

FINAL REPORT

Foundation Investigation and Design Report

High Mast Light Poles

Highway 417 Aviation Parkway to Ramsayville Road

Ottawa Ontario

G.W.P. 4099-11-00

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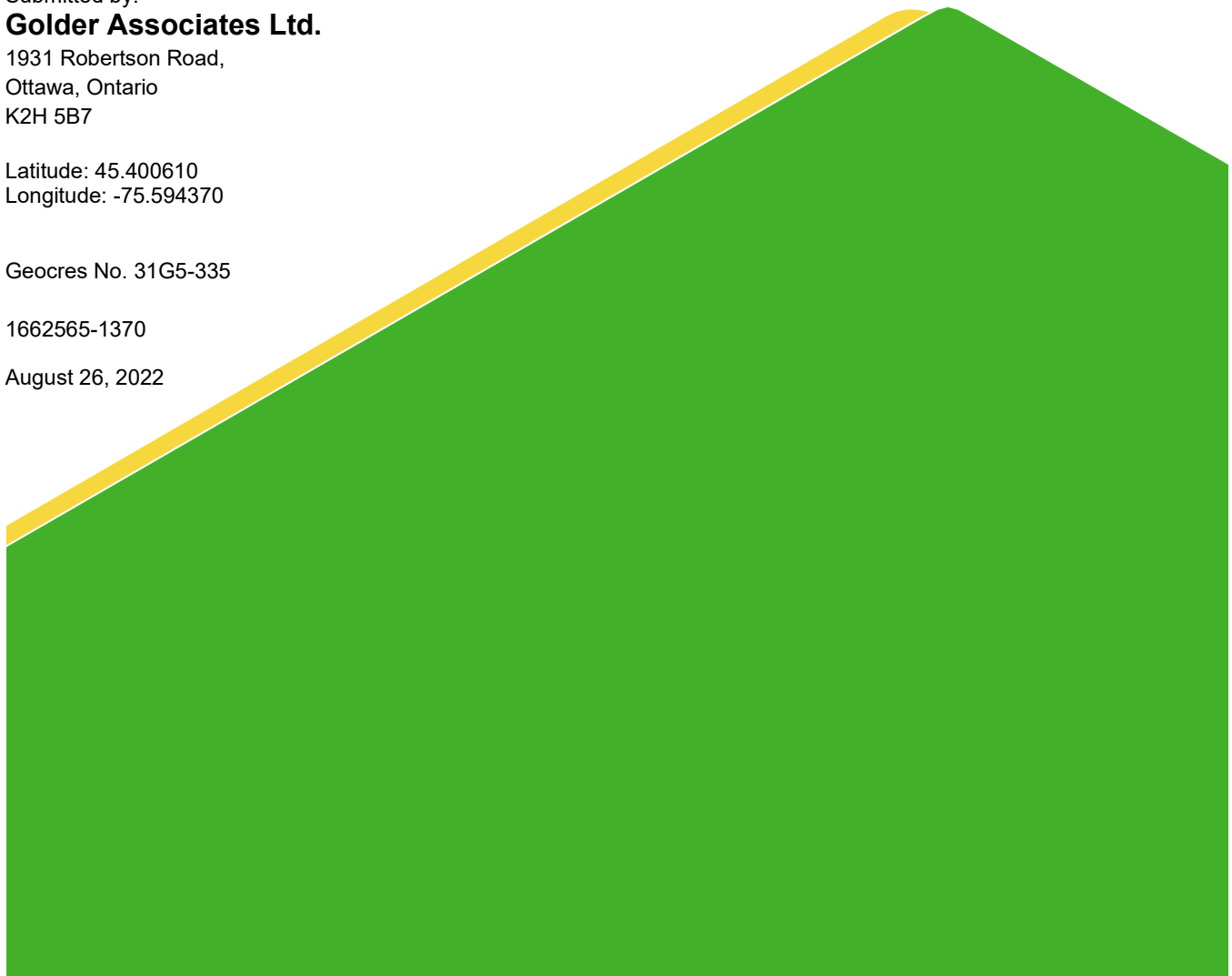
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PART A

Foundation Investigation
High Mast Light Poles
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, Ontario
G.W.P. 4099-11-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by WSP Canada Group Limited (WSP) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations associated with numerous bridge and structural culvert rehabilitations and/or replacements on Highway 417 between the Aviation Parkway and Ramsayville Road as well as the widening of Highway 417 from Ottawa Road (OR) 174 to Hunt Club Road in Ottawa, Ontario (Assignment number 4016-E-0008).

This report presents the results of the foundation investigation carried out to provide foundation design recommendations for the design of 39 new high mast lights (HML) on Highway 417 between Ottawa Road 174 and Walkley Road.

The terms of reference and scope of work for the foundation investigation are outlined in the MTO's Request for Proposal (RFP), dated May 2016, and subsequent addenda. Golder's scope of work for foundation engineering services associated with these HMLs is contained in Table 17.8.3 of WSP's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Quality Control Plan for foundation engineering services for this project, dated March 13, 2017.

The scope of work for the foundation engineering services associated with this investigation was outlined in Golder's Scope Change #5 dated April 7, 2020. The investigation program was developed to meet the requirements of Table 17.8.3 of the RFP Terms of Reference.

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 Site Description.

Highway 417 is a divided highway with two travel lanes in each direction separated by a wide, vegetated median. Based on the design drawing provided by WSP, the majority of the new HMLs will be located within the median. There are several median culvert crossings, creeks and other buried infrastructure within the median. Also, several sections of the median form relatively steep valleys that could make accessing the proposed locations difficult. Cattails and wet areas were also noted at various locations during the field investigation.

2.2 Regional Geology

As delineated in *The Physiography of Southern Ontario*¹, this section of Highway 417 lies within the minor physiographic region known as the Ottawa Valley Clay Plain, which lies within the major physiographic region of the Ottawa-St. Lawrence Lowland.

The Ottawa Valley Clay Plain region is characterized by relatively thick deposits of sensitive marine clay, silt and silty clay that were deposited within the former Champlain Sea basin. These deposits, known as the Champlain Sea clay, overlie relatively thin, commonly reworked glacial till and glaciofluvial deposits, that in turn overlie bedrock.

This region is underlain by a series of sedimentary rocks, consisting of sandstones, dolostones, limestones and shales that are, in turn, underlain at depth by igneous and metamorphic bedrock of the Precambrian Shield. Regional bedrock mapping indicates that the bedrock at this site is primarily Carlsbad Formation shale bedrock.

¹ Chapman, L. J. and Putnam, D. F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources.

West of Innes Road the bedrock transitions to Billings Formation shale bedrock. It should be noted that the Billings Formation shale is susceptible to swelling if exposed to oxygen.

The site falls within the Western Québec (WQ) seismic zone according to the Geological Survey of Canada. The WQ zone constitutes a large area which encompasses the urban areas of Montreal, Ottawa-Hull and Cornwall. Within the WQ zone recent seismic activity has been concentrated in two subzones: one along the Ottawa River and another more active subzone along the Montreal-Maniwaki axis. The two major earthquakes in the WQ zone includes the 1935 Témiscaming event which had a magnitude (i.e., a measure of the intensity of the earthquake) of 6.2, and the 1944 Cornwall-Massena event which had a magnitude of 5.6.

3.0 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out in two parts, the first during summer 2020 and a second investigation in the winter of 2020. During those times, forty boreholes were advanced; one per HML pole location except at Pole 36 where an open void was encountered within the fill materials at the borehole. An alternative location for Pole 36 was provided after consultation with WSP and MTO where an additional borehole was advanced where the void was not encountered. Plans are underway with MTO to return to the void location and attempt to assess the circumstances and fill the void with grout. The borehole locations are shown on Drawings 1 to 6 and are summarized in Table 1.

The boreholes were advanced using track mounted drilling equipment supplied and operated by Marathon Underground Constructors Corporation of Greely, Ontario.

Traffic control required to close the driving lanes of Highway 417 while carrying out the field operations was provided by Beacon Lite Limited of Ottawa, Ontario.

Soil samples were obtained using a 50 mm outer diameter split-spoon sampler in general accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). In-situ vane testing was carried out within the cohesive deposits, using an MTO N-size vane, with the reaction (torque) measured by a pair of calibrated scales, to measure the undrained shear strength of the cohesive soils. After measuring the undrained shear strength, remoulded shear strengths were also measured at selected intervals. Where bedrock was encountered at the boreholes, core samples were obtained using NQ or HQ diamond drilling equipment.

Piezometers were installed in eleven boreholes to observe the stabilised groundwater level across the site. Each piezometer consists of a 32 mm outside diameter PVC tubing with a 1.5 m long slotted tip. The groundwater levels were measured in the piezometers on either September 15, 2020 or January 6, 2021.

The boreholes were backfilled with bentonite mixed with soil cuttings within the overburden. The boreholes were then capped with either asphaltic concrete cold patch or granular material, depending on the surrounding surface cover. The boreholes were backfilled in general accordance with the intent of O.Reg 903, as amended. The site conditions were restored following completion of the field work.

The fieldwork was supervised on a full-time basis by members of Golder's staff who located the boreholes in the field, directed the drilling, sampling, and in-situ testing operations, logged the boreholes and examined and cared for the samples. The soil and bedrock core samples were identified in the field, placed in labelled containers, and transported to Golder's laboratory in Ottawa for further examination and testing. Index and classification tests consisting of water content determinations Atterberg Limits, and grain size distribution analyses were carried out on selected soil samples at Golder's Ottawa laboratory. Uniaxial Compressive Strength (UCS) testing was carried

out on bedrock core samples at Stantec's Ottawa laboratory. The laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate.

Soil samples were submitted to Eurofins Environment Testing for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack).

The borehole locations and elevations were surveyed by Golder using a Trimble R10 GPS unit referenced to the NAD83 CSRS CBNv6-2010.0 MTM Zone 9 geodetic datum. The borehole locations, including northing and easting coordinates, ground surface elevations, and drilled depths, are summarized in Table 1.

Table 1: Borehole Location Summary

Pole	Borehole	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Drilled Length (m)
		Northing (m)	Easting (m)		
Section 1 – Cyrville Road to CPR					
P13	20-1370-13	5031444.2	374152.8	65.1	4.7
P14	20-1370-14	5031306.7	374175.5	64.7	4.0
P15	20-1370-15	5031178.5	374205.1	64.2	3.7
P16	20-1370-16	5031061.0	374254.1	64.1	4.9
P17	20-1370-17	5030962.5	374315.7	63.1	5.6
P32	20-1370-32	5030723.2	374764.1	65.2	12.0
P33	20-1370-33	5030694.9	374922.4	68.3	10.5
P34	20-1370-34	5030635.0	375077.6	71.8	10.5
Section 2 – CPR to Walkley Road					
P35	20-1370-35	5030544.7	375196.1	73.8	10.5
P36	20-1370-36	5030435.0	375290.6	71.8	9.1
P36	20-1370-36A	5030435.7	375289.9	71.5	10.5
P37	20-1370-37	5030320.9	375348.8	69.7	10.5
P38	20-1370-38	5030208.6	375378.2	67.9	10.4
P39	20-1370-39	5030095.4	375405.8	66.7	10.4
P40	20-1370-40	5029984.9	375438.6	66.2	10.4
P41	20-1370-41	5029880.3	375482.4	65.9	10.4

Pole	Borehole	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Drilled Length (m)
		Northing (m)	Easting (m)		
Section 3 – West of Walkley Road					
P74	20-1370-74	5029657.9	375609.1	64.4	10.2
P75	20-1370-75	5029570.3	375663.2	64.3	12.3
P76	20-1370-76	5029468.7	375719.3	63.8	11.0
P77	20-1370-77	5029329.2	375773.2	62.8	9.8
P78	20-1370-78	5029178.9	375807.8	64.4	11.8
P79	20-1370-79	5029131.8	375712.6	65.6	10.1
P98	20-1370-101	5029035.8	375928.9	65.7	11.6
P99	20-1370-102	5028970.0	375829.0	66.2	11.9
P106	20-1370-103	5028787.2	375833.3	68.4	10.7
P107	20-1370-112	5028629.1	375842.8	66.7	10.7
P108	20-1370-113	5028458.9	375872.5	64.4	13.4
P109	20-1370-114	5028283.0	375919.7	66.2	10.3
P110	20-1370-115	5028130.2	375988.9	66.1	12.2
P111	20-1370-116	5027986.6	376071.7	70.4	13.2
P112	20-1370-117	5027843.5	376174.1	67.1	7.8
P113	20-1370-118	5027738.2	376283.9	68.9	11.0
P114	20-1370-119	5027628.5	376196.1	67.1	6.4
P115	20-1370-126	5027649.7	376392.3	66.1	7.9
P117	20-1370-127	5027692.2	376561.7	66.1	8.6
P118	20-1370-128	5027536.7	376531.2	66.5	8.2
P119	20-1370-129	5027542.3	376617.5	66.6	9.3
P120	20-1370-130	5027421.8	376698.1	65.9	9.8
P123	20-1370-131	5027318.7	376822.4	67.1	13.9
P121	20-1370-132	5027344.1	376532.1	68.1	12.2

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 General

The subsurface soil, bedrock and groundwater conditions encountered in the boreholes and the results of in-situ testing from the investigation are given on the Record of Borehole, and Drillhole sheets presented in Appendix A. The results of the laboratory testing carried out during the investigation are presented on the Record of Borehole and Drillhole sheets as well as on Figures B1 to B30 in Appendix B. The borehole locations are also provided on Drawings 1 to 6.

Photographs of the bedrock core recovered at the boreholes are shown on Figures A1 to A50 provided in Appendix A. The results of basic chemical analysis completed on select soil samples are provided in Appendix C.

A borehole was advanced at each proposed HML location. Reference to the borehole associated with the HML location should be made to identify the anticipated soil conditions and founding conditions. Table 9 following the text of this report, summarizes the soil stratigraphy at each pole location.

The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from observations of drilling progress and noncontinuous sampling and therefore represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

4.2 Site Stratigraphy Overview

Table 9 following the text of this report, summarizes the soil stratigraphy for the soils encountered at each borehole location.

The soil and bedrock stratigraphy varies along Highway 417 as shown on the Record of Boreholes. The site alignment can be divided into 3 sections based on the soil and bedrock conditions encountered at the borehole locations. Section 1, from Cyrville Road to west of Highway 417 overpass of the CNR railway tracks (just east of Innes Road) at the boreholes, the subsurface conditions generally consist of varying embankment fill overlying shale bedrock. Section 2, between Innes Road and Walkley Road in general the subsurface conditions consist of varying embankment fill overlying a native sand. Section 3 east of Walkley Road, the subsurface conditions generally consist of a thin layer of varying embankment fill overlying a native clay overlying glacial till deposits overlying shale bedrock.

The following is a general summary of the soils encountered at the various borehole locations across the site. Reference should be made to the corresponding Record of Borehole and Drillhole sheets for the specific soil and bedrock stratigraphy at each pole location.

4.3 Section 1: Highway 417 – Cyrville Road to east of Innes Road

Boreholes 20-1370-13 to 20-1370-17 and 20-1370-32 to 20-1370-34 were advanced at the locations shown on Drawing 1. A detailed description of the subsurface conditions encountered in these boreholes is provided in the following section.

4.3.1 Surface Cover / Surficial Materials

Topsoil with thicknesses ranging from 300 to 600 mm was encountered at the surface at Boreholes 20-1370-14, and 32 to 34.

4.3.2 Fill

Non-cohesive fill consisting predominantly of sand with varying amounts of gravel and silt, was encountered at the ground surface at Boreholes 20-1370-13 and 20-1370-17, below the cohesive fill at Boreholes 20-1370-32 and 20-1370-33 and below the topsoil at Borehole 20-1370-34. The top of this layer was encountered at elevations ranging from 62.8 and 71.2 m. The total thickness of this layer ranges from about 0.5 m at Borehole 20-1370-13 (west end) to greater than 9.6 m at Borehole 20-1370-34 (east end). Boreholes 20-1370-33 and 34 were terminated in this layer. The SPT N values ranged from 7 to 93 blows per 0.3 m of penetration but more typically 18 to 30 indicating a compact state of compactness. The measured moisture contents of 11 tested samples of non-cohesive fill material ranged from 3 to 26%. The results of grain size analysis testing carried out on 11 samples of non-cohesive fill are provided on Figures B1 to B3 in Appendix B.

Cohesive fill consisting predominantly of clayey silt or silty clay, with varying amounts of sand and gravel, was encountered at the ground surface at Boreholes 20-1370-15 and 16, below the topsoil at Boreholes 20-1370-32 and 33 and between layers of the non-cohesive fill at Boreholes 20-1370-33 and 34. The top of this layer was encountered at elevations ranging from 63.0 and 67.7 m. The total thickness of this layer ranges from about 0.3 m at Borehole 20-1370-15 (west end) to 2.3 m at Borehole 20-1370-33 (east end). The SPT N values ranged from 7 to 23 blows per 0.3 m of penetration indicating a stiff to very consistency. The measured moisture content of a single sample tested was 23%.

4.3.3 Sand and Gravel

Sand with gravel was encountered beneath the sand (non-cohesive) fill at Borehole 20-1370-32. The top of this layer was encountered at Elevation 57.6 m and the layer is about 1.1 m thick.

An SPT N value of 46 blows per 0.3 m of penetration was recorded in this layer, indicating a dense state of compactness. The higher refusal blow counts (i.e., >50) noted on the Record of Borehole for the sand layer may have been influenced by the presence of bedrock, rather than the compactness of the soil matrix. The measured moisture content of the single sample tested was 9%. The results of grain size analysis testing carried out on a single sample of the sand and gravel material is provided on Figure B4 in Appendix B.

4.3.4 Glacial Till

A deposit of glacial till was encountered beneath the silty clay fill at Borehole 20-1370-16. The glacial till generally consists of a heterogeneous mixture of sand gravel and silt. Shale bedrock fragments were also encountered in this layer. The thickness of the till layer was 0.6 m. The higher refusal blow counts (i.e., >50) noted on the Record of Borehole for the glacial till layer may have been influenced by the presence of bedrock, rather than the compactness of the soil matrix.

4.3.5 Section 1 – Bedrock

Bedrock was proven by coring using NQ and HQ sized equipment at Boreholes 20-1370-13 to 20-1370-17 and 20-1370-32. Photographs of the bedrock core obtained at the boreholes are shown on Figures A1 to A12 provided in Appendix A.

Table 2 summarizes the depths and the elevations of the bedrock surface as encountered at the borehole locations.

Table 2: Section 1 – Summary of Bedrock and Refusal Depths and Elevations

Pole	Borehole	Ground Surface Elevation (m)	Depth ¹ to Competent Bedrock Surface / Auger Refusal (m)	Elevation of Competent Bedrock Surface / Auger Refusal (m)
P13	20-1370-13	65.1	1.7	63.4
P14	20-1370-14	64.7	0.6	64.1
P15	20-1370-15	64.2	0.6	63.6
P16	20-1370-16	64.1	1.7	62.4
P17	20-1370-17	63.1	2.6	60.5
P32	20-1370-32	65.2	8.8	56.4

Notes: ¹ The upper portion of bedrock at Boreholes 20-1370-13, 15, 17 and 32 is highly weathered and was able to be penetrated by augers and/or the split spoon sampler during drilling.

The majority of the bedrock consists of slightly weathered to fresh, thinly to medium bedded, black, fine grained shale of the Billings formation shale. It should be noted that the Billings Formation shale is susceptible to swelling if exposed to oxygen. East of Innes Road the bedrock at the boreholes transitions to Carlsbad formation shale.

The Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from approximately 0 to 92%, but generally ranged between 35 to 77% indicating a poor to good quality rock.

Results of unconfined compressive strength (UCS) testing carried out on six bedrock core samples are presented on Figure B5 provided in Appendix B. The samples tested had UCS values ranging from 63 to 90 MPa indicating a strong bedrock.

4.3.6 Section 1 – Groundwater Conditions

A piezometer was installed in Boreholes 20-1370-33 to monitor the groundwater level.

Table 3 summarizes the depths and the elevations of the groundwater levels measured in the piezometer installed in Section 1.

The groundwater level was measured at a depth of 1.5 m below the ground surface in Borehole 20-1370-32 in the open borehole prior to carrying out coring operations.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 3: Section 1 – Summary of Groundwater Conditions

Pole	Borehole	Type	Screened Interval	Ground Surface Elevation (m)	Depth (m)	Elevation (m)	Date
P32	20-1370-32	Open borehole	N/A	65.2	1.5	63.7	January 4, 2021
P33	20-1370-33	Piezometer	Fill - Gravelly sand	68.3	2.3	66.0	January 6, 2021

4.4 Section 2: Highway 417 – Innes Road to Walkley Road

Boreholes 20-1370-35 to 20-1370-41 were advanced at the locations shown on Drawings 2 and 3. A detailed description of the subsurface conditions encountered in these boreholes is provided in the following section.

4.4.1 Surface Cover / Surficial Materials

Topsoil with thicknesses ranging from 25 to 600 mm but more typically 200 to 600 was encountered at the surface at Boreholes 20-1370-35, 36 and 38 to 41.

4.4.2 Fill

Based on the results of the borehole investigation the embankment fill was constructed with alternating layers of cohesive and non-cohesive materials. At each pole location the strata varied in thickness and material type. The following sections give an overall summary of fill material however reference to the Record of Boreholes and Drillhole sheets in Appendix A is required to determine site specific soils stratigraphy for each pole location.

Non-cohesive fill consisting predominantly of sand with varying amounts of gravel and silt, was encountered below the topsoil in Borehole 20-1370-41 and in alternating layers with the cohesive fill described below at Boreholes 20-1370-35 to 39. The thickness of the layers ranges from about 0.4 to 3.2 m. The SPT N values ranged from 7 to 93 blows per 0.3 m of penetration but more typically 7 to 29 indicating loose to compact state of compactness. The measured moisture contents of ten samples tested ranged from 3 to 18%. The results of a grain size analysis test carried out on seven samples of the non-cohesive fill material are provided on Figures B6 and B7 in Appendix B.

Borehole 20-1370-35 was terminated within the fill.

Cohesive fill consisting predominantly of clayey silt or silty clay, with varying amounts of sand and gravel, was encountered in alternating layers with the non-cohesive fill described above at all boreholes advanced in Section 2 except 20-1370-41. The cohesive fill was encountered below the topsoil or at ground surface at all the boreholes advanced in Section 2 except 20-1370-41. The thickness of the layers ranges from about 0.9 to 2.1 m. The SPT N values ranged from Weight of Hammer (WH) to 48 blows per 0.3 m of penetration but more typically 2 to 11 indicating a stiff to very stiff consistency. Cobbles were noted at Borehole 20-1370-35 which would account for the higher SPT N value of 48 recorded on the Record of Borehole. The measured moisture contents of seven samples tested ranged from 21 to 41%. The results of a grain size analysis test carried out on two samples of the cohesive fill material are provided on Figure B8 in Appendix B.

4.4.3 Buried Peat and Topsoil

A layer of buried peat and topsoil was encountered beneath the fill materials at Borehole 20-1370-37. The top of this layer was encountered at Elevation 65.9 m and the layer is about 0.8 m thick.

The measured moisture content of a single sample of the peat material was 245%. The result of organic content testing on the peat material indicated an organic content of about 47%.

4.4.4 Open Void

An open void was encountered within the fill materials in Borehole 20-1370-36. The void was encountered at Elevation 66.6 m and is approximately 3.9 m deep. An alternative location for Pole 36 was provided and a new

Borehole 20-1370-36A was advanced where the void was not encountered. Plans are underway with MTO to return to the void location and attempt to assess the circumstances and fill the void with grout.

4.4.5 Sand to Gravel and Sand

Sand with varying amounts of gravel and silt was encountered beneath the non-cohesive fill at Boreholes 20-1370-39 and 41 below the silt and sand at Borehole 20-1370-37 and 38 and below the silt in Borehole 20-1370-40. The top of this layer was encountered at elevations ranging from 60.7 and 64.9 m. The thickness of this layer where fully penetrated at Boreholes 20-1370-39 and 41 was 2.2 and 6.9 m respectively. Boreholes 20-1370-37, 38 and 40 were terminated in this material.

The SPT N values ranged from 8 to 32 blows per 0.3 m of penetration but more typically 8 to 21 indicating a loose to compact state of compactness. The measured moisture contents of the eleven samples tested ranged from 10 to 26%. The results of a grain size analysis test carried out on eight samples of sand to gravel and sand material are provided on Figure B9 and B10 in Appendix B.

4.4.6 Sand and Silt

Sand and silt with varying amounts of gravel was encountered beneath the peat material at Borehole 20-1370-37, and below the clayey silt at Borehole 20-1370-38. The top of this layer was encountered at Elevations 65.1 and 65.8 m. The thickness of this layer where fully penetrated at Borehole 20-1370-38 was 1.0 m. Borehole 20-1370-37 was terminated in this material. Boreholes 20-1370-36A was terminated in this material.

The SPT N values ranged from 4 to 13 blows per 0.3 m of penetration indicating a loose to compact state of compactness. The measured moisture contents of two samples tested were 18 and 22%. The results of grain size analysis testing carried out on three samples of the sand and silt material are provided on Figure B11 in Appendix B.

4.4.7 Clayey Silt and Clay

A clay deposit was encountered below the fill materials at Boreholes 20-1370-38 and 40 at Elevations 66.2 and 64.7 m, respectively. The thickness of the clay layer was 0.4 and 2.0 m at Boreholes 20-1370-38 and 40 respectively. The SPT N values ranged from WH to 5 blows per 0.3 m of penetration. In-situ shear vane test results indicate the undrained shear strength of the clay was 55 to more than 95 kPa, indicating a stiff to very stiff consistency.

The moisture content of two tested samples was 22 and 42%. The results of Atterberg Limits testing completed on two samples of the clayey silt material indicate liquid limits of 33 and 53, plastic limits of 15 and 21 and plasticity indices of 18 and 32. The Atterberg Limits analysis results are illustrated on Figure B12 in Appendix B and indicate a clayey silt to clay (CL to CH) with low and high plasticity, respectively.

4.4.8 Silt

Silt was encountered beneath the clay material at Borehole 20-1370-40. The top of this layer was encountered at Elevation 62.7 m and the layer is about 0.6 m thick.

The measured moisture content of the single sample tested was 15% and the results of Atterberg Limits testing completed on one sample of the silt material indicate a liquid limit of 17, plastic limit of 14 and a plasticity index of 3. The Atterberg Limits analysis results are illustrated on Figure B13 in Appendix B and indicate a low plasticity silt (ML).

4.4.9 Glacial Till

A deposit of glacial till was encountered beneath the sand and gravel at Borehole 20-1370-39 and the sand layer at Borehole 20-1370-41. The glacial till generally consists of a heterogeneous mixture of sand gravel and silt. Shale bedrock fragments were also encountered in this layer. Cobbles and boulders were encountered at Borehole 20-1370-39 and coring techniques were required to advance the borehole. Both Boreholes 20-1370-39 and 41 were terminated in this layer.

The SPT N values ranged from 17 to 34 blows per 0.3 m of penetration indicating a loose to compact to dense state of compactness. The higher refusal blow counts (i.e., 50/0.130 and 102) noted on the Record of Borehole for till layer may have been influenced by the presence of cobbles and boulders, rather than the compactness of the soil matrix. The measured moisture contents of the single sample tested was 12%. The results of a grain size analysis test carried out on three samples of the till material are provided on Figure B14 in Appendix B.

4.4.10 Section 2 – Groundwater Conditions

Piezometers were installed in Boreholes 20-1370-38 and 41 to monitor the groundwater level.

Table 4 summarizes the depths and the elevations of the groundwater levels measured at the boreholes and piezometers installed in Section 2.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 4: Section 2 – Summary of Groundwater Conditions

Pole	Borehole	Type	Screened Interval	Ground Surface Elevation (m)	Depth (m)	Elevation (m)	Date
P35	20-1370-35	Open borehole	N/A	73.8	8.4	65.4	December 22, 2020
P36	20-1370-36A	Open borehole	N/A	71.5	7.7	63.8	December 22, 2020
P37	20-1370-37	Open borehole	N/A	69.7	4.5	65.2	December 21, 2020
P38	20-1370-38	Piezometer	Sand	67.9	4.7	63.2	September 15, 2020
P39	20-1370-39	Open borehole	N/A	66.7	3.8	62.9	July 21, 2020
P40	20-1370-40	Open borehole	N/A	66.2	2.9	63.3	July 20, 2020
P41	20-1370-41	Piezometer	Glacial Till	65.9	2.7	63.2	September 15, 2020

4.5 Section 3: Highway 417 West of Walkley Road

Boreholes 20-1370-74 to 79, 20-1370-101 to 103, 20-1370-112 to 119 and 20-1370-126 to 132 were advanced at the at the locations shown on Drawings 3 to 6. A detailed description of the subsurface conditions encountered in these boreholes is provided in the following section.

4.5.1 Surface Cover / Surficial Materials

Topsoil with thicknesses ranging from 100 to 300 mm was encountered at the surface of all boreholes advanced in Section 3.

4.5.2 Fill

Cohesive fill consisting predominantly of clayey silt or silty clay, with varying amounts of sand and gravel, was encountered below the topsoil at Boreholes 20-1370-74, 77, 115, 117, 118, and 130, below the sand and gravel fill at Borehole 20-1370-132 and below the buried topsoil at Borehole 20-1370-116. The top of this layer was encountered at elevations ranging from 64.3 and 69.5 m. The thickness of this layer ranges from about 0.4 to 3.8 m. The SPT N values ranged from WH to 15 blows per 0.3 m of penetration but more typically 6 to 9 indicating a stiff consistency. The measured moisture contents of three samples tested ranged from 25 to 34%. The results of a grain size analysis test carried out on two samples of this material are provided on Figure B15 in Appendix B. The results of Atterberg Limits testing completed on a single sample of the clay fill indicate a liquid limit of 51, a plastic limit of 20 and a plasticity index of 31. The Atterberg Limits analysis results are illustrated on Figure B16 in Appendix B and indicate a clay of high plasticity (CH).

Non-cohesive fill consisting predominantly of sand with varying amounts of gravel and silt, was encountered below the topsoil at Boreholes 20-1370-101 to 103, 113, 114, 127 to 129, and 132 and at the ground surface at Borehole 20-1370-116. The top of this layer was encountered at elevations ranging from 64.2 and 70.4 m. The thickness of this layer ranges from about 0.3 to 2.0 m. The SPT N values ranged from 5 to 23 blows per 0.3 m of penetration but more typically 8 to 13 indicating a loose to compact state of compactness. The results of a grain size analysis test carried out on a single sample of gravel fill material are provided on Figure B17 in Appendix B.

4.5.3 Buried Topsoil

A layer buried topsoil was encountered beneath the sand fill material at Borehole 20-1370-116. The top of this layer was encountered at Elevation 69.7 m and the layer is about 0.2 m thick.

4.5.4 Clay

A clay deposit was encountered beneath the surficial topsoil, silty sand or fill layers at all boreholes advanced in Section 3.

The entire deposit or the upper portion of the deposit, depending on location, has been weathered to a stiff crust. The top of this layer was encountered at elevations ranging from 60.8 and 67.3 m. The thickness of this layer ranges from about 0.4 to 3.8 m. The SPT N values ranged from 1 to 16 blows per 0.3 m of penetration but more typically 5 to 12. In-situ shear vane test results indicate the undrained shear strength of the grey weathered clay ranges from 58 to greater than 96 kPa, indicating a stiff to very stiff consistency. The ratio of the measured in-situ natural shear strength to the remolded shear strength ranges from 4 to 5, as such the clay crust is classified as sensitive in accordance with Section 3.1.3.4 the Canadian Foundation Engineering Manual (CFME)

The moisture content of 30 samples of the clay crust tested ranged from 13 to 49%. The results of grain size analysis testing carried out on four samples of this material are illustrated on Figure B18 in Appendix B. The results of Atterberg Limits testing completed on 16 samples of weathered clay crust indicate liquid limits ranging from 32 to 74, plastic limits ranging from 18 to 25 and plasticity indices ranging from 18 to 53. These Atterberg Limits testing results indicate a clay of low to high plasticity, but more typically high plasticity (CH). The Atterberg Limits analysis results are illustrated on Figures B19 and B20 in Appendix B.

