TULLOCH
ENGINEERING

GEOTECHNICAL REPORT

Nation Rise Wind Farm Project

Wind Turbine Generator Foundations

March 2019

TULLOCH Report No. 184022-20-2050-001

LICENSED PROFESSIONAL ENGINEER
S. D. HINCHBERGER
29-Mar-2019
PROVINCE OF ONTARIO

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March 29, 2019
18-4022

EDP Renewables North American LLC
808 Travis Street, Suite 700
Houston, Texas
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Attention: Ryan McDonner, Civil Engineering Manager

Re: Geotechnical Report for the Nation Rise Wind Farm Project

Dear Mr. McDonner:

Please find enclosed our Draft Geotechnical Report for the proposed 99.76 MW Nation Rise Wind Farm Project located in the Township of North Stormont, United Counties of Stormont, Dundas, and Glengarry, Ontario, Canada.

This report outlines the results of the geotechnical investigations, which were completed on the site and it provides geotechnical recommendations for the proposed wind turbine foundation design and construction.

We trust the enclosed is adequate for your needs at this time. If there is anything further where we can assist, please contact us at your convenience.

Sincerely,
Tulloch Engineering Inc.

Sean Hinchberger, Ph.D., P.Eng.
General Manager, Geotechnical Specialist

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1 INTRODUCTION

The Nation Rise Wind Project is located 40 km southeast of Ottawa, Ontario, in the Municipality of North Stormont. The project comprises twenty-nine Enercon E138 (3.44 MW) wind turbines with an installed capacity of up to 99.76 MW and associated infrastructure including a 230 kV/34.5 kV Substation, a Hydro One Network Inc. (HONI) interconnection structure, an expansion to an existing O&M building, one MET Tower, collector and transmission lines, and private and public access roads. The project is currently in the detailed engineering design phase.

TULLOCH Engineering Inc. (TULLOCH) was retained by EDP Renewables (the Client) to complete geotechnical site investigations for the proposed wind turbine generator (WTG) sites. The purpose of this geotechnical program was to evaluate the subsurface conditions at the WTG sites and to provide engineering recommendations for site earthworks, access road and foundation design.

Appendix A shows the site location and borehole plan. A list of abbreviations, terminology and principal symbols used throughout this report are included in Appendix B. The following report sections describe the site geology, the investigation methodology, results and engineering recommendations for the project.

2 SITE DESCRIPTION AND GEOLOGY

Based on the Surficial Geology of Southern Ontario Maps as published by the Ontario Geological Survey (i.e., OGS Map 2140A), the site surficial geology varies from exposed bedrock, to glacial till and fine-textured glaciomarine deposits. The bedrock consists of limestone, dolomite, shale, arkose and sandstone of the Ottawa Group (OGS 2011). The bedrock is exposed (i.e., outcropping) mainly along the western boundaries of the project in an area roughly bounded by Crysler, Cannamore and Connaught, ON. Bedrock is also locally exposed east of the South Nation River near Payne Crossing and along Berwick Rd. The glaciomarine deposits primarily consist of silt and clay, with minor sand and gravel; These sediments are massive to well laminated in structure and are found mainly along the South Nation River (OGS 2010) and its tributaries. The glacial till consists of poorly sorted clay, silt, sand and gravel with occasional cobbles and boulders. TULLOCH did not observe any evidence of joint widening of the rocks by dissolution or sinkholes. The shale and dolomitic bedrock found at the project site is generally less susceptible to dissolution in comparison to pure limestone. The high Rock Quality Designation (RQD) values and high-water table indicate insignificant karst features in the bedrock.

3 SITE INVESTIGATIONS AND METHODOLOGY

3.1 Drilling Investigations - WTGs

Geotechnical investigations were completed by TULLOCH for the Wind Turbine Generators (WTGs) between April 27th and June 4th, 2018. The field work consisted of advancing thirty-three (33) boreholes referenced as Boreholes WTG-01 to WTG-58 through the overburden to borehole termination at least 3 m into bedrock. It is noted that the turbine numbers are discontinuous. Prior to commencing the drilling operations, TULLOCH completed utility locates for the boreholes through Ontario One Call. Additionally, to ensure safe operations, TULLOCH staff and subconsultants reviewed a project Health and Safety Plan and held daily tailgate health and safety meetings at the beginning of each day prior to commencing the field work. The applicable landowners were notified of the drilling activities at least 24 hrs prior to accessing the WTG boring locations.

The boreholes were advanced through the overburden and into bedrock using either a CME55 or a CME850 track-mounted drill rig owned and operated by Marathon Drilling Co. Ltd.. Both drill rigs were equipped with 200 mm diameter continuous flight hollow stem augers, standard soil sampling equipment and N-size casing and double tube core barrels (NQ2). Water was supplied for rock coring and intermittent wash boring using two track mounted water totes. Soil samples were obtained at regular intervals with a 51 mm outside diameter split spoon barrel in conjunction with Standard Penetration Tests (SPT) conducted according to ASTM D1586. The sampling was generally conducted at 0.6 m intervals in the upper 3.7 m of the overburden, and at 1.52 m intervals below that, using an automatic safety hammer. Field vane tests (ASTM D2573) were also conducted in all boreholes using a standard NX vane to measure the undrained shear strength of the cohesive soils. Thin-walled Shelby tube samples were also retrieved in accordance with ATSM D1587 to perform oedometer consolidation tests on undisturbed samples of the cohesive soils. All boreholes were advanced at least 3 m into the bedrock; rock cores were retrieved with a NQ2 core barrel.

Standpipe piezometers were installed in all boreholes drilled at the WTG locations to measure the groundwater levels and to conduct falling head permeability tests. Typically, standpipe piezometers were installed in the soil strata at 7.62 m below ground surface (mbgs); occasional piezometers were installed within the bedrock. The typical piezometer installation involved the following:

- Boreholes were backfilled to 7.62 mbgs with bentonite pellets.

- A 38.1 mm (1.5-inch) or 51 mm (2.0-inch) diameter PVC standpipe with a 3.05 m (10 ft) long screen was placed in the borehole; the annular space between the standpipe and borehole was backfilled with silica sand to 0.31 m above the top of the standpipe screen,
- Then bentonite pellets were placed in the borehole to seal around the standpipe from the top of the sand pack to the surface.

After completing the piezometer installations, a lockable steel casing was installed over the above ground portion (stick-up) of the piezometer riser at WTG-12, -16, -18, -20, -21 and -23. At the remaining WTG locations, a 4-inch PVC casing with lockable J-plug was installed over the stick-up. All piezometer stick-ups were secured with padlocks and they were flagged with 2.44 m – 3.05 m poles with high visibility flagging. Piezometer information for each of the WTG locations can be found on the individual borehole logs located in Appendix C.

The drilling, soil sampling, and piezometer installation were completed under the full-time supervision of a TULLOCH representative, who logged the drilling operations, identified the soil samples as they were retrieved, logged the bedrock core and supervised the piezometer installation. Initial groundwater measurements were recorded 24 hours after installation and additional water level readings were taken after the installations as noted in Section 4 of this report. The recovered soil samples were sealed in plastic bags and the bedrock cores were placed in core boxes and both were transported to TULLOCH's CCIL[1] Certified Laboratory in Sault Ste Marie, ON, for detailed examination and testing. All samples will be stored in our laboratory for six (6) months and then disposed of unless directed otherwise. The results of the drilling campaign are summarized on the borehole logs in Appendix C.

3.2 Drilling Investigations – Private Access Roads and Laydown Yard

In addition to the WTG boreholes, seventeen boreholes were drilled at the Nation Rise site to provide subsurface information for access road design. These boreholes, labeled BH PSR-1 to BH PSR-17, were advanced using hollow stem augers and a CME 55 drill rig to depths ranging from 0.58 m to 4.27 m. Continuous split spoon samples were retrieved in conjunction with Standard Penetration Tests (ASTM D1586) while advancing the boreholes.

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[1] Canadian Council of Independent Laboratories

Most of these boreholes were drilled to a depth of 3.66 m except where auger refusal was encountered before reaching the planned depth.

Lastly, two (2) boreholes were drilled at the laydown yard site. These boreholes, labelled BH LD-1 and BH LD-2, were also drilled using a hollow stem auger and a CME-55 drill rig to auger refusal at 2.44 m and 3.2 m depth. Similarly, continuous split spoon samples were retrieved in conjunction with Standard Penetration Tests (ASTM D1586)

Detailed borehole logs are included in Appendix C.

3.3 Laboratory Tests

Table 3-1 summarizes the soil and rock laboratory tests conducted for this geotechnical investigation program and the corresponding ASTM standards. Select samples were also sent to ALS Laboratories for corrosivity testing. Detailed laboratory test reports are attached in Appendix D.

Table 3-1: Summary of Soil/Rock Laboratory Testing Program

Item No.	Test	Number of Tests	ASTM Standard
1	Sieve Analysis	8	ASTM D422
2	Hydrometer Analysis	3	ASTM D7928
3	Atterberg Limits	19	ASTM D4318
4	Moisture Content	161	ASTM D2216
5	Oedometer Consolidation	4	ASTM D2435
6	Unconfined Compressive Strength on Rock	6	ASTM D2166

3.4 Borehole Falling Head Tests

Falling head hydraulic conductivity tests (i.e., slug tests) were conducted between July 5-7, 2018 on the piezometers installed in the WTG boreholes. The falling head tests provide an estimate of the hydraulic conductivity of the soil or bedrock layer(s) intercepted by the piezometer screen. The hydraulic conductivity estimated from the falling head tests were used for permitting purposes and to evaluate the dewatering requirements during the construction phase. These tests were completed in accordance with ASTM D4044-15; the following bullets summarize the methodology:

- In each piezometer, the water level depth and piezometer depth were measured using a Solinst Model 101B flat tape water level meter.

- A Solinst Model 3001 LTC Levellogger Edge transducer was inserted in the piezometer situated 60 cm from the piezometer tip. The Levellogger was set to record water depth at 0.5 sec intervals.
- For the 38 mm outside diameter (O.D.) piezometers, 3 L of water was poured into the piezometer to introduce a near instantaneous rise in the water level; 6 L was poured into the 51 mm O.D. piezometers.
- The water level in the piezometer was simultaneously monitored using the Levellogger and flat tape water level meter until the change in the piezometer water level reduced to 30% of the original slug value.
- The data was reviewed for consistency, saved in a separate file denoted by the borehole # and subsequently interpreted using Hvorslev's method.

Slug tests were conducted in the piezometers installed in bedrock at boreholes WTG-01, -04, -06, -07, -41, and -48) and in glacial till at boreholes WTG-05, -16, -28, -43, -44, -46. The results of the falling head tests are presented in Section 4 and the test data is included in Appendix E.

3.5 MASW Soundings

A series of seven MASW (Multi-channel Analysis of Surface Waves) soundings were done between July 4th - 6th at WTG-02, -05, -12, -16, -21, -44, and -57. The MASW data is discussed further in Section 4.7 of this report. Appendix F contains a report describing the geophysical methods and equipment used to conduct these soundings and the results.

3.6 Plate Load Tests

Lastly, TULLOCH completed plate load testing at the Nation Rise site for road design and to supplement the data collected during the drilling program. These tests were done in general accordance with ASTM D1195M-09. A 301 mm diameter steel plate was loaded to 11 kN in increments of 2.2 kN and the settlement corresponding to each load increment was measured using three dial gauges. The data provided a measurement of the modulus of subgrade reaction of the subgrade soils, which was used to estimate the resilient modulus.

4 SUBSURFACE CONDITIONS

4.1 General

Detailed subsurface profiles are summarized in the borehole logs attached in Appendix C. It is noted that the soil boundaries indicated on the borehole logs are inferred from discontinuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones to support geotechnical design and they should not be interpreted as exact planes of geological change. Third parties relying on the data presented in the logs should account for the approximate nature of these boundaries during design. All soils have been classified using the Unified Soil Classification System (ASTM D2487). Based on the geotechnical data collected, three geologic domains were encountered at the Nation Rise site as summarized below.

Domain 1: In this domain, the subsurface conditions consist of approximately 50 cm of topsoil overlying 0.5 m to 3 m of either Sandy Clayey Silt Till or soft intermediate plasticity Silty Clay (CI) overlying shaly limestone bedrock. Approximately 30% of the WTGs are in this domain including WTG-02 -04, -06, -12, -25, -27, -32, -41, -48 and -56.

Domain 2: The subsurface conditions in Domain 2 consist of approximately 50 cm of top soil overlying an average of 8 m of compact to dense Silt Till (ML) or Gravelly Sand Till (SG) overlying shaly limestone bedrock. Approximately 36% of the WTGs are situated in this domain, including WTG-05, -07, -10, -11, -16, -28, -29, -35, -43, -46, -52, -57 and -58.

Domain 3: The third domain comprises approximately 50 cm of top soil overlying an average of 12 m of soft to firm intermediate plasticity Silty Clay overlying either glacial till over bedrock or directly overlying shaly limestone bedrock. Approximately 34% of the WTGs are situated in this domain including WTG-01, -09, -18, -20, -21, -23, -38, -44, -47 and -54.

The geologic domains are described in detail in the following sections.

4.2 Domain 1 – Shallow Bedrock

Table 4-1 summarizes the stratigraphy in Domain 1. In this domain, the depth to bedrock varies from 0.76 m at BH-WTG-04 to 4.95 m at BH-WTG-41. The overburden soils overlying bedrock comprise a thin veneer of intermediate plasticity Silty Clay and Silt Till with some sand and gravel and occasional cobbles. In BH-WTG-56, the overburden comprises a Gravelly Sand Till. Based on the SPT ‘N’ values, which varied from 0 to 12 blows/30 cm, the Silty Clay varies from very soft to stiff whereas the Till materials are loose to very dense with 'N' values between 6 and 63 blows/30 cm. The groundwater levels in this domain are listed in Table 4-2. Summarizing, based on the 1st round of readings (July 5, 2018), the groundwater level varies from 0.79 mbgs at WTG-41 to 2.62 mbgs at WTG-04. During the 2nd round readings (Sept. 7, 2018), the depth to the groundwater varied from 1.6 mbgs at WTG-12 to 2.8 mbgs at WTG-6 and WTG-56.

The bedrock is generally of fair to good rock mass quality. Detailed rock properties are discussed in Section 4.5.

Table 4-1: Summary of Soil and Rock Parameters in Domain 1

Borehole	Elevation (m)	Bedrock			Overburden Soil			
		Depth (mbgs)[1]	RQD	Rock Mass Quality	Type[2]	'N' Values	W_N (%)	Consistency
WTG-02	70.1	2.13	53-95	Fair –Excellent	CI over Till (ML)	5-18	22-29	Firm – V. Stiff
WTG-04	81.9	0.76	52-73	Fair	CI over Till (ML)	7	–	Firm
WTG-06	77.2	1.88	55-93	Fair – Excellent	CI over Till (ML)	8-82	–	Firm – Hard
WTG-12	70.8	3.81	28-78	Poor – Good	CI	0-7	–	Soft – Firm
WTG-25	70.9	2.13	23-94	Poor – Excellent	Till (ML)	10-14	–	Stiff
WTG-27	79.3	1.22	68-83	Fair – Good	Till (ML)	18-41	–	V. Stiff – Hard
WTG-32	73.1	4.11	76-90	Good	CI over Till (ML)	6-20	–	Firm – V. Stiff
WTG-41	73.9	4.95	76-87	Good	CI	3-6	–	Soft – Firm
WTG-48	82.3	1.0	38-50	Poor – Fair	CI	9-12	–	Firm – Stiff
WTG-56	87.3	2.94	29-73	Poor – Good	Till (SG)	6-63	–	Compact – V. Dense

Note: [1]mbgs refers to meter below ground surface, [2]CI - Intermediate Plasticity Clay; Till (CI) – Clayey Till; Till (SG) – Granular Till, RQD refers to Rock Quality Designation

Table 4-2: Groundwater Levels in Domain 1

Borehole	Elevation (m)	Initial (mbgs) [1]	Round 1 [2] (mbgs)	Round 2 [3] (mbgs)
WTG-02	70.1	1.24	1.95	2.6
WTG-04	81.9	2.09	2.62	2.5
WTG-06	77.2	1.70	2.02	2.8
WTG-12	70.8	0.78	0.98	1.6
WTG-25	70.9	1.86	2.28	2.8
WTG-27	79.3	0.49	2.13	2.4
WTG-32	73.1	0.77	1.14	2.2
WTG-41	73.9	0.34	0.79	2.3
WTG-48	82.3	0.72	1.06	2.4
WTG-56	87.3	0.82	1.07	2.8

Note: [1]mbgs refers to meter below ground surface, [2]Round 1 readings were taken July 5, 2018. [3]Round 2 readings were taken Sep 7, 2017.

4.3 Domain 2 – Glacial Till overlying Bedrock

Table 4-3 summarizes the stratigraphy in Domain 2; Tables 4-4 and 4-5 list the results of grain size distribution tests and Atterberg limits tests on the Gravelly Sand Till and Silt Till materials encountered in this domain. The predominant soil in Domain 2 consists of glacial till overlying relatively deep bedrock compared to Domain 1. Figure 4-1 illustrates the generalized soil profile. The strength profile has been selected based on subtracting half a standard deviation from the mean value. Referring to Table 4-3, the depth to bedrock in this domain varies from 5.28 m at BH-WTG-07 to 14.32 m at BH-WTG-29. Two different till materials were encountered within this domain; The first material is a Gravelly Sand Till with occasional cobbles and trace to no fines. The grain size distribution for this material is summarized in Table 4-4 for soil samples retrieved from BH-WTG-16, -28, -29, -43, -57, and -58. The second material is a Silt Till with some sand, trace gravel, occasional cobbles and trace to no clay. One grain size distribution test was done in this material, see BH-WTG-29 in Table 4-4. Based on the Atterberg Limit tests in Table 4-5, this material is a low plasticity silt. The SPT 'N' values in the till materials vary from 5 to 50 blows/30cm indicting the materials are loose to very dense.

Table 4-6 lists the groundwater level measurements taken since the end of the field program. Based on the round 1 readings, the groundwater depth in Domain 2 varies from 0.65 m at BH WTG-58 to 4.38 m at BH WTG-29. During the round 2 readings, the depth varied from 1.6 m at WTG-16 to 4.9 m at WTG-46. The bedrock rock mass quality varies from fair to good as indicated in Table 4-3; Detailed rock properties are discussed in Section 4.5.

Figure 4-1: Typical Subsurface Profile – Domain 2

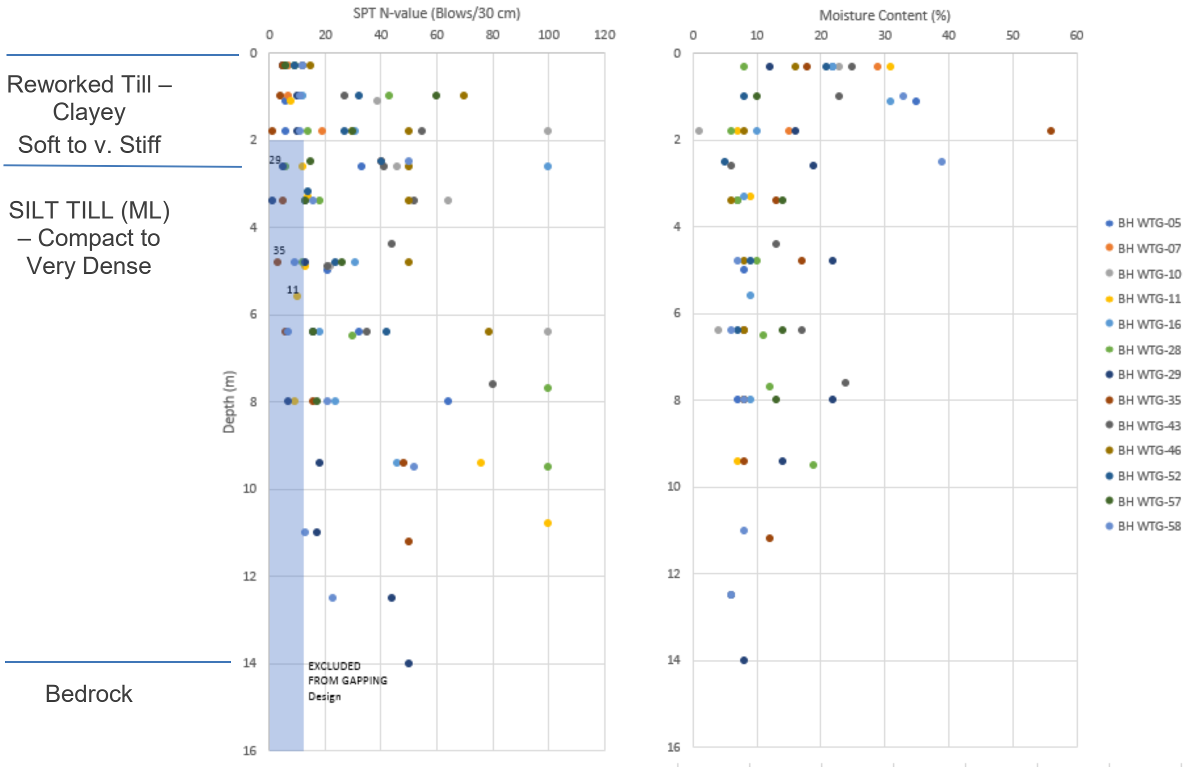


Table 4-3: Summary of Soil and Rock Parameters in Domain 2

Borehole	Elevation (m)	Bedrock			Overburden Soil			
		Depth (mbgs)[1]	RQD	Rock Mass Quality	Type[2]	'N' Values	Moisture Content	Consistency
WTG-05	70.4	8.53	65-99	Fair-Excellent	Till (ML)	6-64	7-35	Loose – Very Dense
WTG-07	72.9	5.28	75-98	Good – Excellent	Till (ML) over Till (SG)	7-40	15 - 29	Loose – Dense
WTG-10	74.8	6.68	83-94	Good – Excellent	Till (ML)	5-50	1 - 23	Loose – Medium Dense
WTG-11	74.0	10.87	76-96	Good-Excellent	Till (ML)	>50	7	Very Dense
WTG-16	69.2	9.83	43-65	Poor – Fair	Till (ML)	6-50	8-9	–

Borehole	Elevation (m)	Bedrock			Overburden Soil			
		Depth (mbgs)1	RQD	Rock Mass Quality	Type2	'N' Values	Moisture Content	Consistency
WTG-28	73.6	11.02	30-93	Poor – Excellent	Till (ML)	5-50	6-10	Loose – Very Dense
WTG-29	74.1	14.32	56-98	Fair – Excellent	Till (ML) over Till (SG)	1-50	6-18	Very Loose – Very Dense
WTG-43	86.8	7.46	19-95	V. Poor - Excellent	Till (ML) over Till (SG)	12-50	19	Medium Dense – Very Dense
WTG-46	86.2	6.55	67-95	Fair – Excellent	Till (ML)	15-50	6-7	Medium Dense – Very Dense
WTG-52	75.8	7.70	51-73	Fair	Till (SG) over Till (ML)	9-42	5 - 21	Loose – Dense
WTG-57	86.1	8.78	57-67	Fair	Till (ML) over Till (SG)	6-50	11-12	Loose – Very Dense
WTG-58	68.7	13.39	96-98	Excellent	Till (ML) over Till (SG)	7-50	6-25	Loose – Very Dense

Note: [1]mbgs refers to meter below ground surface, [2]CI - Intermediate Plasticity Clay; Till (CI) – Clayey Till; Till (SG) – Granular Till

Table 4-4: Grainsize Distribution Results – Gravelly Sand Till (SG)

Borehole	Elevation (m)	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
WGT-16	69.2	SS8	9.14	33	63	4	
WTG-28	73.6	SS9	9.14	9	91	0	
WTG-29	74.1	SS4	2.29	0	6	92	2
WTG-29	74.1	SS11	12.19	51	49	0	
WTG-43	86.8	SS9	7.47	9	81	10	
WTG-57	86.1	SS8	7.62	9	90	1	
WTG-58	68.7	SS11	12.19	49	21	24	6

Table 4-5: Atterberg Limit Results – Silt Till (ML)

Borehole	Elevation (m)	Sample	Depth (m)	Moisture	Liquid Limit	Plastic Limit	Plasticity Index
WTG-09	70.1	SS6	9.14	6.7	10	15	5
WTG-11	74.0	SS9	7.62	8	10	16	6
WTG-16	69.2	SS7	7.62	8	10	16	6
WTG-28	73.6	SS5	3.05	–	–	–	–
WTG-46	86.2	SS7	5.94	7.4	11	16	5

Borehole	Elevation (m)	Sample	Depth (m)	Moisture	Liquid Limit	Plastic Limit	Plasticity Index
WTG-58	68.7	SS3	1.52	5.7	22	42	20
WTG-58	68.7	SS7	6.10	5.7	10	16	6

Table 4-6: Groundwater Levels in Domain 2

Borehole	Elevation (m)	Initial (mbgs)	Round 1 [2] (mbgs)	Round 2 [3] (mbgs)
WTG-05	70.4	0.95	1.40	3.3
WTG-07	72.9	1.16	1.43	2.3
WTG-10	74.8	1.27	1.45	3.2
WTG-11	74.0	0.82	1.64	2.7
WTG-16	69.2	0.50	0.98	1.6
WTG-28	73.6	4.73	NR	2.6
WTG-29	74.1	4.12	4.38	4.5
WTG-43	86.8	0.70	NR[1]	3.0
WTG-46	86.2	1.82	0.96	4.9
WTG-52	75.8	2.42	2.66	2.8
WTG-57	86.1	1.53	NR[1]	3.2
WTG-58	68.7	1.19	0.65	1.9

Notes: [1]No access to borehole location. [2]Round 1 readings were taken July 5, 2018. [3]Round 2 readings were taken Sep 7, 2017.

4.4 Domain 3 – Soft Glaciomarine Clay over Till

Table 4-7 summarizes the stratigraphy in Domain 3 and Table 4-8 lists the results of field vane tests performed in the upper very soft to stiff Silty Clay materials. Figures 4-2 and 4-3 show, respectively, the generalized ground profile and the field vane shear strength profile for Domain 3. Summarizing, subsurface conditions in this domain consists of very soft to stiff intermediate plasticity Silty Clay overlying either Silt Till or Gravelly Sand Till and then bedrock.

Referring to Figure 4-3, the field vane shear strength of the Silty Clay deposit varies from a maximum of between 40 and 60 kPa in the upper 20% of the deposit thickness (i.e. 0 – 0.2D) to between 20 and 40 kPa within a soft to firm zone below the crust between 45% and 60% of the deposit depth, D. The undrained shear strength increases with depth at a rate of between 2.5 and 5 kPa/m below the soft zone. Based on the grain size distribution tests summarized in Table 4-9, the Silty Clay consists of approximately 1% sand, 36% silt and 63% clay; the Gravelly Sand Till consists of 22 to 46% gravel, 49 to 63% Sand and less than 2% silt and clay. Based on RQDs in the bedrock, the rock mass quality generally varies from fair to very good, with occasional zones of poor rock mass quality. As noted above, the mechanical properties of the bedrock are discussed in Section 4.5.

Referring to Table 4-8, based on peak and remoulded field vane shear strengths, the sensitivity of the Silty Clay material varies from 1.8 to 9.0 for WTGs -01, -09, -12, -18, -38, -44, and -54; the average sensitivity is 8.3. At these turbine locations, this material is generally medium sensitive to sensitive, classified per Section 3.1.3.4 of the Canadian Foundation Engineering Manual. At WTGs -21 and -23, however, the sensitivity varies from 7.5 to 27.0; the average sensitivity is 13.1. The data suggests that the Silty Clay material is extra sensitive at turbines located closest to the center of the project site and closest to the South Nation River. The material is less sensitive with distance from the river. At WTG-23, the sensitivity exceeds 25 below an estimated depth of 7.0 m. Based on the Atterberg limits listed in Table 4-10, the liquidity index varies from 1.33 to 1.93, which is consistent with the sensitivity values reported in Table 4-8. The sensitivity is rated based on Section 3.1.3.4 of the Canadian Foundation Engineering Manual (CFEM).

Table 4-11 lists the groundwater level measurements taken since the end of the field program. Based on two rounds of readings, the groundwater levels in Domain 3 vary from 0.11 m above the ground surface at BH-WTG-18 (July 5, 2018) to 2.5 m below the ground surface at BH-WTG-29 (Sept 7, 2018). Based on Table 4-11, slight artesian conditions are present in the bedrock at BH-WTG-18 and -21. The initial water level readings in BHs WTG-18 and -21 were 0.37 m and 0.47 m, respectively, above the ground surface indicating somewhat higher artesian conditions at these locations during the spring compared to the summer and fall. The artesian conditions are in the bedrock only, however. For turbine design, the designer should assume the groundwater table is at the ground surface for the WTGs with artesian pressure in the bedrock.

Lastly, Table 4-12 summarizes the results of 1-dimensional oedometer consolidation tests conducted on the Silty Clay material. These test results indicate that the over-consolidation ratio (OCR) of the Silty Clay varies from 1 to 3 depending on the turbine location, the depth of the sample tested, and the methodology used to interpret the preconsolidation pressure of the material. Generally, the OCR of the material is between 1 and 1.4 at a depth of between 4.8 and 5.1 m in BH-WTG-21 and WTG-44. The OCR values confirm the presence of a normally consolidated (NC) to slightly over-consolidated material within the deposit below the firm to stiff surficial crust. Within the NC zone, the undrained shear strength, s_u, to preconsolidation pressure, p_c', ratio is estimated to be between 0.2 and 0.28, which is within the normal range for the glaciomarine clays in the Ottawa area. The SPT tests gave

’N’ values ranging from 0 to 4 blows/30 cm in the Silty Clay deposit indicating a very soft to soft consistency.

As noted in Appendix D, the hydraulic conductivity of the Silty Clay varies between 1.5×10^{-7} and 6.1×10^{-7} cm/s for the range of *in situ* stress in the ground.

Figure 4-2: Idealized Subsurface Profile – Domain 3

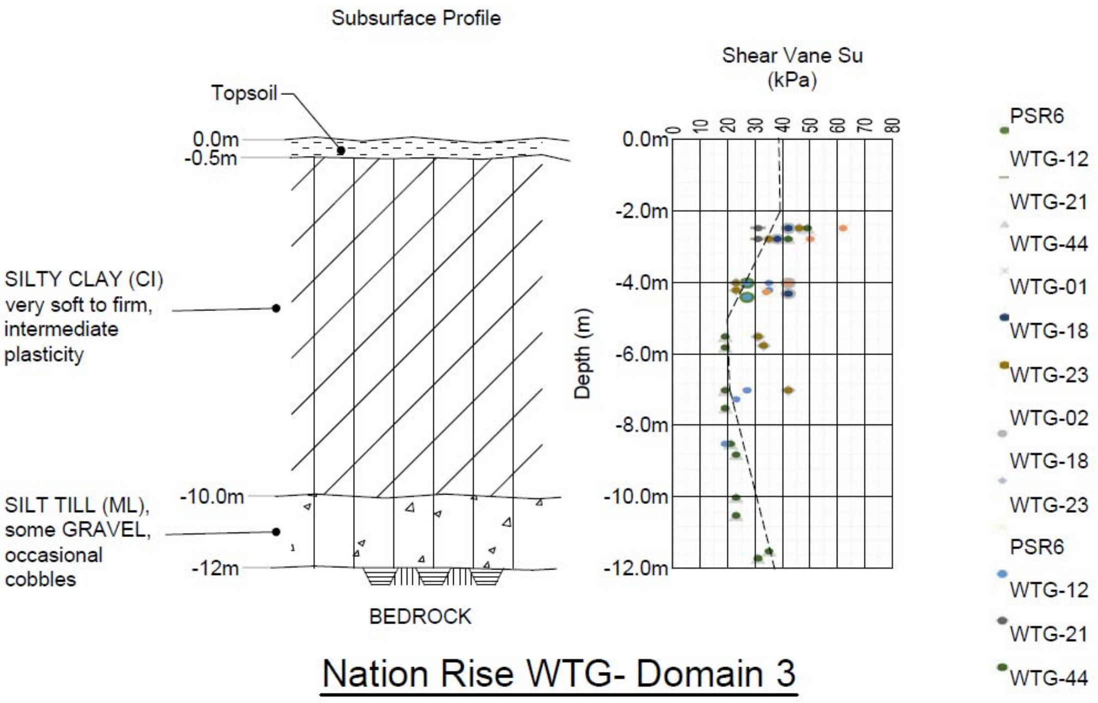


Figure 4-3: Field Vane Shear Strength Profile – Domain 3

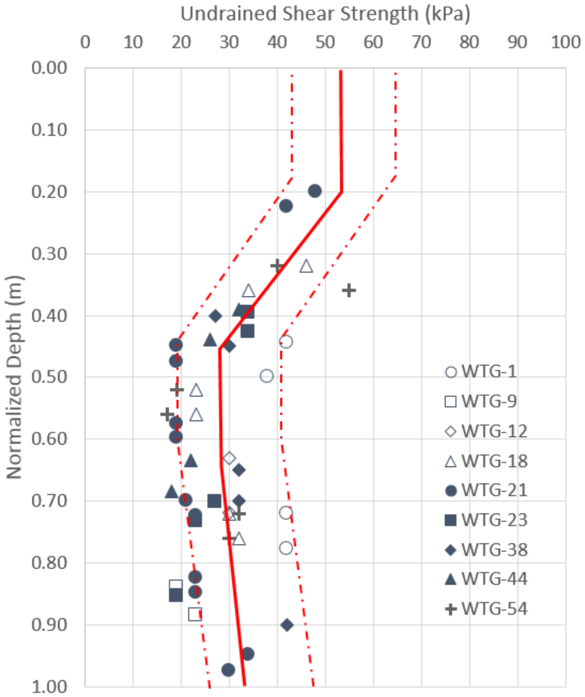


Table 4-7: Summary of Soil and Rock Parameters in Domain 3

Borehole	Elevation (m)	Bedrock			Overburden Soil				
		Depth (mbgs)^1	RQD	Rock Mass Quality	Type^2	Thickness (m)	'N' Values	w_N (%)	Consistency
WGT-01	68.1	5.49	87	Good	CI	5.49	1-8	35-38	Soft to Firm
WTG-09	70.1	7.67	68 - 88	Good	CI	6.55	0-5	39-41	V. Soft to Firm
					Till (ML)	1.12	15	–	Dense
WTG-18	67.3	15.4	45 - 82	Fair – Good	CI	7.62	0-1	–	–
					Till (ML)	7.78	50	8-10	V. Dense
WTG-20	67.6	9.60	26 - 98	Poor – Excellent	CI	6.10	0-4	–	–
WTG-21	67.7	16.0	50 - 85	Fair – Good	CI	19.19	0-8	41	V. Soft to Firm
					Till (ML)	3.81	14-50	–	Dense to V. Dense
WTG-35	73.2	11.48	31 - 86	Poor – Good	CI	3.05	1-5	–	V. Soft to Firm
					Till (CL)	4.57	3-6	–	Soft to Firm
					Till (ML)	3.86	15-50	–	V. Dense
WTG-38	73.0	11.27	73 - 82	Good	CI	7.0	0-4	–	V Soft to Soft
					Till (ML)	4.27	15-50	–	Dense to V. Dense

WTG-44	69.4	6.24	7-100	V. Poor – Excellent	CI	6.24	0-8	–	V. Soft to Firm
WTG-47	75.9	12.80	18 - 80	V. Poor – Good	CI	9.14	0-9	–	V. Soft to Firm
					Till (ML-SG)	3.66	27-50	–	V. Dense
WTG-54	69.6	11.07	35 - 100	Poor-Excellent	CI	7.62	0-9	–	V. Soft to Firm
					Till (SG)	3.45	11-50	–	V. Dense

Note: [1]mbgs refers to meter below ground surface, [2]CI - Intermediate Plasticity Clay; Till (CI) – Clayey Till; Till (SG) – Granular Till

Table 4-8: Field Vane Shear Test Results

Turbine	Elevation (m)	Depth (mbgs)	Normalized Depth (m)	Field Vane Peak Strength (kPa)	Remoulded Strength (kPa)	Sensitivity
WGT-01	68.2	2.44	0.44	42	10	4.2
		2.74	0.50	38	10	3.8
		3.96	0.72	42	9	4.7
		4.27	0.78	42	11	3.8
WTG-09	70.1	5.5	0.84	19	5	3.8
		5.79	0.88	23	5	4.6
WTG-12	70.8	2.4	0.63	30	4	7.5
		2.74	0.72	30	5	6.0
WTG-18	67.3	2.44	0.32	46	15	3.1
		2.74	0.36	34	19	1.8
		3.96	0.52	23	8	2.9
		4.27	0.56	23	8	2.9
		5.49	0.72	30	11	2.7
		5.79	0.76	32	11	2.9
WTG-21	67.7	2.44	0.20	48	7	6.9
		2.74	0.22	42	8	5.3
		5.49	0.45	19	2	9.5
		5.79	0.47	19	2	9.5
		7.01	0.57	19	2	9.5
		7.3	0.60	19	2	9.5
		8.53	0.70	21	2	10.5
		8.84	0.72	23	2	11.5
		10.06	0.82	23	2	11.5
		10.36	0.85	23	2	11.5
		11.58	0.95	34	2	17.0
		11.89	0.97	30	4	7.5
WTG-23	67.3	3.96	0.40	34	3	11.3
		4.27	0.43	34	4	8.5

Turbine	Elevation (m)	Depth (mbgs)	Normalized Depth (m)	Field Vane Peak Strength (kPa)	Remoulded Strength (kPa)	Sensitivity
		7.01	0.70	27	1	27.0
		7.32	0.73	23	1	23.0
		8.53	0.85	19	1	19.0
WTG-38	73.0	2.44	0.40	27	3	9.0
		2.74	0.45	30	5	6.0
		3.96	0.65	32	4	8.0
		4.27	0.70	32	4	8.0
		5.49	0.90	42	10	4.2
WTG-44	69.4	2.44	0.39	32	11	2.9
		2.74	0.44	26	11	2.4
		3.96	0.63	22	3	7.3
		4.27	0.68	18	5	3.6
WTG-54	69.6	2.44	0.32	40	6	6.7
		2.74	0.36	55	9	6.1
		3.96	0.52	19	2.5	7.6
		4.27	0.56	17	4	4.3
		5.49	0.72	32	4	8.0
		5.79	0.76	30	6	5.0

Table 4-9: Grainsize Distribution Results in Domain 3

Borehole	Ground Elevation (m)	Sample	Material	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
WTG-35	73.2	SS9	Till (SG)	10.67	22	77	1	
WTG-44	69.4	SS3	CI	1.52	0		36	63
WTG-47	75.9	SS11	Till (SG)	12.19	46	52	2	
WTG-54	69.6	SS8	Till (SG)	9.14	27	71	2	

Table 4-10: Atterberg Limits - Silty Clay (CI) Deposit

Borehole	Elevation (m)	Sample	Depth	W_N	W_L	W_P	I_P	I_L
WTG-01	68.2	SS4	3.1-3.6	60.5	47	22	25	1.54
WTG-09	70.1	SS6	4.6-5.1	64.4	53	24	29	1.39
WTG-18	67.3	SS6	4.6-5.2	91.9	67	25	42	1.56
WTG-20	67.6	SS5	3.1-3.6	86.1	59	26	33	1.82
WTG-21	67.7	SS10	10.7-11.3	68.3	51	20	31	1.56
WTG-23	67.3	SS8	7.6-8.2	75.7	63	24	39	1.33
WTG-38	73.0	SS5	4.6-5.2	52.8	37	20	17	1.93
WTG-47	75.9	SS7	6.1-6.7	39.4	28	16	12	1.71

WTG-54	69.6	SS4	3.1-3.7	65.3	50	22	28	1.70
WTG-58		SS3	1.5-2.1	33	42	22	20	0.65

Table 4-11: Groundwater Levels in Domain 3

Borehole	Elevation (m)	Initial (mbgs)	Round 1 (mbgs)	Round 2 (mbgs)
WTG-01	68.2	0.95	1.06	1.3
WTG-09	70.1	1.27	1.45	1.8
WTG-18	67.3	-0.37	-0.11	0.5
WTG-20	67.6	0.74	1.22	1.7
WTG-21	67.7	-0.47	1.03	1.1
WTG-35	73.2	0.85	1.22	1.7
WTG-38	73.0	0.64	0.90	2.5
WTG-44	69.4	0.38	0.44	1.4
WTG-47	75.9	1.03	0.97	1.9
WTG-54	69.6	0.88	1.22	1.9

Notes: Round 1 readings were taken July 5, 2018. Round 2 readings were taken Sep 7, 2017.

Table 4-12: Oedometer Consolidation Test Results

Borehole	Sample	Material	W_N (%)	p'_c (kPa)	σ'_{vo} (kPa)	OCR	C_r	C_c
WTG-23	TWS 6	CI	55.7	105-120	77.5	1.9-2.1	0.1	1.2
WTG-21	TWS 5	CI	56.8	65-95	0.9	1.1-1.4	0.1	0.75
SUB-1	TWS 6	CI	53.1	75-120	51.8	1.9-3.0	0.1	0.62
WTG-44	TWS 6	CI	45.1	55-100	71.3	1.0-1.8	0.02	0.2

4.5 Bedrock Properties

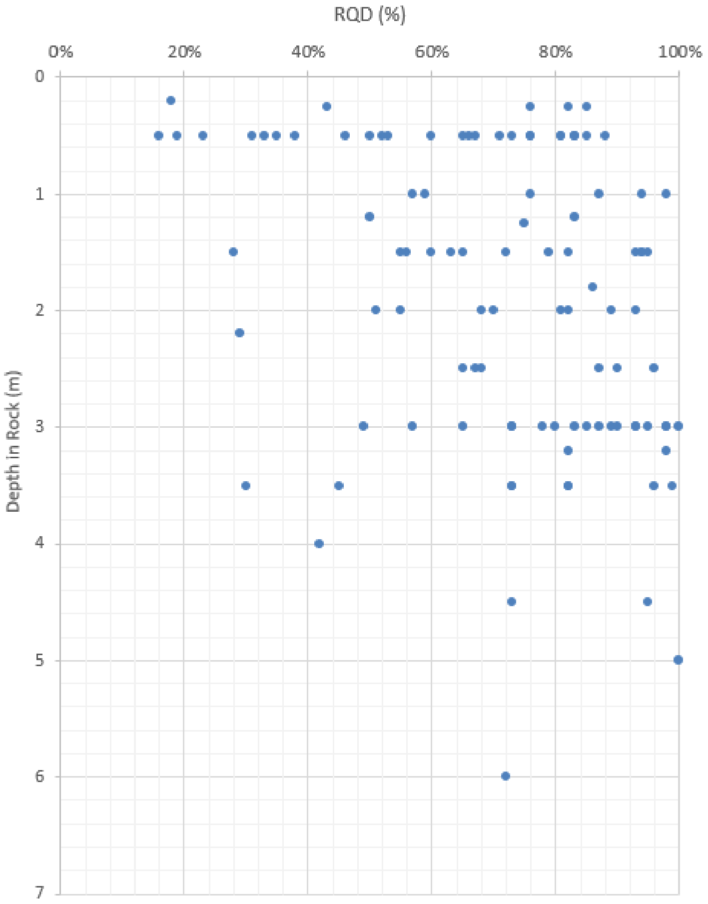
The bedrock at the site consists of grey to black, thinly bedded, fine-grained Shaly Limestone. Based on the rock core logs in Appendix C, the Rock Quality Designation (RQD) values vary significantly but are generally between 25-70% in the upper meter of the bedrock and between 55-100% below that. The Rock Mass Rating (RMR) for the rock mass is about 57 based the RMR classification system (Bieniawski, 1972). As a result, the rock mass quality is judged to be fair to good.

The intact unconfined compressive strength (UCS) of the bedrock is in the range of 66 MPa to 94 MPa with an average value of 80 MPa based on the test results listed in Table 4-13. Figure 4-4 show the summary of the RQD for WTG locations.

Table 4-13: Unconfined Compressive Strength (UCS) Tests on Rock

Sample	Measured Peak Load (kN)	Sample Diameter (mm)	Intact Compressive Strength σ_c(MPa)
WTG-01	142.8	47.1	82
WTG-04	164.1	47.0	94.6
WTG-23	165.5	47.3	94
WTG-25	84.0	47.45	47.5
WTG-41	124.1	47.46	70.2
WTG-44	115.7	47.2	66

Figure 4-4: Summary of the RQD of WTG Sites



4.6 Borehole Falling Head Tests

As noted in Section 3, Falling Head Tests were performed in piezometers installed in the WTG boreholes and the results are included in Appendix E. The following sections summarize the measured hydraulic conductivity values for the different soil units encountered during the investigation program.

4.6.1 Bedrock Hydraulic Conductivity

Table 4-14 presents the interpreted hydraulic conductivity of the bedrock at the Nation Rise site based on the borehole falling head test results. Summarizing, the lag time (T_L) for piezometers installed in bedrock varied from 1.6 seconds (s) to 205 s; the corresponding hydraulic conductivity varies between 1.6×10^{-2} and 3.2×10^{-4} cm/s, which is indicative of fractured bedrock.

Table 4-14: Borehole Slug Test Results in Bedrock

Borehole	Length of Screen (cm)	Stratum	r (cm)	R (cm)	TL (s)	Hydraulic Conductivity, k (cm/s)
WTG-01	335	Bedrock	1.905	3.8	1.6	1.6×10^{-2}
WTG-04	335	Bedrock	1.905	3.8	205	1.2×10^{-4}
WTG-06	335	Bedrock	1.905	3.8	4.5	5.4×10^{-3}
WTG-07	335	Bedrock	1.905	3.8	75	3.2×10^{-4}
WTG-25	330	Bedrock	1.905	3.8	144	1.7×10^{-4}
WTG-41	335	Bedrock	1.905	3.8	8	3.1×10^{-3}
WTG-48	335	Bedrock	1.905	3.8	9	2.7×10^{-3}

Note: r is the radius of the well casing. R is the radius of the well screen

4.6.2 Till Hydraulic Conductivity

Table 4-15 summarizes the interpreted hydraulic conductivity of the Glacial Till (Till) unit at the Nation Rise site based on the borehole falling head tests. The measured lag time (T_L) in the till varied from 4.8 seconds (s) to 12,600 s; the corresponding hydraulic conductivity in the Gravelly Sand Till layers at BH-WTG-16 and BH-WTG-44 varies between 7×10^{-3} and 1.6×10^{-4} cm/s; the Silt Till hydraulic conductivity varies between 1.5×10^{-6} cm/s to 1.4×10^{-5} cm/s.

Table 4-15: Borehole Slug Test Results in Till

Borehole	Length of Screen (cm)	Stratum	r (cm)	R (cm)	TL (s)	Hydraulic Conductivity, k (cm/s)
WTG-05	335	Silt Till	1.905	10	4200	4.5×10^{-6}
WTG-10	335	Silt Till	1.905	10	12600	1.5×10^{-6}
WTG-16	335	Sandy Till	2.54	10	4.8	7.0×10^{-3}
WTG-28	335	Silt Till	1.905	10	2640	7.2×10^{-6}
WTG-43	335	Silt Till	1.905	10	6300	3.0×10^{-6}
WTG-44	335	Sandy Till	1.905	10	150	1.6×10^{-4}
WTG-46	335	Silt Till	1.905	10	3000	6.3×10^{-6}
WTG-56	335	Silt Till	1.905	10	1320	1.4×10^{-5}

4.7 Shear Wave Velocity

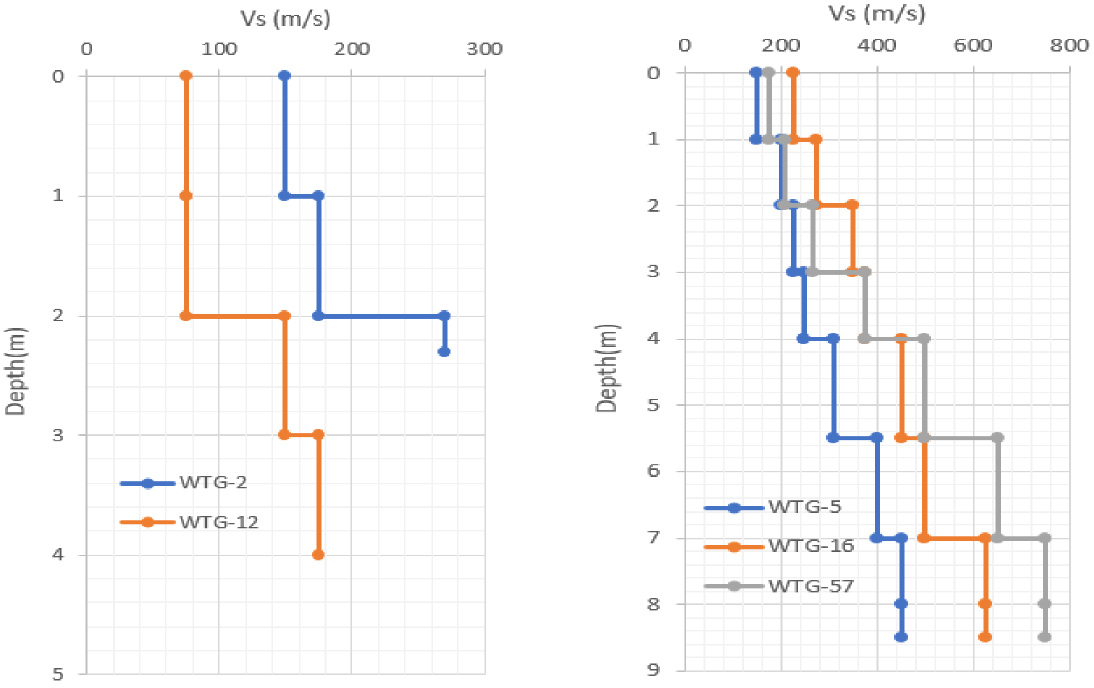
Seven (7) MASW soundings were conducted at the WTG sites to measure the shear wave velocity, V_s, of the soil deposits in the upper 30 m of the ground within the three geologic domains encountered. Figures 4-5 and 4-6 shows the interpreted V_s profiles at WTG-02,

-06, -12, -16, - 44 and -57 based on the MASW soundings. Refer to Appendix F for the detailed report. Summarizing:

- Domain 1: Two MASW soundings at WTG-02 and -12 indicate that the V_s is in the range of 75 m/s to 270 m/s for the Silty Clay and Silt Till soils overlying the bedrock.
- Domain 2: The MASW soundings at WTG-05, -16, and -57 indicate that the V_s is between 150 m/s and 500 m/s for the upper 4 m of the Till deposits in this domain and between 250 m/s and 750 m/s for the soil below 4 m depth.
- Domain 3: Two MASW soundings at WTG-21 and -44 in this domain indicate that the V_s is in the rage of 150 m/s to 200 m/s for the soft silty clay deposit.

The measured V_s in the bedrock is about 1900 m/s. This value was consistently obtained for the bedrock from all seven MASW sounding locations.

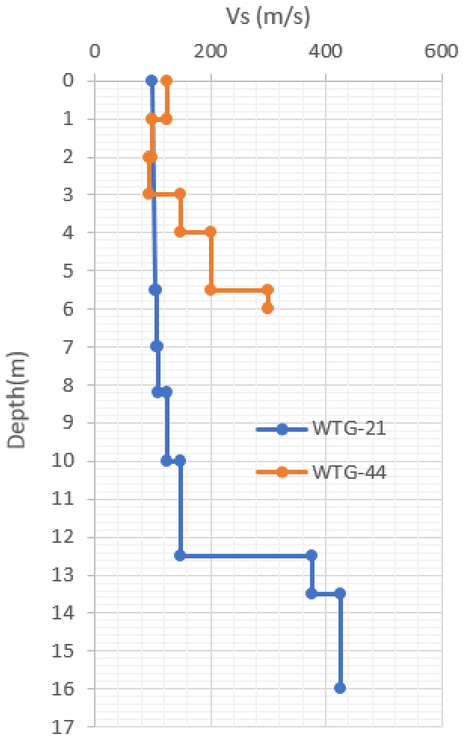
Figure: 4.5: Shear wave velocity profiles for Domains 1 and 2



(a) Domain 1

(b) Domain 2

Figure 4.6: Shear wave Velocity Profile Domain 3



4.8 Plate Load Tests

Lastly, the results of plate load tests are presented in Table 4-16. Refer to Appendix G for the plate load test results.

Table 4-16: Plate load test results at private access roads

Test Pit	WTG Access Rd	Material	Subgrade Modulus (MPa)	Correlated M_R (MPa)	Correlated CBR
TP-PSR-4	WTG-16	Silt Till (ML)	54	24	2.3
TP-PSR-5	WTG-27	Silt Till (ML)	65	29	2.8
TP-PSR-6	WTG-38	Silty Clay (CL)	58	26	2.5
TP-PSR-7	WTG-44	Silt Till (ML)	20	9	0.9
TP-PSR-8	WTG-48	Silt Till (ML)	50	22	2.1
TP-PSR-9	WTG-52	Silty Sand (SM)	34	15	1.5
TP-PSR-10	WTG-56	Silty Sand (SM)	63	28	2.7
TP-PSR-12	WTG-57	Silty Sand (SM)	47	21	2
TP-PSR-14	WTG-35	Silty Clay (CL)	35	16	1.5
TP-PSR-16	WTG-25	Silt Till (ML)	70	31	3.0

Note: MR is the resilient modulus of the subgrade. CBR is the California Bearing Ratio.

5 GEOTECHNICAL RECOMMENDATIONS

This section provides engineering recommendations for the WTG access roads, WTG foundation design and general site earthworks and construction.

5.1 WTG Access Roads

Based on the plate load test data summarized in Section 4, the WTG access roads can be designed using a resilient modulus, M_R, of 20 MPa for the subgrade soils. Table 5-1 provides recommended pavement structures for the WTG access roads based on the recommended M_R and the assessed equivalent standard axle loads (ESALs) provided by EDPR. The following pavement designs are based on the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993). Four pavement structures have been designed for the project as follows:

- Option 1: 400 mm of Granular B fill (OPSS 1010) overlain by 150 mm of Granular A fill (OPSS 1010) compacted to 98% SPMDD.
- Option 2: 500 mm of Granular B (OPSS 1010) overlain by 75 mm of Granular A (OPSS 1010) fill.
- Option 3: A non-woven geotextile (Terrafix 270R) and biaxial grid (Terrafix TBX2000) placed on the prepared subgrade, overlain by 200 mm of Granular B (OPSS 1010) and 150 mm of Granular A (OPSS 1010) fill; and
- Option 4: 200 mm of Cement Stabilized soil overlain by 150 mm of Granular A (OPSS 1010) fill compacted to 98% SPMDD. Refer to Appendix H for further detail regarding cement stabilized soil test results and construction specifications.

The preceding road options will require the following subgrade preparation. All topsoil should be stripped to expose the undisturbed native material. For Pavement Options 1 – 3, depending on the time of construction, there will be a need to adopt an observational approach for the subgrade preparation. If the clayey subgrade is dry and at or below 2% wet of the optimum moisture content (approx. 29%), then the subgrade should be proof rolled using a pad foot compactor and the prepared surface sealed using a smooth drum steel roller prior to constructing the pavement structure. A compaction target of 95% SPMDD should be adopted for dry subgrades. The existence of dry subgrade materials indicates the presence of a stiff crust, which will be beneficial for road construction.

If local zones of wet, weak or compressible materials of limited depth and extent are encountered, then the material should be removed and Select Subgrade Fill (OPSS[2] 1010) used to backfill the excavation and restore the ground to the subgrade design elevation. In some locations, the crust may be very thin or non-existent. If this situation exists, over excavation of soft or weak materials may degrade the subgrade rather than improve it and for these situations, the pavement structures defined as Options 3 or 4 should be used. The project will need to be careful not to over excavate in areas where the crust is thin and underlain by very soft clay.

For Option 4, the subgrade preparation will be significantly different than for Options 1-3. Road construction will consist of removing the top soil, tilling or scarifying and pulverising the existing subgrade materials and then adding cement at dosages between 8 and 16 percent of the dry weight of the material to stabilize the *in-situ* material. The design of cement stabilized soil for roads is addressed in a separate project memo. The cement-soil mixture should be compacted using a pad foot roller until the specified strength, stiffness and uniformity is achieved. After this, the cement stabilized fill may need to be rolled using a smooth steel drum roller to achieve a smooth surface prior to placing the surface coarse material. Place the Granular A fill in one lift and compact to 98% SPMDD. The contractor should ensure proportionate mixing of cement in the soil. Mixing plastic clays with a dosage of lower than 5% cement by weight can make the roads frost susceptible by increasing the silt content of the mixture. Although, frost heave is not a major concern for aggregate surfaced roads as compared to paved roads, it may result in loss of gravel and potholes, requiring the contractor to perform additional maintenance and repairs.

Quality control for the cement stabilized soil should consist of the following:

- Conduct one standard proctor tests every 100 m of road;
- Measure the moisture content of the native soil to be stabilized at 10 to 25 m intervals. Adjust the cement dosage based on averaging the moisture of 10 consecutive readings;
- Adjust the frequency of moisture content measurements based on the variability of the material over the distances noted above.
- Contractors should expect variability and be prepared to adapt their methodology to suit the site conditions at the time of construction.

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[2] Ontario Provincial Standards Specifications

As noted above, Table 5-1, summarizes the recommended pavement structures for the WTG access roads.

Table 5-1: Recommended Road Structure

Layer	Material	Thickness (mm)			
		Option 1	Option 2	Option 3	Option 4
Surface Course	Granular A	150	75	150	150
Base Course	Granular B	400	500	200	–
	Cement Stabilized Soil	–	–	–	200
Subgrade	Geotextile and Geogrid	–	–	270R/TBX2000	–

5.2 Geotechnical Parameters

5.2.1 Bedrock

Table 5-2 lists the recommended design rock mass properties for the Nation Rise project. Summarizing, the Geologic Strength Index, GSI, of the rock is estimated to be 40 (Marinos and Hoek, 2001) and the intact strength of the rock is conservatively estimated to be 50 MPa based on the results of UCS tests summarized in Section 4. The corresponding rock mass compressive strength is 5.5 MPa and rock mass modulus is 8 GPa. Also, as noted in Section 4, the shear wave velocity of the rock is 1900 m/s; which corresponds to a small strain dynamic modulus, G_{max}, of 10 GPa. The dynamic modulus, G_D, at a strain amplitude of 10^{-3} is assumed to be $0.5G_{max}$ (see Table 5-2). This should be used to assess the dynamic behaviour of the WTGs in Domain 1 subject to wind loading.

Table 5-2: Rock Mass Properties

Rock Property	Symbol	Parameters	Unit
Intact Rock Strength	σ_{ci}	50	MPa
Hoek-Brown Constant	m_i	12	–
Geological Strength Index	GSI	40	–
Rock Mass Compressive Strength[1]	σ_{cm}	5.5	MPa
Deformation Modulus[2]	E_m	8	GPa
Shear wave Velocity	V_s	1900	m/s
Small strain dynamic modulus	G_{max}	10	GPa
Large strain dynamic modulus	G_D	5	GPa
Unfactored rock-concrete Bond Strength	f_s	1	MPa

Notes: [1] $\sigma_{cm} = (0.0034m_i^{0.8})\sigma_c[1.029 + 0.025e^{(-0.1m_i}]^{GSI}$ (Eberhardt, 2003); [2] $E_m = \sqrt{\frac{\sigma_{ci}}{100}}10^{(\frac{GSI-10}{40})}$ (Marinos and Hoek, 2001).

5.2.2 *Glacial Till*

The glacial till encountered at the Nation Rise site varies from Silt Till to Gravelly Sand Till. At locations where the till is fine-grained (i.e. Silt Till), undrained analysis is recommended to assess the bearing capacity of the WTG foundations subject to short term loading. Effective stress parameters and analysis can be used for the Gravelly Sand Till. Table 5-3 lists the recommended design parameters for the Silt Till and Gravelly Sand Till. The dynamic shear modulus, G_D, listed in this table is based on $0.25G_{max}$, which corresponds to non-plastic materials and a strain amplitude of 10^{-3} (see Vucetic and Dobry 1991). Furthermore, as discussed below in Section 5.3, the strength and stiffness of the glacial till deposits in Domain 2 are not susceptible to cyclic degradation or fatigue.

Table 5-3: Design Parameters for Silt Till (ML) and Gravelly Sand Till (SG)

Depth (m)	'N' Value (Blows/ 30 cm)	Undrained Parameters			Effective Stress Parameters			Dynamic Modulus (MPa)		k (cm/s)	γ (kN/m^3)
		Eu (MPa)	μ_u	S_u (kPa)	E' (MPa)	μ'	c′ (kPa), ϕ' (°)	G_{max}	G_D		
0-2	8	12.5	0.45	50	15	0.3	0, 34	60	13	$9.6\times10^{--5}$	19.0
2-4	12	24.5	0.45	75	24	0.3	0, 36	110	24	$9.6\times10^{--5}$	19.8
2-8	16	21.2	0.45	95	30	0.3	0, 36	240	50	$9.6\times10^{--5}$	20.1
8-12	20	37.5	0.45	120	40	0.3	0, 36	320	65	$9.6\times10^{--5}$	20.8

Notes: E_u and μ_u are the undrained elastic modulus and Poisson's ratio; E' and μ' are the drained elastic modulus and Poisson's ratio; c′, ϕ' are the effective cohesion and effective friction angle; S_u is the undrained shear strength.

5.2.3 *Silty Clay (CI)*

Table 5-4 lists design parameters for the Silty Clay (CH) deposit in Domain 3. Two values are given for the undrained strength profile at the WTG locations in this domain; First, the upper 20% of the deposit consists of a firm to stiff crust. Additionally, there is a soft to firm zone at a depth between 45% and 60% of the deposit thickness, D. The undrained strength can be assumed to vary linearly between the crust and soft to firm zone; the strength increases at a rate of 3 kPa/m below $0.6D$.

Table 5-4: Design Parameters for Silty Clay (CI)

Borehole	Clay Thickness (m)	Crust (0 – 0.2H)		Soft Zone (0.45-0.6H)		Dynamic Shear Modulus		s_u/p'_c	Compression Indexes	
		s_{uo} (kPa)	E_{uo} (MPa)	s_u (kPa)	E_u (MPa)	G_{max} (MPa)	G_D (MPa)		C_R	C_C
WTG-01	5.5	55	13.8	35	8.8	18.5	4.0	0.25	0.1	0.7

Borehole	Clay Thickness (m)	Crust (0 – 0.2H)		Soft Zone (0.45-0.6H)		Dynamic Shear Modulus		s_u/p'_c	Compression Indexes	
		s_{uo} (kPa)	E_{uo} (MPa)	s_u (kPa)	E_u (MPa)	G_{max} (MPa)	G_D (MPa)		C_R	C_C
WTG-09	6.5	40	10.0	20	5.0	13.5	3.0	0.25	0.1	0.7
WTG-18	7.6	40	10.0	20	5.0	13.5	3.0	0.25	0.15	1.0
WTG-20	6.1	50	12.5	20	5.0	18.5	4.0	0.25	0.15	1.0
WTG-21	12.2	50	12.5	20	5.0	18.5	4.0	0.25	0.15	1.0
WTG-23	10.0	40	10.0	20	5.0	13.5	3.0	0.25	0.15	1.0
WTG-35	11.5	–	–	–	–	–	–	0.25	0.1	0.7
WTG-38	7.2	40	10.0	30	7.5	15.0	3.3	0.25	0.1	0.7
WTG-44	6.2	55	13.8	35	8.8	18.5	4.7	0.25	0.1	0.7
WTG-47	9.1	55	13.8	20	5.0	18.5	4.0	0.25	0.1	0.7
WTG-54	7.6	40	10.0	20	5.0	18.5	4.0	0.25	0.1	0.7

5.2.4 Soil Unit Properties

Table 5-5 lists the unit weight, specific gravity and effective strength parameters for the three main soil types encountered at the site. It is noted that it will take significant lateral movement to mobilize the passive resistance of the Silty Clay deposit at the site. Accordingly, TULLOCH has reduced the passive earth pressure coefficient by 50% to account for this. The effective strength parameters are based on the geotechnical engineer's prior knowledge and experience in the Ottawa Region.

Table 5-5: Silty Clay unit properties

Material	Saturated Unit Weight (kN/m^3)	Specific Gravity	Effective Strength Parameters		Active Earth Pressure Coefficient	Passive Earth Pressure Coefficient	Sliding Coefficient (Soil-Concrete)
			c' (kPa)	ϕ' (°)			
Silty Clay (CL)	17.5	2.7	5	28	0.36	1.4	0.25
Silt Till (ML)	20.5	2.7	0	34	0.28	3.5	0.35
Gravelly Sand Till (SG)	21	2.7	0	36	0.26	3.9	0.35

5.3 WTG Foundations

5.3.1 Foundations on Bedrock (Domain 1)

WTG foundations in Domain 1 can consist of cast-in-place reinforced concrete gravity base foundations constructed either directly on the rock or on a layer of granular fill on the rock. Based on the bedrock depths, WTG-02, -04, -06, -25, -27 and -48 can be placed directly on or embedded slightly into the shaly limestone bedrock; WTG-12, -32, -41, and -56 can be founded on a thin layer of compacted crusher-run Granular A (OPSS 1010) fill placed directly on the bedrock. The maximum thickness of the Granular A – Type II fill will be approximately 2.0 m.

Table 5-6 summarizes the recommended design bearing values for the WTG foundations in Domain 1. WTGs within this domain will be situated below the long-term groundwater level and as such they should be designed for buoyancy forces.

Table 5-6: Bearing Capacity for Foundations on Bedrock

Bearing Material	Factored ULS Bearing Resistance (kPa)	SLS Bearing Resistance (kPa)	Dynamic Shear Modulus, G_D (MPa)
Bedrock[1]	10,000	Does not Govern	5,000
Granular A	500	400	50

Note: [1]Top of prepared intact bedrock surface

Rock Anchors

It is considered feasible to incorporate rock anchors into the WTG foundations in Domain 1; however, this is appropriate only where the foundations are cast directly on the bedrock and not on granular fill on rock. A factored ULS grout-to-bedrock bond strength of 625 kPa can be used for design to estimate the bonded length for the rock anchors assuming a grout strength, f'_c, of 30 MPa. Designers should also ensure adequate strength at the anchor-grout interface. A wedge type failure mechanism is unlikely to develop in the rock mass at this site based on the RQDs and the mainly horizontal jointing.

The preceding guidance for rock anchor design should be confirmed by conducting pullout tests to failure during construction on a representative number of anchors (typically 10% of the anchors). The bonded length can be increased or decreased depending on the results of pullout tests. All anchors should be proof load tested up to 1.1 times the design load.

Foundation Preparation

Given the laminated and bedded nature of the sedimentary bedrock, it should be feasible to excavate the bedrock using bucket and hoe ram equipped hydraulic excavators without requiring drill and blast methods. Prior to placing concrete on the bedrock, weathered, fragmented or loose rock must be removed to expose fresh rock with a rock mass quality of fair to good. After excavating to the design foundation level, the exposed bedrock should be thoroughly cleaned, and pressure washed to ensure the rock surface is free of dirt, debris, standing water, snow or other deleterious materials, and a lean concrete mud mat should be placed on the rock to protect it during foundation construction. Where such removals result in local over excavation, the over excavated zone should be backfilled with lean concrete (15 MPa).

Based on the bedrock elevations reported on the borehole logs, the maximum bedrock slope between the WTG sites is 1.2%. As a result, the rock surface within each WTG site is expected to be essentially flat. Based on experience, however, bedrock levels can change locally where limestone beds have been broken off by glacial action. At these locations, ledges or steps can occur in the bedrock surface of up to 1.5 m in height. If encountered, the rock should be excavated under the entire footing of the WTG to achieve a flat bearing surface. Granular A fill should not be used to even out these step changes in the rock surface.

In some cases, foundations may be constructed on Granular A fill paced directly on the prepared bedrock. Where required, the Granular A fill should be placed in 300 mm thick lifts and compacted to 100% of the Modified Proctor Dry Density (ASTM D1557) to achieve a dense bearing material of uniform thickness. The bearing capacity of the fill layer will be high due to the confinement, i.e. the thickness of this layer should be less than 10% of the foundation diameter.

Lastly, foundation excavations in Domain 1 will likely extend below the groundwater table into fractured permeable bedrock. Since the WTGs in this Domain are located at high points of the local relief (i.e. at higher elevations), the groundwater recharge in the bedrock will be limited. As a result, contractors should be able to use conventional sump and pump techniques to dewater excavations. Furthermore, the quantity of water to be handled should diminish with time or eventually stop completely. The impact of excavations and dewatering on the regional groundwater regime is expected to be insignificant. The application of a lean concrete mud mat on the rock will also ensure that the construction does not introduce sediment to the groundwater adversely impacting the water quality.

Gapping

It is understood that the project may design the WTG foundation in Domain 1 for gapping in order to optimize the foundations. A gapping design is feasible in Domain 1 for WTGs founded directly on bedrock as well as foundations founded on Granular A fill on the bedrock. If a gapping design is adopted, the Granular A thickness should not exceed 2.0

m. Additionally, the Granular A fill should extend at least 2 m beyond the outer edge of the foundations to avoid loosening at the edges.

Based on the bedrock core samples, the bedrock at the Nation Rise site comprises fresh to faintly weathered, strong to very strong limestone; also, the bedrock jointing is tight and free of joint infilling. As such, the bedrock at the Nation Rise site is not considered to be susceptible to fatigue if gapping is adopted in the foundation design. Also, Granular A is not susceptible to fatigue. Thus, the strength and dynamic modulus properties, listed in Table 5-6, are suitable for both conventional and gapping foundation designs including the effects of cyclic degradation or fatigue.

5.3.2 Foundations on Till (Domain 2)

In Domain 2, shallow gravity base foundations are recommended for the WTGs. In this domain, the bearing soil will comprise either Silt Till or Gravelly Sand Till. The following limit state bearing capacities are recommended for design of WTG foundations in Domain 2. The factored ULS has been estimated using conventional bearing capacity equations and a resistance factor of 0.5: The SLS bearing resistance is the maximum bearing pressure at the heel of the foundation corresponding to a differential settlement of 1/300.

Table 5-7: Bearing Capacity for Foundations in Domain 2

Bearing Material	WTGs	Factored ULS Bearing Resistance (kPa)	SLS Bearing Resistance (kPa)
Dense to Very Dense Silt Till (ML)	-05, -07, -10, -16, -43, -46, -52	300	200
Compact Silt Till (ML)	-11, -28, -29, -58	250	200

As noted below in Section 5.5, the frost penetration depth at the site is estimated to be 1.8 mbgs. Accordingly, all foundations on glacial till must be embedded at least 1.8 m into the ground to ensure adequate soil cover to avoid frost heave. However, at some locations, the depth to the bearing layer will exceed 1.8 m due to the presence of soft layers in the foundation including but may not be limited to WTG , -11, -29, -58. These soft layers must be removed as part of the foundation base preparation. In areas requiring the removal of soft materials below 1.8 m depth, the excavations can be backfilled using Granular A compacted to 100% SPMDD. The contractor is required to follow OPSS 501 for compaction of earth and granular material. Table 5-8 summarizes the bearing material and the estimated depth for each of the WTGs in Domain 2. The depths in this table are approximate based on the borehole data at each WTG location. These depths and the corresponding bearing materials must be verified during construction by the Geotechnical Engineer of Record (EOR).

Foundation Preparation and Testing

Foundation preparation in Domain 2 should consist of excavating the overburden soil to between 150 mm and 200 mm below the required foundation bearing level. All soft, loose, compressible and otherwise unsuitable material such as peat and organic soil should be removed to expose undisturbed dense Silt Till or Gravelly Sand Till. After preparing the foundation soil, a 200 mm thick lean concrete mud mat should be placed on the prepared till to allow construction of the foundation and to protect the till subgrade from disturbance. Prior to placing the mud mat, the foundation bearing surface should be divided into quadrants and three (3) to four (4) Dynamic Cone Penetration Tests (DCPTs) should be conducted per quadrant to confirm the density of the bearing material. Tentatively, an equivalent SPT ‘N’ Value of 12 blows/30 cm, averaged over a depth of 1 m, can be used as an acceptance criterion for the foundation bearing material. The preceding acceptance criterion, however, is approximate, and it should be reviewed during construction by the Geotechnical EOR, who may adjust the criterion based on the observed condition of the Till soils after excavation and the response of the soil to DCPTs. Other tests such as plate load tests may be required to establish a suitable DCPT criterion.

Lastly, due to the fine-grained nature of the Nation Rise Silt Till materials and based on the borehole falling head tests, dewatering is expected to require only sump and pump techniques. Locally, however, water bearing sand layers may be encountered during the construction. These layers will have limited recharge and are expected to yield water only temporarily until pumped dry. If encountered, contractors may need to excavate pits into these layers and pump the groundwater from the pits until the granular layers dry up prior to executing the bulk excavation.

Gapping

It is understood that the project would like to design the WTG foundations in Domain 2 for gapping. Considering this, TULLOCH has assessed the borehole data at the Domain 2 WTG locations and concluded that only WTGs -05, -07, -10, -16, -43, -46, -52, and 57 can be considered for gapping designs. These WTGs will be founded mainly on either dense Silt Till or dense coarse-grained Granular Tills. The stiffness and strength of these materials is not normally susceptible to cyclic degradation. To confirm this, TULLOCH has reviewed the cyclic stress cycles that are likely to be imposed on the Till deposits at the above referenced WTG locations. Additionally, we have reviewed historical cyclic triaxial tests on comparable Southern Ontario tills. This review has confirmed that the Silt and Granular Till soils at WTGs -05, -07, -10, -16, -43, -46, -52, and 57 can tolerate the estimated amplitude and number of stress cycles associated with gapping without experiencing significant cyclic degradation or fatigue. Accordingly, the strength and dynamic properties listed in Table 5-3 can be used for gaping designs without needing to be reduced to account for cyclic degradation.

Table 5-8: Estimated Foundation Depth for WTGs in Domain 2

WTG No.	Bearing Material	Min. Depth (m)	Notes
WTG-05	Silt till (ML)	2.3	Remove firm clay from -1.8 to -2.3 m depth; Replace with Granular A
WTG-07	Silt Till (ML)	1.8	Found below the frost penetration depth.
WTG-10	Gravelly Silt Till (ML)	1.8	Found below the frost penetration depth
WTG-11	Silt Till (ML)	1.8	Found below the frost penetration depth
WTG-16	Silt Till (ML)	1.8	Found below the frost penetration depth
WTG-28	Silt Till (ML)	3.0	Excavate to 3m depth to remove loose SILT Till, replace with Granular A to 1.8 m
WTG-29	Silt Till (ML)	4.0	Excavate to 4m depth to remove loose SILT Till, replace with Granular A to 1.8 m
WTG-35	Silt Till (ML)	3.05	Remove Silty Clay from 1.8 – 3.05 m depth; Replace with Granular A
WTG-43	Gravelly Sand Till (SG)	1.8	Found below the frost penetration depth; May require advanced dewatering
WTG-46	Gravelly Silt Till (ML)	1.8	Found below the frost penetration depth; May require advanced dewatering
WTG-52	Sandy Silt Till (ML)	1.8	Found below the frost penetration depth; May require advanced dewatering
WTG-57	Sandy Silt Till (SW)	1.8	Found below the frost penetration depth; May require advanced dewatering
WTG-58	Silt Till (ML)	2.3	Remove the Silty Clay from 0-2.3 m; Replace with Granular A

5.3.3 Deep Foundations (Domain 3)

Deep foundations will be required for the WTGs located in the very soft to firm Silty Clay. It is also understood that the Project will not use driven piles or any H-piles, and therefore will not drive any piles onto or into the bedrock. It is not recommended to use rammed aggregate piers for ground improvement as the granular pier has the potential to serve as a conduit for surface water to penetrate the subsurface, which can have negative impacts on aquifers at depth. Accordingly, the following sections cover drilled foundation alternatives for the Nation Rise WTGs.

5.3.3.1 Bored (Drilled) Shaft Piles

Bored shaft piles between 450 to 750 mm diameter can be used for the WTG foundations in Domain 3. This type of pile involves advancing a casing through the overburden using a vibro-hammer and then slightly into bedrock using an oscillator. A bucket auger can be used to excavate the soil from inside the casing. Reinforcement is then placed into the drill hole and the pile is filled with concrete. The bored shaft piles should be embedded between one diameter (1D) and one and a half diameters (1.5D) into the bedrock, which will require rock coring.

Bored shafts constructed in this manner can be designed as end-bearing piles. Table 5-9 lists the recommended geotechnical design capacities for 450 mm, 600 mm and 750 mm diameter bored shafts. The SLS pile capacity will be governed by the pile elastic displacement only. Due to the weak overburden soils, the skin friction or adhesion will be insignificant. As a result, the foundation designer should select an appropriate displacement criterion for the foundations and estimate the SLS capacity using the elastic deformation PL/AE of the pile assuming the bedrock is rigid.

Table 5-9: Design Geotechnical Capacity of Bored Shafts

Shaft Diameter (mm)	Embedment Depth in Rock (mm)	Factored ULS (kN)	
	1X Pile Diameter	Compression	Tension[1]
450	450	2,100	160
600	600	3,700	300
750	750	5,800	475

Note: [1] Excludes the weight of the pile.

The preceding pile capacities have been calculated using the rock mass properties listed in Table 5-3. The factored ultimate concrete-to-rock bond (290 kPa) and factored ultimate end-bearing pressure (12 MPa) are based on the methodology outlined in FHWA publication FHWA-NHI-10-016 (2009). The bedrock at the tip of the pile must be inspected with a down-hole camera. Contractors may need to use air-lifting techniques to clean the bedrock. However, after coring the bedrock, if a casing is socketed into the rock, then any debris at the pile tip should comprise pieces of medium strong to strong limestone rock.

These pieces, if left in place, should not adversely affect the end-bearing capacity of the drilled shaft.

5.3.4 Micropiles

Micropiles are feasible for WTG foundations situated within the soft Silty Clay geology. This pile alternative consists of either 273 mm, 355 mm or 406 mm OD HSS pipe drilled through the overburden and embedded nominally into the bedrock. The HSS pipe should be advanced through the overburden soils and ½ pile diameter into the bedrock using a casing advancing system. After embedment in the rock, a downhole hammer should be used to drill an additional two-pile diameters (2D) into the rock to create a socket. Figure 5-1 illustrate a typical micropile installed in this way. After completing the drilling, a steel bar should be inserted into the pile extending to the tip of the socket; and the socket and HSS filled with structural grout to complete the installation. It is assumed that the socket will be pressure grouted to enable the use of end-bearing and socket bond in the design.

Table 5-10 lists the recommended geotechnical design capacities for micropiles constructed according to the preceding description. Due to the drilling method, skin friction will be negligible in the overburden. Accordingly, the SLS capacity of the micropiles will be governed by the elastic compression of the pile only (i.e. PL/AE). The designer can assume the bedrock is rigid for this calculation.

Table 5-10: Recommended Geotechnical Capacities for Micropiles

Pile	Embedment into Rock (mm)	Factored ULS (kN)	
		Compression[1]	Tension[2]
HSS 273 mm	546	1,150	140
HSS 355 mm	710	1,950	240
HSS 406 mm	812	2,560	310

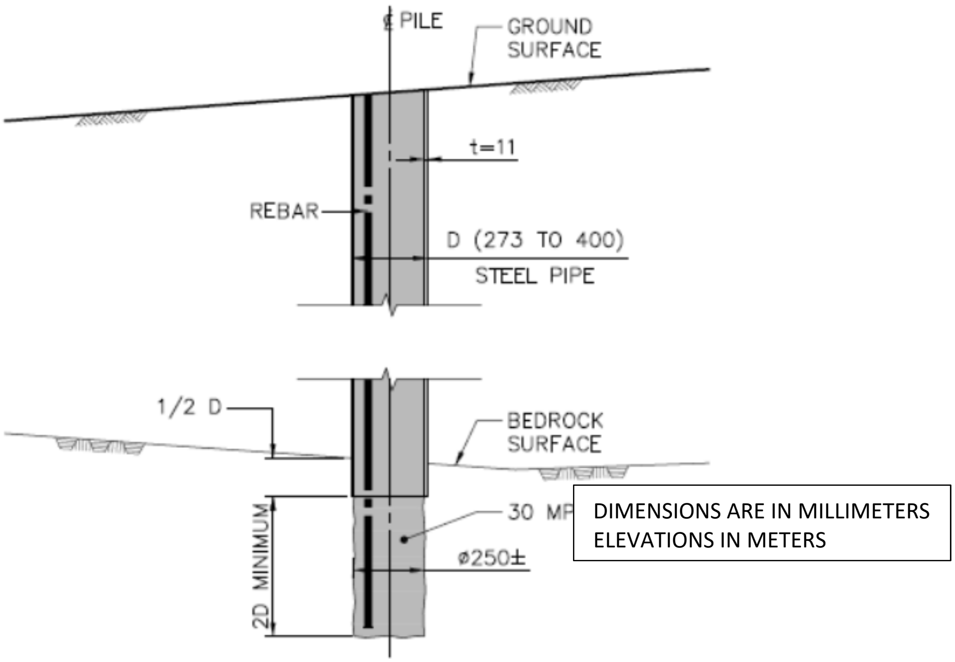
Note: [1]Based on an ultimate grout-to-bond strength of 1,450 kPa; [2]Based on a pullout cone forming in the rock; [1,2]Resistance factors of 0.4 and 0.3 have been used in compression and tension.

5.3.5 Continuous Flight Auger (CFA) Piles

Lastly, CFA piles are also feasible in Domain 3 at the Nation Rise site. CFA piles are bored cast-in-place reinforced concrete piles installed using continuous flight augers to drill through the overburden soils to the bedrock; concrete is injected into the augered hole through the augers as they are retracted, and a rebar cage is subsequently installed after that. Table 5-11 summarizes the recommended geotechnical capacities for CFA piles.

The factored ULS pile capacities values listed in Table 5-11 are based on end-bearing on the bedrock and assume 75% of the tip is in contact with the bedrock. Due to the method of construction and rock hardness, it will not be feasible to socket these piles into the rock. The tensile capacity neglects the pile weight and is based on an 8 m long pile, i.e. 6m in Silty Clay and 2 m in Silt Till, and shaft adhesion values of 35 kPa in the Silty Clay and 80 kPa in the Silt Till.

Figure 5-1: Typical Micropile and End-treatment



DIMENSIONS ARE IN MILLIMETERS
ELEVATIONS IN METERS

Table 5-11: Recommended Geotechnical Capacity of CFA Piles

Shaft Diameter (mm)	Factored ULS (kN)	
	Compression	Tension[1]
500	1,940	175
600	2,800	210
750	4,375	260
900	6,300	310

Note: [1]The tensile capacity is based on the □-method; it neglects the pile weight.

5.4 Lateral Capacity of Piles

The lateral capacity of micropiles, CFA piles and bored shaft piles will be strongly influenced by the lateral stiffness of the Silty Clay deposit, which is low. Ideally, piles should be battered to provide lateral resistance. Although a batter of (4V:1H) is feasible, TULLOCH recommends a maximum batter of (6V:1H) for ease of construction. The designer should contact TULLOCH for guidance on the selection of lateral non-linear spring constants for designing laterally loaded vertical piles.

5.5 Pile Group Impacts

All pile types will end-bear on or nominally into the bedrock and as such pile group effects should be insignificant. However, the pile spacing should be at least three pile diameters apart to minimize group interaction for the lateral stiffness of the foundation. The designer should contact TULLOCH for guidance if closely spaced piles are required.

5.6 Foundation Buoyancy

Based on the measured depth to the groundwater table, buoyant effects should be accounted for during the WTG foundation designs. For the WTGs in the Silty Clay domain, there will be a tendency for groundwater to collect in the backfill around the foundation due to the low permeability of the native soils (i.e., a bathtub effect). For design in this domain, the groundwater table should be assumed to be at the ground surface. The following table summarizes the recommended water table assumptions for the design of foundations in Domains 1 and 2.

Table 5-12: Design water table depths in Domain 1 and 2

WTG No.	Domain	Water Table Depth (mbgs)
2	1	0.2
4	1	1.1
6	1	0.7
12	1	0
25	1	0.8
27	1	0
32	1	0
41	1	0
48	1	0
56	1	0
5	2	0
7	2	0.2

WTG No.	Domain	Water Table Depth (mbgs)
10	2	0.3
11	2	0
16	2	0
28	2	1.6
29	2	3.1
43	2	0
46	2	0
52	2	1.4
57	2	0.5
58	2	0

5.7 Other Piling Considerations

There is evidence of artesian conditions in the bedrock near the South Nation River observed during drilling. As a result, contractors will need to be prepared to handle flowing water from the rock during CFA, Micropile and Bored Shaft construction in Domain 3. All bored pile methods should be executed in a manner that maintains enough length of casing stickup above the ground level to counterbalance the artesian head. Although maintaining adequate stickup and the use of drilling slurry (with subsequent tremie placement of concrete) should be sufficient to control the ground water inflow, a groundwater pressure relief system or dewatering wells near the work area can also be considered as an alternative to drawdown the water table and enable construction. Concrete placement methods (wet vs. dry placement) will need to be decided depending on water conditions encountered during drilling of the piles.

5.8 Backfill

It will be important to pay appropriate attention to the backfill material placed around foundations constructed in the fine-grained deposits at the site. Without proper attention to this detail, infiltration could collect in the backfill (i.e., a bathtub effect) causing full buoyancy on the foundations. Accordingly, backfill around the turbines should consist of the native soil derived from the foundation excavation. If sandy materials are encountered within an otherwise fine-grained deposit, discard the sandy material and use the silt or clayey materials for backfill. Compact the backfill material to 95% SPMDD. If the material is excessively wet, dry the material to achieve a moisture content close to the optimum moisture content for compaction. The foundation designer should ensure that the finished ground around the WTG foundations is sloped generously away from the foundation to prevent water from collecting on, and seeping into the backfill material. The permeability of the backfill should be equal to or less than that of the surrounding native soils.

5.9 Open Cut Excavations

Excavation safety and the stability of temporary construction slopes and lateral support systems are the Contractor's responsibility. Where workers must enter excavations deeper than 1.2 m, the trench excavations must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/9, Construction Projects, January 1, 2010, Part Ill - Excavations, Section 226. Alternatively, the excavation walls should be supported by engineered shoring system, bracing, or trench boxes complying with Sections 235 to 239 and 241 under 0. Reg. 231/91, s. 234(1).

Based on the OHSA, the *in situ* soils may be classified as Type 3 soils above the groundwater table. The Silty Clay can be classified as Type 3 below the water table as well; Granular Till materials should be classified as Type 4 soils below the groundwater table. Temporary excavation side slopes in Type 3 soils should remain stable at a slope of 1H:1V. Temporary excavation side slopes in Type 4 soils should remain stable at a slope of 3H:1V. The *in situ* soils can be excavated using conventional hydraulic excavators.

Based on the borehole investigations, ground water can be expected at a depth of between 0.65 m and 2.7 m below the existing ground surface at the time of drilling; Artesian groundwater may also be encountered at some of the WTG sites near the South Nation River. Excavations above the groundwater table within the native soils should be relatively straight forward and should remain stable at a slope of 1H:1V. However, excavations below the groundwater table will become more difficult particularly when executed in non-cohesive granular soils. For excavations below the groundwater table, the following comments are provided:

- Prior to commencing excavations, all surface water sources must be controlled and diverted away from the proposed excavation to prevent infiltration and subgrade softening. At no time should excavations be left open and exposed to precipitation allowing the subgrade to soften or the side slopes to slump. Temporary berms around the excavation perimeter may be utilized to prevent surface runoff from getting into the excavation.
- Generally, groundwater inflow within the Silty Clay and Silt Till can be controlled to a significant depth below the water table by installing strategically placed filtered sumps and pumping the collected water out of the excavations.

- There may be excavations into the Gravely Sand Till such as at WTG-07, which has a 2 m thick layer of gravel at a depth of 3 m. Also, WTG-10 has a 1 m thick layer of gravel at 1.5 m depth. WTG-28 has surficial sand and gravel layers extending to a depth of about 2.3 m that may also collect perched groundwater depending on prevailing weather conditions. Deeper excavations in this type of material may require advanced dewatering techniques, such as using well points to control the groundwater. As discussed above, it may be feasible to dewater sites in these soils by excavating a few test pits and pumping water from the pits prior to commencing bulk excavations.

All collected water should be discharged a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a filter bag and silt fence should be installed at the discharge point of the dewatering system. A maximum of 400,000 L/day may be discharged per the Renewable Energy Approvals (REA) agreement. Water taking in excess of 400,000 L/day completed during construction is subject to the REA and does not require a separate Permit To Take Water (PTTW), however, a similar assessment to a PTTW would be required as provided in the REA application's Construction Plan Report: Hydrogeological Assessment and Effects Assessment. Utmost care should be taken to avoid any potential adverse impacts on the environment.

Seasonal variations in the groundwater table should be expected, with higher levels occurring during the wet weather conditions in the spring and fall and lower levels occurring during the summer dry weather conditions.

Given the sensitive nature of the glaciomarine clay at the site, TULLOCH recommends detailed engineering assessment of all excavations in this material below 3 m depth to ensure the risk of failure, including potential retrogression of failure surface, is suitably mitigated. The contractor is required to provide their engineering assessments and work plans to TULLOCH for review and approval prior to construction.

5.10 Frost Protection

The estimated frost depth at the site is 1.8 m. The soil type is moderately susceptible to frost action. As such, the footings should be situated at a minimum depth of1.8 mbgs to provide adequate insulation against frost heave. Alternatively, insulation can be used to raise the frost line and allow footings to be placed at a shallower depth provided suitable founding conditions are present at such depths. If shallower embedment is needed, thermal insulation should be placed at the outer surface of the foundation wall extending away horizontally from the foundation to prevent frost penetration under the footing. Insulation details can be provided later, if this option is selected. All roads must be constructed using non-frost susceptible engineered fill to prevent freeze thaw damage.

5.11 Site Classification for Seismic Response

The parameters for determination of Site Classification for Seismic Site Response are set out the 2015 NBCC[3]. The site classification is based on the average shear wave velocity in the top 30 meters of the site stratigraphy. If the average shear wave velocity is not known, the site class can be estimated from energy corrected Standard Penetration Resistance (N_{60}) and/or the average undrained shear strength of the soil in the top 30 meters. The following site classes apply for this project based on the 2015 NBCC:

- Domain 1: Site Class A
- Domain 2: Site Class D
- Domain 3: Site Class E.

These seismic design parameters should be reviewed in detail by the structural engineer and incorporated into the design as required by 2015 NBCC.

5.12 Soil Corrosivity

Soil resistivity testing at the project site is included in Appendix F of the report entitled, "Overhead Underground Collection Transmission Report" dated February 15, 2019. Summarizing, the measured soil resistivities are:

- 0-8m: 1 to 1,200 Ω. m;
- >8m: 8 to 3,490 Ω.m ;

Based on the soil resistivity values, the corrosion rating for the native soils at the project site is considered as a mildly to highly corrosive environment. Historical tests by SENES Consultants (2015) indicate that the site soils have the potential to act as a severe corrosive environment to embedded steel foundation systems.

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[3] National Building Code of Canada

The structural design of foundations should account for these results. Despite the apparent corrosion potential, piles installed in the Silty Clay and Silt Till soils is unlikely to experience significant corrosion due to lack of oxygen below the water table.

5.13 Laydown Yard

The geotechnical data collected for the Laydown Areas at the Nation Rise site is summarized on borehole logs BH LD-1 and LD-2 in Appendix C and in the following table.

Table 5-13: Summary of Soil Parameters

Borehole	Overburden Soil			
	Type	'N' Values	Layer Bottom Depth	Consistency
BH-LD-01	Sand (SM)	8	0.61	Loose
	Silty Clay (CL)	19	1.22	Very Stiff
	Silt (ML)	13-50	2.44	Compact to Very Dense
BH-LD-02	Sand Till (SW)	12 - 78	3.20	Compact to Very Dense

Referring to Table 5-13, the subsurface conditions at Borehole BH-LD-01 consisted of 0.61 meters of compact fine-grained sand, with some silt at the surface transitioning to very stiff Silty Clay material to a depth of 1.22 mbgs and dense to very dense Silt Till from 1.22 mbgs to 2.44 mbgs with the presence of some clay, cobbles, boulders and gravel throughout. Borehole BH-LD-02 contained a topsoil layer at the surface that was 0.13 m in thickness overlying a dense to very dense Sandy Silt Till to refusal at 3.20 mbgs. In general, the subsurface conditions at the Laydown yard are favourable and the site is favorable for use as such.

5.14 Landslide Hazard, Associated Review and Monitoring

An extensive deposit of Silty Clay (Leda Clay) was encountered throughout the central portion of the Nation Rise Wind Project site. The geotechnical data presented in this report indicates that the Leda Clay is moderately sensitive at the WTG locations and the sensitivity increases with increasing proximity to the South Nation River. Leda Clays are known to be susceptible to retrogressive landslides. This section discusses the landslide hazard imposed by the Nation Rise Project.

The main landslide hazard within the project site is associated with the South Nation River and its riverbanks. However, this is a pre-existing hazard. Focusing on the Nation Rise

Project, the site terrain is flat to gently sloping and the terrain is judged to be generally stable. The Project development will require the construction of roads, installation of buried power cables, pile construction, excavations for shallow foundations, and crane lifts during turbine erection. The incremental risk posed by these activities is judged to be insignificant as discussed below.

First, excavations for the WTG foundations at the Nation Rise site will not exceed about 4.5 m depth in the Leda Clay. Most excavations will be 1.8 m deep. Based on the turbine layout, all excavations in Leda Clay will be undertaken within flat terrain and at least 750 m from the South Nation River. At the planned depths, the factor of safety against base heave and slope failure is estimated to exceed 3.0. Considering the high factor of safety, generally flat terrain and the significant distance to the Nation Rise River, the risk of triggering a landslide is judged to be negligible. However, it is essential that proper excavation geometry and support procedures are followed to ensure safe operations, as discussed in Section 5.9.

Bored pile foundations will be constructed for the WTGs situated on Leda Clay. This will involve drilling through the Leda Clay to the bedrock using a steel casing to support the Leda Clay. Contractors will then core into the bedrock, insert reinforcing steel (i.e. a rebar cage) into the cased hole and then fill the hole with concrete before retracting the casing. During these operations, the Leda Clay will always be supported; and hence, the risk of inducing a landslide is judged to be negligible.

Road construction will involve placing a maximum of 450 mm thickness of granular fill materials on the Leda Clay deposit. This thickness is similar to the existing roads at the site and the pressure applied to the Leda Clay (12.5 kPa) is well below the ultimate bearing capacity of the clay (150-200 kPa). Accordingly, road construction will not have a material impact on terrain stability as demonstrated by the existing roads.

Construction of the Project collector system (i.e. power cables) will require the excavation of shallow trenches in each of the three domains encountered at the site. In the Leda Clay domain, the expected depth of the trenching is insufficient to cause a mass landslide. The primary risk imposed by the collector system is where it crosses the South Nation River near WTGs-23 and -25. At this location, the cables are planned to be installed under the South Nation River using Horizontal Direction Drilling (HDD). To mitigate the risk of failing the riverbanks, the HDD boring will be situated in the bedrock at least 3 m below the top of rock. Additionally, the launch and receiving pits shall be limited to a maximum depth of 3m and situated at least 30 m from the river. These measures are considered appropriate and the risk of inducing a landslide is judged to be very low. The HDD final design details and the contractor's launch and receiving pits and installation plan should be reviewed by the Geotechnical EOR prior to implementing the crossing. Additionally, a detailed monitoring plan is recommended for the construction. The monitoring plan should include piezometers, inclinometers and settlement monitoring points to ensure the impact of the HDD construction is insignificant.

Lastly, the project will require several crane lifts during the tower and WTG erection. All of the crane lifts will be undertaken using track mounted crawler cranes situated on crane pads engineered to impose safe bearing pressures on the Leda Clay. The Geotechnical EOR should review the crane pad details to ensure allowable bearing capacities of the foundation soils are not exceeded. We understand that all lifts will have a lift plan as required by Ontario Government regulations and the plans will be reviewed by a third-party independent engineer to ensure their adequacy. Lastly, all crane lifts on Leda Clay will have displacement monitoring during the lift to ensure satisfactory performance. With these provisions, as well as the flat site terrain, the risk of inducing a landslide is insignificant.

6 CLOSURE

TULLOCH has prepared this geotechnical report for the exclusive use of EDP Renewables and their authorized agents for the construction of the proposed Nation Rise Wind Farm.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering, for the above noted location. Classification and identification of soils and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. Foundation design recommendations are based on standard accepted methods of analysis for these types of structures. No warranty or other conditions, expressed or implied, should be understood. Please refer to Appendix I, Report Limitations and Guidelines for Use, which pertains to this report.

We trust that the information and recommendations in this draft report will be found to be complete and adequate for your consideration. Should further elaboration be required for any portion of this project, we would be pleased to provide assistance.

REFERENCES

Marinos, P., and E. Hoek. (2001). Estimating the geotechnical properties of heterogeneous rock masses such as flysch, Bulletin of Engineering Geology and the Environment, 60(2), pp. 85-92.

National Building Code of Canada, NRC, 2015.

Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

Occupational Health and Safety Act (OHSA), Ontario Regulation 213/9, Construction Projects, January 1, 2010, Part III - Excavations, Section 226.

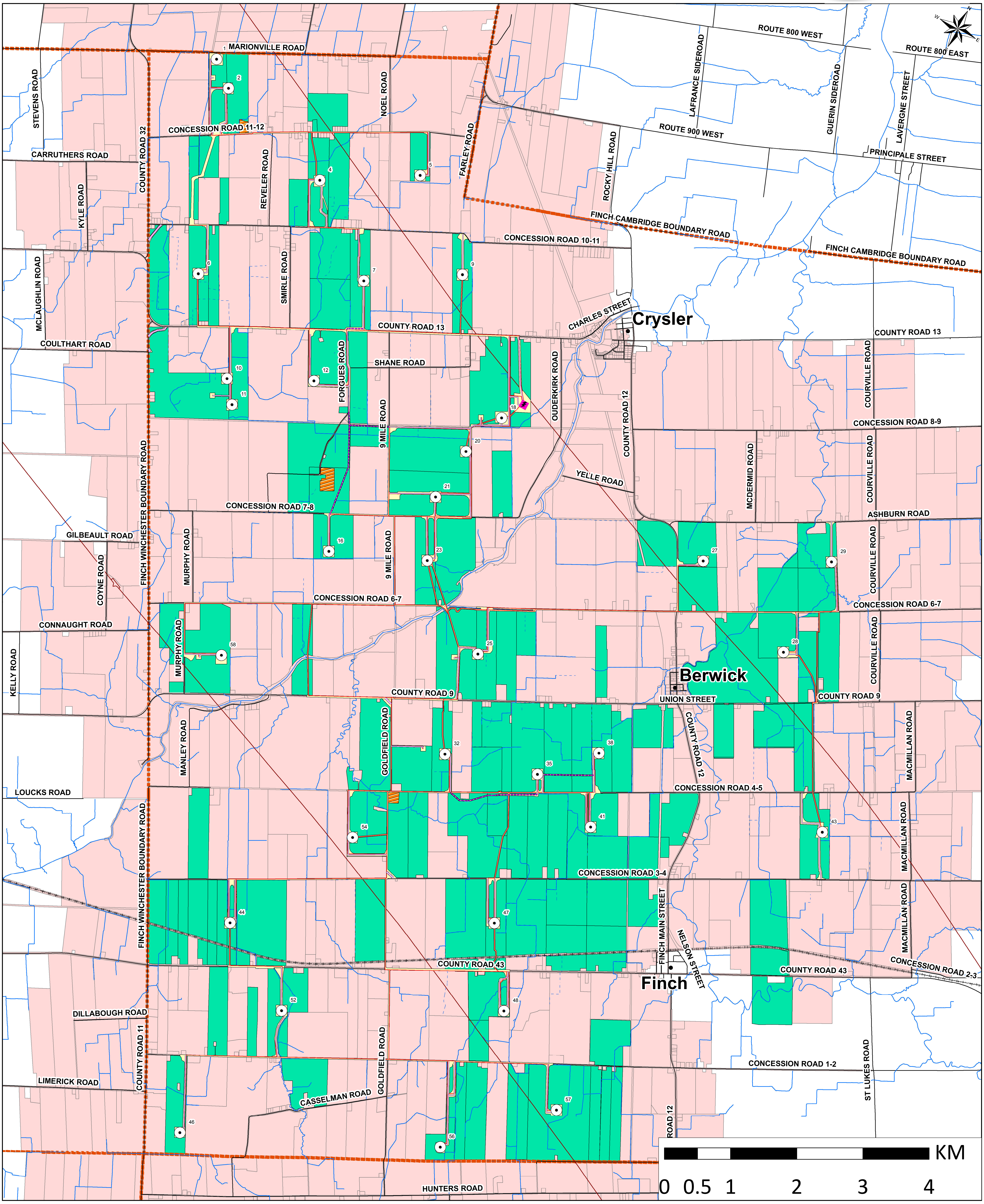
SENES Consultants, 2015

APPENDIX A

SITE LOCATION PLAN

NATION RISE WIND PROJECT

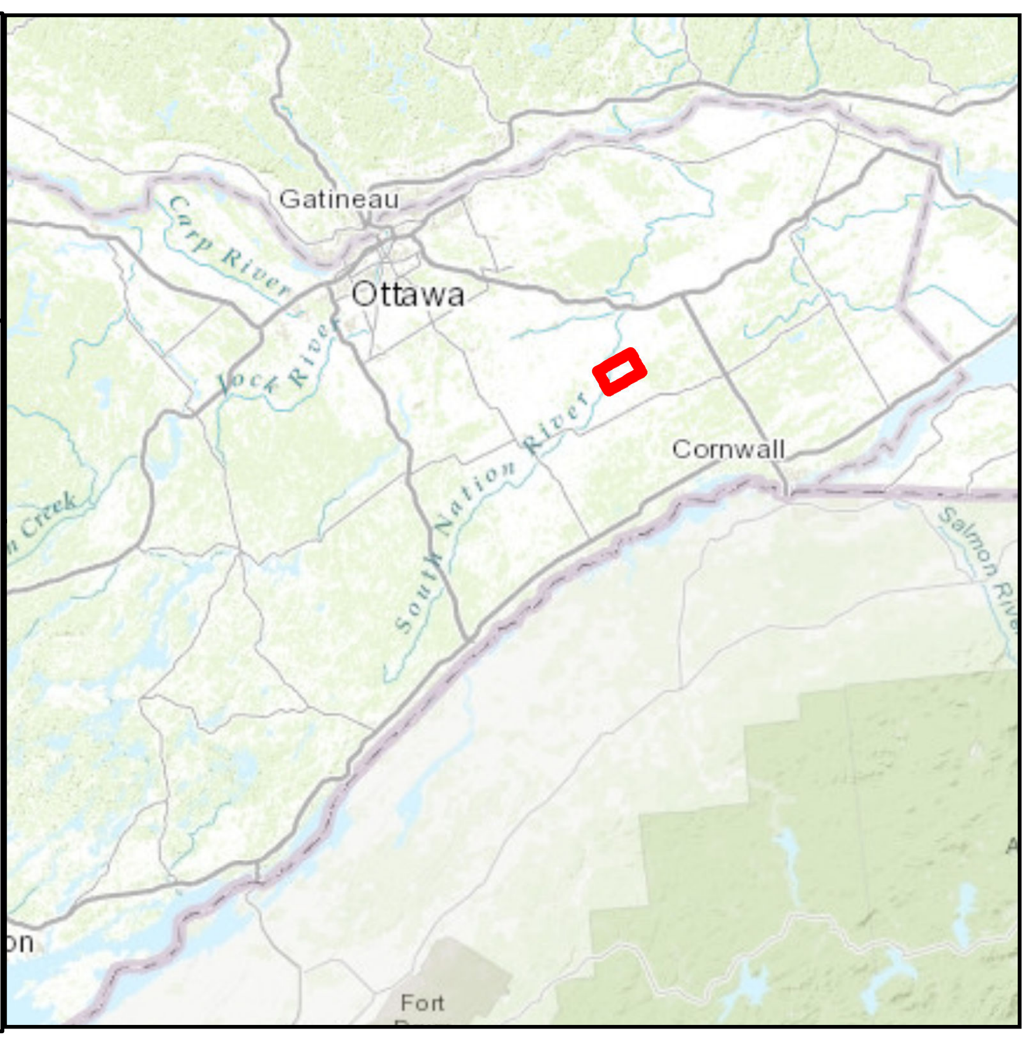
Leased Parcels - 04/20/2018



Legend

- • Towns
- ⊙ 33 WTG Layout
- Substation Location
- Turning Radii
- Access Road
- Crane Path
- Collection Route - Butternut Tree Avoidance
- ▨ Laydown Areas
- 🟨 Project Location Footprint
- 🟪 Substation Area
- Municipal Drains
- Municipal and County Roads
- 🟩 Leased Parcels
- 🟥 Non-Leased Parcels

Author: Nathan Roscoe
Date / Time: 20 April 2018 / 03:58 PM
Version:
Datum: North American 1983
Projection: NAD 1983 UTM Zone 18N
Scale: 1:26,969
Sources: EDPR, ESRI, Ventyx



CONFIDENTIAL

APPENDIX B

ABBREVIATIONS, TERMINOLOGY, AND PRINCIPAL SYMBOLS USED

ABBREVIATIONS, TERMINOLOGY AND PRINCIPAL SYMBOLS USED IN REPORT AND BOREHOLE LOGS

BOREHOLES AND TEST PIT LOGS

AA	Auger Sample
SS	Split Spoon
ST	Thin-walled Tube Sample
BS	Block Sample
W	Washed Sample
HQ	Rock Core (63.5 mm dia.)
NQ	Rock Core (36.5 mm dia.)
BQ	Rock Core (36.5 mm dia.)

IN SITU SOIL TESTING

Standard Penetration Test (SPT) "N" value. The number of blows required to drive a 51 mm OD split barrel sampler into the soil a distance of 300 mm with a 63.5kg weight free falling a distance of 760mm after an initial penetration of 150mm has been achieved.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60 degree apex attached to "A" size drill rods continuously into the soil for each 300mm penetration with a 63.5 kg weight free falling a distance of 760mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm' base area with a 60 degree apex pushed through the soil at a penetration rate of 2cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

SOIL DESCRIPTIONS

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained and highly organrc soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75mm. To aid in quantifying materal amounts by eight within the respective grain size fractions the following terms have been included to expand the USCS:

Soil Classification		Terminology	Proportion
Clay	<0.002 mm	“trace”	1%to 10%
Silt	0.002 to 0.06 mm	"some"	10% to 20%
Sand	0.075 to 4.75 mm	Sandy, Gravelly, etc.	20% to 35%
Gravel	4.751o 75 mm	“and”	>35%
Cobbles	75 to 200 mm	Noun, SAND, SILT, etc.	>35%
Boulders	>200 mm		

Notes:

1. Soil properties, such as strength, gradation, plasticity, structure, etc. dictate the soils engineering behaviour over the grain size fractions;
2. With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the relative density condition of cohesionless soil:

Cohesionless Soils

Compactness	SPT “N” Value (blows/30cm)
Very Loose	0 to 4
Loose	5 to 10
Compact	11 to 30
Dense	31 to 50
Very Dense	>50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-Index:

Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value (blows/30 cm)
Very Soft	<12.5	< 2
Soft	12.5 to 25	2 to 4
Firm	25 to 50	5 to 8
Stiff	50 to 100	9 to 15
Very Stiff	100 to 200	16 to 30
Hard	> 200	>30

Note: Utilizing the SPT, “N” value to correlate the consistency and undrained shear strength of cohesive soils is very approximate and needs to be used with caution.

ROCK CORING

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section rs broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum.

