THURBER ENGINEERING LTD.

FOUNDATION INVESTIGATION REPORT
LYON CREEK CULVERT REPLACEMENT
HIGHWAY 602, DISTRICT OF RAINY RIVER, ONTARIO
AGREEMENT 6019-E-0009, WORK ORDER 35
G.W.P. 6030-22-00, SITE NO. 45X-0151/C0

LATITUDE: 48.6252°, LONGITUDE: -93.8239°

GEOCRES No.: 52C-65

Report

to

HATCH

Date: October 17, 2023
File: 33309

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1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the design of the proposed Lyon Creek Culvert Replacement. Lyon Creek Culvert is located on Highway 602, near Emo, in the District of Rainy River, Ontario. The site is approximately 1 km south of the Highway 11 and Highway 602 Junction.

The purpose of this investigation was to explore the subsurface conditions at the culvert location and, based on the data obtained, to provide a borehole location plan, stratigraphic profile, records of boreholes, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to Hatch, under the Ministry of Transportation Ontario (MTO) Retainer Agreement Number 6019-E-0009 Assignment #35, with additional work carried out under Agreement Number 6021-E-0005 Assignment #16. The original GWP number during preliminary design was 6120-17-00, which was updated during the detailed design phase to 6030-22-00.

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 site is located on Highway 602, between Jessie Street and Howse Road, near Emo, Ontario. The existing culvert allows the Lyon Creek to flow in a south-west direction under Highway 602 towards the Rainy River outlet. Highway 602 runs in a northwest to southeast direction at the site. For the purposes of this report and consistency with the General Arrangement drawings, Highway 602 is considered to run in an east-west direction, with the culvert inlet side (northeast end) considered to be north for construction.

The available General Arrangement (GA) drawings provided by Hatch indicate that the existing structure is a cast-in-place concrete, open footing culvert. The drawings indicate that the existing culvert opening has a span of 6.1 m, height of 2.4 m, and the length is 16.34 m. There are concrete wingwalls at each corner of the culvert. The estimated culvert invert is at approximate Elev. 325.7 m at the inlet (North) and 325.6 m at the outlet (South). The existing road grade at the culvert location is Elev. 331.6 m, which varies from approximately 331.3 m to the west and 332.5 m to the east of the culvert, where the roadway surface is located within a cut area and is lower than the surrounding topography to the north and south. The general topography in the area slopes down towards the Lyon Creek valley, which curves to the west beyond the culvert inlet. The existing highway embankment side slopes above and near the culvert are inclined at approximately 2H:1V. Previous structural assessments of the culvert have noted the presence of erosion of the embankment slopes above the culvert. The local creek water level was reportedly measured at Elev. 327.1 m in July 2018. Flooding of Lyon Creek was observed throughout Spring and early Summer 2022 (see Photo 6 in Appendix C).

The lands surrounding the site are forested areas immediately along the creek, with agricultural zones in the surrounding area. A railway corridor running roughly parallel to Highway 602 exists approximately 75 m south of the site. Photographs in Appendix C show the general nature of the site and the existing culvert.

Based on published geological information, the culvert lies within an area of glaciolacustrine deposits of silt and clay with minor sand ranging to silty clay to silt till. Based on the OGS Map MRD126-REV1 titled “Bedrock Geology of Ontario”, dated 2011, the bedrock at site is identified as metasedimentary rock with iron formations to the east of the site.

3. INVESTIGATION PROCEDURES

The site investigation and field-testing program for this project was carried out in three phases, from April 30 to May 2, 2022, from August 22 to 26, 2022, and from July 26 to 28, 2023. The investigation consisted of drilling and sampling seven (7) boreholes (22-06 to 22-10 and 23-01 to 23-02). Boreholes 22-06 and 22-07 were drilled off road near the culvert inlet and outlet respectively to depths of 5.6 and 12.6 m (Elev. 321.5 and 315.2 m) respectively. Boreholes 22-08 to 22-10 were drilled through the paved portion of Highway 602 each to a depth of 16.3 m (Elev. 316.0 to 314.9 m). Flooding at the inlet and outlet of the site delayed the completion of Boreholes 22-06 and 22-07, which were drilled after the flood waters receded in August 2022. In order to obtain deeper subsurface information for the preferred foundation design, Thurber returned in July 2023 to advance Boreholes 23-01 and 23-02, which were drilled through the paved portion of Highway 602 each to a depth of 25.5 m (Elev. 306.5 to 305.9 m).

The Record of Borehole sheets are included in Appendix A. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from field measurements relative to existing site features and the topographic drawings provided to Thurber by Hatch. The coordinate system MTM NAD 83, Zone 16 was used for the boreholes.

Boreholes 22-08 to 22-10 and 23-01 to 23-02 were advanced using rubber-tired CME 750 and D90 drill rigs, using solid stem augers and NW casing / Tricone with wash boring techniques. Borehole 22-06 was advanced using a tripod with continuous split spoon and wash boring techniques. A Dynamic Cone Penetration Test (DCPT) was conducted adjacent to Borehole 22-06. A half-weight hammer was used for driving the casing, split spoon samples and the DCPT at Borehole 22-06. The 'N' values presented on the record of borehole sheet for Borehole 22-06 have been adjusted to account for the half-weight hammer. Borehole 22-07 was advanced using a Simco track-mounted, limited access drill rig, using solid stem augers. Soil samples were obtained in all boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear testing, typically using an MTO "N" sized shear vane was carried out in the cohesive soils. Thin-walled tube samples (Shelby Tubes) were also collected at selected depths in the cohesive soil for consolidation testing. In Boreholes 23-01 and 23-02, only limited sampling and vane shear testing was conducted in the upper 15 m depth, since sufficient subsurface information was available for the upper 15 m in Boreholes 22-06 to 22-10.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

A monitoring well was installed in Borehole 22-07. The well consisted of 50 mm Schedule 40 PVC pipe with a 3.05 m long slotted screen, enclosed in a column of filter sand to permit groundwater level monitoring. Well installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets.

One sample of surface water was taken from Lyon creek, north of the culvert inlet, and one sample of groundwater was taken from the monitoring well installed in Borehole 22-07. Water samples were submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of water quality parameters. Upon collection of the water sampling on August 28, 2022, the well was decommissioned in general accordance with MECP O.Reg. 903.

Details of the drilling program, including drilling depths, monitoring well installation and completion details are summarized in Table 3.1 below.

Table 3.1: Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
22-06	5.6 / 321.5	N/A	Borehole caved from 5.6 to 1.4 m. Borehole backfilled to surface with bentonite.
22-07	12.6 / 315.2	12.0 / 315.8	Piezometer installed at 12 m with 3.05 m slotted screen length. Filter sand installed from 9.7 to 12.6, bentonite holeplug backfilled from 9.7 m to surface. Monitoring well removed August 28, 2022, borehole backfilled with bentonite to surface.
22-08	16.3 / 315.1	N/A	Borehole backfilled with bentonite holeplug from 16.3 m to 1.2 m, Concrete from 1.2 m to 0.2 m, and asphalt 0.2 m to surface.
22-09	16.3 / 314.9	N/A	Borehole backfilled with bentonite holeplug from 16.3 m to 1.2 m, Concrete from 1.2 m to 0.2 m, and asphalt 0.2 m to surface.
22-10	16.3 / 316.0	N/A	Borehole backfilled with bentonite holeplug from 16.3 m to 1.2 m, Concrete from 1.2 m to 0.2 m, and asphalt 0.2 m to surface.
23-01	25.5 / 306.5	N/A	Borehole backfilled with bentonite holeplug from 25.5 m to 0.1 m, and asphalt 0.1 m to surface.
23-02	25.5 / 305.9	N/A	Borehole backfilled with bentonite holeplug from 25.5 m to 0.1 m, and asphalt 0.1 m to surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification and natural moisture content determination. Approximately 25% of the collected samples were subjected to grain size distribution analyses (sieve and hydrometer). One-dimensional consolidation tests were also conducted on two samples of the native silty clay. The results of this testing program are summarized on the Record of Borehole sheets in Appendix A and are shown on the figures included in Appendix B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, two (2) soil samples and one sample of surface water from Lyon Creek were collected during the investigation and submitted to SGS, a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters. To assess the quality of the groundwater for disposal purposes, a groundwater sample from the well installed in Borehole 22-07 and a surface water sample from the creek were collected. The results of the analytical testing are summarized in this report and presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata drawings in Appendix D. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface stratigraphy below the asphalt typically consists of granular fill overlying silty clay fill, which is underlain by native silty clay with some sand and trace gravel. More detailed descriptions of individual strata are presented below.

5.1 Asphalt

Boreholes 22-08, 22-09, 22-10, 23-01 and 23-02 were drilled through the paved portion of Highway 602. The asphalt thickness ranged from 25 to 75 mm at the borehole locations.

5.2 Granular Fill

Granular embankment fill was encountered immediately below the pavement in Boreholes 22-08, 22-09, and 22-10. The fill was brown, and consisted of sand with some gravel, some silt and trace

clay. The granular fill was encountered from the bottom of asphalt at 0.8 m depth and extended to depths ranging from 0.7 m to 2.2 m (Elev. 330.5 to 330.0 m) across the road boreholes. The thickness of the granular fill ranged from 0.6 to 2.1 m. Granular fill was also encountered in Boreholes 23-01 and 23-02, which were advanced through the granular fill to the underlaying silty clay fill without sampling.

SPT 'N' values in the granular fill ranged from 17 to 51 blows per 0.3 m of penetration, indicating a compact to very dense relative density, typically compact. The measured moisture content for the granular fill was generally 3 to 6% within the first 0.7 m depth. At depths greater than 0.7 m, the moisture content ranged from 10 to 33%.

The results of grain size analyses conducted on three selected samples of the sand fill are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B1 of Appendix B. The results are summarized in Table 5.1 below.

Table 5.1: Granular Fill Grain Size Analysis

Soil Particle	Percentage (%)
Gravel	15 to 21
Sand	59 to 65
Silt and Clay	18 to 22

5.3 Silty Clay Fill

Silty clay fill was encountered below the granular fill in Boreholes 22-08, 22-09 and 22-10 at depths of 0.7 to 2.2 m (Elev. 330.5 to 330.0 m). Silty clay fill was also encountered in Boreholes 23-01 and 23-02. The silty clay fill extended to depths from 5.2 to 5.6 m (Elev. 326.8 to 325.6 m) in the boreholes. The silty clay fill contained some sand to sandy, trace gravel, trace rootlets and occasional wood fragments. The fill was brown to grey in colour. The thickness of the silty clay fill ranged from 3.4 to 4.9 m.

SPT 'N' values in the silty clay fill ranged from 3 to 26 blows per 0.3 m of penetration, indicating a firm to very stiff consistency. Measured moisture contents ranged from 21 to 37%.

The results of grain size analyses conducted on four selected samples of the silty clay fill are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B2 of Appendix B. The results are summarized in Table 5.2 below.

Table 5.2: Silty Clay Fill Grain Size Analysis

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	12 to 28
Silt	36 to 40
Clay	31 to 50

The results of Atterberg Limits Tests conducted on selected samples of the silty clay fill are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B6 of Appendix B. The results are summarized below in Table 5.3 below. The results indicate that the samples tested consist of intermediate to high plasticity silty clay, with group symbols of CI to CH.

Table 5.3: Silty Clay Fill Atterberg Limits Test Results

Parameter	Result
Liquid Limit	48 to 60
Plastic Limit	19 to 21
Plasticity Index	28 to 39

5.4 Topsoil

A 25 mm thick layer of topsoil was observed at the ground surface in Boreholes 22-06 and 22-07. The topsoil thickness may vary in other areas of the site.

5.5 Silty Clay

Native silty clay was encountered below the fill at depths from 5.2 to 5.6 m in Boreholes 22-08, 22-09, 22-10, 23-01 and 23-02 (Elev. 326.8 to 325.6 m) and below the 25 mm thick topsoil layer in Boreholes 22-06 and 22-07. All boreholes were terminated within the silty clay at depths ranging from 5.6 to 25.5 m (Elev. 321.5 to 305.9 m).

The silty clay was generally grey and contained some sand and trace gravel. Occasional organics and wood fragments were observed in the upper part of the silty clay in Boreholes 22-06 and 22-07, extending to depths of 1.2 to 2.1 m (Elev. 325.9 to 325.7 m). SPT ‘N’ values in the silty clay ranged from 4 to 61 (typically 4 to 9) blows per 0.3 m penetration, and field vane shear tests measured undrained shear strengths ranging from 57 to 220 kPa (typically 57 to 114 kPa). The SPT ‘N’ values and undrained shear strength values indicate that the clay has a firm to very stiff consistency (typically stiff to very stiff).

Borehole 22-07 contained a 0.5 m thick sand layer within the silty clay, extending from 2.1 m to 2.6 m depth (Elev. 325.7 to 325.2 m). One grain size analysis indicated the layer was composed of 12% gravel, 62% sand, 14% silt, and 12% clay sized particles. The results of the grain size analysis on the sand layer on the Record of Borehole sheets in Appendix A and plotted in Figure B5 of Appendix B. A moisture content of 25% was measured for the sand.

Recorded moisture contents in the silty clay ranged from 25 to 45%. The results of grain size analyses conducted on selected samples of the silty clay deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B3 and B4 of Appendix B. The results are summarized in Table 5.4.

Table 5.4: Silty Clay Grain Size Analysis

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	13 to 35
Silt	30 to 36
Clay	33 to 56

The results of Atterberg Limits tests conducted on the silty clay are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B7 and B8 of Appendix B. The results are summarized below in Table 5.5 below. The results indicate that the samples tested consist of intermediate to high plasticity silty clay, with group symbols of CI to CH.

Table 5.5: Silty Clay Atterberg Limits Test Results

Parameter	Result
Liquid Limit	40 to 68
Plastic Limit	19 to 31
Plasticity Index	18 to 40

One-dimensional consolidation tests were performed on two samples of the silty clay (thin-walled tube samples), which were collected from Boreholes 22-07 and 22-08. The results of the testing are presented in Appendix B and are summarized in the following table.

Borehole	Sample Depth (m)	e_o	C_c	C_r	p_c' (kPa)	p_o' (kPa)	OCR	c_v (m^2/year)	c_{vr} (m^2/year)
22-07	3.8 to 4.4	0.852	0.302	0.032	285	77	3.7	0.6 – 1.0	1.1 – 4.1
22-08	7.6 to 8.2	0.841	0.284	0.049	245	153	1.6	0.3 – 0.5	0.6 – 5.3

5.6 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling, and in the monitoring well installed in Borehole 22-07. The measured groundwater levels taken are summarized in Table 5.6 below. The monitoring well was decommissioned on August 28, 2022 following water sampling and slug testing.

Table 5.6: Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
22-06	August 26, 2022	---	---	Open borehole dry after caving to 1.4 m.
22-07	August 24, 2022 August 25, 2022 (8:00 AM) August 25, 2022 (12:46 PM)	7.3 5.0 4.8	320.5 322.8 323.0	In monitoring well.
22-08	May 2, 2022	5.2	326.2	Open borehole.
22-09	May 1, 2022	5.6	325.6	Open borehole.
22-10	April 30, 2022	5.6	326.7	Open borehole.

Due to the short duration of the field investigation, it is anticipated that sufficient time was not available for infiltration of groundwater into the open boreholes and monitoring well, given the presence of relatively low permeability silty clay subsurface soils. Therefore, the water level measurements recorded may not represent the stabilized groundwater level.

The groundwater level is likely to reflect the local creek water level. The surface water level of Lyon Creek was reportedly measured at Elev. 327.1 m in July 2018.

It should also be noted that groundwater levels are short term observations and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Samples of silty clay fill and native silty clay from Boreholes 22-07 and 22-08 and a sample of surface water taken from Lyon Creek were submitted for analytical testing of corrosivity

parameters and sulphate. The laboratory certificates of analysis for the current investigation are presented in Appendix B. The results of the analytical tests are summarized below in Table 6.1.

Table 6.1: Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results		
			22-07 SS3B (8'6"-9'6")	22-08 SS3 (5'-7')	Lyon Creek SW
			Silty Clay	Silty Clay Fill	Surface Water
Redox Potential	mV	mV	230	263	207
Sulphide	%	N/A	0.17	< 0.04	---
pH	-	-	8.25	8.85	7.77
Chloride	µg/g	mg/L	48	230	3.1
Sulphate	µg/g	mg/L	430	42	3.5
Conductivity	uS/cm	µS/cm	561	317	100
Resistivity	ohm-cm	ohm-cm	1780	3150	10,000*

** Calculated by Thurber based on conductivity result*

7. WATER QUALITY

For assessment of the general groundwater quality in the project area, a sample of the groundwater from the monitoring well at Borehole 22-07, and a surface water sample from the creek were collected on August 28, 2022. The water samples were analyzed for selected inorganic parameters included in the Ontario Provincial Water Quality Objectives (PWQO), as well as Total Suspended Solids. Filtered sub-samples were also tested for dissolved metal parameters for comparison purposes. The analytical test results are presented in Appendix B.

The analytical results of the water testing were compared to limits for the PWQO for surface water discharge. The concentrations of all parameters tested that did not meet the criteria established in the PWQO are listed below in Table 7.1. All parameters shown in Table 7.1 are from the unfiltered sample, representing total concentrations. No dissolved parameter concentrations (filtered sub-samples) exceeded the PWQO criteria. The Total Suspended Solids concentration for surface water was 12 mg/L and was 1,850 mg/L for the unfiltered water taken from the monitoring well at 22-07 (no assigned PWQO criteria).