The clay below the depth of weathering is grey (except at boreholes 20-1370-74, 20-1370-101, 20-1370-117 to 20-1370-119, where the full depth of the deposit is weathered). The top of this layer was encountered at elevations ranging from 60.1 and 64.8 m. The thickness of this layer where fully penetrated ranges from about 0.3 to 4.8 m. Boreholes 20-1370-103 and 112 were terminated in this layer. The SPT N values ranged from WH to 4 blows per 0.3 m of penetration. In-situ shear vane test results indicate the undrained shear strength of the grey clay ranges from 20 to 80 kPa, but more typically 30 to 55 kPa indicating a firm to stiff consistency. The ratio of the measured in-situ natural shear strength to the remolded shear strength ranges from 2 to 30, but more typically 10 to 20 and the grey clay is classified as sensitive to quick clay in accordance with Section 3.1.3.4 of the CFEM.

The moisture contents of the 21 samples of the grey clay tested ranged from 28 and 63%. The results of grain size analysis testing carried out on four samples of this material are illustrated on Figure B21 in Appendix B. The results of Atterberg Limits testing completed on 15 samples of the grey clayey soils indicate liquid limits ranging from 28 to 62, plastic limits ranging from 17 to 26 and plasticity indices ranging from 9 to 38. These Atterberg Limits testing results indicate clay of low to high plasticity, but more typically intermediate plasticity (CI). The Atterberg Limits analysis results are illustrated on Figure B22 in Appendix B.

4.5.5 Clayey Silt - Silt

Silt with varying amounts of clay and sand was encountered beneath the clay layers at Borehole 20-1370-75 to 78, 102, and 131, and below the topsoil at Borehole 20-1370-112. The top of this layer was encountered at elevations ranging from 59.1 and 60.9 m. The thickness of this layer ranges from about 0.5 to 2.4 m. The SPT N values ranged from 4 to 47 blows per 0.3 m of penetration but more typically 6 to 18 indicating a loose to compact state of compactness.

The measured moisture contents of the eight samples tested ranged from 15 to 41%. The results of grain size analyses carried out on three samples of clayey silt-silt material are provided on Figure B23 in Appendix B. The results of Atterberg Limits testing completed on four samples of this material indicate liquid limits ranging from 18 to 25, plastic limits ranging from 13 to 20 and plasticity indices ranging from 3 to 5. The Atterberg Limits analysis results are illustrated on Figure B24 in Appendix B and indicate a low plasticity silt (ML) to clayey silt-silt (CL-ML).

4.5.6 Sand

Sand was encountered beneath the surficial topsoil layer at Borehole 20-1370-112. The top of this layer was encountered at Elevation 66.4 m and the layer is about 1.3 m thick.

The SPT N values of 7 and 9 blows per 0.3 m of penetration was recorded in this layer, indicating a loose state of compactness. The measured moisture content of a single sample of sand tested was 16%.

4.5.7 Glacial Till

A deposit of glacial till was encountered at all boreholes advanced in Section 3 except Boreholes 20-1370-102, 103 and 112. The glacial till generally consists of a heterogeneous mixture of sand, gravel and silt. Shale bedrock fragments were also encountered in this layer. Cobbles and boulders were encountered at several of the boreholes and coring techniques were required to advance Borehole 20-1370-101. Boreholes 20-1370-74, 79 and 114 were terminated in this layer.

The SPT N values ranged from 17 to 34 blows per 0.3 m of penetration indicating a loose to compact to dense state of compactness. The higher refusal blow counts (i.e., 50/0.130 and 102) noted on the Record of Borehole for till layer may have been influenced by the presence of cobbles and boulders, rather than the compactness of the soil matrix. The measured moisture contents of the 22 samples tested ranged from 8 to 12%. The results of grain size analyses carried out on 18 samples of the till material are provided on Figures B25 to B27 in Appendix B.

Sand layers were encountered within the glacial till at Boreholes 20-1370-74, 113 and 115. The top of this layer was encountered at elevations ranging from 57.5 to 60.8 m. The thickness of this layer ranged from 0.7 m and 4.7 m.

The SPT N values in the sand layer ranged from WH to 30 blows per 0.3 m of penetration but more typically 20 to 25 indicating a compact state of compactness. The measured moisture content of a single sample of this sand layer was 11%. The results of a grain size analysis test carried out on a single sample of sand material are provided on Figure B28 in Appendix B.

4.5.1 Section 3 – Bedrock

Bedrock was proven by coring using NQ sized equipment at the boreholes listed in Table 5. Photographs of the bedrock core obtained at the boreholes are shown on Figures A13 to A50 provided in Appendix A.

Table 5 summarizes the depths and the elevations of the bedrock surface as encountered at the borehole locations.

Table 5: Section 3 – Summary of Bedrock and Refusal Depths and Elevations

Pole	Borehole	Ground Surface Elevation (m)	Depth ¹ to Competent Bedrock Surface / Auger Refusal (m)	Elevation of Competent Bedrock Surface / Auger Refusal (m)
P75	20-1370-75	64.3	8.4	55.9
P76	20-1370-76	63.8	7.5	56.3
P77	20-1370-77	62.8	6.6	56.2
P78	20-1370-78	64.4	7.5	56.9
P98	20-1370-101	65.7	8.4	57.3
P99	20-1370-102	66.2	8.7	57.5
P108	20-1370-113	64.4	10.3	54.1

Pole	Borehole	Ground Surface Elevation (m)	Depth ¹ to Competent Bedrock Surface / Auger Refusal (m)	Elevation of Competent Bedrock Surface / Auger Refusal (m)
P110	20-1370-115	66.1	7.7	58.4
P111	20-1370-116	70.4	9.3	61.1
P112	20-1370-117	67.1	4.7	62.4
P113	20-1370-118	68.9	7.3	61.6
P114	20-1370-119	67.1	3.4	63.7
P115	20-1370-126	66.1	4.6	61.5
P117	20-1370-127	66.1	5.1	61.0
P118	20-1370-128	66.5	4.8	61.7
P119	20-1370-129	66.6	5.8	60.8
P120	20-1370-130	65.9	6.1	59.8
P123	20-1370-131	67.1	9.5	57.7
P121	20-1370-132	68.1	7.5	60.6

Notes: ¹ The upper portion of bedrock at Boreholes 20-1370-77, 116, 117, 119, 127, 129, 130 and 132 is highly weathered and was able to be penetrated by augers and/or the split spoon sampler during drilling.

The bedrock consists of slightly weathered to fresh, thinly to medium bedded, black, fine grained shale of Carlsbad formation.

The Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from approximately 0 to 100%, but generally ranged between 50 to 100% indicating a fair to excellent quality rock.

Results UCS testing carried out on 19 bedrock core samples are presented on Figures B29 and B30 provided in Appendix B. The samples tested had UCS values ranging from 29 to 122 MPa but more typically 50 to 100 MPa indicating a strong bedrock.

4.5.2 Section 3 – Groundwater Conditions

Table 6 summarizes the depths and the elevations of the groundwater levels measured at the boreholes and piezometers installed in Section 3.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 6: Section 3 – Summary of Groundwater Conditions

Pole	Borehole	Type	Screened Interval	Ground Surface Elevation (m)	Depth (m)	Elevation (m)	Date
P74	20-1370-74	Open borehole	-	64.4	0.6	63.8	July 16, 2020
P75	20-1370-75	Open borehole	-	64.3	0.8	63.5	June 15, 2020
P76	20-1370-76	Open borehole	-	63.8	0.9	62.9	June 15, 2020
P77	20-1370-77	Open borehole	-	62.8	0.9	61.9	July 14, 2020
P78	20-1370-78	Open borehole	-	64.4	1.2	63.2	July 13, 2020
P79	20-1370-79	Piezometer	Silty Clay / Glacial Till	65.6	2.2	63.3	September 15, 2020
P98	20-1370-101	Piezometer	Glacial Till	65.7	1.5	64.2	September 15, 2020
P99	20-1370-102	Open borehole	-	66.2	2.3	63.9	July 10, 2020
P106	20-1370-103	Piezometer	Silty Clay	68.4	3.0	65.4	September 15, 2020
P107	20-1370-112	Piezometer	Silty Clay	66.7	1.7	64.9	September 15, 2020
P109	20-1370-114	Open borehole	-	66.2	2.5	63.7	August 10, 2020
P110	20-1370-115	Open borehole	-	66.1	2.3	63.9	June 16, 2020
P111	20-1370-116	Piezometer	Silty Clay / Glacial Till	70.4	4.7	65.7	September 15, 2020
P112	20-1370-117	Open Hole	-	67.1	1.3	65.8	June 18, 2020
P113	20-1370-118	Piezometer	Clay / Glacial Till	68.9	2.7	66.2	September 15, 2020
P115	20-1370-126	Open borehole	-	66.1	1.9	64.2	July 9, 2020
P117	20-1370-127	Piezometer	-	66.1	2.2	63.9	September 15, 2020
P118	20-1370-128	Open borehole	-	66.5	2.4	64.1	July 8, 2020
P120	20-1370-130	Open borehole	-	65.9	0.6 ¹	66.5	July 6, 2020
P123	20-1370-131	Piezometer	Glacial Till	67.1	0.2 ¹	67.3	September 15, 2020

Note: ¹ Denotes metres above existing ground surface.

4.6 Steel Corrosion and Sulphate Attack, Chemical Analysis

A total of 28 soil samples were submitted to Eurofins Environment Testing for chemical analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix C and are summarized in Table 7.

Table 7: Steel Corrosion and Sulphate Attack, Chemical Analysis

Borehole	Sample	Sample Depth (m)	Material	Chloride (%)	Sulphate (%)	Electrical Conductivity (mS/cm)	pH	Resistivity (ohm-cm)
20-1370-13	SS1	0 - 0.5	Sand fill	0.03	0.058	1.49	8.01	667
20-1370-16	SS1	0 - 0.6	Clay fill	0.03	0.014	0.73	7.79	1370
20-1370-17	SS3	1.5 - 2.1	Sand fill	0.08	0.016	0.78	7.66	1280
20-1370-32	SS6	3.8 - 4.4	Sand fill	0.03	0.038	1.06	8.43	935
20-1370-33	SS8	5.3 - 5.9	Clay fill	0.02	0.035	0.92	7.78	1090
20-1370-34	SS14	9.9 - 10.5	Sand and silt fill	0.01	0.009	0.33	8.76	3030
20-1370-35	SS3	1.5 - 2.1	Clay fill	0.06	0.05	1.60	8.22	625
20-1370-36A	SS9	6.1 - 6.7	Clayey sand fill	0.06	0.013	0.44	6.37	2270
20-1370-37	SS7	4.6 - 5.2	Sand and silt	<0.01	0.042	0.96	6.09	1040
20-1370-38	SS2	0.8 - 1.4	Clayey silt fill	0.014	0.04	0.73	6.99	1,370
20-1370-39	SS7	4.6 - 5.2	Glacial till	0.006	0.04	0.34	8.14	2,940
20-1370-40	SS13	9.8 - 10.4	Gravelly sand	0.008	0.06	0.62	8.32	1,610
20-1370-41	SS8	5.3 - 5.9	Sand	0.009	0.02	0.15	8.78	1,670
20-1370-74	SS3	1.5 - 2.1	Silty clay	0.049	<0.01	0.62	7.57	1,590
20-1370-75	SS8	6.1 - 6.7	Glacial till	0.004	0.07	0.54	7.9	1,850
20-1370-76	SS7	6.2 - 6.9	Sand	0.004	0.04	0.32	7.94	3,120
20-1370-77	SS7	4.3 - 4.9	Silt	0.005	0.07	0.55	8.07	1,820
20-1370-78	SS3	1.4 - 2.0	Clay	0.114	0.03	1.46	7.43	685
20-1370-79	SS7	7.6 - 8.2	Clay	0.004	0.06	0.55	7.85	1,820
20-1370-101	SS6	4.6 - 5.2	Glacial till	0.005	0.04	0.25	7.9	4,000
20-1370-102	SS10	8.4 - 9.0	Sandy silt	<0.002	0.04	0.44	7.98	2,270

Borehole	Sample	Sample Depth (m)	Material	Chloride (%)	Sulphate (%)	Electrical Conductivity (mS/cm)	pH	Resistivity (ohm-cm)
20-1370-103	SS9	7.6 - 8.2	Silty clay	0.008	0.04	0.35	8.19	2,860
20-1370-112	SS8	9.1 - 9.8	Silty clay	0.004	0.02	0.32	8.93	3,120
20-1370-113	SS6	3.1 - 3.7	Clay	0.017	0.04	0.6	7.68	1,670
20-1370-114	SS10	7.6 - 8.2	Glacial till	0.003	0.04	0.48	8.65	2,080
20-1370-115	SS7	5.3 - 5.9	Sand	0.005	0.06	0.5	8.29	2,000
20-1370-116	SS11	7.6 - 8.1	Silty clay	0.002	0.03	0.24	8.58	4,170
20-1370-117	SS5	3.0 - 3.7	Glacial till	0.003	0.01	0.2	8.16	5,000
20-1370-118	SS4	2.3 - 2.9	Clay fill	0.004	<0.01	0.27	7.66	3,700
20-1370-119	SS2	0.8 - 1.4	Silty clay	<0.002	<0.01	0.12	7.69	8,330
20-1370-126	SS3	1.4 - 2.0	Clay	0.021	<0.01	0.32	7.29	3,120
20-1370-127	SS4	2.3 - 2.9	Clay	0.004	0.01	0.21	8.06	4,760
20-1370-128	SS4	2.1 - 2.7	Clay	0.031	0.04	0.84	7.95	1,180
20-1370-129	SS4	2.3 - 2.9	Silty clay	0.008	0.02	0.4	8.74	2,500
20-1370-130	SS5	4.6 - 5.2	Silty clay	0.013	0.02	0.39	9.28	2,560
20-1370-131	SS10	8.4 - 9.0	Glacial till	0.009	0.06	0.2	8.86	5,000
20-1370-132	SS5	3.1 - 3.7	Clay	<0.002	<0.01	0.17	7.26	5,880

5.0 CLOSURE

This report was prepared by Ms. Kinjal Gajjar and Mr. Kenton Power, P.Eng. It was reviewed by Michael Snow, P.Eng. a Senior Geotechnical Engineer with Golder. William Cavers, P.Eng. a Senior Geotechnical Engineer with Golder and the Designated MTO Foundations Contact for this project, carried out an independent quality control review of this report.

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PART B

Foundation Design
High Mast Light Poles
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa Ontario

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical recommendations for the design of the proposed high mast light (HML) pole foundations. The input provided herein is based on interpretation of the factual data obtained from the boreholes advanced during the current investigation, and in accordance with the 2014 Canadian Highway Bridge Design Code CAN/CSA-S6-14 (CHBDC) and Guidelines for the Design of High Mast Pole Foundations Fourth Edition, (MTO, 2004)

The foundation investigation report, discussion, and recommendations are intended for the use of the Ministry of Transportation, Ontario (MTO) and shall not be used or relied upon for any other purpose or by any other parties, including the construction contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project. Those requiring information on the aspects of construction must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

The proposed HML pole locations are shown on Drawings 1 to 6, based on the details provided by WSP. The HML poles and the thickness of overburden/depth to bedrock (not including highly weathered bedrock) at the HML pole locations are summarized in Table 8.

Table 8: Summary of Overburden Thickness and Depth to Bedrock Conditions

Pole	Borehole	Ground Surface Elevation (m)	Overburden Thickness ¹ / Augur Refusal Elevation (m)
P13	20-1370-13	65.1	1.7 (63.4)
P14	20-1370-14	64.7	0.6 (64.1)
P15	20-1370-15	64.2	0.6 (63.6)
P16	20-1370-16	64.1	1.7 (62.4)
P17	20-1370-17	63.1	2.6 (60.5)
P32	20-1370-32	65.2	8.8 (56.4)
P33	20-1370-33	68.3	>10.5 N/A ²
P34	20-1370-34	71.8	>10.5 N/A ²
P35	20-1370-35	73.8	>10.5 N/A ²
P36	20-1370-36A	71.5	>10.5 N/A ²
P37	20-1370-37	69.7	>10.5 N/A ²
P38	20-1370-38	67.9	>10.4 N/A ²
P39	20-1370-39	66.7	>10.4 N/A ²
P40	20-1370-40	66.2	>10.4 N/A ²

Pole	Borehole	Ground Surface Elevation (m)	Overburden Thickness ¹ / Augur Refusal Elevation (m)
P41	20-1370-41	65.9	>10.4 N/A ²
P74	20-1370-74	64.4	>10.2 N/A ²
P75	20-1370-75	64.3	8.4 (55.9)
P76	20-1370-76	63.8	7.5 (56.3)
P77	20-1370-77	62.8	6.6 (56.2)
P78	20-1370-78	64.4	7.5 (56.9)
P79	20-1370-79	65.6	>10.1 N/A ²
P98	20-1370-101	65.7	8.4 (57.3)
P99	20-1370-102	66.2	8.7 (57.5)
P106	20-1370-103	68.4	>10.7 N/A ²
P107	20-1370-112	66.7	>10.7 N/A ²
P108	20-1370-113	64.4	10.3 54.1
P109	20-1370-114	66.2	>10.3 N/A ²
P110	20-1370-115	66.1	7.7 (58.4)
P111	20-1370-116	70.4	9.3 (61.1)
P112	20-1370-117	67.1	4.7 (62.4)
P113	20-1370-118	68.9	7.3 (61.6)
P114	20-1370-119	67.1	3.4 (63.7)
P115	20-1370-126	66.1	4.6 (61.5)
P117	20-1370-127	66.1	5.1 (61.0)
P118	20-1370-128	66.5	4.8 (61.7)
P119	20-1370-129	66.6	5.8 (60.8)
P120	20-1370-130	65.9	6.1 (59.8)
P123	20-1370-131	67.1	9.5 (57.7)
P121	20-1370-132	68.1	7.5 (60.6)

Notes: ¹ Depth below existing ground surface at borehole location to intact bedrock (i.e., slightly weathered to fresh).

² Bedrock not encountered within the borehole advancement depth.

6.2 Design of High Mast Light Pole Foundations

The location of the forty HML poles proposed are shown on Drawings 1 – 6.

As outlined in MTO's HML Guidelines the actual length of the caisson foundations for the HML poles depends on the design wind load, pole height, frost depth, overburden stratigraphy and thickness and depth to bedrock surface.

It is understood that the type and height of the HML poles has yet to be finalized. However, HML pole foundations typically consist of reinforced, cast-in-place concrete caissons constructed within the soil, nominally socketed into bedrock (where the overburden soils do not provide sufficient lateral resistance) or embedded into relatively shallow depth bedrock. As an alternative to embedding the caisson into the bedrock, where bedrock is at or just at the existing ground surface (i.e., less than 1.8 m) consideration could also be given to supporting the HML pole on spread footings anchored to the bedrock, or a caisson nominally socketed into the bedrock with dowels/anchors extending into the bedrock to achieve the required lateral/uplift resistance. As outlined in Table 8 the depth to the bedrock surface varies along Highway 417 within the project limits, as such it is anticipated that all these foundation options are considered feasible for this project in accordance with the soil/bedrock conditions at the pole locations.

Recommendations for these foundation options are presented in the following sections.

Table 9 following the text of this report, summarizes the soil stratigraphy at the boreholes advanced at each pole location. The parameters presented in Table 9 are based on field and laboratory test data as well as accepted correlations (NAVFAC 1986, Bowles, 1984 and Kulhawy and Mayne, 1990 and those provided in MTO's HML Guidelines) and the analysis was tempered by engineering judgment based on experience in similar soils.

6.2.1 Frost depth

As per Ontario Provincial Standard Drawing (OPSD) 3090.101 (Foundation Frost Penetration Depths for Southern Ontario), the design frost penetration depth at the site is 1.8 m below the existing ground surface. In the design of the HML pole foundations, the passive resistance within the upper 1.8 m below ground surface should be neglected to account for frost action.

6.2.2 Caisson Foundation Design in Soil

Table 11.1 of the MTO's HML Guidelines provides the allowable foundation diameters based on the proposed HML pole heights. As noted in the Section 12.2.1 of the Guidelines the length of a caisson is to be at least four times its diameter below the depth of frost. Therefore, in accordance with Table 11.1 the minimum caisson length for a 25 m high HML pole (shortest pole height) founded in soil is:

$$L = F + 4D \sim 6.7 \text{ m}$$

Where:

- L = Minimum total length of caisson foundation, m
- D = Diameter of caisson or foundation, (Table 11.1 HML Guidelines), m
- F = Frost depth for project site = 1.8 m; Section 6.2.1

It should be noted that the minimum caisson length will increase with increasing HML pole heights and available lateral resistance in the soil. The procedure to determine the required caisson length for HML poles founded in soil is outlined in Sections 4 and 5 of the HML Guidelines. As outlined in the HML Guidelines the resistance to

lateral loading of caissons may be calculated using subgrade reaction theory where the coefficient of horizontal subgrade reaction (k_h in kPa/m) is determined based on the following equations.

Table 9 outlines the range for the values of γ , S_u , ϕ' , n_h , and K_p , that may be used in the preliminary structural analysis for the various HML pole sites. The ranges in values reflect the variability in the subsurface conditions, the soil properties and the approximate nature of the analysis and the non-linear nature of the soil behaviour (such that k_h is a function of deflection).

Cohesive soils

As outlined in Section 4.0 of the HML Guidelines, for cohesive soils, the factored lateral passive resistance at ULS should be calculated consistent with Figure 4.1(b), and the following formula:

$$k_h = \frac{67 q_u}{2 D} \quad \text{where} \quad \begin{array}{l} q_u = 2 \times S_u \text{ (kPa); and} \\ D \text{ is the caisson diameter (m)} \end{array}$$

The resistance factor F_q in the equation on Figure 4.1(b) should be taken as 0.5 in accordance with Table 6.2 of the CHDBC to obtain the factored ultimate lateral geotechnical resistance.

Non-Cohesive

As outlined in Section 5.0 of the HML Guidelines, for cohesionless soils, the factored lateral passive resistance at ULS should be calculated using the coefficient of passive resistance (K_p), total (γ) or effect (γ') unit weight provided in Table 9 consistent with Figure 5.1(b), and the following formula:

$$k_h = n_h \frac{z}{D} \quad \text{where} \quad \begin{array}{l} n_h \text{ is the constant of horizontal subgrade reaction (kPa/m);} \\ z \text{ is the depth (m); and} \\ D \text{ is the caisson diameter (m)} \end{array}$$

In the case where the foundations are in being installed in multi-layered strata of non-cohesive and cohesive layers the design caisson length is determined as outlined in Section 8.0 of the HML Guidelines.

6.2.3 Soil Foundations with Tip Socketed in Rock

As noted in Table 9, the thickness of the overburden or depth to the bedrock surface at some of the HML pole locations may be insufficient to provide the required lateral resistance and as such "socketing" the bottom of the foundation into the bedrock would be required. Section 7 of the HML Guidelines outlines the design requirements for this installation scenario.

The soil resistances, for both cohesive and non-cohesive soils for this scenario are determined following the same procedures outlined in Section 6.2.2 above but following Figures 7.1(b) and 7.2(b) of the HML Guidelines respectively. However, the total lateral resistance would now include the bedrock contribution (i.e., the depth of the socket must be of sufficient length to provide the additional resistance required). The socket depth should not be taken as less than half the pile diameter and the lateral bearing resistance of the rock must be taken as less than the strength of concrete in the caisson.

At these HML sites, it is anticipated that the highly weathered portion of the shale bedrock (as shown on the logs) that may be encountered within the proposed caisson length is very weak and would behave similarly to the dense glacial till. Assuming the identified highly weathered zones are treated as indicated in design, the overall socket length below the highly weathered layers does not need to be designed to include an additional length to

account for the presence of weathered bedrock at the soil/bedrock interface (i.e., W of 0.0 m), in accordance with Section 7.1 of the HML Guidelines.

6.2.4 Caisson Foundation Design in Rock

Section 6 of the HML Guidelines discusses high mast light pole foundations in bedrock. The two foundation types discussed are caisson type foundations embedded (socketed) in bedrock and foundations anchored to the surface of sound rock with reinforcement.

6.2.4.1 Caisson Foundations Embedded into Rock

Where the bedrock is at or near the ground surface the HML foundation can be designed as a simple rock caisson foundations. In accordance with Section 6 of the HML Guidelines, the caissons are required to have a minimum embedment length into sound bedrock ($RQD > 50\%$) not less than 2.5 m below the bottom of frost penetration. For caisson foundations embedded in rock, the factored lateral passive resistance at ULS should be calculated consistent with Figure 6.1 of the HML Guidelines together with recommended values for f_{horiz} (the factored horizontal bearing capacity (resistance) provided in Table 9.

Based on the results of UCS testing the shale bedrock at the site is generally medium strong to strong as such coring, churn drilling or other appropriate techniques will be necessary to advance the socket into the bedrock.

6.2.4.2 Foundations Anchored into Bedrock

Caisson foundations shall be anchored to rock when sound bedrock is encountered at a relatively shallow depth below grade. As an alternative to the minimum rock socket length of 2.5 m, caissons or spread footings anchored to the rock may be considered.

If anchoring of foundations is adopted for spread footing or caissons constructed at shallow depth with the tip nominally socketed into bedrock, it is recommended that the concrete caissons or spread footings be embedded a minimum of 0.3 m into the bedrock. As per Section 6.2 and Figure 9.3 of the HML Guidelines, to allow sufficient length for the anchorage assembly for HML poles a minimum concrete foundation vertical length of 1.75 m for pole heights of 25, 30 and 35 and 2.0 m lengths for pole heights of 40 and 45 m is required. The number, spacing and anchor bar requirements are also set in out in Section 6.2 of the HML Guidelines.

The unfactored bond strength between the grout and shale bedrock may be taken as 1.0 MPa for design of rock anchors/dowels to support the HML pole foundations in tension. A resistance factor of 0.4 is to be applied for the factored ultimate pull-out resistance in accordance with Table 6.2 of the CHDBC.

A test program should be implemented as part of construction of HML pole anchored foundations to confirm the allowable bond stress, as recommended in the HML Guidelines.

The horizontal resistance of dowels is dependent on the strength of the bedrock, grout and steel. At this site, the rock mass is stronger than concrete, and so the design of the dowels in the rock should be handled in the same way as the dowel embedment into the concrete, assuming that the unconfined compressive strength of the grout is similar to that of the concrete. The structural strength of the dowel and the compressive strength of the grout should not be exceeded.

As these are permanent rock anchors/dowels, they should be provided with suitable corrosion protection or sacrificial thickness of steel. Anchor installation, grouting and testing should be carried out in accordance with OPSS 942 (Construction Specification for Pre-Stressed Soil and Rock Anchors).

6.3 Construction Considerations

6.3.1 Groundwater and Surface Water Control

The water-bearing cohesionless soils at this site should be expected to run or flow into the caisson hole during or after drilling of the caisson foundations for the HML poles. Therefore, appropriate equipment and procedures will be required to minimize ground loss during drilling and concrete placement, such as by using temporary or permanent caisson liners, and/or using drilling mud. Suggested wording for a Non-Standard Special Provision (NSSP) to alert the Contractor of this condition has been provided in Appendix D. Foundations for the HML poles should be constructed in accordance with OPSS.PROV 903 (*Deep Foundations*).

However, the selection and design of a temporary unwatering/dewatering system is the responsibility of the Contractor. The Contract Documents must alert the Contractor to this responsibility and to design the system in accordance with Special Provision (SP) FOUN0003 (Dewatering Structure Excavations) which amends OPSS 902.

In accordance with SP FOUN0003, the temporary dewatering system shall be designed and carried out in accordance with OPSS.PROV 517 (Dewatering) with amendments as per SP 517F01 (Dewatering System). Given the groundwater and soil conditions at this site, dewatering is expected to be of low complexity, and it is therefore not a requirement to carry out a preconstruction survey or to require a dewatering design engineer for the dewatering system as per Table A of SP 517F01.

6.3.2 Obstructions in Overburden

Increased difficulty with the installation of caissons at the location of some of the HML poles should be anticipated due to the presence of cobbles and boulders within the till materials and the relatively shallow depth to the bedrock surface. Recommended wording for an NSSP alerting the Contractor to this condition and the requirement to use appropriate equipment and installation techniques is provided in Appendix D.

6.4 Corrosion and Cement Type

A total of 28 soil samples were submitted to Eurofins Environmental Testing for chemical analysis related to potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The results of the testing are provided in Appendix C and are summarized in Section 4.6.

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. The sulphate results in Table 7 of this report, were compared with Table 3 of Canadian Standards Association Standards A23.1-14 (CSA A23.1) and generally indicate a low degree of sulphate attack potential on concrete structures at this site. Accordingly, GU cement could be specified for concrete in below grade applications.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the sub-surface environment. Generally, the results provided in Table 7 indicate a moderate to high potential for corrosion of exposed ferrous metal at the site which should be considered in the design.

7.0 CLOSURE

This report was prepared by Mr. Kenton Power, P.Eng. It was reviewed by Michael Snow, P.Eng. a Senior Geotechnical Engineer with Golder. William Cavers, P.Eng. a Senior Geotechnical Engineer with Golder and the Designated MTO Foundations Contact for this project, carried out an independent quality control review of this report.