Intact Rock Strength

Intact Strength (Mpa)	Description
< 1	Extremely low strength
1-5	Very low strength
5-25	Low strength
25-50	Medium strength
50-100	High strength
100-250	Very high strength
>250	Extremely high strength

Rock Mass Quality

RQD Classification	RQD Value (%)
Very poor quality	<25
Poor Quality	25 to 50
Fair Qualty	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

Rock Mass Weathering

Term	Grade	Description
Unweathered (Fresh)	I	No visible sign of material weathering to discoloration on major discontinuity surfaces.
Slightly Weathered	II	Discoloration indicates weathering of rock material and discontinuity of surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than its fresh condition.
Moderatly Weathered	III	Less than half the rock material is decomposed and/or disintegrates to soil. Fresh or discolored rock is present either as a continuous frame work of as core stones.
Highly Weathered	IV	More than half the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a discontinuous frame work or as core stones.
Completely Weathered	V	All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.
Residual Soil	VI	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

SYMBOLS

General

w_N	Natural water content within the soil sample
γ	Unit weight
γ'	Effective unit weight
γ_D	Dry unit weight
γ_{SAT}	Saturated unit weight
ρ	Density
ρ_s	Density of solid particles
ρ_w	Density of water
ρ_D	Dry density
ρ_{SAT}	Saturated density
e	Void ratio
n	Porosity
S	Degree of saturation
E_{50}	Fifty percent secant modulus

Consistency

w_L	Liquid Limit
w_P	Plastric Limit
I_P	Plasticity Index
w_S	Shrinkage limit
I_L	Liquidity index
I_C	Consistency index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density index (formerly relative density)

Shear Strength

S_u	Undrained shear strength parameter (total stress)
c'	Effective cohesion intercept
ϕ'	Effective friction angle
τ_R	Peak shear strength
τ_R	Residual shear strength
δ	Angle of interface friction
μ	Coefficient of friction = tan ϕ'

Consolidation

C_c	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
m_v	Coefficient of volume change
c_v	Coefficient of consolidation
T_v	Time factor (vertical direction)
U	Degree of consolidation
σ'_v	Effictive overburden pressure
OCR	Overconsolidation ratio

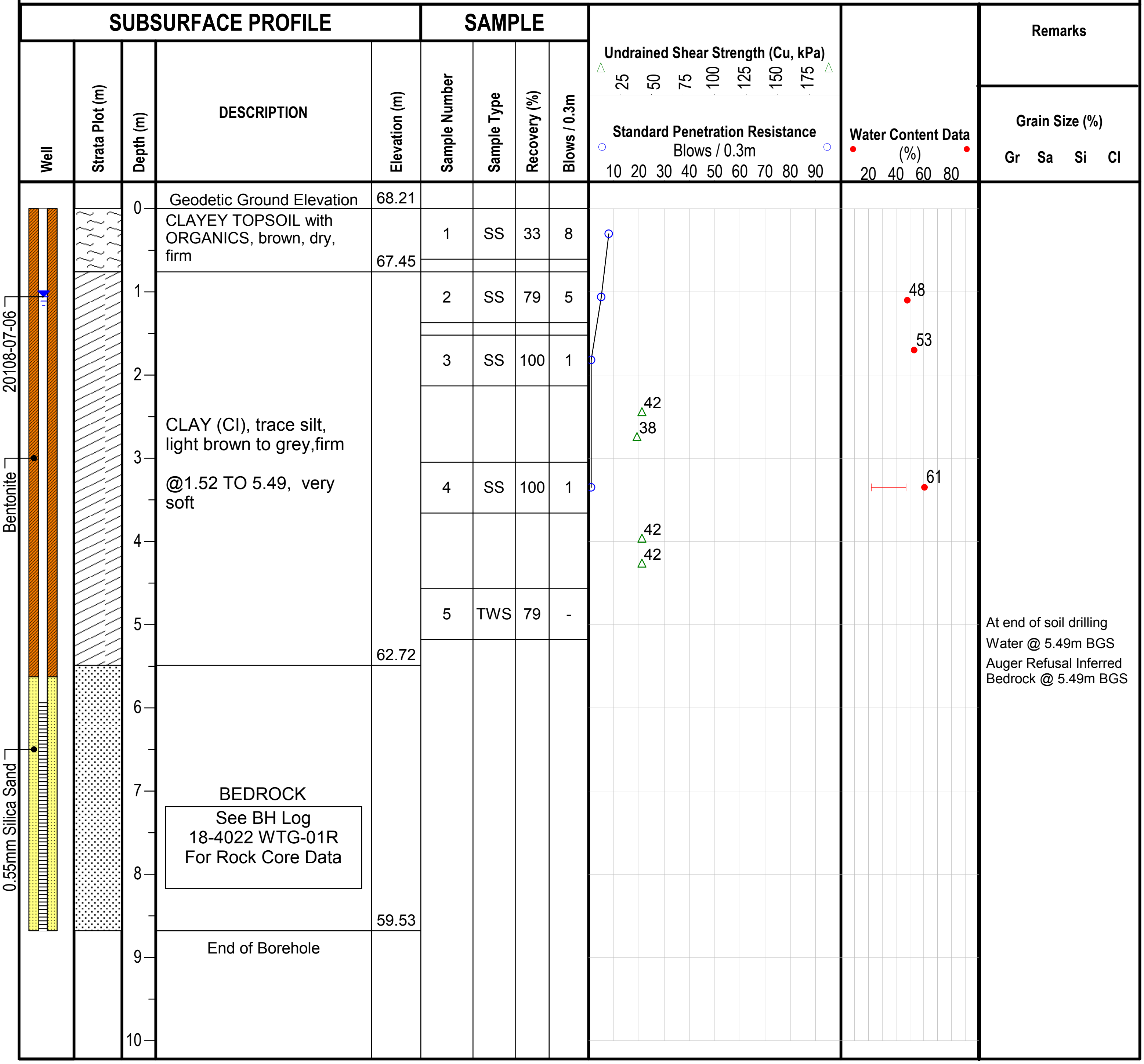
APPENDIX C

BOREHOLE LOGS

Borehole Log: WTG-01

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Marionville Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE

DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	68.21
CLAYEY TOPSOIL with ORGANICS, brown, dry, firm	67.45
CLAY (CI), trace silt, light brown to grey,firm @1.52 TO 5.49, very soft	62.72
BEDROCK See BH Log 18-4022 WTG-01R For Rock Core Data	59.53
End of Borehole	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	33	8
2	SS	79	5
3	SS	100	1
4	SS	100	1
5	TWS	79	-

Remarks

At end of soil drilling
Water @ 5.49m BGS
Auger Refusal Inferred
Bedrock @ 5.49m BGS

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 17, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**
E=480621
N=5007611

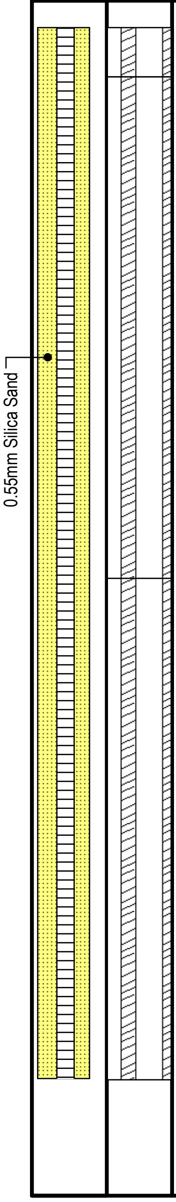
Sheet: **1 of 1**

TULLOCH ENGINEERING

Borehole Log: WTG-01R

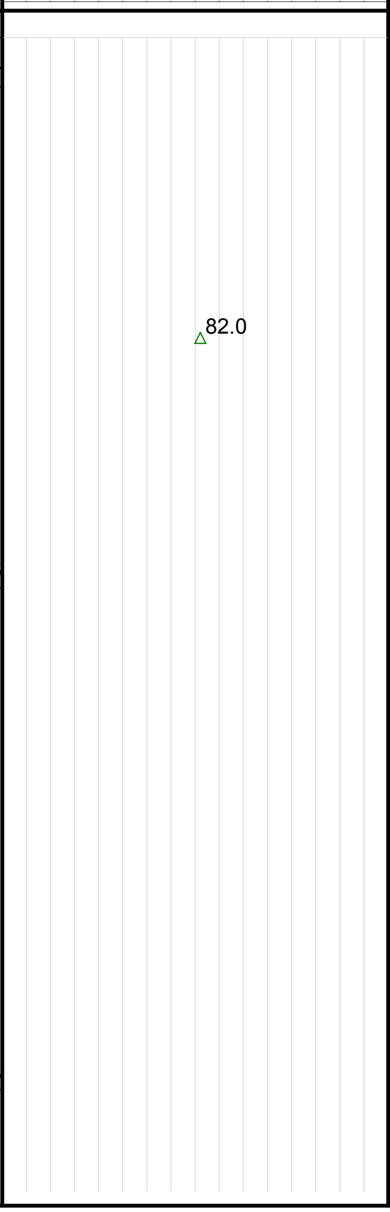
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Marionville Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE			SAMPLE					
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Remarks
	Geodetic Rock Elevation	62.72						
0	SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, broken zone @ top of run with significant weathering	62.57	1	27	0	15	62.57	
1	SHALEY LIMESTONE, black / grey, thinly bedded to thinly laminated, fine grained, some discontinuities with some weathering along horizontal fractures	61.05	2	151	87	152	61.05	TCR exceeds run length due to fragmented nature of rock
2 3	SHALEY LIMESTONE, black / grey, thinly bedded to thinly laminated, fine grained, some discontinuities with minimal weathering along horizontal fractures	59.53	3	152	87	152	59.53	
	End of Rock Core							

Unconfined Compressive Strength
(MPa)



Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 17, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=480621
N=5007611

Sheet: 1 of 1

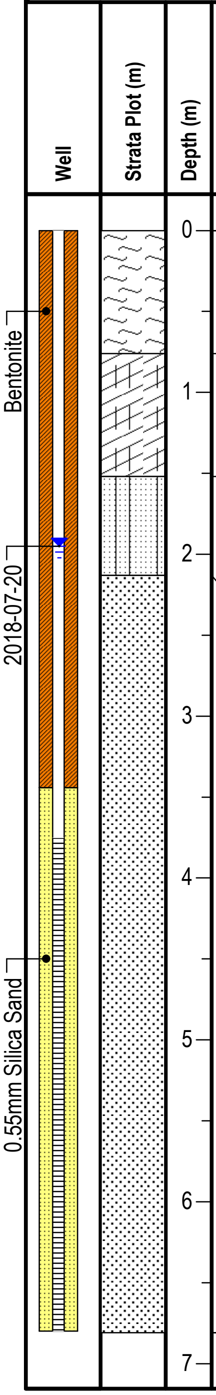
Borehole Log: WTG-02

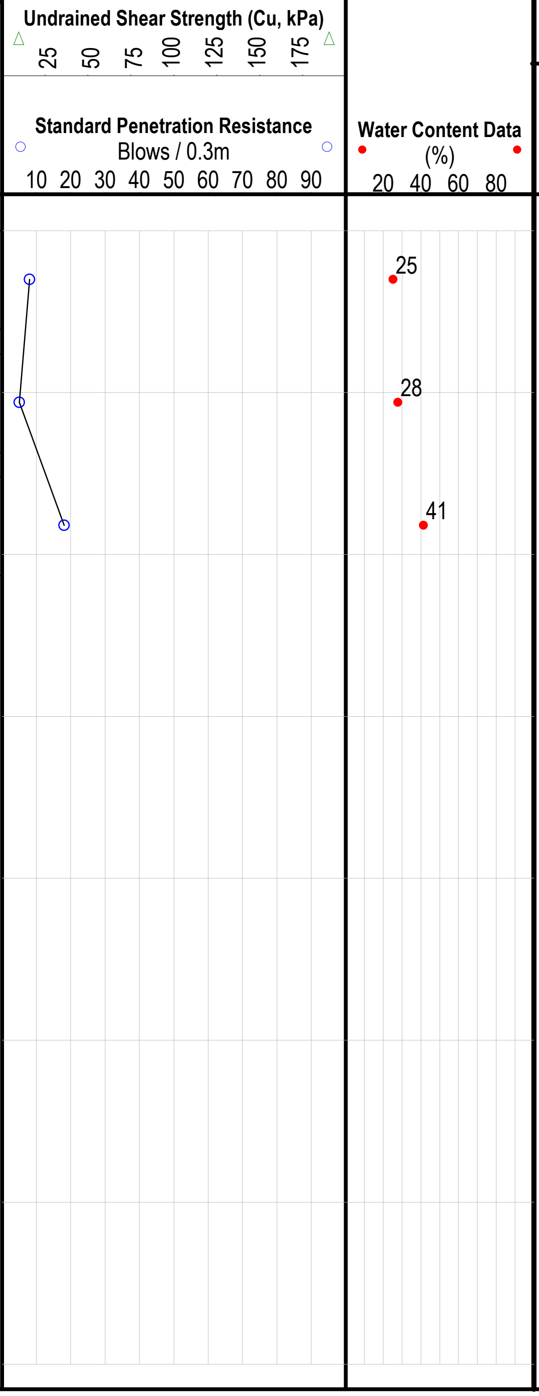
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Marionville Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)
	Geodetic Ground Elevation	70.14					
0	CLAYEY TOPSOIL, trace sand and organics, brown, dry, firm	69.38	1	SS	42	8	25
1	SILTY CLAY (CI), light brown, moist, firm	68.62	2	SS	83	5	28
	SANDY SILT CLAY (CL), fine grained, trace gravel, light brown, moist to wet, very soft	68.01	3	SS	92	18	41
2–7	BEDROCK See BH Log 18-4022 WTG-02R For Rock Core Data	63.33					
7	End of Borehole						





Remarks

Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 17, 2018

Sample Type
- AS - Auger Sample
- SS - Split Spoon
- TWS - Thin Walled Shelby Tube
- BS - Block Sample
- NQ - Rock Core
- W - Water Content
- WL- Liquid Limit
- WP- Plastic Limit
- △ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

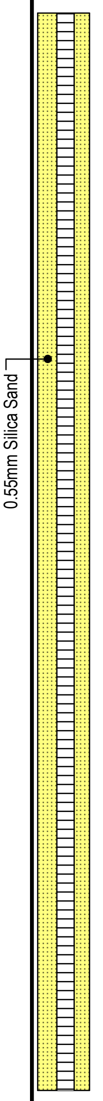
Location: UTM 18T
E=480992
N=5007313

Sheet: 1 of 1

Borehole Log: WTG-02R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Marionville Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	68.01							
0	SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, broken zone @ top of run with significant weathering at fractures / discontinuities	67.32	1	66	53	68.5	67.32		
1 2	SHALEYLIMESTONE, black / grey, fine grained, thinly bedded to thinly laminated, white intrusion ~ 55cm from top of run, horizontal & angled fractures with some weathering at discontinuities	65.77	2	155	63	155	65.77		
3	SHALEYLIMESTONE, black / grey, fine grained, thinly bedded to thinly laminated, horizontal & angled fractures with some weathering at discontinuities	64.35	3	142	73	142	64.35		
4	LIMESTONE, significantly less shale content, thinly laminated to laminated, fine grained, minimal weathering at discontinuities	63.33	4	102	95	102	63.33		
5	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 17, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=480992
N=5007313

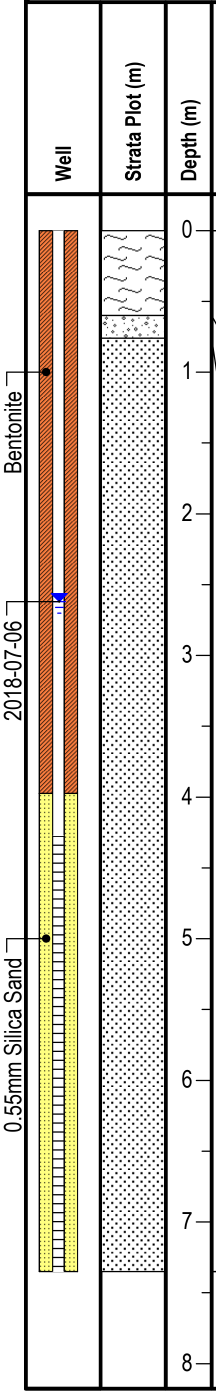
Sheet: 1 of 1

Borehole Log: WTG-04

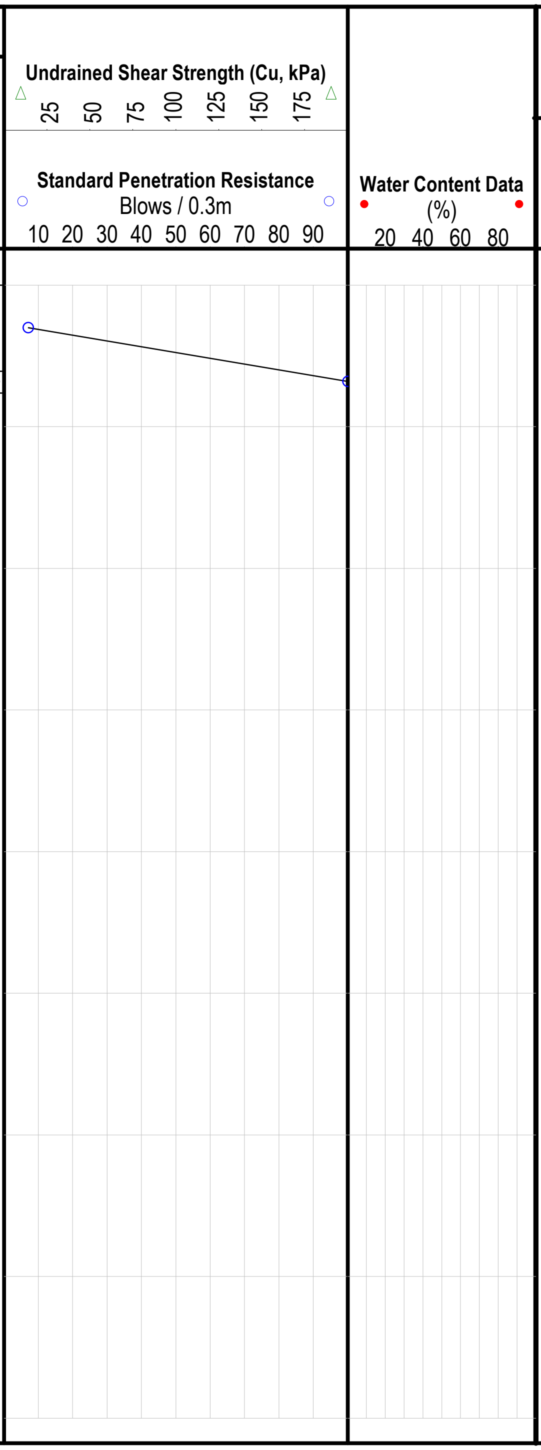
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE | **SAMPLE**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	81.89					
CLAYEY TOPSOIL with ORGANICS, trace sand, some gravel, light brown, dry, loose	81.29	1	SS	25	7	Exposed Bedrock At Surface 65m North Of Drill Site
FRACTURED ROCK with sand and gravel, brown, dry, very dense		2			100+	Spoon Refusal on Inferred Bedrock @ 0.762m BGS
BEDROCK See BH Log 18-4022 WTG-04R For Rock Core Data	74.54					
End of Borehole						



Grain Size (%)
Gr Sa Si Cl

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 16, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**
E=482870
N=5006768

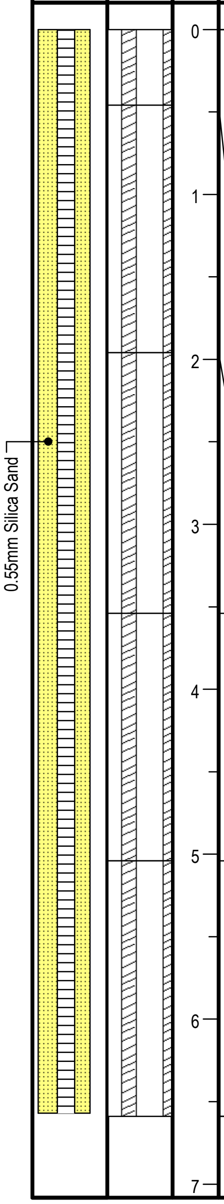
Sheet: **1 of 1**

Borehole Log: WTG-04R

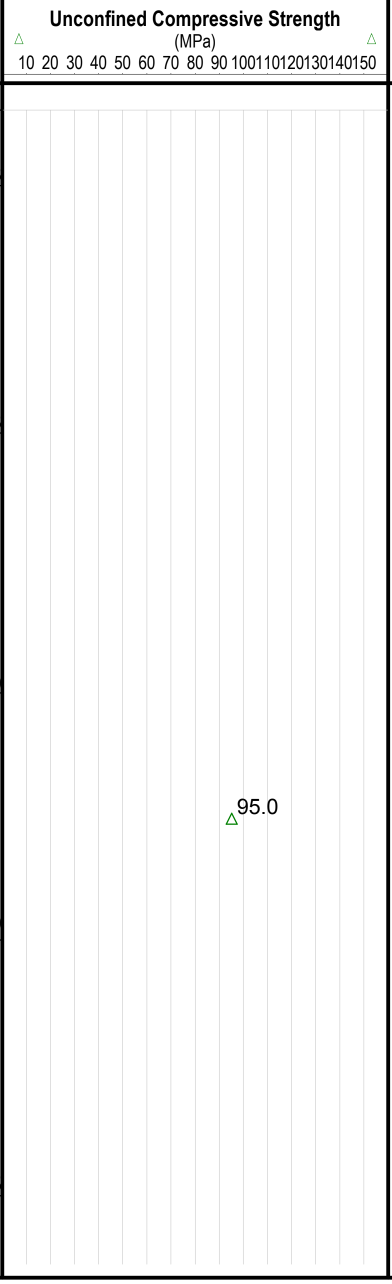
TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)
Geodetic Rock Elevation	74.54					
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, top of run is broken & weathered, discontinuities near bottom of run exhibit significant weathering	74.08	1	51	52	46	74.08
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, horizontal, vertical and angled fractures present in core with significant weathering present at discontinuities	72.58	2	144	65	150	72.58
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, some weathering present at discontinuities (horizontal fractures)	71.00		157.5	73	157.5	71.00
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, some weathering present at discontinuities (horizontal fractures)	69.50	4	149	73	150	69.50
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, minimal weathering present at discontinuities (horizontal fractures)	67.95	5	155	72	155	67.95
End of Rock Core						



Remarks

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 16, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=482870
N=5006768

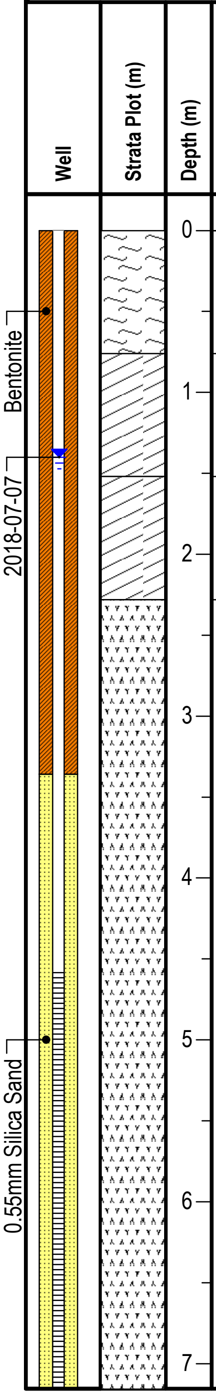
Sheet: **1 of 1**

Borehole Log: WTG-05

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 11-12, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

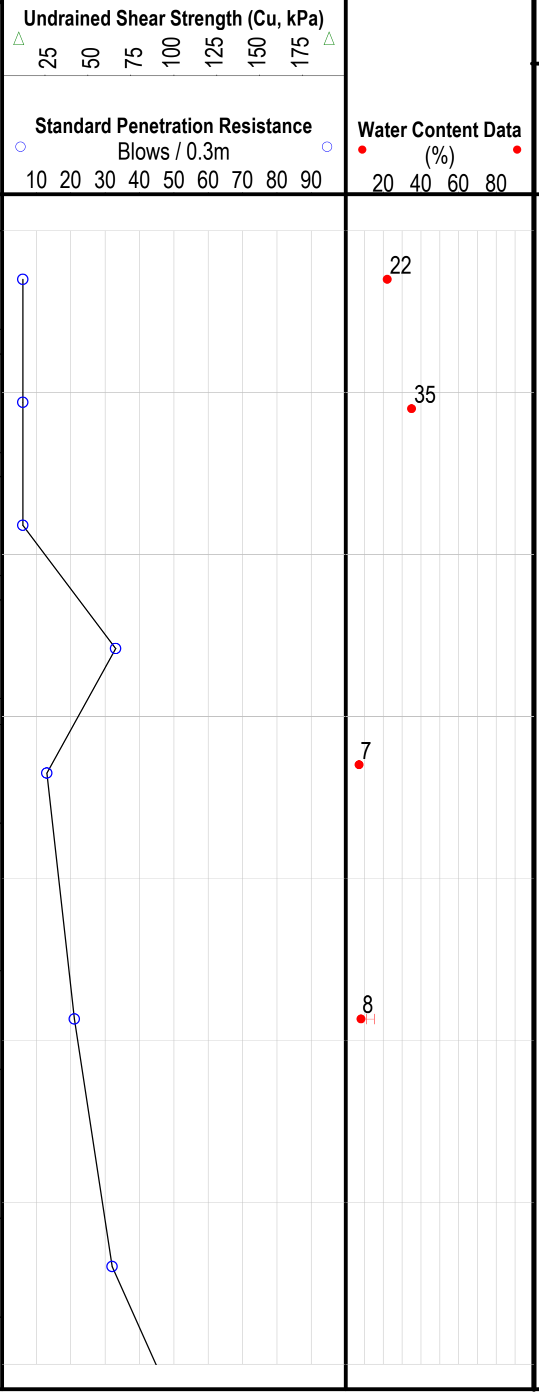
SUBSURFACE PROFILE



Depth (m)	DESCRIPTION	Elevation (m)
	Geodetic Ground Elevation	70.39
0	CLAYEY TOPSOIL (CL), trace organics, trace sand, brown, moist to dry, firm	69.63
1	CLAY (CI), trace to some silt, light brown, moist, firm	68.87
2	254mm SILTY CLAY (CL), to CLAYEY TILL, some gravel, dark brown, moist, firm	68.11
3–7	SILTY TILL (ML), some gravel, trace sand, compact @ 7.62m to 8.53m BGS SILTY TILL (ML), with gravel, trace sand, moist to wet, compact to dense	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	50	6
2	SS	88	6
3	SS	79	6
4	SS	79	33
5	SS	92	13
6	SS	83	21
7	SS	79	32



Remarks

Grain Size (%)

Gr	Sa	Si	Cl

Some Water At 4.57m BGS during drilling

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 15, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

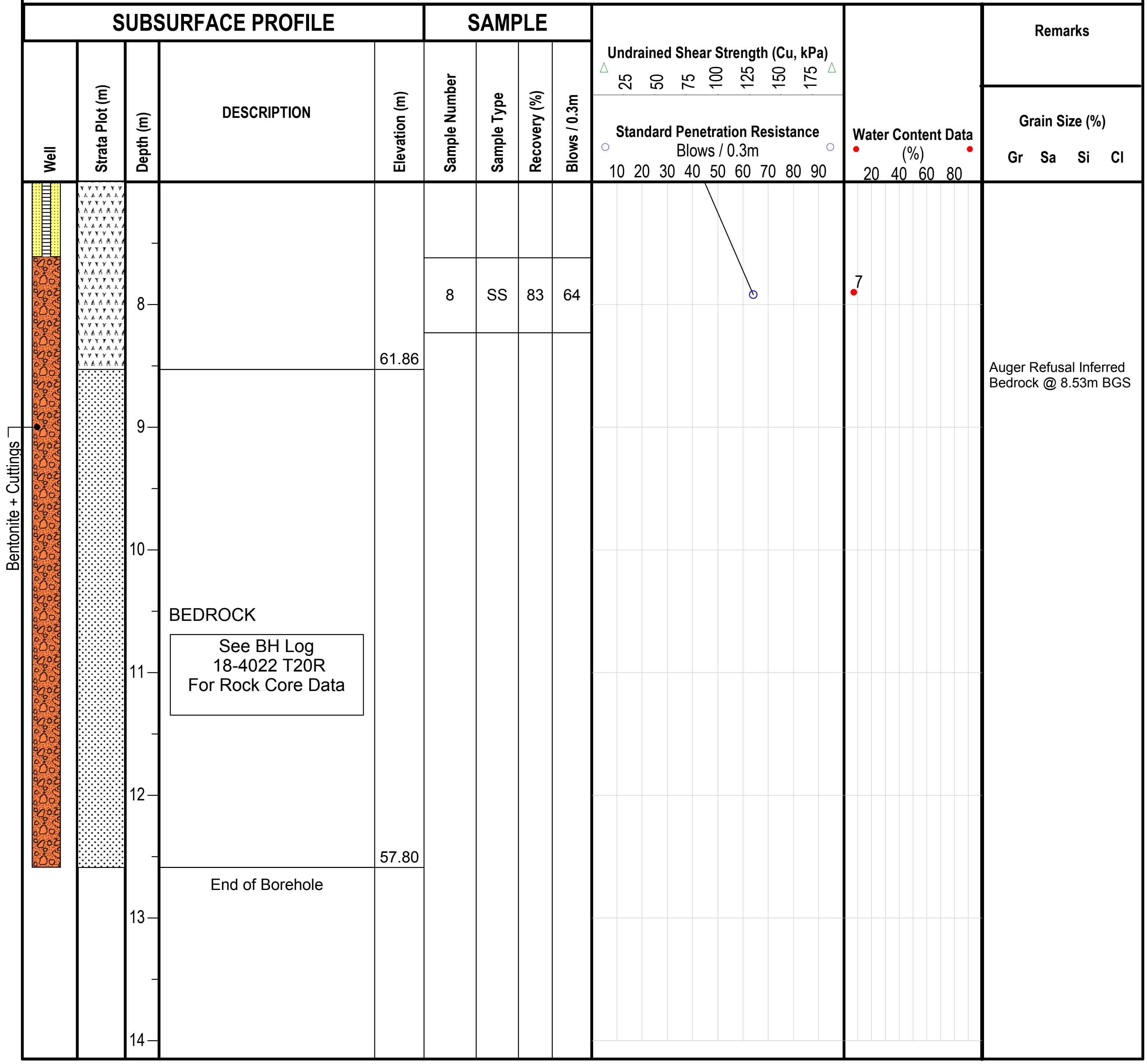
Location: **UTM 18T**
E=484160
N=5007567

Sheet: **1 of 2**

Borehole Log: WTG-05

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 11-12, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



Description	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
		8	SS	83	64	
	61.86					Auger Refusal Inferred Bedrock @ 8.53m BGS
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	57.80					
End of Borehole						

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 15, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T

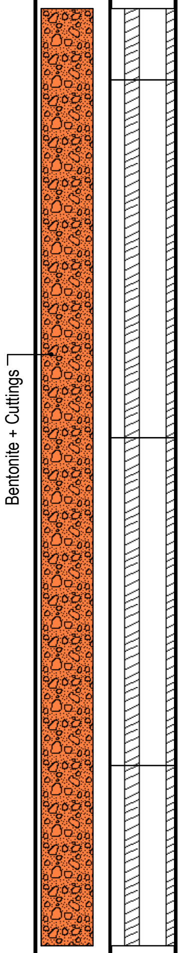
Sheet: 2 of 2

Borehole Log: WTG-05R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 11-12, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	**Elevation (m)**	**Sample Number**	**TCR (cm)**	**RQD (%)**	**Run Length (cm)**	**Run Depth Elevation (m)**	**Unconfined Compressive Strength** (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	**Remarks**
Geodetic Rock Elevation	61.86							
SHALEY LIMESTONE, grey / black, fine grained, laminated to thinly laminated, slight weathering at top of run, horizontal discontinuities	61.55	1	46	85	30.5	61.55		TRR exceeds run length due to gragmented nature of core
SHALEY LIMESTONE, grey / black, fine grained, laminated to thinly laminated, excellent rock, only one horizontal (mechanical in nature) break, no weathering	60.00	2	155	94	155	60.00		
SHALEY LIMESTONE, grey / black, fine grained, laminated to thinly laminated, excellent rock, only one horizontal (mechanical in nature) break, no weathering , extremely weathered and broken section from 10.92m-11.35m BGS	58.58	3	142	65	142	58.58		
SHALEY LIMESTONE, grey / black, fine grained, laminated to thinly laminated, excellent rock, only one horizontal (mechanical in nature) break, no weathering	57.80	4	78	99	78.5	57.80		
End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 15, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

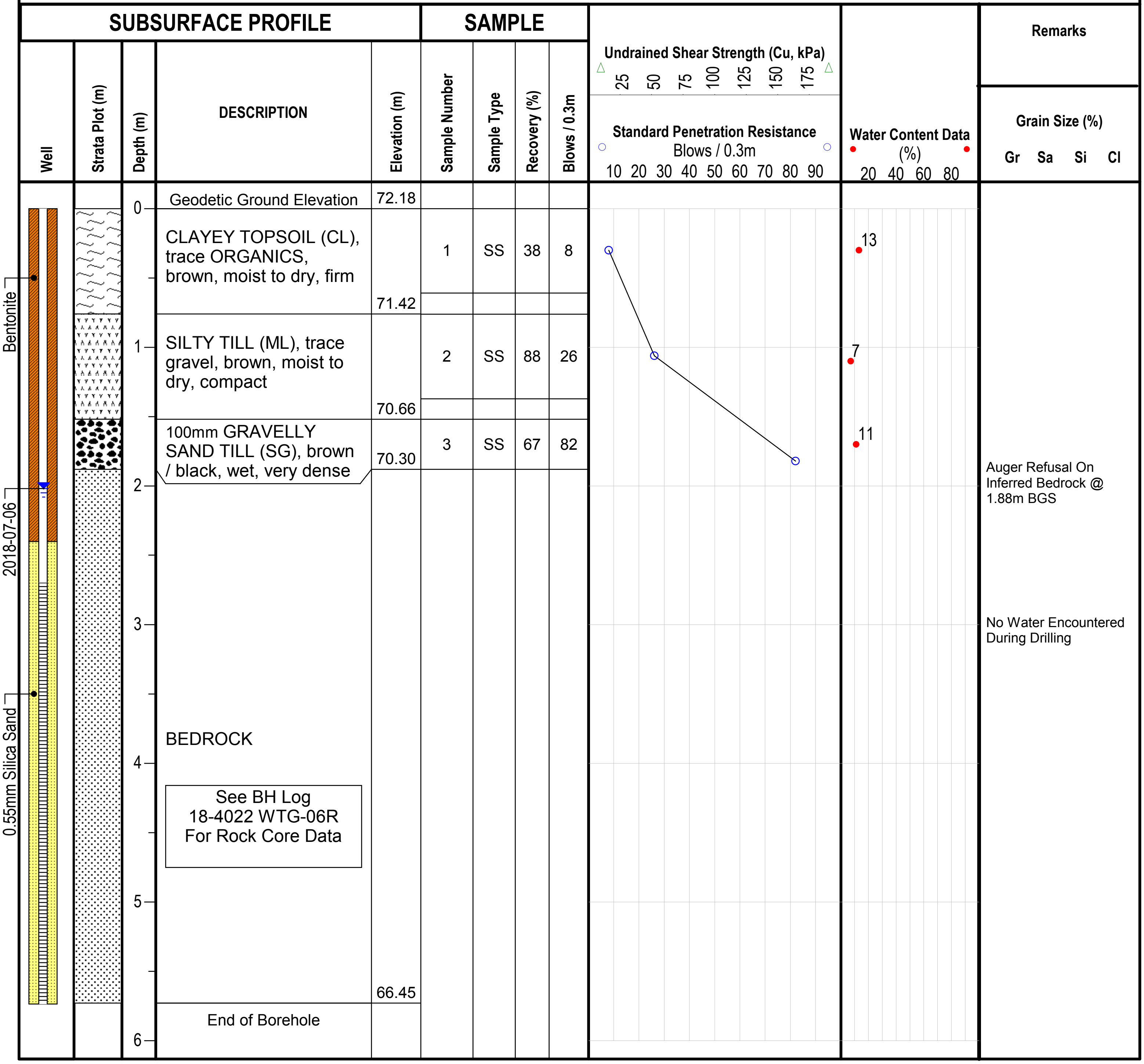
Location: **UTM 18T**
E=484160
N=5007567

Sheet: **1 of 1**

Borehole Log: WTG-06

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE				
DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	72.18					
CLAYEY TOPSOIL (CL), trace ORGANICS, brown, moist to dry, firm	71.42	1	SS	38	8	
SILTY TILL (ML), trace gravel, brown, moist to dry, compact	70.66	2	SS	88	26	
100mm GRAVELLY SAND TILL (SG), brown / black, wet, very dense	70.30	3	SS	67	82	Auger Refusal On Inferred Bedrock @ 1.88m BGS
BEDROCK See BH Log 18-4022 WTG-06R For Rock Core Data	66.45					No Water Encountered During Drilling
End of Borehole						

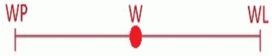
Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 14, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer



Datum: **Ground Surface**

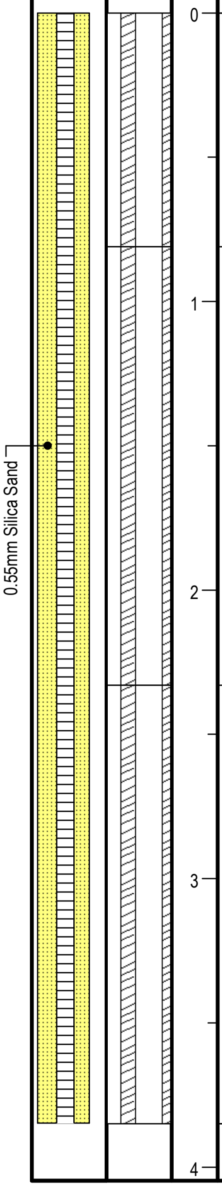
Location: **UTM 18T**
E-481950
N=5004643

Sheet: **1 of 1**

Borehole Log: WTG-06R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 10-11, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Geodetic Rock Elevation	70.30							
SHALEY LIMESTONE, black / grey, fine grained, weathered rock at top of run, thinly laminated to laminated, four (4) discontinuities present with some weathering at horizontal fractures	69.49	1	66	60	81	67.97		
SHALEY LIMESTONE, black / grey, highly weathered at some discontinuities (horizontal fractures and small voids in rock) fine grained, thinly laminated to laminated	67.97	2	152	55	152	64.12		
SHALEY LIMESTONE, black / grey, fine grained, thinly laminated to laminated, some discontinuities with minimal weathering, excellent rock	66.45	3	155	93	152	66.45		
End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 14, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E-481950
N=5004643

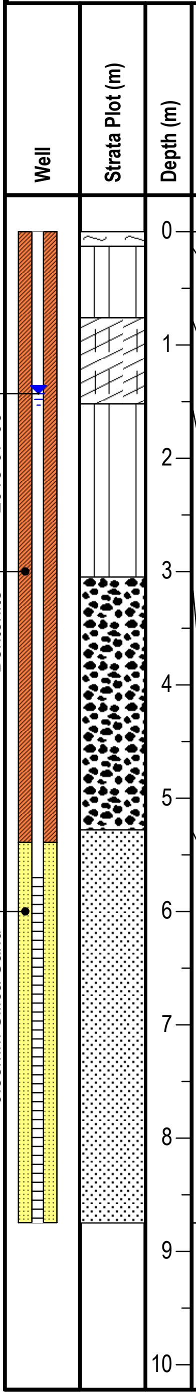
Sheet: 1 of 1

Borehole Log: WTG-07

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

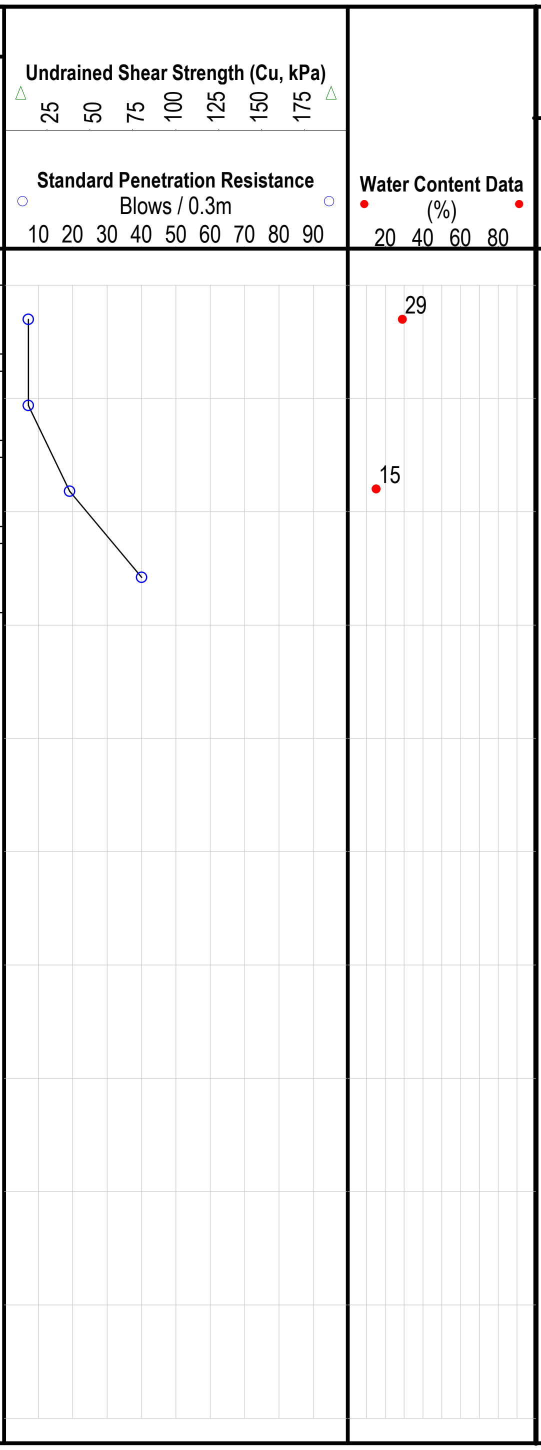
SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	72.88
125mm TOPSOIL	
SILTY CLAY (CI), trace ORGANICS, brown, moist, soft to firm	72.12
SILTY CLAY (CI), trace gravel, oxidated, brown to dark brown, moist, firm	71.36
SILT (ML), trace gravel, angular, trace clay, dark brown, oxidated, moist, compact @2.28m to 3.05m SILT (ML), trace gravel, dark brown, oxidated, moist, dense	69.83
BOULDERS, COBBLES, weathered, angled fractures, horizontal fractures, grey, very dense	67.60
BEDROCK See BH Log 18-4022 WTG-07R For Rock Core Data	64.13
End of Borehole	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	63	7
2	SS	50	7
3	SS	96	19
4	SS	83	40



Remarks

Grain Size (%)

Gr	Sa	Si	Cl

Spoon Refusal Using Casing From 2.89m BGS

Inferred Bedrock @ 5.18m BGS

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 18, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
O- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**
E=484187
N=5005760

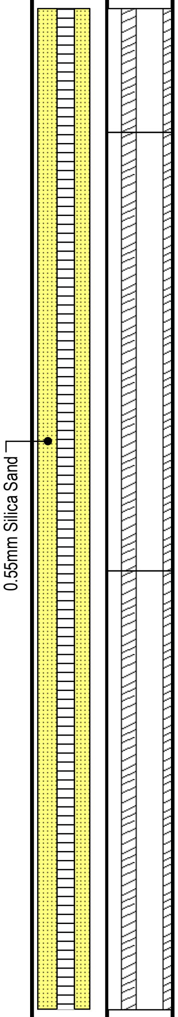
Sheet: **1 of 1**

TULLOCH ENGINEERING

Borehole Log: WTG-07R

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	67.60							
0	LIMESTONE, grey, slightly weathered, horizontal fractures, fine grained, laminated	67.17	1	43	82	43	67.17		
1	LIMESTONE, grey, slightly weathered, horizontal fractures, angular fractures, fine grained, laminated	65.65	2	152	75	152	65.65		
2 3	LIMESTONE, grey, weathered, horizontal fractures, fine grained, laminated	64.13	3	152	98	152	64.13		
4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 18, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=484187
N=5005760

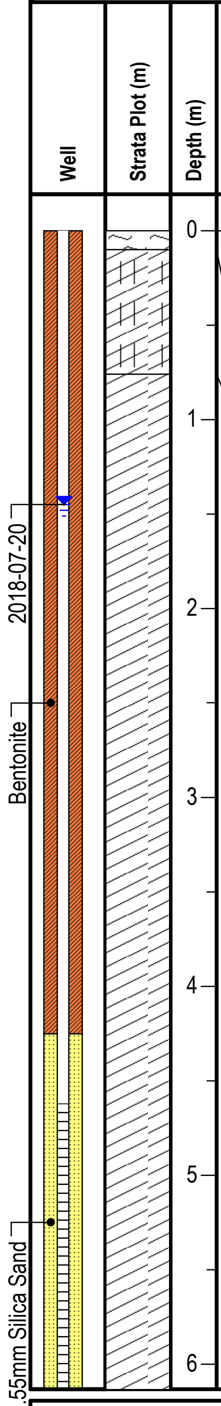
Sheet: **1 of 1**

Borehole Log: WTG-09

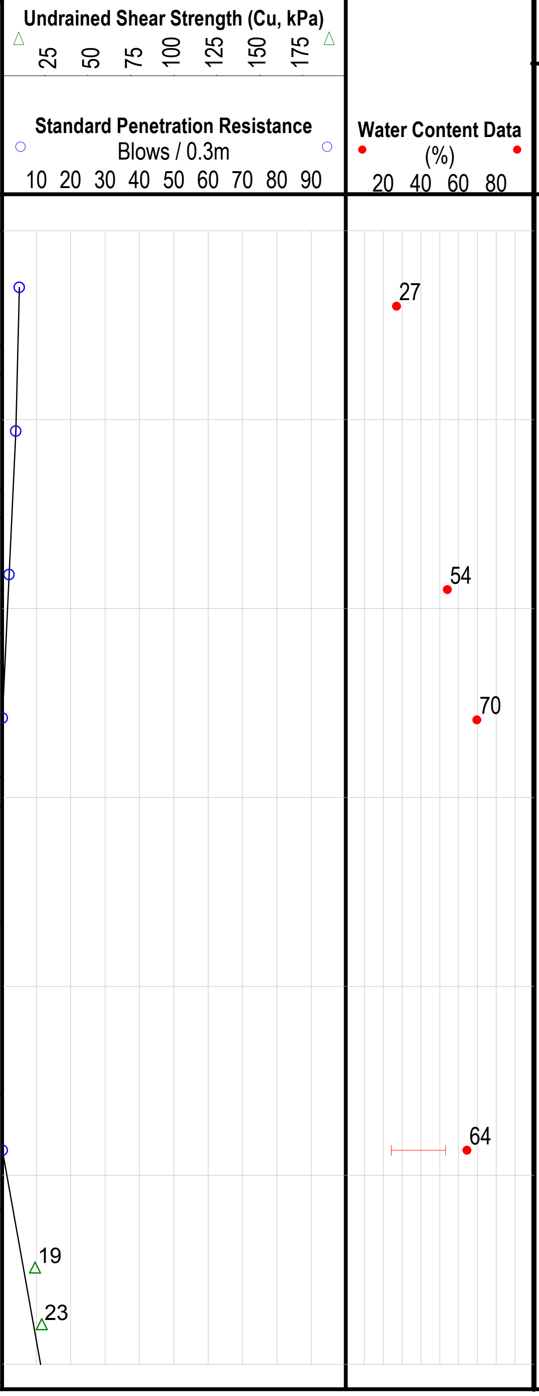
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE | SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	70.07				
100mm TOPSOIL, SILTY SAND (SM), brown, dry		1	SS	71	5
SILTY CLAY (CI), dark brown, moist, firm, some oxidation	69.31				
SILTY CLAY (CI), oxidized, brown to grey, moist, soft		2	SS	83	4
		3	SS	79	2
@1.52m to 2.28m BGS SILTY CLAY (CI), grey, moist, very soft		4	SS	100	WH
@ 2.28m to 6.55m BGS SILTY CLAY (CI), grey, wet, very soft		5	TWS	100	-
		6	SS	100	WH



Remarks

Grain Size (%)

Gr Sa Si Cl

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 18, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
O- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

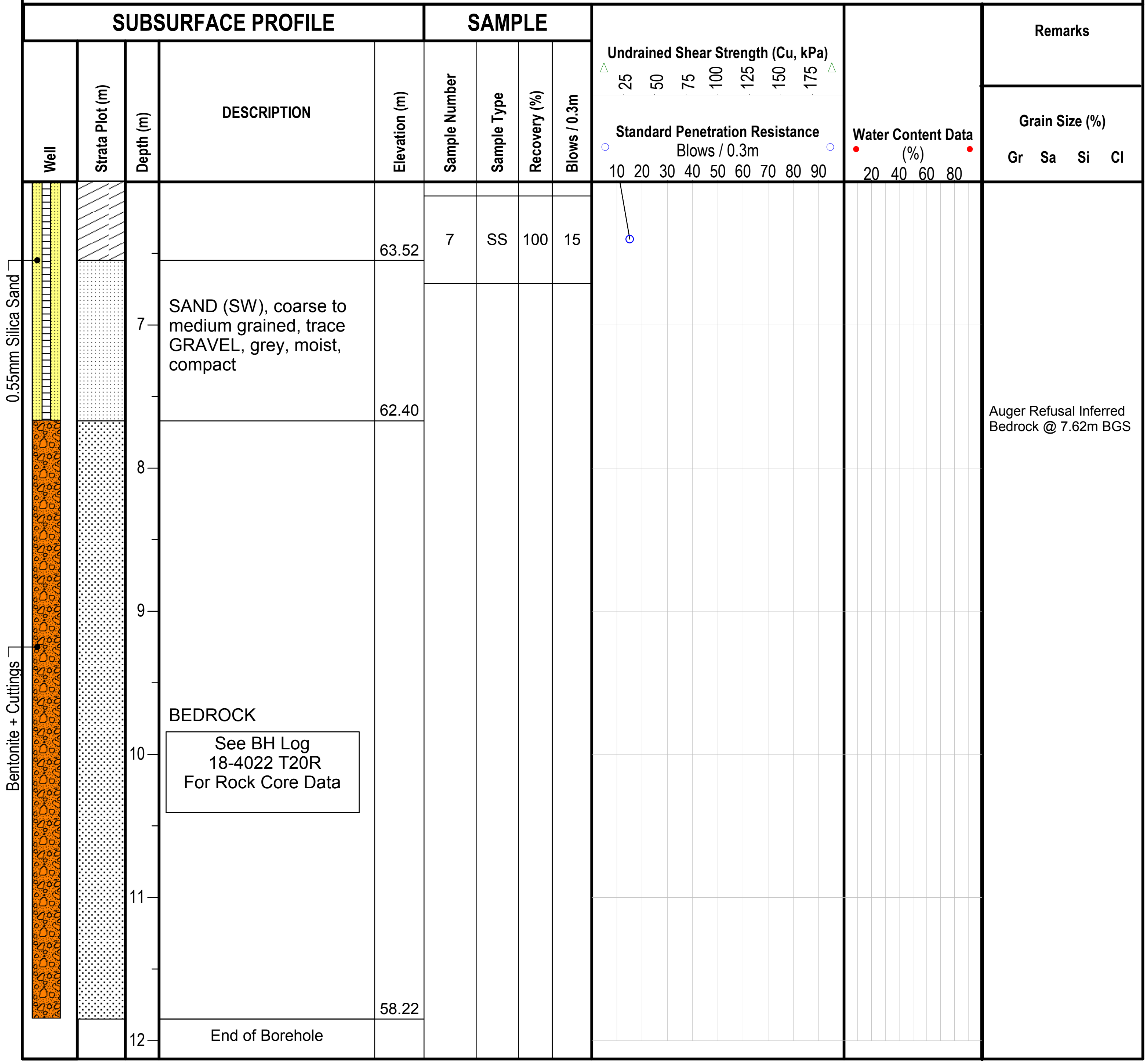
Location: **UTM 18T**
E=485446
N=5006565

Sheet: **1 of 2**

Borehole Log: WTG-09

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
	63.52	7	SS	100	15	
SAND (SW), coarse to medium grained, trace GRAVEL, grey, moist, compact	62.40					Auger Refusal Inferred Bedrock @ 7.62m BGS
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	58.22					
End of Borehole						

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 18, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
O- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**

Sheet: **2 of 2**

Borehole Log: WTG-09R

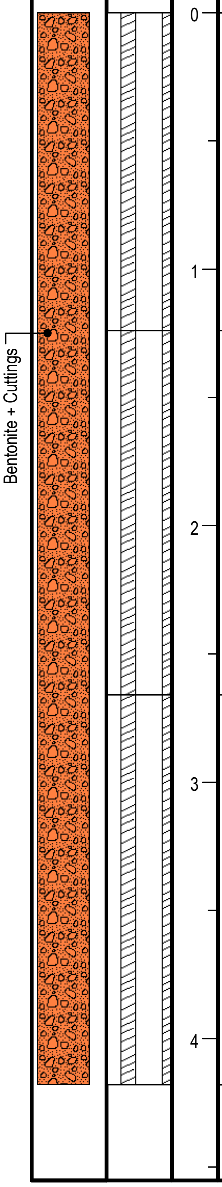
TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 10-11, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

Well | Strata Plot (m) | Depth (m)



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Geodetic Rock Elevation	62.40							
LIMESTONE, grey, weathered, laminated with thin black bedding, horizontal fractures	61.16	1	124	88	124	61.16		
LIMESTONE, grey, slightly weathered, laminated with thin black bedding, horizontal fractures, vertical fractures from 9.75m to 11.88m BGS	59.74	2	152	68	152	59.74		
LIMESTONE, grey, very slightly weathered, laminated with thin black bedding, horizontal fractures	58.22	3	152	82	152	58.22		
End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 18, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

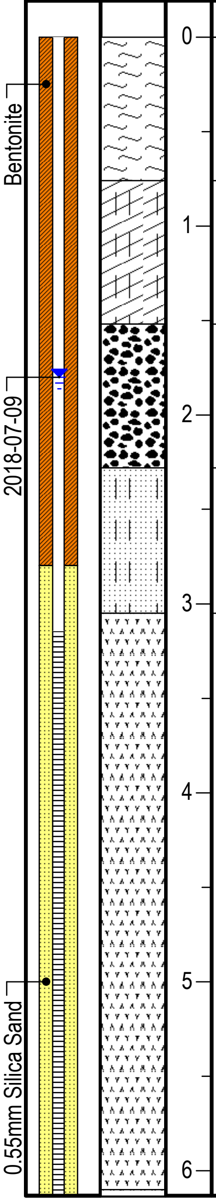
Location: UTM 18T
E=485446
N=5006565

Sheet: 1 of 1

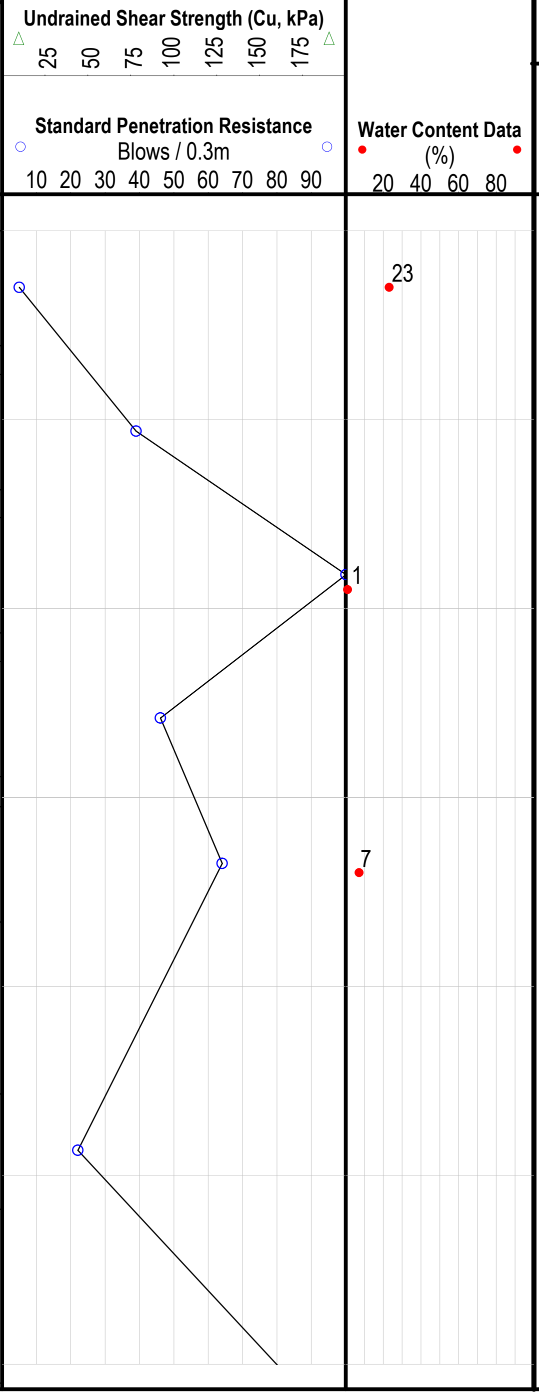
Borehole Log: WTG-10

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Rd 13 & Finch, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE		SAMPLE			
DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	74.75				
SILTY CLAY TOPSOIL (CL), trace organics, trace gravel, brown, firm	73.99	1	SS	54	5
SILTY CLAY (Ci) to clay SILT, some GRAVEL, cobbles & boulders, brown / grey, hard	73.23	2	SS	83	39
GRAVEL (GM), TRACE SILT, boulder fragments, grey, dry to moist, very dense	72.47	3	SS	67	100+
SILTY SAND (SM), with some gravel, grey / brown, very dense	71.70	4	SS	79	46
SILT TILL (ML), with sand, some gravel, grey, moist, compact	68.65	5 6	SS SS	71 58	64 22



Remarks	Grain Size (%)			
	Gr	Sa	Si	Cl
No Water Encountered During Drilling				

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 7, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

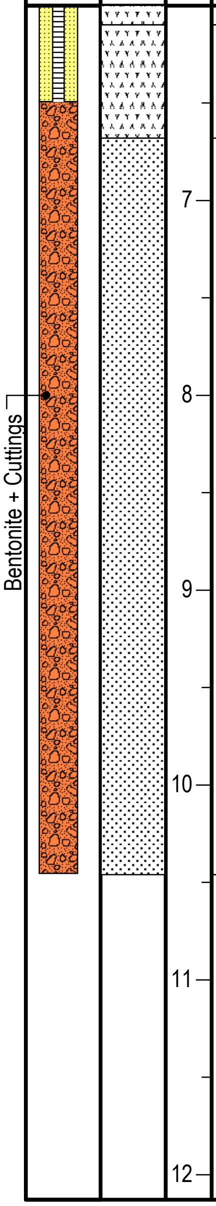
Location: UTM 18T
E=483097
N=5003468

Sheet: 1 of 2

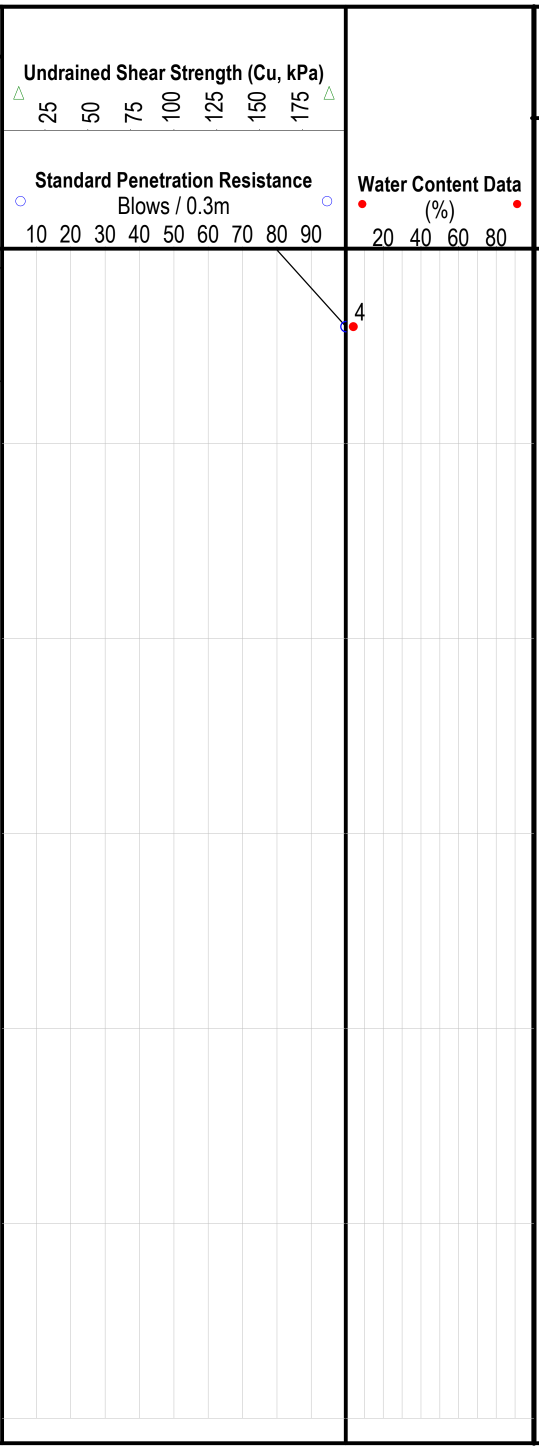
Borehole Log: WTG-10

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Rd 13 & Finch, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE		SAMPLE				
DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
SILT TILL (ML), some gravel, dark grey, moist to dry, very dense	68.07	7	SS	79	100+	
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	64.29					Auger Refusal On Inferred Bedrock @ 6.68m BGS
End of Borehole						



Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 7, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T

Sheet: 2 of 2

TULLOCH ENGINEERING

Borehole Log: WTG-10R

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **County Road 13 & Finch, North Stormont, ON**
Client: **EDPR**

Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	△ Unconfined Compressive Strength (MPa) △ 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	68.07							
Bentonite + Cuttings		0	SHALEY LIMESTONE, very thinly bedded to laminated, grey,slightly weathered	67.33	1	63	83	74	67.33		
		1 2	SHALEY LIMESTONE, very thinly bedded to laminated, slightly weathered, grey	65.81	2	143	94	152	65.81		
		3	SHALEY LIMESTONE, very thinly bedded to laminated, grey to dark grey, slightly weathered	64.29	3	137	90	152	64.29		
		4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 8, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=483097
N=5003468

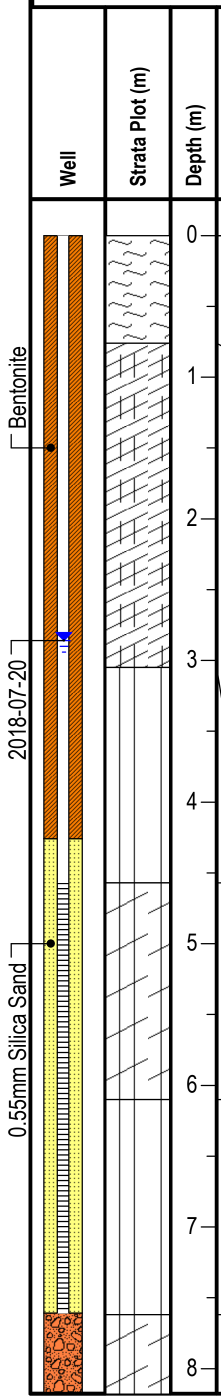
Sheet: **1 of 1**

Borehole Log: WTG-11

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **County Rd 13 & Finch, North Stormont, ON**
Client: **EDPR**

Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

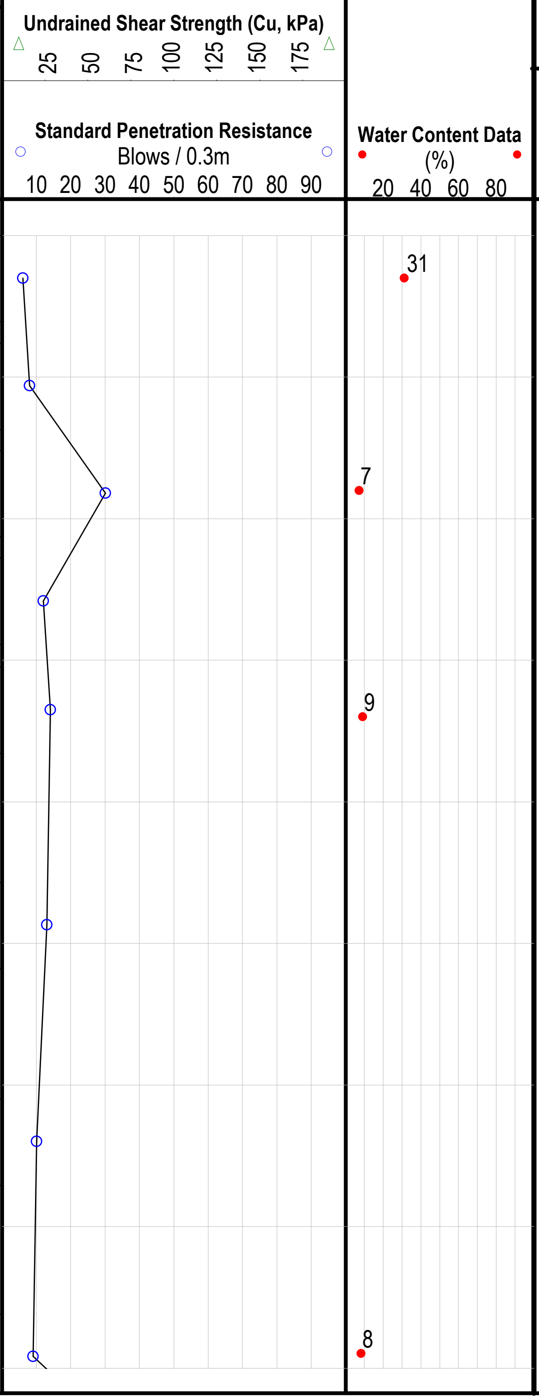
SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	74.00
SILTY CLAY TOPSOIL (CL), trace ORGANICS, brown to grey, moist, firm	73.24
CLAYEY SILT TILL (CI), with some gravel, trace till, grey bits of brown, moist, stiff @ 1.52m to 2.28m BGS (CM) SILT (ML), some gravel, trace sand, till, greyish brown, moist, compact @ 2.28m to 3.05m BGS SILT TILL (ML), with trace gravel, greyish brown, moist, compact	70.95
SILT TILL (ML), some gravel, trace clay, grey, moist, compact	69.43
SILT TILL (ML), some gravel, trace sand, grey, wet, compact	67.90
SILT TILL (ML), some gravel, trace clay, grey, wet, compact	66.38

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	92	6
2	SS	100	8
3	SS	71	30
4	SS	25	12
5	SS	75	14
6	SS	33	13
7	SS	54	10
8	SS	83	9



Remarks

Grain Size (%)

Gr Sa Si Cl

No Water Encountered During Drilling

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 8, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

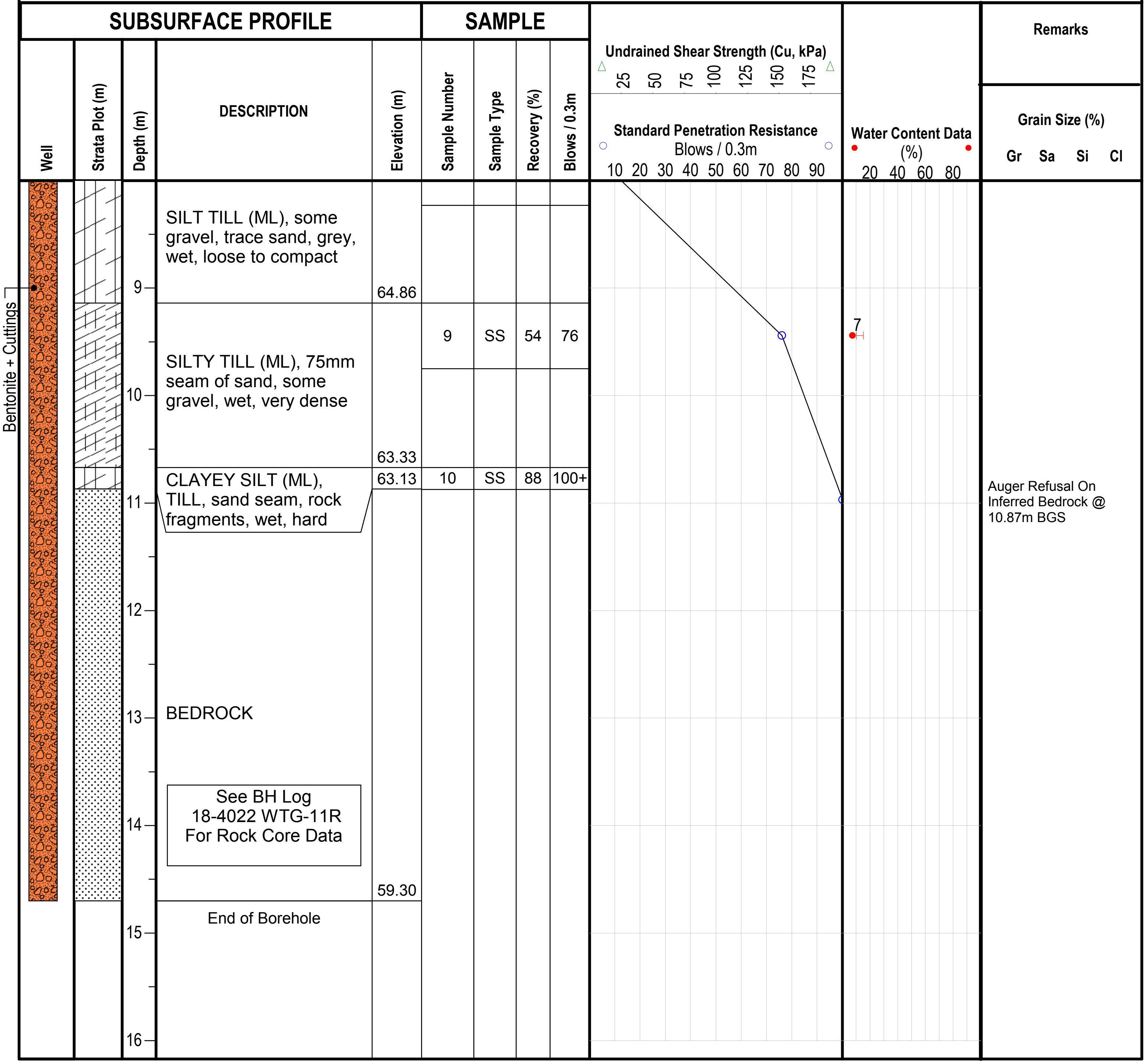
Location: **UTM 18T**
E=483354
N=5003162

Sheet: **1 of 2**

Borehole Log: WTG-11

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **County Rd 13 & Finch, North Stormont, ON**
Client: **EDPR**

Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
SILT TILL (ML), some gravel, trace sand, grey, wet, loose to compact	64.86					
SILTY TILL (ML), 75mm seam of sand, some gravel, wet, very dense	63.33	9	SS	54	76	
CLAYEY SILT (ML), TILL, sand seam, rock fragments, wet, hard	63.13	10	SS	88	100+	Auger Refusal On Inferred Bedrock @ 10.87m BGS
BEDROCK See BH Log 18-4022 WTG-11R For Rock Core Data	59.30					
End of Borehole						

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 8, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**
E=483354
N=5003162

Sheet: **2 of 2**

TULLOCH
ENGINEERING

Borehole Log: WTG-11R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Road 13 & Finch, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	△ Unconfined Compressive Strength (MPa) △ 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	63.13							
		0 1	SHALEY LIMESTONE, grey / black, very thinly bedded to thinly laminated, fine grained, slightly weathered	61.78	1	110	76	135	61.78		
Bentonite + Cuttings		2	SHALEY LIMESTONE, grey / black, very thinly bedded to thinly laminated, fine grained, slightly weathered	60.26	2	152	89	152	60.26		
		3	SHALEY LIMESTONE, grey / black, very thinly bedded to thinly laminated, fine grained, slightly weathered	59.30	3	101	96	96	59.30		
		4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 9, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

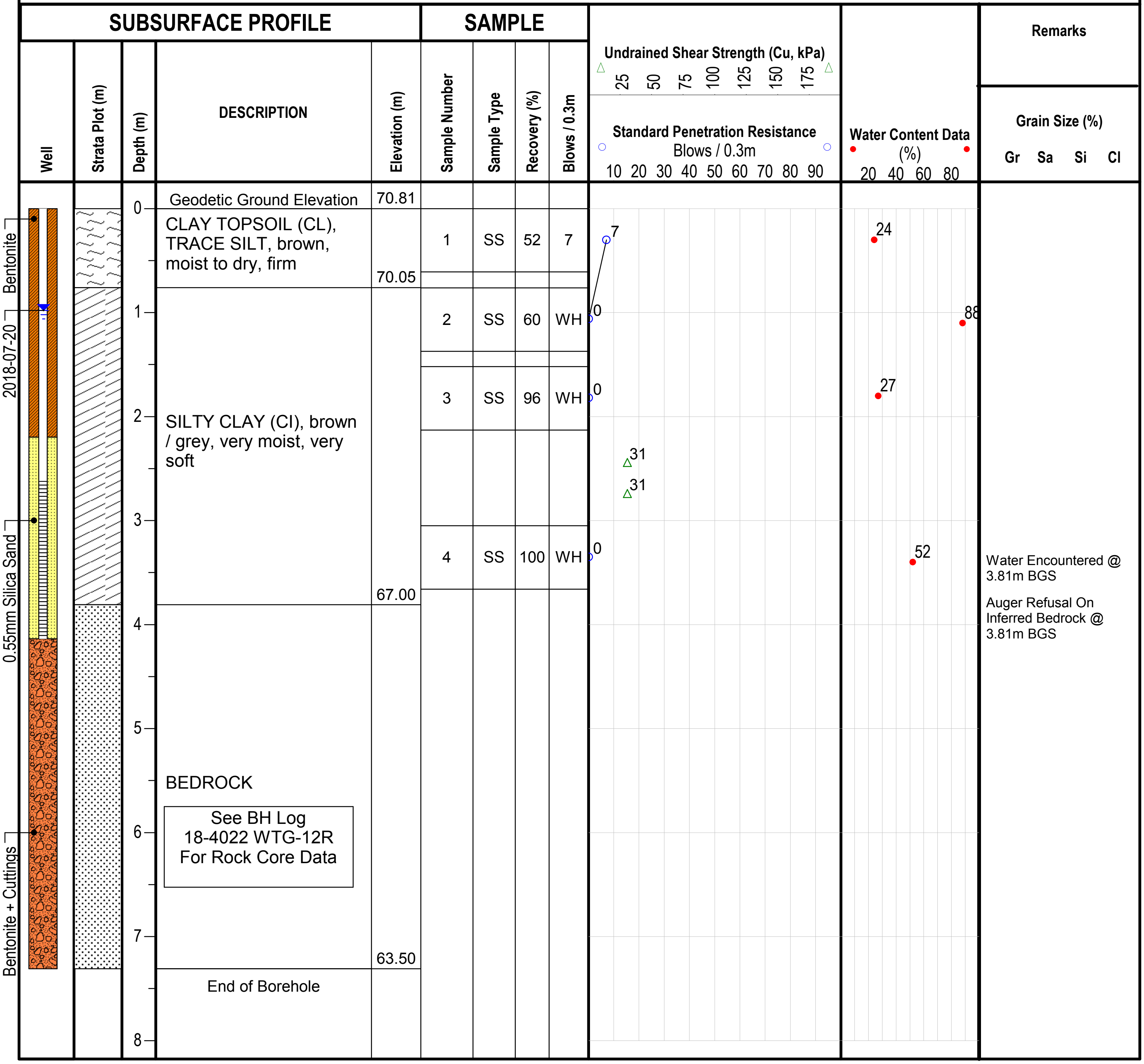
Location: UTM 18T
E=483354
N=5003162

Sheet: 1 of 1

Borehole Log: WTG-12

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Forgues Road, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



Depth (m)	DESCRIPTION	Elevation (m)
0	Geodetic Ground Elevation	70.81
	CLAY TOPSOIL (CL), TRACE SILT, brown, moist to dry, firm	70.05
	SILTY CLAY (CI), brown / grey, very moist, very soft	67.00
	BEDROCK See BH Log 18-4022 WTG-12R For Rock Core Data	63.50
8	End of Borehole	

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	52	7
2	SS	60	WH
3	SS	96	WH
4	SS	100	WH

Remarks

Water Encountered @ 3.81m BGS

Auger Refusal On Inferred Bedrock @ 3.81m BGS

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 6, 2018

Sample Type

AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=484260
N=5004075

Sheet: 1 of 1

Borehole Log: WTG-12R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Forgues Road, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	67.00							
Bentonite + Cuttings		0	SHALEY LIMESTONE, grey / black, top 20cm weathered rock, laminated, fine grained	66.54	1	34	76	46	66.54		
		1	SHALEY LIMESTONE, grey / black, laminated, fine grained	65.02	2	152	28	152	65.02		
		2 3	SHALEY LIMESTONE, grey / black, laminated, fine grained	63.50	3	152	78	152	63.50		
		4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 6, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=484260
N=5004075

Sheet: 1 of 1

Borehole Log: WTG-16

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 7-8, North Stormont, ON**
Client: **EDPR**

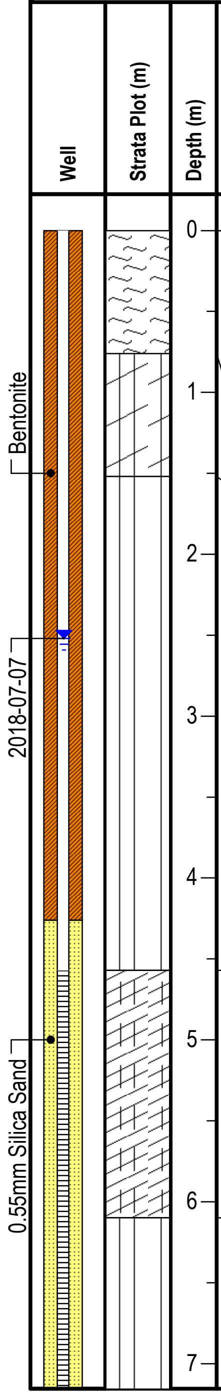
Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

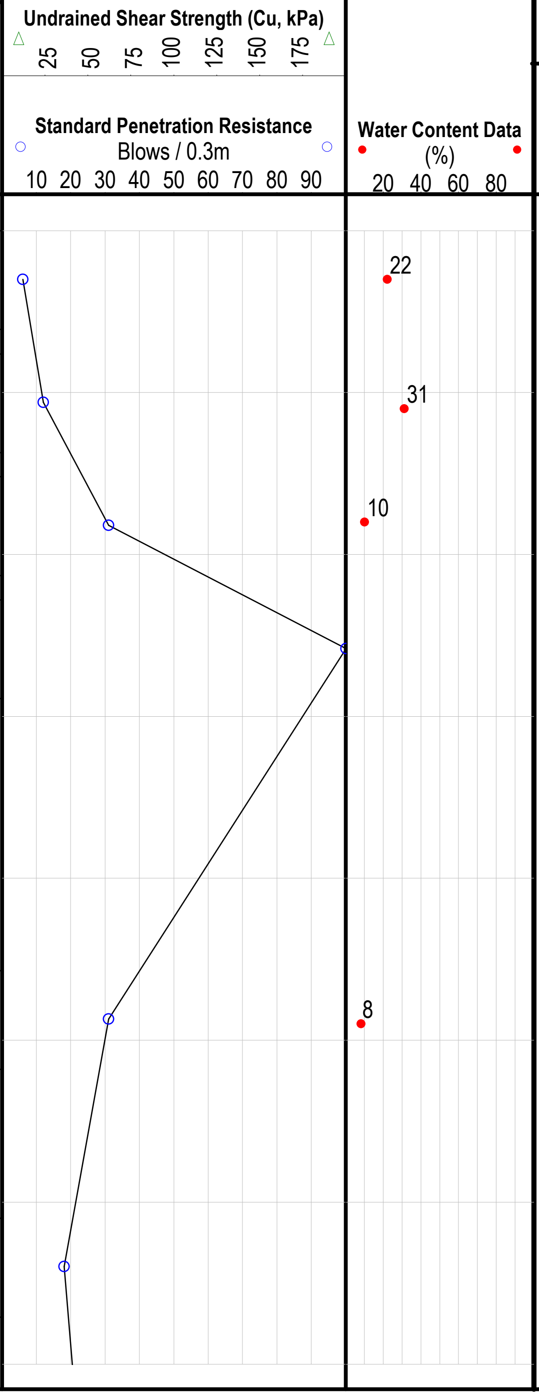
SUBSURFACE PROFILE

Depth (m)	DESCRIPTION	Elevation (m)
0	Geodetic Ground Elevation	69.23
0 – 0.76	100mm CLAY / TOPSOIL WITH ORGANICS, transitioning to 125mm sand seam over clay, light brown, moist, firm	68.47
0.76 – 1.52	CLAYEY SILT (CI), trace gravel, brown, moist, stiff	67.71
1.52 – 4.57	SILT TILL (ML), trace gravel, fractured rocks , grey / brown, moist, very dense	64.66
4.57 – 6.10	SILTY TILL (ML), 75mm fractured rocks, grey, brown, dense	63.13

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	56	6
2	SS	100	12
3	SS	75	31
4	SS	25	100+
5	SS	31	31
6	SS	35	18





Remarks	Grain Size (%)			
	Gr	Sa	Si	Cl

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 5, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

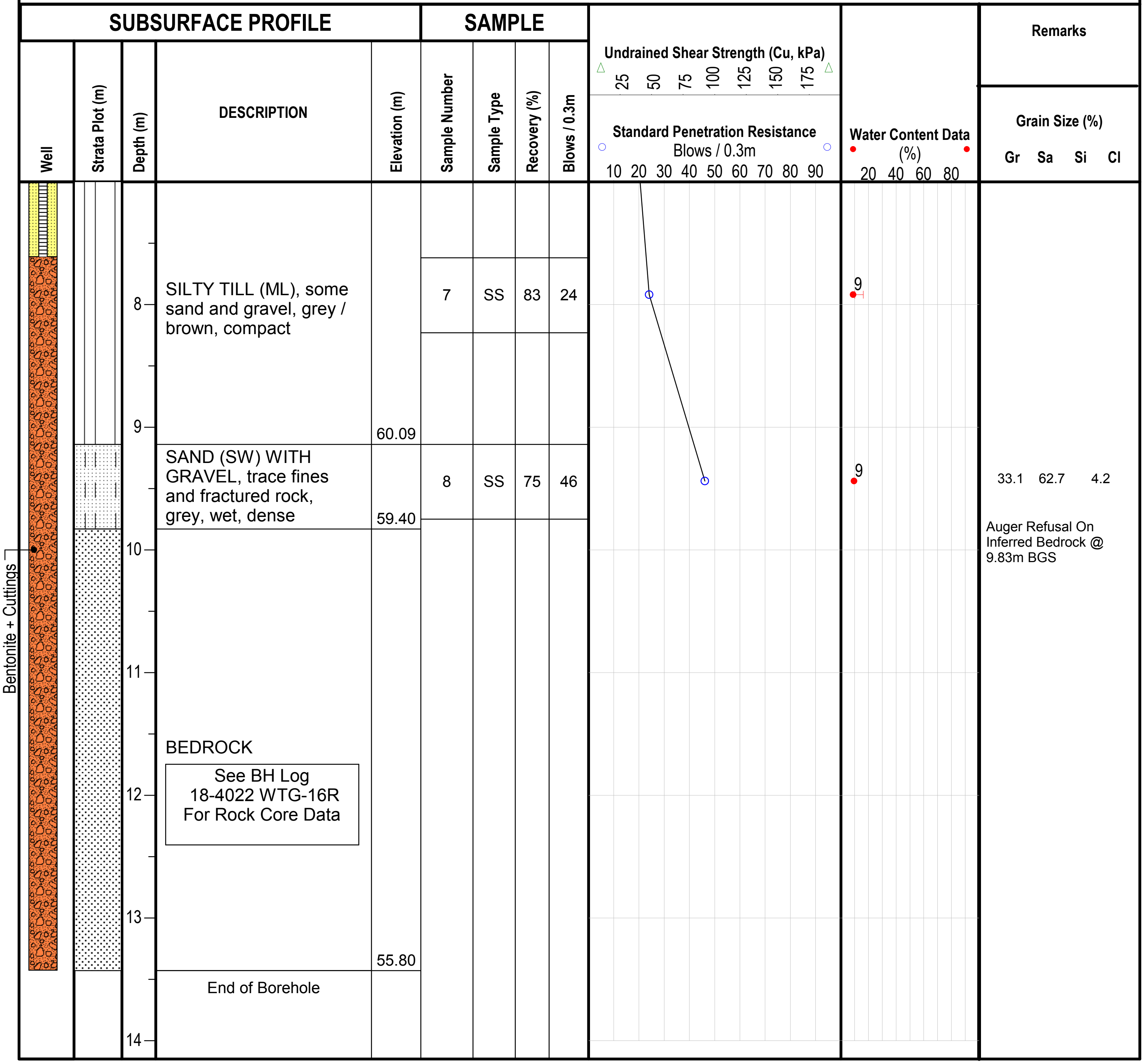
Location: **UTM 18T**
E=485706
N=5001932

Sheet: **1 of 2**

Borehole Log: WTG-16

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 7-8, North Stormont, ON
Client: EDPR

Logged By: A.Pleau
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Grain Size (%) Gr	Sa	Si	Cl	Remarks
SILTY TILL (ML), some sand and gravel, grey / brown, compact	60.09	7	SS	83	24	9					
SAND (SW) WITH GRAVEL, trace fines and fractured rock, grey, wet, dense	59.40	8	SS	75	46	9	33.1	62.7	4.2		Auger Refusal On Inferred Bedrock @ 9.83m BGS
BEDROCK See BH Log 18-4022 WTG-16R For Rock Core Data	55.80										
End of Borehole											

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 5, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=485706
N=5001932

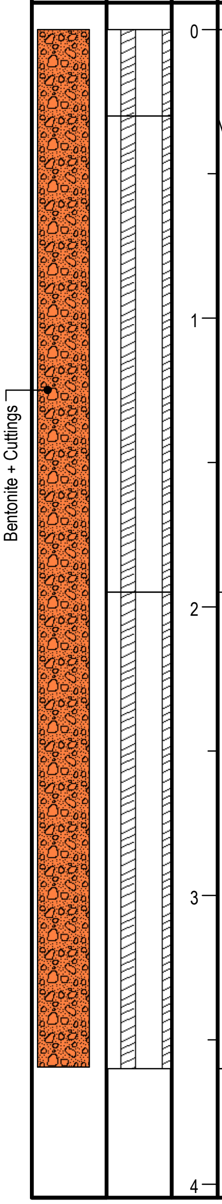
Sheet: 2 of 2

Borehole Log: WTG-16R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 7-8, North Stormont, ON**
Client: **EDPR**

Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	59.40							
0	SHALEY LIMESTONE, grey / black, laminated, fine grained, horizontal fractures with visible weathering	59.10	1	50	43	30	59.1		
1	SHALEY LIMESTONE, grey / black, laminated, fine grained, horizontal and vertical fractures containing visible weathering	57.45	2	158	59	165	57.45		
2	SHALEY LIMESTONE, grey / black, laminated, fine grained, horizontal fractures with visible weathering, vertical fractures present	55.80	3	156	65	165	55.80		
4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 5, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=485706
N=5001932

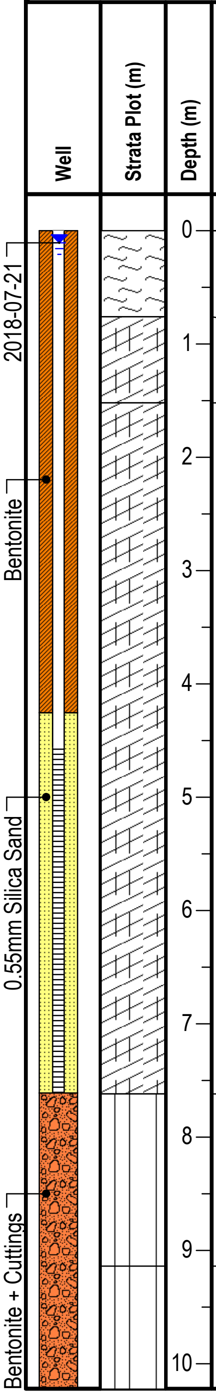
Sheet: 1 of 1

Borehole Log: WTG-18

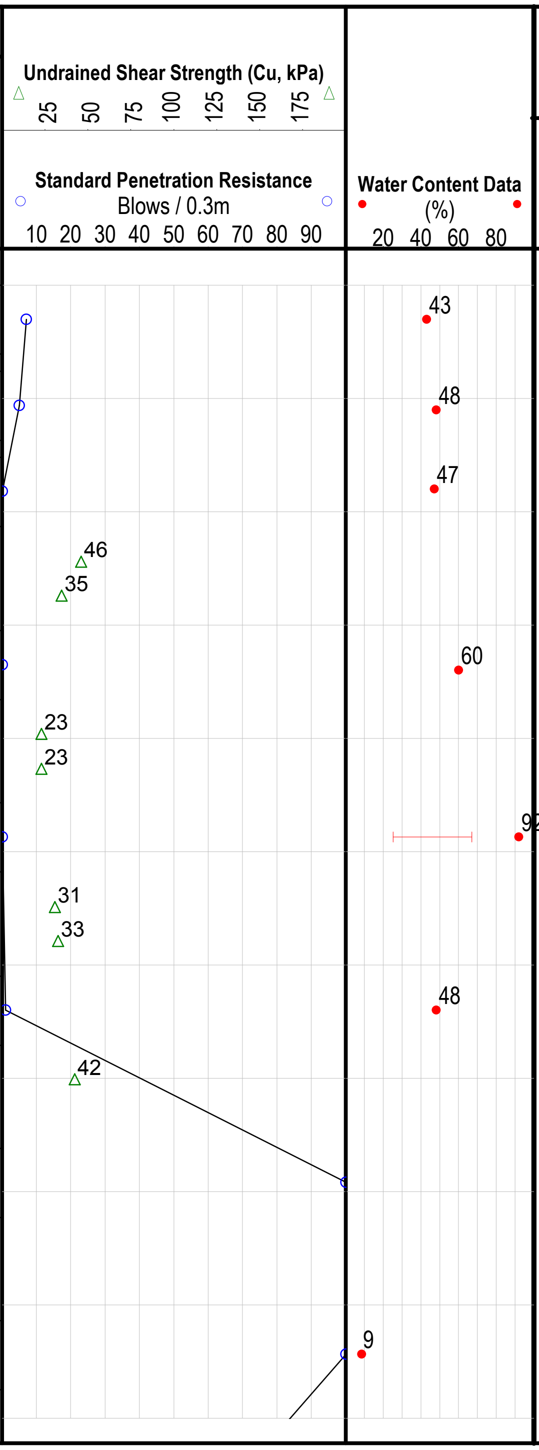
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Rd 13, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	67.32					
CLAY TOPSOIL trace ORGANICS (CL), brown, moist, firm	66.56	1	SS	56	7	
SILTY CLAY (CI), brown, moist, firm	65.80	2	SS	79	5	
@ 1.52m to 610m BGS SILTY CLAY (CI), brown, moist, very soft @ 6.10m to 7.62m BGS silty CLAY (CI), grey, wet, very soft	59.70	3	SS	100	WH	
		5	SS	100	WH	
		6	SS	100	WH	
		7	SS	100	1	Water Encountered @ 6.1m BGS
SILT TILL trace clay, some gravel, (ML), grey, moist, very dense	58.18	8	SS	17	100	Spoon Refusal @7.9m BGS
SILT (ML) with gravel, trace clay, grey, moist to dry, hard		9	SS	33	100	Spoon Refusal @9.4m BGS



Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: April 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=487011
N=5004960

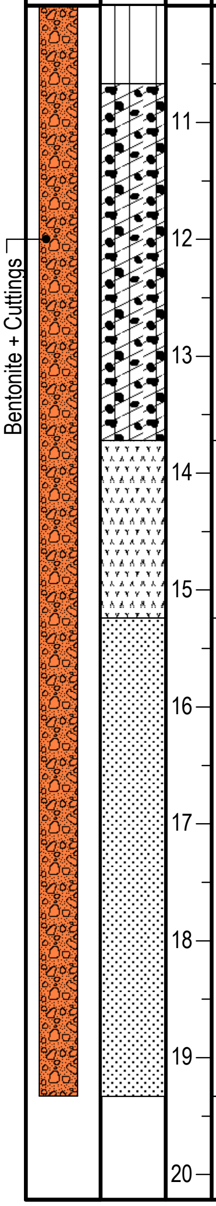
Sheet: 1 of 2

Borehole Log: WTG-18

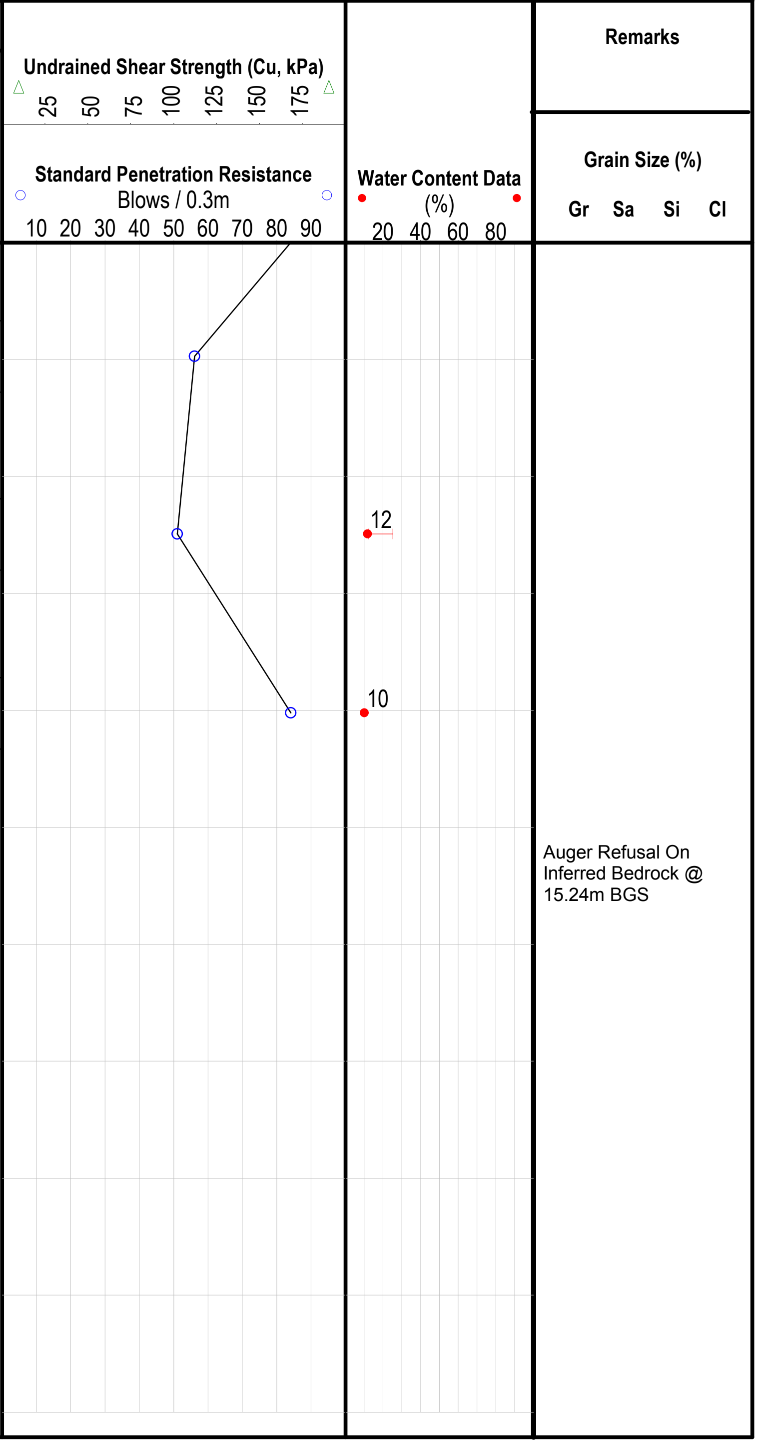
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Rd 13, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
	56.65					
SILTY GRAVEL TILL (SG), brown, wet, very dense		10	SS	63	56	
		11	SS	67	51	
	53.60					
SILTY TILL (ML) some gravel brown, moist, very dense		12	SS	63	84	
	52.08					Auger Refusal On Inferred Bedrock @ 15.24m BGS
BEDROCK See BH Log 18-4022 WTG-18R For Rock Core Data						
	47.99					
End of Borehole						



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: April 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=487011
N=5004960

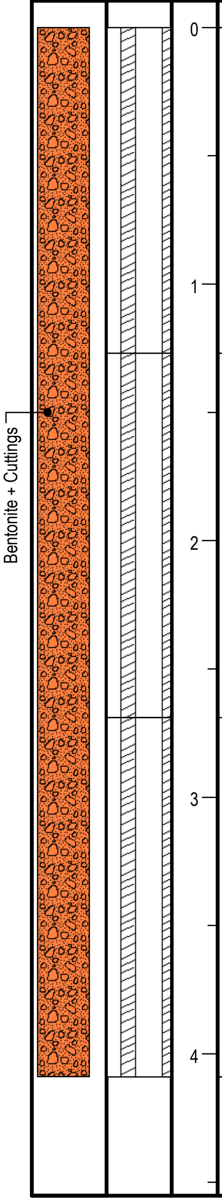
Sheet: 2 of 2

Borehole Log: WTG-18R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **County Rd 13, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Geodetic Rock Elevation	52.08							
LIMESTONE / SHALE, grey, fine grained, medium / soft rock, weathered area @ approx. 77cm from top of run, laminated to thinly laminated, 45cm long intrusion @ 61cm from top of run	50.81	1	136	71	127	50.81		TCR is more than run length due to fractured / weathered sections
LIMESTONE / SHALE, grey, fine grained, medium / soft rock, weathered zone 25cm from top of run, laminated to thinly laminated	49.39	2	152	82	142	49.39		
LIMESTONE / SHALE, grey, fine grained, soft rock, very weathered zone 111cm from top of run, laminated to thinly laminated	47.99	3	140	45	140	47.99		
End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 1, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

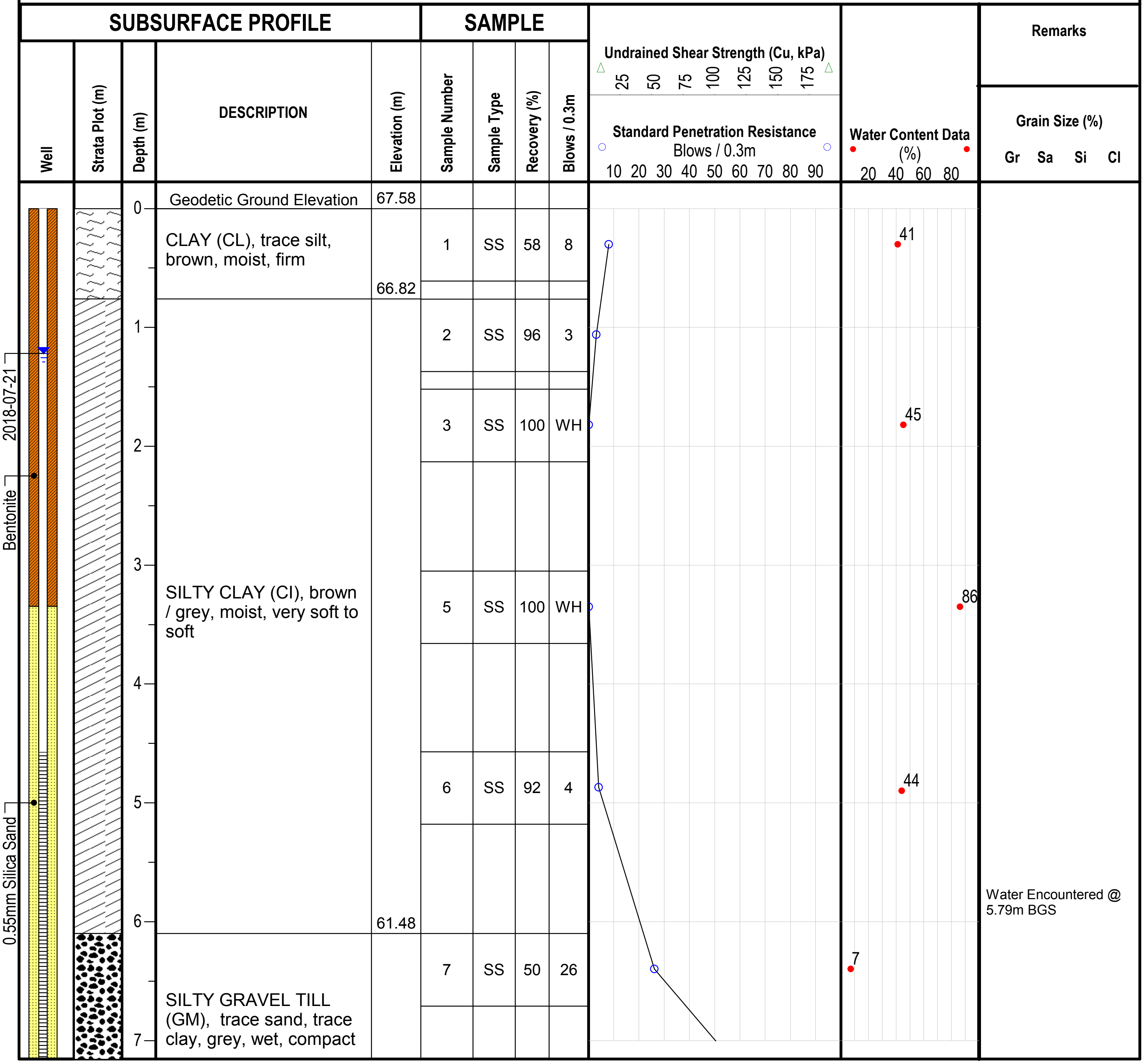
Location: **UTM 18T**
E=487011
N=5004960

Sheet: **1 of 1**

Borehole Log: WTG-20

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Remarks
0	Geodetic Ground Elevation	67.58						
	CLAY (CL), trace silt, brown, moist, firm	66.82	1	SS	58	8	41	
	SILTY CLAY (CI), brown / grey, moist, very soft to soft		2	SS	96	3		
			3	SS	100	WH	45	
			5	SS	100	WH	86	
		61.48	6	SS	92	4	44	Water Encountered @ 5.79m BGS
	SILTY GRAVEL TILL (GM), trace sand, trace clay, grey, wet, compact		7	SS	50	26	7	

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 1, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

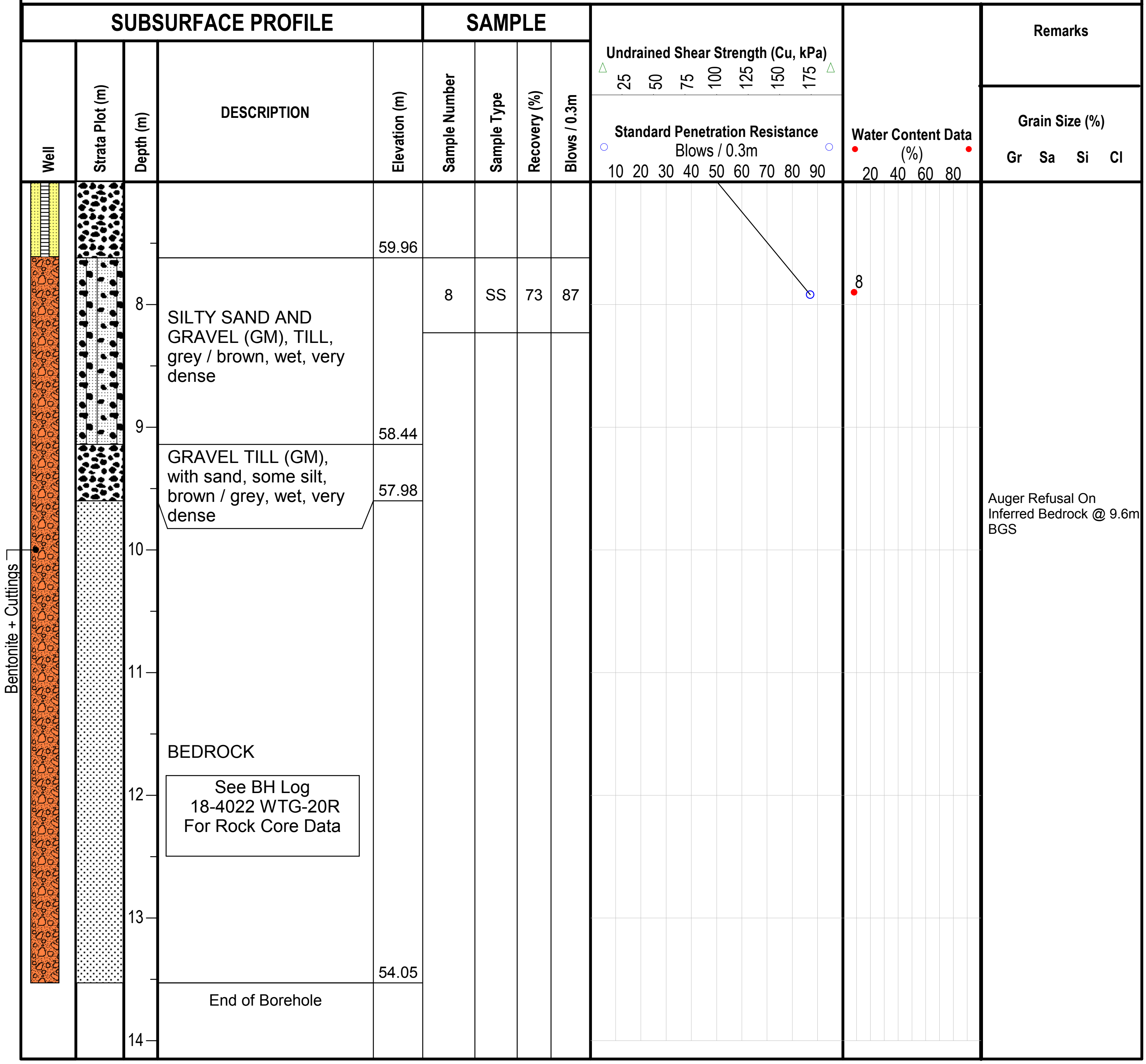
Location: **UTM 18T**
E=486785
N=5004255

Sheet: **1 of 2**

Borehole Log: WTG-20

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
	59.96					
SILTY SAND AND GRAVEL (GM), TILL, grey / brown, wet, very dense	58.44	8	SS	73	87	
GRAVEL TILL (GM), with sand, some silt, brown / grey, wet, very dense	57.98					Auger Refusal On Inferred Bedrock @ 9.6m BGS
BEDROCK See BH Log 18-4022 WTG-20R For Rock Core Data	54.05					
End of Borehole						

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 1, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**
E=486785
N=5004255

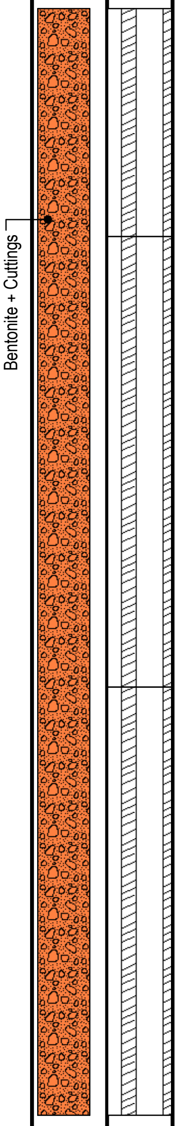
Sheet: **2 of 2**

Borehole Log: WTG-20R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	57.98							
0	SHALEY LIMESTONE grey, fine grained, very thinly bedded, soft to medium rock	57.17	1	125	26	81	57.17		TCR is more than run length due to fractured / weathered sections Broken zone approx. 63cm from top of run
1 2	SHALEY LIMESTONE, grey, fine grained, laminated to very thinly bedded with visible turbidites, medium strength rock, 3 discontinuites with slight weathering at discontinuities	55.57	2	154	93	160	55.57		
3	SHALEY LIMESTONE, grey, fine grained, 4 discontinuities with minimum weathering at horizontal fractures, laminated to thinly bedded, medium strength rock, turbidites present	54.05	3	149	98	152	54.05		
4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 1, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

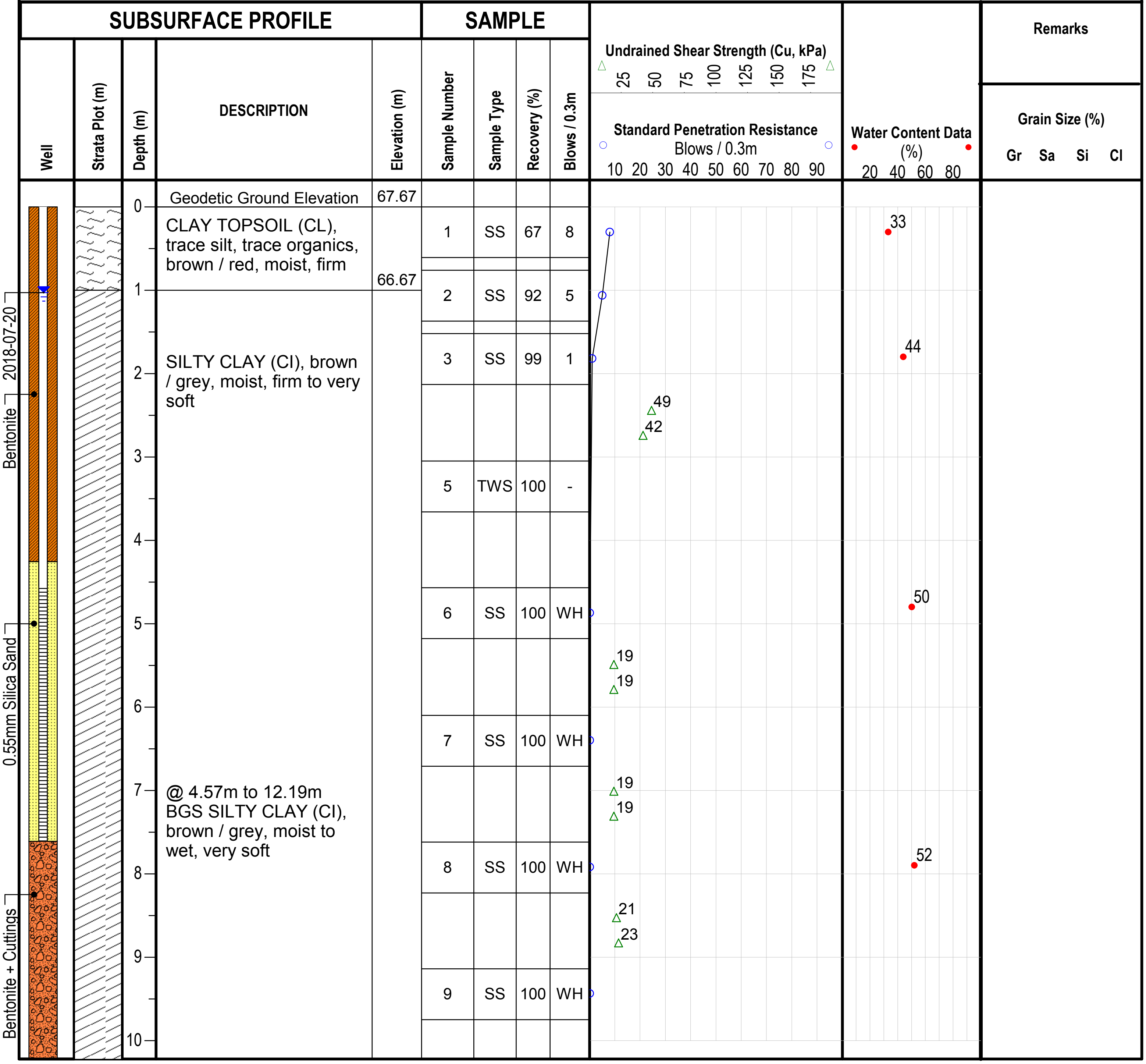
Location: **UTM 18T**
E=486785
N=5004255

Sheet: **1 of 1**

Borehole Log: WTG-21

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	67.67				
CLAY TOPSOIL (CL), trace silt, trace organics, brown / red, moist, firm		1	SS	67	8
	66.67	2	SS	92	5
SILTY CLAY (CI), brown / grey, moist, firm to very soft		3	SS	99	1
		5	TWS	100	-
		6	SS	100	WH
		7	SS	100	WH
@ 4.57m to 12.19m BGS SILTY CLAY (CI), brown / grey, moist to wet, very soft		8	SS	100	WH
		9	SS	100	WH

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 2, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**
E=486717
N=5003432

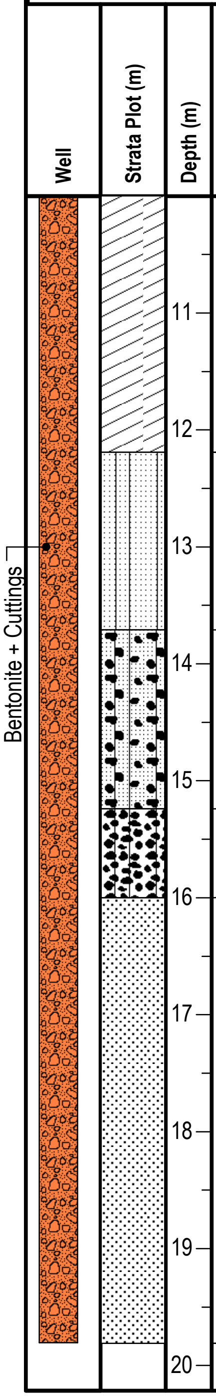
Sheet: **1 of 2**

Borehole Log: WTG-21

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Nine Mile Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

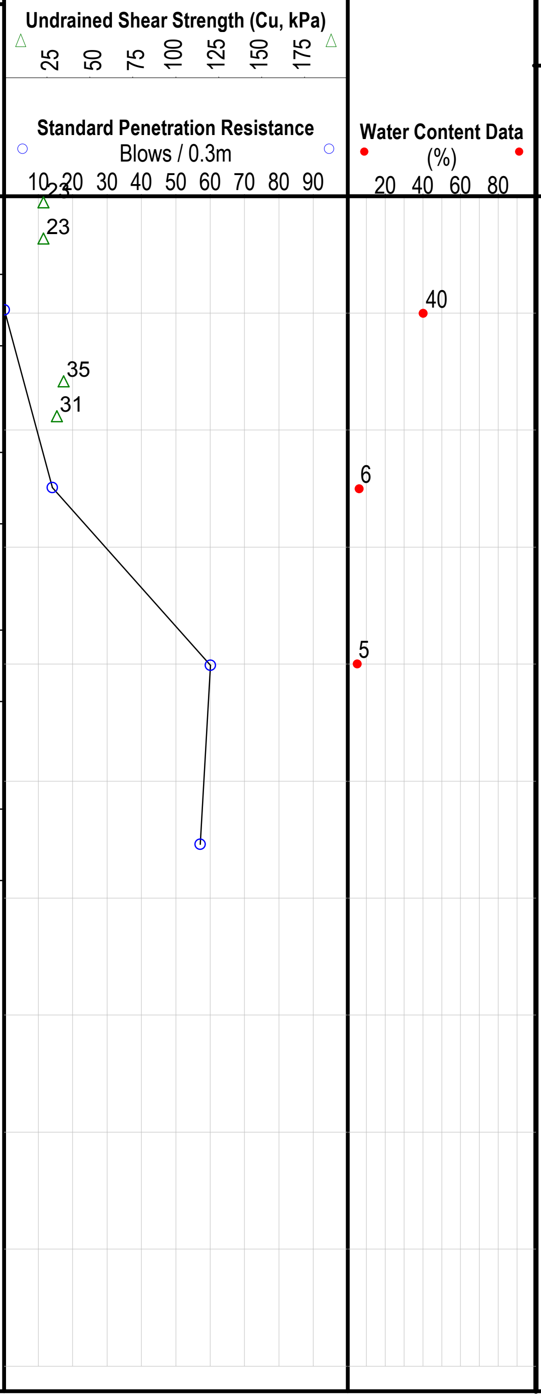
SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)
	55.48
SANDY SILT TILL (SG), with gravel seam,, brown / grey, wet, compact	53.96
SILTY SAND & GRAVEL (SG), TILL, grey / brown, wet, very dense	52.43
SILTY GRAVEL TILL (GM), some sand, brown / grey, wet, very dense	51.67
BEDROCK See BH Log 18-4022 WTG-21R For Rock Core Data	47.86
End of Borehole	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
10	SS	100	WH
14	SS	56	14
15	SS	46	60
16	SS	44	57



Remarks	Grain Size (%) Gr	Sa	Si	Cl
Auger Refusal On Inferred Bedrock @ 16.03m BGS				

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 2, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=486717
N=5003432

Sheet: 2 of 2

TULLOCH ENGINEERING

Borehole Log: WTG-21R

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	51.67							
Bentonite + Cuttings		0	LIMESTONE / SHALE, grey, fine grained, medium / soft rock, weathered area @ approx. 77cm from top of run, laminated to thinly laminated, 45cm long intrusion @ 61cm fron top of run	50.91	1	66	50	155	50.91		
		1	LIMESTONE / SHALE, grey, fine grained, medium / soft rock, weathered zone 25cm from top of run, laminated to thinly laminated	49.36	2	151	82	76	49.36		
		2 3	LIMESTONE / SHALE, grey, fine grained, soft rock, very weathered zone 111cm from top of run, laminated to thinly laminated	47.86	3	147	85	150	47.86		
		4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 2, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

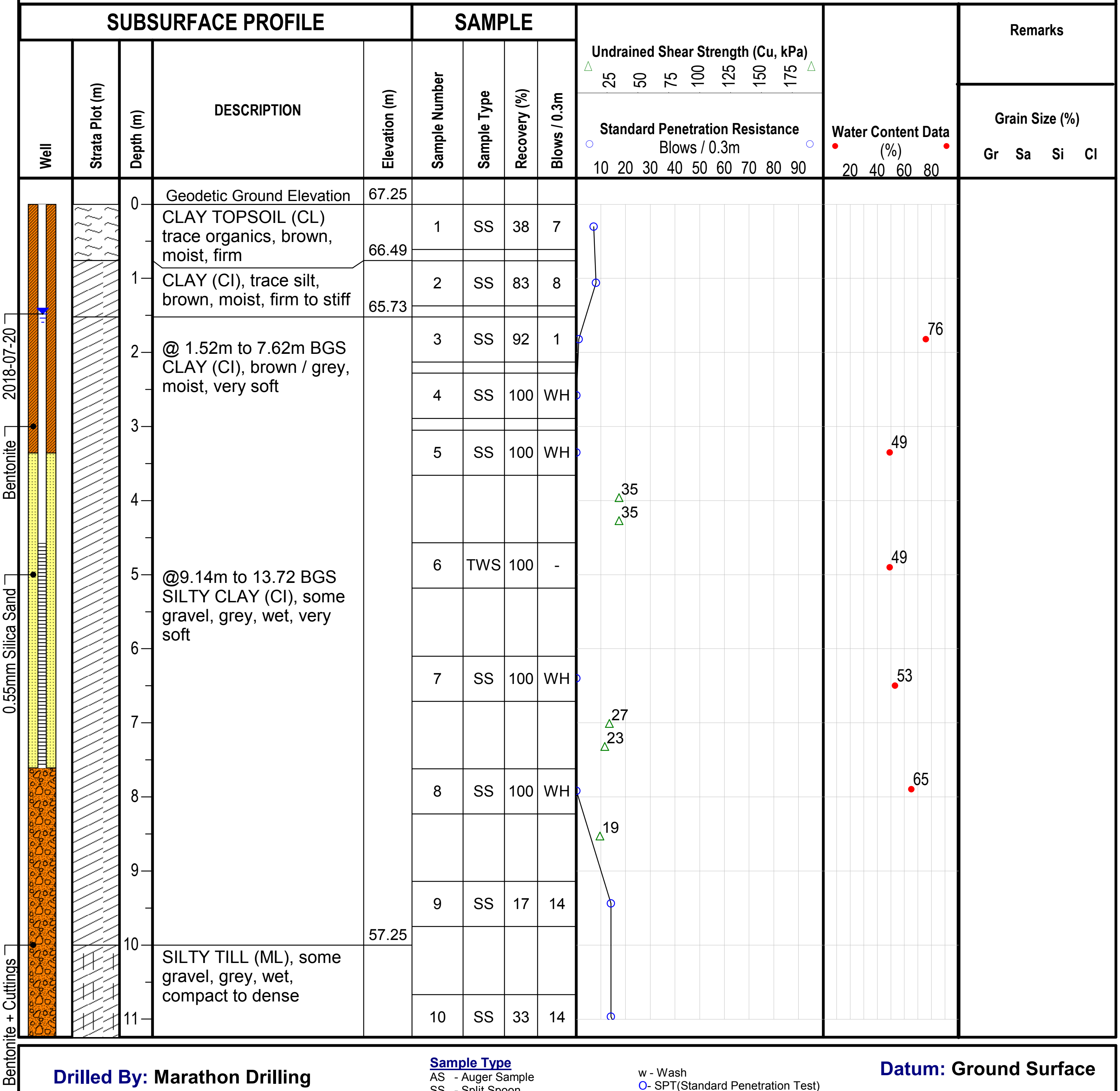
Location: **UTM 18T**
E=486717
N=5003432

Sheet: **1 of 1**

Borehole Log: WTG-23

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Nine Mile Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



Depth (m)	DESCRIPTION	Elevation (m)
	Geodetic Ground Elevation	67.25
0	CLAY TOPSOIL (CL) trace organics, brown, moist, firm	66.49
1	CLAY (CI), trace silt, brown, moist, firm to stiff	65.73
2	@ 1.52m to 7.62m BGS CLAY (CI), brown / grey, moist, very soft	
5	@9.14m to 13.72 BGS SILTY CLAY (CI), some gravel, grey, wet, very soft	57.25
10	SILTY TILL (ML), some gravel, grey, wet, compact to dense	

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	38	7
2	SS	83	8
3	SS	92	1
4	SS	100	WH
5	SS	100	WH
6	TWS	100	-
7	SS	100	WH
8	SS	100	WH
9	SS	17	14
10	SS	33	14

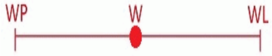
Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 3, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer



Datum: **Ground Surface**

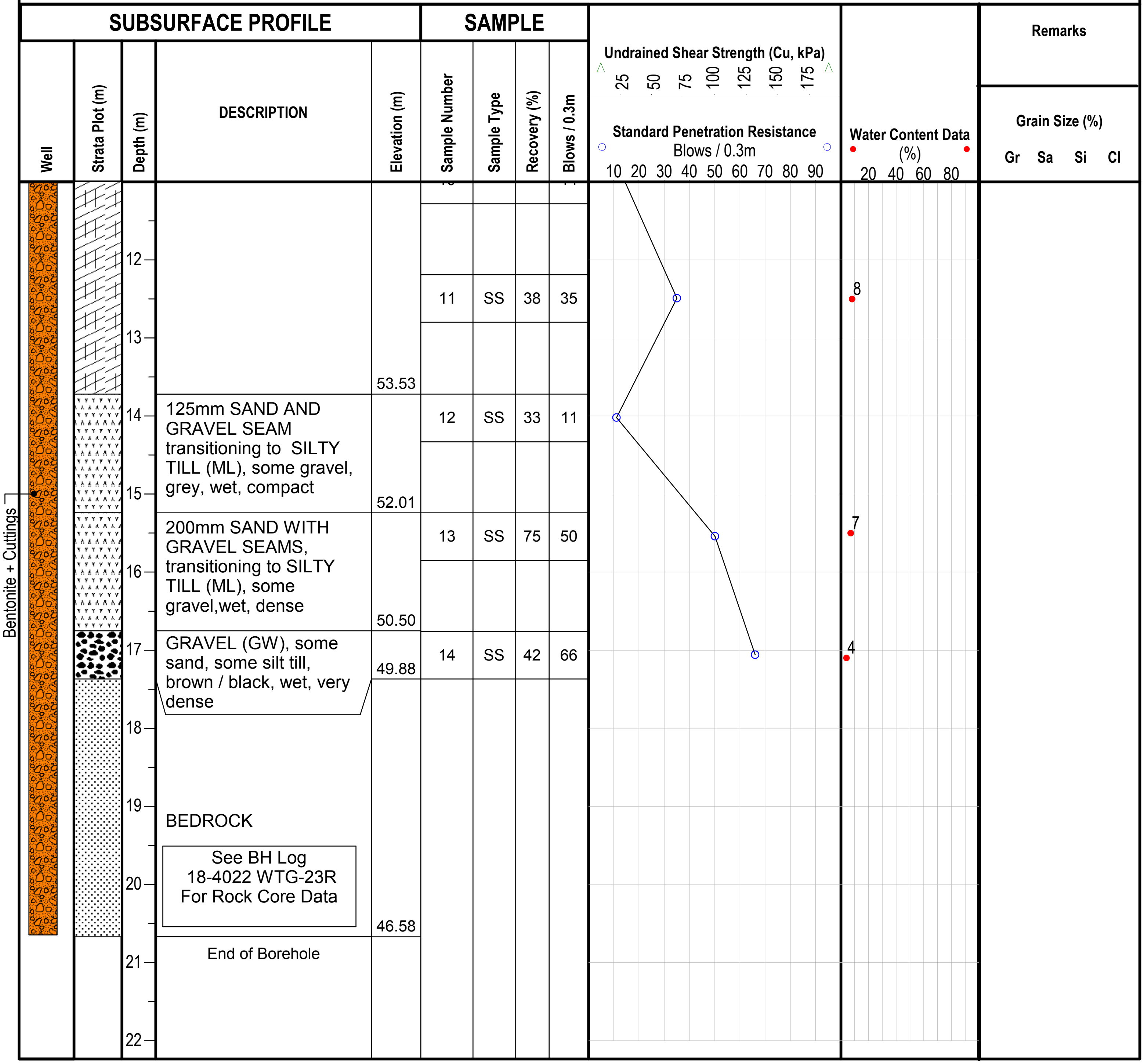
Location: **UTM 18T**
E=487076
N=5002532

Sheet: **1 of 2**

Borehole Log: WTG-23

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Nine Mile Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
	53.53	11	SS	38	35
125mm SAND AND GRAVEL SEAM transitioning to SILTY TILL (ML), some gravel, grey, wet, compact	52.01	12	SS	33	11
200mm SAND WITH GRAVEL SEAMS, transitioning to SILTY TILL (ML), some gravel,wet, dense	50.50	13	SS	75	50
GRAVEL (GW), some sand, some silt till, brown / black, wet, very dense	49.88	14	SS	42	66
BEDROCK See BH Log 18-4022 WTG-23R For Rock Core Data	46.58				
End of Borehole					

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=487076
N=5002532

Sheet: 2 of 2

Borehole Log: WTG-23R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Nine Mile Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE				SAMPLE						
Well	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa)	Remarks
		Geodetic Rock Elevation	49.88							
Bentonite + Cuttings	0	SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, fine grained, with discontinuities & broken section, horizontal fractures with some weathering	48.91	1	97	33	96.5	48.91		
	1 2	SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, fine grained, discontinuities present (13 breaks) broken core area near top of run, horizontal fractures with severe weathering in shaley layers	47.50	2	150	55	142	47.50	94.0	
	3	SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, fine grained, discontinuities present (7 breaks), broken core area near top of run, horizontal fractures with some weathering in shaley layers	46.58	3	82	57	91	46.58		
	4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 4, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

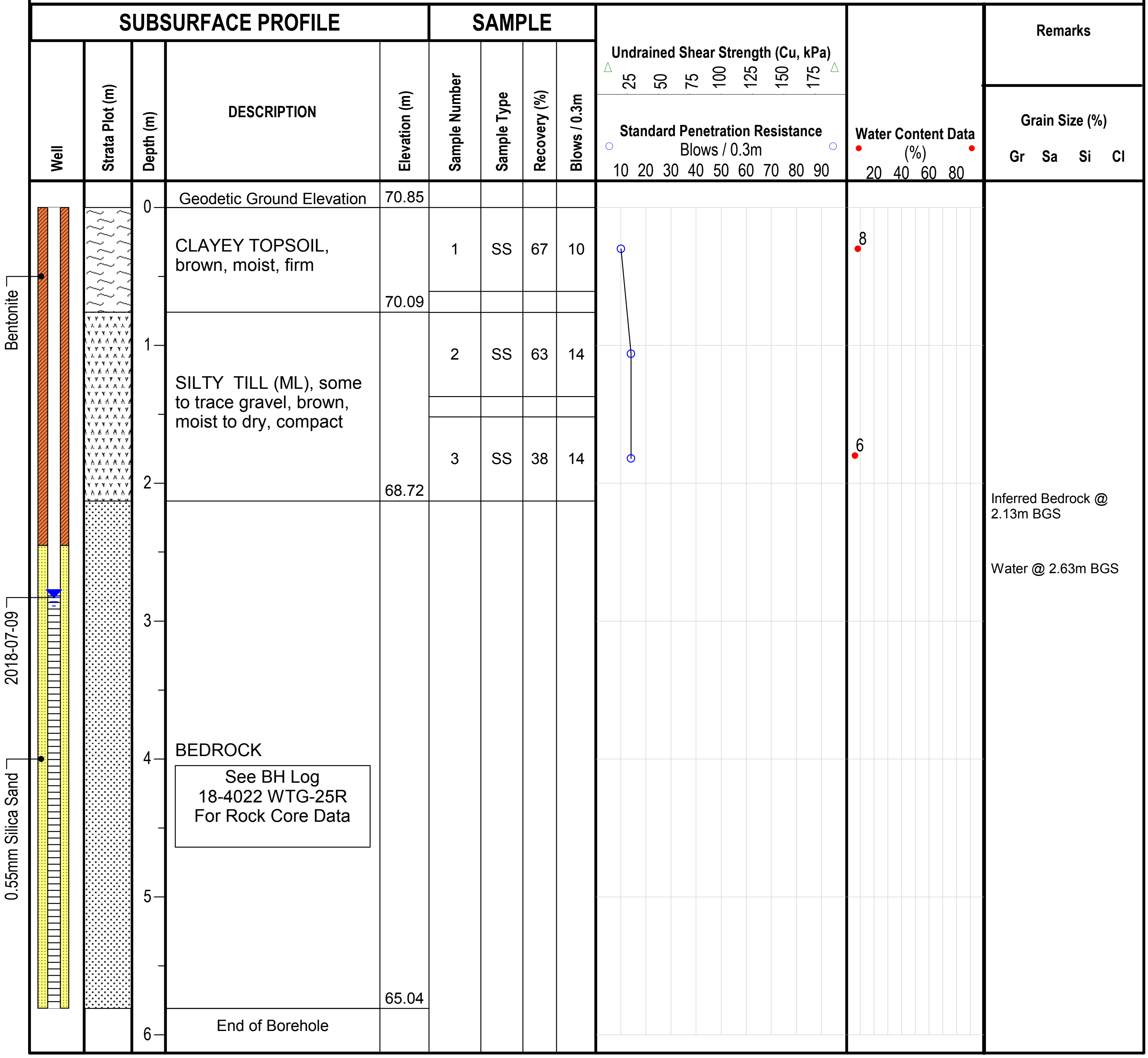
Location: UTM 18T
E=487076
N=5002532

Sheet: 1 of 1

Borehole Log: WTG-25

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Road 9, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE			SAMPLE					
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Remarks
0	Geodetic Ground Elevation	70.85						
	CLAYEY TOPSOIL, brown, moist, firm	70.09	1	SS	67	10	8	
1	SILTY TILL (ML), some to trace gravel, brown, moist to dry, compact		2	SS	63	14		
		68.72	3	SS	38	14	6	
2								Inferred Bedrock @ 2.13m BGS
								Water @ 2.63m BGS
4	BEDROCK See BH Log 18-4022 WTG-25R For Rock Core Data	65.04						
6	End of Borehole							

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=488426
N=5001668

Sheet: 1 of 1

Borehole Log: WTG-25R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Road 9, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa)	Remarks
			Geodetic Rock Elevation	68.72							
0.55mm Silica Sand		0	SHALEY LIMESTONE, grey / black, highly fractured zone @ top of run, fine grained, thinly laminated to laminated, very poor quality rock	68.06	1	66	23	66	68.06		
		1 – 2	SHALEY LIMESTONE, grey / black, horizontal mechanical fractures along weak shale sections, very thinly bedded to laminated, some weathering at discontinuities, fine grained, excellent quality rock	66.56	2	149	94	150	66.56		
		3	SHALEY LIMESTONE, grey / black, horizontal mechanical fractures along weak shale sections, very thinly bedded to laminated, some weathering at discontinuities, fine grained, good quality rock	65.04	3	152	89	152	65.04	△48.0	
		4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: June 2, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=488426
N=5001668

