

3205 US-23 South
Alpena, MI 49707
Ph: 989-356-6375
Fax: 989-354-8286

April 29, 2024

***Underhill Road Construction
Addendum #2***

This Addendum is issued for the purpose of modifying and/or clarifying the original drawings and specifications and shall take precedence over them.

All work included herein shall be in accordance with the original drawings and specifications except as specifically noted herein. All incidental items required to provide the following modifications shall be included even though not specifically described.

It shall be the responsibility of the contractors to notify their subcontractors and/or suppliers of the clarifications, modifications, and/or revisions included herein.

Receipt of this Addendum shall be noted on the Itemized Bid Sheet.

The following project modifications are provided for this project:

1. The existing road surface elevation at the crossings is 712.7+/-.
2. Mobilization and Traffic Control will be incidental to other items as noted in the highlighted section of Page 1 of the Project Specifications. Underhill Road at the structures can be closed to traffic.
3. The Geotechnical Report is included for information only.
4. A revised Bid Tab is being provided to include the pay item for Riprap, Heavy.
5. A Bid Security is not required for this project.

Schedule of Items (Itemized Bid Sheet)

Letting Date: Wednesday, May 8, 2024 9:00 AM

Contract ID: 23.120
Location: Underhill Road Crossing
Description:

Project Number: 23.120	Project Engineer: Rebecca Rivard, P.E.
Estimate Number: 1	Date Created: 2/26/2024
Project Type: Miscellaneous	Fed/State #:
Location: Underhill Road Crossing	Fed Item:
	Control Section:

Description:

Instructions to Bidders: IMPORTANT NOTICE:
If the proposal establishes a maximum price for any of the following work items, and if you bid a price higher than that maximum price, your bid will be considered to have quoted the maximum price and your bid total will be adjusted to reflect that maximum price.

If the proposal provides a specified price for any of the following work items, and if you bid a price higher or lower than that specified price, your bid will be adjusted to reflect that specified price.

If your bid is the lowest accepted bid, and if you refuse to accept the award of the contract due to the change in what you quoted as a maximum or specified price, you will forfeit your proposal guaranty.

Pay Item	Description	Quantity	Units	Unit Price		Bid Amount	
				Dollars	Cts	Dollars	Cts
2040035	Guardrail, Rem	212	Ft				
2040060	Structures, Rem	1	LSUM				
2050010	Embankment, CIP	150	Cyd				
2050016	Excavation, Earth	375	Cyd				
3020001	Aggregate Base	490	Ton				
3070001	Approach, CI I	100	Ton				
3070021	Approach, CI II	39	Ton				
3070121	Shld, CI II	30	Ton				
5010005	HMA Surface, Rem	1,410	Syd				
5010061	HMA Approach	35	Ton				
5012025	HMA, 4EML	150	Ton				
7097051	_ Structure, Timber, Installed	2	LSUM				
8007011	_ Slope Restoration	12	Syd				
8070025	Guardrail Anch, Bridge, Det T4	8	Ea				
8070044	Guardrail Approach Terminal, Type 2M	1	Ea				
8070050	Guardrail Departing Terminal, Type B	3	Ea				
8070080	Guardrail Reflector	16	Ea				
8072142	Guardrail, Curved, Type B, 96 inch Post	75	Ft				
8072176	Guardrail, Type T, 96 inch Post	175	Ft				
8072180	Guardrail, Type MGS-8, 108 inch Post	219.5	Ft				
8130005	Riprap, Heavy	250	Syd				

Pay Item	Description	Quantity	Units	Unit Price		Bid Amount		
				Dollars	Cts	Dollars	Cts	
Total Bid:								

Contractor: _____

(Signature)

(Date)



REPORT OF
GEOTECHNICAL INVESTIGATION
FOR
UNDERHILL ROAD OVER RAPID RIVER

CLEARWATER TOWNSHIP
KALKASKA COUNTY
MICHIGAN

DECEMBER 19, 2023



*Huron Engineering & Surveying, Inc.
3205 US-23 South
Alpena, Michigan 49707*

Project No. 2023.1755



December 19, 2023

Huron Engineering & Surveying, Inc.
3205 US-23 South
Alpena, Michigan 49707

Attention: Ms. Rebecca Rivard, P.E.

Regarding: Underhill Road over Rapid River
Clearwater Township, Kalkaska County, Michigan
Project No. 2023.1755

Dear Ms. Rivard:

Soils & Structures is pleased to present this geotechnical investigation report for the Underhill Road over Rapid River project in Clearwater Township, Kalkaska County, Michigan.

The investigation included four (4) test borings drilled to a depth of 50.0 feet in accordance with ASTM D 1586 procedures.

The report, test boring location plan and test boring logs are enclosed. The report provides soil related recommendations for the construction of two culverts or timber bridges.

We appreciate the opportunity to provide engineering services to Huron Engineering & Surveying. If you have any questions regarding this report, please contact our office.

Sincerely,
Soils & Structures, Inc.

A handwritten signature in black ink that reads "Malcolm P. Thompson".

Malcolm P. Thompson, P.E.
MPT/mt

Reviewed by:

A handwritten signature in black ink that reads "David W. Hohmeyer".

David W. Hohmeyer, P.E.

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- General Soil Profiles
- Test Boring Logs
- Laboratory Tests
- General Soil Information



Location of Soil Investigation

The soil investigation was located at the Underhill Road crossings over the Rapid River in Clearwater Township, Kalkaska County, Michigan. Underhill Road crosses two branches of the Rapid River just north of the Underhill Road and Valley Road Intersection.

Purpose of Investigation

The purpose of this investigation is to provide geotechnical engineering recommendations for the construction of two culverts or timber bridges.

Design Information

The project consists of two road crossings over the Rapid River. The existing structures will be replaced. The new structures will consist of bottomless aluminum box culverts or timber bridges.

The greatest depth of excavation is anticipated to be approximately 10.0 feet which will be required for the construction of foundations and abutments. Groundwater controls and dewatering will probably be necessary.

Allowable settlements of 1.5 inches for total settlement and 1.0 inch for differential settlement are assumed. If the actual crossing replacement details differ significantly from what was assumed in this report, then Soils & Structures should be contacted so that the recommendations included in this report may be reviewed and revised if necessary.

Tests Performed

The investigation included four test borings drilled to a depth of 50.0 feet. The test borings are designated as Test Boring One through Test Boring Four. The locations were determined jointly by Huron Engineering & Surveying and Soils & Structures, Inc. The test borings were conducted in accordance with ASTM D 1586 procedures. The ASTM D 1586 standard describes the procedure for sampling and testing soil using the Standard Penetration Test. An automatic hammer was used to obtain the soil samples.

The surface elevations at the test boring locations and additional points of reference were obtained with a Global Navigation Satellite System (GNSS) Receiver. The receiver was connected to the local MDOT CORS base station. Through this system, vertical measurements are obtained and referenced to the North American Vertical Datum (NAVD88). Horizontal measurements are also obtained at the test boring locations which are referenced to the Michigan State Plane Coordinate System. Both the vertical and horizontal measurements typically have an accuracy of approximately 0.5 inches. The measured test boring locations and surface elevations are represented in Table 1.

**Table 1: Measured Test Boring and Points of Reference
Locations and Surface Elevations**

Test Boring / Location	Elevation (feet)	Northing (feet)	Easting (feet)	Surface Cover
Test Boring One*	713.0	549295.5	19460619.6	Topsoil
Test Boring Two*	712.8	549230.3	19460618.4	Topsoil
Test Boring Three*	712.9	549124.1	19460618.9	Topsoil
Test Boring Four	713.3	549059.3	19460620.0	Sand
Base Setup VRS1	711.9	549060.9	19460617.1	-
Base Setup VRS2	717.5	549257.3	19460595.7	-

*Potential Error: GNNS signal obstructed by tree cover

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the “Material Description” column of the test boring logs.

The soil strength and the allowable soil bearing value were evaluated using the “N” value. The “N” value is the number of blows required to drive a soil sampler one foot with a standard 140 pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0 inch increment is recorded. The sum of the second and third intervals is the “N” value. The number of blows for each 6.0 inch interval is shown on the test boring logs under the column labeled “Penetration.” The “N” value for each sample is shown in the adjacent column.

Laboratory testing consisted of natural moisture content (ASTM D 2216), sieve analysis (ASTM D 6913), and loss on ignition testing (ASTM D 2974). The tests were performed on representative soil samples. The tests were performed in accordance with the ASTM standards listed above. The water content documents the presence of groundwater in the soil. The sieve test determines the particle distribution which is used to classify the soil and estimate its properties. Loss on ignition testing determines the amount of organic material present in a soil sample.

The U.S. Geological Survey Topographic map and the Quaternary Geology map of Southern Michigan were reviewed. These maps provide general geological information about the region. Publicly available well logs were reviewed to determine the depth of bedrock.

Description of Soil

The general soil profile consists of layers of fill and soil containing organic material to depths of 5.5 to 9.0 feet over a layer of sand which extends to a depth of at least 50.0 feet. The upper layer of fill was placed during construction of the existing road embankment. The natural soils are fluvial or lacustrine deposits of sand and gravel. The depth to bedrock appears to be greater than 100.0 feet.