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Table 9: Geotechnical Design Parameters for the High Mast Pole Foundations

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ ⁺	K _p	n _h	f _{horz}	γ	γ [']		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
P13	20-1370-13	65.1	Shale bedrock	63.4	60.4	-	-	-		1,500	-	-	63.4	63.4
P14	20-1370-14	64.7	Shale bedrock	64.1	-	-	-	-		1,500	-	-	64.1	64.1
P15	20-1370-15	64.2	Shale bedrock	63.6	-	-	-	-		1,500	-	-	63.6	63.6
P16	20-1370-16	64.1	Shale bedrock	62.4	-	-	-	-		1,500	-	-	62.4	62.4
P17	20-1370-17	63.1	FILL - loose - gravelly silty sand	61.3	60.6	-	32	3.25	500 to 1,000	-	19	-	60.5	60.5
			Highly weathered bedrock	60.6	60.5	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	< 60.5	-	-	-	-		1,500	-	-		
P32	20-1370-32	65.2	FILL - very stiff - gravelly silty clay	63.4	62.8	125	-	-	-	-	16.5	6.7	63.7	56.4
			FILL - compact to dense - gravelly silty sand	62.8	61.5	-	32	3.25	4,000 to 6,000	-	19	9.2		
			FILL - loose to compact - sand	61.5	57.6	-	30	3.00	2,000 to 4,000	-	19	9.2		
			Dense - gravelly sand	57.6	56.5	-	32	3.25	4,000 to 6,000	-	20	10.2		
			Highly weathered bedrock	56.5	56.4	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	56.4	-	-	-	-		1,500	-	-		
P33	20-1370-33	68.3	FILL - stiff - silty clay	66.5	66.2	100	-	-	-	-	16.5	-	66.0	N/A
			FILL - dense to very dense - sand and gravel	66.2	64.5	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - very dense to compact - silty sand	64.5	63	-	32	3.25	4,000 to 6,000	-	19	9.2		
			FILL - very stiff - silty clay	63	62.2	125	-	-	-	-	16.5	6.7		
			FILL - compact to dense - gravelly sand	62.2	<57.8	-	32	3.25	4,000 to 6,000	-	19	9.2		
P34	20-1370-34	71.8	FILL - compact to very dense - gravel and sand - contains cobbles	70	64.2	-	32	3.25	6,000 to 8,000	-	19	-	62.0	N/A
			FILL – silty clay	64.2	63.9	125	-	-	-		16.5	-		
			FILL – compact - silt and sand	63.9	62.7		28	2.77	4,000 to 6,000	-	18	-		
			FILL - compact - silty sand	62.7	<61.3	-	28	2.77	4,000 to 6,000	-	18	-		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	ϕ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
P35	20-1370-35	73.8	FILL - very stiff - silty clay	72	71.7	125	-	-	-	-	16.5	-	65.4	N/A
			FILL - compact - gravely silty sand	71.7	70.8	-	32	3.25	4,000 to 6,000	-	19	-		
			FILL - compact - silty sand	70.8	70.3	-	32	3.25	4,000 to 6,000	-	19	-		
			FILL - dense to compact - gravely silty sand	70.3	68.5	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - stiff to very stiff - silty clay - contains cobbles and boulders	68.5	67.1	125	-	-	-	-	16.5	-		
			FILL - compact to dense - sand - contains cobbles	67.1	65.4	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - dense to compact - gravely silty sand	65.4	63.9	-	32	3.25	4,000 to 6,000	-	19	9.2		
			FILL - compact – sandy silt	63.9	<63.3	-	28	2.77	2,000 to 4,000	-	18	-		
P36	20-1370-36	71.8	FILL - stiff to firm - silty clay	70.0	68.3	80	-	-	-	-	16.5	-	67.5	N/A
			FILL - dense - gravely silty sand	68.3	67.5	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - very stiff - silty clay	67.5	66.6	125	-	-	-	-	16.5	6.7		
			Inferred void	66.6	-	-	-	-	-	-	-	-		
P36	20-1370-36A	71.5	Soil stratigraphy from at Borehole 20-1370-36A G.S. to 4.6 m is Inferred from Borehole 20-1370-36										63.8	N/A
			FILL - stiff to firm - silty clay	69.7	68	80	-	-	-	-	16.5	-		
			FILL - dense - gravely silty sand	68	67.2	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - very stiff - silty clay	67.2	66.9	125	-	-	-	-	16.5	-		
			FILL - loose - gravely silty sand	66.9	66.3	-	32	3.25	6,000 to 8,000	-	19	-		
			FILL - compact to very dense - clayey sand	66.3	64	-	30	3.00	6,000 to 8,000	-	18	-		
			Loose to compact - sand and silt	64	<61.0	-	28	2.77	1,000 to 2,000	-	18	-		
P37	20-1370-37	69.7	FILL - compact to very dense - sand and gravel	67.9	66.7	-	32	3.25	6,000 to 8,000	-	19	-	65.2	N/A
			FILL - compact - clayey gravely silt	66.7	65.9	-	28	2.77	2,000 to 4,000	-	18	-		
			Buried peat	65.9	65.6	-	-	-	-	-	16.5	-		
			FILL – Silty sand contains peat	65.6	65.1	-	-	-	-	-	16.5	-		
			Loose to compact - sand and silt	65.1	<59.2	-	28	2.77	1,000 to 2,000	-	18	8.2		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
P38	20-1370-38	67.9	Stiff - clayey silt	66.1	65.8	80	-	-	-	-	16.5	-	63.2	N/A
			Loose - gravelly sand and silt	65.8	64.9	-	28	2.77	1,000 to 2,000	-	18	-		
			Compact – sand	64.9	63.8	-	30	3.00	2,000 to 4,000	-	19	-		
			Compact to dense – sand	63.8	<57.4	-	32	3.25	4,000 to 6,000	-	19	-		
P39	20-1370-39	66.7	FILL - firm to stiff - sandy clayey silt	64.9	64.7	80	-	-	-	-	18	-	62.9	N/A
			FILL - gravelly silty sand	64.7	64.3	-	32	3.25	6,000 to 8,000	-	19	-		
			Loose - silty sand	64.3	63.5	-	30	3.00	1,000 to 2,000	-	19	-		
			Compact to dense - gravel and sand	63.5	62.1	-	32	3.25	6,000 to 8,000	-	21	-		
			TILL - dense to very dense - gravelly sand - contains cobbles & boulders	62.1	59.3	-	36	3.85	4,000 to 6,000	-	21	11.2		
			TILL - dense to compact - sand contains cobbles	59.3	<56.3	-	36	3.85	4,000 to 6,000	-	21	11.2		
P40	20-1370-40	66.2	Firm to stiff - silty clay	64.4	62.7	100	-	-	-	-	16.5	-	63.3	N/A
			Compact – silt	62.7	62.1	-	28	2.77	1,000 to 2,000	-	18	8.2		
			Compact to very dense - gravelly sand	62.1	<55.8	-	32	3.25	4,000 to 6,000	-	20	10.2		
P41	20-1370-41	65.9	Very loose to compact – sand	64.1	57.5	-	30	3.00	1,000 to 2,000	-	19	-	63.2	N/A
			TILL - compact to dense - gravelly sand	57.5	<55.5	-	36	3.85	4,000 to 6,000	-	21	11.2		
P74	20-1370-74	64.4	Stiff to very stiff - silty clay (weathered crust)	62.6	61.2	100	-	-	-	-	16.5	6.7	63.8	N/A
			TILL - compact - sand and silt	61.2	60.7	-	32	3.25	2,000 to 4,000	-	20	10.2		
			Compact – sand	60.7	56.5	-	30	3.00	2,000 to 4,000	-	19	9.2		
			TILL - dense to very dense - gravelly silty sand - contains cobbles	56.5	<54.2	-	36	3.85	6,000 to 8,000	-	21	11.2		
P75	20-1370-75	64.3	Very stiff - clay (weathered crust)	62.5	60.6	100	-	-	-	-	16.5	6.7	63.5	8.4
			Stiff - silty clay	60.6	59.7	80	-	-	-	-	16.5	6.7		
			Stiff - clayey silt to silt	59.7	58.5	80	-	-	-	-	16.5	6.7		
			TILL - stiff - clayey silt	58.5	57	100	-	-	-	-	16.5	6.7		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
			TILL - dense - gravely sand	57	55.9	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	55.9	<52.0	-	-	-		1,500	-	-		
P76	20-1370-76	63.8	Stiff to firm - silty clay	62	59.1	50	-	-	-	-	16.5	6.7	62.9	7.5
			Clayey silt to silt	59.1	58.6	50	-	-	-	-	16.5	6.7		
			TILL - Compact to dense - gravelly silty sand	58.6	56.3	-	36	3.85	6,000 to 8,000	-	20	10.2		
			Shale bedrock	56.3	<52.8	-	-	-		1,500	-	-		
P77	20-1370-77	62.8	FILL - stiff to firm - silty clay	61	60.8	50	-	-	-	-	16.5	6.7	61.9	6.6
			Stiff - clay - weathered crust	60.8	60.1	100	-	-	-	-	16.5	6.7		
			Firm - silty clay	60.1	59.3	40	-	-	-	-	16.5	6.7		
			Compact - silt	59.3	58.1	-	28	2.77	1,000 to 2,000	-	18	8.2		
			TILL - compact to very dense - silty sandy gravel	58.1	56.3	-	36	3.85	4,000 to 6,000	-	21	11.2		
			Highly weathered bedrock	56.3	56.2	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	<56.2	-	-	-	-	-	1,500	-	-		
P78	20-1370-78	64.4	Very stiff to stiff - clay - weathered crust	62.6	61.5	125	-	-	-	-	16.5	6.7	63.2	7.5
			Stiff - clayey silt	61.5	60.1	80	-	-	-	-	16.5	6.7		
			Compact - clayey silt to silt	60.1	58.4	-	28	2.77	1,000 to 2,000	-	16.5	6.7		
			TILL - dense to very dense - gravely clayey silt - contains cobbles	58.4	56.9	-	36	3.85	6,000 to 8,000	-	16.5	6.7		
			Shale bedrock	56.9	<52.6	-	-	-	-	1,500	-	-		
P79	20-1370-79	65.6	Very stiff to stiff - clay - weathered crust	63.8	62.5	125	-	-	-	-	16.5	-	63.3	N/A
			Stiff - silty clay	62.5	57.4	60	-	-	-	-	16.5	6.7		
			TILL -Compact to very dense - gravelly silty sand	57.4	<56.5	-	36	3.85	6,000 to 8,000	-	20	10.2		
P98	20-1370-101	65.7	Very stiff - clay - weathered crust	63.9	62.7	125	-	-	-	-	16.5	6.7	64.2	8.4
			TILL - very loose to very dense - gravelly silty sand - contains cobbles	62.7	57.3	-	36	3.85	4,000 to 6,000	-	20	10.2		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
			Shale bedrock	57.3	<54.1	-	-	-	-	1,500	-	-		
P99	20-1370-102	66.2	Very stiff - clay - weathered crust	64.4	62.7	125	-	-	-	-	16.5	-	63.9	8.7
			Stiff - silty clay	62.7	59.6	70	-	-	-	-	16.5	6.7		
			Compact to dense - sandy silt	59.6	57.5	-	28	2.77	1,000 to 2,000	-	18	8.2		
			Shale bedrock	57.5	<54.3	-	-	-	-	1,500	-	-		
P106	20-1370-103	68.4	Very stiff - silty clay - weathered crust	66.6	63.8	125	-	-	-	-	16.5	-	65.4	N/A
			Stiff to firm - silty clay	63.8	<57.7	60	-	-	-	-	16.5	6.7		
P107	20-1370-112	66.7	Very stiff - silty clay - weathered crust	64.9	63.6	125	-	-	-	-	16.5	6.7	64.9	N/A
			Firm to stiff - silty clay	63.6	<56.0	50	-	-	-	-	16.5	6.7		
P108	20-1370-113	64.4	Stiff to firm - clay	62.6	58.6	40	-	-	-	-	16.5	-	58.6	10.3
			TILL - loose - gravelly sand and silt	58.6	57.5	-	32	3.25	1,000 to 2,000	-	19	9.2		
			Very loose - sand	57.5	56.8	-	30	3.00	500 to 1,000	-	19	9.2		
			TILL - loose to very loose - gravelly sand	56.8	54.1	-	36	3.85	1,000 to 2,000	-	20	10.2		
			Shale bedrock	54.1	<51.0	-	-	-	-	1,500	-	-		
P109	20-1370-114	66.2	Very stiff - clay - weathered crust	64.4	63.1	125	-	-	-	-	16.5	-	63.7	N/A
			Stiff to firm - clay	63.1	58.3	40	-	-	-	-	16.5	6.7		
			TILL - loose to compact - sand and silt	58.3	<55.9	-	32	3.25	2,000 to 4,000	-	19	9.2		
P110	20-1370-115	66.1	Very stiff - clay - weathered crust	64.3	62.6	125	-	-	-	-	16.5	-	63.9	7.7
			Silty clay	62.6	61.2	50	-	-	-	-	16.5	6.7		
			TILL - compact - gravelly silty sand	61.2	60.8	-	36	3.85	2,000 to 4,000	-	20	10.2		
			Very loose - sand	60.8	60	-	30	3.00	500 to 1,000	-	19	9.2		
			TILL - dense - gravelly silty sand - contains cobbles	60	58.4	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	58.4	<54.0	-	-	-	-	1,500	-	-		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
P111	20-1370-116	70.4	FILL - stiff to very stiff - silty clay	68.6	65.7	100	-	-	-	-	16.5	-	65.8	9.3
			Very stiff - clay - weathered crust	65.7	63.7	125	-	-	-	-	16.5	6.7		
			Stiff - silty clay	63.7	62.3	80		1.00	-	-	16.5	6.7		
			TILL - loose - gravelly sand and silt	62.3	61.3	-	32	3.25	1,000 to 2,000	-	19	9.2		
			Highly weathered bedrock	61.3	61.1	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	61.1	<57.2	-	-	-	-	1,500	-	-		
P112	20-1370-117	67.1	Very stiff - clay - weathered crust	65.3	64	125	-	-	-	-	16.5	6.7	65.8	4.7
			TILL - compact to loose - silty sand	64	62.5	-	36	3.85	2,000 to 4,000	-	19	9.2		
			Highly weathered bedrock	62.5	62.4	-	36	3.85	6,000 to 8,000		21	11.2		
			Shale bedrock	62.4	<59.3	-	-	-	-	1,500	-	-		
P113	20-1370-118	68.9	FILL - very stiff to stiff - clay	67.1	65.5	100		1.00	-	-	16.5	-	66.2	7.3
			Very stiff - clay - weathered crust	65.5	62.8	100	-	-	-	-	16.5	6.7		
			TILL - loose - silty sand	62.8	61.6	-	36	3.85	1,000 to 2,000	-	19	9.2		
			Shale bedrock	61.6	<57.9	-	-	-	-	1,500	-	-		
P114	20-1370-119	67.1	TILL - compact to dense - silty gravel and sand	65.3	63.9	-	36	3.85	2,000 to 4,000	-	21	11.2	65.4	3.4
			Highly weathered bedrock	63.9	63.7	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	63.7	<60.7	-	-	-	-	1,500	-	-		
P115	20-1370-126	66.1	Very stiff to stiff - clay - weathered crust	64.3	63.4	125	-	-	-	-	16.5	-	64.2	4.6
			Stiff - silty clay	63.4	61.7	60	-	-	-	-	16.5	6.7		
			TILL - very dense - gravelly sandy silt	61.7	61.5	-	32	3.25	6,000 to 8,000	-	18	8.2		
			Shale bedrock	61.5	<58.2	-	-	-	-	1,500	-	-		
P117	20-1370-127	66.1	Very stiff to stiff - clay - weathered crust	64.3	63.1	100	-	-	-	-	16.5	-	63.9	5.1
			Firm - silty clay	63.1	61.8	35	-	-	-	-	16.5	6.7		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	φ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
			TILL - compact - gravelly sand and silt - contains cobbles	61.8	61.2	-	36	3.85	2,000 to 4,000	-	19	9.2		
			Highly weathered bedrock	61.2	61	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	61	<57.5	-	-	-	-	1,500	-	-		
P118	20-1370-128	66.5	Very stiff to stiff - clay - weathered crust	64.7	63.8	125	-	-	-	-	16.5	-	64.1	4.8
			Stiff to firm - silty clay	63.8	62.1	45	-	-	-	-	16.5	6.7		
			TILL - gravelly silty sand	62.1	61.7	-	36	3.85	2,000 to 4,000	-	20	10.2		
			Shale bedrock	61.7	58.4	-	-	-	-	1,500	-	-		
P119	20-1370-129	66.6	Very stiff to stiff - clay - weathered crust	64.8	64.4	125	-	-	-	-	16.5	-	62	5.8
			Firm - silty clay	64.4	62	30	-	-	-	-	16.5	-		
			Very loose - sandy silt	62	61.4	-	28	2.77	500 to 1,000	-	18	8.2		
			TILL - very dense - gravelly silty sand	61.4	60.9	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Highly weathered bedrock	60.9	60.8	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	60.8	<57.3	-	-	-	-	1,500	-	-		
P120	20-1370-130	65.9	Stiff - clay - weathered crust	64.1	63.8	100	-	-	-	-	16.5	6.7	66.5	6.1
			Stiff to firm - silty clay	63.8	60.7	40	-	-	-	-	16.5	6.7		
			TILL - dense - gravelly silty sand	60.7	60.1	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Highly weathered bedrock	60.1	59.8	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	59.8	<56.1	-	-	-	-	1,500	-	-		
P123	20-1370-131	67.1	Very stiff - clay - weathered crust	65.3	64.8	100	-	-	-	-	16.5	6.7	67.3	9.5
			Firm to stiff - silty clay	64.8	60.9	45	-	-	-	-	16.5	6.7		
			Very loose - sandy silt	60.9	60.2	-	28	2.77	500 to 1,000	-	18	8.2		
			TILL - very loose to loose - gravelly silty sand	60.2	57.6	-	36	3.85	1,000 to 2,000	-	21	11.2		
			Shale bedrock	57.6	<53.2	-	-	-	-	1,500	-	-		

Pole ¹	Borehole	Ground Surface Elevation (m)	Stratum ²	Approximate Deposit Elevation (m)		Soil Design Parameters ⁴							Design Groundwater Elevation (m)	Auger Refusal Depth ³ (m)
						S _u	ϕ'	K _p	n _h	f _{horz}	γ	γ'		
				Top	Bottom	(kPa)	(°)		(kPa/m)	(kPa)	(kN/m ³)	(kN/m ³)		
P121	20-1370-132	68.1	FILL - loose - sand and gravel	66.3	66	-	32	3.25	1,000 to 2,000	-	19	-	62.1	7.5
			FILL - very stiff - silty clay	66.0	65.1	125	-	-	-	-	16.5	-		
			Stiff - clay - weathered crust	65.1	64.4	100	-	-	-	-	16.5	-		
			Firm - silty clay	64.4	63.6	45	-	-	-	-	16.5	-		
			TILL - very loose - clayey silty sand to sandy silt	63.6	62.8	-	32	3.25	500 to 1,000	-	16.5	-		
			TILL - very loose - silt and sand	62.8	60.8	-	32	3.25	500 to 1,000	-	19	-		
			Highly weathered bedrock	60.8	60.6	-	36	3.85	6,000 to 8,000	-	21	11.2		
			Shale bedrock	60.6	<55.9	-	-	-	-	1,500	-	-		

NOTES:

1.

Pole numbering and location provided by WSP
2.

Approximate deposit elevations are provided starting from the frost depth elevation; the resistance in the upper 1.8 m below ground surface should be neglected to account for frost action.
3.

N/A = Auger refusal was not encountered to the termination depth of the borehole
4.

Design parameters:

s_u = undrained shear strength (kPa)

ϕ' = effective (drained) friction angle (degrees)

K_p = passive earth pressure coefficient

n_h = constant of horizontal subgrade reaction (kPa/m)

γ = bulk unit weight (kN/m³)

γ' = effective unit weight (below the groundwater level) (kN/m³)
5.

The passive earth pressure coefficients provided assume a vertical foundation element, zero interface friction between the soil and the foundation element, and a horizontal backslope.

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Ontario Provisional Standard Drawing:

- OPSD 3090.101 Foundation, Frost Penetration Depths for Southern Ontario

Ontario Provincial Standard Specification:

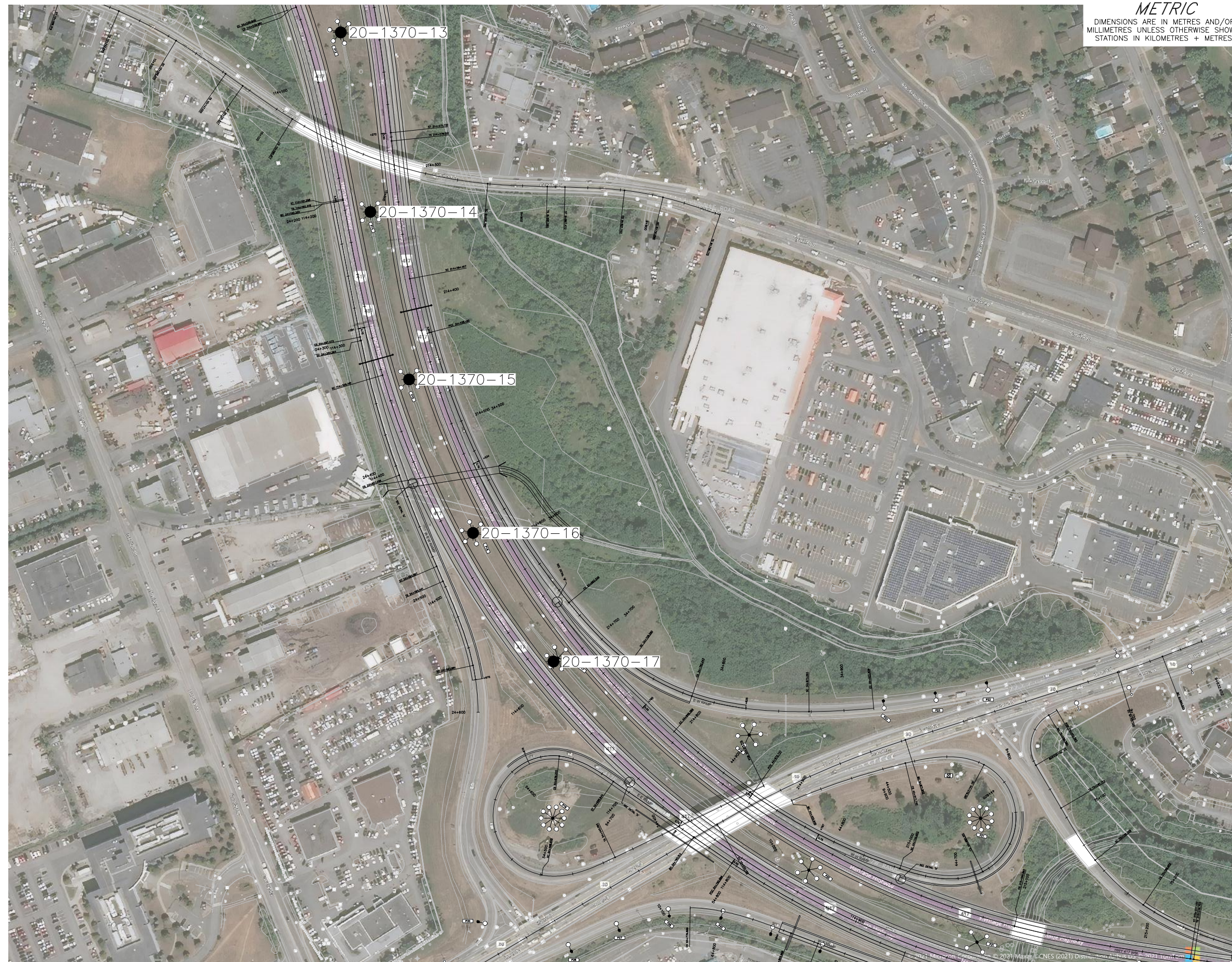
- OPSS 903 Construction Specification for Deep Foundations
- OPSS 915 Construction Specification for Sign Support Structures

Ontario Water Resources Act:

- Ontario Regulation 903 Wells

Ministry of Transportation, Ontario

Ministry of Transportation Ontario. Sign Support Manual. Provincial Highways Management Division, Highway Standards Branch, Bridge Office. February 2019.

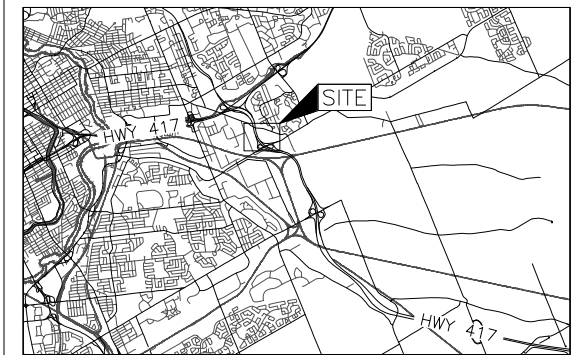


METRIC
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MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 4099-11-00



<p>HIGH MAST LIGHT POLES HIGHWAY 417 AVIATION PARKWAY TO RAMSAYVILLE ROAD</p> <p>BOREHOLE LOCATIONS</p> <p>LAT. 45.416040, LONG. -75.612590</p>	
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KEY PLAN

SCALE

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-13	65.1	5031444.2	374152.8
20-1370-14	64.7	5031306.7	374175.5
20-1370-15	64.2	5031178.5	374205.1
20-1370-16	64.1	5031061.0	374254.1
20-1370-17	63.1	5030962.5	374315.7

NOTES

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REFERENCE

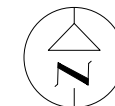
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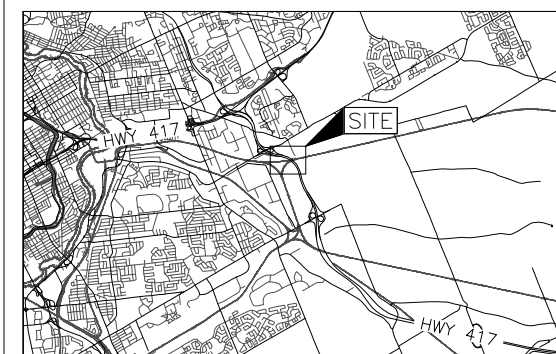
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MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 4099-11-00



SHEET

HIGH MAST LIGHT POLES HIGHWAY 417
AVIATION PARKWAY TO RAMSAYVILLE ROAD
BOREHOLE LOCATIONS
LAT. 45.412120, LONG. -75.602130



KEY PLAN

SCALE

2 0 2 4 km

LEGEND

 Borehole – Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-32	65.2	5030723.2	374764.1
20-1370-33	68.3	5030694.9	374922.4
20-1370-34	71.8	5030635.0	375077.6
20-1370-35	73.8	5030544.7	375196.1
20-1370-36	71.8	5030435.0	375290.6
20-1370-36A	71.5	5030435.7	375289.9
20-1370-37	69.7	5030320.9	375348.8

NOTES

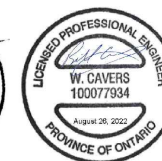
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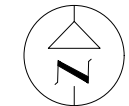
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Geocres No. 31G5-335				
HWY. 417		PROJECT NO. 1662565		DIST. EASTERN
SUBM'D. CRG	CHKD. KCP	DATE: 8/26/2022		SITE: —
DRAWN: ZS	CHKD. MSS	APPD. WC		DWG. 2





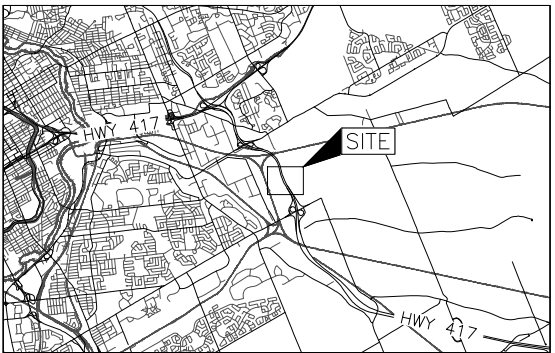
METRIC
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STATIONS IN KILOMETRES + METRES.

CONT No. _____
WP No. 4099-11-00



HIGH MAST LIGHT POLES HIGHWAY 417
AVIATION PARKWAY TO RAMSAYVILLE ROAD
BOREHOLE LOCATIONS
LAT. 45.405300, LONG. -75.597070

SHEET



KEY PLAN



SCALE
2 0 2 4 km

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-38	67.9	5030208.6	375378.2
20-1370-39	66.7	5030095.4	375405.8
20-1370-40	66.2	5029984.9	375438.6
20-1370-41	65.9	5029880.3	375482.4
20-1370-74	64.4	5029657.9	375609.1
20-1370-75	64.3	5029570.3	375663.2

NOTES

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REFERENCE

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PLAN
SCALE
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NO.	DATE	BY	REVISION
Geocres No. 31G5-335			
HWY. 417		PROJECT NO. 1662565	
SUBM'D. CRG		CHKD. KCP	DATE: 8/26/2022
DRAWN: JM		CHKD. MSS	APPD. WC
		DIST. EASTERN	
		SITE: -	
		DWG. 3	



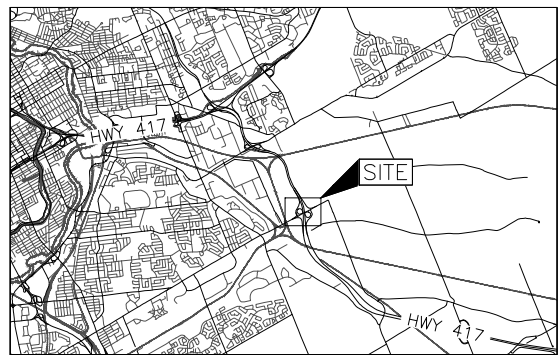
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. _____
WP No. 4099-11-00

HIGH MAST LIGHT POLES HIGHWAY 417
AVIATION PARKWAY TO RAMSAYVILLE ROAD
BOREHOLE LOCATIONS
LAT. 45.398960, LONG. -75.593020



SHEET



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

● Borehole - Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-76	63.8	5029468.7	375719.3
20-1370-77	62.8	5029329.2	375773.2
20-1370-78	64.4	5029178.9	375807.8
20-1370-79	65.6	5029131.8	375712.6
20-1370-101	65.7	5029035.8	375928.9
20-1370-102	66.2	5028970.0	375829.0
20-1370-103	68.4	5028787.2	375833.3

NOTES

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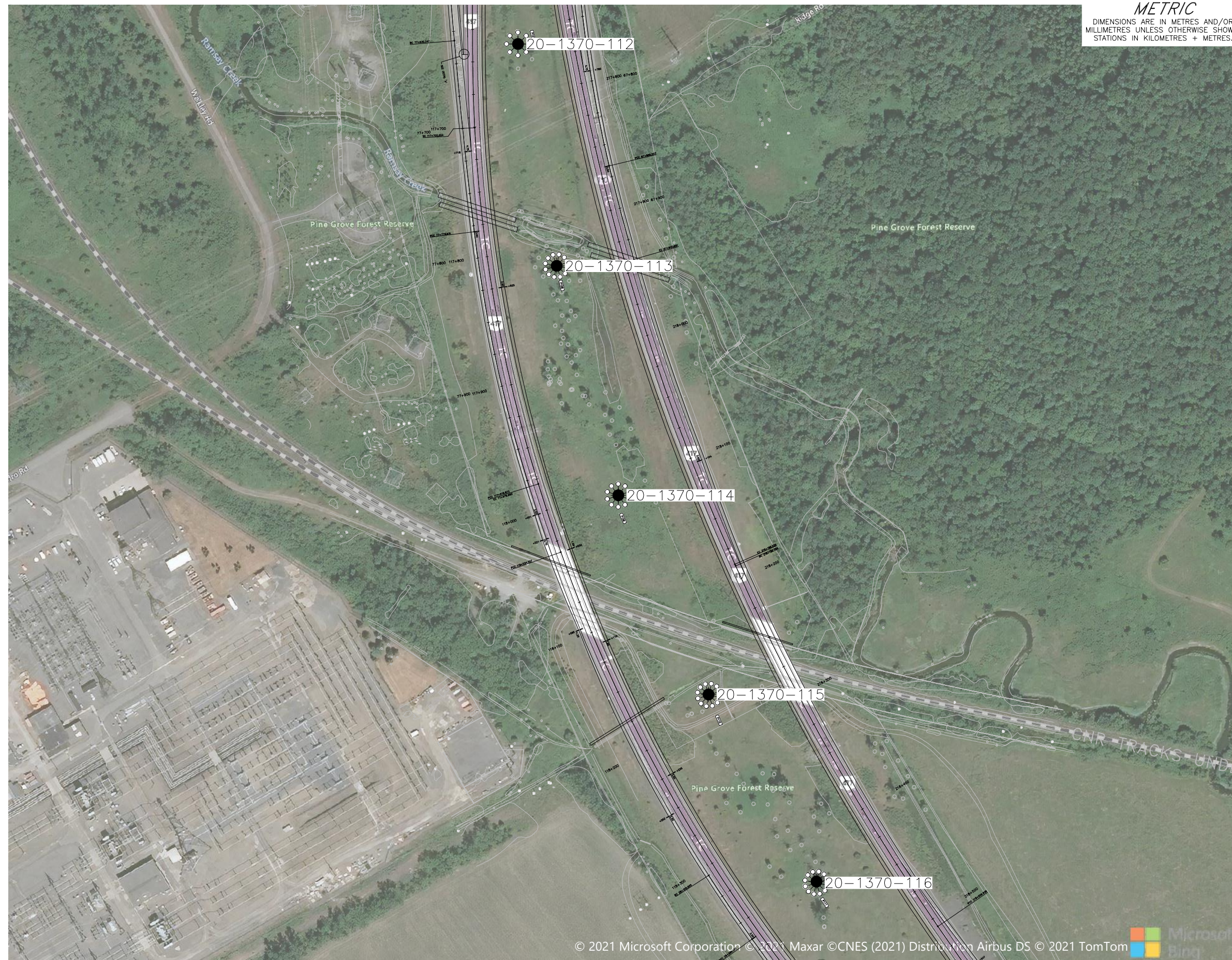
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PLAN
SCALE
30 0 30 60 m



NO.	DATE	BY	REVISION
Geocres No. 31G5-335			
HWY. 417		PROJECT NO. 1662565	DIST. EASTERN
SUBM'D. CRG	CHKD. KCP	DATE: 8/26/2022	SITE: -
DRAWN: JM	CHKD. MSS	APPD. WC	DWG. 4



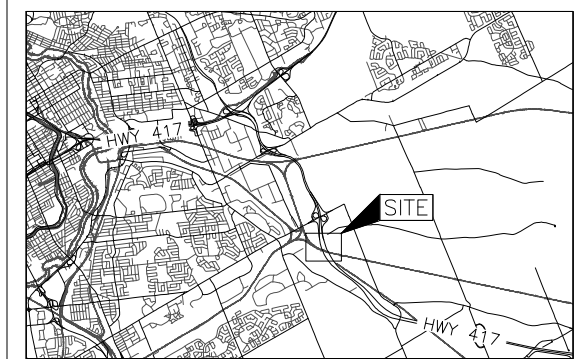
PLAN
SCALE



A horizontal scale bar with tick marks at 30, 0, 30, and 60 m. The segment between 0 and 30 is shaded black, while the segments between 30 and 0, and between 30 and 60 are white.

