rec. = 0.83 ft, 25.0 ft - 27.0 ft				11-9-8-20 (17)	12.5	25.0	42.0	16.0
30		30.0 ft - 35.0 ft, Grey PHYLLITE, moderately to highly weathered, very intensely to intensely fractured, moderately soft to moderately hard rock, cmf grains, 3+ pieces	C-1 (0-30)	91.7 (13.3)	9.5 6 9 7 4.5					
35		35.0 ft - 40.0 ft, Grey PHYLLITE, moderately weathered, moderately fractured, moderately soft to moderately hard rock, cmf grains, 8 pieces	C-2 (30-90)	100 (56.7)	4 4 4.5 5 6					
40		Hole stopped @ 40.0 ft								
45		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 0.5ft South, 0.5ft West of survey-marked location.								

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.

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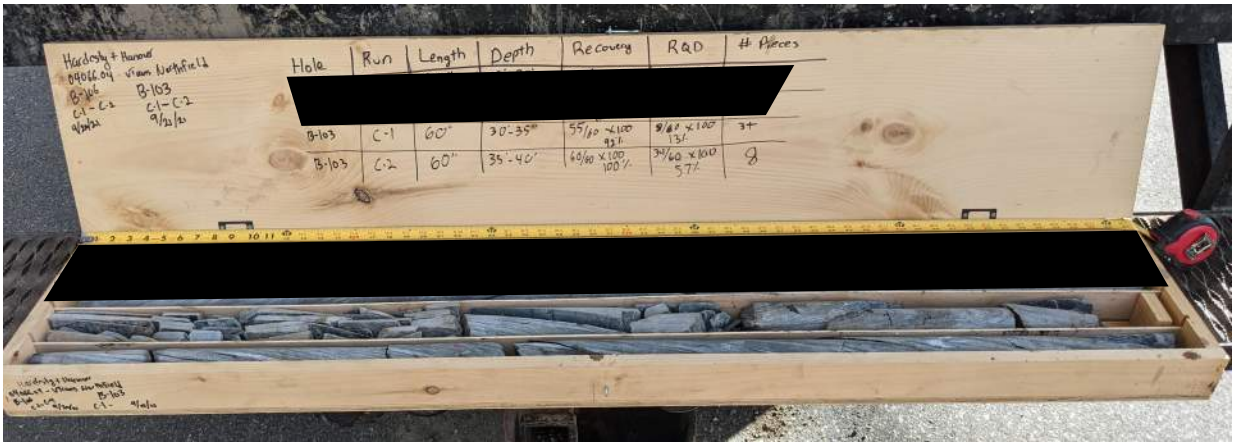
B-103 Rock Cores



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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-104**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/24/21 Date Finished: 9/24/21
VTSPG NAD83: N 601364.21 ft E 1599483.86 ft
Station: 224+18.98 Offset: 28.5' LT
Ground Elevation: 729.56 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/28/21	18.6	B-104MW Reading

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 %
		0.0 ft - 0.5 ft, Asphalt								
		S-1: Brown cmf SAND, some cmf Gravel, Rec. = 1.0 ft, 0.5 ft - 2.0 ft, Environmental Sample - No sample collected				12-16-12-10 (28)				
		S-2: Brown cmf(+) SAND, little cmf Gravel, Rec. = 0.83 ft, 2.0 ft - 4.0 ft				10-10-15-8 (25)				
5		S-3: SAME, Rec. = 0.83 ft, 4.0 ft - 6.0 ft				5-7-8-5 (15)				
		S-4: Brown cmf SAND, some (+) cmf Gravel, Rec. = 0.75 ft, 6.0 ft - 8.0 ft				10-12-12-13 (24)				
		S-5: SAME, Rec. = 0.75 ft, 8.0 ft - 10.0 ft				9-10-12-28 (22)				
10		S-6: Brown/Grey mf Gravel, some (+) Silt, some (-) cm(-)f Sand, Rec. = 1.0 ft, 10.0 ft - 12.0 ft, crumbled rock				14-10-21-50 (31)	8.9	47.0	20.0	33.0
		12.0 ft - 15.0 ft, Cobbles								
15		S-7: Jar A (top 6"): Brown cmf GRAVEL, some cmf Sand, little Silt, Rec. = 0.75 ft, 15.0 ft - 16.5 ft, Partial Environmental Sample - very small sample collected				9-11-42-6 (53)				
		S-7: Jar B (Bott. 3"): Black CLAY & SILT, 16.5 ft - 17.0 ft								
20		S-8: Dark Brown c(-)mf SAND, some Silt, Rec. = 1.5 ft, 20.0 ft - 22.0 ft, Wood fragments throughout sample				2-4-5-8 (9)				
		S-9: Grey c(+)mf Sand, and (-) m(+)f Gravel, little (+) Silt, Rec. = 1.25 ft, 22.0 ft - 24.0 ft				9-9-11-9 (20)	12.2	39.0	43.0	18.0
25		S-10: White/Grey cmf SAND, some (+) c(-)mf Greavel, little Silt, Rec. = 0.83 ft, 25.0 ft - 27.0 ft, Decomposed Rock				15-26-33-50 (59)				
		28.0 ft, Approximate Top of Rock								
30		29.0 ft - 34.0 ft, Grey PHYLLITE, moderately to slightly weathered, slightly fractured, moderately soft rock, cmf grains, 7+ pieces	C-1 (5-80)	100 (95)	4.5 4.5 5 5 5					
35		34.0 ft - 39.0 ft, Grey PHYLLITE, slightly weathered, moderately to slightly fractured, moderately soft to moderately hard rock, cmf grains, 6+ pieces. Bottom 6": Large quartz pocket	C-2 (5-80)	86.7 (66.7)	5 4.5 6.5 7 9					
40		Hole stopped @ 39.0 ft								

Remarks:
1. Mud Rotary drill used. Groundwater not recorded.
2. Hole located 4ft North, 1ft West of survey-marked location.
3. B-104MW installed 0.5ft North, 4ft West of B-104 as-drilled location.

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.

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B-104 Rock Cores

Image 4ft to 5ft
Corrupted

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-105**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/23/21 Date Finished: 9/23/21
VTSPG NAD83: N 601352.94 ft E 1599511.91 ft
Station: 224+13.78 Offset: 1.2' RT
Ground Elevation: 729.72 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		S-1: Grey/Brown mf Gravel, some (+) cm(-)f Sand, some Silt, Rec. = 1.17 ft, 0.5 ft - 2.0 ft				41-50-46-39 (96)	2.5	23.0	33.0	24.0
		S-2: SAME, Rec. = 0.92 ft, 2.0 ft - 4.0 ft				17-13-10-6 (23)				
5		S-3: SAME, Rec. = 0.58 ft, 4.0 ft - 6.0 ft				6-2-5-2 (7)				
		S-4: Grey cmf GRAVEL, little cmf Sand, Rec. = 0.33 ft, 6.0 ft - 8.0 ft				7-6-5-9 (11)				
		S-5: Dark Brown cmf SAND, little (+) cmf Gravel, Rec. = 0.42 ft, 8.0 ft - 10.0 ft				3-4-7-11 (11)				
10		S-6: Grey c(-)mf GRAVEL, trace cmf Sand, trace (-) Silt, Rec. = 1.08 ft, 10.0 ft - 12.0 ft, Crumbled Rock				11-11-11-16 (22)				
15		S-7: Grey cmf GRAVEL, little Silt, trace f Sand, Rec. = 0.5 ft, 15.0 ft - 17.0 ft, Crumbled Rock				3-5-8-20 (13)				
20		S-8: Grey cmf(+) SAND, trace cmf Gravel, Rec. = 0.67 ft, 20.0 ft - 22.0 ft, Environmental Sample - No sample collected				6-4-5-4 (9)				
		S-9: Grey-Black mf(+) Gravel, and (-) cm(-)f Sand, some (-) Silt, Rec. = 1.5 ft, 22.0 ft - 24.0 ft				3-10-16-23 (26)	12.4	44.0	35.0	21.0
25		25.0 ft - 30.0 ft, Grey PHYLLITE, moderately weathered, moderately to slightly fractured, moderately soft rock, cmf grains, 5+ pieces	C-1 (5-90)	91.7 (45)	3 3 3 6 5					
30		30.0 ft - 35.0 ft, Grey PHYLLITE, moderately weathered, moderately fractured, moderately soft rock, cmf grains, 5+ pieces	C-2 (5-90)	100 (58.3)	5.5 3.5 4 4 4.5					
35		Hole stopped @ 35.0 ft								
40		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 3.5ft North of survey-marked location. 3. Could not maintain seal at bottom of casing, used approximately 750 gallons of water during rock coring.								
45										

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.

B-105 Rock Cores

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-106**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/20/21 Date Finished: 9/20/21
VTSPG NAD83: N 601347.71 ft E 1599537.30 ft
Station: 224+13.93 Offset: 27.2' RT
Ground Elevation: 729.97 ft

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		S-1: Brown cmf SAND, little cmf Gravel, grass/organics, Rec. = 0.75 ft, 0.0 ft - 2.0 ft, Environmental Sample - no sample taken				4-6-13-17 (19)				
		S-2: Brown cmf SAND, little cmf Gravel, grass/organics, Rec. = 0.42 ft, 2.0 ft - 4.0 ft, Environmental Sample - no sample taken				15-12-9-7 (21)				
5		S-3: Grey cm(-)f SAND, some (+) f Gravel, little (+) Silt, Rec. = 1.0 ft, 4.0 ft - 6.0 ft				9-6-6-5 (12)				
		S-4: Grey cm(-)f SAND, some (+) f Gravel, little (+) Silt, Rec. = 1.17 ft, 6.0 ft - 8.0 ft				6-7-11-7 (18)	6.2	32.0	50.0	18.0
		S-5: Grey cm(-)f SAND, some (+) f Gravel, little (+) Silt, Rec. = 0.5 ft, 8.0 ft - 10.0 ft				9-8-10-16 (18)				
10		S-6: Tan/Dark Brown c(-)mf SAND, trace f Gravel, trace Silt, Rec. = 1.17 ft, 10.0 ft - 12.0 ft				8-10-10-10 (20)				
15		S-7: Brown f SAND, some Silt, trace (-) f Gravel, Rec. = 0.75 ft, 15.0 ft - 17.0 ft				6-8-9-11 (17)	17.4	1.0	73.0	26.0
20		S-8: Brown f SAND, some Silt, trace (-) f Gravel, Rec. = 0.75 ft, 20.0 ft - 22.0 ft, Large wood fragment in center of sample Environmental Sample - no sample taken				4-3-1-1 (4)				
		S-9: Grey mf(+) Gravel, some (+) cf Sand, some Silt, Rec. = 1.5 ft, 22.0 ft - 24.0 ft, Decomposed Rock				4-12-21-60/3" (33)	10.6	40.0	32.0	28.0
25		24.0 ft, Approximate Top of Rock 25.0 ft - 30.0 ft, Grey PHYLLITE, slightly weathered, moderately fractured, moderately soft rock, mf grains, 12 pieces	C-1 (30-90)	96.7 (63.3)	3.5 5.5 6.5 6 6.5					
30		30.0 ft - 35.0 ft, Grey PHYLLITE, slightly weathered, slightly fractured, moderately soft rock, mf grains, 3+ pieces	C-2 (60)	100 (91.7)	7.5 8 8 7 7.5					
35		Hole stopped @ 35.0 ft								
40		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located as surveyed.								
45										

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.

B-106 Rock Cores

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-101**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/21/21 Date Finished: 9/21/21
VTSPG NAD83: N 601215.68 ft E 1599468.47 ft
Station: 222+70.49 Offset: 12.8' LT
Ground Elevation: 730.27 ft

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/21/21	20.0	Moist Spoils Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Light Brown cmf SAND, some cmf Gravel, Rec. = 0.75 ft, 0.5 ft - 2.0 ft	36-60-REF-REF (100)				
		Visual Description:, Light Brown cmf SAND, some (-) cmf Gravel, intermittant boulders/cobbles					
5							
		Visual Description:, Dark Brown cmf SAND, and cmf Gravel					
10		Visual Description:, Brown cmf SAND, some cmf Gravel					
15							
20		S-2: Grey cmf GRAVEL, trace cmf Sand, Rec. = 0.42 ft, 20.0 ft - 22.0 ft, Decomposed Rock	5-2-1-1 (3)				
		S-3: No Recovery, Rec. = 0.0 ft, 22.0 ft - 24.0 ft	2-1-2-WOH (3)				
25		S-4: Grey SILT, little mf Sand, Rec. = 0.83 ft, 25.0 ft - 27.0 ft, very soft sample	4-5-10-10 (15)				
		S-5: Grey-Brown mf SAND, trace Silt, trace (-) f Gravel, Rec. = 1.08 ft, 27.0 ft - 29.0 ft	15-35-30-65 (65)				
30		Hole stopped @ 29.0 ft					
35							
40							
45							

Remarks:
1. Hole located as surveyed.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.
3. H-101MW installed 2ft South of H-101 as-drilled location.

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.

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-102**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/22/21 Date Finished: 9/22/21
VTSPG NAD83: N 601161.44 ft E 1599480.88 ft
Station: 222+20.01 Offset: 10.6' RT
Ground Elevation: 730.78 ft

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/22/21	17.0	Moist Spoils Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 2.0 ft, Concrete					
		S-1: Grey/Brown cmf SAND, trace mf Gravel, Rec. = 1.25 ft, 2.0 ft - 4.0 ft	25-30-26-26 (56)				
5		S-2: Brown cmf SAND, little Silt, trace f Gravel, Rec. = 1.17 ft, 4.0 ft - 6.0 ft	11-21-23-25 (44)				
		Field Note:, Cobbles/Boulder					
		Visual Description:, Brown cmf SAND, little Silt, trace f Gravel					
10							
15		Field Note:, Boulder					
20		S-3: Grey-Brown mf SAND, trace Silt, Rec. = 1.25 ft, 20.0 ft - 22.0 ft	8-11-14-16 (25)				
		S-4: SAME, 22.0 ft - 25.0 ft, Spoon over-driven to collect extra soil for environmental sample. SPT values correlate to middle 2ft (22.5 - 24.5) Rec. = 2.0 ft	14-20-27-35 (47)				
25		Hole stopped @ 25.0 ft					
30							
35							
40							
45							

Remarks:
1. Hole located 0.5ft South of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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.

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-103**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/27/21 Date Finished: 9/27/21
VTSPG NAD83: N 601373.36 ft E 1599498.83 ft
Station: 224+31.03 Offset: 15.8' LT
Ground Elevation: 729.13 ft

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 1.0 ft, Concrete					
		S-1: Grey/Brown cmf SAND, little cmf Gravel, trace Silt, Rec. = 1.33 ft, 1.0 ft - 3.0 ft	27-24-25-21 (49)				
		S-2: Brown cmf SAND, trace cmf(-) Gravel, Rec. = 0.67 ft, 3.0 ft - 5.0 ft	31-37-44-30 (81)				
5		Visual Description:, Brown mf SAND, little c(-)mf Gravel, little Silt, Boulders/Cobbles throughout					
10		Visual Description:, Grey cmf GRAVEL, some cmf Sand, little Silt					
15		S-3: Brown cmf SAND, little Silt, trace cmf Gravel, Rec. = 0.92 ft, 15.0 ft - 17.0 ft	18-7-9-8 (16)				
		S-4: Top 5": SAME, Rec. = 1.58 ft, 17.0 ft - 17.5 ft	6-3-6-6 (9)				
		S-4: Rest: Black mf SAND, some Silt, 17.5 ft - 19.0 ft					
20		S-5: Top 6": Brown cmf SAND, little Silt, trace mf Gravel, Rec. = 1.92 ft, 19.0 ft - 19.5 ft	7-7-10-50/5" (17)				
		S-5: Rest: Black mf SAND, some Silt, rock fragments, 19.5 ft - 21.0 ft					
		S-6: Black/Grey SILT, little, f Sand, little mf Gravel, Rec. = 0.83 ft, 21.0 ft - 23.0 ft, Decomposed Rock	8-9-12-10 (21)				
		S-7: Grey c(-)mf SAND, Rec. = 0.92 ft, 23.0 ft - 25.0 ft	8-10-13-15 (23)				
25		Hole stopped @ 25.0 ft					
30							
35							
40							
45							

Remarks:
1. Hole located 3ft North of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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.

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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-104**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/20/21 Date Finished: 9/20/21
VTSPG NAD83: N 601363.07 ft E 1599529.46 ft
Station: 224+27.33 Offset: 16.3' RT
Ground Elevation: 729.43 ft

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_F = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/20/21	20.0	Moist Samples Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Brown cmf SAND, little cmf Gravel, trace Silt, Rec. = 0.75 ft, 0.5 ft - 2.0 ft	12-27-31-35 (58)				
		S-2: SAME, Rec. = 1.42 ft, 2.0 ft - 4.0 ft	26-50-36-28 (86)				
5		Visual Description:, Brown c(-)mf SAND, little (+) Silt, trace mf Gravel					
10							
15							
20		S-3: Brown cmf SAND, lttle Silt, Rec. = 1.67 ft, 20.0 ft - 22.0 ft	6-6-8-9 (14)				
		S-4: Grey cm(+)f SAND, little Silt, Rec. = 1.5 ft, 22.0 ft - 24.0 ft	6-10-22-33 (32)				
25		Hole stopped @ 24.0 ft					

Remarks:
1. Hole located 0.5ft South of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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.

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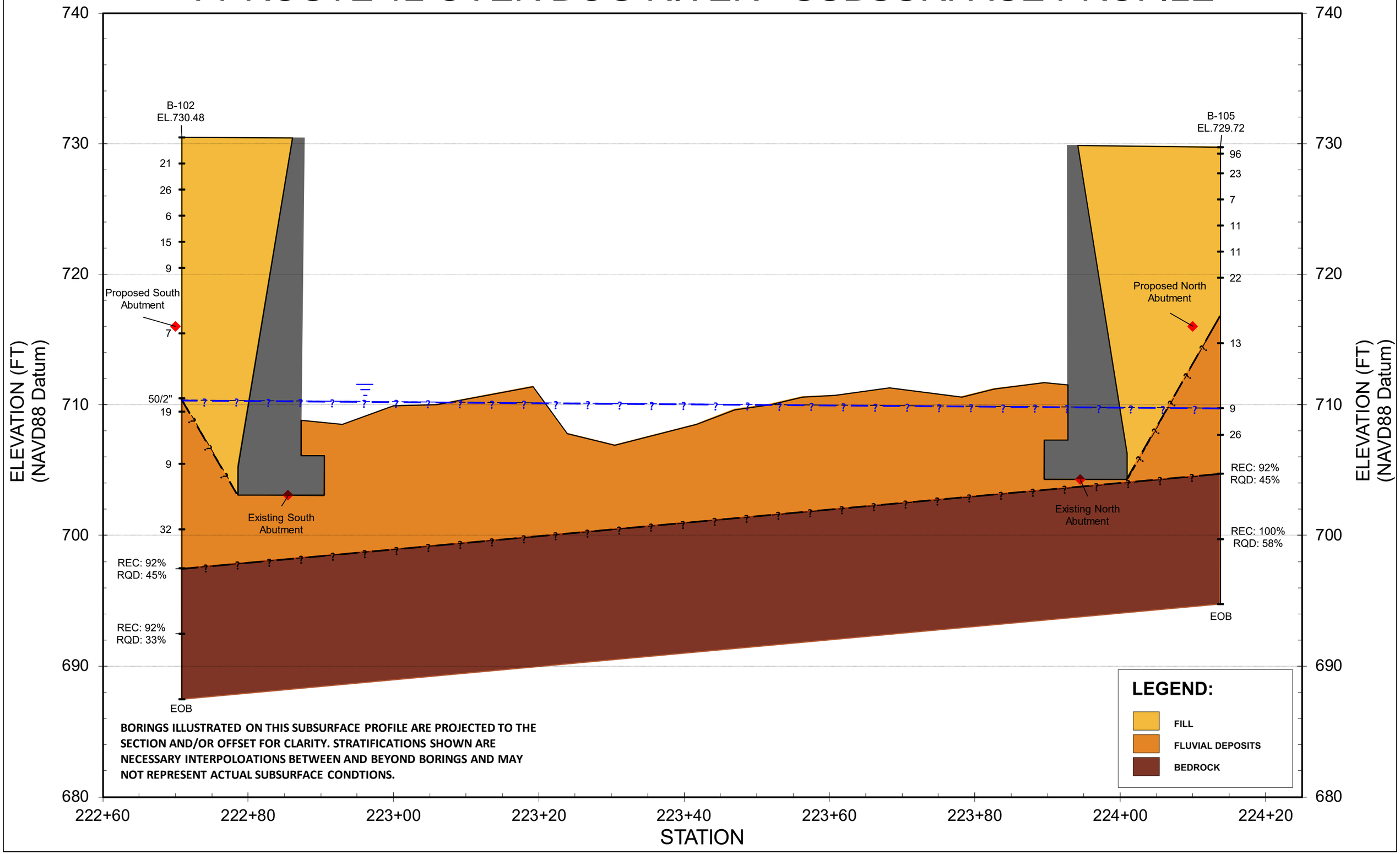
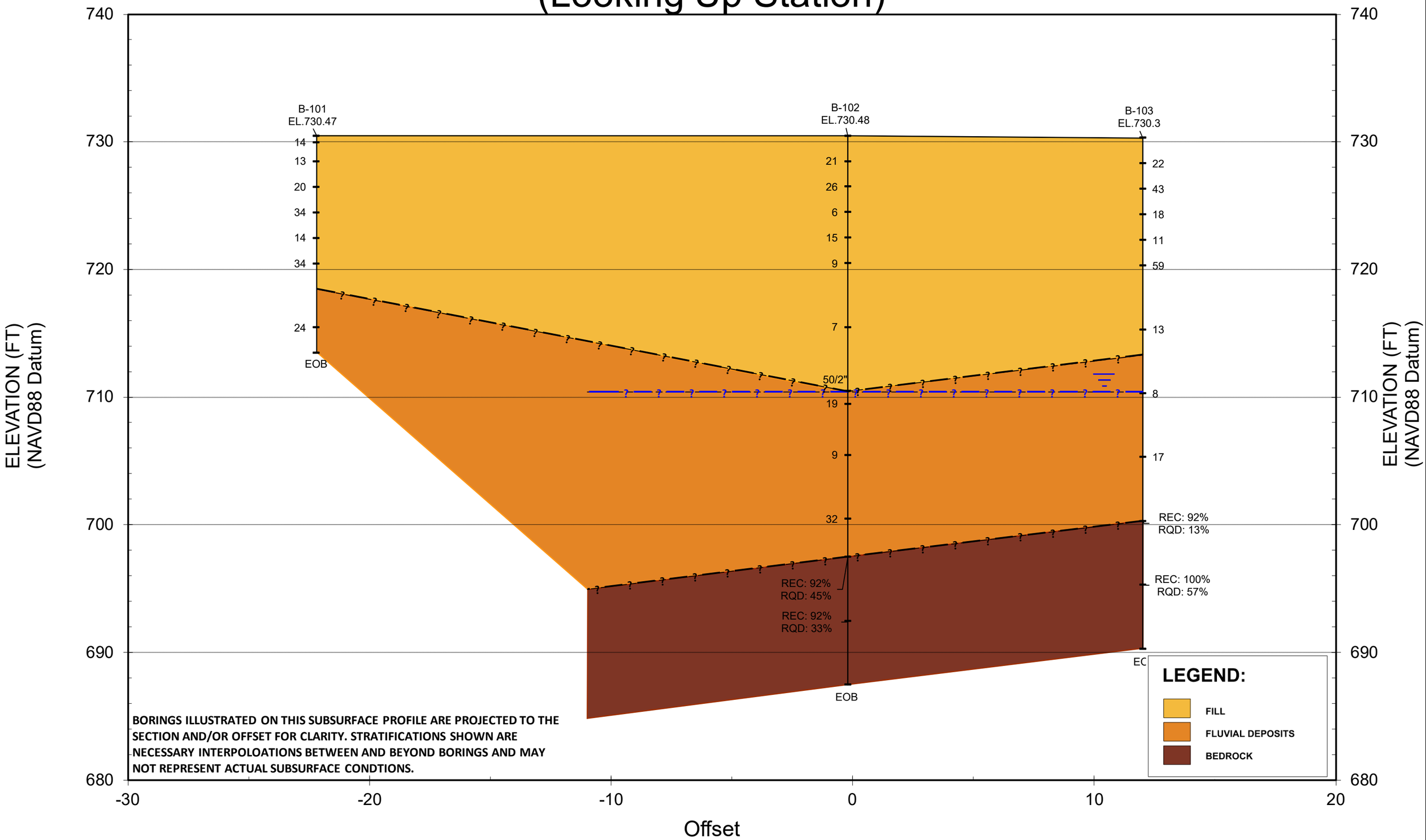
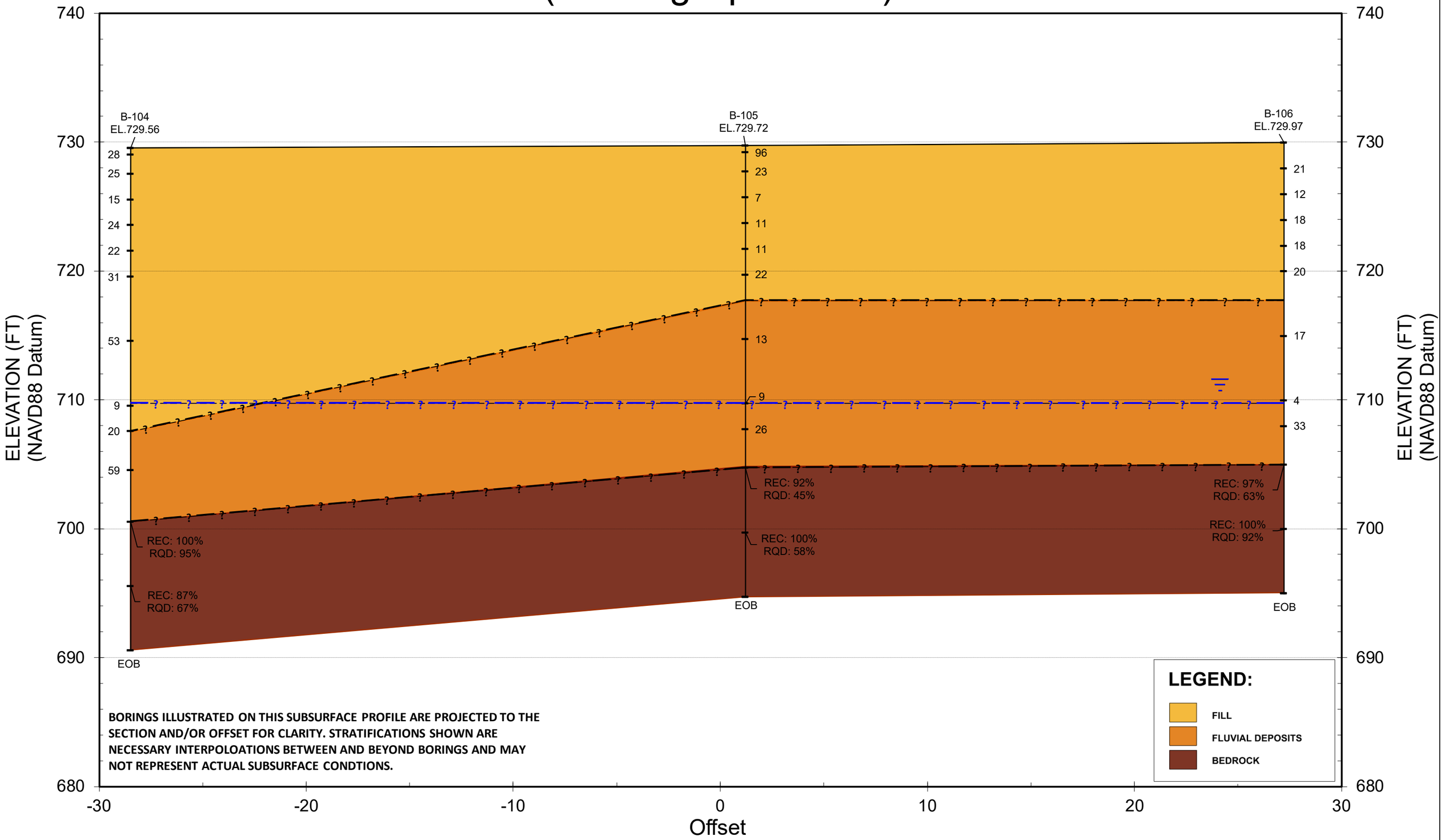
VT ROUTE 12 OVER DOG RIVER - SUBSURFACE PROFILE