The upper 5.5 to 9.0 feet of the soil profile consists of brown sand with varying amounts of silt and gravel. Frequent pockets, lenses and seams of organic material including peat and wood are present in the upper sand layer. Some of the upper sand layer is probably fill placed for the existing road embankment. The “N” values of the upper sand layer range from 2 to 8, indicating the sand is in a loose to compact state. Most of the sand is in a loose state. Loose sand is indicated by “N” values less than or equal to 4. The “N” values correspond to an internal friction angle of less than 28 degrees. The upper portion of the sand layer is not suitable to support foundations.

The portion of the sand layer between depths of 9.0 and at least 50.0 feet consists of brown fine to coarse sand with the occasional pocket of silty sand, clayey sand, or gravel. Frequent seams of silt or clay are present in the lower portion of the sand layer. The “N” values of the lower portion of the sand layer range from 7 to over 50, indicating the sand is in a slightly compact to extremely compact state. Most of the sand is in compact state. Compact sand is indicated by “N” values equal to or greater than 8. The “N” values correspond to an internal friction angle of 30 to 36 degrees. The lower portion of the sand layer is suitable to support foundations.

Description of Groundwater Conditions

The water table is present at depths between 5.5 and 6.5 feet. These depths correspond to an elevation of approximately 606.8 feet. The elevation of the water table will change based on seasonal precipitation and will correspond to the water level of the Rapid River.

Description of Site

The site is located at the Underhill Road crossings over the Rapid River in Clearwater Township, Kalkaska County, Michigan. The site is surrounded by woods and consists of an asphalt road which crosses the Rapid River at two locations. Photographs #1 and #2 show the site at the time the test borings were performed.



Photograph #1: View of Underhill Road and the existing south crossing. (Project No. 2023.1755, Underhill Road over Rapid River, Clearwater Township, Kalkaska County, Michigan, October, 2023)



Photograph #2: View of Underhill Road from the existing north crossing. (Project No. 2023.1755, Underhill Road over Rapid River, Clearwater Township, Kalkaska County, Michigan, October, 2023)

Recommendations

Site & Subgrade Preparation

Trees and vegetation in the construction areas should be cleared and removed as part of subgrade preparation. The topsoil should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. All roots over 0.5 inches in diameter should be removed.

The existing structures will be removed as a part of site preparation. Construction of the culvert or timber bridge will also require the removal of a significant portion of Underhill Road. The road and embankment should be removed to the extent so that the desired width of the Rapid River can be achieved.

The area adjacent to the crossings should be excavated to the required grade, and a cofferdam constructed as necessary to allow for construction of the foundations, wing walls and abutments. The subgrade should be compacted to 95.0 percent of its maximum density. Soft or loose soil incapable of sustaining the required compaction should be removed and replaced with structural fill. The excavation should be lined with geotextile reinforcement to protect from erosion.

Fill or excavation may be required to adjust the grade of Underhill Road to match the planned elevation of the new crossing. Fill should be placed following the recommendations in the "Fill" section of this report. Fill should be compacted to 95.0 percent of the soil's maximum density to its full depth.

Soil brought to the site for fill should be clean sand and gravel meeting MDOT specifications. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the new fill.

Foundations – Aluminum Box Culvert

Spread foundations, or strip steel plate footings are a recommended option to support the culverts provided the subgrade is prepared as discussed in this section as well as the "Site & Subgrade Preparation" and "Fill" sections of this report. The foundations are anticipated to be supported on compacted fill or the in-situ sand following subgrade preparation.

The in-situ soil should be removed below the culvert foundations until a uniform bearing layer is reached. Soil containing organic material, and soft or loose soil incapable of sustaining the required compaction should be removed and replaced with structural fill. Excavations to remove unsuitable soil are anticipated to extend to a minimum depth of 9.0 feet at the north crossing and 6.5 feet at the south crossing. The recommended minimum excavation depth is 12.0 inches below the bottom of foundations. The excavation should extend a minimum of 3.0 feet beyond the sides and ends of the foundations. The excavation should be lined with a non-woven geotextile fabric with proper overlap. Coarse angular aggregate should be placed in the excavation with compaction to reach the required grade. The recommended aggregate is MDOT GAA or an approved alternate.

Fill below foundations should be compacted to a density of 95.0 percent of the soil's maximum density to its full depth. Compaction tests should be performed in the foundation subgrade to verify this level of compaction. Soils not meeting or exceeding the minimum density should be recompacted.

Foundations should not be constructed on frozen soil. During cold weather construction, the foundation subgrade and foundations should be protected from freezing with insulated blankets until backfill is placed over both sides of the foundation. Foundations that are damaged by frost heave should be replaced.

Foundations may be designed using an allowable soil bearing value of 4,000 pounds per square foot provided the recommendations in this report are observed. A minimum width of 16.0 inches is recommended for new foundations. The allowable bearing values may be increased 25.0 percent when considering transient loads such as earthquakes and wind.

Steel sheet pile is recommended as scour protection as part of the permanent structure if the foundations will not extend below the anticipated scour depth. The space between culvert foundations and sheet pile should be filled with grout.

Foundations - Timber Bridge

Timber piles are a recommended option to support the bridge. Timber piles should be treated and should be selected following the ASTM D25 Standard for Specifications for Round Treated Timber Piles. A lightweight hammer with appropriate cushions between the hammer and the pile should be used to avoid damaging the timber pile during installation. Splicing timber piles is not recommended.

The timber piles are anticipated to bear in the very compact sand layer present at elevations below 700.0 feet. The calculated pile length is based on a cutoff elevation of 710.0 feet. If the cutoff elevation is different than assumed, pile lengths should be adjusted accordingly. Table 2 provides the calculated pile length allowable axial capacity and for pile tip diameters of 8.0 and 10.0 inches.

Table 2: Calculated Allowable Axial Capacity and Pile Length for Timber Piles

Pile Tip Diameter (inches)	Calculated Pile Length (feet)	Nominal Pile Driving Resistance (kips)	Factored Axial Capacity (kips)
8.0	35.0	100.0	40.0
10.0	35.0	150.0	60.0

Timber piles should be ordered 5.0 to 10.0 feet longer than the calculated pile length to allow for additional driving distance if necessary or for the removal of the top of the pile if it is damaged during the driving process. Several test piles should be driven to verify the required depth prior to placing the order for the remaining piles. The nominal pile driving resistance should be verified using the wave equation. A resistance factor of 0.40 is recommended to calculate the factored nominal resistance.

Piles should be installed with a minimum center-to-center spacing of 3.0 times the pile diameter. An efficiency factor of 1.0 is recommended for piles spaced at least 3.0 times the pile diameter from the nearest pile. The piles should achieve the entire axial capacity in the portion of the pile below the anticipated scour depth. The contractor should submit the installation equipment calibration charts and drivability analysis prior to mobilization.

Lateral Earth Pressure

Foundation walls, wing walls, and abutments with different soil levels on either side should be designed as retaining walls. Sand should be used as backfill behind retaining and foundation walls. The sand should meet MDOT Class II specifications. The cantilevered walls should be designed using a soil density of 120 pounds per cubic foot and a coefficient of active earth pressure of 0.30 for level sand backfill. Braced excavations and foundation walls that will be braced against lateral movement at the top of the wall should be designed using a soil density of 120 pounds per cubic foot and a coefficient of at rest earth pressure of 0.45 for level sand backfill. The effects of any surcharge, unbalanced water forces or sloping backfill should also be included in the design. Weep holes or drains are recommended to reduce unbalanced hydrostatic forces.

Excavations

The in-situ sand and fill are OSHA type "C" soils. Excavations that will be entered by personnel should be based on OSHA requirements for a type "C" soil. Based on OSHA requirements, a maximum allowable side slope of 34 degrees (1.5H:1V) is recommended for excavations 4.0 to 20.0 feet deep. Excavations less than 4.0 feet deep may have vertical side slopes.

A cofferdam is recommended for excavations that will extend a significant distance below the water table. Cofferdams should be designed by a registered engineer. The cofferdam should be designed so that the quick condition does not occur.

Fill

Fill should be compacted to a density of 95.0 percent of its maximum density to its full depth. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per layer of 6.0 inches is recommended.

Soil brought to the site for structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for a SP or SW which are the designations for clean sand. Compaction tests are recommended to confirm that the fill is compacted to the required density.

Fill should not be placed over frozen ground, snow or ice. Soil which contains frozen material should not be used as fill. During winter construction, removal of frozen ground may be necessary prior to placing fill.

Groundwater Management

Groundwater controls will probably be necessary for construction of the culvert or bridge abutments. The culvert foundations should be permanently protected from scour. The timber piles should achieve bearing below the anticipated scour depth.

Excavations that encounter groundwater less than 1.0 foot below the water table should be stabilized by placing 8.0 to 12.0 inches of coarse graded crushed stone aggregate over the bottom of the excavation.

Cofferdams may be necessary in order to control the size of excavations and simplify dewatering efforts. Cofferdams may be required by The Michigan Department of Environment, Great Lakes, and Energy.

Cofferdams should extend a sufficient distance below the bottom of the excavation so that a quick condition does not occur. The cofferdam design should include a hydraulic analysis to check for the quick condition. A safety factor of 2.0 is recommended.

Quality Control Testing

Compaction tests in accordance with ASTM D 6938 specifications are recommended to confirm that fill in the construction area is compacted to the specified density. While fill is being placed, compaction tests should be performed at the rate of one test per 400 cubic yards of fill and throughout the depth of the fill with a minimum of five tests at each 1.0-foot elevation interval. Full time inspection is recommended while the sand is compacted in the construction area. Tests should also be performed in the backfill over utilities. The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

Inspection of the timber pile installation is recommended. For each pile, the following information should be recorded: date and time of installation, driving resistance, surface elevation, tip elevation, cutoff elevation, pile length, obstructions, and offsets. The nominal pile driving resistance should be verified using the wave equation. Inspection should be performed by a geotechnical engineer.