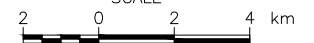


SHEET




KEY PLAN

SCALE



LEGEND

 Borehole – Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-112	66.7	5028629.1	375842.8
20-1370-113	64.4	5028458.9	375872.5
20-1370-114	66.2	5028283.0	375919.7
20-1370-115	66.1	5028130.2	375988.9
20-1370-116	70.4	5027986.6	376071.7

NOTES

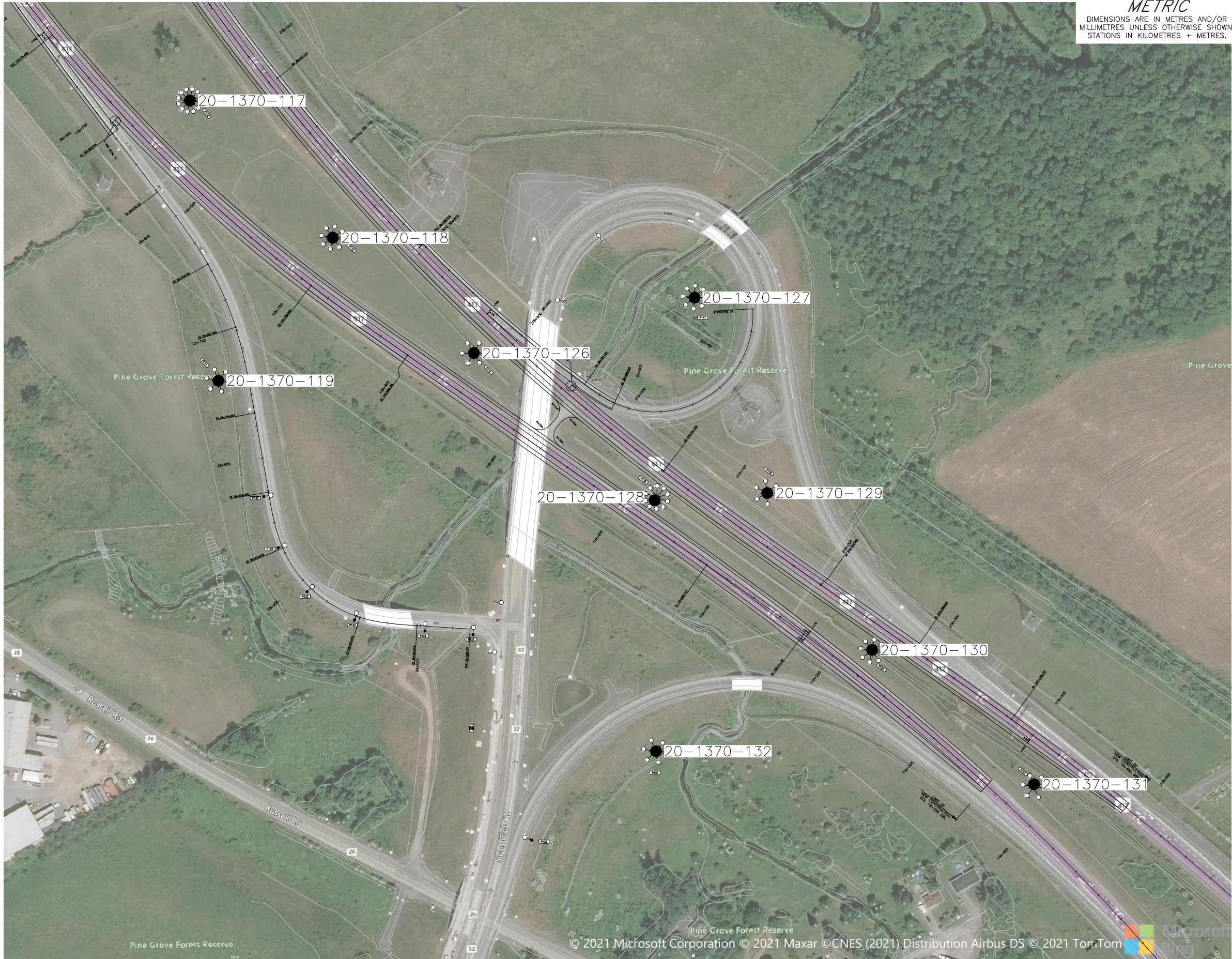
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

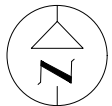
Base plan provided in digital format by WSP, drawing file no.
4016-E-0008 High Mast Pole Locations.dwg, received APRIL 27, 2020.

NO.	DATE	BY	REVISION		
Geocres No. 31G5-335					
HWY. 417			PROJECT NO. 1662565		DIST. EASTERN
SUBM'D. CRG		CHKD. KCP	DATE: 8/26/2022		SITE: —
DRAWN: JM		CHKD. MSS	APPD. WC		DWG. 5



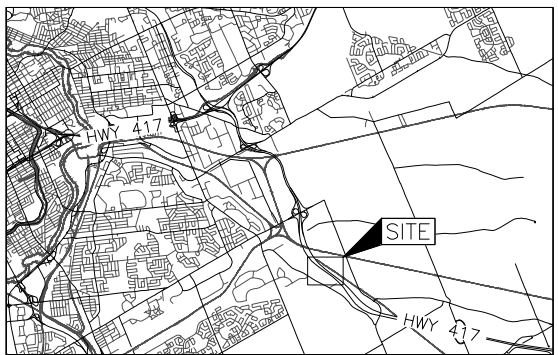
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 4099-11-00
WP No. 4099-11-00



HIGH MAST LIGHT POLES HIGHWAY 417
AVIATION PARKWAY TO RAMSAYVILLE ROAD
BOREHOLE LOCATIONS
LAT. 45.384110, LONG. -75.584020

SHEET



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
20-1370-118	68.9	5027738.2	376283.9
20-1370-119	67.1	5027628.5	376196.1
20-1370-126	66.1	5027649.7	376392.3
20-1370-127	66.1	5027692.2	376561.7
20-1370-128	66.5	5027536.7	376531.2
20-1370-129	66.6	5027542.3	376617.5
20-1370-130	65.9	5027421.8	376698.1
20-1370-131	67.1	5027318.7	376822.4
20-1370-132	68.1	5027344.1	376532.1

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plan provided in digital format by WSP, drawing file no. 4016-E-0008 High Mast Pole Locations.dwg, received APRIL 27, 2020.

PLAN
SCALE
30 0 30 60 m



APPENDIX A

Borehole and Drillhole Records

Lists of Abbreviations and Symbols

Lithological and Geotechnical Rock Description Terminology

Records of Boreholes and Drill Holes

Figures A1 to A50 – Bedrock Core Photographs

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

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

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

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

1. Only applicable to components not described by Primary Group Name.

2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (*q_t*), porewater pressure (*u*) and sleeve friction (*f_s*) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

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

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness¹

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

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

2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

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

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

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

Field Moisture Condition

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

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_P or PL	plastic limit
I_P or PI	plasticity index = $(w_L - w_P)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
$C_{a(e)}$	secondary compression index
C_a	rate of secondary compression
$C_{a(e)}$	modified secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
c'	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q or q'	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ .
where $\gamma = \rho \cdot g$ (i.e., mass density multiplied by
acceleration due to gravity)

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

AXJ Axial Joint	KV Karstic Void
BD Bedding	K Slickensided
BC Broken Core	LC Lost Core
CC Continuous Core	MB Mechanical Break
CL Closed	PL Planar
CO Contact	PO Polished
CU Curved	RO Rough
CT Coated	SA Slightly Altered
FLT Fault	SH Shear
FOL Foliation	SM Smooth
FR Fracture	SR Slightly Rough
GO Gouge	SY Stylolite
IN Infilled	UN Undulating
IR Irregular	VN Vein
JN Joint	VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250

PROJECT		RECORD OF BOREHOLE No 20-1370-13				SHEET 1 OF 2		METRIC									
G.W.P. 4099-11-00		LOCATION N 5031444.2; E 374152.8 MTM NAD 83 ZONE 9 (LAT. 45.419490; LONG. -75.613830)				ORIGINATED BY HRL											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS											
DATUM Geodetic		DATE January 10, 2021				CHECKED BY KCP											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
65.1	GROUND SURFACE							20	40	60	80	100					
0.0	(SM) Silty sand (FILL) Compact Brown Frozen		1	SS	25		65										
64.6	Highly weathered Bedrock						64										
0.5			2	SS	>50												
63.4			3	SS	>50												
1.7	Shale (BEDROCK) Bedrock cored from depths 1.7 m to 4.7 m For bedrock coring details refer to Record of Drillhole 20-1370-13		1	RC	REC 86%		63										RQD = 35%
			2	RC	REC 100%		62										RQD = 78%
			3	RC	REC 100%		61										RQD = 0%
60.4	END OF BOREHOLE																
4.7																	

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PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-13

SHEET 2 OF 2

LOCATION: N 5031444.2 ;E 374152.8

DRILLING DATE: January 10, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
						RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
						TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	W1			W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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DEPTH SCALE

1 : 50




LOGGED: HRL

CHECKED: KCP

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PROJECT <u>1662565-1370</u>		RECORD OF BOREHOLE No 20-1370-14		SHEET 1 OF 2		METRIC	
G.W.P. <u>4099-11-00</u>		LOCATION <u>N 5031306.7; E 374175.5 MTM NAD 83 ZONE 9 (LAT. 45.418260; LONG. -75.613560)</u>		ORIGINATED BY <u>HRL</u>			
DIST <u>Eastern</u> HWY <u>417</u>		BOREHOLE TYPE <u>Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core</u>		COMPILED BY <u>ZS</u>			
DATUM <u>Geodetic</u>		DATE <u>January 3, 2021</u>		CHECKED BY <u>KCP</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20	40	60	80	100	W _p	W	W _L					
64.7 0.0	GROUND SURFACE Silty sand (TOPSOIL) Dark brown Wet		1	SS	-																
64.1 0.6	Shale (BEDROCK) Bedrock cored from depths 0.6 m to 4.0 m For bedrock coring details refer to Record of Drillhole 20-1370-14		1	RC	REC 67%	64													RQD = 44%		
			2	RC	REC 100%	63													RQD = 83%		
			3	RC	REC 100%	62													RQD = 91%		
60.7 4.0	END OF BOREHOLE																				
																			</		

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTOWHY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling

STA-RCK 031 N:\ACTIVE\SPATIAL IM\IMTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

CHECKED: KCP

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-15		SHEET 1 OF 2		METRIC	
G.W.P. 4099-11-00		LOCATION N 5031178.5; E 374205.1 MTM NAD 83 ZONE 9 (LAT. 45.417100; LONG. -75.613200)		ORIGINATED BY HRL			
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core		COMPILED BY ZS			
DATUM Geodetic		DATE January 8, 2021		CHECKED BY KCP			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
								20	40	60	80	100	20	40	60		80	100		
64.2	GROUND SURFACE																			
0.0	(Cl) Silty clay (FILL) Brown		1	SS	>50															
63.9																				
0.3	Highly weathered rock																			
63.6																				
0.6	Shale (BEDROCK) Bedrock cored from depths 0.6 m to 3.7 m For bedrock coring details refer to Record of Drillhole 20-1370-15		1	RC	REC 100%															RQD = 21%
			2	RC	REC 100%															RQD = 74%
			3	RC	REC 100%															RQD = 77%
60.5																				
3.7																				

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-15

SHEET 2 OF 2

LOCATION: N 5031178.5 ;E 374205.1

DRILLING DATE: January 8, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 85

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES					
								RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS D.D. C.R.S.	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX											
								TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Jss	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	W1		W2	W3	W4	W5	W6
								88 88																			

DEPTH SCALE


1 : 50



LOGGED: HRL

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-16 SHEET 1 OF 2				METRIC									
G.W.P. 4099-11-00				LOCATION N 5031061.0; E 374254.1 MTM NAD 83 ZONE 9 (LAT. 45.416040; LONG. -75.612590)				ORIGINATED BY HRL									
DIST Eastern HWY 417				BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, HQ3 Core				COMPILED BY ZS									
DATUM Geodetic				DATE January 6, 2021				CHECKED BY KCP									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
64.1 0.0	GROUND SURFACE (Cl) Silty clay (FILL) Dark brown		1	SS	13												
63.0 1.1	(SM) Gravelly SILTY SAND, contains bedrock fragments (TILL) Grey Wet		2	SS	95												
62.4 1.7	Shale (BEDROCK) Bedrock cored from depths 1.7 m to 4.9 m For bedrock coring details refer to Record of Drillhole 20-1370-16		3	SS	>50												
			1	RC	REC 86%												RQD = 47%
			2	RC	REC 100%												RQD = 65%
			3	RC	REC 100%												RQD = 81%
59.2 4.9	END OF BOREHOLE																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMT\OHVY417\REHAB&WIDENING\02_DATA\GINT1662565.GPJ GAL-GTA.GDT 6/3/22 ZS



SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling

STA-RCK 031 N:\ACTIVE\SPATIAL IM\IMTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

CHECKED: KCP

PROJECT		RECORD OF BOREHOLE No 20-1370-17				SHEET 1 OF 2		METRIC									
G.W.P. 4099-11-00		LOCATION N 5030962.5; E 374315.7 MTM NAD 83 ZONE 9 (LAT. 45.415170; LONG. -75.611800)				ORIGINATED BY HRL											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS											
DATUM Geodetic		DATE January 6, 2021				CHECKED BY KCP											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
63.1 0.0	GROUND SURFACE (SP) sand (FILL) Compact Brown Moist		1	SS	25												
62.0 1.1	(SW-ML) SAND and SILT some gravel (FILL) Loose to compact Dark brown Wet		2	SS	20												
			3	SS	9												
60.6			4	SS	>50												
2.6	Highly weathered bedrock Shale (BEDROCK) Bedrock cored from depths 2.6 m to 5.6 m For bedrock coring details refer to Record of Drillhole 20-1370-17		1	RC	REC 100%											17 42 (41)	
			2	RC	REC 99%												
57.5 5.6	END OF BOREHOLE																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-17

SHEET 2 OF 2

LOCATION: N 5030962.5 ;E 374315.7

DRILLING DATE: January 6, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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DEPTH SCALE

1 : 50




LOGGED: HRL

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

GTA-MTO 001 N:\ACTIVE\SPATIAL IM\MT01HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAI-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-32 SHEET 2 OF 3				METRIC											
G.W.P. 4099-11-00		LOCATION N 5030723.2; E 374764.1 MTM NAD 83 ZONE 9 (LAT. 45.412950; LONG. -75.606130)				ORIGINATED BY HRL											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill Drill, NW Casing				COMPILED BY ZS											
DATUM Geodetic		DATE January 4, 2021				CHECKED BY KCP											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100						
	Shale (BEDROCK)		2	RC													
	Bedrock cored from depths 8.8 m to 12.0 m		2	RC	REC 100%												
	For bedrock coring details refer to Record of Drillhole 20-1370-32		3	RC	REC 100%												
53.2	END OF BOREHOLE																
12.0	NOTES: 1. Water level in open borehole at a depth of 1.5 m below ground surface (Elev. 63.7 m), upon completion of drilling																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-32

SHEET 3 OF 3

LOCATION: N 5030723.2 ;E 374764.1

DRILLING DATE: January 4, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
						RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
						TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	W1			W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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DEPTH SCALE

1 : 50



LOGGED: HRL

CHECKED: KCP



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PROJECT		1662565-1370		RECORD OF BOREHOLE No 20-1370-33				SHEET 1 OF 2		METRIC						
G.W.P.		4099-11-00		LOCATION		N 5030694.9; E 374922.4 MTM NAD 83 ZONE 9 (LAT. 45.412680; LONG. -75.604110)		ORIGINATED BY		HRL						
DIST		Eastern HWY 417		BOREHOLE TYPE		Power Auger, 200 mm Diam. (Hollow Stem)		COMPILED BY		ZS						
DATUM		Geodetic		DATE		January 3, 2021		CHECKED BY		KCP						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
68.3	GROUND SURFACE															
0.0	(CI) Silty clay (TOPSOIL) Brown Frozen		1	SS	11											
67.7																
0.6	(CL/CI) Silty clay, contains sand seams (FILL) Stiff Brown		2	SS	7											
			3	SS	8											
66.2																
2.1	(GM-SM) Gravel and Sand, some silt, contains shale fragments (FILL) Dense to very dense Grey Dry		4	SS	42											46 38 (16)
			5	SS	93											
64.5																
3.8	(ML-SM) Silt and Sand, some gravel (FILL) Very dense to compact Grey Moist		6	SS	79											
			7	SS	21											15 40 (45)
63.0																
5.3	(CI) SILTY CLAY, contains silty sand seams (FILL) Very stiff Brown		8	SS	12											
62.2																
6.1	(SP) Gravelly sand, trace silt (FILL) Compact to dense Grey Wet		9	SS	26											22 72 (6)
			10	SS	24											
			11	SS	27											
			12	SS	25											
59.2																
9.1	sand, some gravel, trace silt (FILL) Dense Grey Wet		13	SS	33											

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT		RECORD OF BOREHOLE				No 20-1370-33		SHEET 2 OF 2		METRIC						
G.W.P. 4099-11-00		LOCATION				N 5030694.9; E 374922.4 MTM NAD 83 ZONE 9 (LAT. 45.412680; LONG. -75.604110)				ORIGINATED BY HRL						
DIST Eastern HWY 417		BOREHOLE TYPE				Power Auger, 200 mm Diam. (Hollow Stem)				COMPILED BY ZS						
DATUM Geodetic		DATE				January 3, 2021				CHECKED BY KCP						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
57.8	sand, some gravel, trace silt (FILL) Dense Grey Wet		14	SS	32		58									
10.5	END OF BOREHOLE															
NOTES:																
1. Water level in well screen at a depth of 2.3 m below ground surface (Elev. 66.0 m), measured on Jan. 6, 2021.																


GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITOHWY417REHAB&WIDENING\02_DATA\GINT1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT		RECORD OF BOREHOLE				No 20-1370-34		SHEET 1 OF 2		METRIC						
G.W.P.		LOCATION		N 5030635.0; E 375077.6 MTM NAD 83 ZONE 9 (LAT. 45.412120; LONG. -75.602130)		ORIGINATED BY		HRL								
DIST		HWY		BOREHOLE TYPE		Power Auger, 200 mm Diam. (Hollow Stem)		COMPILED BY		ZS						
DATUM		DATE		December 29, 2020		CHECKED BY		KCP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
71.8	GROUND SURFACE															
0.0	(CL) Silty clay (TOPSOIL) Brown Frozen		1	SS	16											
71.2	(GM-SM) Gravel and sand, some silt (FILL) Compact to very dense Grey Dry		2	SS	12											
0.6																
			3	SS	15											
			4	SS	29											
			5	SS	22											
			6	SS	33											
			7	SS	68											
			8	SS	21											
			9	SS	27											
			10	SS	22											
64.2	(Cl) Silty clay (FILL) Brown		11	SS	49											
63.9	(ML/SM) Silt and sand, trace gravel (FILL) Compact Grey Dry		12	SS	17											
62.7	(SM) Silty sand, trace gravel (FILL) Compact Grey Dry		13	SS	13											
9.1																

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS


PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-34 SHEET 2 OF 2				METRIC									
G.W.P. 4099-11-00				LOCATION N 5030635.0; E 375077.6 MTM NAD 83 ZONE 9 (LAT. 45.412120; LONG. -75.602130)				ORIGINATED BY HRL									
DIST Eastern HWY 417				BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)				COMPILED BY ZS									
DATUM Geodetic				DATE December 29, 2020				CHECKED BY KCP									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100					WATER CONTENT (%) 25 50 75				
61.3 10.5	END OF BOREHOLE		14	SS	23												

PROJECT		RECORD OF BOREHOLE No 20-1370-35 SHEET 1 OF 2										METRIC					
G.W.P.		4099-11-00		LOCATION		N 5030544.7; E 375196.1 MTM NAD 83 ZONE 9 (LAT. 45.411300; LONG. -75.600630)						ORIGINATED BY		HRL			
DIST		Eastern HWY 417		BOREHOLE TYPE		Power Auger, 200 mm Diam. (Hollow Stem)						COMPILED BY		ZS			
DATUM		Geodetic		DATE		December 22, 2020						CHECKED BY		KCP			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
73.8	GROUND SURFACE						20	40	60	80	100						
0.0	(SM) Silty sand (TOPSOIL) Dark brown Moist		1	SS	7												
73.2	(CI) Silty Clay (FILL) Very Stiff Brown		2	SS	11												
0.6																	
			3	SS	11												
71.7	(SM-GM) Silty Sand and Gravel (FILL) Compact Brown Moist		4	SS	11												
2.1																	
70.8	(SM) Silty sand (FILL) Compact Brown Moist		5	SS	15												
3.1																	
70.3	(GM-SM) Silty Gravel and Sand (FILL) Dense to Compact Grey Dry		6	SS	31												
3.5																	
			7	SS	15												
68.5	(CL-SM) Silty Clay and Sand (FILL) Stiff to very stiff Brown		8	SS	11												
5.3	- Cobbles and boulders from 6.0 m to 6.7 m		9	SS	48												
67.1	(SP) Sand, contains cobbles (FILL) Compact to dense Grey-brown Dry - Cobbles from 6.9 m to 7.8 m		10	SS	40												
6.7																	
			11	SS	29												
65.4	(SM) Gravelly silty sand, contains cobbles (FILL) Dense to compact Grey-brown to grey Wet		12	SS	41												
8.4																	
			13	SS	16												
63.8																	

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+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-35				SHEET 2 OF 2		METRIC								
G.W.P. 4099-11-00		LOCATION N 5030544.7; E 375196.1 MTM NAD 83 ZONE 9 (LAT. 45.411300; LONG. -75.600630)				ORIGINATED BY HRL										
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)				COMPILED BY ZS										
DATUM Geodetic		DATE December 22, 2020				CHECKED BY KCP										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
--- CONTINUED FROM PREVIOUS PAGE ---																
10.0	Sandy silt, trace gravel, contains cobbles (FILL) Compact		14	SS	20											
63.3	END OF BOREHOLE															
10.5	NOTES: 1. Water level in open borehole at a depth of 8.4 m below ground surface (Elev. 65.4 m), upon completion of drilling															

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


PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-36A SHEET 1 OF 2		METRIC
G.W.P. 4099-11-00	LOCATION N 5030435.7; E 375289.9 MTM NAD 83 ZONE 9 (LAT. 45.410316; LONG. -75.599452)	ORIGINATED BY HRL		
DIST Eastern HWY 417	BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)	COMPILED BY ZS		
DATUM Geodetic	DATE December 22, 2020	CHECKED BY KCP		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE						WATER CONTENT (%)						
71.5	GROUND SURFACE							20	40	60	80	100								
0.0	For soil stratigraphy refer to Record of Borehole 20-1370-36																			
66.9																				
4.6	(SM) Gravelly silty sand (FILL) Loose Grey brown Dry		7	SS	5									○					26	46 (28)
66.3																				
5.2	(ML-SM) Silt and Sand (FILL) Compact to very dense Brown to grey Dry to wet		8	SS	12															
			9	SS	51															
			10	SS	16														1	40 55 4
64.0																				
7.5	(SM/ML) SAND and SILT Loose to compact Grey Wet		11	SS	13															
			12	SS	8															
			13	SS	12														0	61 (39)

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+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-36A SHEET 2 OF 2										METRIC			
G.W.P. 4099-11-00					LOCATION N 5030435.7; E 375289.9 MTM NAD 83 ZONE 9 (LAT. 45.410316; LONG. -75.599452)					ORIGINATED BY HRL													
DIST Eastern HWY 417					BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)					COMPILED BY ZS													
DATUM Geodetic					DATE December 22, 2020					CHECKED BY KCP													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L								
	--- CONTINUED FROM PREVIOUS PAGE ---																						
61.0	(SM/ML) SAND and SILT Loose to compact Grey Wet		14	SS	21																		
10.5	END OF BOREHOLE																						
	NOTES: 1. Water level in open borehole at a depth of 7.7 m below ground surface (Elev. 63.8 m), upon completion of drilling																						

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PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-37 SHEET 1 OF 2				METRIC								
G.W.P. 4099-11-00				LOCATION N 5030320.9; E 375348.8 MTM NAD 83 ZONE 9 (LAT. 45.409270; LONG. -75.598710)				ORIGINATED BY HRL								
DIST Eastern HWY 417				BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)				COMPILED BY ZS								
DATUM Geodetic				DATE December 21, 2020				CHECKED BY KCP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
69.7	GROUND SURFACE															
0.0	(Cl) Silty clay, some sand, some gravel (FILL) Stiff to very stiff Grey-brown		1	SS	6											
			2	SS	10											
67.9			3	SS	11											
1.8	(SM-GM) Sand and gravel, some silt (FILL) Compact to very dense Grey Dry		4	SS	57											39 46 (15)
66.7			5	SS	23											
3.1	(ML) Clayey gravelly silt, contains organic matter (FILL) Compact Grey		6	SS	5											
65.9			7	SS	7											
3.8	(SM) Silty sand, contains peat (FILL) Dark brown Moist		8	SS	12											
65.6			9	SS	13											
4.1	PEAT, fibrous Black		10	SS	6											
65.1			11	SS	13											
4.6	(ML/SM) SILT and SAND, trace gravel Loose to compact Grey Moist to wet		12	SS	4											
			13	SS	8											
60.7																
9.0	(SM) SAND, some silt, trace gravel Loose Grey Moist to wet															9 74 16 1

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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<div style="display: flex; justify-content: space-between;"> PROJECT 1662565-1370 RECORD OF BOREHOLE No 20-1370-37 SHEET 2 OF 2 METRIC </div>																	
G.W.P. 4099-11-00		LOCATION N 5030320.9; E 375348.8 MTM NAD 83 ZONE 9 (LAT. 45.409270; LONG. -75.598710)		ORIGINATED BY HRL													
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)		COMPILED BY ZS													
DATUM Geodetic		DATE December 21, 2020		CHECKED BY KCP													
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 </div>					<div style="display: flex; justify-content: space-between;"> W_p W W_L </div>					
							<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 </div>					<div style="display: flex; justify-content: space-between;"> 25 50 75 </div>					
59.2			14	SS	4												
10.5	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 4.5 m below ground surface (Elev. 65.2 m), upon completion of drilling																

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

PROJECT		RECORD OF BOREHOLE				No 20-1370-38		SHEET 2 OF 2		METRIC						
G.W.P. 4099-11-00		LOCATION				N 5030208.6; E 375378.2 MTM NAD 83 ZONE 9 (LAT. 45.408260; LONG. -75.598360)				ORIGINATED BY RI						
DIST Eastern HWY 417		BOREHOLE TYPE				Wash Boring, NW Casing				COMPILED BY ZS						
DATUM Geodetic		DATE				July 21-22, 2020				CHECKED BY KCP						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
10.0	(SP) SAND, some gravel		14	SS	20											
57.5	Compact to dense															
10.4	Brown to grey															
	Moist to wet															
	END OF BOREHOLE															
	NOTES:															
	1. Water level in well screen at a depth of 4.7 m below ground surface (Elev. 63.2 m), measured on Sep. 15, 2020.															

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

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-39				SHEET 2 OF 2		METRIC								
G.W.P. 4099-11-00		LOCATION N 5030095.4; E 375405.8 MTM NAD 83 ZONE 9 (LAT. 45.407240; LONG. -75.598020)				ORIGINATED BY RI										
DIST Eastern HWY 417		BOREHOLE TYPE Wash Boring, NW Casing				COMPILED BY ZS										
DATUM Geodetic		DATE July 20-21, 2020				CHECKED BY KCP										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
56.3			15	SS	34											
10.4	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 3.8 m below ground surface (Elev. 62.9 m), upon completion of drilling.															


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PROJECT		1662565-1370		RECORD OF BOREHOLE No 20-1370-40				SHEET 1 OF 2		METRIC						
G.W.P.		4099-11-00		LOCATION		N 5029984.9; E 375438.6 MTM NAD 83 ZONE 9 (LAT. 45.406250; LONG. -75.597620)		ORIGINATED BY		RI						
DIST		Eastern HWY 417		BOREHOLE TYPE		Wash Boring, NW Casing		COMPILED BY		ZS						
DATUM		Geodetic		DATE		July 19-20, 2020		CHECKED BY		KCP						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
66.2	GROUND SURFACE															
0.0	(CL) Clayey silt (TOPSOIL)															
0.2	Dark brown Moist		1	SS	1											
	(CL) Clayey silt, trace to some sand, contains organic matter (FILL)		2	SS	6											
	Firm Grey-brown															
64.7	(CH) CLAY, some silt, trace sand, contains silt seams		3	SS	WH											
1.5	Firm to stiff Grey-brown															
62.7	(ML) SILT, some gravel		4	SS	3											
3.5	Grey-brown Compact															
62.1	(SW) Gravelly SAND		5	SS	15											
4.1	Compact Grey Wet															
			6	SS	29											
			7	SS	26											
			8	SS	26											
			9	SS	22											
			10	SS	25											
			11	SS	27											
			12	SS	30											
56.2																

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



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PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-40 SHEET 2 OF 2				METRIC										
G.W.P. 4099-11-00				LOCATION N 5029984.9; E 375438.6 MTM NAD 83 ZONE 9 (LAT. 45.406250; LONG. -75.597620)				ORIGINATED BY RI										
DIST Eastern HWY 417				BOREHOLE TYPE Wash Boring, NW Casing				COMPILED BY ZS										
DATUM Geodetic				DATE July 19-20, 2020				CHECKED BY KCP										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
	--- CONTINUED FROM PREVIOUS PAGE ---							<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>										
10.0	(SW) Gravelly SAND		13	SS	31		56											
55.8	Very dense																	
10.4	Grey Wet																	
	END OF BOREHOLE																	
	NOTES:																	
	1. Water level in open borehole at a depth of 2.9 m below ground surface (Elev. 63.3 m), upon completion of drilling.																	

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

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PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-41 SHEET 2 OF 2										METRIC	
G.W.P. 4099-11-00					LOCATION N 5029880.3; E 375482.4 MTM NAD 83 ZONE 9 (LAT. 45.405300; LONG. -75.597070)					ORIGINATED BY RI											
DIST Eastern HWY 417					BOREHOLE TYPE Wash Boring, NW Casing					COMPILED BY ZS											
DATUM Geodetic					DATE July 15-16, 2020					CHECKED BY KCP											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)								
	--- CONTINUED FROM PREVIOUS PAGE ---																				
55.5	(SM) Gravelly SAND, contains silty clay seams (TILL) Compact to dense		14	SS	30																
10.4	END OF BOREHOLE																				
	NOTES: 1. Water level in well screen at a depth of 2.7 m below ground surface (Elev. 63.2 m), measured on Sep. 15, 2020.																				

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-74				SHEET 2 OF 2		METRIC								
G.W.P. 4099-11-00		LOCATION N 5029657.9; E 375609.1 MTM NAD 83 ZONE 9 (LAT. 45.403290; LONG. -75.595490)				ORIGINATED BY RI										
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)				COMPILED BY ZS										
DATUM Geodetic		DATE July 15-16, 2020				CHECKED BY KCP										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p W W _L 25 50 75				
54.2			14													
10.2	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 63.8 m), measured upon completion of drilling.															


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PROJECT		RECORD OF BOREHOLE No 20-1370-75				SHEET 1 OF 3		METRIC						
G.W.P. 4099-11-00		LOCATION N 5029570.3; E 375663.2 MTM NAD 83 ZONE 9 (LAT. 45.402490; LONG. -75.594810)				ORIGINATED BY RI								
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS								
DATUM Geodetic		DATE June 14-15, 2020				CHECKED BY KCP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
64.3	GROUND SURFACE													
0.0	(SM) Silty sand (TOPSOIL)													
0.2	Moist Dark brown (CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff Grey-brown		1	SS	3									
			2	SS	10									
			3	SS	7									
			4	SS	4									
			5	SS	2									
60.6	(CI) SILTY CLAY													
3.7	Stiff Grey													
59.7	(CL-ML) CLAYEY SILT-SILT													
4.6	Stiff Grey		6	SS	6									
			7	SS	4									
58.5	(CI) CLAYEY SILT, some sand, trace to some gravel (TILL)													
5.8	Stiff Dark brown		8	SS	3									
			9	SS	7									
57.0	(SM) Gravelly SAND, some silt (TILL)													
7.3	Dense Grey to dark brown Wet		10	SS	41									
			11	SS	50/0.05									
55.9	Shale (BEDROCK)													
8.4	Bedrock cored from depths 8.4 m to 12.3 m For bedrock coring details refer to Record of Drillhole 20-1370-75		1	RC	REC 74%									RQD = 35%
			2	RC	REC 95%									RQD = 68%

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-75				SHEET 2 OF 3		METRIC									
G.W.P. 4099-11-00		LOCATION N 5029570.3; E 375663.2 MTM NAD 83 ZONE 9 (LAT. 45.402490; LONG. -75.594810)				ORIGINATED BY RI											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS											
DATUM Geodetic		DATE June 14-15, 2020				CHECKED BY KCP											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100					WATER CONTENT (%) 25 50 75					
52.0	Shale (BEDROCK) Bedrock cored from depths 8.4 m to 12.3 m For bedrock coring details refer to Record of Drillhole 20-1370-75		2	RC	REC 95%		54										RQD = 68%
			3	RC	REC 100%		53										RQD = 99%
12.3	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 63.5 m), upon completion of drilling.						52										

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SHEET 3 OF 3


DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling

DATA-RCK 031 N:\ACTIVE\SPATIAL IM\MTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

LOGGED: RI
CHECKED: KCP

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

PROJECT		RECORD OF BOREHOLE				No 20-1370-76		SHEET 2 OF 3		METRIC						
G.W.P. 4099-11-00		LOCATION				N 5029468.7; E 375719.3 MTM NAD 83 ZONE 9 (LAT. 45.401570; LONG. -75.594100)				ORIGINATED BY RI						
DIST Eastern HWY 417		BOREHOLE TYPE				Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS						
DATUM Geodetic		DATE				July 14-15, 2020				CHECKED BY KCP						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
52.8	Shale (BEDROCK) Bedrock cored from depths 7.5 m to 11.0 m For bedrock coring details refer to Record of Drillhole 20-1370-76		3	RC	REC 100%											
11.0	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 0.9 m below ground surface (Elev. 62.9 m), upon completion of drilling.															