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Table 7.1 – Water Parameters Exceeding PWQO Criteria

Sample ID	Parameter	Criteria	Parameter Limit (mg/L)	Result (mg/L)
22-07 (Groundwater)	Total Arsenic	Interim PWQO PWQO	0.005 0.100	0.0084
	Total Cobalt	Interim PWQO	0.0009	0.0141
	Total Cadmium	Interim PWQO PWQO	0.0005[1] 0.0001	0.000593
	Total Copper	Interim PWQO PWQO	0.005[2]	0.0234
	Total Iron	PWQO	0.3	17.2
	Total Nickel	PWQO	0.025	0.0308
	Total Phosphorus	Interim PWQO	0.01[3]	0.599
	Total Silver	PWQO	0.0001	0.00015
	Total Uranium	Interim PWQO	0.005	0.00864
	Total Vanadium	Interim PWQO	0.006	0.0448
	Total Zinc	Interim PWQO PWQO	0.02 0.03	0.075
Lyon Creek (Surface Water)	Total Iron	PWQO	0.3	0.465
	Total Phosphorous	Interim PWQO	0.01[3]	0.108

[1] Cadmium interim PWQO follows a scale based on measured hardness as $CaCO_3$. The interim PWQO of 0.0001 mg/L is set for water with less than 100 mg/L hardness as $CaCO_3$, the interim PWQO OF 0.0005 mg/L is set for water with greater than 100 mg/L hardness as $CaCO_3$. All water samples taken have measured hardness as $CaCO_3$ greater than 100 mg/L. See Appendix B for testing results.

[2] Total Phosphorous Interim PWQO follows site specific guidelines. The interim PWQO of 0.01 mg/L is set as a high level of protection against aesthetic deterioration, the interim PWQO of 0.02 mg/L to avoid nuisance concentrations of algae in lakes, and the interim PWQO of 0.03 mg/L to avoid excessive plant growth in rivers and streams

[3] Copper interim PWQO follows a scale based on measured hardness as $CaCO_3$. The interim PWQO of 0.0001 mg/L is set for water with less than 20 mg/L hardness as $CaCO_3$, the interim PWQO OF 0.0005 mg/L is set for water with greater than 20 mg/L hardness as $CaCO_3$. All water samples taken have measured hardness as $CaCO_3$ greater than 20 mg/L. See Appendix B for testing results.

8. SINGLE WELL RESPONSE TEST RESULTS

8.1 Test Procedure

A Single Well Response Test (SWRT), or “slug” test, was carried out in the 50-mm diameter well installed in Borehole 22-07. The well was screened across silty clay. The test was completed using the following method:

- In advance of conducting the slug test, the monitoring well was developed and purged to remove excess sediment that may have entered the well during installation, to increase the representativeness of the natural groundwater in the well and to improve the transmissivity of the sand pack and well screen.

- A datalogger was inserted into the well following development to monitor the recovery of the water level in the well. The datalogger was set to record water levels every 15 seconds, based on the anticipated rate of recovery of the well.

- Manual and electronic measurements were recorded until the water level in the well recovered sufficiently.

- Manual measurements were compared to electronic measurements for quality control of the data.

8.2 Hydraulic Conductivity

The slug test analyzed using the Hvorslev method. The plot of the slug test result is included in Appendix B. The hydraulic conductivity value calculated from the in-situ slug test is summarized in Table 8.1 below.

Table 8.1: Single Well Response Test Results

Monitoring Well	Hydraulic Conductivity (m/s)	Screened Formation
22-07	9.0×10^{-9}	Silty Clay

9. MISCELLANEOUS

Thurber obtained utility clearances for the borehole locations prior to drilling. Borehole locations were selected and established in the field by Thurber Engineering Ltd.

RPM Drilling of Thunder Bay, Ontario supplied rubber-tired CME 750 and D-90 drill rigs, a Simco Limited Access drill rig, and tripod portable drilling equipment. RPM Drilling conducted the drilling, sampling and in-situ testing operations for the boreholes. Traffic control services were provided by ML Judson Trucking Ltd. of Emo, Ontario.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical testing was carried out by SGS.

The field investigation was supervised on a full-time basis by Mr. Gregory Stanhope and Mr. Matthew MacAskill of Thurber. The overall supervision of the field program was conducted by Ms. Rachel Bourassa, E.I.T., Ms. Alysha Kobylinski, P.Eng., and Mr. Mark Farrant, P.Eng. of Thurber.

Interpretation of the field data and preparation of this report was carried out by Ms. Rachel Bourassa, E.I.T. and Mr. Mark Farrant, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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5. INTERPRETATION OF THE REPORT

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.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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Appendix A

Record of Borehole Sheets

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			

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RECORD OF BOREHOLE No 22-06 1 OF 1 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 746.3 E 244 108.8 ORIGINATED BY GS

DIST Rainy River HWY 602 BOREHOLE TYPE Tripod/Continuous Split Spoon/Wash Boring COMPILED BY MC

DATUM Geodetic DATE 2022.08.25 - 2022.08.26 LATITUDE 48.625292 LONGITUDE -93.823363 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.1	GROUND SURFACE										
0.0	**TOPSOIL:** (25mm)		1	SS	4		327				
	Silty **CLAY**, trace sand, trace organics Firm to Stiff Black to Brown Wet		2	SS	9						
325.9							326				
1.2	Silty **CLAY**, some sand, trace gravel Very Stiff Grey Wet (CI-CH)		3	SS	17						
							325	>> 2.1			
			4	SS	37						0 19 36 45
							324	>> 2.2			
							323				
			5	SS	61						1 17 35 47
321.5							322				
5.6	END OF BOREHOLE AT 5.6m. BOREHOLE CAVED TO 1.4m AND DRY AT 1.4m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.							>>			

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

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

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RECORD OF BOREHOLE No 22-07 1 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 733.4 E 244 079.6 ORIGINATED BY GS

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC

DATUM Geodetic DATE 2022.08.22 - 2022.08.23 LATITUDE 48.625173 LONGITUDE -93.823757 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.8	GROUND SURFACE										
0.0	**TOPSOIL:** (25mm)		1	SS	5						
	Silty **CLAY**, sandy, occasional organics, occasional wood fragments Firm to Stiff Brown to Grey Moist (CL-CI)		2	SS	8		327				0 35 32 33
325.7							326	5.5			
2.1	**SAND**, some gravel, some silt, some clay Loose Grey Wet		3	SS	8		325				12 62 14 12
325.2								3.3			
2.6	Silty **CLAY**, some sand, trace gravel Stiff to Very Stiff Grey Moist (CI)		1	TW		▼	324				1 16 35 48
							323	4.8			
			4	SS	7		322				
			5	SS	9		321				
							320				
			2	TW			319				
							318				

Continued Next Page

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

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

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RECORD OF BOREHOLE No 22-07 2 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 733.4 E 244 079.6 ORIGINATED BY GS

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC

DATUM Geodetic DATE 2022.08.22 - 2022.08.23 LATITUDE 48.625173 LONGITUDE -93.823757 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **CLAY**, some sand, trace gravel Very Stiff Grey Moist (Cl)		6	SS	8		317	+	○		1 20 34 45
			7	SS	14		316		○		
315.2											
12.6	END OF BOREHOLE AT 12.6m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2022.08.24	7.3	320.5
2022.08.25	5.0	322.8
2022.08.25	4.8	323.0

Water level at 4.8m taken on August 25, 2022, was unstabilized.

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

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

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RECORD OF BOREHOLE No 22-08 1 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 739.6 E 244 088.0 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.02.05 - 2022.02.05 LATITUDE 48.625230 LONGITUDE -93.823644 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.4	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, some gravel, some silt, trace clay Compact Brown Dry to Moist (FILL)		1	SS	23		331				
			2	SS	17						15 63 22 (SI+CL)
330.0							330				
1.4	Silty **CLAY**, some sand, trace gravel Very Stiff to Stiff Brown to Grey Moist to Wet (FILL-CH)		3	SS	26						
			4	SS	12		329				1 12 37 50
328.4											
3.0	Silty **CLAY**, some sand to sandy, trace gravel, occasional wood fragments Firm Grey Wet (FILL)		5	SS	7		328				
			6	SS	4	▽	327				
325.8							326				
5.6	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)		7	SS	4		325	2.0			0 17 36 47
			1	ST			324				1 16 34 49
							323	1.6			
			8	SS	5		322				

Continued Next Page

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

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

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RECORD OF BOREHOLE No 22-08 2 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 739.6 E 244 088.0 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.02.05 - 2022.02.05 LATITUDE 48.625230 LONGITUDE -93.823644 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)						321	1.4			
			9	SS	6				○		
							320	1.5			
			10	SS	5		319		○		
								1.6			
							318				
			2	ST							
							317	1.5			
			11	SS	6		316		○		
315.1								1.6			
16.3	END OF BOREHOLE AT 16.3m. BOREHOLE OPEN TO 16.3m AND WATER LEVEL AT 5.2m IN OPEN HOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, AND ASPHALT TO SURFACE.										

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

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

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RECORD OF BOREHOLE No 22-09 1 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 747.3 E 244 081.4 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.01.05 - 2022.01.05 LATITUDE 48.625299 LONGITUDE -93.823735 CHECKED BY RB

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
331.2	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, some gravel, some silt, trace clay Very Dense Brown Dry to Moist (FILL)		1	SS	51		331		○		17 65 18 (SI+CL)
330.5											
0.7	Silty **CLAY**, some sand, trace gravel Stiff Grey Moist (FILL)		2	SS	11		330		○		
			3	SS	14		329		○		
328.2			4	SS	9				○		
3.0	Silty **CLAY**, sandy, trace gravel, occasional wood fragments Firm to Stiff Grey Wet (FILL-CI)		5	SS	4		328		○		1 28 40 31
			6	SS	3	▽	327		○		
325.6							326				
5.6	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)		7	SS	5		325		○		
							324	+ 2.5			
			8	SS	5		323		○		
								+ 1.3			
			9	SS	6		322		○		

Continued Next Page

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

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

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RECORD OF BOREHOLE No 22-09 2 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 747.3 E 244 081.4 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.01.05 - 2022.01.05 LATITUDE 48.625299 LONGITUDE -93.823735 CHECKED BY RB

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
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)						321	1.6			
			1	ST			320				
								1.5			
			10	SS	6		319		○		
							318	1.7			
			11	SS	7		317		○ —		0 15 34 51
								1.6			
			12	SS	6		316		○		
314.9							315	1.7			
16.3	END OF BOREHOLE AT 16.3m. BOREHOLE OPEN TO 16.3m AND WATER LEVEL AT 5.6m IN OPEN HOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, AND ASPHALT TO SURFACE.										

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

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

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RECORD OF BOREHOLE No 22-10 1 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 730.6 E 244 103.6 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.04.30 - 2022.01.05 LATITUDE 48.625151 LONGITUDE -93.823430 CHECKED BY RB

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
332.3	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, some gravel, some silt, trace clay Compact Brown to Grey Moist (FILL)		1	SS	25		332		○		
			2	SS	22		331		○		
			3	SS	25				○		21 59 20 (SI+CL)
330.1							330		○		
2.2	Silty **CLAY**, some sand, trace gravel Firm to Stiff Grey Wet (FILL-CH)		4	SS	5				○		
			1	ST			329				
			5	SS	7		328		○		0 17 36 47
326.7						▽	327	1.7 +			
5.6	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)		6	SS	6		326		○		
							325	1.3 +			
			7	SS	7				○		
							324	1.5 +			
			8	SS	7		323		○		0 16 37 47

Continued Next Page

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

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

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RECORD OF BOREHOLE No 22-10 2 OF 2 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert; MTM NAD 83-16: N 5 387 730.6 E 244 103.6 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA

DATUM Geodetic DATE 2022.04.30 - 2022.01.05 LATITUDE 48.625151 LONGITUDE -93.823430 CHECKED BY RB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel Stiff Grey Wet (CH)						322	1.4			
			9	SS	7		321		○		
			10	SS	5		320		○		
							319	1.5			
			11	SS	5		318		○		
								1.1			
			12	SS	6		317		○		
316.0											
316.3	END OF BOREHOLE AT 16.3m. BOREHOLE OPEN TO 16.3m AND WATER LEVEL AT 5.6m IN OPEN HOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, AND ASPHALT TO SURFACE.						316	1.3			

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

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

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RECORD OF BOREHOLE No 23-01 1 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 734.6 E 244 099.9 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.26 - 2023.07.27 LATITUDE 48.625186 LONGITUDE -93.823482 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
332.0	GROUND SURFACE						
0.0 / 0.0	**ASPHALT:**(25mm)						
	No sampling through fill above 4.6m						
327.4							
4.6	Silty **CLAY**, some sand		1	SS	9		
	Stiff						
	Grey						
326.8	Moist						
5.2	(FILL)						
	Silty **CLAY**, some sand						
	Stiff to Very Stiff						
	Grey						
	Wet						
			2	SS	7		

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

Elevation scale: 331 330 329 328 327 326 325 324 323 322

Continued Next Page

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 23-01 2 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 734.6 E 244 099.9 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.26 - 2023.07.27 LATITUDE 48.625186 LONGITUDE -93.823482 CHECKED BY MEF

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	Silty **CLAY**, some sand Stiff to Very Stiff Grey Wet (CH)						321 320 319 318 317 316 315 314 313 312			
			3	SS	5					
			4	SS	4					
			5	SS	5					
			6	SS	5					0 16 32 52

1.8 1.9 1.6

Continued Next Page

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 23-01 3 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 734.6 E 244 099.9 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.26 - 2023.07.27 LATITUDE 48.625186 LONGITUDE -93.823482 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, some sand Stiff to Very Stiff Grey Wet (CH)		7	SS	5						
			8	SS	6		311	1.7			
			9	SS	7		310	1.6			
			10	SS	7		309				
306.5							308	1.6			
25.5	END OF BOREHOLE AT 25.5m. BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, ASPHALT PATCH TO SURFACE.						307	1.6			

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

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

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THURBER

RECORD OF BOREHOLE No 23-02 1 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 741.5 E 244 085.7 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.27 - 2023.07.28 LATITUDE 48.625247 LONGITUDE -93.823675 CHECKED BY MEF

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
331.3	GROUND SURFACE									
0.0	**ASPHALT:** (25mm)						331			
0.0	No sampling through fill above 4.6m									
							330			
							329			
							328			
326.7							327			
4.6	Silty **CLAY**, some sand, trace rootlets Firm Brown Wet (FILL)		1	SS	7				o	
325.7							326			
5.6	Silty **CLAY**, some sand, trace gravel Stiff to Very Stiff Grey Wet						325			
							324			
							323			
			2	SS	7		322		o	

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 23-02 2 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 741.5 E 244 085.7 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.27 - 2023.07.28 LATITUDE 48.625247 LONGITUDE -93.823675 CHECKED BY MEF

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 **CLAY**, some sand, trace gravel Stiff to Very Stiff Grey Wet						321 320 319 318 317 316 315 314 313 312				
			3	SS	5						
			4	SS	5						
			5	SS	8						

1.8 (315)
1.7 (314)
1.8 (312)

Continued Next Page

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

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

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THURBER

RECORD OF BOREHOLE No 23-02 3 OF 3 METRIC

GWP# 6120-17-00 LOCATION Lyon Creek Culvert N 5 387 741.5 E 244 085.7 ORIGINATED BY MM

DIST Rainy River HWY 602 BOREHOLE TYPE Solid Stem Auger/ HW Wash Boring COMPILED BY JW

DATUM Geodetic DATE 2023.07.27 - 2023.07.28 LATITUDE 48.625247 LONGITUDE -93.823675 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **CLAY**, some sand, trace gravel Stiff to Very Stiff Grey Wet (CH)		6	SS	7		311	1.9			
			7	SS	5		310				
							309	2.1			
			8	SS	7		308	2.0			1 13 30 56
			9	SS	8		307				
305.9							306	1.9			
25.5	END OF BOREHOLE AT 25.5m. BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, ASPHALT PATCH TO SURFACE.										