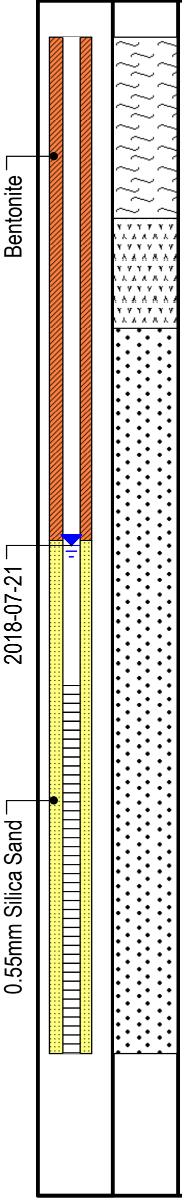
Sheet: 1 of 1

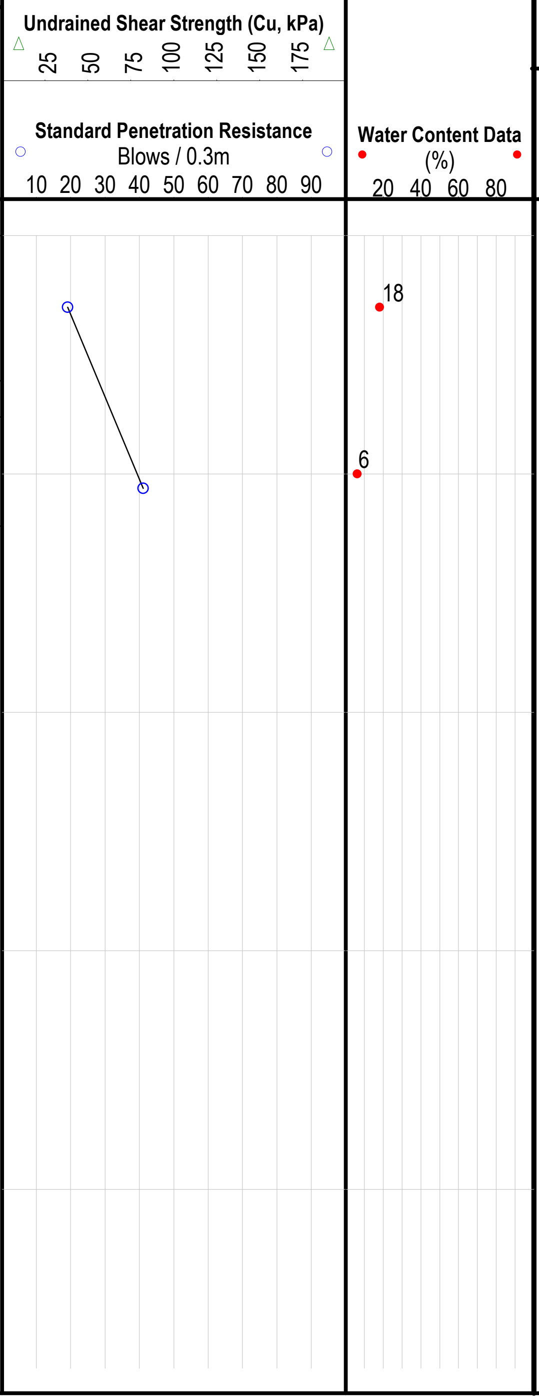
Borehole Log: WTG-27

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Ashburn Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE			SAMPLE				Remarks
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	
	Geodetic Ground Elevation	79.27					
0	CLAYEY TOPSOIL (CL), some gravel trace organics, light brown, moist, very stiff	78.51	1	SS	54	19	
1	SILTY TILL (ML), with gravel, brown, moist to dry, dense	78.05	2	SS	58	41	Inferred Bedrock @ 1.219m BGS
2 3 4	BEDROCK See BH Log 18-4022 WTG-27R For Rock Core Data	75.01					Water At 1.41m BGS
	End of Borehole						





Grain Size (%)

Gr	Sa	Si	Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=490723
N=5004552

Sheet: 1 of 1

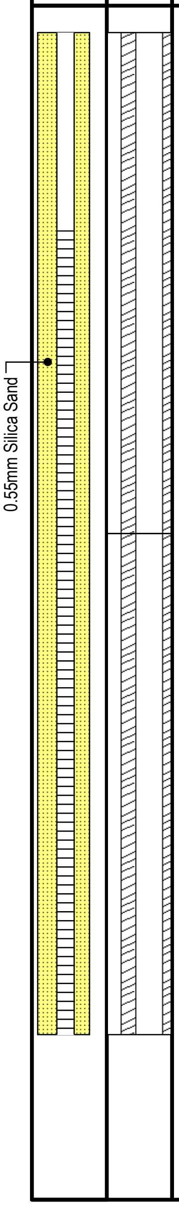
Borehole Log: WTG-27R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Ashburn Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE



Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	78.05							
0 1	SHALEY LIMESTONE, very thinly bedded to laminated, fine grained, horizontal fractures present with some weathering, good quality rock	76.53	1	125.5	83	152	76.53		
2	SHALEY LIMESTONE, very thinly bedded to laminated, fine grained, horizontal fractures present with some weathering, fair quality rock	75.01	2	103	68	152	75.01		
3	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=490723
N=5004552

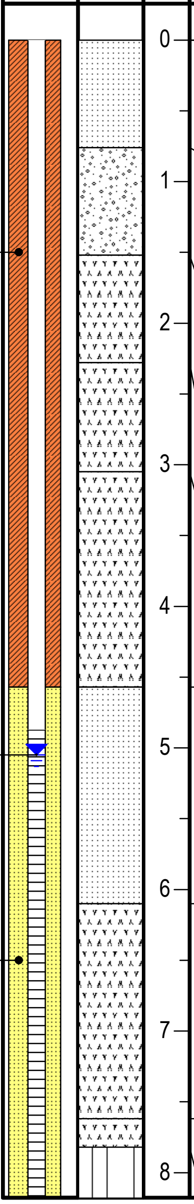
Sheet: 1 of 1

Borehole Log: WTG-28

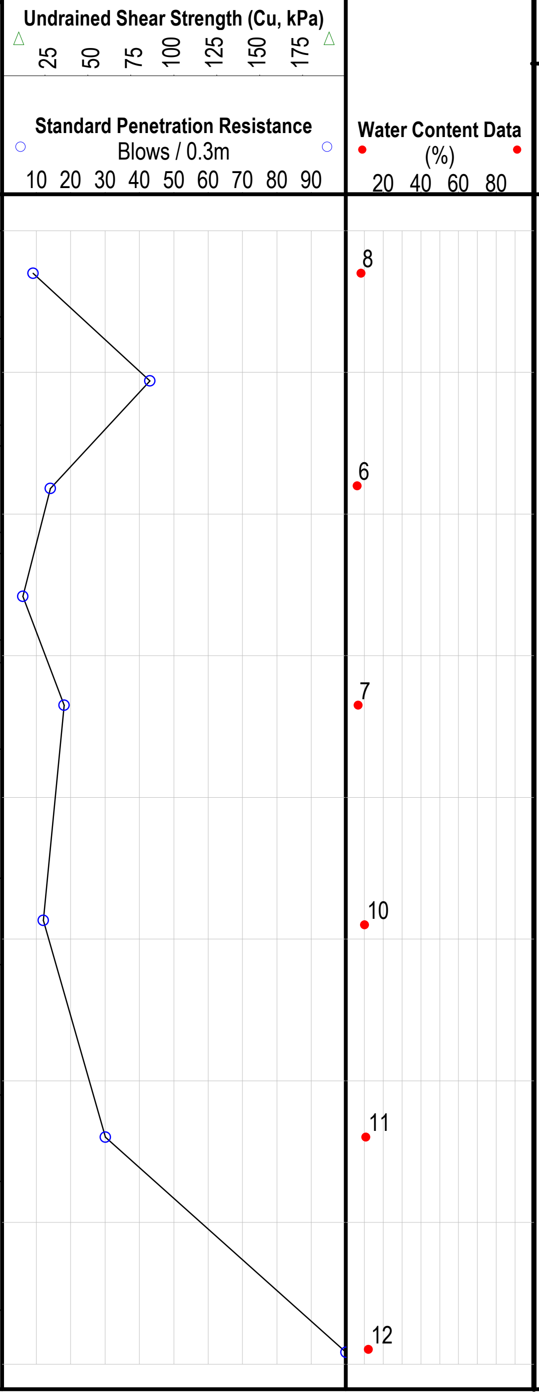
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 6-7, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Remarks
Geodetic Ground Elevation	73.63						
SAND (SW), fine to medium grained, trace gravel, oxidated, light brown, dry, loose	72.87	1	SS	58	9	8	
SAND AND GRAVEL (SW), fine,fragmented rocks, cobbles, oxidated, light brown, dry, dense	72.11	2	SS	71	43		
SAND (SW), fine grained, some clay, trace gravel, brown to grey, moist, compact, TILL	71.35	3	SS	54	14	6	
SILTY TILL (ML), trace gravel, grey, moist, loose	70.58	4	SS	63	6		
SILT AND GRAVEL TILL (ML), angular rocks, grey, wet, compact	69.06	5	SS	67	18	7	
sandy, SILTY TILL (ML), fine grained, grey, wet, compact	67.53	6	SS	42	12	10	Water @ 5.05m BGS
SILTY TILL (ML) with gravel, grey, wet, dense	66.01	7	SS	29	30	11	
	65.81	8	SS	33	100+	12	



Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **June 3, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

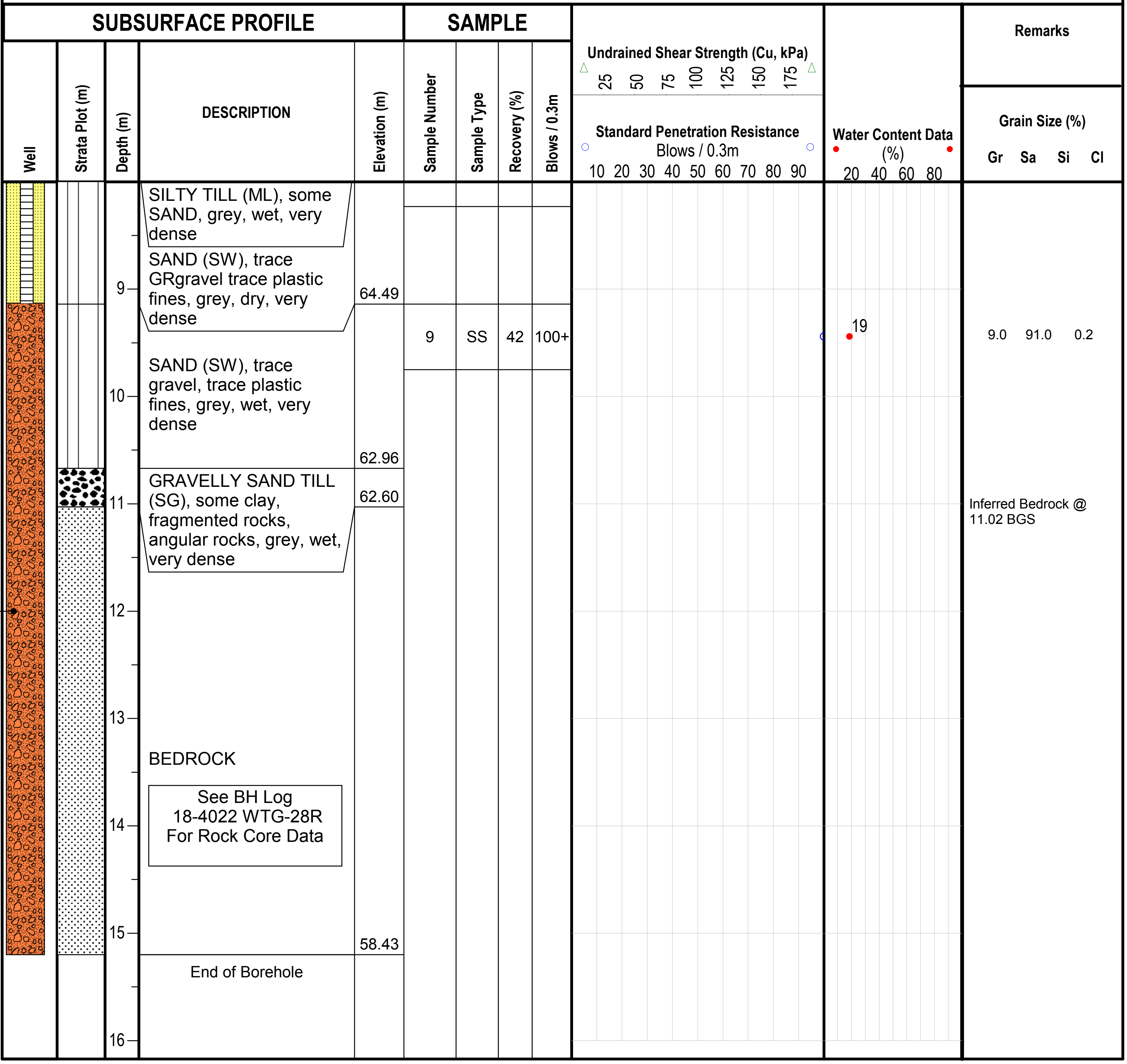
Location: **UTM 18T**
E=492449
N=5003929

Sheet: **1 of 2**

Borehole Log: WTG-28

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 6-7, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)
SILTY TILL (ML), some SAND, grey, wet, very dense	
SAND (SW), trace GRgravel trace plastic fines, grey, dry, very dense	64.49
SAND (SW), trace gravel, trace plastic fines, grey, wet, very dense	62.96
GRAVELLY SAND TILL (SG), some clay, fragmented rocks, angular rocks, grey, wet, very dense	62.60
BEDROCK See BH Log 18-4022 WTG-28R For Rock Core Data	58.43
End of Borehole	

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Gr	Sa	Si	Cl
9	SS	42	100+	9.0	91.0	0.2	

Remarks

Inferred Bedrock @ 11.02 BGS

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=492449
N=5003929

Sheet: 2 of 2

Borehole Log: WTG-28R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 6-7, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	62.60							
Bentonite + Cuttings		0	LIMESTONE, grey, white layer, weathered, vertical, horizontal & angular fractures, very thinly bedded to laminated, fair quality rock	61.31	1	129	65	129	61.31		
		1 2	LIMESTONE, grey, slightly weathered, horizontal & angular fractures, very thinly bedded to laminated, excellent quality rock	59.79	2	152	93	152	59.79		
		3 4	LIMESTONE, grey, horizontal fractures, many vertical fractures, very thinly bedded to laminated, angular fractures, poor quality rock	58.42	3	137	30	137	58.43		
			End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: June 4, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

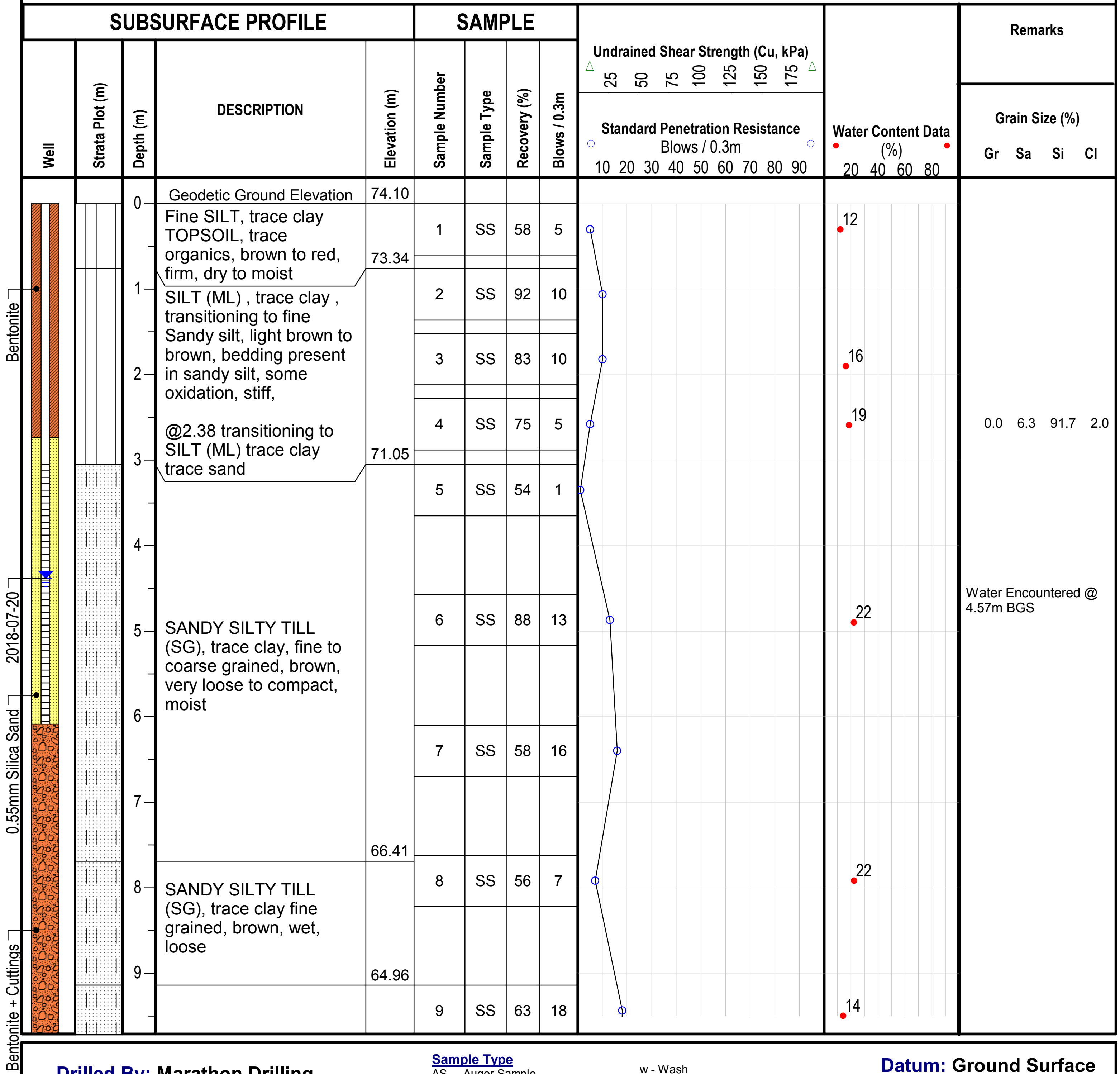
Location: UTM 18T
E=492449
N=5003929

Sheet: 1 of 1

Borehole Log: WTG-29

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Ashburn Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	74.10
Fine SILT, trace clay TOPSOIL, trace organics, brown to red, firm, dry to moist	73.34
SILT (ML) , trace clay , transitioning to fine Sandy silt, light brown to brown, bedding present in sandy silt, some oxidation, stiff, @2.38 transitioning to SILT (ML) trace clay trace sand	71.05
SANDY SILTY TILL (SG), trace clay, fine to coarse grained, brown, very loose to compact, moist	66.41
SANDY SILTY TILL (SG), trace clay fine grained, brown, wet, loose	64.96

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Grain Size (%) Gr	Sa	Si	Cl	Remarks
1	SS	58	5	12					
2	SS	92	10						
3	SS	83	10	16					
4	SS	75	5	19	0.0	6.3	91.7	2.0	
5	SS	54	1						Water Encountered @ 4.57m BGS
6	SS	88	13	22					
7	SS	58	16						
8	SS	56	7	22					
9	SS	63	18	14					

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **June 3, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**
E=492423
N=5005472

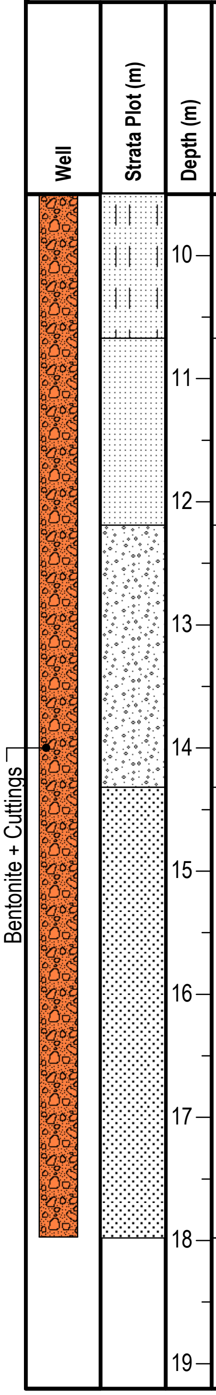
Sheet: **1 of 2**

Borehole Log: WTG-29

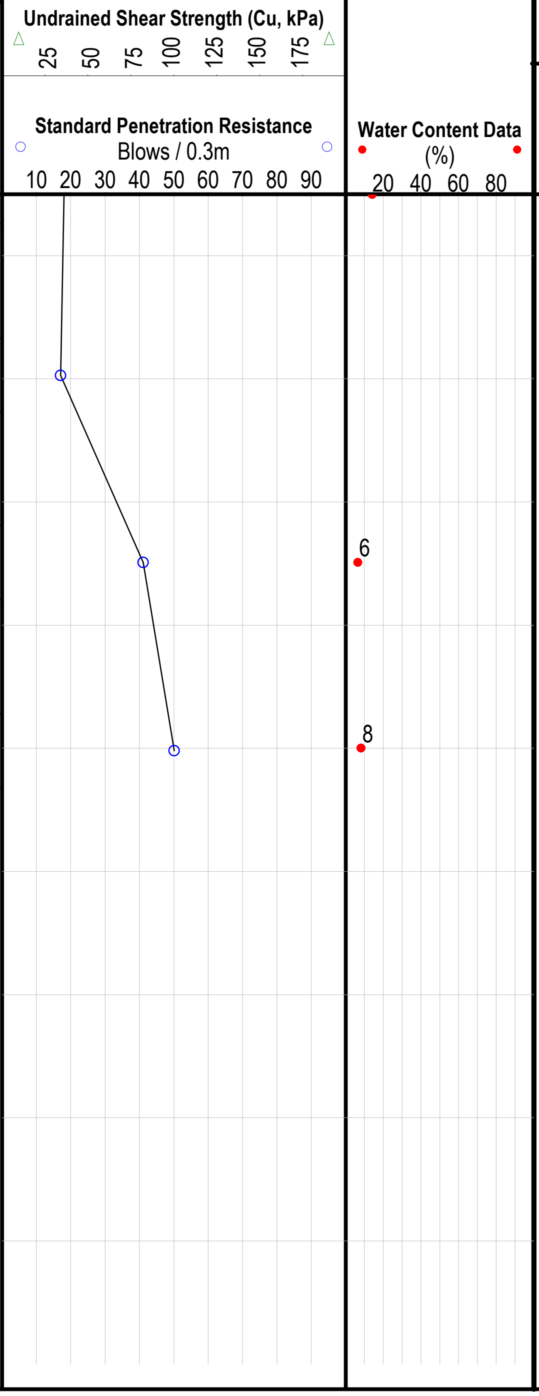
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Ashburn Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Gr	Sa	Si	Cl
SANDY SILTY TILL (SG) AND (SW), medium to coarse grained, trace gravel, brown, wet, compact	63.43									
SANDY SILTY TILL (SG), fine grained, trace gravel, some sand, medium grained, throughout, brown, wet, compact,	61.91	10	SS	67	17					
SAND & GRAVEL (GW), medium to coarse grained, dark grey / brown, wet, dense to very dense	59.78	11	SS	50	44	6	50.5	49.2	0.3	
		12	SS	25	50+	8				
BEDROCK See BH Log 18-4022 WTG-29R For Rock Core Data	56.12									
End of Borehole										



Remarks

Grain Size (%)

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=492423
N=5005472

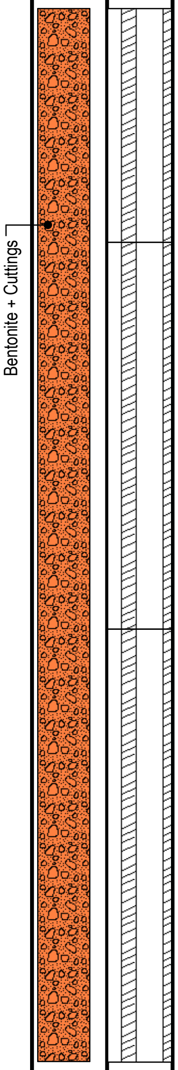
Sheet: 2 of 2

TULLOCH ENGINEERING

Borehole Log: WTG-29R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Ashburn Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	59.78							
0	BOULDER (SANDSTONE) on top of SHALEY LIMESTONE bedrock ,weathered rock at top of bedrock, fine grained / laminated, good quality rock	58.97	1	81	81	81	58.97		
1	SHLEY LIMESTONE, grey / black, vertical fracturing present, very thinly bedded to laminated, fine grained rock, fair quality rock	57.63	2	132	56	134.5	57.63		
2	SHALEY LIMESTONE, grey / black, vertical fracturing present, very thinly bedded to laminated, fine grained rock, some weathering present at horizontal fractures, excellent quality rock	56.13	3	150	98	150	56.13		
3	End of Rock Core								
4									

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: June 4, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=492423
N=5005472

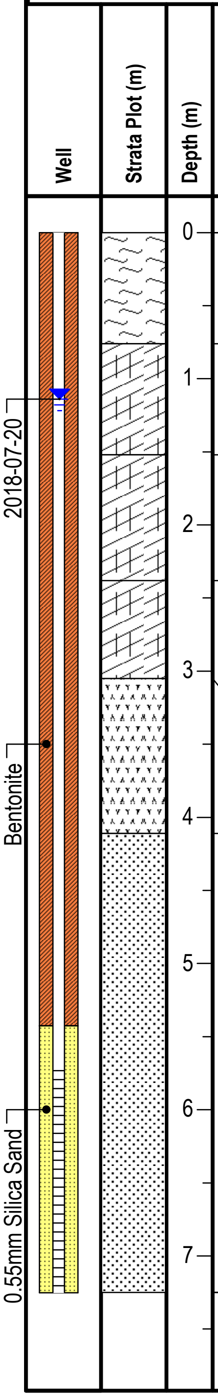
Sheet: 1 of 1

Borehole Log: WTG-32

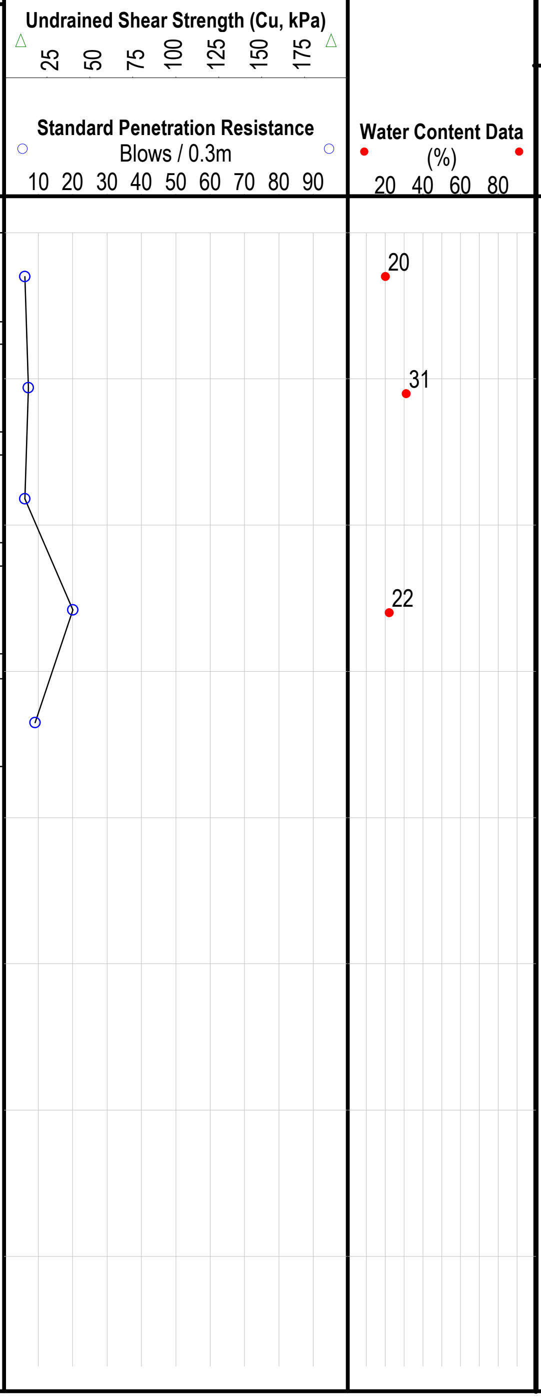
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE



Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Remarks
0	Geodetic Ground Elevation	73.12						
	CLAYEY TOPSOIL, trace ORGANICS, light brown, firm, moist to dry	72.36	1	SS	33	6	20	
1	SILTY CLAY (CI), light brown, firm, moist	71.60	2	SS	100	7	31	
2	SILTY CLAY (CI), light brown, moist, firm	70.74	3	SS	100	6		Water @ 1.66m BGS
	SILTY CLAY (CI), some sand, light brown to light grey, moist to wet , very stiff	70.07	4	SS	83	20	22	
3	CLAYEY SILT TILL (ML), trace GRAVEL, light grey, moist to wet, stiff	69.01	5	SS	46	9		
4	BEDROCK See BH Log 18-4022 WTG-32R For Rock Core Data	65.87						Auger Refusal on Inferred Bedrock @ 4.11m BGS
	End of Borehole							



Remarks

Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 29, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=488724
N=5000105

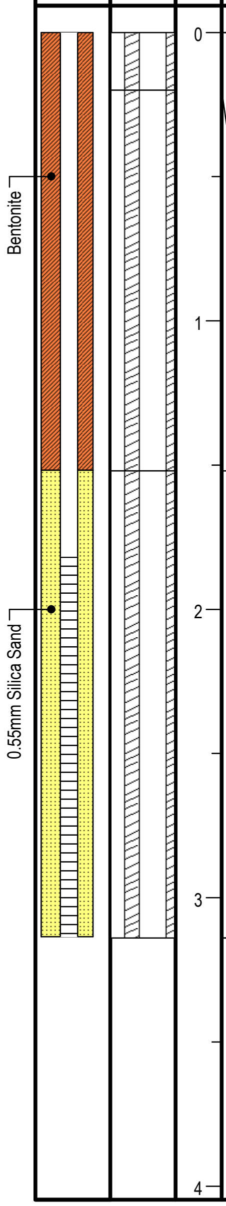
Sheet: 1 of 1

Borehole Log: WTG-32R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Geodetic Rock Elevation	69.01							
SHALEY LIMESTONE, grey / black, fine grained, laminated weathered at top of run, horizontal fractures with some weathering, good quality rock	68.81	1	20	85	20	68.81		
SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, some weathering present at horizontal fractures, good quality rock	67.49	2	129	76	132	67.49		
SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, some weathering present at horizontal fractures, some vertical fractures present, excellent quality rock	65.87	3	158	90	162	65.87		
End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 29, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

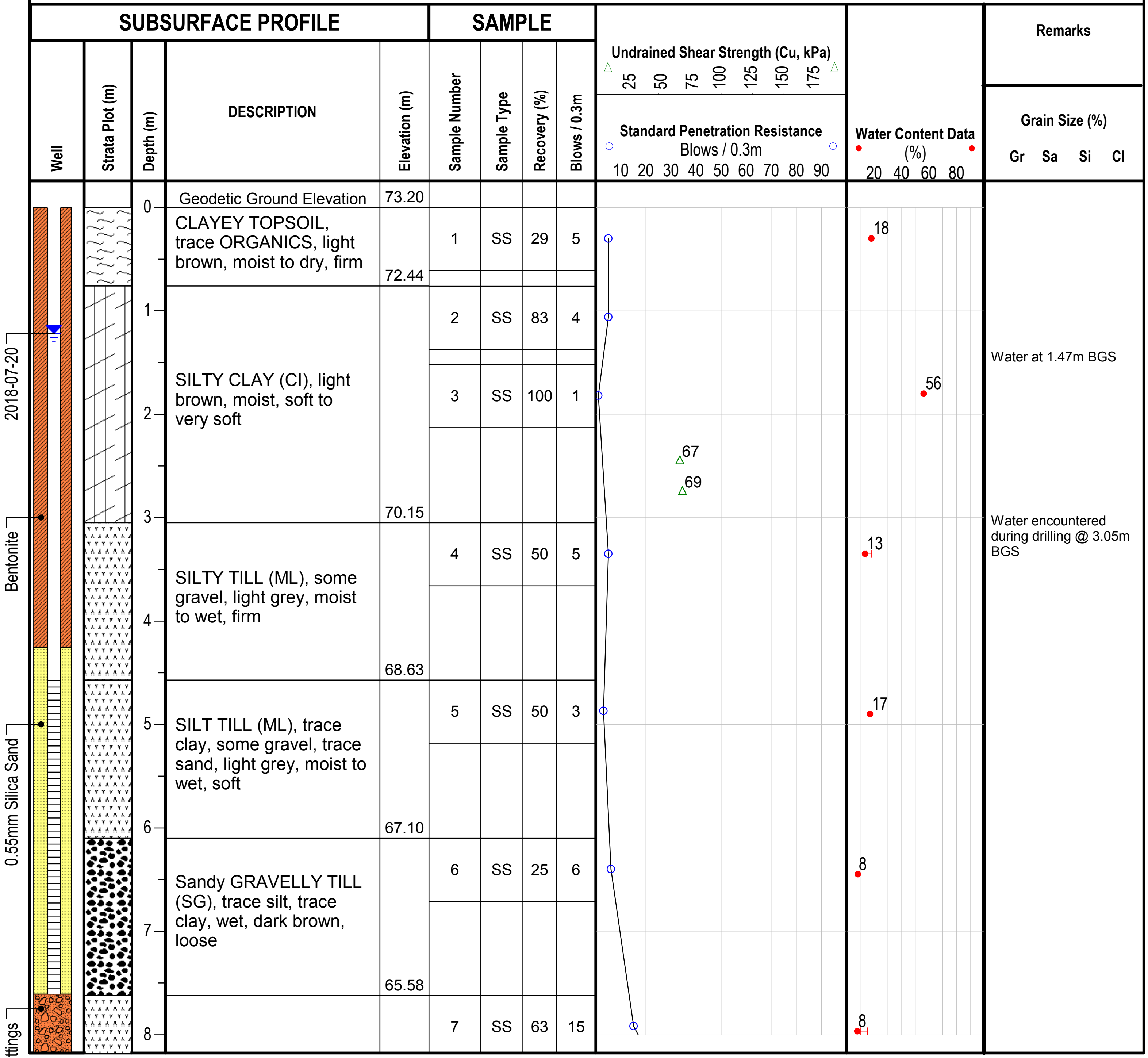
Location: **UTM 18T**
E=488724
N=5000105

Sheet: **1 of 1**

Borehole Log: WTG-35

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	73.20				
CLAYEY TOPSOIL, trace ORGANICS, light brown, moist to dry, firm	72.44	1	SS	29	5
SILTY CLAY (CI), light brown, moist, soft to very soft	70.15	2 3	SS SS	83 100	4 1
SILTY TILL (ML), some gravel, light grey, moist to wet, firm	68.63	4	SS	50	5
SILT TILL (ML), trace clay, some gravel, trace sand, light grey, moist to wet, soft	67.10	5	SS	50	3
Sandy GRAVELLY TILL (SG), trace silt, trace clay, wet, dark brown, loose	65.58	6	SS	25	6
		7	SS	63	15

Water at 1.47m BGS

Water encountered during drilling @ 3.05m BGS

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 31, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

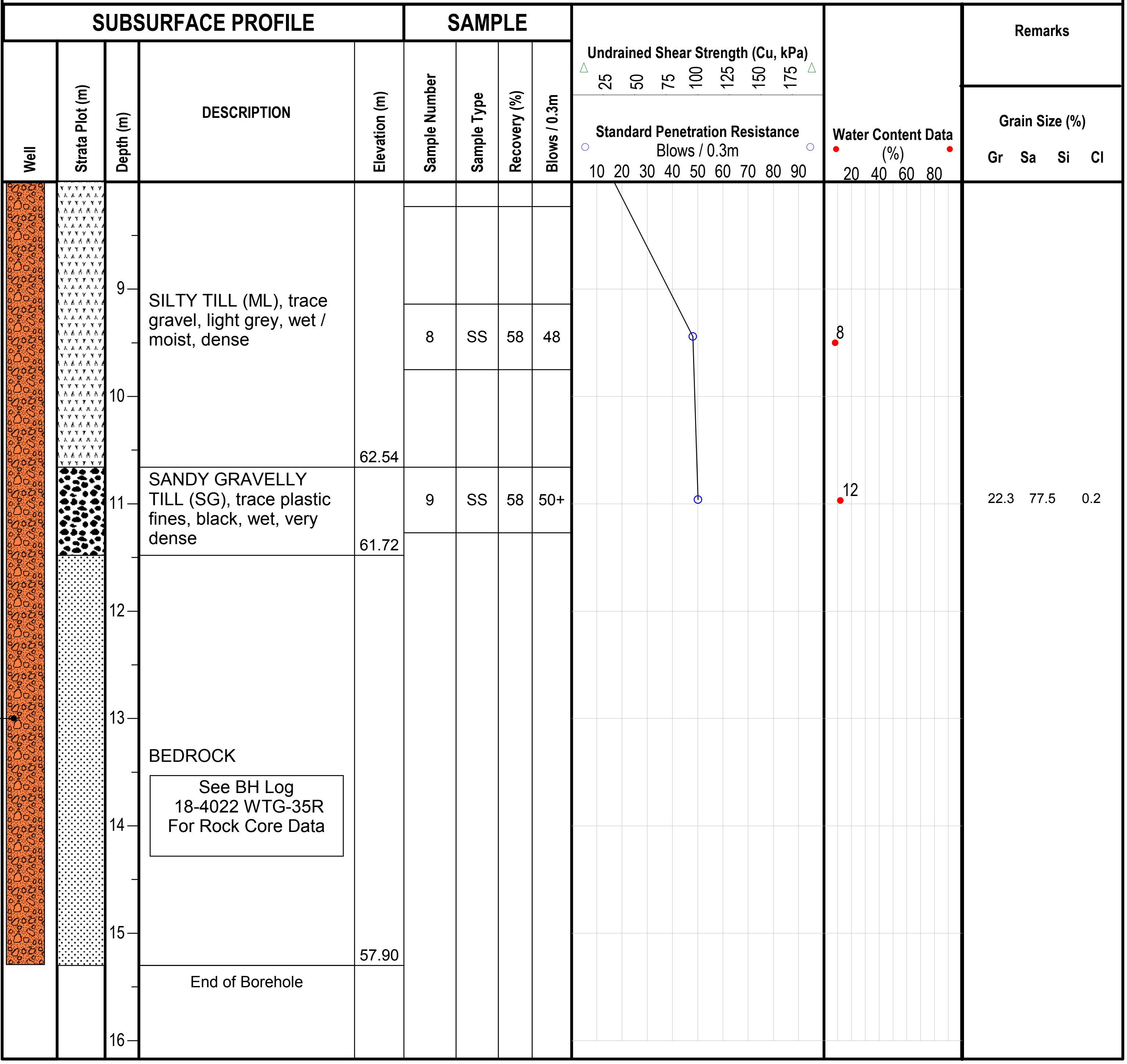
Location: **UTM 18T**
E=490084
N=5000515

Sheet: **1 of 2**

Borehole Log: WTG-35

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks: Grain Size (%) Gr	Sa	Si	Cl
SILTY TILL (ML), trace gravel, light grey, wet / moist, dense	62.54	8	SS	58	48				
SANDY GRAVELLY TILL (SG), trace plastic fines, black, wet, very dense	61.72	9	SS	58	50+	22.3	77.5		0.2
BEDROCK See BH Log 18-4022 WTG-35R For Rock Core Data	57.90								
End of Borehole									

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 31, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**
E=490084
N=5000515

Sheet: **2 of 2**

TULLOCH ENGINEERING

Borehole Log: WTG-35R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Bentonite + Cuttings			Geodetic Rock Elevation	61.72							
		0	SHALEY LIMESTONE, grey / black, vertical & horizontal fracturing present with significant weathering at discontinuities, fine grained, laminated, poor quality rock	60.87	1	85	31	85	60.87		
		1 2	SHALEY LIMESTONE, grey / black, laminated with some weathering present at horizontal fractures, good quality rock	59.35	2	152	86	152	59.35		
		3	SHALEY LIMESTONE, grey / black, vertical & horizontal fracturing present with some weathering present at horizontal fractures, discontinuities occurring along shale interfaces, fine grained, very thinly bedded to laminated, good quality rock	57.90	3	145	83	145	57.90		
		4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 31, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

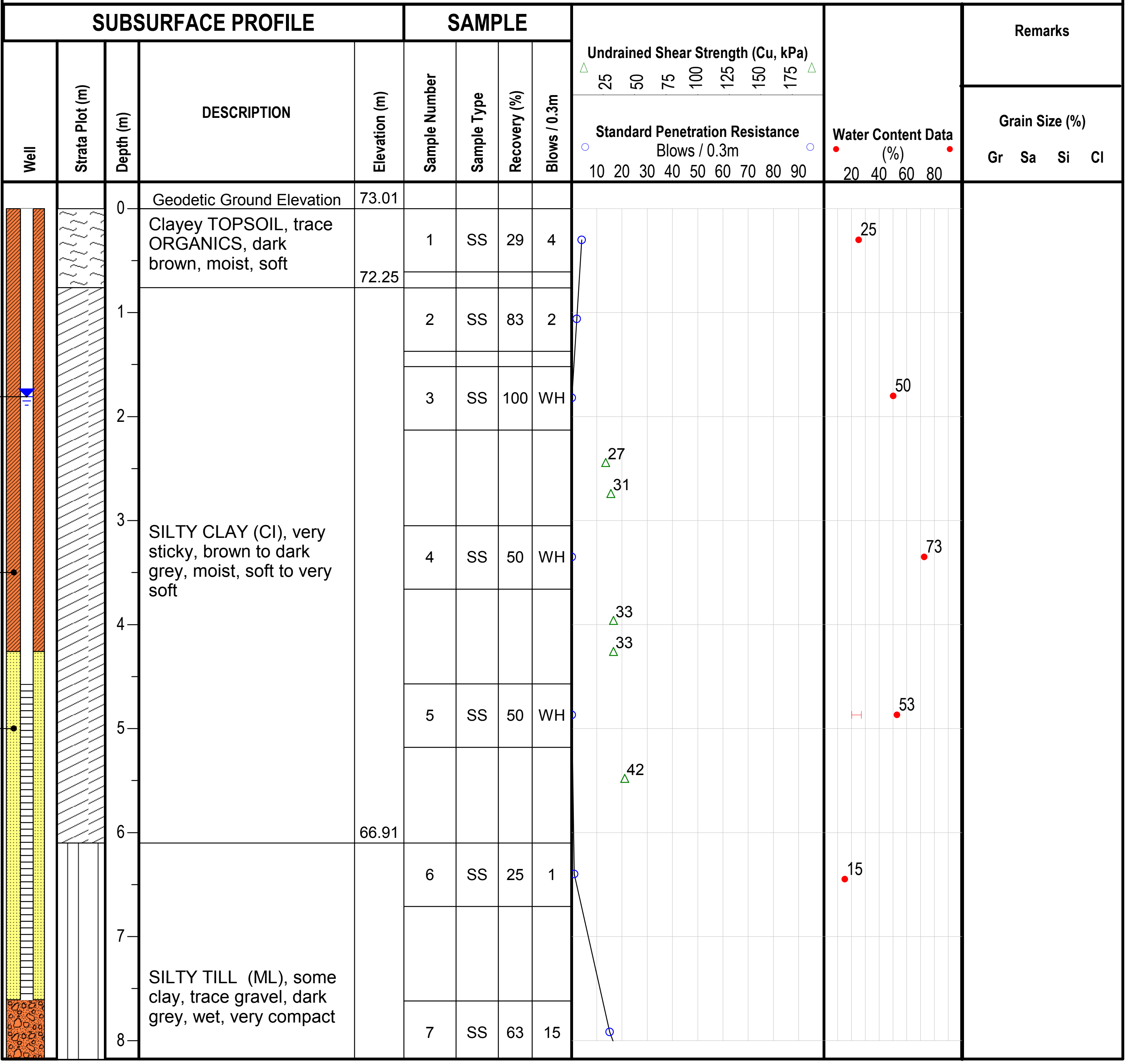
Location: UTM 18T
E=490084
N=5000515

Sheet: 1 of 1

Borehole Log: WTG-38

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
0	Geodetic Ground Elevation	73.01				
	Clayey TOPSOIL, trace ORGANICS, dark brown, moist, soft	72.25	1	SS	29	4
	SILTY CLAY (CI), very sticky, brown to dark grey, moist, soft to very soft	66.91	2	SS	83	2
			3	SS	100	WH
			4	SS	50	WH
			5	SS	50	WH
	SILTY TILL (ML), some clay, trace gravel, dark grey, wet, very compact		6	SS	25	1
			7	SS	63	15

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **June 1, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

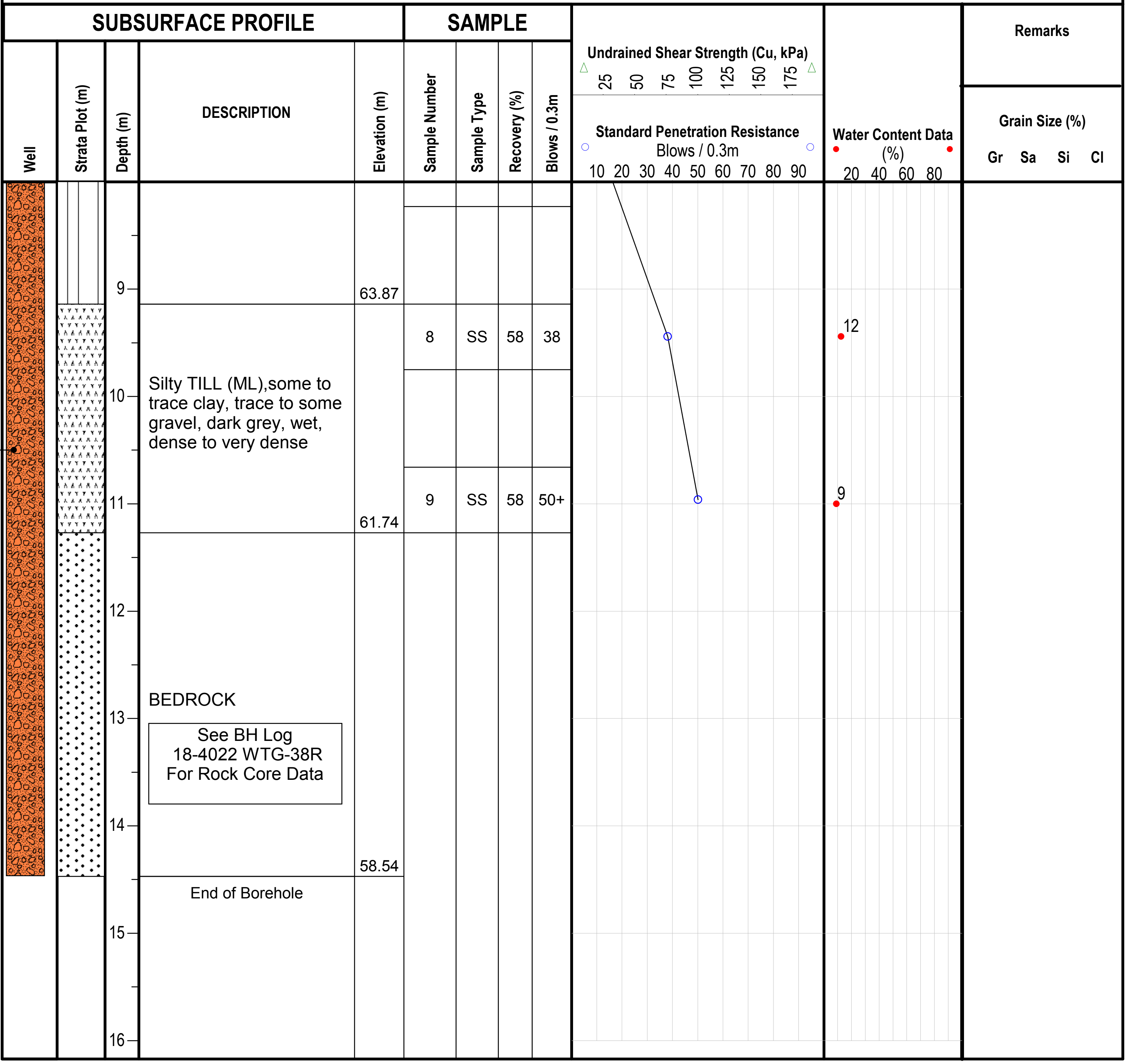
Location: **UTM 18T**
E=490750
N=5001244

Sheet: **1 of 2**

Borehole Log: WTG-38

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



Description	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
	63.87				
Silty TILL (ML),some to trace clay, trace to some gravel, dark grey, wet, dense to very dense		8	SS	58	38
	61.74	9	SS	58	50+
BEDROCK See BH Log 18-4022 WTG-38R For Rock Core Data	58.54				
End of Borehole					

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 1, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=490750
N=5001244

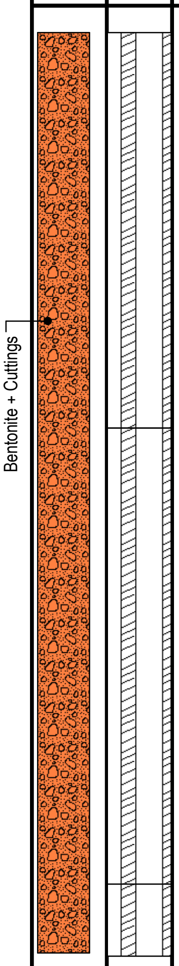
Sheet: 2 of 2

Borehole Log: WTG-38R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE			SAMPLE						
Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
	Geodetic Rock Elevation	61.74							
0	SHALEY LIMESTONE, grey / black, very weathered section at top of run, fine grained, thinly laminated to laminated, some weathering at horizontal discontinuities, fair quality rock	60.37	1	141	73	137	60.37		
2	SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, fine grained, some weathering at discontinuities, horizontal natural fractures, good quality rock	58.79	2	157.5	81	157.5	58.79		
3	SHALEY LIMESTONE, grey / black, laminated, fine grained, no weathering, mechanical fracture present, good quality rock	58.54	3	25	82	25	58.54		
4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **June 2, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

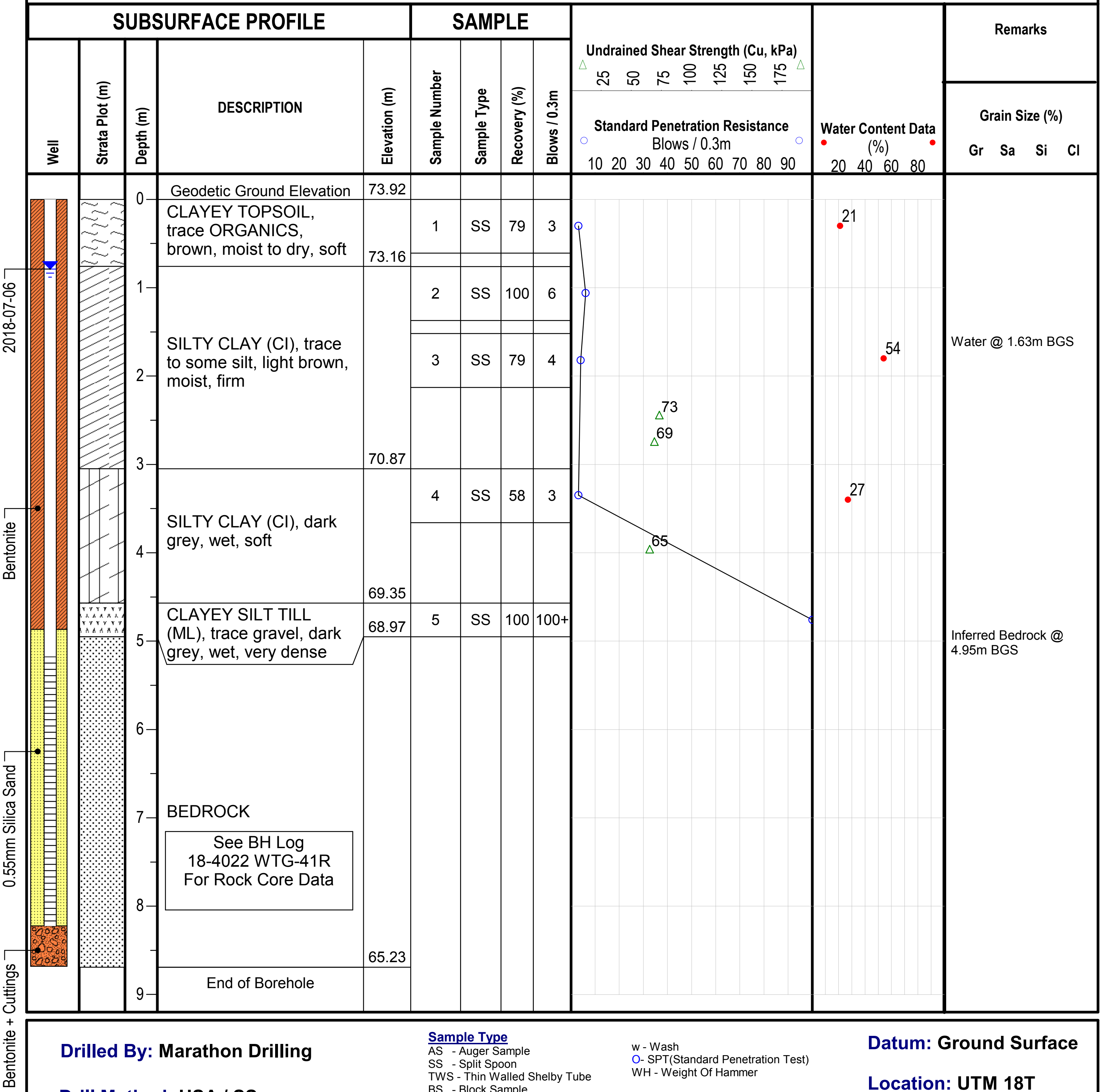
Location: **UTM 18T**
E=490750
N=5001244

Sheet: **1 of 1**

Borehole Log: WTG-41

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	73.92				
CLAYEY TOPSOIL, trace ORGANICS, brown, moist to dry, soft	73.16	1	SS	79	3
SILTY CLAY (CI), trace to some silt, light brown, moist, firm	70.87	2 3	SS SS	100 79	6 4
SILTY CLAY (CI), dark grey, wet, soft	69.35	4	SS	58	3
CLAYEY SILT TILL (ML), trace gravel, dark grey, wet, very dense	68.97	5	SS	100	100+
BEDROCK See BH Log 18-4022 WTG-41R For Rock Core Data	65.23				
End of Borehole					

Remarks

Water @ 1.63m BGS

Inferred Bedrock @ 4.95m BGS

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 2, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=491190
N=5000204

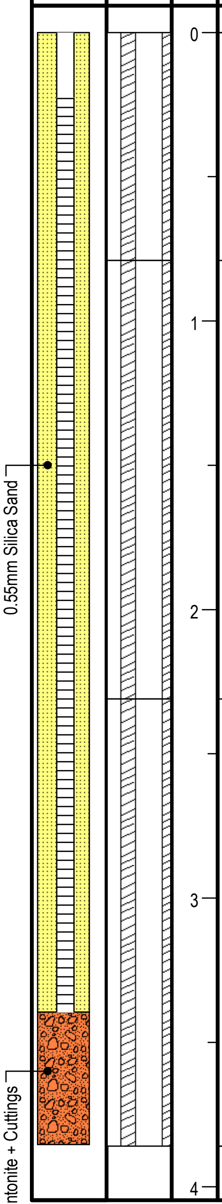
Sheet: 1 of 1

Borehole Log: WTG-41R

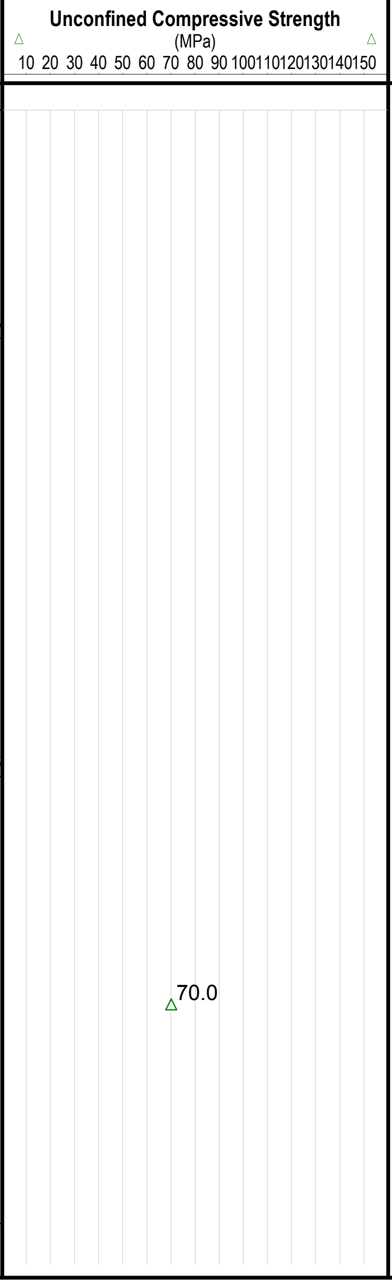
TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE					
DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Remarks
Geodetic Rock Elevation	68.97						
SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, fine grained weathering present & horizontal fractures, weathered broken zone 100mm @ top of run, good quality rock	68.18	1	73	76	79	68.18	
SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, significant weathering @ horizontal fractures, good quality rock	66.66	2	152	79	152	66.66	
SHALEY LIMESTONE, grey / black, laminated, minimal weathering, horizontal fractures, some vertical fractures, good quality rock	65.11	3	149	87	155	65.11	
End of Rock Core							



Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **June 2, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=491190
N=5000204

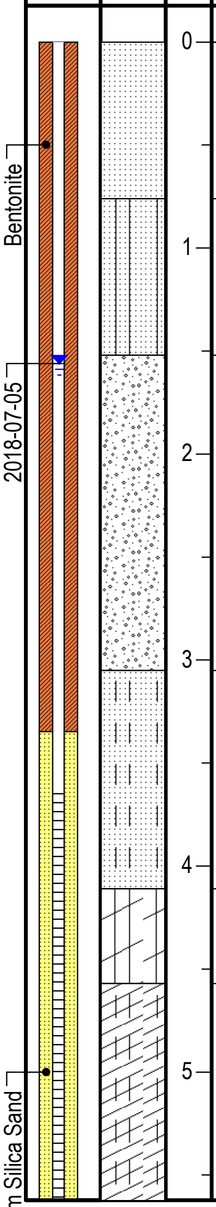
Sheet: **1 of 1**

Borehole Log: WTG-43

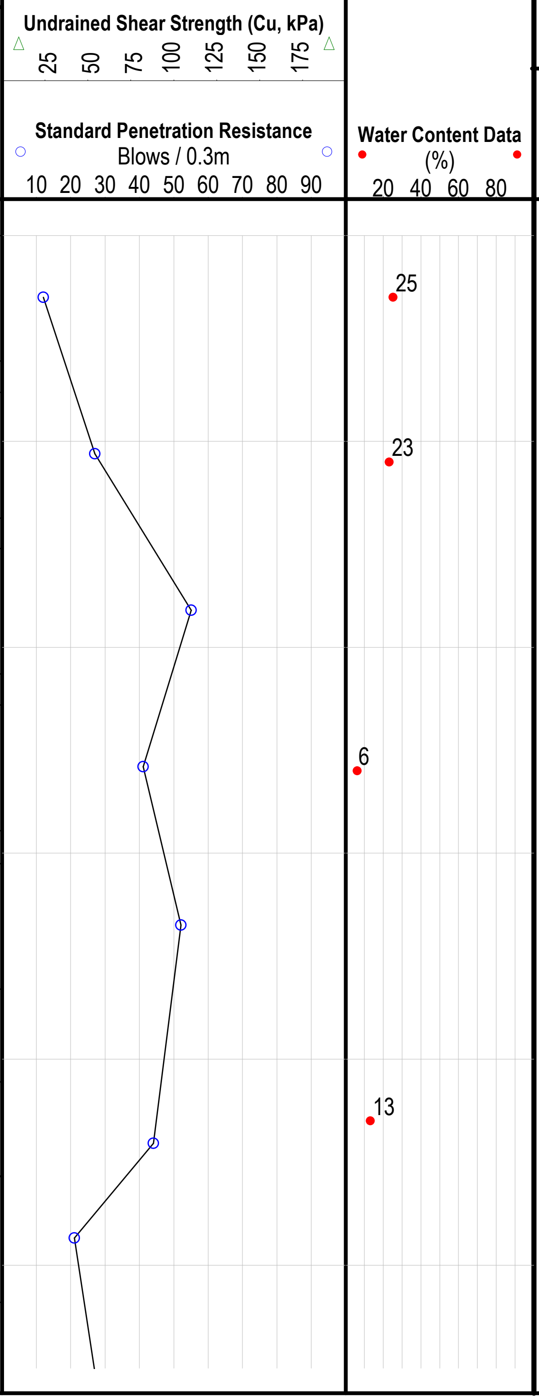
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Remarks
Geodetic Ground Elevation	86.79						
SAND (SP), medium grained, some to trace GRAVEL, brown, dry, compact	86.03	1	SS	79	12	25	
SANDY SILT CLAY (ML), oxidated, brown, dry, very stiff	85.27	2	SS	100	27	23	
SAND & GRAVEL (GW), angular rocks, fragmented rocks, cobbles, browm, dry, very dense to dense	83.74	3 4	SS SS	79 58	55 41	6	Water @ 1.56m BGS
SILTY SAND to Sandy SILT (SM), trace clay, trace gravel, olive / grey, dry, very dense	82.68	5	SS	100	52		
CLAYEY SILT to Silty SAND (ML), grey, dry, hard	82.22	6	SS	83	44	13	
SILTY CLAY (CL), dark grey, moist, very stiff		7	SS	29	21		



Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=0494277
N=5001837

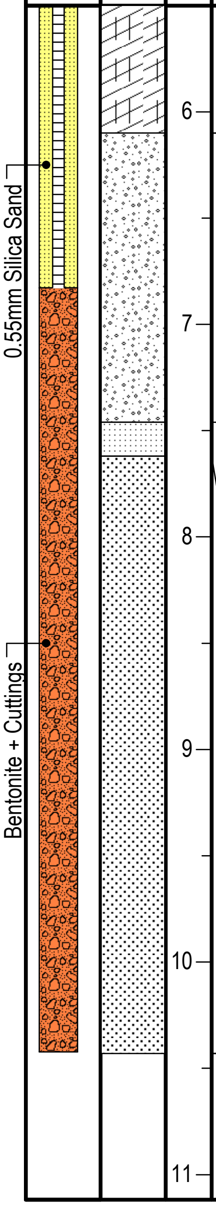
Sheet: 1 of 2

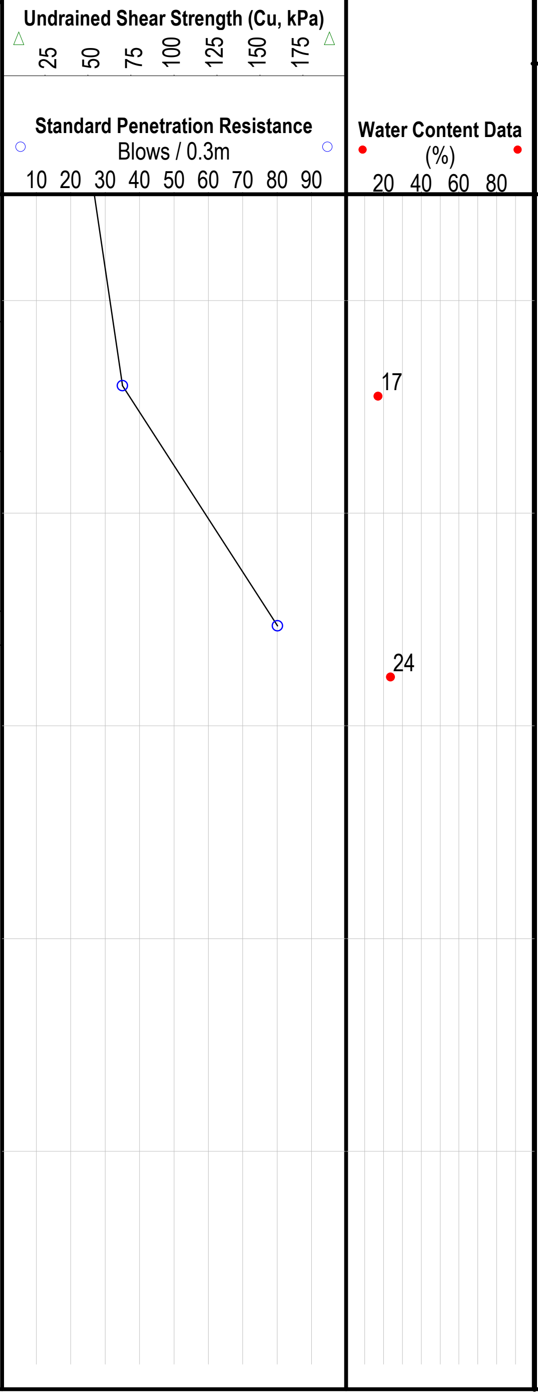
Borehole Log: WTG-43

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE		SAMPLE								
DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Gr	Sa	Si	Cl
	80.69									
SAND & GRAVEL (GW), some to trace clay, dark grey, wet, dense	79.33	8	SS	42	35	17				
SAND (SW) trace clay, trace gravel, trace plastic fines, grey, dry, very dense	79.17	9	SS	100	80	24	9.1	81.4	9.5	
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	76.36									
End of Borehole										





Remarks

Grain Size (%)

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T

Sheet: 2 of 2

TULLOCH
ENGINEERING

Borehole Log: WTG-43R

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 4-5, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	79.17							
Bentonite + Cuttings		0	LIMESTONE, grey, weathered, horizontal & angular fractures, very poor quality rock	78.64	1	53	19	53	78.64		
		1	LIMESTONE, grey, slightly weathered, horizontal & angular fractures, laminated with light grey bedding, good quality rock	77.12	2	152	83	152	77.12		
		2 3	LIMESTONE, grey, slightly weathered, horizontal & angular fractures, laminated with dark grey bedding, excellent quality rock	75.60	3	152	95	152	75.60		
		4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 30, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=0494277
N=5001837

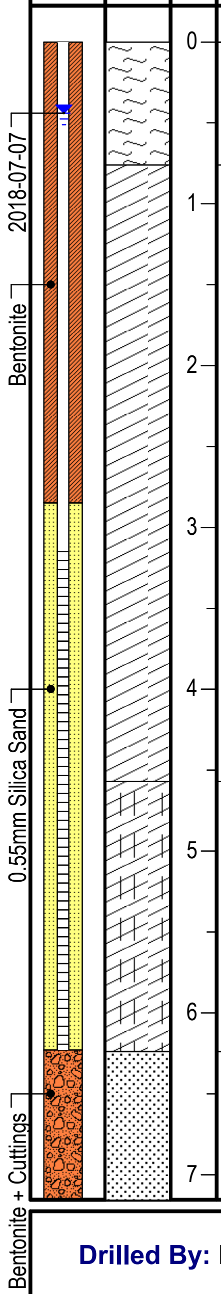
Sheet: **1 of 1**

Borehole Log: WTG-44

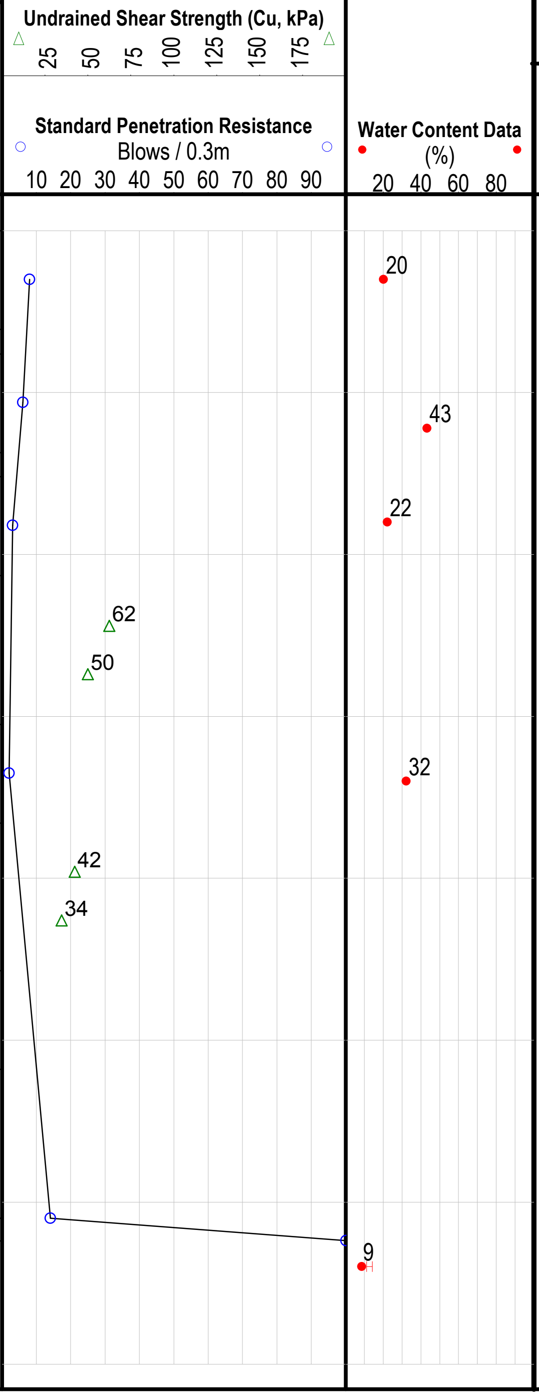
Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 3-4 Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks	Gr	Sa	Si	Cl
Geodetic Ground Elevation	69.37									
CLAYEY TOPSOIL, trace sand, trace organics, brown, moist, firm	68.61	1	SS	71	8					
SILTY CLAY (CI), trace to some silt, light brown to grey, moist, firm to soft	64.80	2	SS	83	6					
		3	SS	79	3		0.0	0.9	36.4	62.7
		5	SS	100	2					
SILTY TILL (MK),some sand, trace gravel, grey, moist, very dense	63.13	6	TWS	100	-					
		7			100+	Auger Refusal on Inferred Bedrock @ 6.24m BGS				



Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 21, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

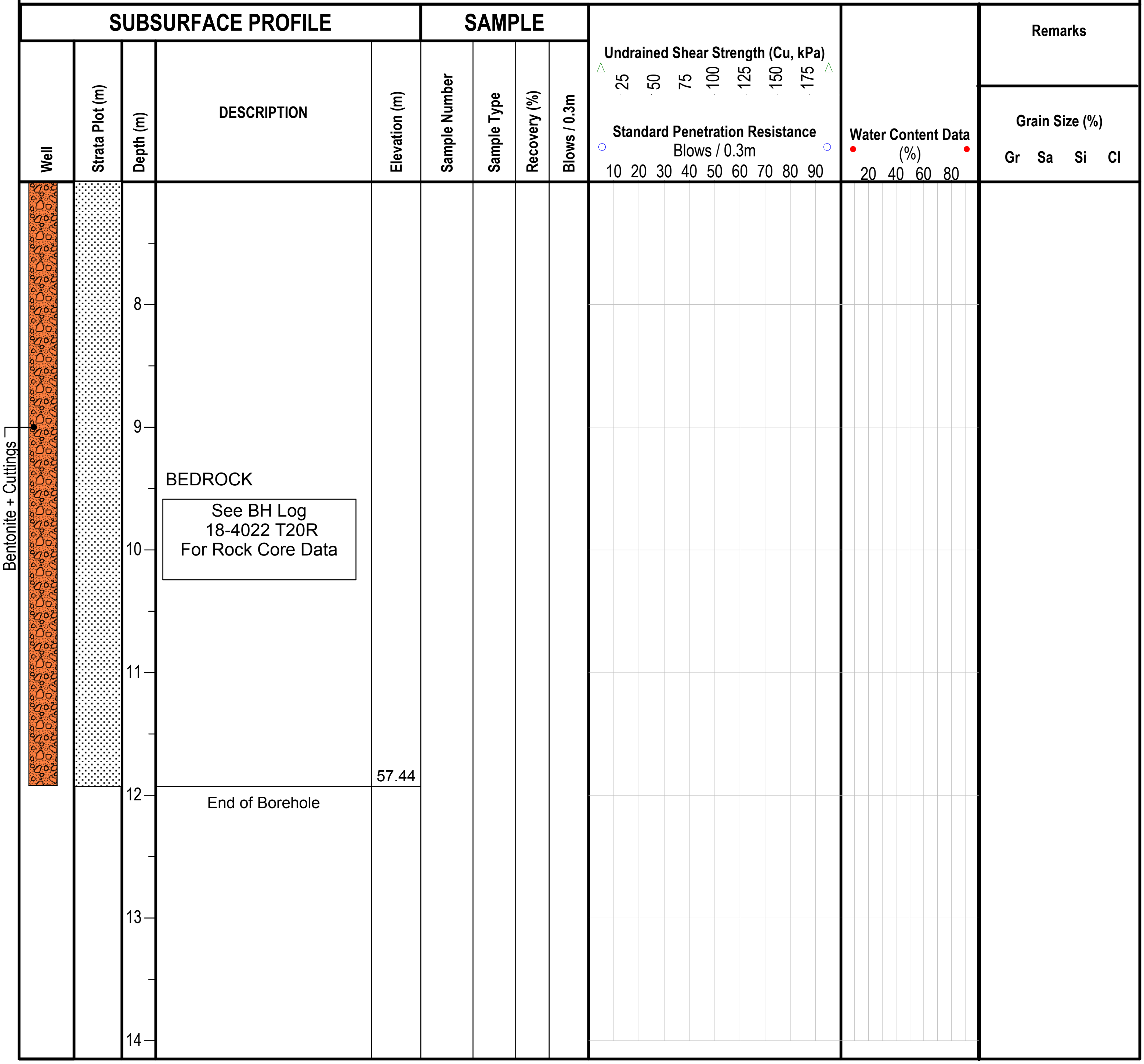
Location: **UTM 18T**
E=487121
N=4996303

Sheet: **1 of 2**

Borehole Log: WTG-44

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 3-4 Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



BEDROCK

See BH Log
18-4022 T20R
For Rock Core Data

End of Borehole

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 21, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T

Sheet: 2 of 2

Borehole Log: WTG-44R

TULLOCH
ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 3-4 Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	63.13							
Bentonite + Cuttings		0	SHALEY LIMESTONE, grey / black, fine grained, extremely weathered, thinly laminated to laminated, broken zones at top & bottom of run	62.12	1	76	16	101.5	62.12		
		1 2	SHALEY LIMESTONE, grey / black, fine grained, broken & weathered sections throughout run, voids were hit throughout run	60.54	2	74	7	157.5	60.54		
		3 4	SHALEY LIMESTONE, grey / black, fine grained, very thinly bedded to laminated, broken zone at top of run (16cm long) angled & horizontal fractures with some weathering present at discontinuities	58.89	3	165	82	165	58.89		
		5	SHALEY LIMESTONE, grey / black, fine grained, very thinly bedded to laminated, mechanical fractures, excellent rock	57.44	4	145	100	145	57.44	△66.0	
		6	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 21, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

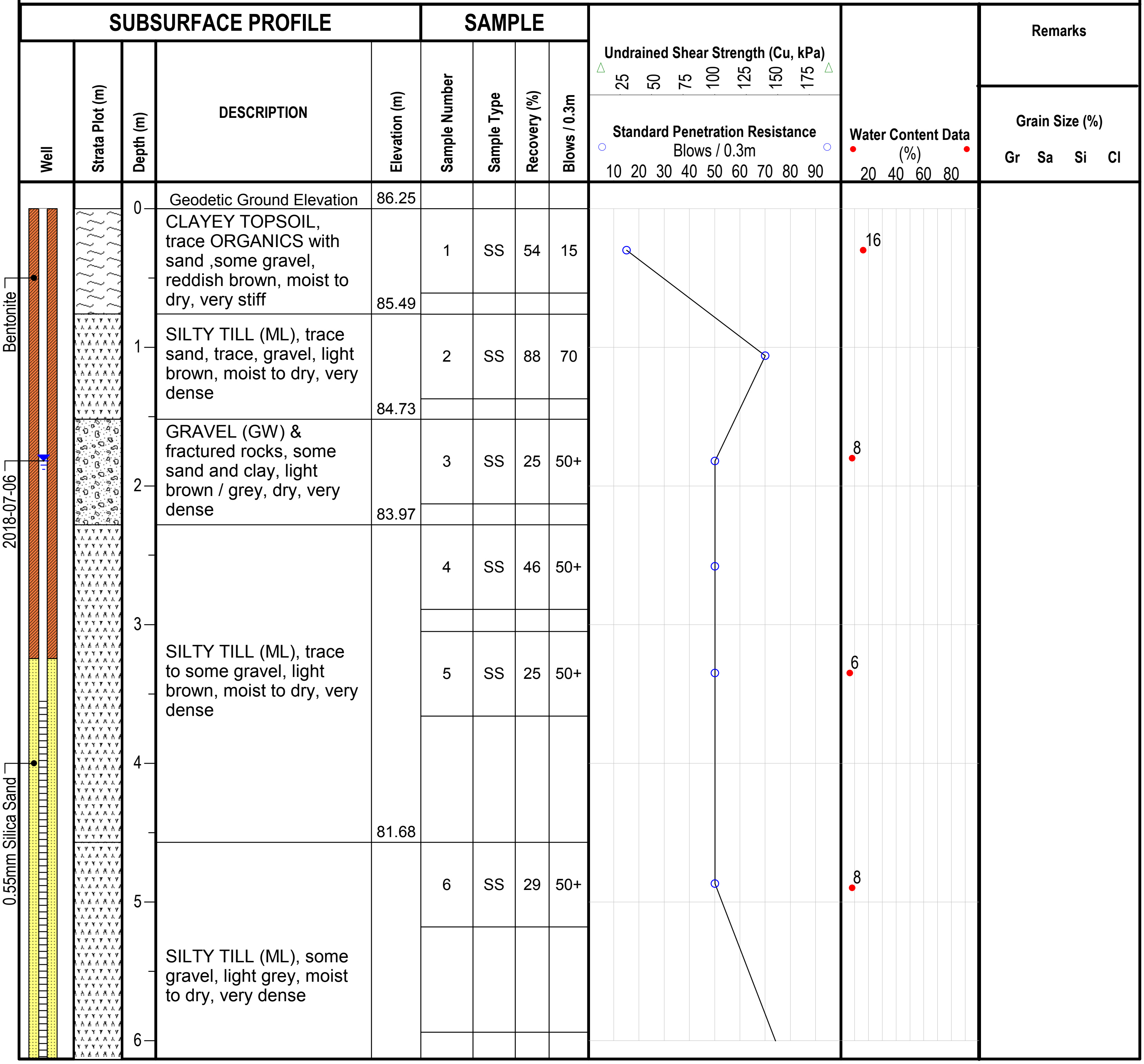
Location: UTM 18T
E=487121
N=4996303

Sheet: 1 of 1

Borehole Log: WTG-46

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2 Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)
Geodetic Ground Elevation	86.25					
CLAYEY TOPSOIL, trace ORGANICS with sand ,some gravel, reddish brown, moist to dry, very stiff	85.49	1	SS	54	15	16
SILTY TILL (ML), trace sand, trace, gravel, light brown, moist to dry, very dense	84.73	2	SS	88	70	
GRAVEL (GW) & fractured rocks, some sand and clay, light brown / grey, dry, very dense	83.97	3	SS	25	50+	8
SILTY TILL (ML), trace to some gravel, light brown, moist to dry, very dense	81.68	4	SS	46	50+	
		5	SS	25	50+	6
SILTY TILL (ML), some gravel, light grey, moist to dry, very dense		6	SS	29	50+	8

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 19, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

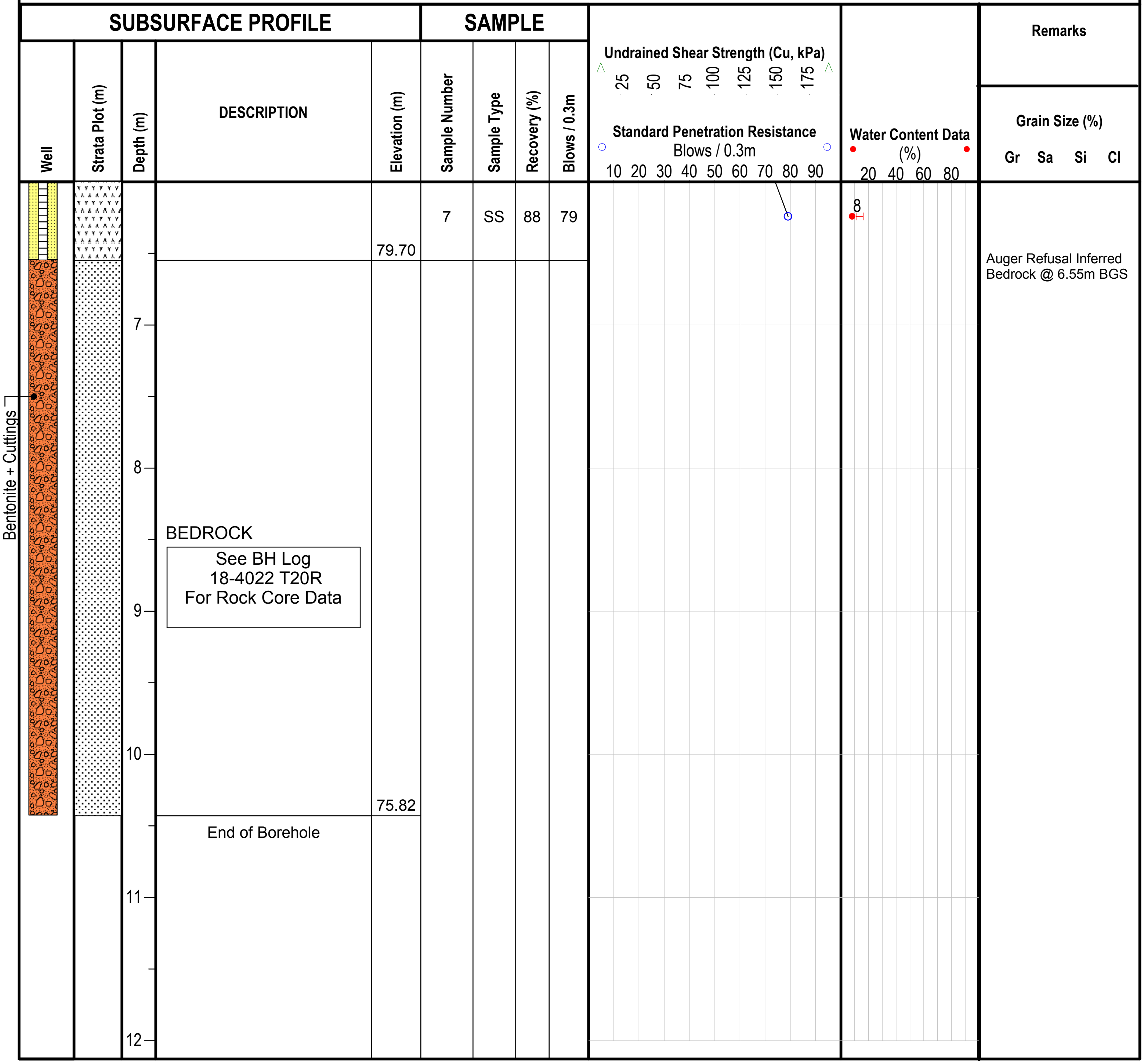
Location: **UTM 18T**
E=487994
N=4993166

Sheet: **1 of 2**

Borehole Log: WTG-46

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2 Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



Description	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
	79.70	7	SS	88	79	Auger Refusal Inferred Bedrock @ 6.55m BGS
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	75.82					
End of Borehole						

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 19, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: **Ground Surface**

Location: **UTM 18T**

Sheet: **2 of 2**

Borehole Log: WTG-46R

TULLOCH
ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2 Road, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Bentonite + Cuttings			Geodetic Rock Elevation	79.70							
		0	SHALEY LIMESTONE, grey / black, fine grained, thinly laminated to laminated, broken sections at top of run with weathering at discontinuities / (horizontal) fractures, fair quality rock	78.89	1	81	67	81	78.89		
		1 2	SHALEY LIMESTONE, grey / black, fine grained, very thinly bedded to laminated, some weathering present at discontinuities, mechanical fractures occuring along weaker shale strata (horizontal fractures), excellent rock	77.37	2	152	95	152	77.37		
		3	SHALEY LIMESTONE, grey / black, very thinly bedded to laminated, minimal weathering, mechanical breaks in soft shale layers (horizontal breaks) excellent rock	75.82	3	155	93	155	75.82		
		4	End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 20, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

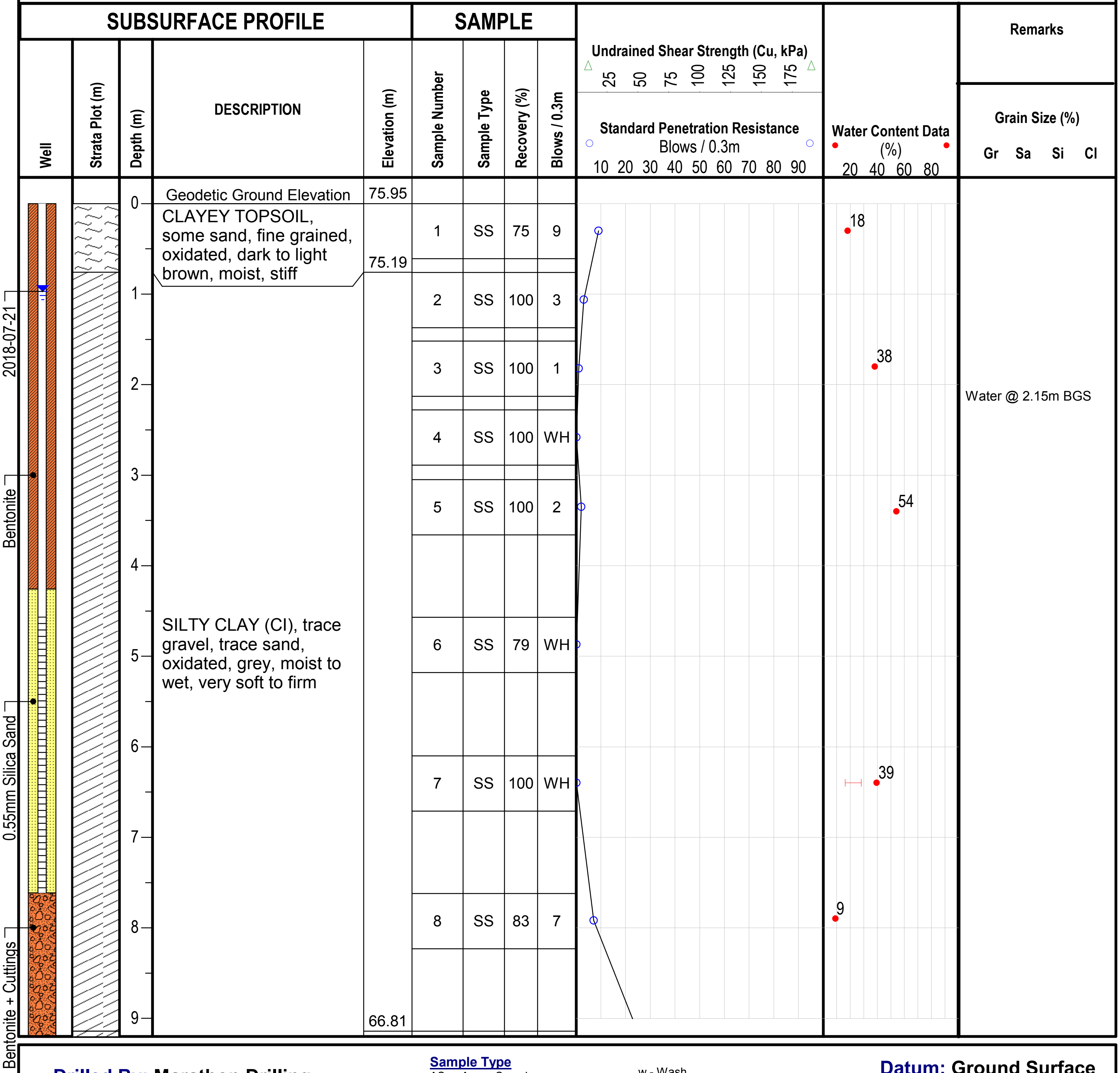
Location: **UTM 18T**
E=487994
N=4993166

Sheet: **1 of 1**

Borehole Log: WTG-47

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



Description	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	75.95				
CLAYEY TOPSOIL, some sand, fine grained, oxidated, dark to light brown, moist, stiff	75.19	1	SS	75	9
SILTY CLAY (CI), trace gravel, trace sand, oxidated, grey, moist to wet, very soft to firm		2	SS	100	3
		3	SS	100	1
		4	SS	100	WH
		5	SS	100	2
		6	SS	79	WH
		7	SS	100	WH
		8	SS	83	7
	66.81				

Remarks: Water @ 2.15m BGS

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 20, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

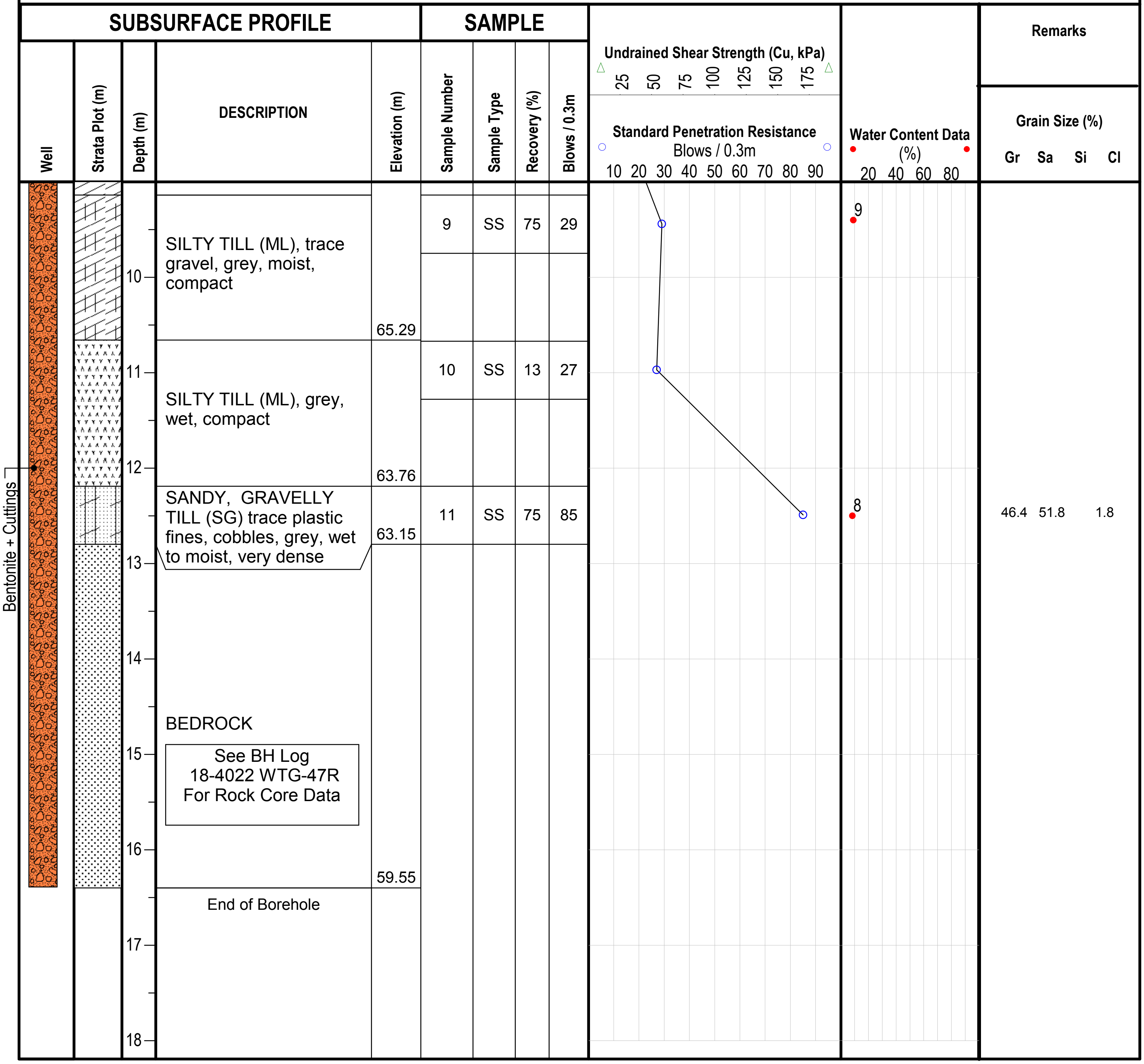
Location: UTM 18T
E=490614
N=4998234

Sheet: 1 of 2

Borehole Log: WTG-47

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Gr	Sa	Si	Cl
SILTY TILL (ML), trace gravel, grey, moist, compact	65.29	9	SS	75	29	9				
SILTY TILL (ML), grey, wet, compact	63.76	10	SS	13	27					
SANDY, GRAVELLY TILL (SG) trace plastic fines, cobbles, grey, wet to moist, very dense	63.15	11	SS	75	85	8	46.4	51.8		1.8
BEDROCK See BH Log 18-4022 WTG-47R For Rock Core Data	59.55									
End of Borehole										

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 20, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=490614
N=4998234

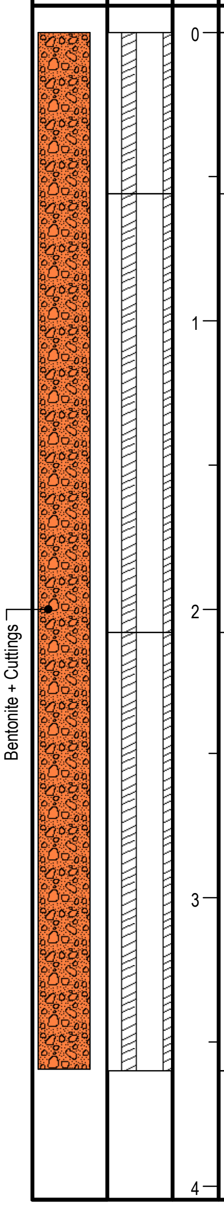
Sheet: 2 of 2

Borehole Log: WTG-47R

TULLOCH ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 3-4, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



SUBSURFACE PROFILE		SAMPLE						
DESCRIPTION	**Elevation (m)**	**Sample Number**	**TCR (cm)**	**RQD (%)**	**Run Length (cm)**	**Run Depth Elevation (m)**	**Unconfined Compressive Strength** (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	**Remarks**
Geodetic Rock Elevation	63.15							
LIMESTONE, grey, weathered, laminated, horizontal fractures, vertical fractures, very poor quality rock	62.59	1	56	18	56	62.59		
LIMESTONE, grey, slightly weathered, horizontal fractures, laminated with thin black bedding, fair quality rock	61.07	2	152	72	152	61.07		
LIMESTONE, grey, very slightly weathered, laminated, horizontal fractures, good quality rock	59.55	3	152	80	152	59.55		
End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 22, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

Location: **UTM 18T**
E=490614
N=4998234

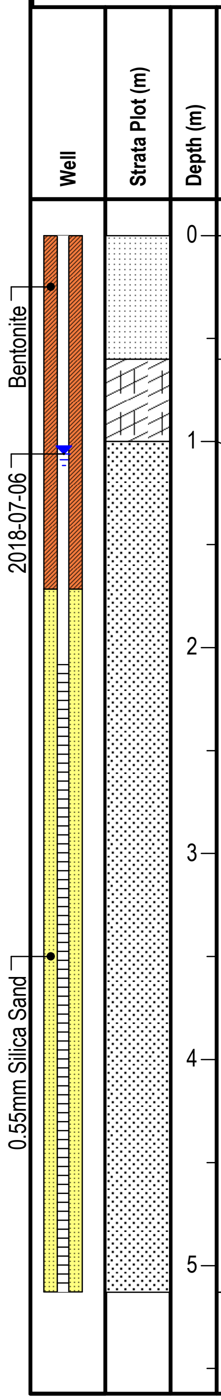
Sheet: **1 of 1**

Borehole Log: WTG-48

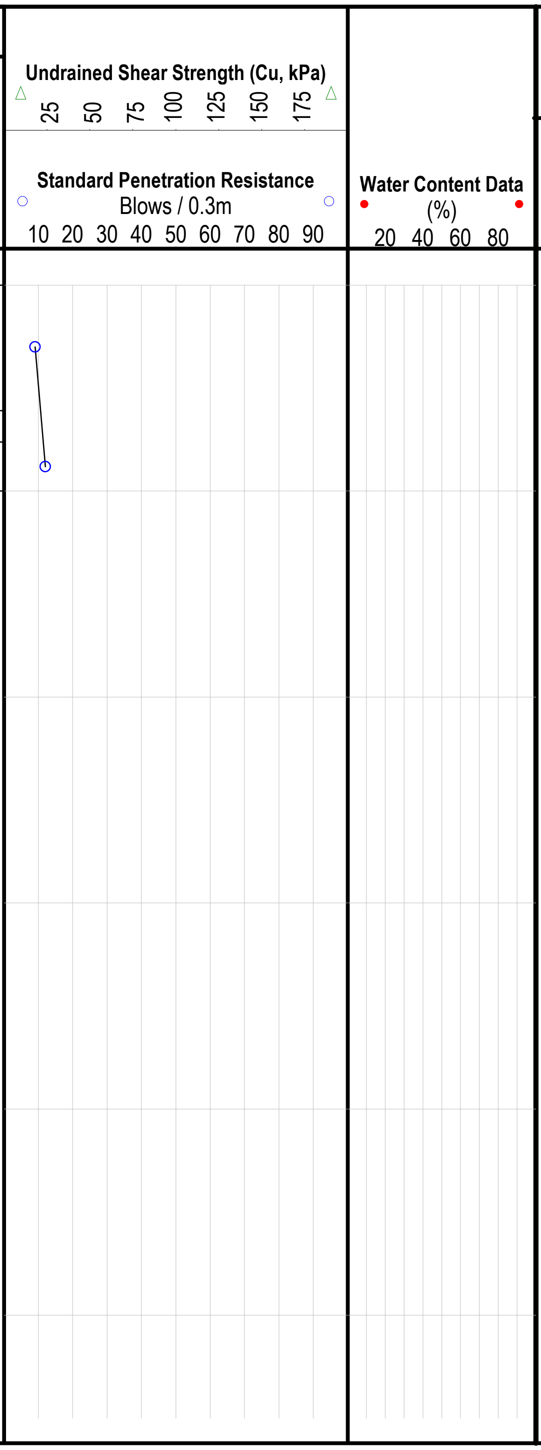
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: County Road 43, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	82.32					
SAND (SW), trace gravel, oxidated, brown, organic, loose	81.72	1	SS	42	9	
SILTY CLAY (CL), trace gravel, oxidated, brown, organics, compact	81.32	2	SS	25	12	
BEDROCK See BH Log 18-4022 WTG-48R For Rock Core Data	77.19					Spoon Refusal on Inferred Bedrock @1.07m BGS Water @ 1.84m BGS
End of Borehole						



Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May , 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

Location: UTM 18T
E=491382
N=4997145

Sheet: 1 of 1

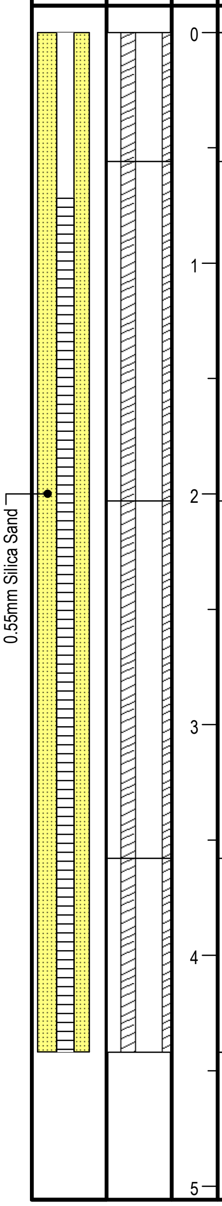
Borehole Log: WTG-48R

TULLOCH
ENGINEERING

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Country Road 43, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE



DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
Geodetic Rock Elevation	81.32							
LIMESTONE, grey, weathered, fine grained, laminated, horizontal fractures, poor quality rock	80.76	1	53	38	56	80.76		
LIMESTONE, grey, slightly weathered, fine grained, laminated, horizontal fractures, fair quality rock	79.29	2	147	50	147	79.29		
LIMESTONE, grey, slightly weathered, fine grained, laminated , horizontal fractures, poor quality rock	77.74	3	155	49	155	77.74		
LIMESTONE, grey, weathered, laminated with thin black bedding, fine grained, horizontal fractures, poor quality rock	76.90	4	84	42	84	76.90		
End of Rock Core								

Drilled By: **Marathon Drilling**

Drill Method: **Casing / NQ Core**

Drill Date: **May 23, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: **Ground Surface**

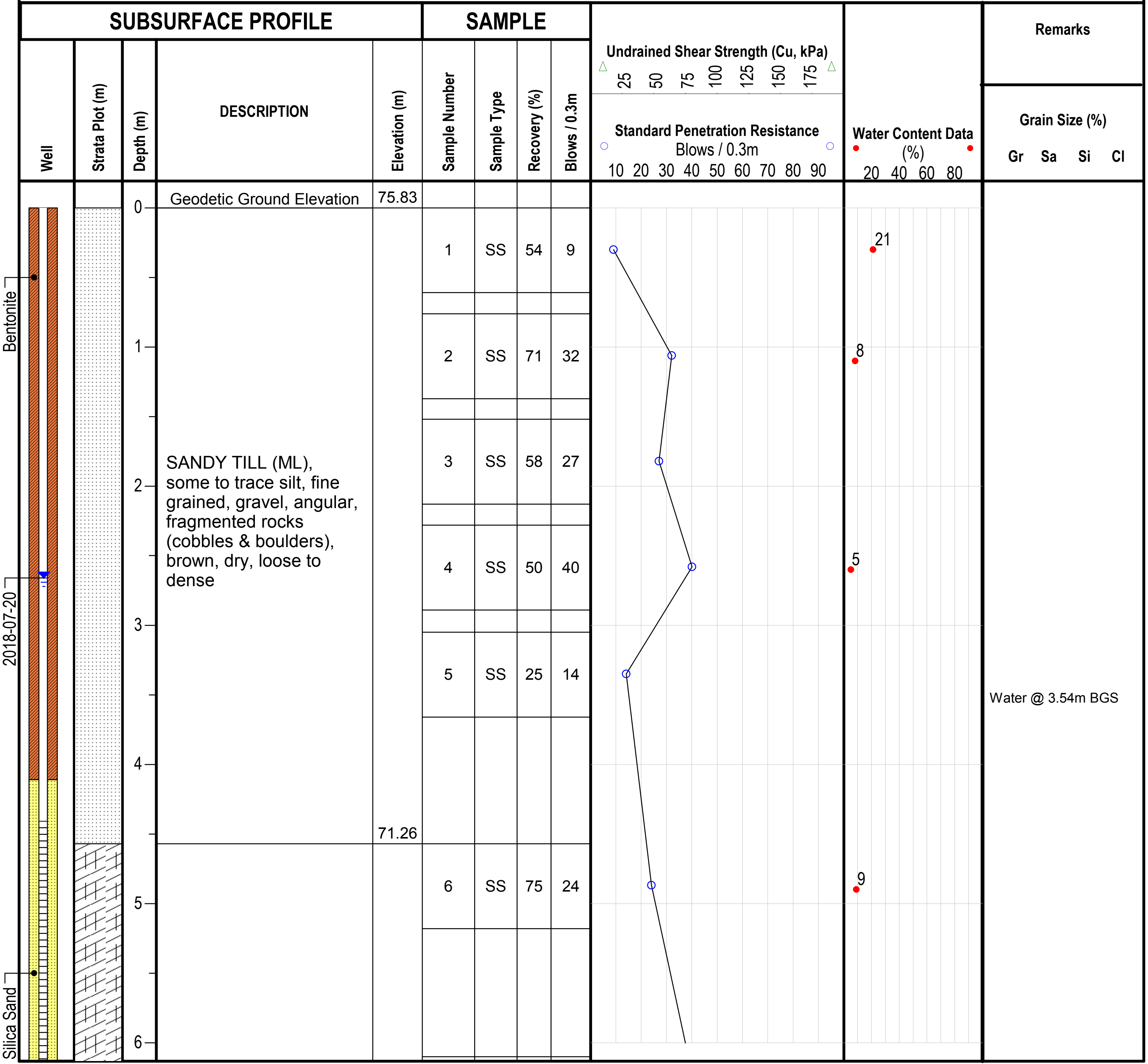
Location: **UTM 18T**
E=491382
N=4997145

Sheet: **1 of 1**

Borehole Log: WTG-52

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Remarks
Geodetic Ground Elevation	75.83						
SANDY TILL (ML), some to trace silt, fine grained, gravel, angular, fragmented rocks (cobbles & boulders), brown, dry, loose to dense		1	SS	54	9	21	
		2	SS	71	32	8	
		3	SS	58	27		
		4	SS	50	40	5	
		5	SS	25	14		Water @ 3.54m BGS
	71.26						
		6	SS	75	24	9	

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 29, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

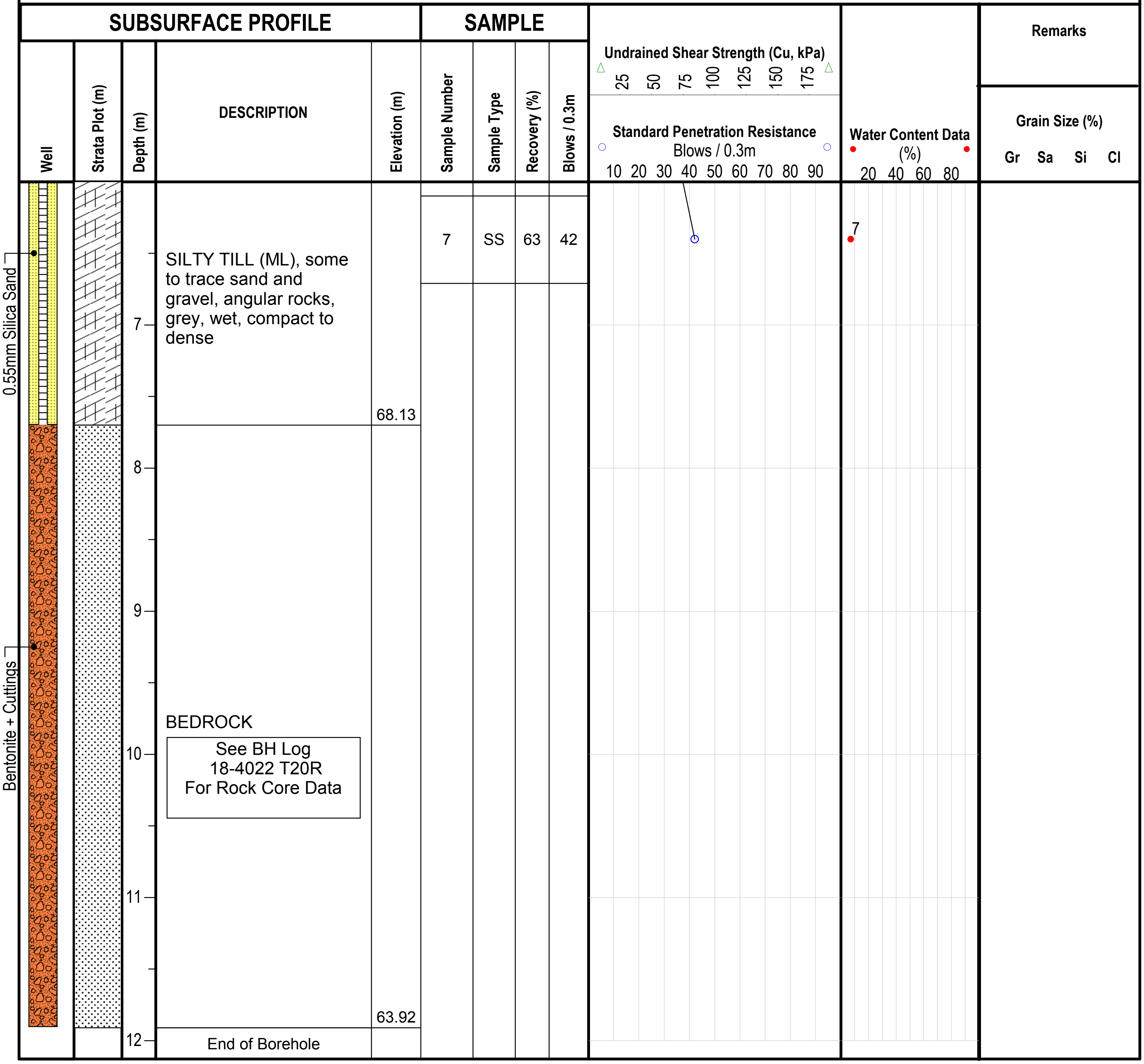
Location: UTM 18T
E=488444
N=4995522

Sheet: 1 of 2

Borehole Log: WTG-52

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
	SILTY TILL (ML), some to trace sand and gravel, angular rocks, grey, wet, compact to dense	68.13	7	SS	63	42
	BEDROCK See BH Log 18-4022 T20R For Rock Core Data	63.92				
12	End of Borehole					

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 29, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**

Sheet: **2 of 2**

Borehole Log: WTG-52R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 1-2, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	68.13							
Bentonite + Cuttings		0 1	LIMESTONE, grey, weathered, fine grained, very thinly bedded to laminated, horizontal fractures, fair quality rock	66.94	1	112	66	119	66.94		
		2	LIMESTONE, grey, slightly weathered, very thinly bedded to laminated, horizontal fractures, angular fractures, fair quality rock	65.44	2	145	51	150	65.44		
		3 4	LIMESTONE, grey, slightly weathered, very thinly bedded to laminated, horizontal fractures, angular fractures, fair quality rock	63.92	3	152	73	152	63.92		
			End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 29, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=488444
N=4995522

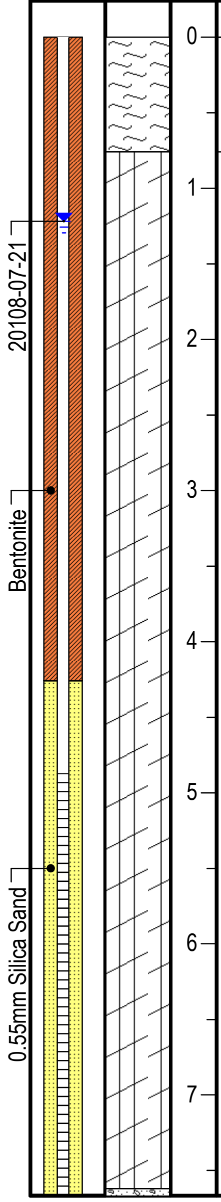
Sheet: 1 of 1

Borehole Log: WTG-54

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

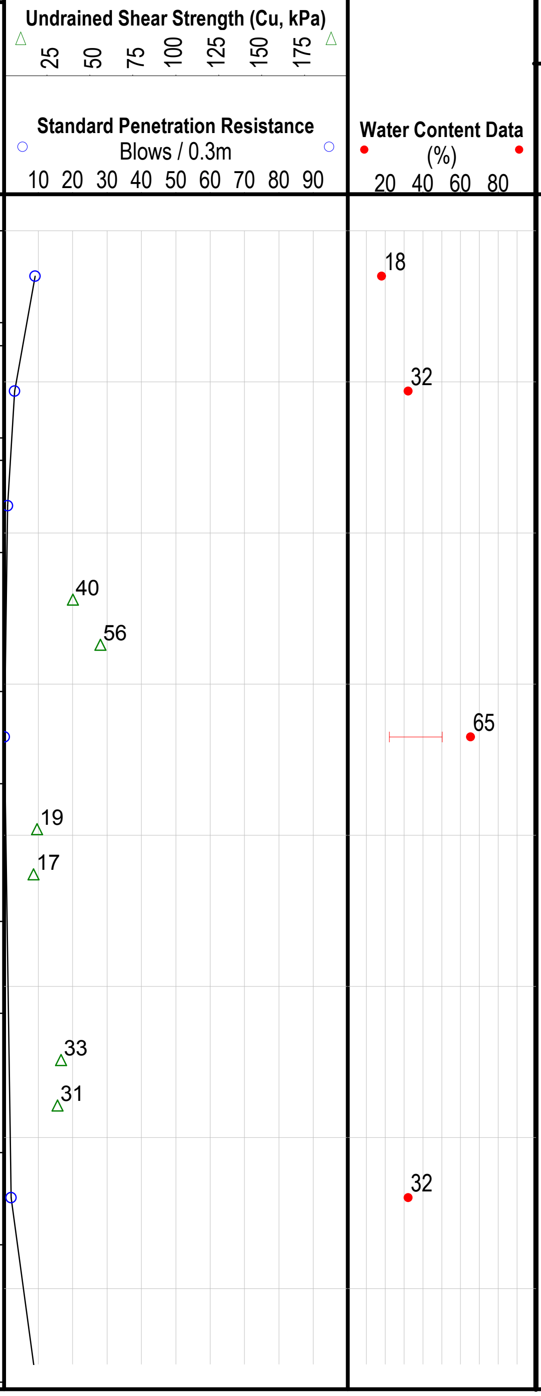
SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	69.57
CLAYEY TOPSOIL, some sand, light to dark brown, dry, stiff	68.81
SILTY CLAY (CL), trace gravel, light brown to grey, moist to wet, very soft to firm	61.95

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	75	9
2	SS	100	4
3	SS	100	2
4	SS	100	WH
5		100	
6	SS	79	2



Remarks

Water @ 2.0m BGS

Grain Size (%)

Gr Sa Si Cl

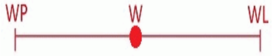
Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer



Datum: Ground Surface

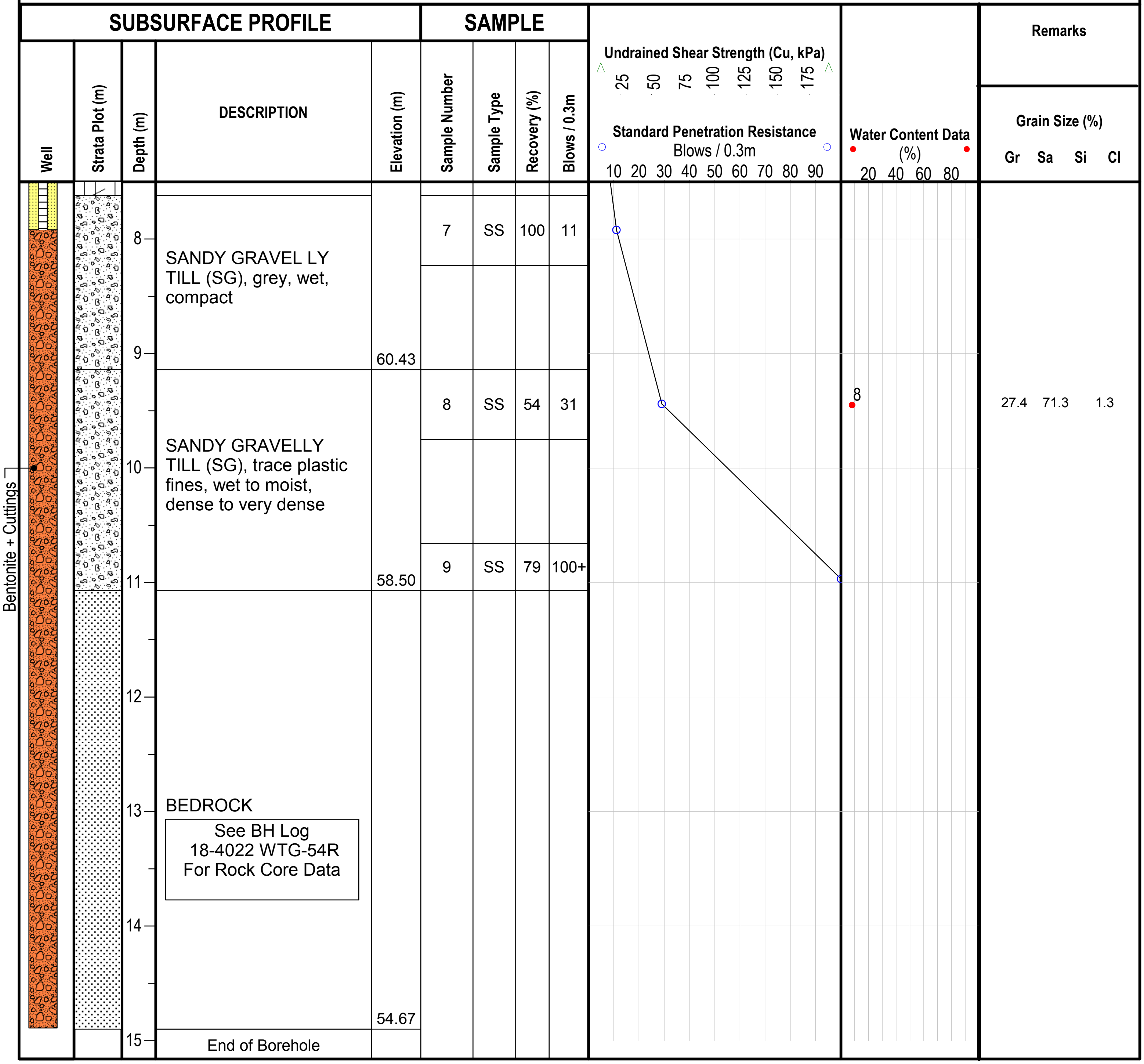
Location: UTM 18T
E=488115
N=4998329

Sheet: 1 of 2

Borehole Log: WTG-54

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



Description	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)	Gr	Sa	Si	Cl
SANDY GRAVEL LY TILL (SG), grey, wet, compact	60.43	7	SS	100	11					
SANDY GRAVELLY TILL (SG), trace plastic fines, wet to moist, dense to very dense	58.50	8	SS	54	31	8	27.4	71.3		1.3
		9	SS	79	100+					
BEDROCK See BH Log 18-4022 WTG-54R For Rock Core Data	54.67									
End of Borehole										

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=488115
N=4998329

Sheet: 2 of 2

TULLOCH ENGINEERING

Borehole Log: WTG-54R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 4-5, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	58.50							
Bentonite + Cuttings		0	LIMESTONE, grey, weathered, laminated, fine grained, horizontal fractures, angular fractures, poor quality rock	57.71	1	71	35	79	57.71		
		1	LIMESTONE, grey, weathered, fine grained , horizontal fractures, angular fractures, laminated with thin black bedding, fair quality rock	56.19	2	152	60	152	56.19		
		2 3	LIMESTONE, grey, slightly weathered, fine grained , horizontal fractures, excellent quality rock	54.67	3	152	100	152	54.67		
		4	End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