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-76

SHEET 3 OF 3

LOCATION: N 5029468.7 ;E 375719.3

DRILLING DATE: July 14-15, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							TOTAL CORE %	SOLID CORE %			DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	W1	W2	W3		W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-77		SHEET 1 OF 2		METRIC	
G.W.P. 4099-11-00		LOCATION N 5029329.2; E 375773.2 MTM NAD 83 ZONE 9 (LAT. 45.400310; LONG. -75.593440)		ORIGINATED BY RI			
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core		COMPILED BY ZS			
DATUM Geodetic		DATE July 13-14, 2020		CHECKED BY KCP			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED								
62.8	GROUND SURFACE							20	40	60	80	100	25	50	75		
0.0	(CI) Silty clay, trace to some sand (TOPSOIL)																
0.2	Dark brown		1	SS	6												
	(CI) Silty clay some gravel, contains sand seams (FILL)		2	SS	2												
	Stiff to firm																
	Grey-brown to grey		3	SS	WH												
60.8																	
2.0	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST)		4	SS	1												
	Stiff																
	Grey-brown																
60.1																	
2.7	(CI) SILTY CLAY		5	SS	WH												
	Firm																
	Grey																
59.3																	
3.5	(ML) SILT		6	SS	11												
	Compact																
	Grey		7	SS	13												
58.1																	
4.7	(GM) SILT SANDY GRAVEL, contains cobbles (TILL)		8	SS	15												
	Compact to very dense																
	Grey																
	Wet		9	SS	55												
56.3																	
6.6	Slightly weathered Bedrock		10	SS	50/0.08												
	Shale (BEDROCK)																
	Bedrock cored from depths 6.6 m to 9.8 m		1	RC	REC 94%												RQD = 26%
	For bedrock coring details refer to Record of Drillhole 20-1370-77																
			2	RC	REC 94%												RQD = 69%
			3	RC	REC 100%												RQD = 100%
53.0																	
9.8																	

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-77 SHEET 2 OF 2					METRIC									
G.W.P. 4099-11-00		LOCATION N 5029329.2; E 375773.2 MTM NAD 83 ZONE 9 (LAT. 45.400310; LONG. -75.593440)					ORIGINATED BY RI									
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core					COMPILED BY ZS									
DATUM Geodetic		DATE July 13-14, 2020					CHECKED BY KCP									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 0.9 m below ground surface (Elev. 61.9 m), upon completion of drilling.															

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-77

SHEET 2 OF 2

LOCATION: N 5029329.2 ;E 375773.2

DRILLING DATE: July 13-14, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
						FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-78		SHEET 1 OF 3		METRIC	
G.W.P. 4099-11-00		LOCATION N 5029178.9; E 375807.8 MTM NAD 83 ZONE 9 (LAT. 45.398960; LONG. -75.593020)		ORIGINATED BY RI			
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core		COMPILED BY ZS			
DATUM Geodetic		DATE July 12-13, 2020		CHECKED BY KCP			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20 40 60 80 100			W _p W W _L								
64.4	GROUND SURFACE																			
0.0	(SM) SILTY SAND (TOPSOIL)																			
0.2	Dark brown Moist (CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff to stiff Grey-brown		1	SS	5	▽														
			2	SS	8															
			3	SS	4															
61.5	(CL) CLAYEY SILT																			
2.9	Stiff Grey		4	SS	3															
60.1	(CL-ML) CLAYEY SILT-SILT, trace to some gravel																			
4.3	Compact Grey																			

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-78

SHEET 3 OF 3

LOCATION: N 5029178.9 ;E 375807.8

DRILLING DATE: July 12-13, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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UCS = 122.0 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

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

PROJECT <u>1662565-1370</u>		RECORD OF BOREHOLE No 20-1370-79				SHEET 2 OF 2		METRIC							
G.W.P. <u>4099-11-00</u>		LOCATION <u>N 5029131.8; E 375712.6 MTM NAD 83 ZONE 9 (LAT. 45.398540; LONG. -75.594240)</u>				ORIGINATED BY <u>RI</u>									
DIST <u>Eastern</u> HWY <u>417</u>		BOREHOLE TYPE <u>Wash Boring, NW Casing</u>				COMPILED BY <u>ZS</u>									
DATUM <u>Geodetic</u>		DATE <u>July 23-24, 2020</u>				CHECKED BY <u>KCP</u>									
SOIL PROFILE		SAMPLES				DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	<div style="display: flex; justify-content: space-between; width: 100%;"> 20 40 60 80 100 </div>		W _p	W	W _L	γ	GR SA SI CL	
--- CONTINUED FROM PREVIOUS PAGE ---								SHEAR STRENGTH kPa		WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED		25 50 75					
55.5 10.1	END OF BOREHOLE SAMPLER REFUSAL NOTES: 1. Water level in well screen at a depth of 2.2 m below ground surface (Elev. 63.3 m), measured on Sep. 15, 2020.														

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITOHWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT		RECORD OF BOREHOLE No 20-1370-101				SHEET 2 OF 3		METRIC									
G.W.P. 4099-11-00		LOCATION N 5029035.8; E 375928.9 MTM NAD 83 ZONE 9 (LAT. 45.397660; LONG. -75.591490)				ORIGINATED BY RI											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS											
DATUM Geodetic		DATE July 22-23, 2020				CHECKED BY KCP											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100	W _p	W	W _L			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
							20	40	60	80	100	25	50	75			
54.1	Shale (BEDROCK)		2	RC	REC 99%		55										RQD = 70%
	Bedrock cored from depths 8.4 m to 11.6 m		3	RC	REC 100%												
11.6	END OF BOREHOLE																
	NOTES: 1. Water level in well screen at a depth of 1.5 m below ground surface (Elev. 64.2 m), measured on Sep. 15, 2020.																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTOWHY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-101

SHEET 3 OF 3

LOCATION: N 5029035.8 ;E 375928.9

DRILLING DATE: July 22-23, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
				ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
							TOTAL CORE %	SOLID CORE %				Jr	Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	W1	W2		W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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UCS =
95.8 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS


PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-102 SHEET 1 OF 3		METRIC
G.W.P. 4099-11-00		LOCATION N 5028970.0; E 375829.0 MTM NAD 83 ZONE 9 (LAT. 45.397070; LONG. -75.592780)		ORIGINATED BY RI
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core		COMPILED BY ZS
DATUM Geodetic		DATE July 9-10, 2020		CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20	40	60	80	100	W _p	W		W _L				
66.2	GROUND SURFACE																				
0.0	(ML) Sandy silt, trace gravel (TOPSOIL)																				
0.2	Dark brown		1	SS	14																
65.7	Moist																				
0.5	(SM) Gravelly silty sand, contains organic matter (FILL) Compact Brown Moist		2	SS	12																
	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff Grey-brown		3	SS	6																
			4	SS	4																
			5	SS	3																
62.7																					
3.5	(CI) SILTY CLAY, contains silt seams Stiff Grey																				
			6	SS	2																
			7	SS	1																
59.7																					
6.6	(ML) Sandy SILT Compact to dense Dark brown to grey Wet		8	SS	18																
			9	SS	32																
			10	SS	47																
57.5																					
8.7	Shale (BEDROCK)		1	RC	REC 75%																
	Bedrock cored from depths 8.7 m to 11.9 m																				
	For bedrock coring details refer to Record of Drillhole 20-1370-102		2	RC	REC 98%																
</																					

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-102 SHEET 2 OF 3				METRIC								
G.W.P. 4099-11-00		LOCATION N 5028970.0; E 375829.0 MTM NAD 83 ZONE 9 (LAT. 45.397070; LONG. -75.592780)				ORIGINATED BY RI										
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS										
DATUM Geodetic		DATE July 9-10, 2020				CHECKED BY KCP										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
	Shale (BEDROCK)		2	RC	REC 98%											
	Bedrock cored from depths 8.7 m to 11.9 m For bedrock coring details refer to Record of Drillhole 20-1370-102		3	RC	REC 100%											
54.3																
11.9	END OF BOREHOLE															
	NOTES: 1. Water level in open borehole at a depth of 2.3 m below ground surface (Elev. 63.9 m), upon completion of drilling.															

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-102

SHEET 3 OF 3

LOCATION: N 5028970.0 ;E 375829.0

DRILLING DATE: July 9-10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
				ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
							TOTAL CORE %	SOLID CORE %			DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	W1	W2		W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
		BEDROCK SURFACE		57.46																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

DEPTH SCALE

1 : 50




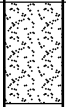
LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

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

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-103 SHEET 2 OF 2										METRIC			
G.W.P. 4099-11-00					LOCATION N 5028787.2; E 375833.3 MTM NAD 83 ZONE 9 (LAT. 45.395430; LONG. -75.592750)					ORIGINATED BY RI													
DIST Eastern HWY 417					BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)					COMPILED BY ZS													
DATUM Geodetic					DATE June 25, 2020					CHECKED BY KCP													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)										
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100											
57.7	(CI) SILTY CLAY, contains silt seams Firm Grey						58	X		+													
10.7	END OF BOREHOLE							X		+													
NOTES: 1. Water level in well screen at a depth of 3.0 m below ground surface (Elev. 65.4 m), measured on Sep. 15, 2020.																							


GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTOWHY417REHAB&WIDENING\02_DATA\GINT1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT 1662565-1370					RECORD OF BOREHOLE No 20-1370-112 SHEET 2 OF 2					METRIC							
G.W.P. 4099-11-00					LOCATION N 5028629.1; E 375842.8 MTM NAD 83 ZONE 9 (LAT. 45.394010; LONG. -75.592650)					ORIGINATED BY RI							
DIST Eastern HWY 417					BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)					COMPILED BY ZS							
DATUM Geodetic					DATE June 24, 2020					CHECKED BY CRG							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
10.0	(Cl) SILTY CLAY, contains sand and silt seams Firm Grey							X	+								
56.0								X	+								
10.7	END OF BOREHOLE						56										
	NOTES: 1. Water level in well screen at a depth of 1.7 m below ground surface (Elev. 64.9 m), measured on Sep. 15, 2020.																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTOWHY417REHAB&WIDENING\02_DATA\GINT1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-113 SHEET 2 OF 3				METRIC									
G.W.P. 4099-11-00				LOCATION N 5028458.9; E 375872.5 MTM NAD 83 ZONE 9 (LAT. 45.392470; LONG. -75.592290)				ORIGINATED BY JS									
DIST Eastern HWY 417				BOREHOLE TYPE Wash Boring/Rotary Drill, NQ Core				COMPILED BY ZS									
DATUM Geodetic				DATE August 5-7				CHECKED BY CRG									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p W W _L 25 50 75				GR SA SI CL	
54.1	Shale (BEDROCK) Bedrock cored from depths 10.3 m to 13.4 m For bedrock coring details refer to Record of Drillhole 20-1370-113		1	RC	REC 100%											RQD = 98%	
10.3			2	RC	REC 96%												RQD = 96%
			3	RC	REC 100%												RQD = 100%
51.0																	
13.4	END OF BOREHOLE																

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

SHEET 3 OF 3

DATUM: Geodetic


DRILLING CONTRACTOR: Marathon Drilling

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL IMMTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

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

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-114 SHEET 2 OF 2				METRIC								
G.W.P. 4099-11-00				LOCATION N 5028283.0; E 375919.7 MTM NAD 83 ZONE 9 (LAT. 45.390880; LONG. -75.591720)				ORIGINATED BY JS								
DIST Eastern HWY 417				BOREHOLE TYPE Wash Boring, NW Casing				COMPILED BY ZS								
DATUM Geodetic				DATE August 10, 2020				CHECKED BY KCP								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>									
55.9 10.3	(SM/ML) SAND AND SILT, some gravel (TILL) Compact Grey Wet END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 2.5 m below ground surface (Elev. 63.7 m), upon completion of drilling.		13	SS	12		56									

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RECORD OF BOREHOLE No 20-1370-115 SHEET 1 OF 3
METRIC

PROJECT 1662565-1370
 G.W.P. 4099-11-00 LOCATION N 5028130.2; E 375988.9 MTM NAD 83 ZONE 9 (LAT. 45.389500; LONG. -75.590860) ORIGINATED BY RI
 DIST Eastern HWY 417 BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core COMPILED BY ZS
 DATUM Geodetic DATE June 16, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED														
								20	40	60	80	100						25	50	75		
66.1	GROUND SURFACE						66															
0.0	(ML) Clayey silt (TOPSOIL) Dark brown																					
0.2	(ML) Clayey silt, some sand, trace gravel, occasional cobbles (FILL) Very stiff Brown to grey		1	SS	10																	
65.3																						
0.8	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff Grey-brown		2	SS	14		65															
			3	SS	12																	
			4	SS	5		64															
			5	SS	3		63															
62.4																						
3.7	(CI) SILTY CLAY Stiff Grey						62															

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MT01HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-115 SHEET 2 OF 3				METRIC									
G.W.P. 4099-11-00		LOCATION N 5028130.2; E 375988.9 MTM NAD 83 ZONE 9 (LAT. 45.389500; LONG. -75.590860)				ORIGINATED BY RI											
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS											
DATUM Geodetic		DATE June 16, 2020				CHECKED BY CRG											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100					WATER CONTENT (%) 25 50 75					
54.0	12.2	Shale (BEDROCK)					56										RQD = 62%
		Bedrock cored from depths 7.7 m to 12.2 m	3	RC	REC 89%		55										RQD = 94%
		For bedrock coring details refer to Record of Drillhole 20-1370-115	4	RC	REC 100%		54										
		END OF BOREHOLE															
		NOTES:															
		1. Water level in open borehole at a depth of 2.3 m below ground surface (Elev. 63.9 m), upon completion of drilling.															

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-115

SHEET 3 OF 3

LOCATION: N 5028130.2 ;E 375988.9

DRILLING DATE: June 16, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Ja	10 ⁻⁵ C	10 ⁻⁴ C	10 ⁻³ C	10 ⁻² C	W1		W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
		BEDROCK SURFACE		58.48																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

UCS = 70.4 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

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PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-116 SHEET 1 OF 3				METRIC									
G.W.P. 4099-11-00				LOCATION N 5027986.6; E 376071.7 MTM NAD 83 ZONE 9 (LAT. 45.388200; LONG. -75.589820)				ORIGINATED BY RI									
DIST Eastern HWY 417				BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS									
DATUM Geodetic				DATE June 17, 2020				CHECKED BY CRG									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
70.4	GROUND SURFACE																
0.0	(SM) Gravelly silty sand, contains cobbles and boulders (FILL) Brown Moist		1	GS	-												
69.7																	
69.5	(ML) Clayey silt, trace to some sand (TOPSOIL) Dark brown		2	SS	9												
0.9	(CI) Silty clay some sand contains sand seams, organic matter, rootlets and wood pieces (FILL) Very stiff Grey-brown		3	SS	9												
			4	SS	6												
			5	SS	5												
			6	SS	8												
65.7			7	SS	14												
4.7	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff Grey-brown		8	SS	14												
			9	SS	8												
63.7			10	SS	2												
6.7	(CI) SILTY CLAY Stiff Grey		11	SS	2												
62.3			12	SS	7												
8.1	(SM) Gravelly SAND and SILT (TILL) Loose Brown to grey Wet		13	SS	100/1.2												
61.3	Highly weathered Bedrock		1	RC	REC 100%												
9.3																	

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\TOD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-116 SHEET 2 OF 3										METRIC			
G.W.P. 4099-11-00										LOCATION N 5027986.6; E 376071.7 MTM NAD 83 ZONE 9 (LAT. 45.388200; LONG. -75.589820)										ORIGINATED BY RI			
DIST Eastern HWY 417										BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core										COMPILED BY ZS			
DATUM Geodetic										DATE June 17, 2020										CHECKED BY CRG			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)										
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100	W _p	W	W _L									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED																
							20	40	60	80	100	25	50	75									
	Shale (BEDROCK)																						
	Bedrock cored from depths 9.3 m to 13.2 m																						
	For bedrock coring details refer to Record of Drillhole 20-1370-116																						
			2	RC	REC 100%		60																
							59																
			3	RC	REC 100%		58																
57.2	END OF BOREHOLE																						
13.2	NOTES:																						
	1. Water level in well screen at a depth of 4.7 m below ground surface (Elev. 65.8 m), measured on Sep. 15, 2020.																						

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-116

SHEET 3 OF 3

LOCATION: N 5027986.6 ;E 376071.7

DRILLING DATE: June 17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																		FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t. CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr	Ja	10 ⁻⁹ C	10 ⁻⁸ C	10 ⁻⁷ C	10 ⁻⁶ C	W1	W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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UCS =
78.5 Mpa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

RECORD OF BOREHOLE No 20-1370-117 SHEET 1 OF 2

METRIC

PROJECT 1662565-1370
G.W.P. 4099-11-00 LOCATION N 5027843.5; E 376174.1 MTM NAD 83 ZONE 9 (LAT. 45.386900; LONG. -75.588530) ORIGINATED BY RI
DIST Eastern HWY 417 BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core COMPILED BY ZS
DATUM Geodetic DATE June 18, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE											
								● QUICK TRIAXIAL	× REMOULDED											
67.1	GROUND SURFACE					▽	67													
0.0	(ML) Clayey silt, some sand (TOPSOIL)																			
66.9	Dark brown		1	SS	6															
0.3	(CI) Silty clay trace gravel contains sand seams (FILL)																			
66.3	Grey-brown																			
0.8	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST)		2	SS	14			66												
	Very stiff																			
	Grey-brown																			
			3	SS	15			65												
			4	SS	6															
64.1								64												
3.1	(SM) SILTY SAND some gravel (TILL) Compact to loose Brown Wet		5	SS	20															
			6	SS	4		63								17 40 30 13					
62.5																				
	Highly weathered Bedrock		7	SS	50/0.15															
4.7	Shale (BEDROCK) Bedrock cored from depths 4.7 m to 7.8 m For bedrock coring details refer to Record of Drillhole 20-1370-117		1	RC	REC 97%		62								RQD = 61%					
							61													
			2	RC	REC 100%		60								RQD = 64%					
59.3	END OF BOREHOLE																			
7.8	NOTES: 1. Water level in open borehole at a depth of 1.3 m below ground surface (Elev. 65.8 m), upon completion of drilling.																			

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-117

SHEET 2 OF 2

LOCATION: N 5027843.5 ;E 376174.1

DRILLING DATE: June 18, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS DEGREES	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
							TOTAL CORE % 80 60 40 20	SOLID CORE % 80 60 40 20				TYPE AND SURFACE DESCRIPTION	Jr	Ja	10 ⁻⁵ 10 ⁻⁴ 10 ⁻³ 10 ⁻² 10 ⁻¹	10 ⁻⁵ 10 ⁻⁴ 10 ⁻³ 10 ⁻² 10 ⁻¹	W1	W2	W3	W4		W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

RECORD OF BOREHOLE No 20-1370-118 SHEET 1 OF 3

METRIC


PROJECT 1662565-1370
G.W.P. 4099-11-00 LOCATION N 5027738.2; E 376283.9 MTM NAD 83 ZONE 9 (LAT. 45.385940; LONG. -75.587140) ORIGINATED BY RI
DIST Eastern HWY 417 BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core COMPILED BY ZS
DATUM Geodetic DATE June 22, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL	
68.9	GROUND SURFACE							20	40	60	80	100									
0.0	(CL/CI) Silty clay, some sand (TOPSOIL)																				
68.7	Dark brown																				
0.2	(CH) Clay some sand contains organic matter, rootlets and wood pieces (FILL) Very stiff Grey-brown		1	SS	9																
			2	SS	14																
			3	SS	7									10	10			1	13	37	49
			4	SS	5																
65.6			5	SS	8																
3.4	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST) Very stiff Grey-brown																				
			6	SS	8										10						
			7	SS	4																

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTOWHY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-118 SHEET 2 OF 3										METRIC	
G.W.P. 4099-11-00					LOCATION N 5027738.2; E 376283.9 MTM NAD 83 ZONE 9 (LAT. 45.385940; LONG. -75.587140)					ORIGINATED BY RI											
DIST Eastern HWY 417					BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core					COMPILED BY ZS											
DATUM Geodetic					DATE June 22, 2020					CHECKED BY CRG											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)								
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100	W _p	W	W _L						
								20	40	60	80	100									
57.9	Shale (BEDROCK) Bedrock cored from depths 7.3 m to 11.0 m For bedrock coring details refer to Record of Drillhole 20-1370-118		3	RC	REC 100%												RQD = 73%				
11.0	END OF BOREHOLE NOTES: 1. Water level in well screen at a depth of 2.7 m below ground surface (Elev. 66.2 m), measured on Sep. 15, 2020.																				

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITOHWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-118

SHEET 3 OF 3

LOCATION: N 5027738.2 ;E 376283.9

DRILLING DATE: June 22, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Ja	10 ⁻⁵ C	10 ⁻⁴ C	10 ⁻³ C	10 ⁻² C	W1		W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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UCS =
41.0 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-119 SHEET 1 OF 2				METRIC							
G.W.P. 4099-11-00				LOCATION N 5027628.5; E 376196.1 MTM NAD 83 ZONE 9 (LAT. 45.384970; LONG. -75.588280)				ORIGINATED BY RI							
DIST Eastern HWY 417				BOREHOLE TYPE Wash Boring/Rotary Drill, NQ Core				COMPILED BY ZS							
DATUM Geodetic				DATE July 27-28, 2020				CHECKED BY CRG							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
67.1	GROUND SURFACE						20	40	60	80	100	25	50	75	GR SA SI CL
0.0	(ML) Clayey silt (TOPSOIL)														
0.2	Brown Moist (CH) CLAY, some silt (WEATHERED CRUST) Stiff Grey-brown		1	SS	7										
			2	SS	5										
65.4															
1.7	(GM-SM) SILTY GRAVEL and SAND contains shale fragments (TILL) Compact to dense Grey Wet		3	SS	18										
			4	SS	49										
63.9			5	SS	50/0.05										
3.4	Highly weathered Bedrock Shale (BEDROCK)														
	Bedrock cored from depths 3.4 m to 6.4 m		1	RC	REC 99%										
	For bedrock coring details refer to Record of Drillhole 20-1370-119														
			2	RC	REC 97%										
60.7															
6.4	END OF BOREHOLE														

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling

DATA-RCK 031 N:\ACTIVE\SPATIAL IM\MTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

LOGGED: RI
CHECKED: KCP

PROJECT		RECORD OF BOREHOLE No 20-1370-126 SHEET 1 OF 2										METRIC			
G.W.P.		LOCATION		BOREHOLE TYPE						ORIGINATED BY					
DIST		HWY		Wash BoringRotary Drill, NQ Core						COMPILED BY					
DATUM		DATE		July 8-9, 2020						CHECKED BY					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
66.1	GROUND SURFACE														
0.0	(CI/CH) SILTY CLAY to CLAY, trace sand (TOPSOIL)														
0.1	Dark brown		1	SS	8										
	(CH) CLAY fissured, contains sand seams (WEATHERED CRUST)														
	Very stiff to stiff		2	SS	12										
	Grey-brown														
			3	SS	9										
			4	SS	3										
63.4	(CI) SILTY CLAY, contains silt seams														
2.7	Stiff		5	SS	2										
	Grey														

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-126

SHEET 2 OF 2

LOCATION: N 5027649.7 ;E 376392.3

DRILLING DATE: July 8-9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																		FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
				ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
							TOTAL CORE %	SOLID CORE %				Jr	Ja	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³	W1	W2	W3	W4		W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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UCS = 39.8 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

RECORD OF BOREHOLE No 20-1370-127 SHEET 1 OF 2

METRIC

PROJECT 1662565-1370
G.W.P. 4099-11-00 LOCATION N 5027692.2; E 376561.7 MTM NAD 83 ZONE 9 (LAT. 45.385500; LONG. -75.583600) ORIGINATED BY JS
DIST Eastern HWY 417 BOREHOLE TYPE Wash Boring/Rotary Drill, NQ Core COMPILED BY ZS
DATUM Geodetic DATE July 26-27, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED							
66.1	GROUND SURFACE						20	40	60	80	100				
0.0	(ML) Sandy silt (TOPSOIL) Brown Moist		1	SS	7										
0.2	(ML) Sandy silt, some gravel (FILL) Loose Brown Moist														
65.4	(CH) CLAY (WEATHERED CRUST) Very stiff to stiff Brown		2	SS	6										
0.7															
			3	SS	4										
			4	SS	2										
63.1	(CI) SILTY CLAY, contains silt seams Firm Grey		5	SS	WH										
61.8	(SM-ML) Gravelly SAND and SILT contains cobbles (TILL) Compact Grey Very moist		6	SS	68/0.18										
61.2	Highly weathered Bedrock														
61.0	Shale (BEDROCK)														
5.1	Bedrock cored from depths 5.1 m to 8.6 m For bedrock coring details refer to Record of Drillhole 20-1370-127		1	RC	REC 98%										
			2	RC	REC 99%										
			3	RC	REC 100%										
57.5	END OF BOREHOLE														
8.6	NOTES: 1. Water level in well screen at a depth of 2.2 m below ground surface (Elev. 63.9 m), measured on Sep. 15, 2020.														

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling

DATA-RCK 031 N:\ACTIVE\SPATIAL IM\MTO\HWY417REHAB&WIDENING\02 DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

CHECKED: KCP

RECORD OF BOREHOLE No 20-1370-128 SHEET 1 OF 2
METRIC

PROJECT 1662565-1370
 G.W.P. 4099-11-00 LOCATION N 5027536.7; E 376531.2 MTM NAD 83 ZONE 9 (LAT. 45.384110; LONG. -75.584020) ORIGINATED BY RI
 DIST Eastern HWY 417 BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core COMPILED BY ZS
 DATUM Geodetic DATE July 7-8, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED												
66.5	GROUND SURFACE						20	40	60	80	100									
0.0	(SM) Silty sand, some gravel (TOPSOIL)																			
0.2	Dark-brown Moist		1	SS	23															
65.7	(SM) Silty sand, some gravel (FILL)																			
0.8	Compact Brown Moist		2	SS	15															
	(CH) CLAY contains sand seams (WEATHERED CRUST) Very stiff to stiff Brown		3	SS	13											0 4 33 63				
			4	SS	4															
63.8	(CI) SILTY CLAY																			
2.7	Stiff to firm Grey		5	SS	3															
62.1	(SM) Gravelly Silty SAND (TILL)																			
4.4	Dark brown Wet		6	SS	>50											21 31 (48)				
61.7	Shale (BEDROCK)															RQD = 81%				
4.8	Bedrock cored from depths 4.8 m to 8.2 m For bedrock coring details refer to Record of Drillhole 20-1370-128		1	RC	REC 100%															
			2	RC	REC 100%											RQD = 74%				
			3	RC	REC 100%											RQD = 91%				
58.4	END OF BOREHOLE																			
8.2	NOTES: 1. Water level in open borehole at a depth of 2.4 m below ground surface (Elev. 64.1 m), upon completion of drilling.																			

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMT\HWHY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-128

SHEET 2 OF 2

LOCATION: N 5027536.7 ;E 376531.2

DRILLING DATE: July 7-8, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX						
							TOTAL CORE %	SOLID CORE %				Jr	Js		W1	W2	W3	W4	W5	W6	

5		BEDROCK SURFACE		61.73																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												</
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UCS = 34.8 Mpa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

PROJECT		RECORD OF BOREHOLE No 20-1370-129 SHEET 1 OF 2										METRIC							
G.W.P.		4099-11-00		LOCATION		N 5027542.3; E 376617.5 MTM NAD 83 ZONE 9 (LAT. 45.384150; LONG. -75.582910)						ORIGINATED BY		JS					
DIST		Eastern		HWY		417		BOREHOLE TYPE		Wash Boring/Rotary Drill, NW Casing						COMPILED BY		ZS	
DATUM		Geodetic		DATE												CHECKED BY		CRG	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × REMOULDED</div><div>20406080100</div></div>				<div><div>WpWwL</div><div>255075</div></div>			<div><div>γ</div><div>kn/m³</div></div>				
66.6	GROUND SURFACE																		
0.0	(SM) Silty sand, some gravel (TOPSOIL)																		
0.2	Brown Moist		1	SS	19														
65.9	(SW/GW) Sand and gravel, some silt (FILL) Compact Grey Moist						66												
0.7	(CH) CLAY contains sand seams (WEATHERED CRUST) Very stiff to stiff Brown		2	SS	9														
			3	SS	5		65												
64.4	(CI) SILTY CLAY Firm Grey																		
2.2			4	SS	WH		64												
			5	SS	WH														
							63												

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-129

SHEET 2 OF 2

LOCATION: N 5027542.3 ;E 376617.5






DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Ja	W1	W2	W3	W4		W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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6	Rotary Drill NQ Core	BEDROCK SURFACE Shale (BEDROCK), with limestone partings Slightly weathered to fresh Thinly to medium bedded Dark grey to black Fine grained Poor to excellent quality Strong		60.81 5.77	1	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

UCS = 83.7 MPa

DEPTH SCALE

1 : 50



LOGGED: JS

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS GDT 6/3/22 ZS

PROJECT 1662565-1370		RECORD OF BOREHOLE No 20-1370-130 SHEET 1 OF 2		METRIC
G.W.P. 4099-11-00		LOCATION N 5027421.8; E 376698.1 MTM NAD 83 ZONE 9 (LAT. 45.383060; LONG. -75.581900)		ORIGINATED BY RI
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core		COMPILED BY ZS
DATUM Geodetic		DATE July 6, 2020		CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
65.9	GROUND SURFACE																			
0.0	(SM) Silty sand (TOPSOIL) Brown to dark brown Moist		1	SS	6															
0.2	(CI) Silty clay, some sand, trace gravel, contains rootlets (FILL) Stiff Brown																			
65.3	(CL) CLAYEY SILT contains sand seams (WEATHERED CRUST) Stiff Grey-brown		2	SS	3															
0.6																				
			3	SS	3															
63.8	(CI) SILTY CLAY contains silt seams Stiff to firm Grey																			
2.1			4	SS	1															
			5	SS	WH															
60.7	(SM) Gravelly SILTY SAND (TILL) Dense Grey Wet		6	SS	31															
5.2	Highly weathered Bedrock																			
60.1	Shale (BEDROCK)																			
5.8	Bedrock cored from depths 6.1 m to 9.8 m		1	RC	REC 100%													RQD = 73%		
59.8	For bedrock coring details refer to Record of Drillhole 20-1370-130		2	RC	REC 100%													RQD = 53%		
6.1			3	RC	REC 100%													RQD = 100%		
56.1																				
9.8																				

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IM\MTD\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

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

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-130

SHEET 2 OF 2

LOCATION: N 5027421.8 ;E 376698.1

DRILLING DATE: July 6, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
						FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	W1		W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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UCS = 50 MPa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

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

PROJECT 1662565-1370				RECORD OF BOREHOLE No 20-1370-131 SHEET 2 OF 3				METRIC								
G.W.P. 4099-11-00		LOCATION N 5027318.7; E 376822.4 MTM NAD 83 ZONE 9 (LAT. 45.382120; LONG. -75.580330)				ORIGINATED BY RI										
DIST Eastern HWY 417		BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/Rotary Drill, NQ Core				COMPILED BY ZS										
DATUM Geodetic		DATE July 2, 2020				CHECKED BY KCP										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
--- CONTINUED FROM PREVIOUS PAGE ---																
	Shale (BEDROCK)															
	Bedrock cored from depths 9.5 m to 13.9 m		1	RC	REC 37%											
	For bedrock coring details refer to Record of Drillhole 20-1370-131															
			2	RC	REC 95%											
			3	RC	REC 100%											
53.2	END OF BOREHOLE															
13.9	NOTES: 1. Water level in well screen at 0.2 m above the ground surface (Elev. 67.3 m), measured on Sep. 15, 2020															

