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Foundation Investigation and Design Report

Highway 35 Maintenance Patrol Yard
Kawartha Lakes, Ontario
Agreement No. 4021-E-0018
G.W.P No. 4044-22-00

Latitude: 44.519924°, Longitude: -78.792568°

GEOCRES No. 31D-828

Client Name: Dillon Consulting Limited
Date: October 12, 2023
File: 36708

Suite 11, 1815 Ironstone Manor, Pickering, Ontario L1W 3W9 | Phone: (905) 829-8666

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PART A – FACTUAL INFORMATION

1. INTRODUCTION

This report presents the data obtained from a foundation investigation carried out by Thurber Engineering Ltd (Thurber) near the proposed maintenance patrol yard, west of Fenelon Falls, in Kawartha Lakes, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the proposed maintenance patrol yard and, based on the data obtained, to provide a borehole location plan, record of borehole, laboratory test results, and a written description of the subsurface conditions.

Thurber carried out the investigation as a subconsultant to Dillon Consulting Limited (Dillon), under the Ministry of Transportation, Ontario (MTO) Assignment No. 4021-E-0018.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

The proposed maintenance patrol yard is located on Glenarm Road approximately 800 m west of the intersection of Highway 35 and Glenarm Road in Kawartha Lakes, Ontario. The site and the surrounding area are agricultural lands, with an active sand and gravel pit on the southwest side of the intersection of Highway 35 and Glenarm Road.

The ground surface across the existing site is generally flat, varying between Elevation 270 m and Elevation 273 m from west to east.

3. INVESTIGATION PROCEDURES

3.1 2021 Investigation (GEOCRES No. 31D-775)

In April 2021, a foundation investigation was carried out by Golder Associates Ltd. (Golder), during which time a total of seven boreholes were advanced, designated Boreholes 21-1 to 21-5A, 21-5B, and 21-5C). the results of this investigation are contained in the report titled, "Foundation Investigation and Design Report, Highway 35 Patrol Yard, Kawartha Lakes, Ontario, MTO Assignment No. 4017-E-0023, G.W.P. 4071-19-00.', dated July 8, 2021 (GEOCRES No. 31D-775).

The location of boreholes, ground surface elevation, and depth of boreholes are summarized in Table 3.1. These boreholes are shown on Drawing 1 and the record of boreholes and figures for laboratory test results are presented in Appendix A.

Table 3.1: 2021 Foundation Investigation (by Others)

Borehole	Northing (Latitude, º)	Easting (Longitude, º)	Ground Surface Elevation (m)	Depth of Borehole (m)
21-1	4,931,350.2 (44.519981)	360,989.0 (-78.793174)	271.2	9.8
21-2	4,931,324.6 (44.519748)	361,026.0 (-78.792711)	269.7	9.8
21-3	4,931,362.3 44.520084)	361,060.8 (-78.792270)	271.0	9.4
21-4	4,931,361.4 (44.520075)	361,089.6 (-78.791908)	271.0	9.3
21-5A	4,931,383.2 (44.520265)	361,154.4 (-78.791091)	272.5	3.8
21-5B	4,931,382.3 (44.520258)	3611,52.1 (-78.791119)	272.4	2.1
21-5C	4,931,381.4 (44.520250)	361,150.2 (-78.791143)	272.4	9.7

3.2 Current Investigation

The foundation and hydrogeology investigation were carried out between May 30 and June 8, 2023, consisting of nine boreholes and one test pit.

The Record of Borehole and Test Pit sheets are included in Appendix B.

The borehole and test pit locations and elevations were surveyed using a Trimble R12 GPS Unit. In accordance with the requirements for surveying of foundation boreholes, the survey readings have a vertical and horizontal accuracy of 0.1 m and 0.5 m, respectively. The locations of the boreholes and test pit as presented on the record of boreholes and test pit, and as shown on Drawing 1 in Appendix B, are positioned relative to coordinate system MTM NAD 83, Zone 10. The geographic coordinates, ground surface elevations and depths of boreholes/test pit prior to termination is summarized in Table 3.2. Site photographs showing site features, borehole drilling and test-pitting are provided in Appendix B.

Table 3.2: 2023 Foundation Investigation

Borehole/Test Pit	MTM Northing (Latitude, º)	MTM Easting (Longitude, º)	Ground Surface Elevation (m)	Depth of Borehole/Test Pit (m)
FST-01	4,931,408.7 (44.520494)	361,060.5 (-78.792266)	263.8	8.2
MSB-01	4,931,324.2 (44.519738)	361,007.0 (-78.792948)	257.4	12.8
MSB-02	4,931,368.0 (44.520129)	361,029.4 (-78.792661)	258.5	12.8
SEP-01	4,931,332.1 (44.519799)	361,133.4 (-78.791357)	266.0	5.2
SWMP-01	4,931,286.4 (44.519396)	361,012.5 (-78.792883)	263.2	6.7
SWMP-02	4,931,303.1 (44.519542)	361,068.2 (-78.79218)	262.9	6.7
SWMP-03	4,931,253.9 (44.519101)	361,059.0 (-78.792301)	263.3	6.7
VMG-01	4,931,374.7 (44.520184)	361,101.4 (-78.791755)	258.4	12.8
VMG-02	4,931,406.6 (44.52047)	361,119.1 (-78.791529)	259.6	12.8
TP-01	4,931,294 (44.51946)	361,035 (-78.792598)	270.4	2.0

Boreholes were advanced using a track-mounted CME-75 drill rig, which was supplied and operated by Drilltech Drill Limited of Newmarket, Ontario, using 150 mm outside diameter solid stem augers. Soil samples were obtained at selected intervals using a split-spoon sampler driven by automatic hammers in general accordance with ASTM D1586 Standard Penetration Testing (SPT) procedures. The maximum particle size that can be sampled from the standard split-spoon hammer used in the investigation is limited to 35 mm and therefore, particles that may exist within the soils larger than this dimension would not be recovered or represented in the grain size analyses.

Monitoring wells were installed in Boreholes FST-01 and SWMP-02. Each well consists of a 32 mm inside diameter Schedule 40 PVC pipe with a 3 m long slotted screen, enclosed in a column of filtered sand to permit the monitoring of groundwater level and infiltration testing. The bottom of each well was sealed with a well cap. Well installation details, groundwater level readings are shown on the record of borehole sheets.

For boreholes without monitoring well installations, each borehole was abandoned in accordance with O.Reg. 903 (as amended) by means of backfilling with bentonite.

Infiltration testing was carried out in the monitoring wells installed in Boreholes FST-01 and SWMP-02, which were screened across a native sand to silt deposit. Both wells were dry at the time of the tests and therefore, distilled water was introduced into the wells. During the tests, both electronic measurements from the datalogger and manual measurements were recorded until the water level in the wells dropped to the well bottom. The electronic and manual measurements were then compared for quality control.

The test pitting was carried out using a B95 Backhoe Loader, which was supplied and operated by Young's Construction Limited of Fenelon Falls, Ontario. Guelph permeameter testing was carried out in hand augered boreholes through the bottom of the test pit excavated to depths of 0.5 m and 2.0 m below existing ground surface. Upon completion of the testing, the test pit was backfilled with the excavated native sands and silts.

Percolation (T-time) tests were carried out in the proposed septic field area near Borehole SEP-01. The tests were carried out in shallow holes that were approximately 15 cm in diameter and 20 cm in depth. The bottom and sides of the pits were scarified with a knife blade to remove any smeared soil surfaces and loose materials to provide a natural soil interface. Prior to performing the tests, the shallow holes were soaked for approximately 30 minutes with distilled water to the top of the hole and readjusted the water level as needed. After the soaking process, the holes were refilled with water to a depth of approximately 15 cm above the bottom. A meter stick was placed in each hole at a fixed reference point to record water level throughout the testing period. During the tests, the water level was readjusted to the initial height when needed.

The investigation was supervised by members of our technical staff, who located the boreholes and test pit, arranged for the clearance of underground services, observed the drilling, sampling, and in situ testing operations, logged the boreholes and test pit, and examined and cared for the soil samples. The samples identified in the field were placed in appropriate containers, labelled, and transported to our Pickering geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All laboratory tests were carried out to MTO and/or ASTM standards, as appropriate.

4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

In general, the site is located within the physiographic region of Peterborough Drumlin Field as delineated in the Physiography of Southern Ontario (Chapman and Putnam, 1984). The Peterborough Drumlin Field extends from Hasting County Simcoe County and includes drumlins south of the moraine in Northumberland County. This region contains numerous drumlins and drumlinoid hills and is underlain by limestone bedrock of the Lindsay and Verulam Formations.

More specifically, the site is located within an esker containing stratified deposits of sands and gravel. This esker is oriented from the northeast to the southwest, which compasses the sand and gravel pit located just east of the site.

4.2 General Description of Subsurface Conditions

Details of the soil stratigraphy as encountered in the current investigation are presented on the Record of Borehole sheets included in Appendices A and B. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. Soil classification is in accordance with ASTM D2487. Description of cohesive soils and secondary components are described as outlined in the MTO Guideline for Foundation Services Manual (April 2022).

The results of in-situ testing as presented in the record of boreholes and in this section are uncorrected. The boundaries between soil deposits on the record of boreholes have been inferred from non-continuous sampling, observation of the progress of drilling, and the results of Standard Penetration Testing. Therefore, the boundaries represent the transitions between soil deposits rather than exact planes of geological change. Variation on the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions consist of a surficial layer of silty sand to silt and sand fill, which is in turn underlain by a native deposit of silty sand to sandy silt containing layers of sand and gravel to sand.

4.3 Fill

Fill consisting of silty sand to silt and sand (i.e., reworked native soils), was encountered at ground surface at all borehole locations. The depth of fill varies from 0.3 m to 2.2 m below ground surface (Elevations 272.1 m to 268.2 m) but in general, the depth of fill ranges between 1.4 m and 1.5 m below ground surface (Elevations 271.1 m to 268.2 m).

The SPT N-values measured within the fill ranged from 2 blows to 15 blows per 0.3 m of penetration, indicating a very loose to compact condition.

The moisture content of the silty sand to silt and sand fill ranged from 4 per cent to 21 per cent. The results of grain analysis carried out on samples of the fill are presented in Figure B-1 in Appendix A and Figure B-1 in Appendix B. The results of the tests are summarized in Table 4.1 and on the Record of Boreholes sheets in Appendices A and B.

Table 4.1: Grain Size Distribution of Silty Sand to Silt and Sand Fill

Soil Particle	Percentage (%)
Gravel	0 to 2
Sand	40 to 79
Silt	20 to 57
Clay	0 to 8

4.4 Silty Sand to Sandy Silt

A native deposit of silty sand to sandy silt containing trace to some gravel was encountered at all borehole locations, which extends to a depth of up to 12.8 m below ground surface (Elevation 257.4 m). Within the silty sand to sandy silt, an interlayer of sand and gravel to gravelly silty sand between 5.7 m and 9.8 m thick was encountered in Boreholes 21-5A to 21-5C, and VMG-02. Except for Borehole 21-1, all boreholes were terminated within this deposit.

The SPT N-values measured within the cohesionless deposit ranged from 2 blows per 0.3 m of penetration to 100 blows per 0.07 m of penetration, indicating a very loose to very dense condition.

The moisture content of the silty sand to sandy silt ranged from 1 per cent to 28 per cent. The results of grain analysis carried out on samples of the silty sand to sandy silt as well as interlayer

of sand, and sand and gravel to gravelly silty sand are presented in Figures B-2 and B-4 in Appendix A and Figures B-2 to B-5 in Appendix B.

The results of the tests are summarized in Table 4.2, and presented on the Record of Boreholes sheets in Appendices A and B.

Table 4.2: Grain Size Distribution of Silty Sand to Sandy Silt Deposit

Soil Particle	Silty Sand to Sandy Silt Percentage (%)	Sand Percentage (%)	Sand and Gravel to Gravelly Silty Sand Percentage (%)
Gravel	0 to 16	0 to 2	28 to 39
Sand	23 to 86	88 to 91	48 to 61
Silt	9 to 76	7 to 10	7 to 15
Clay	0 to 8	0 to 4	0 to 5

It should be noted that Atterberg limits tests were carried out on samples of the silty sand to sandy silt from Boreholes MSB-02, SWMP-03, VMG-01, but the results indicate that the material is non-plastic.

4.5 Sandy Gravel Clayey Silt Till

A 0.3 m thick till deposit consisting of sandy gravel clayey silt was encountered beneath the silty sand deposit in Borehole 21-2. Borehole 21-2 was terminated in this deposit.

The SPT N-value measured within the till deposit is 72 blows per 0.3 m of penetration, indicating a hard consistency.

The result of Atterberg limits tests carried out on the sample of the till deposit is presented on Figure B-5 in Appendix A and is summarized inTable 4.3.

Table 4.3: Atterberg Limits of Sandy Gravel Clayey Silt Till

Parameter	Value
Liquid Limit	15
Plastic Limit	10
Plasticity index	5

The results indicate that the material is a clayey silt of low plasticity (CL-ML).

4.6 Groundwater Conditions

Details of the water level observed in the monitoring wells installation as part of the current investigation are presented on the record of boreholes in Appendices A and B and summarized in Table 4.4.

Table 4.4: Measured Groundwater Levels in Monitoring Wells

Borehole	Date of Reading	Depth and Elevation of Groundwater (m)	Remarks
21-4	2021-04-28 2021-06-24	Dry at 9.3 / 261.7	Monitoring wells were dry.
FST-01	2023-06-08	Dry at 8.2 / 263.8	
VMS-02	2023-06-08	Dry at 6.7 / 262.9	

It should be noted that the groundwater level is subject to seasonal fluctuations and should be expected to be higher elevation after periods of significant or prolonged precipitation.

4.7 Hydrogeological Testing

4.7.1 Guelph Permeameter Tests in the Stormwater Management Pond Area

The Guelph Permeameter tests were carried out in hand augered boreholes advanced at the bottom of the test pit. At each depth interval, two 75 mm diameter boreholes were augered at approximately 1.5 m apart. In each test hole, two sets of readings were obtained using the combined reservoirs method. The two sets of readings were processed using the single head method. The average of the two single head test results were reported as the field saturated hydraulic conductivity (K_{fs}) at the subject test hole location.

The Guelph Permeameter calculation sheets are presented in Appendix C. A summary of the test results is presented in Table 4.5.

Table 4.5: Results of Guelph Permeameter Tests

Test Depth	Test 1	Test 2	Average
0.7 m (1)	1.2×10^{-5} m/s	3.0×10^{-6} m/s	7.7×10^{-6} m/s
2.4 m (2)	1.0×10^{-4} m/s	2.7×10^{-5} m/s	6.3×10^{-5} m/s

1. Test conducted in a 0.2 m deep borehole advanced through the base of a 0.5 m deep test pit.
2. Test conducted in a 0.4 m deep borehole advanced through the base of a 2 m deep test pit.

4.7.2 Percolation (T-time) Tests – Septic Field Area

Two percolation tests were carried out in two shallow holes approximately 1.5 m apart. Each test continued for approximately 70 to 75 minutes and during which time, water was introduced four times to near the top of the shallow holes. The time it took for the water level to drop by one centimeter (i.e., T-time) varied between 1.0 and 1.7 minutes for one test, and between 2.4 and 3.1 minutes for the other.

4.7.3 Borehole Infiltration Tests – Dry monitoring wells

Borehole infiltration tests were carried out in each dry monitoring well. The monitoring wells installed in Boreholes FST-01 and SWMP-02 were dry and as such, a total of 18 L and 24 L of distilled water was introduced into wells in Boreholes FST-01 and SWMP-02, respectively, for the purpose of the infiltration tests. Due to the high rate of infiltration, the highest recorded water level was approximately 0.8 m above the bottom in each well, which was observed to dropped to the bottom of the well in approximately 1.5 minutes. A water level-time plot for each test is included in Appendix C.

In addition, the data were also analyzed as a slug test using the Hvorslev method. Although the assumption that the surrounding soil is saturated is not valid as a result of the wells being dry, the results were in the order of 10^{-5} m/s, which are in general agreement with Guelph Permeameter results.

4.8 Analytical Laboratory Testing

Samples of the native silty sand to sandy silt was submitted for analytical testing for corrosivity analysis and sulphide content. The analytical test results for the soils are presented in Appendices A and B and summarized in Table 4.6.

Table 4.6: Results of Corrosivity Tests

Borehole / Sample	Depth / Elevation (m)	Resistivity (ohm-cm)	Electrical Conductivity (µS/cm)	Soluble Sulphate Content (µg/g)	Chloride Content (µg/g)	pH
21-2 SS2	1.1 / 268.8	11,000	88	<20	<20	7.9
21-3 SS4	2.6 / 268.4	13,000	76	<20	<20	7.8
21-5C SS4	2.6 / 269.8	7,200	138	<20	<20	5.8
VMG-02 SS3	1.9 / 270.5	20,800	48	< 0.4	1.1	8.82
MSB-02 SS2	1.0 / 270.3	83,300	12	< 0.4	0.6	7.87

5. MISCELLANEOUS

The foundation and hydrogeology investigation were supervised on a full-time basis by Vihang Patel, EIT, and Klayton Irvine, EIT, respectively. The Foundation Investigation Report was prepared by Ms. Yidan (Eda) Cui, P.Eng., and Messrs. Ali Rajaei, P. Eng. and Christopher Ng, P.Eng. The report was reviewed by Messrs. and David Hill, P.Geo., P.Eng., Senior Hydrogeological Engineer, and Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Ali Rajaei, P.Eng.,
Geotechnical Engineer

Christopher Ng, P.Eng.,
Senior Geotechnical Engineer

Jason Lee, P.Eng.,
Review Principal,
Designated MTO Contact

Date: ***October 12, 2023***
File: ***36708***

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PART B – ENGINEERING DISCUSSION AND RECOMMENDATIONS

6. GENERAL

This report presents interpretation of the subsurface information obtained from the foundation investigation carried out on site and provides foundation design recommendations for the design of the proposed maintenance patrol yard. The foundation discussion and recommendations are based on our understanding of the project and the factual data obtained during the subsurface investigation and are provided to assist the designers with sufficient information on design aspects related to foundations engineering.

The discussions and recommendations are intended for the use of the Ministry of Transportation, Ontario and shall not be used or relied upon by any other parties including the construction or design-build contractor. The contractor undertaking the work must make their own interpretation based on the information presented in the factual sections of the report (Part A of this report). Where comments are made on construction, they are provided to highlight those aspects which could affect the design of the project. Those requiring information on the aspects of construction must make their own interpretations of the data provided as it may affect equipment selection, construction methods, scheduling and the like.