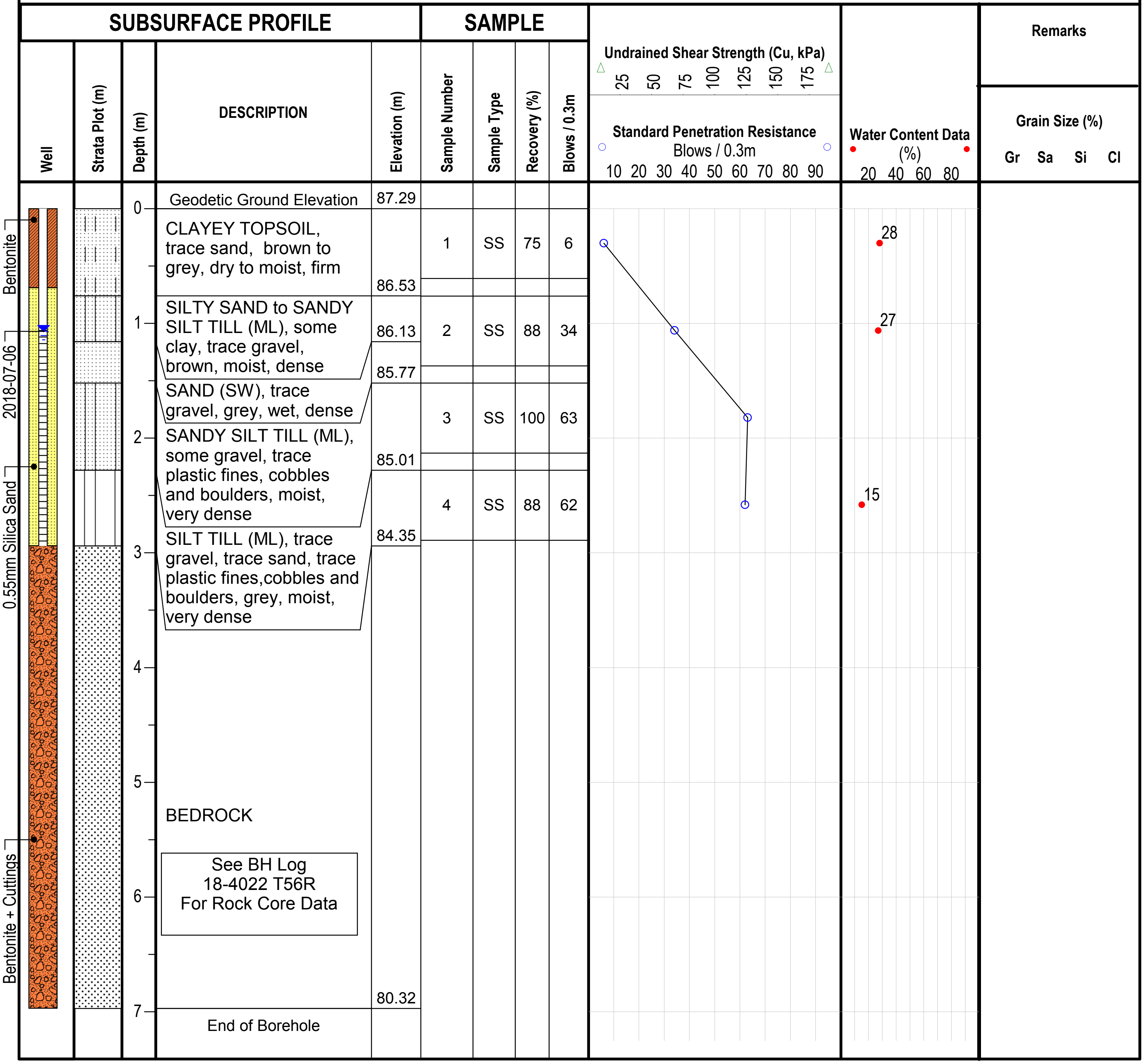
Location: UTM 18T
E=488115
N=4998329

Sheet: 1 of 1

Borehole Log: WTG-56

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	87.29
CLAYEY TOPSOIL, trace sand, brown to grey, dry to moist, firm	86.53
SILTY SAND to SANDY SILT TILL (ML), some clay, trace gravel, brown, moist, dense	86.13
SAND (SW), trace gravel, grey, wet, dense	85.77
SANDY SILT TILL (ML), some gravel, trace plastic fines, cobbles and boulders, moist, very dense	85.01
SILT TILL (ML), trace gravel, trace sand, trace plastic fines, cobbles and boulders, grey, moist, very dense	84.35
BEDROCK	
See BH Log 18-4022 T56R For Rock Core Data	80.32
End of Borehole	

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content (%)
1	SS	75	6	28
2	SS	88	34	27
3	SS	100	63	
4	SS	88	62	15

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 14, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**
E=491538
N=4994880

Sheet: **1 of 1**

Borehole Log: WTG-56R

TULLOCH ENGINEERING

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 1-2, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	84.35							
Bentonite + Cuttings		0 1	LIMESTONE, grey, weathered, laminated with thin black bedding, horizontal fractures, poor quality rock	83.03	1	132	46	132	83.03		
		2	LIMESTONE, grey, weathered, laminated with thin black bedding, horizontal fractures, vertical fracture @ 5.41m-5.49m BGS, poor quality rock	81.46	2	157	29	157	81.46		
		3 4	LIMESTONE, grey, slightly weathered, laminated with thin black bedding , horizontal fractures, fair quality rock	80.32	3	114	73	114	80.32		
			End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 14, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=491538
N=4994880

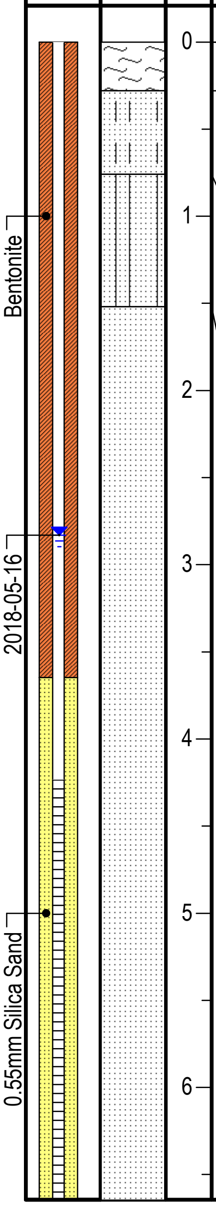
Sheet: 1 of 1

Borehole Log: WTG-57

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 1-2, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

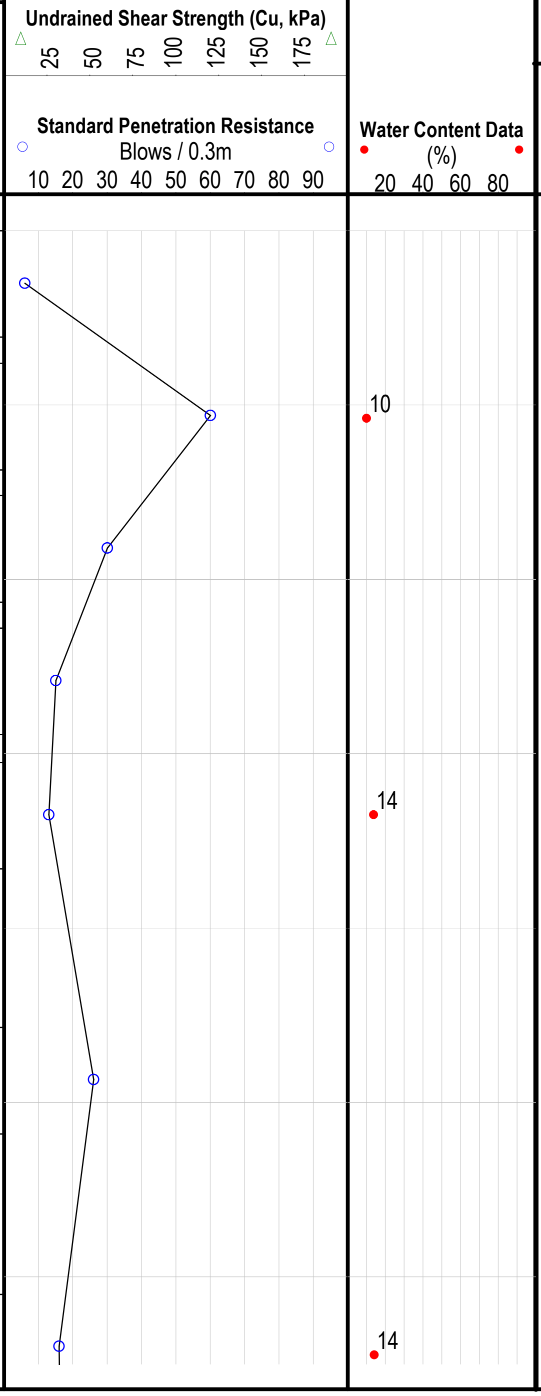
SUBSURFACE PROFILE



DESCRIPTION	Elevation (m)
Geodetic Ground Elevation	86.14
280mm TOPSOIL	85.86
SILTY SAND (SM), trace fine grained sand, dark brown to brown, moist, loose	85.38
SANDY SILT TILL (SM), trace gravel, trace clay fragmented rock, cobbles, boulders, oxidation, moist, very dense	84.62
SAND SILT TILL (SW), coarse to fine grained, trace gravel, fragmented rocks, cobbles, boulders, oxidation, wet, brown to grey, dense to compact	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)
1	SS	67	6	
2	SS	100	60	10
3	SS	96	30	
4	SS	-	15	
5	SS	46	13	14
6	SS	38	26	
7	SS	46	16	14



Remarks

Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 16, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

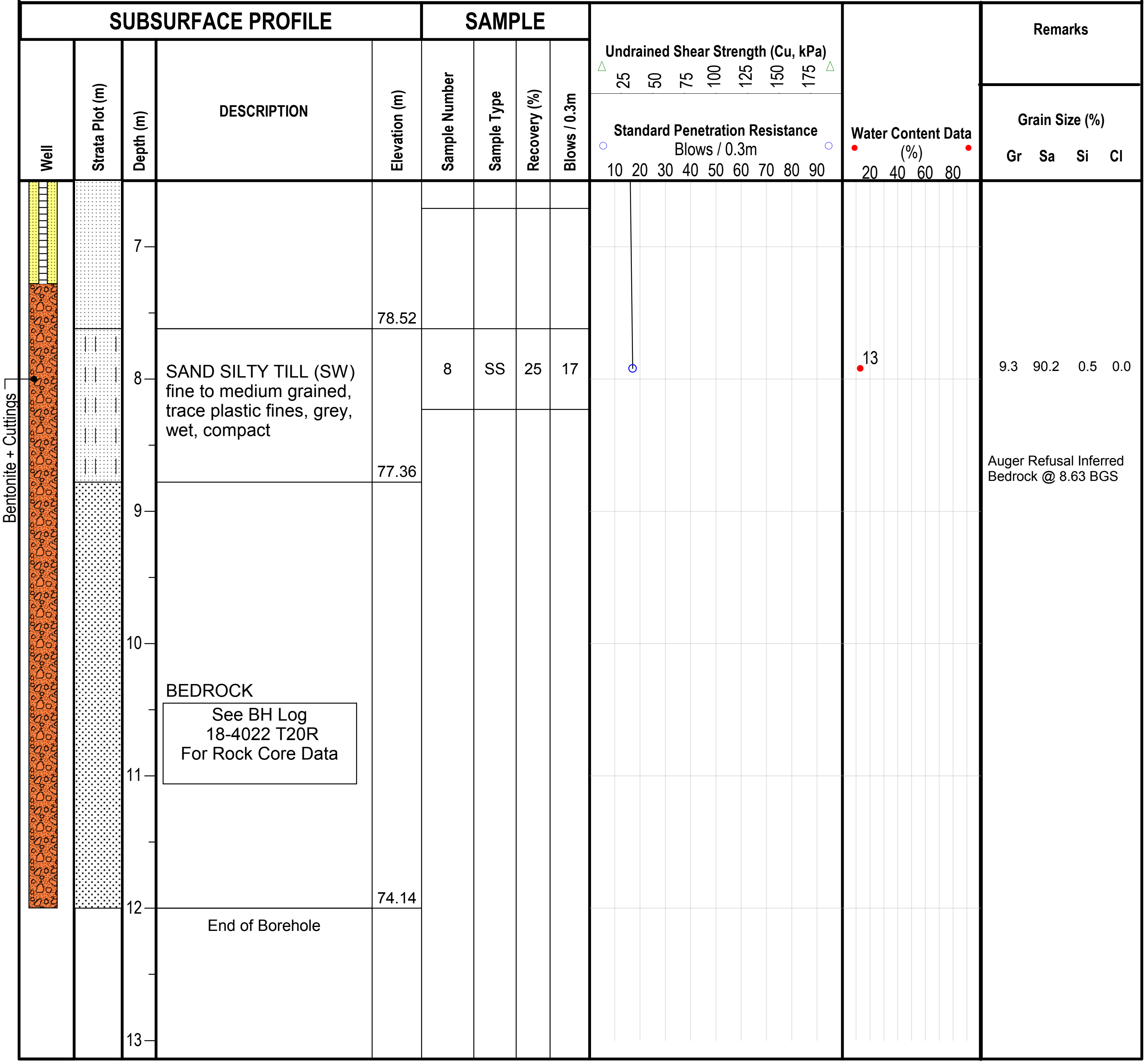
Location: UTM 18T
E=492803
N=4996220

Sheet: 1 of 2

Borehole Log: WTG-57

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 1-2, North Stormont, ON**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**



DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Gr	Sa	Si	Cl	Remarks
	78.52										
SAND SILTY TILL (SW) fine to medium grained, trace plastic fines, grey, wet, compact	77.36	8	SS	25	17	13	9.3	90.2	0.5	0.0	Auger Refusal Inferred Bedrock @ 8.63 BGS
BEDROCK See BH Log 18-4022 T20R For Rock Core Data	74.14										
End of Borehole											

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 16, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: **Ground Surface**

Location: **UTM 18T**

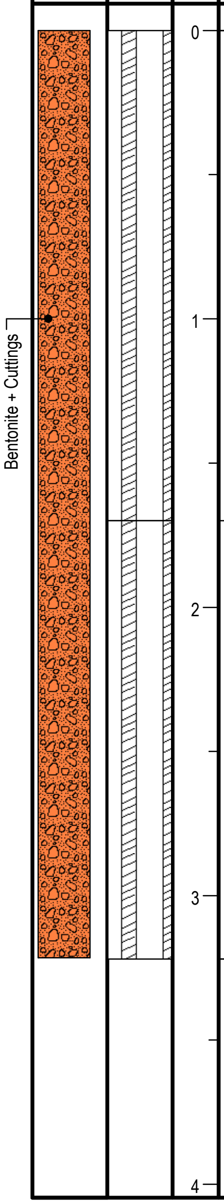
Sheet: **2 of 2**

TULLOCH
ENGINEERING

Borehole Log: WTG-57R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 1-2, North Stormont, ON
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	77.36							
			LIMESTONE, grey, weathered to slightly weathered, laminated with thin black bedding, fine grained, horizontal fractures, vertical fracture	75.66	1	165	57	170	75.66		
			LIMESTONE, grey, slightly weathered, horizontal fractures, laminated, fine grained	74.14	2	152	67	152	74.14		
			End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 16, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=492803
N=4996220

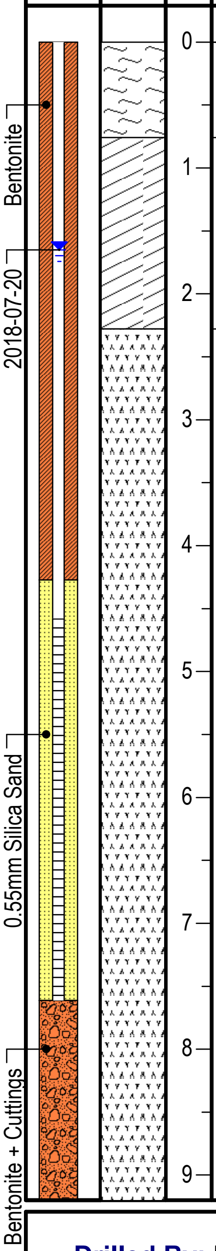
Sheet: 1 of 1

Borehole Log: WTG-58

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Murphy Road, North Stormont, ON
Client: EDPR

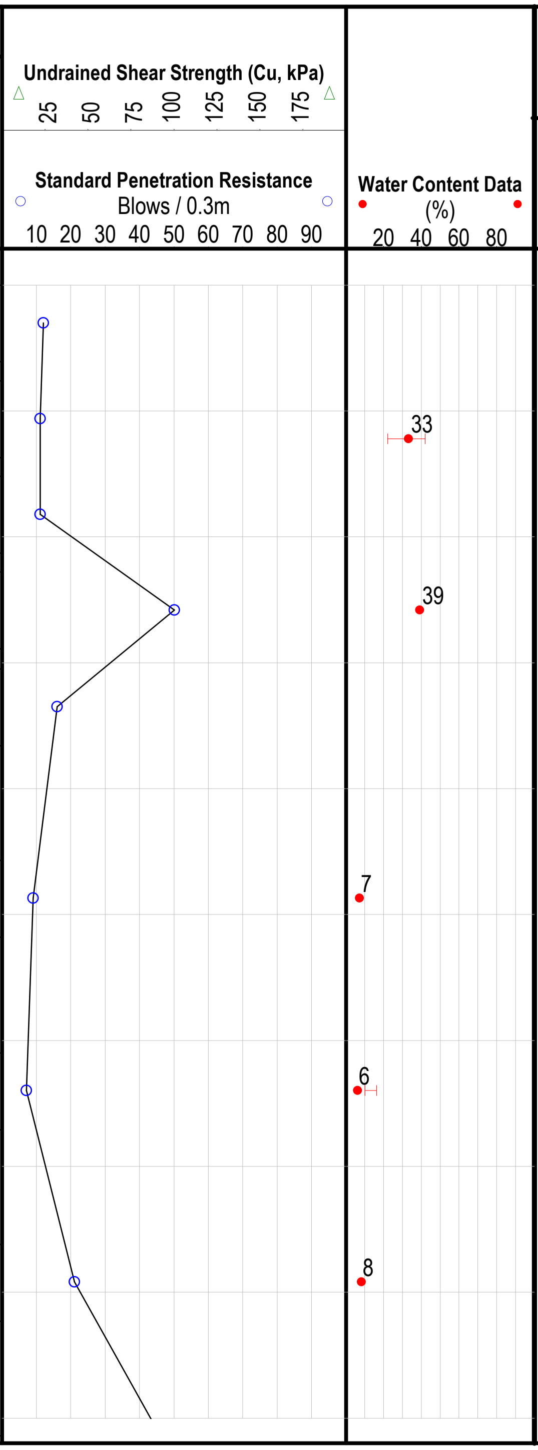
Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE



SAMPLE

DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	68.74					
CLAY TOPSOIL, trace organics, light brown, moist to dry, stiff	67.98	1	SS	38	12	
SILTY CLAY (CI), trace gravel, light brown, moist, stiff	66.46	2	SS	96	11	
		3	SS	92	11	
SILTY TILL (ML), some to trace gravel, light brown to grey, moist to wet, loose to dense		4	SS	25	50+	Spoon Refusal @ 2.51m BGS
		5	SS	25	16	
						Could Not Install Well Due To Artesian Conditions At This Location Well Was Installed 1.52m North Of T58
		6	SS	29	9	
		7	SS	21	7	Water Table Encountered @ 6.4m BGS
		8	SS	13	21	



Remarks

Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 22, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum: Ground Surface

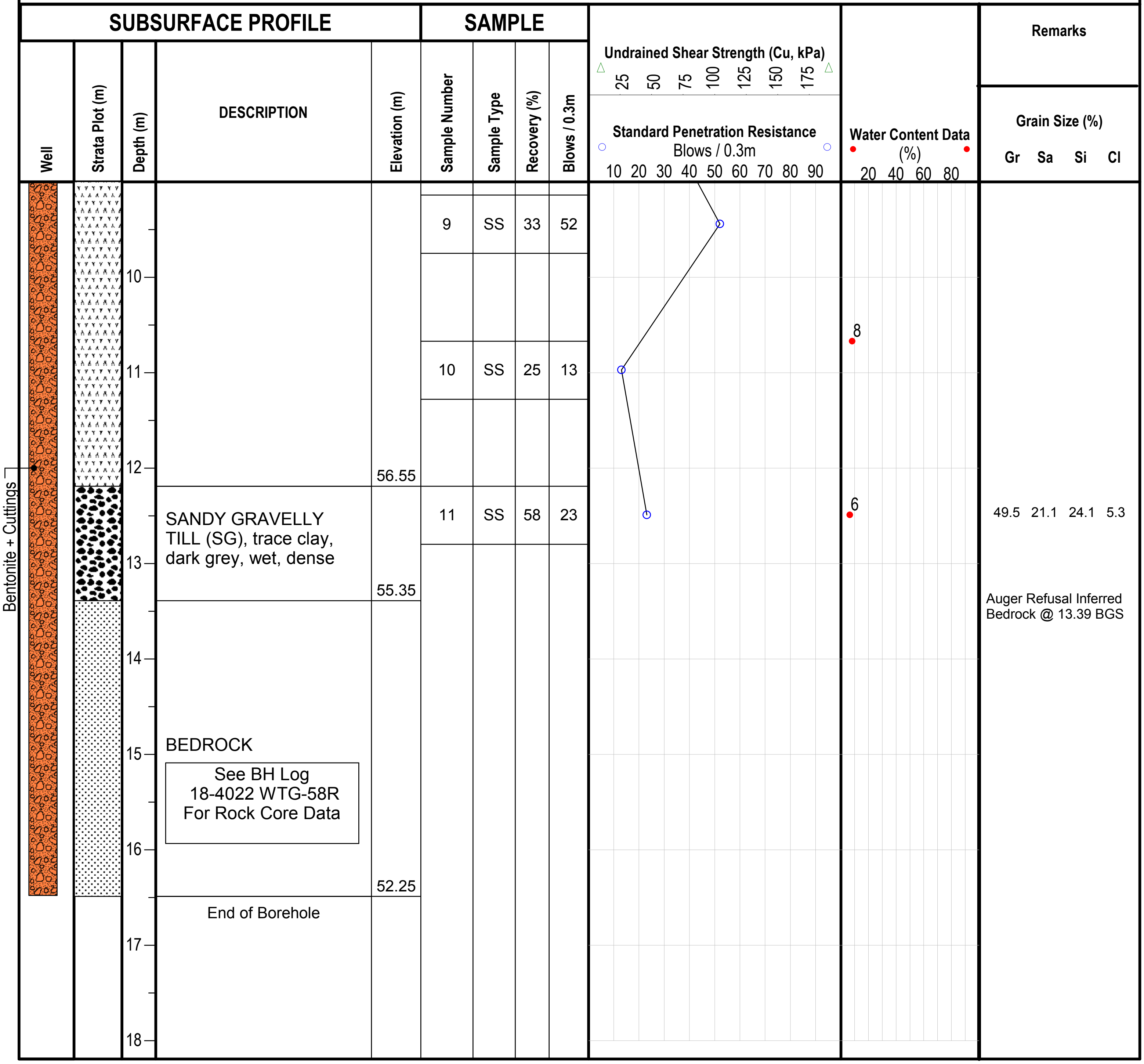
Location: UTM 18T
E=485047
N=4999775

Sheet: 1 of 2

Borehole Log: WTG-58

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Murphy Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles



DESCRIPTION	Elevation (m)
	56.55
SANDY GRAVELLY TILL (SG), trace clay, dark grey, wet, dense	55.35
BEDROCK See BH Log 18-4022 WTG-58R For Rock Core Data	52.25
End of Borehole	

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
9	SS	33	52
10	SS	25	13
11	SS	58	23

Remarks

Gr	Sa	Si	Cl
49.5	21.1	24.1	5.3

Auger Refusal Inferred Bedrock @ 13.39 BGS

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 22, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum: Ground Surface

Location: UTM 18T
E=485047
N=4999775

Sheet: 2 of 2

TULLOCH ENGINEERING

Borehole Log: WTG-58R

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Murphy Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE						
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	TCR (cm)	RQD (%)	Run Length (cm)	Run Depth Elevation (m)	Unconfined Compressive Strength (MPa) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150	Remarks
			Geodetic Rock Elevation	55.35							
Bentonite + Cuttings		0 1	SHALEY LIMESTONE, black / grey, thinly laminated to laminated, fine grained, some horizontal & vertical fracturing with significant weathering at discontinuities	53.75	1	160	98	160	53.75		
		2 3	SHALEY LIMESTONE, black / grey, thinly laminated to laminated, horizontal fractures with some weathering at discontinuities, highly weathered section at end of run	52.25	2	155	96	150	52.25		
			End of Rock Core								

Drilled By: Marathon Drilling

Drill Method: Casing / NQ Core

Drill Date: May 22, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ- Rock Core
W - Water Content
WL - Liquid Limit
WP - Plastic Content
△ - Unconfined Compressive Strength

w - Wash
o - SPT(Standard Penetration Test)
TCR - Total Core Recovery
RQD - Rock Quality Designation

Datum: Ground Surface

Location: UTM 18T
E=485047
N=4999775

Sheet: 1 of 1

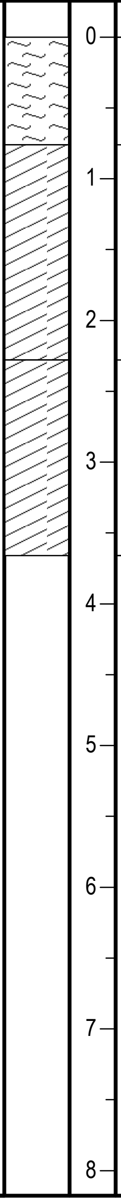
Borehole Log: BH PSR1

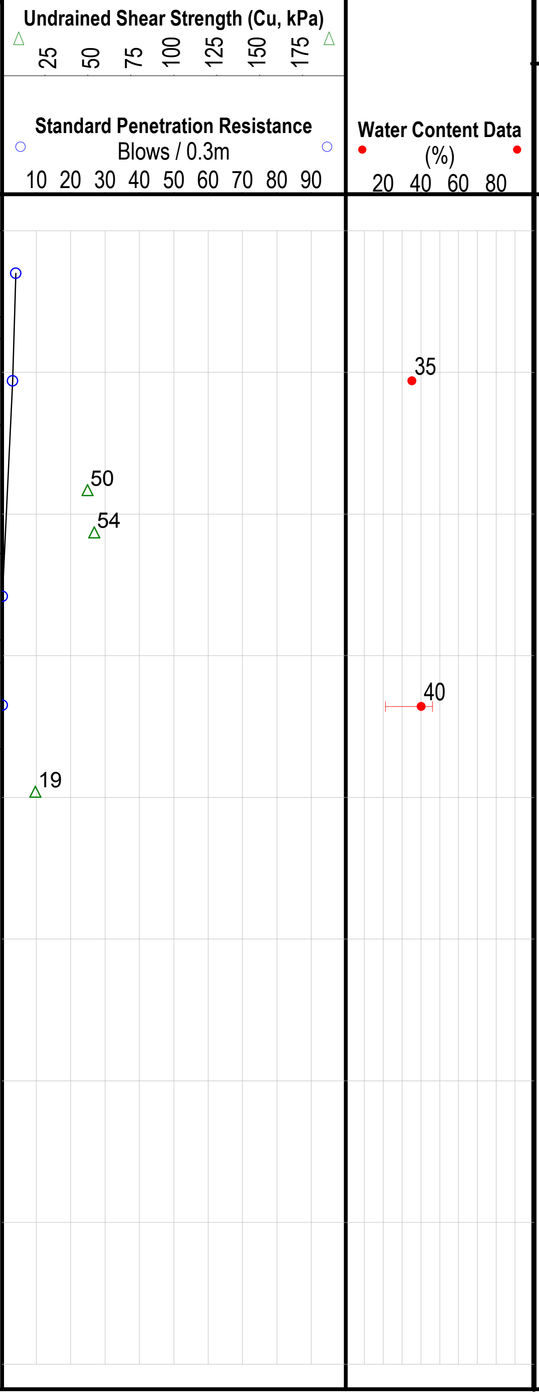
Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: BH-PSR1
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks	Gr	Sa	Si	Cl
Geodetic Ground Elevation	67.53									
CLAY Topsoil, with ORGANICS (corn), brown, moist, soft	66.77	1	SS	46	4					
(CL) CLAY, trace silt, brown, moist, soft	65.25	2	SS	96	3					
(CL) CLAY, trace silt, brown to grey, moist to wet, very soft	63.87	4 5	SS SS	100 -	WH WH	Water Encountered @ 2.28m BGS	0.0	0.8	40.0	59.2
End of Borehole										





Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: April 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

Sheet: 1 of 1

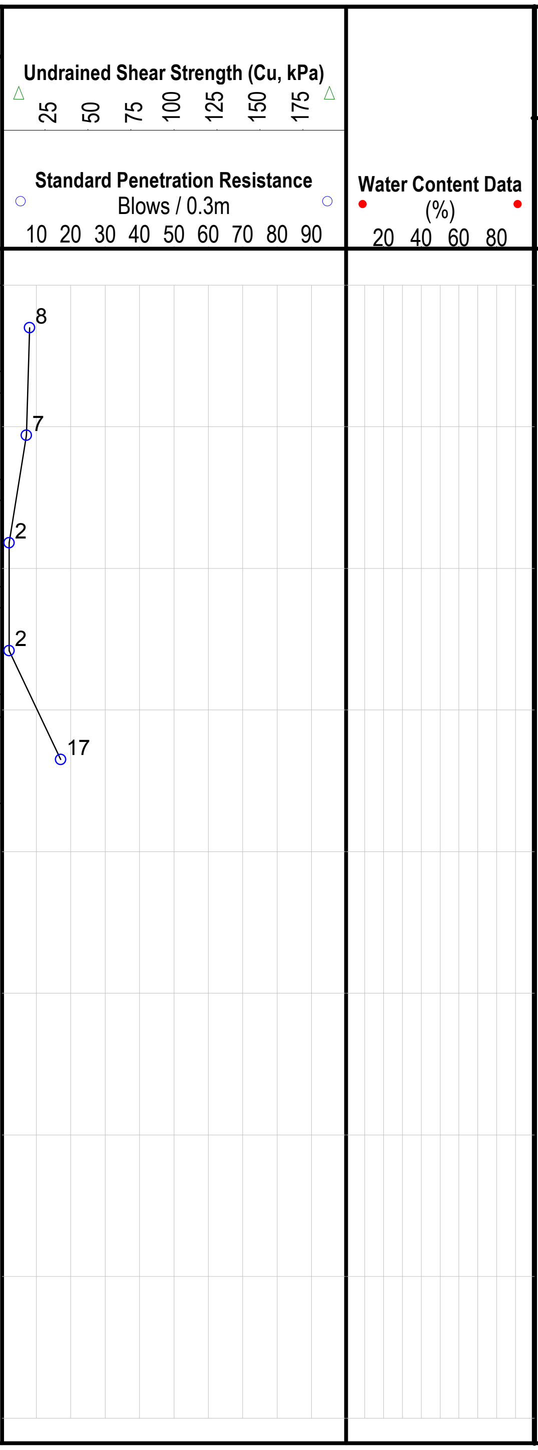
Borehole Log: BH PSR1B

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: BH-PSR1B
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	67.36				
CLAY Topsoil, trace SILT, with trace ORGANICS (corn), brown, moist, firm	66.60	1	SS	44	8
(CL) CLAY, trace to some SILT, brown / grey, moist, firm	65.84	2	SS	96	7
(CL) CLAY, trace SILT, brown / grey, moist, very soft	64.31	3 4	SS SS	100 100	2 2
(CL) 228mm CLAY, trace SILT, transitioning to silty TILL, with CLAY, trace gravel, brown, moist, very stiff	63.70	5	SS	54	17
End of Borehole					



Remarks

No Water Encountered During Drilling

Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: April 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

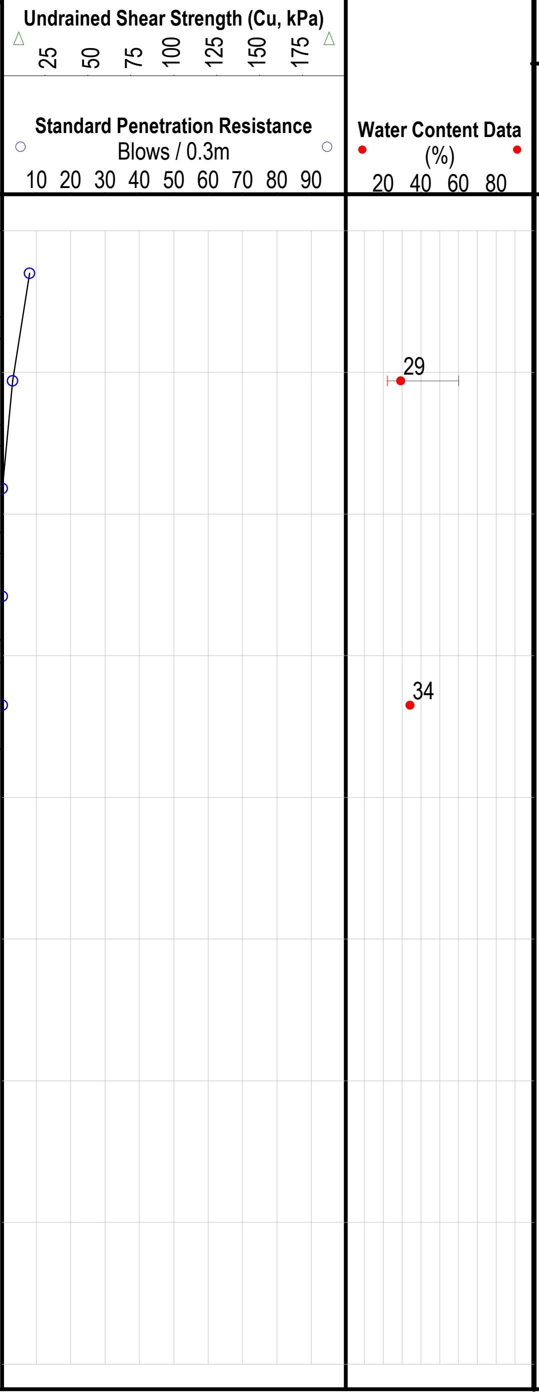
Sheet: 1 of 1

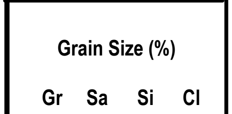
Borehole Log: BH PSR2

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **BH-PSR2, Nine Mile Road, North Stormont**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE				SAMPLE				Remarks
Well	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	
		Geodetic Ground Elevation	67.75					
	0	CLAY Topsoil, trace ORGANICS, brown, moist, firm to stiff	66.99	1	SS	38	8	Auger Thru Cobbles / Boulders From 0-2.28m
	1	(CL) CLAY, trace SILT, brown, moist, soft	66.23	2	SS	85	3	
	2	(CL) CLAY, trace SILT, brown, moist, very soft	65.47	3	SS	100	WH	No Water Encountered During Drilling
	3	(CL) CLAY, trace SILT, brown / grey, moist, very soft	64.09	4 5	SS SS	100 100	WH WH	
		End of Borehole						
	4							
	5							
	6							
	7							
	8							





Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

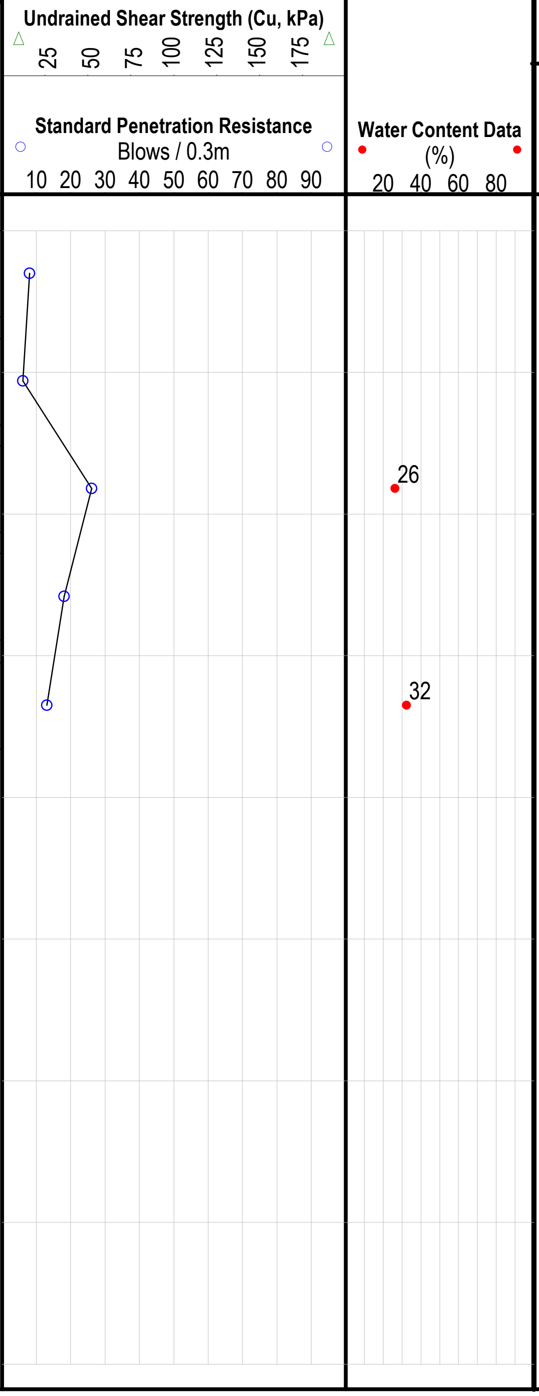
Sheet: 1 of 1

Borehole Log: BH PSR3

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Forgues Road, North Stormont**
Client: **EDPR**

Logged By: **A.Pleau**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Remarks	Gr	Sa	Si	Cl
0	Geodetic Ground Elevation	72.43										
	silty CLAY Topsoil, trace ORGANICS, brown, moist, firm	71.67	1	SS	50	8						
1	(CL) silty CLAY , brown / grey, moist, firm	70.91	2	SS	100	6						
2	(CL) silty CLAY, trace SAND, some GRAVEL, brown / grey, moist, very stiff, TILL	69.38	3 4	SS SS	83 38	26 18	26	No Water Encountered During Drilling				
3	(CL) silty CLAY, trace SAND, some GRAVEL, brown / grey, moist, stiff	68.77	5	SS	63	13	32		65.2	13.3		21.5
4	End of Borehole											
5												
6												
7												
8												



Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 7, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: **UTM 18T**

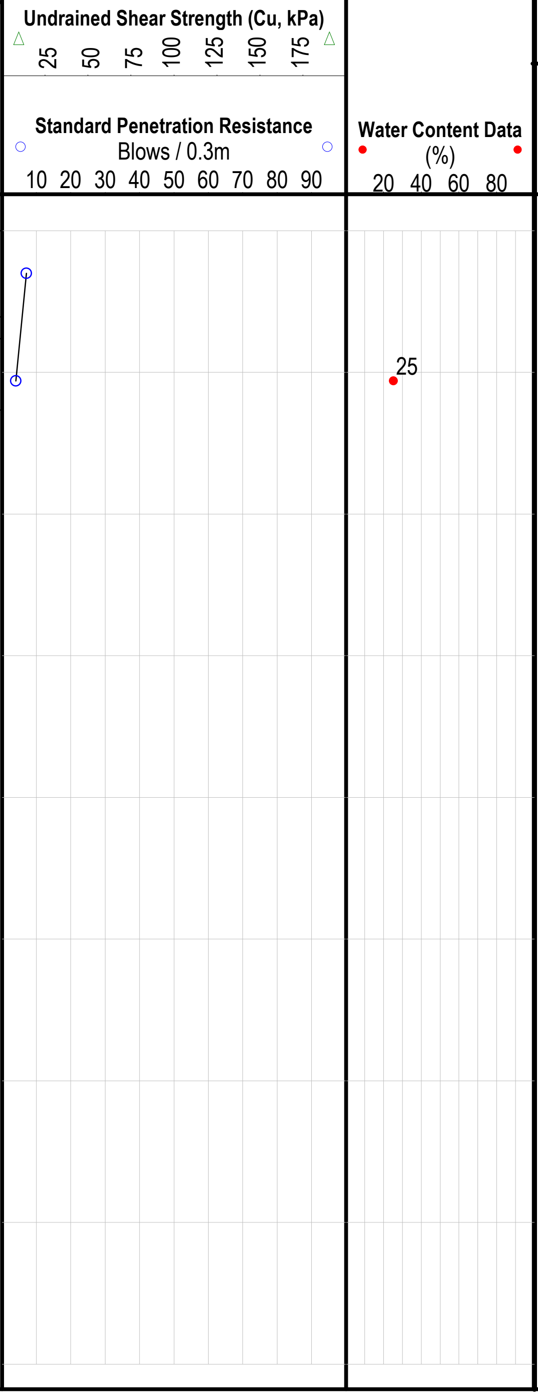
Sheet: **1 of 1**

Borehole Log: BH PSR4

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Concession 10-11, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Water Content Data (%)	Remarks
		0	Geodetic Ground Elevation	77.20						
			clayey Topsoil, brown, moist, firm	76.44	1	SS	46	7		
		1	(CL) CLAY , trace SILT, trace GRAVEL, brown, moist, soft	75.93	2	SS	83	4	25	No Water Encountered During Drilling
			End of Borehole							



Grain Size (%)

Gr Sa Si Cl

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 14, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: **UTM 18T**

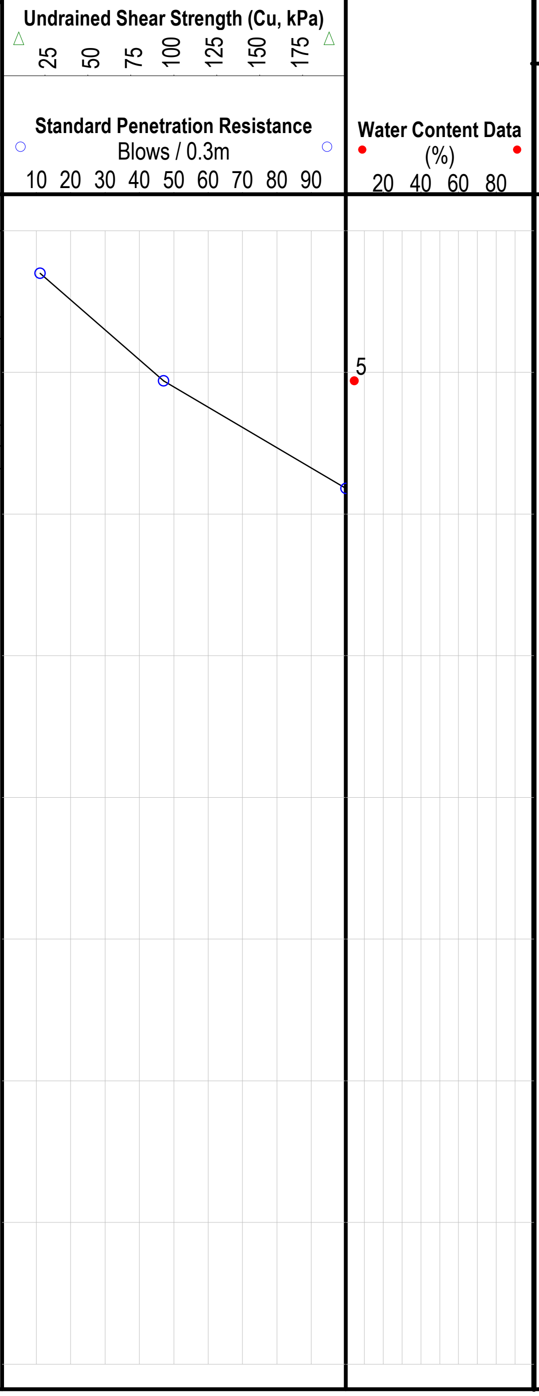
Sheet: **1 of 1**

Borehole Log: BH PSR5

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE				Remarks			
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Gr	Sa	Si	Cl
			Geodetic Ground Elevation	77.88								
		0	silty SAND, trace GRAVEL, dark brown, moist, compact	77.12	1	SS	54	11				
		1	SAND, coarse GRAVEL, angular rock, oxidated, brown, moist to dry, dense	76.36	2	SS	96	47	49.0	30.6	20.4	
			SAND, trace to some SILT, trace GRAVEL, oxidated, dark brown, moist to wet, compact		3			+100	Auger Refusal @ 1.68m BGS			
		2	End of Borehole									



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 20, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

Sheet: 1 of 1

Borehole Log: BH PSR6

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

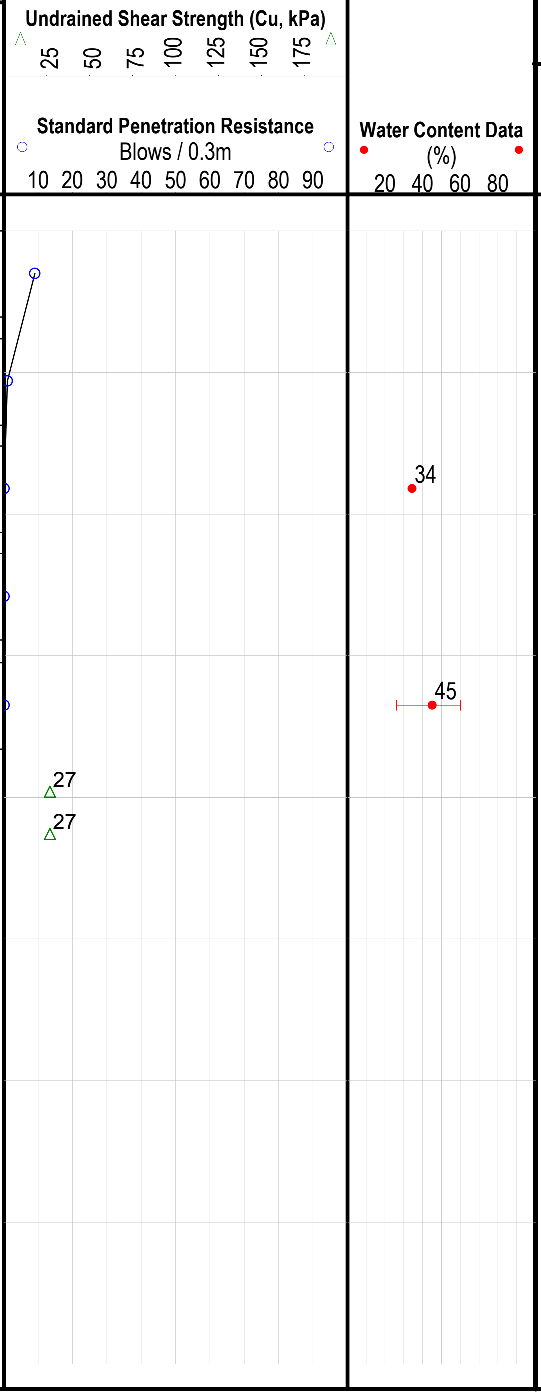
Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE

Depth (m)	DESCRIPTION	Elevation (m)
	Geodetic Ground Elevation	70.01
0	177mm TOPSOIL	
	sandy Silt, trace CLAY, transitioning to silty CLAY, brown to dark brown, dry to moist, loose	69.41
	CLAY, grey, wet, very soft	65.74
	End of Borehole	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	79	9
2	SS	88	1
3	SS	100	WH
4	SS	100	WH
5	SS	100	WH



Remarks

Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 17, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

Sheet: 1 of 1

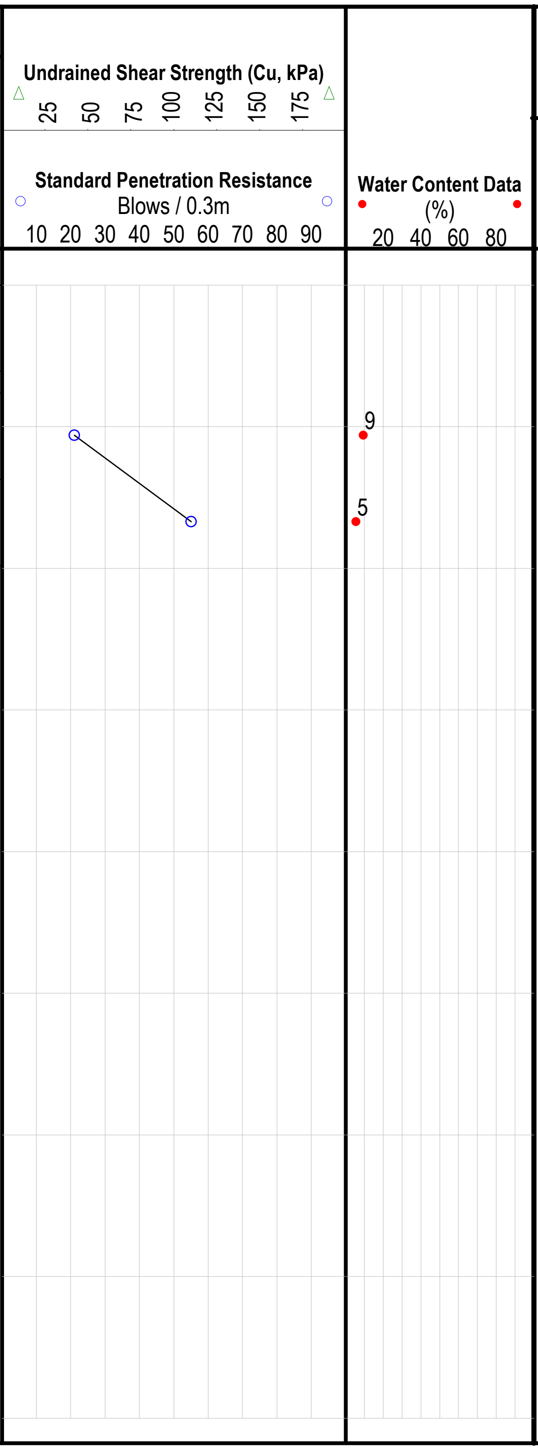
Borehole Log: BH PSR7

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Concession 11-12, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
0	Geodetic Ground Elevation	75.56					
	Topsoil / organics, dark brown, moist, loose to very dense	74.80	1	SS	38	-	Auger Refusal at 0.457m BGS on Inferred bedrock or boulder
1	sandy Topsoil, some GRAVEL and anuglar rock, brown, moist to dry, compact	74.19	2	SS	58	21	Auger Refusal at 1.37m BGS
2	SAND & GRAVEL, angular stone, brown to light brown, dry, very dense	73.58	3	SS	88	55	40.8 No Water Encountered During Drilling
	End of Borehole						

Grain Size (%): Gr Sa Si Cl



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 15, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

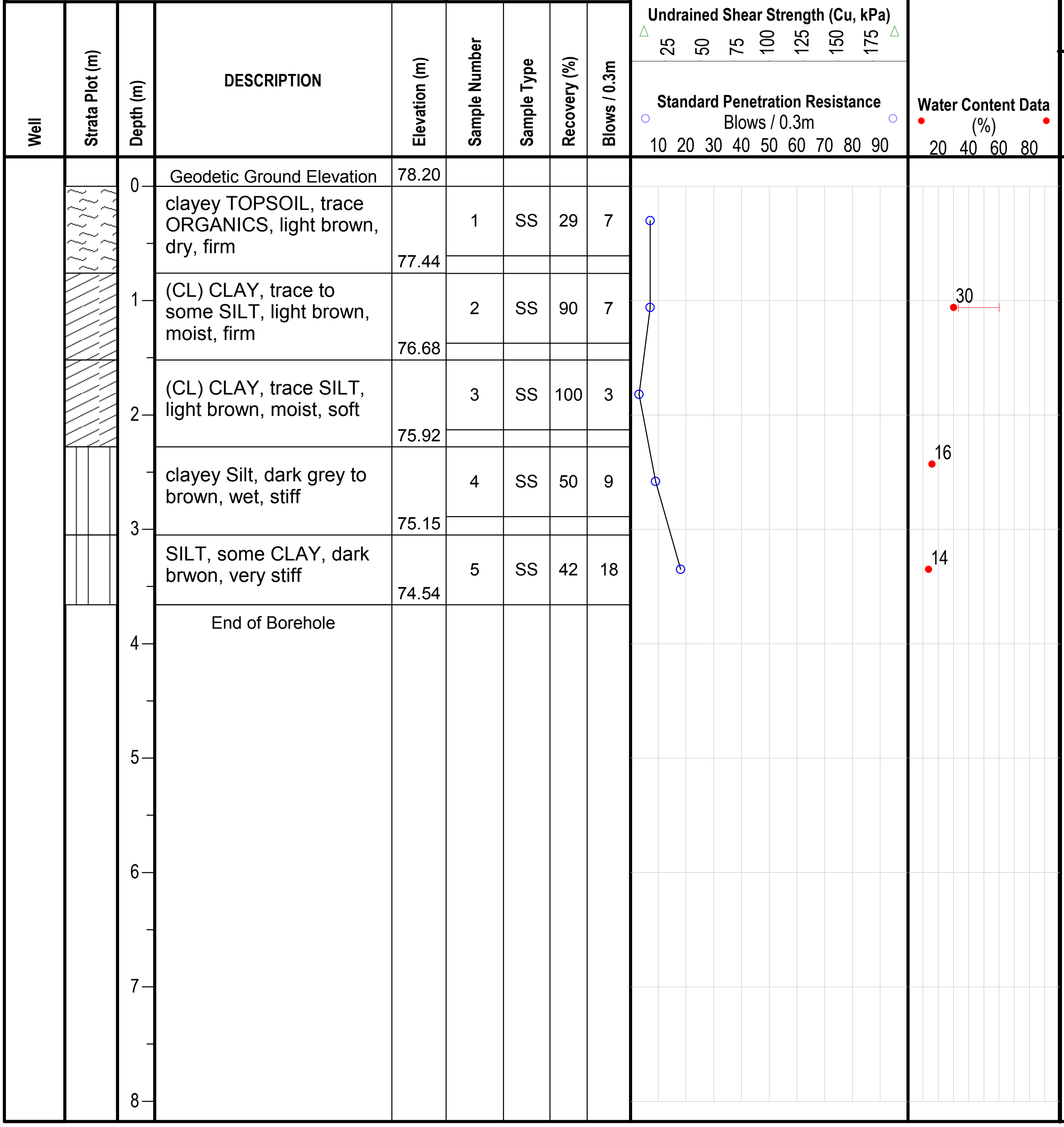
Sheet: 1 of 1

Borehole Log: BH PSR8

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: Marionville Road, North Stormont, ON
Client: EDPR

Logged By: S.deBortoli
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE				SAMPLE				Remarks				
Depth (m)	DESCRIPTION	Elevation (m)		Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Grain Size (%) Gr	Sa	Si	Cl	
	Geodetic Ground Elevation	78.20										
0	clayey TOPSOIL, trace ORGANICS, light brown, dry, firm	77.44		1	SS	29	7					
1	(CL) CLAY, trace to some SILT, light brown, moist, firm	76.68		2	SS	90	7	0.0	3.1	22.9	74.0	
2	(CL) CLAY, trace SILT, light brown, moist, soft	75.92		3	SS	100	3					No Water Encountered During Drilling
	clayey Silt, dark grey to brown, wet, stiff	75.15		4	SS	50	9					
3	SILT, some CLAY, dark brwon, very stiff	74.54		5	SS	42	18					
4	End of Borehole											



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 17, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

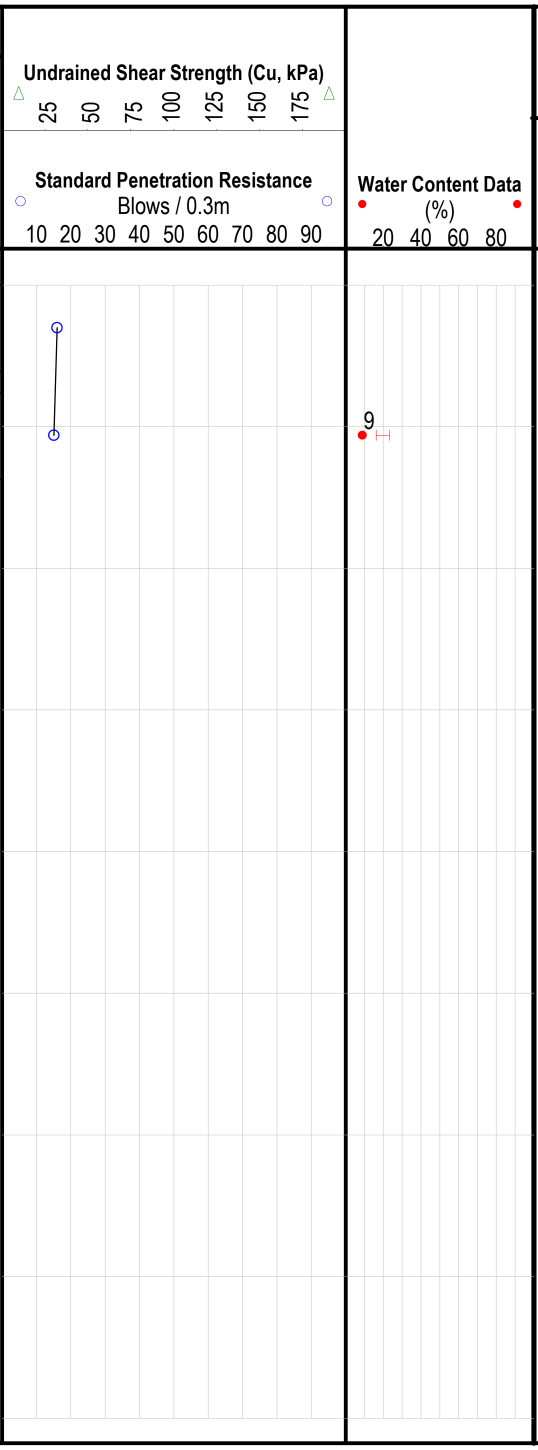
Sheet: 1 of 1

Borehole Log: BH PSR9

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location:
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE				Remarks
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Grain Size (%) Gr Sa Si Cl
			Geodetic Ground Elevation	72.00					
		0	Clayey TOPSOIL / ORGANICS, dark brown, moist, very stiff	71.40	1	SS	67	16	
		1	CLAY TILL, trace to some GRAVEL, light brown, moist, very stiff	70.48	2	SS	75	15	Inferred Bedrock @ 1.52m BGS
			End of Borehole						



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

Sheet: 1 of 1

Borehole Log: BH PSR10

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

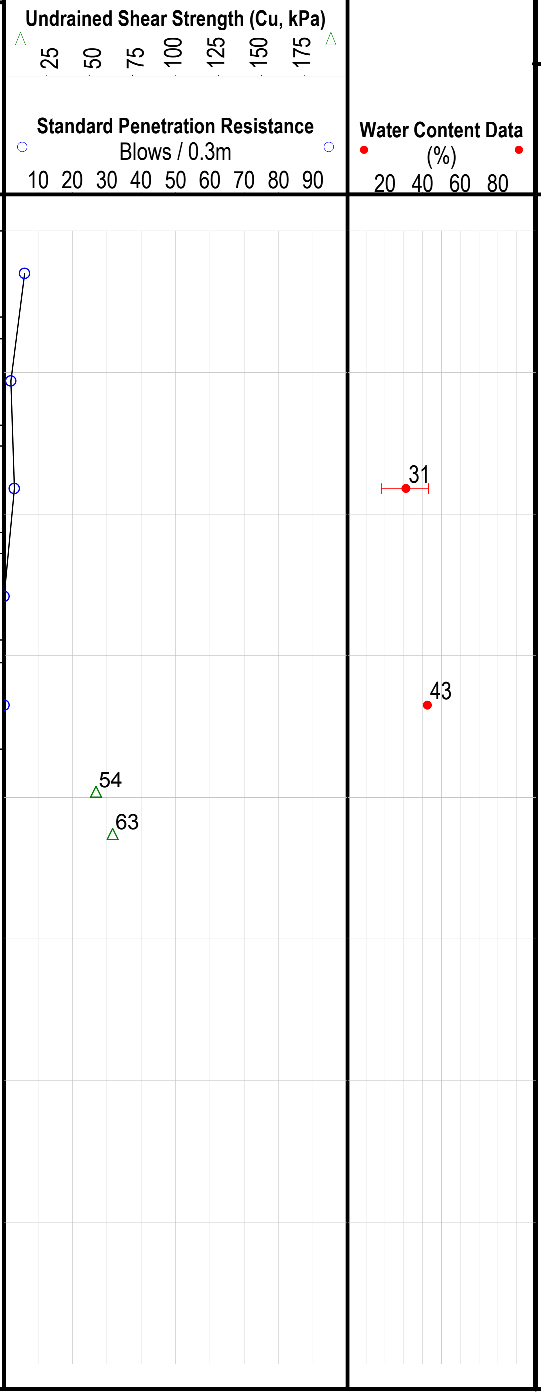
Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE

Depth (m)	DESCRIPTION	Elevation (m)
0	Geodetic Ground Elevation	71.75
0 – 0.1	100mm TOPSOIL	
0.1 – 0.76	SILT, with CLAY, dark brown, dry, firm	70.99
0.76 – 1.52	silty CLAY to CLAY, light brown to light grey, moist, very soft	70.23
1.52 – 4.26	CLAY, dark grey, wet, soft to very soft	67.49
4.26	End of Borehole	

SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	54	6
2	SS	71	2
3	SS	100	3
4	SS	100	WH
5	SS	100	WH



Remarks

Gr	Sa	Si	Cl
3.0	5.4	44.7	46.9

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: June 3, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
O- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

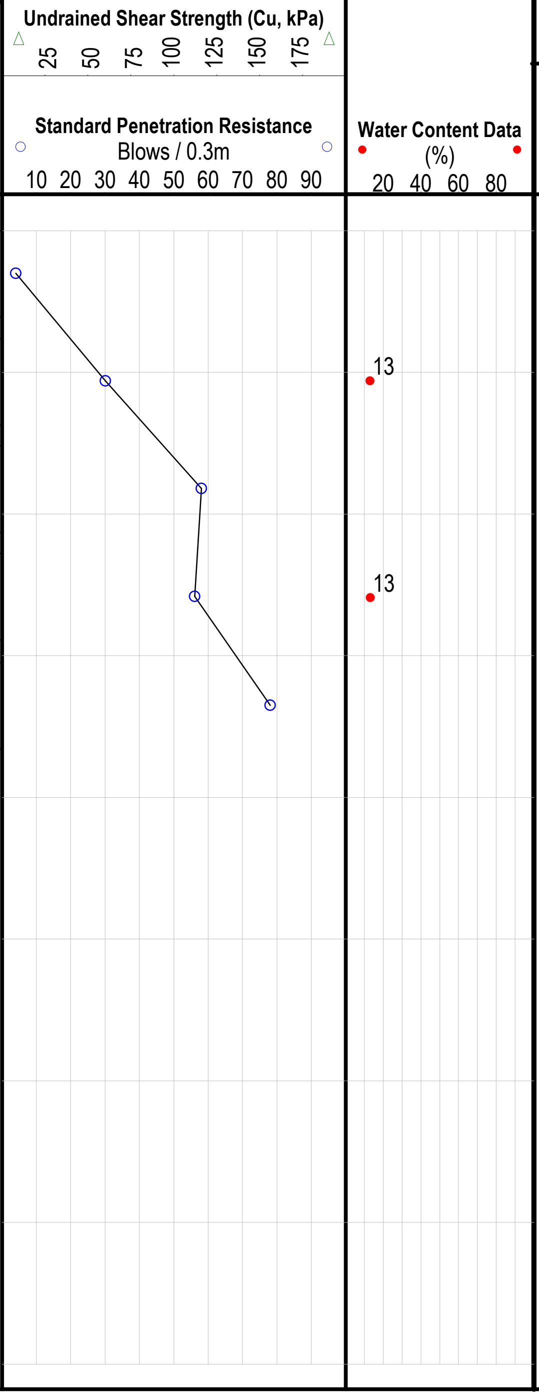
Sheet: 1 of 1

Borehole Log: BH PSR11

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE					SAMPLE				Remarks	Grain Size (%) Gr Sa Si Cl
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m		
		0	Geodetic Ground Elevation	92.91						
			SAND, fine grained, ORGANICS, oxidation, dark brown, dry, loose	92.15	1	SS	71	4		
		1	Sandy SILT to SILT, oxidation, light brown, dry, very stiff	91.39	2	SS	100	30		
		2	SILT to Sandy SILT, trace GRAVEL, oxidation, light brown, dry, very hard	90.63	3	SS	100	58		
		3	Sandy SILT, light brown, moist to wet, very hard	89.25	4 5	SS SS	83 79	56 78		
		4	End of Borehole							
		5								
		6								
		7								
		8								



Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

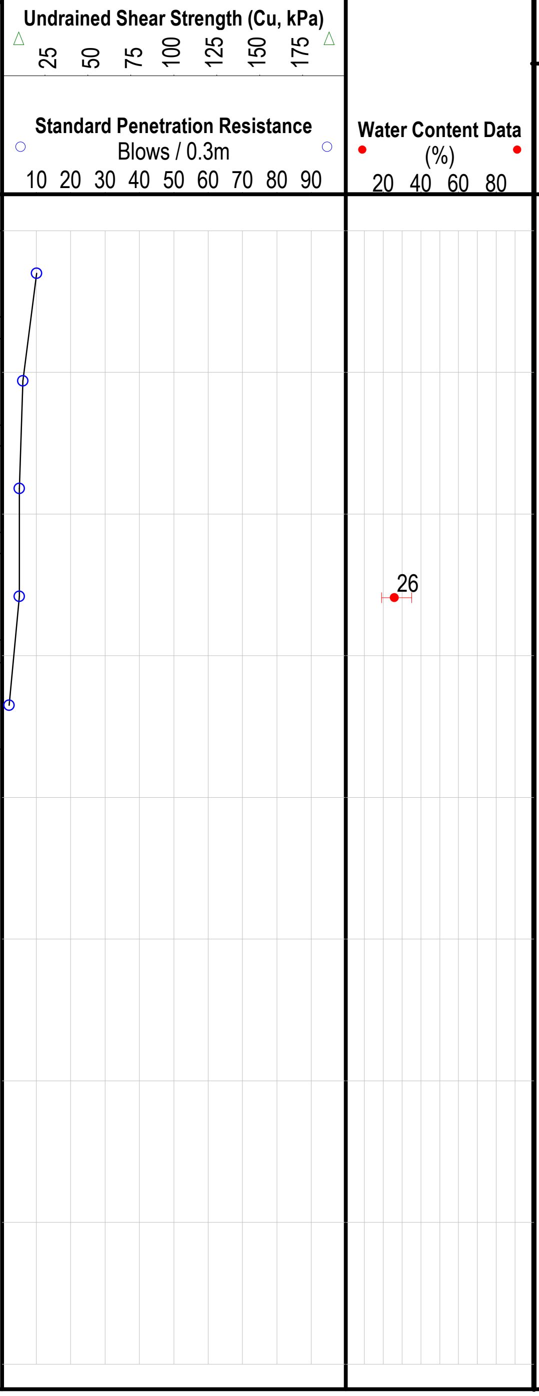
Sheet: 1 of 1

Borehole Log: BH PSR12

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location:
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE			SAMPLE			
Depth (m)	**DESCRIPTION**	**Elevation (m)**	**Sample Number**	**Sample Type**	**Recovery (%)**	**Blows / 0.3m**
	Geodetic Ground Elevation	70.34				
0	SILT, trace CLAY, oxidated, brown, dry, stiff	69.58	1	SS	67	10
1	silty CLAY, oxidated, brown, moist, firm	68.82	2	SS	100	6
2	CLAY, some SILT, oxidated, greenish grey, moist, firm	68.06	3	SS	100	5
	CLAY, greenish grey, moist to wet, firm	67.29	4	SS	100	5
3	CLAY, some GRAVEL, grey, wet, very soft	66.68	5	SS	92	2
4	End of Borehole					
5						
6						
7						
8						



Remarks

Grain Size (%)

Gr	Sa	Si	Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 28, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

Sheet: 1 of 1

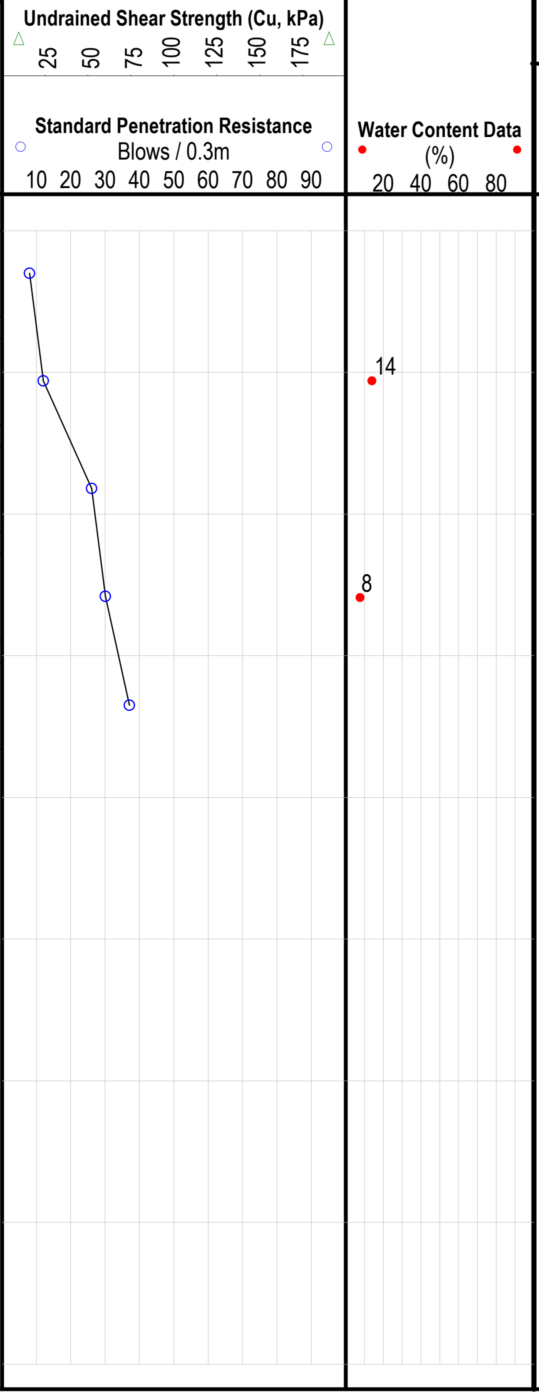
Borehole Log: BH PSR13

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location:
Client: EDPR

Logged By: S.Khan
Compiled By: D.A.Mousseau
Reviewed By: E. Giles

SUBSURFACE PROFILE / SAMPLE

DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
Geodetic Ground Elevation	74.34				
SAND, some to trace SILT, brown, dry, loose	73.58	1	SS	33	8
Silty SAND, some to trace GRAVEL, fragmented ROCKS, oxidated, brown, dry, compact	72.82	2	SS	25	12
SAND to Silty SAND, fragmented ROCKS, GRAVEL & PEBBLES, brown, dry, compact	72.06	3	SS	33	26
SAND, fine to medium grained, GRAVEL, fragmented ROCKS, brown, dry to moist, dense	71.29	4	SS	88	30
SAND, fine to medium grained, GRAVEL, fragmented ROCKS, brown, wet, dense	70.68	5	SS	50	37
End of Borehole					



Remarks

Grain Size (%)
Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 30, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

Sheet: 1 of 1

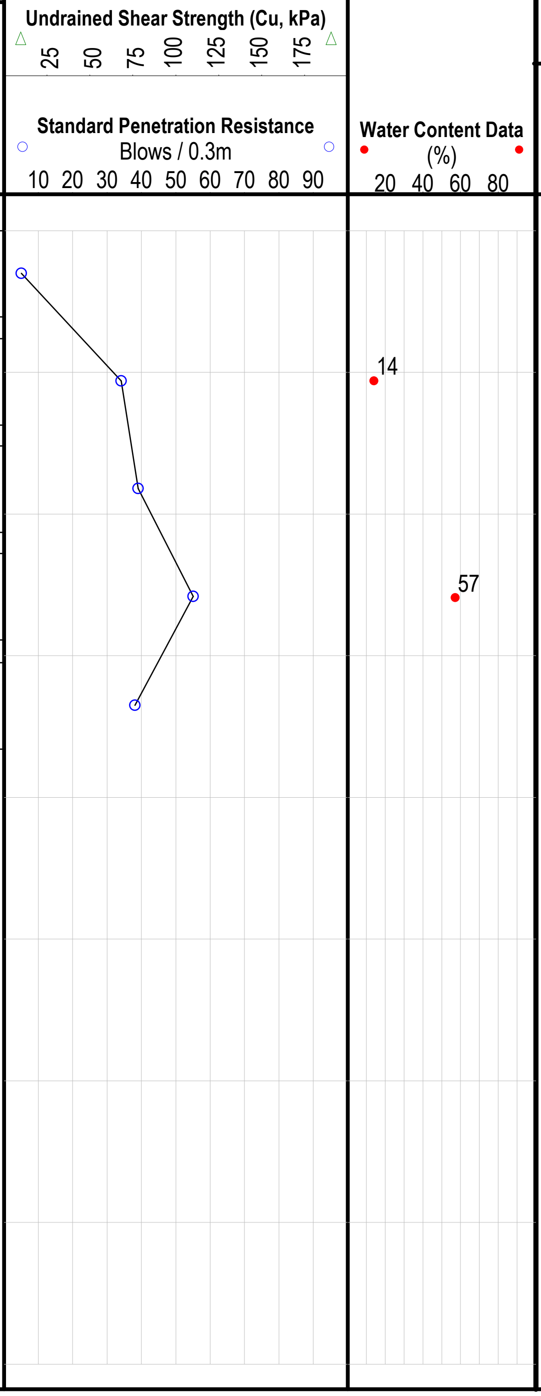
Borehole Log: BH PSR14

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location:
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE

DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
Geodetic Ground Elevation	84.66					
125mm TOPSOIL						
sandy SILT, trace CLAY, trace ORGANICS, dark brown, moist, loose	83.90	1	SS	71	5	
SILT, trace to some SAND, oxidation, brown to grey, moist, dense	83.14	2	SS	75	34	
silty SAND, trace plastic fines, trace GRAVEL, TILL, grey, wet, dense to very dense	81.61	3	SS	88	39	
		4	SS	71	55	Gr 35.5 Sa 3.3 Si 34.4 Cl 6.8 Auger Refusal @ 2.72m BGS
silty SAND, trace GRAVEL, fagmented rocks & cobbles, boulders, grey, moist, dense	81.00	5	SS	96	38	
End of Borehole						



Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 15, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: **UTM 18T**
E=492501
N=4996450

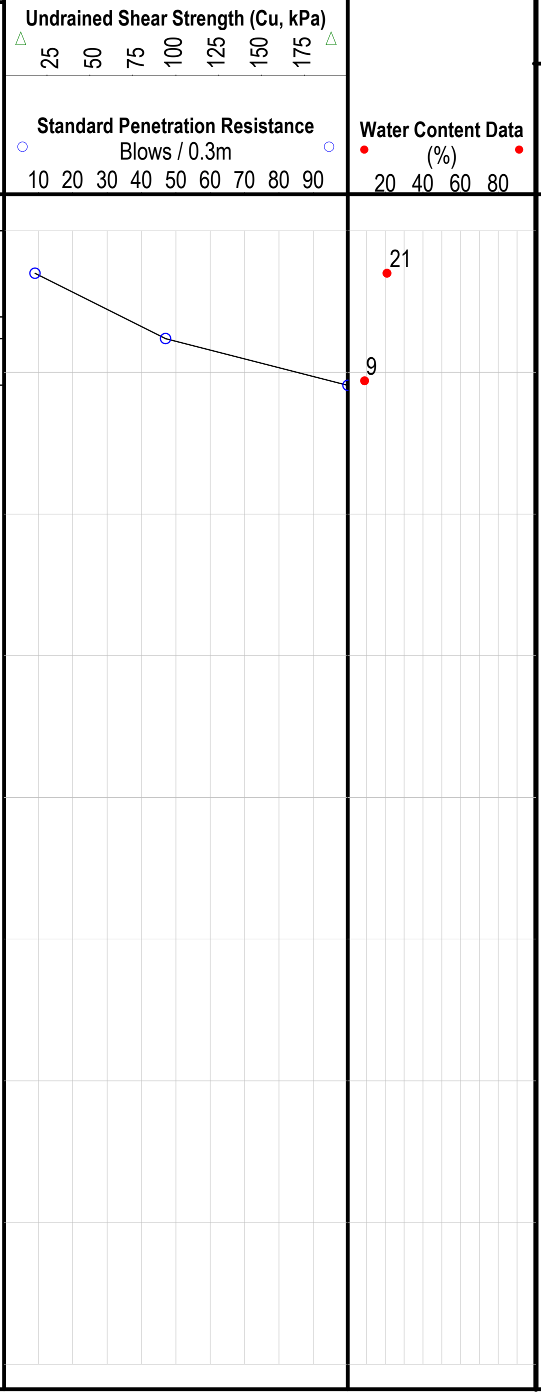
Sheet: **1 of 1**

Borehole Log: BH PSR15

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **BH PSR 15**
Client: **EDPR**

Logged By: **S.Khan**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE				SAMPLE				
Well	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
	0	Geodetic Ground Elevation	86.88					
		75mm TOPSOIL						
		sandy SILT, trace plastic fines, trace CLAY, trace ORGANICS, trace GRAVEL, fragmented rocks, dark brown, moist, very dense		1	SS	58	5	
	1		85.79	2	SS	29	47	Inferred Bedrock Auger Refusal @ 1.09m BGS
		End of Borehole						



Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 15, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

WP W WL

Datum:

Location: UTM 18T

Sheet: 1 of 1

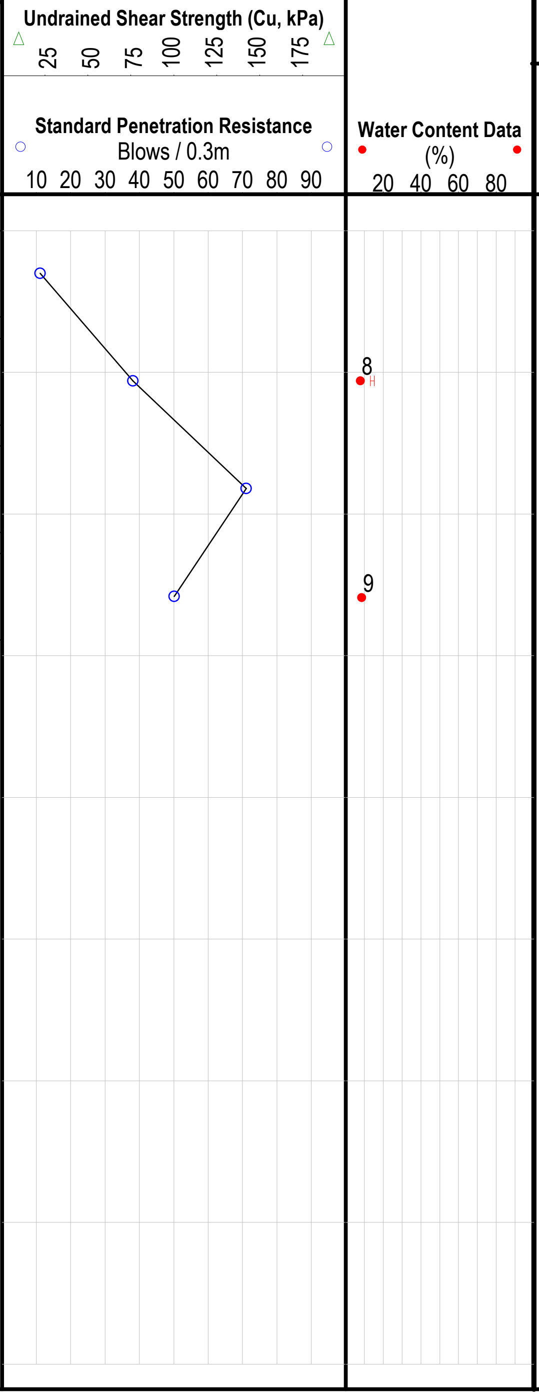
Borehole Log: BH PSR16

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **Conc 1-2, Finch**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE / SAMPLE

Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
		0	Geodetic Ground Elevation	82.16				
			clay TOPSOIL, trace SAND, some GRAVEL & fractured rock, light brown, moist to dry, stiff	81.40	1	SS	46	11
		1	clayey TILL, some to trace GRAVEL, trace SAND, light brown, moist to dry, hard	79.88	2 3	SS SS	100 100	38 71
		2	clayey TILL, with fractured rock, light brown, moist to dry, hard	79.27	4	SS	50	50+
		3	End of Borehole					



Remarks	Gr	Sa	Si	Cl
Grain Size (%)	0.0	36.3	50.8	12.9

No Water Encountered During Drilling

Auger Refusal @ 2.62m BGS Inferred Bedrock

Drilled By: **Marathon Drilling**

Drill Method: **HSA / SS**

Drill Date: **May 20, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: **UTM 18T**

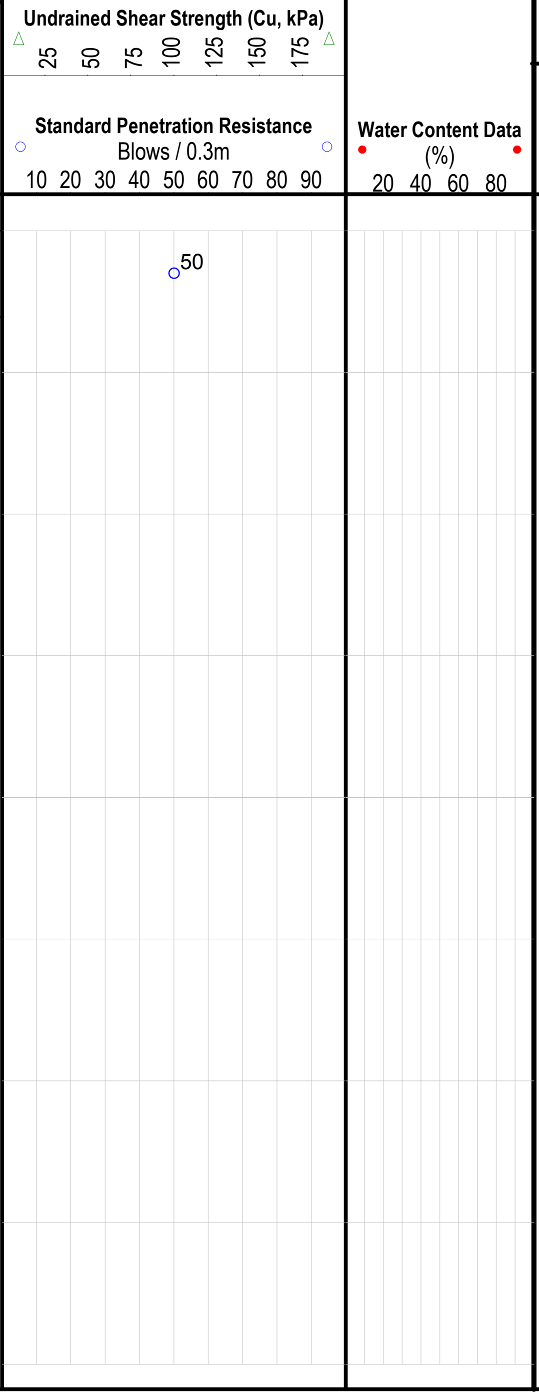
Sheet: **1 of 1**

Borehole Log: BH PSR17

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **County Road 9, North Stormont, ON**
Client: **EDPR**

Logged By: **S.deBortoli**
Compiled By: **D.A.Mousseau**
Reviewed By: **E. Giles**

SUBSURFACE PROFILE					SAMPLE				
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m	Remarks
			Geodetic Ground Elevation	0.00					
	≈≈	0	TOPSOIL, trace ORGANICS, broken / fractured rocks, brown, moist to dry	-0.60	1	SS	50	20	Inferred Bedrock @ 0.58m BGS
		1	End of Borehole						No Water Encountered
		2							
		3							
		4							
		5							
		6							
		7							
		8							



Grain Size (%)

Gr Sa Si Cl

Drilled By: Marathon Drilling

Drill Method: HSA / SS

Drill Date: May 29, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T

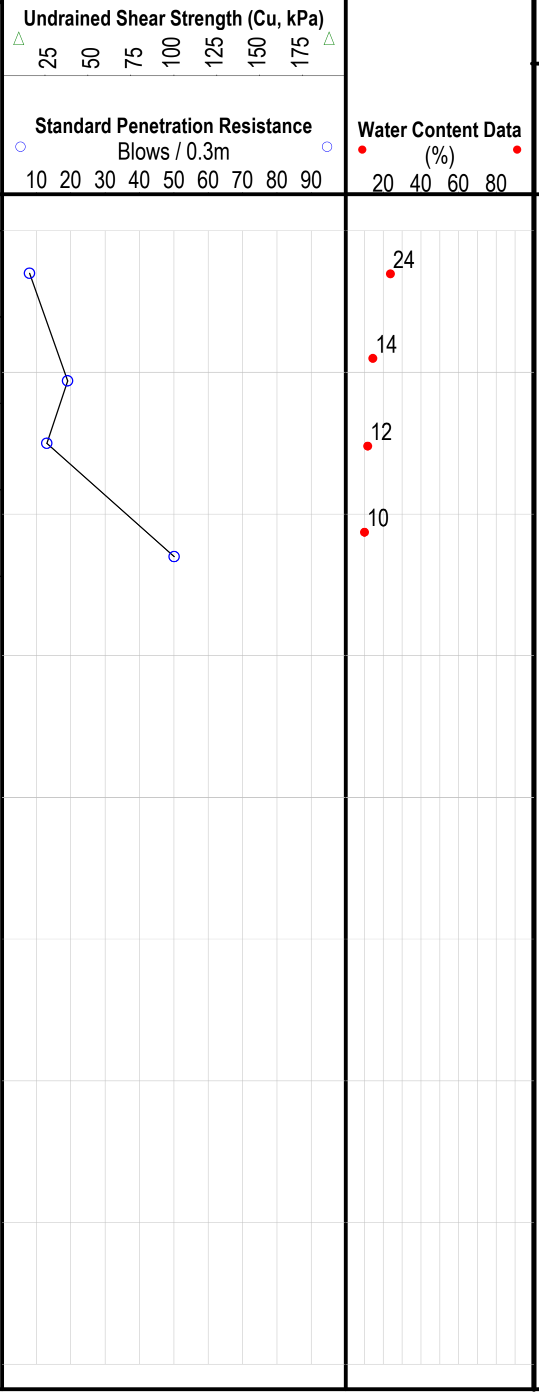
Sheet: 1 of 1

Borehole Log: BH LD 1

Project No: 18-4022
Project: Nation Rise Wind Farm
Site Location: North Stormont, Ontario
Client: EDPR

Logged By: S. Khan
Compiled By: A.Byers
Reviewed By: E.Giles

SUBSURFACE PROFILE					SAMPLE				Remarks	Grain Size (%)			
Well	Strata Plot (m)	Depth (m)	DESCRIPTION	Elevation (m)	Sample Number	Sample Type	Recovery (%)	Blows / 0.3m		Gr	Sa	Si	Cl
		0	Geodetic Ground Elevation	0.00									
			SAND (SM), fine grained, some SILT, oxidated, brown, loose, transitioning to SILTY CLAY (CL), oxidated, brown/grey, stiff	-0.61	1	SS	37	8					
		1		-1.22	2	SS	79	19					
			SILTY CLAY (CL), oxidated, brownish grey, dry, very stiff	-1.83	3	SS	88	13					
		2	SILT (ML), some CLAY, some cobble, boulders some GRAVEL, fragmented rocks, brown, moist, compact	-2.44	4	SS	50	50					
		3	SILT (ML),some GRAVEL, fragmented rocks, cobbles, oxidated, brown, moist						Auger and spoon refusal at 2.74m				
		4	End of Borehole										
		5											
		6											
		7											
		8											



Drilled By: Marathon Drilling

Drill Method: CME 55

Drill Date: June 12, 2018

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: UTM 18T
E=481474
N=5006914

Sheet: 1 of 1

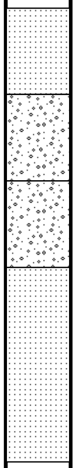
Borehole Log: BH LD 2

Project No: **18-4022**
Project: **Nation Rise Wind Farm**
Site Location: **North Stormont, Ontario**
Client: **EDPR**

Logged By: **S. Khan**
Compiled By: **A.Byers**
Reviewed By: **E.Giles**

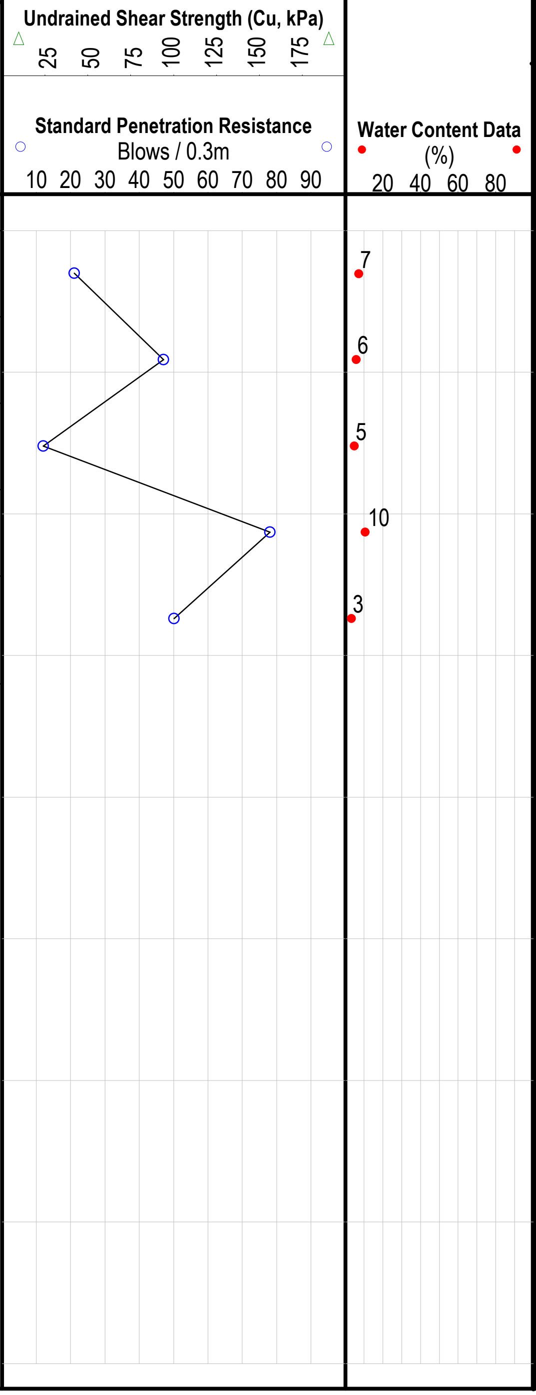
SUBSURFACE PROFILE

Depth (m)	DESCRIPTION	Elevation (m)
	Geodetic Ground Elevation	0.00
0	SAND (SW), medium grained, dark brown, dry, compact transitioning to GRAVEL (GP), fragmented/angular rocks, cobbles and boulders	-0.61
	Fragmented rocks and cobbles, SAND (SW), oxidated, dry to moist, brown, dense	-1.22
	SAND (SW), coarse grained, fragmented/angular rocks, cobbles, boulders, brown, dry, very dense	-1.83
	SAND (SW) and GRAVEL , fragmented/angular rocks, cobbles, boulders, brown, dry, very dense	-3.20
	End of Borehole	



SAMPLE

Sample Number	Sample Type	Recovery (%)	Blows / 0.3m
1	SS	54	21
2	SS	50	47
3	SS	92	12
4	SS	79	78
5	SS	25	50



Grain Size (%)

Gr Sa Si Cl

Remarks

Topsoil 0-0.13m

Spoon refusal at 2.74m

Auger refusal at 3.2m

Drilled By: **Marathon Drilling**

Drill Method: **CME 55**

Drill Date: **June 12, 2018**

Sample Type
AS - Auger Sample
SS - Split Spoon
TWS - Thin Walled Shelby Tube
BS - Block Sample
NQ - Rock Core
W - Water Content
WL- Liquid Limit
WP- Plastic Limit
△ - Field Vane

w - Wash
○- SPT(Standard Penetration Test)
WH - Weight Of Hammer

Datum:

Location: **UTM 18T**
E=485175
N=5002885

Sheet: **1 of 1**

APPENDIX D

LAB RESULTS

Moisture Contents

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 18-4022

DATE SAMPLED: varies

PROJECT: Nation Rise - Turbines

SOURCE: Boreholes

DATE TESTED: 7/16/18

TESTED BY: S.Hoffman

Tare ID	Sample ID	Depth (m)	SA #	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	T1-3	1.52-2.13		76.65	55.26	14.80	21.39	34.6%
	T1-4	3.05-3.66		613.40	465.90	222.22	147.50	37.7%
	T2-2	.76-1.37		77.38	63.59	13.74	13.79	21.7%
	T2-3	1.52-2.13		59.70	46.59	14.74	13.11	29.2%
	T5-6	4.57-5.18		615.80	585.00	197.95	30.80	7.4%
	T9-4	2.29-2.90		58.99	40.42	13.77	18.57	41.1%
	T9-6	4.57-5.18		657.22	492.70	237.11	164.52	39.2%
	T11-9	9.14-9.75		587.14	562.70	221.63	24.44	6.7%
	T16-7	7.62-8.23		603.30	571.20	203.98	32.10	8.0%
	T16-8	9.14-9.75		1055.00	984.10	230.60	70.90	8.6%
	T18-6	4.57-5.18		518.20	379.10	227.70	139.10	47.9%
	T18-9	9.14-9.75		64.77	60.85	14.81	3.92	7.8%
	T18-11	12.19-12.80		666.70	621.70	234.90	45.00	10.4%
	T18-12	13.72-14.33		81.10	75.06	14.84	6.04	9.1%
	T20-3	1.52-2.13		113.95	83.09	14.88	30.86	31.1%
	T20-5	3.05-3.66		602.00	431.10	232.50	170.90	46.3%
	T21-10	10.67-11.28		510.30	394.90	226.00	115.40	40.6%
	T23-8	7.62-8.23		466.30	360.00	219.50	106.30	43.1%
	T23-13	15.24-15.85		712.80	675.00	171.50	37.80	7.0%
	T28-5	3.05-3.66		720.20	691.80	256.00	28.40	6.1%
	T28-7	6.1-6.71		89.67	82.36	13.76	7.31	9.6%
	T28-10	9.14-9.75		778.00	701.85	212.70	76.15	13.5%
	T29-4	2.29-2.90		585.00	535.00	265.20	50.00	15.6%
	T29-8	7.62-8.23		132.29	110.96	15.08	21.33	18.2%
	T29-11	12.19-12.80		1019.30	973.80	248.70	45.50	5.9%

REMARKS:

CLIENT:

COPIES TO:

TULLOCH
ENGINEERING

CSA A283 Certified Laboratory for Concrete Testing
IL Certified Laboratory for Aggregates and Asphalt Test
CSA/CCIL Certified Technicians

Canadian Council of Independent Laboratories
Conseil canadie des laboratoires indépendants

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 18-4022
DATE SAMPLED: varies
PROJECT: Nation Rise - Turbines
SOURCE: Boreholes
DATE TESTED: 7/16/18
TESTED BY: S.Hoffman

Tare ID	Sample ID	Depth (m)	SA #	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	T35-4	3.05-3.66		533.90	494.30	198.00	39.60	11.8%
	T35-7	7.62-8.23		634.80	604.80	218.50	30.00	7.2%
	T35-9	10.67-11.28		637.60	598.80	271.90	38.80	10.6%
	T38-4	3.05-3.66		82.86	53.88	13.94	28.98	42.0%
	T38-5	4.57-5.18		506.00	389.50	168.90	116.50	34.6%
	T38-8	9.14-9.75		124.00	111.98	14.75	12.02	11.0%
	T43-9	7.47-7.62		919.60	788.70	231.00	130.90	19.0%
	T44-3	1.52-2.13		468.00	390.80	211.50	77.20	30.1%
	T44-7	6.1-6.71		526.80	502.30	214.20	24.50	7.8%
	T46-5	3.05-3.66		85.78	81.48	13.61	4.30	6.0%
	T46-7	5.94-6.71		608.40	577.20	187.10	31.20	7.4%
	T47-7	6.1-6.71		587.30	474.10	186.60	113.20	28.3%
	T47-11	12.2-12.81		698.30	661.40	214.80	36.90	7.6%
	T54-4	3.05-3.76		605.70	454.00	221.60	151.70	39.5%
	T54-8	9.14-9.75		916.30	869.50	289.40	46.80	7.5%
	T57-5	3.05-3.76		123.40	110.39	15.08	13.01	12.0%
	T57-8	7.62-8.23		559.10	526.70	274.10	32.40	11.4%
	T58-3	1.52-2.13		554.40	464.20	190.50	90.20	24.8%
	T58-7	6.1-6.71		480.60	464.50	197.50	16.10	5.7%
	T58-11	12.19-12.80		906.30	866.40	242.00	39.90	6.0%

REMARKS:

CLIENT:

COPIES TO:

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WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO:	18-4022	DATE SAMPLED:	Refer to BH logs
PROJECT:	Nation Rise	SOURCE:	Boreholes
DATE TESTED:	Aug,8/2018	TESTED BY:	S.Hoffman

Tare ID	Sample ID	Depth (m)	SA	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	WTG-01 SS2	0.8-1.4		57.65	43.46	13.77	14.2	47.8%
	WTG-02 SS1	0.0-0.6		58.18	49.26	13.72	8.9	25.1%
	WTG-04 SS1	not present						
	WTG-05 SS1	0.0-0.6		67.07	57.51	13.74	9.6	21.8%
	WTG-05 SS3	1.5-2.1		76.55	60.36	13.76	16.2	34.7%
	WTG-05 SS5	3.1-3.7		115.07	108.62	13.69	6.4	6.8%
	WTG-05 SS8	7.6-8.2		119.67	113.16	13.78	6.5	6.6%
	WTG-06 SS1	0.0-0.6		71.12	64.48	15.07	6.6	13.4%
	WTG-06 SS2	0.8-1.4		97.62	92.34	13.84	5.3	6.7%
	WTG-06 SS3	1.5-2.1		63.59	58.83	13.75	4.8	10.6%
	WTG-07 SS1	0.0-0.6		90.38	73.40	14.82	17.0	29.0%
	WTG-07 SS3	1.5-2.1		77.63	69.41	13.61	8.2	14.7%
	WTG-09 SS1	0.0-0.6		69.80	58.09	15.05	11.7	27.2%
	WTG-09 SS3	1.5-2.1		99.92	70.28	14.92	29.6	53.5%
	WTG-10 SS1	0.0-0.6		64.03	54.67	13.77	9.4	22.9%
	WTG-10 SS3	1.5-2.1		71.06	70.36	13.63	0.7	1.2%
	WTG-10 SS5	4.6-5.2		89.05	84.04	14.89	5.0	7.2%
	WTG-10 SS7	6.1-6.7		84.20	81.52	13.73	2.7	4.0%
	WTG-11 SS1	0.0-0.6		71.37	57.71	13.77	13.7	31.1%
	WTG-11 SS3	1.5-2.1		84.75	80.20	13.72	4.6	6.8%
	WTG-11 SS5	3.1-3.7		64.45	60.21	13.75	4.2	9.1%
	WTG-11 SS10	10.7-11.3		104.06	97.13	14.74	6.9	8.4%
	WTG-12 SS1	0.0-0.6		60.47	51.44	13.78	9.0	24.0%
	WTG-12 SS2	0.8-1.4		59.51	38.24	13.60	21.3	86.3%
	WTG-12 SS3	1.5-2.1		64.60	53.79	13.62	10.8	26.9%
	WTG-12 SS4	3.1-3.7		82.72	59.07	13.93	23.7	52.4%

REMARKS:

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WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 18-1016
DATE SAMPLED: Refer to BH logs
PROJECT: Bolton River Bridge
SOURCE: Boreholes
DATE TESTED: Aug,8/2018
TESTED BY: S.Hoffman

Tare ID	Sample ID	Depth (m)	SA	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	WTG-16 SS1	0.0-0.6		69.6	59.8	14.84	9.8	21.7%
	WTG-16 SS2	0.8-1.4		71.0	57.9	15.1	13.1	30.7%
	WTG-16 SS3	1.5-2.1		92.7	86.0	14.8	6.8	9.5%
	WTG-16 SS5	4.6-5.2		93.3	87.4	15.1	5.9	8.2%
	WTG-18 SS1	0.0-0.6		72.1	54.7	13.9	17.4	42.5%
	WTG-18 SS2	0.8-1.4		100.1	73.5	15.1	26.6	45.6%
	WTG-18 SS3	1.5-2.1		59.9	45.0	13.6	14.8	47.2%
	WTG-18 SS5	3.1-3.7		69.4	48.6	13.8	20.9	60.0%
	WTG-18 SS7	6.1-6.7		56.7	43.5	14.8	13.2	45.8%
	WTG-20 SS1	0.0-0.6		84.8	64.2	14.8	20.6	41.8%
	WTG-20 SS6	4.6-5.2		67.2	51.2	14.7	16.1	44.2%
	WTG-20 SS7	6.1-6.7		117.8	111.4	15.1	6.4	6.7%
	WTG-20 SS8	7.6-8.2		144.0	134.0	15.0	10.0	8.4%
	WTG-21 SS1	0.0-0.6		80.7	64.1	13.7	16.6	33.0%
	WTG-21 SS3	1.5-2.1		83.8	62.4	13.8	21.4	44.1%
	WTG-21 SS6	4.6-5.2		83.6	60.2	13.7	23.4	50.3%
	WTG-21 SS8	7.6-8.2		84.5	60.6	14.9	23.9	52.2%
	WTG-21 SS10	10.7-11.3		72.0	55.7	14.9	16.3	39.9%
	WTG-21 SS14	13.7-14.3		114.1	108.5	15.0	5.6	6.0%
	WTG-21 SS15	15.2-15.9		107.9	103.5	14.9	4.5	5.0%
	WTG-23 SS65	3.1-3.7		80.1	58.8	15.1	21.3	48.8%
	WTG-23 SS7	6.1-6.7		93.1	65.9	14.7	27.2	53.2%
	WTG-23 SS8	7.6-8.2		80.2	54.1	13.6	26.1	64.5%
	WTG-23 SS11	12.2-12.8		82.7	77.76	13.6	4.9	7.7%
	WTG-23 SS13	15.2-15.9		116.5	110.13	13.8	6.4	6.6%
	WTG-23 SS14	16.8-18.4		111.2	107.92	13.7	3.3	3.5%

REMARKS: WTG-21 SS16 not present , WTG-23 SS6 empty bag

CLIENT:

COPIES TO:

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO:	18-4022	DATE SAMPLED:	Refer to BH logs
PROJECT:	Nation Rise	SOURCE:	Boreholes
DATE TESTED:	Aug,8/2018	TESTED BY:	S.Hoffman

Tare ID	Sample ID	Depth (m)	SA	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	WTG-25 SS1	0.0-0.6		100	93.64	13.7	6.4	8.0%
	WTG-25 SS3	1.5-2.1		65.7	62.8	13.7	2.9	5.9%
	WTG-27 SS1	0.0-0.6		70.8	62.0	13.7	8.8	18.2%
	WTG-27 SS2	0.8-1.4		89.9	85.6	13.8	4.3	6.0%
	WTG-28 SS1	0.0-0.6		85.9	80.7	16.8	5.2	8.1%
	WTG-28 SS3	1.5-2.1		89.5	85.3	17.4	4.2	6.2%
	WTG-28 SS6	4.6-5.2		76.7	71.5	16.7	5.2	9.5%
	WTG-28 SS8	7.6-8.4		84.8	77.7	17.7	7.1	11.8%
	WTG-29 SS1	0.0-0.6		55.1	50.9	15.0	4.2	11.7%
	WTG-29 SS3	1.5-2.1		59.3	53.6	16.8	5.7	15.5%
	WTG-29 SS6	4.6-5.2		84.7	72.6	17.1	12.1	21.8%
	WTG-29 SS9	9.1-9.8		116.1	103.9	17.6	12.2	14.1%
	WTG-29 SS12	13.7-14.3		78.9	74.2	17.0	4.7	8.2%
	WTG-32 SS1	0.0-0.6		80.1	69.4	16.4	10.7	20.2%
	WTG-32 SS2	0.8-1.4		63.5	52.6	17.6	10.9	31.1%
	WTG-32 SS4	2.3-2.9		92.4	78.6	16.8	13.8	22.3%
	WTG-35 SS1	0.0-0.6		67.8	60.1	17.8	7.7	18.2%
	WTG-35 SS3	1.5-2.1		53.0	41.2	20.1	11.8	55.9%
	WTG-35 SS5	4.6-5.2		77.2	68.8	18.5	8.4	16.7%
	WTG-35 SS6	6.1-6.7		96.2	90.7	19.8	5.5	7.8%
	WTG-35 SS8	9.1-9.8		105.3	98.8	13.8	6.5	7.6%
	WTG-38 SS1	0.0-0.6		90.4	76.5	20.3	13.9	24.7%
	WTG-38 SS3	1.5-2.1		67.1	52.6	23.4	14.5	49.7%
	WTG-38 SS6	6.7-6.7		103.7	92.1	15.5	11.6	15.1%
	WTG-38 SS8	9.1-9.8		90.9	82.4	13.7	8.5	12.4%
	WTG-38 SS9	10.7-11.3		91.8	85.1	13.8	6.7	9.4%

REMARKS: BH-WTG-38 SS7 sample bag was empty

CLIENT:

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WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO:	18-4022	DATE SAMPLED:	Refer to BH logs
PROJECT:	Nation Rise	SOURCE:	Boreholes
DATE TESTED:	Aug. 10/2018	TESTED BY:	S.Hoffman

Tare ID	Sample ID	Depth (m)	SA	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	WTG-41 SS1	0.0-0.6		71.7	61.5	13.8	10.2	21.4%
	WTG-41 SS3	1.5-2.1		71.2	51.5	14.8	19.7	53.7%
	WTG-41 SS4	3.1-3.7		85.9	70.5	13.7	15.4	27.1%
	WTG-43 SS1	0.0-0.6		69.1	58.9	17.3	10.2	24.5%
	WTG-43 SS2	0.8-1.4		61.4	53.0	16.3	8.4	22.9%
	WTG-43 SS4	2.3-2.9		79.4	75.5	13.7	3.9	6.3%
	WTG-43 SS6	4.1-4.5		67.7	61.8	16.2	5.9	12.9%
	WTG-43 SS8	6.1-6.7		59.4	52.8	13.9	6.6	17.0%
	WTG-44 SS1	0.0-0.6		59.6	52.1	15.1	7.5	20.3%
	WTG-44 SS3	1.5-2.1		94.6	80.7	17.4	13.9	22.0%
	WTG-44 SS5	3.1-3.7		90.6	73.4	18.8	17.2	31.5%
	WTG-46 SS1	0.0-0.6		82.2	73.8	20.8	8.4	15.8%
	WTG-46 SS3	1.5-2.1		113.0	105.9	19.6	7.1	8.2%
	WTG-46 SS6	4.6-5.2		68.2	64.2	14.8	4.0	8.1%
	WTG-47 SS1	0.0-0.6		98.8	86.8	20.1	12.0	18.0%
	WTG-47 SS3	1.5-2.1		79.9	63.2	18.9	16.7	37.7%
	WTG-47 SS5	3.1-3.7		76.9	54.6	13.8	22.3	54.7%
	WTG-47 SS8	7.6-8.2		152.8	142.8	28.2	10.0	8.7%
	WTG-47 SS9	9.1-9.8		98.4	92.1	18.5	6.3	8.6%
	WTG-52 SS1	0.0-0.6		62.2	53.9	15.0	8.3	21.3%
	WTG-52 SS2	0.8-1.4		92.2	86.6	15.1	5.6	7.8%
	WTG-52 SS4	2.3-2.9		77.1	74.0	14.8	3.1	5.2%
	WTG-52 SS6	4.6-5.2		93.5	87.0	14.8	6.5	9.0%
	WTG-52 SS7	6.1-6.7		112	105.9	18.2	6.1	7.0%

REMARKS:

CLIENT:

COPIES TO:

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 18-4022
DATE SAMPLED: Refer to BH logs
PROJECT: Nation Rise
SOURCE: Boreholes
DATE TESTED: Aug. 10/2018
TESTED BY: S.Hoffman

Tare ID	Sample ID	Depth (m)	SA	Wet Weight	Dry Weight	TARE	Mass Lost	Water %
	WTG-54 SS1	0.0-0.61		82.1	71.5	13.6	10.6	18.3%
	WTG-54 SS2	0.8-1.4		79.2	63.4	13.8	15.8	31.9%
	WTG-54 SS4	6.1-6.7		57.6	41.0	13.8	16.6	61.0%
	WTG-54 SS6	0.0-0.6		116.5	91.4	13.7	25.1	32.3%
	WTG-56 SS1	0.0-0.6		96.4	78.6	14.8	17.8	27.9%
	WTG-56 SS2A	0.8-1.3		84.3	69.4	14.8	14.9	27.3%
	WTG-56 SS4	2.3-2.9		96.3	85.7	13.8	10.6	14.7%
	WTG-57 SS2	0.0-0.6		83.4	76.9	13.9	6.5	10.3%
	WTG-57 SS7	6.1-6.7		131.1	117.6	19.6	13.5	13.8%
	WTG-58 SS3	1.5-2.1		66.6	51.7	13.9	14.9	39.4%
	WTG-58 SS6	4.6-5.2		89.4	84.6	13.9	4.8	6.8%
	WTG-58 SS8	7.6-8.2		95.7	89.7	13.6	6.0	7.9%
	WTG-58 SS10	10.7-11.3		126.2	118.0	13.8	8.2	7.9%

REMARKS:

CLIENT:

COPIES TO:

Atterberg Limits

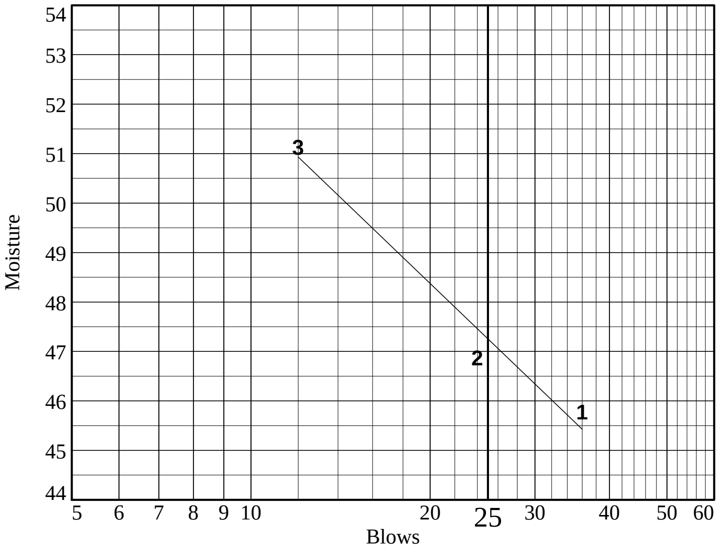
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T1 - 4
Depth: 3.05m - 3.6mm
Sample Number: 4
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.32	31.81	33.26			
Dry+Tare	26.10	26.46	27			
Tare	14.70	15.05	14.76			
# Blows	36	24	12			
Moisture	45.8	46.9	51.1			

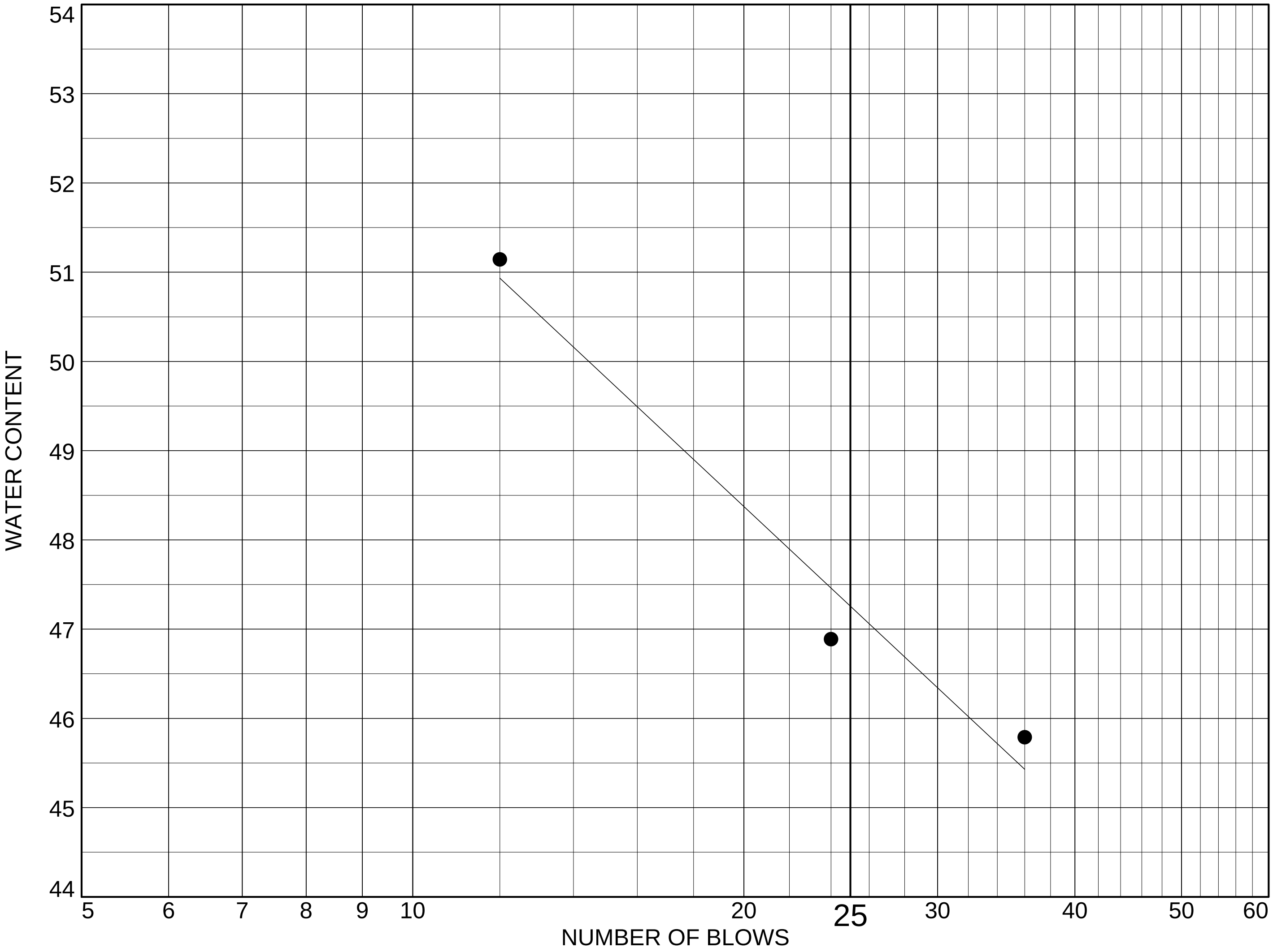


Liquid Limit= 47
Plastic Limit= 22
Plasticity Index= 25
Natural Moisture= 37.7
Liquidity Index= 0.6

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.21	22.82			
Dry+Tare	19.28	21.33			
Tare	14.83	14.73			
Moisture	20.9	22.6			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T1 - 4	4	3.05m - 3.6mm	37.7	22	47	25	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

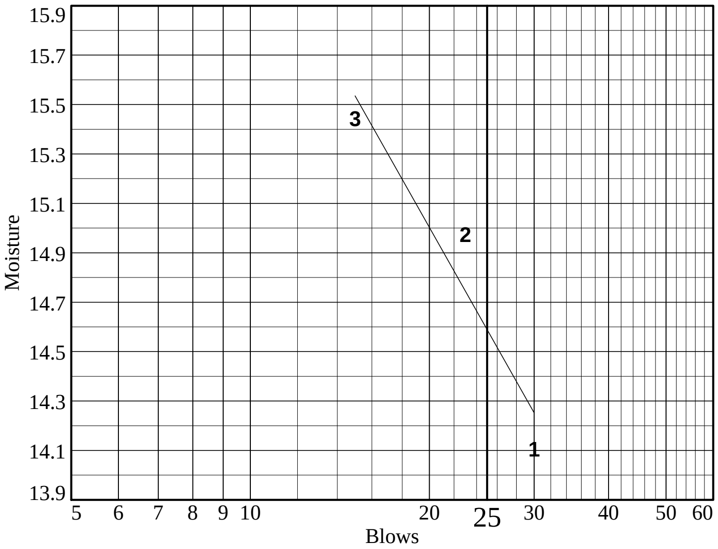
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T11 - 9
Depth: 9.14m - 9.75m
Sample Number: 9
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.17	33.71	28.23			
Dry+Tare	29.89	31.11	26.29			
Tare	13.73	13.75	13.73			
# Blows	30	23	15			
Moisture	14.1	15.0	15.4			

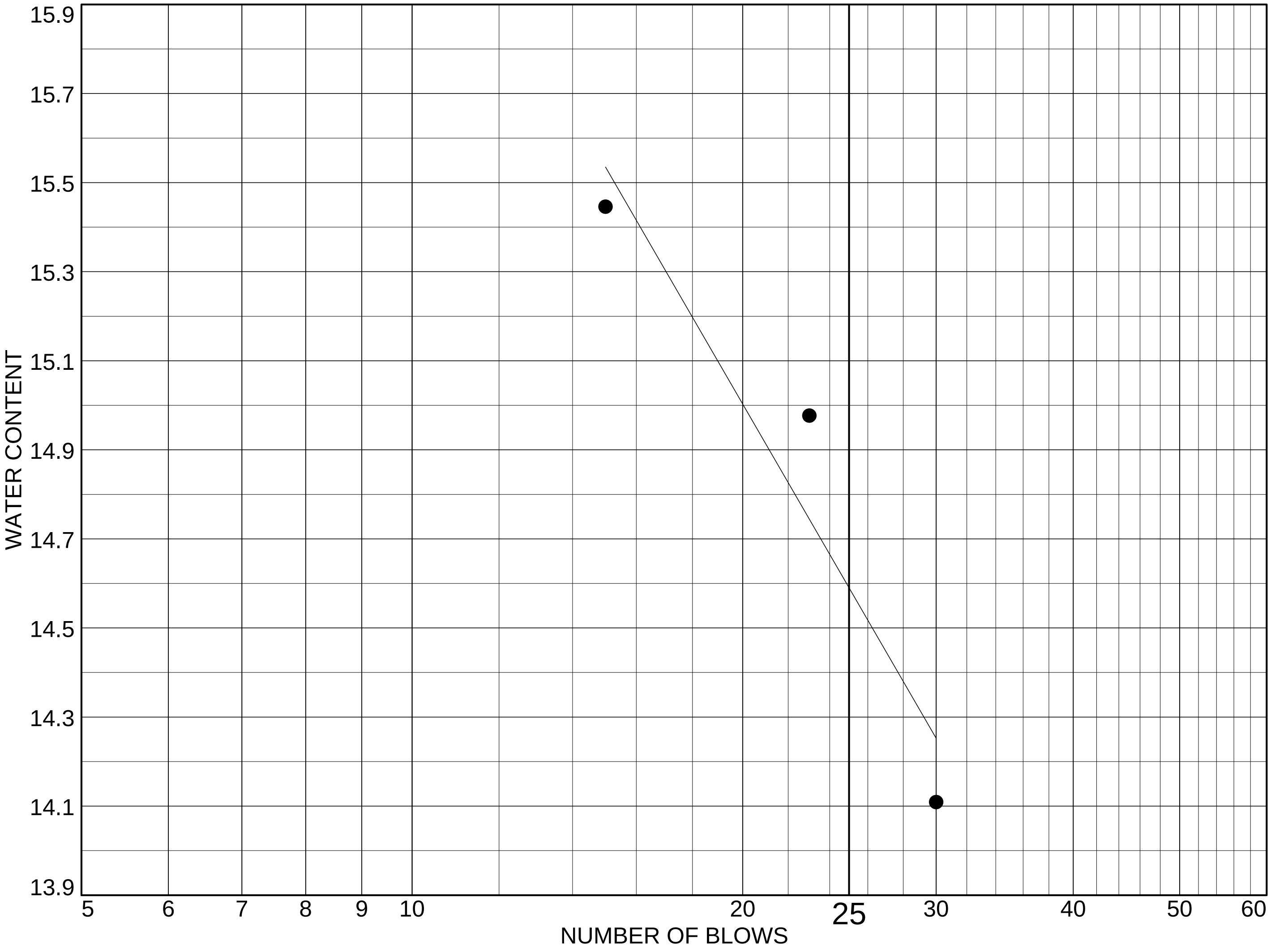


Liquid Limit= 15
Plastic Limit= 10
Plasticity Index= 5
Natural Moisture= 6.7
Liquidity Index= -0.7

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	26.64	26.72			
Dry+Tare	25.52	25.60			
Tare	14.61	14.88			
Moisture	10.3	10.4			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T11 - 9	9	9.14m - 9.75m	6.7	10	15	5	