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-131

SHEET 3 OF 3

LOCATION: N 5027318.7 ;E 376822.4

DRILLING DATE: July 2, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr		Ja	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		W1	W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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UCS =
98.2 Mpa

DEPTH SCALE

1 : 50



LOGGED: RI

CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

RECORD OF BOREHOLE No 20-1370-132 SHEET 1 OF 3
METRIC


PROJECT 1662565-1370
 G.W.P. 4099-11-00 LOCATION N 5027344.1; E 376532.1 MTM NAD 83 ZONE 9 (LAT. 45.382370; LONG. -75.584030) ORIGINATED BY JS
 DIST Eastern HWY 417 BOREHOLE TYPE Wash Boring/Rotary Drill, NW Casing COMPILED BY ZS
 DATUM Geodetic DATE July 27-August 28, 2020 CHECKED BY CRG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE								
						● QUICK TRIAXIAL	×	REMOULDED										
68.1	GROUND SURFACE							20	40	60	80	100						
0.0	(ML) Sandy silt (TOPSOIL)																	
0.1	Brown Dry		1	SS	13		68											
	(GP) Gravel some sand (FILL)																	
	Loose to compact																	
	Dark grey																	
	Moist																	
			2	SS	11		67											
			3	SS	8		66										86 13 (1)	
66.0																		
2.1	(CI/CH) Silty clay, some gravel, some sand (FILL)																	
	Very stiff																	
	Brown-grey		4	SS	15		66											
65.1																		
3.0	(CH) CLAY, contains sand seams (WEATHERED CRUST)						65											
	Stiff																	
	Grey-brown to grey		5	SS	2													
64.4																		
3.7	(CI) SILTY CLAY, contains sand seams						64											
	Firm																	
	Grey		6	SS	1													
63.6																		
4.5	(SM/ML) CLAYEY SILTY SAND to sandy SILT, some gravel to gravelly (TILL)						63											
	Very loose																	
	Grey																	
	Wet		7	SS	2													
62.8																		
5.3	(ML-SM) SILT and SAND, some gravel (TILL)						62											
	Very loose																	
	Very wet to moist																	
			8	SS	WH												15 35 (50)	
			9	SS	2		62											
			10	SS	110/0.25		61											
60.8																		
	Highly weathered Bedrock																	
60.6																		
7.5	Shale (BEDROCK)																	
	Bedrock cored from depths 7.5 m to 12.2 m		1	RC	REC 28%		60										RQD = 0%	
	For bedrock coring details refer to Record of Drillhole 20-1370-132																	
			2	RC	REC 61%												RQD = 18%	
							59											
			3	RC	REC 100%												RQD = 84%	

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMT\Hwy417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT 1662565-1370										RECORD OF BOREHOLE No 20-1370-132 SHEET 2 OF 3										METRIC			
G.W.P. 4099-11-00					LOCATION N 5027344.1; E 376532.1 MTM NAD 83 ZONE 9 (LAT. 45.382370; LONG. -75.584030)					ORIGINATED BY JS													
DIST Eastern HWY 417					BOREHOLE TYPE Wash Boring/Rotary Drill, NW Casing					COMPILED BY ZS													
DATUM Geodetic					DATE July 27-August 28, 2020					CHECKED BY CRG													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L								
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100											
	Shale (BEDROCK)		3	RC	REC 100%		58																
	Bedrock cored from depths 7.5 m to 12.2 m		4	RC	REC 100%		57																
55.9	For bedrock coring details refer to Record of Drillhole 20-1370-132						56																
12.2	END OF BOREHOLE																						

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMITO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-GTA.GDT 6/3/22 ZS

PROJECT: 1662565-1370

RECORD OF DRILLHOLE: 20-1370-132

SHEET 3 OF 3

LOCATION: N 5027344.1 ;E 376532.1

DRILLING DATE: July 27-August 28, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																		FEATURES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
				ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY K, cm/sec			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr	Js	10 ⁻⁵	10 ⁻⁴	10 ⁻³	W1	W2	W3	W4		W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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DEPTH SCALE

1 : 50



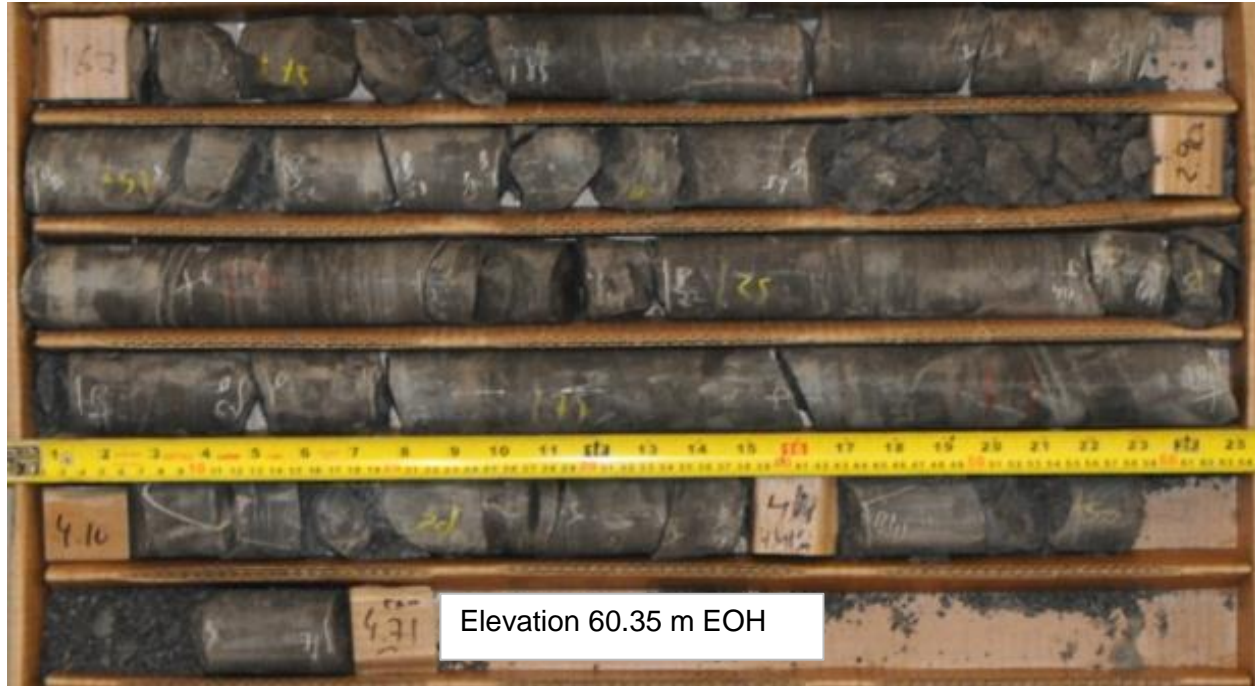
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CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417\REHAB&WIDENING\02_DATA\GINT\1662565.GPJ GAL-MISS.GDT 6/3/22 ZS

BH 20-1370-13 (Dry)
Cored Length of 63.38 to 60.35 m
Core Box 1 to 2 of 2

Elevation 63.38 m Top of Bedrock



Elevation 60.35 m EOH

BH 20-1370-13 (Wet)
Cored Length of 63.38 to 60.35 m
Core Box 1 to 2 of 2

Elevation 63.38 m Top of Bedrock



BH 20-1370-14 (Dry)
Cored Length of 64.06 to 60.71 m
Core Box 1 to 2 of 2

Elevation 64.06 m Top of Bedrock



Elevation 60.71 m EOH

BH 20-1370-14 (Wet)
Cored Length of 64.06 to 60.71 m
Core Box 1 to 2 of 2

Elevation 64.06 m Top of Bedrock



Elevation 60.71 m EOH



Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A4

BH 20-1370-15 (Dry)
Cored Length of 63.61 to 60.56 m
Core Box 1 to 2 of 2

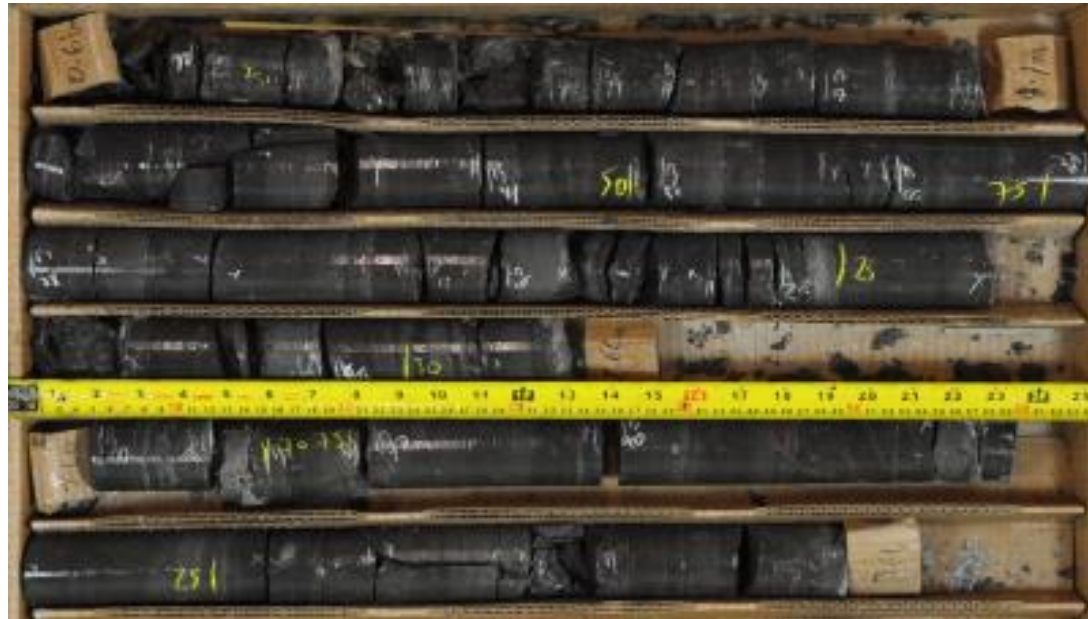
Elevation 63.61 m Top of Bedrock



Elevation 60.56 m EOH

BH 20-1370-15 (Wet)
Cored Length of 63.61 to 60.56 m
Core Box 1 to 2 of 2

Elevation 63.61 m Top of Bedrock



Elevation 60.56 m



Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A6

BH 20-1370-16 (Dry)
Cored Length of 62.38 to 59.19 m
Core Box 1 to 2 of 2

Elevation 62.38 m Top of Bedrock



Elevation 59.19 m EOH



Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A7

BH 20-1370-16 (Wet)
Cored Length of 62.38 to 59.19 m
Core Box 1 to 2 of 2

Elevation 62.38 m Top of Bedrock



Elevation 59.19 m EOH

BH 20-1370-17 (Dry)
Cored Length of 60.49 to 57.49 m
Core Box 1 to 2 of 2

Elevation 60.49 m Top of Bedrock



Elevation 57.49 m EOH



Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A9

BH 20-1370-17 (Wet)
Cored Length of 60.49 to 57.49 m
Core Box 1 to 2 of 2

Elevation 60.49 m Top of Bedrock



Elevation 57.49 m EOH



Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A10

BH 20-1370-32 (Dry)
Cored Length of 56.35 to 56.16 m
Core Box 1 to 2 of 2

Elevation 56.35 m Top of Bedrock



Elevation 56.16 m EOH

BH 20-1370-32 (Wet)
Cored Length of 56.35 to 53.16 m
Core Box 1 to 2 of 2

Elevation 56.35 m Top of Bedrock



Elevation 53.16 m



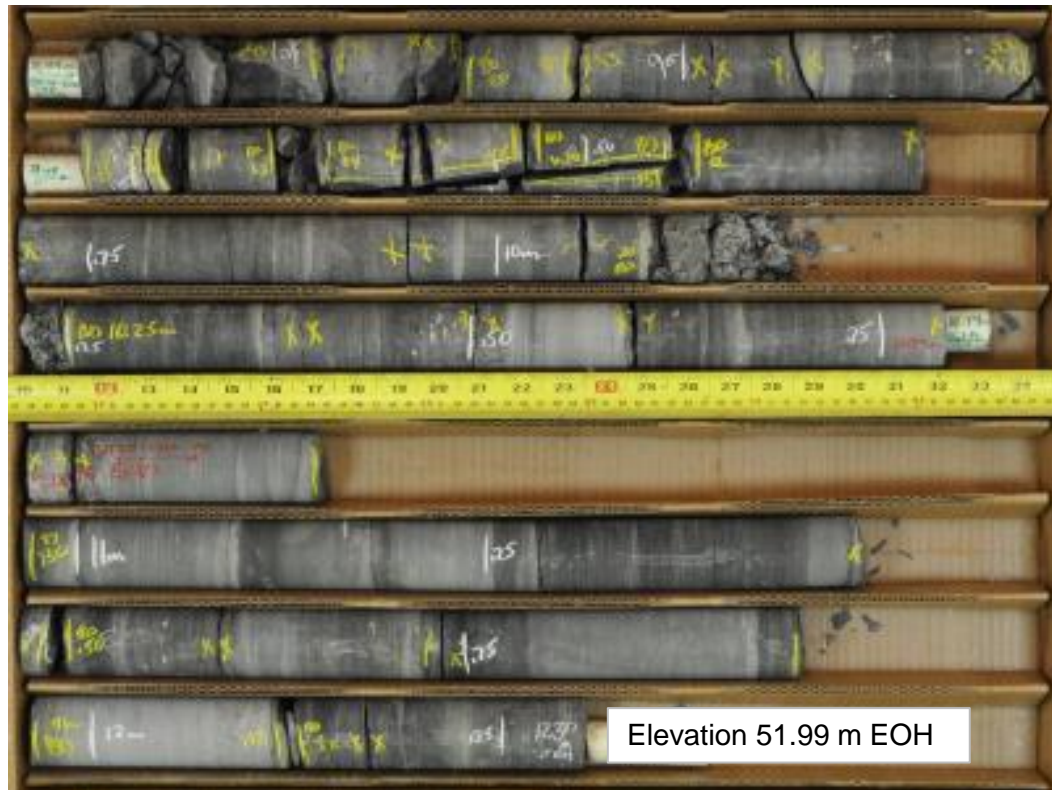
Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A12

BH 20-1370-75 (Dry)
Cored Length of 55.85 to 51.99 m
Core Box 1 to 2 of 2

Elevation 55.85 m Top of Bedrock



Elevation 51.99 m EOH

BH 20-1370-76 (Wet)
Cored Length of 56.31 to 52.77 m
Core Box 1 to 2 of 2

Elevation 55.85 m Top of Bedrock



Elevation 9.30 m EOH

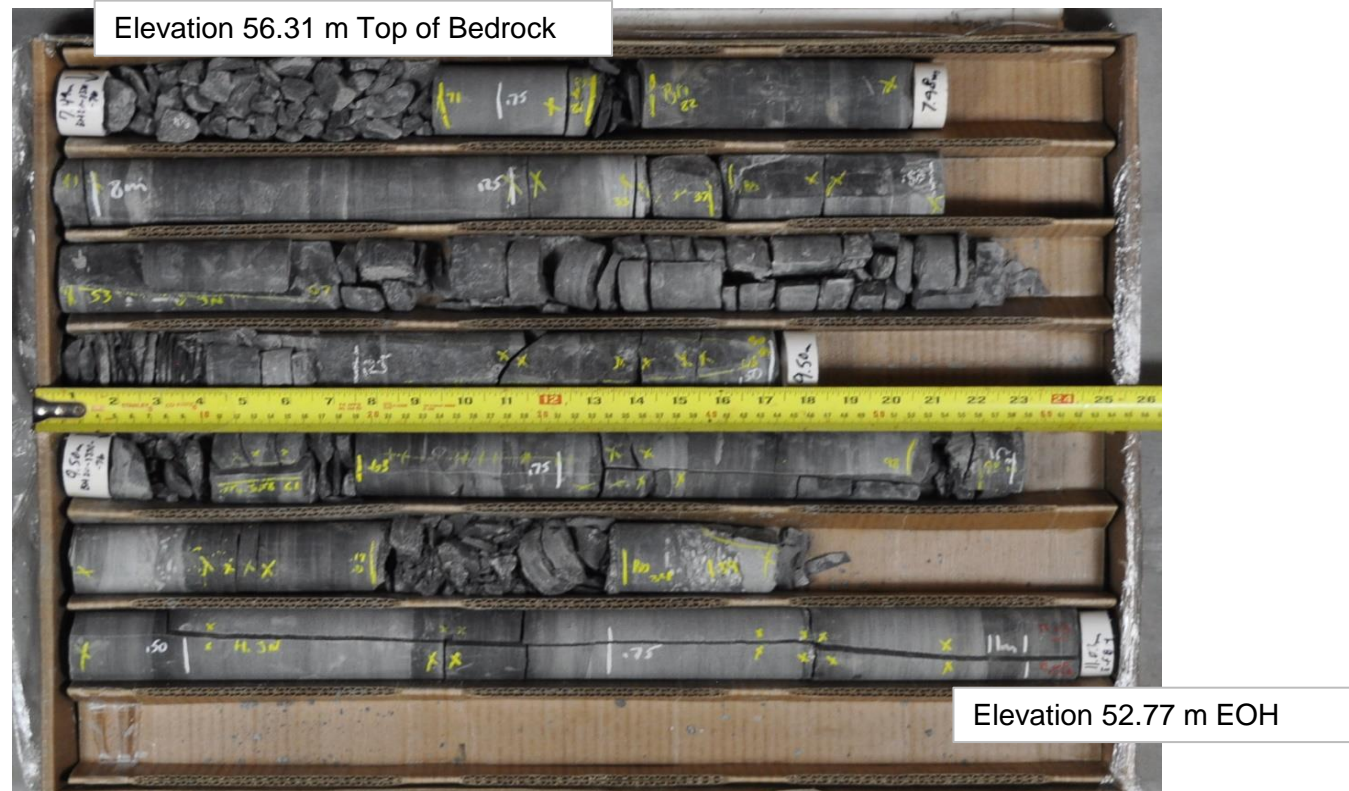


Foundation Investigation
High Mast Light Poles
GWP: 4099-11-00
Highway 417 Aviation Parkway to Ramsayville Road
Ottawa, ON

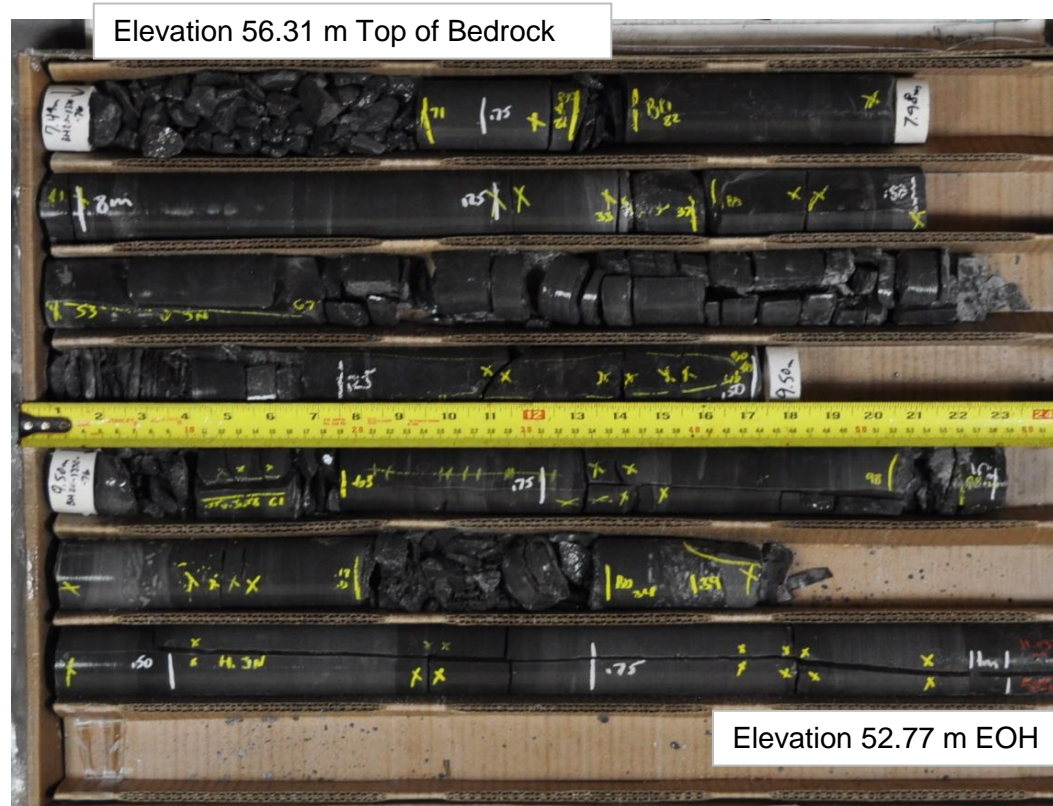
Project No.	1662565-1370
Drawn:	RA
Date:	2021-06-01
Checked:	MS
Review:	WC

Figure A14

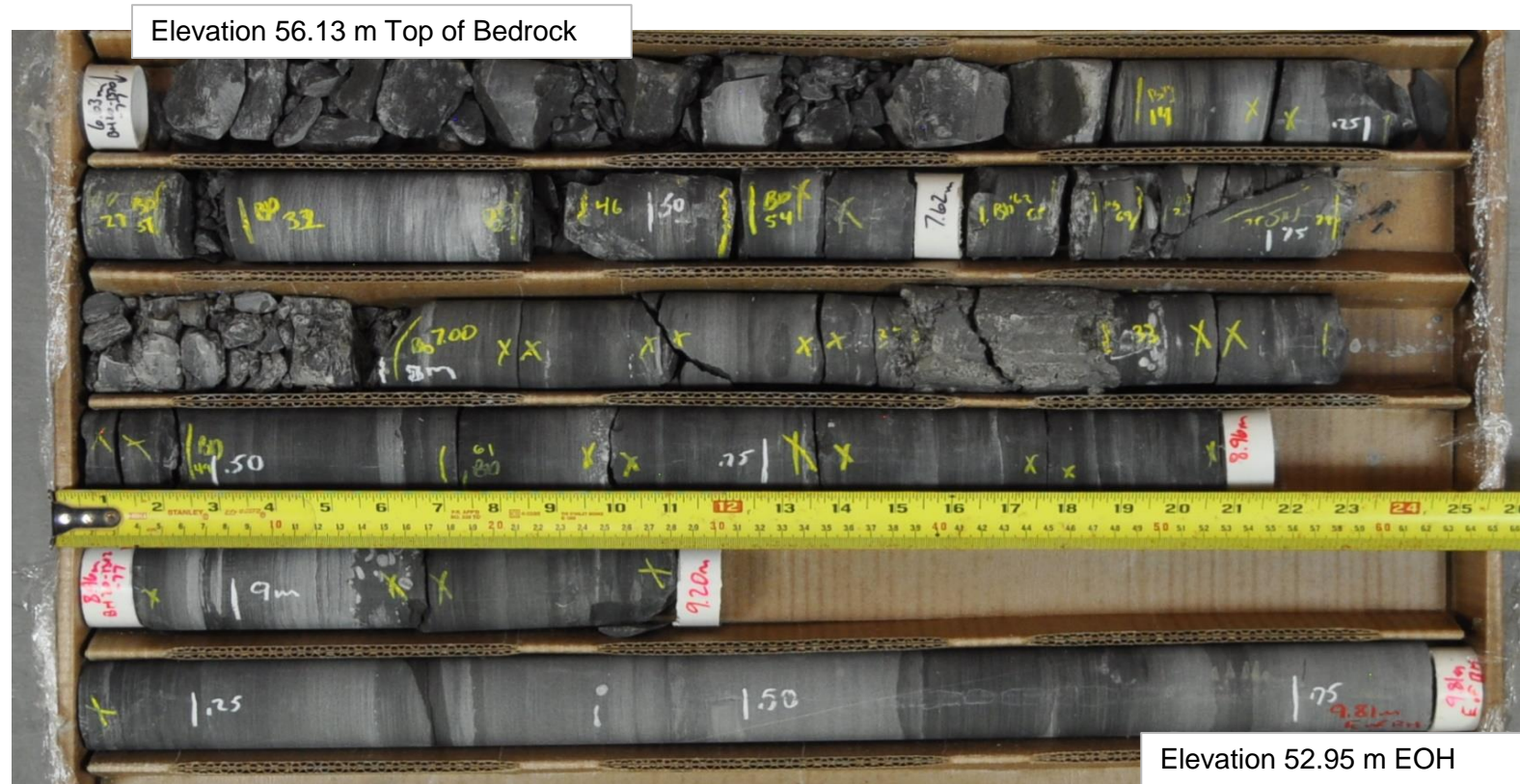
BH 20-1370-76 (Dry)
Cored Length of 56.31 to 52.77 m
Core Box 1 to 2 of 2



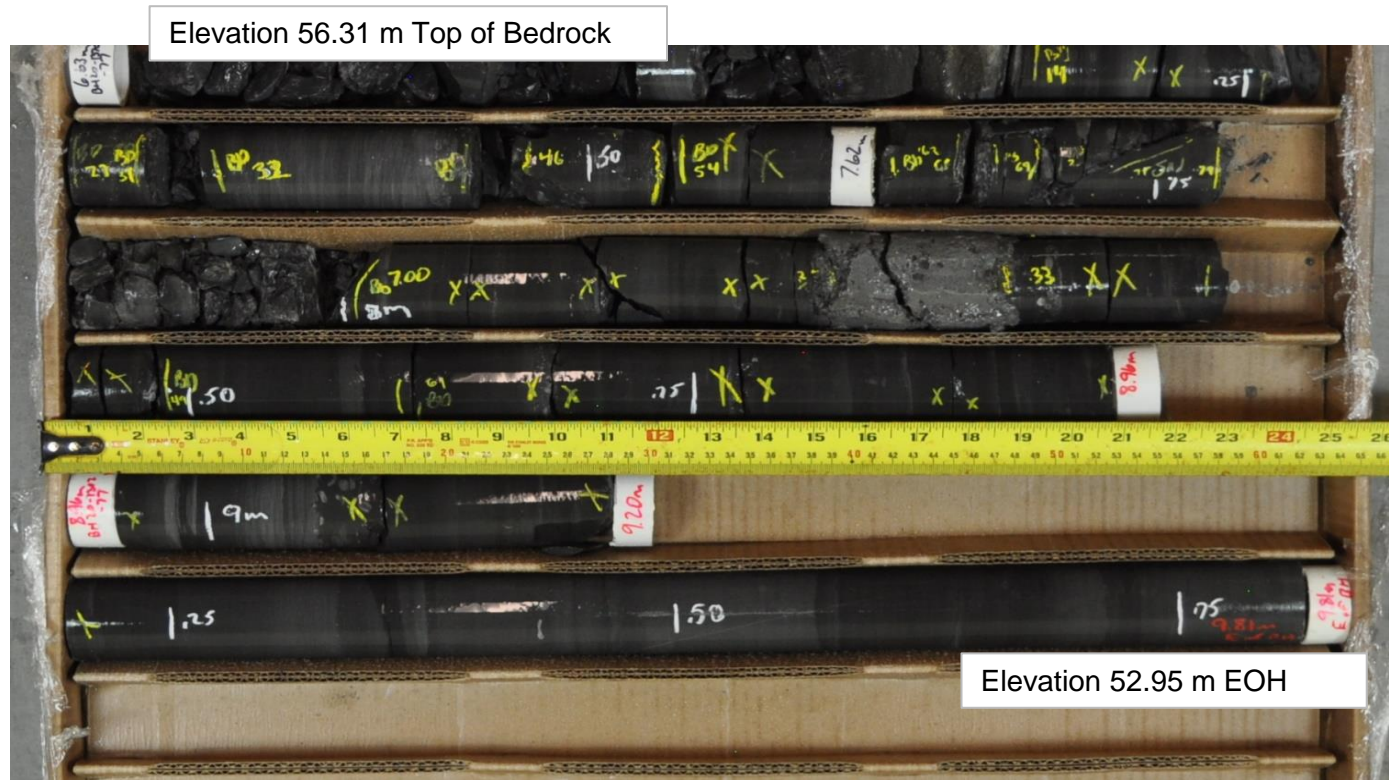
BH 20-1370-76 (Wet)
Cored Length of 56.31 to 52.77 m
Core Box 1 to 2 of 2



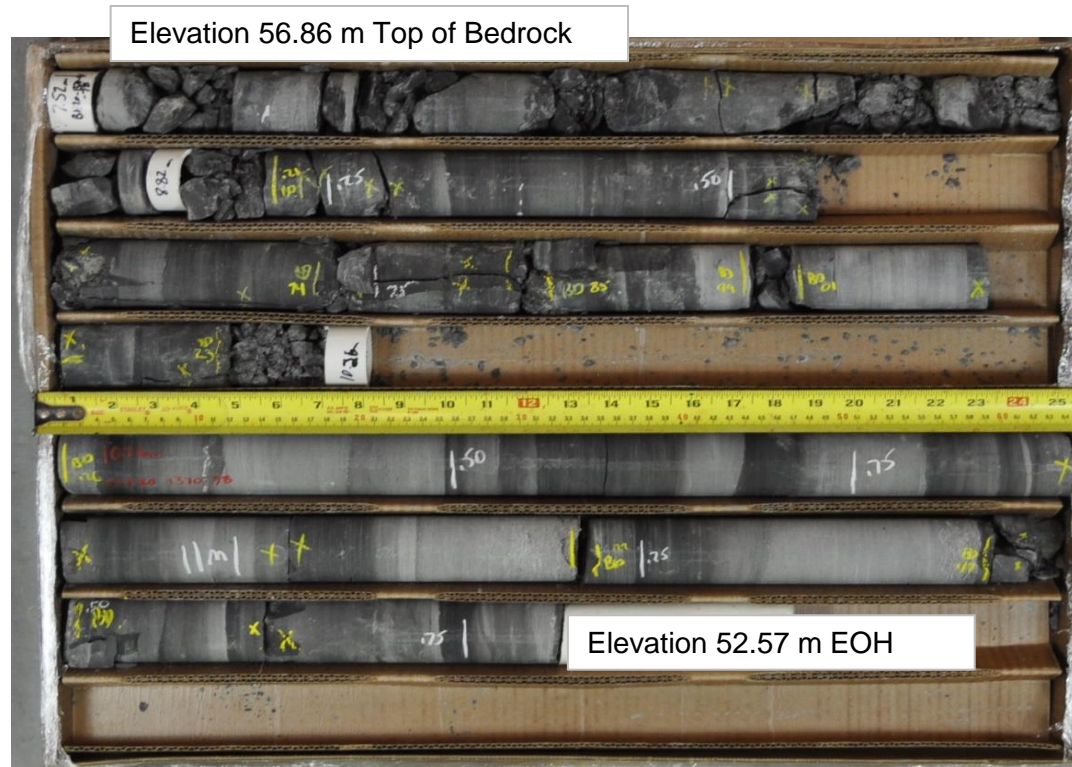
BH 20-1370-77 (Dry)
 Cored Length of 56.13 to 52.95 m
 Core Box 1 to 2 of 2



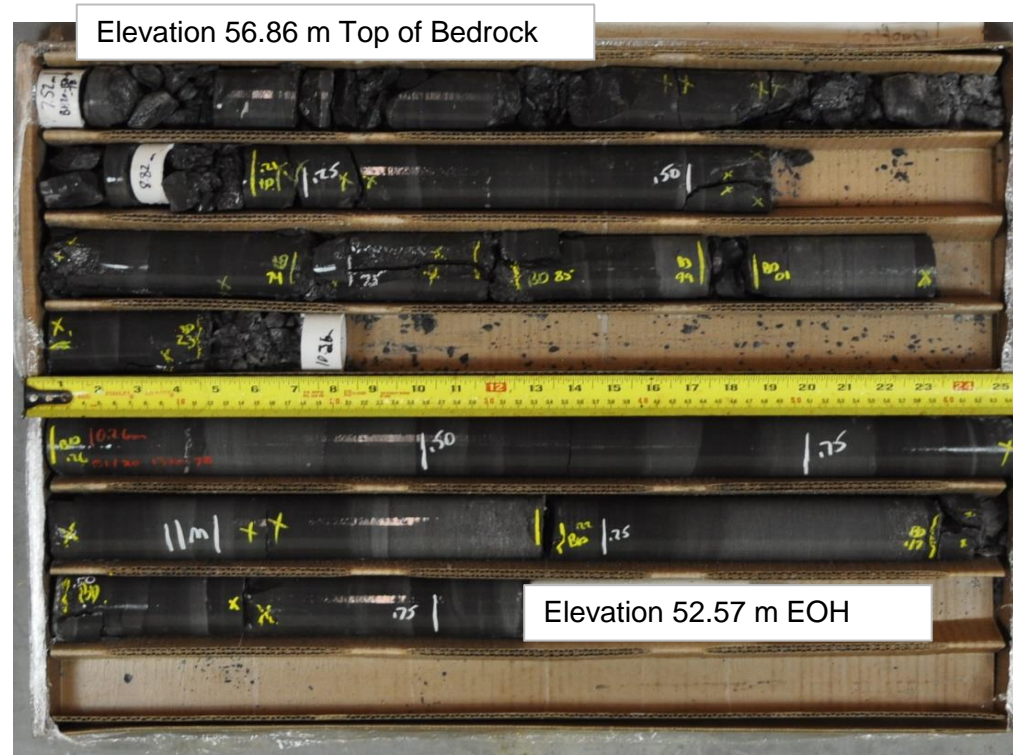
BH 20-1370-77 (Wet)
Cored Length of 56.13 to 52.95 m
Core Box 1 to 2 of 2