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

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

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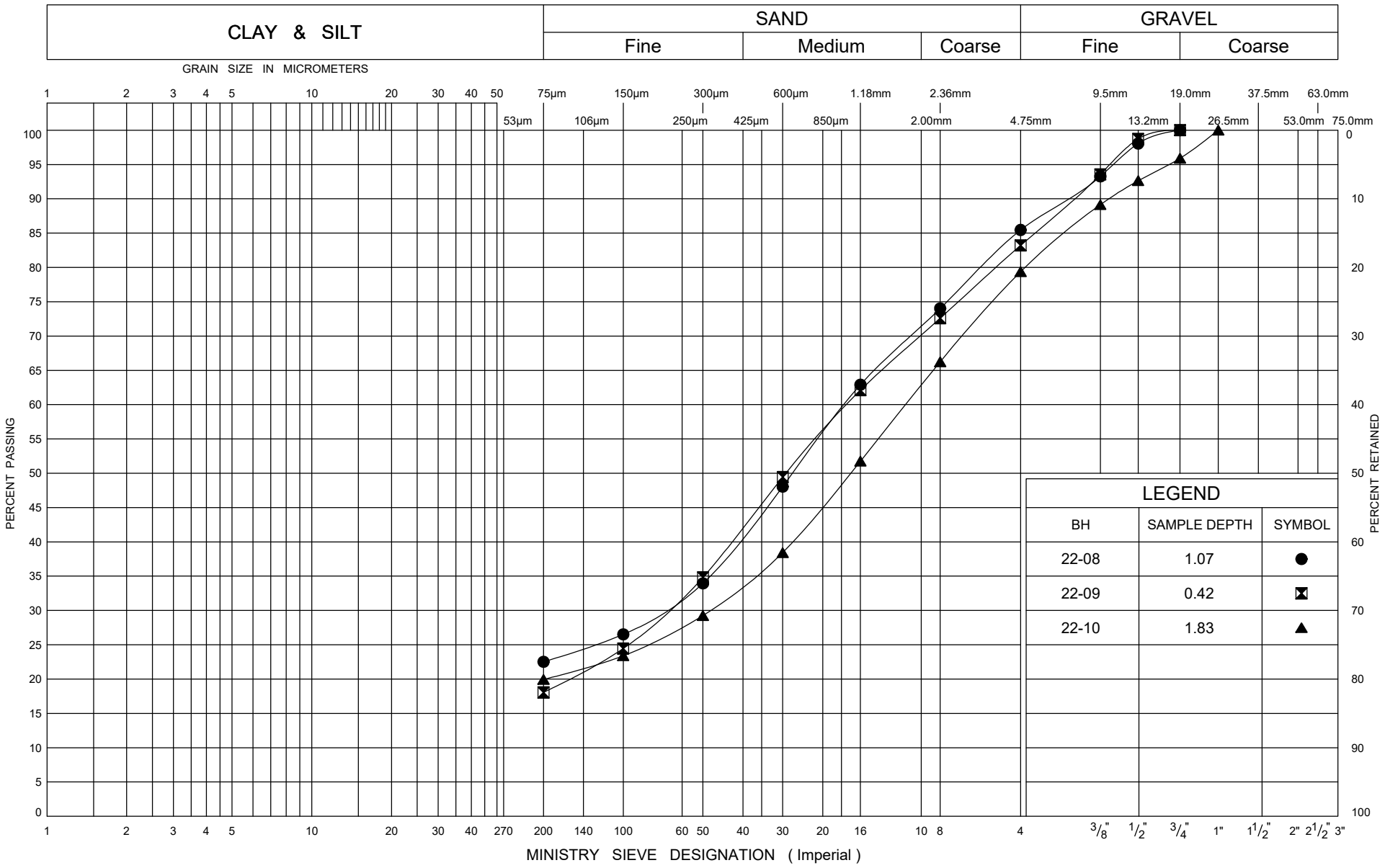
Appendix B