A smooth 0.5-to-0.75-inch diameter rod should be used in conjunction with compaction tests to probe for loose areas below the culverts and in fill.

A dynamic cone should not be substituted for compaction tests for evaluating backfill.

Testing should be performed by technicians supervised by a registered geotechnical engineer.



General Conditions & Reliance

The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing four test borings and providing soil related recommendations for the design and construction of the proposed culvert or timber bridge. The scope of work did not include an environmental study or wetland determination.

The report and the associated test borings were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test borings are an exact representation of the soil or groundwater conditions at all points on this site.

The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings, Soils & Structures should be consulted for additional recommendations.

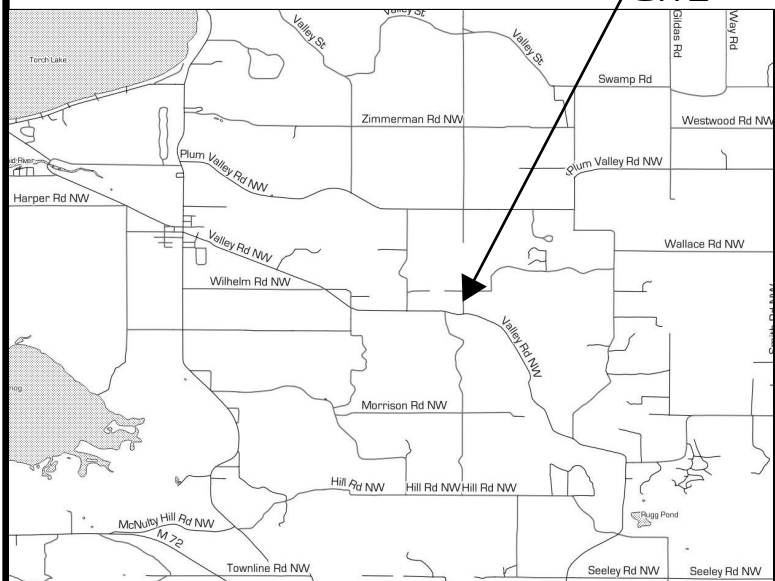
The report and test borings may be relied upon by Huron Engineering & Surveying for the design, construction, permitting and financing associated with the construction of the Underhill Road over Rapid River project in Clearwater Township, Kalkaska County, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing, consent to third party use should not be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.

Appendix

Test Boring Location Plan
General Soil Profiles
Test Boring Logs
Laboratory Tests
General Soil Information



VICINITY MAP



SITE

TEST BORING LOCATION PLAN
NTS



Note: The background of the test boring plan is a portion of an aerial photograph from Google Earth dated 5/8/2016

Underhill Road over Rapid River

Clearwater Township, Kalkaska County, Michigan

Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO.: 2023.1755

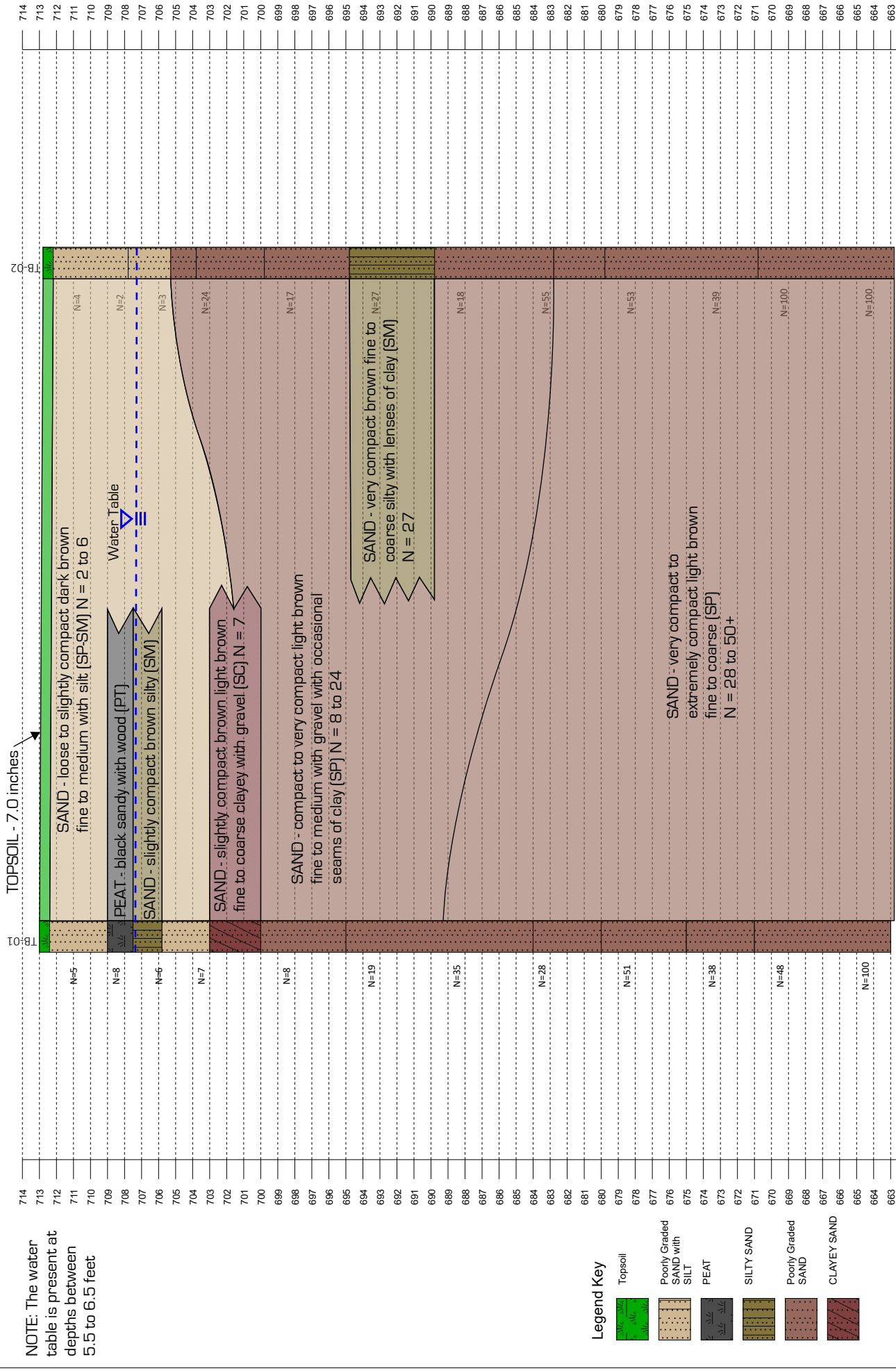
DATE: 12-5-2023

GENERAL SOIL PROFILE

Project Id: 2023.1755
 Project Title: Underhill Road over Rapid River
 Location: Kalkaska, Michigan
 Client: Huron Engineering & Surveying, Inc.

Title: Section line 1
 Vertical Scale: 1:94
 Horizontal Scale: 1:155
 Engineer: Malcolm Thompson, P.E.

NOTE: The water table is present at depths between 5.5 to 6.5 feet



Project Id: 2023.1755

Project Title: Underhill Road over Rapid River

Location: Kalkaska, Michigan

Client: Huron Engineering & Surveying, Inc.