VT ROUTE 12 OVER DOG RIVER - SOUTH ABUTMENT
(Looking Up Station)



VT ROUTE 12 OVER DOG RIVER - NORTH ABUTMENT
(Looking Up Station)



Appendix B: Laboratory Testing Results

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	10/18/21	Checked By:	jsc
Depth :	---	Test Id:	632792		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
B-101	S- 2	2-4	Moist, dark grayish brown silty sand with gravel	4.5
B-101	S- 6	10-12	Moist, dark brown silty sand with gravel	11.2
B-101	S- 7	15-17	Moist, dark grayish brown sand with silt and gravel	15.1
B-102	S- 5	10-12	Moist, very dark brown silty sand	6.9
B-102	S- 10 J2	30-32	Moist, dark olive brown silt	31.3
B-103	S- 3	6-8	Moist, dark brown silty sand with gravel	6.6
B-103	S- 7	20-22	Moist, very dark brown silt	91.8
B-103	S- 8	25-27	Moist, dark grayish brown silty sand with gravel	12.5
B-104	S- 6	10-12	Moist, grayish brown silty gravel with sand	8.9
B-104	S- 9	22-24	Moist, dark grayish brown silty sand with gravel	12.2

Notes: Temperature of Drying : 110º Celsius

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	10/17/21	Checked By:	jsc
Depth :	---	Test Id:	632797		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
B-105	S- 1	0-2	Moist, grayish brown silty sand with gravel	2.5
B-105	S- 9	22-24	Moist, olive brown silty sand with gravel	12.4
B-106	S- 4	6-8	Moist, dark yellowish brown silty sand with gravel	6.2
B-106	S- 7	15-17	Moist, olive brown silty sand	17.4
B-106	S- 9	22-24	Moist, dark grayish brown silty sand with gravel	10.6

Notes: Temperature of Drying : 110º Celsius

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield - RT12 Bridge Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/15/21
Tested By:	amp
Checked By:	jsc

pH of Soil by ASTM G51

Boring ID	Sample ID	Depth, ft	Description	pH Reading
B-102	S9	25-27	Moist, dark grayish brown silty sand	6.29
B-104	S3	4-6	Moist, very dark grayish brown silty sand	6.37

Notes:

Client:	Hardesty & Hanover
Project:	Vtrans Northfield - RT12 Bridge Dog River
Location:	---
GTX#:	314375
Test Date:	10/15/21
Tested By:	amp
Checked By:	jsc

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
B-102	S9	25-27	Moist, dark grayish brown silty sand	4,959	2.02E-04
B-104	S3	4-6	Moist, very dark grayish brown silty sand	3,926	2.55E-04

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

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GEOTESTING EPXRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2109900
Report Date	21 October 2021
Date Sampled	15 October 2021
Date Received	19 October 2021
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil: Project: VTrans Northfield Route 12 Bridge; Site Location: - ; Job Number: GTX-314375

When examined to the applicable requirements of:

ASTM D 512-12*	"Standard Test Methods for Chloride Ion in Water" Method B
ASTM D 516-16	"Standard Test Method for Sulfate Ion in Water"

Results:

ASTM D 512 - Chloride Method B

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
102		16.	0.0016	10.
S-9	25 – 27'			
104		48.	0.0048	
S-3	4 – 6'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard. *Withdrawn 2021 without Replacement

ASTM D 516 – Sulfates (Soluble)

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
102		< 10.	< 0.0010	10.
S-9	25 – 27'			
104		10.	0.0010	
S-3	4 – 6'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

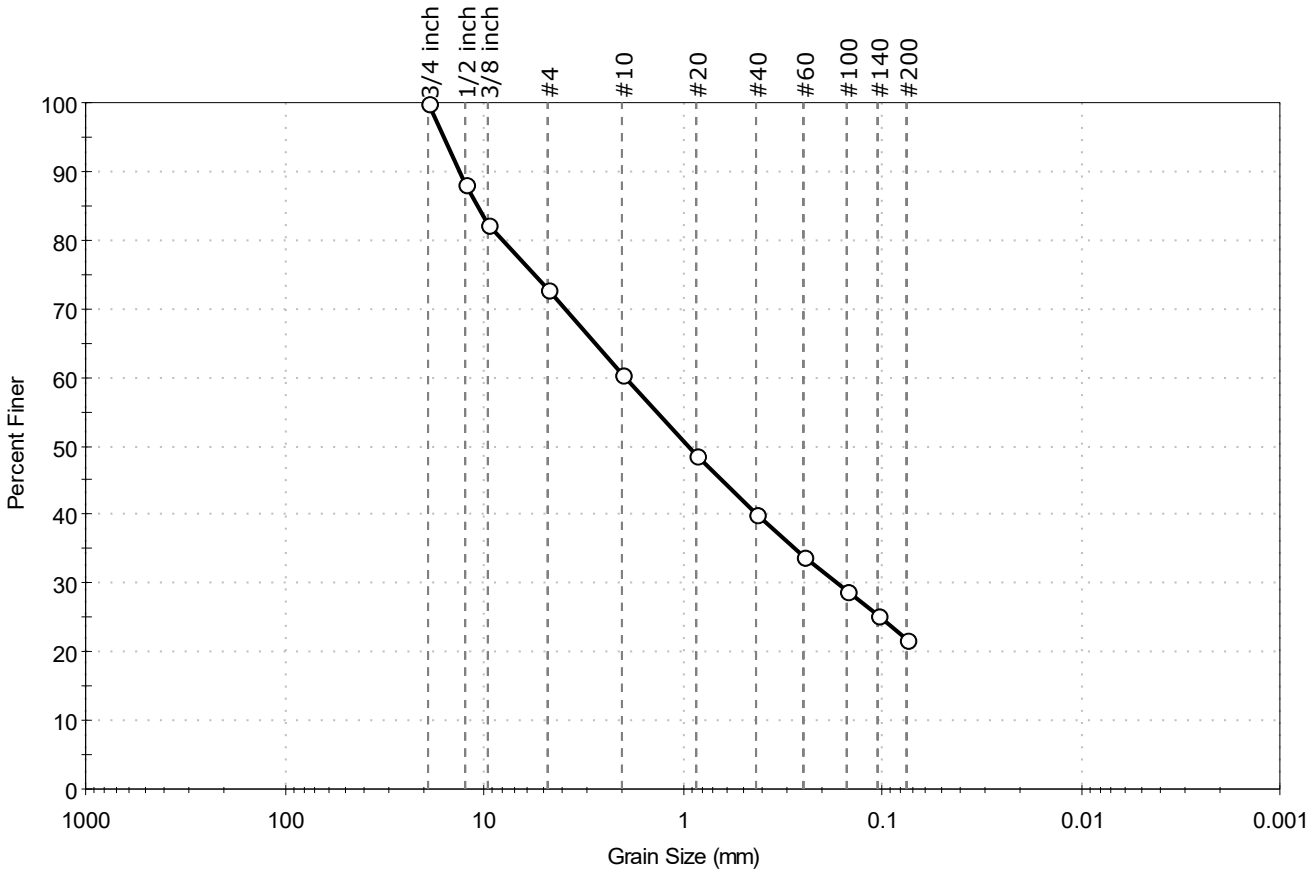
END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-101	Sample Type:	tube	Tested By:	ckg
Sample ID:	S-2	Test Date:	10/15/21	Checked By:	jsc
Depth :	2-4	Test Id:	632800		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	27.0	51.1	21.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	88		
3/8 inch	9.50	82		
#4	4.75	73		
#10	2.00	61		
#20	0.85	49		
#40	0.42	40		
#60	0.25	34		
#100	0.15	29		
#140	0.11	25		
#200	0.075	22		

Coefficients

D_{85} = 10.7954 mm D_{30} = 0.1675 mm

D_{60} = 1.9217 mm D_{15} = 0.3478 mm

D_{50} = 0.9392 mm D_{10} = 1.0654 mm

C_u = 1.804 C_c = 0.014

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

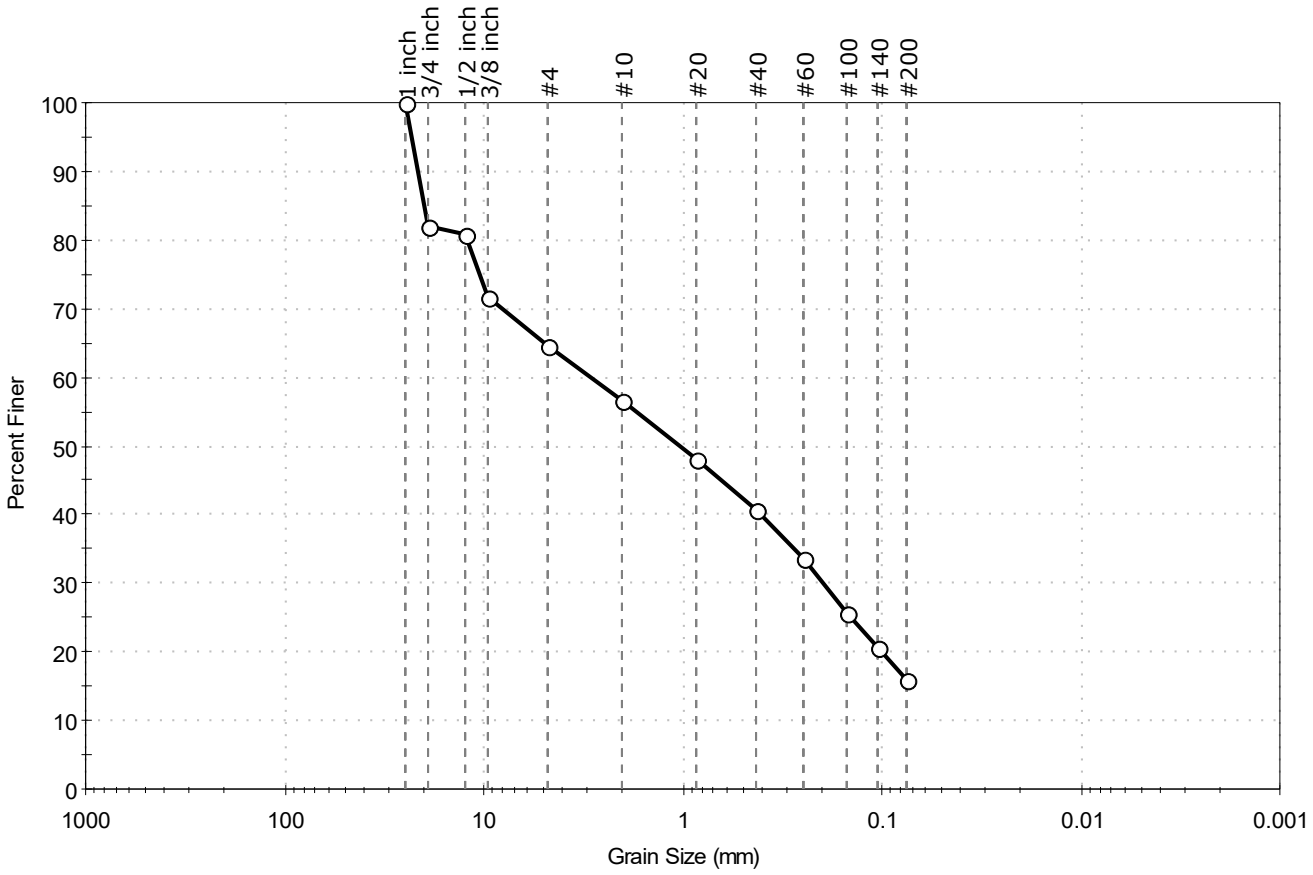
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-101	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-6	Test Date:	10/15/21	Checked By:	jsc
Depth :	10-12	Test Id:	632801		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	35.4	48.7	15.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 inch	25.00	100		
3/4 inch	19.00	82		
1/2 inch	12.50	81		
3/8 inch	9.50	72		
#4	4.75	65		
#10	2.00	57		
#20	0.85	48		
#40	0.42	41		
#60	0.25	34		
#100	0.15	26		
#140	0.11	21		
#200	0.075	16		

Coefficients

D_{85} = 19.9050 mm D_{30} = 0.1986 mm

D_{60} = 2.8695 mm D_{15} = N/A

D_{50} = 1.0204 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

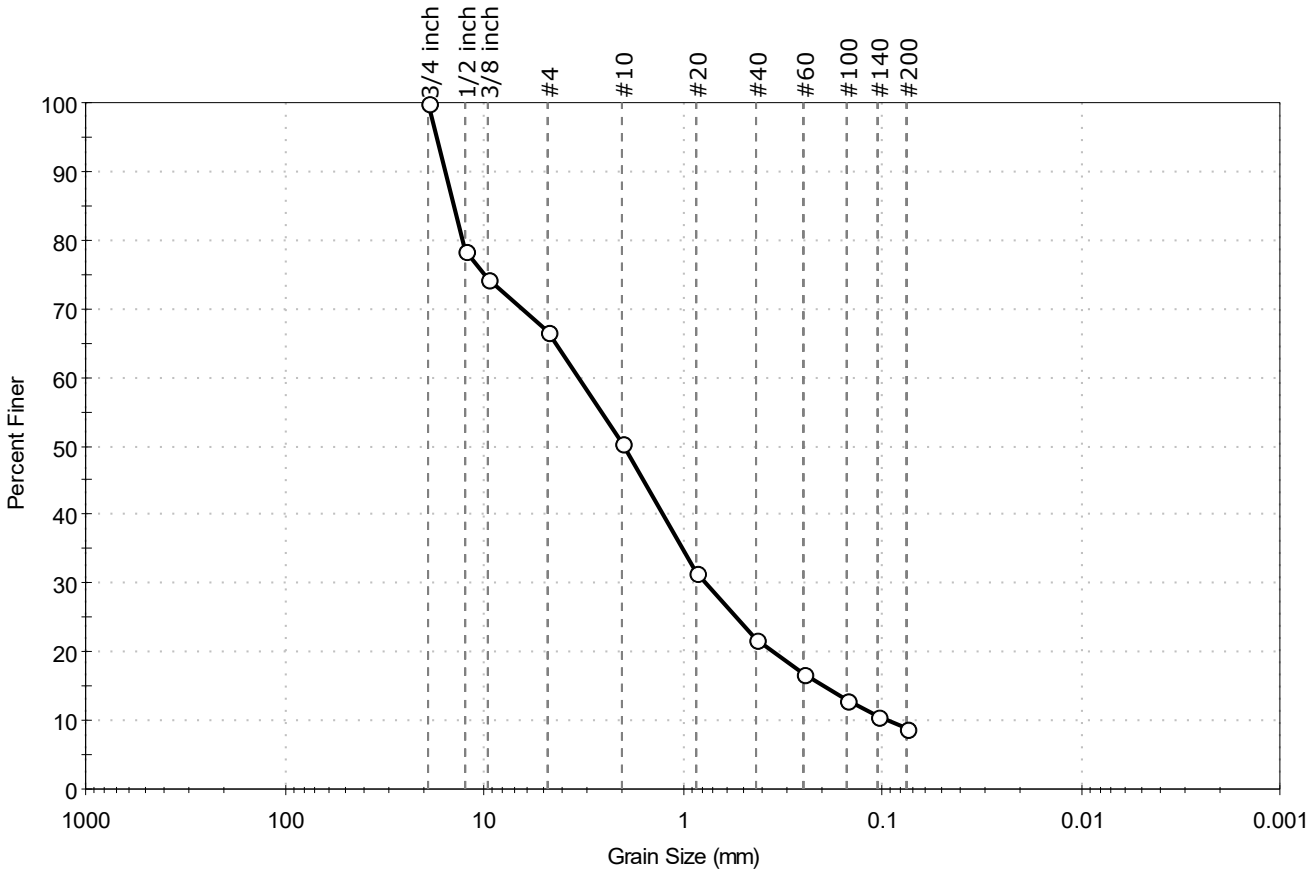
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-101	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-7	Test Date:	10/15/21	Checked By:	jsc
Depth :	15-17	Test Id:	632802		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown sand with silt and gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	33.3	57.9	8.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	78		
3/8 inch	9.50	74		
#4	4.75	67		
#10	2.00	50		
#20	0.85	32		
#40	0.42	22		
#60	0.25	17		
#100	0.15	13		
#140	0.11	11		
#200	0.075	8.8		

Coefficients

D_{85} = 14.1898 mm D_{30} = 0.7582 mm

D_{60} = 3.3382 mm D_{15} = 0.1980 mm

D_{50} = 1.9707 mm D_{10} = 0.0956 mm

C_u = 34.918 C_c = 1.801

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

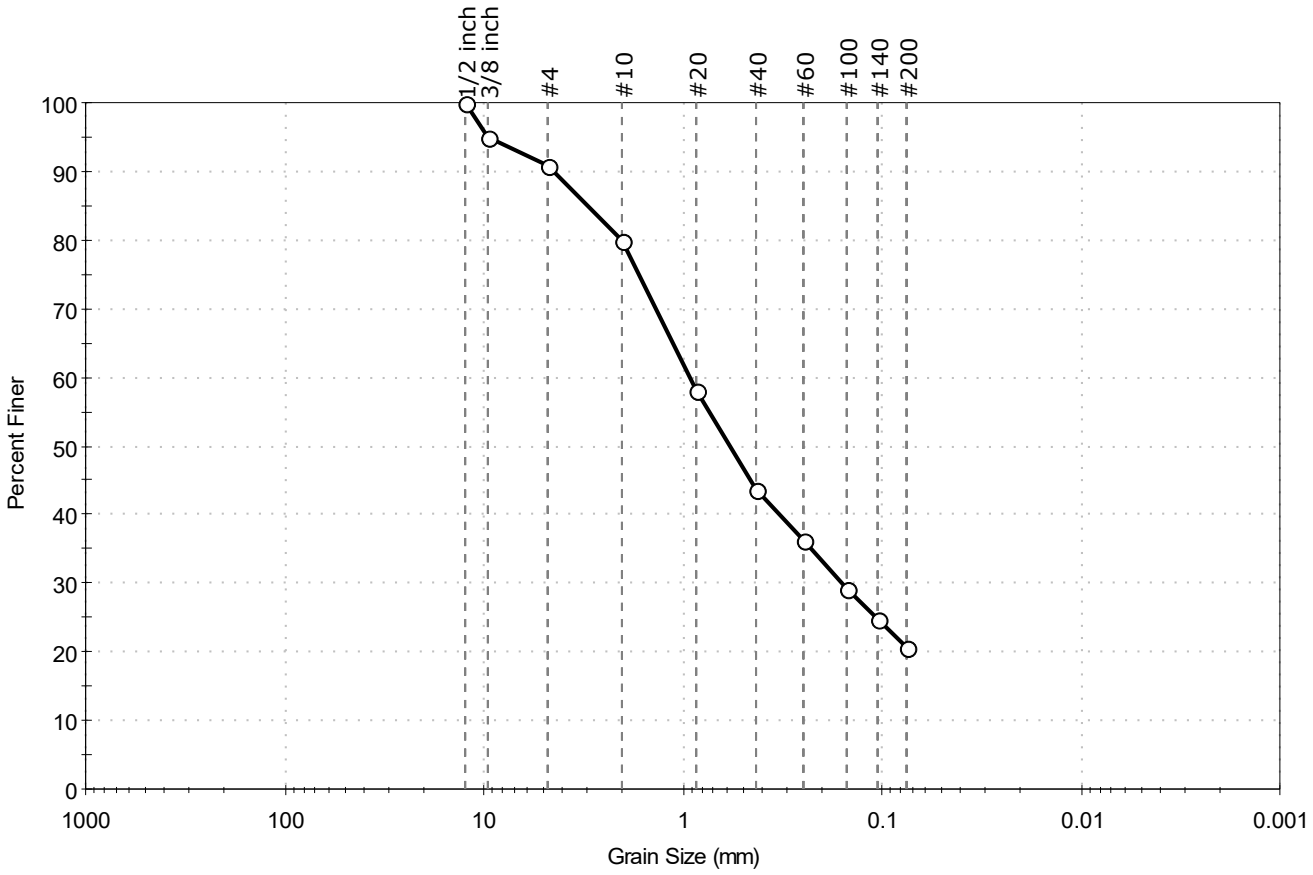
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-102	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-5	Test Date:	10/15/21	Checked By:	jsc
Depth :	10-12	Test Id:	632803		
Test Comment:	---				
Visual Description:	Moist, very dark brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	9.2	70.2	20.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	95		
#4	4.75	91		
#10	2.00	80		
#20	0.85	58		
#40	0.42	44		
#60	0.25	36		
#100	0.15	29		
#140	0.11	25		
#200	0.075	21		

Coefficients

D_{85} = 2.9810 mm D_{30} = 0.1574 mm

D_{60} = 0.9187 mm D_{15} = N/A

D_{50} = 0.5792 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

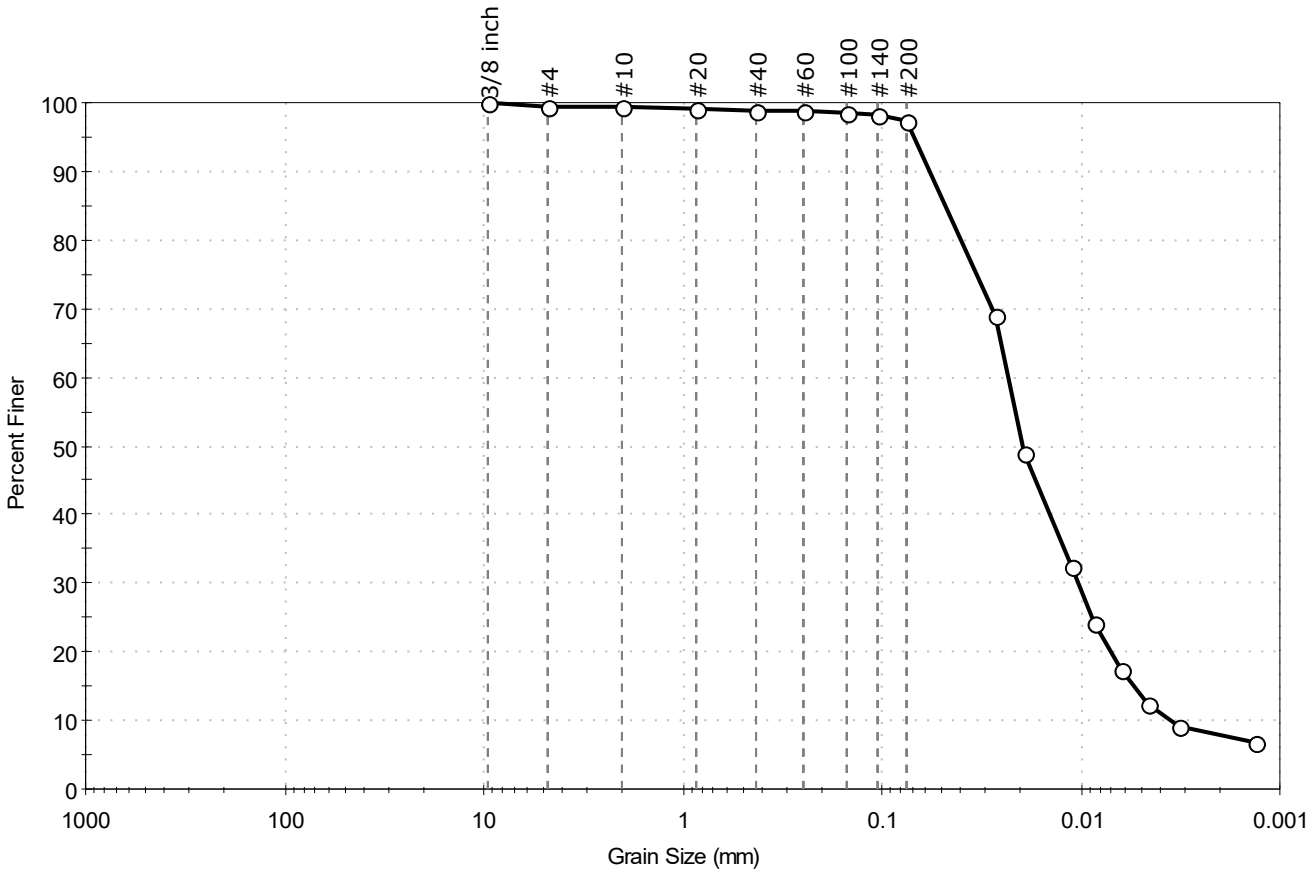
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-102	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-10 J2	Test Date:	10/21/21	Checked By:	jsc
Depth :	30-32	Test Id:	632804		
Test Comment:	---				
Visual Description:	Moist, dark olive brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.5	2.3	97.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	99		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#140	0.11	98		
#200	0.075	97		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0268	69		
---	0.0191	49		
---	0.0110	32		
---	0.0085	24		
---	0.0063	17		
---	0.0046	12		
---	0.0032	9		
---	0.0013	7		