7. PROJECT DESCRIPTION

The proposed Highway 35 maintenance patrol yard consists of the following structures/facilities as shown on Drawing 1:

- A Materials Storage Building (MSB),
- A Vehicle Maintenance Garage (VMG) and Office Space,
- An Auxiliary Storage Building (ASB),
- A Stormwater Management Pond (SWMP),
- Underground water storage tanks, and,
- A septic field.

Based on drawings provided by Dillon on June 15, 2023, it is understood that the final grade of the proposed site will vary between Elevations 272.7 m and 273.7 m, which generally corresponds to a grade raise of about 1.5 m to 2.5 m across the site. In addition, the base of the stormwater management pond will be at Elevation 269.5 m. Although the finished floor elevation (FFE) has not been finalized, Table 7.1 presents the FFE as of the writing of this report.

Table 7.1: Final Finished Elevations

Structure	Final Finished Elevation (m)
Materials Storage Building	273.1
Vehicle Maintenance Garage and Office Space	273.5
Auxiliary Storage Building	272.8

8. BUILDINGS AND GARAGE

8.1 Shallow Foundations

8.1.1 Frost Protection

All footings of unheated buildings and exterior footings should be provided with a minimum of 1.7 m of conventional soil cover for frost protection, in accordance with OPSD 3090.101. Consideration could be given to the use of an equivalent thickness of insulation installed around the perimeter of the footings as frost protection; however, for the purposes of this report, it is assumed footings will be provided with conventional soil cover for frost protection.

8.1.2 Founding Elevations

Based on the results of the foundation investigation and the proposed grade raise, the proposed Materials Storage Building, Vehicle Maintenance Garage, and Auxiliary Storage Building may be supported on conventional spread footings founded on compacted granular fill, over compacted native silty sand to silt and sand. Prior to the construction of the spread footings, the subgrade should be prepared as outlined in Section 8.3.

Table 8.1 is a summary of the existing ground surface elevation, elevation of compact native soils, proposed founding elevation, and associated founding condition.

Table 8.1: Founding Elevations and Founding Conditions

Structure	Existing Ground Surface Elevation [1] (m)	Estimated Elevation of Compact Native Soils (m)	Founding Elevation Below Depth of Frost Penetration (m)	Founding Condition
Materials Storage Building	269.5 to 271.5	267.0 to 269.0	271.0	Approximately 1.0 m to 3.0 m of compacted Granular 'A', 'B' Type II over compact to dense native silty sand to silt and sand
Vehicle Maintenance Garage	271.0 to 272.5	268.5 to 271.0	271.5	Up to 1.5 m of compacted Granular 'A', 'B' Type II over compact to very dense native silty sand to silt and sand
Auxiliary Storage Building	270.0 to 271.0	268.2 to 268.8	271.0	Up to about 3.0 m of compacted Granular 'A', 'B' Type II over compact to very dense native silty sand to sand

Note: 1. Elevations are based on contour drawing provided by Dillon dated June 15, 2023.

8.1.3 Geotechnical Resistances

Based on the founding elevation and condition as presented in Table 8.1, the factored ultimate and serviceability geotechnical resistances for footings constructed on properly prepared subgrade presented in Table 8.2 may be used for design.

Table 8.2: Footing Dimensions and Factored Geotechnical Resistances

Structure	Footing Dimension (m)	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement (kPa)
Materials Storage Building / Vehicle Maintenance Garage	1.5 by 1.5 square	725	450
	2.0 by 2.0 square	750	325
	2.5 by 2.5 square	775	250
	0.7 strip	450	325
Materials Storage Building Push Wall	2.0 strip	600	200
	2.5 strip	650	175
	3.0 strip	700	150
	3.5 strip	750	125
Auxiliary Storage Building	0.7 strip	375 [1]	275 [1]

Note: 1. Assumes there is a minimum horizontal distance of 2.0 m between the edge of footing and the crest of slope for the grade raise.

It should be noted that the factored ultimate and serviceability geotechnical resistances are dependent on the footing dimension and founding elevation and as such, the geotechnical resistances should be reviewed if the footing dimensions and founding elevation differ from those specified in Table 8.2. The factored geotechnical resistances provided above are based on load applied concentrically to the centreline/centroid of the footing, as shown on Figure 6.4 of the CHBDC (2019). Where a load is applied eccentrically from the centreline/centroid of the footing, the pressure distribution at Ultimate Limits States (ULS) and Serviceability Limits States (SLS) and the eccentricity limit of the footing should be taken into consideration in accordance with Section 6.10.5 of the CHBDC (2019) and its Commentary. Once the structural design is substantially complete, the structural engineer should verify with Thurber whether the factored ultimate and serviceability geotechnical resistances provided above require revision based on any load eccentricity and/or inclination.

8.2 Resistance to Lateral Loads

Resistance to lateral loads (i.e., sliding resistance) between the concrete footing and the subgrade should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). Table 8.3 presents the unfactored coefficient of friction that may be used for design.

Table 8.3: Coefficient of Friction Between Footing and Subgrade

Footing and Subgrade Interface	Coefficient of Friction, $tan\varphi'$
Cast-in-place footing on compacted Granular 'A', 'B' Type II over compact native silty sand to silt and sand	0.55

8.3 Lateral Earth Pressures

The following static at-rest and active lateral earth pressure coefficients may be used for the design of the push wall associated with the Material Storage Building.

Table 8.4: Coefficient of Lateral Earth Pressures

Material	Unit Weight (kN/m^3)	Coefficient of Static Lateral Earth Pressures	
		At Rest, K_o	Active, K_a
De-icing Salt	13	0.72 [1]	0.72 [1]
Sand	16	0.69 [1]	0.69 [1]
Granular 'A'	22	0.43 [2]	0.27 [2]
Granular 'B' Type I or II	21	0.43 [2]	0.27 [2]
Select Subgrade Material	20	0.47 [2]	0.31 [2]

Note: 1. Assumes the material is stored at a positive inclination at the angle of repose.
2. Assumes level backfill.

8.4 Sub-Excavation, Subgrade Inspection, and Grading

All topsoil/organic matter, very loose to loose fill or native soils, or other deleterious materials should be removed from the area of the spread footings and grade raise. From site observations and the results of the foundation investigations, it is estimated that the uppermost 100 mm to

150 mm layer of fill contains topsoil and organic matter; however, there may be locally up to 500 mm of topsoil and organic matter.

Based on the depth to compact to dense native silty sand to silt and sand from existing ground surface, the depth of excavation is anticipated to range from about 1.5 m to 2.5 m. In general, the excavation is expected to extend to Elevation 269.0 m but may vary between Elevations 267.0 m and 271.0 m at the western and eastern portions of the site, respectively.

The exposed subgrade should be proof-rolled and be inspected by qualified geotechnical personnel. Any softened/loosened or poorly performing areas of the subgrade should be sub-excavated and replaced with compacted engineered fill as directed by qualified geotechnical personnel.

Site grading should be carried out in accordance with OPSS.PROV 206.

Alternatively, consideration could be given to ground densification techniques such as rapid impact compaction, dynamic compaction, and/or vibro compaction in lieu of sub-excavating and compacting the existing fill and native silty sand to sandy silt.

8.5 Engineered Fill

Imported granular material meeting the specification of OPSS.PROV 1010, Granular 'A', 'B' Type I or II, or Select Subgrade Material (SSM) will be required in the areas of the Material Storage Building, Vehicle Maintenance Garage, and Auxiliary Storage Building, and may be used as engineered fill elsewhere on site. All imported fills should be approved by qualified geotechnical personnel at their source prior to importing to site.

The granular fill shall extend at least 1 m beyond the footprint of the Material Storage Building Vehicle Maintenance Garage, and Auxiliary Storage Building, then outward and downward at 1 horizontal to 1 vertical (1H:1V).

Beyond the area described above, the existing fill and native soil containing less than 25 per cent fines by mass (i.e., soil particles less than 75 µm) and free of topsoil, organic matter, or other deleterious material may be reused on site as engineered fill. The existing fill and native soils to be reused as engineered fill must be approved by qualified geotechnical personnel prior to placement. Based on the natural measured water contents, the existing fill and native soils are generally below their estimated optimum water contents for compaction and as such, water may be applied as needed to achieve the degree of compaction required.

Following the proof-rolling and approval of the subgrade, the engineered fill should be placed in accordance with OPSS.PROV 501. The engineered fill should be placed in maximum 200 mm loose lifts and compacted to 100 per cent of the materials Standard Proctor Maximum Dry Density (SPMDD). Placement of engineered fill and in situ density testing should be completed under full-time inspection by qualified geotechnical personnel.

The final surface of the engineered fill should be protected from construction traffic, as necessary, and should be sloped to provide positive drainage for surface water during construction. If the engineered fill is left exposed during periods of wet and/or freezing weather, consideration should be given to placing a sacrificial soil cover to protect the final subgrade.

Subject to the fines content of the engineered fill, settlement of the engineered fill should be expected upon the completion of the grade raise, and that footings and floor slab should be constructed after the settlement is complete. As a general guide, settlement of Granular 'B' Type I and II may occur within two weeks of construction, while SSM may occur between 1 month to 3 months.

8.6 Settlement of Native Soils and Engineered Fill

To estimate the magnitude of settlement due to the proposed grade raise of about up to about 2.5 m, settlement analyses were carried out using the commercially available program Settle3 (version 5.0), developed by Rocscience Inc., using the subsurface profiles from the foundation investigations, and considering the very loose to loose fill and native soils will be replaced with compacted engineered fill. Based on the results of the analyses, placement of fill will result in up to 50 mm of total settlement. Due to the cohesionless nature of the native soils, the estimated total settlement native silty sand to sandy silt is considered immediate and will take place during the placement of engineered fill. However, as indicated in Section 8.5, the settlement of engineered fill may require up to 3 months to complete following the completion of fill placement and as such, an operational constraint to allow for the settlement to occur prior to construction of footings and slab-on-grades is included in Appendix D for reference.

Additional quantities of engineered fill should be allowed to compensate for the volume of ground loss resulting from the settlement.

8.7 Slab-on-Grade

The final finished elevation of the Materials Storage Building, Vehicle Maintenance Garage, and Auxiliary Storage Building has not yet been finalized but is assumed to be at or above

Elevation 273.0 m to match the grades of the proposed site. Prior to the construction of the slab-on-grade, the exposed subgrade should be inspected by qualified geotechnical personnel, and remedial work should be carried out on loosened areas as directed.

The final lift of engineered fill immediately below the slab-on-grade should consist of a minimum 200 mm thick OPSS.PROV 1010 Granular 'A' and compacted to 100 per cent of its Standard Proctor Maximum Dry Density (SPMDD) in accordance with OPSS.PROV 501.

The following modulus of subgrade reaction may be used for the design of slab-on-grades.

Table 8.5: Modulus of Subgrade Reaction

Modulus of Subgrade Reaction for compacted Granular 'A' (MPa/m)
20

The slab-on-grade should be structurally separated from the foundation walls and columns and sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for any differential settlement of the floor slab. Where the slab-on-grade is overlying perimeter strip footings, a construction joint should be included to accommodate potential differential settlement.

8.8 Seismic Considerations

Based on the 2012 Ontario Building Code, (OBC), a seismic site classification can be assessed using subsurface information and SPT 'N' values measured in the soil deposits and the interpreted shear wave velocity of soils up to 30 m below founding level.

Although the foundation investigation does not extend 30 m below the founding level, based on this methodology, it is considered that a Site Class D ($N_{60} > 50$) would be applicable for the design of the structures in accordance with Table 4.1.8.4A of the 2012 OBC and in the absence of any geophysical testing.

The seismic site classification can be refined through geophysical testing, such as Multichannel Analysis of Surface Waves (MASW), that measures shear wave velocity on site. A higher (improved) seismic site class may result from performing such tests; however, it is not necessarily guaranteed.

8.9 Corrosion Potential

Based on results of corrosivity testing on sand and silty sand (from both fill and native), the following statements can be made in reference to the MTO Gravity Pipe Design Guideline. However, the effects of road de-icing salts/chemicals should be considered when selecting pipe material and/or corrosion mitigation measures.

- The resistivity measured from soil samples ranged from 7,200 to 83,300 ohm-cm, which indicates the soil has a corrosiveness of very low corrosion potential (6,000 ohm-cm < R < 10,000 ohm-cm) according to Table 3.2 of the MTO Gravity Pipe Design Guideline.
- The sulphate concentration measured from soil samples were less than 20 µg/g, which is considered to have a negligible degree of sulphate attack on concrete according to Table 7.2 of the MTO Gravity Pipe Design Guideline.

9. STORMWATER MANAGEMENT POND

9.1 Design Details

Based on drawings provided by Dillon on June 15, 2023, the proposed Stormwater Management Pond is designed to be a dry pond and it will be situated in a depression on site. The construction of the pond will require a combination of cut and fill operation: a shallow excavation for the design elevation of the base of pond and the construction of the perimeter berms. Table 9.1 summarizes details of the Stormwater Management Pond (SWMP).

Table 9.1: Details of Stormwater Management Pond

Elevation of Base of Pond / Low Flow Channel (m)	Elevation of Perimeter Berm (m)	100-Year Water Level (m)	Estimated Depth of Excavation to Base of Pond [1] (m)	Estimated Height of Perimeter Containment Berm [1] (m)	Side slope of Perimeter Berms (m)
270.0 to 269.5	271.1	270.7	Up to 0.5	Up to 1.5	3H:1V (Exterior) 5H:1V (Interior)

Note 1: As measured from existing ground surface.

Given the SWMP is designed to be a dry pond, sections of the SWMP may be constructed without the use of a low-permeability liner where conditions are considered suitable to allow for surface water infiltration. In other sections, the SWMP may include a low-permeability liner where provisions are made for positive discharge of inflowing stormwater.

The subsurface conditions at the proposed location of the SWMP consist of existing cohesionless fill, native silt sandy to sandy silt, and the groundwater table below the depth of investigation at 6.7 m below existing ground surface (Elevations 263.3 m to 262.9) and below the depth of monitoring wells installed across the site (Elevations 263.8 m to 261.7 m). As such, the design of the SWMP without a low-permeability liner would allow for the subsurface regime to provide for filtration groundwater into the native soils. If attenuation of stormwater or containment of surface water is desired, a low-permeability liner should be included as part of the design.

A positive outlet should be provided in the design to allow for discharge of stormwater to the local stormwater management and/or conveyance system, such as a local surface water receptor or storm sewer (as applicable).

Should a low-permeability liner be required, a natural clay liner is preferred over a geosynthetic clay liner (GCL) because it is less susceptible to damage from plant root penetration and excavation operations for sediment removal, whereas a GCL would require a chemical coating to minimize plant root penetration and, given its very thin composition, is more prone to damage during de-sedimentation maintenance operations. Recommendations for a compacted natural clay liner are provided in Section 9.3.1.

9.2 Pond Base Stability

Groundwater was not encountered in monitoring wells installed at the site during the foundation investigation.

As the groundwater level is well below the design base of the pond, the net hydraulic gradient is downwards through the base of the pond. As a result, the risk of base instability due to base heave is not expected. In addition, seepage into the excavation of the pond during construction is not anticipated.

9.3 Pond Liner Considerations

It is expected that the SWMP will be dry during normal operating conditions, as the design base of pond will be well above the natural groundwater level. During precipitation events, the pond will receive stormwater runoff inflow and a negative, or downward seepage gradient, will develop such that any seepage from the pond will result in the recharge of local groundwater regime. Given the relatively highly permeable nature of the foundation materials, high exfiltration rates from the pond will likely occur. Where control exfiltration rate or reduction of seepage is desired, a liner, comprised of compacted natural clay or a manufactured composite geosynthetic /

bentonite product (commonly called a geosynthetic clay liner – GCL) should be constructed on the pond bottom and/or on the interior pond slopes.

9.3.1 Compacted Clay / Geosynthetic Clay Liner

Where required, a compacted natural clay liner, or a geosynthetic clay liner (GCL) is recommended on the base and interior slopes of the pond.

The pond side slopes should be constructed a 3H:1V or flatter to allow construction equipment to place and compact of the natural clay material or place the GCL and top layer of protective soil.

The natural clay soil for the pond liner should have a minimum clay content of 15 per cent, and a plasticity index greater than 10 per cent. The natural clay liner should be constructed to a thickness of 450 mm, placed in three equal thickness loose lifts and each lift compacted to at least 95 per cent of the material's Standard Proctor Maximum Dry Density (SPMDD). If a geosynthetic clay liner (GCL) is used, it should be placed in accordance with the manufacturer's guidelines, including carrying out any construction quality control / assurance inspection and testing operations.

Neither the natural clay liner nor a GCL will require a ballast cover layer given there are no hydrostatic uplift pressures acting at the base of the liner. However, the liner will require a minimum 300 mm thick cover of granular soil, such as OPSS.PROV 1010 Granular B Type I or Selected Subgrade Material (SSM), for protection during maintenance operations. In addition, a Class I non-woven geotextile as specified in OPSS.PROV 1860, having a Filtration Opening Size (FOS) of 600 µm, should be incorporated between the liner and ballast cover layer to act as a pseudo-barrier to maintenance operations during excavation, alert them to the presence of the underlying clay liner.

9.4 Subgrade Preparation, and Berm Construction

Based on the drawings provided by Dillon, the existing ground surface is up to about 0.5 m above the base on the pond and as such, the construction of the SWMP will be primarily constructed in fill for the perimeter containment berms, and a shallow excavation to attain the desired level for the base of pond. The perimeter containment berms will require up to about 1.5 m of fill above the existing ground surface.

The existing silty sand to silt and sand fill overlying native silty sand to sandy silt at the proposed SWMP location is a suitable subgrade for construction of the base of the pond and perimeter berms.

Prior to construction of the base of the pond and perimeter berms, all topsoil, organic matter, and deleterious material should be removed from the pond footprint. The exposed subgrade should be proof-rolled and be inspected by qualified geotechnical personnel. Any softened/loosened or poorly performing areas of the subgrade should be sub-excavated and replaced with compacted engineered fill as directed by qualified geotechnical personnel.

The existing fill and native soil containing less than 25 per cent fines by mass (i.e., soil particles less than 75 µm) and free of topsoil, organic matter, or other deleterious material may be reused on site as engineered fill. The existing fill and native soils to be reused as engineered fill must be approved by qualified geotechnical personnel prior to placement. Based on the measured water contents, the existing fill and native soils are generally below their estimated optimum water contents for compaction and as such, water may be applied as needed to achieve the degree of compaction required. Alternatively, imported material meeting the specification of OPSS.PROV 1010, Granular 'A', 'B' Type I or II, or Select Subgrade Material (SSM) may be used as engineered fill. All imported fills should be approved by qualified geotechnical personnel at their source prior to importing to site.