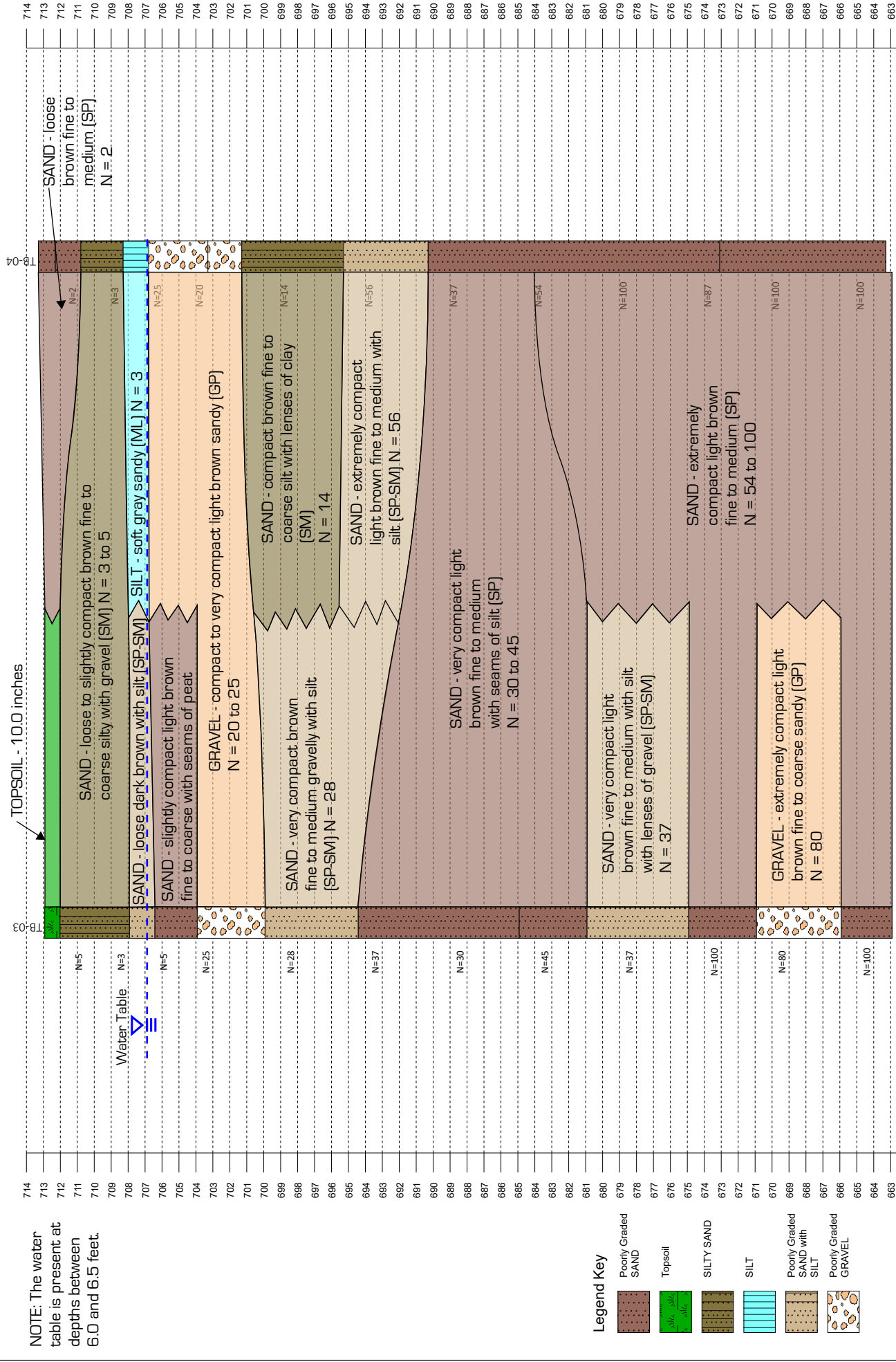
Title: Section line 2

Vertical Scale: 1:94

















Horizontal Scale: 1:155

Engineer: Malcolm Thompson, P.E.

GENERAL SOIL PROFILE



Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 10 2023 Completed: Oct 10 2023	Northing: 549295.5 Easting: 19460619.6 Elevation: 713.00
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	<input checked="" type="checkbox"/> At Time of Drilling 6.50' on Oct 10 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
1		TOPSOIL - dark brown sandy with silt and a trace of gravel (7.0")															
2		SAND - slightly compact dark brown fine to medium with silt with a trace of gravel (fill)															
3			▲	SPT-A	100	4-2-3	5			20.2							SP-SM
4		PEAT - stiff black sandy with wood															
5		Organic Content - 8.8%															
6		SAND - slightly compact brown to light brown fine to medium silty															
7			▲														
8		SAND - slightly compact light brown fine to medium with silt with seams of clay															
9			▲	SPT-C	100	4-3-3	6			18.8							SP-SM
10		SAND - slightly compact light brown fine to medium with seams of clay															
11		SAND - slightly compact light brown fine to coarse clayey with gravel															
12			▲	SPT-D	100	5-3-4	7			17.6							SP-SM
13		SAND - compact light brown fine to medium with seams of clay															
14			▲														
15		SAND - compact light brown fine to medium with seams of clay															
16			▲	SPT-E	100	5-3-5	8										SP
17		SAND - compact light brown fine to medium with seams of clay															
18			▲														
19		SAND - compact to very compact light brown fine to medium															
20			▲	SPT-F	100	7-8-11	19										SP
21		SAND - compact to very compact light brown fine to medium															
22			▲														
23		SAND - compact to very compact light brown fine to medium															
24			▲	SPT-G	100	18-14-21	35			17.7							SP
25		SAND - compact to very compact light brown fine to medium															
26			▲														
27		SAND - compact to very compact light brown fine to medium															
28			▲														
29		SAND - very compact light brown fine to coarse															
30			▲														

Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 10 2023 Completed: Oct 10 2023	Northing: 549295.5 Easting: 19460619.6 Elevation: 713.00
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	<input checked="" type="checkbox"/> At Time of Drilling 6.50' on Oct 10 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
31		SAND - very compact light brown fine to coarse	▲	SPT-H	80	12-13-15	28									SP	
32																	
33			SAND - extremely compact light brown fine to medium	▼													
34				▲	SPT-I	100	16-16-35	51			17.5						SP
35				▼													
36			▲														
37			▼														
38		SAND - very compact light brown fine to medium with seams of silt and clay	▲														
39			▼	SPT-J	100	12-13-25	38									SP	
40			▲														
41			▼														
42		SAND - very compact to extremely compact light brown fine to medium with seams of silt	▲														
43			▼	SPT-K	100	20-23-25	48									SP	
44			▲														
45			▼														
46			▲														
47			▼														
48			▲														
49			▼	SPT-L	89	24-36-5...	50/6									SP	
50			▲				"										
51																	
52																	
53																	
54																	
55																	
56																	
57																	
58																	
59																	
60																	

Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 10 2023 Completed: Oct 10 2023	Northing: 549230.3 Easting: 19460618.4 Elevation: 712.79
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth _____
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	<input checked="" type="checkbox"/> At Time of Drilling 5.50' on Oct 10 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
1		TOPSOIL - dark brown sandy with a trace of gravel (7.0")															
2		SAND - loose dark brown fine to coarse gravelly with silt (possible fill)															
3			SPT-A	100	3-2-2	4				9.4							SP-SM
4																	
5		SAND - loose brown fine to medium with silt with lenses of wood (Possibly Organic)															
6			SPT-B	100	3-1-1	2				22.9							SP-SM
7		SAND - loose light brown to white fine to coarse with a trace of silt															
8			SPT-C	100	1-2-1	3				56.4							SP-SP
9			SAND - very compact light brown fine to coarse gravelly with a trace of silt														
10		SPT-D		100	7-13-11	24				17.0							SP
11		SAND - compact light brown fine to medium with seams of silt															
12																	
13			SAND - compact light brown fine to medium with seams of silt														
14		SPT-E		33	15-10-7	17											SP
15		SAND - very compact brown fine to coarse silty with lenses of clay with a trace of gravel															
16																	
17			SAND - very compact brown fine to coarse silty with lenses of clay with a trace of gravel														
18		SPT-F		100	24-14-13	27				14.1							SM
19		SAND - compact light brown medium to coarse gravelly with lenses of silt															
20																	
21			SAND - compact light brown medium to coarse gravelly with lenses of silt														
22		SPT-G		100	9-7-11	18											SP
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	

















Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 10 2023 Completed: Oct 10 2023	Northing: 549230.3 Easting: 19460618.4 Elevation: 712.79
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	<input checked="" type="checkbox"/> At Time of Drilling 5.50' on Oct 10 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plastic Limit	Plasticity Index			
31		SAND - extremely compact light brown fine to coarse	▲	SPT-H	100	15-25-30	55									SP	
32																	
33			SAND - extremely compact to very compact light brown fine to medium	▼													
34				▲	SPT-I	100	15-18-35	53			14.3						SP
35				▼													
36			▲														
37			▼														
38			▲	SPT-J	100	18-15-24	39										SP
39			▼														
40			▲														
41			▼														
42		SAND - extremely compact light brown fine to coarse	▲														
43			▼														
44			▲	SPT-K	96	18-36-5...	50/3										SP
45			▼				"										
46			▲														
47			▼														
48			▲	SPT-L	80	14-38-5...	50/3										SP
49			▼				"										
50			▲														
51			▼														
52			▲														
53			▼														
54			▲														
55			▼														
56			▲														
57			▼														
58			▲														
59			▼														
60			▲														

Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 09 2023 Completed: Oct 09 2023	Northing: 549124.1 Easting: 19460618.9 Elevation: 712.92
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	At Time of Drilling 6.00' on Oct 09 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
1		TOPSOIL - dark brown sandy with a trace of gravel (10.0")															
2		SAND - slightly compact dark brown to brown fine to coarse gravelly silty (possible fill)	▲	SPT-A	100	3-3-2	5			8.0							SM
3			▲														
4				▲	SPT-B	100	2-1-2	3			25.2						SP- SM
5		SAND - loose dark brown to black fine to medium with silt (possible fill)	▲														SP- SM
6				▲	SPT-C	100	2-2-3	5			37.5						SP
7		SAND - slightly compact light brown to white fine to coarse with precipitated lime with seams of peat Organic Content - 0.9%	▲														SP
8				▲	SPT-D	100	10-15-10	25			11.0						GP
9		SAND - very compact brown fine to medium gravelly with silt	▲														
10				▲	SPT-E	100	11-13-15	28			20.3						SP- SM
11				▲													
12		SAND - very compact light brown fine to medium with seams of silt	▲														
13				▲	SPT-F	100	24-19-18	37									SP
14		SAND - very compact light brown fine to medium with seams of silt and clay	▲														
15				▲	SPT-G	100	11-13-17	30									SP
16				▲													
17			▲														
18			▲														
19			▲														
20			▲														
21			▲														
22			▲														
23			▲														
24			▲														
25			▲														
26			▲														
27			▲														
28			▲														
29			▲														
30			▲														