Coefficients

D_{85} =0.0481 mm	D_{30} =0.0102 mm
D_{60} =0.0230 mm	D_{15} =0.0054 mm
D_{50} =0.0194 mm	D_{10} =0.0035 mm
C_u =6.571	C_c =1.292

Classification

ASTM SILT (ML)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

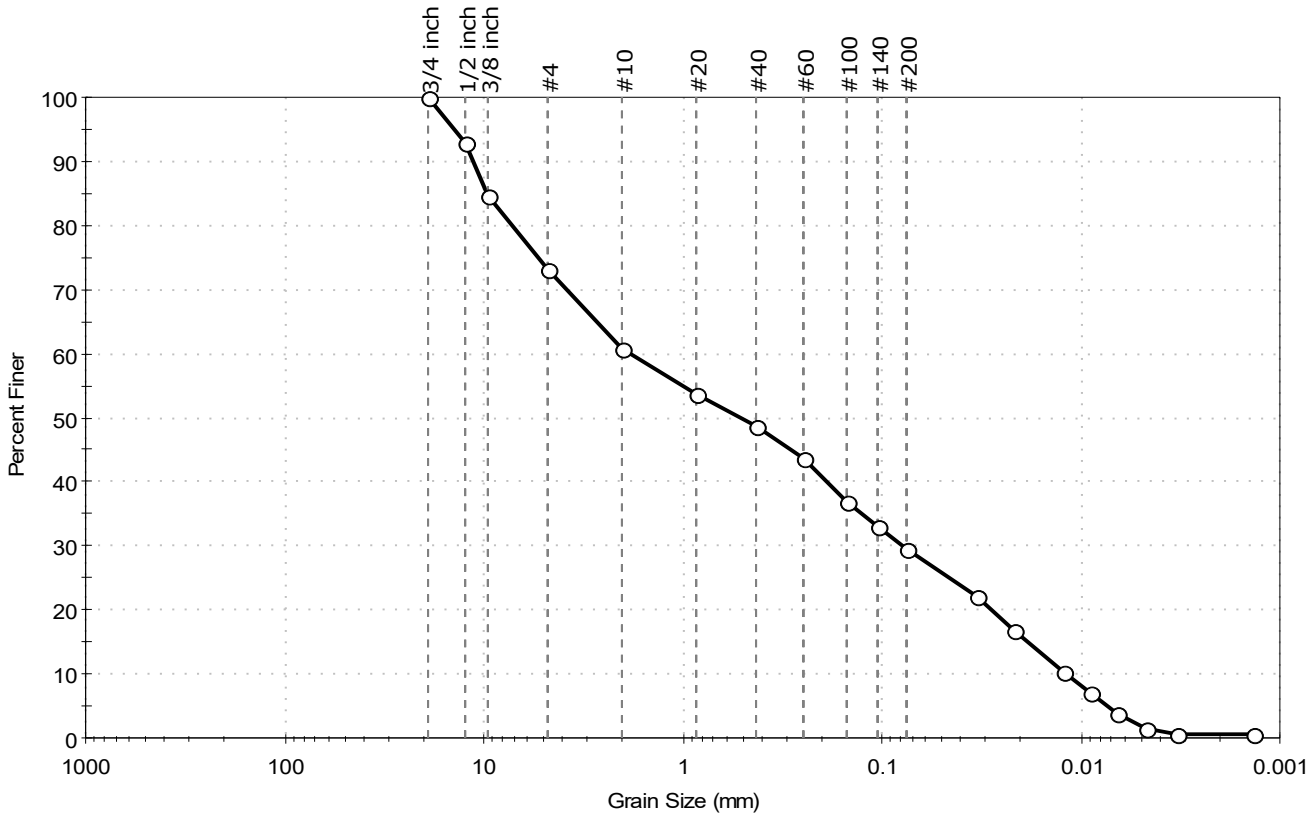
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-103	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-3	Test Date:	10/21/21	Checked By:	jsc
Depth :	6-8	Test Id:	632805		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	26.9	43.6	29.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	93		
3/8 inch	9.50	85		
#4	4.75	73		
#10	2.00	61		
#20	0.85	54		
#40	0.42	49		
#60	0.25	44		
#100	0.15	37		
#140	0.11	33		
#200	0.075	30		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0334	22		
---	0.0215	17		
---	0.0122	10		
---	0.0090	7		
---	0.0066	4		
---	0.0047	2		
---	0.0033	1		
---	0.0014	1		

Coefficients

D_{85} = 9.5704 mm D_{30} = 0.0787 mm

D_{60} = 1.8105 mm D_{15} = 0.0185 mm

D_{50} = 0.5058 mm D_{10} = 0.0119 mm

C_u = 152.143 C_c = 0.287

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

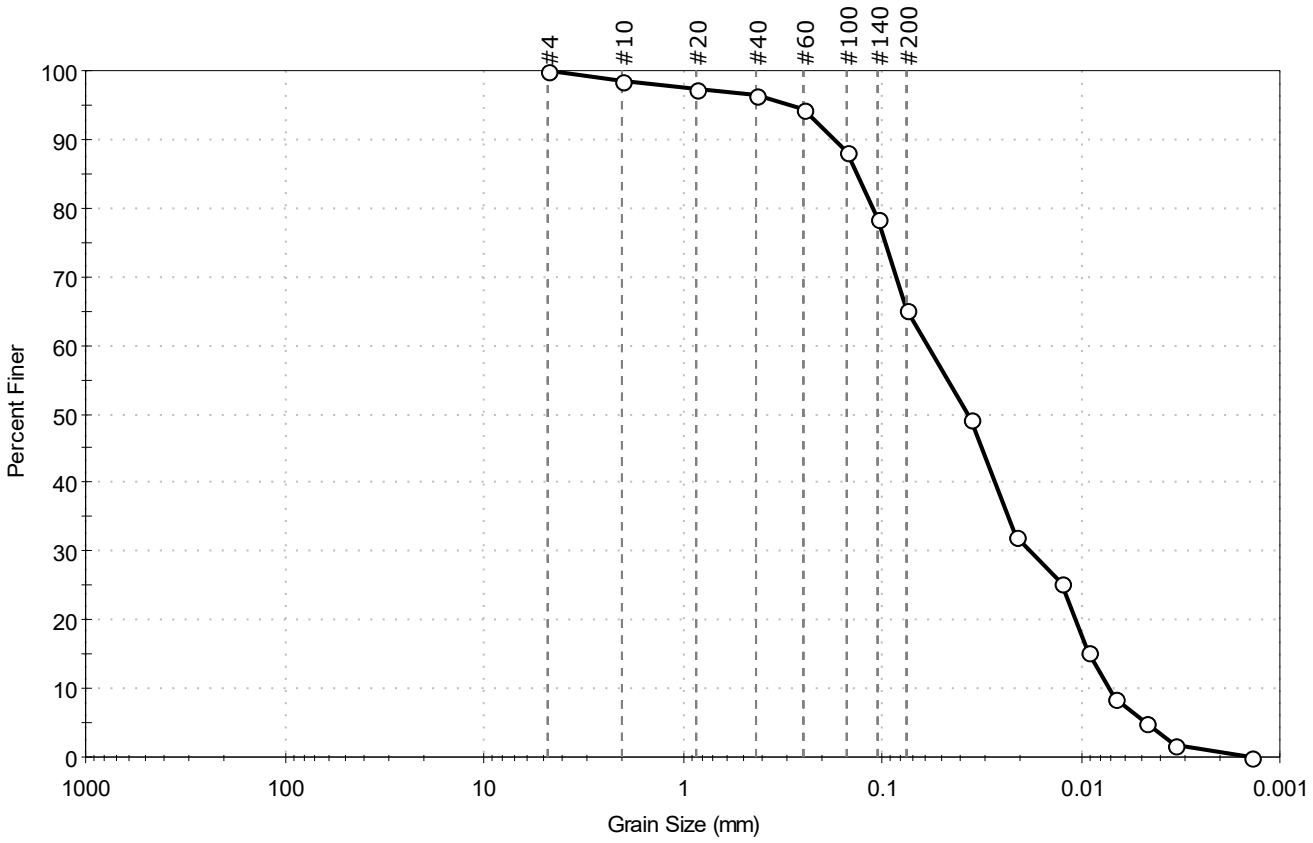
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-103	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-7	Test Date:	10/21/21	Checked By:	jsc
Depth :	20-22	Test Id:	632806		
Test Comment:	---				
Visual Description:	Moist, very dark brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	34.7	65.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	97		
#40	0.42	96		
#60	0.25	94		
#100	0.15	88		
#140	0.11	78		
#200	0.075	65		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0354	49		
---	0.0213	32		
---	0.0127	25		
---	0.0092	15		
---	0.0067	8		
---	0.0047	5		
---	0.0033	2		
---	0.0014	0		

Coefficients

D_{85} =0.1336 mm	D_{30} =0.0180 mm
D_{60} =0.0586 mm	D_{15} =0.0091 mm
D_{50} =0.0368 mm	D_{10} =0.0072 mm
C_u =8.139	C_c =0.768

Classification

ASTM Sandy Elastic SILT (MH)

AASHTO Clayey Soils (A-7-5 (14))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

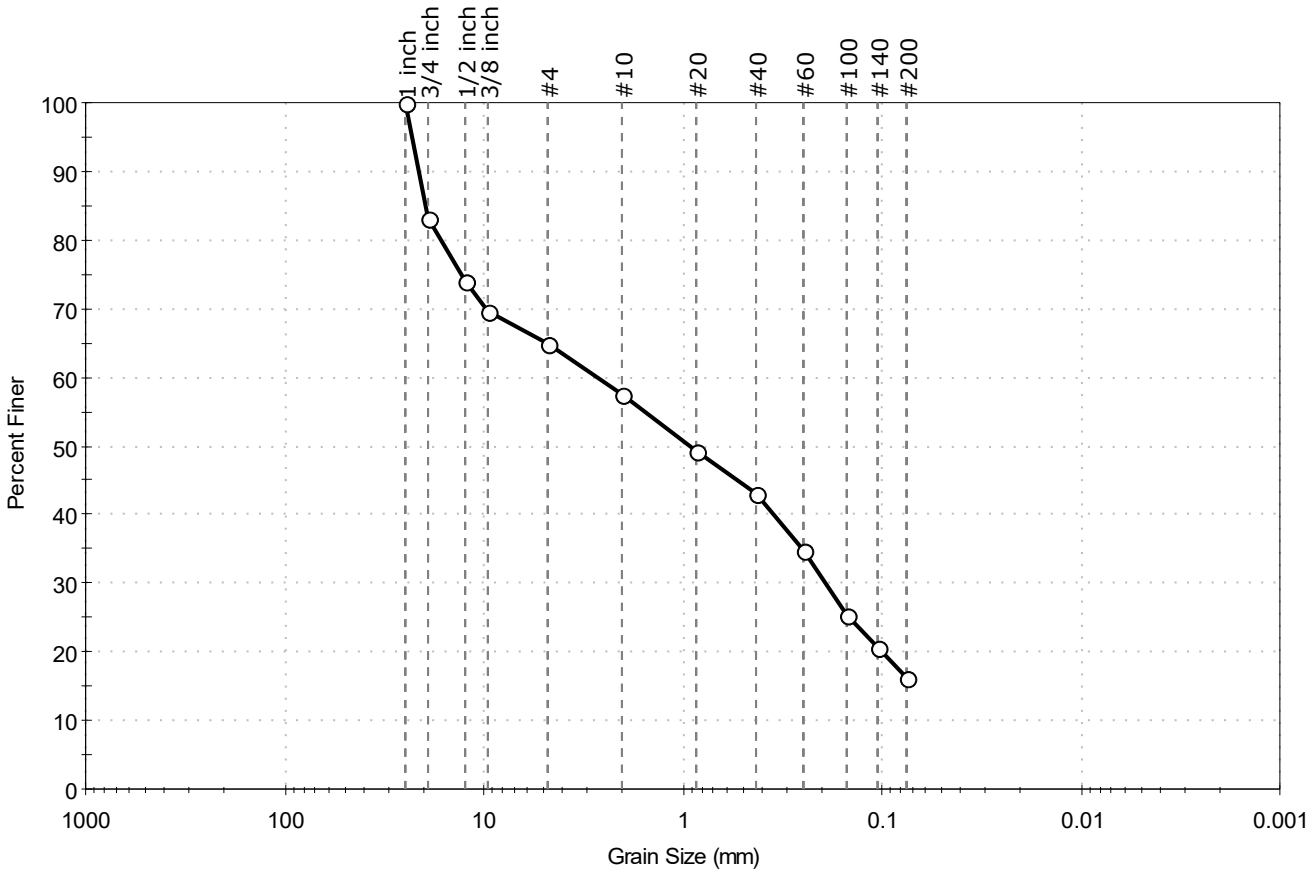
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-103	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-8	Test Date:	10/15/21	Checked By:	jsc
Depth :	25-27	Test Id:	632807		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	35.1	48.7	16.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 inch	25.00	100		
3/4 inch	19.00	83		
1/2 inch	12.50	74		
3/8 inch	9.50	70		
#4	4.75	65		
#10	2.00	58		
#20	0.85	49		
#40	0.42	43		
#60	0.25	35		
#100	0.15	25		
#140	0.11	21		
#200	0.075	16		

Coefficients

D_{85} = 19.6022 mm D_{30} = 0.1919 mm

D_{60} = 2.6759 mm D_{15} = N/A

D_{50} = 0.9187 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

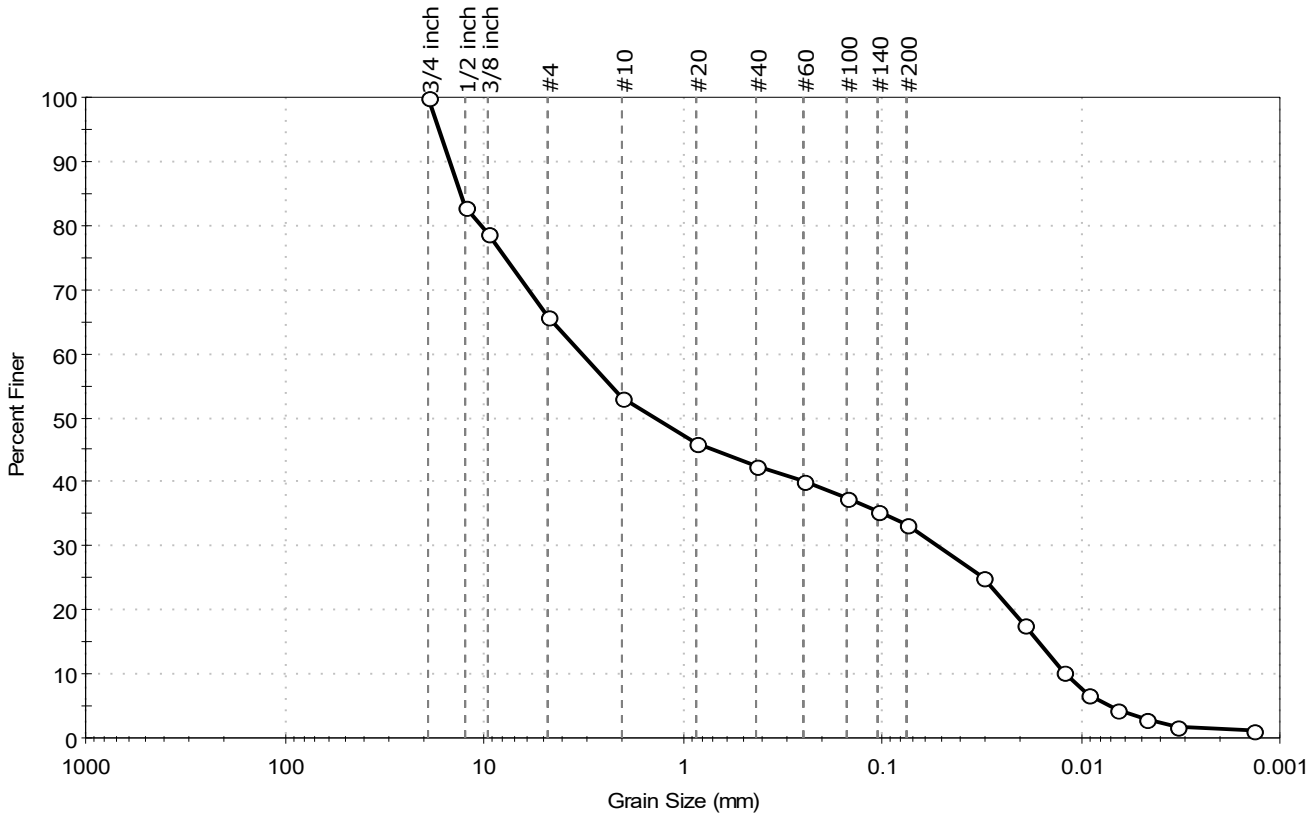
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-6	Test Date:	10/21/21	Checked By:	jsc
Depth :	10-12	Test Id:	632808		
Test Comment:	---				
Visual Description:	Moist, grayish brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	34.3	32.4	33.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	83		
3/8 inch	9.50	79		
#4	4.75	66		
#10	2.00	53		
#20	0.85	46		
#40	0.42	43		
#60	0.25	40		
#100	0.15	38		
#140	0.11	35		
#200	0.075	33		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0311	25		
---	0.0194	18		
---	0.0122	10		
---	0.0092	7		
---	0.0066	4		
---	0.0047	3		
---	0.0033	2		
---	0.0014	1		

Coefficients

D_{85} = 13.1399 mm D_{30} = 0.0528 mm
D_{60} = 3.2092 mm D_{15} = 0.0163 mm
D_{50} = 1.3768 mm D_{10} = 0.0118 mm
C_u = 271.966 C_c = 0.074

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

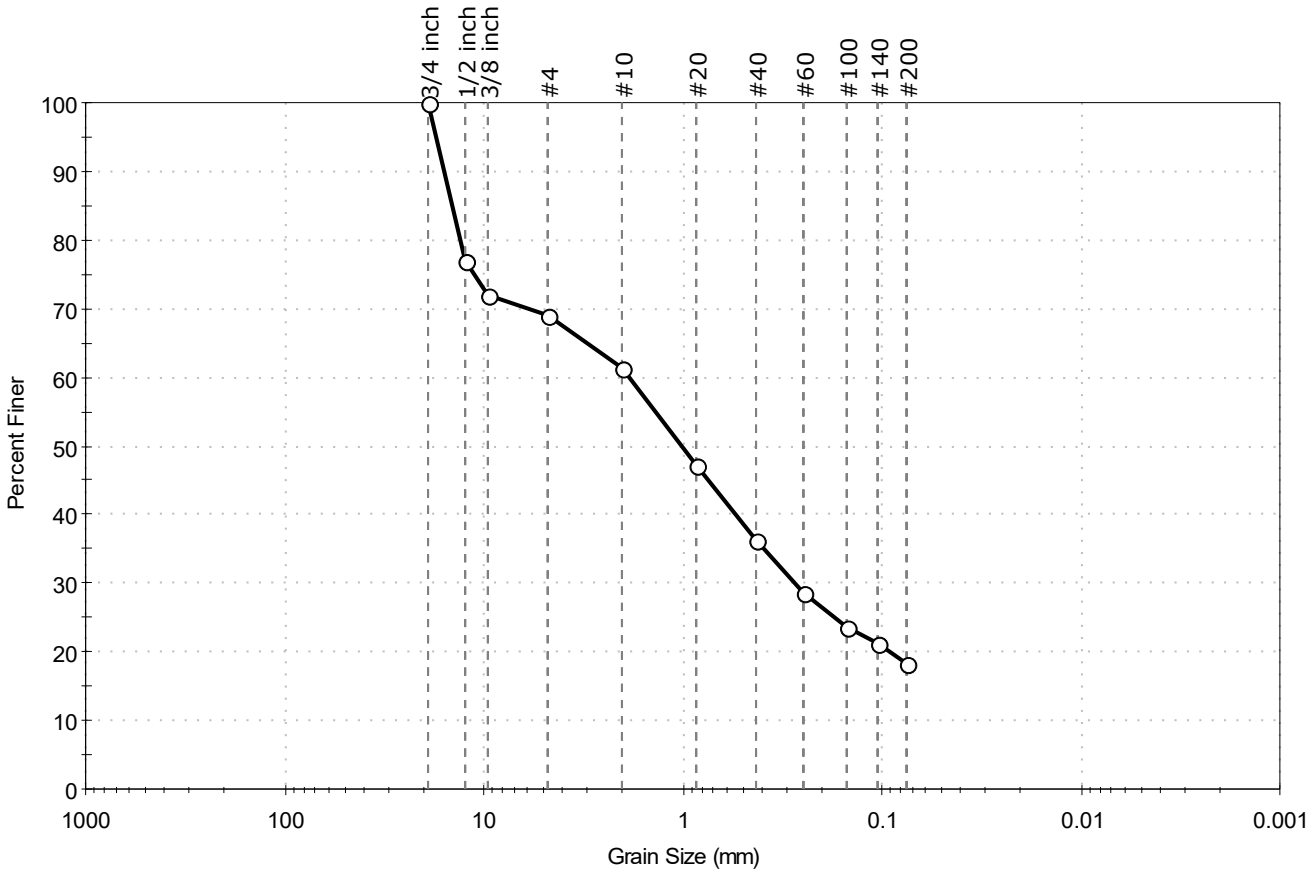
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-104	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-9	Test Date:	10/15/21	Checked By:	jsc
Depth :	22-24	Test Id:	632809		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	30.9	50.8	18.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	77		
3/8 inch	9.50	72		
#4	4.75	69		
#10	2.00	61		
#20	0.85	47		
#40	0.42	36		
#60	0.25	29		
#100	0.15	24		
#140	0.11	21		
#200	0.075	18		

Coefficients

D_{85} = 14.4753 mm	D_{30} = 0.2755 mm
D_{60} = 1.8301 mm	D_{15} = N/A
D_{50} = 1.0024 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

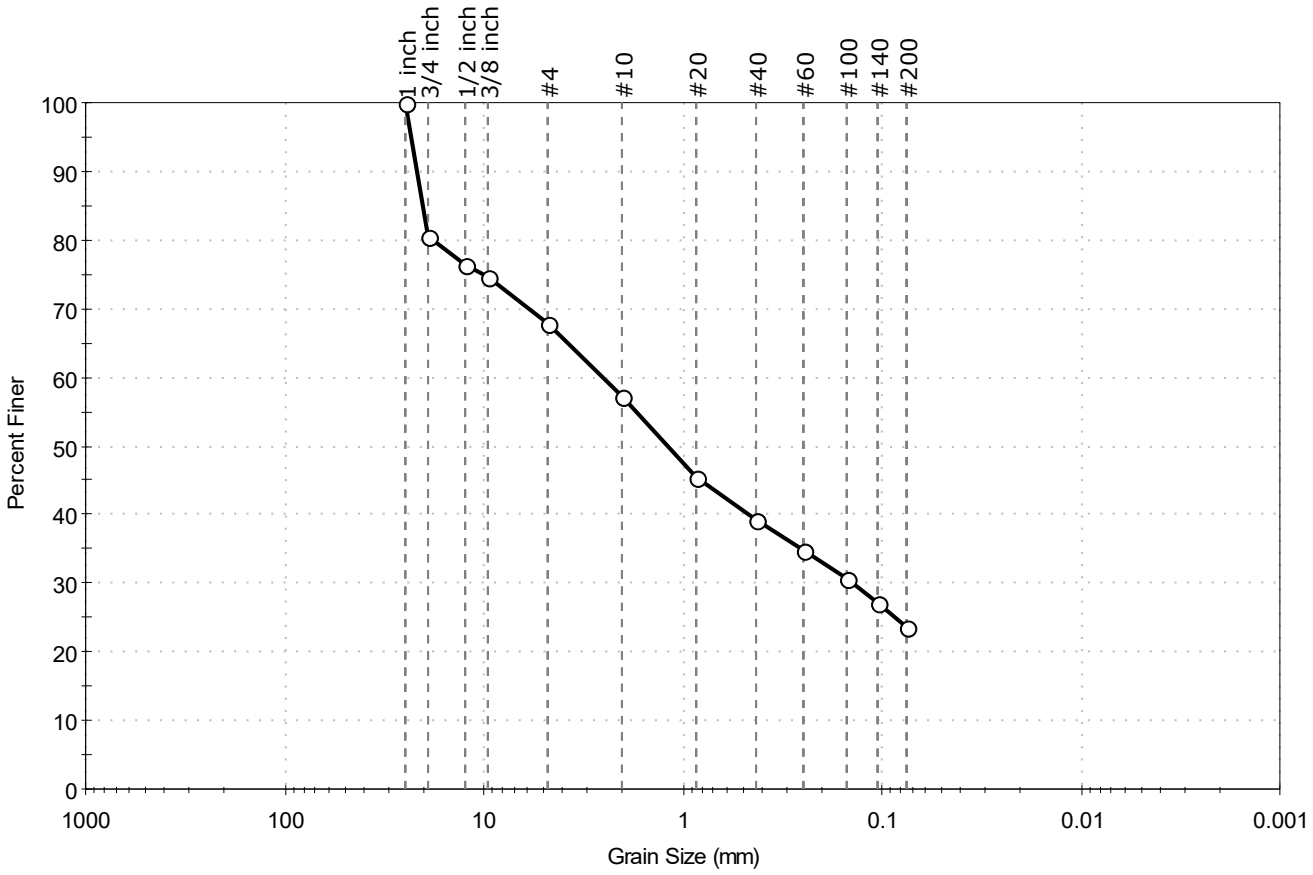
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-105	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-1	Test Date:	10/15/21	Checked By:	jsc
Depth :	0-2	Test Id:	632810		
Test Comment:	---				
Visual Description:	Moist, grayish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	32.1	44.4	23.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 inch	25.00	100		
3/4 inch	19.00	80		
1/2 inch	12.50	77		
3/8 inch	9.50	75		
#4	4.75	68		
#10	2.00	57		
#20	0.85	45		
#40	0.42	39		
#60	0.25	35		
#100	0.15	31		
#140	0.11	27		
#200	0.075	24		