Following the proof-rolling and approval of the subgrade, the engineered fill should be placed in accordance with OPSS.PROV 501. The engineered fill should be placed in maximum 200 mm loose lifts and compacted to 100 per cent of the materials Standard Proctor Maximum Dry Density (SPMDD). Placement of engineered fill should be completed under full-time inspection and in situ density testing by qualified geotechnical personnel.

9.5 Stability of Perimeter Berms

Based on drawings provided by Dillon on June 15, 2023, it is understood that the interior and exterior of the proposed SWMP is 3H:1V and 5H:1V, respectively, and that the proposed height of the perimeter berms do not exceed 1.5 m. Considering the slope and height of the perimeter berms, subsurface conditions (including the natural groundwater level is below the depth of investigation at Elevation 261.7 m), the Factor of Safety against instability is expected to be greater than 1.5 which is considered adequate for short term and permanent conditions.

9.6 Settlement of Perimeter Berms

Settlement of the founding soils beneath the perimeter berms can be expected as a result of up to 1.5 m of new fills placed on the existing fill material and underlying native silty sand to sandy silt.

Based on the results of the settlement analyses, the settlement of the perimeter berms due to compression of the very loose to compact founding soils is estimated to be up to 40 mm, while the settlement of compacted fill due to self-compression is estimated to be up to 10 mm. This settlement is expected to occur during or shortly after construction in response to fill placement.

9.7 Surficial Stability and Erosion Protection

The requirements for design of erosion protection measures at the water inlet and outlet works should be assessed by the hydraulic design engineer. As a minimum, rip-rap treatment at the inlet and outlet of the SWMP pipes should be consistent with the standard presented in OPSD 810.010 Rip-Rap Treatment Type A, with the rip-rap placed to above the pipe obvert, in combination with cut-off headwalls, if these are adopted.

A vegetative cover in accordance with OPSS.PROV 803 should be placed on the perimeter berms as soon as practical after construction to minimize the potential for erosion due to surface water run-off. Alternatively, consideration could also be given to protecting the slopes with a minimum 150 mm thick layer of OPSS.PROV 1004 R-10 rip-rap, constructed in accordance with OPSS.PROV 511.

9.8 Excavations, and Control of Groundwater and Surface Water

It is anticipated that the excavation for the SWMP will be through the existing fill to a depth of up to about 0.5 m. Excavation should be reviewed during construction to confirm that the soil and groundwater conditions are as anticipated. The excavation should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act (OHSA) for Construction Activities (O.Reg. 213). Despite the excavation is expected to be shallow, the existing fill and native silty sand are classified as Type 3 soils and therefore, temporary excavations should be made with side slopes of 1H:1V or flatter in accordance with OSHA. Excavations for the SWMP are not expected to encounter the groundwater level; however, surface water should be directed away from the excavation.

For the construction of footings, it is anticipated that excavations will extend through the existing fill, native sandy silt to sand, and new engineered fill. Excavations should be observed and reviewed during construction to confirm that the soil and groundwater conditions are as anticipated. These materials should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act (OHSA) for Construction Activities (Ontario Regulation 213). The existing fill and native granular soils above the are classified as Type 3 soil, according to the OHSA and as such, temporary excavations should be made with side slopes 1H:1V or flatter.

As indicated in Section 9.4, the base of the excavation should be inspected by qualified geotechnical personnel, and any softened/loosened or poorly performing areas should be sub-excavated and replaced with compacted engineered fill as directed.

10. UNDERGROUND WATER STORAGE TANKS

10.1 Excavation, Control of Groundwater and Surface Water, Installation and Backfilling

It is anticipated that the excavation for the installation of the underground water storage tanks will extend through the existing fill and into the native silty sand. Excavation should be reviewed during construction to confirm that the soil and groundwater conditions are as anticipated. The excavation should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act (OHSA) for Construction Activities (O.Reg. 213). According to OSHA, the existing fill and native silty sand are classified as Type 3 soils and therefore, temporary excavations should be made with side slopes of 1H:1V or flatter.

Excavations for the underground fire storage tank are not expected to encounter the groundwater level; however, surface water should be directed away from the excavations.

The base on the excavation should be inspected by qualified geotechnical personnel, and any softened/loosened or poorly performing areas should be sub-excavated and replaced with engineered fill as directed.

The installation of the storage tanks and anchors, as well as the specification and placement of bedding, backfill, and cover should be carried out in accordance with the manufacturer's guidelines.

11. CLOSURE

The Foundation Design Report was prepared by Messrs. Ali Rajaei, P. Eng., and Christopher Ng, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Ali Rajaei, P.Eng.,
Geotechnical Engineer

Christopher Ng, P.Eng.,
Senior Geotechnical Engineer

Jason Lee, P.Eng.,
Review Principal,
Designated MTO Contact

Date: ***October 12, 2023***
File: ***36708***

THURBER

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a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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THURBER ENGINEERING LTD.

APPENDIX A

- Record of Borehole Sheets (Golder)
- Geotechnical Laboratory Test Results (Golder)
- Certificate of Analysis Report – Corrosivity Test Results (Golder)

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS
MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS[1,2]

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (*i.e.,* SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (*i.e.,* some sand)
≤ 10	trace (*i.e.,* trace fines)

1. Only applicable to components not described by Primary Group Name.
2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

COARSE-GRAINED SOILS

Compactness[1]

Term	SPT 'N' (blows/0.3m)[2]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

1. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-1

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)

G.W.P. 4071-19-00 LOCATION N 4931350.2; E 360989.0 MTM NAD ZONE (LAT. 44.519981; LONG. -78.793174) ORIGINATED BY SC

DIST Eastern HWY 35 BOREHOLE TYPE Power Auger; 100 mm O.D. Solid Stem Augers COMPILED BY MB

DATUM HT_2 (Goedetic) DATE April 29, 2021 CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.2	GROUND SURFACE										
0.0 / 270.7	SILTY SAND (SM), trace rootlets and organics (FILL) Very loose Dark brown Moist		1A 1B	SS	3		271		○		
0.5	SILTY SAND (SM) Very loose to very dense Brown, oxidation staining to a depth of 2.2 m Moist		2	SS	4		270		○		
			3	SS	7						0 82 13 5
			4	SS	4		269		○		
			5	SS	20		268				
			6	SS	21		267		○		
			7	SS	30		266				
			8	SS	22		265		○		0 74 21 5
			9	SS	40		264				
			10	SS	86		263				
261.5							262		○		
9.8	END OF BOREHOLE										

NOTE:

1. Borehole open and dry upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_35_PATROL_YARD\02_DATA\GINT\HWY_35_PATROL_YARD.GPJ GAL-GTA.GDT 6/16/21

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-2

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)
G.W.P. 4071-19-00
LOCATION N 4931324.6; E 361026.0 MTM NAD ZONE (LAT. 44.519748; LONG. -78.792711)
ORIGINATED BY SC
DIST Eastern HWY 35
BOREHOLE TYPE Power Auger; 100 mm O.D. Solid Stem Augers
COMPILED BY MB
DATUM HT_2 (Goedetic)
DATE April 28, 2021
CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
269.7	GROUND SURFACE										
0.0 / 269.2	SILTY SAND (SM), trace rootlets and organics (FILL) Very loose Dark brown Moist		1A 1B	SS	3		269		○		
0.5	SAND (SP-SM), trace silt, trace clay Very loose to dense Brown, oxidation staining to a depth of 3.0 m Moist		2	SS	4						
			3	SS	8		268				
			4	SS	21		267				
			5	SS	23				○		
			6	SS	21		266				0 89 7 4
			7	SS	34		265		○		
264.1											
5.6	SILTY SAND (SM), some gravel Dense to very dense Brown Moist		8	SS	43		264				16 68 12 4
			9	SS	71		263				
	- Auger grinding from a depth of 8.5 m to 8.8 m						262		○		
260.2			10A 10B	SS	72		261				
9.8	Sandy gravelly CLAYEY SILT-SILT (CL-ML) (TILL) Hard Brown Moist						260				
	END OF BOREHOLE										

NOTE:

1. Borehole open and dry upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_35_PATROL_YARD\02_DATA\GINT\HWY_35_PATROL_YARD.GPJ GAL-GTA.GDT 6/16/21

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-3

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)
G.W.P. 4071-19-00
LOCATION N 4931362.3; E 361060.8 MTM NAD ZONE (LAT. 44.520084; LONG. -78.792270)
ORIGINATED BY SC
DIST Eastern HWY 35
BOREHOLE TYPE Power Auger; 100 mm O.D. Solid Stem Augers
COMPILED BY MB
DATUM HT_2 (Goedetic)
DATE April 28, 2021
CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.0	GROUND SURFACE										
0.0	SILTY SAND (SM), trace rootlets and organics to a depth of 0.4 m (FILL) Very loose to loose Dark brown Moist to wet		1A 1B	SS	3						
			2	SS	7		270				2 49 41 8
			3	SS	4		269				
268.8											
2.2	SAND (SP-SM) to SILTY SAND (SM) Compact to dense Brown Moist		4	SS	12		268				
			5	SS	15						0 88 7 5
			6	SS	24		267				
			7	SS	15		266				
			8	SS	37		265				
263.8							264				
7.2	Gravelly SILTY SAND (SM) Very dense Brown Moist		9	SS	100/0.15		263				28 52 15 5
261.6			10	SS	100/0.07		262				
9.4	END OF BOREHOLE NOTE: 1. Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE

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GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-4

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)

G.W.P. 4071-19-00 LOCATION N 4931361.4; E 361089.6 MTM NAD ZONE (LAT. 44.520075; LONG. -78.791908) ORIGINATED BY SC

DIST Eastern HWY 35 BOREHOLE TYPE Power Auger; 200 mm O.D. Hollow Stem Augers COMPILED BY MB

DATUM HT_2 (Goedetic) DATE April 28, 2021 CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.0	GROUND SURFACE										
0.0	SILT (ML) and sand (FILL) Loose Brown Moist		1	SS	5				○		
			2	SS	6		270				
269.6											
1.5	SILT (ML) and sand Loose Brown Moist		3	SS	4		269		○		0 47 50 3
268.8											
2.2	SAND (SW-SM), trace silt, trace gravel Compact Brown Dry		4	SS	19						2 88 8 2
			5	SS	30		268		○		
			6	SS	15		267				
			7	SS	24				○		
							266				
			8	SS	29		265				
							264				
			9	SS	30		263		○		
262.5											
8.5	Gravelly SILTY SAND (SM) Very dense Brown Moist						262				
261.7			10	SS	50/0.15						
9.3	END OF BOREHOLE NOTE: 1. Water not encountered during drilling. 2. Monitoring well dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-5A

SHEET 1 OF 1 **METRIC**

PROJECT 1786659 (13000)
G.W.P. 4071-19-00 LOCATION N 4931383.2; E 361154.4 MTM NAD ZONE (LAT. 44.520265; LONG. -78.791091) ORIGINATED BY SC
DIST Eastern HWY 35 BOREHOLE TYPE Power Auger; 100 mm O.D. Solid Stem Augers COMPILED BY MB
DATUM HT_2 (Goedetic) DATE April 29, 2021 CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.5	GROUND SURFACE										
0.0 / 271.8	Gravelly SILTY SAND (SM) (FILL) Loose Dark brown Moist		1	SS	4		272	○	○		
0.7 / 268.7	Gravelly SILTY SAND (SM) Dense to very dense Brown Moist -Auger grinding below a depth of 0.8 m		2	SS	33		271				31 52 14 3
			3	SS	67		270	○			
			4	SS	53		269				
			5	SS	95			○			
3.8	END OF BOREHOLE NOTE: 1. Borehole terminated due to caving. A separate borehole (Borehole 21-5B) was advanced using hollow-stem augers, adjacent to Borehole 21-5A. See Record of Borehole 21-5B.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No 21-5B

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)

G.W.P. 4071-19-00 LOCATION N 4931382.3; E 361152.1 MTM NAD ZONE (LAT. 44.520258; LONG. -78.791119) ORIGINATED BY SC

DIST Eastern HWY 35 BOREHOLE TYPE Power Auger; 200 mm O.D. Hollow Stem Augers COMPILED BY MB

DATUM HT_2 (Goedetic) DATE April 29, 2021 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
272.4	GROUND SURFACE										
0.0 / 271.7	Stratigraphy inferred from Borehole 21-5A						272				
0.7	- Auger grinding, difficult drilling below a depth of 1.2 m						271				
270.3											
2.1	AUGER REFUSAL END OF BOREHOLE NOTE: 1. Borehole terminated due to auger refusal. A third borehole attempt was made adjacent to Borehole 21-5B, see Record of Borehole 21-5C.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-5C

SHEET 1 OF 1

METRIC

PROJECT 1786659 (13000)

G.W.P. 4071-19-00 LOCATION N 4931381.4; E 361150.2 MTM NAD ZONE (LAT. 44.520250; LONG. -78.791143) ORIGINATED BY SC

DIST Eastern HWY 35 BOREHOLE TYPE Power Auger; 200 mm O.D. Hollow Stem Augers COMPILED BY MB

DATUM HT_2 (Goedetic) DATE April 30, 2021 CHECKED BY AMP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.4	GROUND SURFACE										
0.0 / 272.1	SILTY SAND (SM), trace organics (FILL) Loose Dark brown Moist		1A 1B	SS	4		272				
0.3	SILTY SAND (SM) Loose Brown, oxidation staining Moist		2	SS	6						
271.0 / 1.5	SILTY SAND (SM) and gravel to gravelly SILTY SAND (SM) Dense to very dense Brown Moist		3	SS	39		271				34 50 14 2
	-Auger grinding below a depth of 1.5 m.		4	SS	39		270	○			
			5	SS	56		269				
			6	SS	65		268	○			36 48 13 3
			7	SS	102/0.20		267				
			8	SS	28		266	○			
265.2 / 7.2	SILTY SAND (SM), trace gravel Very dense Brown Moist		9	SS	54		265				3 56 39 2
	-Auger grinding below a depth of 7.2 m.						264				
262.7 / 9.7	END OF BOREHOLE		10	SS	54		263	○			

NOTE:

1. Borehole open and dry upon completion of drilling.

+ ^{3}, × ^{3}: Numbers refer to Sensitivity ○ $^{3\%}$ STRAIN AT FAILURE

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Your Project #: 1786659
Site Location: HWY35
Your C.O.C. #: 136465

Attention: Michael Bentley

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2021/05/12
Report #: R6630743
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1C2198
Received: 2021/05/06, 14:30

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	3	2021/05/10	2021/05/11	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	3	2021/05/11	2021/05/11	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	3	2021/05/10	2021/05/10	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	3	2021/05/07	2021/05/11	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	3	2021/05/10	2021/05/11	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1786659
Site Location: HWY35
Your C.O.C. #: 136465

Attention: Michael Bentley

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2021/05/12
Report #: R6630743
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1C2198
Received: 2021/05/06, 14:30

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1C2198
Report Date: 2021/05/12

Golder Associates Ltd
Client Project #: 1786659
Site Location: HWY35
Sampler Initials: SC

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		PMT538	PMT539	PMT540		
Sampling Date		2021/04/30 17:00	2021/04/28 17:00	2021/04/28 17:00		
COC Number		136465	136465	136465		
	UNITS	21-5C SA2	21-2 SA4	21-3 SA4	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	7200	11000	13000		7340563
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	<20	<20	<20	20	7342952
Conductivity	umho/cm	138	88	76	2	7345096
Available (CaCl2) pH	pH	7.54	7.87	7.76		7342579
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	<20	20	7342958

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: C1C2198
Report Date: 2021/05/12

Golder Associates Ltd
Client Project #: 1786659
Site Location: HWY35
Sampler Initials: SC

TEST SUMMARY

BV Labs ID: PMT538
Sample ID: 21-5C SA2
Matrix: Soil

Collected: 2021/04/30
Shipped:
Received: 2021/05/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7342952	2021/05/10	2021/05/11	Deonarine Ramnarine
Conductivity	AT	7345096	2021/05/11	2021/05/11	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7342579	2021/05/10	2021/05/10	Neil Dassanayake
Resistivity of Soil		7340563	2021/05/11	2021/05/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7342958	2021/05/10	2021/05/11	Deonarine Ramnarine

BV Labs ID: PMT539
Sample ID: 21-2 SA4
Matrix: Soil

Collected: 2021/04/28
Shipped:
Received: 2021/05/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7342952	2021/05/10	2021/05/11	Deonarine Ramnarine
Conductivity	AT	7345096	2021/05/11	2021/05/11	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7342579	2021/05/10	2021/05/10	Neil Dassanayake
Resistivity of Soil		7340563	2021/05/11	2021/05/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7342958	2021/05/10	2021/05/11	Deonarine Ramnarine

BV Labs ID: PMT540
Sample ID: 21-3 SA4
Matrix: Soil

Collected: 2021/04/28
Shipped:
Received: 2021/05/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7342952	2021/05/10	2021/05/11	Deonarine Ramnarine
Conductivity	AT	7345096	2021/05/11	2021/05/11	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7342579	2021/05/10	2021/05/10	Neil Dassanayake
Resistivity of Soil		7340563	2021/05/11	2021/05/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7342958	2021/05/10	2021/05/11	Deonarine Ramnarine

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BV Labs Job #: C1C2198
Report Date: 2021/05/12

Golder Associates Ltd
Client Project #: 1786659
Site Location: HWY35
Sampler Initials: SC

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.3°C

Results relate only to the items tested.