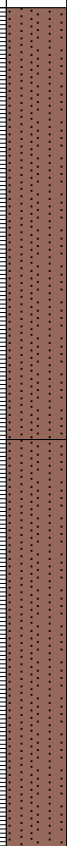
Project Name: Underhill Road over Rapid River	Project Number: 2023.1755
Project Location: Kalkaska, Michigan	Logged By: R Roda Reviewed By: R Roda
Client: Huron Engineering & Surveying, Inc.	Survey Datum: NAD 1983 StatePlane Michigan Central Hole Depth: 50.00
Date Started: Oct 09 2023 Completed: Oct 09 2023	Northing: 549124.1 Easting: 19460618.9 Elevation: 712.92
Drilling Method: 3.25" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Automatic Hammer	<input checked="" type="checkbox"/> At Time of Drilling 6.00' on Oct 09 2023 - Groundwater Encountered
Notes: Potential Elevation Error	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
31		SAND - very compact light brown fine to medium with seams of silt and clay	▲	SPT-H	100	11-18-27	45										SP
32		SAND - very compact light brown to brown fine to medium with silt with lenses of gravel and clay															
33																	
34																	
35			▼	SPT-I	100	11-13-24	37			17.0							SP-SM
36		SAND - extremely compact light brown fine to medium with a trace of silt and gravel															
37																	
38			▼	SPT-J	89	12-28-5...	50/6										SP
39							"										
40		GRAVEL - extremely compact light brown fine to coarse sandy															
41																	
42			▼	SPT-K	100	13-34-46	80										GP
43																	
44		SAND - extremely compact light brown fine to medium with a trace of gravel															
45																	
46			▼	SPT-L	84	18-50/0...	50/4										SP
47							"										
48																	
49																	
50																	
51																	
52																	
53																	
54																	
55																	
56																	
57																	
58																	
59																	
60																	

Project Name: Underhill Road over Rapid River **Project Number:** 2023.1755
Project Location: Kalkaska, Michigan **Logged By:** R Roda **Reviewed By:** R Roda
Client: Huron Engineering & Surveying, Inc. **Survey Datum:** NAD 1983 StatePlane Michigan Central **Hole Depth:** 50.00
Date Started: Oct 09 2023 **Completed:** Oct 09 2023 **Northing:** 549059.3 **Easting:** 19460620.0 **Elevation:** 713.29
Drilling Method: 3.25" Hollow Stem Auger **Frost Depth** _____
Equipment: Diedrich D-50 **Ground Water Levels** _____
Hammer Type: Automatic Hammer At Time of Drilling 6.50' on Oct 09 2023 - Groundwater Encountered
Notes: _____

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS	
											Liquid Limit	Plastic Limit	Plasticity Index				
1		SAND - dark brown to brown fine to coarse with a trace of gravel (fill)															
2		SAND - loose brown fine to medium with a trace of silt and gravel (possible fill)															
3		SAND - loose brown fine to coarse silty	▲	SPT-A	100	2-1-1	2			11.2							SM
4																	SM
5		SILT - soft gray sandy with seams of clay	▲	SPT-B	100	1-2-1	3			19.1							ML
6																	ML
7		GRAVEL - very compact light brown fine to coarse with sand with a trace of silt	▲	SPT-C	100	13-12-13	25			8.1							GP
8																	
9																	
10		GRAVEL - compact light brown fine to coarse sandy	▲	SPT-D	100	12-8-12	20			11.7							GP
11																	
12		SAND - compact brown fine to coarse silty with lenses of clay															
13																	
14																	
15			▲	SPT-E	100	6-6-8	14			19.2							SM
16																	
17																	
18		SAND - extremely compact light brown fine to medium with silt	▲	SPT-F	100	15-24-32	56			17.6							SP- SM
19																	
20																	
21																	
22																	
23		SAND - very compact to extremely compact light brown fine to medium with seams of silt	▲	SPT-G	100	12-15-22	37										SP
24																	
25																	
26																	
27																	
28																	
29																	
30																	

Project Name: Underhill Road over Rapid River **Project Number:** 2023.1755
Project Location: Kalkaska, Michigan **Logged By:** R Roda **Reviewed By:** R Roda
Client: Huron Engineering & Surveying, Inc. **Survey Datum:** NAD 1983 StatePlane Michigan Central **Hole Depth:** 50.00
Date Started: Oct 09 2023 **Completed:** Oct 09 2023 **Northing:** 549059.3 **Easting:** 19460620.0 **Elevation:** 713.29
Drilling Method: 3.25" Hollow Stem Auger **Frost Depth** _____
Equipment: Diedrich D-50 **Ground Water Levels**
Hammer Type: Automatic Hammer At Time of Drilling 6.50' on Oct 09 2023 - Groundwater Encountered
Notes: _____

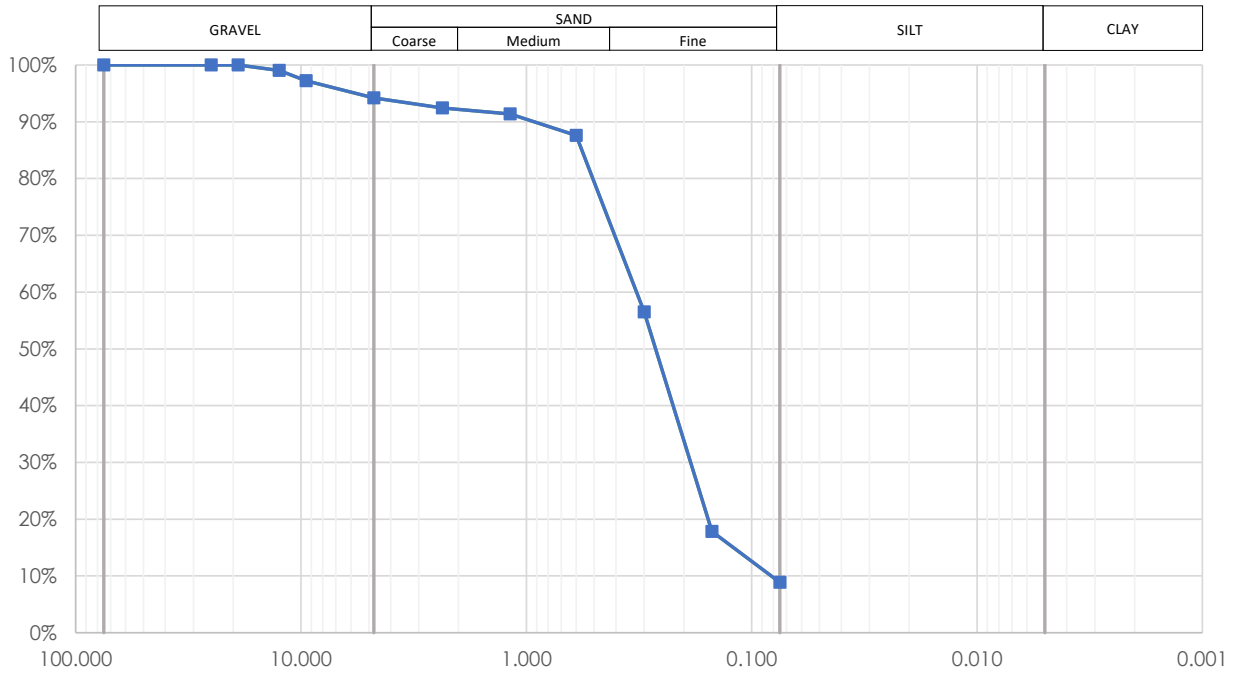
Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits			USCS
											Liquid Limit	Plastic Limit	Plasticity Index	
31		SAND - very compact to extremely compact light brown fine to medium with seams of silt	▲	SPT-H	100	11-21-33	54							SP
32														
33														
34														
35				▼	SPT-I	75	15-38-5...	50/6						
36			▲				"							
37														
38														
39														
40		SAND - extremely compact light brown fine to medium with lenses of clay	▼	SPT-J	100	23-38-49	87							SP
41														
42														
43														
44				▼	SPT-K	85	22-38-5...	50/5						
45			▲				"							
46														
47														
48														
49			✕	SPT-L	87	50/0.46'	50/6							SP
50							"							
51														
52														
53														
54														
55														
56														
57														
58														
59														
60														



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-01 Sample ID A Depth (ft) 2.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	5.8%	2.1%	22.7%	60.6%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.5749	0.3338	0.2748	0.1972	0.1263	0.0845	8.9%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	99%
3/8 in.	97%
No. 4	94%
No. 8	92%
No. 16	91%
No. 30	88%
No. 50	56%
No. 100	18%
No. 200	8.9%

Hydrometer	
Particle Size (mm)	% Passing

Material Description

SAND - dark brown fine to medium with silt and a trace of gravel (SP-SM)