Coefficients

D_{85} = 20.2442 mm D_{30} = 0.1412 mm

D_{60} = 2.4820 mm D_{15} = N/A

D_{50} = 1.1784 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

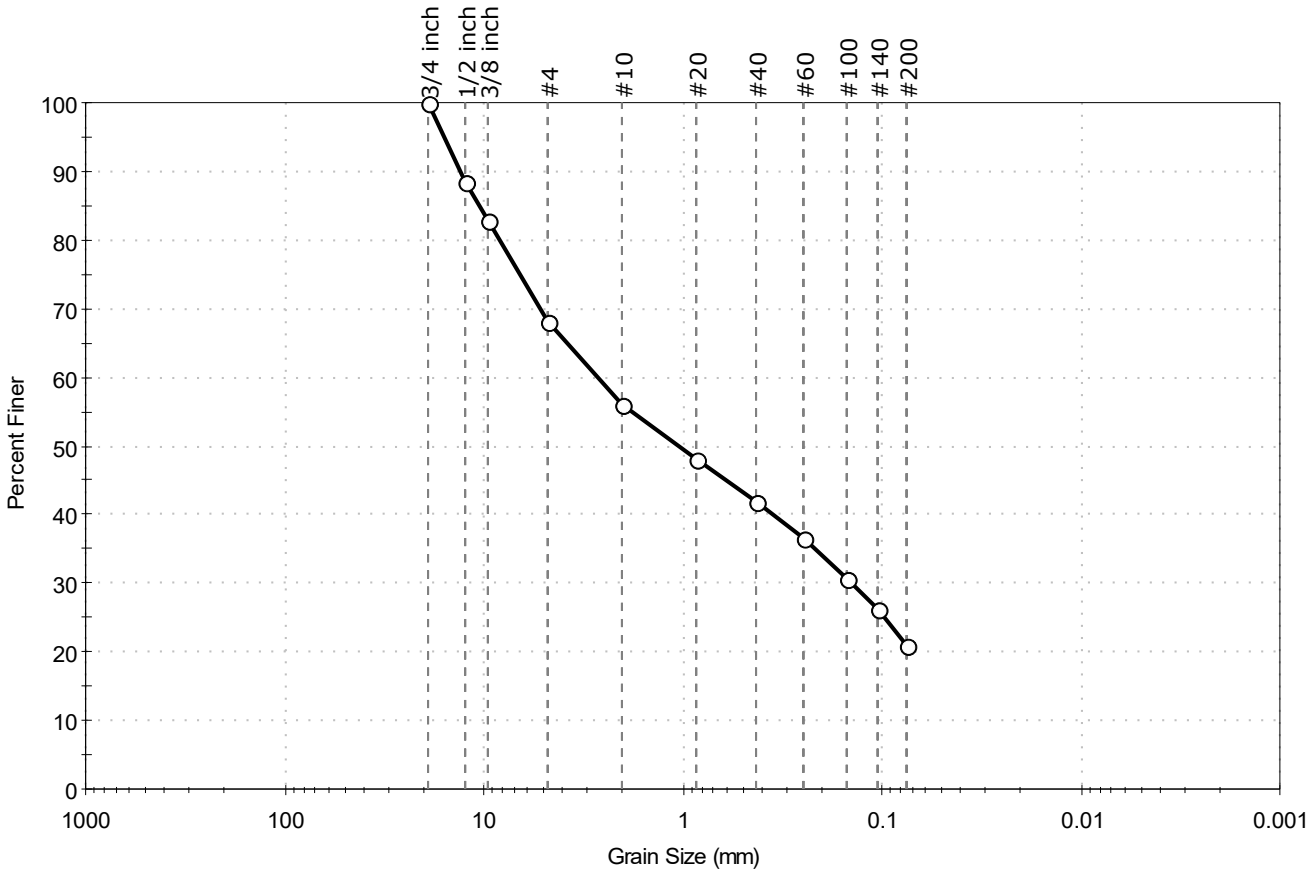
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-105	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-9	Test Date:	10/15/21	Checked By:	jsc
Depth :	22-24	Test Id:	632811		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	31.7	47.3	21.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	89		
3/8 inch	9.50	83		
#4	4.75	68		
#10	2.00	56		
#20	0.85	48		
#40	0.42	42		
#60	0.25	37		
#100	0.15	31		
#140	0.11	26		
#200	0.075	21		

Coefficients

D_{85} = 10.5413 mm D_{30} = 0.1426 mm

D_{60} = 2.6396 mm D_{15} = N/A

D_{50} = 1.0544 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

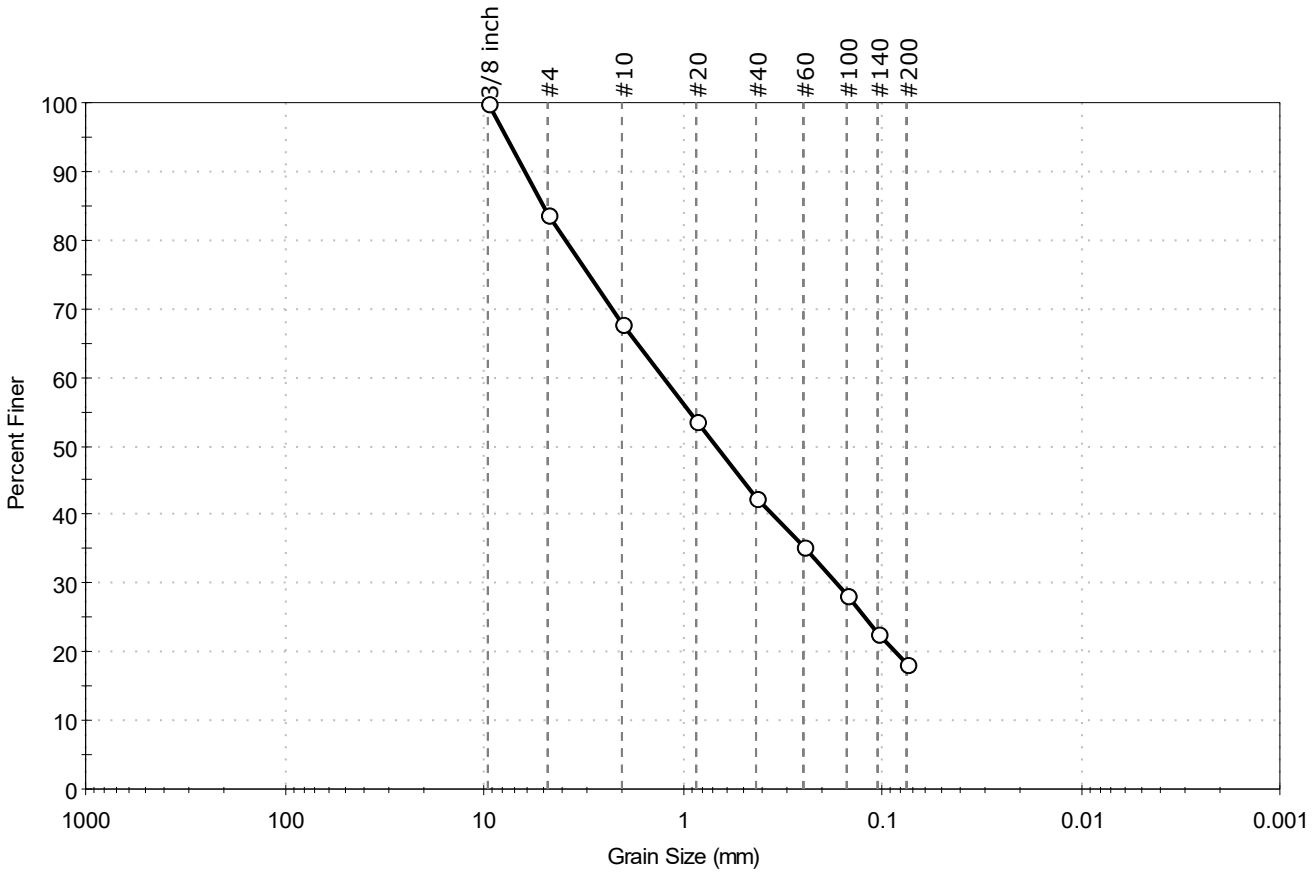
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-106	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-4	Test Date:	10/15/21	Checked By:	jsc
Depth :	6-8	Test Id:	632812		
Test Comment:	---				
Visual Description:	Moist, dark yellowish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	16.2	65.5	18.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	84		
#10	2.00	68		
#20	0.85	54		
#40	0.42	43		
#60	0.25	35		
#100	0.15	28		
#140	0.11	23		
#200	0.075	18		

Coefficients

D_{85} =4.9896 mm	D_{30} =0.1696 mm
D_{60} =1.2519 mm	D_{15} =N/A
D_{50} =0.6787 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

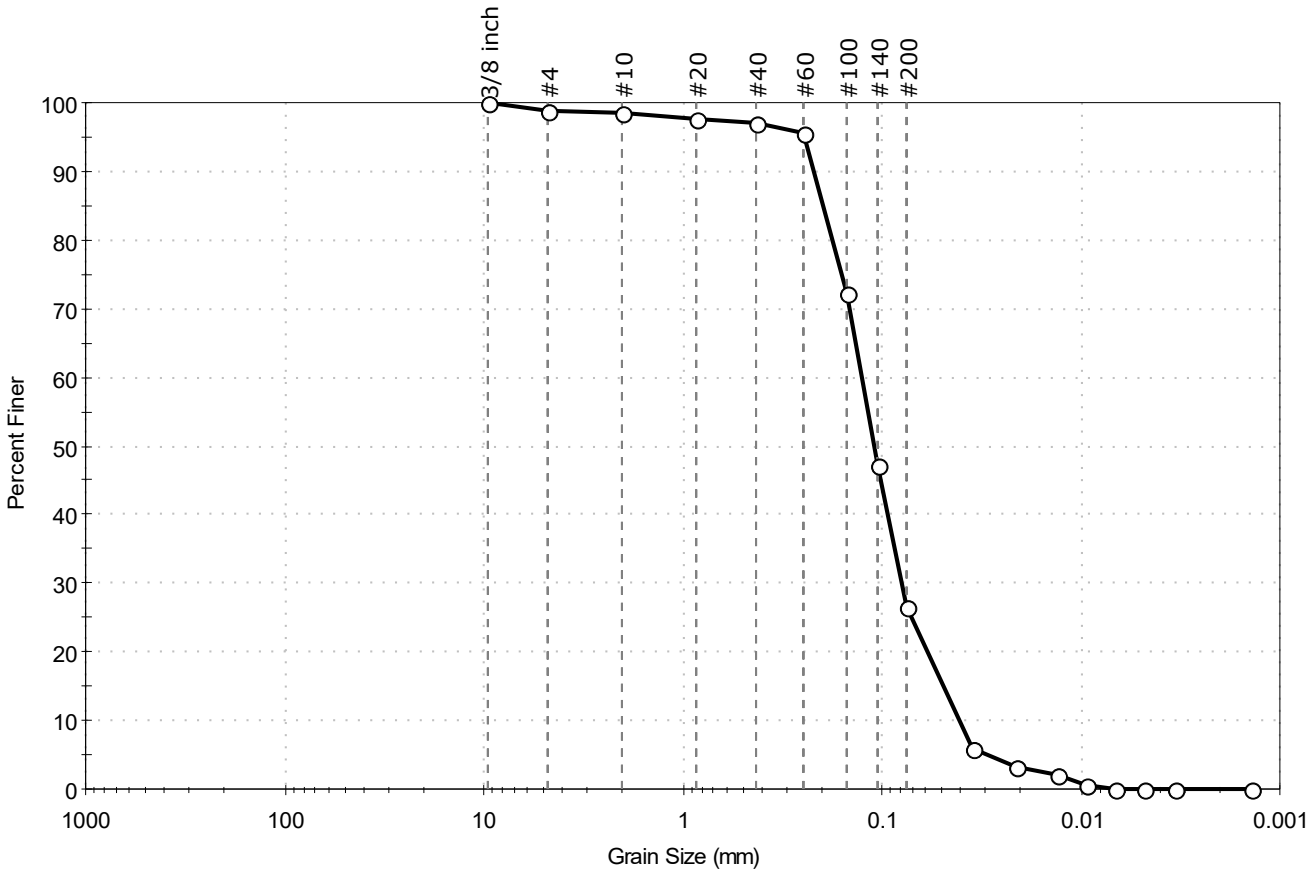
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-106	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-7	Test Date:	10/21/21	Checked By:	jsc
Depth :	15-17	Test Id:	632813		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.1	72.5	26.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	99		
#10	2.00	99		
#20	0.85	98		
#40	0.42	97		
#60	0.25	96		
#100	0.15	72		
#140	0.11	47		
#200	0.075	26		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0347	6		
---	0.0211	3		
---	0.0131	2		
---	0.0093	1		
---	0.0068	0		
---	0.0048	0		
---	0.0034	0		
---	0.0014	0		

Coefficients

D_{85} = 0.1980 mm	D_{30} = 0.0796 mm
D_{60} = 0.1265 mm	D_{15} = 0.0488 mm
D_{50} = 0.1102 mm	D_{10} = 0.0405 mm
C_u = 3.123	C_c = 1.237

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

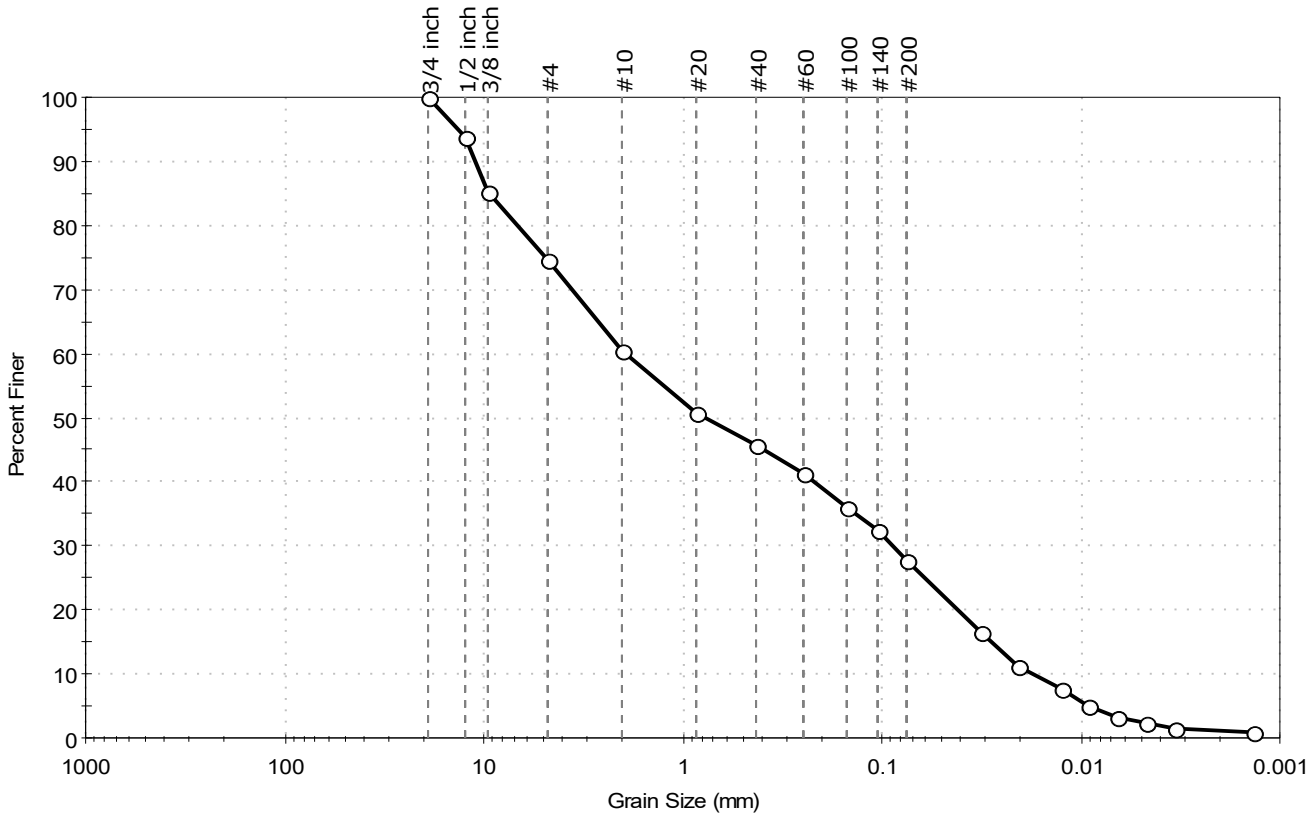
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-106	Sample Type:	jar	Tested By:	ckg
Sample ID:	S-9	Test Date:	10/21/21	Checked By:	jsc
Depth :	22-24	Test Id:	632814		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	25.4	46.9	27.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	94		
3/8 inch	9.50	85		
#4	4.75	75		
#10	2.00	60		
#20	0.85	51		
#40	0.42	46		
#60	0.25	41		
#100	0.15	36		
#140	0.11	32		
#200	0.075	28		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0322	17		
---	0.0207	11		
---	0.0125	8		
---	0.0091	5		
---	0.0066	3		
---	0.0047	2		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 9.3194 mm D_{30} = 0.0887 mm
D_{60} = 1.9294 mm D_{15} = 0.0283 mm
D_{50} = 0.7796 mm D_{10} = 0.0175 mm
C_u = 110.251 C_c = 0.233

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-102	Sample Type:	jar	Tested By:	cam
Sample ID:	S-10 J2	Test Date:	10/20/21	Checked By:	jsc
Depth :	30-32	Test Id:	632798		
Test Comment:	---				
Visual Description:	Moist, dark olive brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

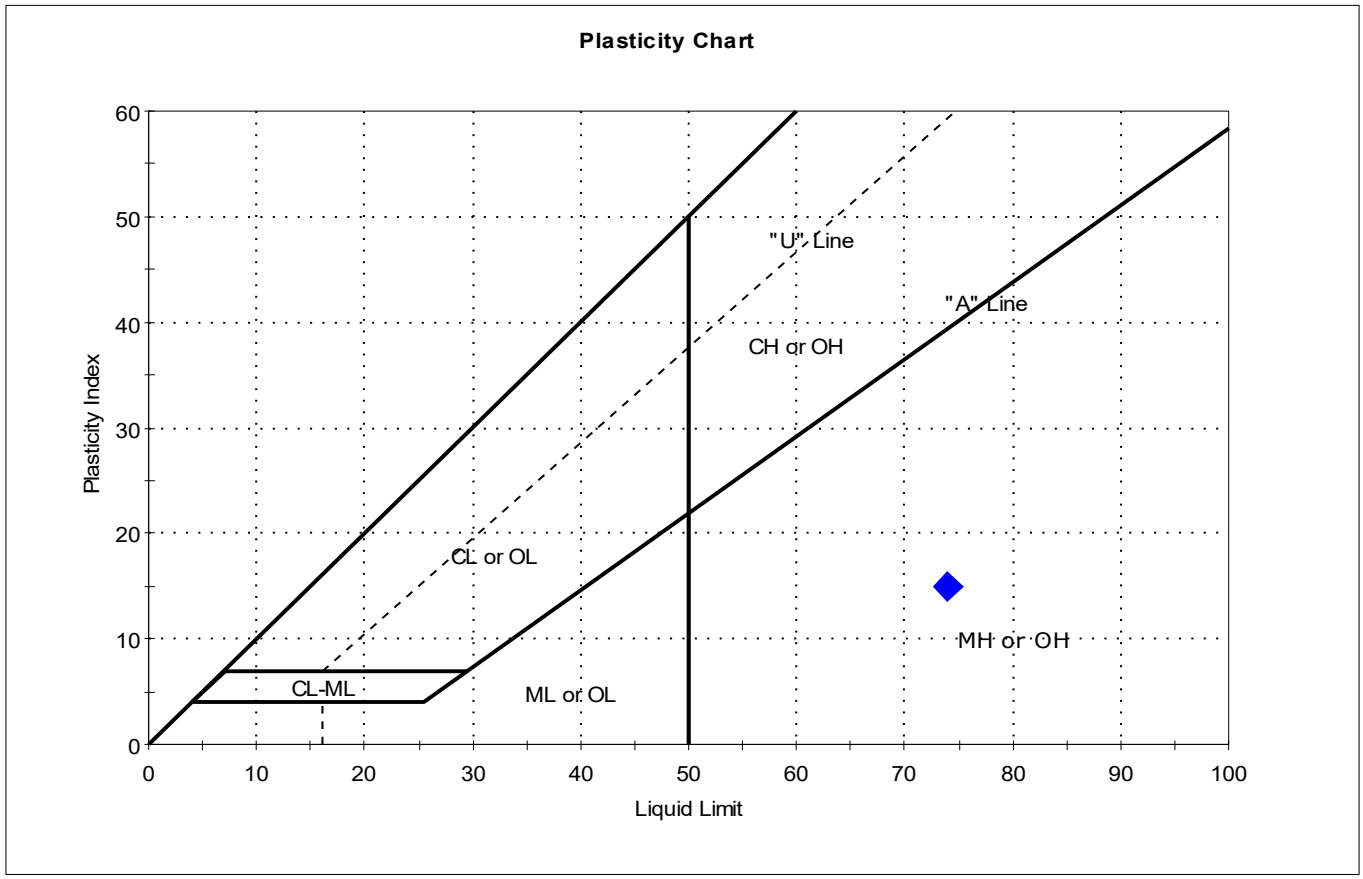
Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-10 J2	B-102	30-32	31	n/a	n/a	n/a	n/a	SILT (ML)

1% Retained on #40 Sieve
Dry Strength: LOW
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

GeoTesting EXPRESS

Client:	Hardesty & Hanover				
Project:	Vtrans Northfield - RT12 Bridge Dog River				
Location:				Project No:	GTX-314375
Boring ID:	B-103	Sample Type:	jar	Tested By:	cam
Sample ID:	S-7	Test Date:	10/20/21	Checked By:	jsc
Depth :	20-22	Test Id:	632799		
Test Comment:	---				
Visual Description:	Moist, very dark brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

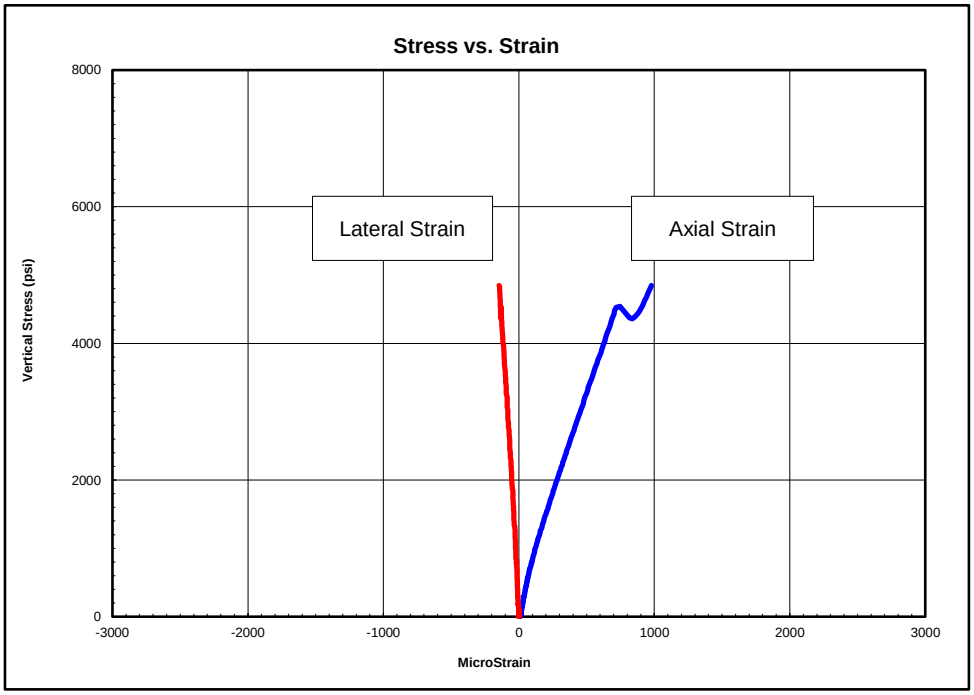


Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-7	B-103	20-22	92	74	59	15	2.2	Sandy Elastic SILT (MH)

Sample Prepared using the WET method
4% Retained on #40 Sieve
Dry Strength: HIGH
Dilatancy: SLOW
Toughness: LOW

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	jsc
Boring ID:	B-102
Sample ID:	C-1
Depth, ft:	36.40-36.76
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 4,847 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
500-1800	6,860,000	0.18
1800-3100	5,830,000	0.18
3100-4400	4,050,000	0.14

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Hardesty & Hanover	Test Date:	10/15/2021
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River	Tested By:	ak
Project Location:	---	Checked By:	smd
GTX #:	314375		
Boring ID:	B-102		
Sample ID:	C-1		
Depth:	36.40-36.76 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.30	4.30	4.30
Specimen Diameter, in:	1.97	1.96	1.97
Specimen Mass, g:	603.11		
Bulk Density, lb/ft^3	176	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:

Is the maximum gap ≤ 0.02 in.? NO

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? NO

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00030	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00030	-0.00040
Diameter 2, in (rotated 90°)	-0.00070	-0.00060	-0.00050	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00020	0.00030

Difference between max and min readings, in:

0° = 0.00070 90° = 0.00100

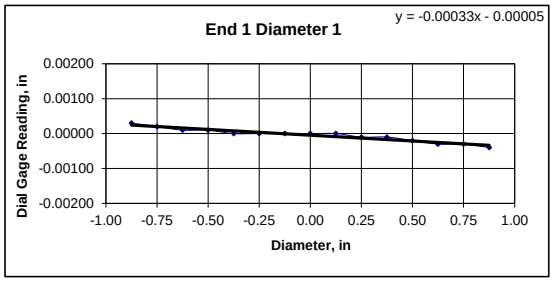
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00020	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00020	-0.00030	-0.00060
Diameter 2, in (rotated 90°)	0.00040	0.00020	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040	-0.00060

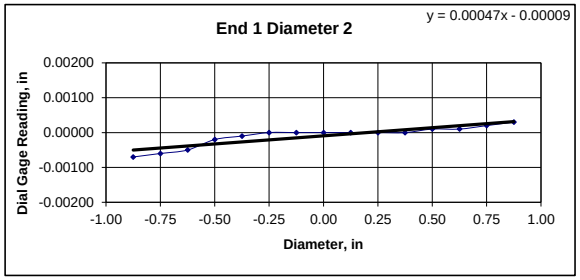
Difference between max and min readings, in:

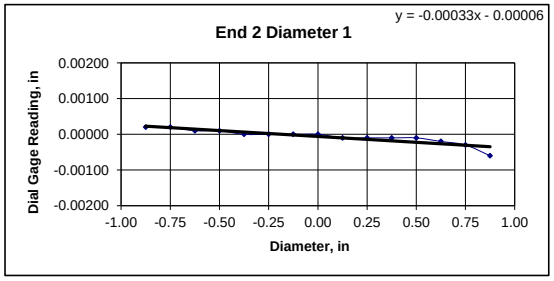
0° = 0.0008 90° = 0.001

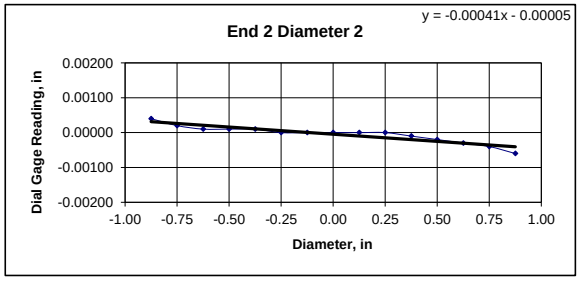
Maximum difference must be < 0.0020 in. Difference = ± 0.00050

Flatness Tolerance Met? YES









DIAMETER 1

End 1:
- Slope of Best Fit Line: 0.00033
- Angle of Best Fit Line: 0.01899

End 2:
- Slope of Best Fit Line: 0.00033
- Angle of Best Fit Line: 0.01883

Maximum Angular Difference: 0.00016

Parallelism Tolerance Met? YES

Spherically Seated

DIAMETER 2

End 1:
- Slope of Best Fit Line: 0.00047
- Angle of Best Fit Line: 0.02668

End 2:
- Slope of Best Fit Line: 0.00041
- Angle of Best Fit Line: 0.02357

Maximum Angular Difference: 0.00311

Parallelism Tolerance Met? YES

Spherically Seated

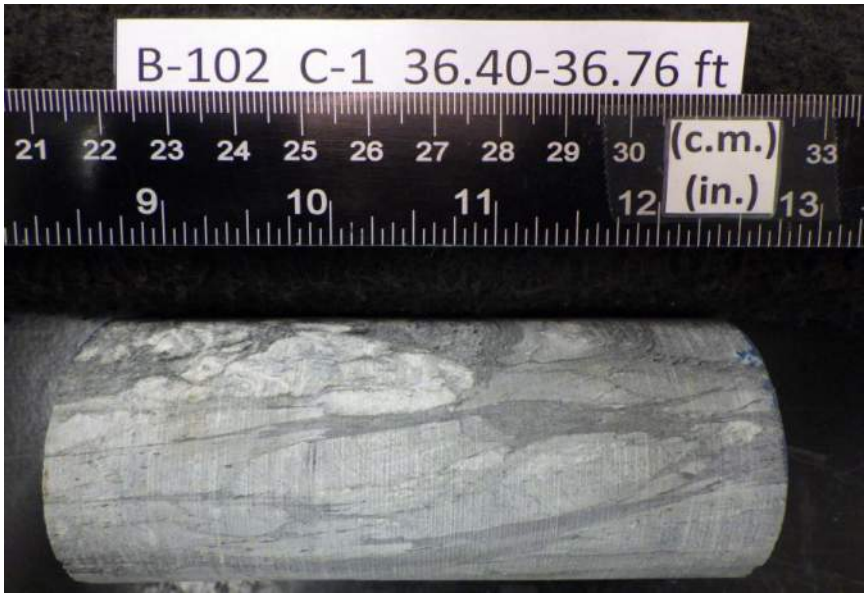
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00070	1.965	0.00036	0.020	YES
Diameter 2, in (rotated 90°)	0.00100	1.965	0.00051	0.029	YES
END 2					
Diameter 1, in	0.00080	1.965	0.00041	0.023	YES
Diameter 2, in (rotated 90°)	0.00100	1.965	0.00051	0.029	YES

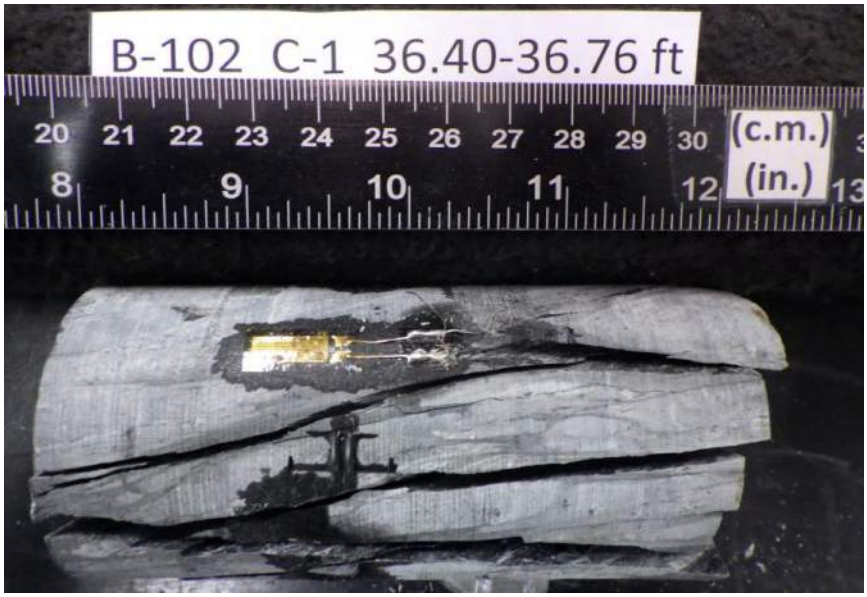
Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? YES

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	smd
Boring ID:	B-102
Sample ID:	C-1
Depth, ft:	36.40-36.76 ft



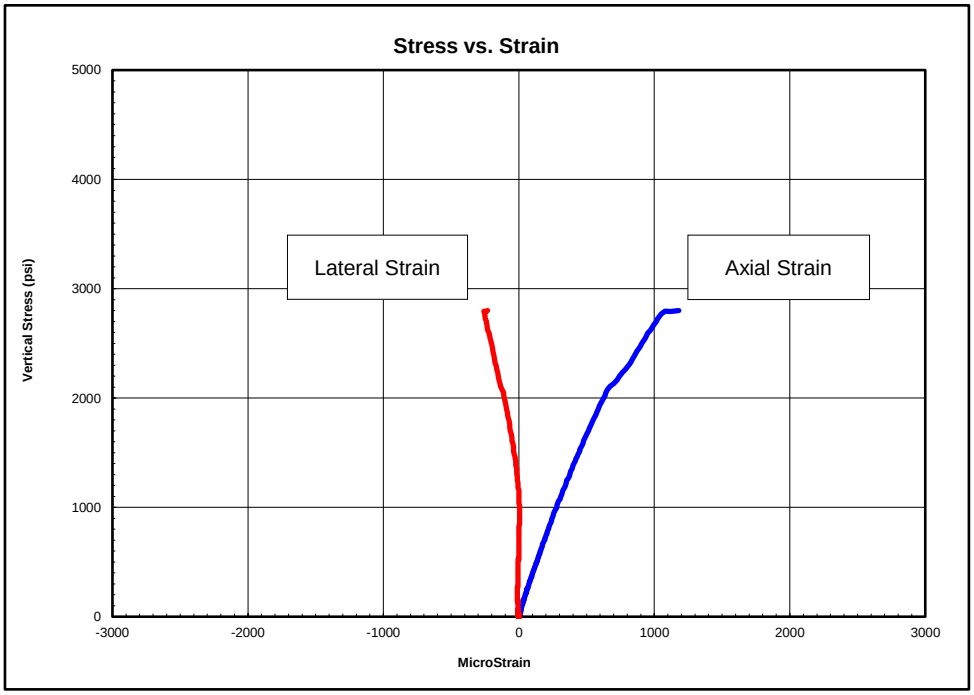
After cutting and grinding



After break

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	jsc
Boring ID:	B-103
Sample ID:	C-2
Depth, ft:	36.71-37.09
Sample Type:	rock core
Sample Description:	See photographs Discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 2,800 psi

The strain values recorded for this test produce unrealistic values of Poisson's Ratio within the first stress range.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
300-1000	3,490,000	---
1000-1800	2,950,000	0.30
1800-2500	1,790,000	0.35

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Hardesty & Hanover	Test Date:	10/18/2021
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River	Tested By:	ak
Project Location:	---	Checked By:	smd
GTX #:	314375		
Boring ID:	B-103		
Sample ID:	C-2		
Depth:	36.71-37.09 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.62	4.61	4.62
Specimen Diameter, in:	1.98	1.98	1.98
Specimen Mass, g:	658.5		
Bulk Density, lb/ft^3	176	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

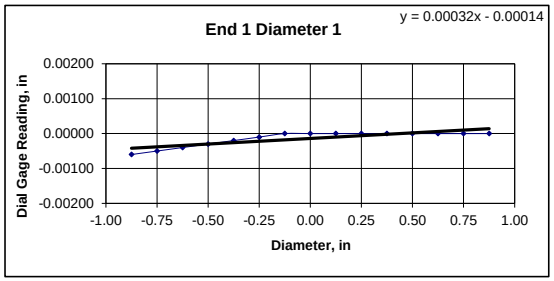
END FLATNESS AND PARALLELISM (Procedure FP1)

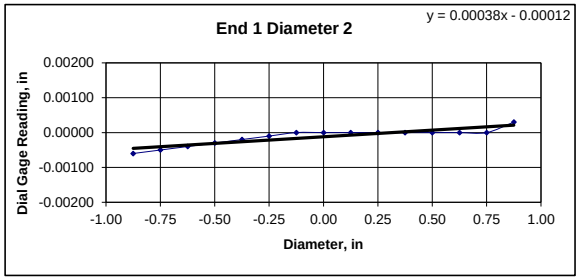
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00030

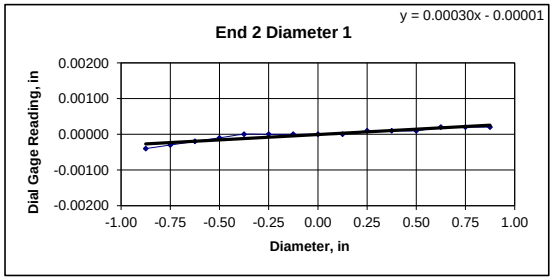
Difference between max and min readings, in:
0° = 0.00060 90° = 0.00090

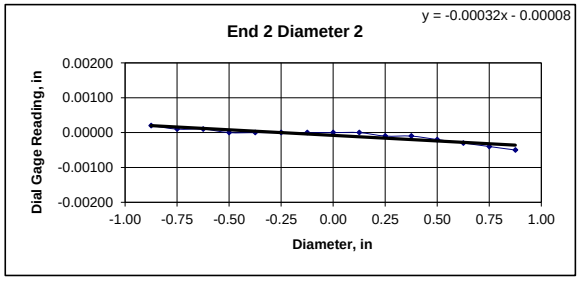
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00020	0.00020	0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050

Difference between max and min readings, in:
0° = 0.0006 90° = 0.0007
Maximum difference must be < 0.0020 in. Difference = ± 0.00045
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00032
Angle of Best Fit Line: 0.01833

End 2:
Slope of Best Fit Line 0.00030
Angle of Best Fit Line: 0.01719

Maximum Angular Difference: 0.00115

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00038
Angle of Best Fit Line: 0.02177

End 2:
Slope of Best Fit Line 0.00032
Angle of Best Fit Line: 0.01833

Maximum Angular Difference: 0.00344

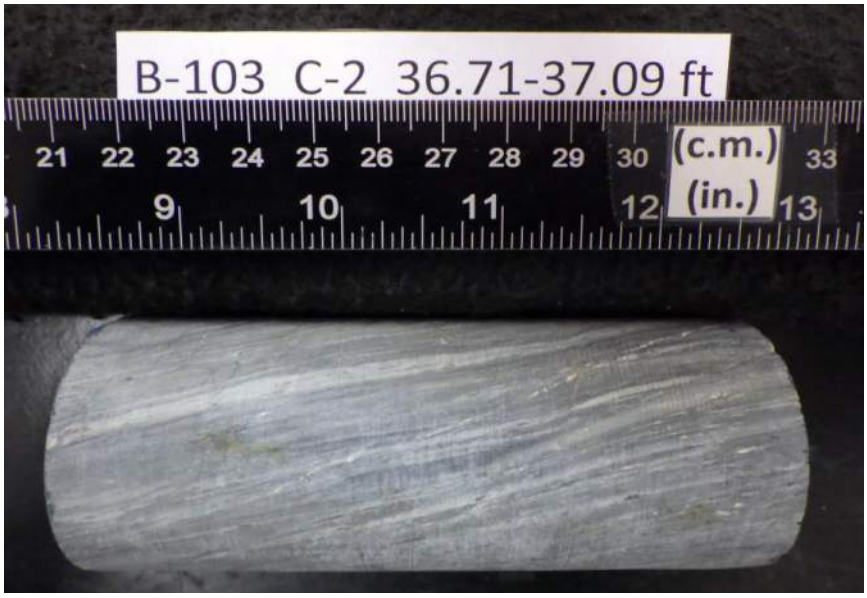
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00060	1.980	0.00030	0.017	YES
Diameter 2, in (rotated 90°)	0.00090	1.980	0.00045	0.026	YES
END 2					
Diameter 1, in	0.00060	1.980	0.00030	0.017	YES
Diameter 2, in (rotated 90°)	0.00070	1.980	0.00035	0.020	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	smd
Boring ID:	B-103
Sample ID:	C-2
Depth, ft:	36.71-37.09 ft

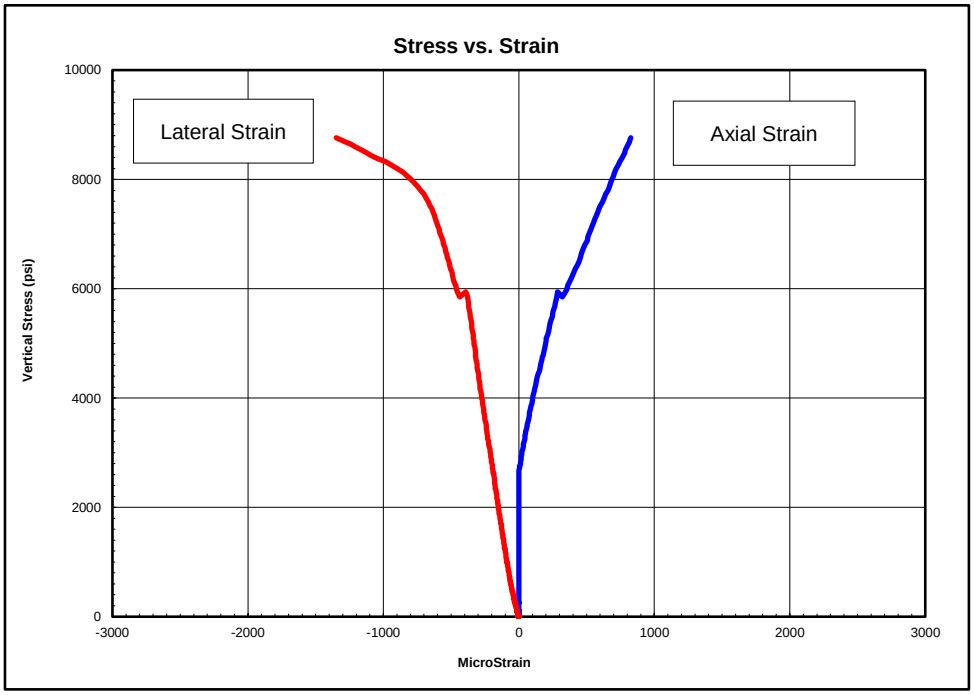


After cutting and grinding

After break

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	jsc
Boring ID:	B-104
Sample ID:	C-1
Depth, ft:	29.52-29.89
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 8,762 psi

The strain values recorded for this test produce values of Poisson's Ratio that exceed maximum values found in rocks.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
900-3200	---	---
3200-5500	11,000,000	---
5500-7900	5,500,000	---

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Hardesty & Hanover	Test Date:	10/18/2021
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River	Tested By:	ak
Project Location:	---	Checked By:	smd
GTX #:	314375		
Boring ID:	B-104		
Sample ID:	C-1		
Depth:	29.52-29.89 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.35	4.35	4.35
Specimen Diameter, in:	1.97	1.98	1.98
Specimen Mass, g:	610.76		
Bulk Density, lb/ft^3	174	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

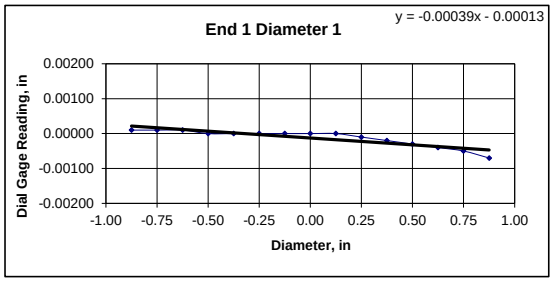
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050	-0.00070
Diameter 2, in (rotated 90°)	-0.00070	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010

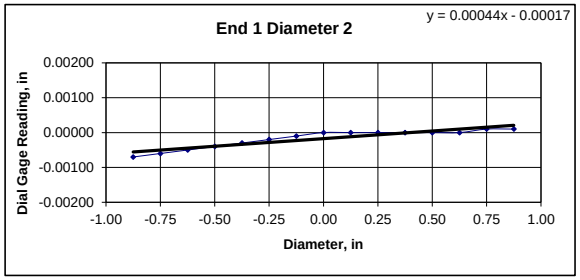
Difference between max and min readings, in:
0° = 0.00080 90° = 0.00080

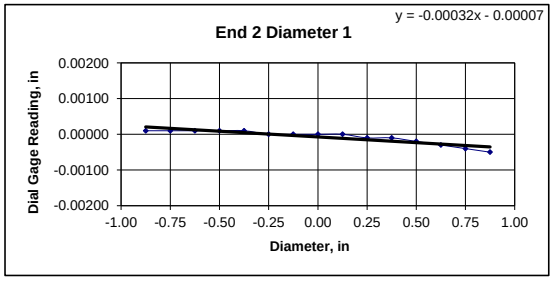
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050
Diameter 2, in (rotated 90°)	0.00030	0.00030	0.00020	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050	-0.00060

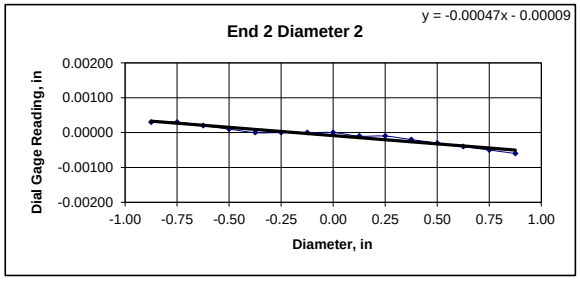
Difference between max and min readings, in:
0° = 0.0006 90° = 0.0009

Maximum difference must be < 0.0020 in. Difference = ± 0.00045
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00039
Angle of Best Fit Line: 0.02243

End 2:
Slope of Best Fit Line 0.00032
Angle of Best Fit Line: 0.01833

Maximum Angular Difference: 0.00409

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00044
Angle of Best Fit Line: 0.02505

End 2:
Slope of Best Fit Line 0.00047
Angle of Best Fit Line: 0.02717

Maximum Angular Difference: 0.00213

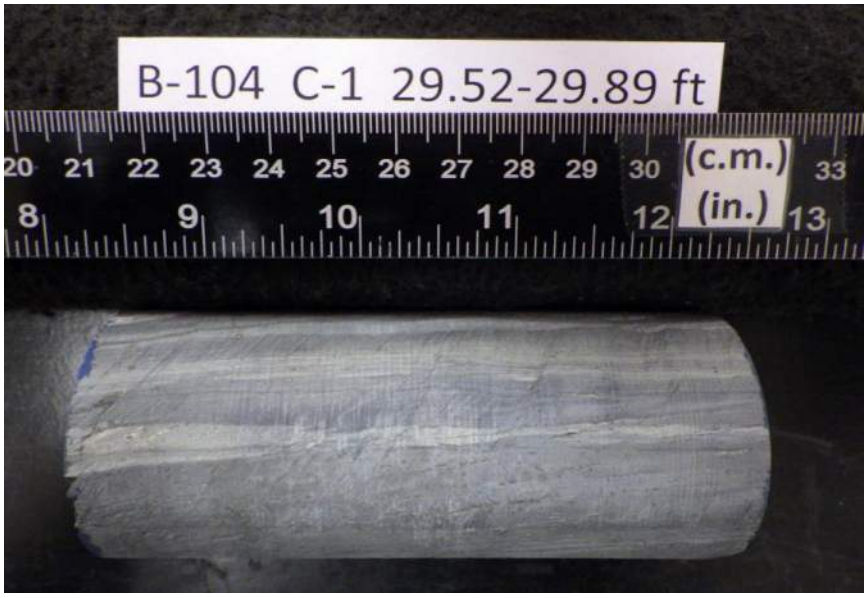
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

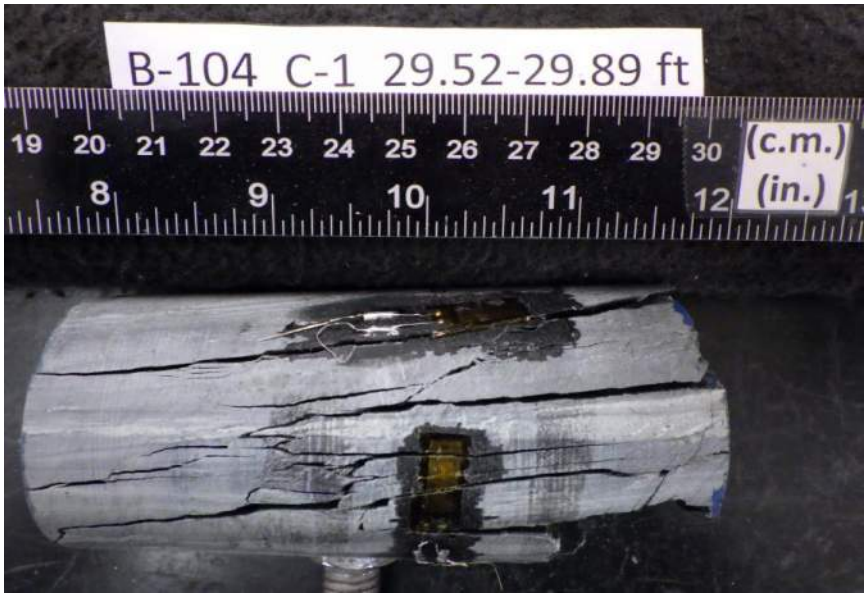
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00080	1.975	0.00041	0.023	YES
Diameter 2, in (rotated 90°)	0.00080	1.975	0.00041	0.023	YES
END 2					
Diameter 1, in	0.00060	1.975	0.00030	0.017	YES
Diameter 2, in (rotated 90°)	0.00090	1.975	0.00046	0.026	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	smd
Boring ID:	B-104
Sample ID:	C-1
Depth, ft:	29.52-29.89 ft



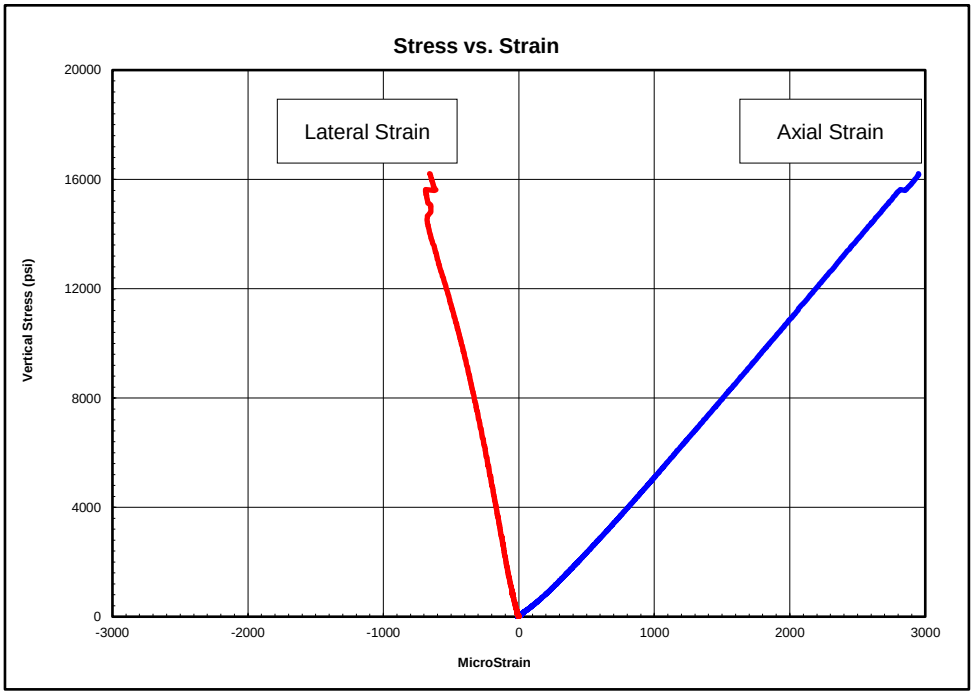
After cutting and grinding



After break

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	jsc
Boring ID:	B-105
Sample ID:	C-1
Depth, ft:	26.18-26.54
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 16,210 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
1600-5900	5,480,000	0.20
5900-10300	5,770,000	0.26
10300-14600	5,860,000	0.34