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BV Labs Job #: C1C2198
Report Date: 2021/05/12

Golder Associates Ltd
Client Project #: 1786659
Site Location: HWY35
Sampler Initials: SC

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7342579	NYS	Spiked Blank	Available (CaCl2) pH	2021/05/10		99	%	97 - 103
7342579	NYS	RPD	Available (CaCl2) pH	2021/05/10	0.099		%	N/A
7342952	DRM	Matrix Spike	Soluble (20:1) Chloride (Cl-)	2021/05/11		NC	%	70 - 130
7342952	DRM	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2021/05/11		107	%	70 - 130
7342952	DRM	Method Blank	Soluble (20:1) Chloride (Cl-)	2021/05/11	<20		ug/g	
7342952	DRM	RPD	Soluble (20:1) Chloride (Cl-)	2021/05/11	6.9		%	35
7342958	DRM	Matrix Spike	Soluble (20:1) Sulphate (SO4)	2021/05/11		132 (1)	%	70 - 130
7342958	DRM	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2021/05/11		107	%	70 - 130
7342958	DRM	Method Blank	Soluble (20:1) Sulphate (SO4)	2021/05/11	<20		ug/g	
7342958	DRM	RPD	Soluble (20:1) Sulphate (SO4)	2021/05/11	NC		%	35
7345096	KHP	Spiked Blank	Conductivity	2021/05/11		101	%	90 - 110
7345096	KHP	Method Blank	Conductivity	2021/05/11	<2		umho/cm	
7345096	KHP	RPD	Conductivity	2021/05/11	1.6		%	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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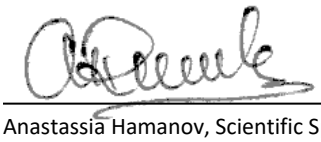
BV Labs Job #: C1C2198
Report Date: 2021/05/12

Golder Associates Ltd
Client Project #: 1786659
Site Location: HWY35
Sampler Initials: SC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

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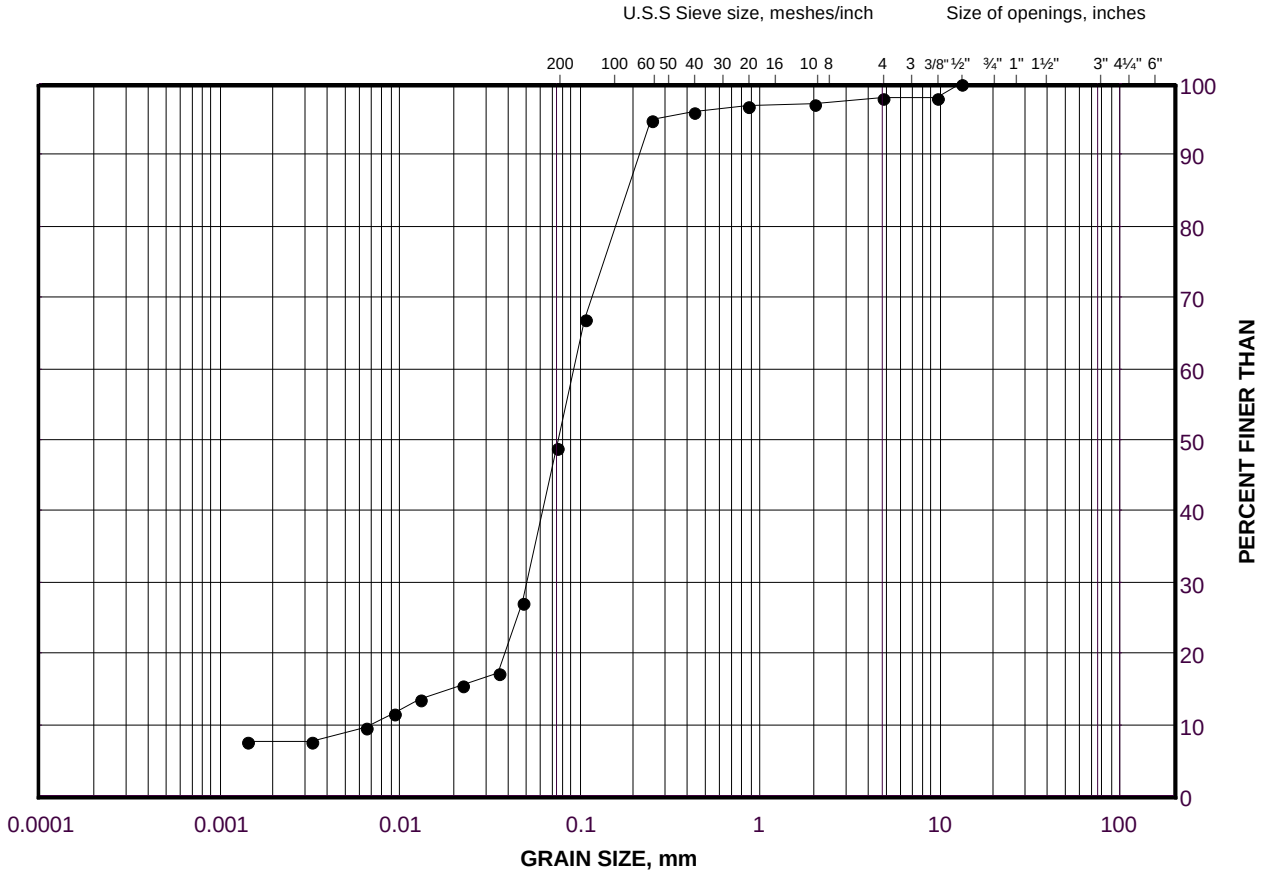
GRAIN SIZE DISTRIBUTION

SILTY SAND (SM) (FILL)

FIGURE B-1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	21-3	2	269.2

Project Number: 1786659 (13 000)

Checked By: AMP

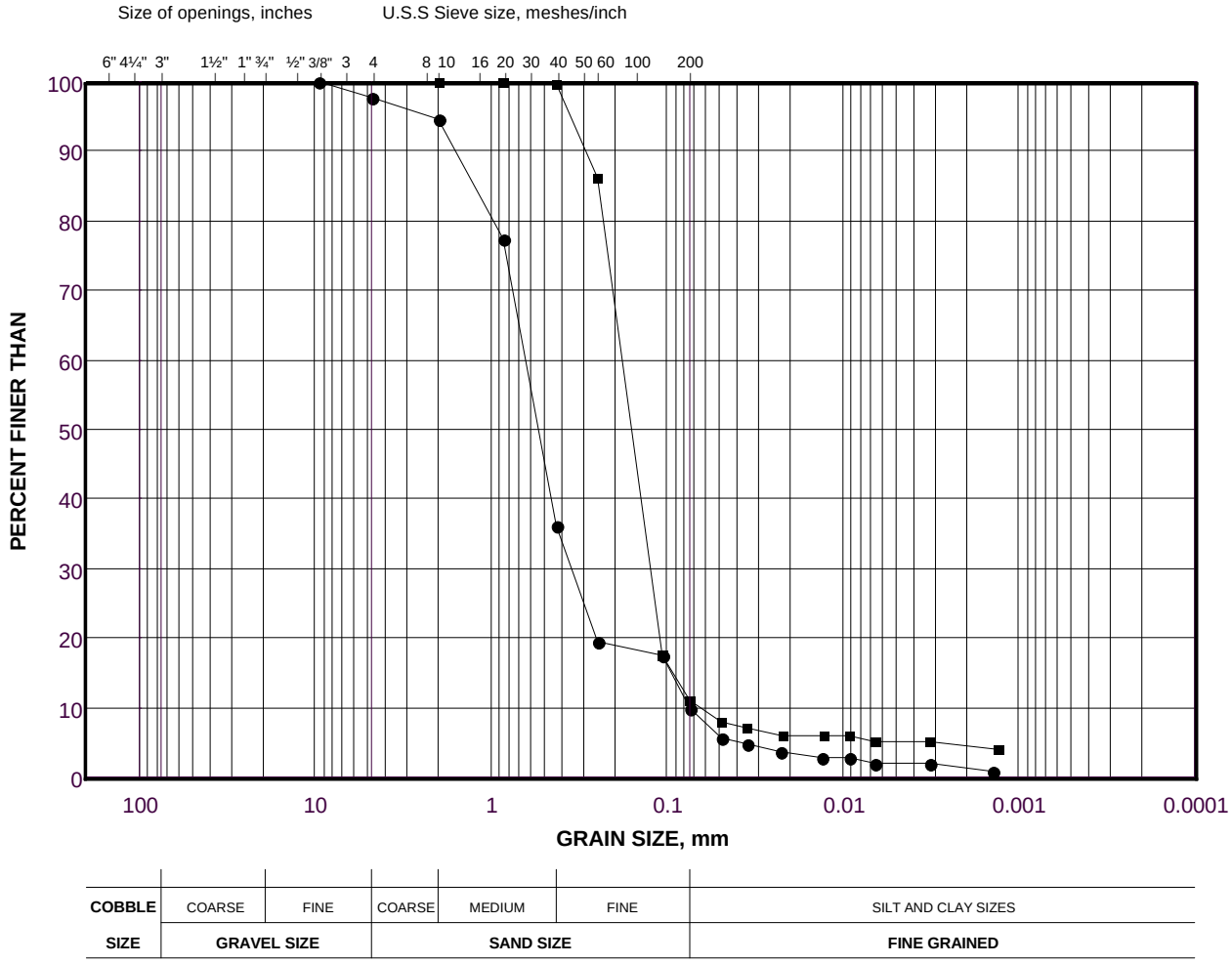
Golder Associates

Date: 31-May-21

GRAIN SIZE DISTRIBUTION

SAND (SP-SM/SW-SM)

FIGURE B-2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	21-4	4	268.4
■	21-2	6	265.6

Project Number: 1786659 (13 000)

Checked By: AMP

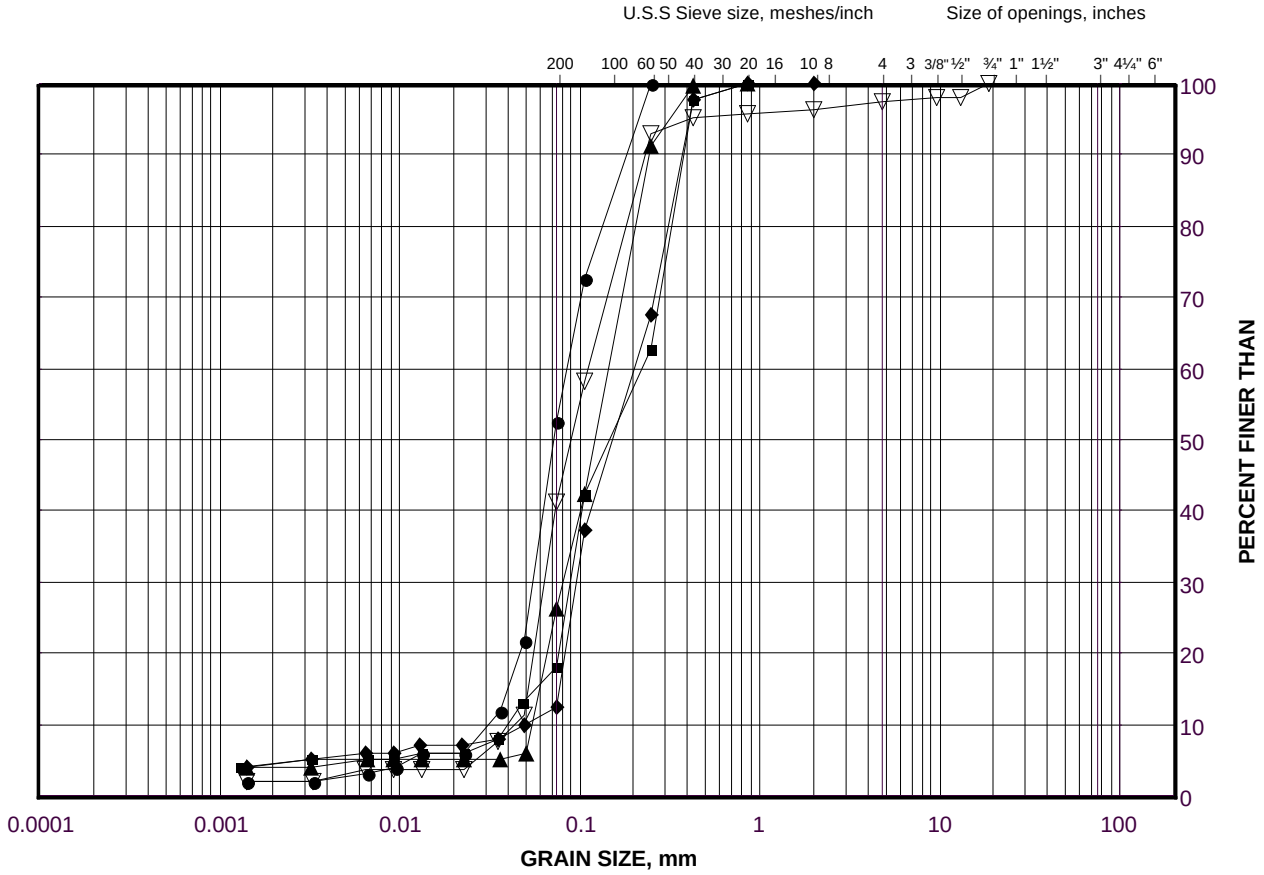
Golder Associates

Date: 26-May-21

GRAIN SIZE DISTRIBUTION

SILTY SAND (SM) to SILT (ML) and sand

FIGURE B-3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	21-4	3	269.2
■	21-1	3	269.4
◆	21-3	5	267.6
▲	21-1	8	264.8
▽	21-5C	9	264.5

Project Number: 1786659 (13 000)

Checked By: AMP

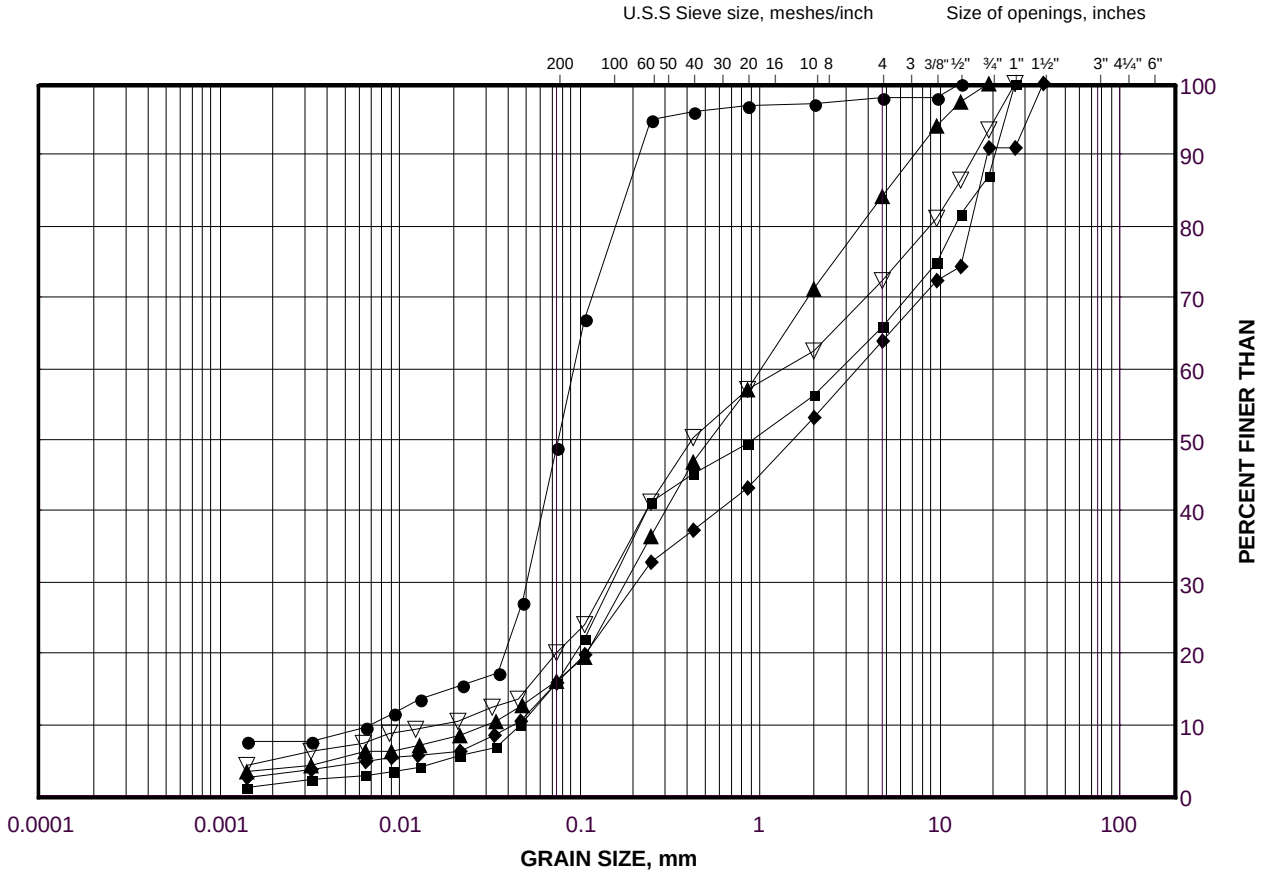
Golder Associates

Date: 31-May-21

GRAIN SIZE DISTRIBUTION

SILTY SAND (SM) and gravel to SILTY SAND (SM)

FIGURE B-4



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	21-3	2	269.2
■	21-5C	3	270.6
◆	21-5C	6	268.3
▲	21-2	8	263.3
▽	21-3	9	263.1

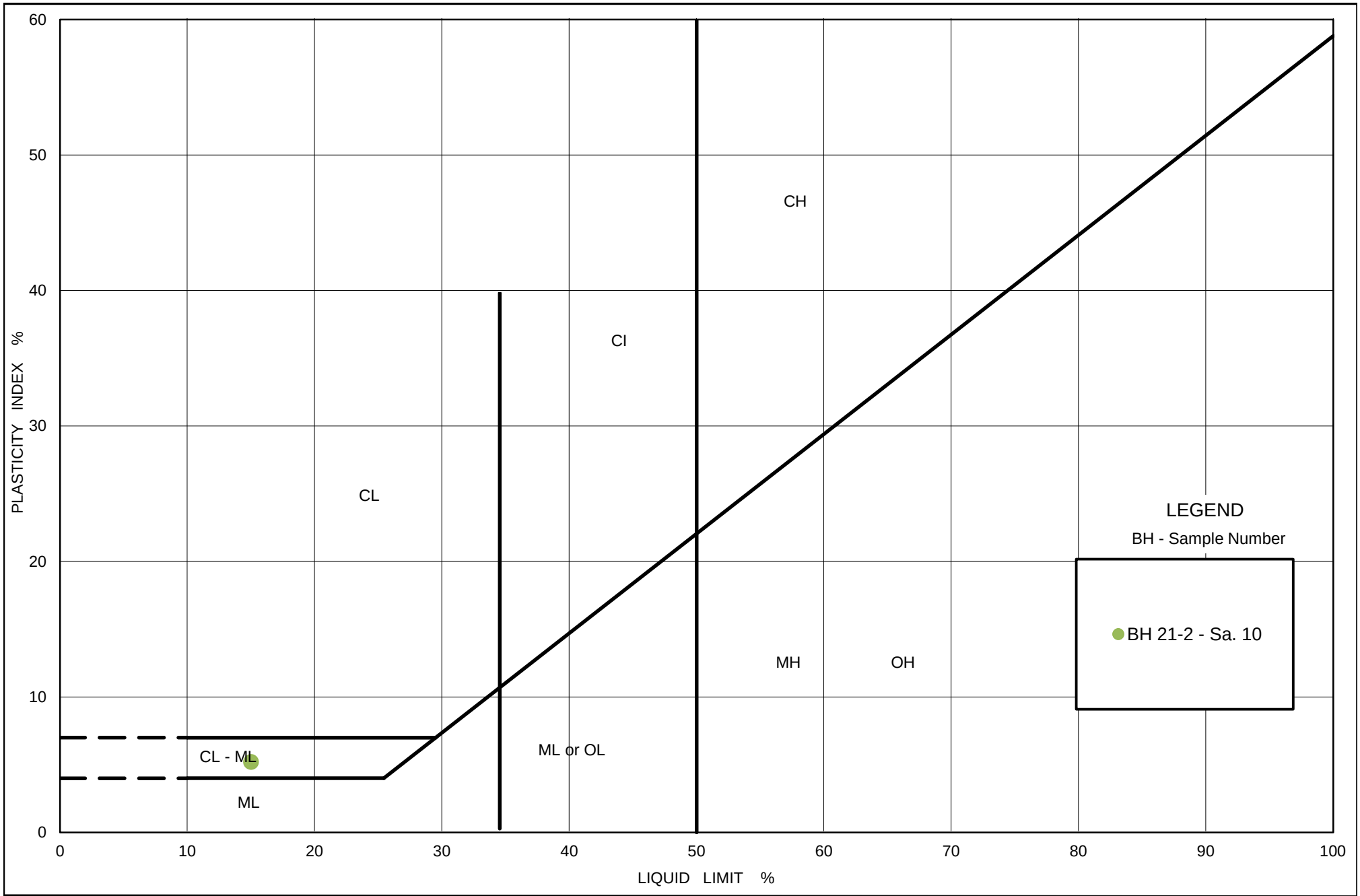
Project Number: 1786659 (13 000)

Checked By: AMP

Golder Associates

Date: 31-May-21

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ASTM D4318)



PLASTICITY CHART

Sandy gravelly CLAYEY SILT-SILT (CL-ML) (TILL)

Figure No.: B-5

Project No.: 1786659 (13 000)

Checked By: AMP

THURBER ENGINEERING LTD.