Remarks

Technician
rroda

Checked
rroda

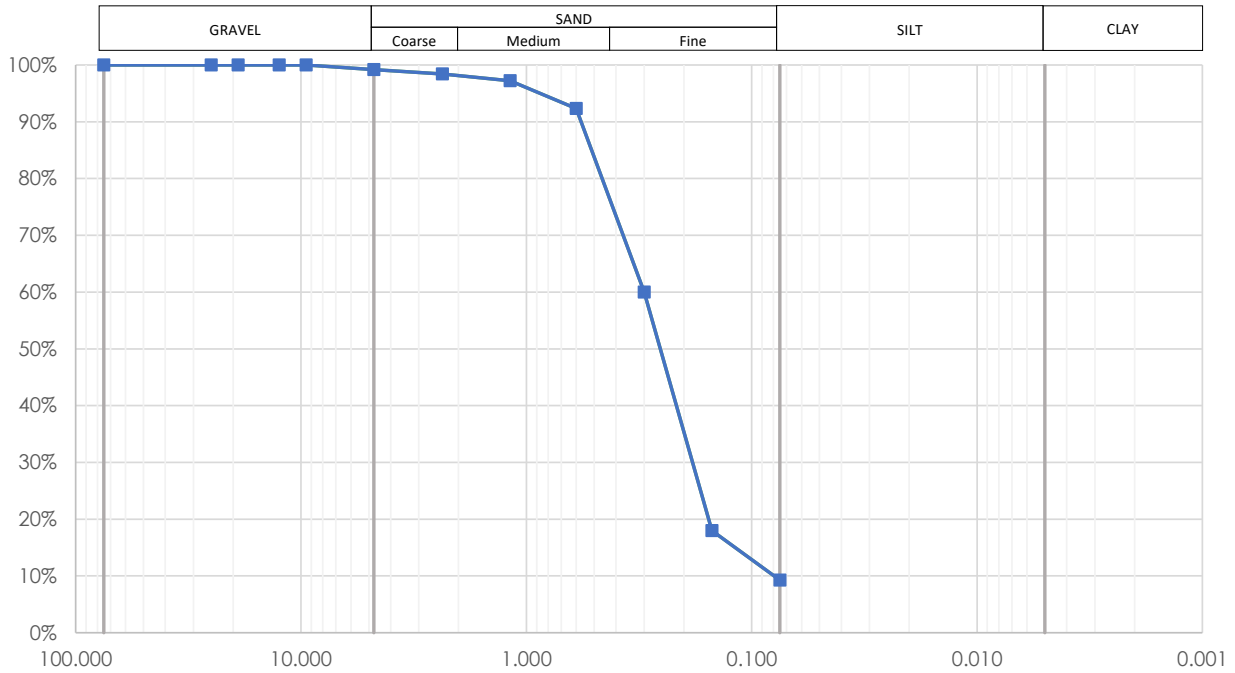
Approved
rroda



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-03 Sample ID B Depth (ft) 4.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.8%	1.2%	24.6%	64.2%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.5321	0.3002	0.2643	0.1929	0.1243	0.0813	9.3%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	99%
No. 8	98%
No. 16	97%
No. 30	92%
No. 50	60%
No. 100	18%
No. 200	9.3%

Hydrometer	
Particle Size (mm)	% Passing

Material Description

SAND - dark brown to black fine to medium with silt (SP-SM)

Remarks

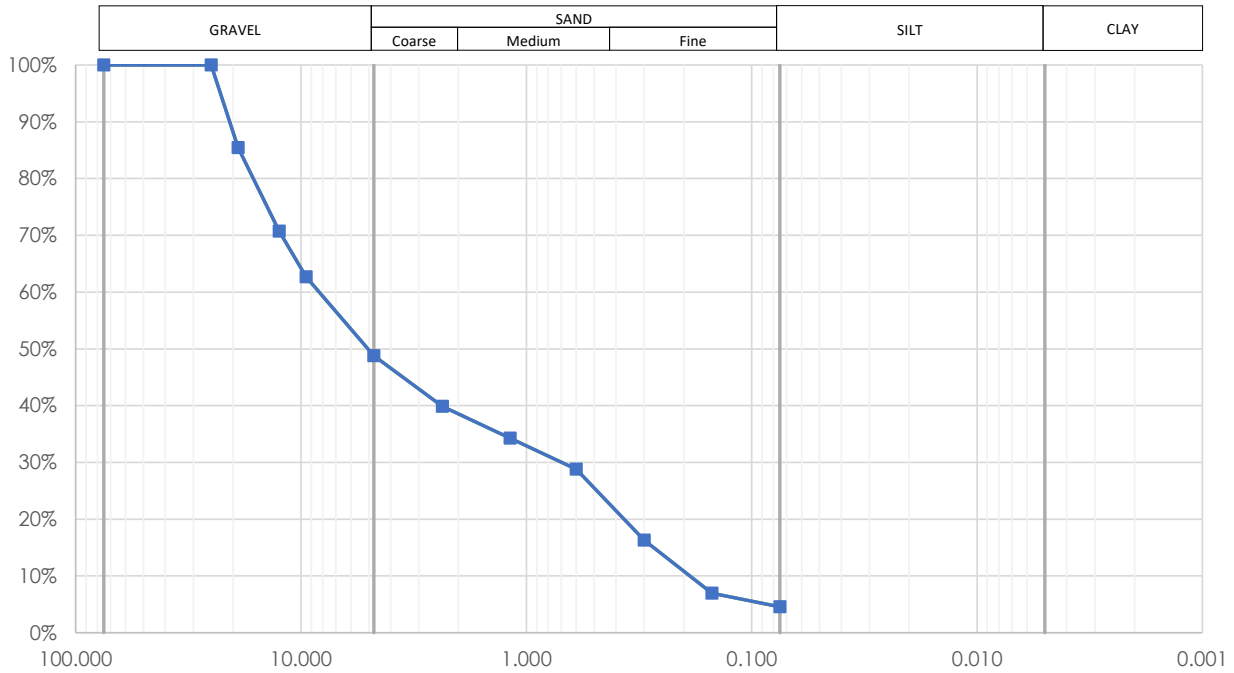
Technician
rroda

Checked
rroda

Approved
rroda



Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-03 Sample ID D Depth (ft) 9.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	14.6%	36.6%	10.6%	16.6%	16.9%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
18.8131	8.5856	5.1675	0.7274	0.2791	0.1987	4.6%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	85%
1/2 in.	71%
3/8 in.	63%
No. 4	49%
No. 8	40%
No. 16	34%
No. 30	29%
No. 50	16%
No. 100	7%
No. 200	4.6%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
GRAVEL - light brown fine to coarse sandy (GP)

Remarks

Technician
rroda

Checked
rroda

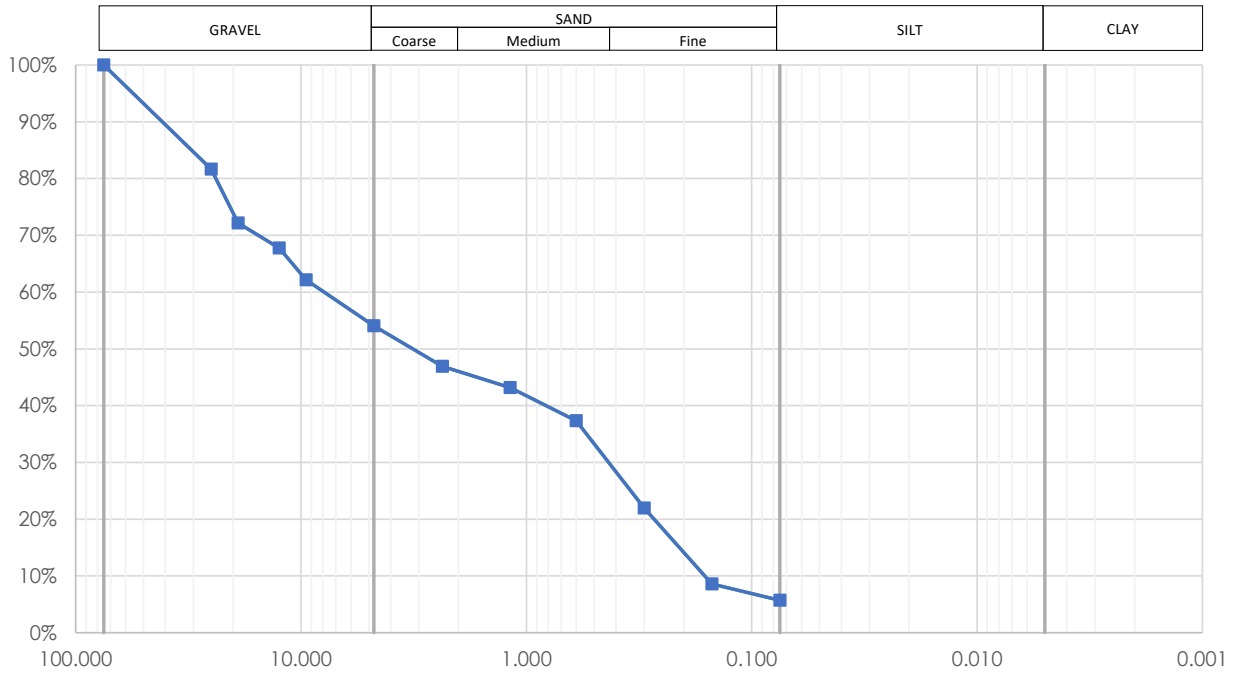
Approved
rroda



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-02 Sample ID D Depth (ft) 9.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	27.8%	18.1%	8.3%	17.4%	22.7%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
34.0861	8.2396	3.3935	0.4567	0.2220	0.1660	5.7%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	82%
3/4 in.	72%
1/2 in.	68%
3/8 in.	62%
No. 4	54%
No. 8	47%
No. 16	43%
No. 30	37%
No. 50	22%
No. 100	9%
No. 200	5.7%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
SAND - light brown fine to coarse gravelly with a trace of silt (SP)