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Hardesty & Hanover	Test Date:	10/15/2021
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River	Tested By:	ak
Project Location:	---	Checked By:	smd
GTX #:	314375		
Boring ID:	B-105		
Sample ID:	C-1		
Depth:	26.18-26.54 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.28	4.28	4.28
Specimen Diameter, in:	1.98	1.98	1.98
Specimen Mass, g:	587.17		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

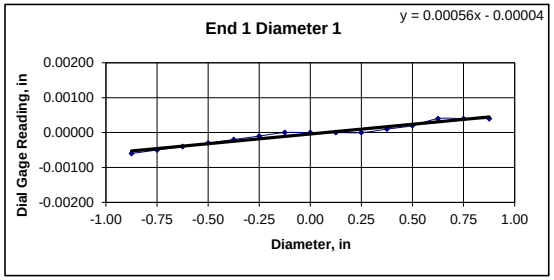
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00060	-0.00050	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00020	0.00040	0.00040	0.00040
Diameter 2, in (rotated 90°)	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010

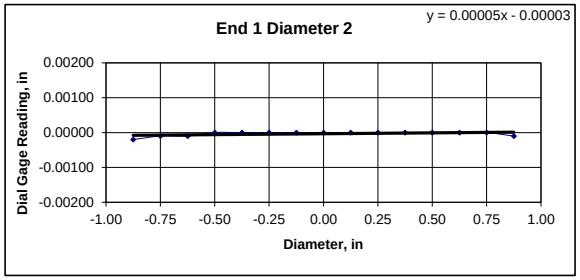
Difference between max and min readings, in:
0° = 0.00100 90° = 0.00020

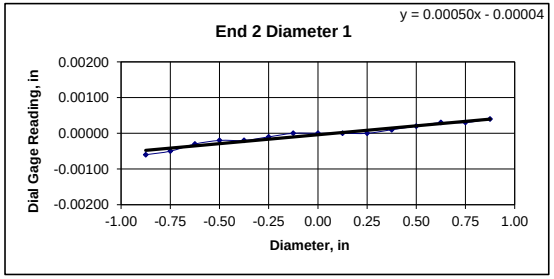
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00060	-0.00050	-0.00030	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00020	0.00030	0.00030	0.00040
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010

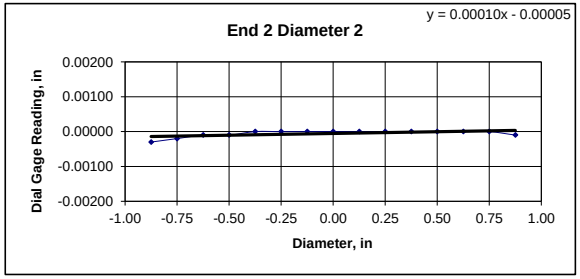
Difference between max and min readings, in:
0° = 0.001 90° = 0.0003

Maximum difference must be < 0.0020 in. Difference = ± 0.00050
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00056
Angle of Best Fit Line: 0.03192

End 2:
Slope of Best Fit Line 0.00050
Angle of Best Fit Line: 0.02865

Maximum Angular Difference: 0.00327

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

End 2:
Slope of Best Fit Line 0.00010
Angle of Best Fit Line: 0.00573

Maximum Angular Difference: 0.00278

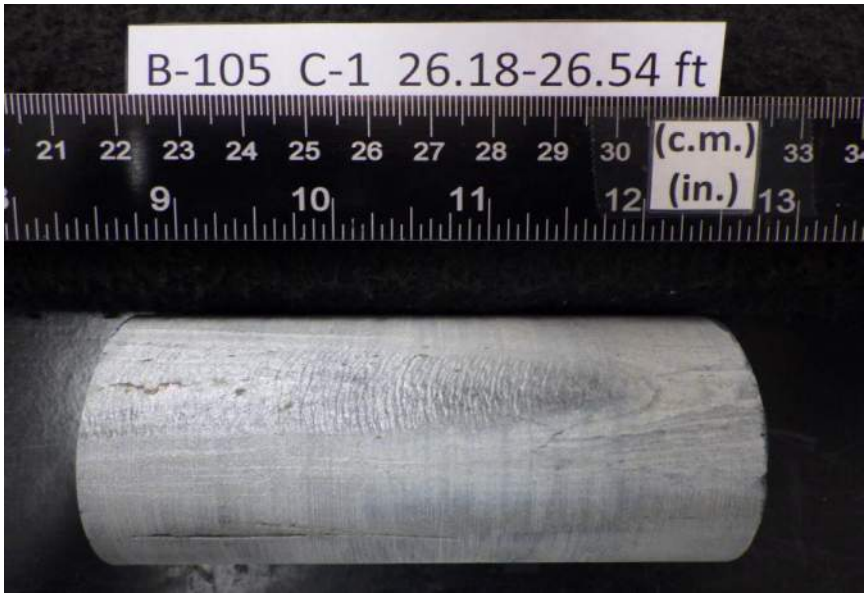
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00100	1.980	0.00051	0.029	YES
Diameter 2, in (rotated 90°)	0.00020	1.980	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00100	1.980	0.00051	0.029	YES
Diameter 2, in (rotated 90°)	0.00030	1.980	0.00015	0.009	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	smd
Boring ID:	B-105
Sample ID:	C-1
Depth, ft:	26.18-26.54 ft



After cutting and grinding

After break

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	jsc
Boring ID:	B-106
Sample ID:	C-1
Depth, ft:	27.15-27.54
Sample Type:	rock core
Sample Description:	See photographs Intact material and discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D

Peak Compressive Stress: 21,353 psi

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
2100-7800	3,510,000	0.12
7800-13500	4,710,000	0.10
13500-19200	5,020,000	0.29

Notes:
Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Hardesty & Hanover	Test Date:	10/15/2021
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River	Tested By:	ak
Project Location:	---	Checked By:	smd
GTX #:	314375		
Boring ID:	B-106		
Sample ID:	C-1		
Depth:	27.15-27.54 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.56	4.56	4.56
Specimen Diameter, in:	1.99	1.98	1.99
Specimen Mass, g:	619.9		
Bulk Density, lb/ft^3	167	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

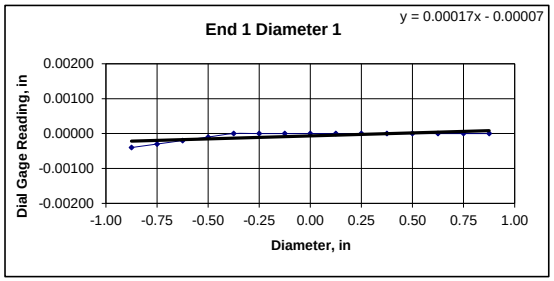
END FLATNESS AND PARALLELISM (Procedure FP1)

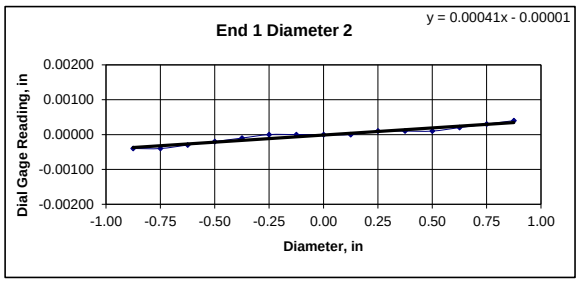
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00040	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00020	0.00030	0.00040

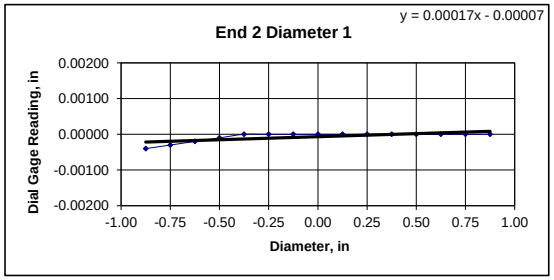
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00080

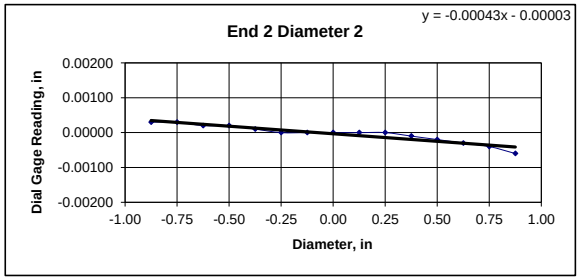
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00030	0.00030	0.00020	0.00020	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040	-0.00060

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0009
Maximum difference must be < 0.0020 in. Difference = ± 0.00045
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00017
Angle of Best Fit Line: 0.00982

End 2:
Slope of Best Fit Line 0.00017
Angle of Best Fit Line: 0.00982

Maximum Angular Difference: 0.00000

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00041
Angle of Best Fit Line: 0.02341

End 2:
Slope of Best Fit Line 0.00043
Angle of Best Fit Line: 0.02488

Maximum Angular Difference: 0.00147

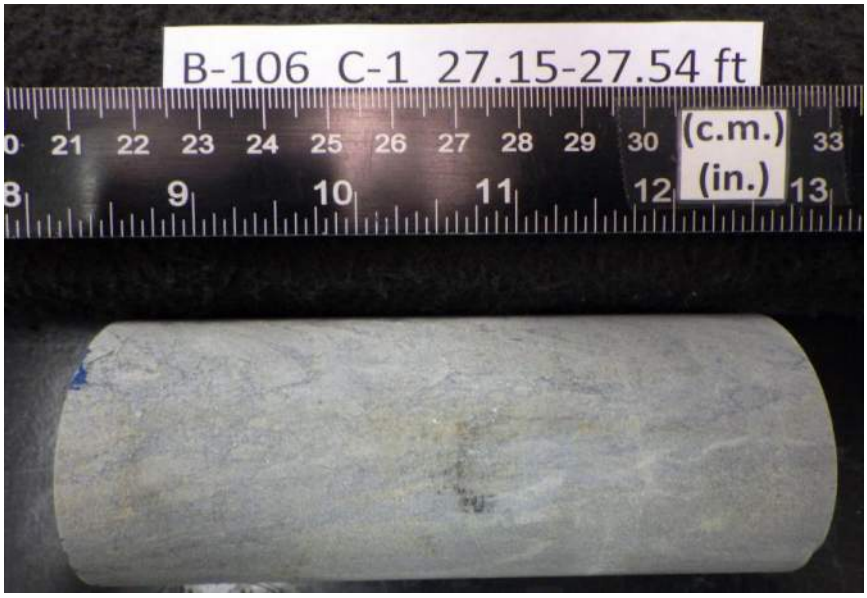
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

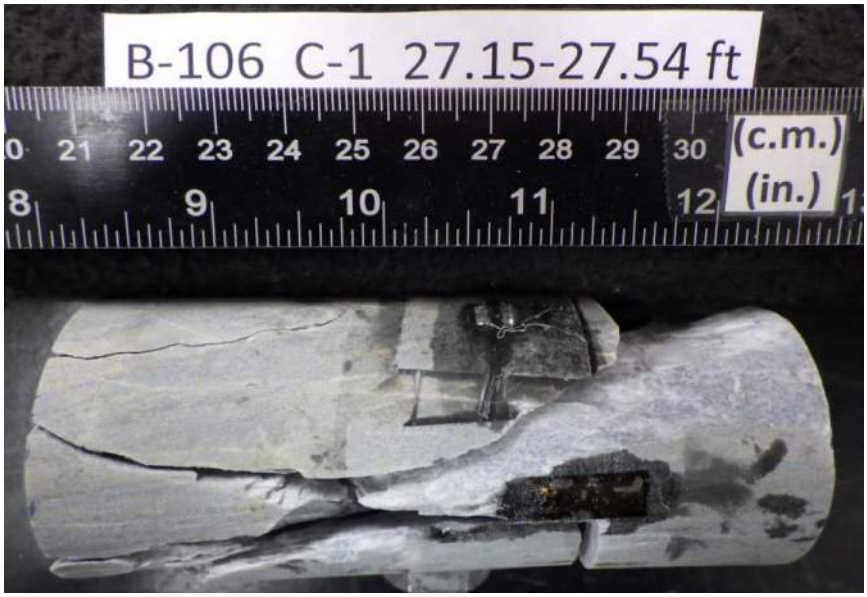
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	1.985	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00080	1.985	0.00040	0.023	YES
END 2					
Diameter 1, in	0.00040	1.985	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00090	1.985	0.00045	0.026	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	Hardesty & Hanover
Project Name:	Vtrans Northfield- RT12 Bridge over Dog River
Project Location:	---
GTX #:	314375
Test Date:	10/21/2021
Tested By:	ak
Checked By:	smd
Boring ID:	B-106
Sample ID:	C-1
Depth, ft:	27.15-27.54 ft



After cutting and grinding



After break

Appendix C: Geophysical Testing Report

HAGER-RICHTER
GEOSCIENCE, INC.

SEISMIC REFRACTION SURVEYS
DOG RIVER BRIDGE
VERMONT ROUTE 12
NORTHFIELD, VERMONT

Prepared for:

Hardesty & Hanover
1501 Broadway
New York, New York 10036

Prepared by:

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

File 21MH12
November 2021

HAGER-RICHTER
GEOSCIENCE, INC.

GEOPHYSICS FOR THE ENGINEERING COMMUNITY
SALEM, NEW HAMPSHIRE
Tel: 603.893.9944
FORDS, NEW JERSEY
Tel: 732.661.0555

November 11, 2021
File 21MH12

Ryan Gurriell
Geotechnical Engineer
Hardesty & Hanover
1501 Broadway
New York, New York 10036

Mobile: 201.675.0234
Email: rgurriell@hardestyhanover.com

RE: Geophysical Survey
Dog River Bridge
VT Route 12
Northfield, Vermont

Dear Mr. Gurriell:

In this report, we summarize the results of a seismic survey conducted by Hager-Richter Geoscience, Inc. (HRGS) in support of a geotechnical investigation at the above referenced site located in Northfield, Vermont for Hardesty & Hanover, in September 2021. The scope of work and areas of interest were specified by Hardesty & Hanover.

INTRODUCTION

The site for the geophysical survey is the existing bridge carrying Vermont Route 12 over Dog River in Northfield Vermont. Figure 1 shows the general location of the Site. As part of a geotechnical investigation being conducted in support of the design of new bridge abutments, Hardesty & Hanover requested a seismic refraction survey to determine the depth and configuration of the bedrock along the bridge approaches on each side of the river.

Hardesty & Hanover specified the locations of four (4) transects for seismic refraction surveying, including transects along the shoulders of the northbound and southbound lanes of the road on the north and south sides of the river. The locations of the seismic transects in the area of interest are shown in Figure 2.

Based on logs for borings B-101A through B-106, provided by Hardesty & Hanover, copy attached in Appendix 1, the subsurface stratigraphy consists of approximately 0 to 20 feet of fill over varying thicknesses of silt, sand, gravel, and weathered rock. Competent bedrock was sampled in borings Borings B102 through B-106, and the bedrock depths reported in the boring logs ranges from approximately 24 feet to 31feet below ground surface. Boring B-101A encountered difficult drilling from 18 feet to 25 feet, and bedrock was suspected but not sampled. The locations of the borings are shown in Figure 2.

OBJECTIVE

The objective of the seismic survey was to determine the depth and configuration of the bedrock surface along four specified transects in Northfield, Vermont.

THE SURVEY

HRGS personnel conducted the geophysical survey on September 27, 2021. Michael Howley, P.G., Vanja Dezelic, Ph.D., and Bryan Carnahan conducted the seismic survey. The project was coordinated with Ryan Gurriell of Hardesty & Hanover, who was on-site for the geophysical survey. Original data and field notes reside in the HRGS files and will be retained for a minimum of three years.

The survey was conducted using the seismic refraction method along four seismic lines, designated as Seismic Lines 1 - 4. Photo 1, below, shows the site conditions at the time of the survey along Seismic Line 1. For lines 1, 2, and 3, all geophones were located on asphalt. For Line 4, geophones were planted in grassy turf. The positions of the start and end points of the seismic transects, as well as the locations of existing and proposed borings and other site features were recorded with GPS. The locations of the seismic lines are shown in Figure 2.

Photo 1. Looking south along Seismic Line 1 acquired on the southbound side of Vermont Route 12 on the north side of bridge.

EQUIPMENT AND PROCEDURES

Seismic Refraction. The seismic refraction survey was conducted using our 48-channel seismograph (two 24-channel Geometrics Geodes) coupled to as many as 48 14-Hz geophones. A geophone spacing of 3 feet was used for the seismic lines. A 12-pound sledgehammer was used as the energy source. Seven shot points were used per seismic spread - three located internal to the spread, one at each end of the spread, and offset shots located in-line but outside of each end of the geophone spread. The seismograph was connected to, and controlled by, a notebook PC computer. The software provides for the acquisition, display, plotting, filtering, and storage of seismic data.

The seismic refraction data were interpreted with the Generalized Reciprocal Method (GRM) For the GRM interpretation, we used IXRefraX, commercially licensed software from Interpex Limited. GRM allows the depth to bedrock to be determined for *each* geophone location, rather than only at the shot points as for most other methods, and it is less sensitive to the presence of dipping interfaces and hidden layers. The GRM method requires at least one shot at each end of the cable. This configuration provides reversed profiles.

LIMITATIONS OF THE METHOD

> HAGER-RICHTER GEOSCIENCE, INC. MAKES NO GUARANTEE THAT THE DEPTH OF BEDROCK WAS ACCURATELY DETERMINED IN THIS SURVEY. HAGER-RICHTER GEOSCIENCE, INC. IS NOT RESPONSIBLE FOR DETERMINING THE DEPTH OF BEDROCK WHERE THE INTERFACE CANNOT BE DETECTED BECAUSE OF SITE CONDITIONS.
>
> IN GENERAL, THE ACCURACY (STANDARD DEVIATION) OF THE APPARENT DEPTHS OF RELATIVELY COMPETENT BEDROCK DETERMINED BY THE SEISMIC REFRACTION METHOD IS ABOUT ± 10% OF THE APPARENT DEPTH OF BEDROCK, OR ± 2 FEET, WHICHEVER IS GREATER. THE BEDROCK MODEL SHOWN AS A PROFILE OR LISTED AS TABULAR DATA SHOULD NOT BE USED SOLELY FOR CONTRACT BEDROCK REMOVAL QUANTITIES.

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

whichever is greater. The results of this survey should not be relied upon for contract bedrock removal quantities.

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

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

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

RESULTS

General. The seismic refraction survey consisted of four seismic lines identified as Seismic Lines 1 - 4. The locations of the seismic lines and borings installed by Hardesty & Hanover are shown in Figure 2. The results of the seismic refraction survey are shown in profile form in Figure 3 and are listed in Table 1.

Data Quality. The quality of the seismic refraction data was poor to good. In particular, determination of bedrock depths was not possible for 18- to 36-foot sections of Seismic Lines 1,

2, and 3 that were located closest to the bridge because of interference from subsurface structures. In addition, asphalt and concrete surfaces present along Lines 1, 2, and 3 reduced the signal to noise ratio due to interference from seismic arrivals from the pavement. The seismic noise/signal ratio was not significantly impacted by vehicular traffic along Vermont Route 12. Higher numbers of 'stacks' of the seismic data at each shot point were not found to improve data quality.

A measure of the accuracy of the data can be obtained by comparing the seismically determined bedrock depths with bedrock depths reported in borings that intersect bedrock. As reported in Table 2, the average difference between the seismically determined bedrock depths and the depths of bedrock from nearby borings is 1.5 feet, or 6%. Only borings that sampled bedrock and that were located closer than about 20 feet to a seismically determined depth of bedrock are shown in Table 2 for direct comparison. As indicated in the limitations section, the overall accuracy of depths determined is estimated to be in general about ±10% or 3 feet, whichever is greater.

Interpretation of Velocities. Materials with two distinct velocities were detected for Seismic Lines 1 through 4. The upper material exhibits a compressional wave velocity range of about 1,750 feet per second (ft/sec) to 2,100 ft/sec and is interpreted to consist of mostly unsaturated soils. The lower material exhibits a compressional wave velocity range of about 10,000 ft/sec to 16,000 ft/sec and is interpreted to consist of competent bedrock.

Bedrock Depths and Configuration. The results of the seismic refraction survey are shown in profile form in Figure 3 and are listed in Table 1. Note that interference from subsurface structures and surface pavement prevented the accurate determination of bedrock depth for the sections of Lines 1, 2, and 3 closest to the bridge. Line 4, which was conducted mostly in a grassy area, was not affected by such interference. In the profiles shown in Figure 3, the bedrock surface is shown as a dashed line that projects from bedrock encountered in borings near the bridge to the nearest seismically determined depth of rock on each of Seismic Lines 1, 2, and 3. Likewise, the zones of interference are shown in grey in Table 1.

The depth of seismically determined bedrock along the roadway near the Dog River Bridge varies between about 23 and 30 feet below ground surface. The seismically determined elevation of the bedrock surface at Bridge 89 varies between about 699 and 708 feet above sea level, for a total relief of 9 feet.

Note that borings B-102 through B-106 encountered the top of bedrock at depths of between 24 and 32 feet, and each sampled several feet of rock. Boring B-101A, located on the south side of the bridge, encountered difficult drilling at a depth of 18 feet, which was presumed to be rock, although no samples were taken. Because interference prevented the determination of bedrock along the section of Seismic Line 2 that was closest to B-101A, the seismic data could not help confirming whether a bedrock high was present in the vicinity of B-101A.

CONCLUSIONS

Based on the seismic surveys conducted at the bridge carrying Vermont Route 12 over the Dog River in Northfield, Vermont by Hager-Richter Geoscience, Inc. in support of a geotechnical investigation by Hardesty & Hanover in September 2021, we conclude the following:

- The depth of seismically determined competent bedrock along the roadway near the Dog River Bridge varies between approximately 23 and 30 feet below ground surface.

- The elevation of seismically determined competent bedrock along the roadway near the Dog River Bridge varies between approximately 699 and 708 feet above sea level, for a total relief of 9 feet.

LIMITATIONS ON USE OF THE REPORT

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

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

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

If you have any questions or comments on this report, please contact us at your convenience. It has been a pleasure to work with you on this project.

Sincerely,
HAGER-RICHTER GEOSCIENCE, INC.

Steven Grant, P.G.
Senior Geophysicist

Jeffrey Reid, P.G.
Owner / Principal Geophysicist

Attachments: Tables 1 & 2
Figures 1 – 3
Appendix 1

TABLE 1
SEISMIC REFRACTION RESULTS
DOG RIVER BRIDGE – VT ROUTE 12
NORTHFIELD, VERMONT

Line	Station (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Depth (ft)	Elevation (ft)
1	*0+00*	*1599488.72*	*601340.85*	*25*	*730*	*705*
1	*0+03*	*1599489.32*	*601343.79*	*25*	*730*	*705*
1	*0+06*	*1599489.93*	*601346.72*	*25*	*730*	*705*
1	*0+09*	*1599490.53*	*601349.66*	*25*	*730*	*705*
1	*0+12*	*1599491.14*	*601352.60*	*25*	*730*	*705*
1	*0+15*	*1599491.74*	*601355.54*	*25*	*730*	*705*
1	*0+18*	*1599492.35*	*601358.48*	*25*	*730*	*705*
1	0+21	1599492.95	601361.42	25	730	705
1	0+24	1599493.56	601364.36	25	730	705
1	0+27	1599494.16	601367.29	25	730	705
1	0+30	1599494.77	601370.23	24	729	705
1	0+33	1599495.37	601373.17	25	729	705
1	0+36	1599495.97	601376.11	25	729	704
1	0+39	1599496.58	601379.05	25	729	705
1	0+42	1599497.18	601381.99	24	729	705
1	0+45	1599497.79	601384.92	24	729	705
1	0+48	1599498.39	601387.86	25	729	704
1	0+51	1599499.00	601390.80	26	729	703
1	0+54	1599499.60	601393.74	26	729	703
1	0+57	1599500.21	601396.68	26	729	703
1	0+60	1599500.81	601399.62	27	729	702
1	0+63	1599501.42	601402.55	28	729	701
1	0+66	1599502.02	601405.49	29	729	700
1	0+69	1599502.63	601408.43	29	729	700
1	0+72	1599503.23	601411.37	29	729	699
1	0+75	1599503.84	601414.31	29	729	700
1	0+78	1599504.44	601417.25	29	729	700
1	0+81	1599505.05	601420.18	29	729	700
1	0+84	1599505.65	601423.12	28	729	700
1	0+87	1599506.26	601426.06	27	729	701
1	0+90	1599506.86	601429.00	27	729	702
1	0+93	1599507.47	601431.94	27	729	702
1	0+96	1599508.07	601434.88	26	728	702
1	0+99	1599508.68	601437.82	26	728	703

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Entries in grey for Lines 1, 2, and 3 represent zones where interference from existing subsurface structures prevented the accurate determination of depth of rock – bedrock information shown in grey are projections based on nearby borings. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to New York State Plane West NAD83 in US survey feet. Elevations along the seismic lines were determined from plans provided by Hardesty & Hanover.