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adam.byers@TULLOCH.ca

Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

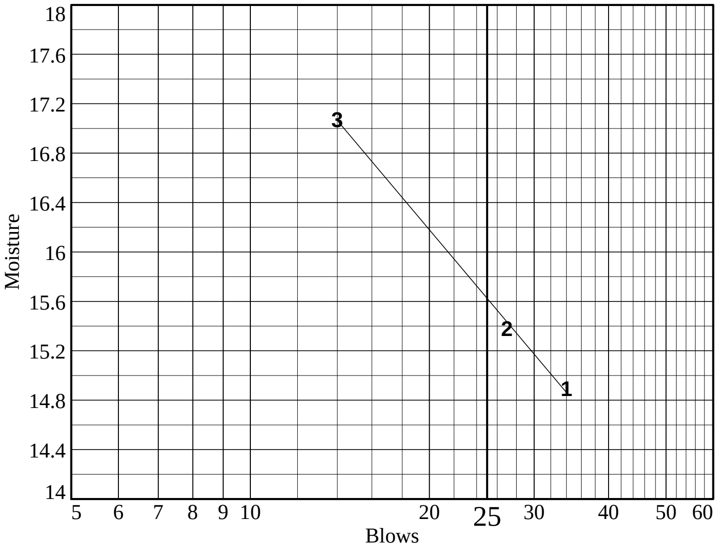
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T16 - 7
Depth: 7.62m - 8.23m
Sample Number: 7
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	37.39	29.35	28.32			
Dry+Tare	34.34	27.25	26.17			
Tare	13.87	13.60	13.58			
# Blows	34	27	14			
Moisture	14.9	15.4	17.1			



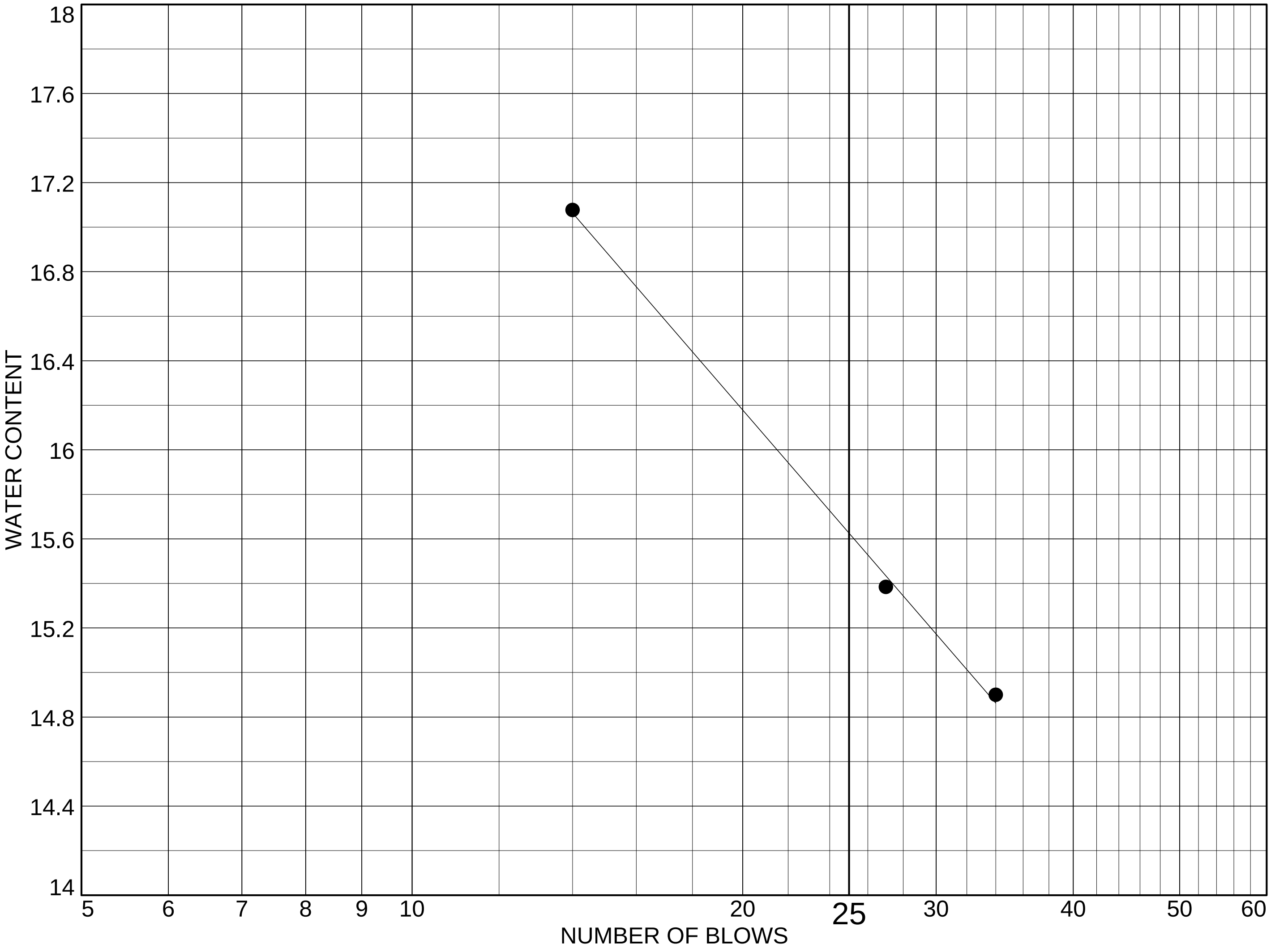
Liquid Limit= 16
Plastic Limit= 10
Plasticity Index= 6
Natural Moisture= 8
Liquidity Index= -0.3

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.18	21.60			
Dry+Tare	23.21	20.84			
Tare	13.65	13.69+			
Moisture	10.1	10.6			

Tulloch Engineering Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T16 - 7	7	7.62m - 8.23m	8	10	16	6	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

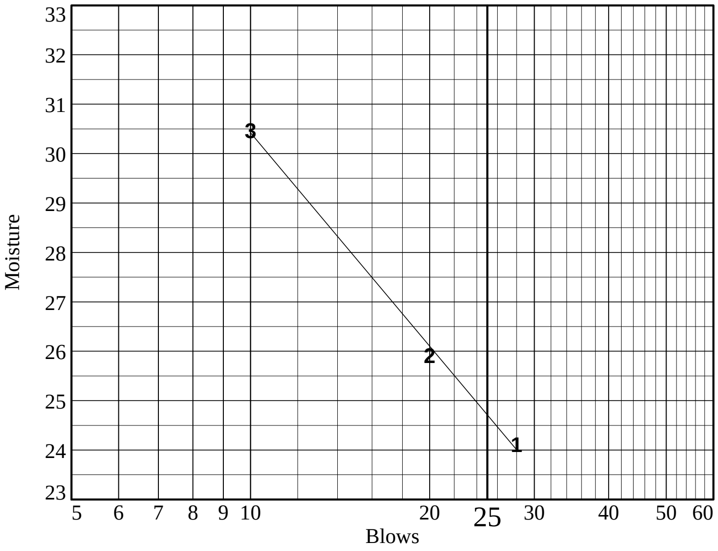
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T18 - 11
Depth: 12.19m - 12.80m
Sample Number: 11
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	28.27	34.11	33.91			
Dry+Tare	25.65	30.19	29.53			
Tare	14.79	15.07	15.16			
# Blows	28	20	10			
Moisture	24.1	25.9	30.5			

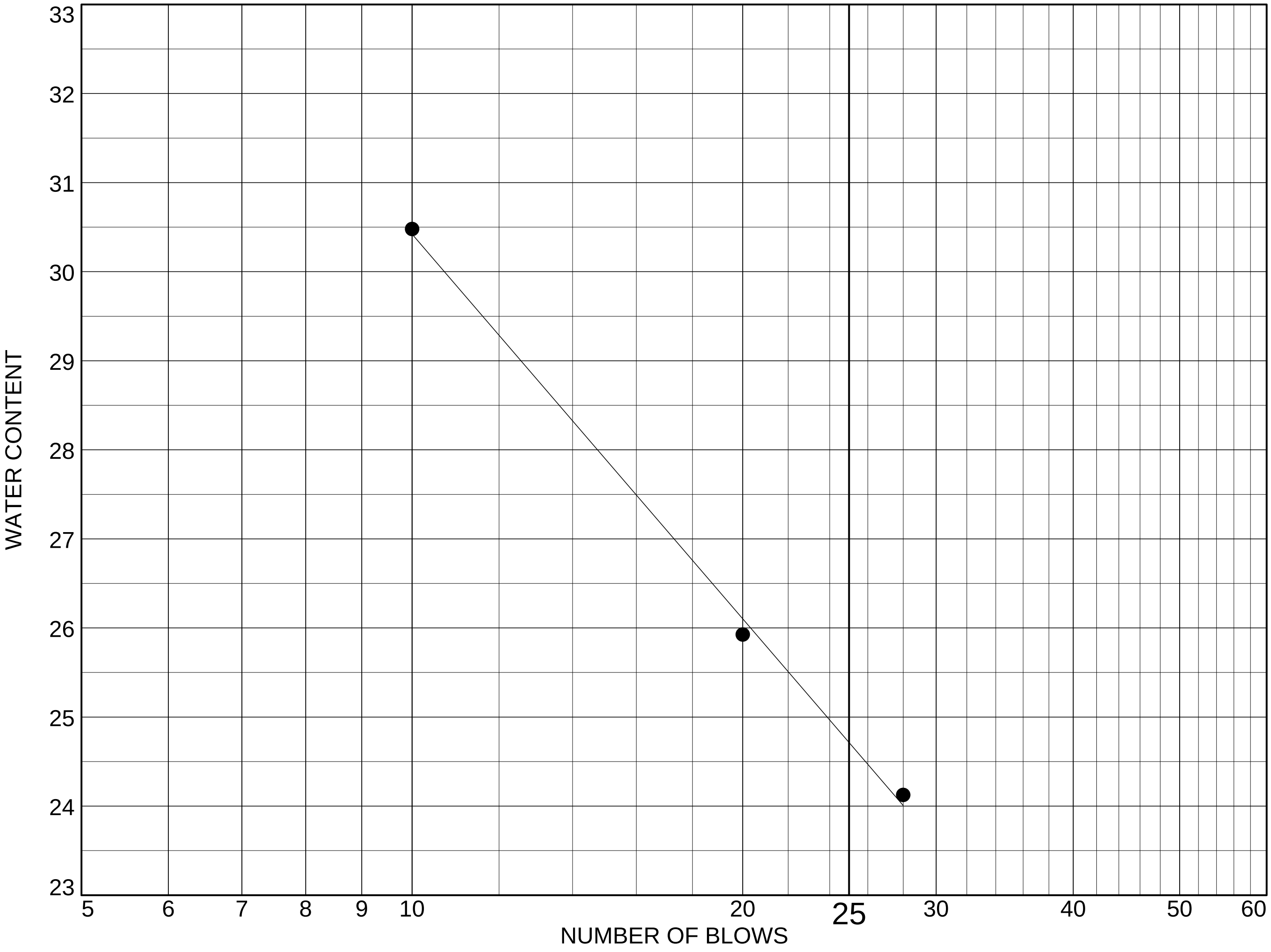


Liquid Limit= 25
Plastic Limit= 12
Plasticity Index= 13
Natural Moisture= 10.4
Liquidity Index= -0.1

Plastic Limit Data

Run No.	**1**	**2**	**3**	**4**	
Wet+Tare	25.44	21.97			
Dry+Tare	24.212	21.08			
Tare	13.75	13.59			
Moisture	11.7	11.9			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T18 - 11	11	12.19m - 12.80m	10.4	12	25	13	

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Client: EDP

Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

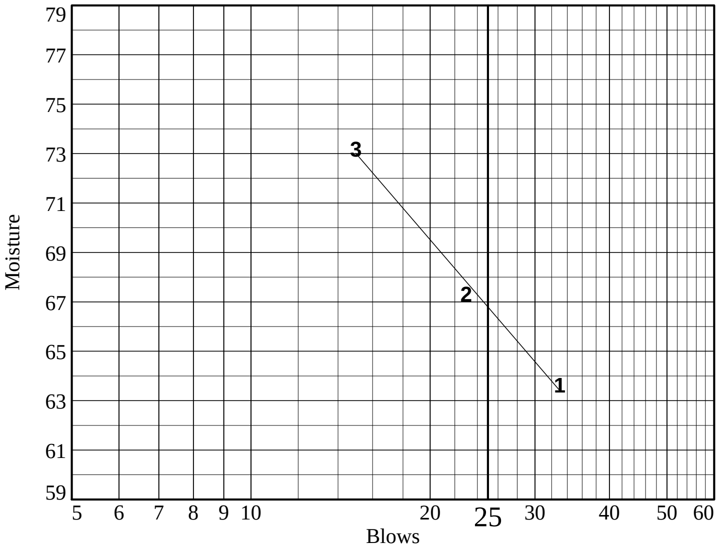
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T18 - 6
Depth: 4.57m - 5.18m
Sample Number: 6
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	27.99	25.97	30.47			
Dry+Tare	22.40	21.04	23.47			
Tare	13.62	13.72	13.91			
# Blows	33	23	15			
Moisture	63.7	67.3	73.2			

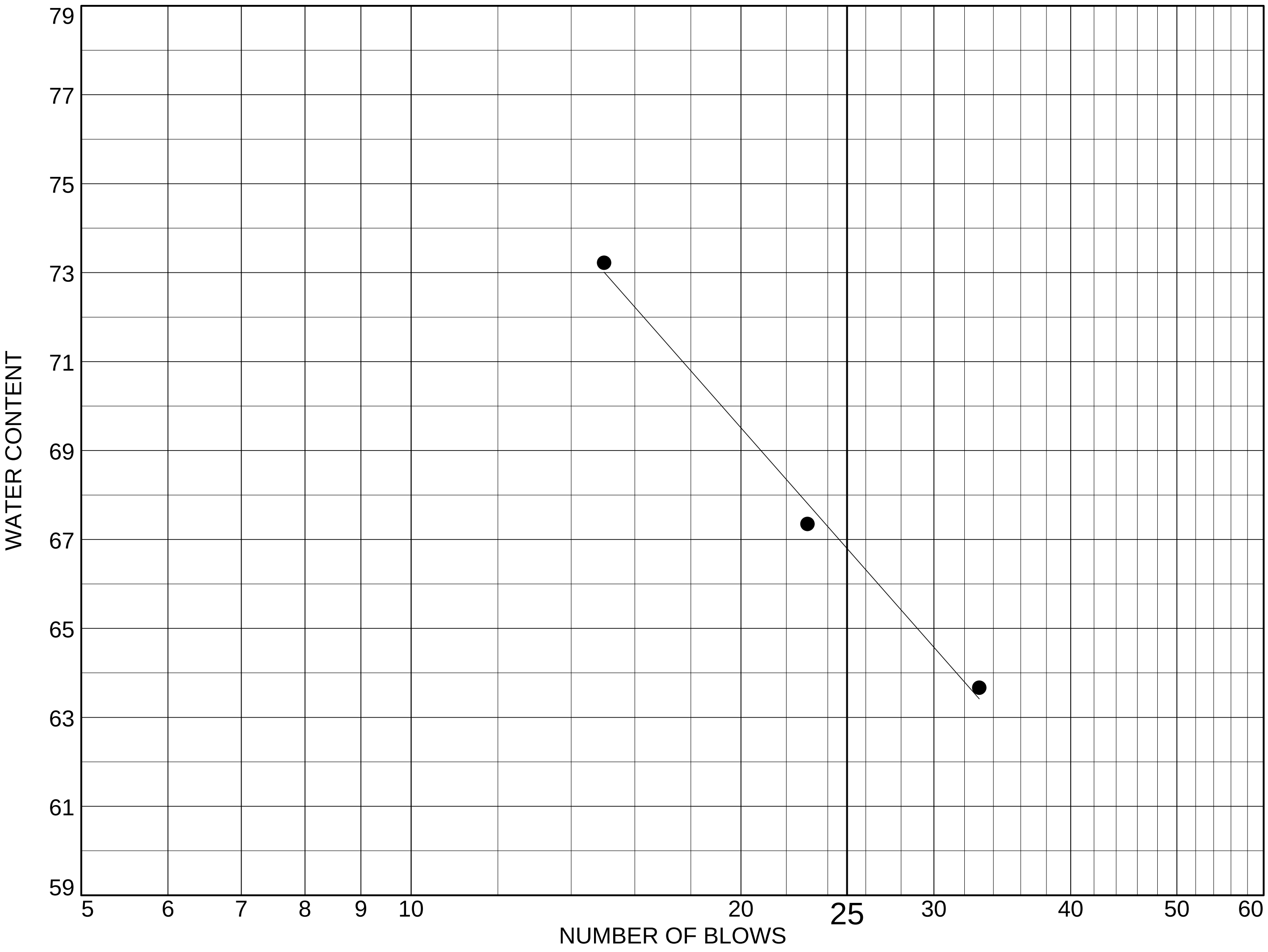


Liquid Limit= 67
Plastic Limit= 25
Plasticity Index= 42
Natural Moisture= 47.9
Liquidity Index= 0.5

Plastic Limit Data

Run No.	**1**	**2**	**3**	**4**	
Wet+Tare	21.75	21.54			
Dry+Tare	20.14	19.96			
Tare	13.75	13.77			
Moisture	25.2	25.5			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T18 - 6	6	4.57m - 5.18m	47.9	25	67	42	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

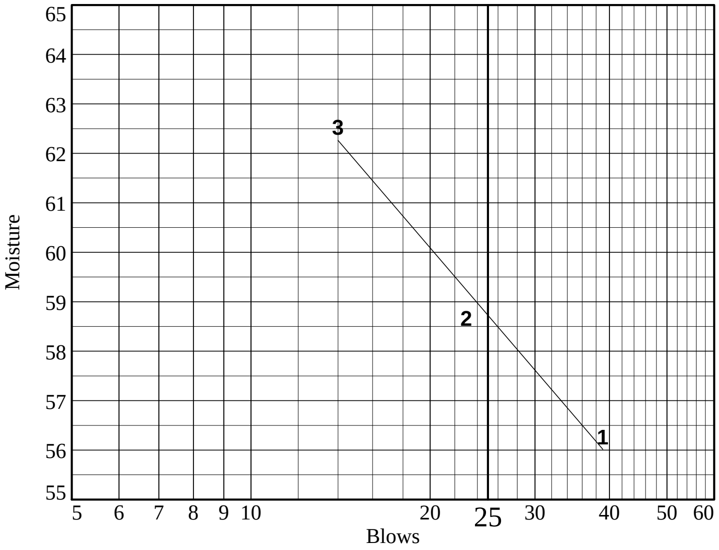
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T20 - 5
Depth: 3.05m 3.66m
Sample Number: 5
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.31	28.43	31.50			
Dry+Tare	23.07	22.99	24.72			
Tare	13.76	13.72	13.88			
# Blows	39	23	14			
Moisture	56.3	58.7	62.5			

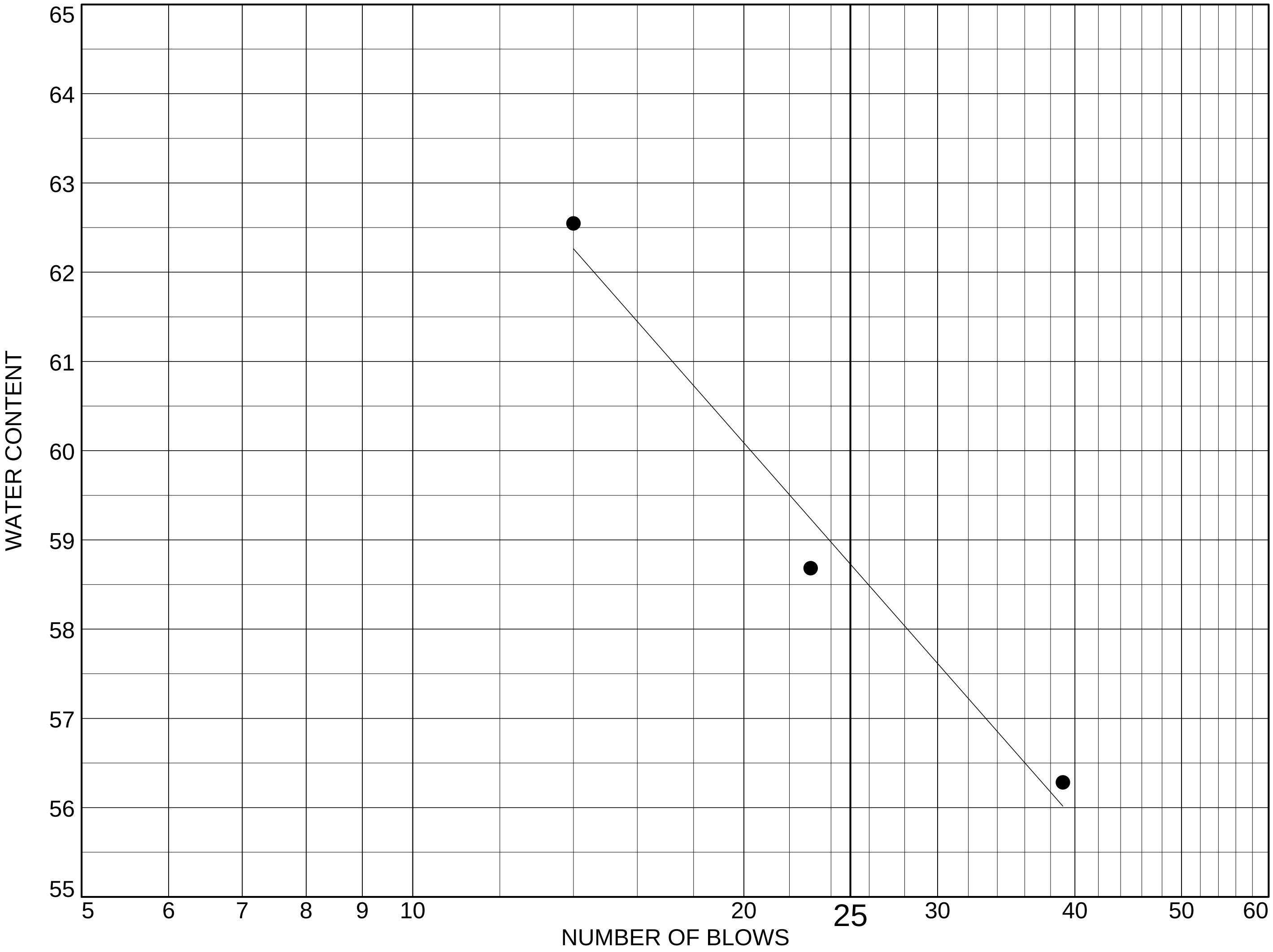


Liquid Limit= 59
Plastic Limit= 26
Plasticity Index= 33
Natural Moisture= 46.3
Liquidity Index= 0.6

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.27	20.69			
Dry+Tare	18.94	19.24			
Tare	13.72	13.66			
Moisture	25.5	26.0			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T20 - 5	5	3.05m 3.66m	46.3	26	59	33	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

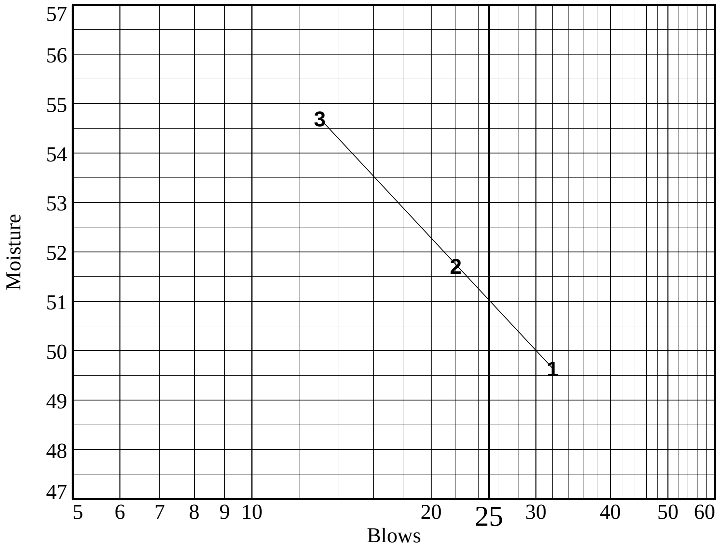
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T21-10
Depth: 10.67m - 11.28m **Sample Number:** 10
Tested by: S.Hoffman **Checked by:** S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30	29.17	34.11			
Dry+Tare	24.97	24.38	27.31			
Tare	14.84	15.12	14.88			
# Blows	32	22	13			
Moisture	49.7	51.7	54.7			

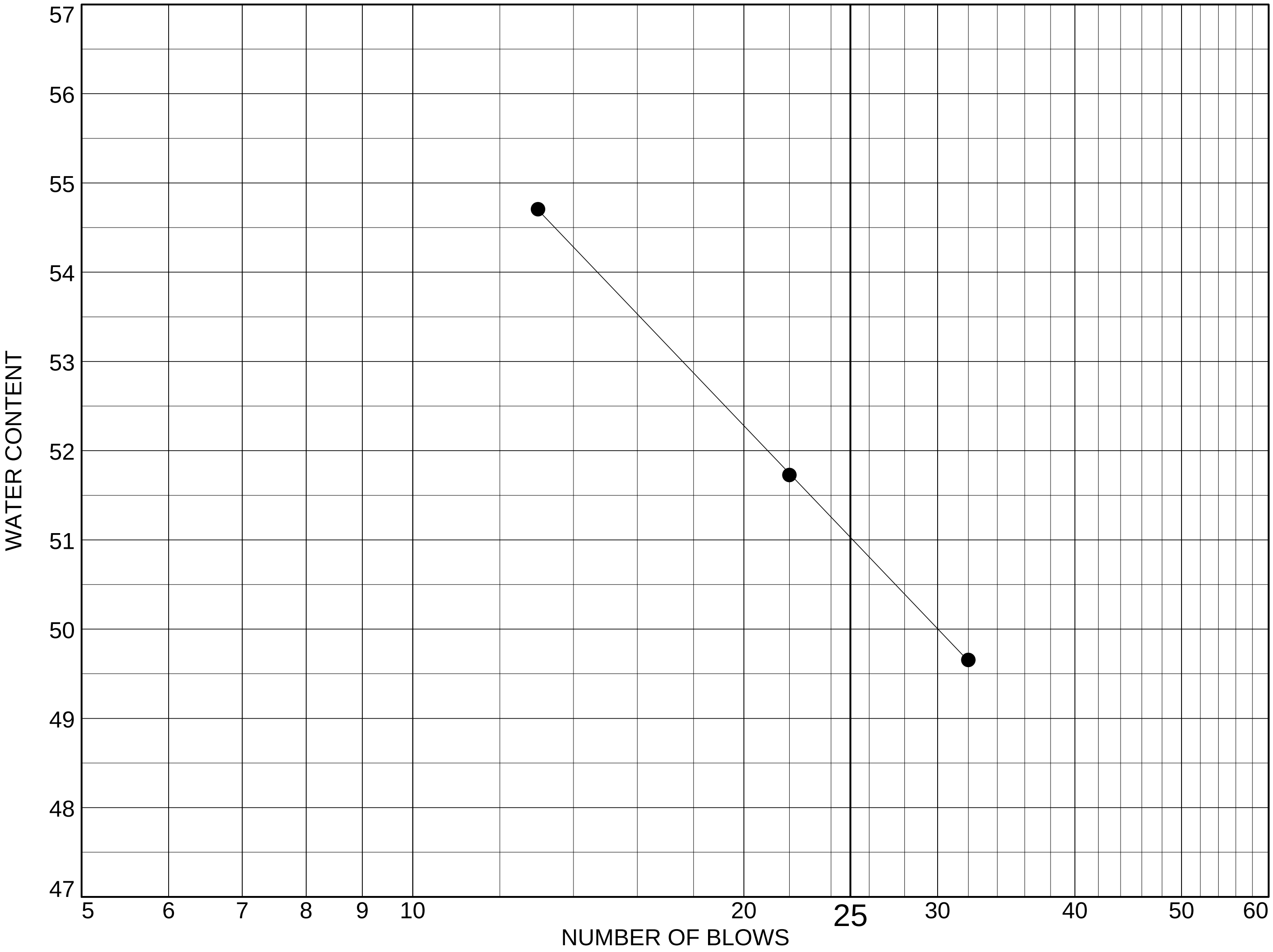


Liquid Limit= 51
Plastic Limit= 20
Plasticity Index= 31

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	19.41	19.61			
Dry+Tare	18.45	18.61			
Tare	13.74	13.75			
Moisture	20.4	20.6			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T21-10	10	10.67m - 11.28m		20	51	31	

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Client: EDP

Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

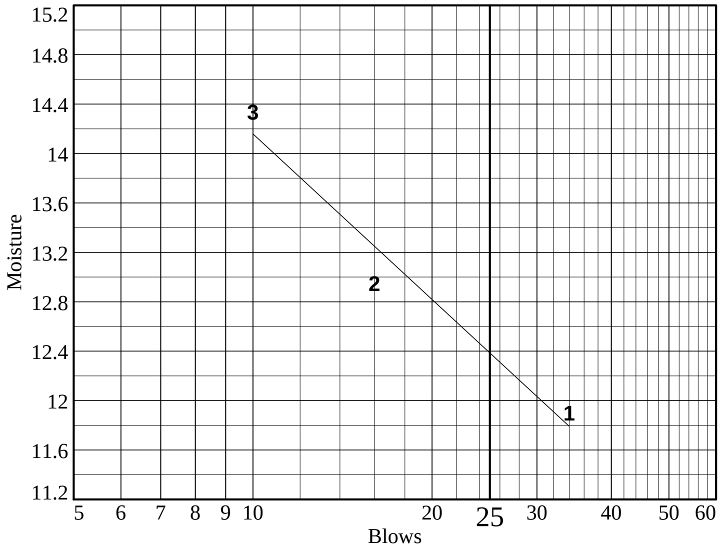
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T23-13
Depth: 15.24m - 15.85m
Sample Number: 13
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	37.05	27.56	37.25			
Dry+Tare	34.57	25.99	34.30			
Tare	13.74	13.87	13.73			
# Blows	34	16	10			
Moisture	11.9	13.0	14.3			

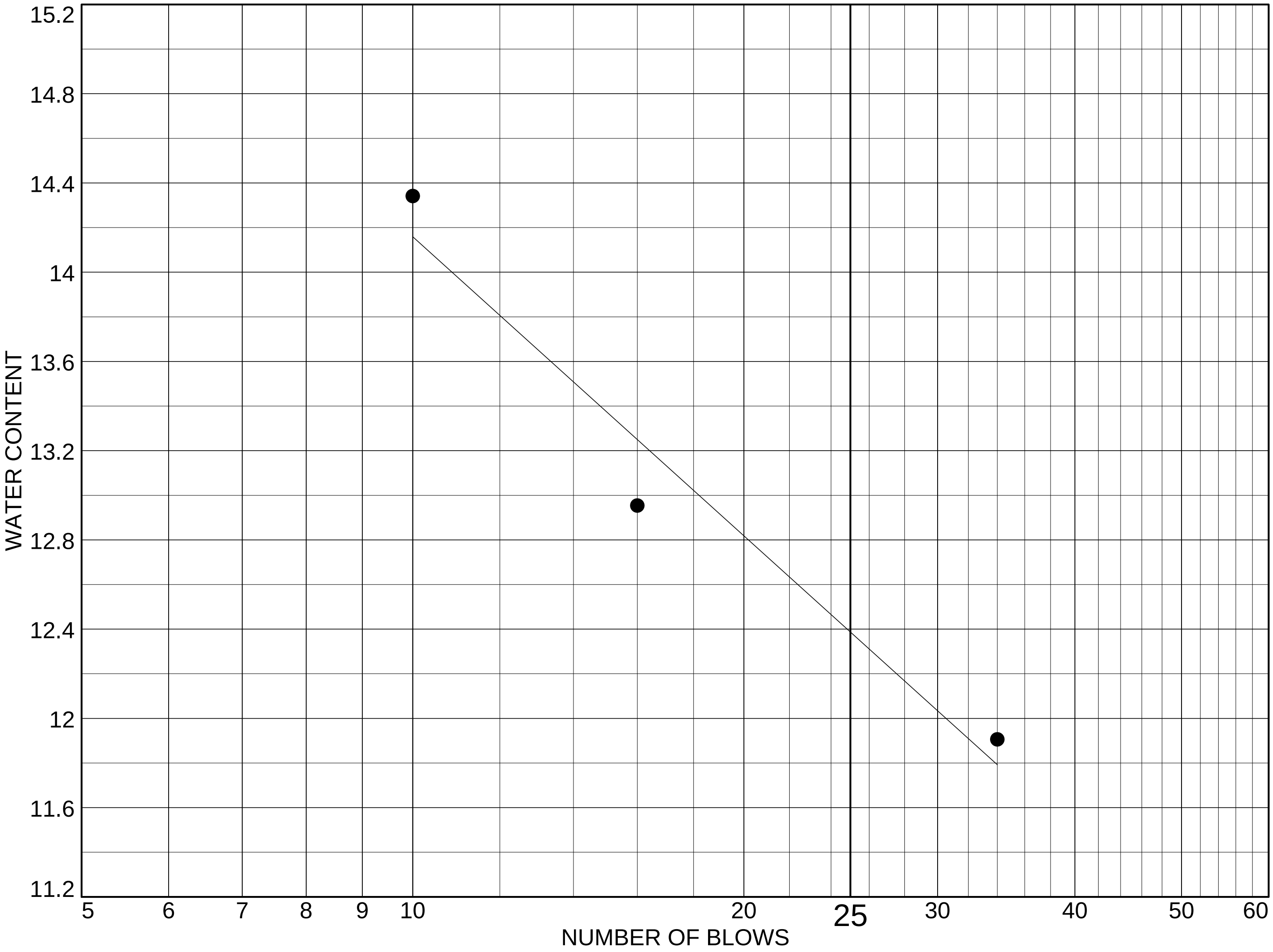


Liquid Limit= 12
Plastic Limit= 10
Plasticity Index= 2
Natural Moisture= 7.0
Liquidity Index= -1.5

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	29.87	23.81			
Dry+Tare	28.40	22.94			
Tare	13.61	13.90			
Moisture	9.9	9.6			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T23-13	13	15.24m - 15.85m	7.0	10	12	2	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

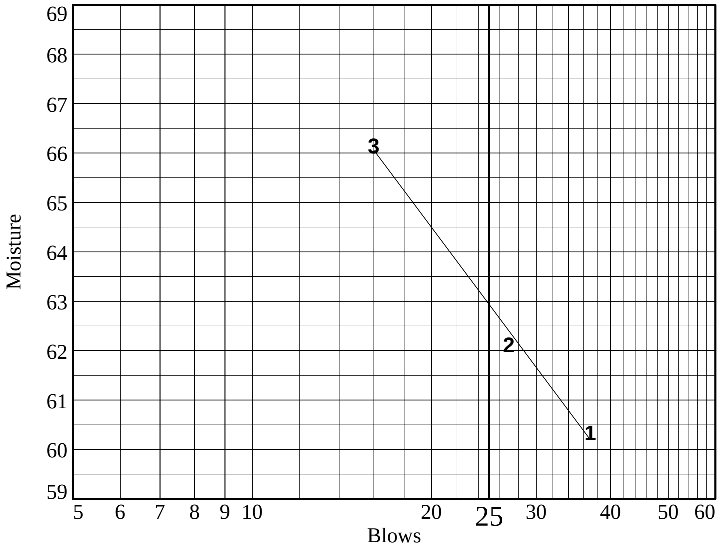
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T23-8
Depth: 7.62m - 8.23m
Sample Number: 8
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.52	27.51	33.35			
Dry+Tare	25.44	22.21	25.55			
Tare	13.71	13.68	13.76			
# Blows	37	27	16			
Moisture	60.4	62.1	66.2			

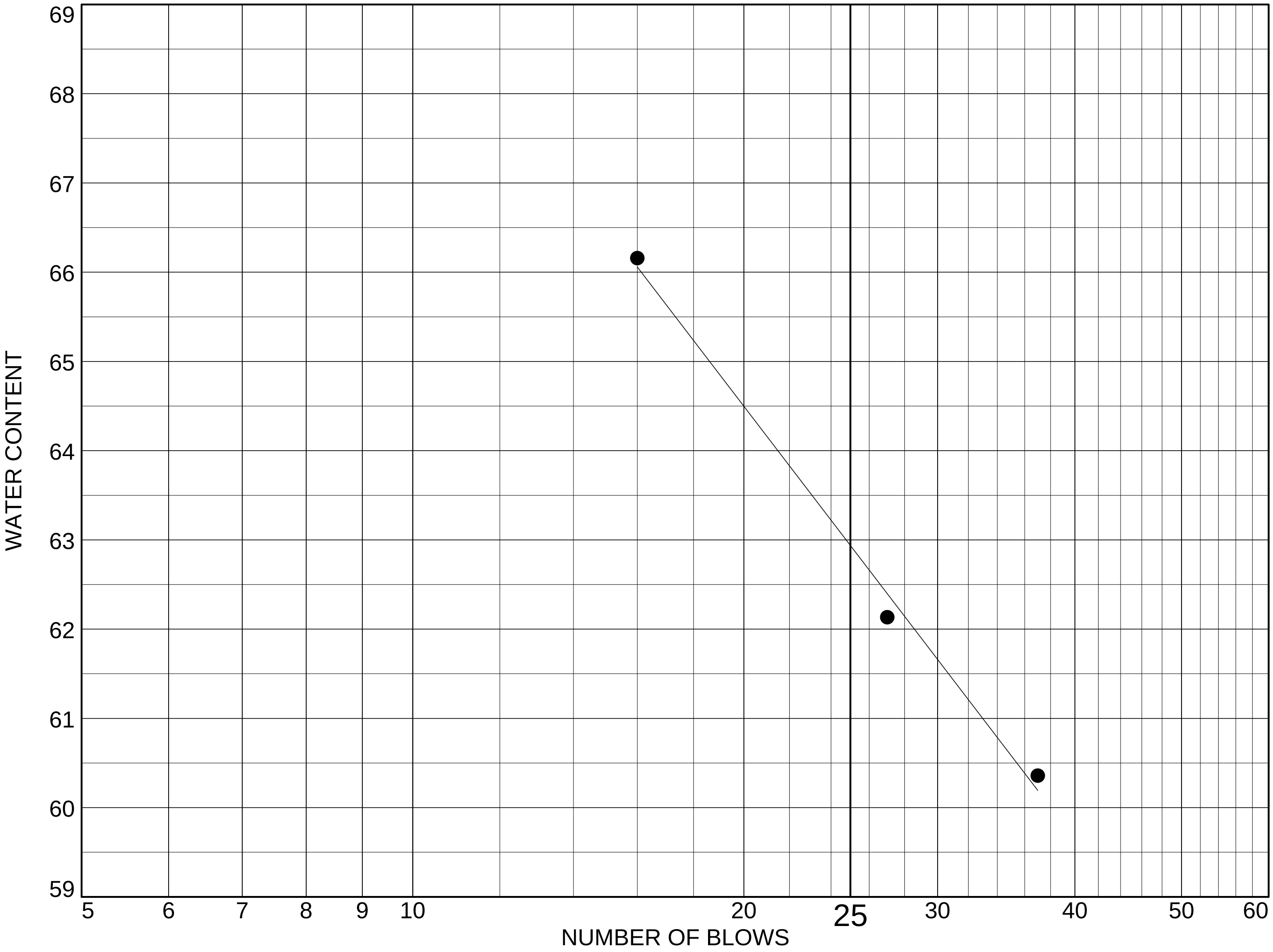


Liquid Limit= 63
Plastic Limit= 24
Plasticity Index= 39
Natural Moisture= 43.1
Liquidity Index= 0.5

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	25.01	20.24			
Dry+Tare	23.09	19.23			
Tare	15.10	14.88			
Moisture	24.0	23.2			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T23-8	8	7.62m - 8.23m	43.1	24	63	39	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

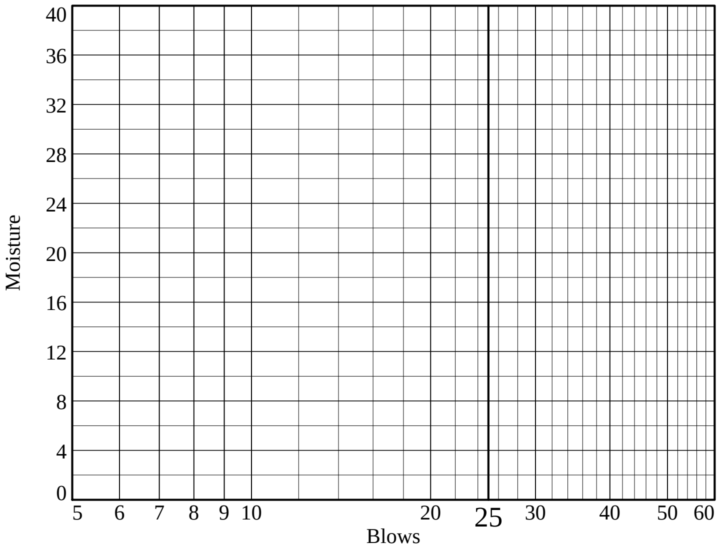
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T28-5
Depth: 3.05m 3.66m
Sample Number: 5
Material Description: ******Not Plastic*****
Tested by: S.Hoffman
Checked by: S.Hoffman

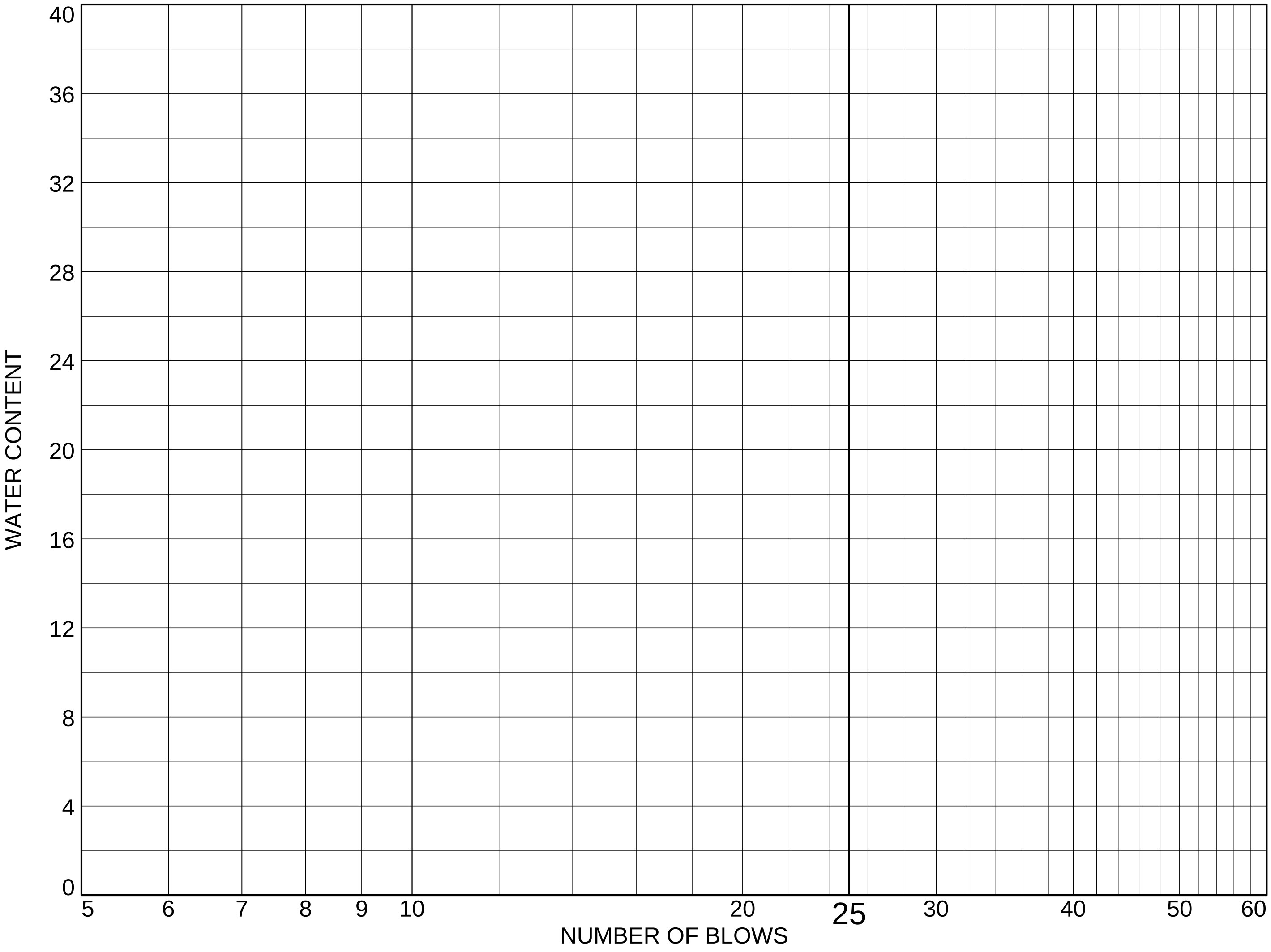
Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	N/A					
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= ______
Plastic Limit= ______
Plasticity Index= ______

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T28-5	5	3.05m 3.66m					

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

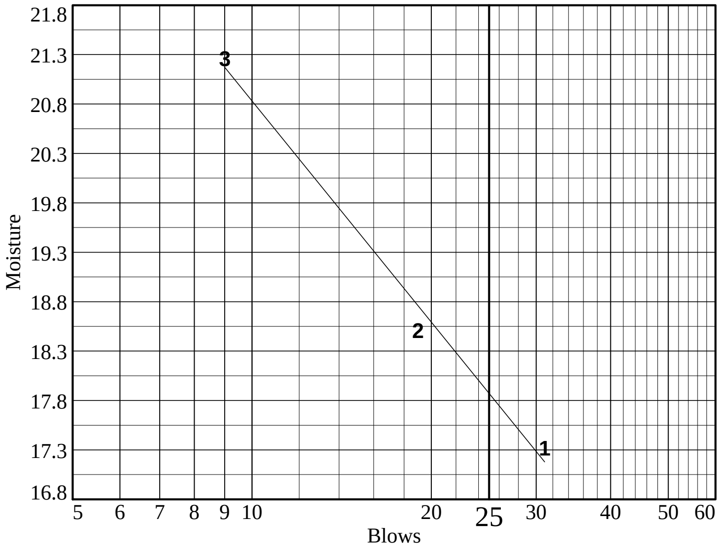
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T35-4
Depth: 3.05m - 3.66m
Sample Number: 4
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	32.55	30.82	29.31			
Dry+Tare	29.79	28.15	26.59			
Tare	13.86	13.73	13.80			
# Blows	31	19	9			
Moisture	17.3	18.5	21.3			

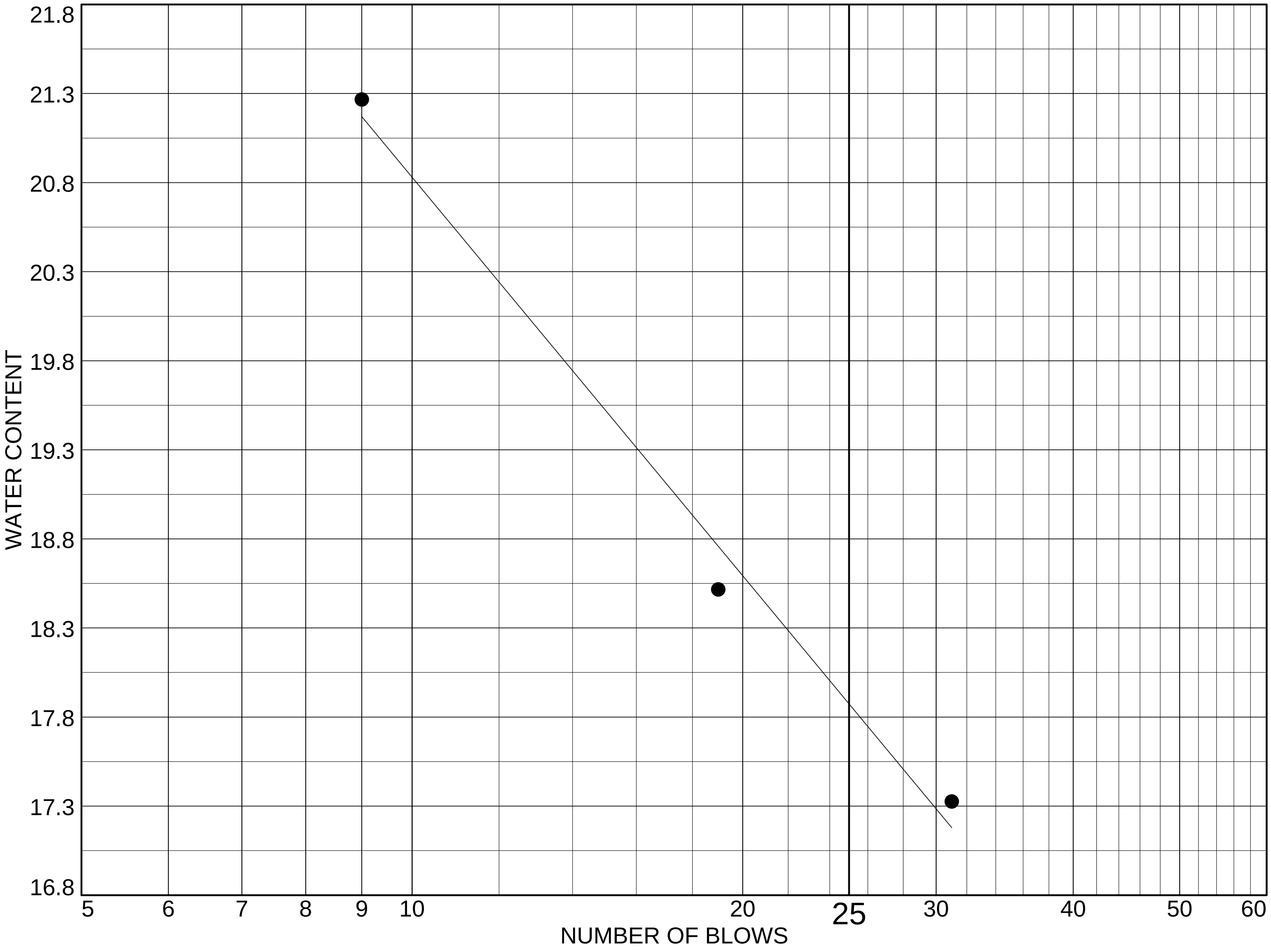


Liquid Limit= 18
Plastic Limit= 14
Plasticity Index= 4

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.08	21.54			
Dry+Tare	21.08	20.62			
Tare	13.75	13.75			
Moisture	13.6	13.4			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T35-4	4	3.05m - 3.66m		14	18	4	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

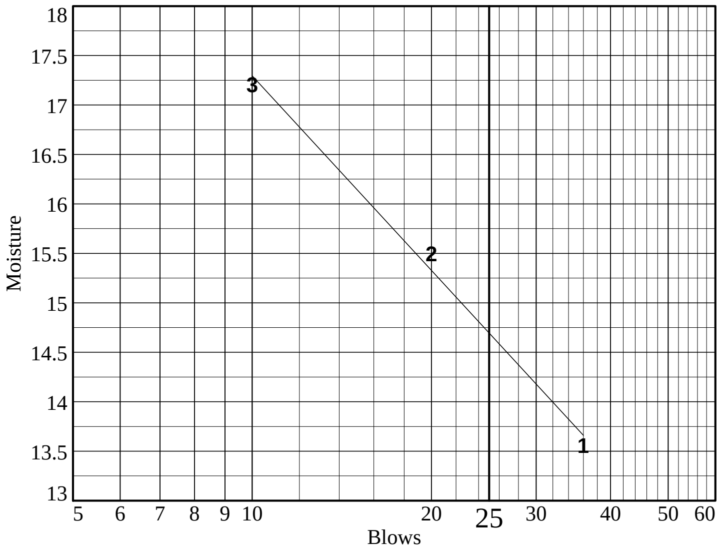
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T35-7
Depth: 7.62m - 8.23m
Sample Number: 7
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	31.72	35.96	36.50			
Dry+Tare	29.57	32.98	33.15			
Tare	13.72	13.76	13.69			
# Blows	36	20	10			
Moisture	13.6	15.5	17.2			



Liquid Limit= 15
Plastic Limit= 10
Plasticity Index= 5
Natural Moisture= 7.2
Liquidity Index= -0.6

Plastic Limit Data

Run No.	**1**	**2**	**3**	**4**	
Wet+Tare	23.57	24.68			
Dry+Tare	22.72	23.73			
Tare	13.74	13.91			
Moisture	9.5	9.7			

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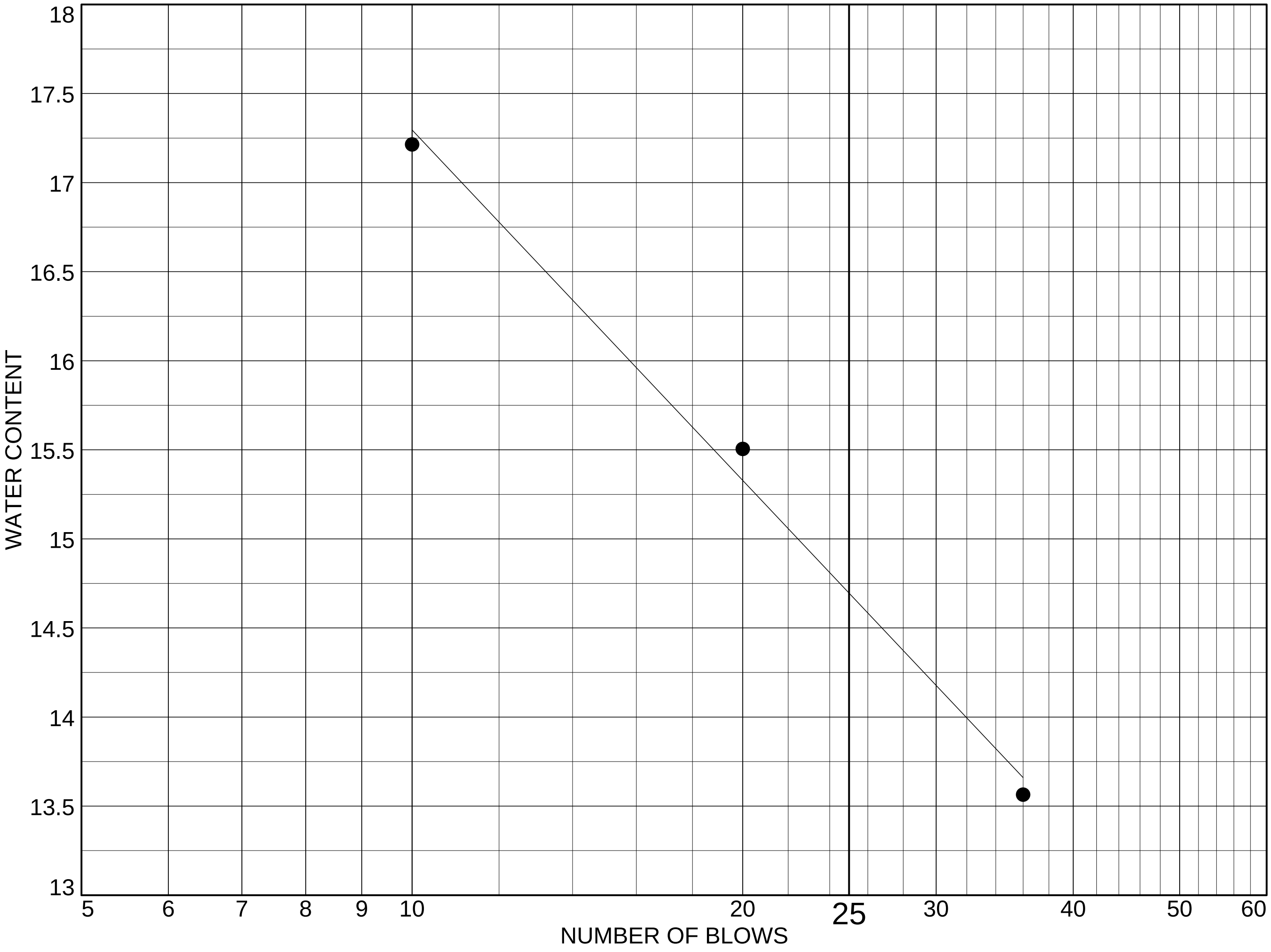
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T35-7	7	7.62m - 8.23m	7.2	10	15	5	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

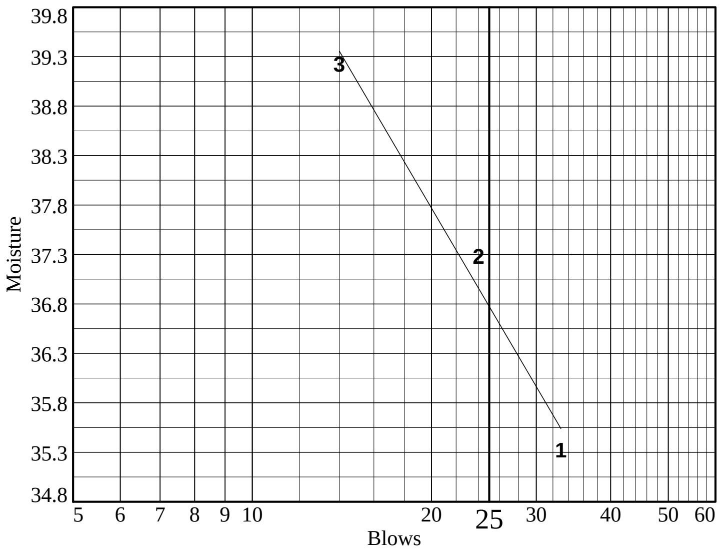
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T38-5
Depth: 4.57m - 5.18m
Sample Number: 5
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	34.38	30.46	30.01			
Dry+Tare	29.31	26.28	25.71			
Tare	14.96	15.07	14.75			
# Blows	33	24	14			
Moisture	35.3	37.3	39.2			

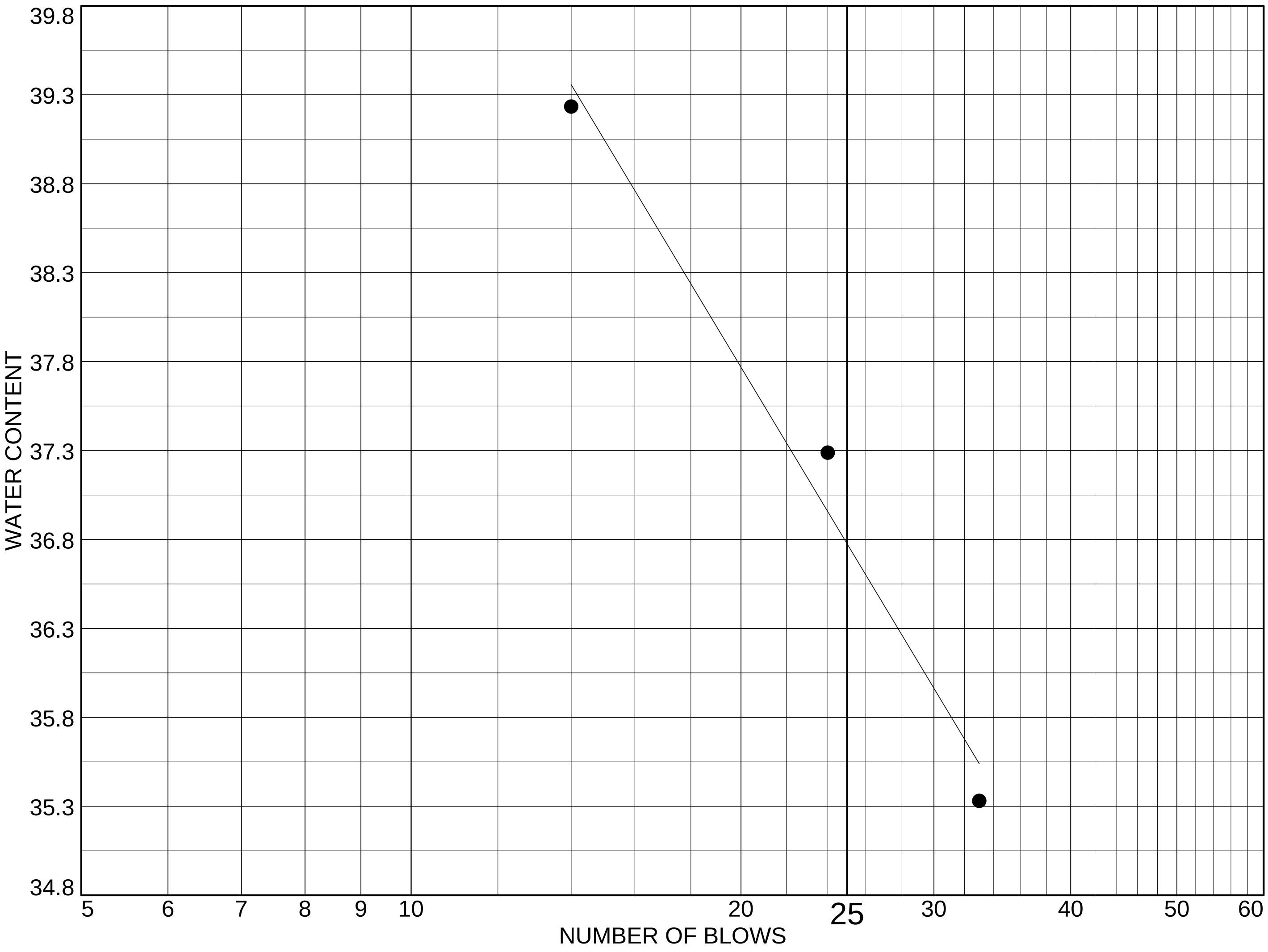


Liquid Limit= 37
Plastic Limit= 20
Plasticity Index= 17
Natural Moisture= 34.6
Liquidity Index= 0.9

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.89	24.39			
Dry+Tare	22.41	22.79			
Tare	14.92	15.00			
Moisture	19.8	20.5			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T38-5	5	4.57m - 5.18m	34.6	20	37	17	

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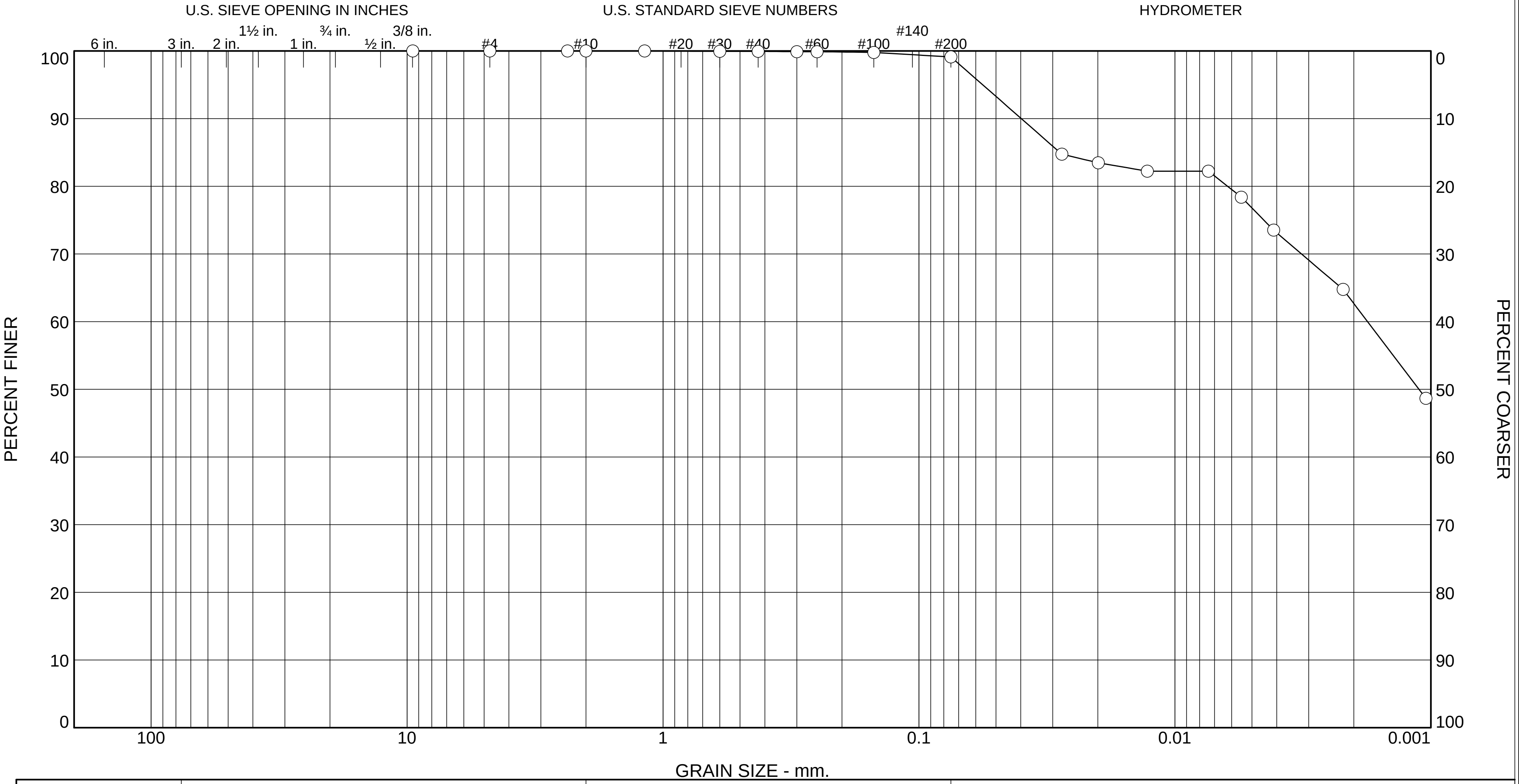
adam.byers@TULLOCH.ca

Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

Particle Size Distribution Report



	% +75mm	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	0.0	0.1	0.8	99.1	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T44-3 Depth: 1.52m - 2.13m Sample Number: 3	5/21/18		7/19/18

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T.Linley **Checked By:** S.Hoffman

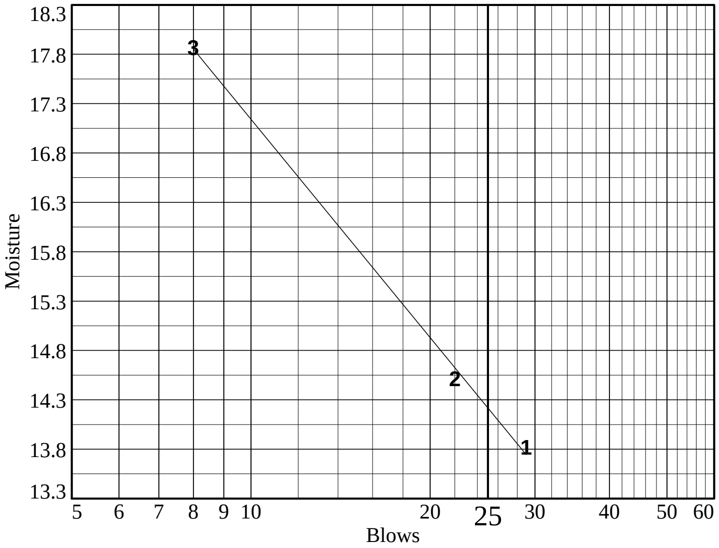
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T44-7
Depth: 6.10m - 6.71m **Sample Number:** 7
Tested by: S.Hoffman **Checked by:** S.Hoffman

Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	27.91	31.95	36.79			
Dry+Tare	26.18	29.64	33.29			
Tare	13.67	13.73	13.71			
# Blows	29	22	8			
Moisture	13.8	14.5	17.9			

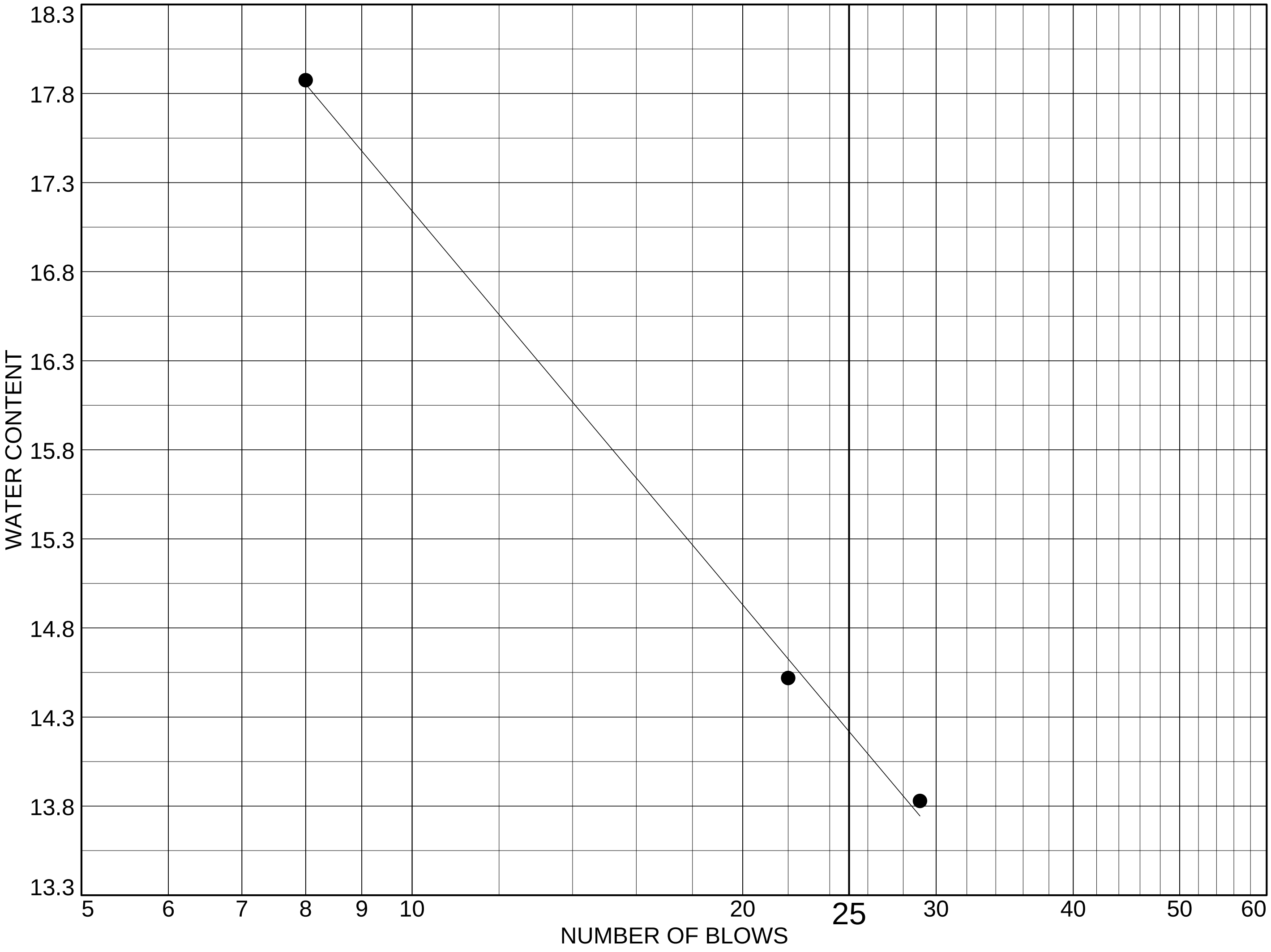


Liquid Limit= 14
Plastic Limit= 11
Plasticity Index= 3
Natural Moisture= 7.8
Liquidity Index= -1.1

Plastic Limit Data

Run No.	**1**	**2**	**3**	**4**	
Wet+Tare	24.54	23.74			
Dry+Tare	23.48	22.74			
Tare	13.57	13.76			
Moisture	10.7	11.1			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T44-7	7	6.10m - 6.71m	7.8	11	14	3	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

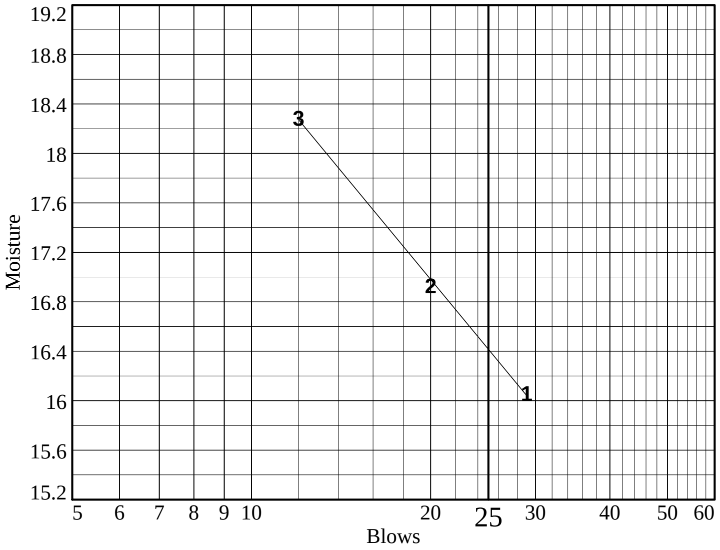
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T46-7
Depth: 5.94m - 6.55m
Sample Number: 7
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	31.77	30.35	27.46			
Dry+Tare	29.27	27.94	25.32			
Tare	13.71	13.71	13.62			
# Blows	29	20	12			
Moisture	16.1	16.9	18.3			

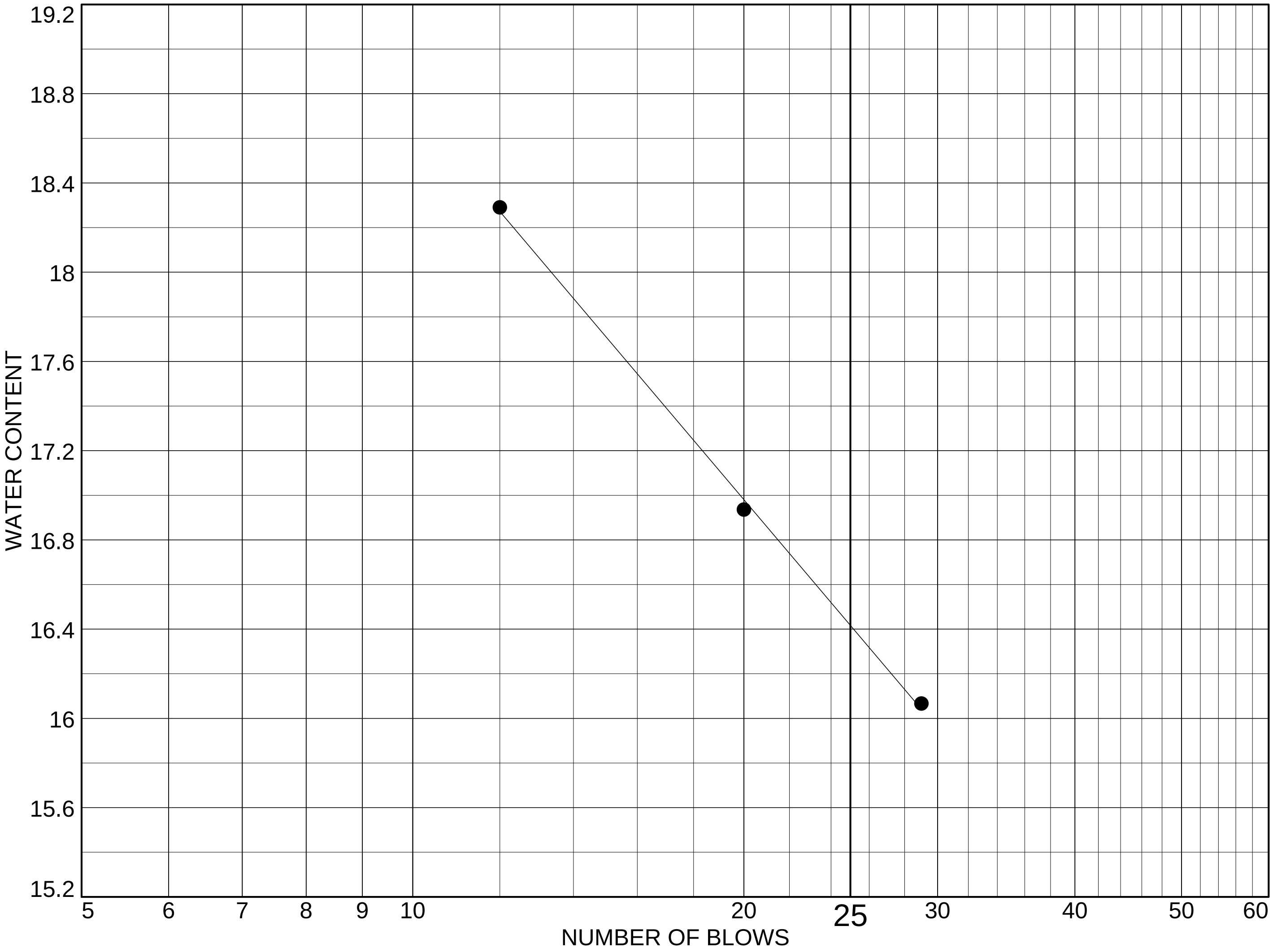


Liquid Limit= 16
Plastic Limit= 11
Plasticity Index= 5
Natural Moisture= 7.4
Liquidity Index= -0.7

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	26.11	31.10			
Dry+Tare	24.94	29.46			
Tare	14.59	14.59			
Moisture	11.3	11.0			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T46-7	7	5.94m - 6.55m		11	16	5	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

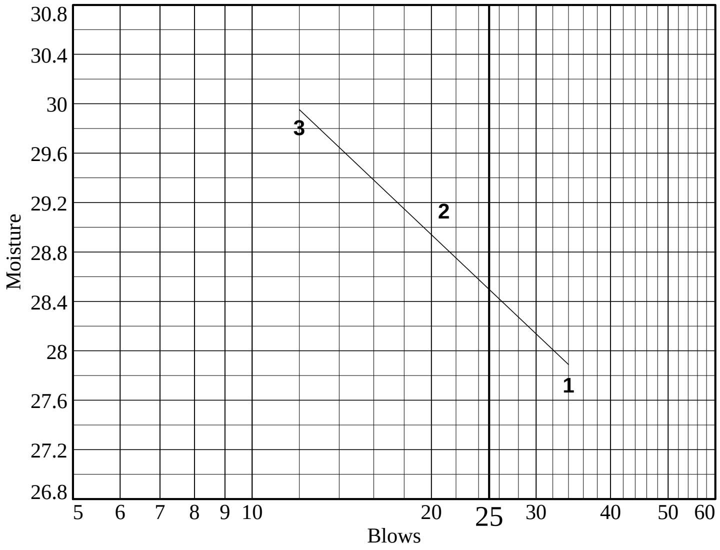
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T47-7
Depth: 6.10m - 6.71m
Sample Number: 7
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.19	29.20	29.93			
Dry+Tare	26.66	25.68	26.20			
Tare	13.93	13.60	13.69			
# Blows	34	21	12			
Moisture	27.7	29.1	29.8			

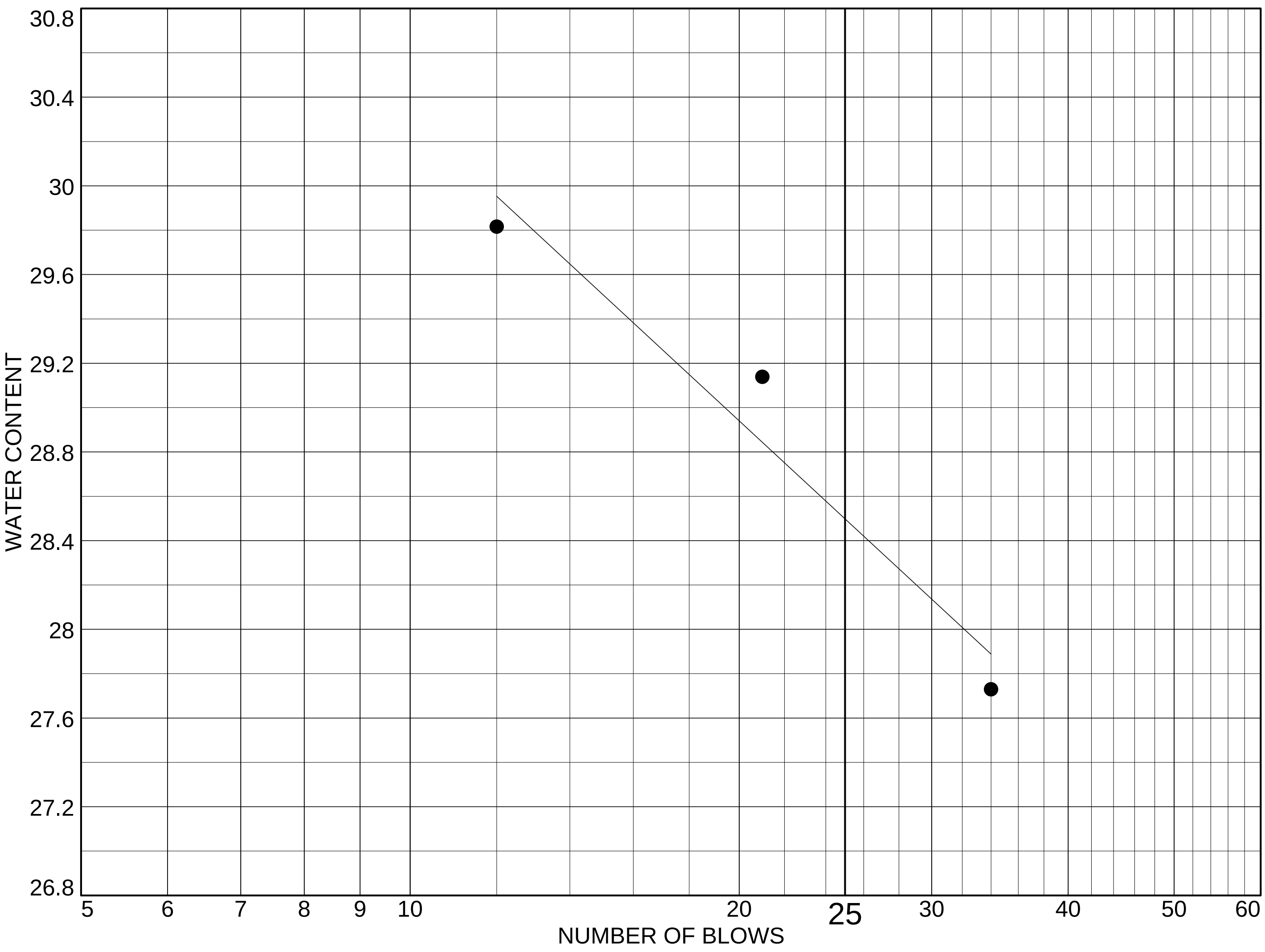


Liquid Limit= 28
Plastic Limit= 16
Plasticity Index= 12
Natural Moisture= 28.3
Liquidity Index= 1.0

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	23.96	23.60			
Dry+Tare	22.49	22.24			
Tare	13.64	13.66			
Moisture	16.6	15.9			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T47-7	7	6.10m - 6.71m	28.3	16	28	12	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

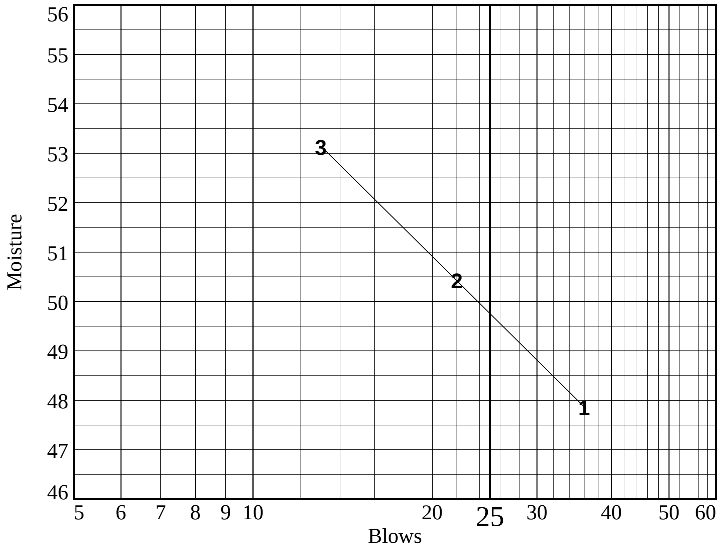
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T54-4
Depth: 3.05m - 3.66m
Sample Number: 4
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.08	27.64	26.41			
Dry+Tare	23.49	22.98	22.01			
Tare	13.90	13.74	13.73			
# Blows	36	22	13			
Moisture	47.9	50.4	53.1			

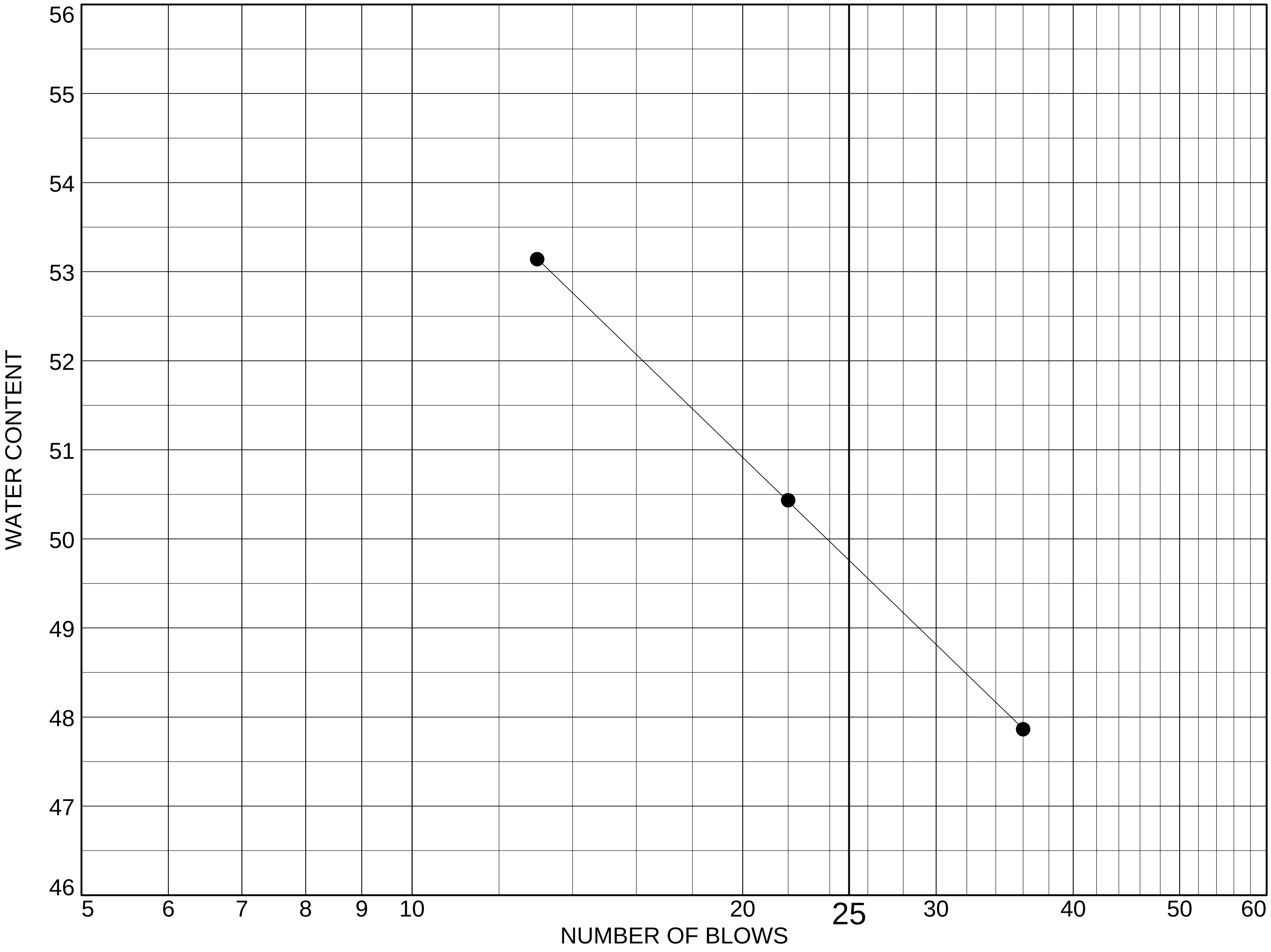


Liquid Limit= 50
Plastic Limit= 22
Plasticity Index= 28

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.14	20.29			
Dry+Tare	19.14	19.30			
Tare	14.69	14.86			
Moisture	22.5	22.3			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T54-4	4	3.05m - 3.66m		22	50	28	

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Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

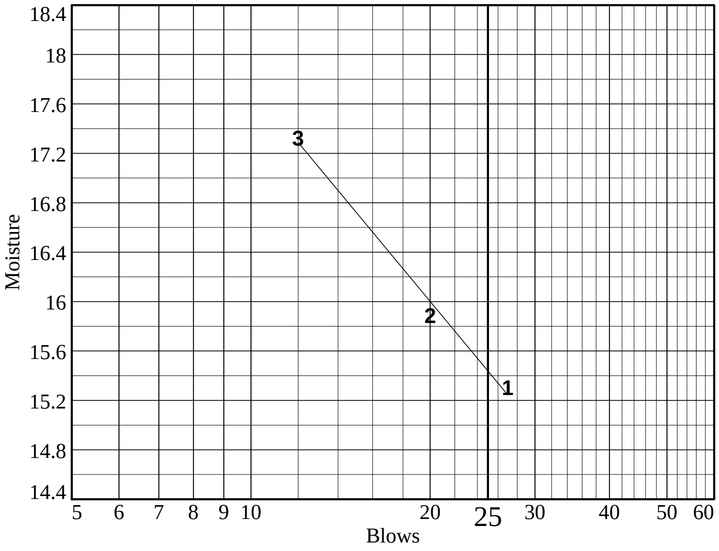
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T5 - 6
Depth: 4.57m - 5.18m
Sample Number: 6
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	35.92	33.17	34.10			
Dry+Tare	32.98	30.50	31.09			
Tare	13.78	13.70	13.72			
# Blows	27	20	12			
Moisture	15.3	15.9	17.3			

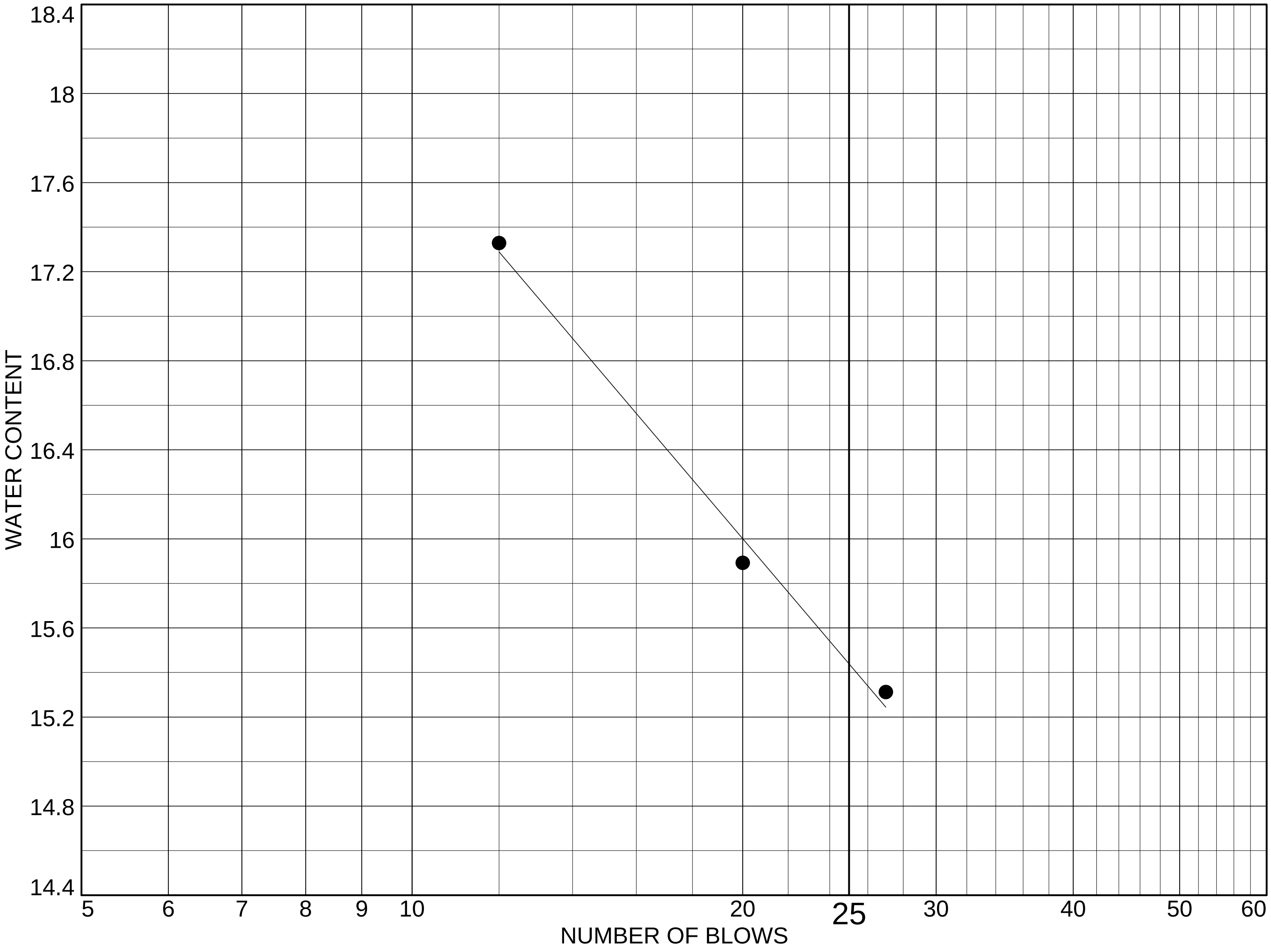


Liquid Limit= 15
Plastic Limit= 11
Plasticity Index= 4
Natural Moisture= 7.4
Liquidity Index= -0.9

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.93	23.41			
Dry+Tare	22.02	22.48			
Tare	13.76	13.96			
Moisture	11.0	10.9			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T5 - 6	6	4.57m - 5.18m		11	15	4	

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Client: EDP

Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

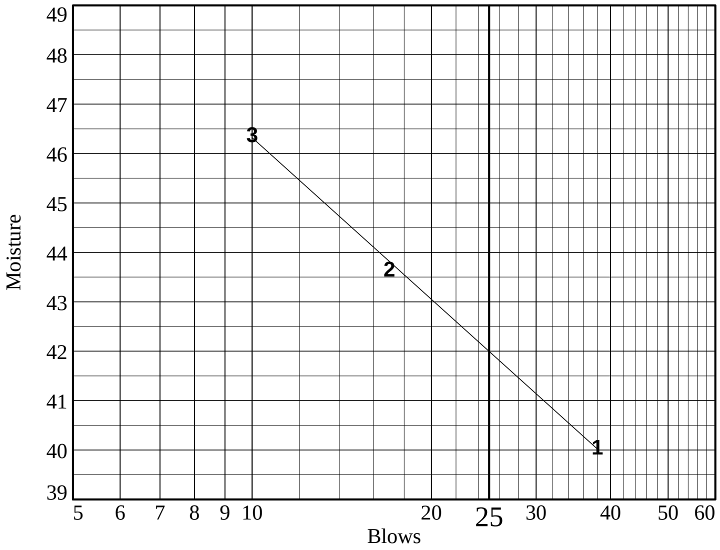
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T58-3
Depth: 1.52m - 2.13m
Sample Number: 3
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	**1**	**2**	**3**	**4**	**5**	**6**
Wet+Tare	32.47	34.30	32.07			
Dry+Tare	27.12	28.11	26.27			
Tare	13.77	13.94	13.77			
# Blows	38	17	10			
Moisture	40.1	43.7	46.4			

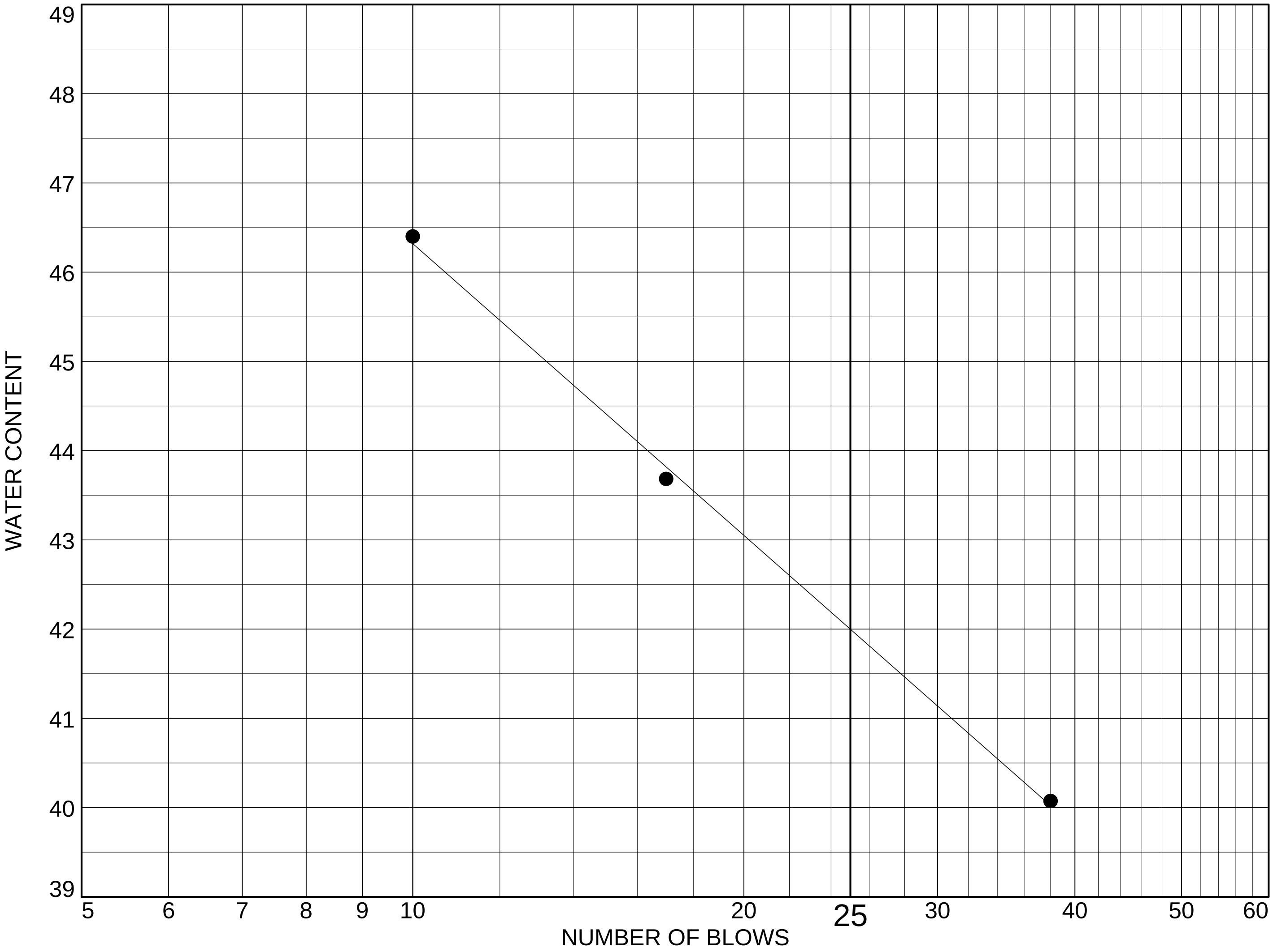


Liquid Limit= 42
Plastic Limit= 22
Plasticity Index= 20
Natural Moisture= 5.7
Liquidity Index= -0.8

Plastic Limit Data

Run No.	**1**	**2**	**3**	**4**	
Wet+Tare	21.08	21.08			
Dry+Tare	19.96	19.96			
Tare	14.76	14.89			
Moisture	21.5	22.1			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T58-3	3	1.52m - 2.13m	5.7	22	42	20	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

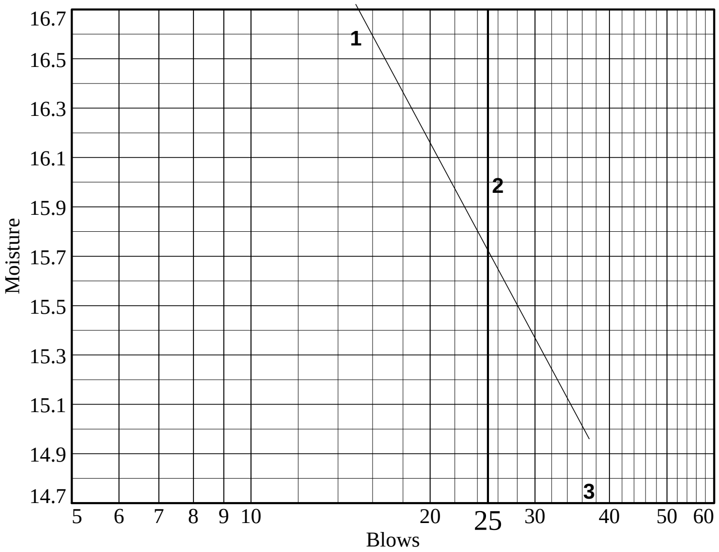
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T58-7
Depth: 6.10m - 6.71m
Sample Number: 7
Tested by: J.Draper
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	23.45	23.87	26.60			
Dry+Tare	22.07	22.49	24.97			
Tare	13.75	13.86	13.92			
# Blows	15	26	37			
Moisture	16.6	16.0	14.8			

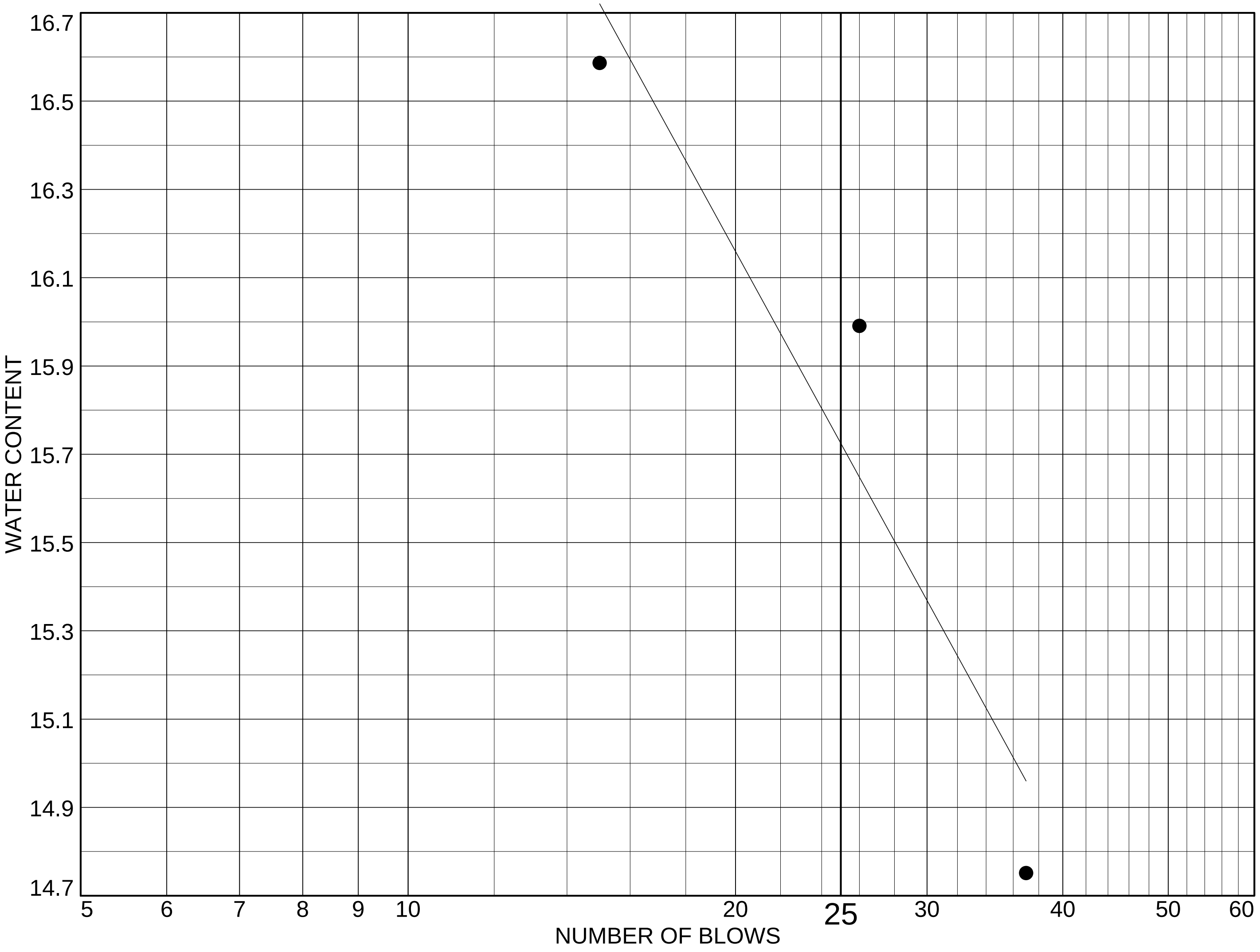


Liquid Limit= 16
Plastic Limit= 10
Plasticity Index= 6
Natural Moisture= 5.7
Liquidity Index= -0.7

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	20.27	19.76			
Dry+Tare	19.68	19.21			
Tare	13.59	13.76			
Moisture	9.7	10.1			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T58-7	7	6.10m - 6.71m	5.7	10	16	6	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: J.Draper **Checked By:** S.Hoffman

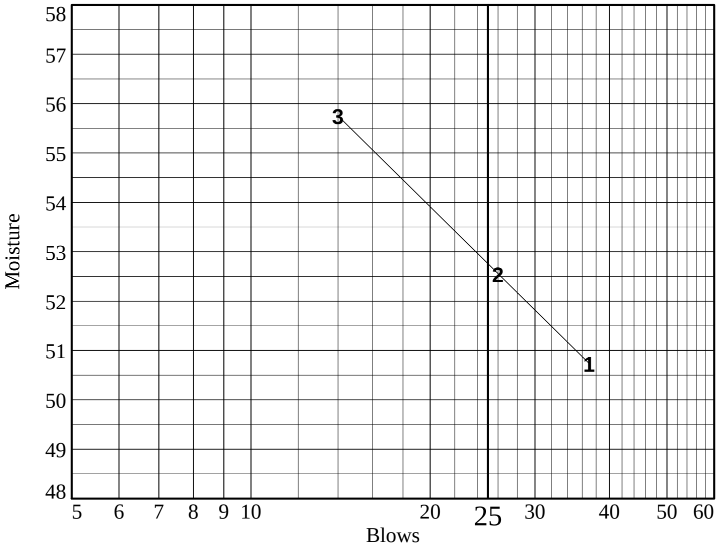
LIQUID AND PLASTIC LIMIT TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T9 - 6
Depth: 4.57m - 5.18m
Sample Number: 6
Tested by: S.Hoffman
Checked by: S.Hoffman

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.09	31.54	27.71			
Dry+Tare	23.28	25.47	22.72			
Tare	13.80	13.92	13.77			
# Blows	37	26	14			
Moisture	50.7	52.6	55.8			

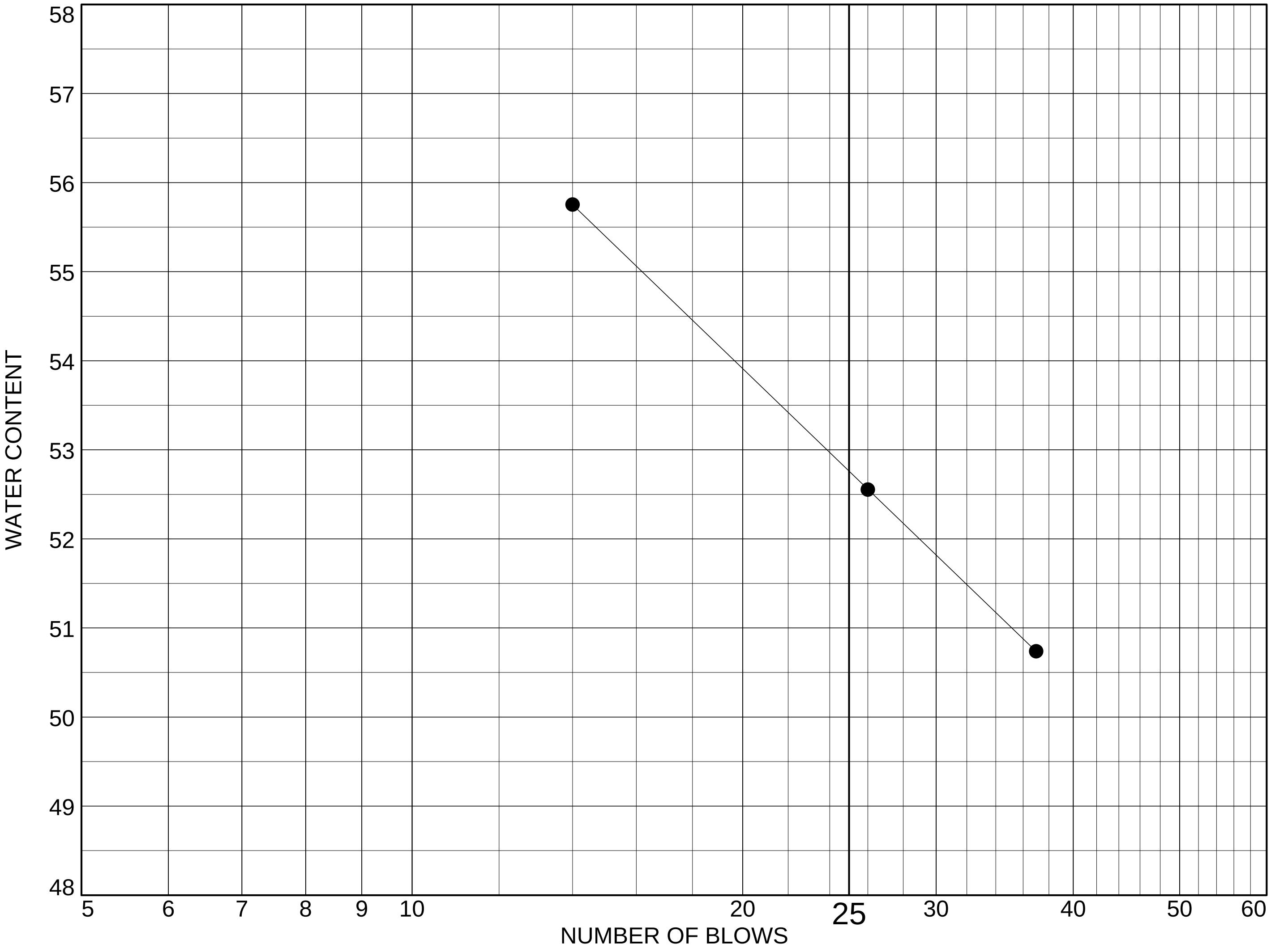


Liquid Limit= 53
Plastic Limit= 24
Plasticity Index= 29
Natural Moisture= 39.2
Liquidity Index= 0.5

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	21.44	19.47			
Dry+Tare	19.96	18.38			
Tare	13.67	13.74			
Moisture	23.5	23.5			

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	T9 - 6	6	4.57m - 5.18m	39.2	24	53	29	

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Client: EDP
Project: Nation Rise Wind Farm

Project No.: 18-4022

Tested By: S.Hoffman **Checked By:** S.Hoffman

Grain Size Distribution

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T16-8
Depth: 30'-32' **Sample Number:** T16-8
Date Sampled: May 5, 2018 **Date Tested:** July 18, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
621.30	0.00	0.00	1"	0.00	100.0	0.0
			3/4"	67.10	89.2	10.8
			5/8"	93.60	84.9	15.1
			1/2"	117.90	81.0	19.0
			3/8"	145.50	76.6	23.4
			#4	205.50	66.9	33.1
			#8	236.20	62.0	38.0
			#16	272.80	56.1	43.9
			#30	316.40	49.1	50.9
			#50	343.80	44.7	55.3
			#100	451.60	27.3	72.7
			#200	595.30	4.2	95.8

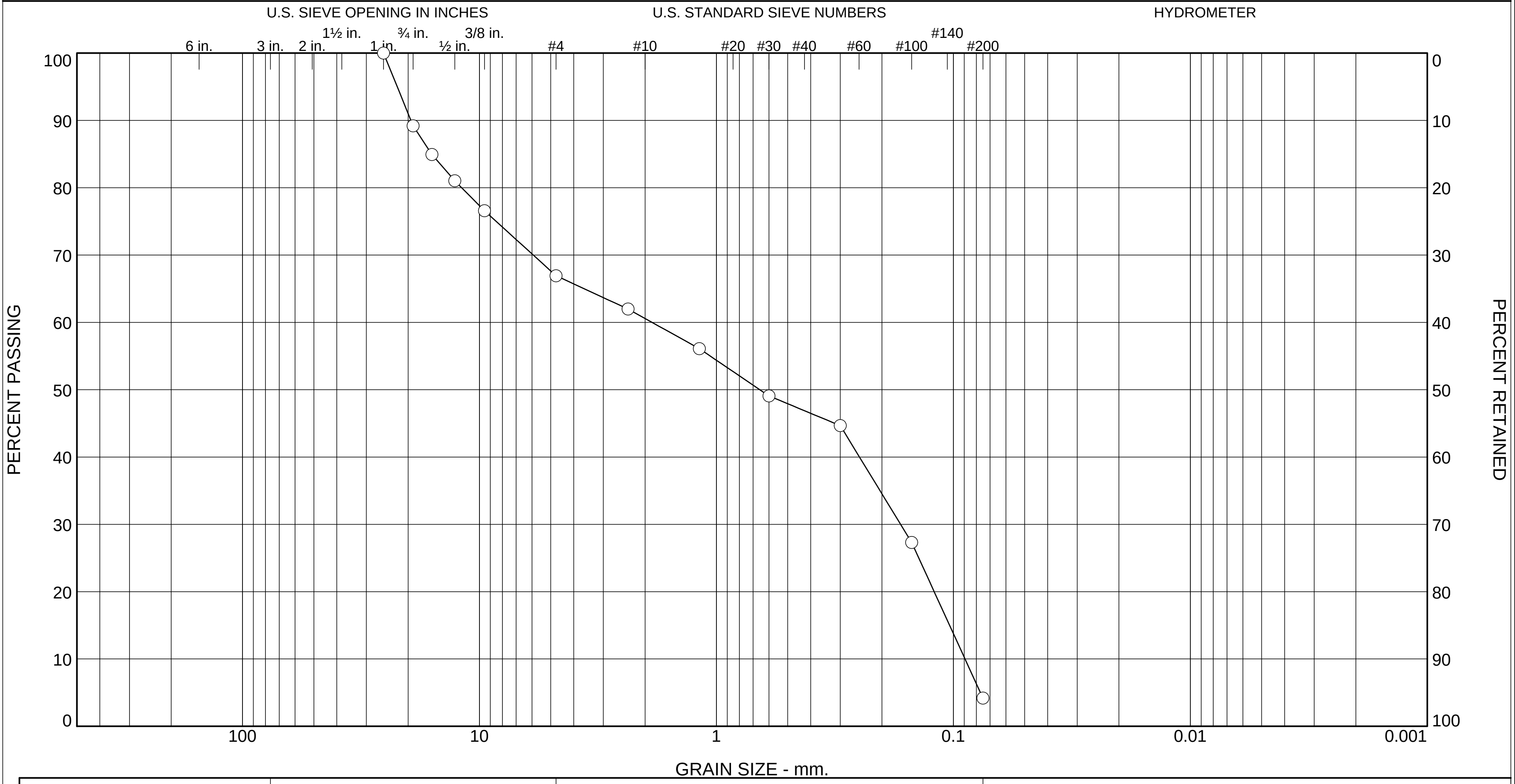
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	10.8	22.3	33.1	6.3	13.7	42.7	62.7			4.2

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0769	0.0893	0.1037	0.1205	0.1670	0.2490	0.6560	1.8689	11.8854	15.9193	19.4603	22.2327

Fineness Modulus	C_u	C_c
3.28	20.93	0.17

Particle Size Distribution Report



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<tr><th rowspan="2"></th><th rowspan="2">% +3"</th><th colspan="2">% Gravel</th><th colspan="3">% Sand</th><th colspan="2">% Fines</th></tr>
<tr><th>Coarse</th><th>Fine</th><th>Coarse</th><th>Medium</th><th>Fine</th><th>Silt</th><th>Clay</th></tr>
<tr><td>○</td><td></td><td></td><td colspan="6">89.2</td></tr>
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Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T16-8 Depth: 30'-32' Sample Number: T16-8	May 5, 2018		July 18, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T28-9
Depth: 30'-32' **Sample Number:** T28-9
Material Description: T28-9
Date Sampled: June 4, 2018 **Date Tested:** July 18, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
129.30	0.00	0.00	19mm.	0.00	100.0	0.0
			13.2mm.	0.00	100.0	0.0
			9.5mm.	1.40	98.9	1.1
			#4	11.70	91.0	9.0
			#8	24.90	80.7	19.3
			#16	40.60	68.6	31.4
			#30	59.60	53.9	46.1
			#40	78.00	39.7	60.3
			#50	98.40	23.9	76.1
			#100	125.00	3.3	96.7
			#200	129.00	0.2	99.8

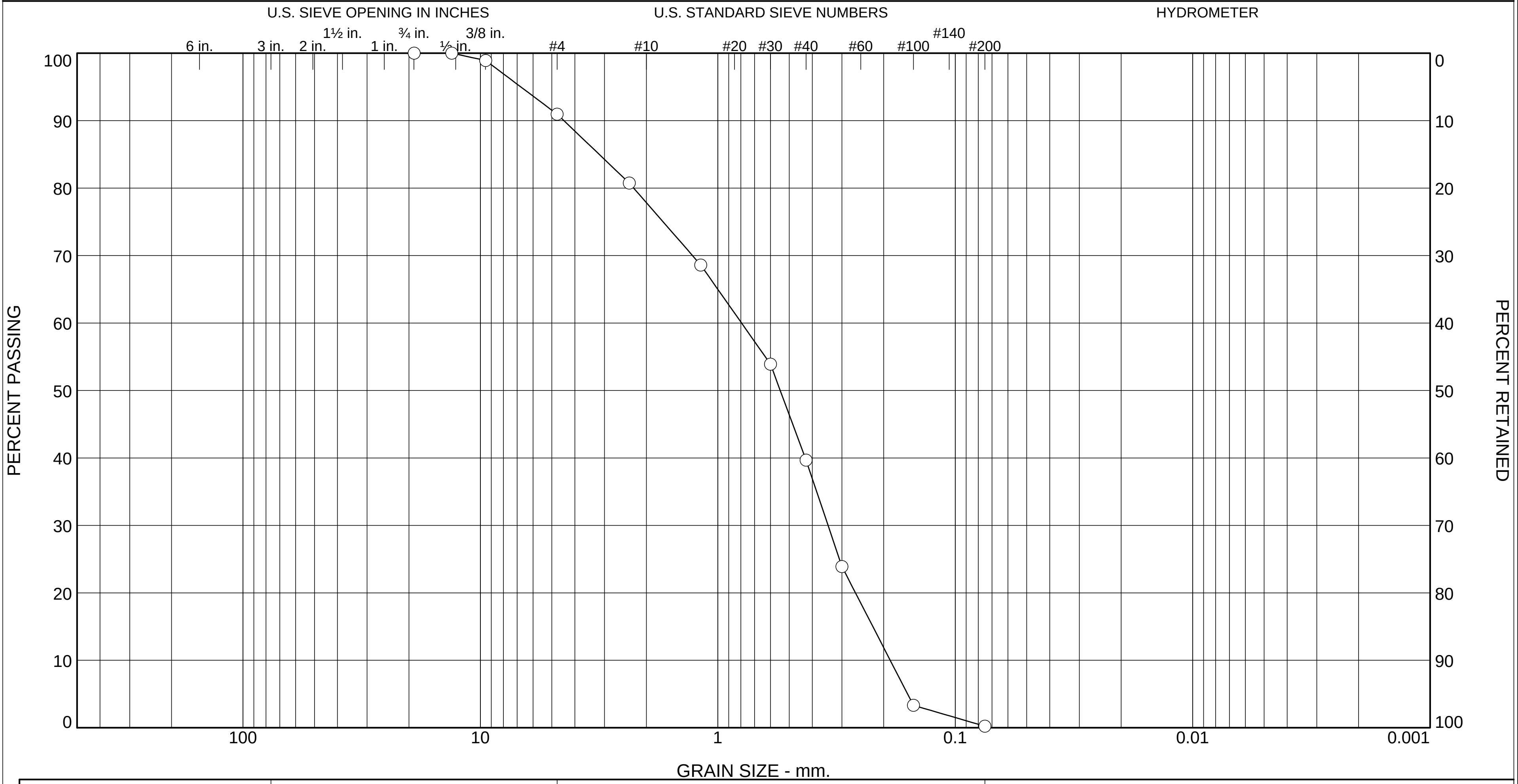
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	9.0	9.0	13.2	38.1	39.5	90.8			0.2