Remarks

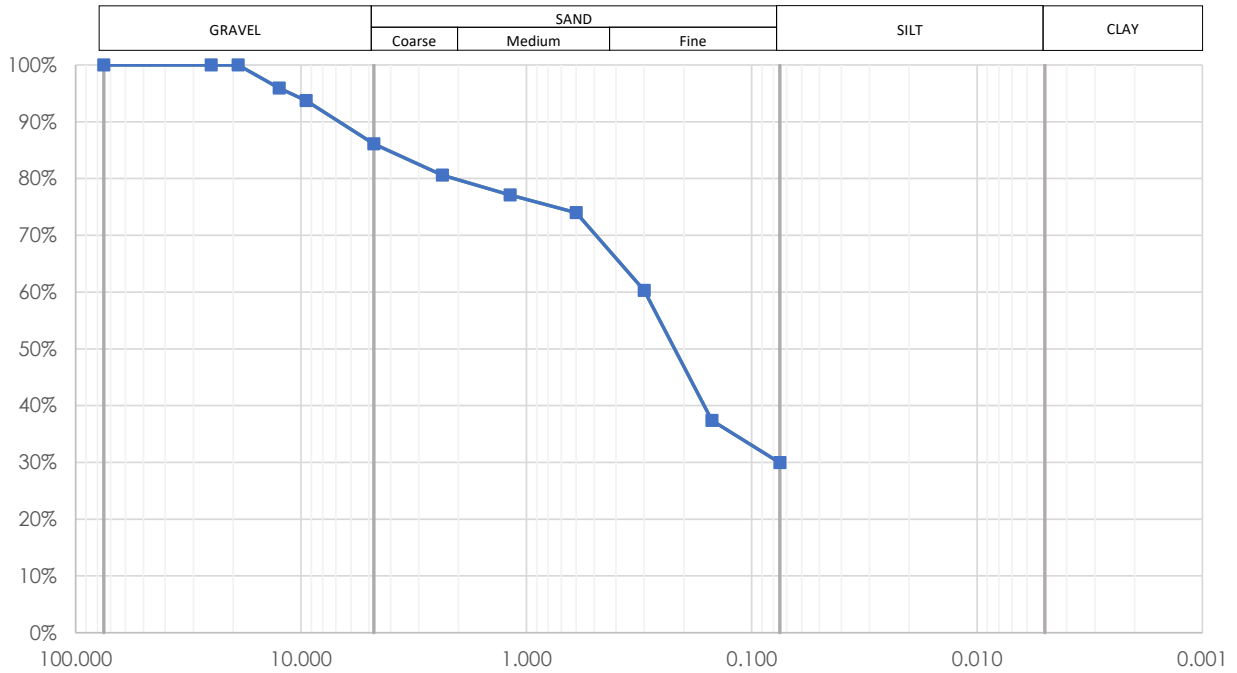
Technician
rroda

Checked
rroda

Approved
rroda



Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-01 Sample ID D Depth (ft) 9.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	13.9%	6.6%	13.5%	36.1%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
4.2813	0.2981	0.2327	0.0757	0.0376	0.0251	29.9%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	96%
3/8 in.	94%
No. 4	86%
No. 8	81%
No. 16	77%
No. 30	74%
No. 50	60%
No. 100	37%
No. 200	29.9%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
SAND - light brown fine to coarse clayey and gravelly (SC)

Remarks

Technician
rroda

Checked
rroda

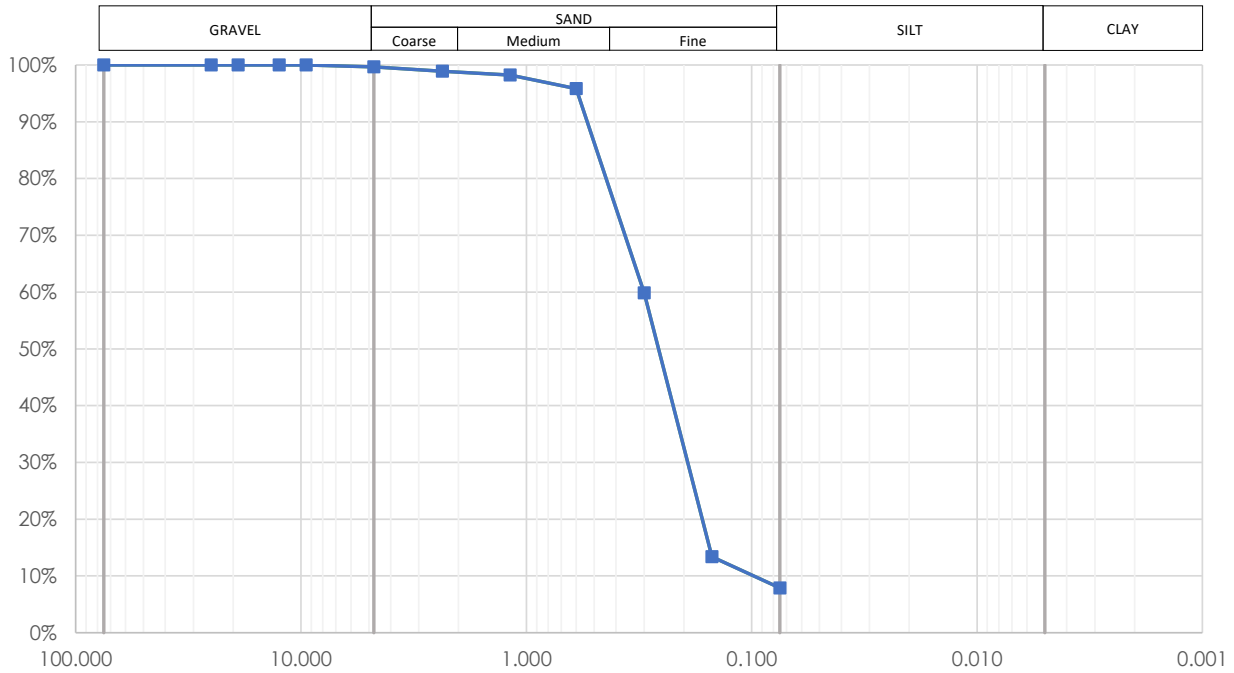
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rroda



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-04 Sample ID F Depth (ft) 19.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.3%	1.0%	23.9%	66.9%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.5097	0.3014	0.2683	0.2037	0.1553	0.1039	7.9%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	100%
No. 8	99%
No. 16	98%
No. 30	96%
No. 50	60%
No. 100	13%
No. 200	7.9%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
SAND - light brown fine to medium with silt (SP-SM)

Remarks

Technician
rroda

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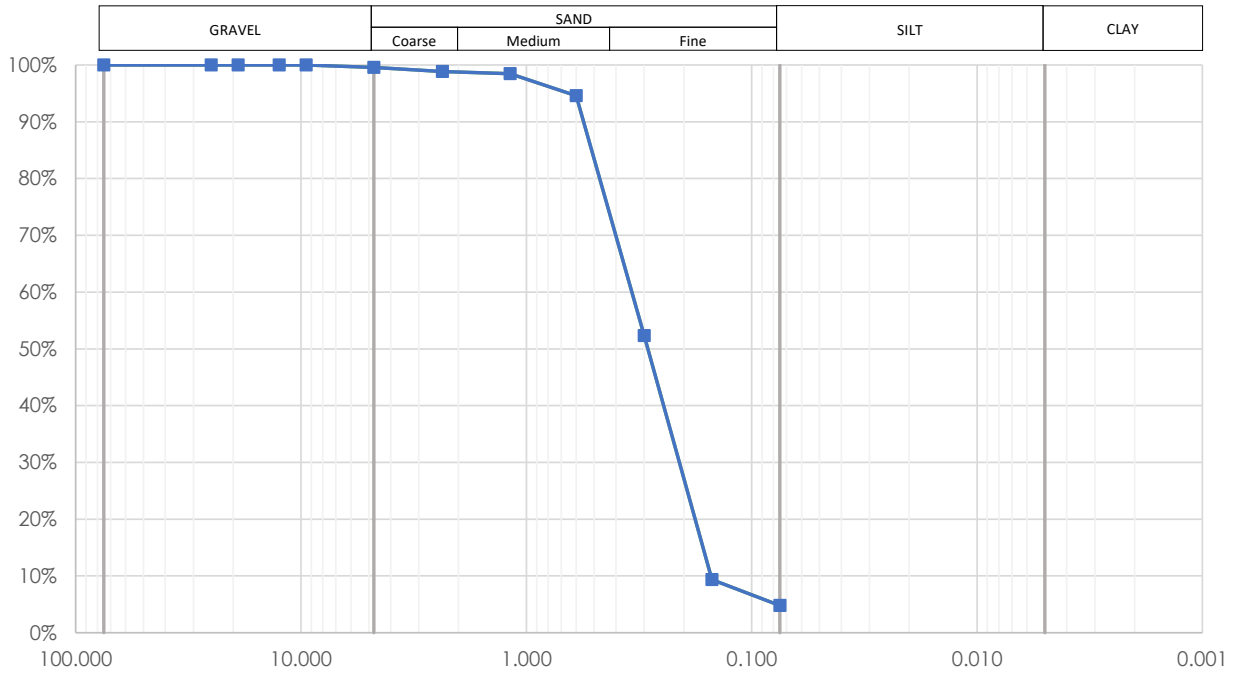
Approved
rroda



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-01 Sample ID I Depth (ft) 34.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.4%	0.8%	28.8%	65.1%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.5321	0.3545	0.2919	0.2220	0.1697	0.1522	4.8%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	100%
No. 8	99%
No. 16	98%
No. 30	95%
No. 50	52%
No. 100	9%
No. 200	4.8%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
SAND - light brown fine to medium (SP)