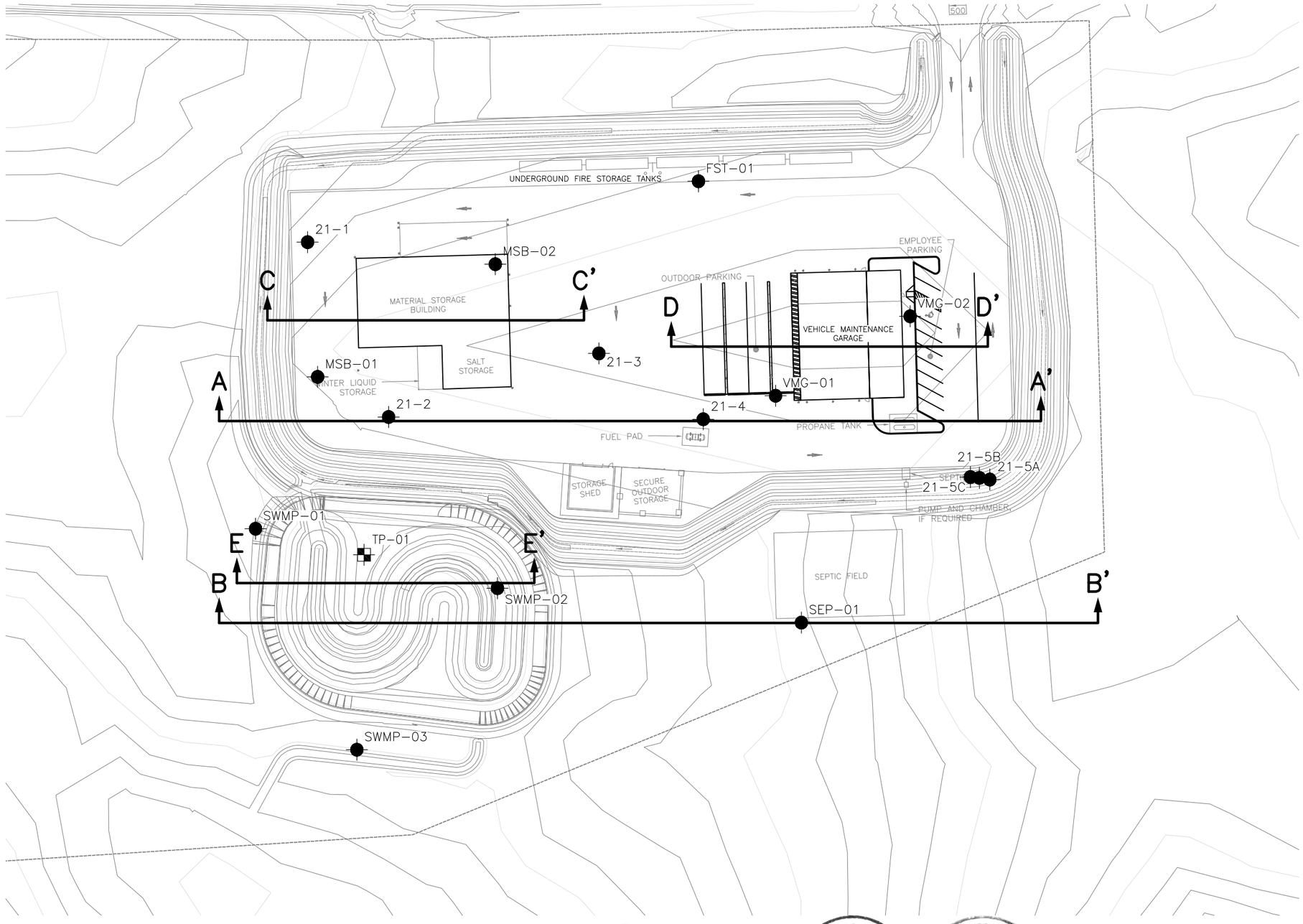
APPENDIX B

- Borehole Locations and Soil Strata (Thurber)
- Record of Borehole Sheets (Thurber)
- Test Pit Logs (Thurber)
- Geotechnical Laboratory Test Results (Thurber)
- Certificate of Analysis Report – Corrosivity Test Results (SGS for Thurber)
- Site Photographs (Thurber)

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



PLAN

20 0 20 40m

SCALE 1:1000

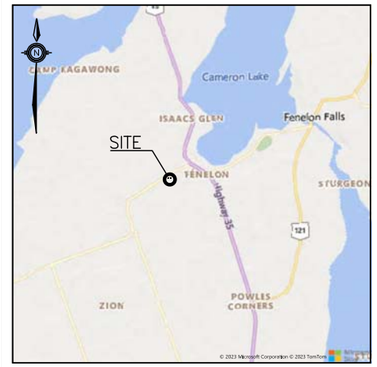
CONT No
GWP No 4044-22-00

SHEET

HIGHWAY 35 MAINTENANCE PATROL YARD

BOREHOLE LOCATIONS AND SOIL STRATA

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
■	Test Pit
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
21-1	271.2	4 931 350.2	360 989.0
21-2	269.7	4 931 324.6	361 026.0
21-3	271.0	4 931 362.3	361 060.8
21-4	271.0	4 931 361.4	361 089.6
21-5A	272.5	4 931 383.2	361 154.4
21-5B	272.4	4 931 382.3	361 152.1
21-5C	272.4	4 931 381.4	361 150.2
FST-01	272.0	4 931 408.7	361 060.5
MSB-01	270.2	4 931 324.3	361 007.0
MSB-02	271.0	4 931 368.0	361 029.4
SEP-01	271.2	4 931 332.1	361 133.4
SWMP-01	269.9	4 931 286.4	361 012.5
SWMP-02	269.6	4 931 303.1	361 068.2
SWMP-03	270.0	4 931 253.9	361 059.0
TP-01	268.5	4 931 294.0	361 037.4
VMG-01	271.2	4 931 374.7	361 101.4
VMG-02	272.4	4 931 406.6	361 119.0

GEOCRES No. 31D-828

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
2023/09/28
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.P.K. LEE
100086735
2023/09/28
PROVINCE OF ONTARIO

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Coordinate system is MTM NAD 83 Zone 10.

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CN	CHK	CODE	LOAD	DATE SEP 2023
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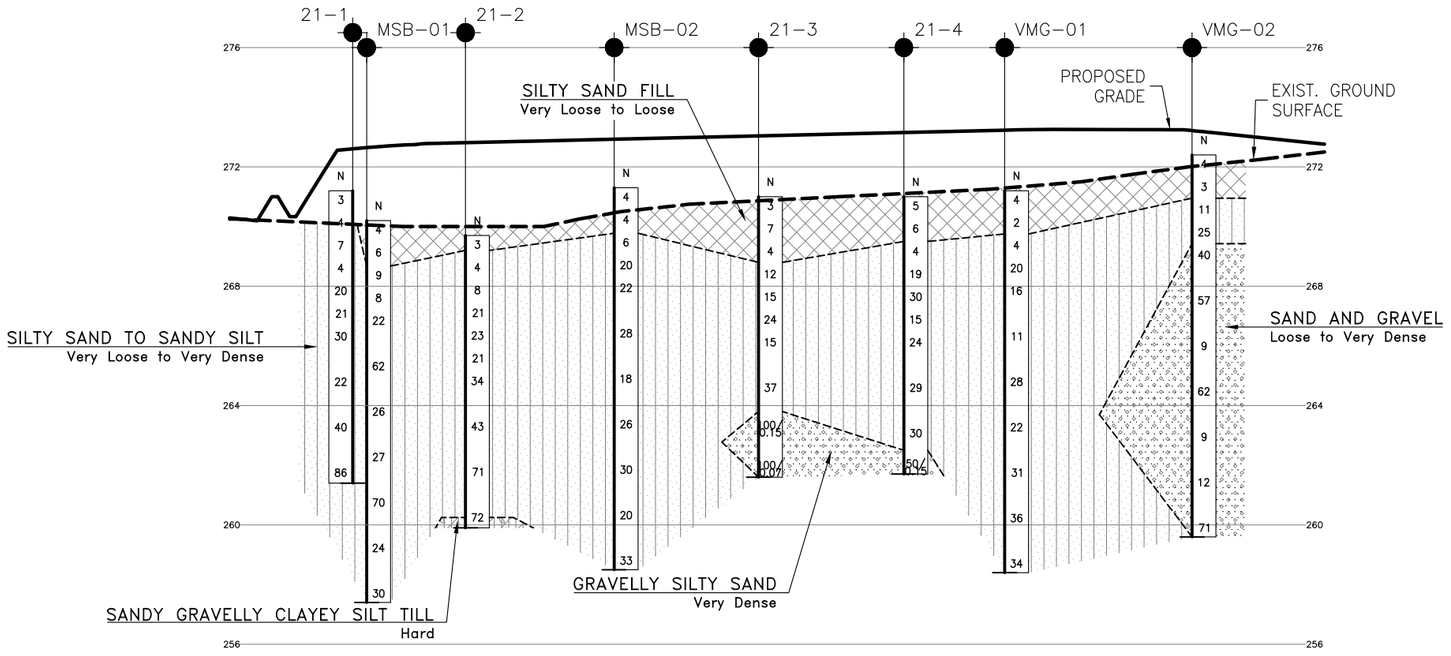
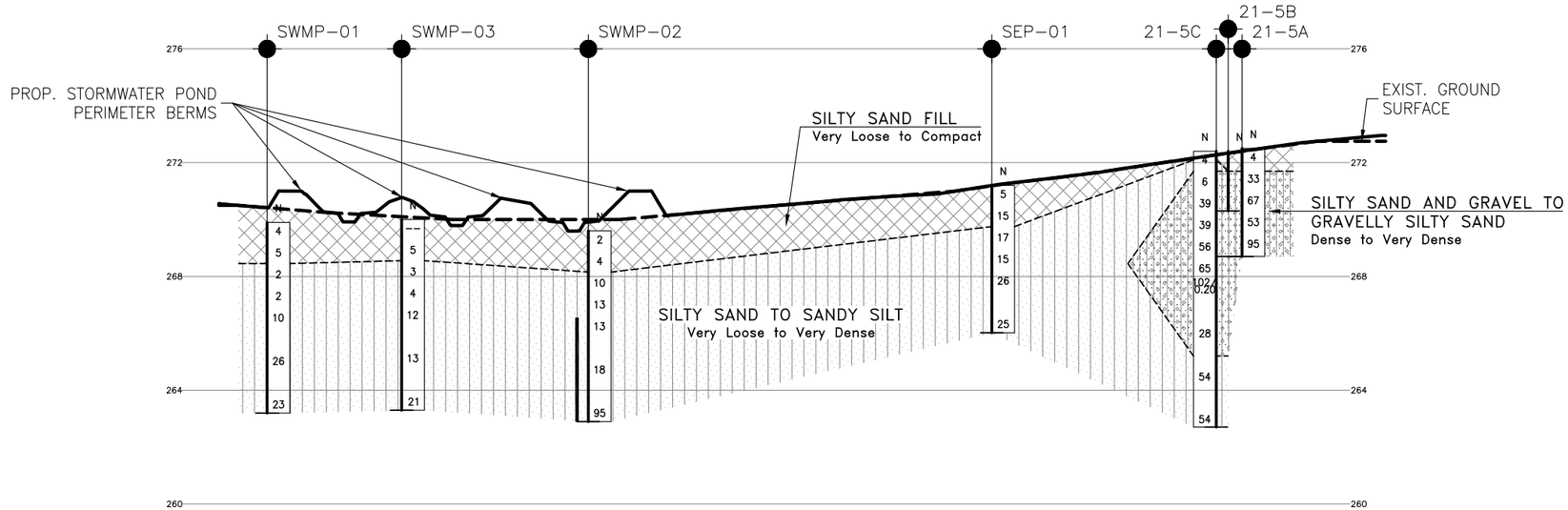
MINISTRY OF TRANSPORTATION, ONTARIO



SECTION OF HIGHWAY 35 PATROL YARD (A–A')

20 0 20 40m H 1:1000

4 0 4 8m V 1:200



SECTION OF HIGHWAY 35 PATROL YARD (B–B')

20 0 20 40m H 1:1000

4 0 4 8m V 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

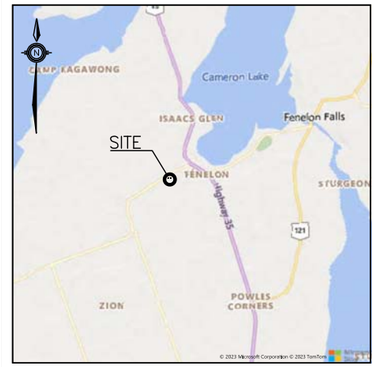
CONT No
GWP No 4044–22–00

HIGHWAY 35 MAINTENANCE PATROL YARD

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
■	Test Pit
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
21–1	271.2	4 931 350.2	360 989.0
21–2	269.7	4 931 324.6	361 026.0
21–3	271.0	4 931 362.3	361 060.8
21–4	271.0	4 931 361.4	361 089.6
21–5A	272.5	4 931 383.2	361 154.4
21–5B	272.4	4 931 382.3	361 152.1
21–5C	272.4	4 931 381.4	361 150.2
FST–01	272.0	4 931 408.7	361 060.5
MSB–01	270.2	4 931 324.3	361 007.0
MSB–02	271.0	4 931 368.0	361 029.4
SEP–01	271.2	4 931 332.1	361 133.4
SWMP–01	269.9	4 931 286.4	361 012.5
SWMP–02	269.6	4 931 303.1	361 068.2
SWMP–03	270.0	4 931 253.9	361 059.0
TP–01	268.5	4 931 294.0	361 037.4
VMG–01	271.2	4 931 374.7	361 101.4
VMG–02	272.4	4 931 406.6	361 119.0

GEOCRES No. 31D-828

LICENSED PROFESSIONAL ENGINEER C.C. NG 100088170 2023/09/28 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J.P.K. LEE 100086735 2023/09/28 PROVINCE OF ONTARIO

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REVISIONS			
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MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

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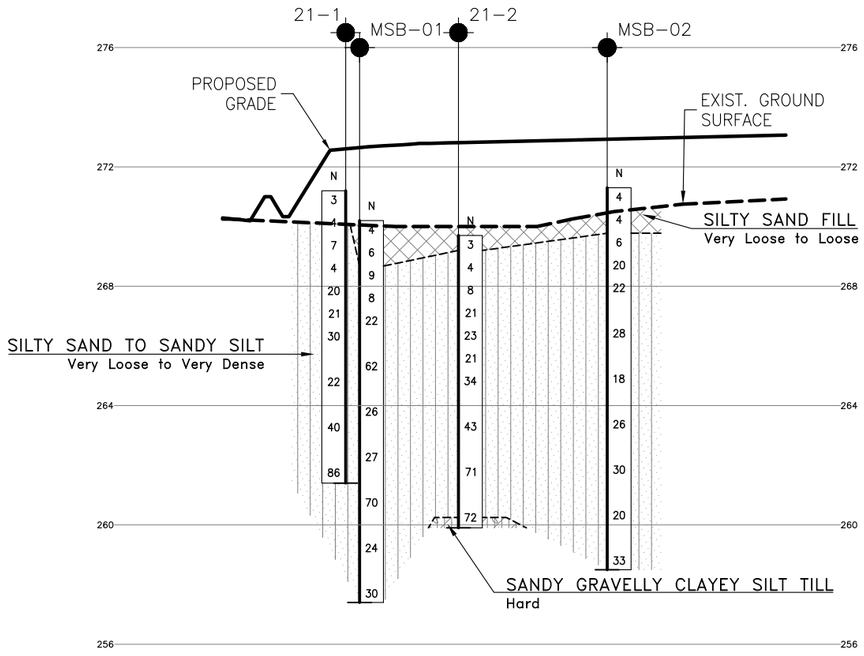

SECTION OF MATERIAL STORAGE BUILDING SECTION (C-C')