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1587	0.1878	0.2223	0.2631	0.3433	0.4284	0.5458	0.7943	2.2621	3.1594	4.4503	6.7560

Fineness Modulus	C_u	C_c
2.80	4.23	0.79

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				91.0				

Identification			Date Sampled	Date Received	Date Tested
Source of Sample: T28-9	Depth: 30'-32'	Sample Number: T28-9	June 4, 2018		July 18, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T29-11
Depth: 12.19m - 12.80m **Sample Number:** T29-11
Material Description: T29-11
Date Sampled: June 3, 2018 **Date Tested:** July 18, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
690.30	0.00	0.00	26.5mm.	0.00	100.0	0.0
			19.0mm.	82.90	88.0	12.0
			16mm.	125.70	81.8	18.2
			13.2mm.	154.40	77.6	22.4
			9.5mm.	210.50	69.5	30.5
			#4	348.60	49.5	50.5
			#8	475.30	31.1	68.9
			#16	540.80	21.7	78.3
			#30	569.90	17.4	82.6
			#50	611.00	11.5	88.5
			#100	658.50	4.6	95.4
			#200	688.10	0.3	99.7

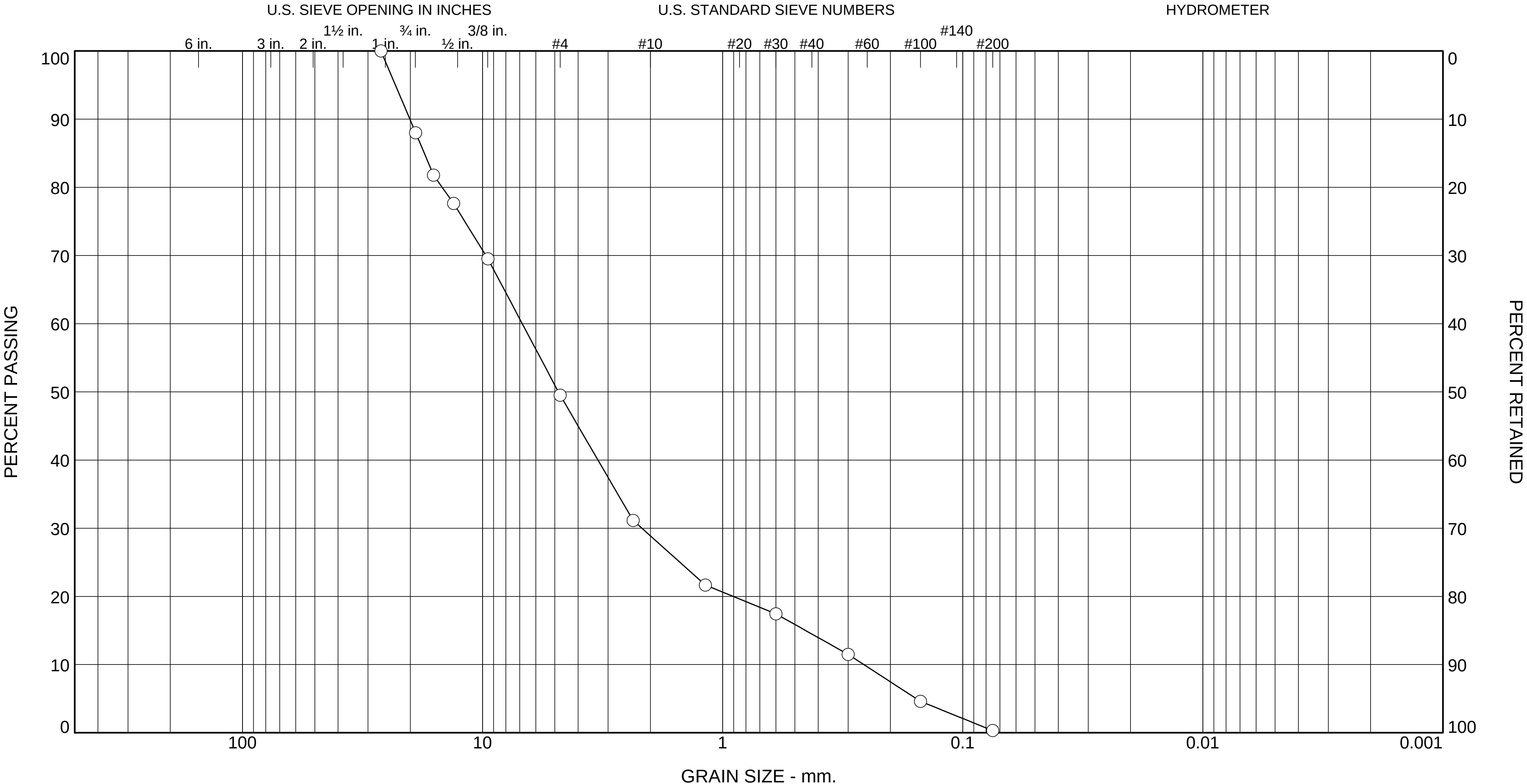
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	11.9	38.6	50.5	20.6	14.4	14.2	49.2			0.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1561	0.2582	0.4515	0.9045	2.1705	3.3072	4.8330	6.8342	14.7279	17.4885	20.0876	23.0721

Fineness Modulus	C_u	C_c
5.07	26.46	2.67

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	11.9	38.6	20.6	14.4	14.2	0.3	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T29-11 Depth: 12.19m - 12.80m Sample Number: T29-11	June 3, 2018		July 18, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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○ F.M.=5.07

Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T35-9
Depth: 35'-37' **Sample Number:** T35-9
Material Description: T35-9
Date Sampled: May 31, 2018 **Date Tested:** July 19, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
321.80	0.00	0.00	19.0mm.	0.00	100.0	0.0
			16.0mm.	0.00	100.0	0.0
			13.2mm.	8.50	97.4	2.6
			9.5mm.	21.80	93.2	6.8
			#4	71.80	77.7	22.3
			#8	121.10	62.4	37.6
			#16	171.60	46.7	53.3
			#30	244.40	24.1	75.9
			#50	301.10	6.4	93.6
			#100	318.20	1.1	98.9
			#200	321.20	0.2	99.8

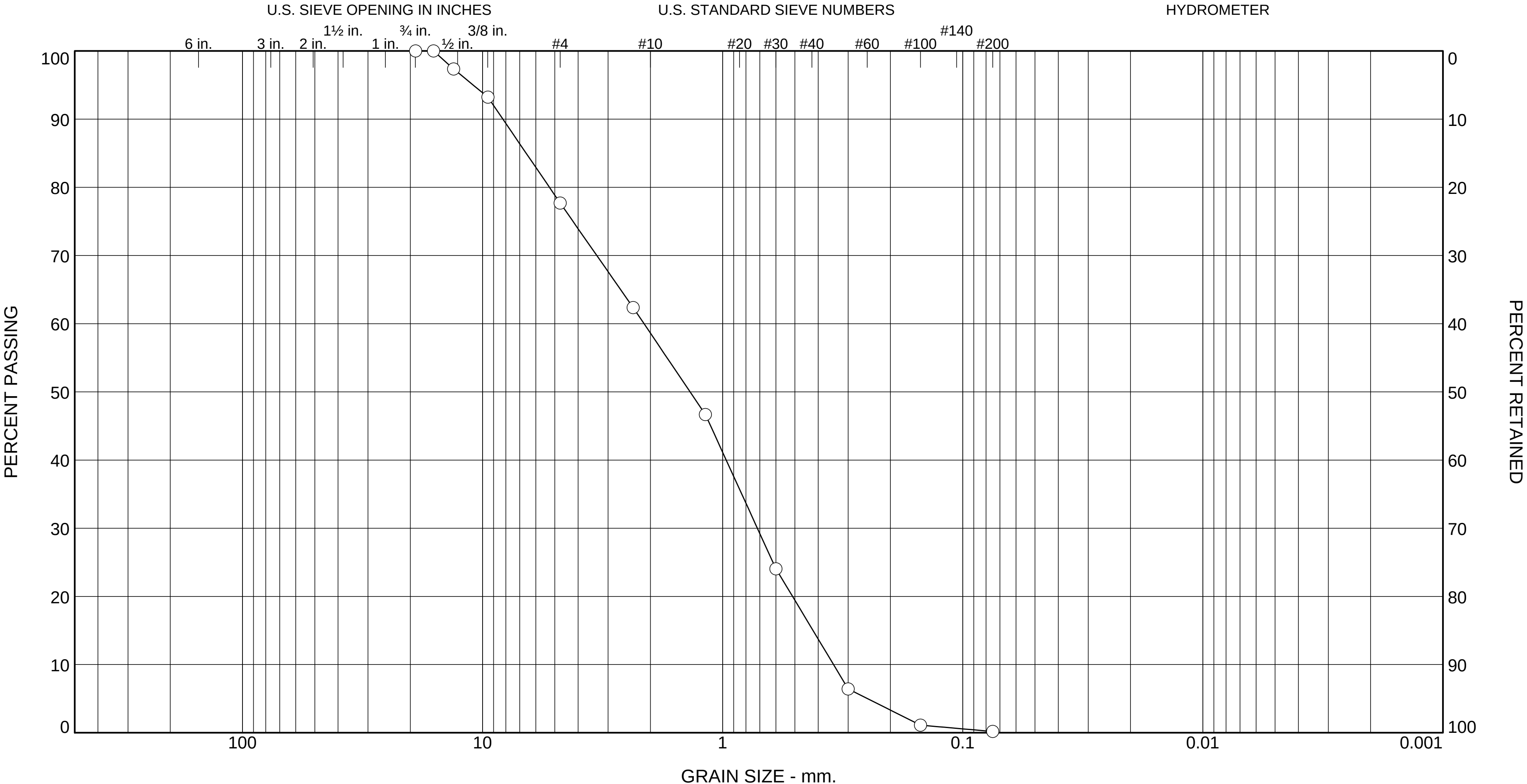
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	22.3	22.3	19.1	43.3	15.1	77.5			0.2

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.2489	0.3452	0.4202	0.5116	0.7168	0.9665	1.3667	2.1256	5.2661	6.5820	8.2268	10.9409

Fineness Modulus	C_u	C_c
3.88	6.16	0.70

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	22.3	19.1	43.3	15.1	0.2	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T35-9 Depth: 35'-37' Sample Number: T35-9	May 31, 2018		July 19, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T43-9
Depth: 24.5'-25.0' **Sample Number:** T43-9
Material Description: T43-9
Date Sampled: May 31, 2018 **Date Tested:** July 18, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
321.70	0.00	0.00	19mm.	0.00	100.0	0.0
			13.2mm.	4.90	98.5	1.5
			9.5mm.	12.20	96.2	3.8
			#4	29.40	90.9	9.1
			#8	63.50	80.3	19.7
			#16	99.90	68.9	31.1
			#30	137.00	57.4	42.6
			#50	175.10	45.6	54.4
			#100	229.80	28.6	71.4
			#200	291.00	9.5	90.5

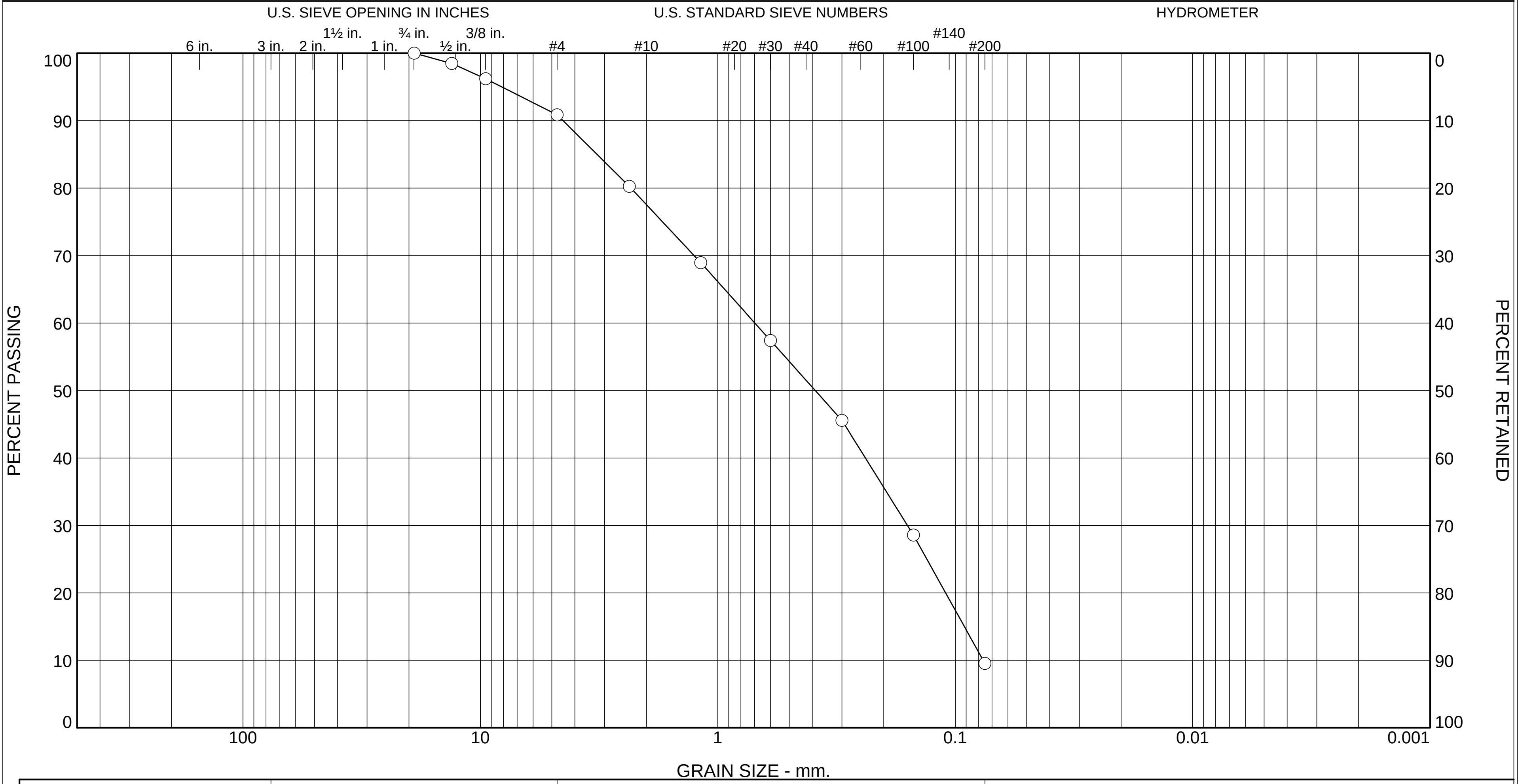
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	9.1	9.1	13.3	26.1	42.0	81.4			9.5

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0763	0.0915	0.1098	0.1590	0.2391	0.3888	0.6983	2.3226	3.2264	4.4876	8.1232

Fineness Modulus	C_u	C_c
2.32	9.16	0.47

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	9.1	13.3	26.1	42.0	9.5	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T43-9 Depth: 24.5'-25.0' Sample Number: T43-9	May 31, 2018		July 18, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T47-11
Depth: 40'-42' **Sample Number:** T47-11
Material Description: T47-11
Date Sampled: May 22, 2018 **Date Tested:** July 19, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
270.70	0.00	0.00	25mm.	0.00	100.0	0.0
			19mm.	44.20	83.7	16.3
			16.0mm.	64.00	76.4	23.6
			13.2mm.	81.70	69.8	30.2
			9.5mm.	85.70	68.3	31.7
			#4	125.60	53.6	46.4
			#8	156.90	42.0	58.0
			#16	181.70	32.9	67.1
			#30	201.90	25.4	74.6
			#50	220.40	18.6	81.4
			#100	242.20	10.5	89.5
			#200	265.80	1.8	98.2

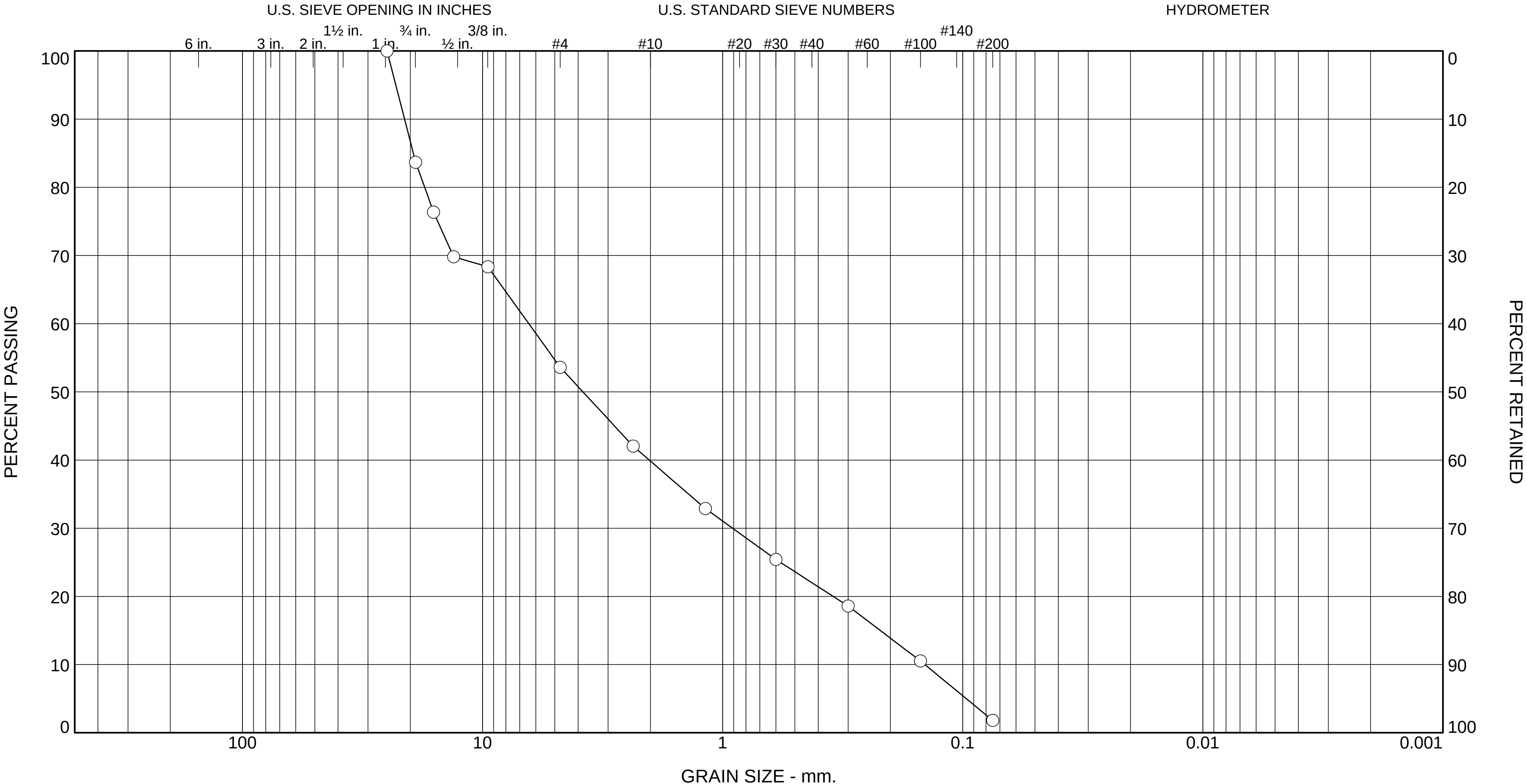
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	16.2	30.2	46.4	13.7	17.9	20.2	51.8			1.8

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0967	0.1438	0.2204	0.3464	0.9091	2.0226	3.8200	6.4175	17.4295	19.4289	21.1322	22.9849

Fineness Modulus	C_u	C_c
4.65	44.62	0.90

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	16.2	30.2	13.7	17.9	20.2	1.8	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T47-11 Depth: 40'-42' Sample Number: T47-11	May 22, 2018		July 19, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T54-8
Depth: 30-32' **Sample Number:** T54-8
Material Description: T54-8
Date Sampled: May 28, 2018 **Date Tested:** July 19, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
345.80	0.00	0.00	19mm.	0.00	100.0	0.0
			16.0mm.	11.90	96.6	3.4
			13.2mm.	23.60	93.2	6.8
			9.5mm.	60.00	82.6	17.4
			#4	94.80	72.6	27.4
			#8	135.20	60.9	39.1
			#16	175.30	49.3	50.7
			#30	215.40	37.7	62.3
			#50	253.80	26.6	73.4
			#100	297.30	14.0	86.0
			#200	341.20	1.3	98.7

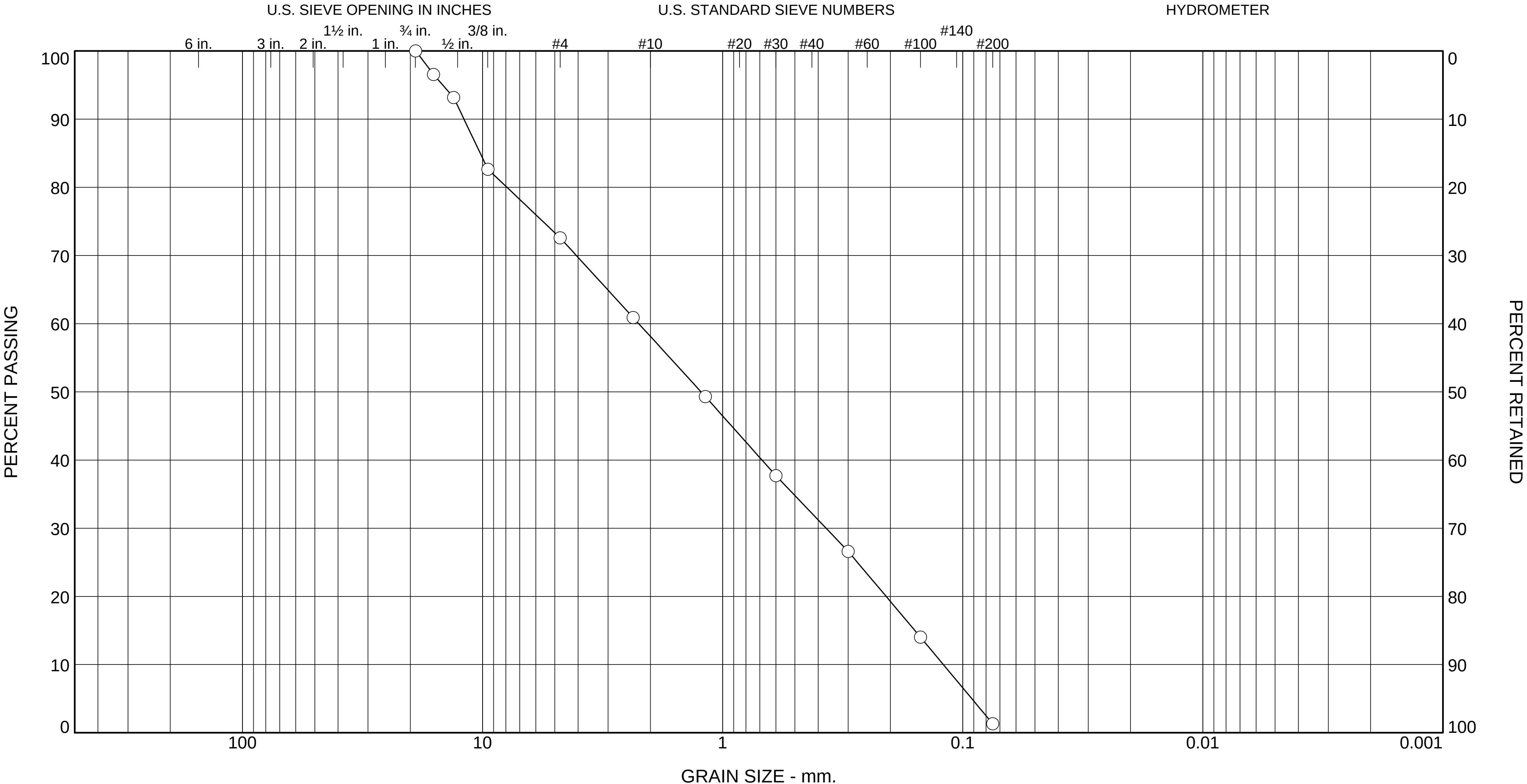
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	27.4	27.4	14.5	25.9	30.9	71.3			1.3

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0916	0.1204	0.1583	0.2085	0.3708	0.6857	1.2300	2.2361	7.9157	10.2242	11.9532	14.6431

Fineness Modulus	C_u	C_c
3.56	18.57	0.51

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	27.4	14.5	25.9	30.9	1.3	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T54-8 Depth: 30-32' Sample Number: T54-8	May 28, 2018		July 19, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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○ F.M.=3.56

Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T57-8
Sample Number: T57-8
Material Description: T57-8
Date Tested: July 18, 2018
Tested by: T. Nott **Checked by:** T. Linley

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
235.60	0.00	0.00	16.0mm.	7.60	96.8	3.2
			13.2mm.	7.60	96.8	3.2
			9.5mm.	9.70	95.9	4.1
			#4	21.80	90.7	9.3
			#8	39.40	83.3	16.7
			#16	68.60	70.9	29.1
			#30	118.50	49.7	50.3
			#50	187.70	20.3	79.7
			#100	218.80	7.1	92.9
			#200	234.40	0.5	99.5

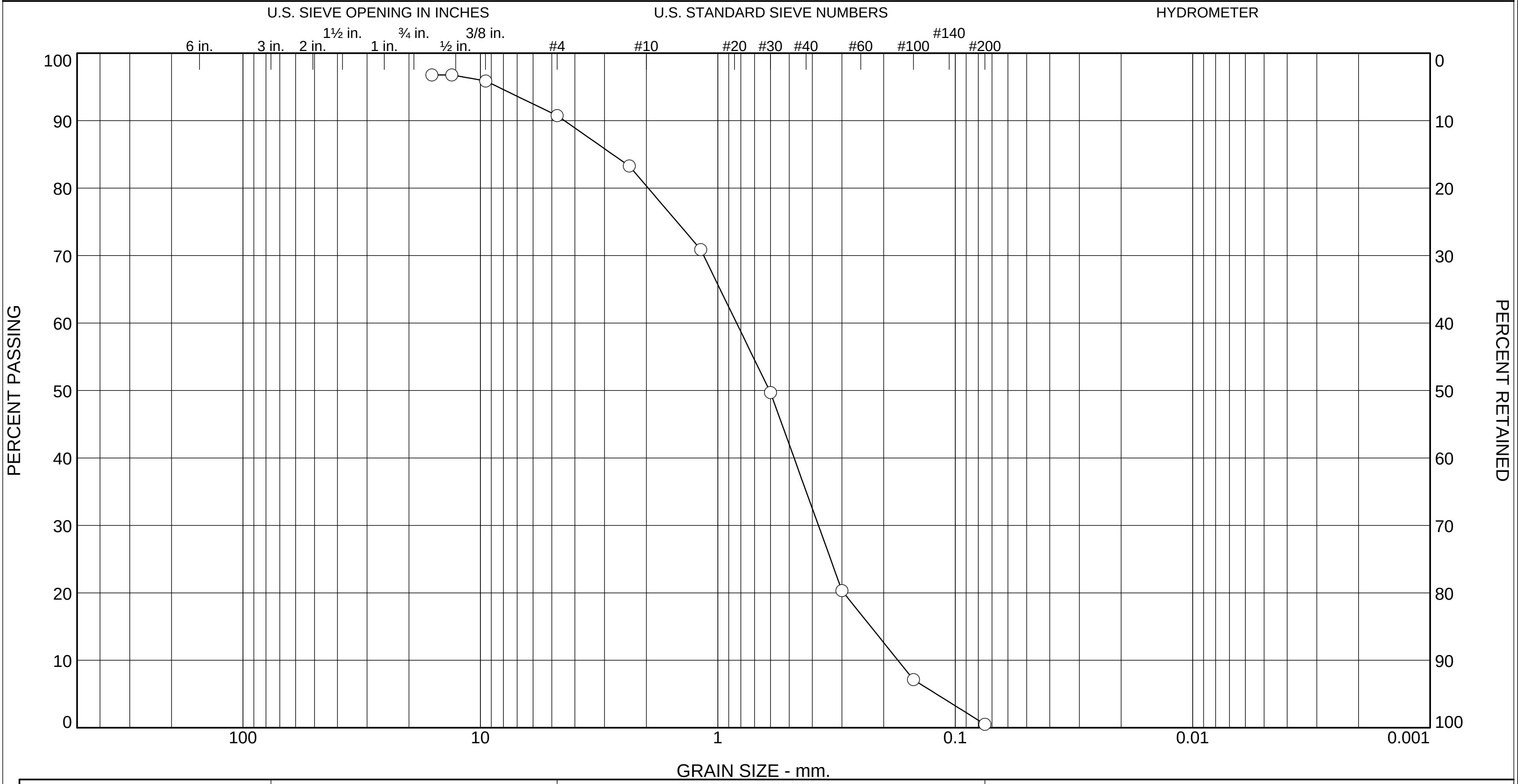
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
				10.4	45.2	34.6	90.2			0.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1200	0.1744	0.2268	0.2948	0.3769	0.4772	0.6057	0.8336	1.9648	2.7732	4.4291	8.4329

Fineness Modulus	C_u	C_c
2.82	4.78	0.98

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				90.7				

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T57-8 Sample Number: T57-8			July 18, 2018

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T. Nott **Checked By:** T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T29-4
Depth: 2.29m-2.90m **Sample Number:** 4
Date Sampled: 6/3/18 **Date Tested:** 7/19/18
Tested by: T.Linley **Checked by:** S.Hoffman

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
319.80	0.00	9.5mm	0.00	0.00	100.0	0.0
		#4	0.00	0.00	100.0	0.0
		#8	0.00	0.00	100.0	0.0
		#10	0.00	0.00	100.0	0.0
		#16	0.00	0.00	100.0	0.0
		#30	0.00	0.00	100.0	0.0
		#40	0.00	0.00	100.0	0.0
		#50	0.00	0.00	100.0	0.0
		#60	0.10	0.00	100.0	0.0
		#100	1.40	0.00	99.5	0.5
		#200	18.70	0.00	93.7	6.3

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =75.8
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5
Meniscus correction only = -1.0
Specific gravity of solids = 2.6
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	25.8	33.0	29.6	0.0129	32.0	11.0	0.0430	39.5	60.5
2.00	25.8	23.0	19.6	0.0129	22.0	12.7	0.0325	26.1	73.9
5.00	25.8	16.0	12.6	0.0129	15.0	13.8	0.0215	16.8	83.2
15.00	25.6	10.0	6.5	0.0130	9.0	14.8	0.0129	8.7	91.3
30.00	25.6	8.0	4.5	0.0130	7.0	15.1	0.0092	6.0	94.0
60.00	25.9	6.0	2.6	0.0129	5.0	15.5	0.0066	3.5	96.5
250.00	25.8	5.0	1.6	0.0129	4.0	15.6	0.0032	2.1	97.9
1440.00	25.5	5.0	1.5	0.0130	4.0	15.6	0.0014	1.9	98.1

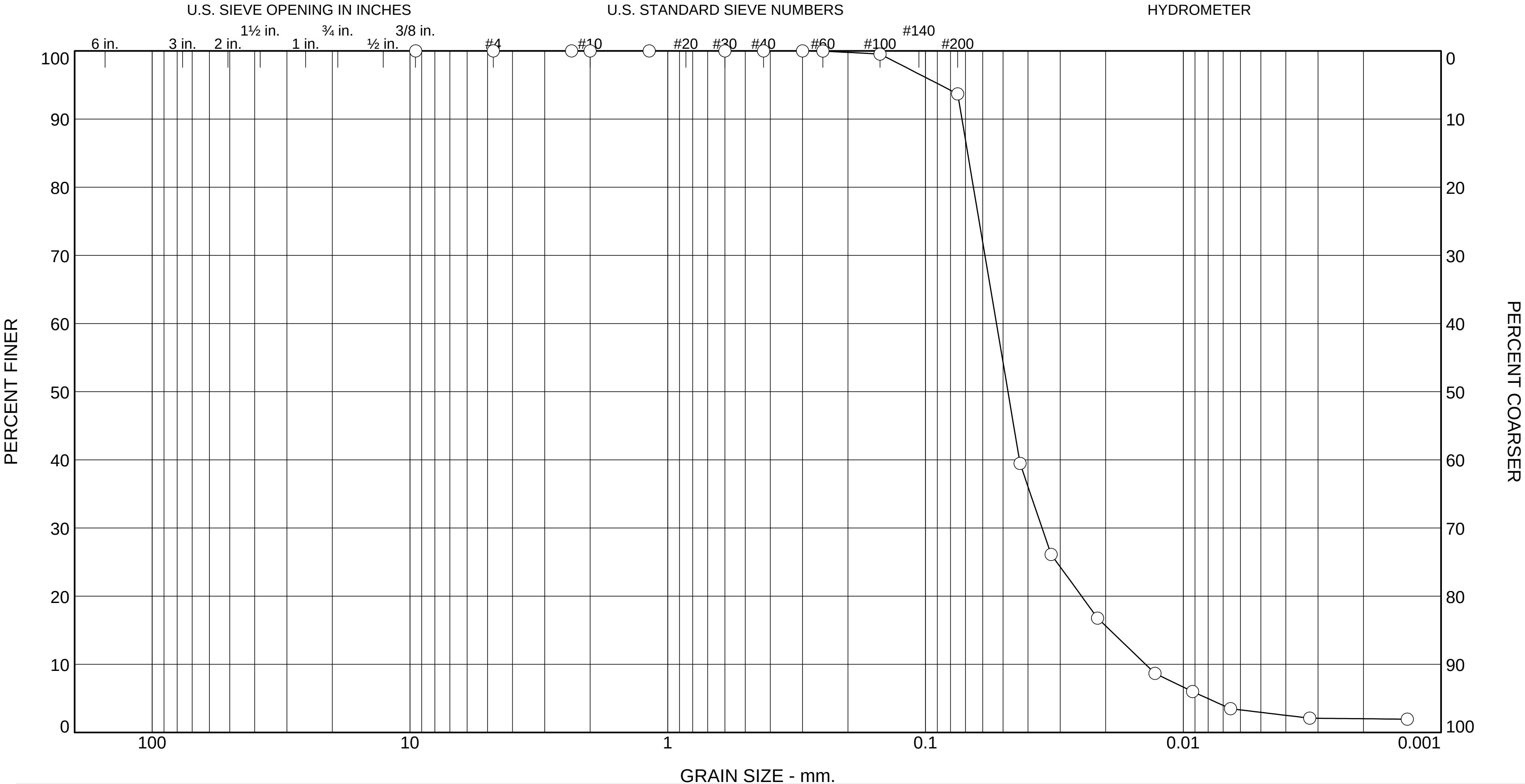
Fractional Components

Cobbles	Gravel	Sand			Fines		
		Coarse	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	6.3	6.3	91.7	2.0	93.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0080	0.0140	0.0192	0.0248	0.0353	0.0432	0.0479	0.0530	0.0652	0.0686	0.0722	0.0877

Fineness Modulus	C_u	C_c
0.00	3.79	1.68

Particle Size Distribution Report



	% +75mm	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	0.0	0.0	6.3	91.7	2.0

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T29-4 Depth: 2.29m-2.90m Sample Number: 4	6/3/18		7/19/18

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

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Tested By: T.Linley **Checked By:** S.Hoffman

GRAIN SIZE DISTRIBUTION TEST DATA

7/20/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T44-3
Depth: 1.52m - 2.13m **Sample Number:** 3
Date Sampled: 5/21/18 **Date Tested:** 7/19/18
Tested by: T.Linley **Checked by:** S.Hoffman

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
179.30	0.00	9.5mm	0.00	0.00	100.0	0.0
		#4	0.00	0.00	100.0	0.0
		#8	0.00	0.00	100.0	0.0
		#10	0.00	0.00	100.0	0.0
		#16	0.00	0.00	100.0	0.0
		#30	0.10	0.00	99.9	0.1
		#40	0.00	0.00	99.9	0.1
		#50	0.10	0.00	99.9	0.1
		#60	0.00	0.00	99.9	0.1
		#100	0.20	0.00	99.8	0.2
		#200	1.20	0.00	99.1	0.9

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =82.2
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5
Meniscus correction only = -1.0
Specific gravity of solids = 2.6
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	26.5	72.0	68.8	0.0128	71.0	4.7	0.0276	84.7	15.3
2.00	26.4	71.0	67.8	0.0128	70.0	4.8	0.0199	83.5	16.5
5.00	26.4	70.0	66.8	0.0128	69.0	5.0	0.0128	82.2	17.8
15.00	26.4	70.0	66.8	0.0128	69.0	5.0	0.0074	82.2	17.8
30.00	26.1	67.0	63.7	0.0129	66.0	5.5	0.0055	78.4	21.6
60.00	26.2	63.0	59.7	0.0129	62.0	6.1	0.0041	73.5	26.5
250.00	25.9	56.0	52.6	0.0129	55.0	7.3	0.0022	64.8	35.2
1440.00	25.7	43.0	39.5	0.0129	42.0	9.4	0.0010	48.7	51.3

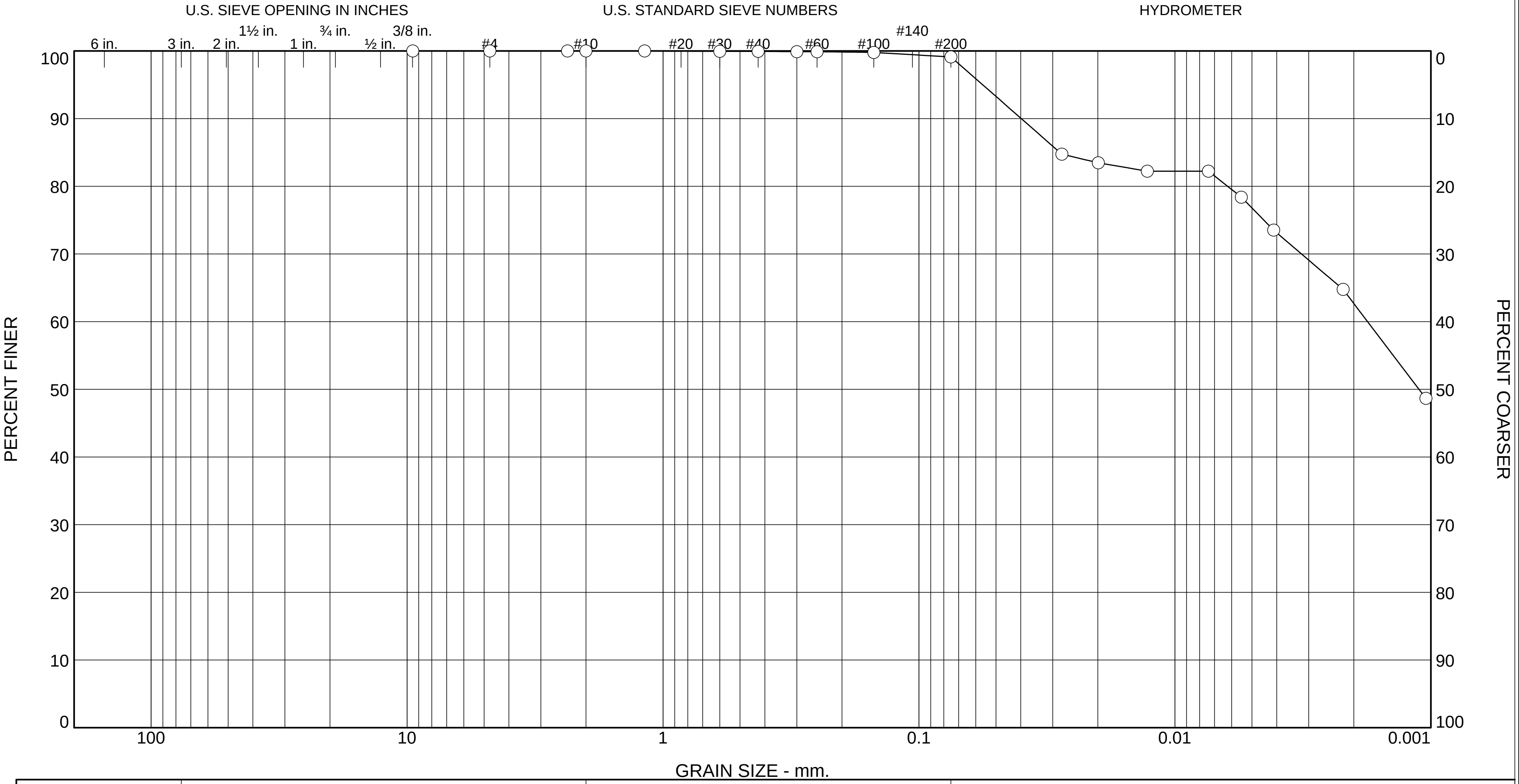
Fractional Components

Cobbles	Gravel	Sand			Fines		
		Coarse	Fine	Total	Silt	Clay	Total
0.0	0.0	0.1	0.8	0.9			99.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}

Fineness Modulus
0.00

Particle Size Distribution Report



	% +75mm	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	0.0	0.1	0.8	99.1	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T44-3 Depth: 1.52m - 2.13m Sample Number: 3	5/21/18		7/19/18

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

TULLOCH
ENGINEERING

71 Black Road
Unit 3
Sault Ste.
Marie, ON
P6B 0A3

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adam.byers@TULLOCH.ca

Tested By: T.Linley **Checked By:** S.Hoffman

GRAIN SIZE DISTRIBUTION TEST DATA

7/24/2018

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: T58-11
Depth: 12.19m - 12.80m **Sample Number:** 11
Date Sampled: 5/22/18 **Date Tested:** 7/22/18
Tested by: T.Linley **Checked by:** S.Hoffman

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
624.40	0.00	1.5"	0.00	0.00	100.0	0.0
		25.4mm	141.10	0.00	77.4	22.6
		19mm	25.50	0.00	73.3	26.7
		16mm	25.00	0.00	69.3	30.7
		13.2mm	5.00	0.00	68.5	31.5
		9.5mm	24.60	0.00	64.6	35.4
		#4	38.90	0.00	58.3	41.7
		#8	43.40	0.00	51.4	48.6
78.20	0.00	#16	5.90	0.00	47.5	52.5
		#30	7.10	0.00	42.8	57.2
		#40	2.90	0.00	40.9	59.1
		#50	3.60	0.00	38.6	61.4
		#60	1.90	0.00	37.3	62.7
		#100	5.20	0.00	33.9	66.1
		#200	6.80	0.00	29.4	70.6

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 48.6
Weight of hydrometer sample =78.2
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5
Meniscus correction only = -1.0
Specific gravity of solids = 2.6
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	26.9	41.0	38.0	0.0128	40.0	9.7	0.0398	23.9	76.1
2.00	26.9	38.0	35.0	0.0128	37.0	10.2	0.0289	22.0	78.0
5.00	26.9	33.5	30.5	0.0128	32.5	11.0	0.0189	19.2	80.8
15.00	26.8	30.0	27.0	0.0128	29.0	11.5	0.0112	17.0	83.0
30.00	26.8	28.0	25.0	0.0128	27.0	11.9	0.0080	15.7	84.3
60.00	26.9	24.0	21.0	0.0128	23.0	12.5	0.0058	13.2	86.8
250.00	27.2	12.0	9.2	0.0127	11.0	14.5	0.0031	5.8	94.2
1440.00	26.0	11.0	7.6	0.0129	10.0	14.7	0.0013	4.8	95.2

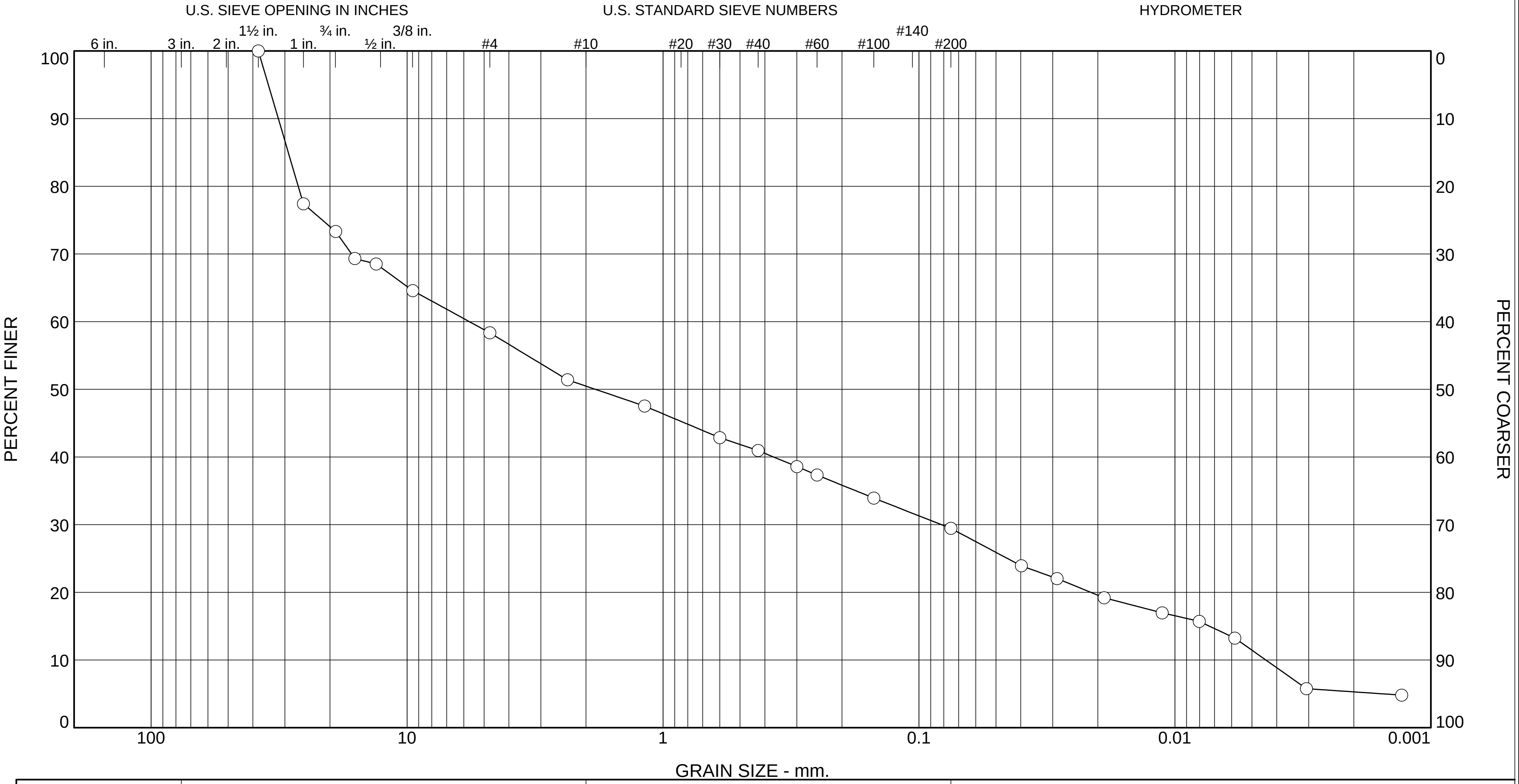
Fractional Components

Cobbles	Gravel	Sand			Fines		
		Coarse	Fine	Total	Silt	Clay	Total
0.0	49.5	9.6	11.5	21.1	24.1	5.3	29.4

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0015	0.0044	0.0073	0.0213	0.0818	0.3699	1.8397	5.7110	26.6119	29.1097	31.8420	34.8307

Fineness Modulus	C_u	C_c
3.89	1293.38	0.27

Particle Size Distribution Report



	% +75mm	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	49.5	9.6	11.5	24.1	5.3

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: T58-11 Depth: 12.19m - 12.80m Sample Number: 11	5/22/18		7/22/18

Client EDP

Project Nation Rise Wind Farm

Project No. 18-4022

TULLOCH ENGINEERING

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Tested By: T.Linley **Checked By:** S.Hoffman

Consolidation Tests

TULLOCH

Project Number	**18-4022**			Test No. 1
Document Number	**18-4022-1**			
Sheet	**1**	of	**5**	

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Moisture Before Test		
Tin I.D.	01	
Tare (g)	0.4	
Tare + WS (g)	54.9	
Tare + DS (g)	43.5	
% Moist	**26.5%**	

	Before Test	**After Test**
Height (cm)	1.5	1.17
Diameter (cm)	5	5
Area (cm²)	19.63	19.63
Volume (cm³)	29.45	22.9
Ring + Wet Sample (gm)	102.4	101.8
Ring + Dry Sample (gm)	-	84
Water(gm)	-	17.8
Ring(gm)	50.2	50.2
Wet Sample (gm)	52.2	49.5
Water Content (%)	55.7	35.9
Dry Weight (gm)	-	33.8
Dry Density (gm/cm³)		1.48
Dry Unit Weight (kN/m³)		14.5
Specific Gravity	2.7	2.7
Degree of Saturation (%)	100%	100%
Volume of Solids (cm³)		11.78
Height of Solids (cm)	0.6	0.6
Void Ratio	1.504	0.95

Legend

N/A not applicable

Hanger Load Kg	**Pressure** kPa	**Change in** mm	**New Height** mm	**Strain** %	**Void Height** mm	**Void Ratio** e	**t-50/t-90** min	**Cv** m²/y
0.5	25	0.099	14.901	0.66%	89.901	1.487	0.35	16.2
1	50	0.060	14.841	0.40%	89.841	1.477	1.44	17.2
2	100	0.142	14.699	0.96%	89.699	1.454	0.35	15.6
4	200	1.646	13.053	11.20%	88.053	1.179	14	0.4
8	400	1.624	11.429	12.44%	86.429	0.909	3.1	1.1
4	200	-0.0579	11.487	-0.51%	86.487	0.918	-	-
2	100	-0.1831	11.670	-1.59%	86.670	0.949	-	-

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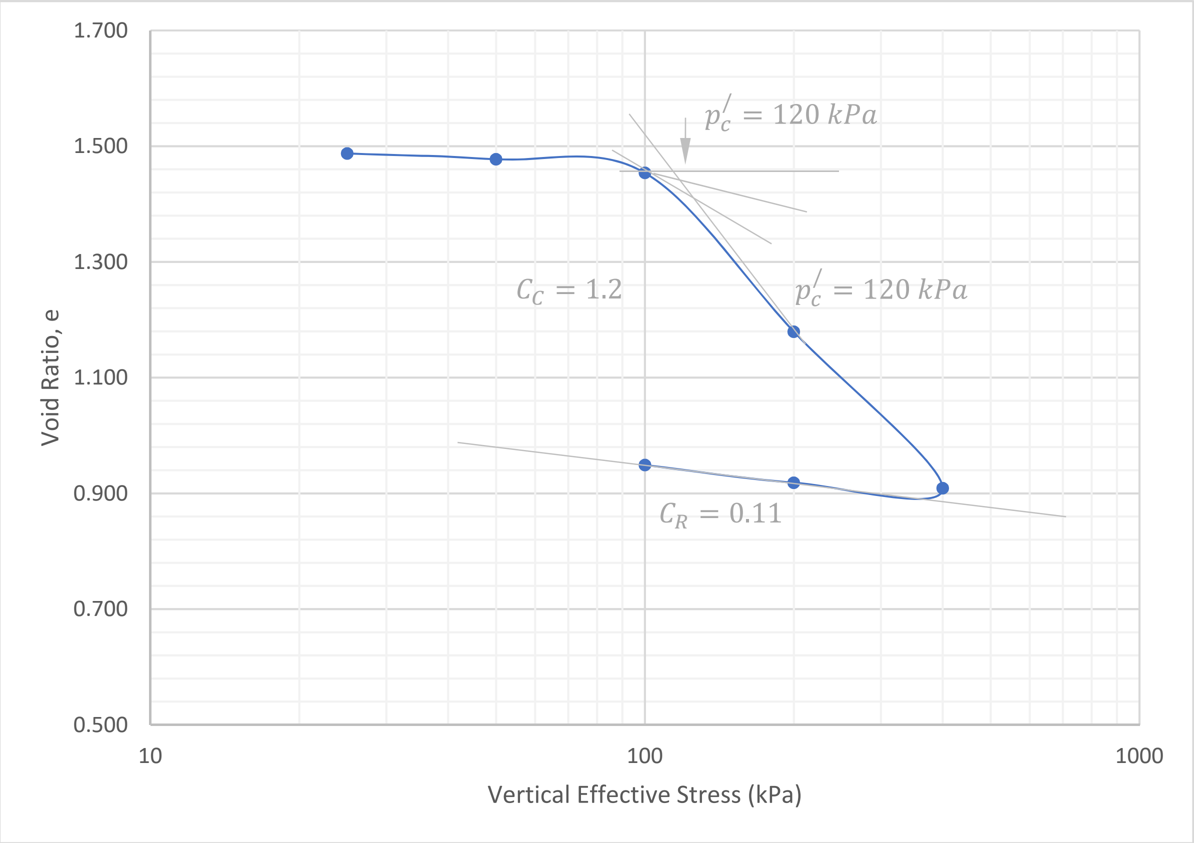
ASTM D-2435 Consolidation Test

Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**2**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH
Machine #	1

Nation Rise Wind Project
WTG23 TWS6 5.02m



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ASTM D-2435 Consolidation Test

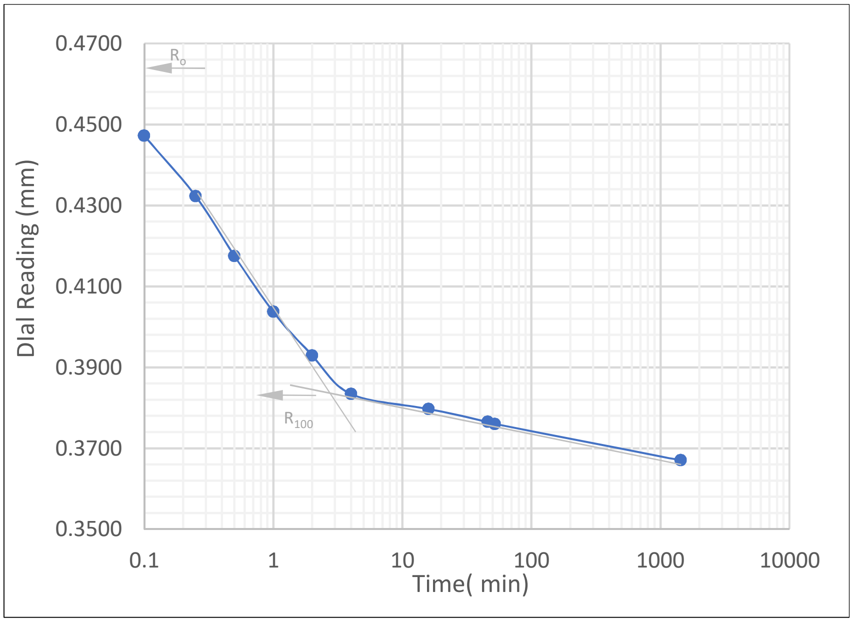
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**3**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 1

Load Inc. (kg)	0.5	R_0	0.466
kPa	0-25	R_{100}	0.383
Start Date	18-Jun-18	R_{50}	0.424
Correction (mm	-	t_{50}	0.39

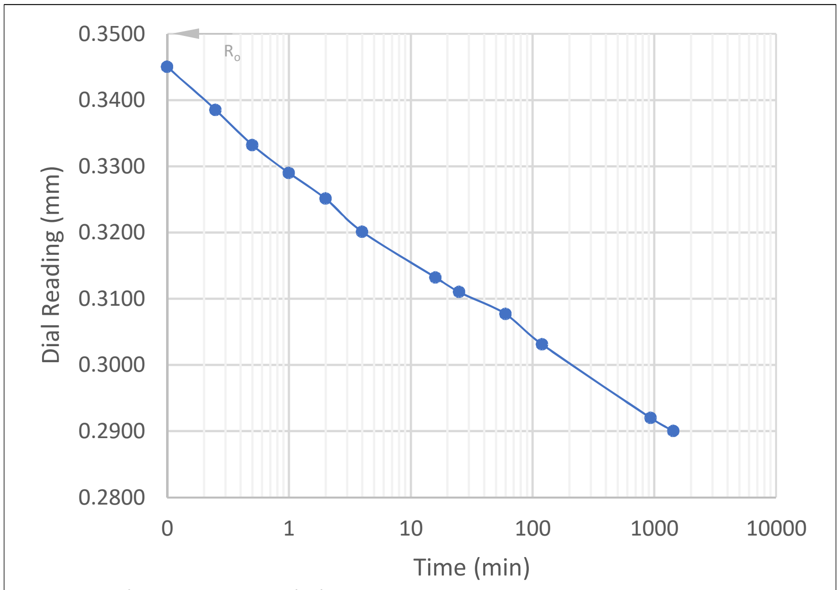
Time	Elapsed Time (min)	Reading (mm)
14:11:00	0	0.5120
14:11:15	0.1	0.4472
14:11:15	0.25	0.4323
14:11:30	0.5	0.4175
14:12:00	1	0.4037
14:13:00	2	0.3929
14:15:00	4	0.3834
14:27:00	16	0.3797
14:57:00	46	0.3765
15:03:00	52	0.3760
14:10:00	1439	0.3670



Load 2

Load Inc.(kg)	0.5	R_0	0.350
kPa	25-50	R_{90}	0.329
Start Date	19-Jun-18	t_{90}	1.44
Correction (mm	-		

Time	Elapsed Time (min)	Reading (mm)
14:16:00	0.00	0.3620
14:16:00	0.10	0.3450
14:16:15	0.25	0.3385
14:16:30	0.50	0.3332
14:17:00	1.00	0.3290
14:18:00	2.00	0.3251
14:20:00	4.00	0.3201
14:32:00	16.00	0.3132
14:41:00	25.00	0.3110
15:16:00	60.00	0.3077
16:16:00	120.00	0.3031
8:47:00	931.00	0.2920
14:10:00	1434.00	0.2900



Interpretted using Root Time Method

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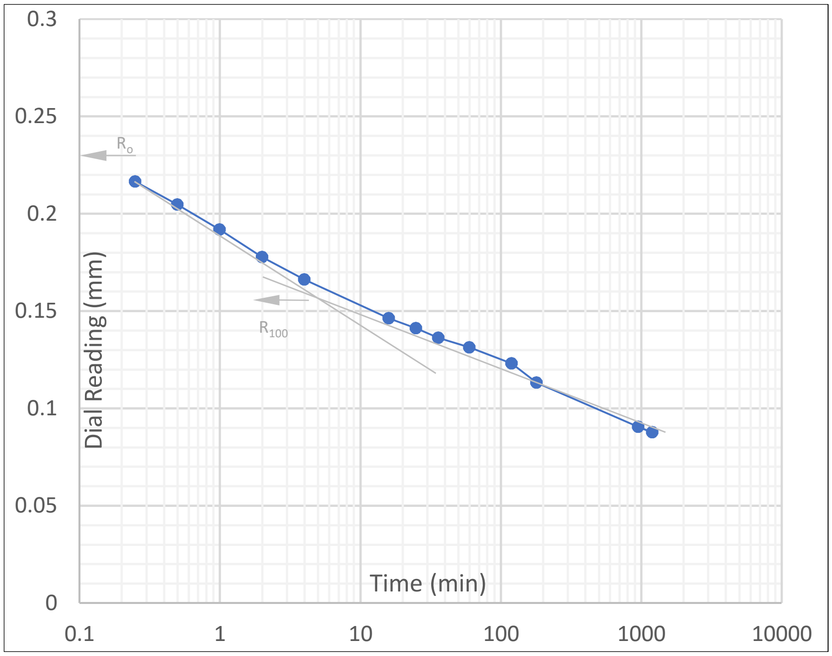
ASTM D-2435 Consolidation Test

Project Number	**18-4022**			
Document Number	**18-4022-1**			
Sheet	**4**	of	**5**	

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH
Machine #	1

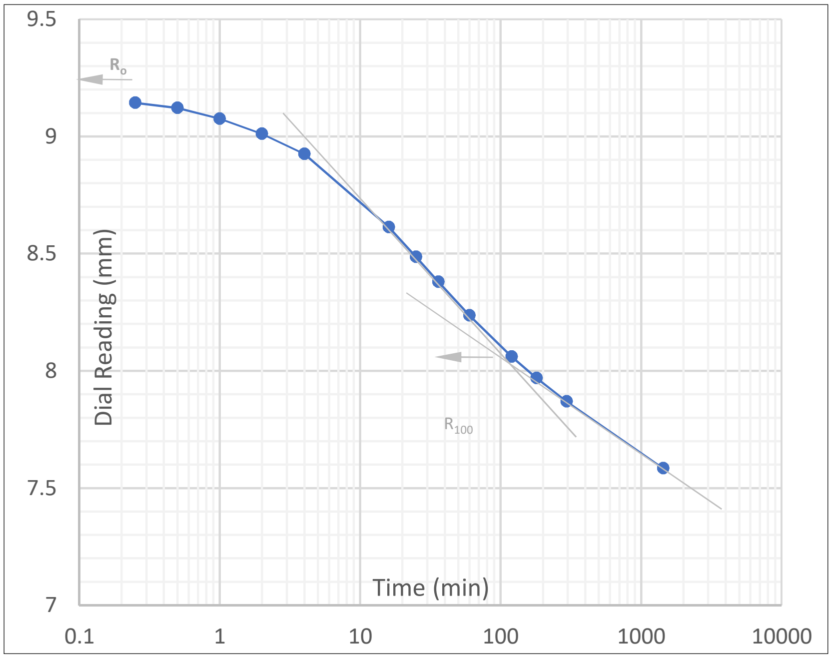
Load 3			
Load Inc.lbs	1	R_0	0.23
kPa	50-100	R_{100}	0.158
Start Date	20-Jun-18	R_{50}	0.194
Correction (mm	-	t_{50}	0.35

Time	Elapsed Time (min)	Reading (mm)
14:28:00	0	0.2919
14:28:15	0.25	0.2165
14:28:30	0.5	0.2047
14:29:00	1	0.1918
14:30:00	2	0.1776
14:32:00	4	0.1661
14:44:00	16	0.1462
14:53:00	25	0.1412
15:04:00	36	0.1362
15:28:00	60	0.1312
16:28:00	120	0.1231
17:28:00	180	0.1131
+1d, 6:56:00	956	0.0904
12:28:00	1202	0.0876



Load 4			
Load Inc.lbs	2	R_0	9.23
kPa	100-200	R_{100}	8.05
Start Date	21-Jun-18	R_{50}	8.64
Correction (mm	-	t_{50}	14

Time	Elapsed Time (min)	Reading (mm)
12:30:00	0	9.2358
12:30:15	0.25	9.1429
12:30:30	0.5	9.1207
12:31:00	1	9.0743
12:32:00	2	9.0101
12:34:00	4	8.9243
12:46:00	16	8.6125
12:55:00	25	8.4853
13:06:00	36	8.3786
13:30:00	60	8.2365
14:30:00	120	8.0598
15:30:00	180	7.9691
17:25:00	295	7.8693
1d + 12:30:00	1440	7.5843



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ASTM D-2435 Consolidation Test

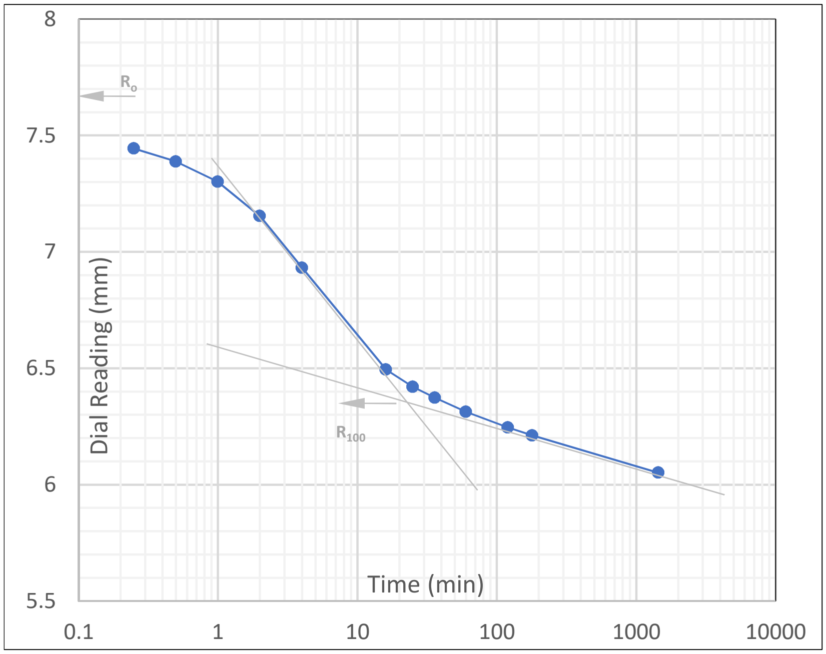
Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**5** of **5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 5

Load Inc.(kg)	4	R_0	7.675
kPa	200-400	R_{100}	6.36
Start Date	22-Jun-18	R_{50}	7.018
Correction (mm	-	t_{50}	3.1

Time	**Elapsed Time (min)**	**Reading (mm)**
13:00:00	0	7.5837
13:00:15	0.25	7.4441
13:00:30	0.5	7.3882
13:01:00	1	7.3018
13:02:00	2	7.1542
13:04:00	4	6.9314
13:16:00	16	6.4945
13:25:00	25	6.4199
13:36:00	36	6.374
14:00:00	60	6.3128
15:00:00	120	6.2456
16:00:00	180	6.2117
1d + 13:00:00	1440	6.0511



Load 6

Load Inc. (kg)	4
kPa	400-200
Start Date	23-Jun-18
Correction (mm)	

Time	**Elapsed Time (min)**	**Reading (mm)**
14:28:00	0	6.0511
13:00:00		6.109

Load 7

Load Inc. (kg)	4
kPa	200-100
Start Date	24-Jun-18
Correction (mm	-

Time	**Elapsed Time (min)**	**Reading (mm)**
13:10:00	0	6.109
13:10:00	0.25	6.2921

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ASTM D-2435 Consolidation Test

Project Number	**18-4022**		Test No. 2
Document Number	**18-4022-2**		
Sheet	**1**	of	**5**

Client Nation Rise Wind Project
Project 18-4022
BH# T21
Sample TWS 5
Depth 3.35m
Sample Type Silty Clay (CL)
Tested By J.H.
Machine # 1

Moisture Before Test		
Tin I.D.	2	
Tare (g)	0.4	
Tare + WS (g)	30.2	
Tare + DS (g)	19.4	
% Moist	**56.8%**	

	Before Test	**After Test**
Height (cm)	1.5	
Diameter (cm)	5	
Area (cm²)	19.63	
Volume (cm³)	29.45	
Ring + Wet Sample (gm)	107	
Ring + Dry Sample (gm)		
Water(gm)	20.57	
Ring(gm)	50.2	
Wet Sample (gm)	56.8	
Water Content (%)	**56.8**	
Dry Weight (gm)	36.23	
Dry Density (gm/cm³)	1.23	
Dry Unit Weight (kN/m³)	12.06	
Specific Gravity	2.7	
Degree of Saturation (%)	100%	
Volume of Solids (cm³)		
Height of Solids (cm)	5.92	
Void Ratio	1.534	

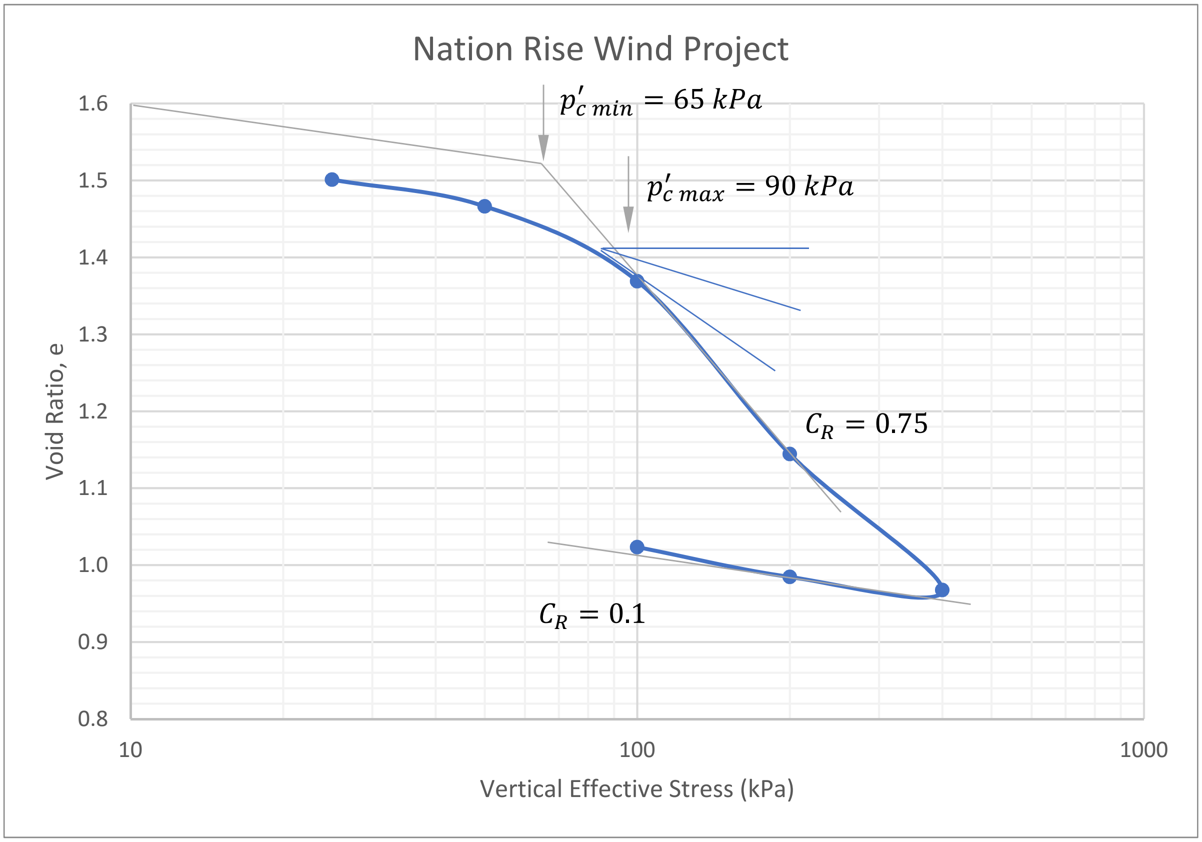
Legend
N/A not applicable

Hanger Load Kg	**Pressure** kPa	**Change in** mm	**New Height** mm	**Strain** %	**Void Height** mm	**Void Ratio** e	**t-50** min	**Cv** m²/y
0.5	25	0.194	14.806	1.29%	8.886	1.501	0.57	9.7
1	50	0.205	14.795	1.37%	8.681	1.466	0.4	13.8
2	100	0.576	14.424	3.84%	8.1048	1.369	0.85	6.2
4	200	1.330	13.670	8.87%	6.7748	1.144	2	2.6
8	400	1.046	13.954	6.97%	5.7288	0.968	1.8	2.6
4	200	-0.1	15.1	-0.67%	5.8288	0.985	-	-
2	100	-0.23	15.23	-1.53%	6.0588	1.023	-	-

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Nation Rise Wind Project
WTG23 TWS6 5.02m



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Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**3** of **5**

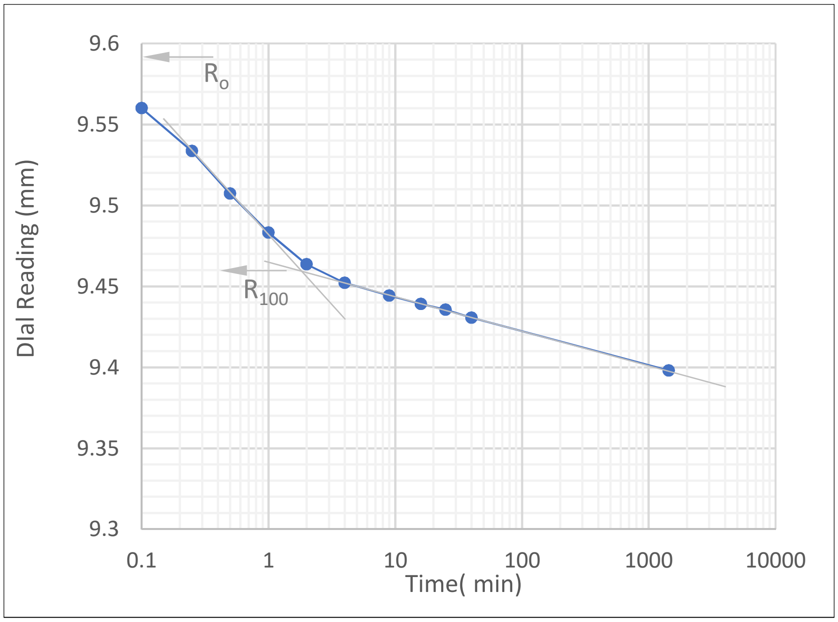
ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH
Machine #	1

Load 1

Load Inc.(kg)	0.5	R_0	9.592
kPa	0-25	R_{100}	9.458
Start Date	18-Jun-18	R_{50}	9.525
Correction (mm)	-	t_{50}	0.57

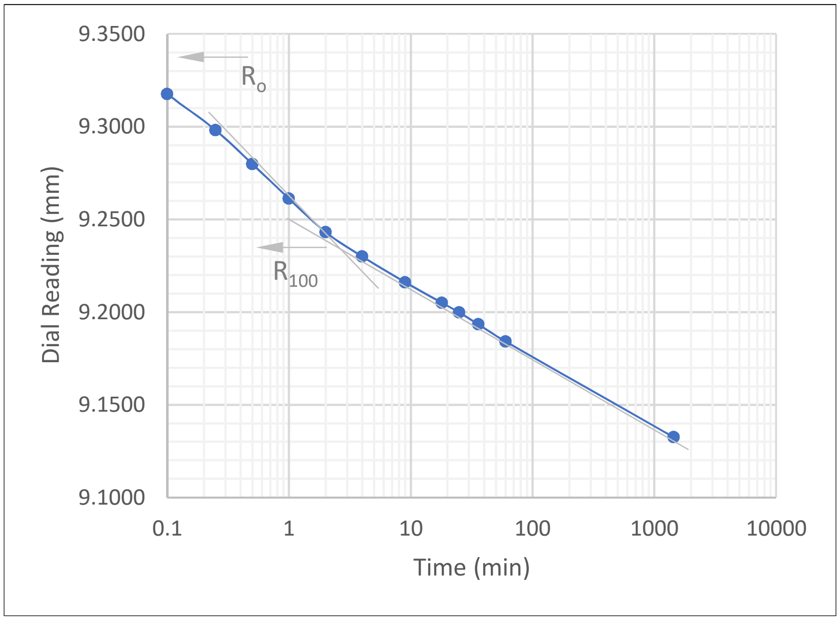
Time	**Elapsed Time (min)**	**Reading (mm)**
14:11:00	0	9.57
14:11:05	0.1	9.56
14:11:15	0.25	9.5335
14:11:30	0.5	9.5073
14:12:00	1	9.4832
14:13:00	2	9.4635
14:15:00	4	9.452
14:20:00	9	9.4442
14:27:00	16	9.4391
14:36:00	25	9.4355
14:51:00	40	9.4305
1d + 14:11:00	1440	9.398



Load 2

Load Inc.(kg)	1	R_0	9.337
kPa	25-50	R_{100}	9.236
Start Date	19-Jun-18	R_{50}	9.287
Correction (mm)	-	t_{50}	0.4

Time	**Elapsed Time (min)**	**Reading (mm)**
16:05:00	0	9.3980
16:05:06	0.1	9.3175
16:05:15	0.25	9.2980
16:05:30	0.5	9.2798
16:06:00	1	9.2611
16:07:00	2	9.2430
16:09:00	4	9.2299
16:14:00	9	9.2160
16:23:00	18	9.2050
16:30:00	25	9.1997
16:41:00	36	9.1933
17:05:00	60	9.1841
1d + 16:05:00	1440	9.1325



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ASTM D-2435 Consolidation Test

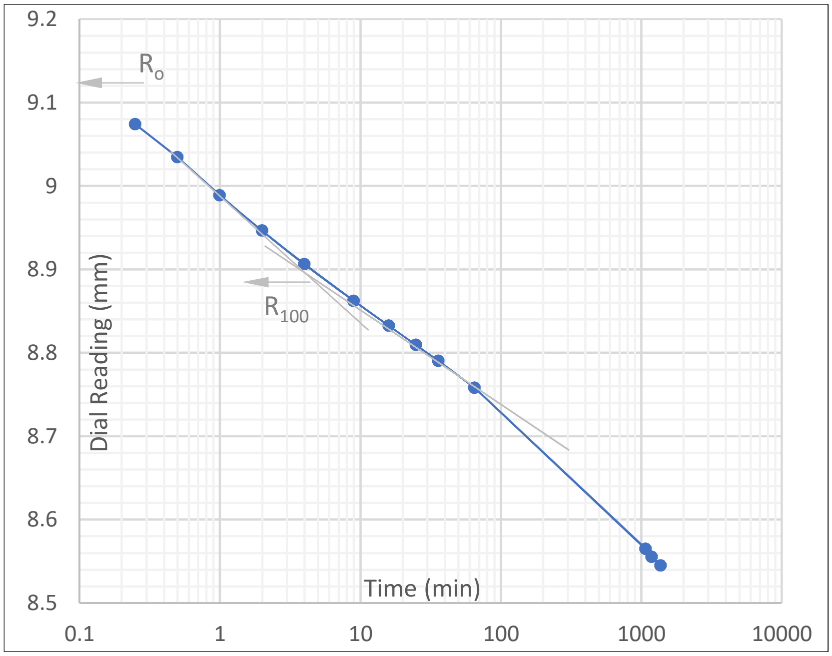
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**4**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 3

Load Inc. (kg)	2	R_0	9.121
kPa	50-100	R_{100}	8.892
Start Date	20-Jun-18	R_{50}	0.194
Correction (mm	-	t_{50}	0.85

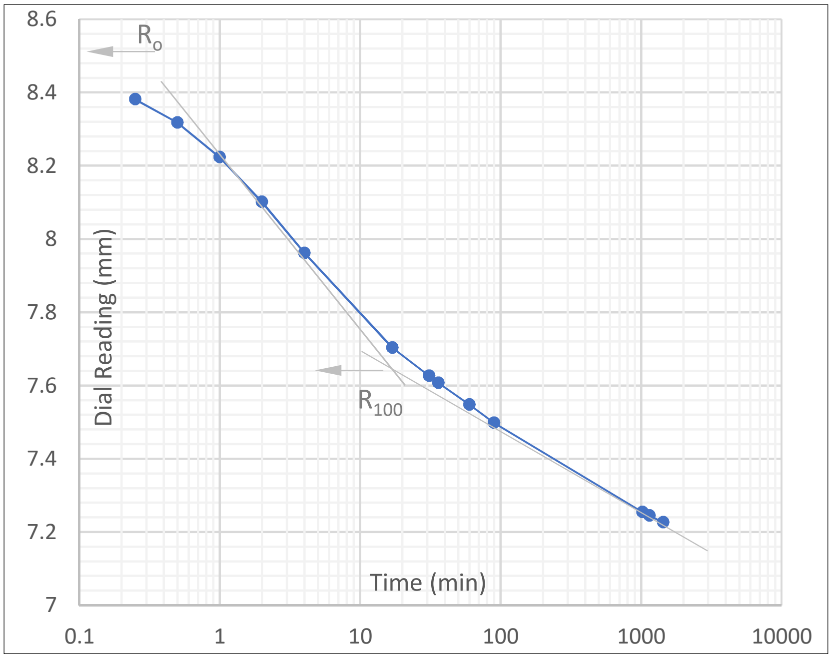
Time	**Elapsed Time (min)**	**Reading (mm)**
17:10:00	0	9.2166
17:10:15	0.25	9.0738
17:10:30	0.5	9.0343
17:11:00	1	8.9888
17:12:00	2	8.9466
17:14:00	4	8.9061
17:19:00	9	8.8618
17:26:00	16	8.8323
17:35:00	25	8.8092
17:46:00	36	8.7901
18:15:00	65	8.7581
1d + 11:06:00 AI	1076	8.5648
1d + 13:00:00	1190	8.5554
1d + 16:10:00	1380	8.5448



Load 4

Load Inc.lbs	4	R_0	8.555
kPa	100-200	R_{100}	7.655
Start Date	21-Jun-18	R_{50}	8.105
Correction (mm	-	t_{50}	2

Time	**Elapsed Time (min)**	**Reading (mm)**
16:30:00	0	8.5554
16:30:15	0.25	8.3807
16:30:30	0.5	8.3171
16:31:00	1	8.223
16:32:00	2	8.1008
16:34:00	4	7.9615
16:47:00	17	7.7028
17:01:00	31	7.6259
17:06:00	36	7.6065
17:30:00	60	7.5471
18:00:00	90	7.4975
1d + 9:22:00	1022	7.2537
1d + 11:30:00	1150	7.2449
1d + 16:30:00	1440	7.2259



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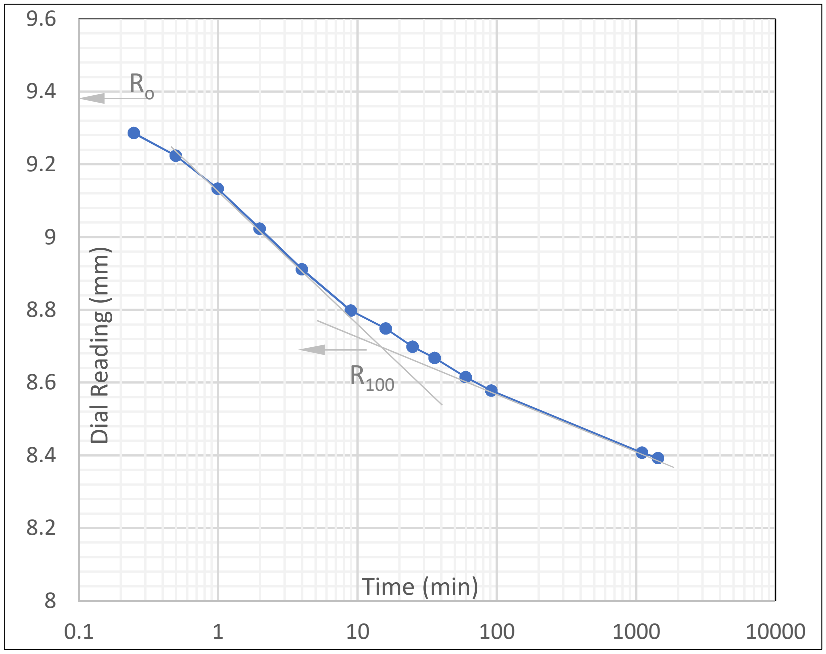
ASTM D-2435 Consolidation Test

Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**5**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 5			
Load Inc. (kg)	8	R_0	9.438
kPa	200-400	R_{100}	8.68
Start Date	22-Jun-18	R_{50}	9.059
Correction (mm)	-	t_{50}	1.2

Time	**Elapsed Time (min)**	**Reading (mm)**
16:40:00	0	
16:40:15	0.25	9.2854
16:40:30	0.5	9.2231
16:41:00	1	9.1328
16:42:00	2	9.0224
16:44:00	4	8.9107
16:49:00	9	8.7975
16:56:00	16	8.7483
17:05:00	25	8.6976
17:16:00	36	8.667
17:40:00	60	8.6143
18:12:00	92	8.5774
1d + 11:10:00	1110	8.407
1d + 16:40:00	1440	8.3919



Load 6	
Load Inc. (kg)	4
kPa	400-200
Start Date	22-Jun-18
Correction (mm)	

Time	**Elapsed Time (min)**	**Reading (mm)**
14:28:00	0	6.0511
13:00:00		6.109

Load 7	
Load Inc. (kg)	2
kPa	200-100
Start Date	23-Jun-18
Correction (mm)	-

Time	**Elapsed Time (min)**	**Reading (mm)**
13:10:00	0	6.109
13:10:00	0.25	6.2921

Project Number	**18-4022**		Test No. 3
Document Number	**18-4022-2**		
Sheet	**1**	of	**5**

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	Sub 1
Sample	TWS6 B
Depth	3.05
Sample Type	Gray Silty Clay (CH)
Tested By	J.H.
Machine #	1

Moisture Before Test		
Tin I.D.	3	
Tare (g)	0.4	
Tare + WS (g)	28.6	
Tare + DS (g)	19.9	
% Moist	**44.6%**	

	Before Test	**After Test**
Height (cm)	1.5	
Diameter (cm)	5	
Area (cm²)	19.63	
Volume (cm³)	29.45	
Ring + Wet Sample (gm)		
Ring + Dry Sample (gm)		
Water(gm)		
Ring(gm)	50.2	
Wet Sample (gm)		
Water Content (%)	44.6	
Dry Weight (gm)		
Dry Density (gm/cm³)		
Dry Unit Weight (kN/m³)		
Specific Gravity	2.7	
Degree of Saturation (%)	100%	
Volume of Solids (cm³)	13.358	
Height of Solids (cm)	0.6805	
Void Ratio	1.2042	

Legend

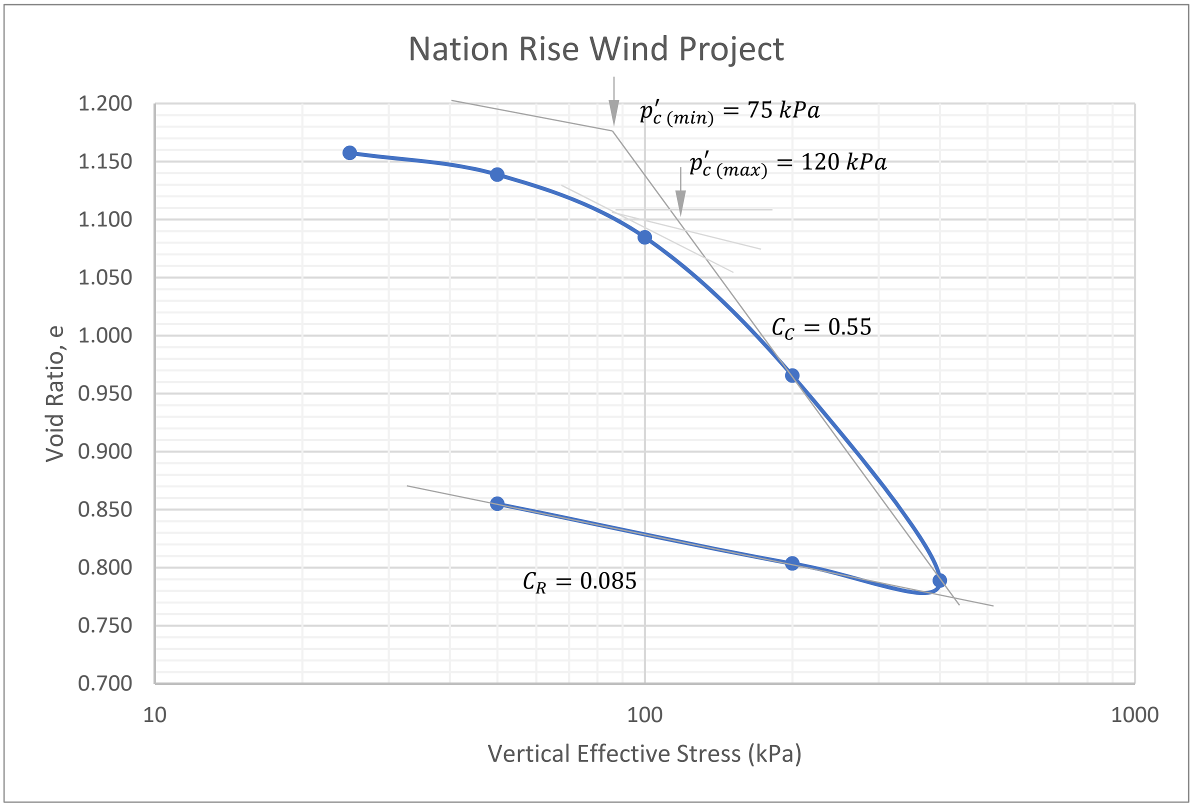
N/A not applicable

Hanger Load Kg	**Pressure kPa**	**Change in mm**	**New Height mm**	**Strain %**	**Void Height mm**	**Void Ratio e**	**t-50 min**	**Cv m²/y**
0.5	25	0.134	14.866	0.89%	7.876	1.157	0.9	6.3
1	50	0.127	14.873	0.85%	7.749	1.139	0.9	6.3
2	100	0.368	14.632	2.45%	7.381	1.085	0.82	6.8
4	200	0.811	14.189	5.41%	6.57	0.965	2.95	1.8
8	400	1.202	13.798	8.01%	5.368	0.789	2.8	1.8
4	200	-0.1	15.1	-0.67%	5.468	0.804	-	-
1	50	-0.35	15.35	-2.33%	5.818	0.855	-	-

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	Sub 1
Sample	TWS6 B
Depth	3.05
Sample Type	Gray Silty Clay (CH)
Tested By	J.H.
Machine #	1

Nation Rise Wind Project
Suib 1 TWS6 B 3.05m



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Project Number 18-4022
Document Number 18-4022-1
Sheet 3 of 5

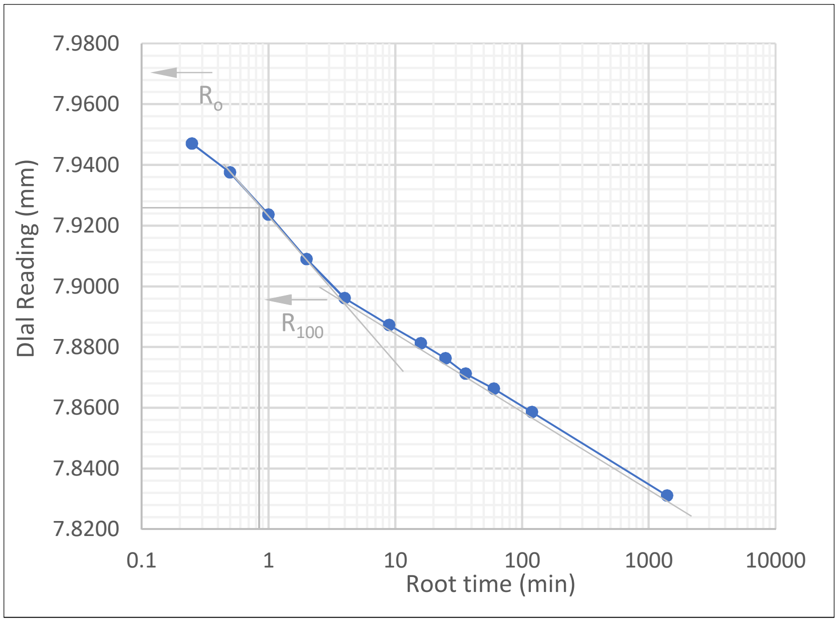
ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	Sub 1
Sample	TWS6 B
Depth	3.05
Sample Type	Gray Silty Clay (CH)
Tested By	J.H.
Machine #	1

Load 1

Load Inc.(kg)	0.25	R_0	7.965
kPa	0-25	R_{100}	7.888
Start Date	25-Jun-18	R_{50}	7.927
Correction (mm	-	t_{50}	0.9

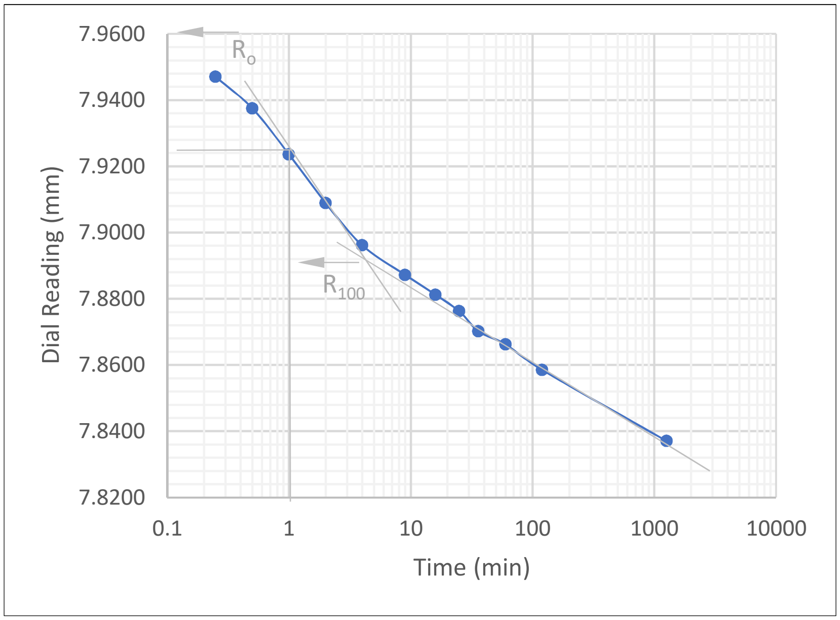
Time	Elapsed Time (min)	Reading (mm)
9:15:00	0	8.0007
9:15:15	0.25	7.9470
9:15:30	0.5	7.9375
9:16:00	1	7.9236
9:17:00	2	7.9089
9:19:00	4	7.8961
9:24:00	9	7.8872
9:31:00	16	7.8812
9:40:00	25	7.8762
9:51:00	36	7.8712
10:15:00	60	7.8662
11:15:00	120	7.8585
1d+ 8:35:00	1400	7.831



Load 2

Load Inc.lbs	0.25	R_0	7.964
kPa	25-50	R_{100}	7.886
Start Date	26-Jun-18	R_{50}	7.925
Correction (mm	-	t_{50}	0.9

Time	Elapsed Time (min)	Reading (mm)
11:20:00	0	8.0007
11:20:15	0.25	7.9470
11:20:30	0.5	7.9375
11:21:00	1	7.9236
11:22:00	2	7.9089
11:24:00	4	7.8961
11:29:00	9	7.8872
11:36:00	16	7.8812
11:45:00	25	7.8762
11:56:00	36	7.8702
12:20:00	60	7.8662
13:20:00	120	7.8585
1d+	1260	7.8370



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ASTM D-2435 Consolidation Test

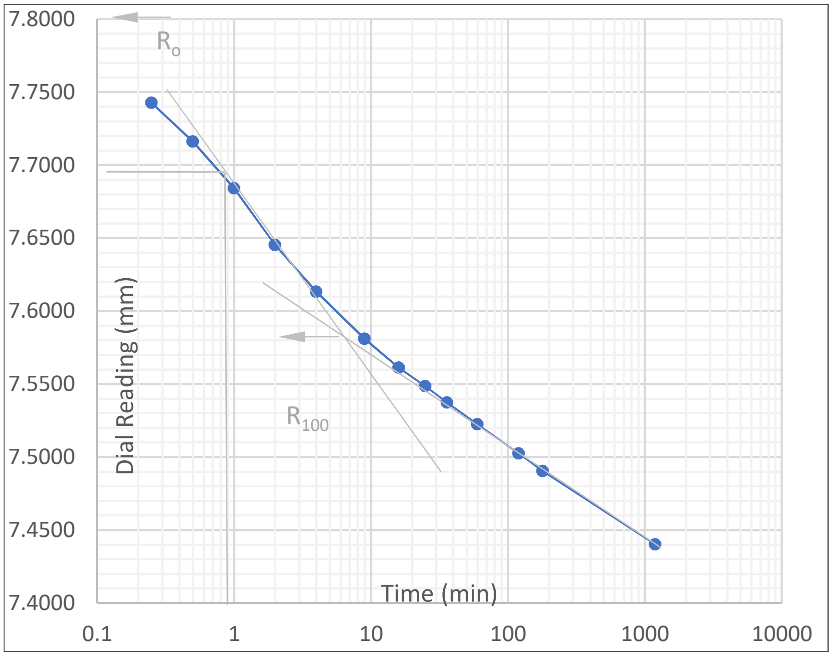
Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**4** of **5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	Sub 1
Sample	TWS6 B
Depth	3.05
Sample Type	Gray Silty Clay (CH)
Tested By	J.H.
Machine #	1

Load 3

Load Inc.(kg)	0.25	R_0	7.808
kPa	50-100	R_{100}	7.582
Start Date	27-Jun-18	R_{50}	7.695
Correction (mm	-	t_{50}	.35

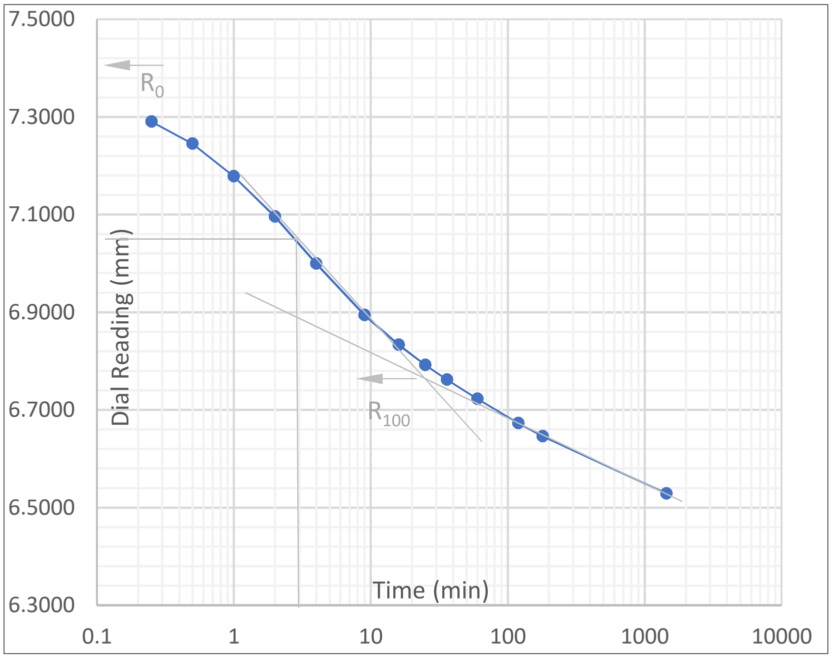
	Time	Elapsed Time (min)	Reading (mm)
	13:30:00	0	7.8585
	13:30:15	0.25	7.7426
	13:30:30	0.5	7.7161
	13:31:00	1	7.6840
	13:32:00	2	7.6452
	13:34:00	4	7.6131
	13:39:00	9	7.5810
	13:46:00	16	7.5612
	13:55:00	25	7.5484
	14:06:00	36	7.5372
	14:30:00	60	7.5224
	15:30:00	120	7.5024
	16:30:00	180	7.4903
1d+	8:56:00	1196	7.4401



Load 4

Load Inc.lbs	0.25	R_0	7.340
kPa	100-200	R_{100}	6.760
Start Date	28-Jun-18	R_{50}	7.050
Correction (mm	-	t_{50}	2.95

	Time	Elapsed Time (min)	Reading (mm)
	9:00:00	0	7.4397
	9:00:15	0.25	7.2901
	9:00:30	0.5	7.2447
	9:01:00	1	7.1781
	9:02:00	2	7.0954
	9:04:00	4	6.9995
	9:09:00	9	6.8937
	9:16:00	16	6.8332
	9:25:00	25	6.7917
	9:36:00	36	6.7616
	10:00:00	60	6.7225
	11:00:00	120	6.6728
	12:00:00	180	6.646
1d+	9:02:00	1442	6.5287



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ASTM D-2435 Consolidation Test

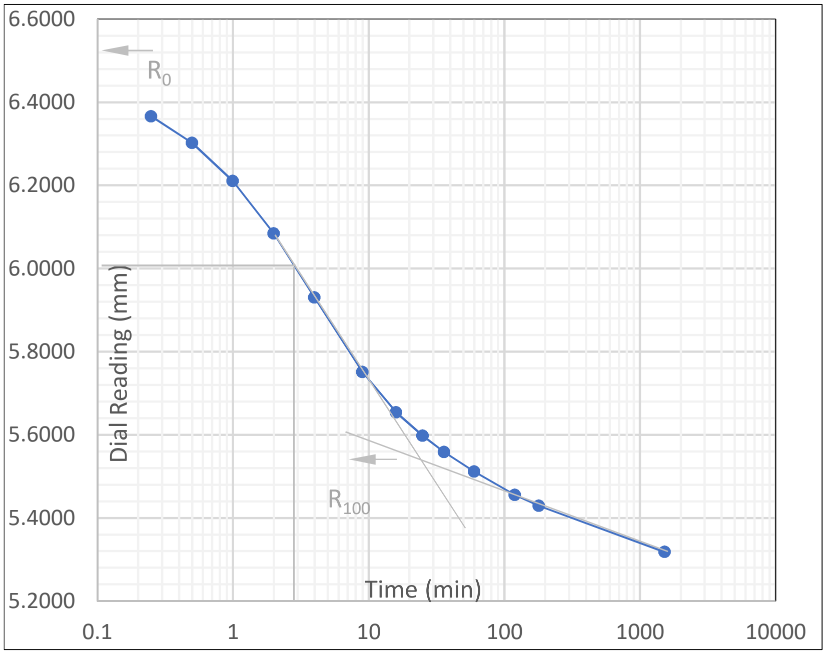
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**5**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	Sub 1
Sample	TWS6 B
Depth	3.05
Sample Type	Gray Silty Clay (CH)
Tested By	J.H.
Machine #	1

Load 5

Load Inc.lbs	0.25	R_0	6.52
kPa	200-400	R_{100}	5.54
Start Date	29-Jun	R_{50}	6.03
Correction (mm)		t_{50}	2.80

Time	**Elapsed Time (min)**	**Reading (mm)**
10:00:00	0	6.5287
10:00:15	0.25	6.3661
10:00:30	0.5	6.3021
10:01:00	1	6.2105
10:02:00	2	6.0842
10:04:00	4	5.9297
10:09:00	9	5.7510
10:16:00	16	5.6534
10:25:00	25	5.5972
10:36:00	36	5.558
11:00:00	60	5.511
12:00:00	120	5.4547
13:00:00	180	5.4291
1d + 11:24:00 Al	1524	5.3179



Load 6

Load Inc. (kg)	4
kPa	400-200
Start Date	23-Jun-18
Correction (mm)	

Time	**Elapsed Time (min)**	**Reading (mm)**
14:28:00	0	5.3179
13:00:00		5.6679

Load 7

Load Inc. (kg)	2
kPa	200-100
Start Date	24-Jun-18
Correction (mm	-

Time	**Elapsed Time (min)**	**Reading (mm)**
13:10:00	0	5.6679
13:10:00	0.25	5.7679

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ASTM D-2435 Consolidation Test

Project Number **18-4022** Test No. 4
Document Number **18-4022-1**
Sheet **1** of **5**

Client Nation Rise Wind Project
Project 18-4022
BH# T44
Sample TWS 6B
Depth 4.88 m 57.2
Sample Type Silty Clay (CL)
Tested By J.H.
Machine # 1

Moisture Before Test		
Tin I.D.		
Tare (g)		
Tare + WS (g)		
Tare + DS (g)		
% Moist		

	Before Test	**After Test**
Height (cm)	1.5	
Diameter (cm)	5	5
Area (cm²)	19.63	19.63
Volume (cm³)	29.45	29.45
Ring + Wet Sample (gm)	107	106.6
Ring + Dry Sample (gm)	-	91.8
Water(gm)	-	14.8
Ring(gm)	50.2	50.2
Wet Sample (gm)	56.8	56.4
Water Content (%)	45.1%	35.6%
Dry Weight (gm)	43.4	41.6
Dry Density (gm/cm³)		1.41
Dry Unit Weight (kN/m³)		14.32
Specific Gravity	2.7	2.7
Degree of Saturation (%)		100%
Volume of Solids (cm³)		13.69
Height of Solids (cm)		0.6975
Void Ratio	1.218	0.961

Legend
N/A not applicable

Hanger Load Kg	**Pressure** kPa	**Change in** mm	**New Height** mm	**Strain** %	**Void Height** mm	**Void Ratio** e	**t-50** min	**Cv** m²/y
0.5	25	0.527	14.901	3.51%	89.473	1.143	4	1.92
1	50	0.159	14.742	1.07%	89.314	1.120	3.80	1.9
2	100	0.285	14.457	1.93%	89.029	1.079	4.6	1.86
4	200	0.414	14.043	2.86%	88.615	1.020	2	1.79
8	400	0.493	13.550	3.51%	88.122	0.949	1.4	1.69
4	200	-0.037	13.587	-0.27%	88.159	0.954	-	-
2	100	-0.043	13.630	-0.32%	88.202	0.961	-	-

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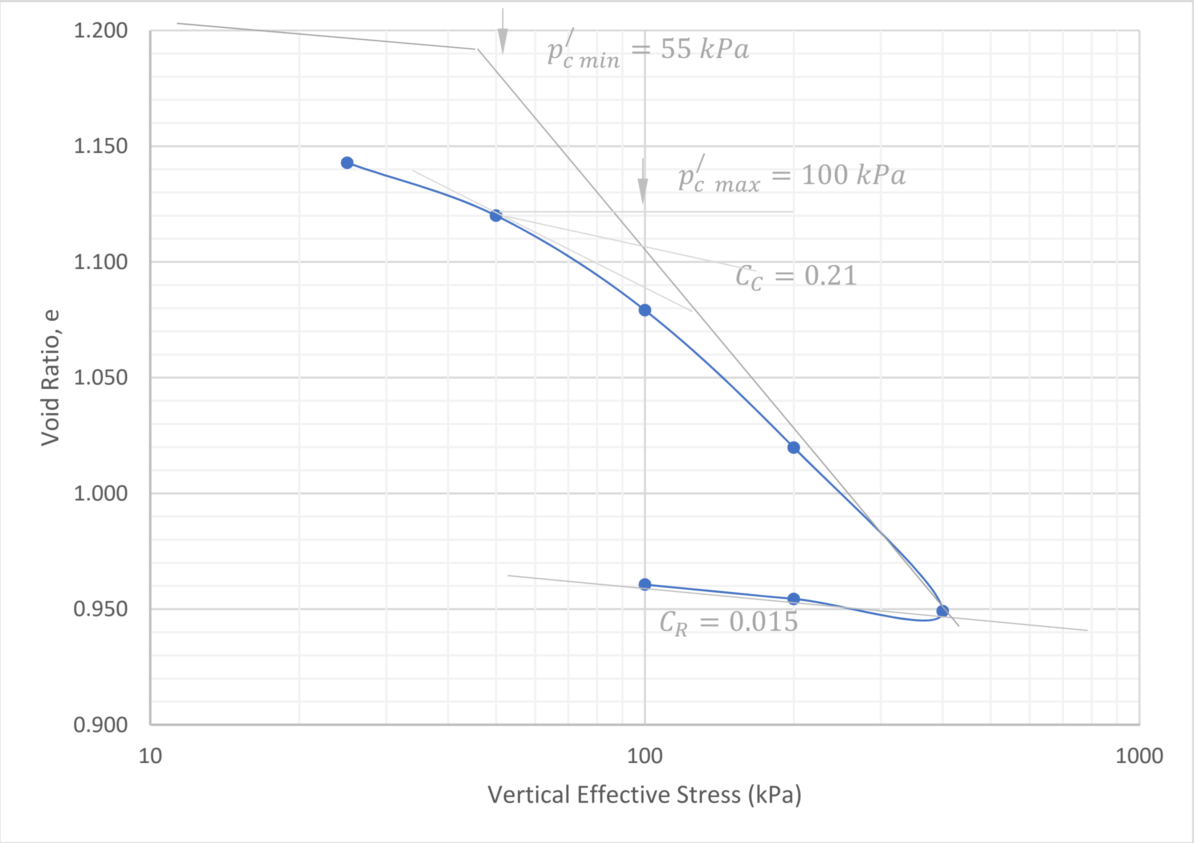
ASTM D-2435 Consolidation Test

Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**2**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	T44
Sample	TWS 6B
Depth	4.88 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Nation Rise Wind Project
WTG44 TWS6 5.02m



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ASTM D-2435 Consolidation Test

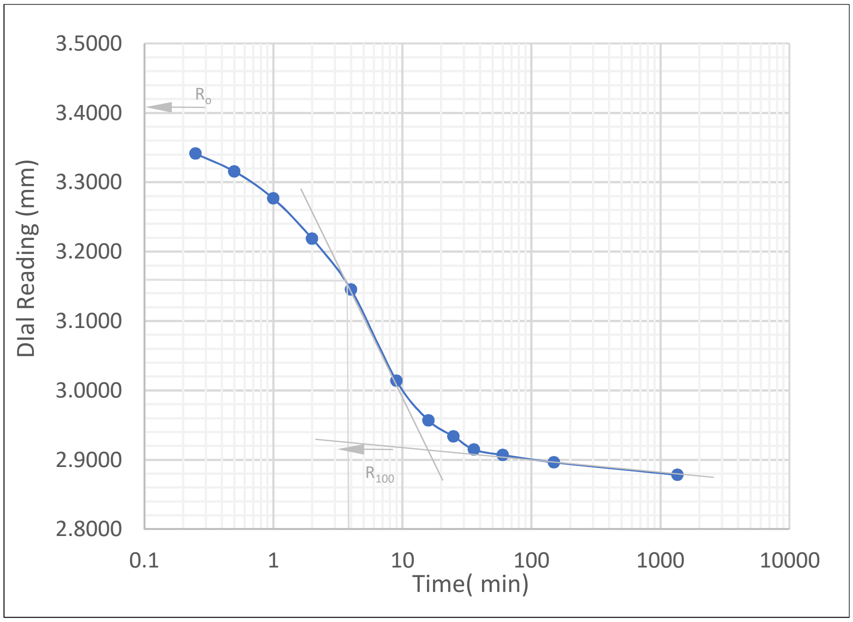
Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**3** of **5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	T44
Sample	TWS 6B
Depth	4.88 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Load 1

Load Inc. (kg)	0.5	R_0	3.405
kPa	0-25	R_{100}	2.915
Start Date	30-Jul-18	R_{50}	3.160
Correction (mm	-	t_{50}	4.0

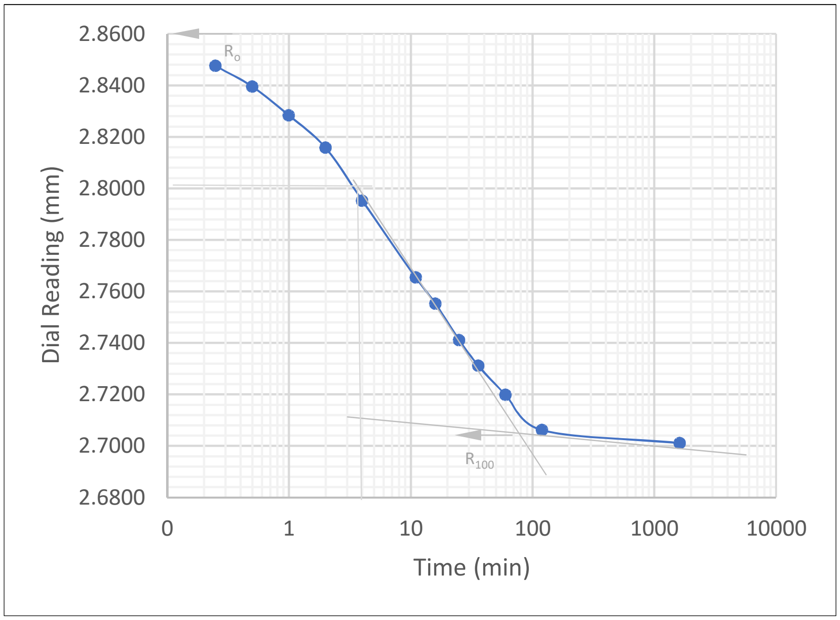
Time	**Elapsed Time (min)**	**Reading (mm)**
11:22:00	0	3.4841
11:22:15	0.25	3.3410
11:22:30	0.5	3.3155
11:23:00	1	3.2765
11:24:00	2	3.2185
11:26:00	4	3.1453
11:31:00	9	3.0139
11:38:00	16	2.9566
11:47:00	25	2.9335
11:58:00	36	2.9147
12:22:00	60	2.9068
13:52:00	150	2.896
9:58:00	1356	2.878



Load 2

Load Inc.(kg)	0.5	R_0	0.350
kPa	25-50	R_{90}	0.329
Start Date	31-Jul-18	t_{90}	1.44
Correction (mm	-		

Time	**Elapsed Time (min)**	**Reading (mm)**
10:00:00	0.00	2.8786
10:00:15	0.25	2.8475
10:00:30	0.50	2.8395
10:01:00	1.00	2.8283
10:02:00	2.00	2.8157
10:04:00	4.00	2.7952
10:11:00	11.00	2.7653
10:16:00	16.00	2.7552
10:25:00	25.00	2.7410
10:36:00	36.00	2.7311
11:00:00	60.00	2.7198
12:00:00	120.00	2.7061
13:00:00	1620.00	2.7011



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ASTM D-2435 Consolidation Test

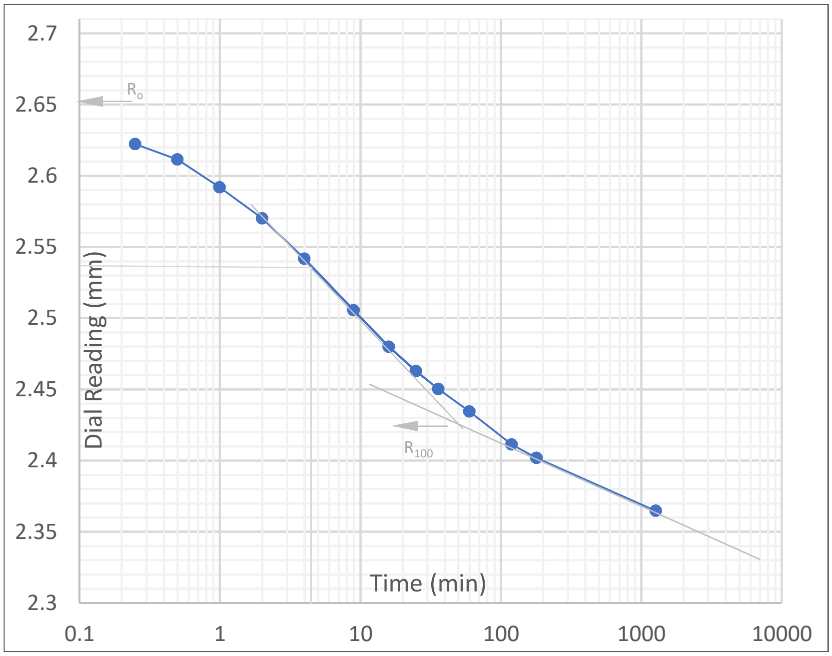
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**4**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	T44
Sample	TWS 6B
Depth	4.88 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Load 3

Load Inc.lbs	1	R_0	2.650
kPa	50-100	R_{100}	2.425
Start Date	02-Aug-18	R_{50}	2.538
Correction (mm	-	t_{50}	0.35

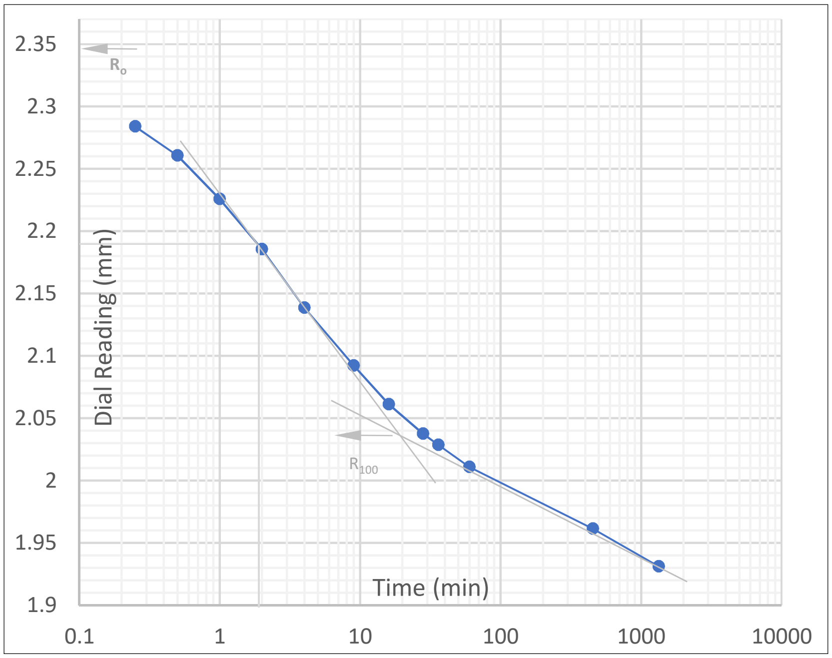
Time	Elapsed Time (min)	Reading (mm)
13:00:00	0	2.7011
13:00:15	0.25	2.6222
13:00:30	0.5	2.6113
13:01:00	1	2.5919
13:02:00	2	2.57
13:04:00	4	2.5416
13:09:00	9	2.5056
13:16:00	16	2.4798
13:25:00	25	2.4628
13:36:00	36	2.4501
14:00:00	60	2.4344
15:00:00	120	2.4112
16:00:00	180	2.4019
10:12:00	1272	2.3647



Load 4

Load Inc.lbs	2	R_0	2.345
kPa	100-200	R_{100}	2.035
Start Date	03-Aug-18	R_{50}	2.19
Correction (mm	-	t_{50}	14

Time	Elapsed Time (min)	Reading (mm)
11:00:00	0	2.3635
11:00:15	0.25	2.2839
11:00:30	0.5	2.2607
11:01:00	1	2.2256
11:02:00	2	2.1854
11:04:00	4	2.1384
11:09:00	9	2.0922
11:16:00	16	2.061
11:28:00	28	2.0376
11:36:00	36	2.0284
12:00:00	60	2.0108
18:35:00	455	1.9614
9:20:00	1340	1.9311



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ASTM D-2435 Consolidation Test

Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**5**	of	**5**

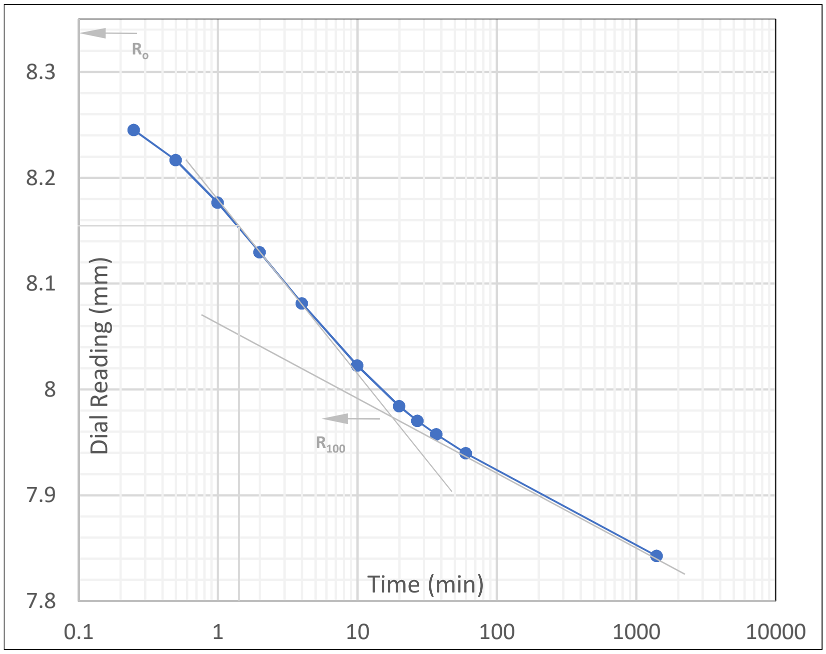
Client	Nation Rise Wind Project
Project	18-4022
BH#	T44
Sample	TWS 6B
Depth	4.88 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Load 5

Load Inc.(kg)	4
kPa	200-400
Start Date	05-Aug-18
Correction (mm	-

R_0	8.335
R_{100}	7.972
R_{50}	8.154
t_{50}	3.1

Time	Elapsed Time (min)	Reading (mm)
9:25:00	0	8.3422
9:25:15	0.25	8.245
9:25:30	0.5	8.2166
9:26:00	1	8.1762
9:27:00	2	8.1296
9:29:00	4	8.0812
9:35:00	10	8.0224
9:45:00	20	7.984
9:52:00	27	7.97
10:02:00	37	7.9575
10:25:00	60	7.9394
10:00:00	1405	7.8424