Laboratory and Well Test Results



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GRAIN SIZE DISTRIBUTION

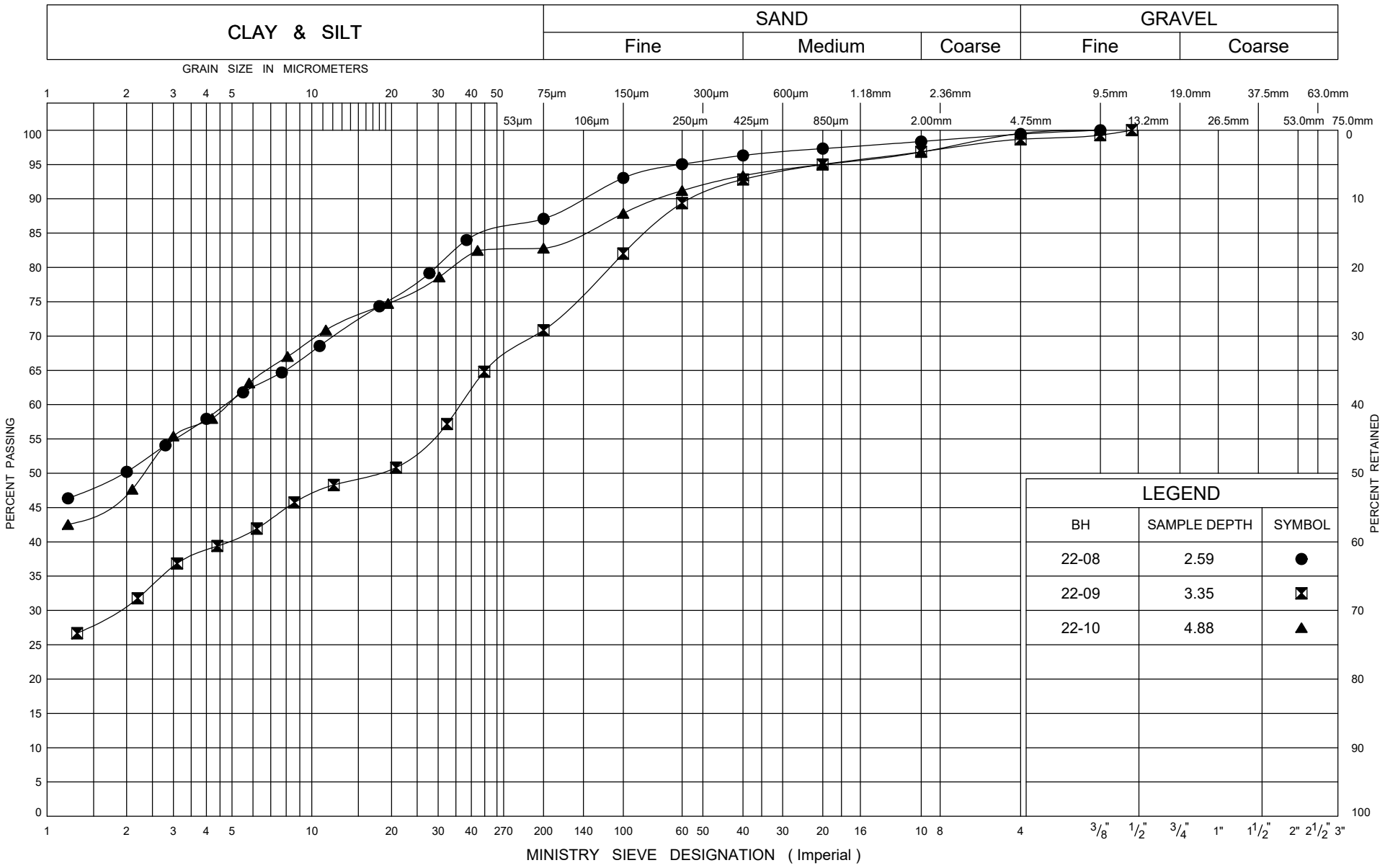
SAND FILL

FIG No B1

GWP# 6120-17-00

Lyon Creek Culvert

ONTARIO MOT GRAIN SIZE 3 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22



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GRAIN SIZE DISTRIBUTION

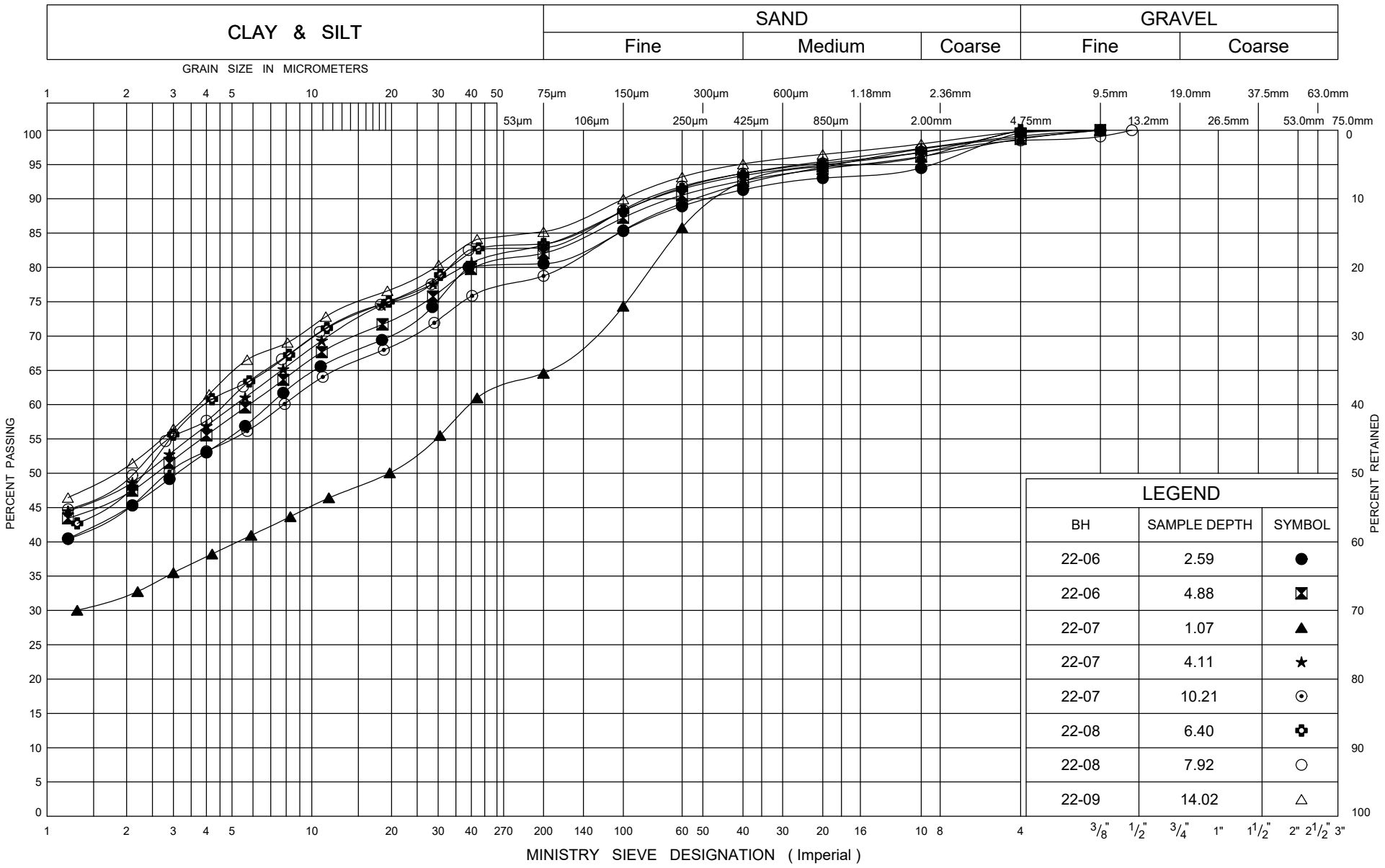
Silty CLAY FILL

FIG No B2

GWP# 6120-17-00

Lyon Creek Culvert

ONTARIO MOT GRAIN SIZE 3 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22



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GRAIN SIZE DISTRIBUTION

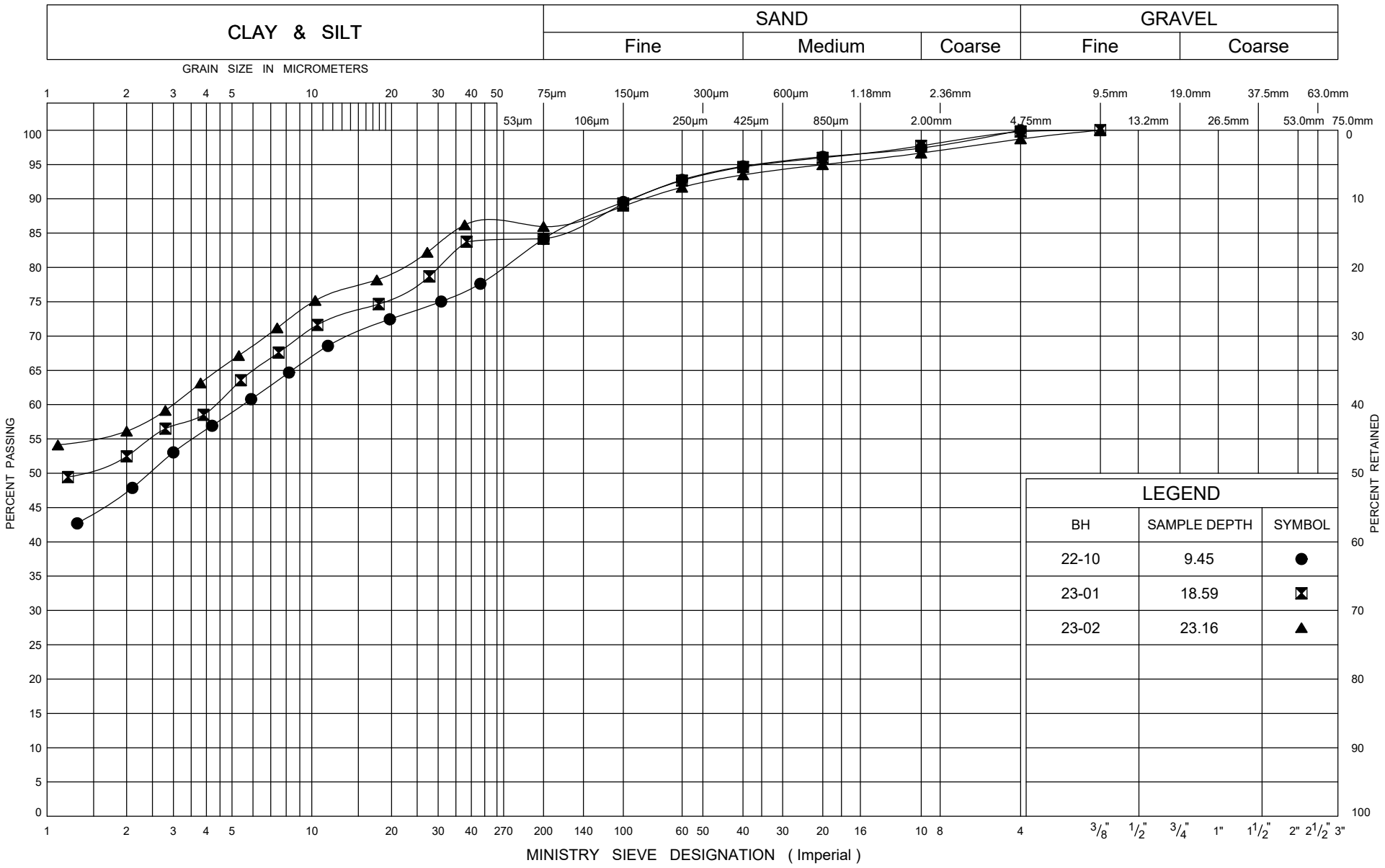
Silty CLAY

FIG No B3

GWP# 6120-17-00

Lyon Creek Culvert

ONTARIO MOT GRAIN SIZE 3 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22



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GRAIN SIZE DISTRIBUTION

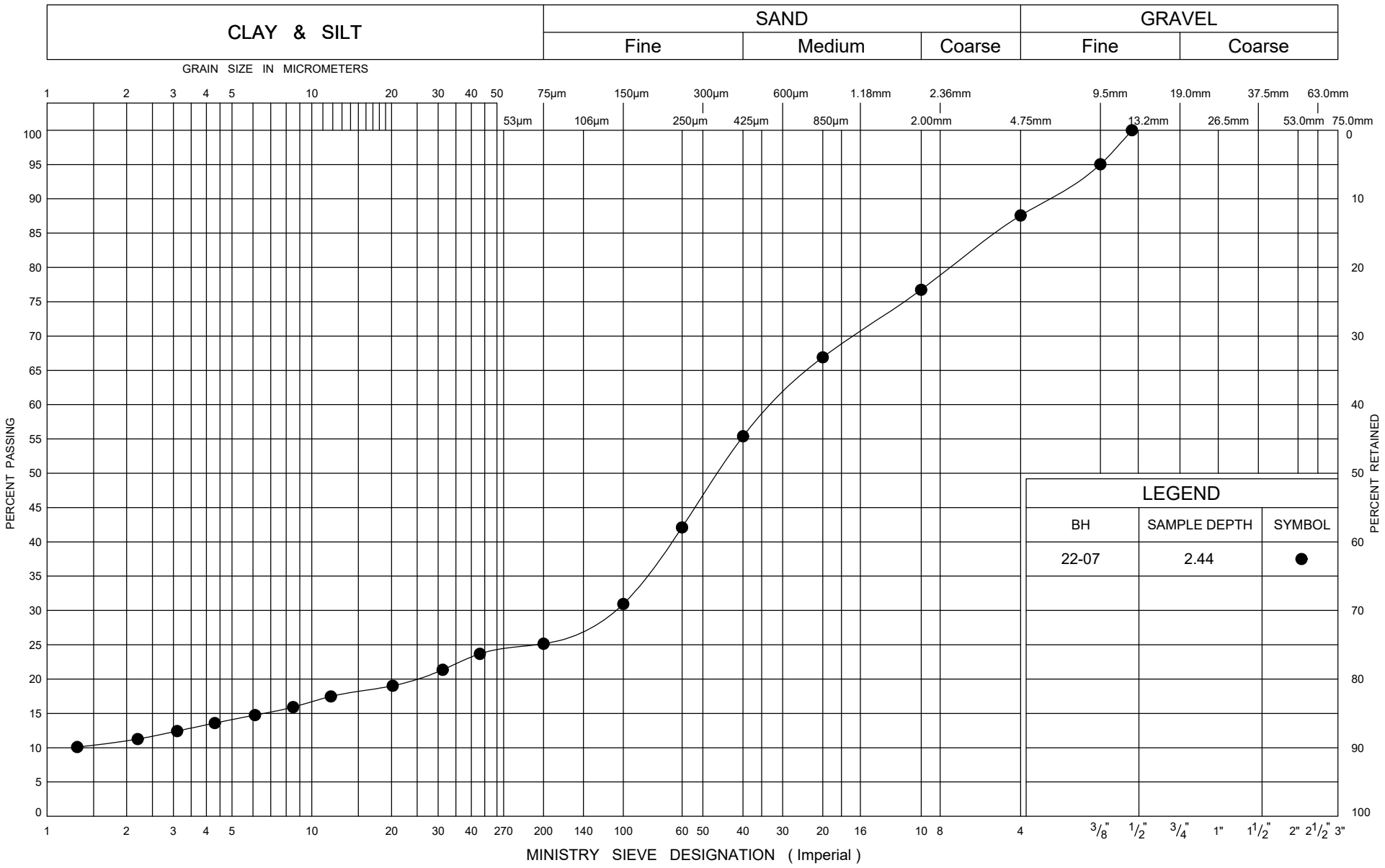
Silty CLAY

FIG No B4

GWP# 6120-17-00

Lyon Creek Culvert

ONTARIO MOT GRAIN SIZE 3 MTO-33309.GPJ ONTARIO MOT.GDT 8/31/23



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GRAIN SIZE DISTRIBUTION

SAND

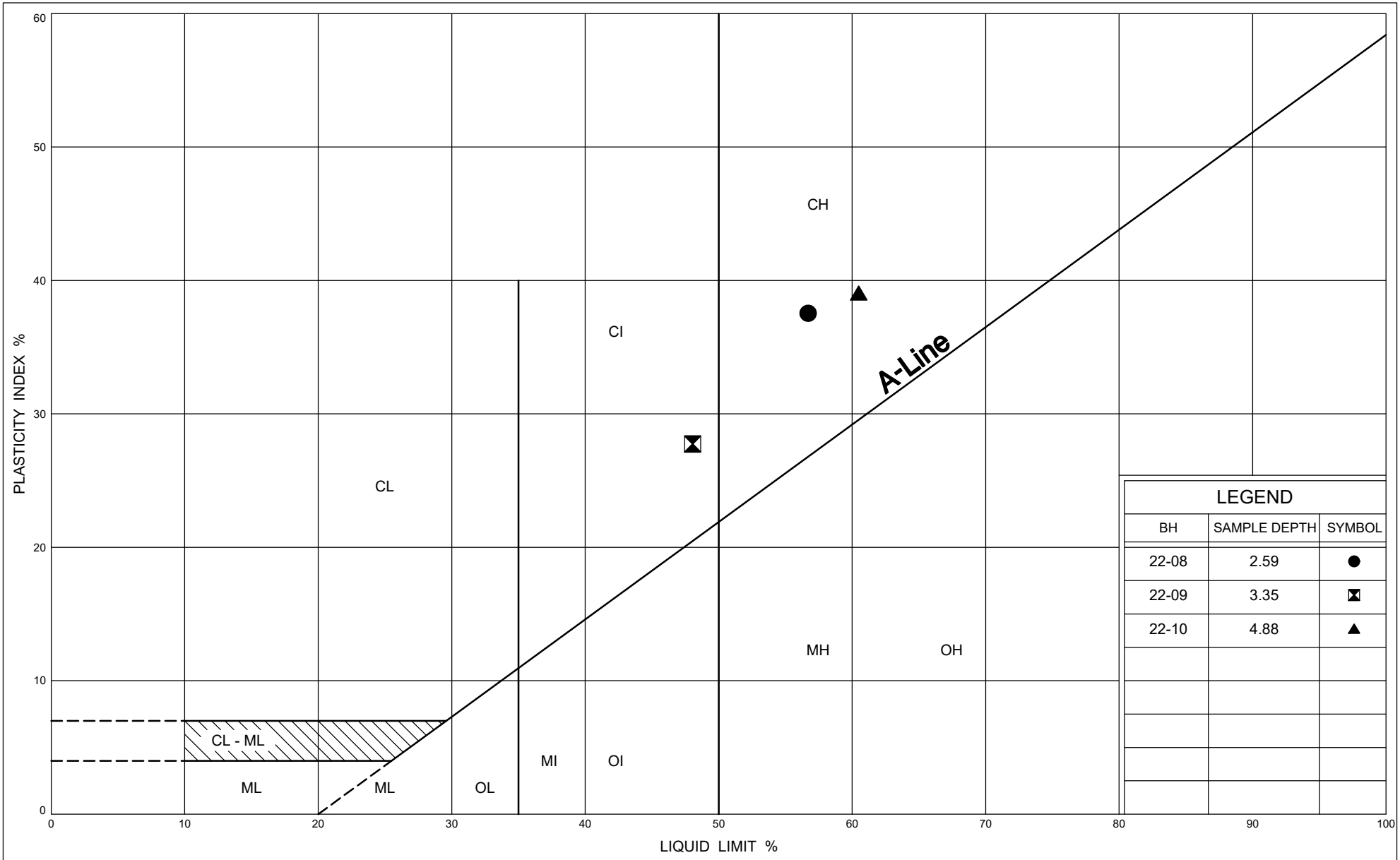
FIG No B5

GWP# 6120-17-00

Lyon Creek Culvert

ONTARIO MOT GRAIN SIZE 3 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22

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Ontario

PLASTICITY CHART

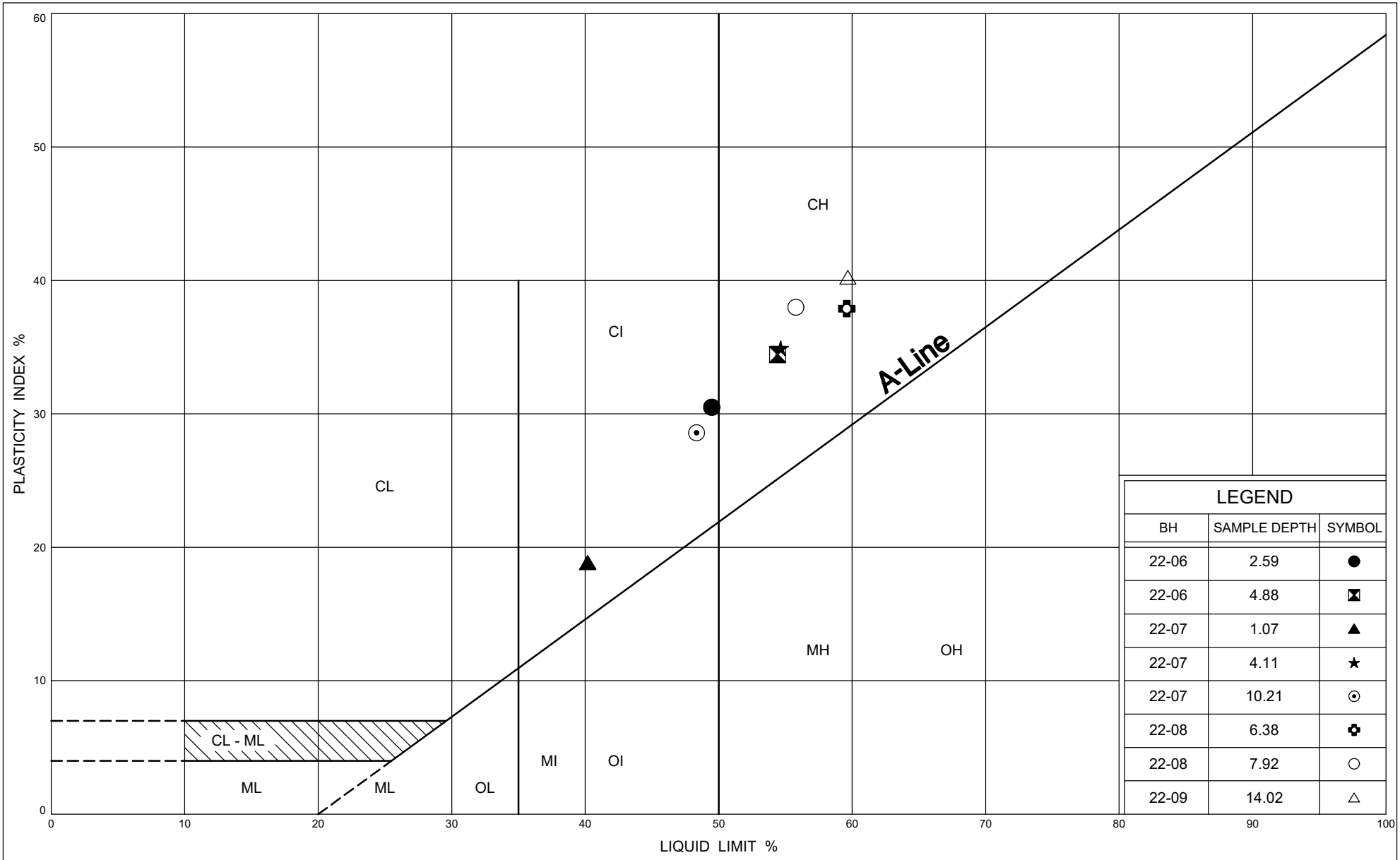
Silty CLAY FILL

FIG No B6

GWP# 6120-17-00

Lyon Creek Culvert

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-33309.GPJ ONTARIO MOT.GDT 11/16/22

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Ontario

PLASTICITY CHART

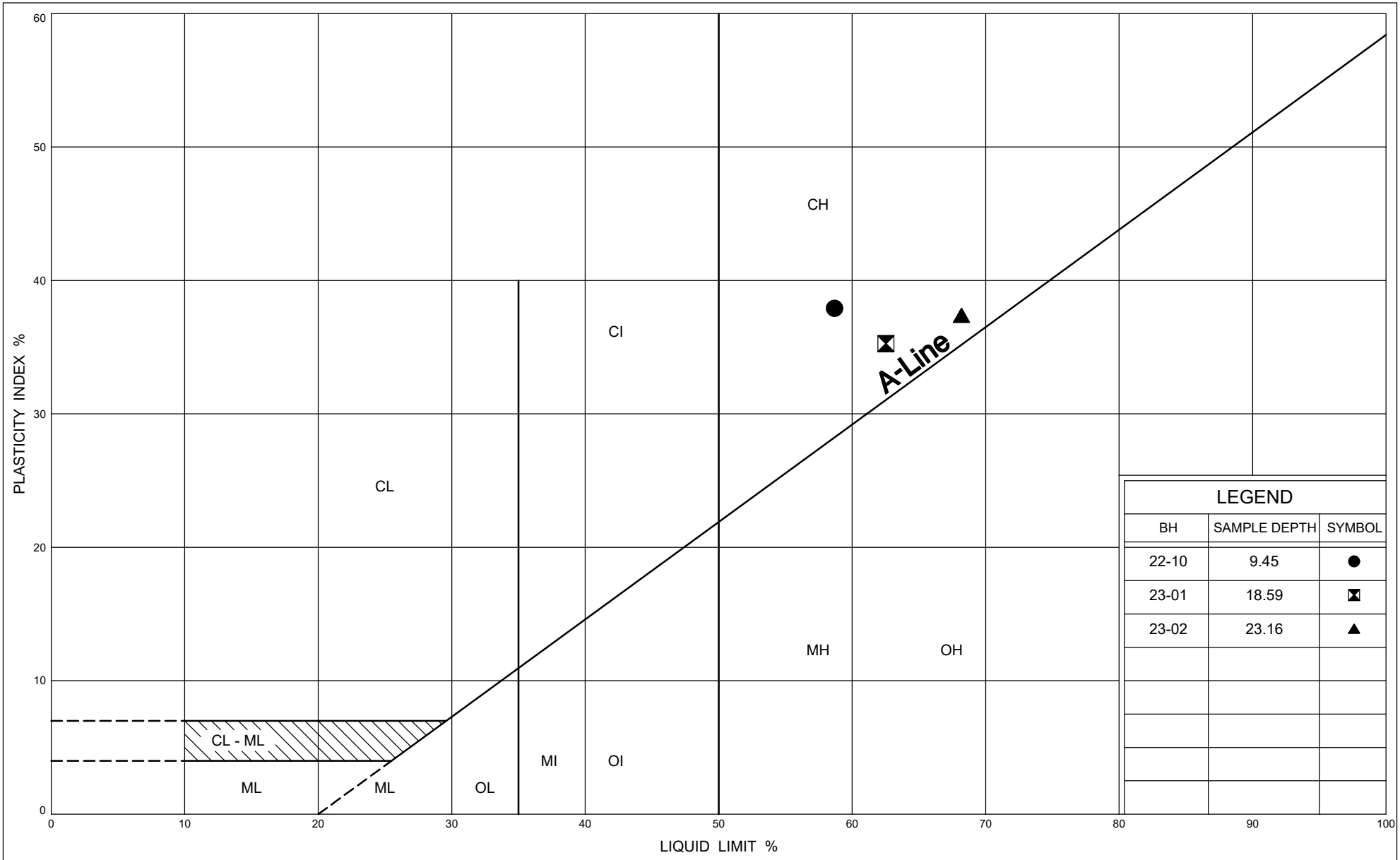
Silty CLAY

FIG No B7

GWP# 6120-17-00

Lyon Creek Culvert

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-33309.GPJ ONTARIO MOT.GDT 8/31/23

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Ontario

PLASTICITY CHART

Silty CLAY

FIG No B8

GWP# 6120-17-00

Lyon Creek Culvert

THURBER ENGINEERING LTD.

Consolidation Test Report

CLIENT: MTO

FILE NUMBER: 33309

PROJECT: Cameron and Lyon Creek Culvert Investigations

REPORT DATE: October 12, 2022

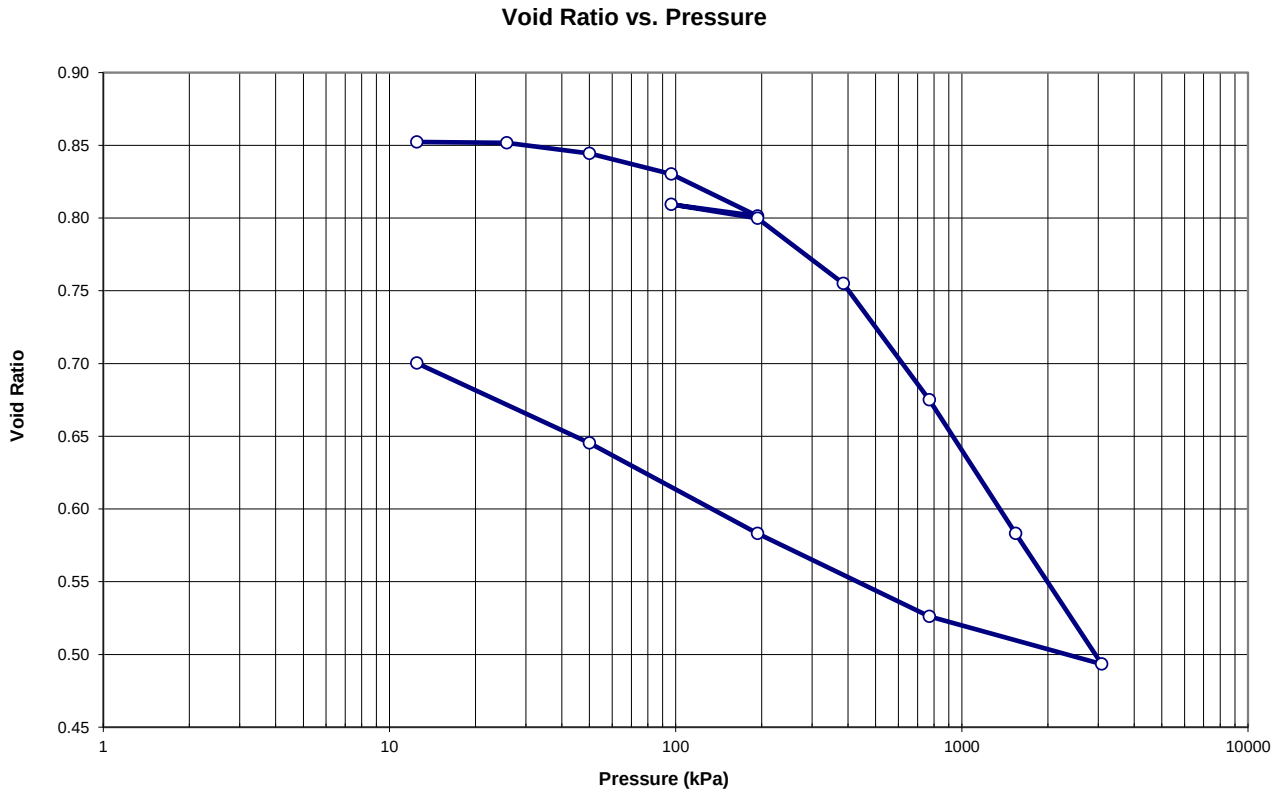
TEST DATES: September 21, 2022 - October 04, 2022

SAMPLE: BH 22-07 ST1 12.5'-14.5'
Silty clay, some sand, some gravel, brown, moist.

PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B.

	Start of Test	End of Test
Sample Height (mm)	25.40	23.32
Wet Dens. (kg/m^3)	1920.7	2002.9
Dry Dens. (kg/m^3)	1460.6	1590.9
Moisture Cont. (%)	31.5	25.9
Void Ratio	0.852	0.700
Saturation (%)	100.0	100.0

Note: A Specific Gravity (Gs) of 2.705 was obtained for the void ratio and saturation calculations.



TEST DONE BY: BT
REVIEWED BY: WM

THURBER ENGINEERING LTD.

Consolidation Test Report

Cameron and Lyon Creek Culvert Investigations
33309 BH 22-07 ST1 12.5'-14.5'

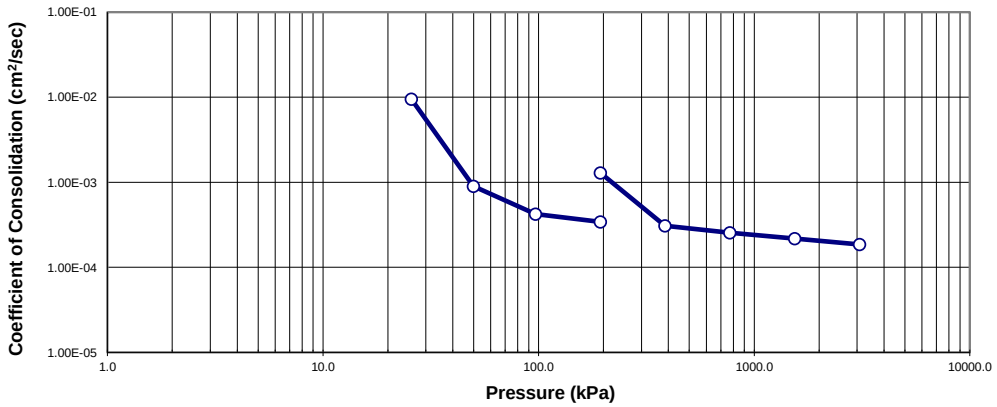
TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 31.4%.