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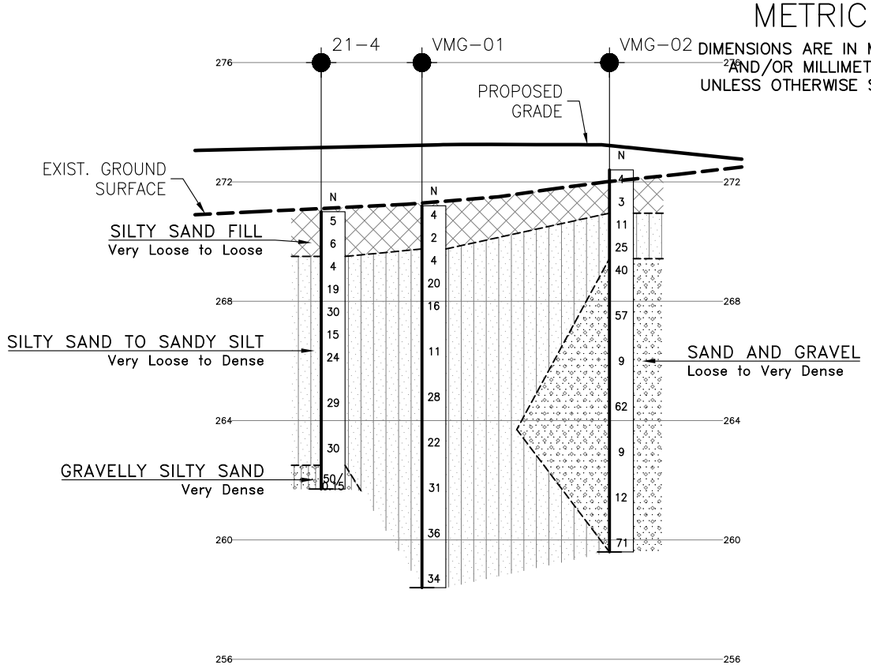
4 0 4 8m V 1:200



SECTION OF VEHICLE MAINTENANCE GARAGE (D-D')

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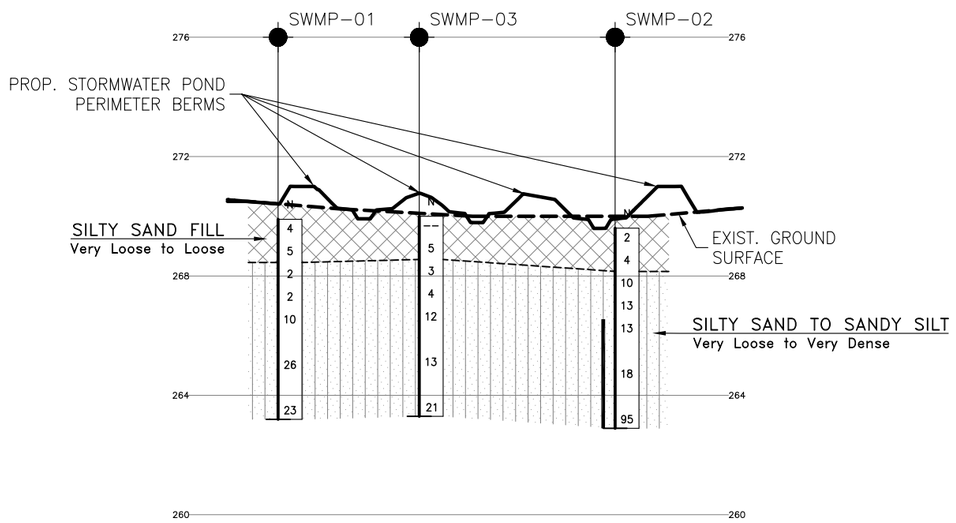
4 0 4 8m V 1:200



SECTION OF STORMWATER MANAGEMENT POND (E-E')

20 0 20 40m H 1:1000

4 0 4 8m V 1:200

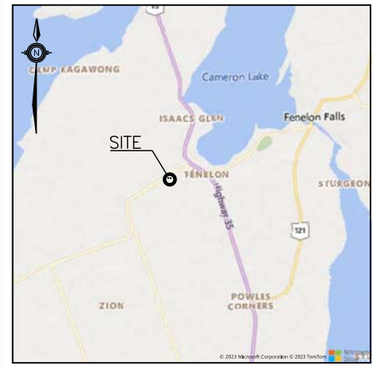
CONT No
GWP No 4044-22-00

HIGHWAY 35 MAINTENANCE PATROL YARD

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
⊞	Test Pit
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
21-1	271.2	4 931 350.2	360 989.0
21-2	269.7	4 931 324.6	361 026.0
21-3	271.0	4 931 362.3	361 060.8
21-4	271.0	4 931 361.4	361 089.6
21-5A	272.5	4 931 383.2	361 154.4
21-5B	272.4	4 931 382.3	361 152.1
21-5C	272.4	4 931 381.4	361 150.2
FST-01	272.0	4 931 408.7	361 060.5
MSB-01	270.2	4 931 324.3	361 007.0
MSB-02	271.0	4 931 368.0	361 029.4
SEP-01	271.2	4 931 332.1	361 133.4
SWMP-01	269.9	4 931 286.4	361 012.5
SWMP-02	269.6	4 931 303.1	361 068.2
SWMP-03	270.0	4 931 253.9	361 059.0
TP-01	268.5	4 931 294.0	361 037.4
VMG-01	271.2	4 931 374.7	361 101.4
VMG-02	272.4	4 931 406.6	361 119.0

GEOCRES No. 31D-828

LICENSED PROFESSIONAL ENGINEER C.C. NG 100088170 2023/09/28 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J.P.K. LEE 100086735 2023/09/28 PROVINCE OF ONTARIO

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN CN	CHK	CODE	LOAD	DATE	SEP 2023
DRAWN MC	CHK CN	SITE	STRUCT	DWG	3

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No FST-01 1 OF 1 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 408.7 E 361 060.5 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.520494 LONGITUDE -78.792266 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.0	GROUND SURFACE										
0.0	Silty **SAND**, trace rootlets Loose Dark Brown Moist (FILL)		1	SS	4				○		
			2	SS	5		271		○		0 78 22 0
270.5											
1.5	Silty **SAND** Loose to Compact Brown Moist		3	SS	4		270		○		
			4	SS	6				○		0 68 32 0
			5	SS	24		269		○		
267.9							268				
4.1	Silty **SAND**, some gravel Compact Brown Moist		6	SS	23		267		○		
			7	SS	25		266				
							265				
			8	SS	9		264		○		14 69 9 8
263.8											
8.2	END OF BOREHOLE AT 8.2 m. BOREHOLE CAVED TO 7.9 m AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.06.08 Dry -										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MSB-01 1 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 324.3 E 361 007.0 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.30 - 2023.05.30 LATITUDE 44.519738 LONGITUDE -78.792948 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
270.2	GROUND SURFACE										
0.0	Silty **SAND**, trace rootlets Loose Dark Brown Moist (FILL)		1	SS	4		270	○	○		
			2	SS	6		269		○		
268.7											
1.5	**SILT** and **SAND**, trace silt Loose to Compact Brown Moist		3	SS	9				○		
			4	SS	8		268		○		0 43 57 0
			5	SS	22		267		○		
266.1											
4.1	**SAND**, some gravel to gravelly, trace to some silt Compact to Very Dense Brown Moist		6	SS	62		266		○		
			7	SS	26		265				
							264		○		31 61 7 1
							263		○ ○		
			8	SS	27		262		○		
			9	SS	70		261		○ ○		

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MSB-01 2 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 324.3 E 361 007.0 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.30 - 2023.05.30 LATITUDE 44.519738 LONGITUDE -78.792948 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND, some gravel to gravelly, trace to some silt Compact to Very Dense Brown Moist						260				
			10	SS	24				○		
							259				
							258				
257.4			11	SS	30				○ ○		10 75 14 1
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MSB-02 1 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 368.0 E 361 029.4 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.520129 LONGITUDE -78.792661 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.3	GROUND SURFACE										
0.0	Silty **SAND** Very Loose Dark Brown Moist (FILL)		1	SS	4		271		○		
			2	SS	4		270		○		
269.8											
1.5	Silty **SAND** Loose to Compact Brown Moist		3	SS	6				○		
			4	SS	20		269		○		
			5	SS	22		268		○		0 82 17 1 Non-plastic
			6	SS	28		267		○		
			7	SS	18		266				
			8	SS	26		265		○		
			9	SS	30		264		○		0 85 15 0
							263				
							262				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No MSB-02 2 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 368.0 E 361 029.4 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.520129 LONGITUDE -78.792661 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Loose to Compact Brown Moist						261				
			10	SS	20				o		
259.6							260				
11.7	**SAND**, some silt Dense Brown Moist										
			11	SS	33		259		o		0 91 9 0
258.5											
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SEP-01 1 OF 1 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 332.1 E 361 133.4 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.519799 LONGITUDE -78.791357 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.2	GROUND SURFACE										
0.0	Silty **SAND** Loose to Compact Brown Moist (FILL)		1	SS	5		271	○	○		
			2	SS	15		270	○	○		0 79 20 1
269.8											
1.4	Silty **SAND** Compact Brown Moist		3	SS	17			○			
			4	SS	15		269	○	○		
			5	SS	26		268	○	○		0 71 29 0
							267				
266.0			6	SS	25			○	○		
5.2	END OF BOREHOLE AT 5.2 m. BOREHOLES WAS OPEN AND REMAINED DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No SWMP-01 1 OF 1 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 286.4 E 361 012.5 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.30 - 2023.05.30 LATITUDE 44.519396 LONGITUDE -78.792883 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
269.9	GROUND SURFACE										
0.0	Silty **SAND**, trace rootlets Very Loose to Loose Dark Brown to Brown Moist (FILL)		1	SS	4				o		0 52 48 0
			2	SS	5		269		o		
268.5											
1.4	**SILT** and **SAND** Very Loose Brown Wet		3	SS	2		268		o		
			4	SS	2				o		0 40 60 0
266.9							267				
3.0	**SAND**, trace silt Compact Brown Moist		5	SS	10				o		
							266				
			6	SS	26		265		o		
							264				
263.2			7	SS	23				o		
6.7	END OF BOREHOLE AT 6.7 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SWMP-02 1 OF 1 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 303.1 E 361 068.2 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.30 - 2023.05.30 LATITUDE 44.519542 LONGITUDE -78.792180 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
269.6	GROUND SURFACE										
0.0	Silty **SAND**, trace rootlets Very Loose Dark Brown Moist (FILL)		1	SS	2		269		o		0 67 30 3
			2	SS	4				o		
268.2											
1.4	Silty **SAND** Compact to Very Dense Brown Moist		3	SS	10		268		o		3 67 25 5
			4	SS	13		267		o		
			5	SS	13		266		o		
			6	SS	18		265		o		0 62 38 0
			7	SS	95		264		o o		
262.9							263				
6.7	END OF BOREHOLE AT 6.7 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.06.08 Dry -										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}$ 5 $\frac{}{10}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SWMP-03 1 OF 1 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 253.9 E 361 059.0 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.30 - 2023.05.30 LATITUDE 44.519101 LONGITUDE -78.792301 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
270.0	GROUND SURFACE										
0.0	**SILT** and **SAND** Loose Dark Brown Moist (FILL)		1	AS	--				○		
			2	SS	5		269		○		0 40 57 3
268.6											
1.4	Sandy **SILT** Loose to Compact Greish Brown Moist		3	SS	3		268		○		
			4	SS	4				○		
			5	SS	12		267		○		0 35 62 3 Non-plastic
							266				
			6	SS	13		265		○		
							264				
263.3			7	SS	21				○		
6.7	END OF BOREHOLE AT 6.7 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No VMG-01 1 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 374.7 E 361 101.4 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.30 LATITUDE 44.520184 LONGITUDE -78.791755 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.2	GROUND SURFACE									
0.0	Silty **SAND**, trace gravel Very Loose Dark Brown Moist (FILL)		1	SS	4		271	○		
			2	SS	2		270	○		
269.8										
1.4	**SILT** and **SAND** Loose to Compact Brown to Grey Moist		3	SS	4		269	○		
			4	SS	20			○		
			5	SS	16		268	○		
			6	SS	11		267	○		0 44 52 4
265.6							266			
5.6	**SAND**, some silt Compact Brown Moist		7	SS	28		265	○		
			8	SS	22		264			
262.5							263			
8.7	Sandy **SILT** Dense Brown Moist		9	SS	31		262	○		0 23 76 1 Non-plastic

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No VMG-01 2 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 374.7 E 361 101.4 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.30 LATITUDE 44.520184 LONGITUDE -78.791755 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
261.0											
10.2	**SAND**, some silt, trace to some gravel Dense Brown Moist		10	SS	36		261 260 259		o		1 89 10 0
258.4			11	SS	34				o		
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE WAS OPEN AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No VMG-02 1 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 406.6 E 361 119.0 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.520470 LONGITUDE -78.791529 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.4	GROUND SURFACE									
0.0	Silty **SAND**, trace rootlets, trave gravel Very Loose to Loose Dark Brown Moist (FILL)		1	SS	4		272			
			2	SS	3					
271.0							271			
1.4	Silty **SAND** Compact Brown Moist		3	SS	11					
			4	SS	25		270			1 86 13 0
269.4										
3.0	**SAND** and **GRAVEL**, trace silt Loose to Very Dense Brown Moist		5	SS	40		269			
			6	SS	57		268			39 52 9 0
			7	SS	9		267			
			8	SS	62		266			
			9	SS	9		265			
							264			
							263			

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No VMG-02 2 OF 2 METRIC

W.P. 4044-22-00 LOCATION MTM Zone 10: N 4 931 406.6 E 361 119.0 ORIGINATED BY VP

DIST HWY 35 BOREHOLE TYPE C.M.E. 75, Track Mounted (Morooka 1100), Solid Stem Auger COMPILED BY AR

DATUM Geodetic DATE 2023.05.31 - 2023.05.31 LATITUDE 44.520470 LONGITUDE -78.791529 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	SAND and **GRAVEL**, trace silt Loose to Very Dense Brown Moist						262			
			10	SS	12				o	33 51 10 6
							261			
259.6			11	SS	71		260		o	
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE WAS CAVED to 7.3 m AND REMAINED DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.									

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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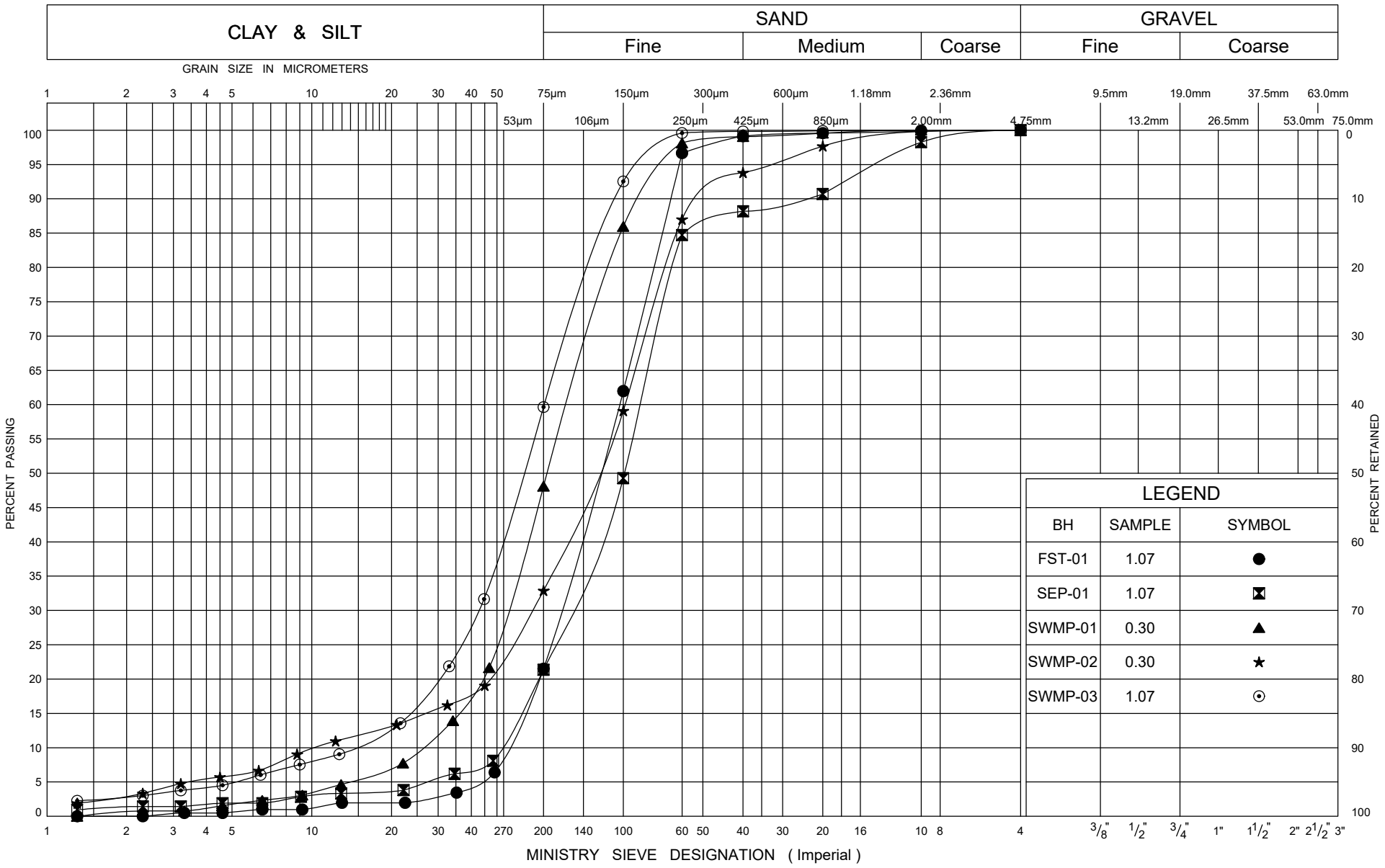
THURBER ENGINEERING LTD.