Remarks

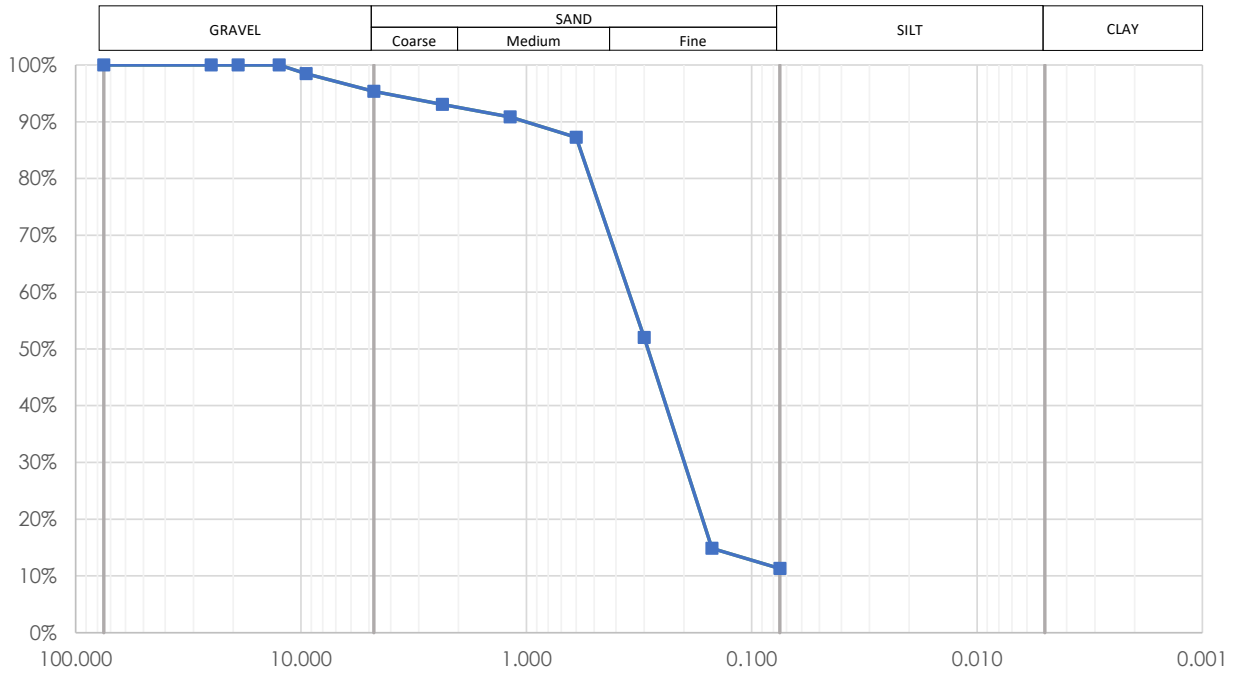
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Project Name Underhill Road over Rapid River
 Project Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023
 Sample Location TB-03 Sample ID I Depth (ft) 34.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	4.6%	3.0%	25.7%	55.4%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.5807	0.3681	0.2920	0.2112	0.1506	0.0664	11.3%	

Particle Size	
Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	98%
No. 4	95%
No. 8	93%
No. 16	91%
No. 30	87%
No. 50	52%
No. 100	15%
No. 200	11.3%

Hydrometer	
Particle Size (mm)	% Passing

Material Description
SAND - light brown to brown fine to medium with silt (SP-SM)

Remarks

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Organic Content

ASTM D2974

Project Name Underhill Road over Rapid River
 Job Number 2023.1755
 Client Huron Engineering & Surveying, Inc.
 Date 12/4/2023

Sample Location		TB-01	TB-03	
Sample ID		B	C	
Depth	ft	4.5	7.0	
Sample Type		SPT	SPT	

Material Description		PEAT - black sandy with wood	SAND - light brown to white fine to coarse with precipitated lime and seams of peat	
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Container Weight	g	178.3	177.5	
Weight of Wet Soil & Container	g	496.1	498.9	
Weight of Dry Soil & Container	g	449.8	411.3	
Weight of Burnt Soil & Container	g	425.8	409.3	
Weight of Wet Soil	g	317.8	321.4	
Weight of Dry Soil	g	271.5	233.8	
Weight of Burnt Soil	g	247.5	231.8	
Percent Moisture		17.1%	37.5%	
Organic Content		8.8%	0.9%	

Remarks				
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Sample Location				
Sample ID				
Depth	ft			
Sample Type				

Material Description				
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Container Weight	g			
Weight of Wet Soil & Container	g			
Weight of Dry Soil & Container	g			
Weight of Burnt Soil & Container	g			
Weight of Wet Soil	g			
Weight of Dry Soil	g			
Weight of Burnt Soil	g			
Percent Moisture				
Organic Content				

Remarks				
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General Information for Method of Field Investigation

The soil investigation was performed in accordance with the American Society of Testing and Materials method ASTM D 1586, which is the "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". Samples of compressible clays or organic soils are obtained in accordance with ASTM D 1587, which is the "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes." Rock may be cored in conjunction with the above methods as specified in ASTM D 2113 which is the "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."

Field Testing

Standard Penetration Tests (SPT) in accordance with ASTM D 1586 were generally performed at depths of 2.0', 4.5', 7.0', 9.5' and 5.0' intervals thereafter.

Laboratory Testing

Samples obtained from the Standard Penetration Test, ASTM D 1586 or thin walled tube method, ASTM D 1587, were tested in the laboratory for the moisture content and density and/or particle size, where applicable. When soils sampled possessed sufficient cohesive properties, it was tested for its compressive strength in the unconfined state.

Natural Percent Moisture content (N.P.M.) of the soil is the percentage by weight of water contained in the soil sample compared to the dry weight of the solids of which the soil is composed. The NPM of select samples is determined in accordance with ASTM D 2216.

Natural Density (N.D.) of soil as reported on the appended boring logs is the natural wet density of the soils expressed in pounds per cubic foot.

The unconfined compressive strength of cohesive soils is determined in the laboratory on "undisturbed" select samples in accordance with ASTM D 2166. This test determines the maximum load required at a specified rate to deform the cohesive soil specimen length twenty (20%) percent. The primary purpose of the unconfined compression test is to obtain approximate quantitative values of the compressive strength of soils possessing sufficient coherence to permit testing in the unconfined state. The shear strength of the cohesive soil can be calculated from the results of the unconfined compressive strength test.

Color

When the color of the soils is uniform throughout, the color recorded will be such as brown, gray, and black and may be modified by adjectives such as light and dark. If the soils predominant color is shaded by secondary color, the secondary color precedes the primary color, such as gray-brown, or yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled; such as mottled brown and gray.

Water Observations

Depth of water recorded in the test boring is measured from the ground surface to the water surface. Initial depth indicates water level during boring, completing depth indicates water level immediately after boring, and depth after "X" number of hours indicates water level after allowing the groundwater rise or fall over a period of time. Water observations in pervious soils are considered reliable groundwater levels for accurate groundwater measurements at the time the test borings were performed unless records are made over several days' time. Factors such as weather, soils porosity, etc., will cause the groundwater level to fluctuate for both pervious and impervious soils.

Sample Type

If not otherwise indicated, the sample is a split-barrel liner sample ASTM D 1586.

"S.T." – Shelby tube sample, ASTM D 1587
"A" – disturbed augered sample
"C" – rock core sampled ASTM D 2113
N.P.M. – Natural Percent Moisture of in-situ soils sample
N.D. – Natural Density of in-situ soils sample in pcf.
S.S. – Shear Strength of cohesive soils samples as determined by the Unconfined Compression tests in ksf.

Classification Data – Laboratory data to assist in classification of soils and classification of soils characteristics; i.e., plastic limit or liquid limit

Test Boring Logs

Particle Size	Visual
Boulders	Larger than 12" (300 mm)
Cobbles	12" to 3" (300 to 75 mm)
Gravel - Coarse	3" to ¾" (75 to 19 mm)
Gravel - Fine	19.0 to 4.75 mm
Sand- Coarse	4.75 to 2.0 mm
Sand - Medium	2.0 to 0.425 mm
Sand - Fine	0.425 to 0.075 mm
Silt	0.075 to 0.002 mm
Clay	0.002 mm and smaller

Soils Components

Major Component	Minor Component
Gravel	Trace (1 - 10%)
Sand	Some (11 - 35%)
Silt/Clay	And (36 - 50%)

Condition of Soil Relative to Compactness

Granular Material	"N" Value
Loose	0 - 4
Slightly Compact	5 - 7
Compact	8 - 20
Very Compact	21 - 50
Extremely Compact	51 and above

Cohesive Material	"N" Value
Soft	0 - 4
Firm	5 - 7
Stiff	8 - 20
Very Stiff	21 - 50
Extremely Stiff	51 and above

"N" values in clay soils are not to be used as a measure of shear strength. However, they may be used as a general indication of strength.

Unified Soil Classification System Chart

Major Divisions			Letter Symbol	Typical Descriptions
Coarse Grained Soils	Gravel – Gravelly Soils	Clean gravels (little or no fines)	GW	Well-Graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
	more than 50% of coarse fraction retained on No. 4 sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-Graded sands, gravelly sands, little or no fines
			SP	Poorly-Graded sands, gravelly sands, little or no fines
		Sand with Fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils	Silts and Clays Liquid limit less than 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
		CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		OL	Organic silts and organic silty clays or low plasticity	
	Silts and Clays Liquid limit greater than 50	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils	
		CH	Inorganic clays of high plasticity, fat clays	
		OH	Organic clays or medium to high plasticity, organic silts	
	Highly organic soils	PT	Peat, humus, swamp soils with high organic contents	

For Laboratory Classification of Fine Grained Soil
Plasticity Chart