LOADING: A seating load of 12.45 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached at each load increment.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	D_{90} (mm)	t_{90} (min)	c_v (cm^2/s)	Void Ratio	m_v (m^2/kN)	k (cm/s)
0.0	25.400					0.852		
12.5	25.404	25.402				0.852		
25.7	25.395	25.400	-0.046	2.40	9.49E-03	0.852	2.67E-05	2.49E-08
49.9	25.296	25.346	-0.091	25.20	9.01E-04	0.844	1.61E-04	1.42E-08
96.6	25.101	25.199	-0.174	52.85	4.24E-04	0.830	1.65E-04	6.87E-09
193.2	24.706	24.904	-0.340	64.00	3.42E-04	0.801	1.63E-04	5.47E-09
96.6	24.816	24.761				0.809		
193.2	24.685	24.751	-0.108	16.81	1.29E-03	0.800	5.46E-05	6.90E-09
385.7	24.069	24.377	-0.474	68.06	3.08E-04	0.755	1.30E-04	3.92E-09
770.6	22.972	23.521	-0.855	76.56	2.55E-04	0.675	1.18E-04	2.96E-09
1540.7	21.712	22.342	-0.987	80.82	2.18E-04	0.583	7.12E-05	1.52E-09
3081.4	20.481	21.097	-0.990	84.64	1.86E-04	0.493	3.68E-05	6.71E-10
770.6	20.932	20.707				0.526		
193.2	21.712	21.322				0.583		
49.9	22.567	22.140				0.645		
12.5	23.319	22.943				0.700		

Coefficient of Consoildation vs. Pressure



Note: C_v and k calculated using t_{90} values (square root of time method)

TEST DONE BY: BT
REVIEWED BY: WM

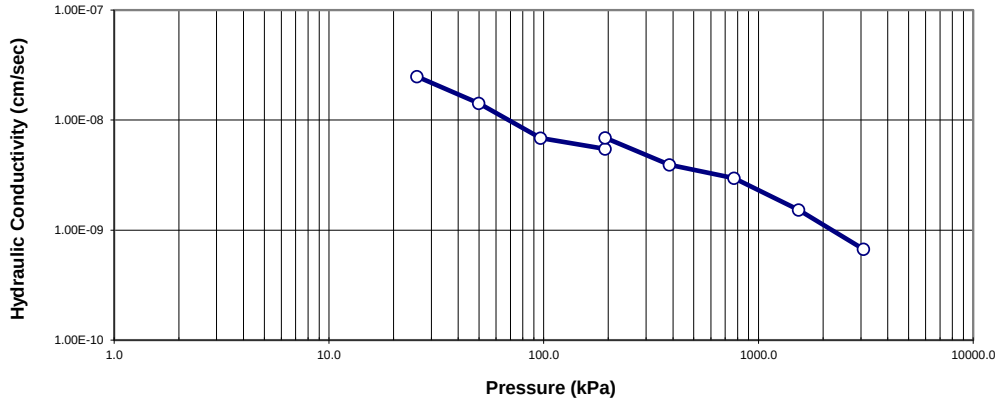
THURBER ENGINEERING LTD.

Consolidation Test Report

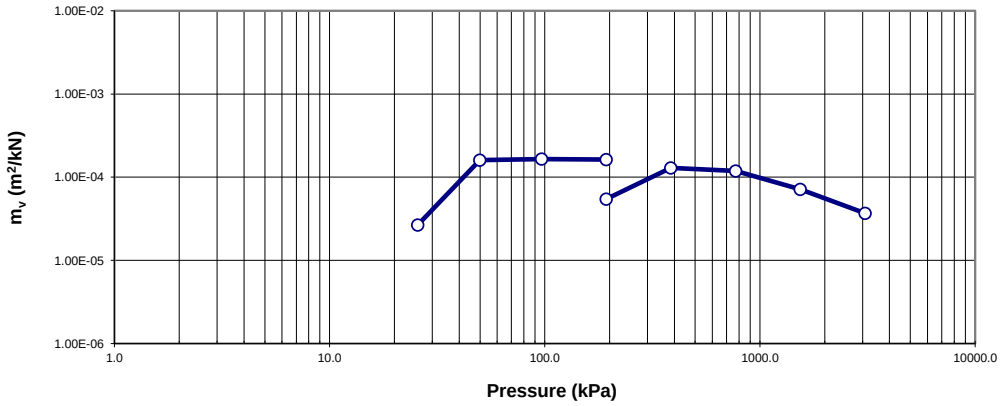
Cameron and Lyon Creek Culvert Investigations

33309 BH 22-07 ST1 12.5'-14.5'

Hydraulic Conductivity vs. Pressure



m_v vs. Pressure



TEST DONE BY: BT
REVIEWED BY: WM

THURBER ENGINEERING LTD.

Consolidation Test Report

CLIENT: MTO

FILE NUMBER: 33309

PROJECT: Cameron and Lyon Creek Culvert Investigations

REPORT DATE: October 12, 2022

TEST DATES: September 22, 2022 - October 06, 2022

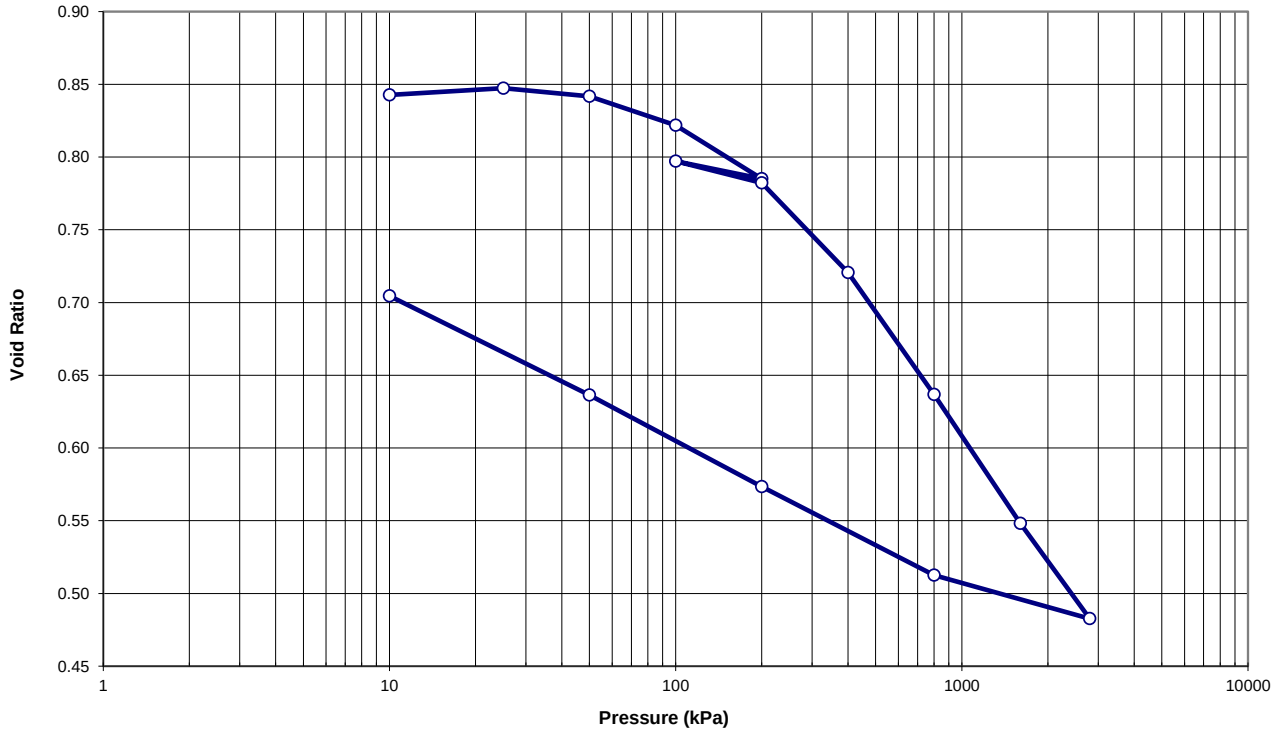
SAMPLE: BH 22-08 ST1 25'-27'
Silty clay, some sand, some gravel, brown, moist

PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B.

	Start of Test	End of Test
Sample Height (mm)	25.40	23.52
Wet Dens. (kg/m^3)	1923.1	1996.7
Dry Dens. (kg/m^3)	1466.1	1583.5
Moisture Cont. (%)	31.2	26.1
Void Ratio	0.841	0.705
Saturation (%)	100.0	100.0

Note: A Specific Gravity (Gs) of 2.699 was obtained for the void ratio and saturation calculations.

Void Ratio vs. Pressure



TEST DONE BY: BT
REVIEWED BY: WM

THURBER ENGINEERING LTD.

Consolidation Test Report

Cameron and Lyon Creek Culvert Investigations
33309 BH 22-08 ST1 25'-27'

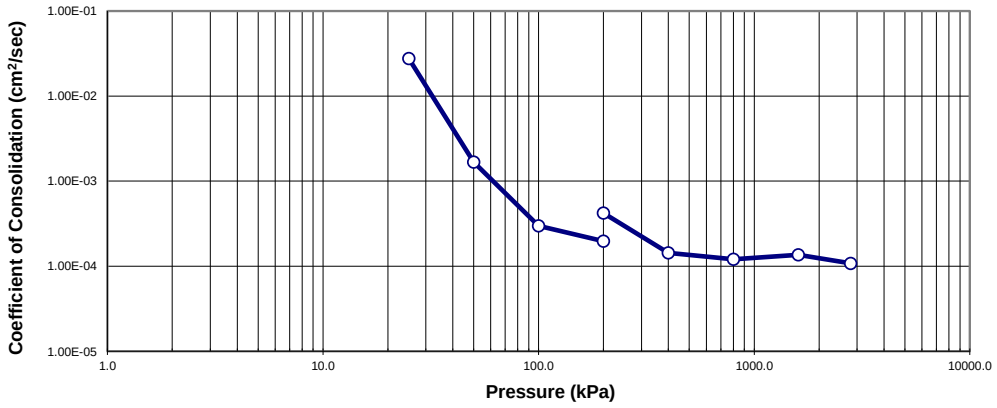
TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 30.6%.

LOADING: A seating load of 10 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached at each load increment.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	D_{90} (mm)	t_{90} (min)	c_v (cm^2/s)	Void Ratio	m_v (m^2/kN)	k (cm/s)
0.0	25.400					0.841		
10.0	25.423	25.412				0.843		
25.0	25.488	25.455	-0.081	0.83	2.76E-02	0.847		
50.0	25.410	25.449	-0.097	13.69	1.67E-03	0.842	1.22E-04	1.99E-08
100.0	25.136	25.273	-0.255	75.69	2.98E-04	0.822	2.16E-04	6.32E-09
200.0	24.630	24.883	-0.478	111.30	1.97E-04	0.785	2.01E-04	3.88E-09
100.0	24.794	24.712				0.797		
200.0	24.589	24.691	-0.168	51.12	4.21E-04	0.782	8.27E-05	3.42E-09
400.0	23.738	24.163	-0.731	144.00	1.43E-04	0.721	1.73E-04	2.43E-09
800.0	22.583	23.160	-1.026	156.50	1.21E-04	0.637	1.22E-04	1.44E-09
1600.0	21.359	21.971	-1.058	125.44	1.36E-04	0.548	6.78E-05	9.04E-10
2800.0	20.455	20.907	-0.883	142.80	1.08E-04	0.483	3.52E-05	3.74E-10
800.0	20.867	20.661				0.512		
200.0	21.707	21.287				0.573		
50.0	22.577	22.142				0.636		
10.0	23.517	23.047				0.705		

Coefficient of Consoildation vs. Pressure



Note: C_v and k calculated using t_{90} values (square root of time method)

TEST DONE BY: BT
REVIEWED BY: WM

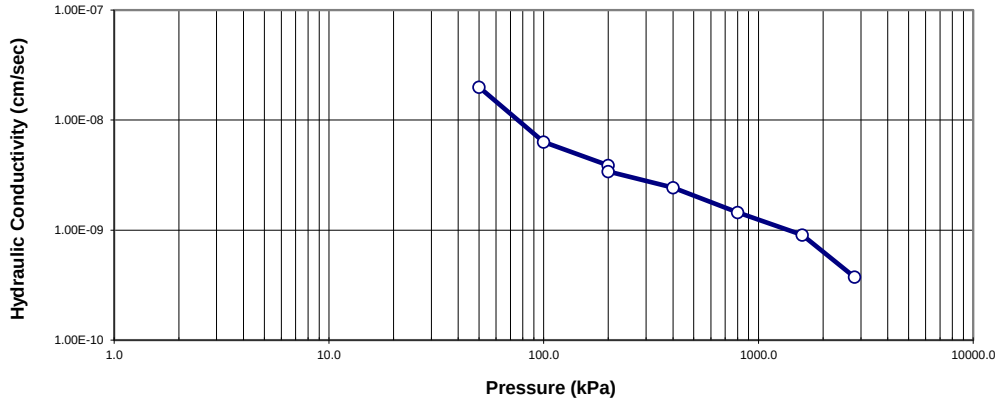
THURBER ENGINEERING LTD.

Consolidation Test Report

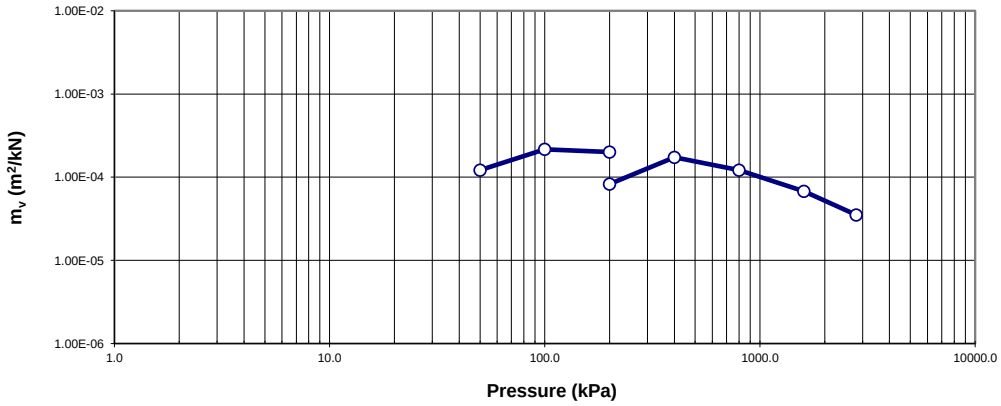
Cameron and Lyon Creek Culvert Investigations

33309 BH 22-08 ST1 25'-27'

Hydraulic Conductivity vs. Pressure



m_v vs. Pressure



TEST DONE BY: BT

REVIEWED BY: WM

THURBER ENGINEERING LTD.

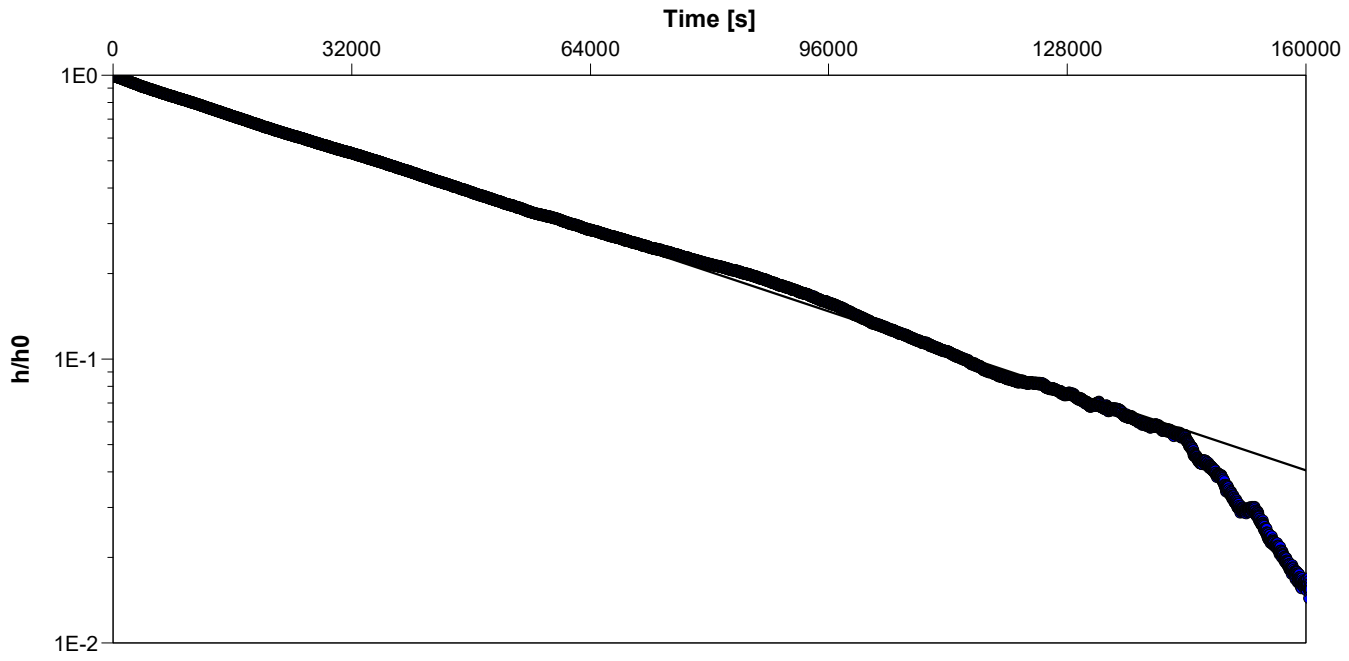
Slug Test Analysis Report

Project: Lyon Creek Culvert Replacement

Number: 33309

Client: MTO

Location: District of Rainey River	Slug Test: 22-07	Test Well: 22-07
Test Conducted by: GS		Test Date: 2022-08-25
Analysis Performed by: JR	22-07 SWRT Analysis	Analysis Date: 2022-10-27
Aquifer Thickness:		
		Checked by: PC