LOG OF TEST PIT: TP-01

PROJECT NO.:	36708	**CLIENT:**	Dillon	**DATE:**	June 7, 2023
PROJECT:	Highway 35 Patrol Yard	**METHOD:**	B95 Backhoe Loader	**LOGGED:**	KI
LOCATION:	Kawartha Lake, ON	**CONTRACTOR:**	Young's Construction	**CHECKED:**	AR
	N 4,931,294 E 361,035	**SURFACE ELEV.**	270.4		Page 1 of 1

Depth (ft)	Depth (m)	STRATIGRAPHY		Sample Depth (m)	Soils Class.	Water Content (%)	Grain Size Distribution (%) GR SA SI CL
	0	Silty **SAND**, trace clay, trace organics, brown, moist (FILL)	0				
	0.2		0.2				
1.0	0.4		0.4				
2.0	0.6		0.6				
	0.8		0.8				
3.0	1.0		1.0				
4.0	1.2		1.2				
	1.4		1.4				
5.0	1.6		1.6				
6.0	1.8		1.8				
	2.0		2.0				
7.0	2.2	Test pit was terminated at a depth of 2.0 m. Open test pit was dry upon completion of excavation. Test pit was backfilled using excavated material.	2.2				



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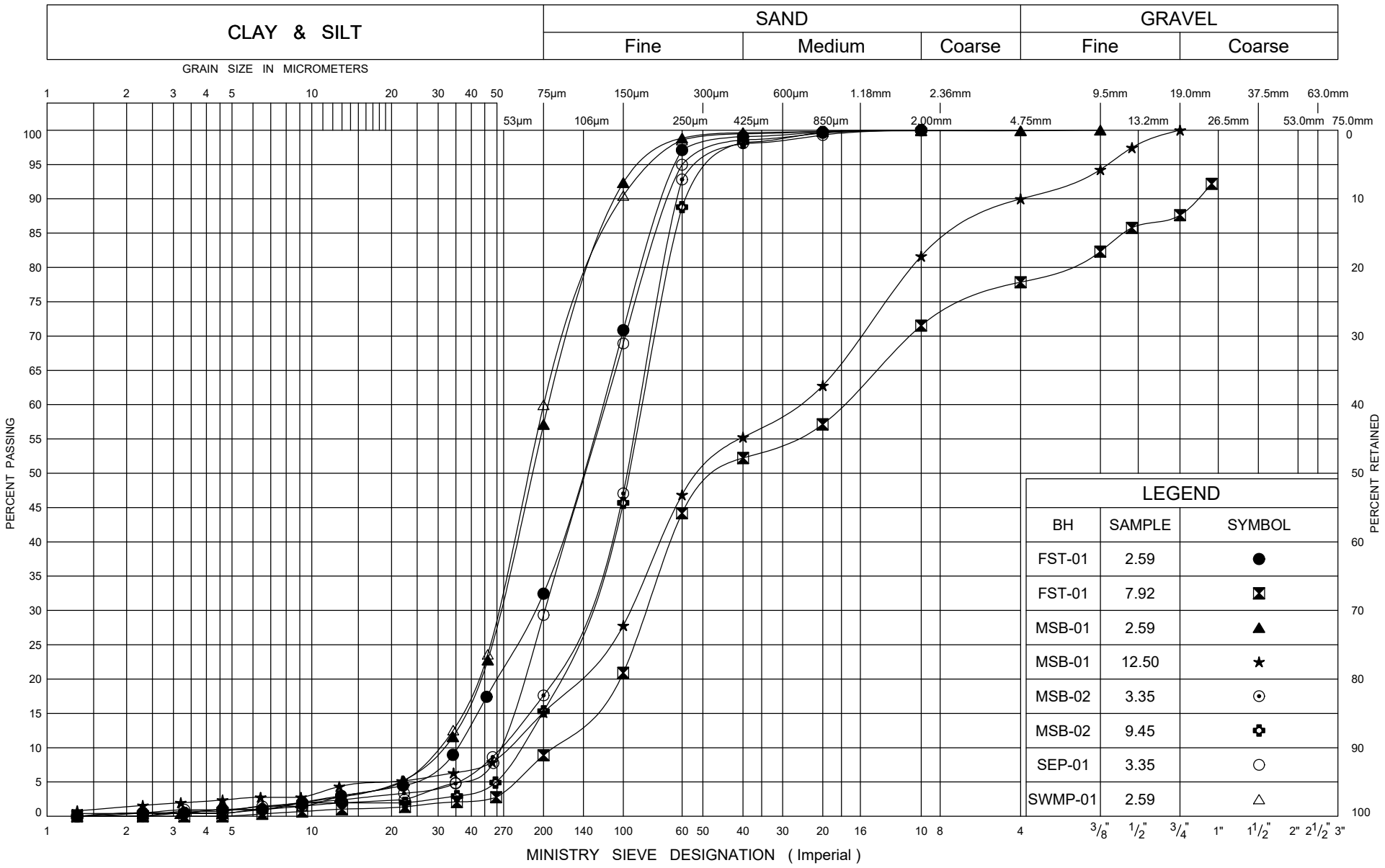
Ontario

GRAIN SIZE DISTRIBUTION

Silty SAND FILL

FIG No B-1

G.W.P. 4044-22-00



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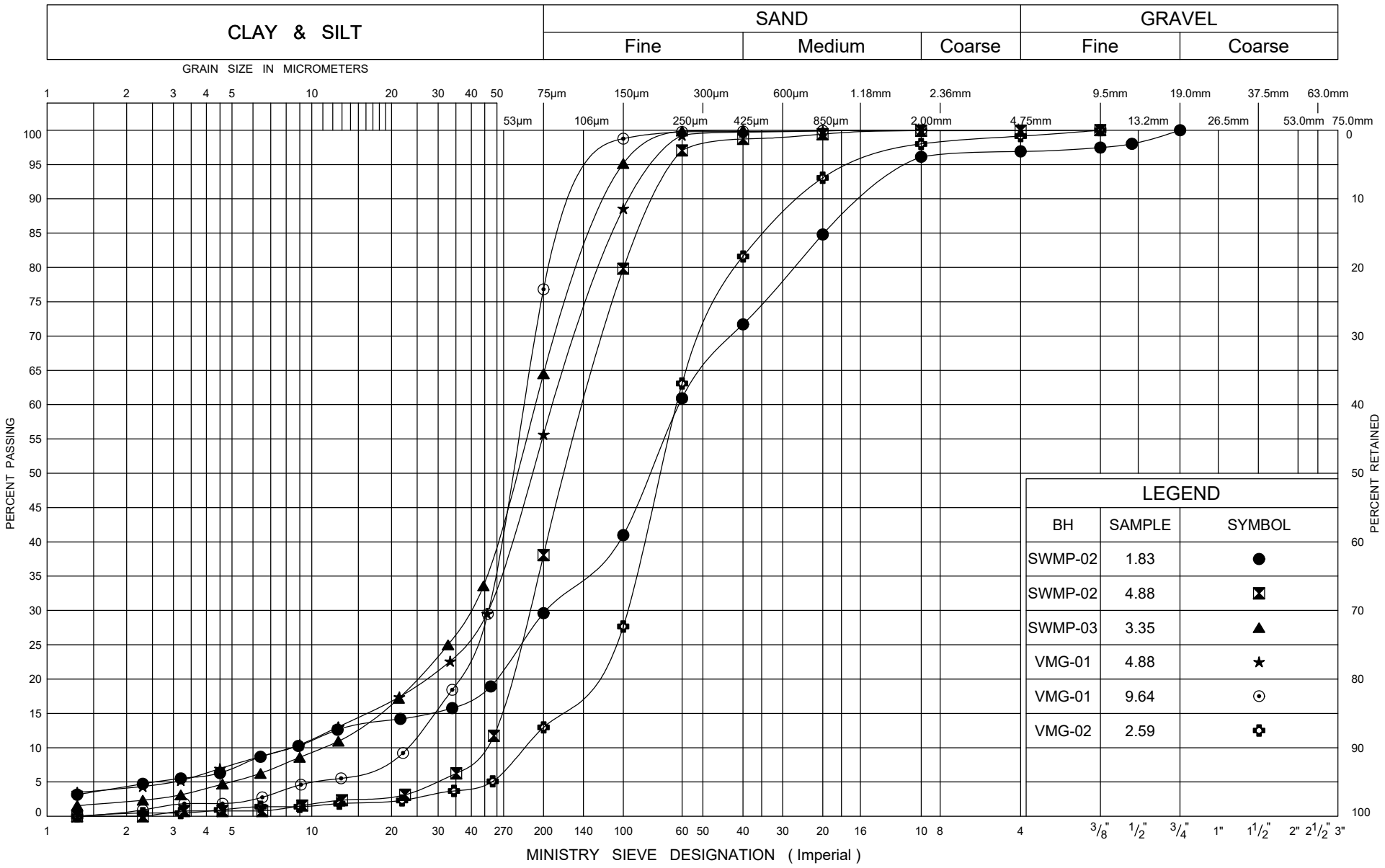
GRAIN SIZE DISTRIBUTION

Silty SAND to Sandy SILT

FIG No B-2

G.W.P. 4044-22-00

ONTARIO MOT GRAIN SIZE 2 MTO-36708.GPJ ONTARIO MOT.GDT 6/19/23



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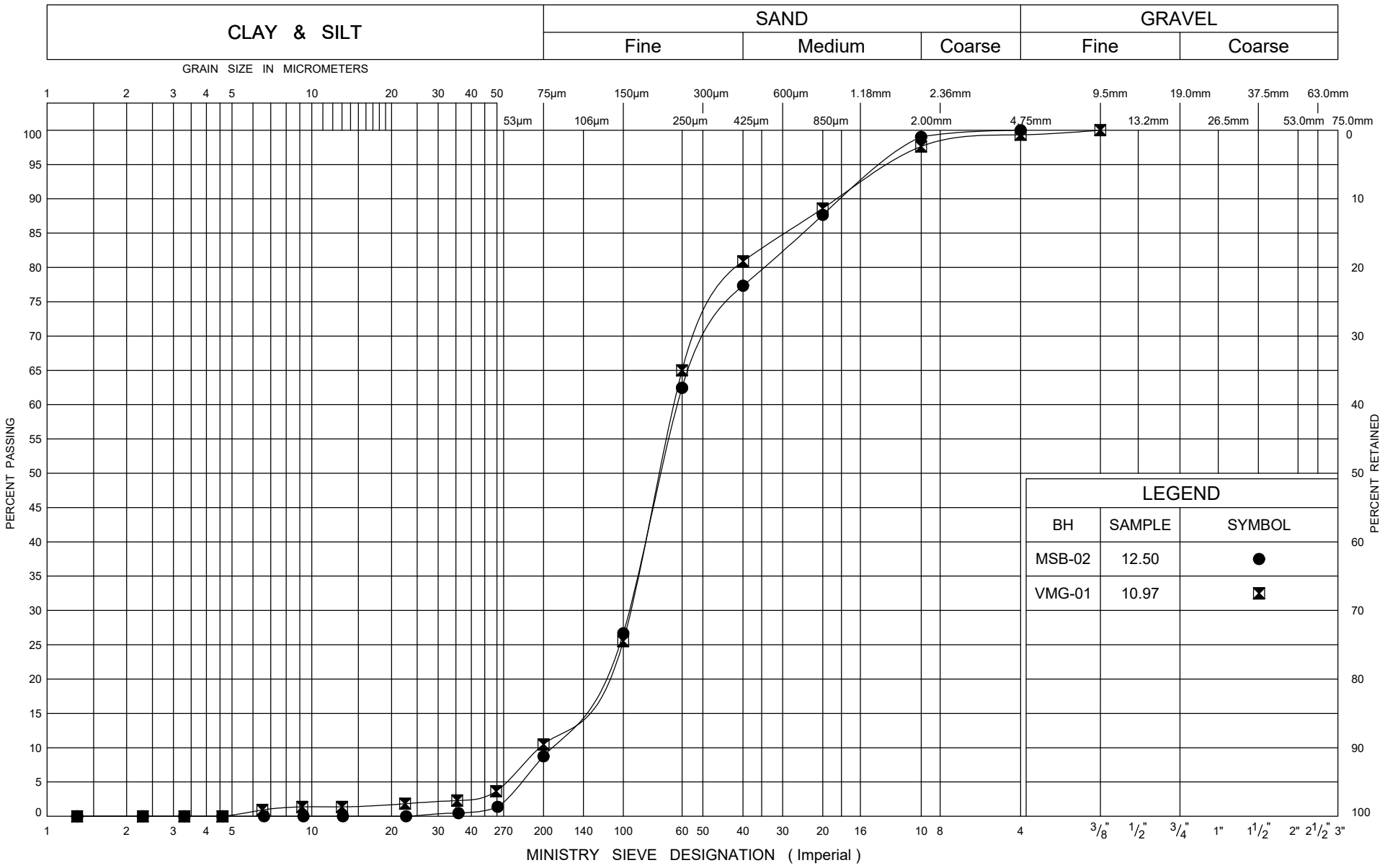
GRAIN SIZE DISTRIBUTION

Silty SAND to Sandy SILT

FIG No B-3

G.W.P. 4044-22-00

ONTARIO MOT GRAIN SIZE 2 MTO-36708.GPJ ONTARIO MOT.GDT 6/19/23



ONTARIO MOT GRAIN SIZE 2 MTO-36708.GPJ ONTARIO MOT.GDT 6/19/23

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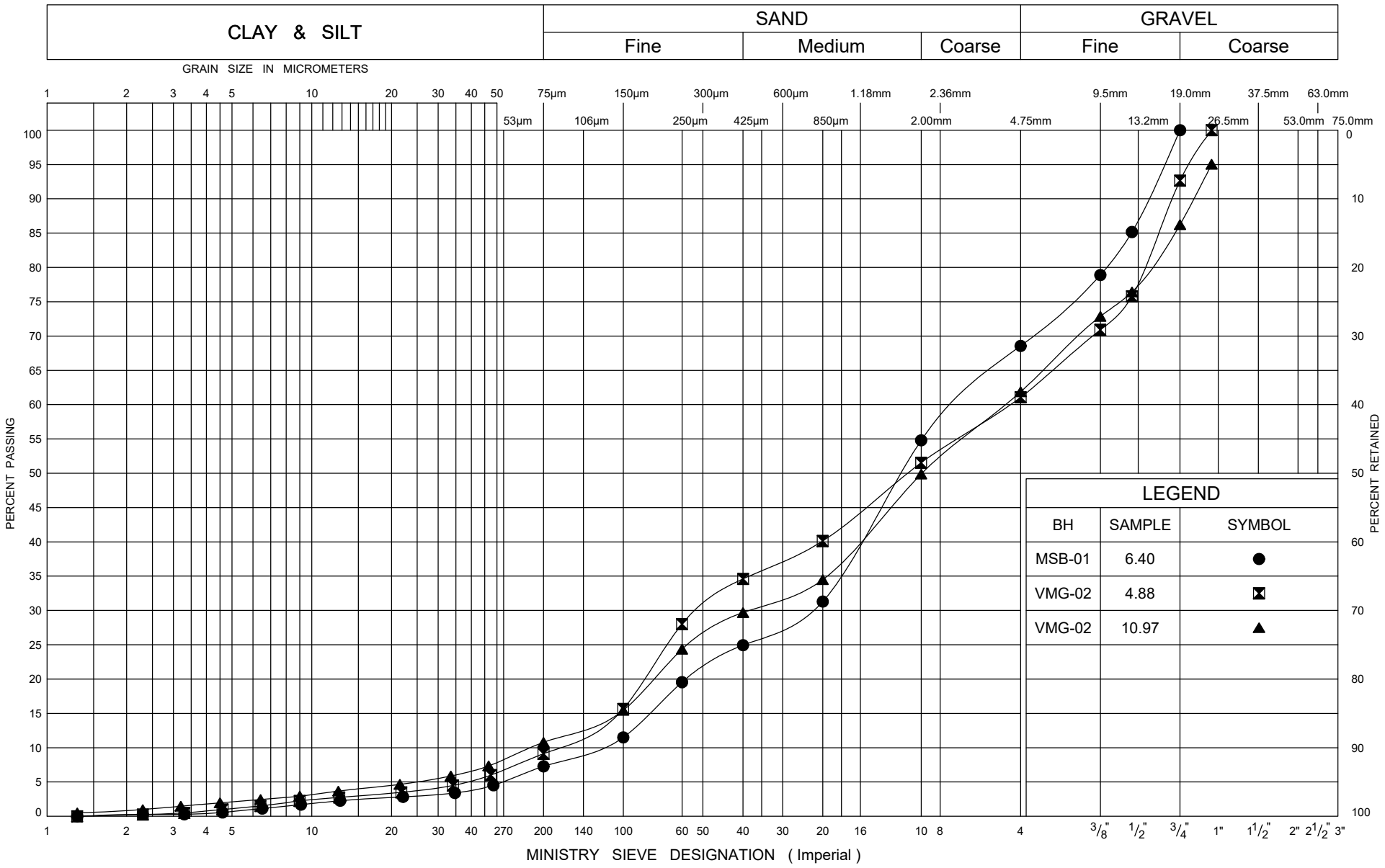
GRAIN SIZE DISTRIBUTION

SAND

FIG No B-4

G.W.P. 4044-22-00



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GRAIN SIZE DISTRIBUTION

SAND and GRAVEL

FIG No B-5

G.W.P. 4044-22-00

ONTARIO MOT GRAIN SIZE 2 MTO-36708.GPJ ONTARIO MOT.GDT 6/19/23

FINAL REPORT

CA40119-JUN23 R1

36708, Hwy 35 Patrol Yard

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Ali Rajaei
Telephone	
Facsimile	
Email	arajaei@thurber.ca; jzoldy@thurber.ca
Project	36708, Hwy 35 Patrol Yard
Order Number	
Samples	Soil (2)

LABORATORY DETAILS

Project Specialist	Jill Campbell, B.Sc.,GISAS
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	2165
Facsimile	705-652-6365
Email	jill.campbell@sgs.com
SGS Reference	CA40119-JUN23
Received	06/14/2023
Approved	06/22/2023
Report Number	CA40119-JUN23 R1
Date Reported	06/22/2023

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: n/a

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

FINAL REPORT

CA40119-JUN23 R1

Client: Thurber Engineering Ltd.
Project: 36708, Hwy 35 Patrol Yard
Project Manager: Ali Rajaei
Samplers: Ali Rajaei

MATRIX: SOIL

			Sample Number	5	6
			Sample Name	VMB-02/SS3	MSB-02/SS2
			Sample Matrix	Soil	Soil
			Sample Date	31/05/2023	31/05/2023
Parameter	**Units**	**RL**		**Result**	**Result**
Corrosivity Index					
Corrosivity Index	none	1		4	1
Soil Redox Potential	mV	no		214	207
Sulphide (Na2CO3)	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		8.82	7.87
Resistivity (calculated)	ohms.cm	-9999		20800	83300
General Chemistry					
Conductivity	uS/cm	2		48	12
Metals and Inorganics					
Moisture Content	%	0.1		5.8	8.8
Sulphate	µg/g	0.4		< 0.4	< 0.4
Other (ORP)					
Chloride	µg/g	0.4		1.1	0.6

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0434-JUN23	µg/g	0.4	<0.4	1	35	98	80	120	97	75	125
Sulphate	DIO0434-JUN23	µg/g	0.4	<0.4	1	35	98	80	120	96	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0039-JUN23	%	0.04	< 0.04	ND	20	92	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0364-JUN23	uS/cm	2	< 2	0	20	100	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0364-JUN23	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No:

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Kirk Kinnon
Received Date (mm/dd/yy): 06-14-23
Received Time: 14:15
Received By (signature): [signature]
Custody Seal Present: ✓
Custody Seal Intact: ✓
Cooling Agent Present: ✓ 90 K3
Temperature Upon Receipt (°C)
LAB LIMS #: CA40119-Jun 23

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Engineering Ltd.	✓ (same as Report Information)	Quotation #: P.O. #: 36708
Contact: Ali Rajaei	Company:	Project #: 36708 Site Location/ID: Hwy 35 Patrol Yard
Address: 1815 Ironstone Manor Suite 11, Pickering, ON L1W 3W9	Contact:	**TURNAROUND TIME (TAT) REQUIRED**
Phone: 4165759069	Address:	✓ Regular TAT (5-7days) — TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day
Email: arajaei@thurber.ca	Phone:	RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
Email: Rgeddam@thurber.ca	Email:	PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
		Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04:	Other Regulations:	Sewer By-Law:
☐ Table 1 ☐ R/P/I	☐ Reg 347/558 (3 Day min TAT)	☐ Sanitary
☐ Table 2 ☐ I/C/C	☐ PWQO ☐ MMER	☐ Storm
☐ Table 3 ☐ A/O	☐ CCME ☐ Other:	Municipality:
☐ Table ____	☐ MISA	
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine		

RECORD OF SITE CONDITION (RSC) ☐ YES ✓ NO

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☐ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☐ BTEX ☐ VOC ☐ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	Corrosivity/Resistivity					COMMENTS:
1	VMG-02/SS3	5/31/23	17:30	1	Soil		☐	☐	☐	☐	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	Please include Sulphide as well
2	MSB-02/SS2	5/31/23	17:20	1	Soil		☐	☐	☐	☐	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	Please include Sulphide as well
3							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME): Ali Rajaei	Signature: AR	Date: 06/13/23	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): "	Signature: AR	Date: 06/14/23	(mm/dd/yy)	Yellow & White Copy - SGS

Revision # 1.1
Date of Issue: 04 April, 2018

Photograph #1 – General view of the site. The site is a vacant land with concrete fencing posts and barbed wire around the site. Track-mounted drill rig in the background.