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Line	Station (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Depth (ft)	Elevation (ft)
1	1+02	1599509.28	601440.75	24	728	704
1	1+05	1599509.89	601443.69	24	728	705
1	1+08	1599510.49	601446.63	24	728	705
1	1+11	1599511.10	601449.57	23	728	705
1	1+14	1599511.70	601452.51	23	728	706
1	1+17	1599512.30	601455.45	23	728	705
1	1+20	1599512.91	601458.38	23	728	705
1	1+23	1599513.51	601461.32	24	728	704
1	1+26	1599514.12	601464.26	24	728	704
1	1+29	1599514.72	601467.20	24	728	704
1	1+32	1599515.33	601470.14	24	728	704
1	1+35	1599515.93	601473.08	24	728	704
1	1+38	1599516.54	601476.01	24	728	704
1	1+41	1599517.14	601478.95	24	728	704
2	*0+00*	*1599464.40*	*601230.07*	*32*	*730*	*698*
2	*0+03*	*1599463.76*	*601227.14*	*32*	*730*	*698*
2	*0+06*	*1599463.13*	*601224.21*	*32*	*730*	*698*
2	*0+09*	*1599462.49*	*601221.28*	*32*	*730*	*698*
2	*0+12*	*1599461.85*	*601218.34*	*32*	*730*	*698*
2	*0+15*	*1599461.21*	*601215.41*	*31*	*730*	*699*
2	*0+18*	*1599460.58*	*601212.48*	*31*	*730*	*699*
2	*0+21*	*1599459.94*	*601209.55*	*30*	*730*	*700*
2	*0+24*	*1599459.30*	*601206.62*	*30*	*730*	*700*
2	*0+27*	*1599458.66*	*601203.69*	*29*	*730*	*701*
2	*0+30*	*1599458.03*	*601200.76*	*29*	*730*	*701*
2	*0+33*	*1599457.39*	*601197.82*	*29*	*730*	*702*
2	*0+36*	*1599456.75*	*601194.89*	*28*	*730*	*702*
2	0+39	1599456.11	601191.96	28	731	703
2	0+42	1599455.48	601189.03	28	731	703
2	0+45	1599454.84	601186.10	28	731	703
2	0+48	1599454.20	601183.17	29	731	702
2	0+51	1599453.57	601180.23	29	731	701
2	0+54	1599452.93	601177.30	29	731	702
2	0+57	1599452.29	601174.37	29	731	702
2	0+60	1599451.65	601171.44	29	731	702
2	0+63	1599451.02	601168.51	29	731	702
2	0+66	1599450.38	601165.58	29	731	702
2	0+69	1599449.74	601162.65	29	731	702
2	0+72	1599449.10	601159.71	29	731	702
2	0+75	1599448.47	601156.78	29	731	702

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Entries in grey for Lines 1, 2, and 3 represent zones where interference from existing subsurface structures prevented the accurate determination of depth of rock – bedrock information shown in grey are projections based on nearby borings. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to New York State Plane West NAD83 in US survey feet. Elevations along the seismic lines were determined from plans provided by Hardesty & Hanover.

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Line	Station (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Depth (ft)	Elevation (ft)
2	0+78	1599447.83	601153.85	28	731	703
2	0+81	1599447.19	601150.92	28	731	703
2	0+84	1599446.55	601147.99	28	731	703
2	0+87	1599445.92	601145.06	28	731	703
2	0+90	1599445.28	601142.13	29	731	702
2	0+93	1599444.64	601139.19	29	731	703
2	0+96	1599444.00	601136.26	28	731	703
2	0+99	1599443.37	601133.33	28	731	703
2	1+02	1599442.73	601130.40	27	731	704
2	1+05	1599442.09	601127.47	28	731	704
2	1+08	1599441.45	601124.54	27	731	704
2	1+11	1599440.82	601121.60	27	731	705
2	1+14	1599440.18	601118.67	26	731	706
2	1+17	1599439.54	601115.74	25	731	706
2	1+20	1599438.90	601112.81	25	731	707
2	1+23	1599438.27	601109.88	24	731	707
2	1+26	1599437.63	601106.95	24	731	707
2	1+29	1599436.99	601104.02	25	731	707
2	1+32	1599436.35	601101.08	24	732	707
2	1+35	1599435.72	601098.15	24	732	707
2	1+38	1599435.08	601095.22	24	732	708
2	1+41	1599434.44	601092.29	24	732	708
3	*0+00*	*1599502.21*	*601221.74*	*30*	*730*	*700*
3	*0+03*	*1599501.73*	*601218.78*	*30*	*730*	*700*
3	*0+06*	*1599501.26*	*601215.82*	*30*	*730*	*700*
3	*0+09*	*1599500.78*	*601212.86*	*30*	*730*	*700*
3	*0+12*	*1599500.31*	*601209.89*	*30*	*730*	*700*
3	*0+15*	*1599499.84*	*601206.93*	*30*	*730*	*700*
3	*0+18*	*1599499.36*	*601203.97*	*30*	*730*	*700*
3	*0+21*	*1599498.89*	*601201.01*	*30*	*730*	*700*
3	*0+24*	*1599498.41*	*601198.05*	*30*	*730*	*700*
3	*0+27*	*1599497.94*	*601195.08*	*30*	*730*	*700*
3	*0+30*	*1599497.47*	*601192.12*	*30*	*730*	*700*
3	0+33	1599496.99	601189.16	30	730	700
3	0+36	1599496.52	601186.20	30	730	701
3	0+39	1599496.04	601183.23	30	731	701
3	0+42	1599495.57	601180.27	30	731	701
3	0+45	1599495.10	601177.31	30	731	700
3	0+48	1599494.62	601174.35	30	731	701
3	0+51	1599494.15	601171.38	30	731	701

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Entries in grey for Lines 1, 2, and 3 represent zones where interference from existing subsurface structures prevented the accurate determination of depth of rock – bedrock information shown in grey are projections based on nearby borings. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to New York State Plane West NAD83 in US survey feet. Elevations along the seismic lines were determined from plans provided by Hardesty & Hanover.

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Line	Station (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Depth (ft)	Elevation (ft)
3	0+54	1599493.67	601168.42	30	731	701
3	0+57	1599493.20	601165.46	30	731	701
3	0+60	1599492.73	601162.50	30	731	701
3	0+63	1599492.25	601159.54	30	731	701
3	0+66	1599491.78	601156.57	29	731	702
3	0+69	1599491.30	601153.61	29	731	702
3	0+72	1599490.83	601150.65	29	731	702
3	0+75	1599490.36	601147.69	29	731	702
3	0+78	1599489.88	601144.72	29	731	702
3	0+81	1599489.41	601141.76	29	731	702
3	0+84	1599488.93	601138.80	29	731	702
3	0+87	1599488.46	601135.84	29	731	702
3	0+90	1599487.99	601132.87	29	731	702
3	0+93	1599487.51	601129.91	29	731	702
3	0+96	1599487.04	601126.95	29	731	702
3	0+99	1599486.57	601123.99	29	731	702
3	1+02	1599486.09	601121.03	29	731	702
3	1+05	1599485.62	601118.06	29	731	702
3	1+08	1599485.14	601115.10	29	731	702
3	1+11	1599484.67	601112.14	29	731	703
3	1+14	1599484.20	601109.18	28	731	703
3	1+17	1599483.72	601106.21	29	731	703
3	1+20	1599483.25	601103.25	29	731	703
3	1+23	1599482.77	601100.29	29	731	703
3	1+26	1599482.30	601097.33	29	731	703
3	1+29	1599481.83	601094.36	29	732	703
3	1+32	1599481.35	601091.40	29	732	703
3	1+35	1599480.88	601088.44	29	732	703
3	1+38	1599480.40	601085.48	29	732	703
3	1+41	1599479.93	601082.51	29	732	703
4	0+00	1599532.16	601330.36	25	730	705
4	0+03	1599532.79	601333.29	25	730	705
4	0+06	1599533.41	601336.22	25	730	705
4	0+09	1599534.04	601339.16	25	730	705
4	0+12	1599534.67	601342.09	26	730	704
4	0+15	1599535.29	601345.03	27	730	703
4	0+18	1599535.92	601347.96	27	730	703
4	0+21	1599536.54	601350.89	27	730	703
4	0+24	1599537.17	601353.83	27	730	702
4	0+27	1599537.80	601356.76	27	730	702

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Entries in grey for Lines 1, 2, and 3 represent zones where interference from existing subsurface structures prevented the accurate determination of depth of rock – bedrock information shown in grey are projections based on nearby borings. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to New York State Plane West NAD83 in US survey feet. Elevations along the seismic lines were determined from plans provided by Hardesty & Hanover.

TABLE 1 (CONTINUED)
SEISMIC REFRACTION RESULTS

Line	Station (ft)	Easting (ft)	Northing (ft)	Surface Elevation (ft)	Depth (ft)	Elevation (ft)
4	0+30	1599538.42	601359.70	27	730	702
4	0+33	1599539.05	601362.63	27	730	703
4	0+36	1599539.67	601365.56	27	729	703
4	0+39	1599540.30	601368.50	27	729	702
4	0+42	1599540.93	601371.43	27	729	702
4	0+45	1599541.55	601374.37	27	729	702
4	0+48	1599542.18	601377.30	27	729	702
4	0+51	1599542.80	601380.23	27	729	702
4	0+54	1599543.43	601383.17	28	729	702
4	0+57	1599544.06	601386.10	28	729	702
4	0+60	1599544.68	601389.04	28	729	701
4	0+63	1599545.31	601391.97	29	729	700
4	0+66	1599545.93	601394.90	29	729	700
4	0+69	1599546.56	601397.84	29	729	700
4	0+72	1599547.18	601400.77	29	729	700
4	0+75	1599547.81	601403.71	29	729	700
4	0+78	1599548.44	601406.64	29	729	700
4	0+81	1599549.06	601409.57	29	729	700
4	0+84	1599549.69	601412.51	29	729	700
4	0+87	1599550.31	601415.44	29	729	700
4	0+90	1599550.94	601418.38	29	729	700
4	0+93	1599551.57	601421.31	29	729	700
4	0+96	1599552.19	601424.24	28	729	701
4	0+99	1599552.82	601427.18	27	729	702
4	1+02	1599553.44	601430.11	27	729	701
4	1+05	1599554.07	601433.05	28	728	701
4	1+08	1599554.70	601435.98	27	728	701
4	1+11	1599555.32	601438.91	27	728	702
4	1+14	1599555.95	601441.85	27	728	702
4	1+17	1599556.57	601444.78	27	728	702
4	1+20	1599557.20	601447.72	27	728	701
4	1+23	1599557.83	601450.65	27	728	701
4	1+26	1599558.45	601453.58	27	728	701
4	1+29	1599559.08	601456.52	27	728	701
4	1+32	1599559.70	601459.45	27	728	701
4	1+35	1599560.33	601462.39	27	728	701
4	1+38	1599560.95	601465.32	27	728	701
4	1+41	1599561.58	601468.25	27	728	701

Estimated standard deviation of depth of interfaces for seismic lines is normally taken as 10% or 2 feet, whichever is greater. Depths and elevations of bedrock determined here are for competent bedrock. Entries in grey for Lines 1, 2, and 3 represent zones where interference from existing subsurface structures prevented the accurate determination of depth of rock – bedrock information shown in grey are projections based on nearby borings. Heavily weathered or highly fractured bedrock may occur at shallower depths. The easting and northing coordinates are relative to New York State Plane West NAD83 in US survey feet. Elevations along the seismic lines were determined from plans provided by Hardesty & Hanover.

TABLE 2
COMPARISON OF ELEVATIONS BETWEEN SEISMIC DATA AND BORINGS
DOG RIVER BRIDGE – VT ROUTE 12
NORTHFIELD, VERMONT

Location of Boring Relative to Seismic Line				Bedrock Depth From Seismic Line (feet)	Bedrock Depth from Boring (feet)	Difference	
Seismic Line and Station		Boring	Distance from Seismic Line To Boring			Feet	Percent
Line 1	0+18	B-105	18’ E	25	25	0	0
Line 1	0+21	B-104	9’ W	25	28	3	12
Line 3	0+33	B-103	18.5’ NW	30	30	0	0
Line 4	0+18	B-106	1.5’ E	27	24	3	13
				Average		**1.5**	**6**
				Standard Deviation		**1.5**	**6**

The differences in feet reflect the absolute difference between bedrock elevation determined seismically and at a nearby boring. The percentage differences were calculated by dividing the absolute differences in feet by the depth of bedrock reported for the nearby boring. Only borings located less than 20 feet from a seismic line were used in this comparison. Elevations along the seismic lines and for borings were determined from plans provided by Hardesty & Hanover and are relative to the NAVD 1988 datum.

N

H-R

APPROXIMATE SCALE (feet)

0 1000 2000

VT

LOCATION

NOTE:

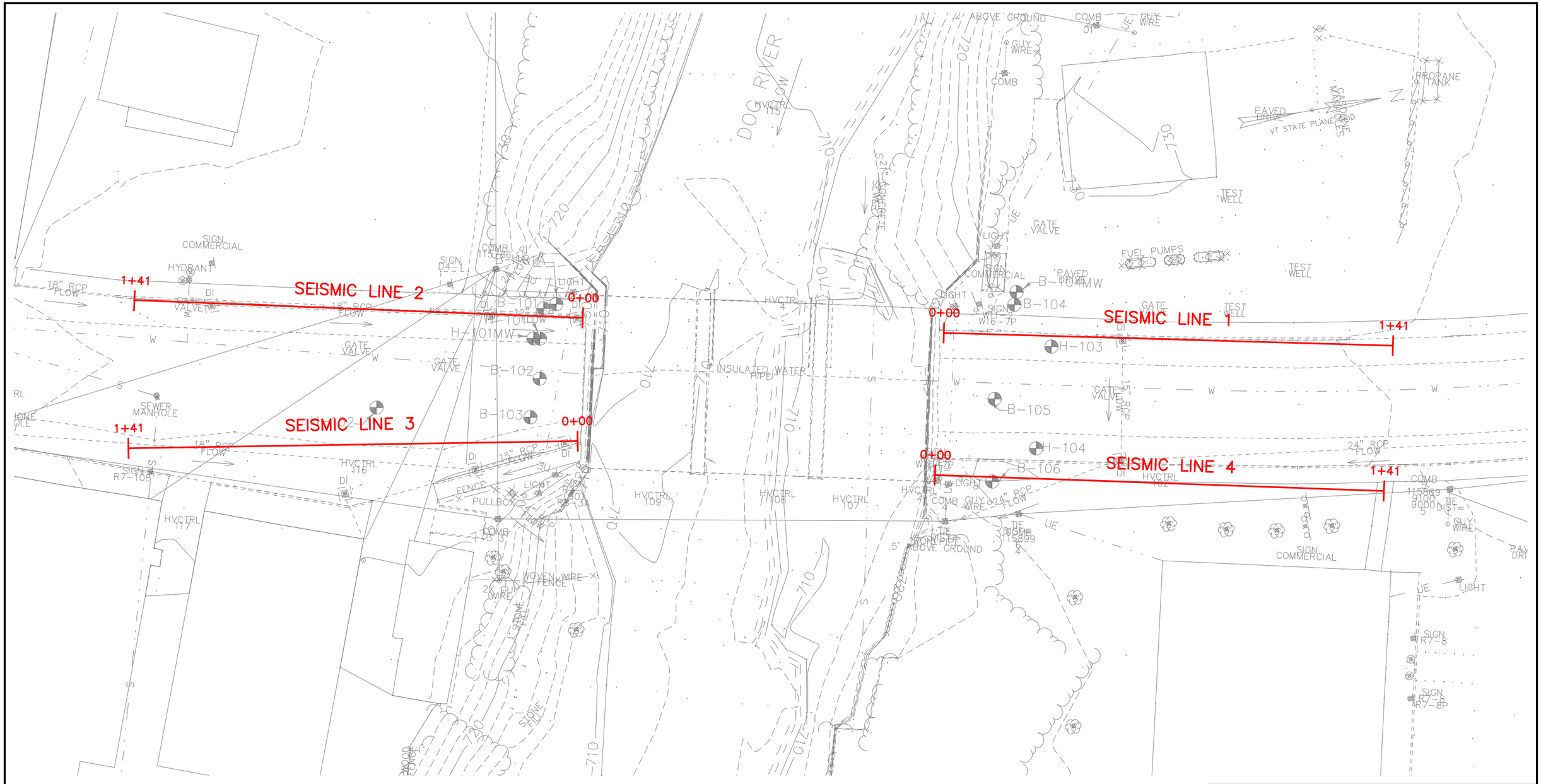
Modified from Google Earth Pro aerial photograph.

Figure 1
General Site Location
Dog River Bridge
VT Route 12
Northfield, Vermont

File 21MH12 | November, 2021

HAGER–RICHTER

Salem, NH | Fords, NJ



LEGEND

SEISMIC LINE

BORING

SCALE (feet)

0 30 60

N

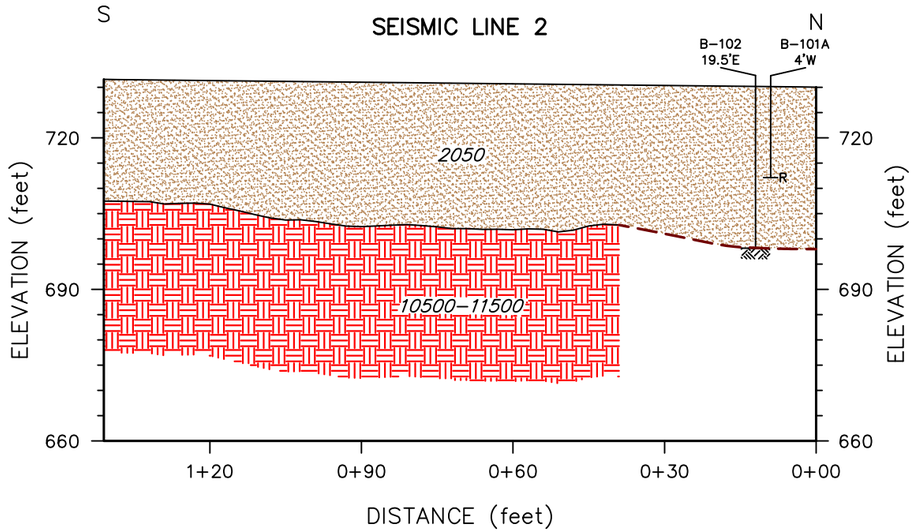
NOTE:

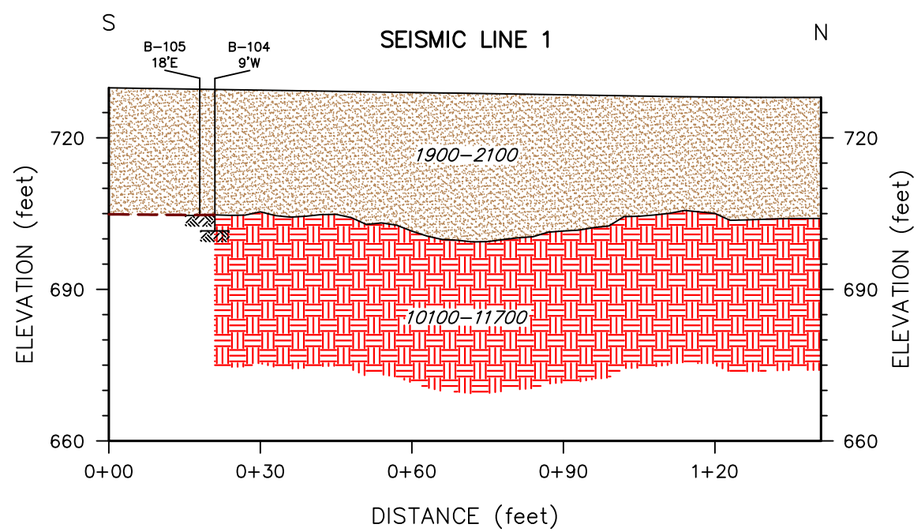
Modified from site plan provided by Hardesty & Hanover, identified as Northfield Br. 60–Borings.dgn.

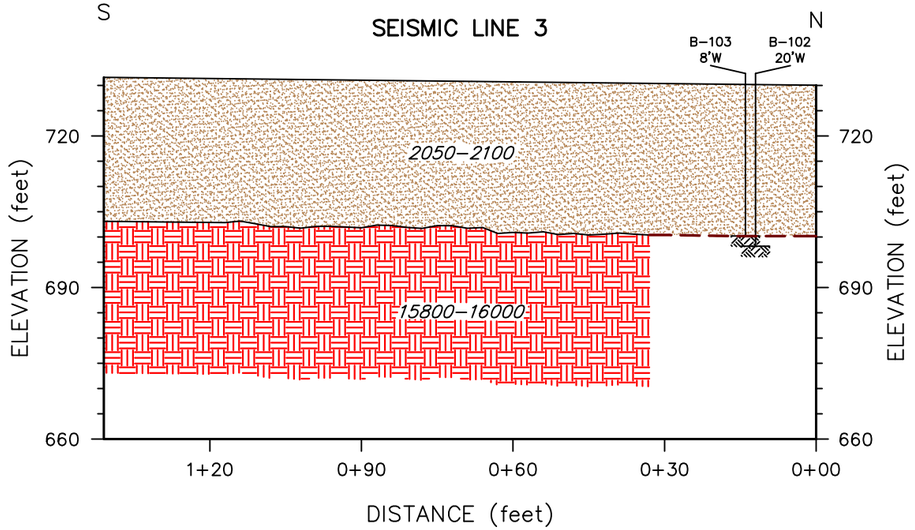
Figure 2
Site Plan
Dog River Bridge
VT Route 12
Northfield, Vermont

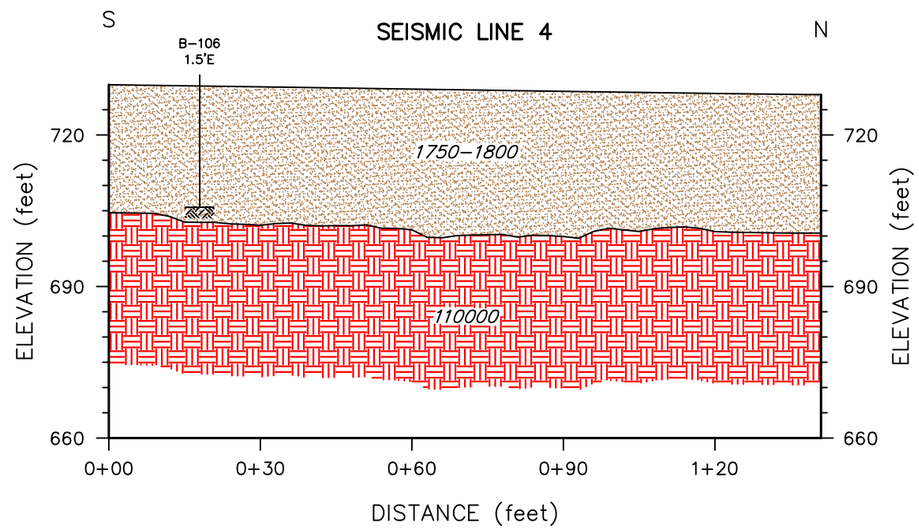
File 21MH12 | November, 2021

HAGER–RICHTER
Salem, NH | Fords, NJ









NOTES:

1. Estimated accuracy (standard deviation) of depth of bedrock is ±10% or 2 feet, whichever is greater.
2. The depths determined for bedrock are depths of competent rock; weathered and/or fractured bedrock might occur at shallower depths.
3. Surface elevations estimated from plans provided by Ove Arup & Partners, PC.
4. Data were analyzed using the Generalized Reciprocal Method.

LEGEND

- Unsaturated soils
- Bedrock
- *10100–11700* Velocity (fps)
- Interface determined from seismic refraction data
- Inferred bedrock surface
- B–105 18'E — Boring with identification, distance from traverse, and depth of bedrock based on logs provided by Hardesty & Hanover.
- B–101A 4'W R — Boring with identification, distance from traverse, and depth of refusal, based on logs provided by Hardesty & Hanover.