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-07	9.0×10^{-9}	

FINAL REPORT

CA40191-OCT22 R1

33309, C.ameron and Lyon Creek Culvert

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	Rachel Bourassa
Telephone	905-829-8666 x 263
Facsimile	
Email	rbourassa@thurber.ca
Project	33309, C.ameron and Lyon Creek Culvert
Order Number	
Samples	Soil (1)

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	CA40191-OCT22
Received	10/26/2022
Approved	11/04/2022
Report Number	CA40191-OCT22 R1
Date Reported	11/08/2022

COMMENTS

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

Chain of Custody Number: No.1

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

Client: Thurber Engineering Ltd.
Project: 33309, C.ameron and Lyon Creek Culvert
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

MATRIX: SOIL

Sample Number	5
Sample Name	22-07 SS3B (8'6"-9'6")
Sample Matrix	Soil
Sample Date	23/10/2022

Parameter	Units	RL		Result
Corrosivity Index				
Corrosivity Index	none	1		12
Soil Redox Potential	mV	no		230
Sulphide (Na2CO3)	%	0.04		0.17
pH	pH Units	0.05		8.25
Resistivity (calculated)	ohms.cm	-9999		1780
General Chemistry				
Conductivity	uS/cm	2		561
Metals and Inorganics				
Moisture Content	%	0.1		23.7
Sulphate	µg/g	0.4		430
Other (ORP)				
Chloride	µg/g	0.4		48

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	DIO0587-OCT22	µg/g	0.4	<0.4	1	35	98	80	120	92	75	125
Sulphate	DIO0587-OCT22	µg/g	0.4	<0.4	3	35	99	80	120	107	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)	ECS0088-OCT22	%	0.04	< 0.04	ND	20	117	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	EWL0670-OCT22	uS/cm	2	< 2	0	20	99	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	EWL0670-OCT22	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: 1

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: EO
Received Date (mm/dd/yy): 10-26-22
Received Time: 1140
Received By (signature):
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 9x3
LAB LIMS #: OCT 26TH CA 40191

REPORT INFORMATION

Company: Thurber Engineering Ltd.
Contact: Rachel Bourassa
Address: 103-2010 Winston Park Drive
Oakville, Ontario
Phone: 416-523-1015
Email: rbourassa@thurber.ca
Email:

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 33309
Site Location/ID: Cameron and Lyon Creek Culvert

TURNAROUND TIME (TAT) REQUIRED

☑ 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

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☑ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

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

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

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	22-07 SS3B (8'6" - 9'6")	8/23/22	—	1	Soil		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
2	22-02 SS1 (0'-2')	8/27/22	—	1	Soil		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
3							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions * Corrosivity Should Include Sulphate

Sampled By (NAME): Rachel Bourassa / GS	Signature: Rachel Bourassa	Date: 8/27/22	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: 10/26/22	(mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA40152-JUN22 R1

33309, C.ameron and Lyon Creek Culvert

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Jill Campbell, B.Sc.,GISAS
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Rachel Bourassa	Telephone	2165
Telephone	905-829-8666 x 263	Facsimile	705-652-6365
Facsimile		Email	jill.campbell@sgs.com
Email	rbourassa@thurber.ca	SGS Reference	CA40152-JUN22
Project	33309, C.ameron and Lyon Creek Culvert	Received	06/09/2022
Order Number		Approved	06/26/2022
Samples	Soil (1)	Report Number	CA40152-JUN22 R1
		Date Reported	11/08/2022

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number:1

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

Client: Thurber Engineering Ltd.
Project: 33309, C.ameron and Lyon Creek Culvert
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

MATRIX: SOIL

Sample Number	6
Sample Name	22-08 SS3 (5'-7')
Sample Matrix	Soil
Sample Date	02/05/2022

Parameter	Units	RL		Result
Corrosivity Index				
Corrosivity Index	none	1		4
Soil Redox Potential	mV	no		263
Sulphide (Na2CO3)	%	0.04		< 0.04
pH	pH Units	0.05		8.85
Resistivity (calculated)	ohms.cm	-9999		3150
General Chemistry				
Conductivity	uS/cm	2		317
Metals and Inorganics				
Moisture Content	%	0.1		18.7
Sulphate	µg/g	0.4		42
Other (ORP)				
Chloride	µg/g	0.4		230

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	DIO0242-JUN22	µg/g	0.4	<0.4	3	35	97	80	120	99	75	125
Sulphate	DIO0242-JUN22	µg/g	0.4	<0.4	5	35	96	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)	ECS0029-JUN22	%	0.04	< 0.04								

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	EWL0245-JUN22	uS/cm	2	2	0	20	101	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	EWL0245-JUN22	pH Units	0.05	NA	0		99			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: 1

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Nicole Brigant
Received Date (mm/dd/yy): June 9/22
Received Time: 10:00
Received By (signature):
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑ Ice
Temperature Upon Receipt (°C) 8°C
LAB LIMS #: CA4055-JUN22

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Engineering Ltd.	☑ (same as Report Information)	Quotation #:
Contact: Rachel Bourassa	Company:	P.O. #:
Address: 103-2010 Winston Park Drive Oakville, Ontario	Contact:	Project #: 33309
Phone: 416-523-1015	Address:	Site Location/ID: Cameron and Lyon Creek Culvert
Email: rbourassa@thurber.ca	Phone:	
Email:	Email:	

TURNAROUND TIME (TAT) REQUIRED

☑ 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

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O — Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☑ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

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

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

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 ☐ F2-F4 ☐ BTEX/F1 ☐	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	22-03 SS4(7'6" - 9'6")	5/3/22	9:00 A.M.	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
2	22-08 SS3(5' - 7')	05/02/22	11:00 A.M.	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
3							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions
*Jars from a different Lab were used

Sampled By (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: 05/03/22	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: 06/07/22	(mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA40013-SEP22 R

33309, Emo, ON.

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA40013-SEP22 R

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Rachel Bourassa	Telephone	705-652-2143
Telephone	905-829-8666 x 263	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	rbourassa@thurber.ca	SGS Reference	CA40013-SEP22
Project	33309, Emo, ON.	Received	09/01/2022
Order Number		Approved	09/06/2022
Samples	Surface Water (1)	Report Number	CA40013-SEP22 R
		Date Reported	09/06/2022

COMMENTS

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

Chain of custody: 010116

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA40013-SEP22 R

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	6
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Parameter	Units	RL	L1	Result
General Chemistry				
Conductivity	uS/cm	2		100
Redox Potential	mV	no		207
Metals and Inorganics				
Sulphate	mg/L	0.04		3.5
Other (ORP)				
pH	No unit	0.05	8.6	7.77
Chloride	mg/L	0.04		3.1

EXCEEDANCE SUMMARY

No exceedances are present above the regulatory limit(s) indicated

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	DIO0073-SEP22	mg/L	0.04	<0.04	4	20	97	90	110	96	75	125
Sulphate	DIO0073-SEP22	mg/L	0.04	<0.04	7	20	98	90	110	97	75	125

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	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

pH

Method: SM 4500 | 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
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		

QC SUMMARY

Redox Potential

Method: SM 2580 I

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
Redox Potential	EWL0057-SEP22	mV	no	NA	0	20	103	80	120	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: 010116

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Sadi
Received Date (mm/dd/yyyy): 09/01/2022 (mm\dd\yy)
Received Time: 11:30
Received By (signature): S
Custody Seal Present: ☐
Custody Seal Intact: ☐
Cooling Agent Present: ☑ Ice
Temperature Upon Receipt (°C): 9 C x 3
LAB LIMS #: 40012-13

REPORT INFORMATION

Company: Thurber Engineering LTD
Contact: Rachel Bourassa
Address: 2010 Winston Park Dr #103 Oakville ON L6M 5R7
Phone: 416 523 1015
Email: rbourassa@thurber.ca
Email:

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 33309
Site Location/ID: Emo, ON

TURNAROUND TIME (TAT) REQUIRED

☑ 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

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☑ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

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 ☐ VOC ☐ BTEX ☐ 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:	TSS	Lab Filtered Metals	Water Characterization Package (general)	Corrosivity *	COMMENTS:
1	Lyon Creek SW	Aug 28/22		15	Water											✓	✓	✓	✓	
2	22-07	Aug 28/22		14	Water											✓	✓	✓		
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions * Corrosivity includes pH, Soluble Sulphate, chloride, Resistivity, Electrical Conductivity.

Sampled By (NAME): Greg Stanhope	Signature: GS	Date: Aug 28 / 2022 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: Aug / 2022 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA40012-SEP22 R1

33309, Emo, ON.

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	Rachel Bourassa
Telephone	905-829-8666 x 263
Facsimile	
Email	rbourassa@thurber.ca
Project	33309, Emo, ON.
Order Number	
Samples	Ground Water (1)

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	CA40012-SEP22
Received	09/01/2022
Approved	11/11/2022
Report Number	CA40012-SEP22 R1
Date Reported	11/11/2022

COMMENTS

MAC - Maximum Acceptable Concentration
AO/OG - Aesthetic Objective / Operational Guideline
NR - Not reportable under applicable Provincial drinking water regulations as per client.

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

Chain of Custody Number: 010116

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	22-07
Sample Matrix	Ground Water
Sample Date	28/08/2022

General Chemistry

Parameter	Units	RL	L1	Result
Total Suspended Solids	mg/L	2		1850
Alkalinity	mg/L as CaCO3	2		456
Bicarbonate	mg/L as CaCO3	2		456
Carbonate	mg/L as CaCO3	2		< 2
OH	mg/L as CaCO3	2		< 2
Colour	TCU	3		43
Conductivity	uS/cm	2		1560
Turbidity	NTU	0.10		850
Ammonia+Ammonium (N)	as N mg/L	0.1		0.4
Phosphorus (total reactive)	mg/L	0.03		< 0.03
Total Organic Carbon	mg/L	1		7
Ion Ratio	-	-9999		1.23
Total Dissolved Solids (calculated)	mg/L	-9999		955
Conductivity (calculated)	uS/cm	-9999		1990
Langeliers Index 4° C	@ 4° C	-9999		0.83
Saturation pH 4°C	pHs @ 4°C	-9999		7.07

Client: Thurber Engineering Ltd.
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Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	22-07
Sample Matrix	Ground Water
Sample Date	28/08/2022

Metals and Inorganics

Parameter	Units	RL	L1	Result
Fluoride	mg/L	0.06		0.19
Bromide	mg/L	0.3		< 0.3
Nitrite (as N)	as N mg/L	0.03		< 0.03
Nitrate (as N)	as N mg/L	0.06		< 0.06
Sulphate	mg/L	0.2		27
Hardness (dissolved)	mg/L as CaCO3	0.05		573
Aluminum (dissolved)	mg/L	0.001	0.075	0.010
Aluminum (0.2µm)	mg/L	0.001	0.075	0.007
Arsenic (dissolved)	mg/L	0.0002		0.0043
Boron (dissolved)	mg/L	0.002		0.146
Barium (dissolved)	mg/L	0.00008		0.150
Beryllium (dissolved)	mg/L	0.000007		< 0.000007
Cobalt (dissolved)	mg/L	0.000004		0.00165
Calcium (dissolved)	mg/L	0.01		146
Cadmium (dissolved)	mg/L	0.000003		0.000085
Copper (dissolved)	mg/L	0.0002		0.0020
Chromium (dissolved)	mg/L	0.00008		< 0.00008
Iron (dissolved)	mg/L	0.007		0.010
Potassium (dissolved)	mg/L	0.009		5.19
Magnesium (dissolved)	mg/L	0.001		50.5
Manganese (dissolved)	mg/L	0.00001		0.430
Molybdenum (dissolved)	mg/L	0.00004		0.0156

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
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Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	22-07
Sample Matrix	Ground Water
Sample Date	28/08/2022

Metals and Inorganics (continued)

Parameter	Units	RL	L1	Result
Nickel (dissolved)	mg/L	0.0001		0.0044
Sodium (dissolved)	mg/L	0.01		105
Phosphorus (dissolved)	mg/L	0.003		< 0.003
Lead (dissolved)	mg/L	0.00009		< 0.00009
Silicon (dissolved)	mg/L	0.02		6.86
Silver (dissolved)	mg/L	0.00005		< 0.00005
Strontium (dissolved)	mg/L	0.00008		0.601
Thallium (dissolved)	mg/L	0.000005		0.000011
Tin (dissolved)	mg/L	0.00006		0.00142
Titanium (dissolved)	mg/L	0.00005		0.00021
Antimony (dissolved)	mg/L	0.0009		0.0011
Selenium (dissolved)	mg/L	0.00004		0.00012
Uranium (dissolved)	mg/L	0.000002		0.00726
Vanadium (dissolved)	mg/L	0.00001		0.00189
Zinc (dissolved)	mg/L	0.002		0.004
Hardness	mg/L as CaCO3	0.05		763
Aluminum (total)	mg/L	0.001		11.4
Arsenic (total)	mg/L	0.0002	0.005	0.0084
Boron (total)	mg/L	0.002	0.2	0.151
Barium (total)	mg/L	0.00008		0.268
Beryllium (total)	mg/L	0.000007	1.1	0.000582
Cobalt (total)	mg/L	0.000004	0.0009	0.0141

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	22-07
Sample Matrix	Ground Water
Sample Date	28/08/2022

Metals and Inorganics (continued)

Parameter	Units	RL	L1	Result
Calcium (total)	mg/L	0.01		189
Cadmium (total)	mg/L	0.000003	0.0005	0.000593
Copper (total)	mg/L	0.0002	0.005	0.0234
Chromium (total)	mg/L	0.00008	0.1	0.0282
Iron (total)	mg/L	0.007	0.3	17.2
Potassium (total)	mg/L	0.009		8.23
Magnesium (total)	mg/L	0.001		70.8
Manganese (total)	mg/L	0.00001		0.934
Molybdenum (total)	mg/L	0.00004	0.04	0.0111
Nickel (total)	mg/L	0.0001	0.025	0.0308
Sodium (total)	mg/L	0.01		95.9
Phosphorus (total)	mg/L	0.003	0.01	0.599
Lead (total)	mg/L	0.00009	0.025	0.0127
Silicon (total)	mg/L	0.02		27.5
Silver (total)	mg/L	0.00005	0.0001	0.00015
Strontium (total)	mg/L	0.00008		0.602
Thallium (total)	mg/L	0.000005	0.0003	0.000259
Tin (total)	mg/L	0.00006		0.00168
Titanium (total)	mg/L	0.00005		0.232
Antimony (total)	mg/L	0.0009	0.02	< 0.0009
Selenium (total)	mg/L	0.00004	0.1	0.00024
Uranium (total)	mg/L	0.000002	0.005	0.00864

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	22-07
Sample Matrix	Ground Water
Sample Date	28/08/2022

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Vanadium (total)	mg/L	0.00001	0.006	0.0448
Zinc (total)	mg/L	0.002	0.02	0.075
Cation sum	meq/L	-9999		21.94
Anion Sum	meq/L	-9999		17.86
Anion-Cation Balance	% difference	-9999		10.25
Other (ORP)				
pH	No unit	0.05	8.6	7.90
Chloride	mg/L	0.2		290
Mercury (total)	mg/L	0.00001	0.0002	0.00007
Mercury (dissolved)	mg/L	0.00001	0.0002	0.00005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
22-07				
Arsenic	SM 3030/EPA 200.8	mg/L	0.0084	0.005
Cadmium	SM 3030/EPA 200.8	mg/L	0.000593	0.0005
Cobalt	SM 3030/EPA 200.8	mg/L	0.0141	0.0009
Copper	SM 3030/EPA 200.8	mg/L	0.0234	0.005
Iron	SM 3030/EPA 200.8	mg/L	17.2	0.3
Nickel	SM 3030/EPA 200.8	mg/L	0.0308	0.025
Phosphorus	SM 3030/EPA 200.8	mg/L	0.599	0.01
Silver	SM 3030/EPA 200.8	mg/L	0.00015	0.0001
Uranium	SM 3030/EPA 200.8	mg/L	0.00864	0.005
Vanadium	SM 3030/EPA 200.8	mg/L	0.0448	0.006
Zinc	SM 3030/EPA 200.8	mg/L	0.075	0.02

QC SUMMARY

Alkalinity

Method: SM 2320 I 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
Alkalinity	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

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
Ammonia+Ammonium (N)	SKA0040-SEP22	as N mg/L	0.1	<0.1	1	10	97	90	110	98	75	125

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-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
Bromide	DIO0070-SEP22	mg/L	0.3	<0.3	ND	20	99	90	110	102	75	125
Nitrite (as N)	DIO0070-SEP22	mg/L	0.03	<0.03	ND	20	99	90	110	102	75	125
Nitrate (as N)	DIO0070-SEP22	mg/L	0.06	<0.06	ND	20	100	90	110	103	75	125
Chloride	DIO0134-SEP22	mg/L	0.2	<0.2	15	20	101	90	110	100	75	125
Sulphate	DIO0134-SEP22	mg/L	0.2	<0.2	3	20	99	90	110	94	75	125
Chloride	DIO0195-SEP22	mg/L	0.2	<0.2	1	20	98	90	110	99	75	125
Sulphate	DIO0195-SEP22	mg/L	0.2	<0.2	NV	20	97	90	110	NV	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

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
Total Organic Carbon	SKA5019-SEP22	mg/L	1	<1	0	20	100	90	110	96	75	125

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | 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
Carbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-002

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
Colour	EWL0075-SEP22	TCU	3	< 3	ND	10	100	80	120	NA		

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENVIEWL-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	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

Fluoride by Specific Ion Electrode

Method: SM 4500 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-014

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
Fluoride	EWL0070-SEP22	mg/L	0.06	<0.06	ND	10	103	90	110	97	75	125
Fluoride	EWL0083-SEP22	mg/L	0.06	<0.06	0	10	102	90	110	99	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