Load 6

Load Inc. (kg)	4
kPa	400-200
Start Date	07-Aug-18
Correction (mm)	

Time	Elapsed Time (min)	Reading (mm)
10:00:00	0	7.8419
10:01:00	1	7.8739
15:45:00	345	7.8789

Load 7

Load Inc. (kg)	4
kPa	200-100
Start Date	07-Aug-18
Correction (mm	-

Time	Elapsed Time (min)	Reading (mm)
16:51:00	0	7.8772
16:53:00	2	7.9106
17:20	29	7.9205

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Project Number	**18-4022**			Test No. 1
Document Number	**18-4022-1**			
Sheet	**1**		of	**5**

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay (CL)
Tested By	J.H.
Machine #	1

Moisture Before Test		
Tin I.D.	01	
Tare (g)	0.4	
Tare + WS (g)	54.9	
Tare + DS (g)	43.5	
% Moist	**26.5%**	

	Before Test	**After Test**
Height (cm)	1.5	1.17
Diameter (cm)	5	5
Area (cm²)	19.63	19.63
Volume (cm³)	29.45	22.9
Ring + Wet Sample (gm)	102.4	101.8
Ring + Dry Sample (gm)	-	84
Water(gm)	-	17.8
Ring(gm)	50.2	50.2
Wet Sample (gm)	52.2	49.5
Water Content (%)	55.7	35.9
Dry Weight (gm)	-	33.8
Dry Density (gm/cm³)		1.48
Dry Unit Weight (kN/m³)		14.5
Specific Gravity	2.7	2.7
Degree of Saturation (%)	100%	100%
Volume of Solids (cm³)		11.78
Height of Solids (cm)	0.6	0.6
Void Ratio	1.504	0.95

Legend

N/A not applicable

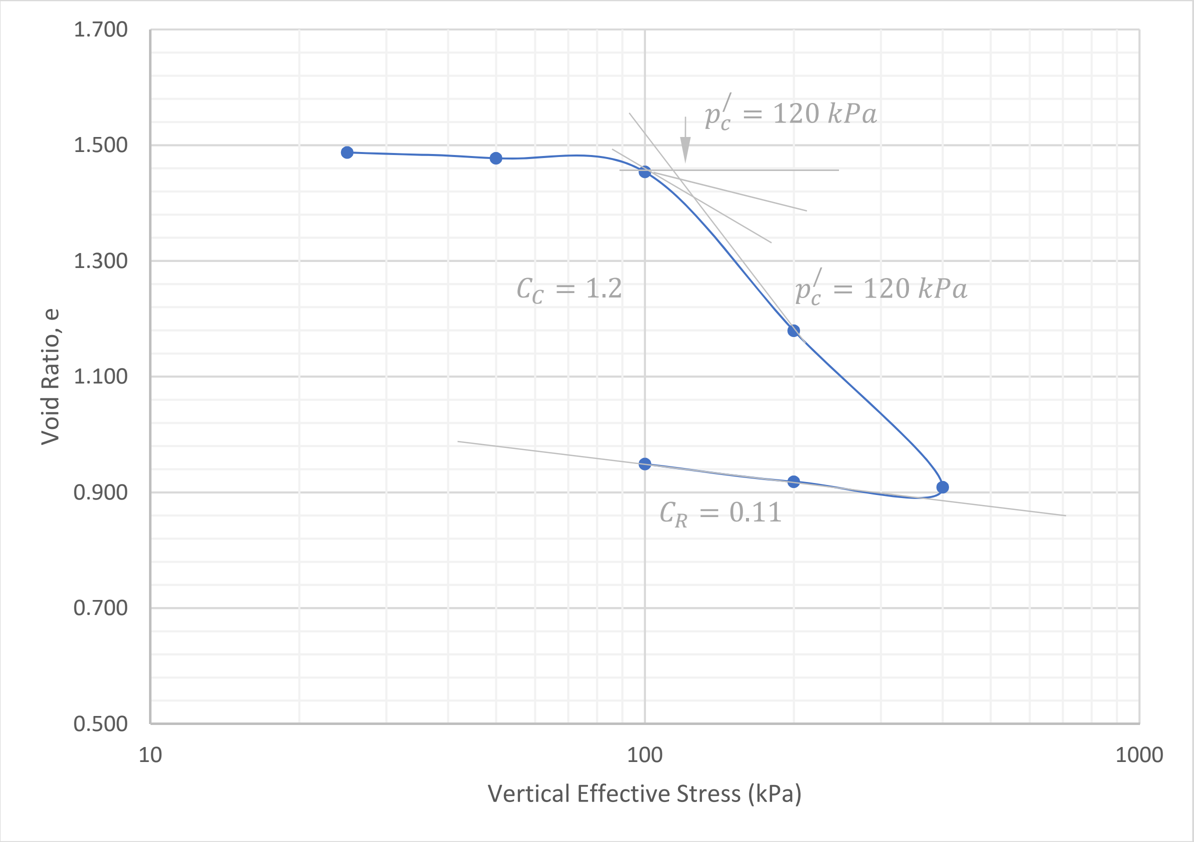
Hanger Load Kg	**Pressure** kPa	**Change in** mm	**New Height** mm	**Strain** %	**Void Height** mm	**Void Ratio** e	**t-50/t-90** min	**Cv** m²/y
0.5	25	0.099	14.901	0.66%	89.901	1.487	0.35	16.2
1	50	0.060	14.841	0.40%	89.841	1.477	1.44	17.2
2	100	0.142	14.699	0.96%	89.699	1.454	0.35	15.6
4	200	1.646	13.053	11.20%	88.053	1.179	14	0.4
8	400	1.624	11.429	12.44%	86.429	0.909	3.1	1.1
4	200	-0.0579	11.487	-0.51%	86.487	0.918	-	-
2	100	-0.1831	11.670	-1.59%	86.670	0.949	-	-

Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**2** of **5**

ASTM D-2435 Consolidation Test

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH
Machine #	1

Nation Rise Wind Project
WTG23 TWS6 5.02m



TULLOCH

ASTM D-2435 Consolidation Test

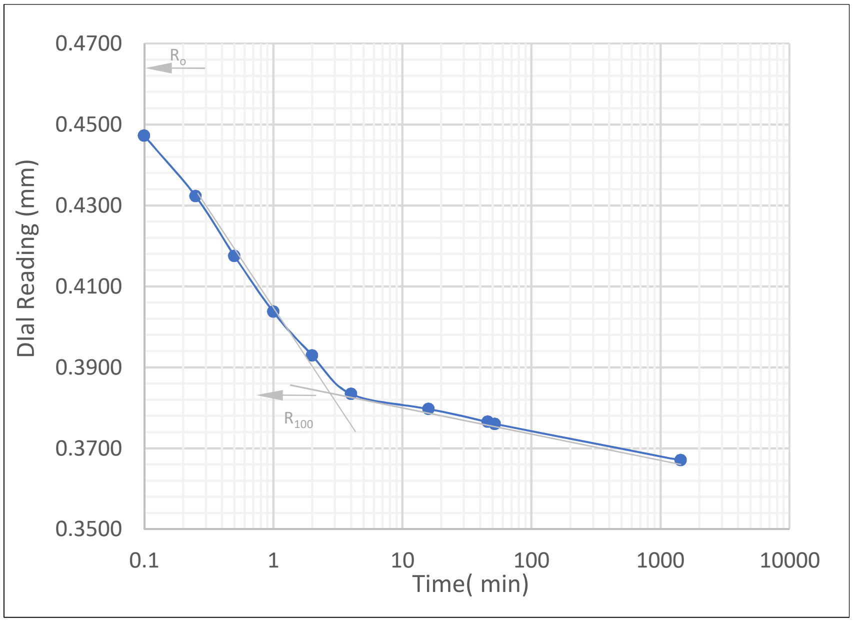
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**3**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 1

Load Inc. (kg)	0.5	R_0	0.466
kPa	0-25	R_{100}	0.383
Start Date	18-Jun-18	R_{50}	0.424
Correction (mm	-	t_{50}	0.39

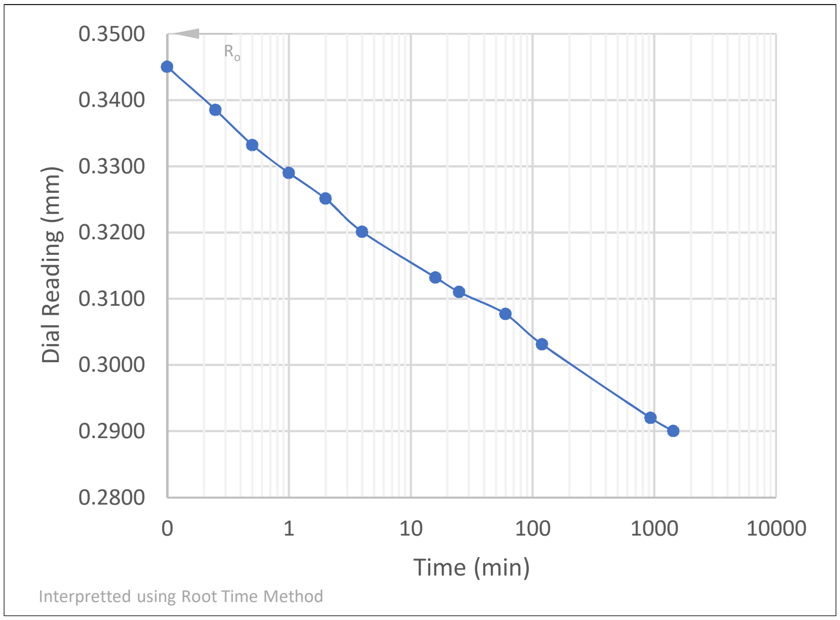
Time	Elapsed Time (min)	Reading (mm)
14:11:00	0	0.5120
14:11:15	0.1	0.4472
14:11:15	0.25	0.4323
14:11:30	0.5	0.4175
14:12:00	1	0.4037
14:13:00	2	0.3929
14:15:00	4	0.3834
14:27:00	16	0.3797
14:57:00	46	0.3765
15:03:00	52	0.3760
14:10:00	1439	0.3670



Load 2

Load Inc.(kg)	0.5	R_0	0.350
kPa	25-50	R_{90}	0.329
Start Date	19-Jun-18	t_{90}	1.44
Correction (mm	-		

Time	Elapsed Time (min)	Reading (mm)
14:16:00	0.00	0.3620
14:16:00	0.10	0.3450
14:16:15	0.25	0.3385
14:16:30	0.50	0.3332
14:17:00	1.00	0.3290
14:18:00	2.00	0.3251
14:20:00	4.00	0.3201
14:32:00	16.00	0.3132
14:41:00	25.00	0.3110
15:16:00	60.00	0.3077
16:16:00	120.00	0.3031
8:47:00	931.00	0.2920
14:10:00	1434.00	0.2900



TULLOCH

ASTM D-2435 Consolidation Test

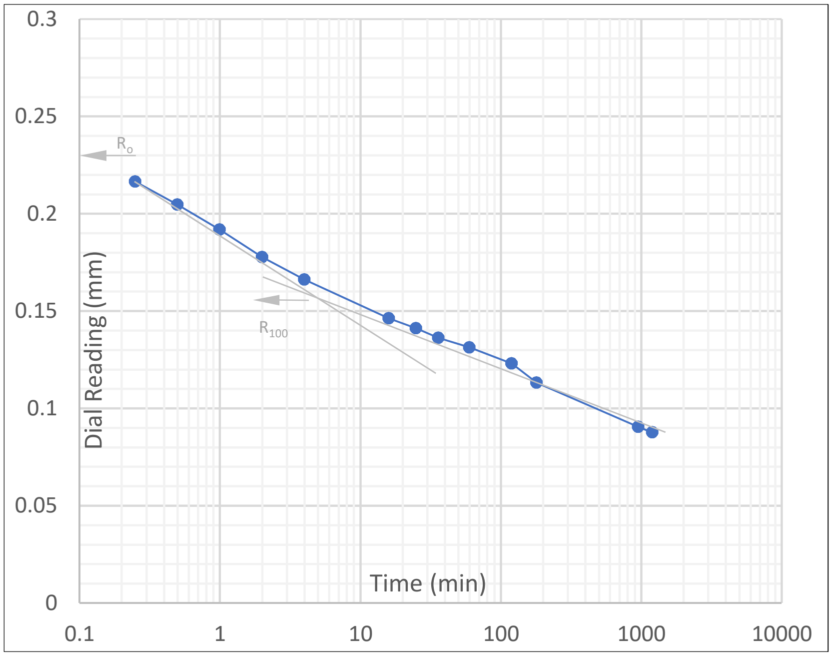
Project Number	**18-4022**
Document Number	**18-4022-1**
Sheet	**4** of **5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH
Machine #	1

Load 3

Load Inc.lbs	1	R_0	0.23
kPa	50-100	R_{100}	0.158
Start Date	20-Jun-18	R_{50}	0.194
Correction (mm	-	t_{50}	0.35

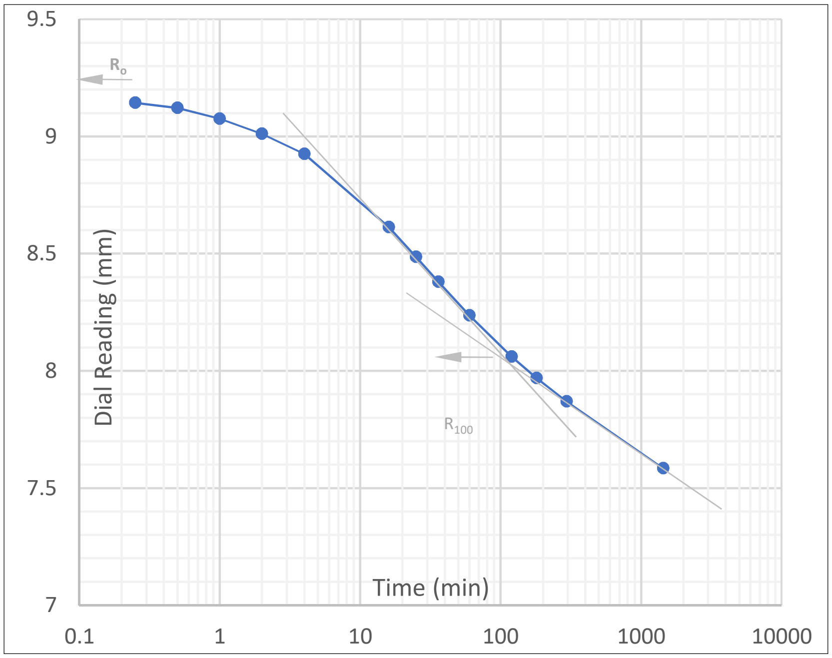
Time	Elapsed Time (min)	Reading (mm)
14:28:00	0	0.2919
14:28:15	0.25	0.2165
14:28:30	0.5	0.2047
14:29:00	1	0.1918
14:30:00	2	0.1776
14:32:00	4	0.1661
14:44:00	16	0.1462
14:53:00	25	0.1412
15:04:00	36	0.1362
15:28:00	60	0.1312
16:28:00	120	0.1231
17:28:00	180	0.1131
+1d, 6:56:00	956	0.0904
12:28:00	1202	0.0876



Load 4

Load Inc.lbs	2	R_0	9.23
kPa	100-200	R_{100}	8.05
Start Date	21-Jun-18	R_{50}	8.64
Correction (mm	-	t_{50}	14

Time	Elapsed Time (min)	Reading (mm)
12:30:00	0	9.2358
12:30:15	0.25	9.1429
12:30:30	0.5	9.1207
12:31:00	1	9.0743
12:32:00	2	9.0101
12:34:00	4	8.9243
12:46:00	16	8.6125
12:55:00	25	8.4853
13:06:00	36	8.3786
13:30:00	60	8.2365
14:30:00	120	8.0598
15:30:00	180	7.9691
17:25:00	295	7.8693
1d + 12:30:00	1440	7.5843



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ASTM D-2435 Consolidation Test

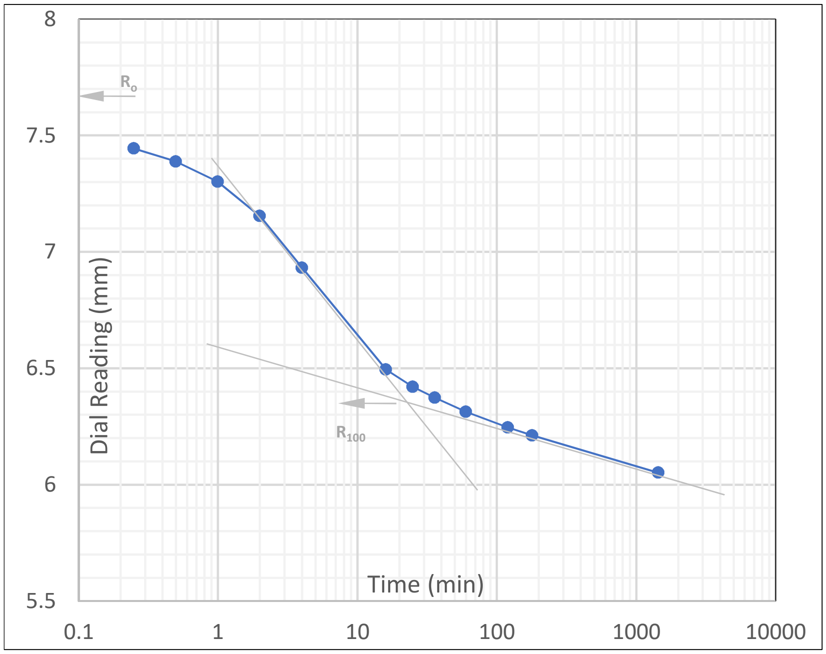
Project Number	**18-4022**		
Document Number	**18-4022-1**		
Sheet	**5**	of	**5**

Client	Nation Rise Wind Project
Project	18-4022
BH#	WTG 23
Sample	TWS 6
Depth	5.02 m
Sample Type	Silty Clay
Tested By	JH & SH
Machine #	1

Load 5

Load Inc.(kg)	4	R_0	7.675
kPa	200-400	R_{100}	6.36
Start Date	22-Jun-18	R_{50}	7.018
Correction (mm	-	t_{50}	3.1

Time	**Elapsed Time (min)**	**Reading (mm)**
13:00:00	0	7.5837
13:00:15	0.25	7.4441
13:00:30	0.5	7.3882
13:01:00	1	7.3018
13:02:00	2	7.1542
13:04:00	4	6.9314
13:16:00	16	6.4945
13:25:00	25	6.4199
13:36:00	36	6.374
14:00:00	60	6.3128
15:00:00	120	6.2456
16:00:00	180	6.2117
1d + 13:00:00	1440	6.0511



Load 6

Load Inc. (kg)	4
kPa	400-200
Start Date	23-Jun-18
Correction (mm)	

Time	**Elapsed Time (min)**	**Reading (mm)**
14:28:00	0	6.0511
13:00:00		6.109

Load 7

Load Inc. (kg)	4
kPa	200-100
Start Date	24-Jun-18
Correction (mm	-

Time	**Elapsed Time (min)**	**Reading (mm)**
13:10:00	0	6.109
13:10:00	0.25	6.2921

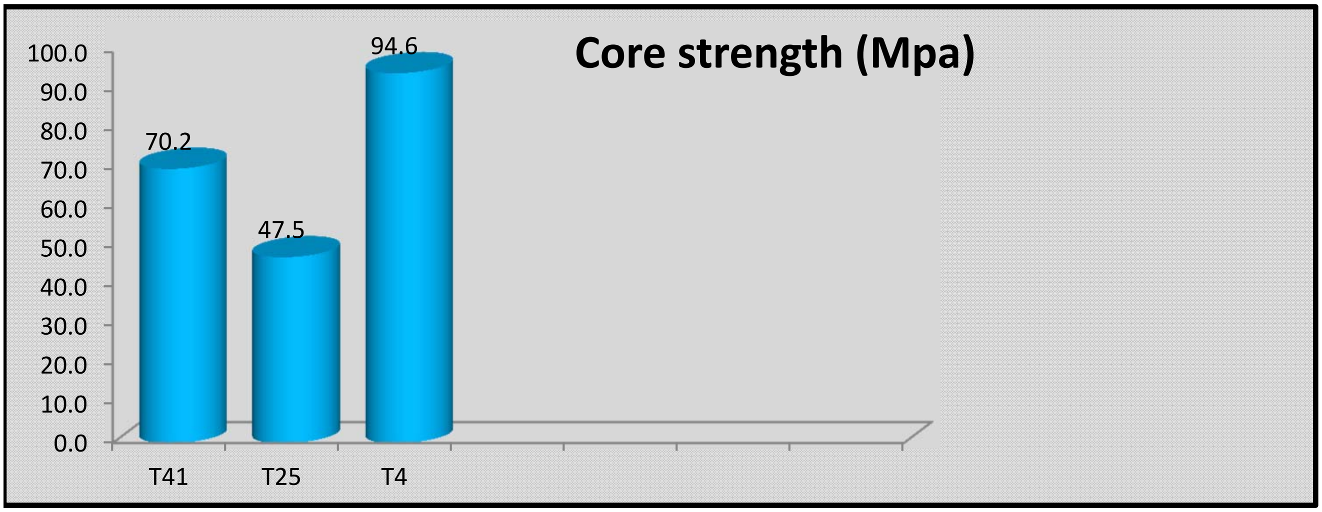
ROCK CORE COMPRESSIVE STRENGTH

Rock Core Compressive Strength Report

PROJECT: Nation Rise
DATE SAMPLED: Refer to Sample Log
DATE TESTED: Aug 10/18

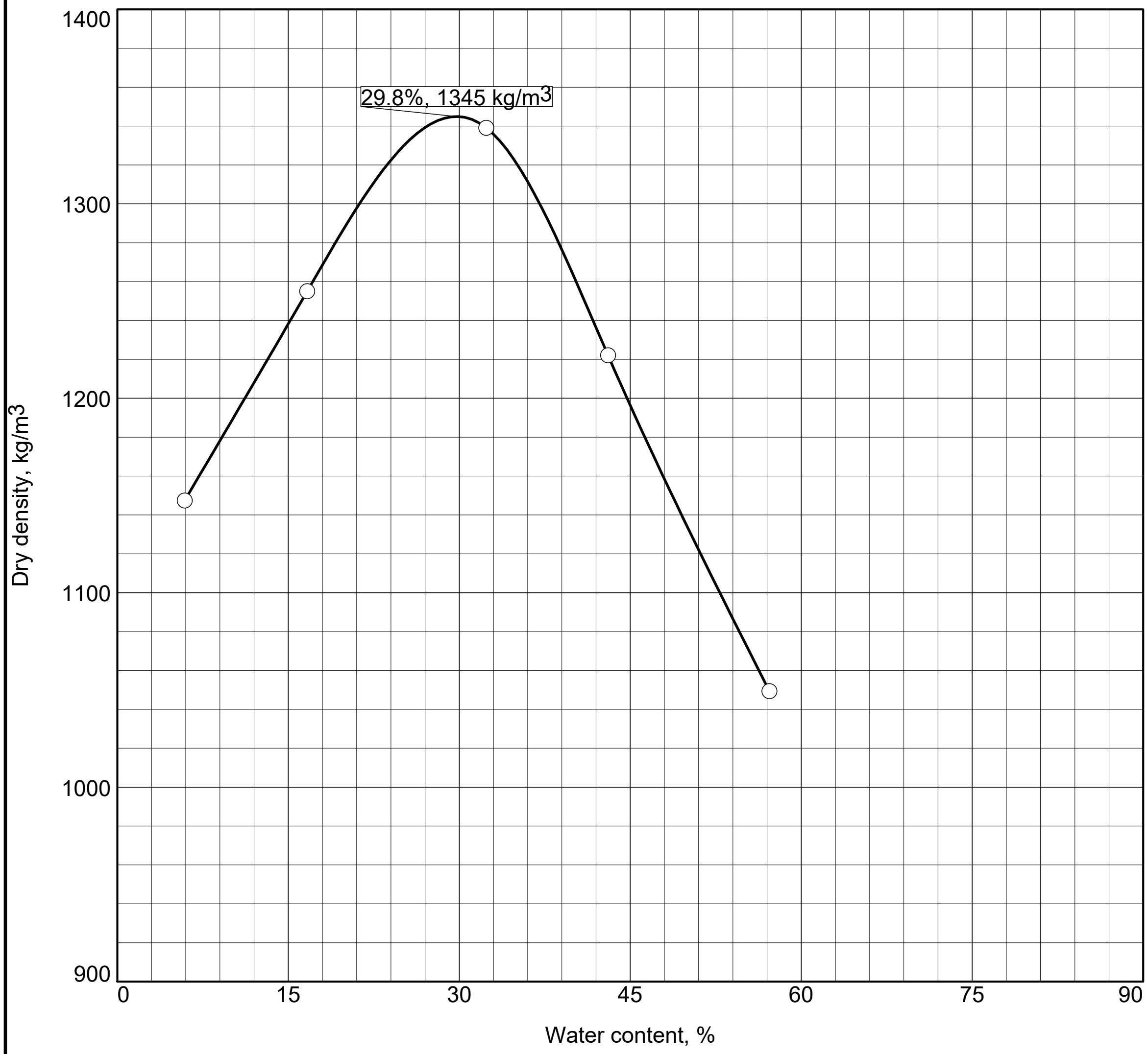
CONTRACT: **18-4022**
RUN BY: **J.Draper**
SOURCE: **BH**

Sample Location	Run #	Distance from top of run (cm)	Height (mm)	Diameter (mm)	Peak Load (lbs)	Compressive Stength (Mpa)
T41	3	63	94.92	47.46	27900	70.2
T25	3	79	94.90	47.45	18900	47.5
T4	4	73	93.98	46.99	36900	94.6



COMPACTION TEST REPORT

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 1345 kg/m^3 Optimum moisture = 29.8 %	

Project No. 18-4022 **Client:** EDP

Project: Nation Rise Wind Farm

○ **Source:** Cement Stabilization SA5 & SA11 **Sample No.:** PD 3036

Remarks:

Mixed SA5 and SA11

TULLOCH ENGINEERING
71 Black Road
Unit 3
Sault Ste.
Marie, ON
P6B 0A3
T. 705 949.1457
F. 705 949.9606
TF. 866 806.6602
adam.byers@TULLOCH.ca

Figure

Tested By: D.Stadnisky **Checked By:** T. Linley

MOISTURE DENSITY TEST DATA

2018-10-12

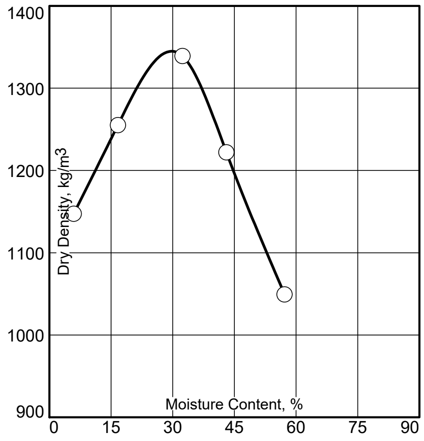
Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: Cement Stabilization SA5 & SA11
Sample Number: PD 3036
Testing Remarks: Mixed SA5 and SA11
Tested by: D.Stadnisky **Checked by:** T. Linley

Test Data and Results

Test Specification:

Type of Test: ASTM D 698-12 Method A Standard

Mold Dia: 4.00 **Hammer Wt.:** 5.5 lb. **Drop:** 12 in. **Layers:** three **Blows per Layer:** 25



Point No.	1	2	3	4	5
Wt. M+S	5647.0	5882.0	6173.0	6150.0	6057.0
Wt. M	4500.0	4500.0	4500.0	4500.0	4500.0
Wt. W+T	295.4	275.1	292.4	298.6	372.2
Wt. D+T	287.6	260.1	260.9	254.0	296.0
Tare	155.7	170.1	163.6	150.4	162.8
Moist.	5.9	16.7	32.4	43.1	57.2
Dry Den.	1147	1255	1339	1222	1049

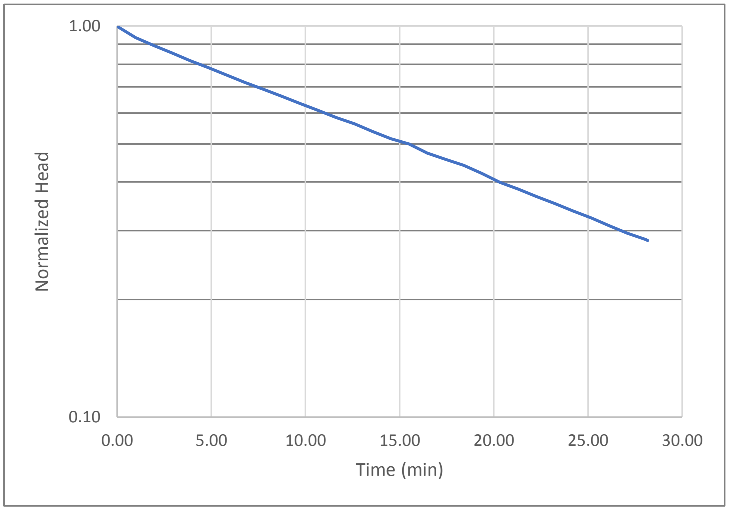
Test Results: **Max. Dry Den.=** 1345 kg/m^3 **Opt. Moist.=** 29.8%

APPENDIX E

BOREHOLE FALLING HEAD TESTS

Slug Test Interpretation

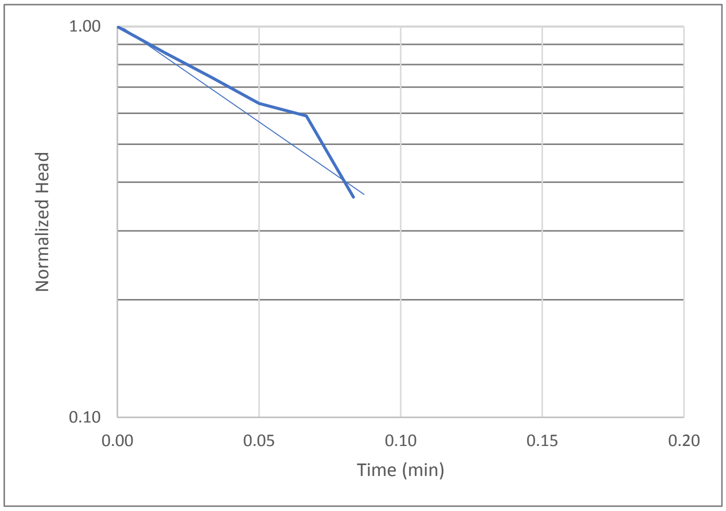
Project ID:		
184022		
Location:		
Nation Rise WTG6		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	0.869	m
T_L (s)	1320	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	1.4E-05	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/9/2018	4:09:56 PM	0.00	3.0625	1.00	16.097
7/9/2018	4:10:55 PM	0.98	2.9224	0.94	15.321
7/9/2018	4:11:53 PM	1.95	2.8272	0.89	15.047
7/9/2018	4:12:51 PM	2.92	2.7425	0.85	14.904
7/9/2018	4:13:49 PM	3.88	2.661	0.82	14.812
7/9/2018	4:14:47 PM	4.85	2.5876	0.78	14.743
7/9/2018	4:16:44 PM	6.80	2.4452	0.72	14.621
7/9/2018	4:17:42 PM	7.77	2.3832	0.69	14.567
7/9/2018	4:18:40 PM	8.73	2.3221	0.66	14.511
7/9/2018	4:19:38 PM	9.70	2.2612	0.63	14.457
7/9/2018	4:20:36 PM	10.67	2.2063	0.61	14.415
7/9/2018	4:21:34 PM	11.63	2.1504	0.58	14.373
7/9/2018	4:22:32 PM	12.60	2.1034	0.56	14.329
7/9/2018	4:23:30 PM	13.57	2.0501	0.54	14.29
7/9/2018	4:24:28 PM	14.53	2.0011	0.52	14.257
7/9/2018	4:25:26 PM	15.50	1.9654	0.50	14.228
7/9/2018	4:26:24 PM	16.47	1.9084	0.47	14.198
7/9/2018	4:27:22 PM	17.43	1.8702	0.46	14.172
7/9/2018	4:28:20 PM	18.40	1.8356	0.44	14.195
7/9/2018	4:29:18 PM	19.37	1.7908	0.42	14.208
7/9/2018	4:30:16 PM	20.33	1.7442	0.40	14.19
7/9/2018	4:31:14 PM	21.30	1.7101	0.38	14.162
7/9/2018	4:32:12 PM	22.27	1.6741	0.37	14.132
7/9/2018	4:33:10 PM	23.23	1.6408	0.35	14.102
7/9/2018	4:34:08 PM	24.20	1.6086	0.34	14.077
7/9/2018	4:35:06 PM	25.17	1.5785	0.32	14.059
7/9/2018	4:36:04 PM	26.13	1.5459	0.31	14.044
7/9/2018	4:37:02 PM	27.10	1.5166	0.30	14.031
7/9/2018	4:38:00 PM	28.07	1.4936	0.28	14.024
7/9/2018	4:38:01 PM	28.08	1.4928	0.28	14.024
7/9/2018	4:38:06 PM	28.17	1.49	0.28	14.024

Slug Test Interpretation

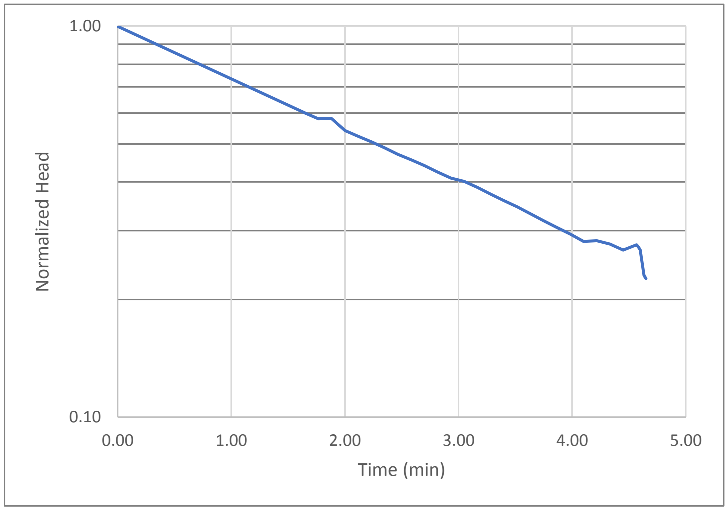
Project ID:		
184022		
Location:		
Nation Rise WTG41		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	7.08	m
T_L (s)	6	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	4.0E-03	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	10:07:39 AM	0.00	7.1961	1.00	10.527
7/6/2018	10:07:40 AM	0.02	7.1797	0.86	10.508
7/6/2018	10:07:41 AM	0.03	7.166	0.74	10.489
7/6/2018	10:07:42 AM	0.05	7.1538	0.64	10.471
7/6/2018	10:07:43 AM	0.07	7.1486	0.59	10.453
7/6/2018	10:07:44 AM	0.08	7.1225	0.37	10.434

Slug Test Interpretation

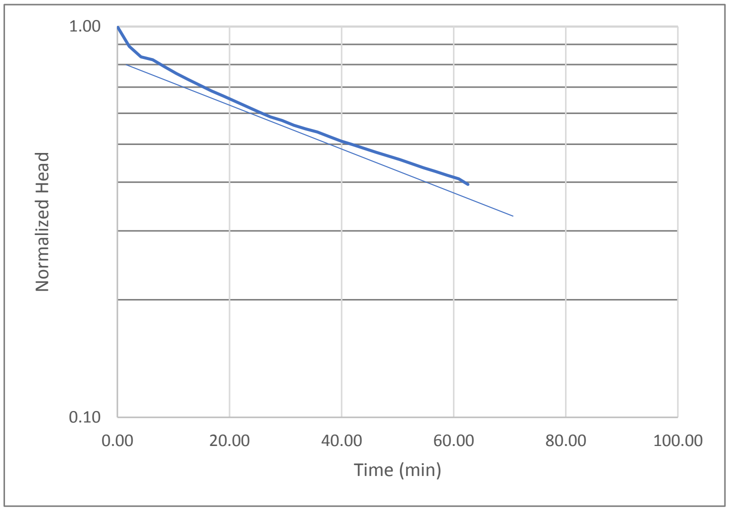
Project ID:		
184022		
Location:		
Nation Rise WTG4		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	3.8705	m
T_L (s)	204	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	1.2E-04	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	11:40:40 AM	0.00	5.7574	1.00	16.116
7/6/2018	11:42:19 AM	1.65	5.003	0.60	11.074
7/6/2018	11:42:26 AM	1.77	4.9656	0.58	10.933
7/6/2018	11:42:33 AM	1.88	4.9671	0.58	10.804
7/6/2018	11:42:40 AM	2.00	4.8911	0.54	10.686
7/6/2018	11:42:47 AM	2.12	4.8571	0.52	10.577
7/6/2018	11:42:54 AM	2.23	4.8257	0.51	10.476
7/6/2018	11:43:01 AM	2.35	4.7926	0.49	10.383
7/6/2018	11:43:08 AM	2.47	4.7581	0.47	10.297
7/6/2018	11:43:15 AM	2.58	4.7296	0.46	10.217
7/6/2018	11:43:22 AM	2.70	4.7007	0.44	10.142
7/6/2018	11:43:29 AM	2.82	4.6705	0.42	10.072
7/6/2018	11:43:36 AM	2.93	4.6427	0.41	10.007
7/6/2018	11:43:43 AM	3.05	4.6275	0.40	9.946
7/6/2018	11:43:50 AM	3.17	4.6005	0.39	9.885
7/6/2018	11:43:57 AM	3.28	4.5728	0.37	9.825
7/6/2018	11:44:04 AM	3.40	4.5466	0.36	9.765
7/6/2018	11:44:11 AM	3.52	4.5215	0.35	9.708
7/6/2018	11:44:18 AM	3.63	4.4958	0.33	9.653
7/6/2018	11:44:25 AM	3.75	4.4706	0.32	9.602
7/6/2018	11:44:32 AM	3.87	4.4469	0.31	9.554
7/6/2018	11:44:39 AM	3.98	4.4253	0.29	9.508
7/6/2018	11:44:46 AM	4.10	4.4017	0.28	9.463
7/6/2018	11:44:53 AM	4.22	4.4039	0.28	9.421
7/6/2018	11:45:00 AM	4.33	4.3935	0.28	9.38
7/6/2018	11:45:07 AM	4.45	4.3751	0.27	9.34
7/6/2018	11:45:14 AM	4.57	4.3915	0.28	9.302
7/6/2018	11:45:15 AM	4.58	4.384	0.27	9.297
7/6/2018	11:45:16 AM	4.60	4.3763	0.27	9.292
7/6/2018	11:45:18 AM	4.63	4.3054	0.23	9.28
7/6/2018	11:45:19 AM	4.65	4.2974	0.23	9.275

Slug Test Interpretation

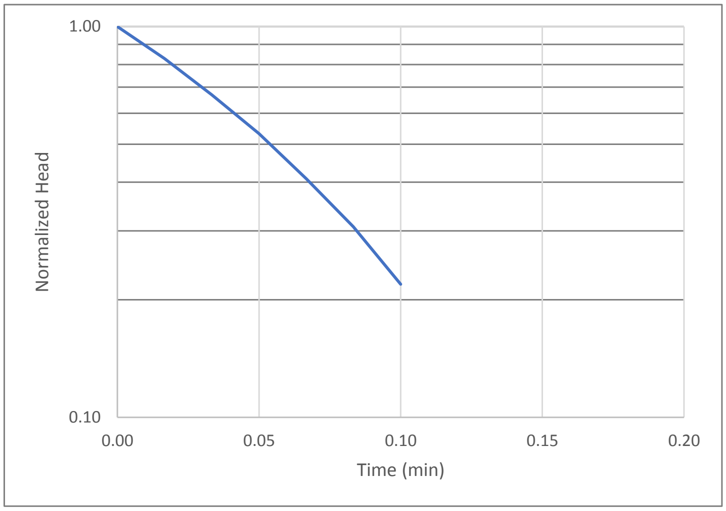
Project ID:		
184022		
Location:		
Nation Rise WTG5		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	5.1467	m
T_L (s)	4200	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	4.5E-06	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/7/2018	9:10:28 AM	0.00	6.2919	1.00	13.286
7/7/2018	9:12:34 AM	2.10	6.1665	0.89	9.593
7/7/2018	9:14:40 AM	4.20	6.1051	0.84	8.838
7/7/2018	9:16:46 AM	6.30	6.089	0.82	8.565
7/7/2018	9:18:52 AM	8.40	6.0507	0.79	8.39
7/7/2018	9:20:58 AM	10.50	6.0159	0.76	8.246
7/7/2018	9:23:04 AM	12.60	5.985	0.73	8.117
7/7/2018	9:25:10 AM	14.70	5.9577	0.71	8
7/7/2018	9:27:16 AM	16.80	5.9304	0.68	7.901
7/7/2018	9:29:22 AM	18.90	5.907	0.66	7.813
7/7/2018	9:31:28 AM	21.00	5.8844	0.64	7.76
7/7/2018	9:33:34 AM	23.10	5.8616	0.62	7.736
7/7/2018	9:35:40 AM	25.20	5.8397	0.61	7.721
7/7/2018	9:37:46 AM	27.30	5.8198	0.59	7.71
7/7/2018	9:39:52 AM	29.40	5.805	0.57	7.706
7/7/2018	9:41:58 AM	31.50	5.7871	0.56	7.712
7/7/2018	9:44:04 AM	33.60	5.7736	0.55	7.731
7/7/2018	9:46:10 AM	35.70	5.7624	0.54	7.753
7/7/2018	9:48:16 AM	37.80	5.7455	0.52	7.77
7/7/2018	9:50:22 AM	39.90	5.7295	0.51	7.786
7/7/2018	9:52:28 AM	42.00	5.7177	0.50	7.8
7/7/2018	9:54:34 AM	44.10	5.7045	0.49	7.81
7/7/2018	9:56:40 AM	46.20	5.6921	0.48	7.819
7/7/2018	9:58:46 AM	48.30	5.681	0.47	7.821
7/7/2018	10:00:52 AM	50.40	5.6695	0.46	7.821
7/7/2018	10:02:58 AM	52.50	5.6573	0.45	7.818
7/7/2018	10:05:04 AM	54.60	5.6452	0.44	7.817
7/7/2018	10:07:10 AM	56.70	5.635	0.43	7.816
7/7/2018	10:09:16 AM	58.80	5.6241	0.42	7.812
7/7/2018	10:11:22 AM	60.90	5.614	0.41	7.808
7/7/2018	10:13:01 AM	62.55	5.5985	0.39	7.805

Slug Test Interpretation

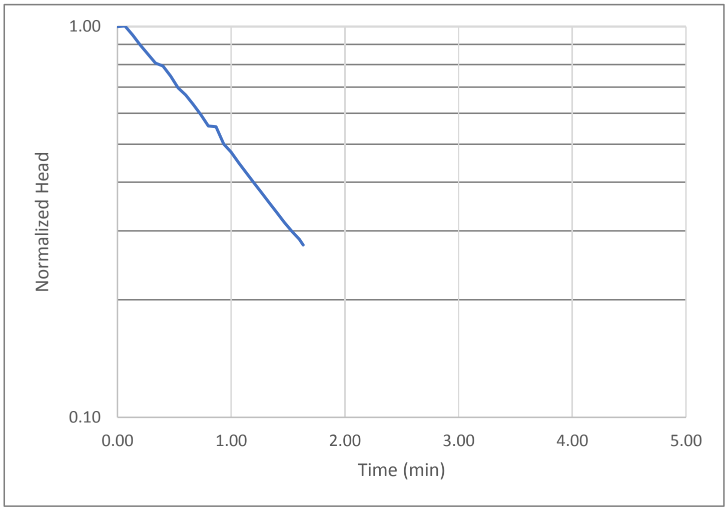
Project ID:		
184022		
Location:		
Nation Rise WTG6		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	3.062	m
T_L (s)	4.8	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	5.1E-03	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	2:06:00 PM	0.00	3.7831	1.00	12.469
7/6/2018	2:06:01 PM	0.02	3.6597	0.83	12.427
7/6/2018	2:06:02 PM	0.03	3.5444	0.67	12.387
7/6/2018	2:06:03 PM	0.05	3.4455	0.53	12.346
7/6/2018	2:06:04 PM	0.07	3.3563	0.41	12.306
7/6/2018	2:06:05 PM	0.08	3.2836	0.31	12.267
7/6/2018	2:06:06 PM	0.10	3.22	0.22	12.228

Slug Test Interpretation

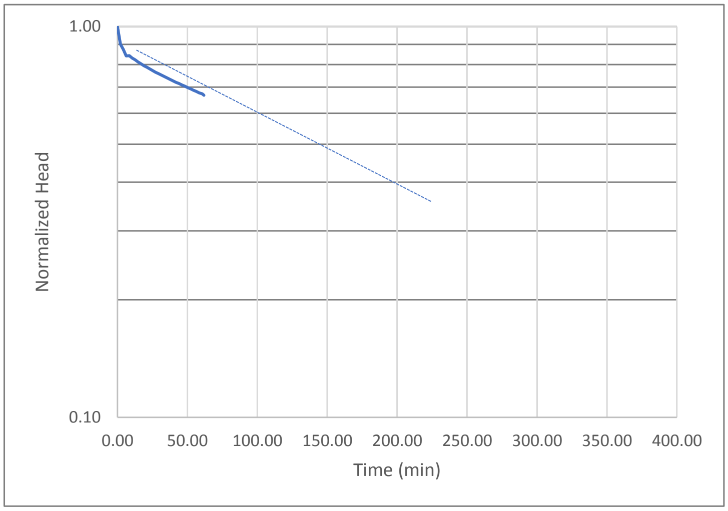
Project ID:		
184022		
Location:		
Nation Rise WTG7		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	6.516	m
T_L (s)	76.8	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	3.2E-04	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	12:55:11 PM	0.00	8.1892	1.00	12.566
7/6/2018	12:55:15 PM	0.07	8.1949	1.00	12.352
7/6/2018	12:55:19 PM	0.13	8.1083	0.95	12.154
7/6/2018	12:55:23 PM	0.20	8.0183	0.90	11.968
7/6/2018	12:55:27 PM	0.27	7.9403	0.85	11.794
7/6/2018	12:55:31 PM	0.33	7.8645	0.81	11.632
7/6/2018	12:55:35 PM	0.40	7.8423	0.79	11.48
7/6/2018	12:55:39 PM	0.47	7.7665	0.75	11.338
7/6/2018	12:55:43 PM	0.53	7.6827	0.70	11.205
7/6/2018	12:55:47 PM	0.60	7.6343	0.67	11.081
7/6/2018	12:55:51 PM	0.67	7.5738	0.63	10.963
7/6/2018	12:55:55 PM	0.73	7.512	0.60	10.853
7/6/2018	12:55:59 PM	0.80	7.4478	0.56	10.749
7/6/2018	12:56:03 PM	0.87	7.4434	0.55	10.651
7/6/2018	12:56:07 PM	0.93	7.3534	0.50	10.559
7/6/2018	12:56:11 PM	1.00	7.3141	0.48	10.473
7/6/2018	12:56:15 PM	1.07	7.2652	0.45	10.39
7/6/2018	12:56:19 PM	1.13	7.2226	0.42	10.312
7/6/2018	12:56:23 PM	1.20	7.1825	0.40	10.239
7/6/2018	12:56:27 PM	1.27	7.1455	0.38	10.169
7/6/2018	12:56:31 PM	1.33	7.1093	0.35	10.103
7/6/2018	12:56:35 PM	1.40	7.077	0.34	10.041
7/6/2018	12:56:39 PM	1.47	7.044	0.32	9.982
7/6/2018	12:56:43 PM	1.53	7.0165	0.30	9.926
7/6/2018	12:56:47 PM	1.60	6.9941	0.29	9.873
7/6/2018	12:56:48 PM	1.62	6.9858	0.28	9.861
7/6/2018	12:56:49 PM	1.63	6.978	0.28	9.848

Slug Test Interpretation

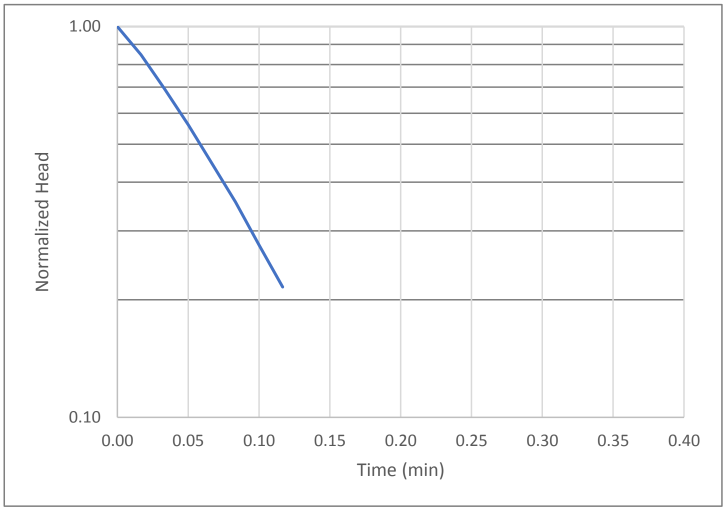
Project ID:		
184022		
Location:		
Nation Rise WTG10		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	3.118	m
T_L (s)	12600	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	1.5E-06	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/9/2018	7:08:41 PM	0.00	4.9681	1.00	12.597
7/9/2018	7:10:47 PM	2.10	4.7868	0.90	10.242
7/9/2018	7:12:53 PM	4.20	4.7352	0.87	9.65
7/9/2018	7:14:59 PM	6.30	4.6753	0.84	9.334
7/9/2018	7:17:05 PM	8.40	4.6773	0.84	9.107
7/9/2018	7:19:11 PM	10.50	4.6557	0.83	8.989
7/9/2018	7:21:17 PM	12.60	4.6387	0.82	8.922
7/9/2018	7:23:23 PM	14.70	4.6201	0.81	8.854
7/9/2018	7:25:29 PM	16.80	4.6026	0.80	8.799
7/9/2018	7:27:35 PM	18.90	4.5875	0.79	8.741
7/9/2018	7:29:41 PM	21.00	4.5737	0.79	8.688
7/9/2018	7:31:47 PM	23.10	4.5598	0.78	8.662
7/9/2018	7:33:52 PM	25.18	4.5451	0.77	8.647
7/9/2018	7:35:57 PM	27.27	4.5328	0.76	8.677
7/9/2018	7:38:02 PM	29.35	4.5204	0.76	8.739
7/9/2018	7:40:07 PM	31.43	4.5075	0.75	8.815
7/9/2018	7:42:12 PM	33.52	4.4963	0.74	8.827
7/9/2018	7:44:17 PM	35.60	4.4852	0.74	8.841
7/9/2018	7:46:22 PM	37.68	4.4734	0.73	8.844
7/9/2018	7:48:27 PM	39.77	4.4613	0.73	8.856
7/9/2018	7:50:32 PM	41.85	4.4509	0.72	8.859
7/9/2018	7:52:37 PM	43.93	4.441	0.72	8.841
7/9/2018	7:54:42 PM	46.02	4.43	0.71	8.831
7/9/2018	7:56:47 PM	48.10	4.4203	0.70	8.817
7/9/2018	7:58:52 PM	50.18	4.4091	0.70	8.818
7/9/2018	8:00:57 PM	52.27	4.3996	0.69	8.809
7/9/2018	8:03:02 PM	54.35	4.3893	0.69	8.787
7/9/2018	8:05:07 PM	56.43	4.3798	0.68	8.768
7/9/2018	8:07:12 PM	58.52	4.3701	0.68	8.751
7/9/2018	8:09:17 PM	60.60	4.3633	0.67	8.744
7/9/2018	8:10:30 PM	61.82	4.3524	0.67	8.74

Slug Test Interpretation

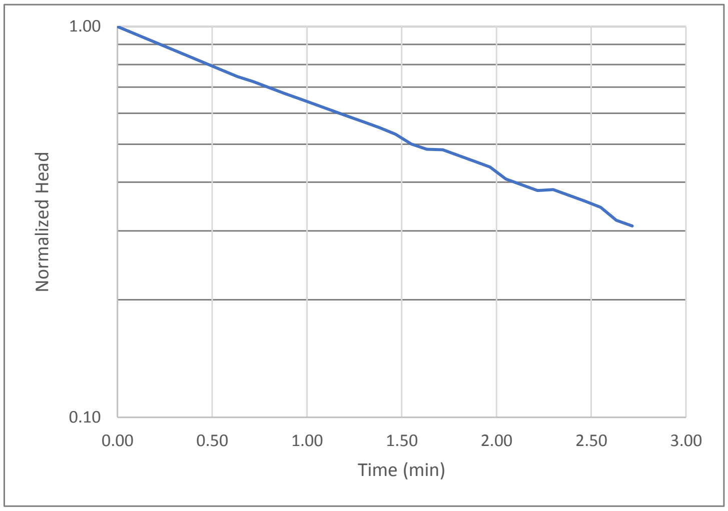
Project ID:		
184022		
Location:		
Nation Rise WTG6		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	5.9167	m
T_L (s)	4.8	
L (cm)	335	
r (cm)	2.54	
R (cm)	10	
K (cm/s)	7.0E-03	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/7/2018	11:11:07 AM	0.00	6.1839	1.00	8.778
7/7/2018	11:11:08 AM	0.02	6.143	0.85	8.77
7/7/2018	11:11:09 AM	0.03	6.102	0.69	8.763
7/7/2018	11:11:10 AM	0.05	6.0666	0.56	8.755
7/7/2018	11:11:11 AM	0.07	6.0362	0.45	8.747
7/7/2018	11:11:12 AM	0.08	6.0117	0.36	8.74
7/7/2018	11:11:13 AM	0.10	5.9905	0.28	8.732
7/7/2018	11:11:14 AM	0.12	5.9743	0.22	8.725

Slug Test Interpretation

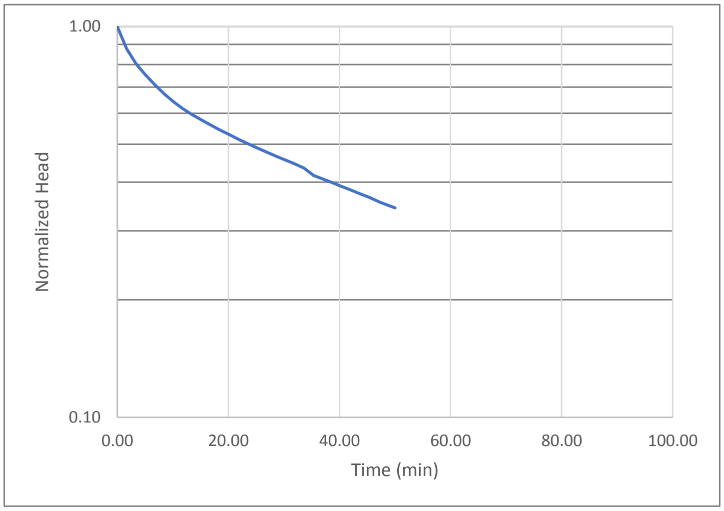
Project ID:		
184022		
Location:		
Nation Rise WTG25		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	2.664	m
T_L (s)	144	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	1.7E-04	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/9/2018	5:34:38 PM	0.00	4.8736	1.00	10.473
7/9/2018	5:35:16 PM	0.63	4.3093	0.74	9.816
7/9/2018	5:35:21 PM	0.72	4.262	0.72	9.755
7/9/2018	5:35:26 PM	0.80	4.2055	0.70	9.698
7/9/2018	5:35:31 PM	0.88	4.153	0.67	9.646
7/9/2018	5:35:36 PM	0.97	4.1042	0.65	9.598
7/9/2018	5:35:41 PM	1.05	4.0564	0.63	9.552
7/9/2018	5:35:46 PM	1.13	4.0112	0.61	9.51
7/9/2018	5:35:51 PM	1.22	3.9665	0.59	9.47
7/9/2018	5:35:56 PM	1.30	3.924	0.57	9.432
7/9/2018	5:36:01 PM	1.38	3.8824	0.55	9.396
7/9/2018	5:36:06 PM	1.47	3.8369	0.53	9.362
7/9/2018	5:36:11 PM	1.55	3.7698	0.50	9.33
7/9/2018	5:36:16 PM	1.63	3.7362	0.49	9.298
7/9/2018	5:36:21 PM	1.72	3.7336	0.48	9.269
7/9/2018	5:36:26 PM	1.80	3.6971	0.47	9.24
7/9/2018	5:36:31 PM	1.88	3.6632	0.45	9.213
7/9/2018	5:36:36 PM	1.97	3.6292	0.44	9.187
7/9/2018	5:36:41 PM	2.05	3.5642	0.41	9.162
7/9/2018	5:36:46 PM	2.13	3.5341	0.39	9.138
7/9/2018	5:36:51 PM	2.22	3.5053	0.38	9.114
7/9/2018	5:36:56 PM	2.30	3.5096	0.38	9.092
7/9/2018	5:37:01 PM	2.38	3.4812	0.37	9.07
7/9/2018	5:37:06 PM	2.47	3.4541	0.36	9.05
7/9/2018	5:37:11 PM	2.55	3.4254	0.34	9.029
7/9/2018	5:37:16 PM	2.63	3.3694	0.32	9.01
7/9/2018	5:37:21 PM	2.72	3.3465	0.31	8.991

Slug Test Interpretation

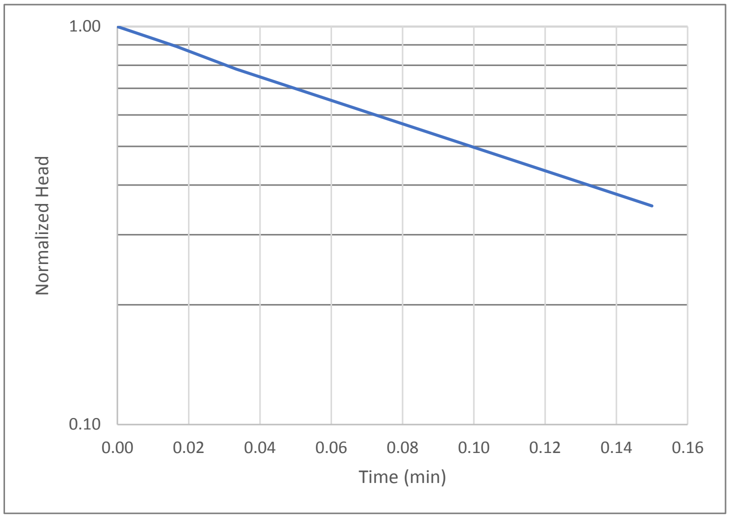
Project ID:		
184022		
Location:		
Nation Rise WTG 28		
LEVEL		
UNIT: m		
Offset: -10.323000 m		
TEMPERATURE		
UNIT: °C		
Ho	6.9775	m
T_L (s)	2700	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	7.0E-06	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/5/2018	10:30:33 AM	0.00	9.273	1.00	14.077
7/5/2018	10:32:14 AM	1.68	8.9893	0.88	10.479
7/5/2018	10:33:55 AM	3.37	8.8204	0.80	9.618
7/5/2018	10:35:36 AM	5.05	8.7058	0.75	9.334
7/5/2018	10:37:17 AM	6.73	8.6062	0.71	9.104
7/5/2018	10:38:58 AM	8.42	8.5221	0.67	8.924
7/5/2018	10:40:39 AM	10.10	8.4513	0.64	8.786
7/5/2018	10:42:20 AM	11.78	8.3933	0.62	8.675
7/5/2018	10:44:01 AM	13.47	8.3441	0.60	8.586
7/5/2018	10:45:42 AM	15.15	8.3007	0.58	8.517
7/5/2018	10:47:23 AM	16.83	8.262	0.56	8.461
7/5/2018	10:49:04 AM	18.52	8.2248	0.54	8.413
7/5/2018	10:50:45 AM	20.20	8.1913	0.53	8.373
7/5/2018	10:52:26 AM	21.88	8.1582	0.51	8.336
7/5/2018	10:54:07 AM	23.57	8.1284	0.50	8.305
7/5/2018	10:55:48 AM	25.25	8.0995	0.49	8.281
7/5/2018	10:57:29 AM	26.93	8.0728	0.48	8.262
7/5/2018	10:59:10 AM	28.62	8.0472	0.47	8.248
7/5/2018	11:00:51 AM	30.30	8.0228	0.46	8.236
7/5/2018	11:02:32 AM	31.98	8	0.45	8.227
7/5/2018	11:04:13 AM	33.67	7.9742	0.43	8.22
7/5/2018	11:05:54 AM	35.35	7.9325	0.42	8.207
7/5/2018	11:07:35 AM	37.03	7.9126	0.41	8.193
7/5/2018	11:09:16 AM	38.72	7.8922	0.40	8.193
7/5/2018	11:10:57 AM	40.40	7.8722	0.39	8.196
7/5/2018	11:12:38 AM	42.08	7.8531	0.38	8.199
7/5/2018	11:14:19 AM	43.77	7.8344	0.37	8.2
7/5/2018	11:16:00 AM	45.45	7.8162	0.37	8.198
7/5/2018	11:17:41 AM	47.13	7.7943	0.36	8.197
7/5/2018	11:19:22 AM	48.82	7.7772	0.35	8.191
7/5/2018	11:20:34 AM	50.02	7.7663	0.34	8.183

Slug Test Interpretation

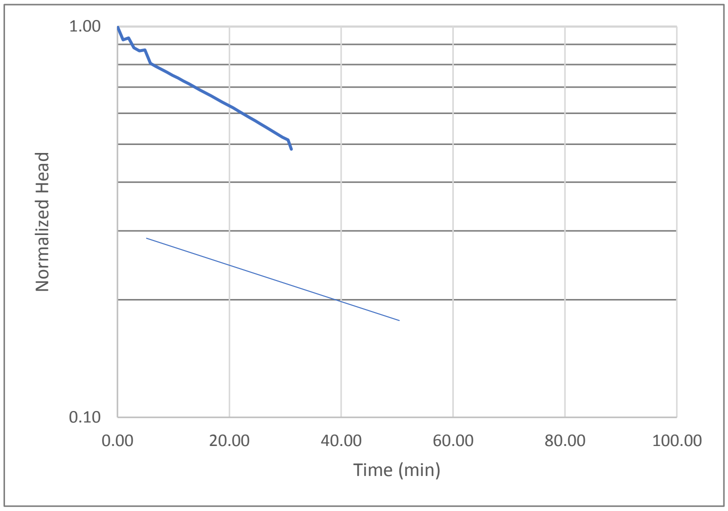
Project ID:		
184022		
Location:		
Nation Rise WTG41		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	6.15	m
T_L (s)	7.8	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	3.1E-03	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	3:23:01 PM	0.00	6.3072	1.00	10.979
7/6/2018	3:23:02 PM	0.02	6.29	0.89	10.948
7/6/2018	3:23:03 PM	0.03	6.273	0.78	10.917
7/6/2018	3:23:10 PM	0.15	6.2057	0.35	10.714

Slug Test Interpretation

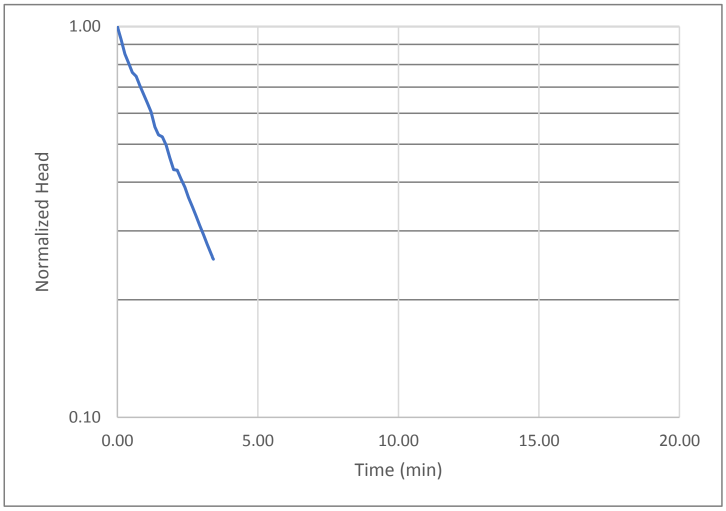
Project ID:		
184022		
Location:		
Nation Rise WTG 43		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	4.928	m
T_L (s)	3000	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	6.3E-06	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/5/2018	12:28:05 PM	0.00	6.1901	1.00	9.81
7/5/2018	12:29:04 PM	0.98	6.096	0.93	9.389
7/5/2018	12:30:03 PM	1.97	6.1092	0.94	9.188
7/5/2018	12:31:02 PM	2.95	6.0418	0.88	9.02
7/5/2018	12:32:01 PM	3.93	6.0223	0.87	8.919
7/5/2018	12:33:00 PM	4.92	6.0282	0.87	8.849
7/5/2018	12:33:59 PM	5.90	5.945	0.81	8.789
7/5/2018	12:34:58 PM	6.88	5.926	0.79	8.735
7/5/2018	12:35:57 PM	7.87	5.9096	0.78	8.685
7/5/2018	12:36:56 PM	8.85	5.892	0.76	8.642
7/5/2018	12:37:55 PM	9.83	5.8755	0.75	8.597
7/5/2018	12:38:54 PM	10.82	5.8602	0.74	8.55
7/5/2018	12:39:53 PM	11.80	5.8437	0.73	8.51
7/5/2018	12:40:52 PM	12.78	5.8292	0.71	8.476
7/5/2018	12:41:51 PM	13.77	5.8129	0.70	8.445
7/5/2018	12:42:50 PM	14.75	5.7966	0.69	8.418
7/5/2018	12:43:49 PM	15.73	5.7826	0.68	8.394
7/5/2018	12:44:49 PM	16.73	5.7675	0.67	8.371
7/5/2018	12:46:47 PM	18.70	5.7376	0.64	8.336
7/5/2018	12:47:46 PM	19.68	5.7239	0.63	8.32
7/5/2018	12:48:45 PM	20.67	5.7099	0.62	8.307
7/5/2018	12:49:44 PM	21.65	5.6948	0.61	8.296
7/5/2018	12:51:42 PM	23.62	5.666	0.58	8.276
7/5/2018	12:52:41 PM	24.60	5.6525	0.57	8.268
7/5/2018	12:53:40 PM	25.58	5.6389	0.56	8.26
7/5/2018	12:54:39 PM	26.57	5.6259	0.55	8.252
7/5/2018	12:55:38 PM	27.55	5.6118	0.54	8.246
7/5/2018	12:56:37 PM	28.53	5.5981	0.53	8.238
7/5/2018	12:57:36 PM	29.52	5.5851	0.52	8.232
7/5/2018	12:58:35 PM	30.50	5.5749	0.51	8.226
7/5/2018	12:59:10 PM	31.08	5.5407	0.49	8.223

Slug Test Interpretation

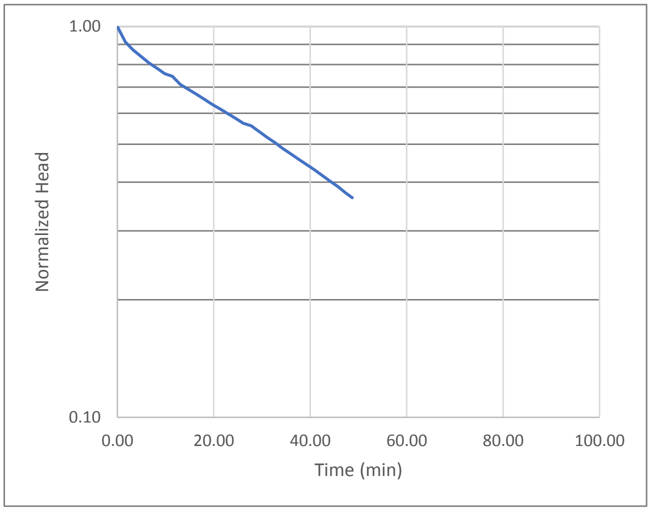
Project ID:		
184022		
Location:		
Nation Rise WTG 44		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	4.5535	m
T_L (s)	150	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	1.3E-04	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/7/2018	1:10:06 PM	0.00	5.8781	1.00	10.587
7/7/2018	1:10:14 PM	0.13	5.7821	0.93	10.404
7/7/2018	1:10:22 PM	0.27	5.6809	0.85	10.235
7/7/2018	1:10:30 PM	0.40	5.6203	0.81	10.077
7/7/2018	1:10:38 PM	0.53	5.5642	0.76	9.932
7/7/2018	1:10:46 PM	0.67	5.5413	0.75	9.797
7/7/2018	1:10:54 PM	0.80	5.4897	0.71	9.675
7/7/2018	1:11:02 PM	0.93	5.4421	0.67	9.562
7/7/2018	1:11:10 PM	1.07	5.3972	0.64	9.458
7/7/2018	1:11:18 PM	1.20	5.3554	0.61	9.361
7/7/2018	1:11:26 PM	1.33	5.2872	0.55	9.271
7/7/2018	1:11:34 PM	1.47	5.253	0.53	9.189
7/7/2018	1:11:42 PM	1.60	5.2458	0.52	9.112
7/7/2018	1:11:50 PM	1.73	5.2118	0.50	9.042
7/7/2018	1:11:58 PM	1.87	5.1649	0.46	8.976
7/7/2018	1:12:06 PM	2.00	5.1237	0.43	8.916
7/7/2018	1:12:14 PM	2.13	5.1217	0.43	8.86
7/7/2018	1:12:22 PM	2.27	5.093	0.41	8.808
7/7/2018	1:12:30 PM	2.40	5.0676	0.39	8.759
7/7/2018	1:12:38 PM	2.53	5.0371	0.37	8.715
7/7/2018	1:12:46 PM	2.67	5.0118	0.35	8.674
7/7/2018	1:12:54 PM	2.80	4.9868	0.33	8.635
7/7/2018	1:13:02 PM	2.93	4.9634	0.31	8.599
7/7/2018	1:13:10 PM	3.07	4.9414	0.29	8.566
7/7/2018	1:13:18 PM	3.20	4.9209	0.28	8.535
7/7/2018	1:13:26 PM	3.33	4.9009	0.26	8.507
7/7/2018	1:13:27 PM	3.35	4.8985	0.26	8.503
7/7/2018	1:13:28 PM	3.37	4.8966	0.26	8.5
7/7/2018	1:13:29 PM	3.38	4.8933	0.26	8.496
7/7/2018	1:13:30 PM	3.40	4.8911	0.25	8.493
7/7/2018	1:13:31 PM	3.42	4.8899	0.25	8.49

Slug Test Interpretation

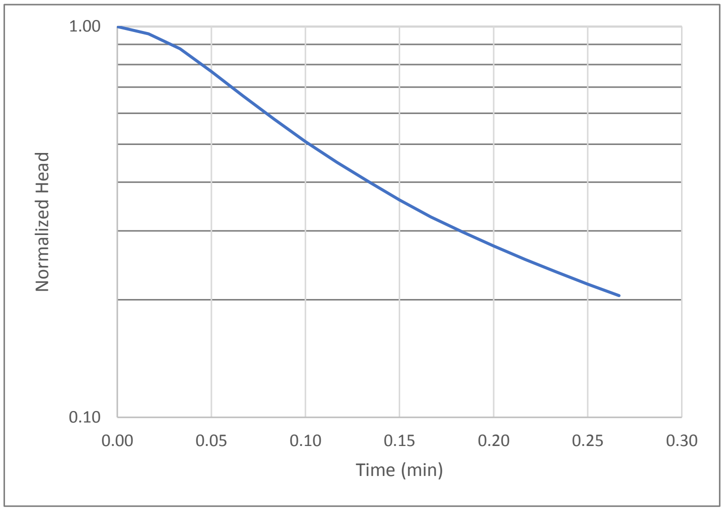
Project ID:		
184022		
Location:		
Nation Rise WTG 46		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	4.8585	m
T_L (s)	2910	
L (cm)	335	
r (cm)	1.905	
R (cm)	10	
K (cm/s)	6.5E-06	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	6:05:03 PM	0.00	7.0951	1.00	11.307
7/6/2018	6:06:41 PM	1.63	6.9003	0.91	9.598
7/6/2018	6:08:19 PM	3.27	6.8067	0.87	8.972
7/6/2018	6:09:57 PM	4.90	6.7362	0.84	8.686
7/6/2018	6:11:35 PM	6.53	6.6652	0.81	8.529
7/6/2018	6:13:13 PM	8.17	6.6084	0.78	8.43
7/6/2018	6:14:51 PM	9.80	6.5539	0.76	8.367
7/6/2018	6:16:29 PM	11.43	6.5261	0.75	8.322
7/6/2018	6:18:07 PM	13.07	6.4494	0.71	8.287
7/6/2018	6:19:45 PM	14.70	6.4038	0.69	8.264
7/6/2018	6:21:23 PM	16.33	6.3604	0.67	8.252
7/6/2018	6:23:01 PM	17.97	6.3171	0.65	8.245
7/6/2018	6:24:39 PM	19.60	6.2756	0.63	8.24
7/6/2018	6:26:17 PM	21.23	6.2367	0.62	8.238
7/6/2018	6:27:55 PM	22.87	6.1977	0.60	8.237
7/6/2018	6:29:33 PM	24.50	6.1615	0.58	8.234
7/6/2018	6:31:11 PM	26.13	6.1233	0.57	8.227
7/6/2018	6:32:49 PM	27.77	6.1053	0.56	8.219
7/6/2018	6:34:27 PM	29.40	6.0642	0.54	8.211
7/6/2018	6:36:05 PM	31.03	6.024	0.52	8.204
7/6/2018	6:37:43 PM	32.67	5.9874	0.50	8.197
7/6/2018	6:39:21 PM	34.30	5.9493	0.49	8.19
7/6/2018	6:40:59 PM	35.93	5.9155	0.47	8.182
7/6/2018	6:42:37 PM	37.57	5.8825	0.46	8.177
7/6/2018	6:44:15 PM	39.20	5.8512	0.44	8.171
7/6/2018	6:45:53 PM	40.83	5.8204	0.43	8.164
7/6/2018	6:47:31 PM	42.47	5.7888	0.42	8.16
7/6/2018	6:49:09 PM	44.10	5.7583	0.40	8.156
7/6/2018	6:50:47 PM	45.73	5.7301	0.39	8.152
7/6/2018	6:52:25 PM	47.37	5.6982	0.38	8.148
7/6/2018	6:53:46 PM	48.72	5.6742	0.36	8.145

Slug Test Interpretation

Project ID:		
184022		
Location:		
Nation Rise WTG48		
LEVEL		
UNIT: m		
Offset: -10.331000 m		
TEMPERATURE		
UNIT: °C		
Ho	2.8576	m
T_L (s)	9	
L (cm)	335	
r (cm)	1.905	
R (cm)	3.8	
K (cm/s)	2.7E-03	



Date	Time	Elapsed Time (min)	LEVEL	Normalized Head	TEMPERATURE
7/6/2018	4:27:48 PM	0.00	3.8181	1.00	12.993
7/6/2018	4:27:49 PM	0.02	3.7786	0.96	12.943
7/6/2018	4:27:50 PM	0.03	3.7006	0.88	12.896
7/6/2018	4:27:51 PM	0.05	3.595	0.77	12.849
7/6/2018	4:27:52 PM	0.07	3.4963	0.66	12.804
7/6/2018	4:27:53 PM	0.08	3.4146	0.58	12.76
7/6/2018	4:27:54 PM	0.10	3.3456	0.51	12.718
7/6/2018	4:27:55 PM	0.12	3.2896	0.45	12.678
7/6/2018	4:27:56 PM	0.13	3.2434	0.40	12.64
7/6/2018	4:27:57 PM	0.15	3.2034	0.36	12.603
7/6/2018	4:27:58 PM	0.17	3.1705	0.33	12.569
7/6/2018	4:27:59 PM	0.18	3.1441	0.30	12.537
7/6/2018	4:28:00 PM	0.20	3.1211	0.27	12.507
7/6/2018	4:28:01 PM	0.22	3.1012	0.25	12.478
7/6/2018	4:28:02 PM	0.23	3.084	0.24	12.452
7/6/2018	4:28:03 PM	0.25	3.0681	0.22	12.428
7/6/2018	4:28:04 PM	0.27	3.0544	0.20	12.405

APPENDIX F

GPR INTERNATIONAL MASW REPORT

GEOPHYSICS GPR INTERNATIONAL INC.
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Mississauga, Ontario
Canada L5T 2G9
Tel.: (905) 696-0656
Fax: (905) 696-0570
gprtor@gprtor.com
www.geophysicsgpr.com

July 31, 2018 GPR file: T18743

Usman Khan
Geotechnical Engineer
Tulloch Engineering Inc.
1100 South Service Road, Suite 420
Stoney Creek, ON
L8E 0C5

RE: Shear-wave velocity sounding at different locations in Chysler, North Stormont and North Dundas areas, Ottawa area, Ontario

Dear Mr. Khan:

Geophysics GPR International Inc. has been requested by Tulloch Enginnering Inc. to carry out a shear-wave velocity sounding at the above site in Ottawa. Figure 1 shows the location of the test profiles.

The survey was performed on July 4th to 6th, 2018.

The investigation included the multi-channel analysis of surface waves (MASW), the refraction methods to generate a shear-wave velocity model (Figures 4 to 10).

The following paragraphs describe the survey design, the principles of the test method, the methodology for interpreting the data, and provide a culmination of the results in table format.

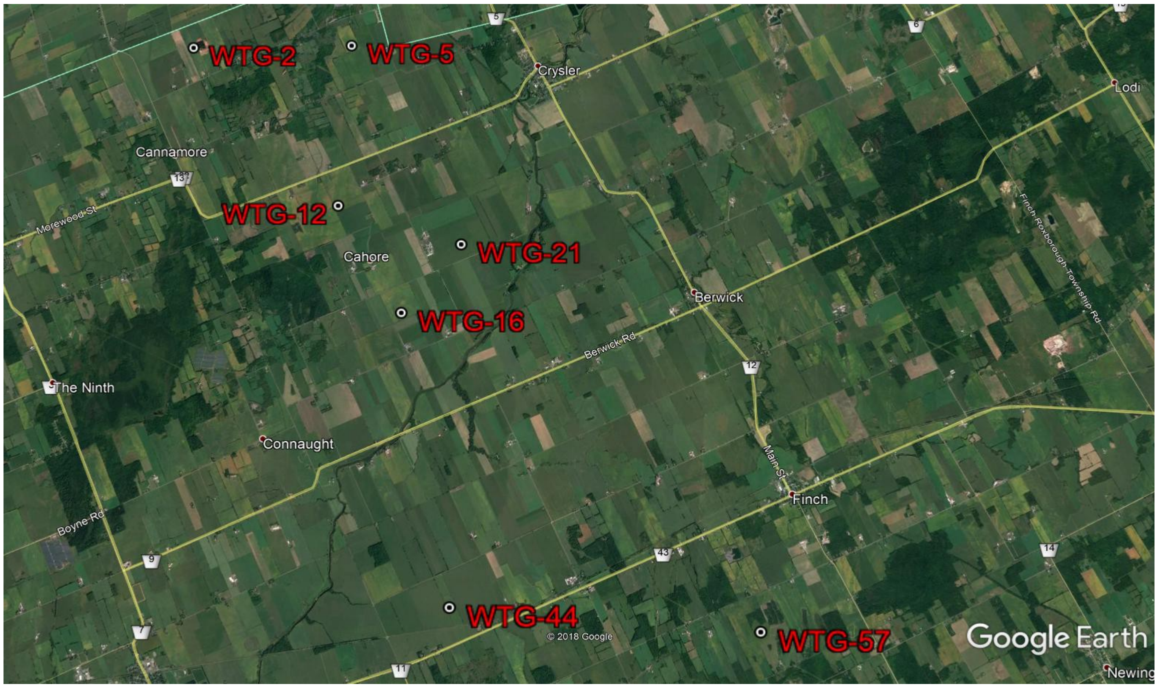


Figure 1: Approximate location of the shear-wave velocity soundings

MASW and MAM Surveys

Basic Theory

The Multi-channel Analysis of Surface Waves (MASW) and the Micro-tremor Array Measurements (MAM) are seismic methods used to evaluate the shear-wave velocities of subsurface materials through the analysis of the dispersion properties of Rayleigh surface waves ("ground roll"). The dispersion properties are measured as a change in phase velocity with frequency. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. Inversion of the Rayleigh wave dispersion curve yields a shear-wave (V_s) velocity depth profile (sounding). Figure 2 outlines the basic operating procedure for the MASW method. Figure 3 is an example image of a typical MASW record and resulting 1D V_s model. A more detailed description of the method can be found in the paper *Multi-channel Analysis of Surface Waves,* Park, C.B., Miller, R.D. and Xia, J. Geophysics, Vol. 64, No. 3 (May-June 1999); P. 800–808.

Survey Design

The geometry of an MASW survey is similar to that of a seismic refraction investigation (i.e. 24 geophones in a linear array). The fundamental principle involves intentionally generating an acoustic wave at the surface and digitally recording the surface waves from the moment of source impact with a linear series of geophones on the surface. This is referred to as an "active source" method. An elastic-wave hammer was used as the primary energy source with traces being recorded at 6 locations: approximately 6 m off both ends, 25 to 30 m off both ends, and in the middle of the spread. Data were collected with geophones spacing of 3m and 1m for a total of 10 shot records per sounding.

Unlike the refraction method, which produces a data point beneath each geophone, the shear-wave depth profile is the average of the bulk area within the middle third of the geophone spread.

The theoretical maximum depth of penetration (34.5m) is half of the maximum seismic array length (69 m), in practice the maximum depth of penetration is often influenced by the geology.

The MAM/passive survey used the same geophone array set up as for the MASW survey. Unlike the MASW survey, the MAM method is considered a "passive source" method in that there is no time break and the motions recorded are from ambient energy generated by cultural noise such as traffic, wind, wave motion, etc. Data collection for the passive method involves recording approximately 10 minutes of background "noise." The records generated by the MAM method contain lower frequency data, thus increasing the data resolution at greater depths of investigation. Typically the MAM results aid in clarifying the MASW results for depths greater than 20 m; however, the direction of noise propagation relative to the spread orientation can influence the results.

Interpretation Method and Accuracy of Results

The main processing sequence involved plotting, picking, and 1-D inversion of the MASW/MAM shot records using the SeisimagerSW™ software package. In theory, all MASW shot records should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation and localized surface variations. The results of the inversion process are inherently non-unique and the final model must be judged to be geologically realistic. The inversion modelling also assumes that all layering is flat/horizontal and laterally uniform.

The results of the MASW/MAM tests are presented in chart format as Figures 4 to 10. The chart presents the 1-D shear wave velocity values from the inversion models of the passive and active seismic records.

The V_s30 values for the sounding are presented in Table 1. The V_s30 values are based on the harmonic mean of the shear wave velocities over the upper 30 m. The V_s30 value is calculated by dividing the total depth of interest (e.g. 30 m) by the sum of the time spent in each velocity layer up to that depth. This harmonic mean value reflects the equivalent single layer response.

The estimated error in the average V_s30 value determined through MASW tests is typically +/-10 to 15% for overburden sites. The shear-wave velocities modelled through the MASW method within bedrock have a higher estimated error.

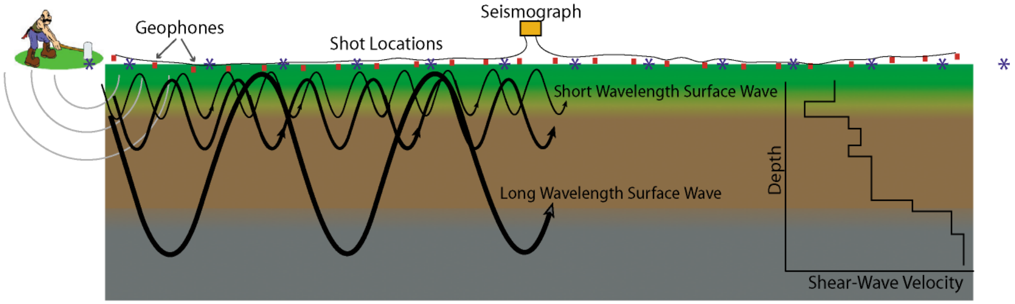
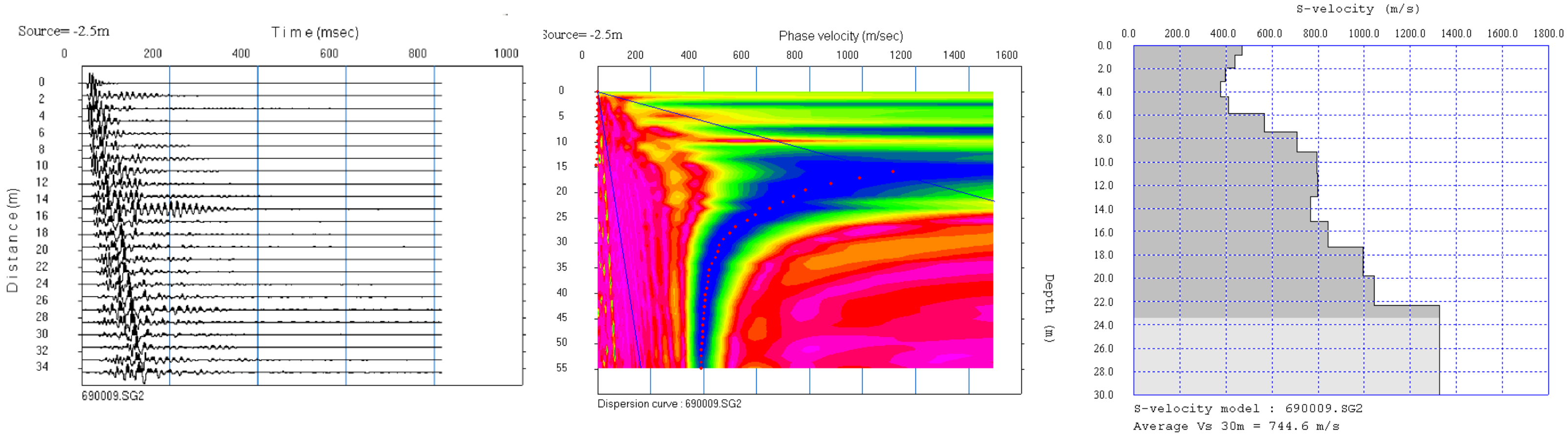


Figure 2: MASW Operating Principle



Raw Seismic Shot Record

Phase Velocity-Frequency Transformation indicating Dispersion Curve

1D Shear-Wave Velocity Profile from Inversion of Dispersion Curve

Figure 3: Example of a typical MASW shot record, phase velocity/frequency curve and resulting 1D shear-wave velocity model.

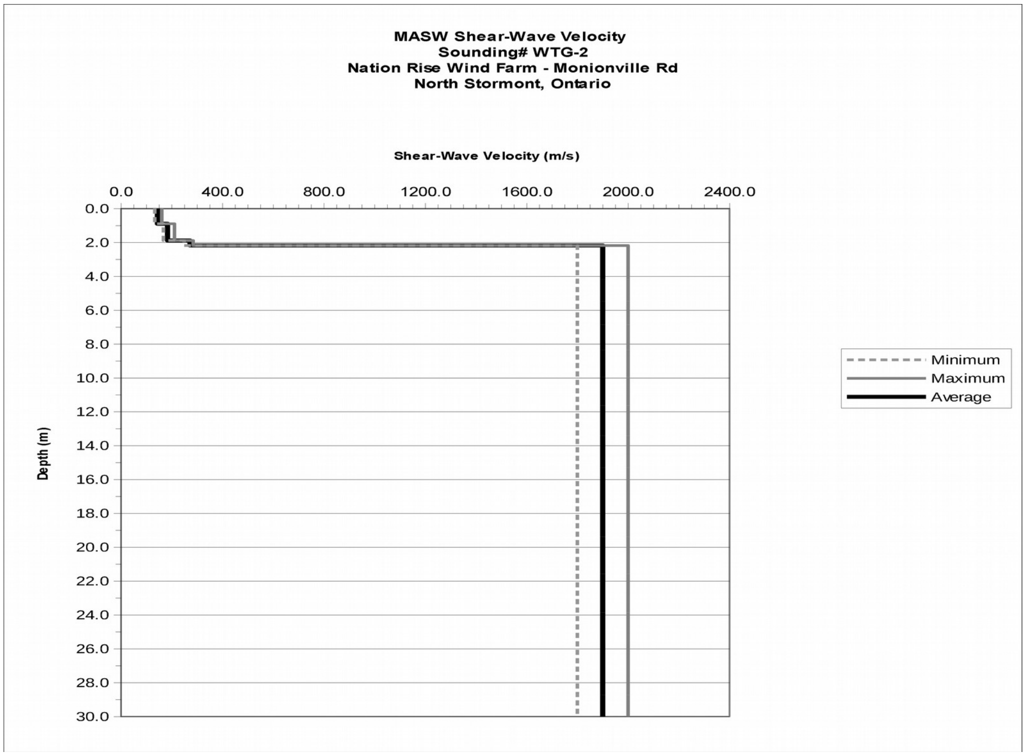


Figure 4: MASW Shear-wave Velocity Sounding

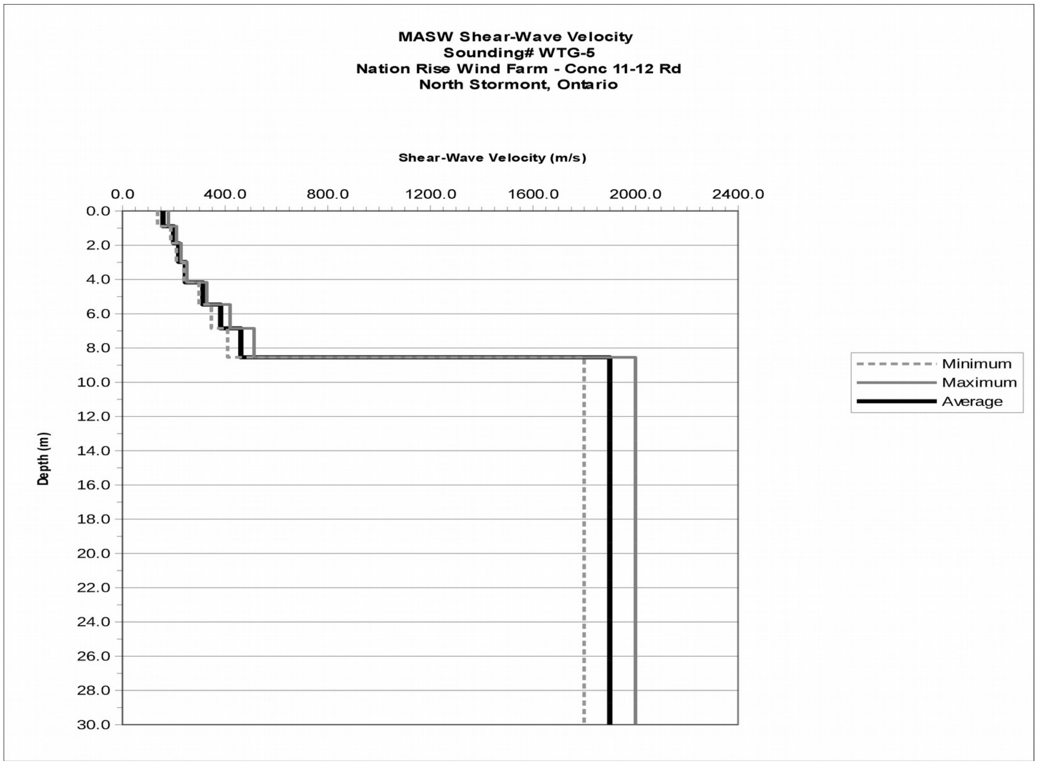


Figure 5: MASW Shear-wave Velocity Sounding

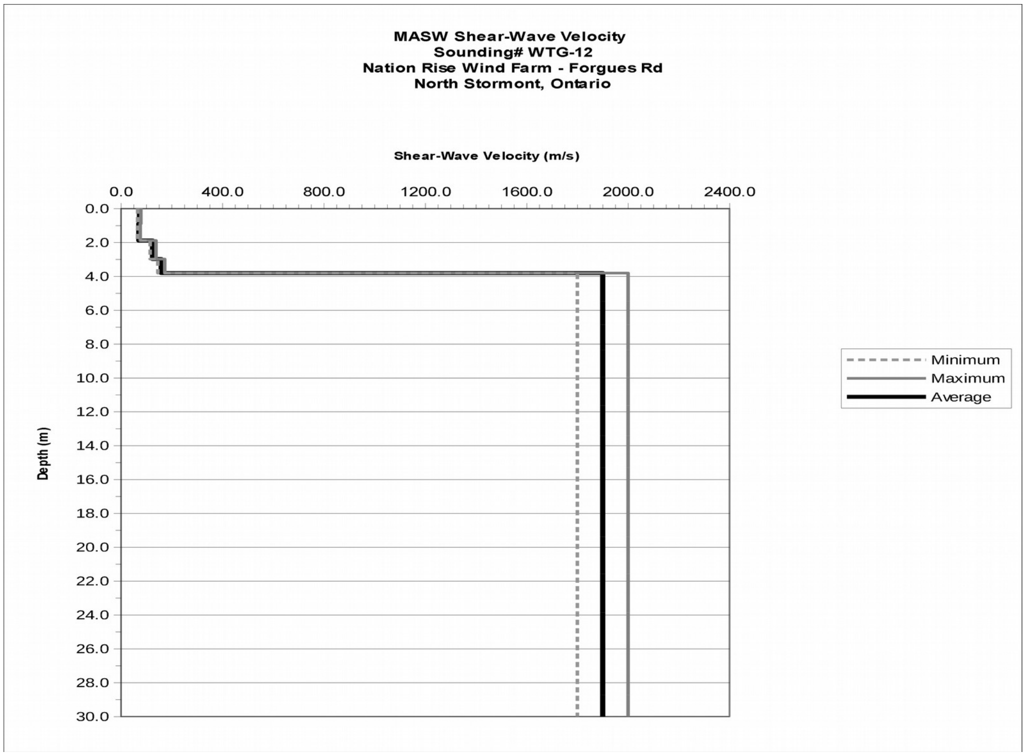


Figure 6: MASW Shear-wave Velocity Sounding

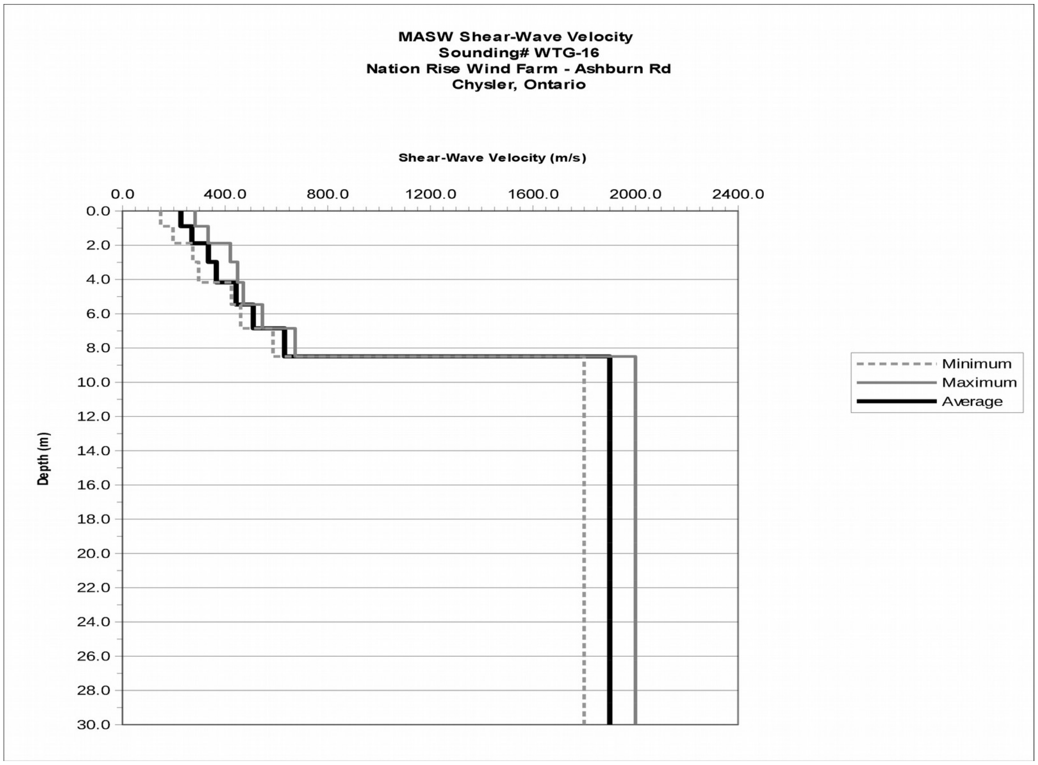


Figure 7: MASW Shear-wave Velocity Sounding

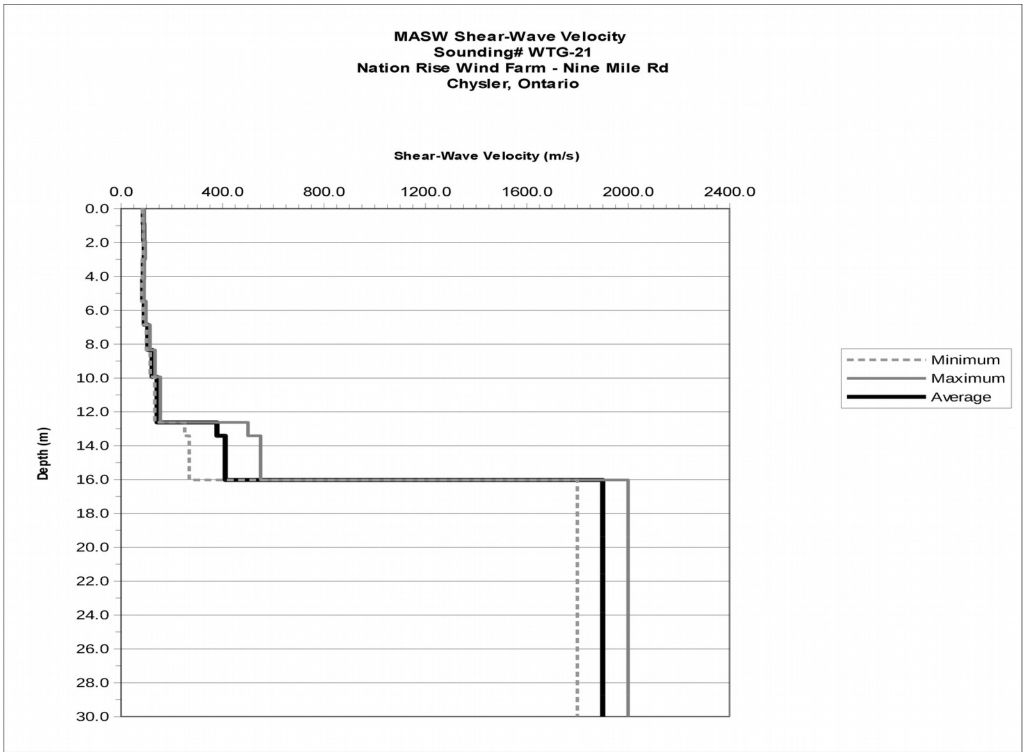


Figure 8: MASW Shear-wave Velocity Sounding

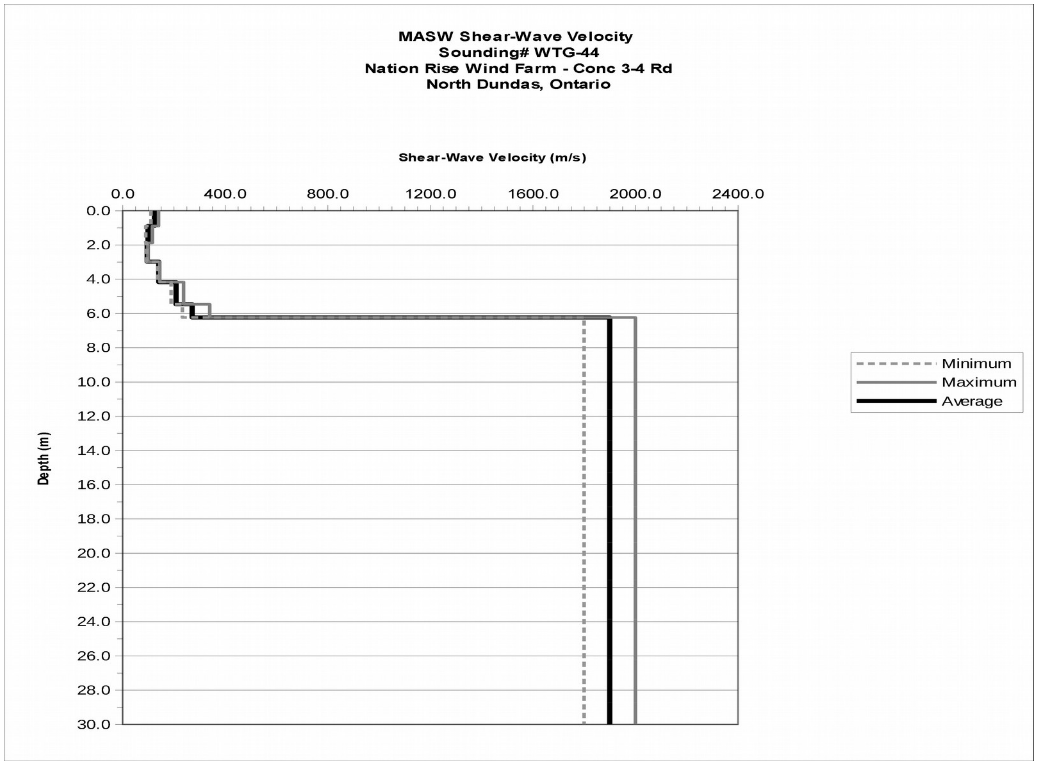


Figure 9: MASW Shear-wave Velocity Sounding

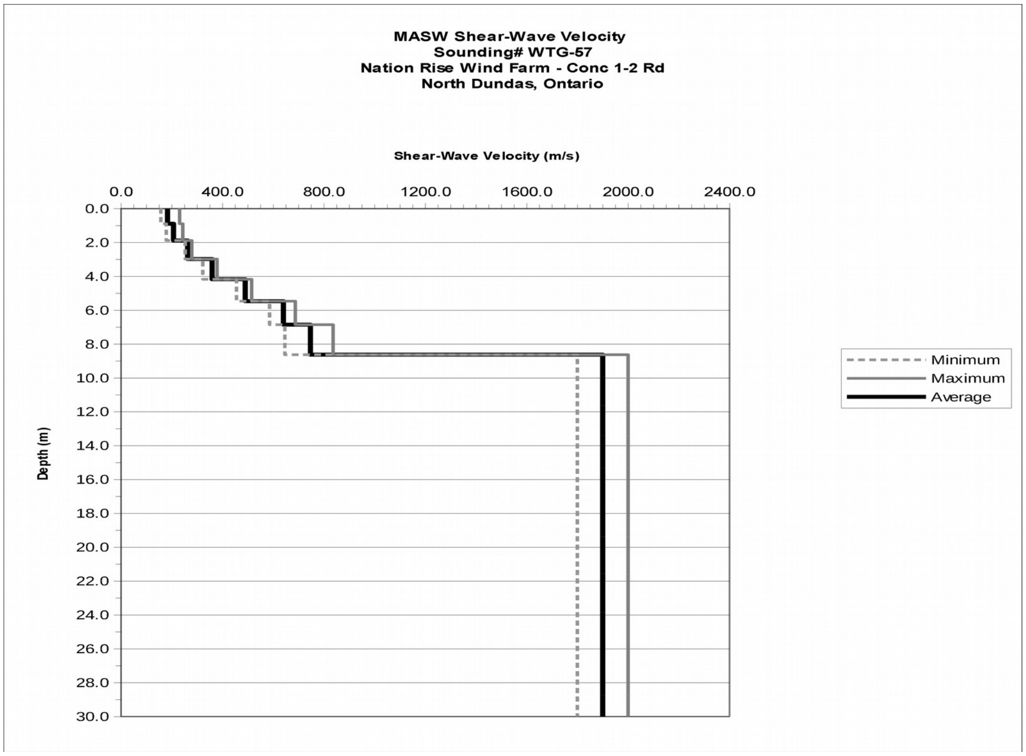


Figure 10: MASW Shear-wave Velocity Sounding

CONCLUSIONS

The approximate location of the shear-wave sounding is indicated in Figure 1.

The MASW shear-wave models are presented in Figure 4. The results are summarized in Table 1. The background seismic noise levels at this site were moderate. The quality of the seismic records was good. However, the resulting dispersion was not well defined as usual for sites with shallow bedrock.

The results of calculations from refracted P-waves are summarized in the attached drawing.

As is typical for sites with shallow rock, the shear-wave velocities modelled using the MASW method are often poorly constrained within the rock. Comparison with measured refracted P-wave velocities and estimates of Poisson's ratio can be used to better constrain the shear-wave models. The measured refracted P-wave velocities for the rock at this site were on the order of 5000m/s. These P-wave velocities correspond to an estimated S-wave velocity range of 1800 to 2000m/s.

The boreholes data were use for bedrock depth to constrain the MASW models.

Table 1: Calculated V_s30 values (m/s) from the MASW data (0 to 30m)

Sounding	Minimum	Average	Maximum	Site Class
WTG-2	1024	**1096**	1189	**B***
WTG-5	647	**695**	740	**C**
WTG-12	510	**553**	595	**C**
WTG-16	753	**891**	1004	**C***
WTG-21	200	**216**	232	**D**
WTG-44	477	**512**	557	**C**
WTG-57	767	**843**	927	**C***

* NBC 2015 Commentary 'J' requirements

The calculated average V_s30 values from the 1D MASW soundings collected was 1096, 695, 553, 891, 216, 512, and 843m/s +/-15% to 20% respectively for WTG2 to WTG57.

The V_s30 values calculated for the minimum and the maximum envelopes ranged from 216 to 1096m/s.

Based on the average V_s30 values (as determined through the MASW method) and table 4.1.8.4.A of the National Building Code of Canada, 2015 Edition, the investigated sites classes are summarized in the table 1.

The use of Site Class 'B' is conditional on the requirements of Commentary 'J' sentence 100, specifically, *"Site Classes A and B, are not to be used if there is more than 3 m of soil between the rock surface and the bottom of the spread footing or* *mat foundation, even if the computed average shear wave velocity is greater than 760m/s*".

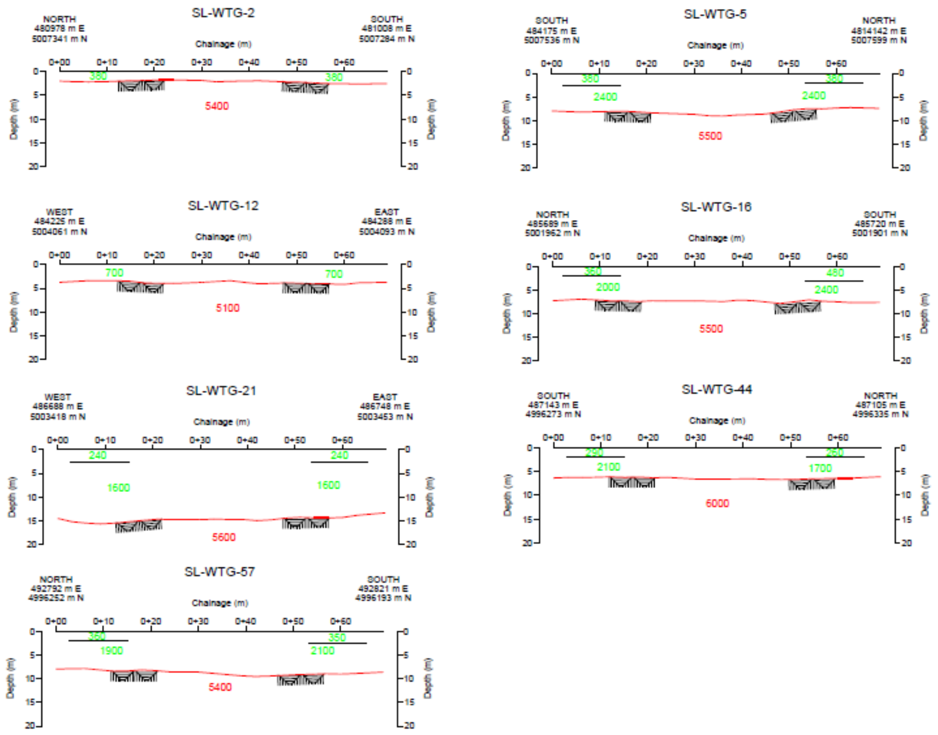
It must be noted that the site classification provided in this report is based solely on the V_s30 value as derived from the MASW method and that it can be superseded by other geotechnical information. This geotechnical information includes, but is not limited to, the presence of sensitive and/or liquefiable soils, more than 3m of soft clays, high moisture content, etc. The reader is referred to section 4.1.8.4 of the National Building Code of Canada, 2015 Edition for more information on the requirements for site classification.

This report has been written by Milan Situm, P.Geo.

Milan Situm

Milan Situm, P.Geo.
Manager

PROFESSIONAL GEOSCIENTIST
MILAN SITUM
PRACTISING MEMBER
0237
ONTARIO



5 0 5 10

(meters)

WGS84 / UTM zone 18T

LEGEND

—	Topography profile
5400	Bedrock P-wave velocity (m/s)
▬	Bedrock profile from seismic refraction

NOT VALID FOR CONSTRUCTION

No	NOTES
1	THE SEISMIC SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. July 2018
2	COORDINATE SYSTEM: WGS84 UTM ZONE 18T
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLGIES, RESULTS AND LIMITATIONS
4	
5	
6	

No	DATE	MODIFICATIONS	GPR APP

SCEAU PROFESSIONNEL

DRAFT

PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR DRAWN BY	I.G		
VERIFIÉ PAR CHECKED BY	M.S		
APPROUVÉ PAR APPROVED BY	M.Sfum, P.Geo		
# CONTRAT CONTRACT #	T-18743	DATE	July 2018
ÉCHELLE SCALE	AS SHOWN	# DESSIN DRAWING #	T18743_A1

CLIENT — CLIENT
Tulloch Engineering Inc.