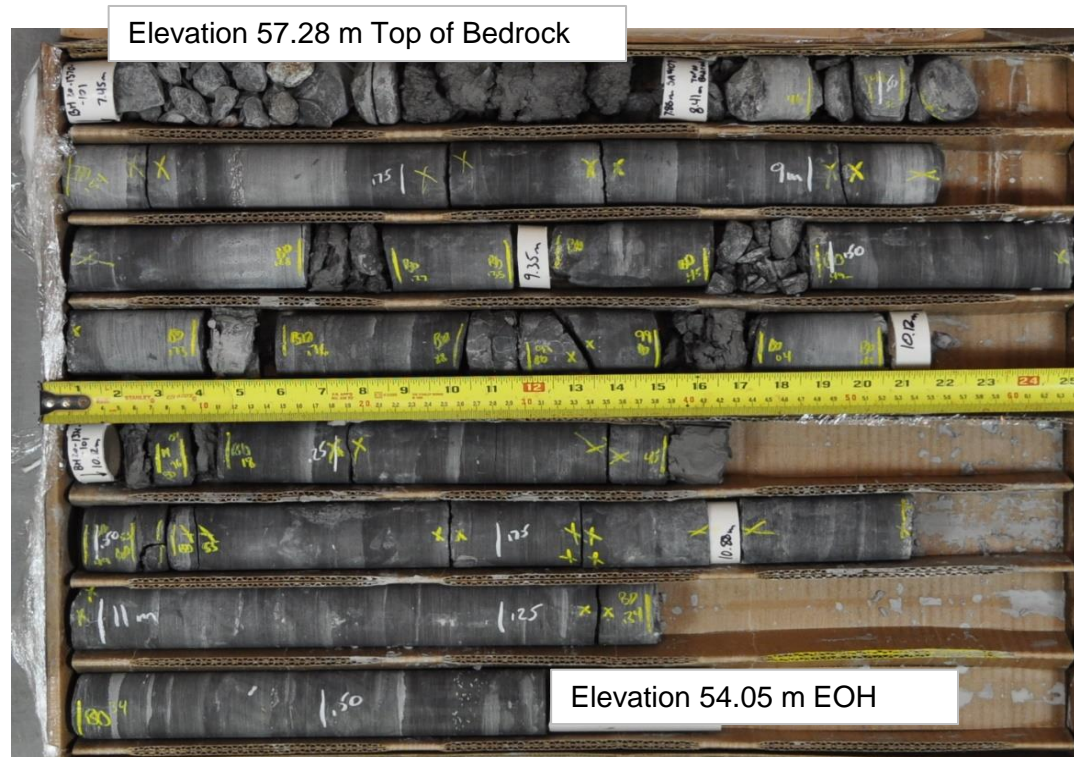
BH 20-1370-78 (Dry)
Cored Length of 56.86 to 52.57 m
Core Box 1 to 2 of 2



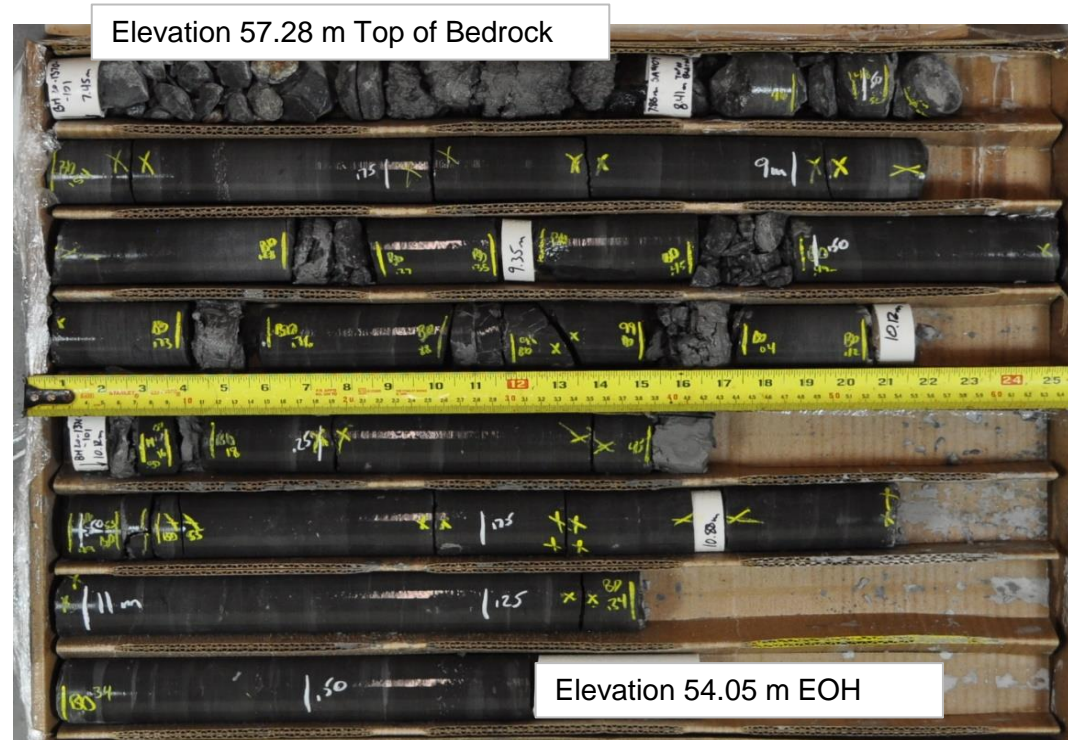
BH 20-1370-78 (Wet)
Cored Length of 56.86 to 52.57 m
Core Box 1 to 2 of 2



BH 20-1370-101 (Dry)
Cored Length of 57.28 to 54.05 m
Core Box 1 to 2 of 2



BH 20-1370-101 (Wet)
Cored Length of 57.28 to 54.05 m
Core Box 1 to 2 of 2



BH 20-1370-102 (Dry)
Cored Length of 57.46 to 54.30 m
Core Box 1 to 2 of 2

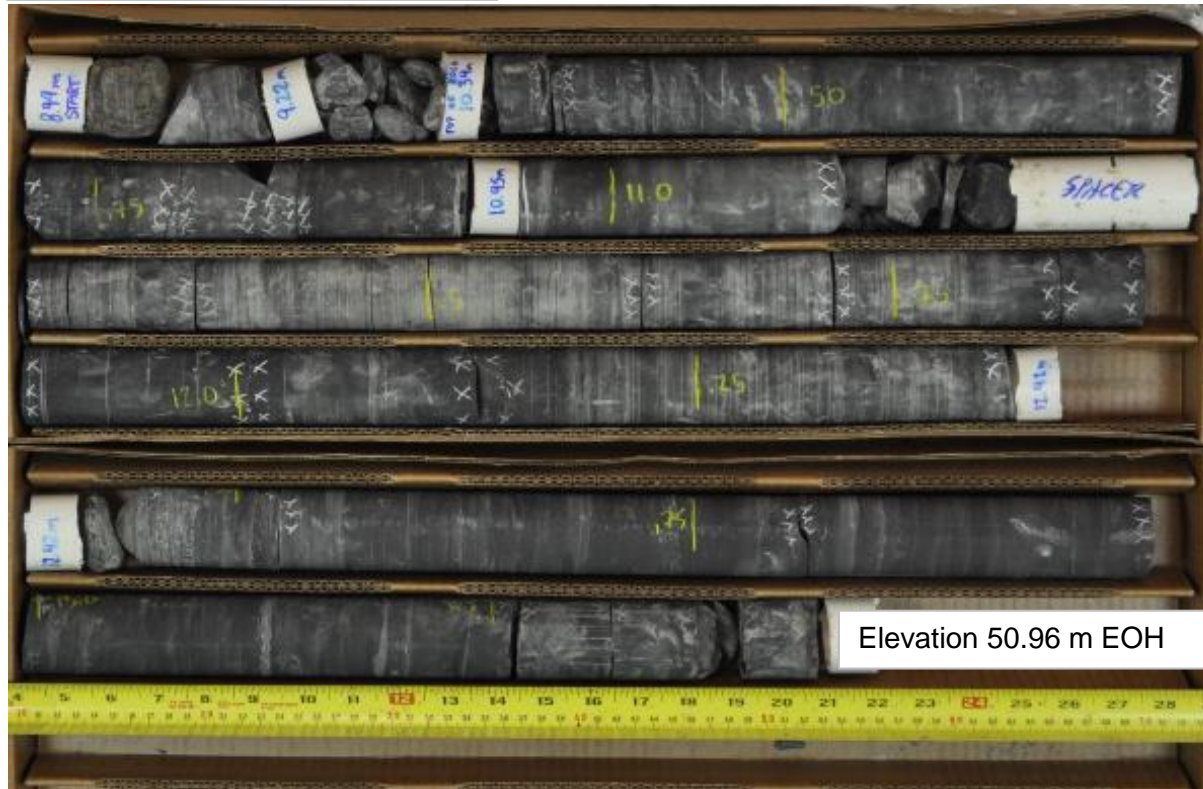


BH 20-1370-102 (Wet)
Cored Length of 57.46 to 54.30 m
Core Box 1 to 2 of 2



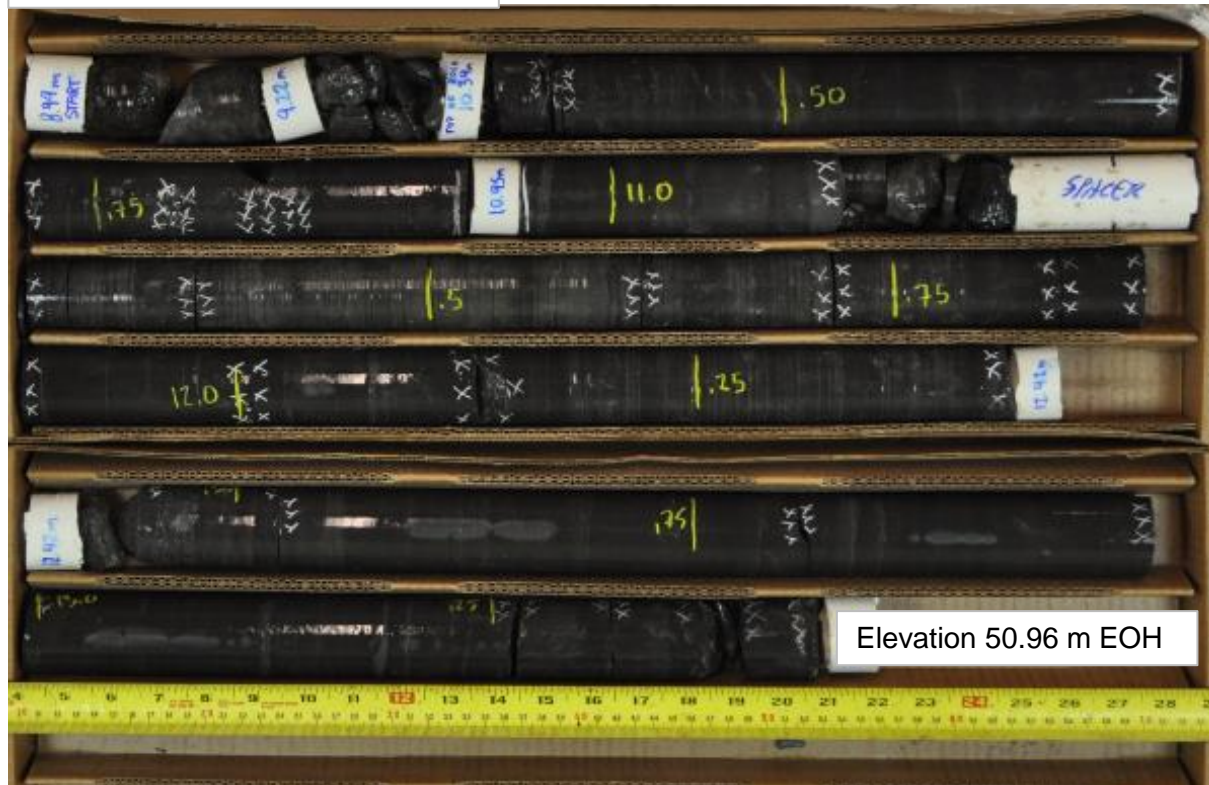
BH 20-1370-113 (Dry)
Cored Length of 54.04 to 50.96 m
Core Box 1 to 2 of 2

Elevation 54.04 m Top of Bedrock



BH 20-1370-113 (Wet)
Cored Length of 54.04 to 50.96 m
Core Box 1 to 2 of 2

Elevation 54.04 m Top of Bedrock



Elevation 50.96 m EOH



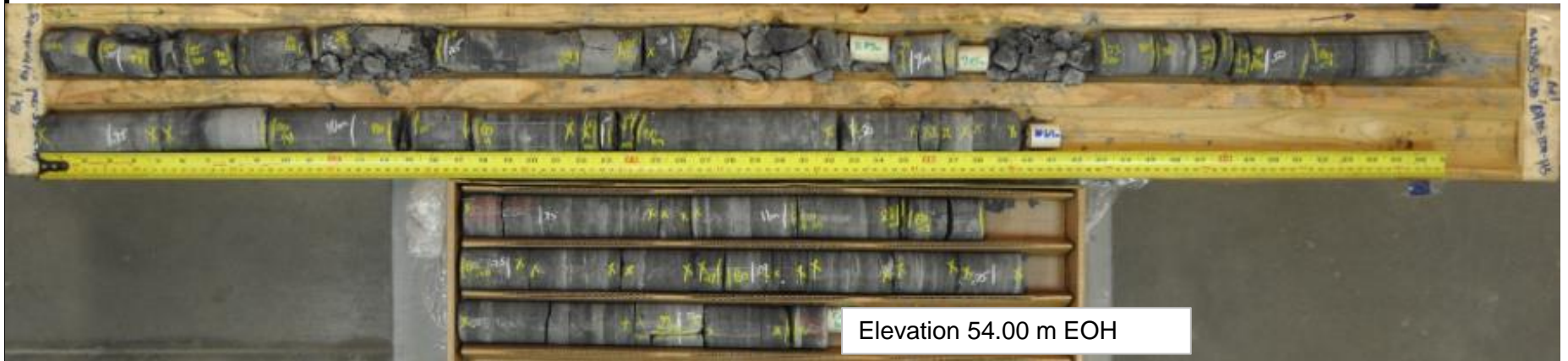
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Figure A26

BH 20-1370-115 (Dry)
Cored Length of 58.48 to 54.00 m
Core Box 1 to 2 of 2

Elevation 58.48 m Top of Bedrock



Elevation 54.00 m EOH



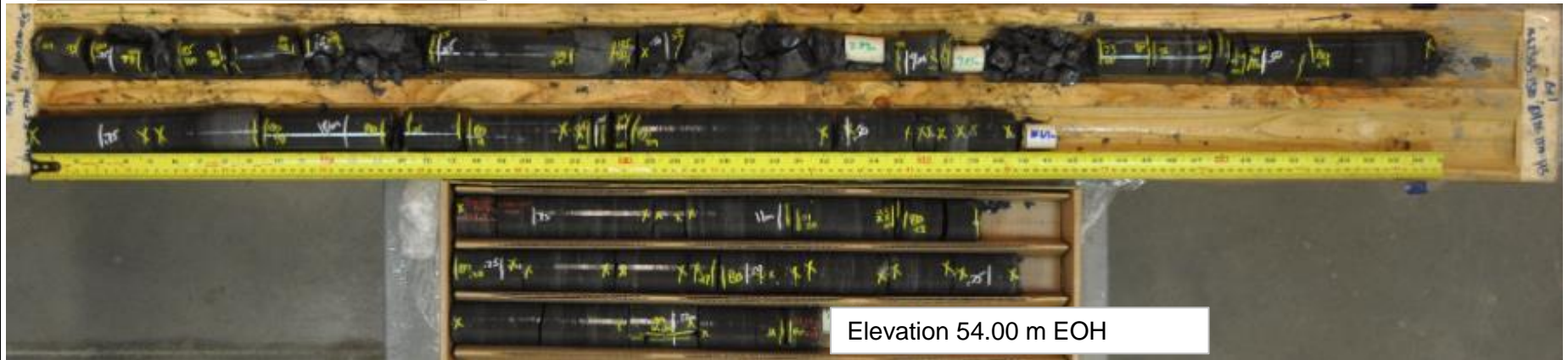
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Figure A27

BH 20-1370-115 (Wet)
Cored Length of 58.48 to 54.00 m
Core Box 1 to 2 of 2

Elevation 58.48 m Top of Bedrock



Elevation 54.00 m EOH



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Figure A28

BH 20-1370-116 (Dry)
Cored Length of 61.18 to 57.29 m
Core Box 1 to 2 of 2

Elevation 61.18 m Top of Bedrock



Elevation 57.29 m EOH



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Figure A29

BH 20-1370-116 (Wet)
Cored Length of 61.18 to 57.29 m
Core Box 1 to 2 of 2

Elevation 61.18 m Top of Bedrock



Elevation 57.29 m EOH



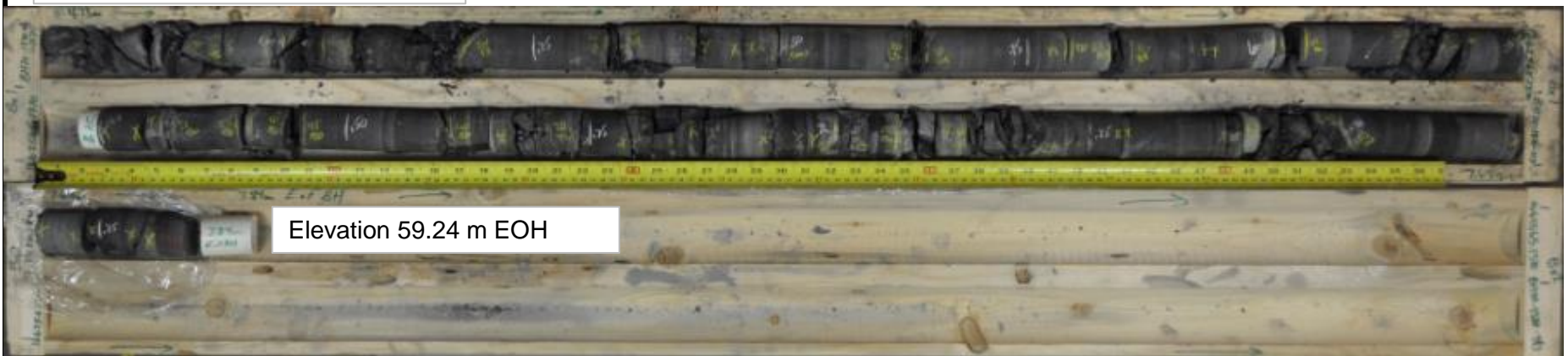
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Figure A30

BH 20-1370-117 (Dry)
Cored Length of 62.35 to 59.24 m
Core Box 1 to 2 of 2

Elevation 62.35 m Top of Bedrock



Elevation 59.24 m EOH



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Figure A31

BH 20-1370-117 (Wet)
Cored Length of 62.35 to 59.24 m
Core Box 1 to 2 of 2

Elevation 62.35 m Top of Bedrock



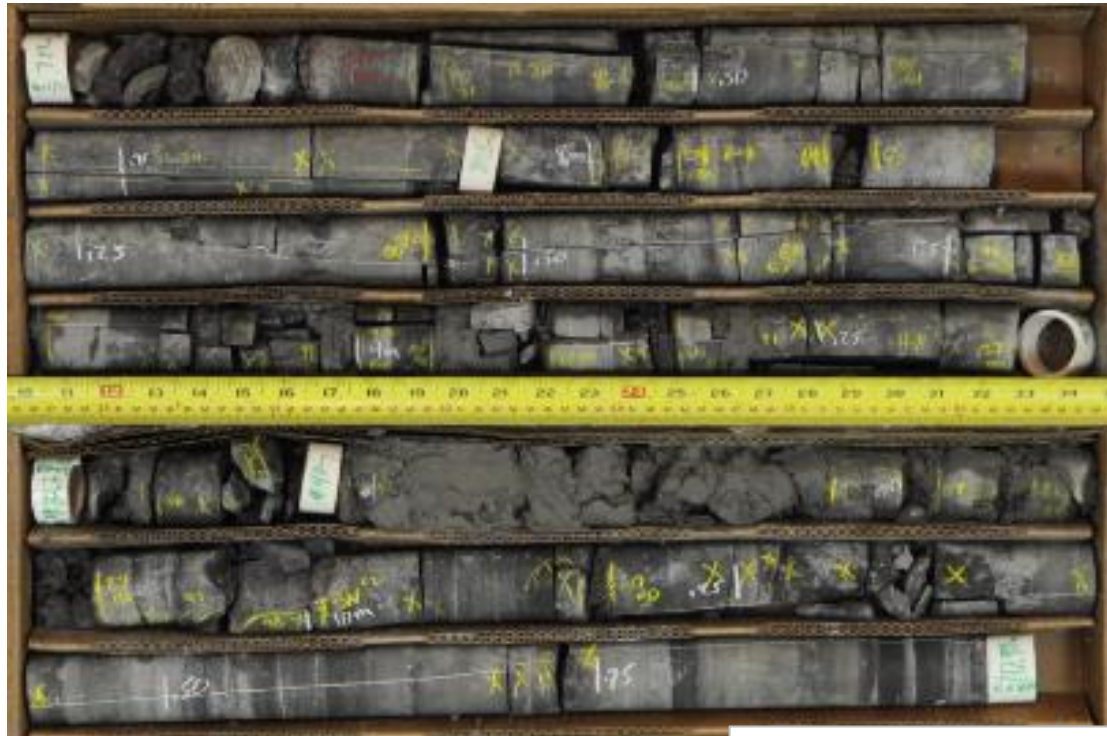
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Figure A32

BH 20-1370-118 (Dry)
Cored Length of 61.60 to 57.90 m
Core Box 1 to 2 of 2

Elevation 61.60 m Top of Bedrock



Elevation 57.90 m EOH



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Figure A33

BH 20-1370-118 (Wet)
Cored Length of 61.60 to 57.90 m
Core Box 1 to 2 of 2

Elevation 61.60 m Top of Bedrock



Elevation 57.90 m EOH



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Figure A34

BH 20-1370-119 (Dry)
Cored Length of 63.75 to 60.73 m
Core Box 1 to 2 of 2

Elevation 63.75 m Top of Bedrock



Elevation 60.73 m EOH



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Figure A35

BH 20-1370-119 (Wet)
Cored Length of 63.75 to 60.73 m
Core Box 1 to 2 of 2

Elevation 63.75 m Top of Bedrock



Elevation 60.73 m EOH

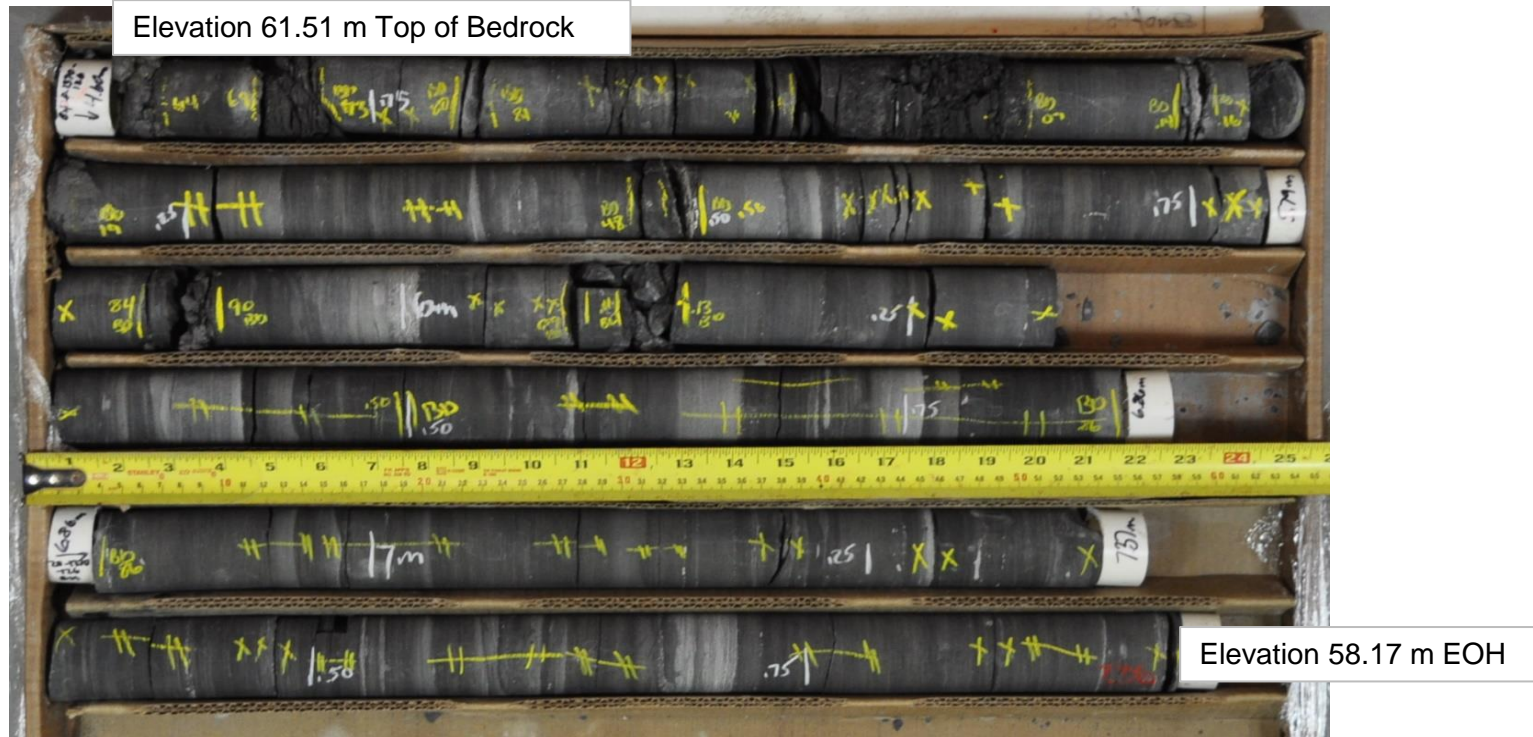


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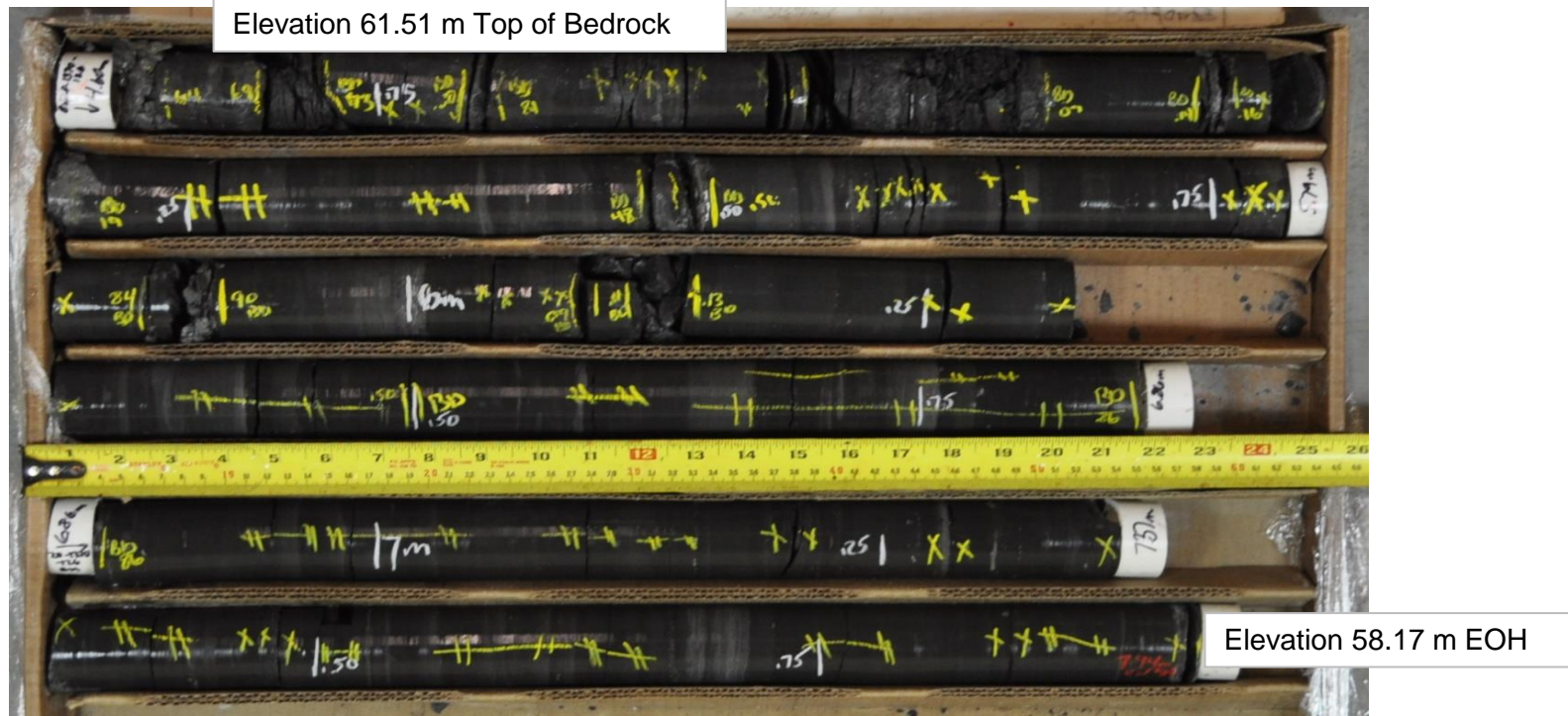
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Figure A36