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
Mercury (total)	EHG0005-SEP22	mg/L	0.00001	< 0.00001	18	20	105	80	120	101	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-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
Silver (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	ND	20	107	90	110	99	70	130
Aluminum (total)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Aluminum (0.2µm)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Arsenic (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	2	20	102	90	110	91	70	130
Barium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	10	20	106	90	110	108	70	130
Beryllium (total)	EMS0061-SEP22	mg/L	0.000007	<0.000007	ND	20	96	90	110	88	70	130
Boron (total)	EMS0061-SEP22	mg/L	0.002	<0.002	12	20	101	90	110	99	70	130
Calcium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	101	90	110	102	70	130
Cadmium (total)	EMS0061-SEP22	mg/L	0.000003	<0.000003	ND	20	104	90	110	104	70	130
Cobalt (total)	EMS0061-SEP22	mg/L	0.000004	<0.000004	10	20	105	90	110	107	70	130
Chromium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00008	1	20	99	90	110	92	70	130
Copper (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	ND	20	103	90	110	119	70	130
Iron (total)	EMS0061-SEP22	mg/L	0.007	<0.007	ND	20	97	90	110	125	70	130
Potassium (total)	EMS0061-SEP22	mg/L	0.009	<0.009	1	20	96	90	110	114	70	130
Magnesium (total)	EMS0061-SEP22	mg/L	0.001	<0.001	0	20	95	90	110	109	70	130
Manganese (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	9	20	101	90	110	91	70	130
Molybdenum (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	3	20	102	90	110	108	70	130
Sodium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	98	90	110	110	70	130
Nickel (total)	EMS0061-SEP22	mg/L	0.0001	<0.0001	4	20	99	90	110	104	70	130
Lead (total)	EMS0061-SEP22	mg/L	0.00009	<0.00001	0	20	106	90	110	111	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 I Internal ref.: ME-CA-IENVISPE-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
Phosphorus (total)	EMS0061-SEP22	mg/L	0.003	<0.003	13	20	96	90	110	NV	70	130
Antimony (total)	EMS0061-SEP22	mg/L	0.0009	<0.0009	ND	20	98	90	110	128	70	130
Selenium (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	ND	20	102	90	110	89	70	130
Silicon (total)	EMS0061-SEP22	mg/L	0.02	<0.02	13	20	93	90	110	NV	70	130
Tin (total)	EMS0061-SEP22	mg/L	0.00006	<0.00006	ND	20	108	90	110	NV	70	130
Strontium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	0	20	104	90	110	105	70	130
Titanium (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	6	20	101	90	110	NV	70	130
Thallium (total)	EMS0061-SEP22	mg/L	0.000005	<0.000005	ND	20	96	90	110	99	70	130
Uranium (total)	EMS0061-SEP22	mg/L	0.000002	<0.000002	1	20	108	90	110	118	70	130
Vanadium (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	3	20	99	90	110	102	70	130
Zinc (total)	EMS0061-SEP22	mg/L	0.002	<0.002	2	20	101	90	110	110	70	130

pH

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-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
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		

QC SUMMARY

Reactive Phosphorus by SFA

Method: SM 4500-P F | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-004

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
Phosphorus (total reactive)	SKA0035-SEP22	mg/L	0.03	<0.03	ND	10	104	90	110	93	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

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
Total Suspended Solids	EWL0066-SEP22	mg/L	2	< 2	1	10	99	90	110	NA		

Turbidity

Method: SM 2130 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-003

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
Turbidity	EWL0064-SEP22	NTU	0.10	< 0.10	4	10	100	90	110	NA		

QC SUMMARY

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

No: 010116

Page 1 of 1

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

Laboratory Information Section - Lab use only

Received By: [signature] Received By (signature): [signature]
Received Date (mm/dd/yyyy): 09/01/2022 (mm\dd\yy) Custody Seal Present: ☐ Cooling Agent Present: ☑ Ice
Received Time: 11:30 Custody Seal Intact: ☐ Temperature Upon Receipt (°C): 9.C.3 LAB LIMS #: 40012-13

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Engineering LTD	☑ (same as Report Information)	Quotation #: P.O. #:
Contact: Rachel Bourassa	Company:	Project #: 33309 Site Location/ID: Emo, ON
Address: 2010 Winston Park Dr #103 Oakville ON L6M 5R7	Contact:	**TURNAROUND TIME (TAT) REQUIRED**
Phone: 416 523 1015	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: rbourassa@thurber.ca	Phone:	**RUSH TAT (Additional Charges May Apply):** ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
Email:	Email:	**PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION**
		Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☑ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

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

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

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 ☐ VOC ☐ BTEX ☐ 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:	TSS	Lab Filtered Metals	Water Characterization Package (general)	* Corrosivity	COMMENTS:
1	Lyon Creek SW	Aug 28/22		15	Water											✓	✓	✓	✓	
2	22-07	Aug 28/22		14	Water											✓	✓	✓		
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions * Corrosivity Includes pH, Soluble Sulphate, Chloride, Resistivity, Electrical Conductivity.

Sampled By (NAME): Greg Stanhope	Signature: GS	Date: Aug 28 / 2022 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: Aug / / 2022 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA40012-SEP22 R1

33309, Emo, ON.

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	Rachel Bourassa
Telephone	905-829-8666 x 263
Facsimile	
Email	rbourassa@thurber.ca
Project	33309, Emo, ON.
Order Number	
Samples	Surface Water (1)

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	CA40012-SEP22
Received	09/01/2022
Approved	11/11/2022
Report Number	CA40012-SEP22 R1
Date Reported	11/11/2022

COMMENTS

MAC - Maximum Acceptable Concentration
AO/OG - Aesthetic Objective / Operational Guideline
NR - Not reportable under applicable Provincial drinking water regulations as per client.

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

Chain of Custody Number: 010116

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Parameter	Units	RL	L1	Result
General Chemistry				
Total Suspended Solids	mg/L	2		12
Alkalinity	mg/L as CaCO3	2		37
Bicarbonate	mg/L as CaCO3	2		37
Carbonate	mg/L as CaCO3	2		< 2
OH	mg/L as CaCO3	2		< 2
Colour	TCU	3		49
Conductivity	uS/cm	2		99
Turbidity	NTU	0.10		8.5
Ammonia+Ammonium (N)	as N mg/L	0.1		< 0.1
Phosphorus (total reactive)	mg/L	0.03		< 0.03
Total Organic Carbon	mg/L	1		11
Ion Ratio	-	-9999		1.16
Total Dissolved Solids (calculated)	mg/L	-9999		49
Conductivity (calculated)	uS/cm	-9999		99
Langeliers Index 4° C	@ 4° C	-9999		-1.59
Saturation pH 4°C	pHs @ 4°C	-9999		9.27

Client: Thurber Engineering Ltd.
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MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Fluoride	mg/L	0.06		< 0.06
Bromide	mg/L	0.3		< 0.3
Nitrite (as N)	as N mg/L	0.03		< 0.03
Nitrate (as N)	as N mg/L	0.06		< 0.06
Sulphate	mg/L	0.2		3.8
Hardness (dissolved)	mg/L as CaCO3	0.05		41.8
Aluminum (dissolved)	mg/L	0.001	0.075	0.015
Aluminum (0.2µm)	mg/L	0.001	0.075	0.009
Arsenic (dissolved)	mg/L	0.0002		0.0008
Boron (dissolved)	mg/L	0.002		0.015
Barium (dissolved)	mg/L	0.00008		0.0110
Beryllium (dissolved)	mg/L	0.000007		< 0.000007
Cobalt (dissolved)	mg/L	0.000004		0.000041
Calcium (dissolved)	mg/L	0.01		11.1
Cadmium (dissolved)	mg/L	0.000003		< 0.000003
Copper (dissolved)	mg/L	0.0002		0.0012
Chromium (dissolved)	mg/L	0.00008		< 0.00008
Iron (dissolved)	mg/L	0.007		0.093
Potassium (dissolved)	mg/L	0.009		0.977
Magnesium (dissolved)	mg/L	0.001		3.42
Manganese (dissolved)	mg/L	0.00001		0.00071
Molybdenum (dissolved)	mg/L	0.00004		0.00024

Client: Thurber Engineering Ltd.
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MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Metals and Inorganics (continued)

Parameter	Units	RL	L1	Result
Nickel (dissolved)	mg/L	0.0001		0.0009
Sodium (dissolved)	mg/L	0.01		3.65
Phosphorus (dissolved)	mg/L	0.003		0.033
Lead (dissolved)	mg/L	0.00009		< 0.00009
Silicon (dissolved)	mg/L	0.02		1.15
Silver (dissolved)	mg/L	0.00005		< 0.00005
Strontium (dissolved)	mg/L	0.00008		0.0290
Thallium (dissolved)	mg/L	0.000005		< 0.000005
Tin (dissolved)	mg/L	0.00006		< 0.00006
Titanium (dissolved)	mg/L	0.00005		0.00088
Antimony (dissolved)	mg/L	0.0009		< 0.0009
Selenium (dissolved)	mg/L	0.00004		< 0.00004
Uranium (dissolved)	mg/L	0.000002		0.000117
Vanadium (dissolved)	mg/L	0.00001		0.00066
Zinc (dissolved)	mg/L	0.002		< 0.002
Hardness	mg/L as CaCO3	0.05		41.6
Aluminum (total)	mg/L	0.001		0.226
Arsenic (total)	mg/L	0.0002	0.005	0.0011
Boron (total)	mg/L	0.002	0.2	0.010
Barium (total)	mg/L	0.00008		0.0138
Beryllium (total)	mg/L	0.000007	0.011	0.000018
Cobalt (total)	mg/L	0.000004	0.0009	0.000357

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Metals and Inorganics (continued)

Parameter	Units	RL	L1	Result
Calcium (total)	mg/L	0.01		10.9
Cadmium (total)	mg/L	0.000003	0.0001	0.000015
Copper (total)	mg/L	0.0002	0.005	0.0016
Chromium (total)	mg/L	0.00008	0.1	0.00048
Iron (total)	mg/L	0.007	0.3	0.465
Potassium (total)	mg/L	0.009		1.06
Magnesium (total)	mg/L	0.001		3.49
Manganese (total)	mg/L	0.00001		0.101
Molybdenum (total)	mg/L	0.00004	0.04	0.00033
Nickel (total)	mg/L	0.0001	0.025	0.0013
Sodium (total)	mg/L	0.01		3.43
Phosphorus (total)	mg/L	0.003	0.01	0.108
Lead (total)	mg/L	0.00009	0.01	0.00025
Silicon (total)	mg/L	0.02		1.54
Silver (total)	mg/L	0.00005	0.0001	< 0.00005
Strontium (total)	mg/L	0.00008		0.0297
Thallium (total)	mg/L	0.000005	0.0003	0.000006
Tin (total)	mg/L	0.00006		< 0.00006
Titanium (total)	mg/L	0.00005		0.00682
Antimony (total)	mg/L	0.0009	0.02	< 0.0009
Selenium (total)	mg/L	0.00004	0.1	< 0.00004
Uranium (total)	mg/L	0.000002	0.005	0.000169

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON.
Project Manager: Rachel Bourassa
Samplers: Grey Stanhope

MATRIX: WATER

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	7
Sample Name	Lyon Creek SW
Sample Matrix	Surface Water
Sample Date	28/08/2022

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Vanadium (total)	mg/L	0.00001	0.006	0.00143
Zinc (total)	mg/L	0.002	0.02	0.003
Cation sum	meq/L	-9999		1.07
Anion Sum	meq/L	-9999		0.92
Anion-Cation Balance	% difference	-9999		7.24
Other (ORP)				
pH	No unit	0.05	8.6	7.68
Chloride	mg/L	0.2		3.6
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001
Mercury (dissolved)	mg/L	0.00001	0.0002	< 0.00001

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
Lyon Creek SW				
Iron	SM 3030/EPA 200.8	mg/L	0.465	0.3
Phosphorus	SM 3030/EPA 200.8	mg/L	0.108	0.01

QC SUMMARY

Alkalinity

Method: SM 2320 I 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
Alkalinity	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-007

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
Ammonia+Ammonium (N)	SKA0040-SEP22	as N mg/L	0.1	<0.1	1	10	97	90	110	98	75	125

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-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
Bromide	DIO0070-SEP22	mg/L	0.3	<0.3	ND	20	99	90	110	102	75	125
Nitrite (as N)	DIO0070-SEP22	mg/L	0.03	<0.03	ND	20	99	90	110	102	75	125
Nitrate (as N)	DIO0070-SEP22	mg/L	0.06	<0.06	ND	20	100	90	110	103	75	125
Chloride	DIO0134-SEP22	mg/L	0.2	<0.2	15	20	101	90	110	100	75	125
Sulphate	DIO0134-SEP22	mg/L	0.2	<0.2	3	20	99	90	110	94	75	125
Chloride	DIO0195-SEP22	mg/L	0.2	<0.2	1	20	98	90	110	99	75	125
Sulphate	DIO0195-SEP22	mg/L	0.2	<0.2	NV	20	97	90	110	NV	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

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
Total Organic Carbon	SKA5019-SEP22	mg/L	1	<1	0	20	100	90	110	96	75	125

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | 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
Carbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-002

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
Colour	EWL0075-SEP22	TCU	3	< 3	ND	10	100	80	120	NA		

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENVIEWL-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	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

Fluoride by Specific Ion Electrode

Method: SM 4500 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-014

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
Fluoride	EWL0070-SEP22	mg/L	0.06	<0.06	ND	10	103	90	110	97	75	125
Fluoride	EWL0083-SEP22	mg/L	0.06	<0.06	0	10	102	90	110	99	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

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
Mercury (total)	EHG0005-SEP22	mg/L	0.00001	< 0.00001	18	20	105	80	120	101	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-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
Silver (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	ND	20	107	90	110	99	70	130
Aluminum (total)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Aluminum (0.2µm)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Arsenic (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	2	20	102	90	110	91	70	130
Barium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	10	20	106	90	110	108	70	130
Beryllium (total)	EMS0061-SEP22	mg/L	0.000007	<0.000007	ND	20	96	90	110	88	70	130
Boron (total)	EMS0061-SEP22	mg/L	0.002	<0.002	12	20	101	90	110	99	70	130
Calcium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	101	90	110	102	70	130
Cadmium (total)	EMS0061-SEP22	mg/L	0.000003	<0.000003	ND	20	104	90	110	104	70	130
Cobalt (total)	EMS0061-SEP22	mg/L	0.000004	<0.000004	10	20	105	90	110	107	70	130
Chromium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00008	1	20	99	90	110	92	70	130
Copper (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	ND	20	103	90	110	119	70	130
Iron (total)	EMS0061-SEP22	mg/L	0.007	<0.007	ND	20	97	90	110	125	70	130
Potassium (total)	EMS0061-SEP22	mg/L	0.009	<0.009	1	20	96	90	110	114	70	130
Magnesium (total)	EMS0061-SEP22	mg/L	0.001	<0.001	0	20	95	90	110	109	70	130
Manganese (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	9	20	101	90	110	91	70	130
Molybdenum (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	3	20	102	90	110	108	70	130
Sodium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	98	90	110	110	70	130
Nickel (total)	EMS0061-SEP22	mg/L	0.0001	<0.0001	4	20	99	90	110	104	70	130
Lead (total)	EMS0061-SEP22	mg/L	0.00009	<0.00001	0	20	106	90	110	111	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 I Internal ref.: ME-CA-IENVISPE-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
Phosphorus (total)	EMS0061-SEP22	mg/L	0.003	<0.003	13	20	96	90	110	NV	70	130
Antimony (total)	EMS0061-SEP22	mg/L	0.0009	<0.0009	ND	20	98	90	110	128	70	130
Selenium (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	ND	20	102	90	110	89	70	130
Silicon (total)	EMS0061-SEP22	mg/L	0.02	<0.02	13	20	93	90	110	NV	70	130
Tin (total)	EMS0061-SEP22	mg/L	0.00006	<0.00006	ND	20	108	90	110	NV	70	130
Strontium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	0	20	104	90	110	105	70	130
Titanium (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	6	20	101	90	110	NV	70	130
Thallium (total)	EMS0061-SEP22	mg/L	0.000005	<0.000005	ND	20	96	90	110	99	70	130
Uranium (total)	EMS0061-SEP22	mg/L	0.000002	<0.000002	1	20	108	90	110	118	70	130
Vanadium (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	3	20	99	90	110	102	70	130
Zinc (total)	EMS0061-SEP22	mg/L	0.002	<0.002	2	20	101	90	110	110	70	130

pH

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-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
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		

QC SUMMARY

Reactive Phosphorus by SFA

Method: SM 4500-P F | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-004

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
Phosphorus (total reactive)	SKA0035-SEP22	mg/L	0.03	<0.03	ND	10	104	90	110	93	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

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
Total Suspended Solids	EWL0066-SEP22	mg/L	2	< 2	1	10	99	90	110	NA		

Turbidity

Method: SM 2130 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-003

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
Turbidity	EWL0064-SEP22	NTU	0.10	< 0.10	4	10	100	90	110	NA		

QC SUMMARY

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

No: 010116

Page 1 of 1

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

Laboratory Information Section - Lab use only

Received By: [signature] Received By (signature): [signature]
Received Date (mm/dd/yyyy): 09/01/2022 (mm\dd\yy) Custody Seal Present: ☐ Cooling Agent Present: ☑ Ice
Received Time: 11:30 Custody Seal Intact: ☐ Temperature Upon Receipt (°C): 9.C.3 LAB LIMS #: 40012-13

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Engineering LTD	☑ (same as Report Information)	Quotation #: P.O. #:
Contact: Rachel Bourassa	Company:	Project #: 33309 Site Location/ID: Emo, ON
Address: 2010 Winston Park Dr #103 Oakville ON L6M 5R7	Contact:	**TURNAROUND TIME (TAT) REQUIRED**
Phone: 416 523 1015	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: rbourassa@thurber.ca	Phone:	**RUSH TAT (Additional Charges May Apply):** ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
Email:	Email:	**PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION**
		Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☑ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

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

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

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 ☐ VOC ☐ BTEX ☐ 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:	TSS	Lab Filtered Metals	Water Characterization Package (general)	* Corrosivity	COMMENTS:
1	Lyon Creek SW	Aug 28/22		15	Water											✓	✓	✓	✓	
2	22-07	Aug 28/22		14	Water											✓	✓	✓		
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions * Corrosivity Includes pH, Soluble Sulphate, Chloride, Resistivity, Electrical Conductivity.