PROJET — PROJECT
Nation Rise Wind Farm
Ottawa Area, Ontario

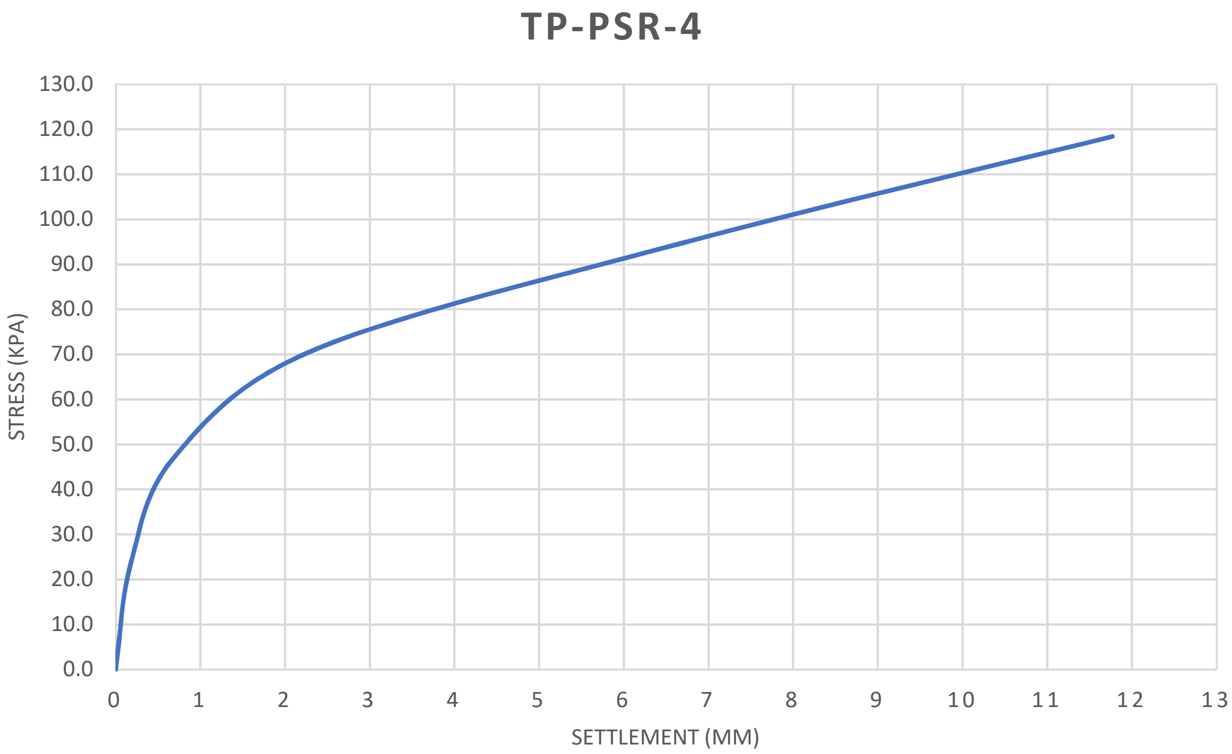
TITRE — TITLE
SEISMIC SURVEY
WTG2 to WTG57

APPENDIX G

PLATE LOAD TEST RESULTS

Location: TP-PSR-4
Material Type: Silt Till (ML)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.18	23.7	
4.4	0.7	47.4	
6.6	2.349	71.0	
8.8	6.689	94.7	
11	11.769	118.4	Slight Creep

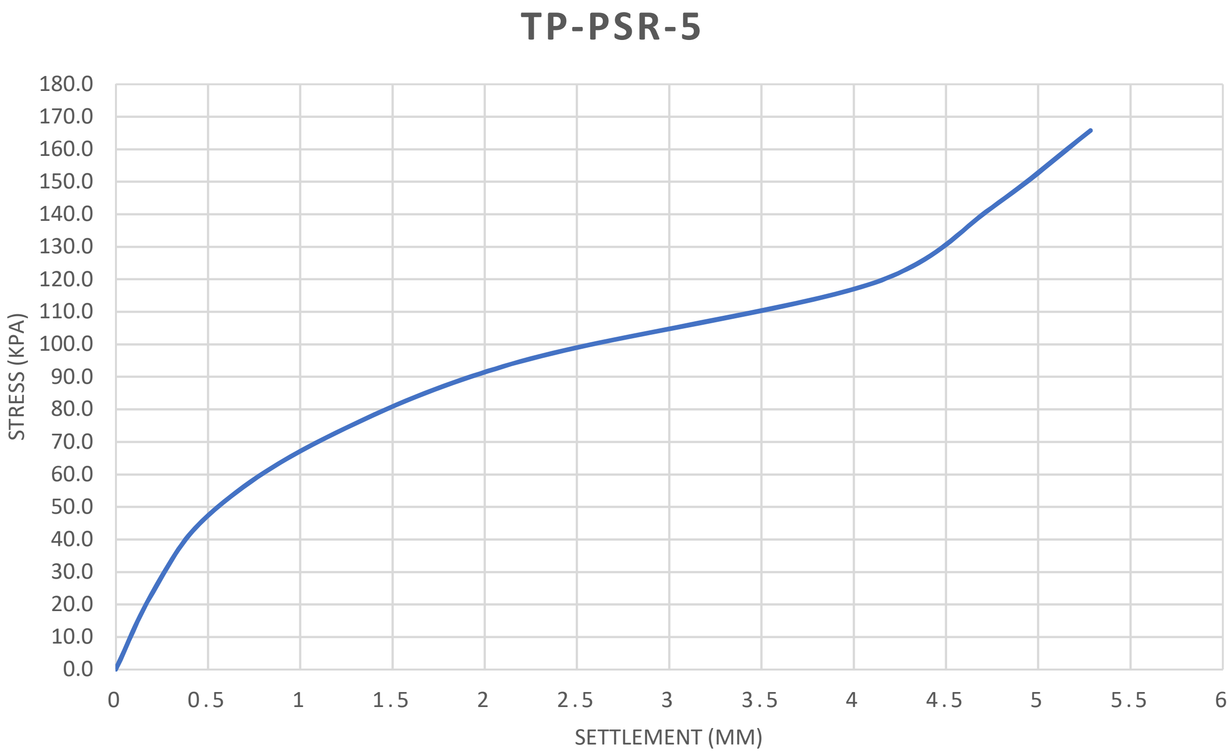


Notes:

K_{secant} = 54 MPa/m
M_R = 24 MPa
$CBR_{correlated}$= 2.3

Location: TP-PSR-5
Material Type: Silt Till (ML)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.2	23.7	
4.4	0.5	47.4	
6.6	1.132	71.0	
8.8	2.191	94.7	
11	4.082	118.4	Slight Creep
13.2	4.749	142.1	Slight Creep
15.4	5.283	165.8	

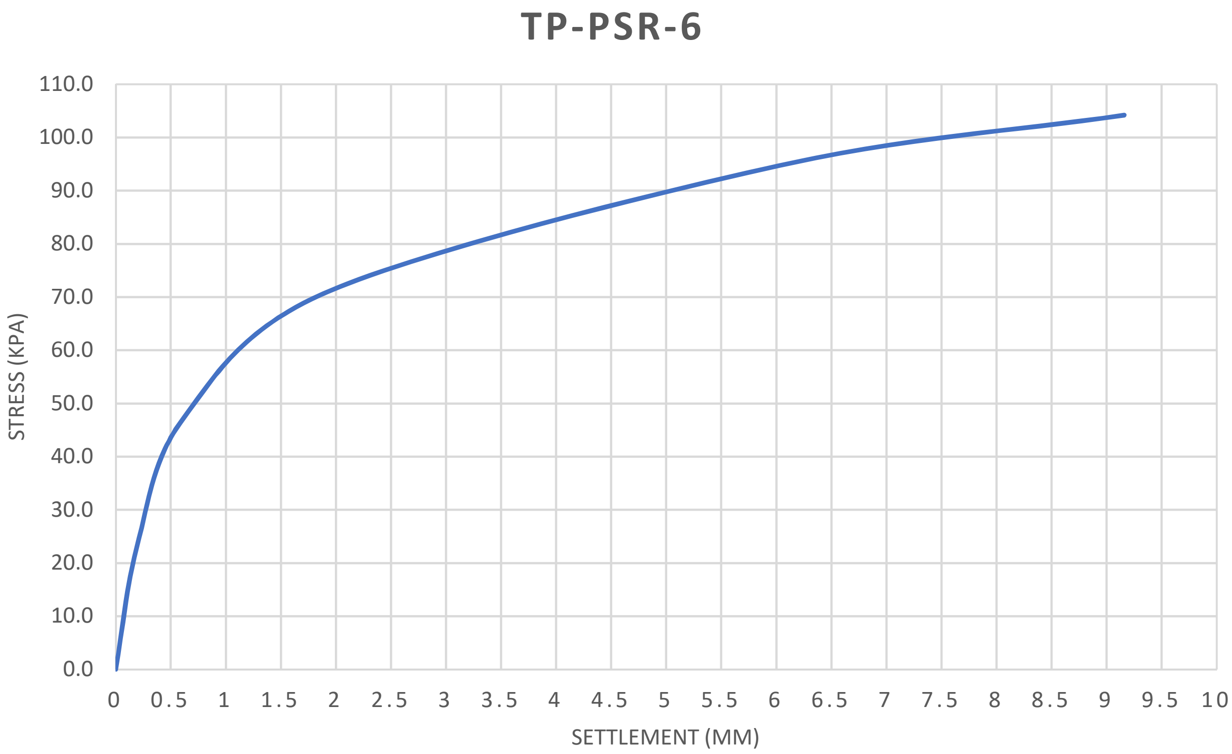


Notes:

K_{secant} = 65 MPa/m
M_R = 29 MPa 4189.978
$CBR_{correlated}$= 2.8

Location: TP-PSR-6
Material Type: Silty Clay (CL)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.2	23.7	
4.4	0.62	47.4	
6.6	1.93	71.0	
8.8	6.03	94.7	
9.68	9.16	104.2	Failing

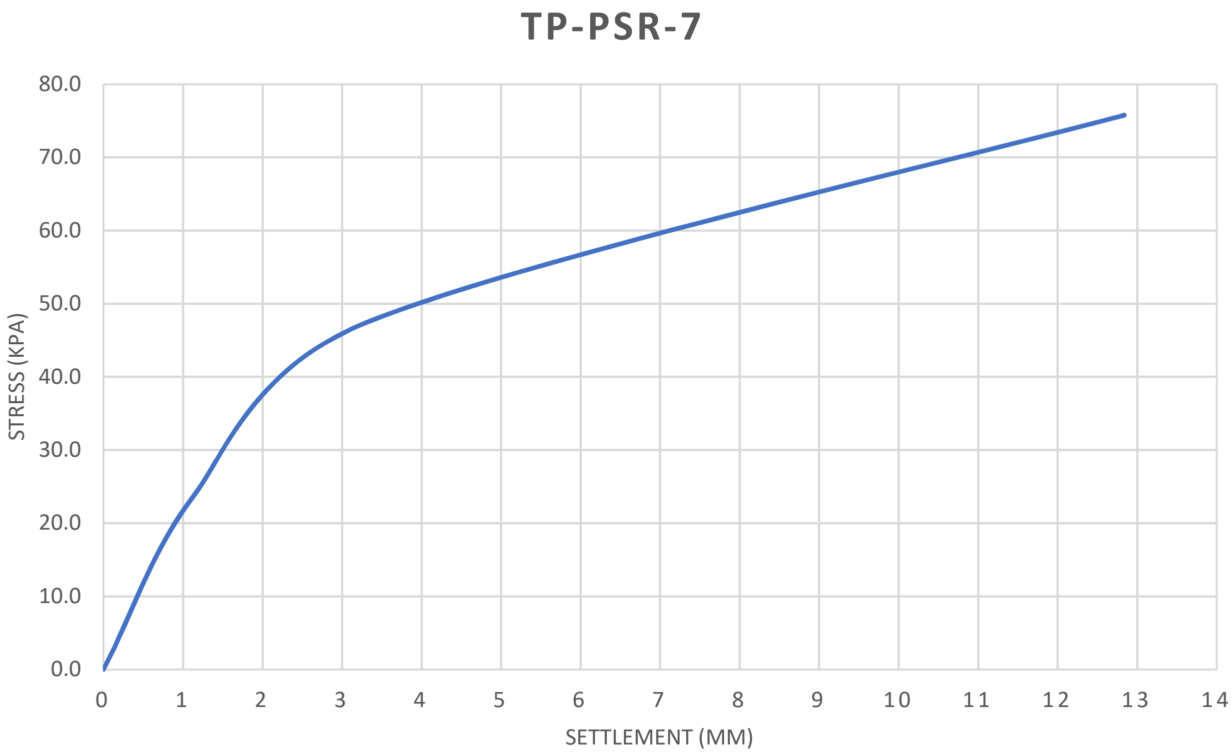


Notes:

K_{secant} = 58 MPa/m
M_R = 26 MPa
$CBR_{correlated}$= 2.5

Location:	TP-PSR-7
Material Type:	Silt Till (ML)
Plate Type:	304.8 mm x 304.8 mm
Plate Area (m^2)	0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	1.13	23.7	
4.4	3.29	47.4	
7.04	12.84	75.8	Creeping; possible failure

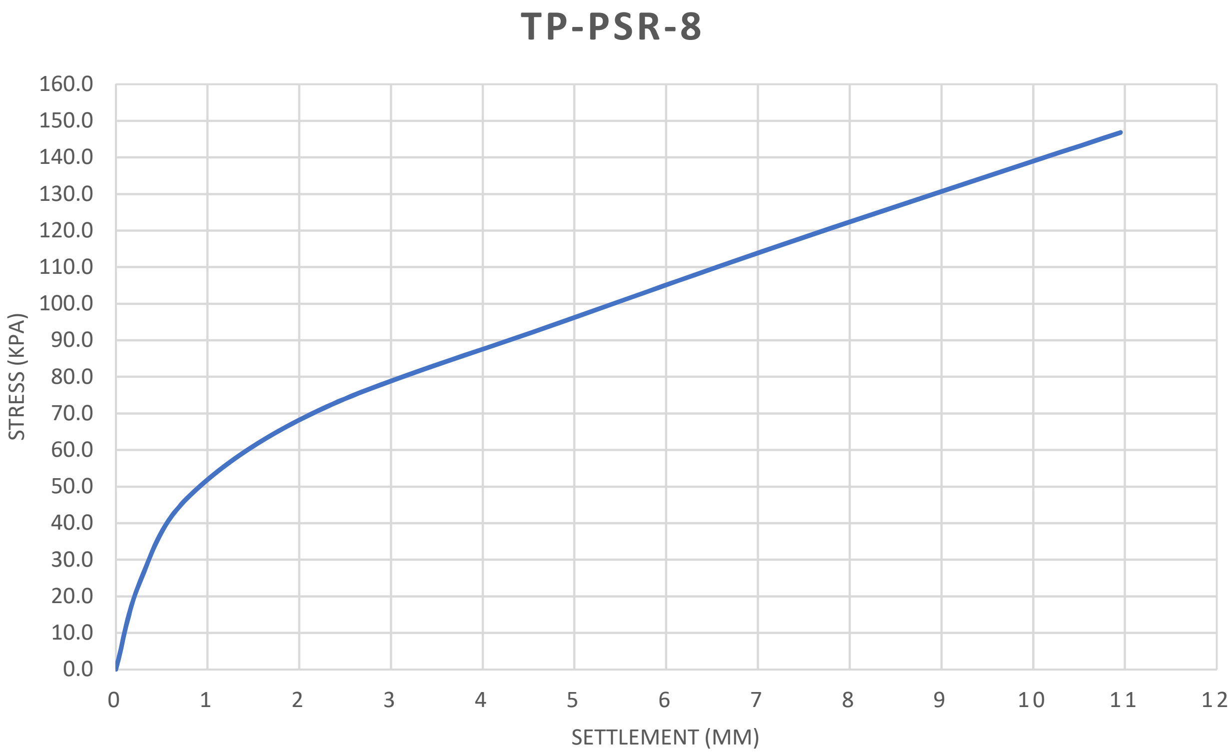


Notes:

K_{secant} = 20 MPa/m
M_R = 9 MPa
$CBR_{correlated}$= 0.9

Location:	TP-PSR-8
Material Type:	Silt Till (ML)
Plate Type:	304.8 mm x 304.8 mm
Plate Area (m^2)	0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	Deflection guage slid during seating
2.2	0.26	23.7	
4.4	0.8	47.4	
6.6	2.23	71.0	
8.8	4.83	94.7	
11	7.53	118.4	
13.64	10.951	146.8	Failing



Notes:

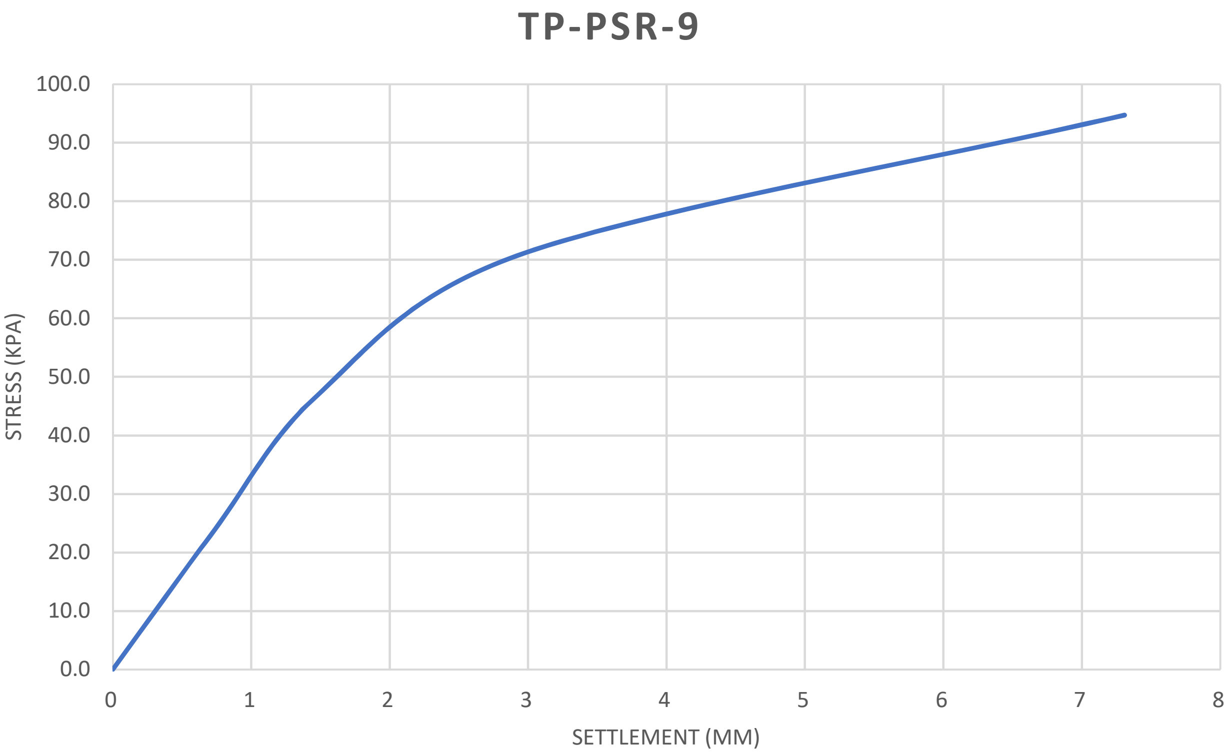
K_{secant} = 50 MPa/m

M_R = 22 MPa

$CBR_{correlated}$= 2.1

Location: TP-PSR-9
Material Type: Silty Sand (SM)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.73	23.7	
4.4	1.5	47.4	
6.6	2.96	71.0	
8.8	7.309	94.7	Creep likely Failing

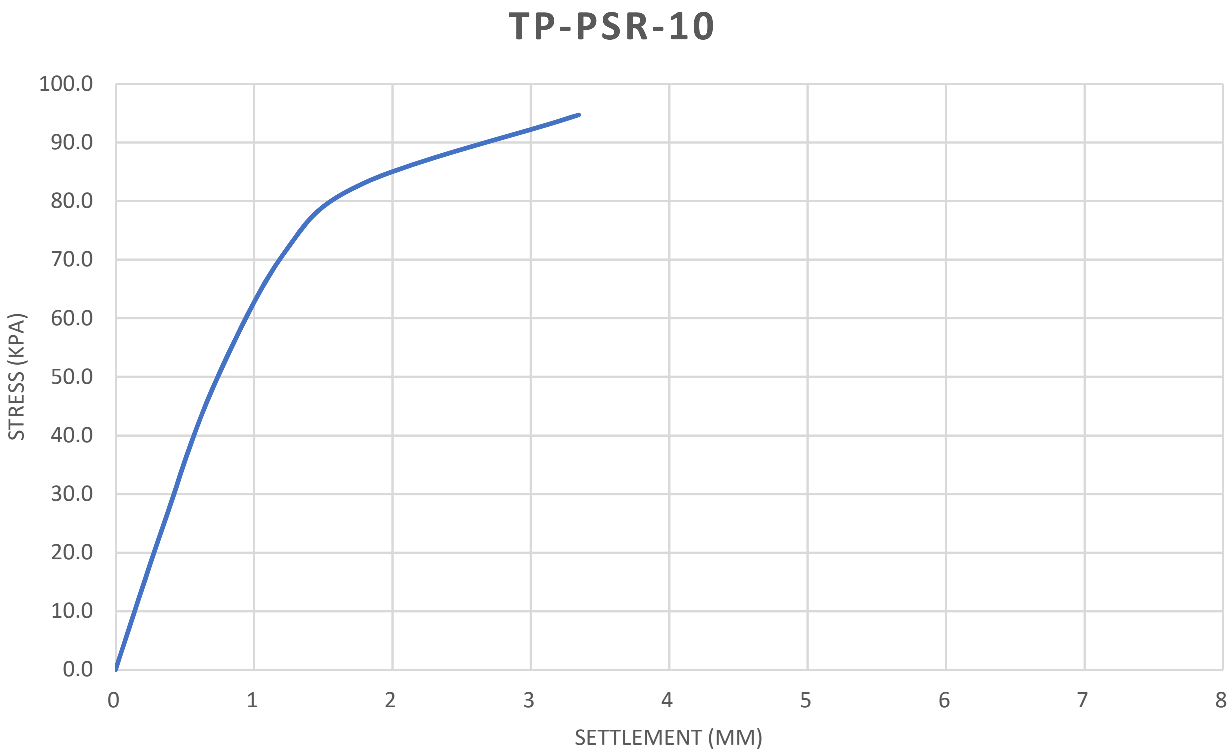


Notes:

K_{secant} = 34 MPa/m
M_R = 15 MPa
$CBR_{correlated}$= 1.5

Location: TP-PSR-10
Material Type: Silty Sand (SM)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0.0	0	0.0	
2.3	0.345	24.6	
4.5	0.7	47.9	
6.6	1.215	71.0	
7.7	1.775	82.9	
8.8	3.345	94.7	Creeping

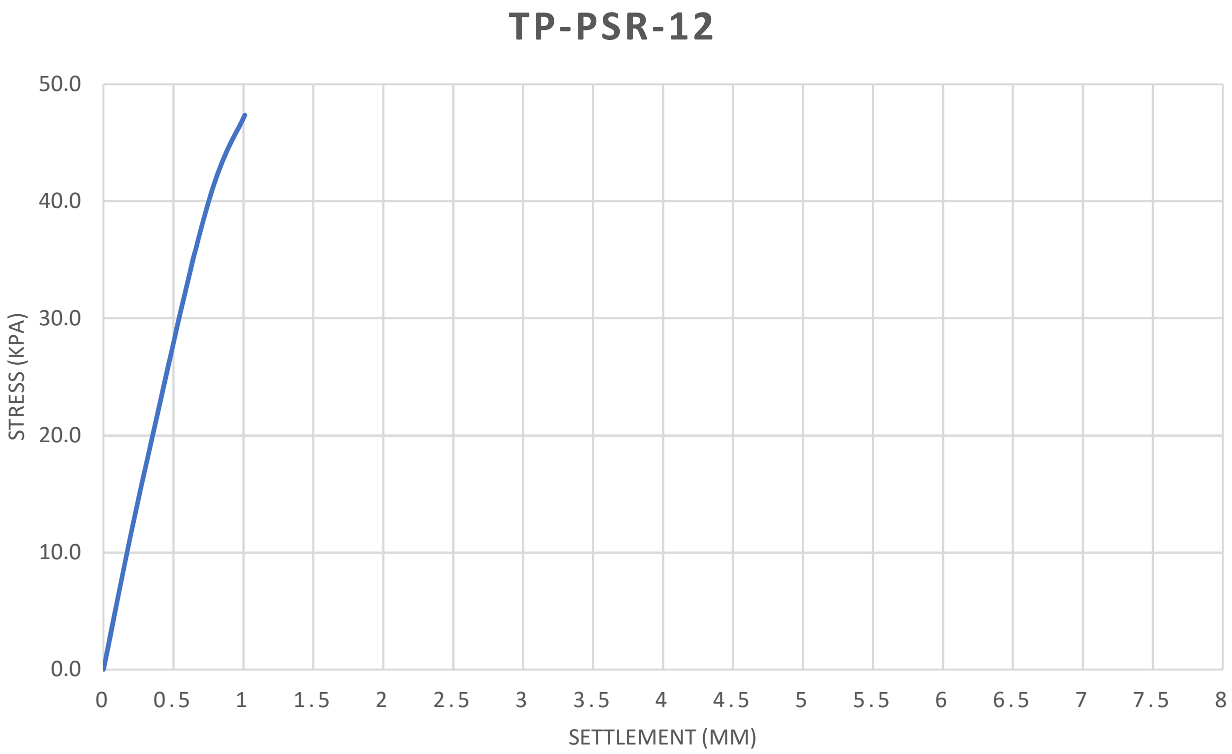


Notes:

K_{secant} = 63 MPa/m
M_R = 28 MPa
$CBR_{correlated}$= 2.7

Location: TP-PSR-12
Material Type: Silty Sand (SM)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	**Settlement (mm)**	**Stress (kPa)**	**Notes**
0	0	0.0	
1.1	0.2	11.8	
2.2	0.42	23.7	
3.3	0.65	35.5	
3.96	0.824	42.6	
4.4	1.01	47.4	Creep; Likely

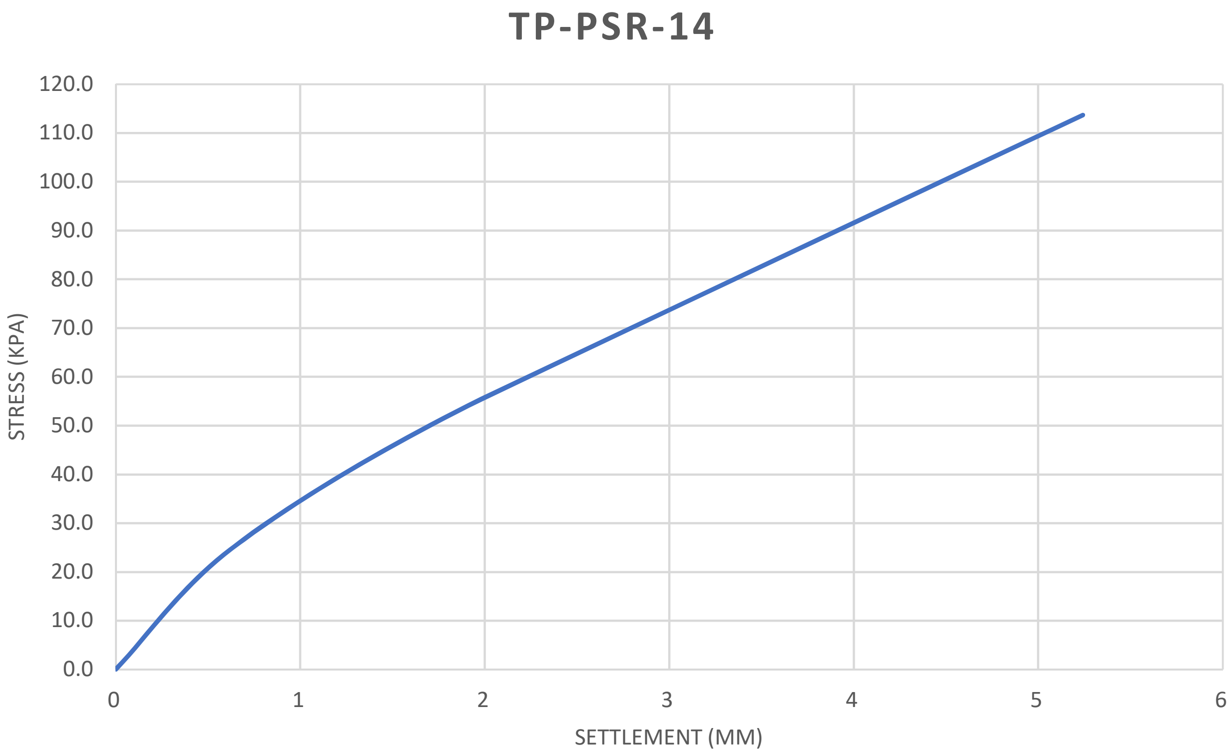


Notes:

K_{secant} = 47 MPa/m
M_R = 21 MPa
$CBR_{correlated}$= 2.0

Location: TP-PSR-14
Material Type: Silty Clay (CL)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.591	23.7	
4.4	1.571	47.4	
6.6	2.851	71.0	
10.56	5.241	113.7	

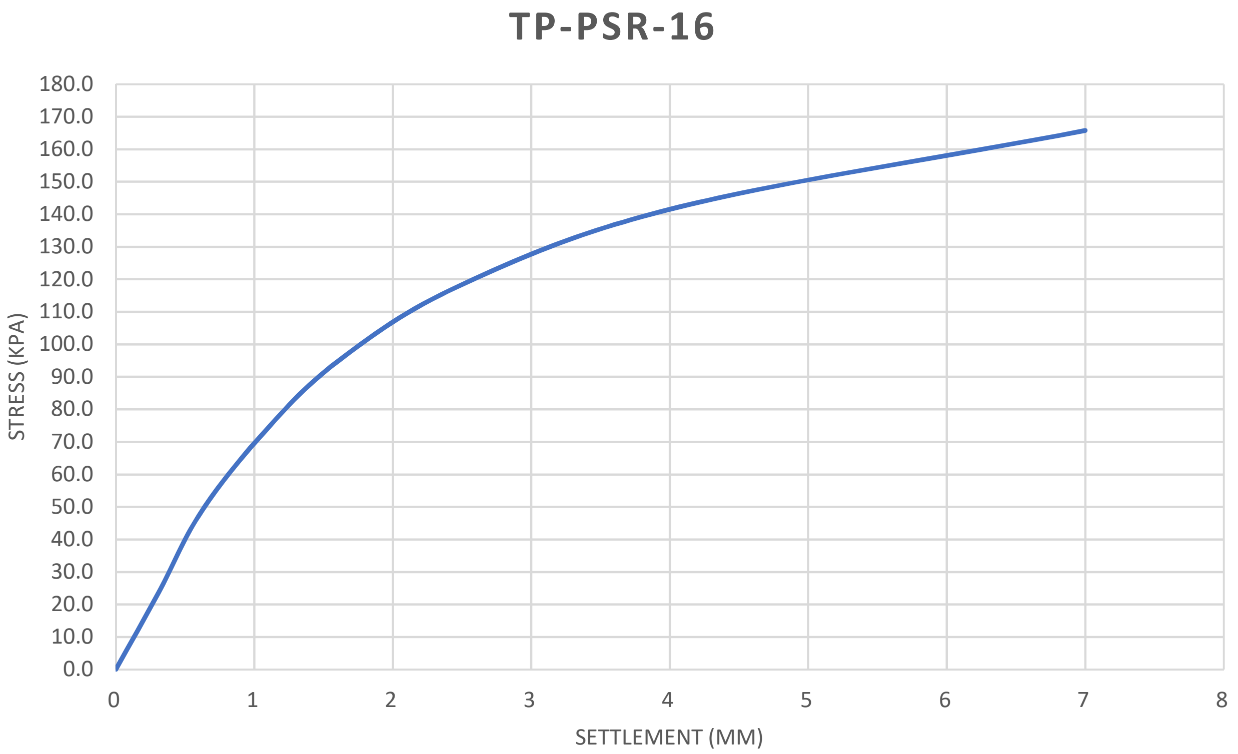


Notes:

K_{secant} = 35 MPa/m
M_R = 16 MPa
$CBR_{correlated}$= 1.5

Location: TP-PSR-16
Material Type: Silt Till (ML)
Plate Type: 304.8 mm x 304.8 mm
Plate Area (m^2) 0.09

Load (kN)	Settlement (mm)	Stress (kPa)	Notes
0	0	0.0	
2.2	0.309	23.7	
4.4	0.6	47.4	
6.6	1.03	71.0	
8.8	1.6	94.7	
11	2.5	118.4	Slight Creep
13.2	4.05	142.1	Slight Creep
15.4	7	165.8	Failing



Notes:

K_{secant} = 70 MPa/m
M_R = 31 MPa
$CBR_{correlated}$= 3.0

APPENDIX H

Cement Stabilized Soil Laboratory Test Results and Recommendations Memo

April 2, 2019
18-4022

Ryan McDonner

EDP Renewables North America LLC

Civil Engineering Manager – Central Region

808 Travis Street, Suite 700, Houston, TX 77002

ryan.mcdonner@edpr.com

Attention: McDonner, Ryan

RE: CEMENT STABILIZED SOIL TESTING, RESULTS AND RECOMMENDATIONS

1 INTRODUCTION AND SCOPE

TULLOCH was retained by EDP Renewables (Client) to complete cement stabilized soil testing for the proposed Nation Rise Wind Project and provide results, analysis and recommendations to support design of the private access site roads to the wind turbines and associated buildings.

A bulk sample was collected at the project site and two compressive strength tests were completed for each of 6 distinct soil-cement mixes. The results were then confirmed by retesting three of the soil-cement mixes in a TULLOCH geotechnical laboratory.

2 FIELD EXPLORATION AND LABORATORY TESTING

A TULLOCH geotechnical engineer mobilized to the project site to collect a representative sample for the cement stabilized soil testing in September 2018. The location of Turbine No. 18 was selected based on its location, soil type and moisture content. A test pit was excavated to a depth of 600 mm using a medium sized backhoe. The bulk soil sample was mixed in the test pit, visually classified and a representative sample was collected in sealed bags to preserve the in-situ moisture content.

The native soil was tested for moisture content, gradation, plasticity, maximum dry density, California Bearing Ratio (CBR) and unconfined compressive strength. Soil-cement mixes at 6%, 8% and 10% by mass cement were prepared at optimal moisture content (OMC) and 8% above the OMC and recompacted into standard PVC cores and sent to the

TULLOCH Geotechnical Laboratory in Sault Ste Marie, ON for unconfined compressive strength testing. A 1-point soaked CBR test for one of the soil-cement mixes is currently in progress and the results will be reported later. Laboratory testing was completed following the ASTM standards listed in Table 1.

Table 1: Standards for Laboratory Testing of Soils

Test	Applicable Standard
Particle Size Distribution and Hydrometer	ASTM D6913
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216
Soil Density	ASTM D698
Unconfined Compressive Strength	ASTM D2166
California Bearing Ratio (CBR)	ASTM D1883

3 LABORATORY TEST RESULTS

The bulk sample collected at the Turbine No. 18 location was classified based on visual and tactile assessment on site and tested in the TULLOCH geotechnical lab. Table 2 lists soil description and test results for the native soil.

Table 2: Laboratory Test Results

Test	Results
Visual Classification	Clay, some Silt, (CH)
Natural Moisture Content	44.7%
Gradation	20% Silt, 80% Clay
Atterberg Limits	LL: 69, PL: 29, PI: 40 LI: 0.4
Maximum Dry Density and Optimum Moisture Content	1345 kg/m^3 , 29.8%

Unconfined compression testing was completed for the native and cement stabilized soil samples to assess the strength parameters at varying compositions of water and cement in the mix. The samples were cured for 7 days prior to compression testing. Cylinders for compression testing were prepared at the TULLOCH geotechnical lab and testing was outsourced to a third-party lab. Table 3 summarizes the compressive strength results for the soil-cement mix.

Table 3: Unconfined Compression Test Results

Sample	Load (N)	Average Cross-Sectional Area (mm^2)	Compressive Strength (MPa)
Native Soil	1051	3837	0.274
Native Soil	929	3837	0.242
6% Cement at OMC – 1	7630	8092	0.940
6% Cement at OMC – 2	6688	8124	0.820
6% Cement at OMC + 8% Moisture – 1	5193	8124	0.640*
6% Cement at OMC + 8% Moisture – 2	6886	8124	0.850

8% Cement at OMC – 1	13078	8140	1.61
8% Cement at OMC – 2	13354	8156	1.64
8% Cement at OMC + 8% Moisture – 1	12390	8140	1.52
8% Cement at OMC + 8% Moisture – 2	10332	8140	1.27
10% Cement at OMC – 1	10823	8124	1.33
10% Cement at OMC – 2	8863	8140	1.09
10% Cement at OMC + 8% Moisture – 1	14056	8156	1.72
10% Cement at OMC + 8% Moisture – 2	9402	8124	1.16

*Layer separation at middle of sample noted.

In addition, 6 samples were prepared at the TULLOCH geotechnical lab to confirm test results. Table 4 provides test results for the additional compression tests. On average, the unconfined compressive strength (UCS) for 6%, 8% and 10% cement mix is 0.9, 1.6 and 1.2 MPa at the optimum moisture content. The UCS for 6%, 8% and 10% cement mix is 0.7, 1.4 and 1.4 MPa at 8% above the optimum moisture content. It is noted that there is a high degree of scatter on the data at a cement composition of higher than 8%. This is likely due to the amount of water available to hydrate the cement. The amount and type of clay mineral has an impact on the of water available for cement hydration.

Table 4: Additional Unconfined Compression Test Results

Sample	Load (N)	Average Cross-Sectional Area (mm^2)	Compressive Strength (MPa)
8% Cement at OMC – 1	14234	8125	1.75
8% Cement at OMC – 2	12900	8112	1.59
10% Cement at OMC – 1	12455	8121	1.53
10% Cement at OMC – 2	16903	8096	2.09
10% Cement at OMC + 8% Moisture – 1	9786	8098	1.21
10% Cement at OMC + 8% Moisture – 2	8452	8112	1.04

3-point soaked and un-soaked CBR testing was completed for the native soil to provide input for road design at a variable moisture content of the subgrade.

Table 5: 3-Point Soaked and UnSoaked CBR Test Results

Sample	Condition	Moisture Content (%)	CBR at 5 mm
Sample 1	UnSoaked	25	15.34
Sample 1	Soaked	41	2.18
Sample 1	UnSoaked	37	4.28
Sample 1	Soaked	30	10.61
Sample 1	UnSoaked	34	4.03
Sample 1	Soaked	39	3.45
8% Cement Mix at OMC	Soaked	21	127.38

Table 5 highlights the impact of moisture content on the strength of subgrade. The data shows approximately a reduction of 0.75% in CBR per increase of 1% in moisture content.

It is advised to have a moisture content within 5% of the optimum to ensure the specified compaction can be achieved.

In addition to the laboratory testing, plate load testing was completed at 10 of the turbines to provide supplementary data for road design. Table 6 provides the plate load test results. The CBR values were correlated based on the following relationship.

$$M_R = 10.3 \times CBR$$

Table 6: Correlated CBR based on Plate Load Testing

Test Pit	WTG Access Rd	Material	Subgrade Modulus (MN/m3)	Correlated Resilient Modulus M_R (MPa)	Correlated CBR
TP-PSR-4	WTG-16	Silt Till (ML)	54	24	2.3
TP-PSR-5	WTG-27	Silt Till (ML)	65	29	2.8
TP-PSR-6	WTG-38	Silty Clay (CL)	58	26	2.5
TP-PSR-7	WTG-44	Silt Till (ML)	20	9	0.9
TP-PSR-8	WTG-48	Silt Till (ML)	50	22	2.1
TP-PSR-9	WTG-52	Silty Sand (SM)	34	15	1.5
TP-PSR-10	WTG-56	Silty Sand (SM)	63	28	2.7
TP-PSR-12	WTG-57	Silty Sand (SM)	47	21	2
TP-PSR-14	WTG-35	Silty Clay (CL)	35	16	1.5
TP-PSR-16	WTG-25	Silt Till (ML)	70	31	3.0

The correlated California Bearing Ratio (CBR) for the private site roads ranges from 0.9 to 3. This indicates poor subgrade soil. The lower CBR value is likely due to a high composition of clay sized particles in the upper soil layer. The subgrade strength of clayey soils is highly dependent on the moisture content as highlighted in Table 5. The strength will change due to seasonal variations. The subgrade strength will be highest during the dry seasons and when the ground is frozen. The lowest strength will be encountered during the spring thaw or following a rain fall.

4 TRAFFIC LOADING

American Association of State Highway and Transportation Officials (AASHTO) utilizes Equivalent Single Axle Load (ESAL) to standardize traffic loading for the purpose of road design. ESAL converts vehicles to an equivalent single axle load of 80 kN(18 kips) . Construction vehicles were divided into Single Unit Trucks and Tractor Trailer combinations. Table 7 summarizes the estimated ESALs for each vehicle type.

Table 7: ESALs for each vechile

Vehicle Type	ESAL
Single Unit Truck	0.881
Tractor Trailer Combination	2.073

The turbine delivery vehicles were estimated based on the quantity of material required to construct each turbine. Table 8 provides the assumed number of delivery vehicles (tractor trailer combination) and single unit vehicles for each turbine.

Table 8: Estimated number of delivery vehicles per turbine

Vehicle Type	No. of ESALs
Turbine Delivery Vehicles	12
Concrete Trucks	80
Crane Trucks	17
Gravel Trucks for Site	280
Gravel Trucks for Roads	Varies per road length
Stabilization Trucks for Roads	Varies per road length
Single Unit Trucks	100

A factor of safety of 2 is used to account for uncertainties relating to the preliminary nature of traffic loading estimate. The safety factor may be adjusted once more accurate information is available. Some access roads may be used to access multiple turbines, increasing the traffic loading accordingly. Table 9 provides the estimated traffic loading for the access roads.

Table 9: Calculated ESALs for each Access Road

Access Road	ESALs
1 – 2	4,290
4	2,180
5	2,140
6	2,190
7	2,130
9	2,070
10 – 11	4,130
12	2,050
16	2,050
18 – 20 – 21	15,340
23	2,140
25	8,400
27	1,980
28	2,200
29	2,150
58	2,060
32	2,080
35	1,930
38	2,090
41	2,020
43	2,140

Access Road	ESALs
54	2,200
44	2,110
47	2,110
48	2,250
52	7,840
46	2,340
56	2,470
57	2,190
Laydown	81,760

5 DESIGN AND GEOTECHNICAL RECOMMENDATIONS

This section provides recommendations for design of the private access roads for the Nation Rise Project Site. There are two applicable methods described in the AASHTO pavement design manual. The first method is the Design of flexible and rigid pavements based on the concept of the required Structural Number. The required Structural Number is a function of the traffic loading, subgrade resilient modulus, serviceability loss measuring the riding quality provided by the pavement, reliability intended to account for variations in traffic prediction and performance prediction and overall standard deviation. Table 10 provides the parameters used for the cement stabilized soil access road design recommendations. The parameters are based on recommendations and correlations provided in AASHTO guide for pavement design (1993).

Table 10: Design Parameters for the road design

Design Parameter	Estimate
Reliability	75%
Standard Deviation	0.45
Traffic Loading (ESALs)	Varies
Subgrade Resilient Modulus	20 MPa
Design Serviceability Loss	1.7
Gravel - Layer Coefficient	0.12
Cement Stabilized Soil – Layer Coefficient	0.14
Rut Depth	38.1mm (1.5 inches)

The second method prescribed in AASHTO guide is for the design of Low Volume Aggregate roads. This method utilizes traffic loading, elastic modulus of the base gravel, allowable rutting and subgrade resilient modulus.

5.1 CEMENT STABILIZED AND GEOGRID REINFORCED ACCESS ROAD

Based on the laboratory test results and plate load test data summarized in Section 3, the WTG access roads can be designed using a resilient modulus, M_R, of 20 MPa for the subgrade soils. Table 11 provides recommended road structure for the WTG access roads. The road thicken ss is recommended based on the American Association of Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993). The road thickness for the ESALs provided in Table 8 is not sensitive to a CBR of the subgrade, for CBR values higher than 2%. The road design is based on a subgrade CBR value of 2%, therefore the design in Table 11 should be utilized for all access roads.

Table 11: Proposed Road design for Private Access Roads

Material	Option 1 (mm)	Option 2 (mm)
Gravel – Granular A	150	150
Gravel – Granular B Type II	-	300
Cement Stabilized Soil	300	-
Geotextile and Geogrid	-	TBX2000 or equivalent

5.2 DRAINAGE

The recommended road design in section 5.1 is based on good drainage and assumes a drainage coefficient of 1. Natural drainage in the area is poor. After a rainfall event, water can remain ponded for an extended period. The water may stay and saturate the subgrade material and soften the road subgrade. The contractor is required to crown the subgrade properly directing the water to the road side ditches. In the absence of ditches, the water should be collected using subdrains along the edge of the road, out-letting into a natural low point away from the road. It is assumed the construction will be carried out during dry conditions. If the construction is carried out in wet conditions, the contractor must consult a geotechnical engineer to provide recommendations on the use of geotextile and geogrid.

5.3 MAINTENANCE

The road design recommendations assume a rut depth of 1.5 inches. This will require periodic grading and resurfacing of the roads to account for gravel loss due to traffic, precipitation and snow removal operations. During wet conditions the contractor will encounter wet areas and pumping of finer subgrade into the granular fill. This will result in loss of stiffness and weakening of the road structure. The contractor should overlay a layer of geotextile to prevent migration of fines where pumping of fines is observed in the road base. In addition, geogrid reinforcement will be required to stiffen up the road structure.

If potholes are observed, the loose gravel should be removed and the area should be excavated to a depth of 200 mm and a patch of 1m x 1m, and replaced with Granular A (OPSS 1010).

5.4 SPECIFICATIONS

The following specifications must be met for the access road construction.

- Subgrade soil designated as undesirable by the consultant shall be excavated, removed and disposed of at a time and place as directed by the consultant. The excavated areas shall be immediately backfilled with approved material as designated by the consultant.
- Subgrade shall be scarified to a depth of 150 mm. The loosened material shall be windrowed to the side, and the exposed surface shall be thoroughly compacted. The windrowed material shall then be uniformly mixed, shaped to conform to the dimensions, lines, grades and cross-section as established by the designer, and compacted to obtain compaction of 95% of the Standard Proctor Maximum Dry Density (SPMDD) in the upper 150 mm of the subgrade. Conduct a standard proctor test every 200m of the road to adjust the standard proctor maximum dry density for each section.
- When moisture content of the subgrade is lower than the optimum , the material shall be watered and thoroughly mixed until optimum moisture content is attained. When the material is higher than the optimum, the material shall be worked and aerated until optimum moisture content is attained. Should excess moisture from continuous or heavy precipitation threaten to unduly delay the completion of the Contract, apply in writing to the Consultant requesting permission to use Lime or Portland Cement to dry out the clay subgrade or sub-base material at specific locations.
- The finished subgrade shall be firm and uniform, true to grade and cross section, and shall be approved by the consultant before placing subsequent material thereon.
- Where removal for higher than 150 mm of the subgrade is required, the subgrade shall be recompacted in layers not exceeding a depth of 150 mm or three times the maximum aggregate size, whichever is less.

- Where geotextiles are used, place gravel by end dumping methods and level with a front end loader to avoid damage to the geotextile fabric.
- Compact base gravel to 100 % of the SPMDD and compact in layers not exceeding 75mm in depth. Conduct compaction testing testing on the base gravel for every 100 m of gravel placed on the road.
- Spread the base gravel uniformly to avoid segregation i.e. pockets of fine and course material.
- There should no construction traffic on exposed subgrade. If the subgrade ruts excessively, the subgrade should be scarified, moisture conditioned and recompacted prior to placement of base and/or sub-base.
- The contractor is responsible for maintaining drainage throughout the project. Roadside ditches shall be graded as necessary to maintain drainage. Grading work performed in the ditches should be seeded and protected with erosion mat immediately after grading is complete.
- For at grade access roads, the subgrade and base material should be crowned appropriately to divert water away from the road. Subdrains wrapped in geotextile running along the road edges out letting to a low point should be utilized if the road base cannot be drained properly.
- All aggregates used for bases or surface treatments on access roads shall be a 100% crushed stone (quarried bedrock).
- Pit or band run aggregates may only be used for earthen fill or Portland cement concrete mixes. The contractor shall submit, for approval, an aggregate gradation that meet the requirements stipulated in the TULLOCH memo entitled, “ Nation Rise Public Road Recommendation Memo” dated April XX, 2019.
- The gradation requirements of Granular A and Granular B material should meet the Ontario Provincial Standard Specification (OPSS) 1010.
- The contractor or aggregate supplier should perform at least one gradation test per day. Testing can be exempt for any day when placement is less than 100 tons. Testing shall be performed per ASTM D6913. Testing should be performed by a Canadian Council of Independent Laboratories (CCIL) certified Lab and CCIL certified technician and the results made available to the owner within 24 hours of sample collection.

- All proof rolls shall be performed by a minimum 33 Ton tandem axle truck and witnessed by a representative from a geotechnical consulting firm approved by the owner. The observed deflection shall be less than 13 mm. The contractor may use geotextiles, geogrid reinforcement, additional gravel, additional compaction effort, or additional cement to remedy failed tests. The geotechnical engineer should be contacted for approval if other means of repair are used.
- Prior to exposing the roads to heavy traffic, the contractor should allow access roads to dry up following a freeze thaw and wet weather . Properly prepared subgrade may not perform well if the subgrade is saturated. It is recommended to perform another round of proof rolling if the subgrade is expected to be saturated.
- Prior to Commencing access road construction, the contractor shall collect subgrade samples for each turbine access road and deliver for compression testing (ASTM D2166) at 8% cement by mass, optimum moisture content and 95% compaction (per ASTM D558) of the SPMDD. The sample should be tested 7 days after mixing for unconfined compressive strength. The unconfined compression strength should be a minimum of 1.7 MPa, if the tests do not meet the minimum strength, the percent cement or other factors may be re-evaluated.
- All access roads should receive an 8% cement mix to a depth of 300 mm. The cement mix may be adjusted with prior approval by the owner.
- Determine moisture prior to mixing cement in the soil and adjust to +/- 2% of the optimum determined per compaction test results (ASTM D558).
- Compaction should begin within one hour of cement mixing. Density and moisture should be determined within two hours of the cement mixing. The testing should be completed every 100 m of the road.
- Cement stabilization shall not be performed on frozen subgrade

Enclosed: Lab Test Results

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 18-4022

DATE SAMPLED: Refer to BH logs

PROJECT: Nation Rise Cement Stabilization

SOURCE: Boreholes

DATE TESTED: 10-Oct-18

TESTED BY: T. Linley

			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	TP18 SA13		677.42	518.50	162.73	158.92	44.7%

REMARKS:

CLIENT:

COPIES TO:

GRAIN SIZE DISTRIBUTION TEST DATA

2018-10-15

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: TP 18
Sample Number: 13
Liquid Limit: 69 **Plastic Limit:** 29
USCS Classification: CH **AASHTO Classification:** A-7-6(48)

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
518.50	162.73	#10	0.00	0.00	100.0
		#16	0.00	0.00	100.0
		#30	0.10	0.00	100.0
		#40	0.10	0.00	99.9
		#50	0.20	0.00	99.9
		#60	0.20	0.00	99.8
		#100	0.40	0.00	99.7
		#200	0.70	0.00	99.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =74.6
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5
Meniscus correction only = -1.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	24.7	69.0	65.2	0.0129	68.0	5.1	0.0292	87.4
2.00	24.7	68.0	64.2	0.0129	67.0	5.3	0.0210	86.0
5.00	24.7	66.0	62.2	0.0129	65.0	5.6	0.0137	83.3
15.00	24.7	65.0	61.2	0.0129	64.0	5.8	0.0080	82.0
30.00	24.1	64.0	60.0	0.0130	63.0	6.0	0.0058	80.4
60.00	24.0	63.0	59.0	0.0130	62.0	6.1	0.0042	79.0
250.00	26.3	59.5	56.3	0.0127	58.5	6.7	0.0021	75.4
1440.00	20.5	53.0	48.1	0.0136	52.0	7.8	0.0010	64.4

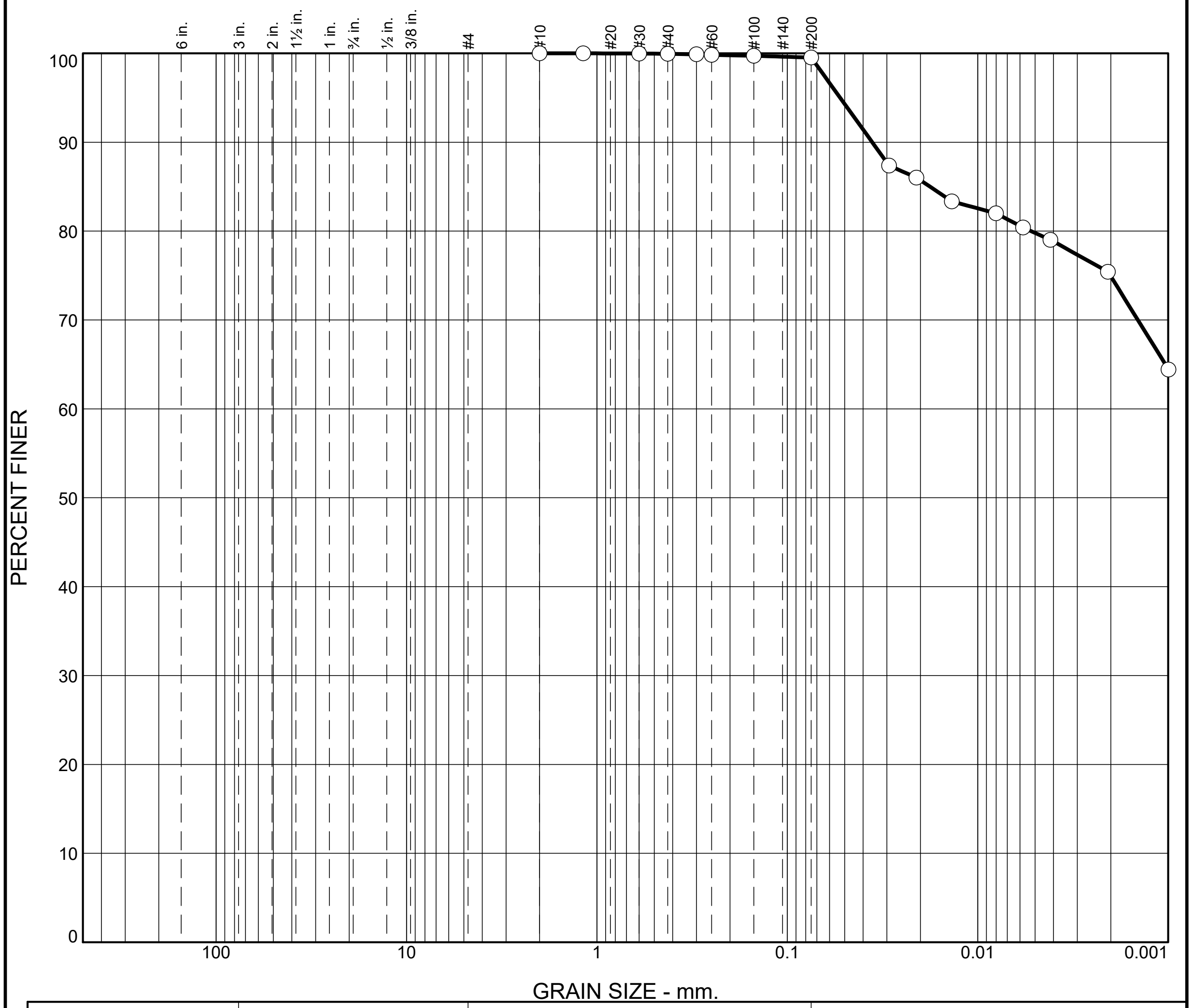
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	19.7	79.8	99.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
								0.0053	0.0178	0.0359	0.0528

Fineness Modulus
0.00

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.1	0.4	19.7	79.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	69	29	0.0178							

Material Description	USCS	AASHTO
○	CH	A-7-6(48)

Project No. 18-4022 **Client:** EDP

Project: Nation Rise Wind Farm

○ **Source of Sample:** TP 18 **Sample Number:** 13

Remarks:

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Figure

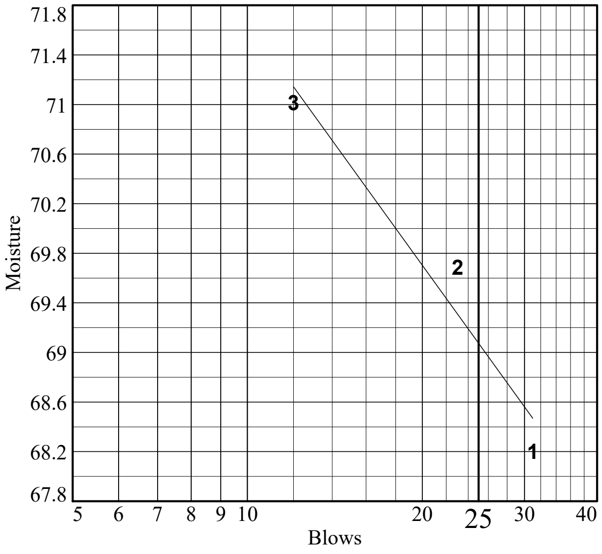
LIQUID AND PLASTIC LIMIT TEST DATA

2018-10-15

Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: TP 18
Sample Number: 13
%<#40: 99.9 **%<#200:** 99.5 **USCS:** CH **AASHTO:** A-7-6(48)
Tested by: S.Hoffman **Checked by:** J.Draper

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.17	25.79	25.67			
Dry+Tare	21.15	20.80	20.67			
Tare	13.79	13.64	13.63			
# Blows	31	23	12			
Moisture	68.2	69.7	71.0			



Liquid Limit= 69
Plastic Limit= 29
Plasticity Index= 40
Natural Moisture= 44.7
Liquidity Index= 0.4

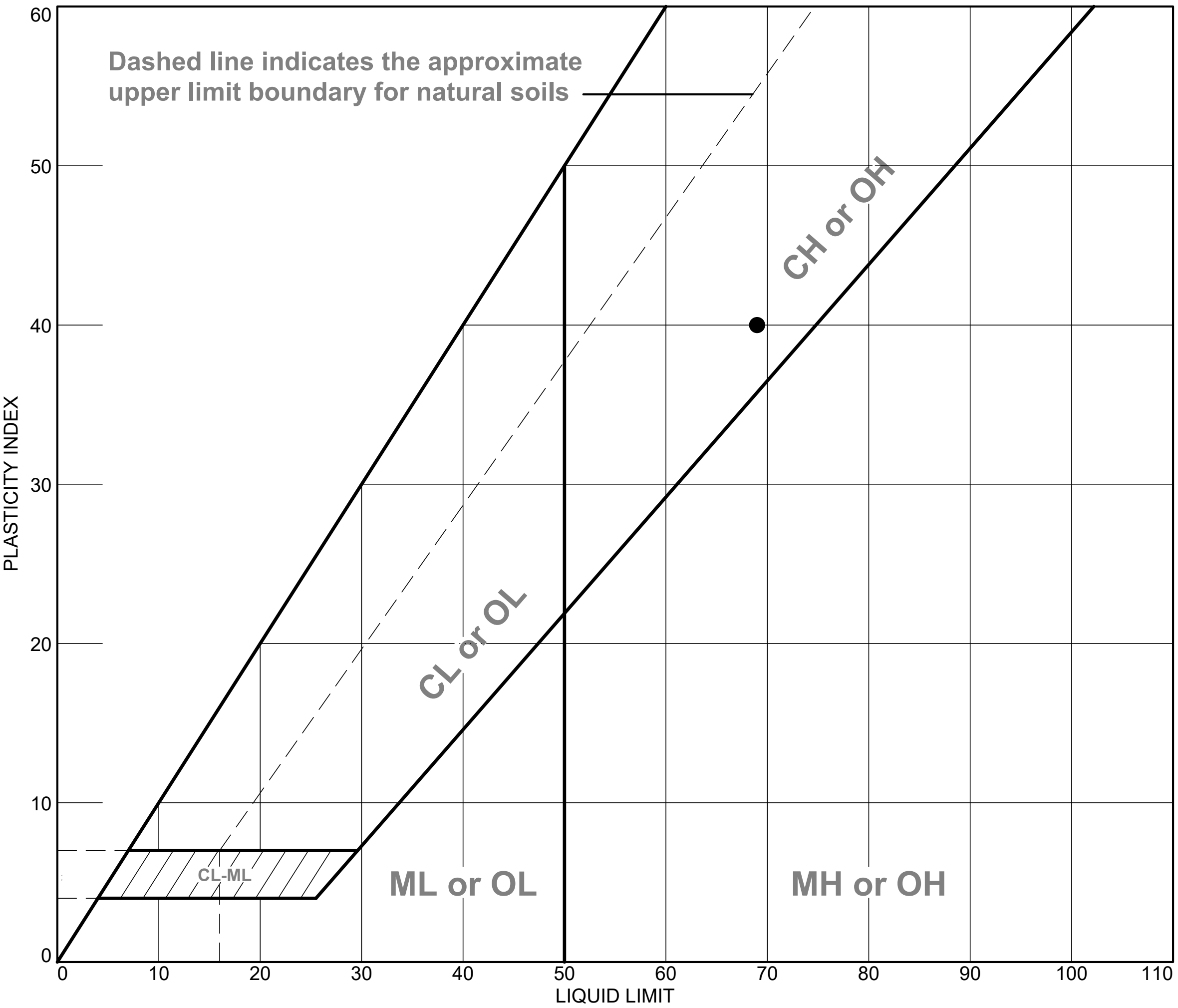
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	17.46	16.32			
Dry+Tare	16.59	15.75			
Tare	13.60	13.74			
Moisture	29.1	28.4			

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
677.42	518.5	162.73	44.7

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		69	29	40	99.9	99.5	CH

Project No. 18-4022 **Client:** EDP

Project: Nation Rise Wind Farm

● **Source of Sample:** TP 18 **Sample Number:** 13

Remarks:

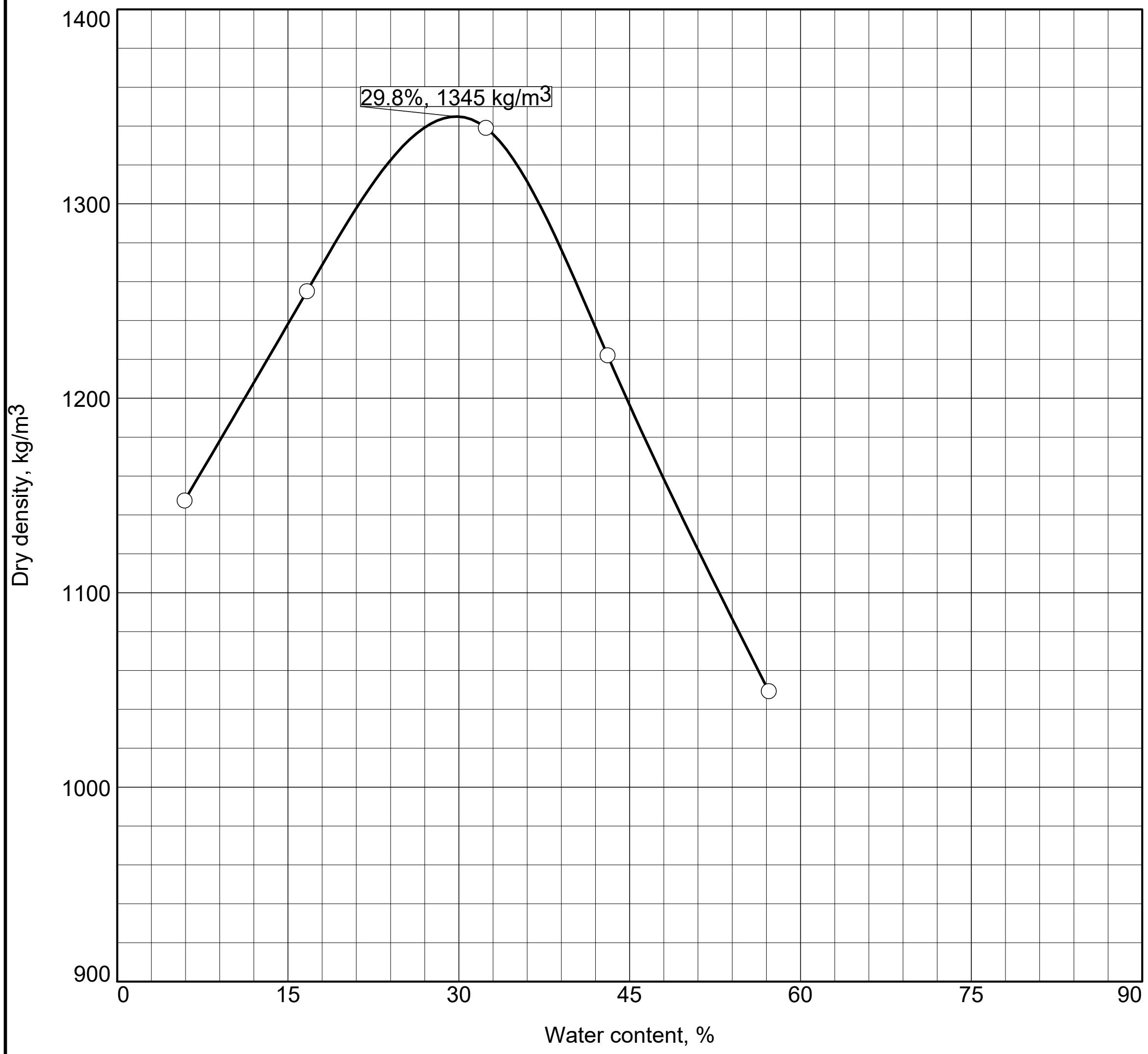
TULLOCH ENGINEERING
71 Black Road
Unit 3
Sault Ste.
Marie, ON
P6B 0A3

T. 705 949.1457
F. 705 949.9606
TF. 866 806.6602
adam.byers@TULLOCH.ca

Figure

Tested By: S.Hoffman **Checked By:** J.Draper

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 1345 kg/m^3 Optimum moisture = 29.8 %	

Project No. 18-4022 **Client:** EDP

Project: Nation Rise Wind Farm

○ **Source:** Cement Stabilization SA5 & SA11 **Sample No.:** PD 3036

TULLOCH ENGINEERING

71 Black Road
Unit 3
Sault Ste.
Marie, ON
P6B 0A3

T. 705 949.1457
F. 705 949.9606
TF. 866 806.6602
adam.byers@TULLOCH.ca

Remarks:

Mixed SA5 and SA11

Figure

Tested By: D.Stadnisky **Checked By:** T. Linley

MOISTURE DENSITY TEST DATA

2018-10-12

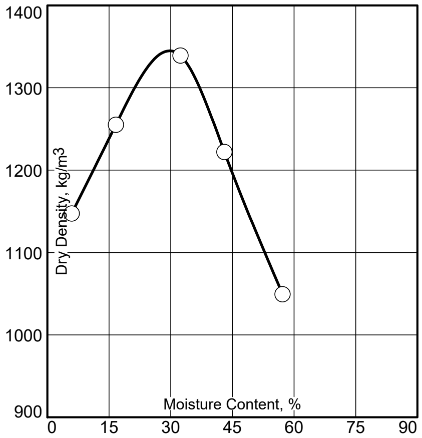
Client: EDP
Project: Nation Rise Wind Farm
Project Number: 18-4022
Location: Cement Stabilization SA5 & SA11
Sample Number: PD 3036
Testing Remarks: Mixed SA5 and SA11
Tested by: D.Stadnisky **Checked by:** T. Linley

Test Data and Results

Test Specification:

Type of Test: ASTM D 698-12 Method A Standard

Mold Dia: 4.00 **Hammer Wt.:** 5.5 lb. **Drop:** 12 in. **Layers:** three **Blows per Layer:** 25



Point No.	1	2	3	4	5
Wt. M+S	5647.0	5882.0	6173.0	6150.0	6057.0
Wt. M	4500.0	4500.0	4500.0	4500.0	4500.0
Wt. W+T	295.4	275.1	292.4	298.6	372.2
Wt. D+T	287.6	260.1	260.9	254.0	296.0
Tare	155.7	170.1	163.6	150.4	162.8
Moist.	5.9	16.7	32.4	43.1	57.2
Dry Den.	1147	1255	1339	1222	1049

Test Results: **Max. Dry Den.=** 1345 kg/m^3 **Opt. Moist.=** 29.8%

Peto MacCallum Ltd.
CONSULTING ENGINEERS

SUMMARY OF COMPRESSIVE STRENGTH RESULTS

CLIENT	TULLOCH Engineering Inc.	PML REF.	18HM133
PROJECT	Lab Testing of Aggregates	REPORT NO.	1
LOCATION	Sault St. Marie, Ontario	ENCLOSURE	1
SPECIMEN TYPE	100 mm dia. Cylinders (soil/cement)	DATE RECEIVED	November 28, 2018

SAMPLE REFERENCE	**LAB NUMBER**	**LOAD (N)**	**AREA (MM2)**	**DATE CAST**	**COMPRSSIVE STRENGTH (MPa)**		**Comments**
					7 days	**28 days**	
18-4022 Mix 1	1851864 A&B	7630.2	8092	November 21, 2018	0.94	--	Soil at 30% moisture Cement 6%
		6687.5	8124		0.82	--	
					--	--	
AVERAGE					0.88	--	
18-4022 Mix 2	1851864 C&D	5193.6	8124	November 21, 2018	0.64*	--	OMC +8% Cement 6% *Layer separation at middle of sample noted
		6886.1	8124		0.85	--	
					--	--	
AVERAGE					0.75	--	
18-4022 Mix 3	1851864 E&F	13078.3	8140	November 22, 2018	1.61	--	OMC Cement 8%
		13353.6	8156		1.64	--	
					--	--	
AVERAGE					1.63	--	
18-4022 Mix 4	1851864 G&H	12390.2	8140	November 22, 2018	1.52	--	OMC +8% Cement 8%
		10332.8	8140		1.27	--	
					--	--	
AVERAGE					1.40	--	
18-4022 Mix 5	1851864 I&J	10822.6	8124	November 22, 2018	1.33	--	OMC Cement 10%
		8863.1	8140		1.09	--	
					--	--	
AVERAGE					1.21	--	
18-4022 Mix 6	1851864 K&L	14055.9	8156	November 22, 2018	1.72	--	OMC +8% Cement 10%
		9402.0	8124		1.16	--	
					--	--	
AVERAGE					1.44	--	

NOTE:
Sample Type: Nominal 100mm diameter cylinder.

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	24% Soaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/04/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	96	RELATIVE COMPACTION, %	94

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.66	11.66	DRY WEIGHT, g	2776.07	2776.07
SAMPLE DIAMETER, cn	15.23	15.23	WATER CONTENT, %	25.20	40.75
SAMPLE AREA, cm^2	182.18	182.18	UNIT WEIGHT, kN/m^3	16.04	18.03
SAMPLE VOLUME, cc	2123.62	2124.90	DRY UNIT WT., kN/m^3	12.81	12.81
WET WEIGHT, g	3475.64	3907.24			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	-	0.00	0.0	0.00	0.00
0.5	-	0.00	0.5	2.06	0.01
1.0	-	0.00	1.0	12.36	0.06
1.5	-	0.00	1.5	16.75	0.08
2.0	-	0.00	2.0	23.07	0.12
2.5	**-**	0.00	**2.5**	**28.83**	0.15
3.0	-	0.00	3.0	32.68	0.16
3.5	-	0.00	3.5	36.66	0.18
4.0	-	0.00	4.0	37.35	0.19
4.5	-	0.00	4.5	39.95	0.20
5.0	**-**	0.00	**5.0**	**42.56**	0.21
5.5	-	0.00	5.5	44.76	0.23
6.0	-	0.00	6.0	47.64	0.24
6.5	-	0.00	6.5	51.35	0.26
7.0	-	0.00	7.0	53.55	0.27
7.5	-	0.00	7.5	55.06	0.28
8.0	-	0.00	8.0	57.12	0.29
8.5	-	0.00	8.5	58.90	0.30
9.0	-	0.00	9.0	60.27	0.30
9.5	-	0.00	9.5	62.06	0.31
10.0	-	0.00	10.0	63.57	0.32
10.5	-	0.00	10.5	64.67	0.33
11.0	-	0.00	11.0	66.31	0.33
11.5	-	0.00	11.5	67.27	0.34
12.0	-	0.00	12.0	68.79	0.35
12.5	-	0.00	12.5	70.16	0.35
13.0	-	0.00	13.0	71.26	0.36

TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	-	41.50
SWELL, %	-	0.06
CORRECTED STRESS VALUE (at 2.5 mm), MPa	-	0.16
CORRECTED STRESS VALUE (at 5.0 mm), MPa	-	0.23
BEARING RATIO (at 2.5 mm), %	***-***	***2.32***
BEARING RATIO (at 5.0 mm), %	***-***	***2.18***

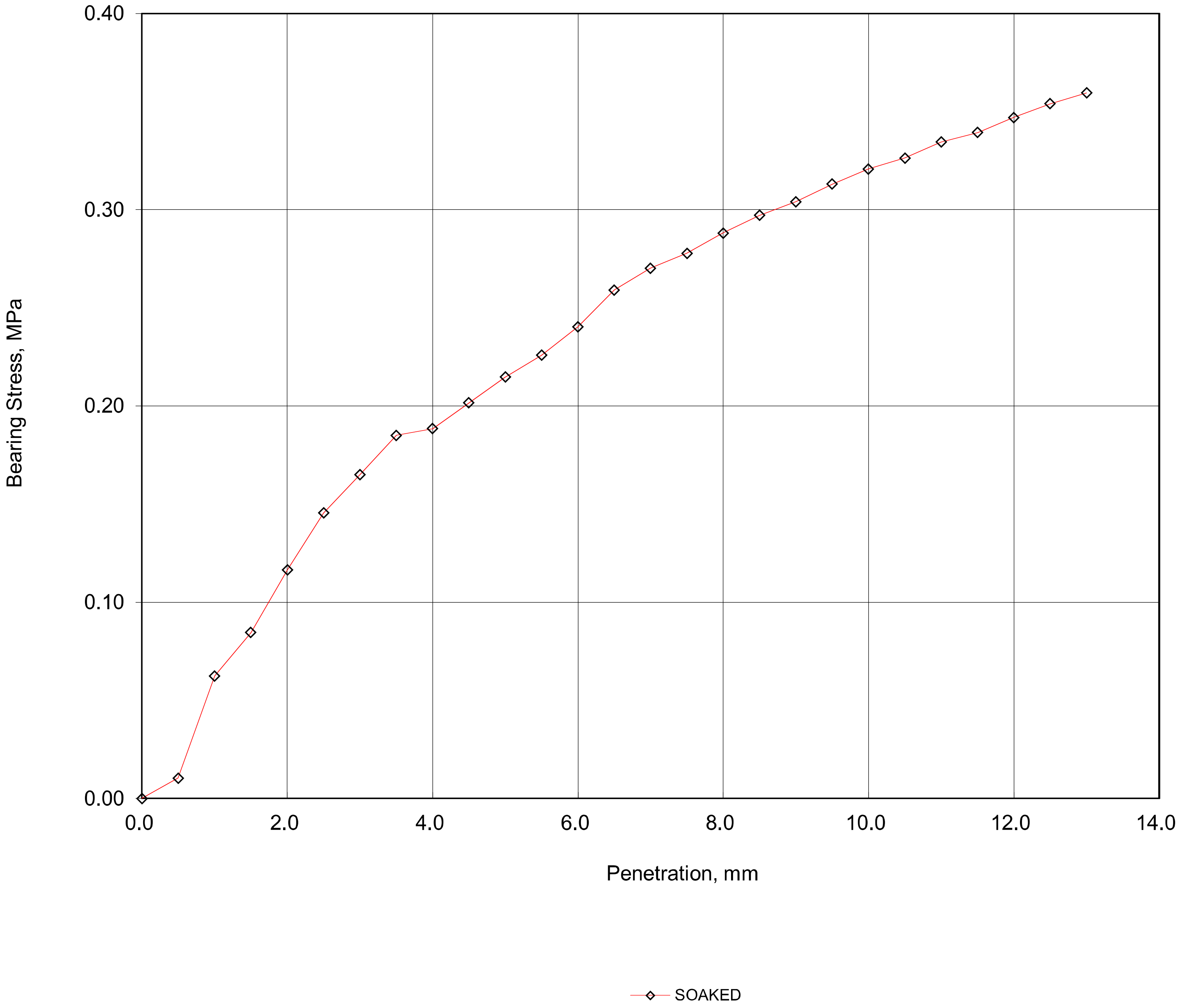
Checked By:

Project No. 18105808 (5000)

Golder Associates

CALIFORNIA BEARING RATIO TEST (CBR)

24% Soaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



Checked By:

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	24% Unsoaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/05/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	N/A	RELATIVE COMPACTION, %	92

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.66	-	DRY WEIGHT, g	2791.48	-
SAMPLE DIAMETER, cn	15.24	-	WATER CONTENT, %	23.90	-
SAMPLE AREA, cm^2	182.42	-	UNIT WEIGHT, kN/m^3	15.94	-
SAMPLE VOLUME, cc	2126.41	-	DRY UNIT WT., kN/m^3	12.87	-
WET WEIGHT, g	3458.64	-			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	0.00	0.00	0.0	-	0.00
0.5	54.78	0.28	0.5	-	0.00
1.0	126.99	0.64	1.0	-	0.00
1.5	172.99	0.87	1.5	-	0.00
2.0	215.00	1.08	2.0	-	0.00
2.5	**239.71**	1.21	**2.5**	**-**	0.00
3.0	256.32	1.29	3.0	-	0.00
3.5	268.67	1.36	3.5	-	0.00
4.0	285.15	1.44	4.0	-	0.00
4.5	300.66	1.52	4.5	-	0.00
5.0	**313.57**	1.58	**5.0**	**-**	0.00
5.5	323.59	1.63	5.5	-	0.00
6.0	334.85	1.69	6.0	-	0.00
6.5	342.26	1.73	6.5	-	0.00
7.0	349.67	1.76	7.0	-	0.00
7.5	358.60	1.81	7.5	-	0.00
8.0	369.85	1.87	8.0	-	0.00
8.5	376.58	1.90	8.5	-	0.00
9.0	382.48	1.93	9.0	-	0.00
9.5	391.00	1.97	9.5	-	0.00
10.0	398.00	2.01	10.0	-	0.00
10.5	401.98	2.03	10.5	-	0.00
11.0	408.98	2.06	11.0	-	0.00
11.5	413.51	2.09	11.5	-	0.00
12.0	420.24	2.12	12.0	-	0.00
12.5	424.49	2.14	12.5	-	0.00
13.0	431.91	2.18	13.0	-	0.00

TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	23.20	-
SWELL, %	N/A	-
CORRECTED STRESS VALUE (at 2.5 mm), MPa	1.21	-
CORRECTED STRESS VALUE (at 5.0 mm), MPa	1.58	-
BEARING RATIO (at 2.5 mm), %	***17.54***	***-***
BEARING RATIO (at 5.0 mm), %	***15.34***	***-***

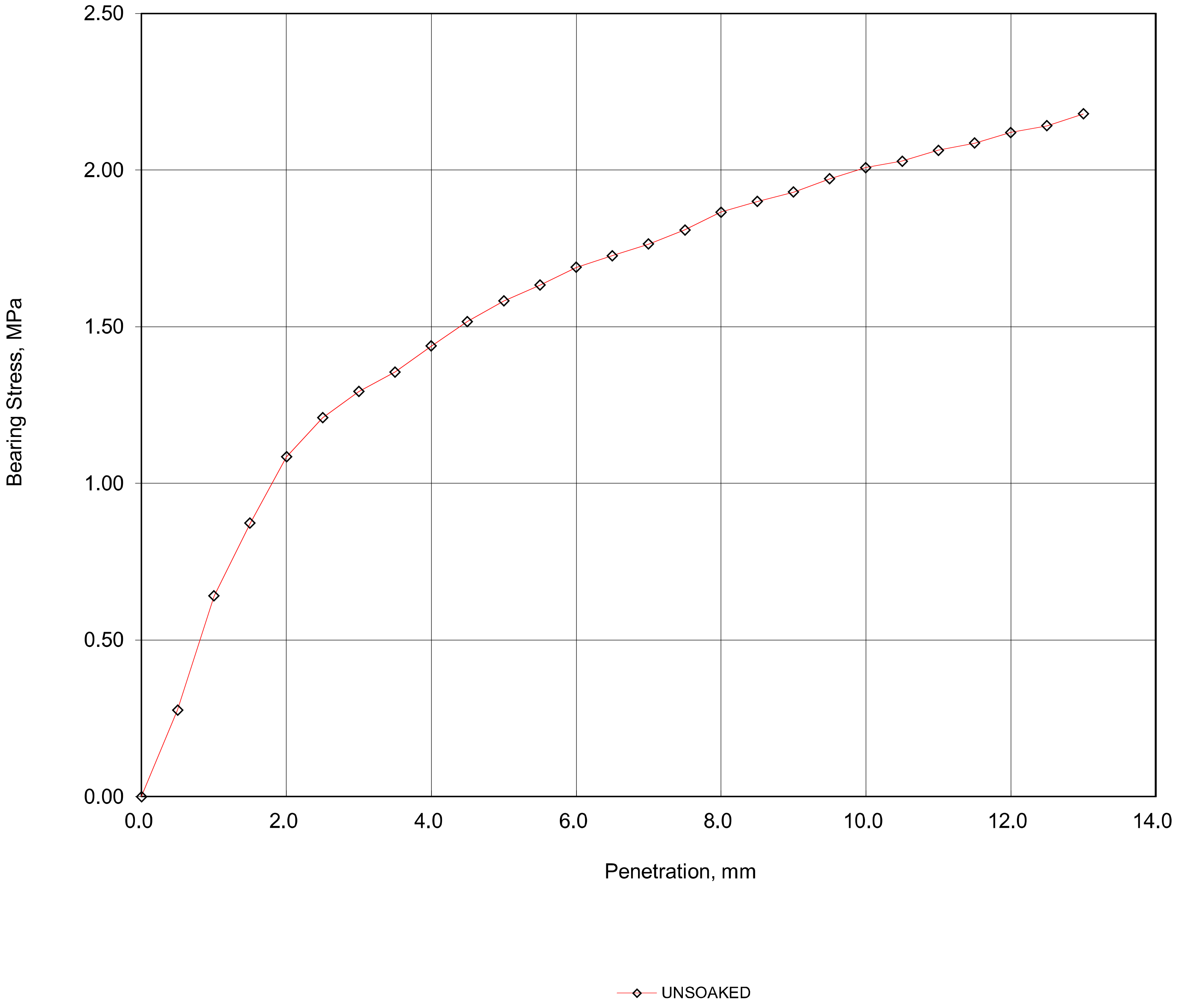
Checked By:

Project No. 18105808 (5000)

Golder Associates

CALIFORNIA BEARING RATIO TEST (CBR)

24% Unsoaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



Checked By:

GOLDER

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	29.8% Soaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/04/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	96	RELATIVE COMPACTION, %	96

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.65	11.65	DRY WEIGHT, g	2869.88	2869.88
SAMPLE DIAMETER, cn	15.24	15.24	WATER CONTENT, %	29.60	36.60
SAMPLE AREA, cm^2	182.42	182.42	UNIT WEIGHT, kN/m^3	17.16	18.08
SAMPLE VOLUME, cc	2124.59	2125.13	DRY UNIT WT., kN/m^3	13.24	13.24
WET WEIGHT, g	3719.36	3920.36			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	-	0.00	0.0	0.00	0.00
0.5	-	0.00	0.5	21.42	0.11
1.0	-	0.00	1.0	43.25	0.22
1.5	-	0.00	1.5	55.06	0.28
2.0	-	0.00	2.0	65.22	0.33
2.5	**-**	0.00	**2.5**	**73.45**	0.37
3.0	-	0.00	3.0	76.88	0.39
3.5	-	0.00	3.5	79.49	0.40
4.0	-	0.00	4.0	82.65	0.42
4.5	-	0.00	4.5	85.53	0.43
5.0	**-**	0.00	**5.0**	**87.46**	0.44
5.5	-	0.00	5.5	89.65	0.45
6.0	-	0.00	6.0	91.85	0.46
6.5	-	0.00	6.5	93.63	0.47
7.0	-	0.00	7.0	95.14	0.48
7.5	-	0.00	7.5	96.52	0.49
8.0	-	0.00	8.0	98.30	0.50
8.5	-	0.00	8.5	99.67	0.50
9.0	-	0.00	9.0	100.64	0.51
9.5	-	0.00	9.5	102.15	0.52
10.0	-	0.00	10.0	103.11	0.52
10.5	-	0.00	10.5	104.75	0.53
11.0	-	0.00	11.0	106.26	0.54
11.5	-	0.00	11.5	107.50	0.54
12.0	-	0.00	12.0	108.87	0.55
12.5	-	0.00	12.5	110.11	0.56
13.0	-	0.00	13.0	111.07	0.56

TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	-	34.80
SWELL, %	-	0.03
CORRECTED STRESS VALUE (at 2.5 mm), MPa	-	0.37
CORRECTED STRESS VALUE (at 5.0 mm), MPa	-	0.44
BEARING RATIO (at 2.5 mm), %	**-**	***5.37***
BEARING RATIO (at 5.0 mm), %	**-**	***4.28***

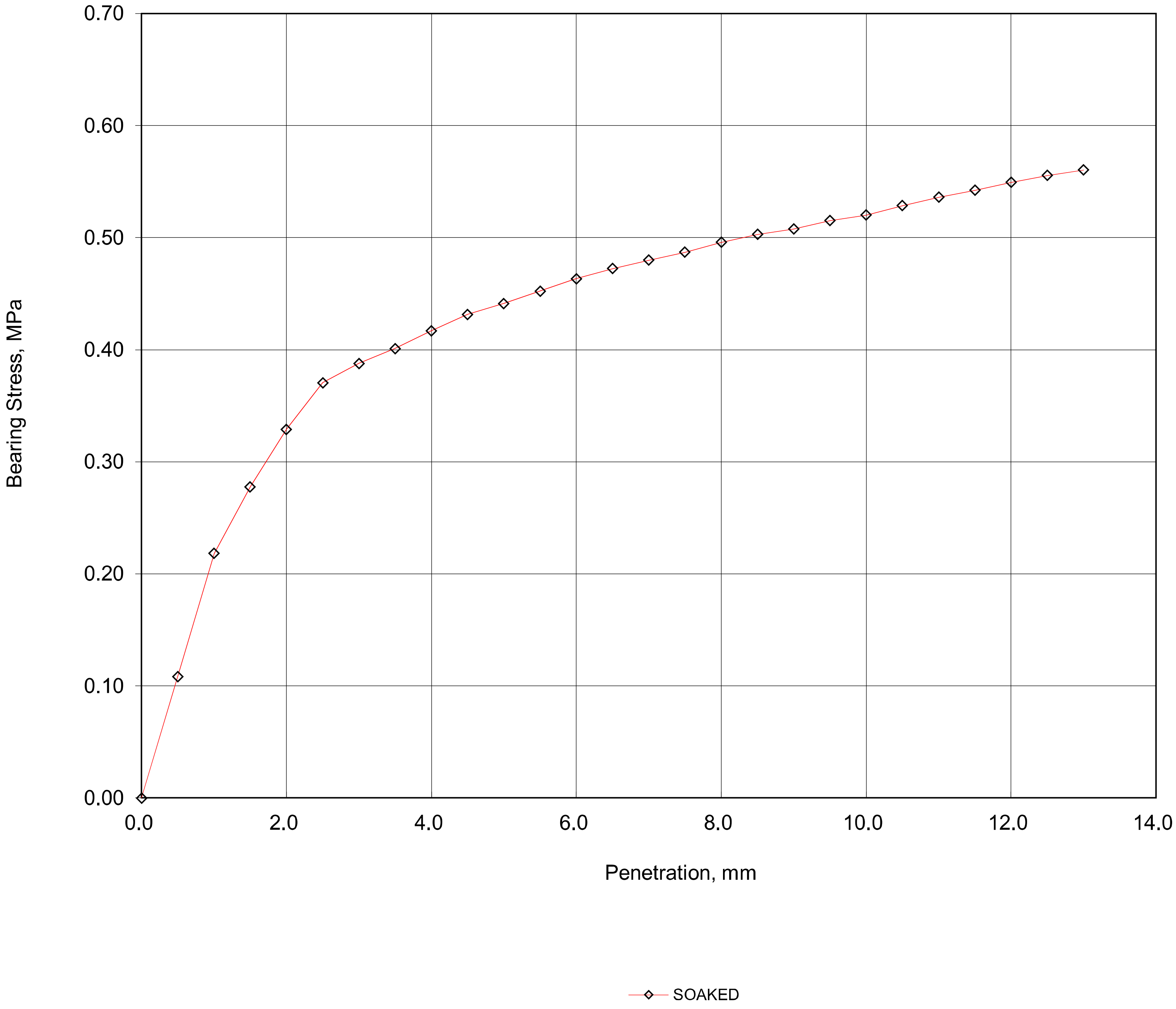
Checked By:

Golder

Project No. 18105808 (5000)

Golder Associates

29.8% Soaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



Checked By:

CALIFORNIA BEARING RATIO TEST (CBR)

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	29.8% Unsoaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/05/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	N/A	RELATIVE COMPACTION, %	93

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.65	-	DRY WEIGHT, g	2842.24	-
SAMPLE DIAMETER, cn	15.24	-	WATER CONTENT, %	30.10	-
SAMPLE AREA, cm^2	182.42	-	UNIT WEIGHT, kN/m^3	17.06	-
SAMPLE VOLUME, cc	2125.14	-	DRY UNIT WT., kN/m^3	13.11	-
WET WEIGHT, g	3697.76	-			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	0.00	0.00	0.0	-	0.00
0.5	64.25	0.32	0.5	-	0.00
1.0	105.72	0.53	1.0	-	0.00
1.5	128.64	0.65	1.5	-	0.00
2.0	148.27	0.75	2.0	-	0.00
2.5	**164.61**	0.83	**2.5**	**-**	0.00
3.0	175.73	0.89	3.0	-	0.00
3.5	189.05	0.95	3.5	-	0.00
4.0	200.17	1.01	4.0	-	0.00
4.5	206.76	1.04	4.5	-	0.00
5.0	**216.64**	1.09	**5.0**	**-**	0.00
5.5	224.88	1.13	5.5	-	0.00
6.0	232.43	1.17	6.0	-	0.00
6.5	236.82	1.19	6.5	-	0.00
7.0	243.69	1.23	7.0	-	0.00
7.5	249.32	1.26	7.5	-	0.00
8.0	255.08	1.29	8.0	-	0.00
8.5	258.79	1.31	8.5	-	0.00
9.0	264.01	1.33	9.0	-	0.00
9.5	267.30	1.35	9.5	-	0.00
10.0	271.69	1.37	10.0	-	0.00
10.5	274.17	1.38	10.5	-	0.00
11.0	277.19	1.40	11.0	-	0.00
11.5	280.89	1.42	11.5	-	0.00
12.0	283.36	1.43	12.0	-	0.00
12.5	286.11	1.44	12.5	-	0.00
13.0	288.99	1.46	13.0	-	0.00

TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	28.30	-
SWELL, %	N/A	-
CORRECTED STRESS VALUE (at 2.5 mm), MPa	0.83	-
CORRECTED STRESS VALUE (at 5.0 mm), MPa	1.09	-
BEARING RATIO (at 2.5 mm), %	***12.04***	***-***
BEARING RATIO (at 5.0 mm), %	***10.61***	***-***

Checked By:

Golder

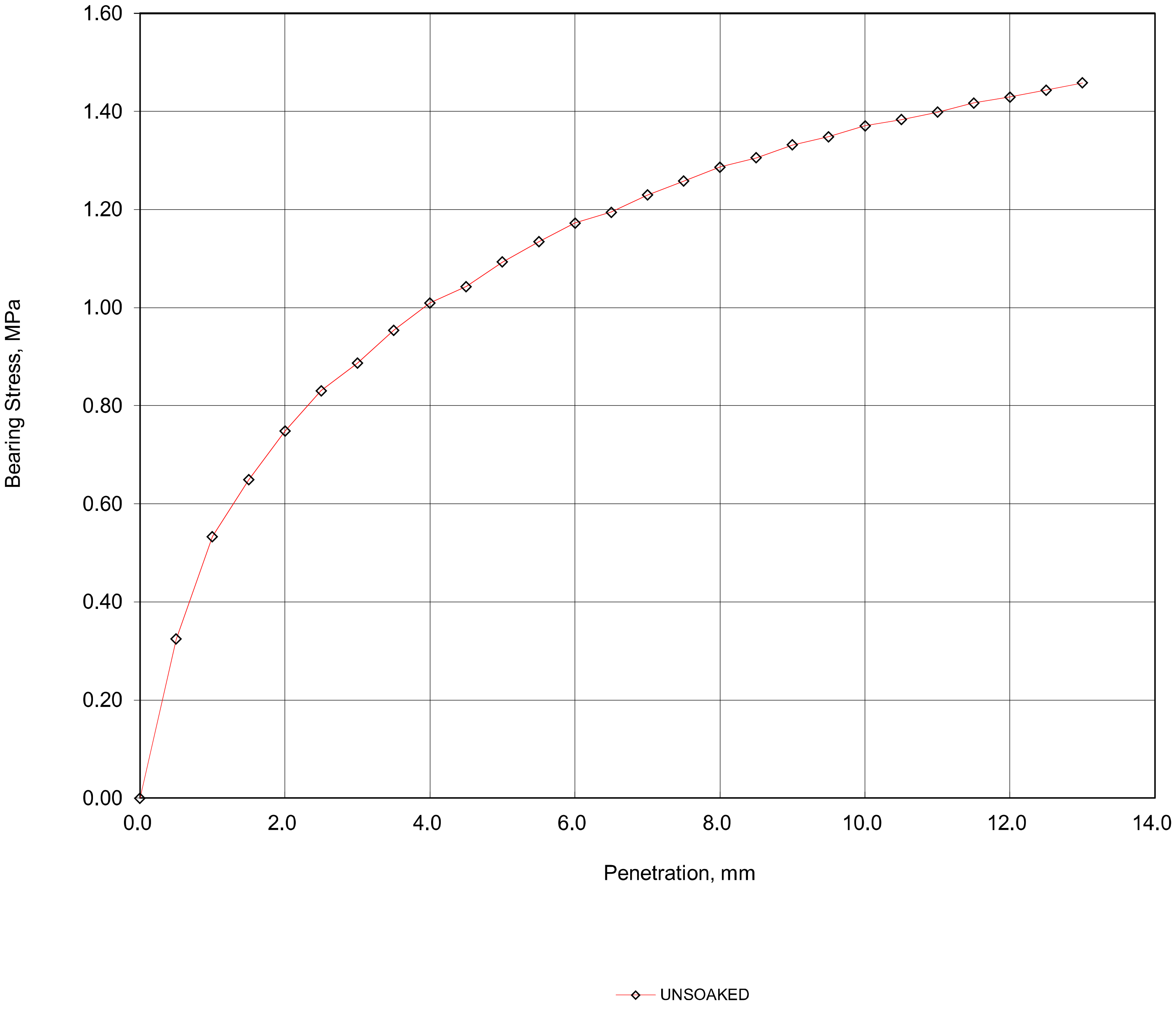
Project No. 18105808 (5000)

Golder Associates

Checked By:

CALIFORNIA BEARING RATIO TEST (CBR)

29.8% Unsoaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	36% Soaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/04/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	96	RELATIVE COMPACTION, %	92

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.65	11.65	DRY WEIGHT, g	2785.31	2785.31
SAMPLE DIAMETER, cn	15.23	15.23	WATER CONTENT, %	36.00	38.55
SAMPLE AREA, cm^2	182.18	182.18	UNIT WEIGHT, kN/m^3	17.50	17.83
SAMPLE VOLUME, cc	2121.80	2122.01	DRY UNIT WT., kN/m^3	12.87	12.87
WET WEIGHT, g	3788.02	3859.12			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	-	0.00	0.0	0.00	0.00
0.5	-	0.00	0.5	22.79	0.11
1.0	-	0.00	1.0	31.72	0.16
1.5	-	0.00	1.5	44.35	0.22
2.0	-	0.00	2.0	50.11	0.25
2.5	**-**	0.00	**2.5**	**55.88**	0.28
3.0	-	0.00	3.0	62.20	0.31
3.5	-	0.00	3.5	62.61	0.32
4.0	-	0.00	4.0	66.45	0.34
4.5	-	0.00	4.5	68.10	0.34
5.0	**-**	0.00	**5.0**	**70.43**	0.36
5.5	-	0.00	5.5	71.81	0.36
6.0	-	0.00	6.0	73.86	0.37
6.5	-	0.00	6.5	75.10	0.38
7.0	-	0.00	7.0	76.34	0.39
7.5	-	0.00	7.5	78.12	0.39
8.0	-	0.00	8.0	79.49	0.40
8.5	-	0.00	8.5	81.42	0.41
9.0	-	0.00	9.0	82.24	0.41
9.5	-	0.00	9.5	83.75	0.42
10.0	-	0.00	10.0	84.85	0.43
10.5	-	0.00	10.5	86.36	0.44
11.0	-	0.00	11.0	88.01	0.44
11.5	-	0.00	11.5	89.38	0.45
12.0	-	0.00	12.0	90.34	0.46
12.5	-	0.00	12.5	91.71	0.46
13.0	-	0.00	13.0	92.54	0.47

TEST RESULTS

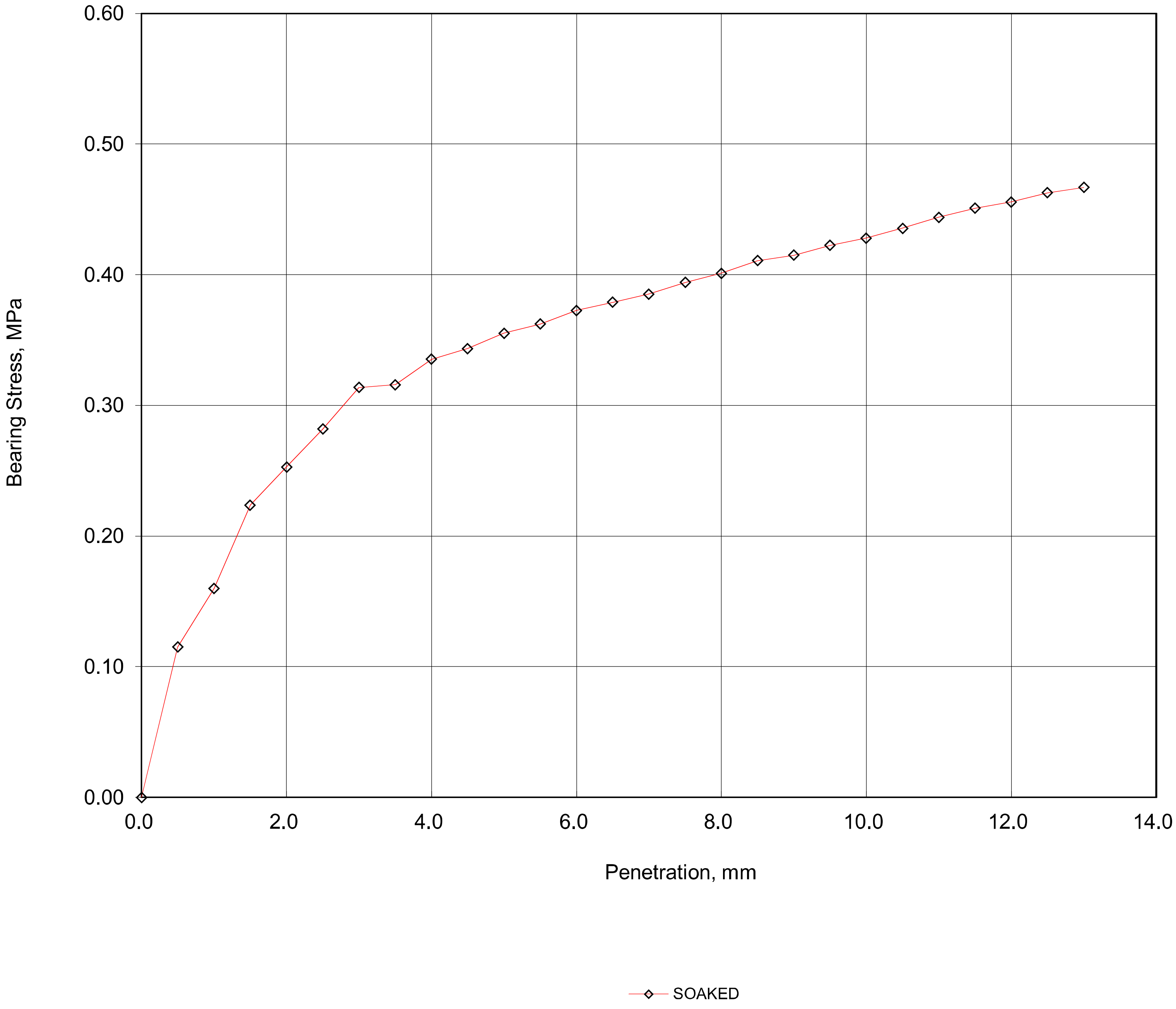
	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	-	35.70
SWELL, %	-	0.01
CORRECTED STRESS VALUE (at 2.5 mm), MPa	-	0.28
CORRECTED STRESS VALUE (at 5.0 mm), MPa	-	0.36
BEARING RATIO (at 2.5 mm), %	***-***	***4.09***
BEARING RATIO (at 5.0 mm), %	***-***	***3.45***

Checked By:

Project No. 18105808 (5000)

Golder Associates

36% Soaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



Checked By:

CALIFORNIA BEARING RATIO TEST (CBR)

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	36% Unsoaked - Cement Stabilizer
PROJECT NAME	Tulloch Nation Rise	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/05/2019

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	178671	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	45
SOAKING TIME, hr	N/A	RELATIVE COMPACTION, %	93

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.65	-	DRY WEIGHT, g	2829.72	-
SAMPLE DIAMETER, cn	15.23	-	WATER CONTENT, %	34.00	-
SAMPLE AREA, cm^2	182.18	-	UNIT WEIGHT, kN/m^3	17.51	-
SAMPLE VOLUME, cc	2122.35	-	DRY UNIT WT., kN/m^3	13.07	-
WET WEIGHT, g	3791.82	-			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	0.00	0.00	0.0	-	0.00
0.5	17.44	0.09	0.5	-	0.00
1.0	30.21	0.15	1.0	-	0.00
1.5	43.11	0.22	1.5	-	0.00
2.0	51.62	0.26	2.0	-	0.00
2.5	**57.66**	0.29	**2.5**	**-**	0.00
3.0	67.41	0.34	3.0	-	0.00
3.5	70.84	0.36	3.5	-	0.00
4.0	75.10	0.38	4.0	-	0.00
4.5	78.40	0.40	4.5	-	0.00
5.0	**82.38**	0.42	**5.0**	**-**	0.00
5.5	84.71	0.43	5.5	-	0.00
6.0	88.01	0.44	6.0	-	0.00
6.5	90.89	0.46	6.5	-	0.00
7.0	93.50	0.47	7.0	-	0.00
7.5	95.28	0.48	7.5	-	0.00
8.0	97.07	0.49	8.0	-	0.00
8.5	98.99	0.50	8.5	-	0.00
9.0	100.91	0.51	9.0	-	0.00
9.5	102.28	0.52	9.5	-	0.00
10.0	104.07	0.53	10.0	-	0.00
10.5	105.03	0.53	10.5	-	0.00
11.0	106.54	0.54	11.0	-	0.00
11.5	107.50	0.54	11.5	-	0.00
12.0	108.87	0.55	12.0	-	0.00
12.5	110.11	0.56	12.5	-	0.00
13.0	111.34	0.56	13.0	-	0.00

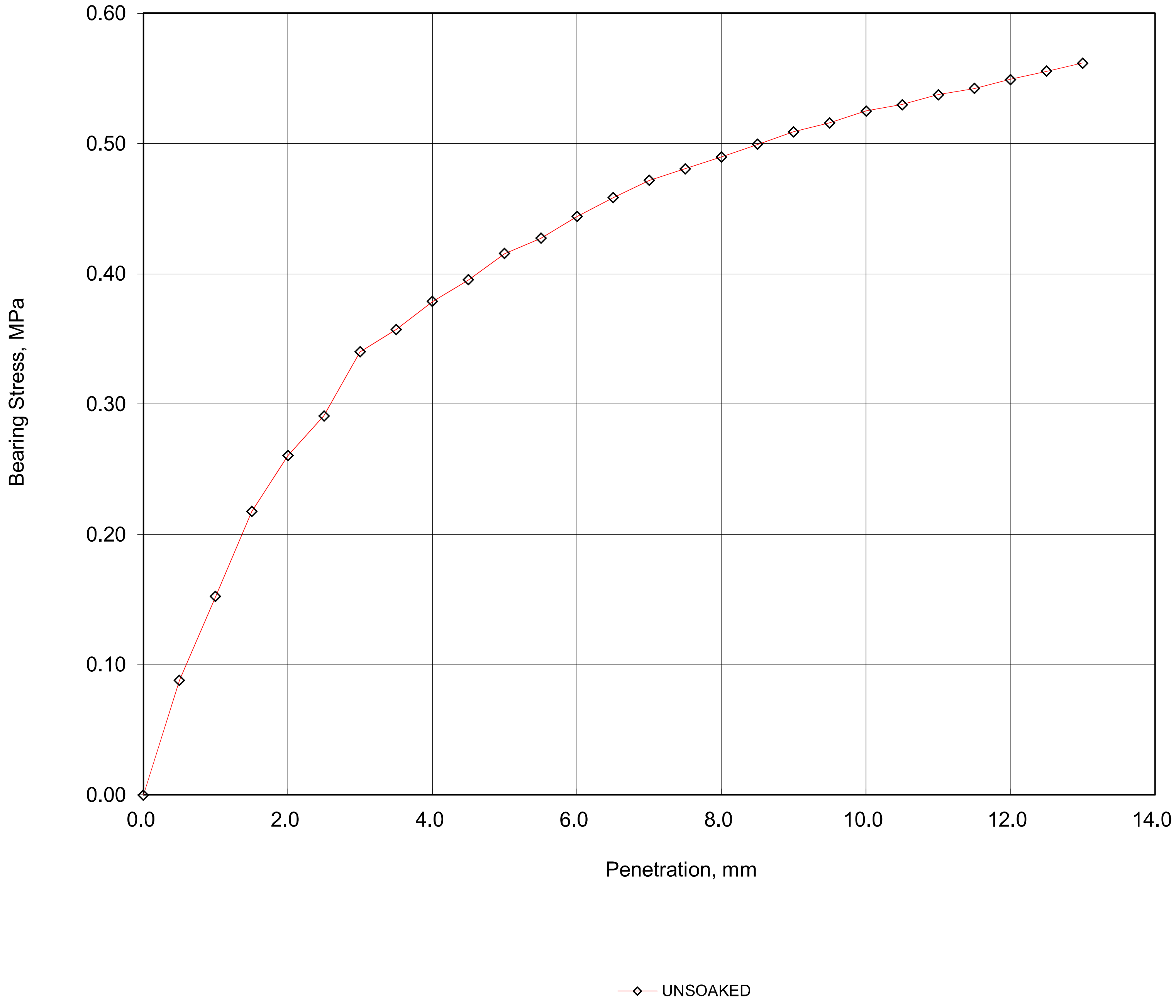
TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	34.60	-
SWELL, %	N/A	-
CORRECTED STRESS VALUE (at 2.5 mm), MPa	0.29	-
CORRECTED STRESS VALUE (at 5.0 mm), MPa	0.42	-
BEARING RATIO (at 2.5 mm), %	***4.22***	**-**
BEARING RATIO (at 5.0 mm), %	***4.03***	**-**

Checked By:

CALIFORNIA BEARING RATIO TEST (CBR)

36% Unsoaked - Cement Stabilizer
California Bearing Ratio Test - ASTM D1883



Project No. 18105808 (5000)

Golder Associates

Checked By:

UNCONFINED COMPRESSIVE STRENGTH TEST (UC) OF COHESIVE SOIL

ASTM D 2166

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	UC #1
BOREHOLE NUMBER	-	SAMPLE DEPTH, m	-

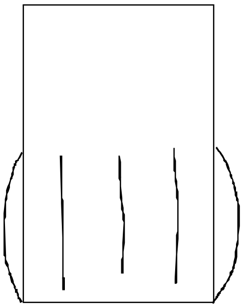
TEST CONDITIONS

MACHINE SPEED, mm/min	1.40	TYPE OF SPECIMEN	Compacted
RATE OF AXIAL STRAIN, %/min	1.00	L/D	2.00

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	14.01	WATER CONTENT, (specimen) %	29.05
SAMPLE DIAMETER, cm	6.99	UNIT WEIGHT, kN/m^3	17.96
SAMPLE AREA, cm^2	38.37	DRY UNIT WT., kN/m^3	13.92
SAMPLE VOLUME, cm^3	537.59	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	984.90	VOID RATIO	0.90
DRY WEIGHT, g	763.22		

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	2.6	UNCONFINED COMPRESSIVE STRENGTH, kl	273.7
		SHEAR STRENGTH, kPa	136.8

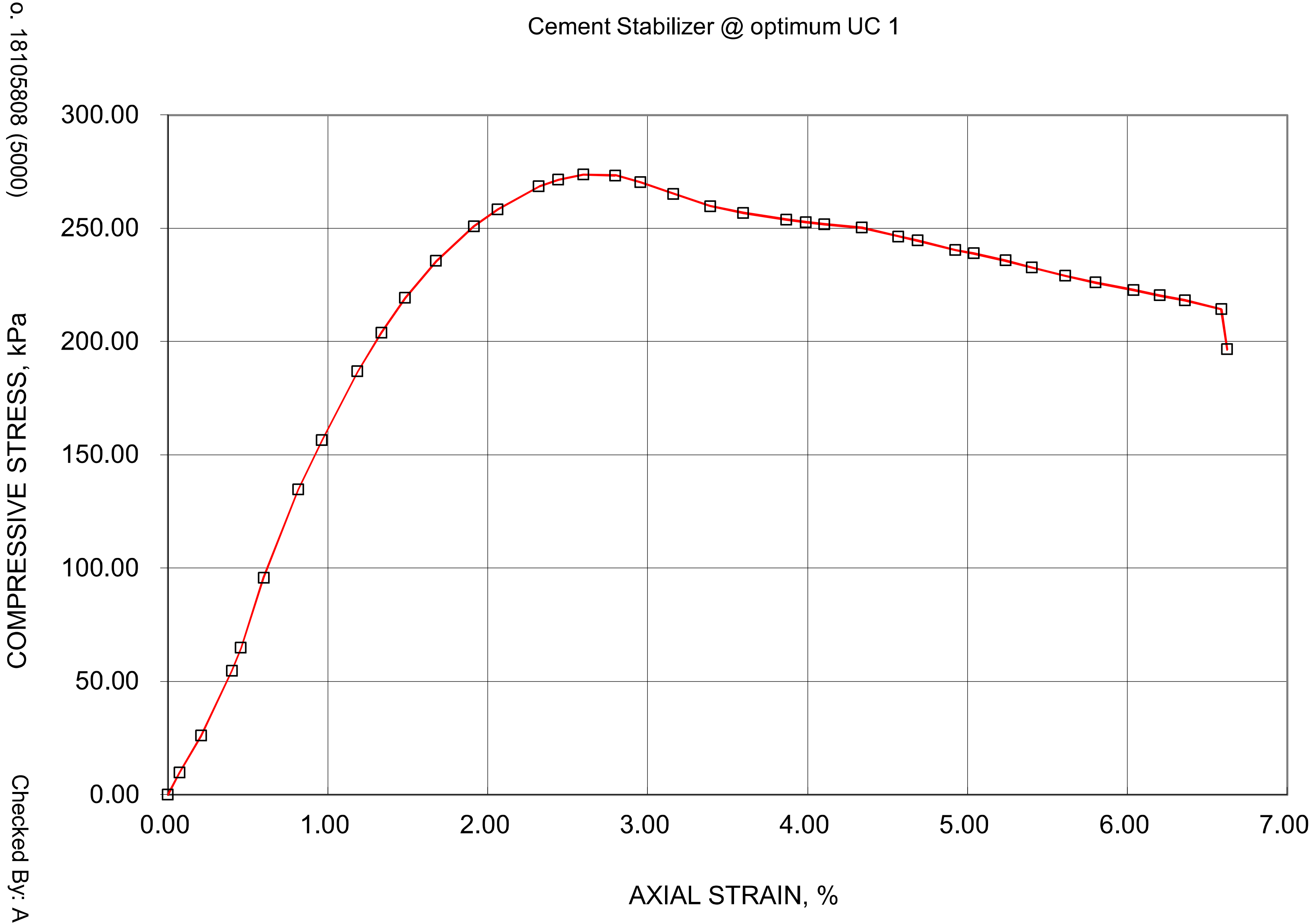
REMARKS:

DATE OF TESTING: March 4, 2019

Checked By: AL

Golder Associates

Project No. 18105808 (5000)



Checked By: AL

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL

FIGURE

UNCONFINED COMPRESSIVE STRENGTH TEST (UC) OF COHESIVE SOIL

ASTM D 2166

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (5000)	SAMPLE NUMBER	UC #2
BOREHOLE NUMBER	-	SAMPLE DEPTH, m	-

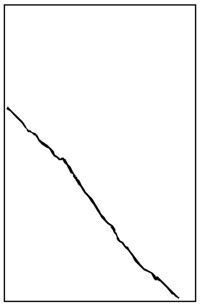
TEST CONDITIONS

MACHINE SPEED, mm/min	1.40	TYPE OF SPECIMEN	Compacted
RATE OF AXIAL STRAIN, %/min	1.00	L/D	2.01

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	14.02	WATER CONTENT, (specimen) %	29.23
SAMPLE DIAMETER, cm	6.99	UNIT WEIGHT, kN/m^3	17.70
SAMPLE AREA, cm^2	38.37	DRY UNIT WT., kN/m^3	13.70
SAMPLE VOLUME, cm^3	537.98	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	971.43	VOID RATIO	0.93
DRY WEIGHT, g	751.71		

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	2.7	UNCONFINED COMPRESSIVE STRENGTH, kl	241.9
		SHEAR STRENGTH, kPa	120.9

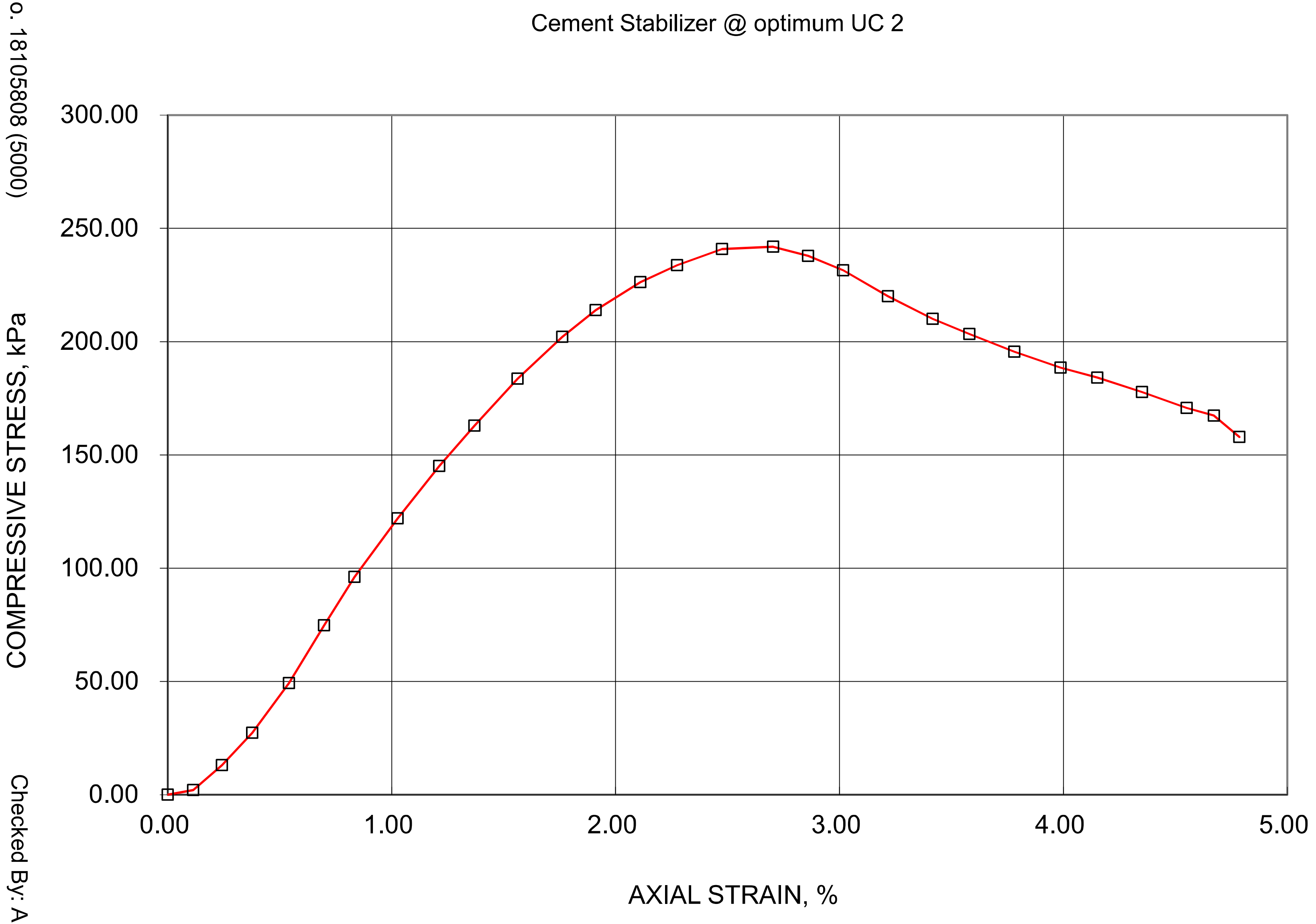
REMARKS:

DATE OF TESTING: March 4, 2019

Checked By: AL

Golder Associates

Project No. 18105808 (5000)



Checked By: AL

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL

FIGURE

GOLDER

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	18105808 Phase 3000	SAMPLE NUMBER	15% Soaked with 8% Cement
PROJECT NAME	TullochEngineering/MaterialsTesting	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	03/20/19

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	< 19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	234341	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	40
SOAKING TIME, hr	96	RELATIVE COMPACTION, %	N/A

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.65	11.65	DRY WEIGHT, g	3604.29	3604.29
SAMPLE DIAMETER, cn	15.24	15.24	WATER CONTENT, %	13.20	20.69
SAMPLE AREA, cm^2	182.42	182.42	UNIT WEIGHT, kN/m^3	18.83	20.07
SAMPLE VOLUME, cc	2124.59	2124.61	DRY UNIT WT., kN/m^3	16.63	16.63
WET WEIGHT, g	4080.06	4350.06			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	-	0.00	0.0	1.85	0.01
0.5	-	0.00	0.5	259.14	1.31
1.0	-	0.00	1.0	1249.13	6.30
1.5	-	0.00	1.5	1875.31	9.46
2.0	-	0.00	2.0	2215.61	11.18
2.5	-	0.00	**2.5**	**2456.31**	12.39
3.0	-	0.00	3.0	2569.74	12.96
3.5	-	0.00	3.5	2601.09	13.12
4.0	-	0.00	4.0	2605.24	13.14
4.5	-	0.00	4.5	2595.10	13.09
5.0	-	0.00	**5.0**	**2594.64**	13.09
5.5	-	0.00	5.5	2610.78	13.17
6.0	-	0.00	6.0	2654.12	13.39
6.5	-	0.00	6.5	2702.08	13.63
7.0	-	0.00	7.0	2757.87	13.91
7.5	-	0.00	7.5	2830.26	14.28
8.0	-	0.00	8.0	2895.28	14.61
8.5	-	0.00	8.5	2948.77	14.88
9.0	-	0.00	9.0	3017.93	15.22
9.5	-	0.00	9.5	3083.41	15.56
10.0	-	0.00	10.0	3136.90	15.83
10.5	-	0.00	10.5	3206.99	16.18
11.0	-	0.00	11.0	3243.88	16.36
11.5	-	0.00	11.5	3299.21	16.64
12.0	-	0.00	12.0	3355.92	16.93
12.5	-	0.00	12.5	3388.20	17.09
13.0	-	0.00	13.0	3441.23	17.36

TEST RESULTS

	UNSOAKED	SOAKED
WATER CONTENT AT PENETRATION POINT, %	-	16.10
SWELL, %	-	0.00
CORRECTED STRESS VALUE (at 2.5 mm), MPa	-	12.65
CORRECTED STRESS VALUE (at 5.0 mm), MPa	-	13.12
BEARING RATIO (at 2.5 mm), %	-	***183.33***
BEARING RATIO (at 5.0 mm), %	-	***127.38***

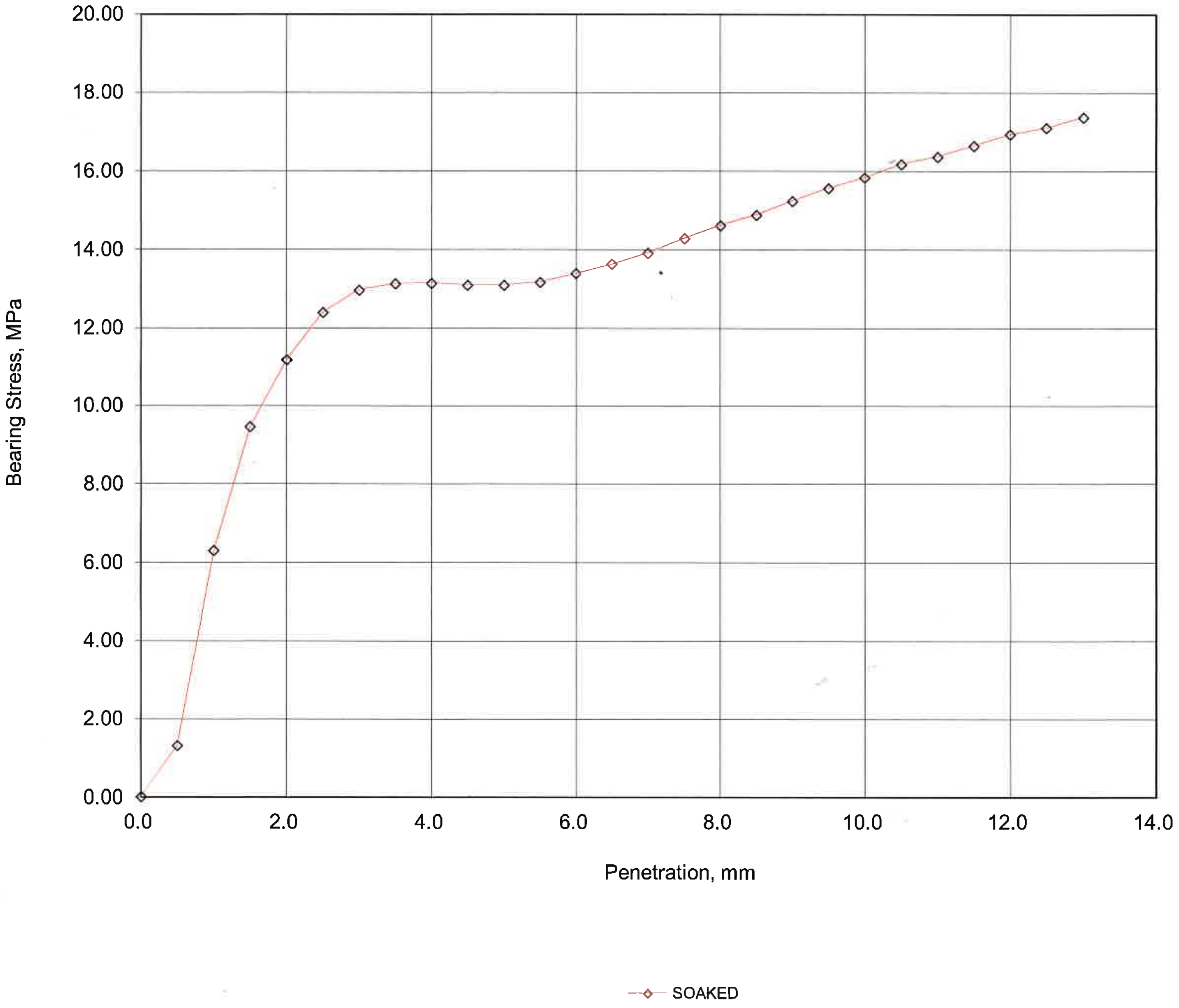
Checked By:

CALIFORNIA BEARING RATIO TEST (CBR)

Project No. 18105808 Phase 3000

Golder Associates

Sample 15% Soaked with 8% Cement
California Bearing Ratio Test - ASTM D1883



Checked By:

TULLOCH
ENGINEERING

CSA A283 Certified Laboratory for Concrete Testing
CCIL Certified Laboratory for Aggregates and Asphalt Testing
CSA/CCIL Certified Technicians

Canadian Council of Independent Laboratories Conseil canadien des laboratoires indépendant

Soil Cement Stabilization Strength Results

Project: Nation Rise Wind Farm
Date: 12/6/2018
Tested By: S. Hoffman
Contract No.: 18-4022
Speciment Type 100mm dia. Cylinders

Sample Reference	Lab Number	Load (N)	Area (mm^2)	Date Cast	Compressive Strength (Mpa)	Date Tested	Remarks
					7 days		
Mix # 3	18-4022-3	14234	8125	12/6/2018	1.75	12/13/2018	O.M.C. @ 8% cement
	18-4022-3	12900	8112	12/6/2018	1.59	12/13/2018	
Average					**1.67**	-	
Mix # 5	18-4022-5	12455	8121	12/6/2018	1.53	12/13/2018	O.M.C. @ 10% cement
	18-4022-5	16903	8096	12/6/2018	2.09	12/13/2018	
Average					**1.81**	-	
Mix # 6	18-4022-6	9786	8089	12/6/2018	1.21	12/13/2018	O.M.C.+8% moisture @ 10% cement
	18-4022-6	8452	8112	12/6/2018	1.04	12/13/2018	
Average					**1.13**	-	

Compressive Strength Test of molded Soil-Cement Cylinders

Project: Nation Rise Wind Farm
Contract No.: 18-4022
Date Cast: 12/6/2018
Date Tested: 12/13/2018
Tested By: S. Hoffman
Sample No.: O.M.C @ 8% cement

Initial Speciman Conditions	
Average Diameter	1.02mm
Average Height	2.02mm
Maximum Dry Density	1345 kg/m³
Optimum Moisture	29.80%

Compressive Strength Test Results

Lab Number	Strength (MPa)	Average (MPa)
18-4022-3	1.75	1.67
18-4022-3	1.59	

Compressive Strength Test of molded Soil-Cement Cylinders

Project: Nation Rise Wind Farm
Contract No.: 18-4022
Date Cast: 12/6/2018
Date Tested: 12/13/2018
Tested By: S. Hoffman
Sample No.: O.M.C @ 10% cement

Initial Speciman Conditions	
Average Diameter	1.02mm
Average Height	2.02mm
Maximum Dry Density	1345 kg/m³
Optimum Moisture	29.80%

Compressive Strength Test Results

Lab Number	Strength (MPa)	Average (Mpa)
18-4022-5	1.53	1.81
18-4022-5	2.09	

Compressive Strength Test of molded Soil-Cement Cylinders

Project: Nation Rise Wind Farm
Contract No.: 18-4022
Date Cast: 12/6/2018
Date Tested: 12/13/2018
Tested By: S. Hoffman
Sample No.: 8% above O.M.C @ 10 % cement

Initial Speciman Conditions	
Average Diameter	1.02mm
Average Height	2.02mm
Maximum Dry Density	1345 kg/m^3
Optimum Moisture	29.80%

Compressive Strength Test Results		
Lab Number	Strength (MPa)	Average (MPa)
18-4022-6	1.21	1.13
18-4022-6	1.04	

APPENDIX I

REPORT LIMITATIONS AND GUIDELINES FOR USE

REPORT LIMITATIONS AND GUIDELINES FOR USE

This information has been provided to help manage risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS, AND PROJECTS

This geotechnical report has been prepared for the exclusive use of the client, their authorized agents, and other members of the design team. It is not intended for use by others, and the information contained herein is not applicable to other sites, or for purposes other than those specified in the report.

TULLOCH Engineering (TULLOCH) cannot be held responsible for reliance on the information contained in this report, by persons other than the client or 'authorized' agent without prior written approval.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical investigation report is based on existing conditions at the time the study was performed, and our opinion of soil conditions are strictly based on soil samples collected at specific borehole locations. The findings and conclusions of our reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

LIMITATIONS TO PROFESSIONAL OPINIONS

Interpretations of subsurface conditions are based on field observations from boreholes and/or test pits that were spaced to capture a 'representative' snapshot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. TULLOCH reviews field and laboratory data and then applies our professional judgment to formulate an opinion of subsurface conditions throughout the site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

LIMITATIONS OF RECOMMENDATIONS

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. TULLOCH should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing, and consultation should be provided by TULLOCH during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the borehole and/or test pit investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing, and consultation by TULLOCH should be completed to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining TULLOCH for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by TULLOCH is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT

Misinterpretation of our report by other design team members can result in costly problems. You could lower that risk by having TULLOCH confer with appropriate members of the design team after submitting the report. Also, retain TULLOCH to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having TULLOCH participate in pre-bid and pre-construction conferences, and by providing construction observation. Please be advised that retaining TULLOCH to participation in any ‘other’ activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

CONTRACTORS RESPONSIBILITY FOR SITE SAFETY

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties. It is ultimately the contractor’s responsibility that the Ontario Occupational Health and Safety Act is adhered to, and site conditions satisfy all ‘other’ acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION

This report is geotechnical in nature and specifically excludes the investigation, detection, prevention or assessment of the presence of subsurface contaminants. Accordingly, the scope of services does not include any interpretations, recommendations, findings, or conclusions regarding the detection, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their byproducts.