SCALE (feet)

0 30 60

Figure 3
Seismic Lines 1–4
Dog River Bridge
VT Route 12
Northfield, Vermont

File 21MH12 | November, 2021

HAGER–RICHTER

APPENDIX 1

Draft Boring Logs Provided by Hardesty & Hanover

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-101**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/28/21 Date Finished: 9/28/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Brown cmf SAND, little Grey cmf Gravel, Rec. = 0.75 ft, 0.5 ft - 2.0 ft, Environmental Sample - No sample collected	5-7-7-8 (14)				
		S-2: SAME, Rec. = 0.83 ft, 2.0 ft - 4.0 ft	7-6-7-6 (13)				
5		S-3: Brown cmf SAND, some cmf Gravel (crushed rock), Rec. = 0.92 ft, 4.0 ft - 6.0 ft	8-9-11-9 (20)				
		S-4: No Recovery, Rec. = 0.0 ft, 6.0 ft - 8.0 ft	13-12-22-13 (34)				
		S-5: Brown cmf SAND, little Silt, little c(-)mf Gravel, Rec. = 0.75 ft, 8.0 ft - 10.0 ft	11-7-7-12 (14)				
10		S-6: Brown cmf SAND, little Silt, trace mf Gravel, Rec. = 1.08 ft, 10.0 ft - 12.0 ft	24-19-15-14 (34)				
15		S-7: Top 6": Grey cmf SAND, little f Gravel, Rec. = 0.67 ft, 15.0 ft - 16.5 ft, Small green glass fragments throughout	9-16-8-4 (24)				
		S-7: Bott 2": Grey SILT, little mf Sand, 16.5 ft - 17.0 ft, Small green glass fragments throughout					
		Hole stopped @ 17.0 ft					
20		Casing snapped at approximately 15ft. Hole abandoned with 5ft of casing left in the hole.					
25		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 1ft North, 1ft East of survey-marked location. 3. Boulder 8ft - 13ft, very hard drilling					
30							
35							
40							
45							

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-101A**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/28/21 Date Finished: 9/28/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	AUGER	
I.D.:		
Hammer Wt:	N.A.	N.A.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	AWJ	
Rig:	MOBILE	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 %
		0.0 ft - 0.5 ft, Asphalt					
5		Visual Description:, Brown cmf SAND, little cmf Gravel, trace Silt, Solid-Stem Auger, no sample taken - spoils visually classified					
10							
15							
		Field Note:, Solid-Stem Auger, drilling becomes hard - no samples taken					
		Field Note:, Solid-Stem Auger, possible top of bedrock - no samples taken					
20		Field Note:, Mud Rotary, Hard drilling, likely bedrock - no samples taken					
25		Hole stopped @ 25.0 ft					
30		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 4ft North, 1.5ft West of B-101 as-drilled location. 3. For soil samples 0ft - 20ft, see B-101.					
35							
40							
45							

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-102**
Page No.: 1 of 2
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/22/21 Date Finished: 9/23/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		0.5 ft - 2.0 ft, Concrete/Rebar								
		S-1: Brown cmf SAND, little mf Gravel, little (-) Silt, Rec. = 0.83 ft, 2.0 ft - 4.0 ft, Environmental Sample - No sample collected				10-10-11-11 (21)				
5		S-2: Grey cmf SAND, little (+) cmf Gravel, Rec. = 0.67 ft, 4.0 ft - 6.0 ft				22-17-9-4 (26)				
		S-3: Brown cmf SAND, little c(-)mf Gravel, Rec. = 0.58 ft, 6.0 ft - 8.0 ft, Environmental Sample - No sample collected				3-3-3-4 (6)				
10		S-4: Brown/Grey cmf SAND, little cmf Gravel, Rec. = 1.0 ft, 8.0 ft - 10.0 ft, Environmental Sample - No sample collected				10-9-6-7 (15)				
		S-5: Black/Brown cmf SAND, little c(-)mf Gravel, Rec. = 1.0 ft, 10.0 ft - 12.0 ft				9-3-6-6 (9)				
15		S-6: Dark Brown cmf SAND, some cm(+)f Gravel, Rec. = 0.5 ft, 15.0 ft - 17.0 ft, Wood fragments present in sample				3-3-4-7 (7)				
		18.0 ft - 20.0 ft, Drilled through large piece of wood (Confirmed by wood stuck to casing upon removal)								
20		S-7: Grey/Black cm SAND, Rec. = 0.17 ft, 20.0 ft - 21.0 ft, Wood in tip of spoon.				50/2" (100)				
		S-8: SAME, Rec. = 0.58 ft, 21.0 ft - 23.0 ft				9-7-12-16 (19)				
25		S-9: Grey mf GRAVEL, little cmf Sand, Rec. = 1.33 ft, 25.0 ft - 27.0 ft, Wood fragments present in sample				6-6-3-4 (9)				
30		S-10: J1 (Top 8"): Grey-Brown mf(+) SAND, some Silt, Rec. = 1.17 ft, 30.0 ft - 31.0 ft				14-16-16-15 (32)				
		S-10: J2 (Bott. 6"): Grey Clayey SILT, 31.0 ft - 32.0 ft								
		32.0 ft, Approximate Top of Rock	C-1 (5-90)	91.7 (45)	6					
35		33.0 ft - 38.0 ft, Grey PHYLLITE, moderately to highly weathered, moderately to slightly fractured, moderately soft to moderately hard rock, cmf grains, 5+ pieces			4 4.5 12 3.5					
		38.0 ft - 43.0 ft, Grey PHYLLITE, moderately weathered, intensely to moderately fractured, moderately soft to moderately hard rock, cmf grains, 7+ pieces	C-2 (5-90)	91.7 (33.3)	7 6 6 6 16					
40		Hole stopped @ 43.0 ft								
45										

Remarks:
1. Mud Rotary drill used. Groundwater not recorded.
2. Hole located 0.5ft South, 2.5ft West of survey-marked location.
3. Large piece of wood @ approximately 18ft.

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-102**
Page No.: 2 of 2
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/22/21 Date Finished: 9/23/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		4. Lost water in casing at approximately 14ft and 19ft.								
55										
60										
65										
70										
75										
80										
85										
90										
95										

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-103**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/21/21 Date Finished: 9/21/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		0.5 ft - 2.0 ft, Concrete/Rebar								
		S-1: J1 (Top 7"): Brown mf SAND, little Silt, Rec. = 0.92 ft, 2.0 ft - 3.0 ft, Environmental Sample - No sample collected				14-12-10-9 (22)				
5		S-1: J2 (Bott. 4"): Grey cmf(-) SAND, little (+) Gravel, 3.0 ft - 4.0 ft				31-25-18-8 (43)				
		S-2: Grey-Brown cmf(+) GRAVEL, some cmf Sand, Rec. = 0.92 ft, 4.0 ft - 6.0 ft				10-8-10-13 (18)				
		S-3: SAME, Rec. = 1.0 ft, 6.0 ft - 8.0 ft				14-6-5-5 (11)				
10		S-4: Grey-Brown cmf SAND, some (+) cmf(+) Gravel, Rec. = 0.83 ft, 8.0 ft - 10.0 ft				12-19-40-50 (59)				
		S-5: Grey-Brown cmf SAND, little (+) mf Gravel, Rec. = 1.17 ft, 10.0 ft - 12.0 ft, Highly decomposed shale/phyllite								
15		S-6: Brown cmf SAND, little c(-)mf Gravel, Rec. = 1.08 ft, 15.0 ft - 17.0 ft				4-6-7-7 (13)				
20		S-7: Dark Grey SILT, little f Sand, trace mf Gravel, Rec. = 2.0 ft, 20.0 ft - 22.0 ft, Wood fragments in top 6" of sample				3-4-4-4 (8)				
25		S-8: Grey c(-)mf SAND, little cmf Gravel, trace Silt, Rec. = 0.83 ft, 25.0 ft - 27.0 ft				11-9-8-20 (17)				
30		30.0 ft - 35.0 ft, Grey PHYLLITE, moderately to highly weathered, very intensely to intensely fractured, moderately soft to moderately hard rock, cmf grains, 3+ pieces	C-1 (0-30)	91.7 (13.3)	9.5 6 9 7 4.5					
35		35.0 ft - 40.0 ft, Grey PHYLLITE, moderately weathered, moderately fractured, moderately soft to moderately hard rock, cmf grains, 8 pieces	C-2 (30-90)	100 (56.7)	4 4 4.5 5 6					
40		Hole stopped @ 40.0 ft								
45		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 0.5ft South, 0.5ft West of survey-marked location.								

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.

BORING LOG NORTHFIELD - VT-12 OVER DOG RIVER.GPJ VERMONT AOT.GDT 10/20/21

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-104**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/24/21 Date Finished: 9/24/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/28/21	18.6	B-104MW Reading

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 %
		0.0 ft - 0.5 ft, Asphalt								
		S-1: Brown cmf SAND, some cmf Gravel, Rec. = 1.0 ft, 0.5 ft - 2.0 ft, Environmental Sample - No sample collected				12-16-12-10 (28)				
		S-2: Brown cmf(+) SAND, little cmf Gravel, Rec. = 0.83 ft, 2.0 ft - 4.0 ft				10-10-15-8 (25)				
5		S-3: SAME, Rec. = 0.83 ft, 4.0 ft - 6.0 ft				5-7-8-5 (15)				
		S-4: Brown cmf SAND, some (+) cmf Gravel, Rec. = 0.75 ft, 6.0 ft - 8.0 ft				10-12-12-13 (24)				
		S-5: SAME, Rec. = 0.75 ft, 8.0 ft - 10.0 ft				9-10-12-28 (22)				
10		S-6: Brown/Grey c(-)mf GRAVEL, some cmf Sand, little (-) Silt, Rec. = 1.0 ft, 10.0 ft - 12.0 ft, crumbled rock				14-10-21-50 (31)				
		12.0 ft - 15.0 ft, Cobbles								
15		S-7: Jar A (top 6"): Brown cmf GRAVEL, some cmf Sand, little Silt, Rec. = 0.75 ft, 15.0 ft - 16.5 ft, Partial Environmental Sample - very small sample collected				9-11-42-6 (53)				
		S-7: Jar B (Bott. 3"): Black CLAY & SILT, 16.5 ft - 17.0 ft								
20		S-8: Dark Brown c(-)mf SAND, some Silt, Rec. = 1.5 ft, 20.0 ft - 22.0 ft, Wood fragments throughout sample				2-4-5-8 (9)				
		S-9: Grey cmf SAND, little (+) Silt, little mf Gravel, Rec. = 1.25 ft, 22.0 ft - 24.0 ft				9-9-11-9 (20)				
25		S-10: White/Grey cmf SAND, some (+) c(-)mf Greavel, little Silt, Rec. = 0.83 ft, 25.0 ft - 27.0 ft, Decomposed Rock				15-26-33-50 (59)				
		28.0 ft, Approximate Top of Rock								
30		29.0 ft - 34.0 ft, Grey PHYLLITE, moderately to slightly weathered, slightly fractured, moderately soft rock, cmf grains, 7+ pieces	C-1 (5-80)	100 (95)	4.5 4.5 5 5 5					
35		34.0 ft - 39.0 ft, Grey PHYLLITE, slightly weathered, moderately to slightly fractured, moderately soft to moderately hard rock, cmf grains, 6+ pieces. Bottom 6": Large quartz pocket	C-2 (5-80)	86.7 (66.7)	5 4.5 6.5 7 9					
40		Hole stopped @ 39.0 ft								
45		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located 4ft North, 1ft West of survey-marked location. 3. B-104MW installed 0.5ft North, 4ft West of B-104 as-drilled location.								

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-105**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/23/21 Date Finished: 9/23/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		0.0 ft - 0.5 ft, Asphalt								
		S-1: Grey/Brown cmf SAND, some c(-)mf Gravel, Rec. = 1.17 ft, 0.5 ft - 2.0 ft				41-50-46-39 (96)				
		S-2: SAME, Rec. = 0.92 ft, 2.0 ft - 4.0 ft				17-13-10-6 (23)				
5		S-3: SAME, Rec. = 0.58 ft, 4.0 ft - 6.0 ft				6-2-5-2 (7)				
		S-4: Grey cmf GRAVEL, little cmf Sand, Rec. = 0.33 ft, 6.0 ft - 8.0 ft				7-6-5-9 (11)				
		S-5: Dark Brown cmf SAND, little (+) cmf Gravel, Rec. = 0.42 ft, 8.0 ft - 10.0 ft				3-4-7-11 (11)				
10		S-6: Grey c(-)mf GRAVEL, trace cmf Sand, trace (-) Silt, Rec. = 1.08 ft, 10.0 ft - 12.0 ft, Crumbled Rock				11-11-11-16 (22)				
15		S-7: Grey cmf GRAVEL, little Silt, trace f Sand, Rec. = 0.5 ft, 15.0 ft - 17.0 ft, Crumbled Rock				3-5-8-20 (13)				
20		S-8: Grey cmf(+) SAND, trace cmf Gravel, Rec. = 0.67 ft, 20.0 ft - 22.0 ft, Environmental Sample - No sample collected				6-4-5-4 (9)				
		S-9: Grey-Black cmf(+) SAND, little Silt, Rec. = 1.5 ft, 22.0 ft - 24.0 ft				3-10-16-23 (26)				
25		25.0 ft - 30.0 ft, Grey PHYLLITE, moderately weathered, moderately to slightly fractured, moderately soft rock, cmf grains, 5+ pieces	C-1 (5-90)	91.7 (45)	3 3 3 6 5					
30		30.0 ft - 35.0 ft, Grey PHYLLITE, moderately weathered, moderately fractured, moderately soft rock, cmf grains, 5+ pieces	C-2 (5-90)	100 (58.3)	5.5 3.5 4 4 4.5					
35		Hole stopped @ 35.0 ft								
40										
45										

Remarks:
1. Mud Rotary drill used. Groundwater not recorded.
2. Hole located 3.5ft North of survey-marked location.
3. Could not maintain seal at bottom of casing, used approximately 750 gallons of water during rock coring.

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

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **B-106**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/20/21 Date Finished: 9/20/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	WASH BORE	SS
I.D.:	4 in	1.5 in
Hammer Wt:	300	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Manual/AWJ	
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

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 %
		S-1: Brown cmf SAND, little cmf Gravel, grass/organics, Rec. = 0.75 ft, 0.0 ft - 2.0 ft, Environmental Sample - no sample taken				4-6-13-17 (19)				
		S-2: SAME, Rec. = 0.42 ft, 2.0 ft - 4.0 ft, Environmental Sample - no sample taken				15-12-9-7 (21)				
5		S-3: Tan/Brown mf SAND, little mf Gravel, trace Silt, Rec. = 1.0 ft, 4.0 ft - 6.0 ft				9-6-6-5 (12)				
		S-4: SAME, Rec. = 1.17 ft, 6.0 ft - 8.0 ft				6-7-11-7 (18)				
		S-5: SAME, Rec. = 0.5 ft, 8.0 ft - 10.0 ft				9-8-10-16 (18)				
10		S-6: Tan/Dark Brown c(-)mf SAND, trace f Gravel, trace Silt, Rec. = 1.17 ft, 10.0 ft - 12.0 ft				8-10-10-10 (20)				
15		S-7: Brown mf(+) SAND, little Silt, Rec. = 0.75 ft, 15.0 ft - 17.0 ft				6-8-9-11 (17)				
20		S-8: SAME, Rec. = 0.75 ft, 20.0 ft - 22.0 ft, Large wood fragment in center of sample Environmental Sample - no sample taken				4-3-1-1 (4)				
		S-9: Grey cmf SAND, some (-) cmf Gravel, Rec. = 1.5 ft, 22.0 ft - 24.0 ft, Decomposed Rock				4-12-21-60/3" (33)				
25		24.0 ft, Approximate Top of Rock 25.0 ft - 30.0 ft, Grey PHYLLITE, slightly weathered, moderately fractured, moderately soft rock, mf grains, 12 pieces	C-1 (30-90)	96.7 (63.3)	3.5 5.5 6.5 6 6.5					
30		30.0 ft - 35.0 ft, Grey PHYLLITE, slightly weathered, slightly fractured, moderately soft rock, mf grains, 3+ pieces	C-2 (60)	100 (91.7)	7.5 8 8 7 7.5					
35		Hole stopped @ 35.0 ft								
40		Remarks: 1. Mud Rotary drill used. Groundwater not recorded. 2. Hole located as surveyed.								
45										

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
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CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-101**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/21/21 Date Finished: 9/21/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/21/21	20.0	Moist Spoils Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Light Brown cmf SAND, some cmf Gravel, Rec. = 0.75 ft, 0.5 ft - 2.0 ft	36-60-REF-REF (100)				
		Visual Description:, Light Brown cmf SAND, some (-) cmf Gravel, intermittant boulders/cobbles					
5							
		Visual Description:, Dark Brown cmf SAND, and cmf Gravel					
10		Visual Description:, Brown cmf SAND, some cmf Gravel					
15							
20		S-2: Grey cmf GRAVEL, trace cmf Sand, Rec. = 0.42 ft, 20.0 ft - 22.0 ft, Decomposed Rock	5-2-1-1 (3)				
		S-3: No Recovery, Rec. = 0.0 ft, 22.0 ft - 24.0 ft	2-1-2-WOH (3)				
25		S-4: Grey SILT, little mf Sand, Rec. = 0.83 ft, 25.0 ft - 27.0 ft, very soft sample	4-5-10-10 (15)				
		S-5: Grey-Brown mf SAND, trace Silt, trace (-) f Gravel, Rec. = 1.08 ft, 27.0 ft - 29.0 ft	15-35-30-65 (65)				
30		Hole stopped @ 29.0 ft					
35							
40							
45							

Remarks:
1. Hole locateed as surveyed.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.
3. H-101MW installed 2ft South of H-101 as-drilled location.

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
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MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-102**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/22/21 Date Finished: 9/22/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/22/21	17.0	Moist Spoils Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 2.0 ft, Concrete					
		S-1: Grey/Brown cmf SAND, trace mf Gravel, Rec. = 1.25 ft, 2.0 ft - 4.0 ft	25-30-26-26 (56)				
5		S-2: Brown cmf SAND, little Silt, trace f Gravel, Rec. = 1.17 ft, 4.0 ft - 6.0 ft	11-21-23-25 (44)				
		Field Note:, Cobbles/Boulder					
		Visual Description:, Brown cmf SAND, little Silt, trace f Gravel					
10							
		Field Note:, Boulder					
15							
20		S-3: Grey-Brown mf SAND, trace Silt, Rec. = 1.25 ft, 20.0 ft - 22.0 ft	8-11-14-16 (25)				
		S-4: SAME, 22.0 ft - 25.0 ft, Spoon over-driven to collect extra soil for environmental sample. SPT values correlate to middle 2ft (22.5 - 24.5) Rec. = 2.0 ft	14-20-27-35 (47)				
25		Hole stopped @ 25.0 ft					
30							
35							
40							
45							

Remarks:
1. Hole located 0.5ft South of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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
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BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-103**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/27/21 Date Finished: 9/27/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 1.0 ft, Concrete					
		S-1: Grey/Brown cmf SAND, little cmf Gravel, trace Silt, Rec. = 1.33 ft, 1.0 ft - 3.0 ft	27-24-25-21 (49)				
		S-2: Brown cmf SAND, trace cmf(-) Gravel, Rec. = 0.67 ft, 3.0 ft - 5.0 ft	31-37-44-30 (81)				
5		Visual Description:, Brown mf SAND, little c(-)mf Gravel, little Silt, Boulders/Cobbles throughout					
10		Visual Description:, Grey cmf GRAVEL, some cmf Sand, little Silt					
15		S-3: Brown cmf SAND, little Silt, trace cmf Gravel, Rec. = 0.92 ft, 15.0 ft - 17.0 ft	18-7-9-8 (16)				
		S-4: Top 5": SAME, Rec. = 1.58 ft, 17.0 ft - 17.5 ft	6-3-6-6 (9)				
		S-4: Rest: Black mf SAND, some Silt, 17.5 ft - 19.0 ft					
20		S-5: Top 6": Brown cmf SAND, little Silt, trace mf Gravel, Rec. = 1.92 ft, 19.0 ft - 19.5 ft	7-7-10-50/5" (17)				
		S-5: Rest: Black mf SAND, some Silt, rock fragments, 19.5 ft - 21.0 ft					
		S-6: Black/Grey SILT, little, f Sand, little mf Gravel, Rec. = 0.83 ft, 21.0 ft - 23.0 ft, Decomposed Rock	8-9-12-10 (21)				
		S-7: Grey c(-)mf SAND, Rec. = 0.92 ft, 23.0 ft - 25.0 ft	8-10-13-15 (23)				
25		Hole stopped @ 25.0 ft					
30							
35							
40							
45							

Remarks:
1. Hole located 3ft North of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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
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CENTRAL LABORATORY

BORING LOG

VTrans Northfield - VT-12 over Dog River
BF 0241(58)

Boring No.: **H-104**
Page No.: 1 of 1
Pin No.: 19J223
Checked By: A. Sajewska

Boring Crew: M. St John (NEBC), R. Gurriell (H&H)
Date Started: 9/20/21 Date Finished: 9/20/21
VTSPG NAD83:
Station: Offset:
Ground Elevation:

	Casing	Sampler
Type:	AUGER	SS
I.D.:		1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Manual/AWJ
Rig:	MOBILE	C_E = 1

Groundwater Observations

Date	Depth (ft)	Notes
09/20/21	20.0	Moist Samples Noted

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		S-1: Brown cmf SAND, little cmf Gravel, trace Silt, Rec. = 0.75 ft, 0.5 ft - 2.0 ft	12-27-31-35 (58)				
		S-2: SAME, Rec. = 1.42 ft, 2.0 ft - 4.0 ft	26-50-36-28 (86)				
5		Visual Description:, Brown c(-)mf SAND, little (+) Silt, trace mf Gravel					
10							
15							
20		S-3: Brown cmf SAND, lttle Silt, Rec. = 1.67 ft, 20.0 ft - 22.0 ft	6-6-8-9 (14)				
		S-4: Grey cm(+)f SAND, little Silt, Rec. = 1.5 ft, 22.0 ft - 24.0 ft	6-10-22-33 (32)				
25		Hole stopped @ 24.0 ft					

Remarks:
1. Hole located 0.5ft South of survey-marked location.
2. Environmental Hole, no samples collected. Samples & auger spoils visually classified.

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.

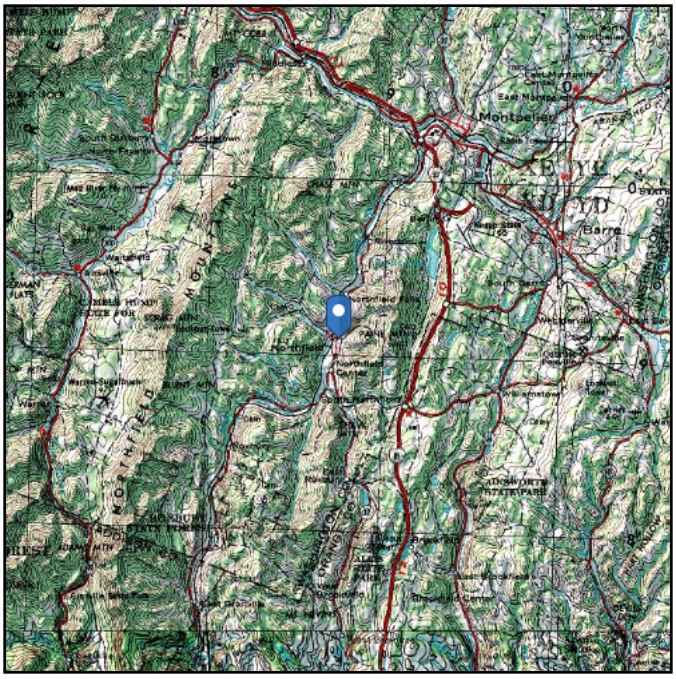
BORING LOG NORTHFIELD - VT-12 OVER DOG RIVER.GPJ VERMONT AOT.GDT 10/20/21

Appendix D: ASCE-7 Hazard Tool Report

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-22	**Latitude:**	44.149436
Risk Category:	I	**Longitude:**	-72.655966
Soil Class:	D - Stiff Soil	**Elevation:**	0 ft (NAVD 88)



Seismic

D - Stiff Soil

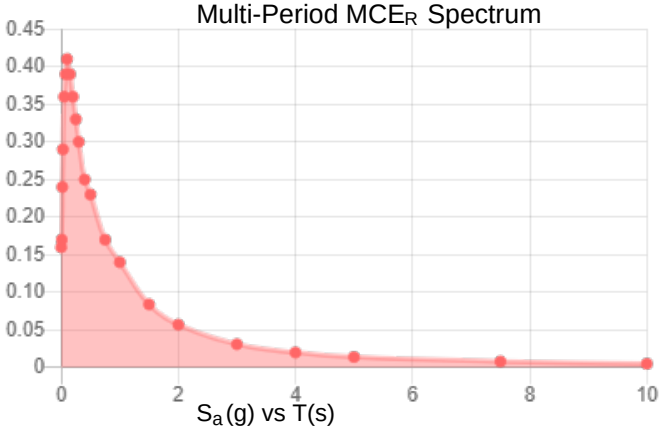
Site Soil Class:

Results:

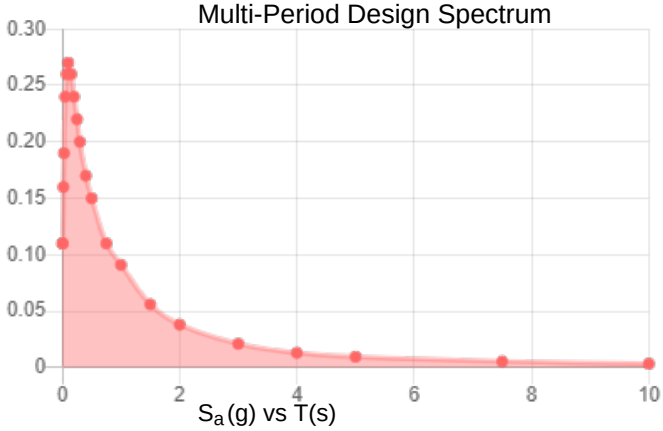
PGA_M :	0.14	T_L :	6
S_{MS} :	0.32	S_S :	0.27
S_{M1} :	0.14	S_1 :	0.065
S_{DS} :	0.22	V_{S30} :	260
S_{D1} :	0.091		

Seismic Design Category: B

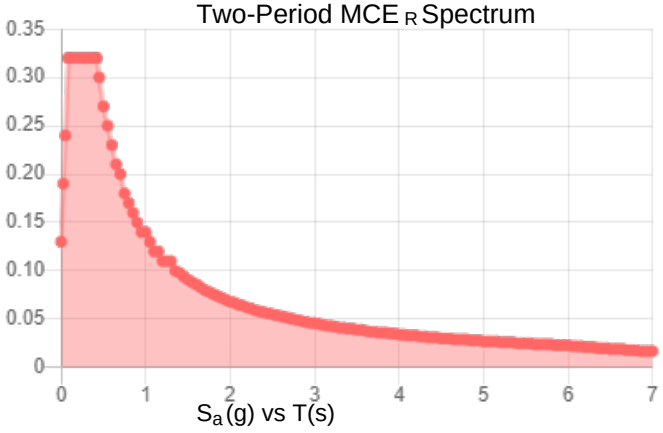
Multi-Period MCE_R Spectrum



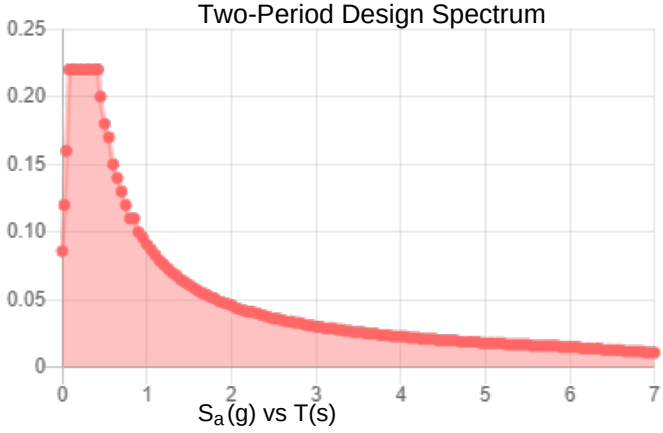
Multi-Period Design Spectrum



Two-Period MCE_R Spectrum



Two-Period Design Spectrum



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: Tue Aug 08 2023

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.