Sampled By (NAME): Greg Stanhope	Signature: GS	Date: Aug 28 / 2022 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Rachel Bourassa	Signature: Rachel Bourassa	Date: Aug / / 2022 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

THURBER

Appendix C

Site Photographs

Photo 1: Looking North at Lyon Creek Culvert, August 28, 2022

Photo 2: Looking West along HWY 602 at Lyon Creek Culvert, August 28, 2022

Photo 3: Looking south at Lyon Creek Culvert, August 22, 2022

Photo 4: Looking East along HWY 602 from Lyon Creek Culvert, August 28, 2022

Photo 5: Looking North from Lyon Creek Culvert, August 22, 2022

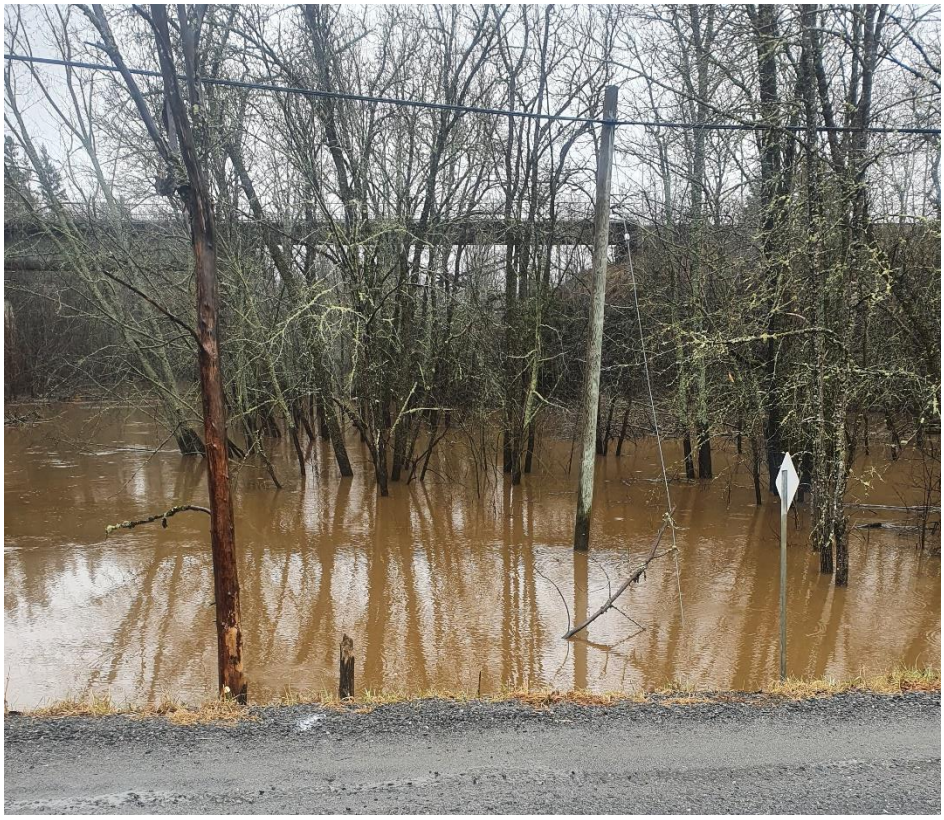


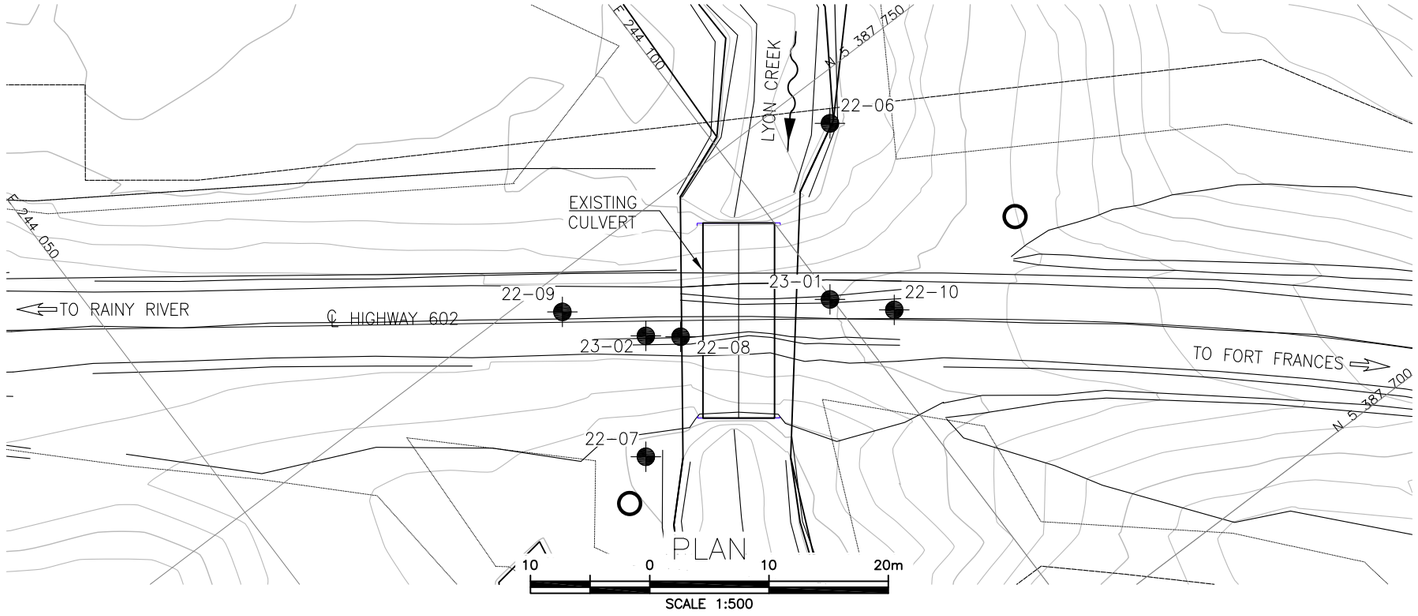
Photo 6: Looking South from HWY 602 at flooding of Lyon Creek, May 4, 2022

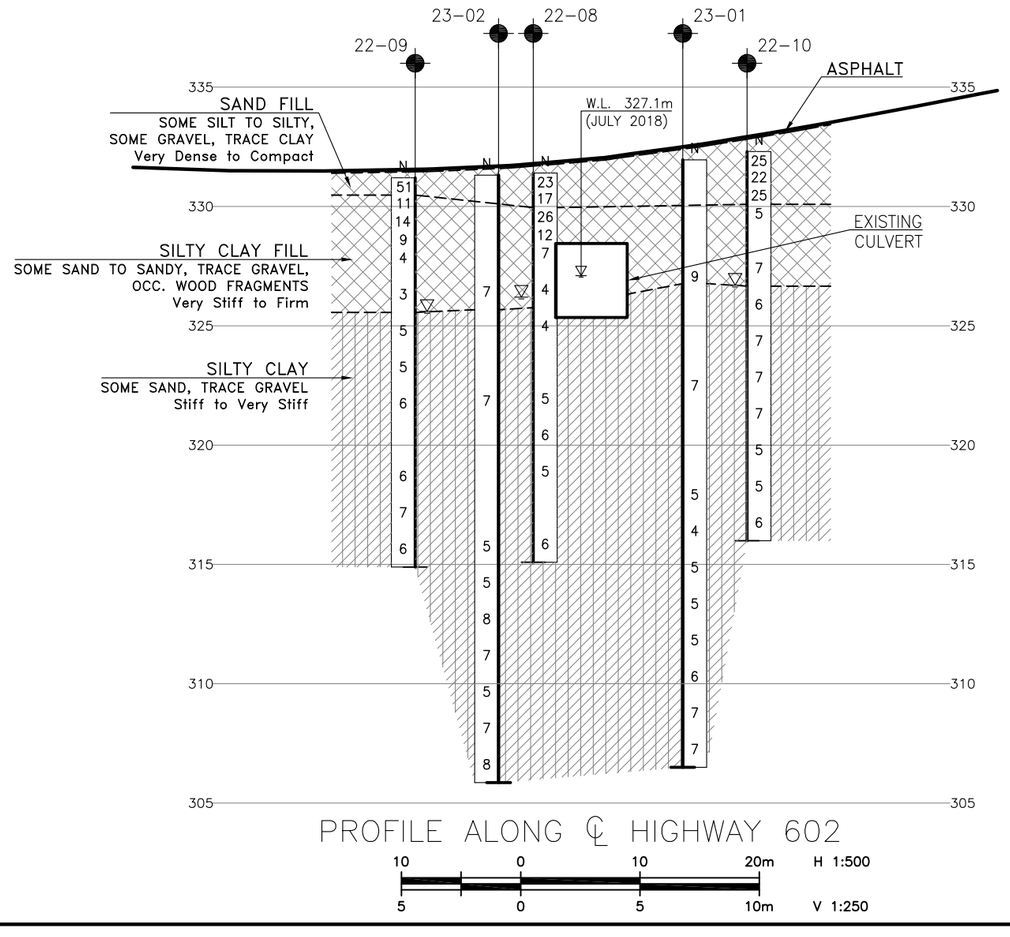
THURBER

Appendix D

Borehole Locations and Soil Strata Drawings

MINISTRY OF TRANSPORTATION, ONTARIO





METRIC

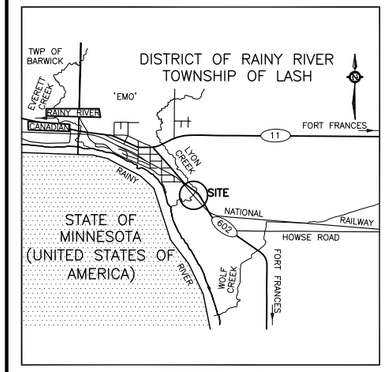
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No 2023-6036
GWP No 6030-22-00

HIGHWAY 602
CULVERT CROSSING AT
LYON CREEK
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 12

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
22-06	327.1	5 387 746.3	244 108.8
22-07	327.8	5 387 733.4	244 079.6
22-08	331.4	5 387 739.6	244 088.0
22-09	331.2	5 387 747.3	244 081.4
22-10	332.3	5 387 730.6	244 103.6
23-01	332.0	5 387 734.6	244 099.9
23-02	331.3	5 387 741.5	244 085.7

-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 16.

GEOCRES No. 52C-65

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct. 17, 2023
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.E. FARRANT
100053767
Oct. 17, 2023
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RB	CHK	MEF	CODE	LOAD	DATE	OCT 2023
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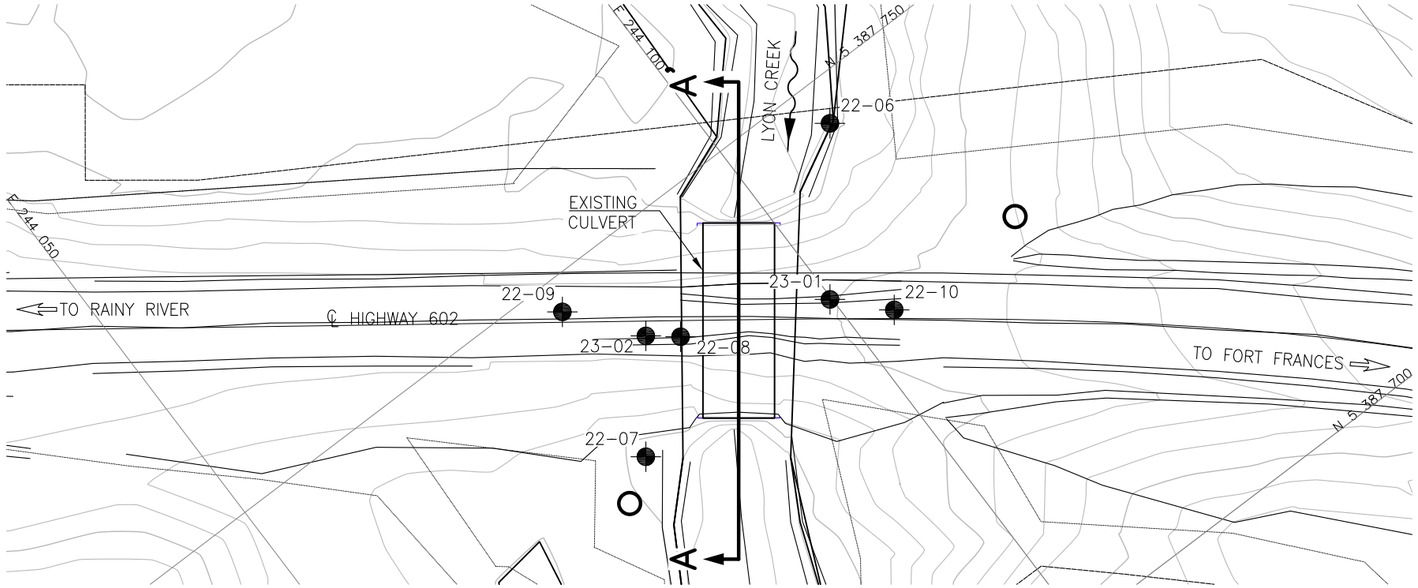
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

10 0 10 20m

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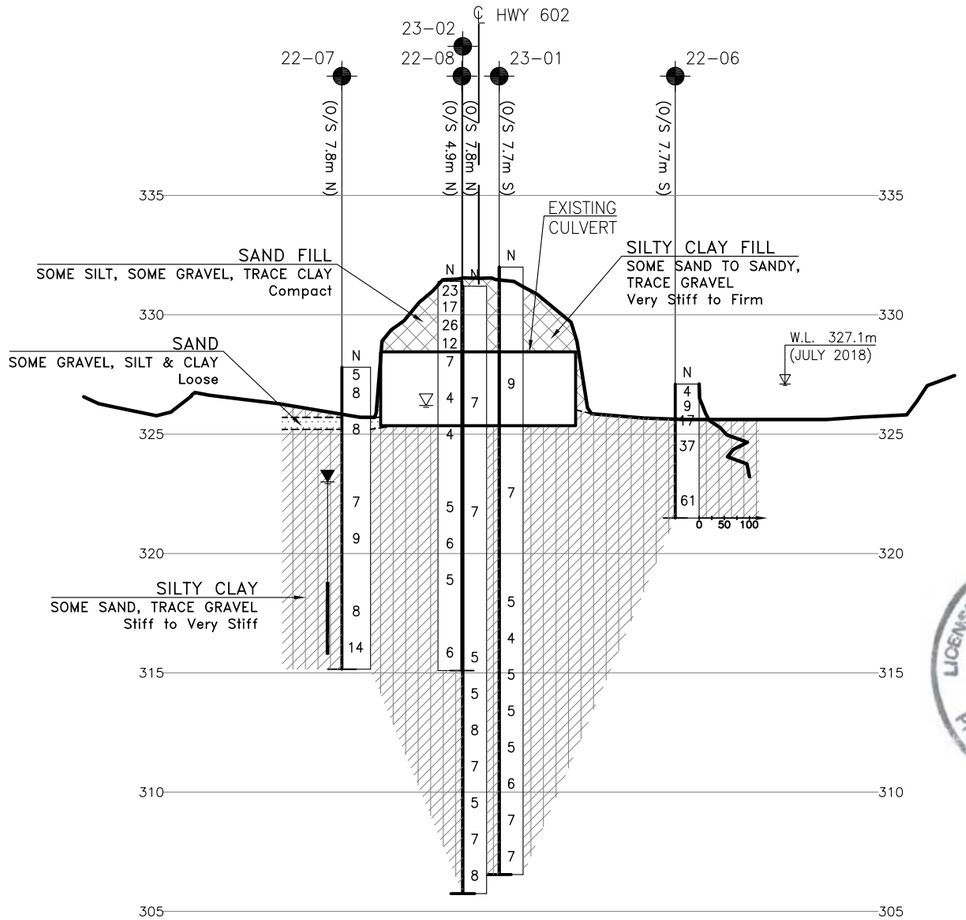


PROFILE ALONG A–A'

10 0 10 20m H 1:500

5 0 5 10m V 1:250

METRIC

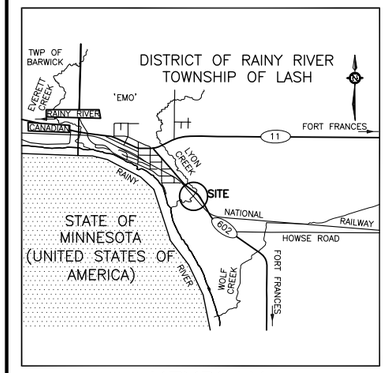
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No 2023-6036
GWP No 6030-22-00

HIGHWAY 602
CULVERT CROSSING AT
LYON CREEK
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 13

THURBER ENGINEERING LTD.



KEYPLAN

	LEGEND
●	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▼	Head Artesian Water
▮	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
22-06	327.1	5 387 746.3	244 108.8
22-07	327.8	5 387 733.4	244 079.6
22-08	331.4	5 387 739.6	244 088.0
22-09	331.2	5 387 747.3	244 081.4
22-10	332.3	5 387 730.6	244 103.6
23-01	332.0	5 387 734.6	244 099.9
23-02	331.3	5 387 741.5	244 085.7

-NOTES-

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3) Coordinate system is MTM NAD 83 Zone 16.

GEOCRES No. 52C-65

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Oct. 17, 2023
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.E. FARRANT
100053767
Oct. 17, 2023
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RB	CHK	MEF	CODE	LOAD	DATE	OCT 2023
DRAWN	AN	CHK	RB	SITE 45X-0151/C0	STRUCT	DWG	3

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