Photograph #2 – Another view of the site and barbed fence. Looking southeast.

Photograph #3 – Looking east. Monitoring well is installed in the area of the proposed stormwater management pond (Borehole SWMP-02).

Photograph #4 – Looking east. Monitoring well is installed in the area of the proposed underground water storage tanks (Borehole FST-01).

Site Photographs

Photograph #5 – Test pit excavation to perform in-situ infiltration (Guelph permeameter) test at the proposed stormwater management pond location (Test Pit TP-01).

Photograph #6 – Looking southeast. Backfilled test pit (Test Pit TP-01).

THURBER ENGINEERING LTD.

APPENDIX C

- Hydrogeological Test Results

THURBER ENGINEERING LTD.

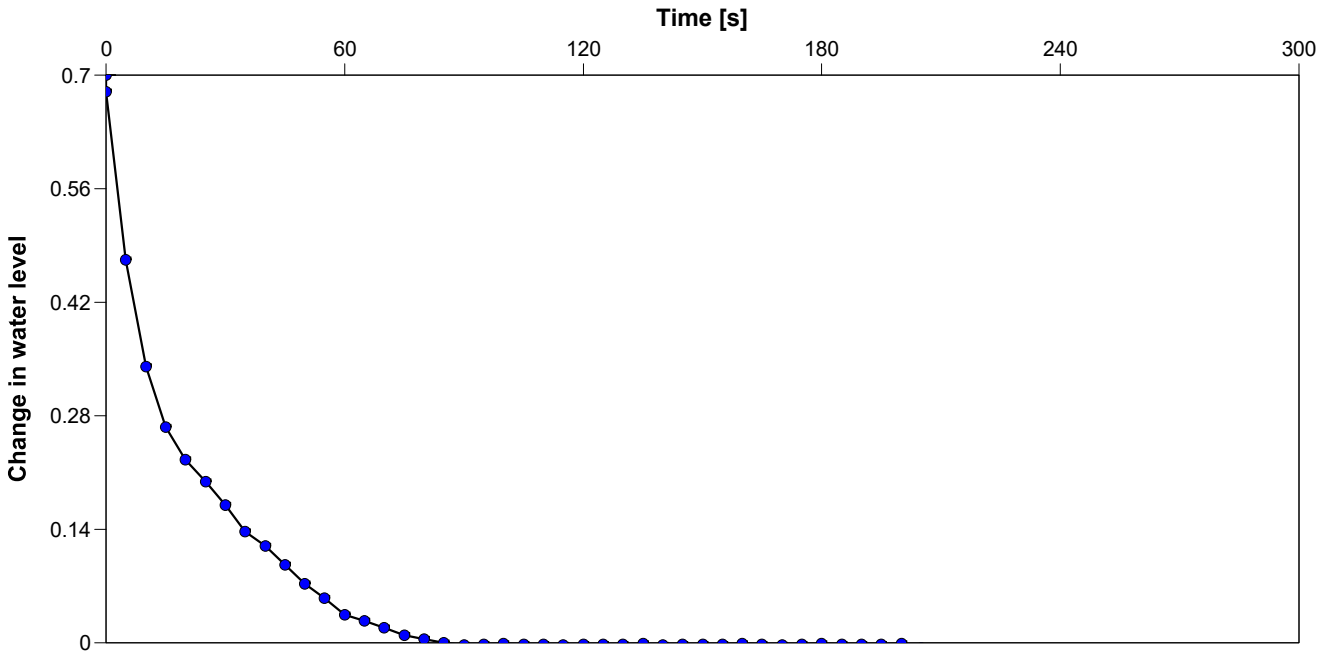
Slug Test Analysis Report

Project: Hwy 35 MTO Patrol Yard

Number: 36708

Client: Dillon Consulting Limited

Location: Kawartha Lakes	Slug Test: FS-01	Test Well: FS-01
Test Conducted by: KI		Test Date: 2023-06-08
Analysis Performed by: YC	Time-Drawdown Plot	Analysis Date: 2023-07-12
Aquifer Thickness:		



THURBER ENGINEERING LTD.

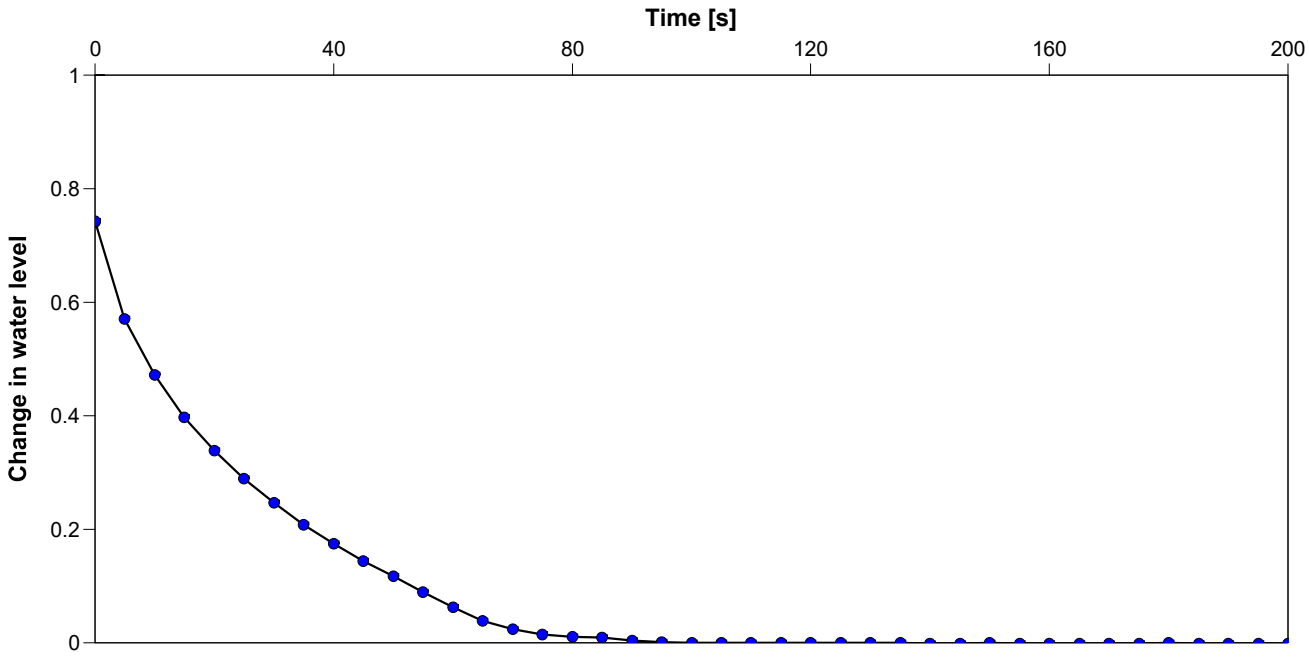
Slug Test Analysis Report

Project: Hwy 35 MTO Patrol Yard

Number: 36708

Client: Dillon Consulting Limited

Location: Kawartha Lakes	Slug Test: SWMP-02	Test Well: SWMP-02
Test Conducted by: KI		Test Date: 2023-06-08
Analysis Performed by:	Time-Drawdown Plot	Analysis Date: 2023-07-12
Aquifer Thickness:		



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	0.5 m Deep Test Pit, 1st test, H1=5 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	0.70	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.3000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	1.300
Q	0.763
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

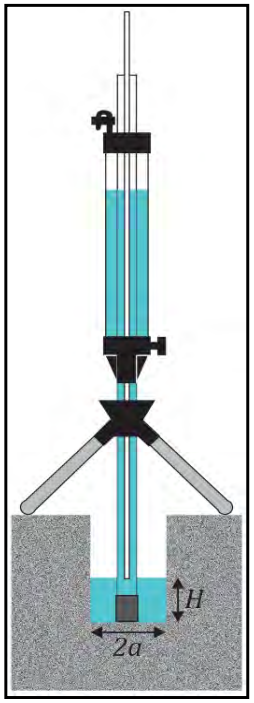
$C =$ **0.8031543**
$Q =$ **0.7631**

$K_{fs} =$ **1.4E-03** *cm/sec*
8.3E-02 *cm/min*
1.4E-05 *m/sec*
3.3E-02 *inch/min*
5.5E-04 *inch/sec*

$\Phi_m =$ **1.2E-02** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	0.5 m Deep Test Pit, 1st test, H2=10 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	0.70	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.7000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	1.700
Q	0.998
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

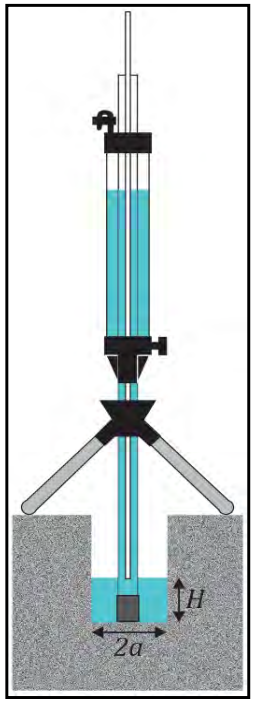
$C =$ **1.2875428**
$Q =$ **0.9979**

$K_{fs} =$ **1.1E-03** *cm/sec*
6.5E-02 *cm/min*
1.1E-05 *m/sec*
2.6E-02 *inch/min*
4.3E-04 *inch/sec*

$\Phi_m =$ **9.0E-03** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	0.5 m Deep Test Pit, 2nd test, H1=10 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	0.70	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	0.400
Q	0.235
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

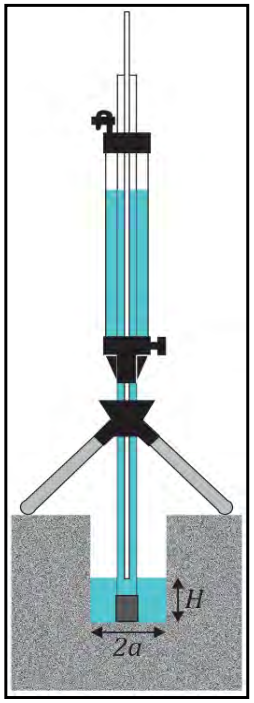
$C =$ **1.2875428**
$Q =$ **0.2348**

$K_{fs} =$ **2.5E-04** *cm/sec*
1.5E-02 *cm/min*
2.5E-06 *m/sec*
6.0E-03 *inch/min*
1.0E-04 *inch/sec*

$\Phi_m =$ **2.1E-03** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	0.5 m Deep Test Pit, 2nd test, H2=20 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	0.70	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 20
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.1000

Res Type	35.22
H	20
a	3
H/a	6.667
a*	0.12
C0.01	1.755
C0.04	1.903
C0.12	1.98
C0.36	1.98
C	1.98
R	1.100
Q	0.646
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

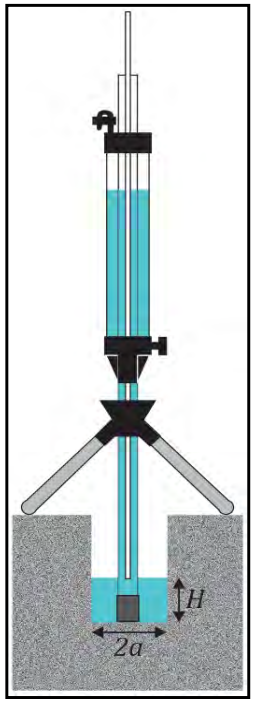
$C =$ 1.9801925
$Q =$ 0.6457

$K_{fs} =$ 3.5E-04 *cm/sec*
2.1E-02 *cm/min*
3.5E-06 *m/sec*
8.4E-03 *inch/min*
1.4E-04 *inch/sec*

$\Phi_m =$ 2.9E-03 (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	2 m Deep Test Pit, 1st test, H1=5 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	2.40	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 8.0000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	8.000
Q	4.696
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

$C =$ **0.8031543**

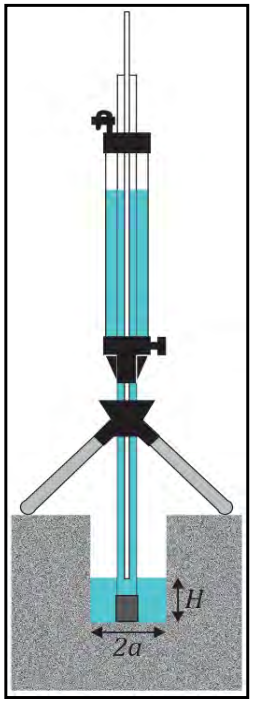
$Q =$ **4.696**

$K_{fs} =$ **8.5E-03** *cm/sec*
5.1E-01 *cm/min*
8.5E-05 *m/sec*
2.0E-01 *inch/min*
3.4E-03 *inch/sec*

$\Phi_m =$ **7.1E-02** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	2 m Deep Test Pit, 1st test, H2=10 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	2.40	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 18.0000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	18.000
Q	10.57
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

$C =$ **1.2875428**
$Q =$ **10.566**

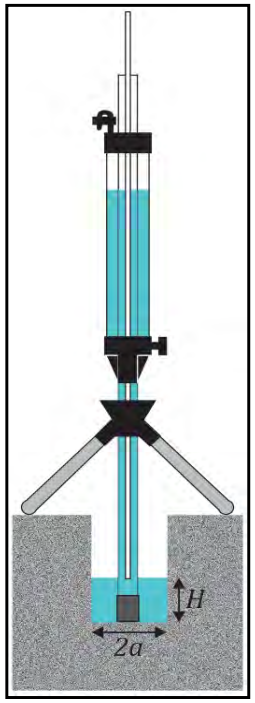
$K_{fs} =$

1.1E-02	*cm/sec*
6.9E-01	*cm/min*
1.1E-04	*m/sec*
2.7E-01	*inch/min*
4.5E-03	*inch/sec*

$\Phi_m =$ **9.5E-02** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	2 m Deep Test Pit, 2nd test, H1=5 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	2.40	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.5000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	1.500
Q	0.881
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

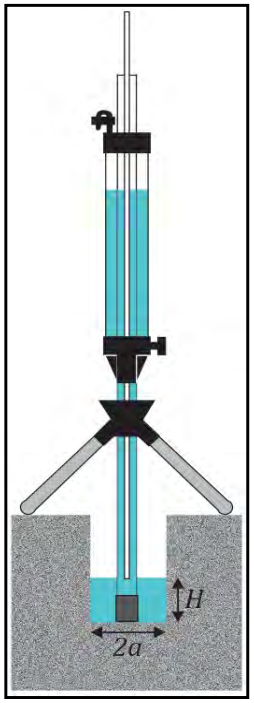
$C =$ **0.8031543**
$Q =$ **0.8805**

$K_{fs} =$ **1.6E-03** *cm/sec*
9.6E-02 *cm/min*
1.6E-05 *m/sec*
3.8E-02 *inch/min*
6.3E-04 *inch/sec*

$\Phi_m =$ **1.3E-02** (cm^2/min)

Input

Result



Saturated Hydraulic Copnductivity Calculations

Project:	Highway 35 MTO Patrol Yard	**Test Date:**	2020-06-07
Number:	36708	**Client:**	Dillon Consulting Ltd.
Performed by:	KI/ YC	**Checked by:**	DH
Test ID:	2 m Deep Test Pit, 2nd test, H2=10 cm.	**Soil Sample ID:**	-
Test Pit Easting (m):	-	**Test Pit Northing (m):**	-
Test Depth (mbgs):	2.40	**Test Elevation (masl):**	-
Soil Description:	-		

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 6.0000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	6.000
Q	3.522
pi	3.142

$\alpha^* =$ **0.12** (cm^{-1})

$C =$ **1.2875428**

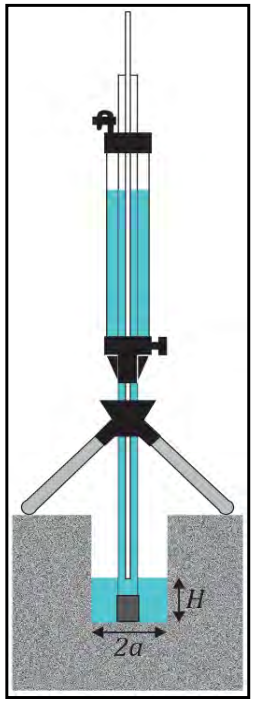
$Q =$ **3.522**

$K_{fs} =$ **3.8E-03** *cm/sec*
2.3E-01 *cm/min*
3.8E-05 *m/sec*
9.0E-02 *inch/min*
1.5E-03 *inch/sec*

$\Phi_m =$ **3.2E-02** (cm^2/min)

Input

Result



THURBER ENGINEERING LTD.

APPENDIX D

- Operational Constraint

<u>OPERATIONAL CONSTRAINT</u> – Construction of Footings and Slab-on-Grades

Special Provision

Upon completion of engineered fill placement, construction of footings and slab-on-grades shall not commence sooner than:

- Two (2) weeks if OPSS.PROV 1010 Granular ‘B’ Type I or II is used as engineered fill; or,
- Three (3) months if OPSS.PROV 1010 Select Subgrade Materials is used as engineered fill.