BH 20-1370-126 (Dry)
Cored Length of 61.51 to 58.17 m
Core Box 1 to 2 of 2

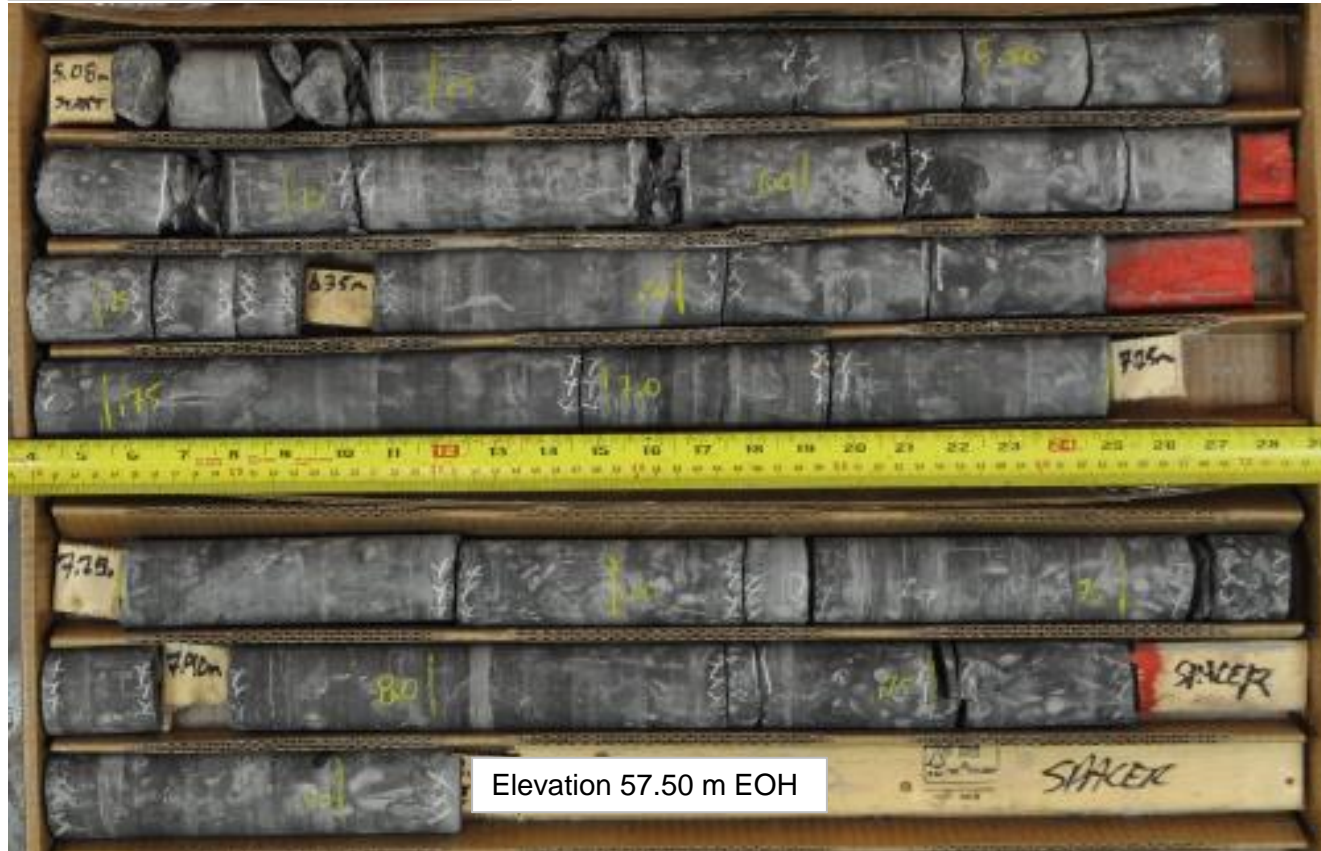


BH 20-1370-126 (Wet)
 Cored Length of 61.51 to 58.17 m
 Core Box 1 to 2 of 2



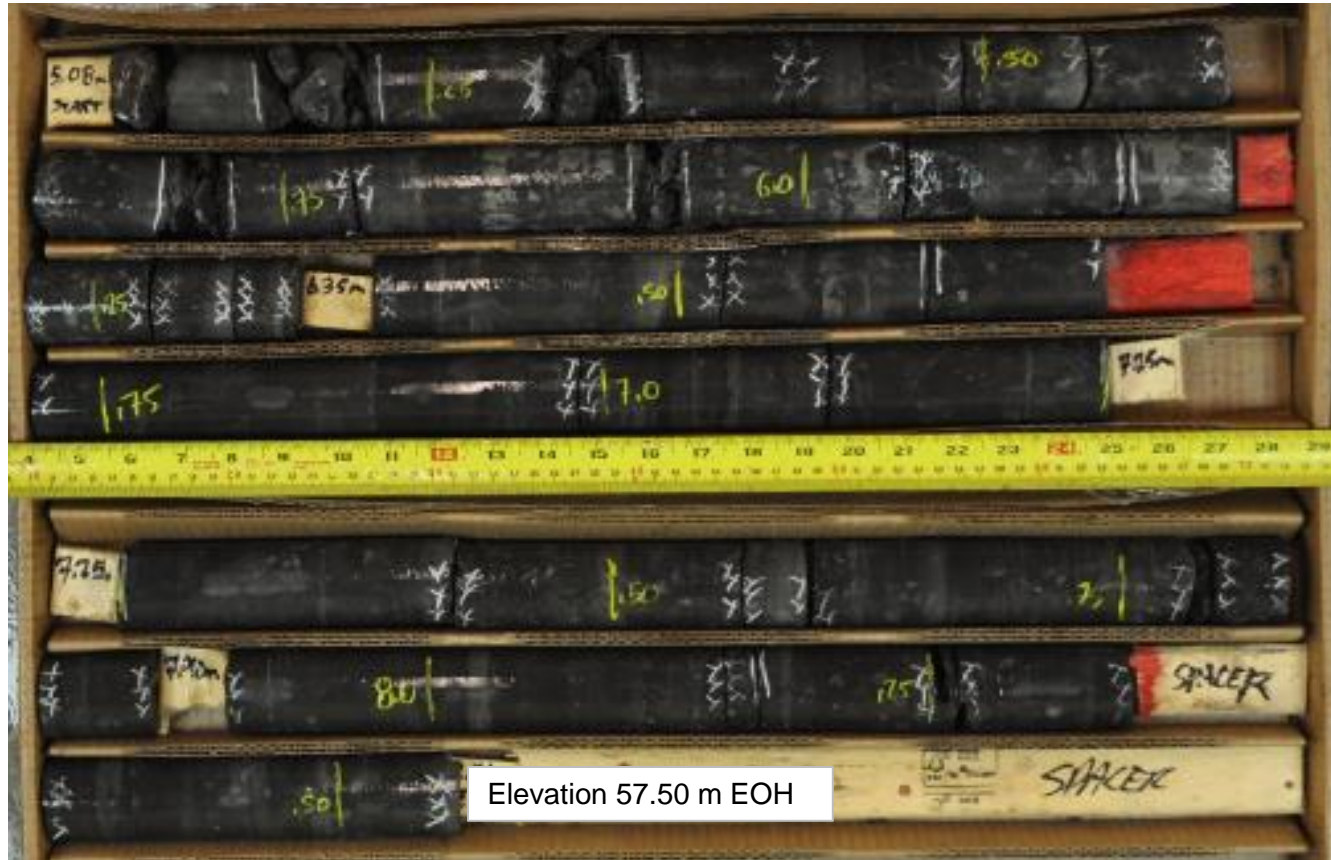
BH 20-1370-127 (Dry)
Cored Length of 60.98 to 57.50 m
Core Box 1 to 2 of 2

Elevation 60.98 m Top of Bedrock



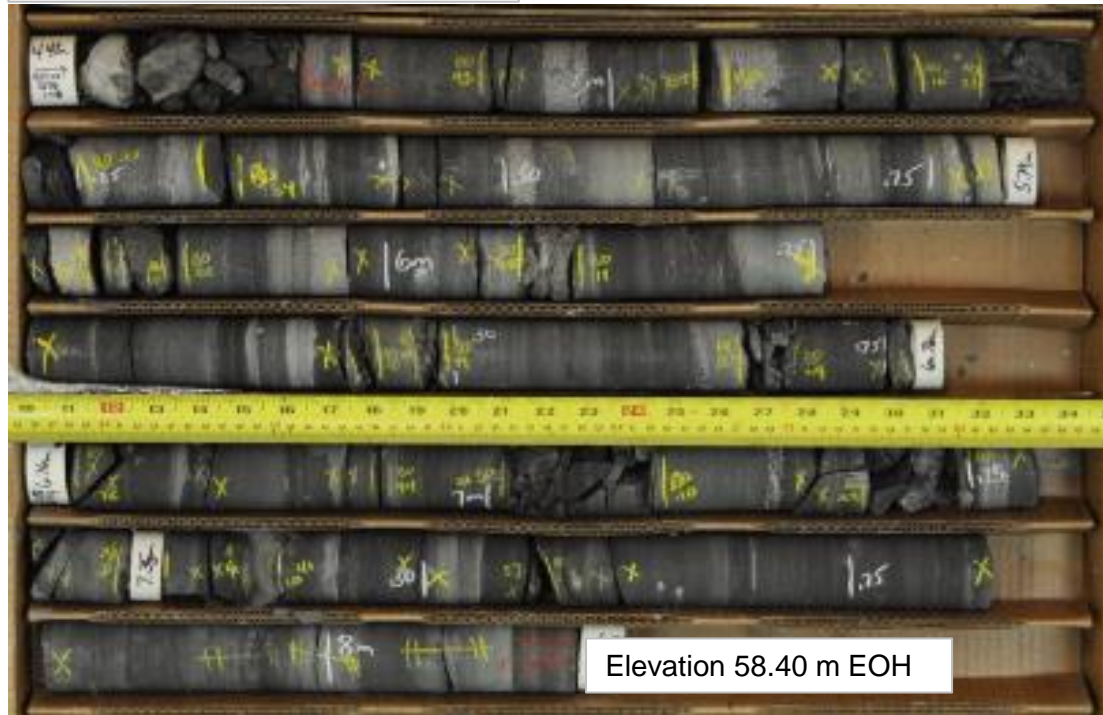
BH 20-1370-127 (Wet)
 Cored Length of 60.98 to 57.50 m
 Core Box 1 to 2 of 2

Elevation 60.98 m Top of Bedrock



BH 20-1370-128 (Dry)
Cored Length of 61.73 to 58.40 m
Core Box 1 to 2 of 2

Elevation 61.73 m Top of Bedrock



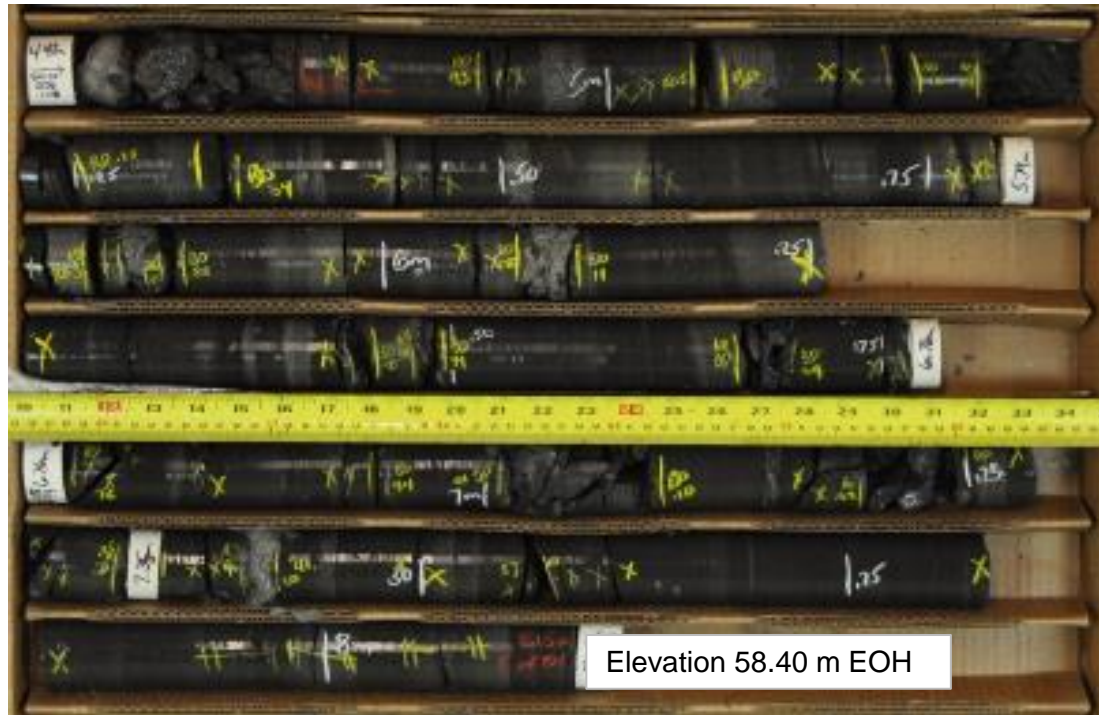
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Figure A41

BH 20-1370-128 (Wet)
Cored Length of 61.73 to 58.40 m
Core Box 1 to 2 of 2

Elevation 61.73 m Top of Bedrock



Elevation 58.40 m EOH



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Figure A30

BH 20-1370-129 (Dry)
Cored Length of 60.81 to 57.29 m
Core Box 1 to 2 of 2

Elevation 60.81 m Top of Bedrock



BH 20-1370-129 (Wet)
Cored Length of 60.81 to 57.29 m
Core Box 1 to 2 of 2

Elevation 60.81 m Top of Bedrock



Elevation 57.29 m EOH



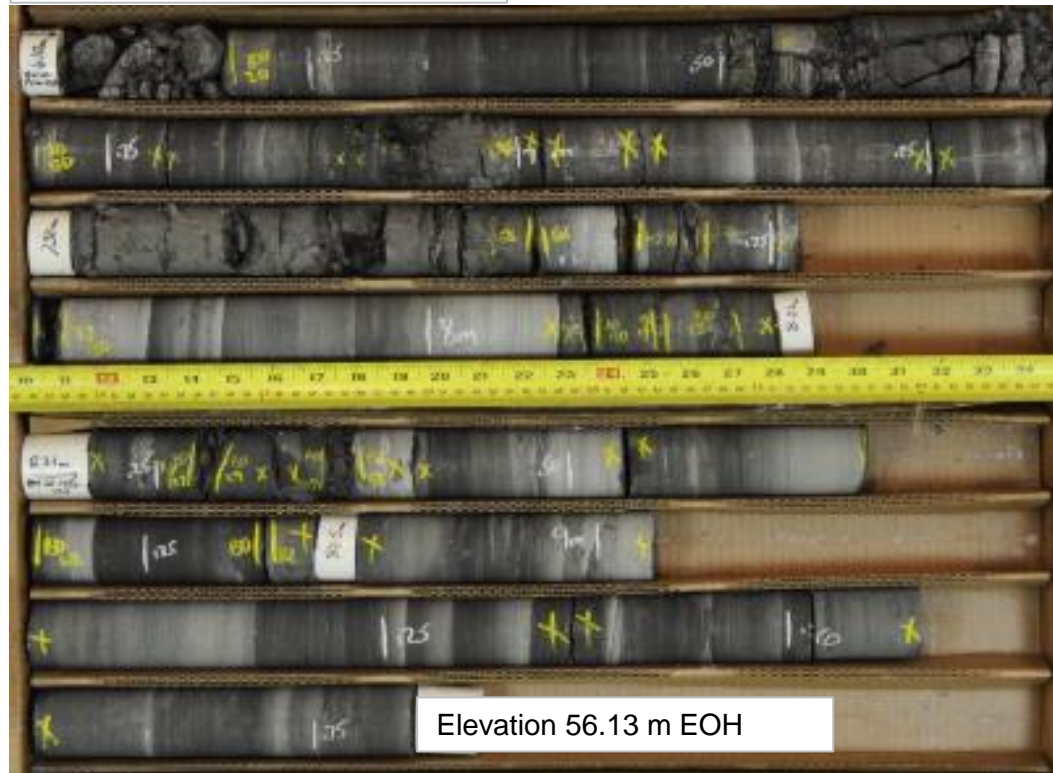
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Figure A44

BH 20-1370-130 (Dry)
Cored Length of 59.84 to 56.13 m
Core Box 1 to 2 of 2

Elevation 59.84 m Top of Bedrock



Elevation 56.13 m EOH



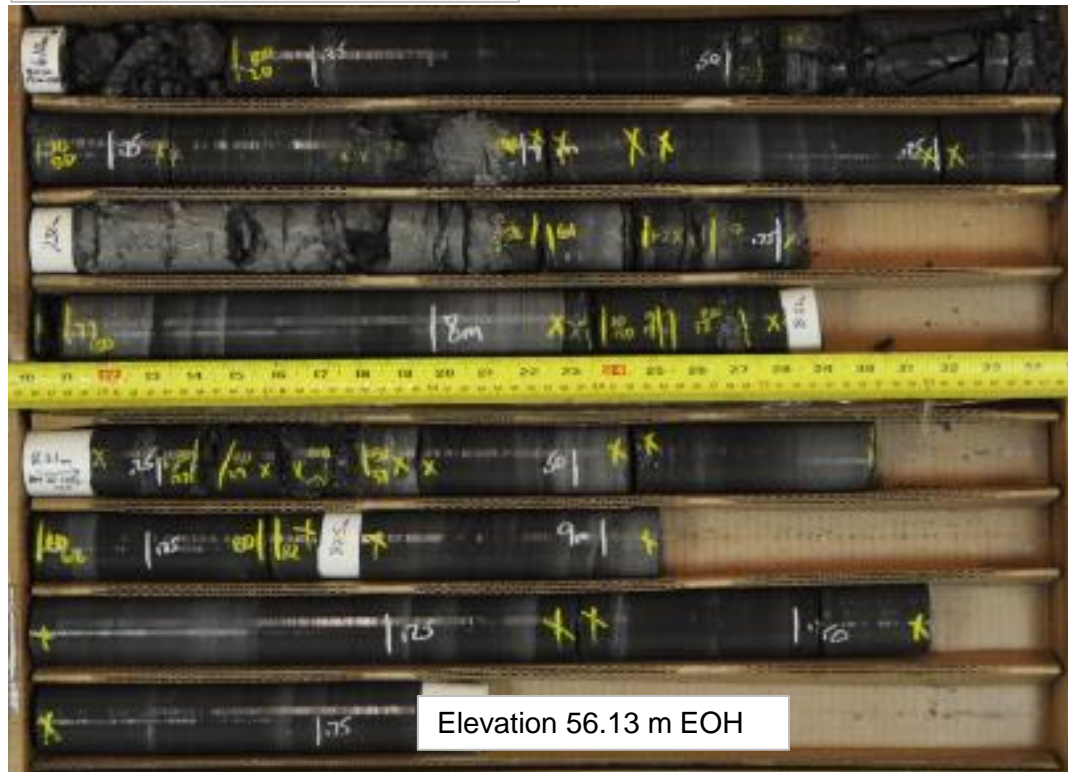
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Figure A45

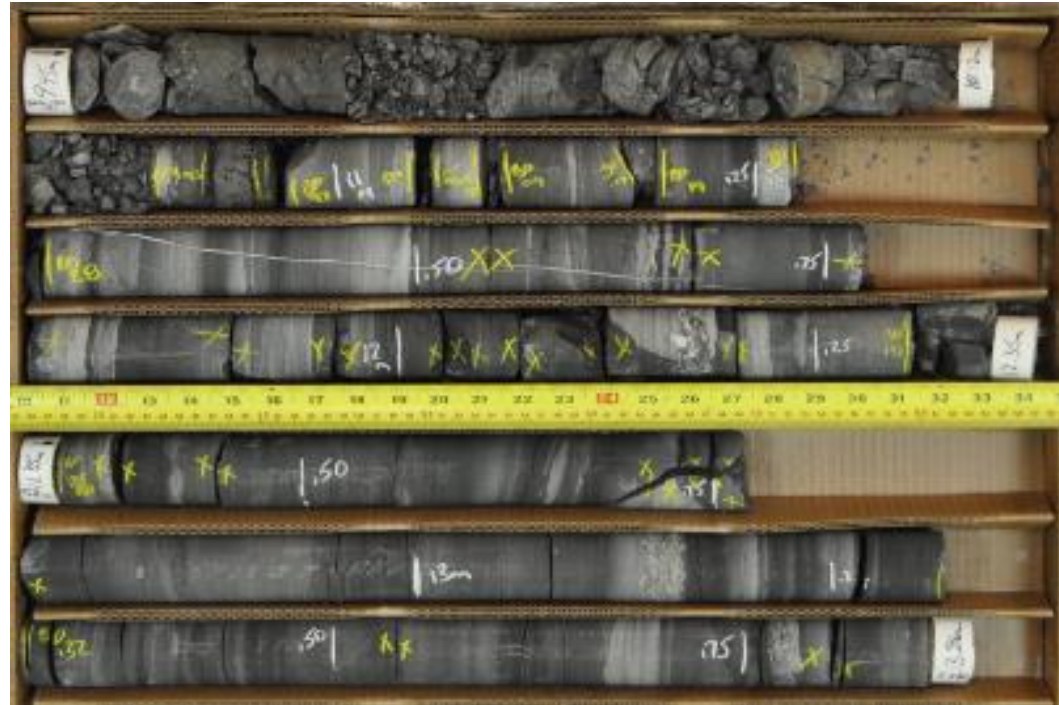
BH 20-1370-130 (Wet)
Cored Length of 59.84 to 56.13 m
Core Box 1 to 2 of 2

Elevation 59.84 m Top of Bedrock



BH 20-1370-131 (Dry)
Cored Length of 57.66 to 53.25 m
Core Box 1 to 2 of 2

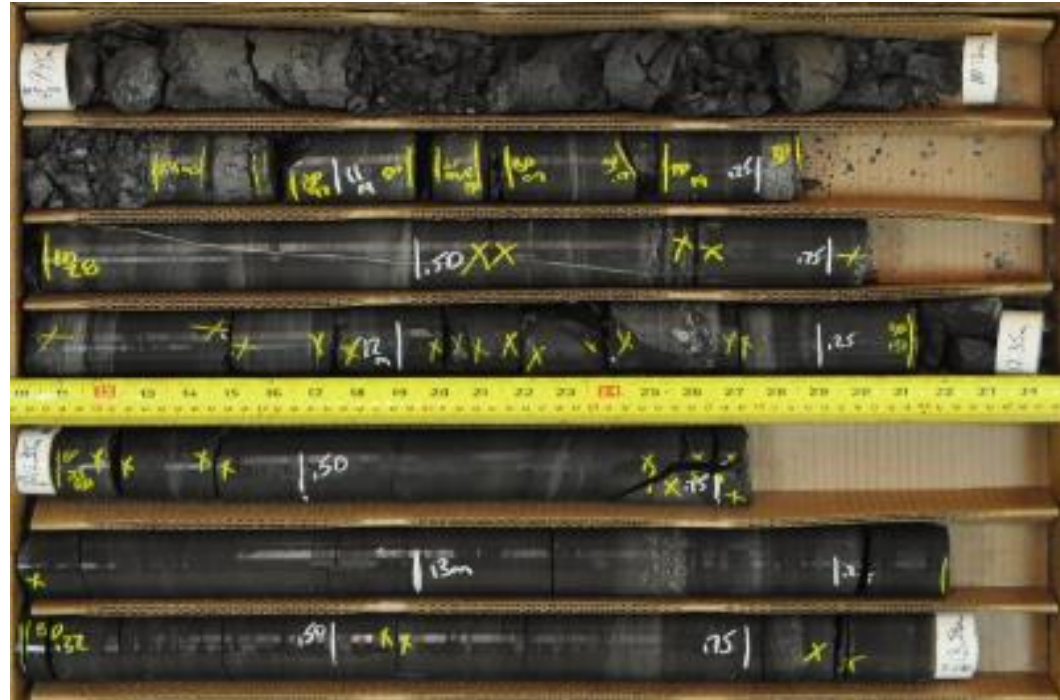
Elevation 57.66 m Top of Bedrock



Elevation 53.25 m EOH

BH 20-1370-131 (Wet)
Cored Length of 57.66 to 53.25 m
Core Box 1 to 2 of 2

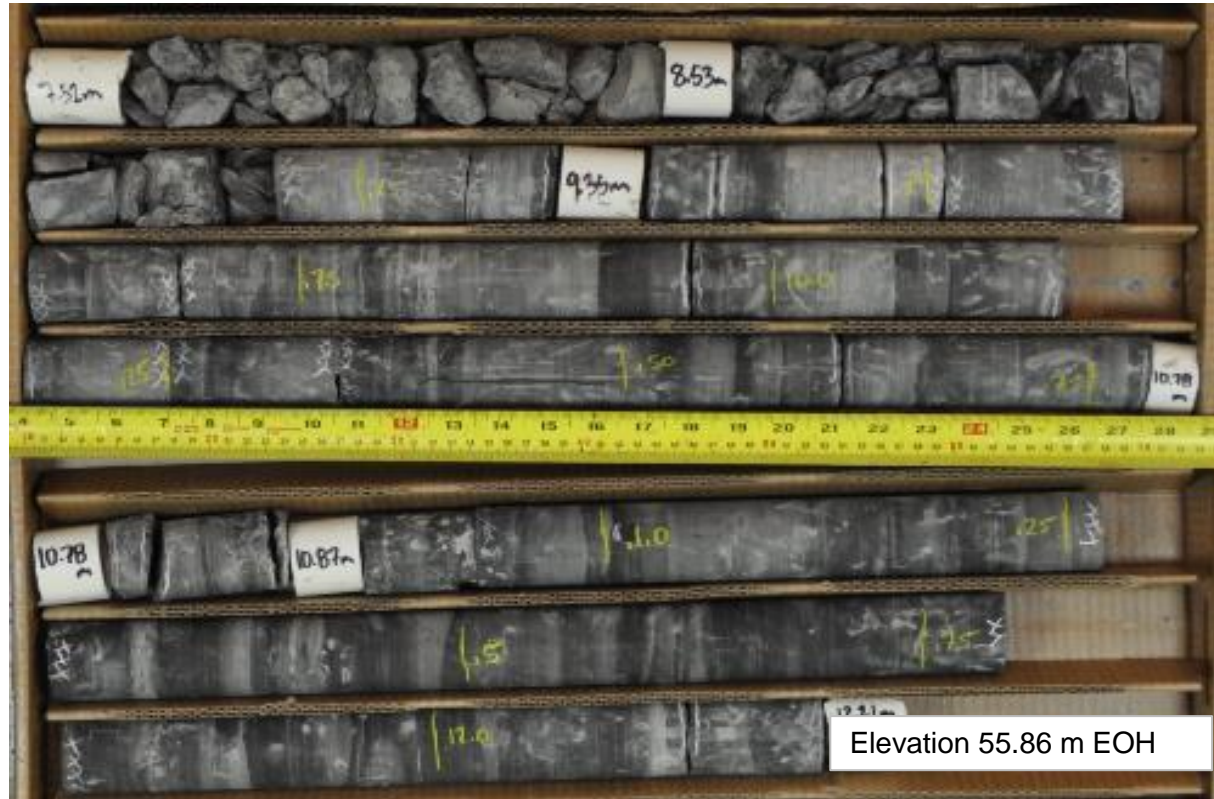
Elevation 57.66 m Top of Bedrock



Elevation 53.25 m EOH

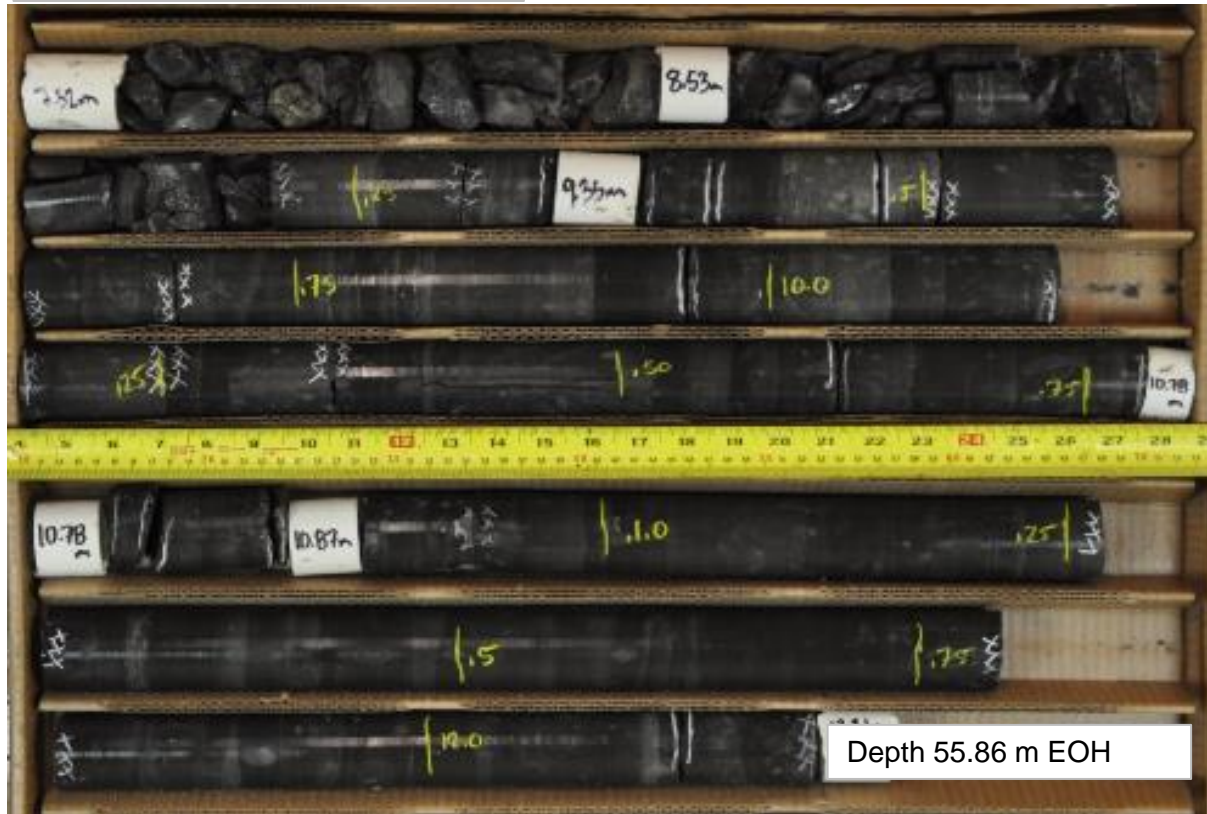
BH 20-1370-132 (Dry)
Cored Length of 60.57 to 55.86 m
Core Box 1 to 2 of 2

Elevation 60.57 m Top of Bedrock



BH 20-1370-132 (Wet)
Cored Length of 60.57 to 55.86 m
Core Box 1 to 2 of 2

Elevation 60.57 m Top of Bedrock



Depth 55.86 m EOH



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Figure A50

APPENDIX B

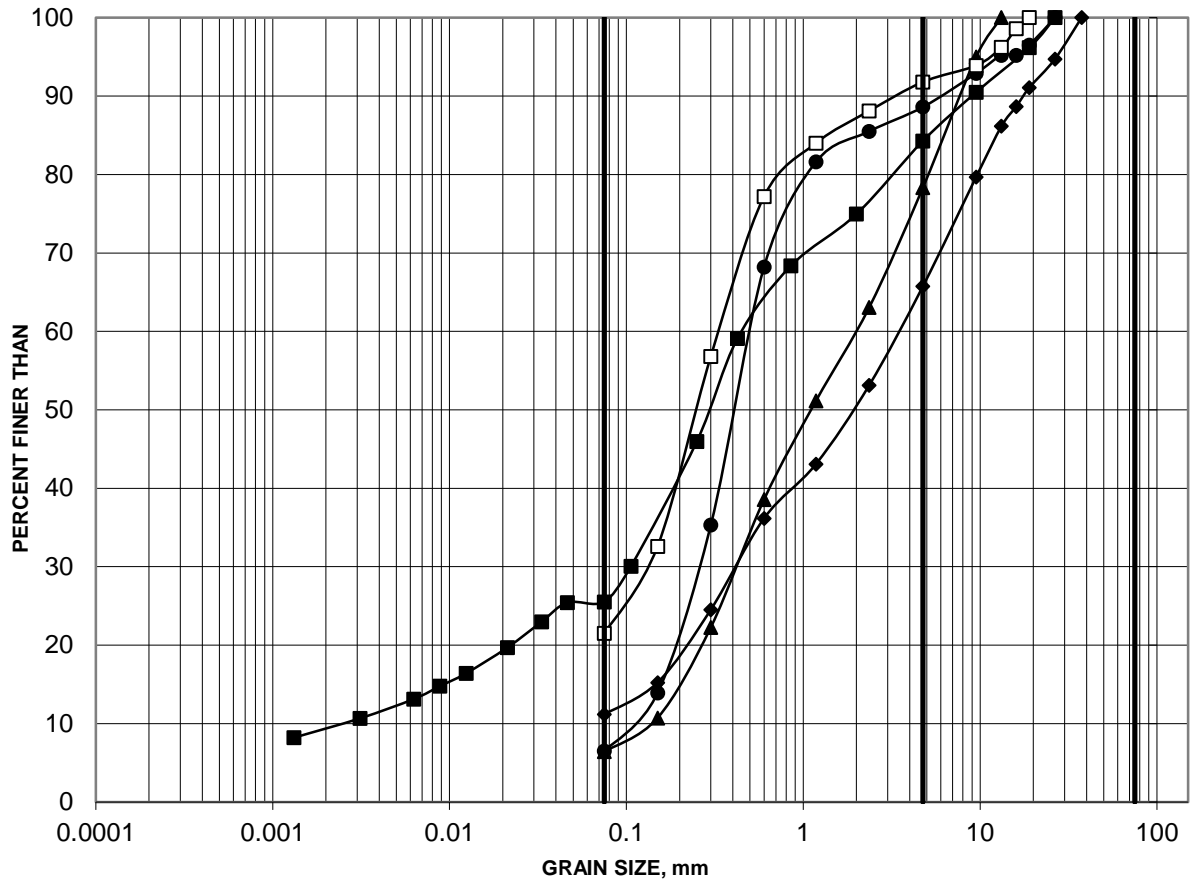
Laboratory Test Results

Figures B1 to B30

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-32	7	4.57-5.18	16	58	17	9
◆	1370-32	5	3.05-3.66	34	55	11	
▲	1730-33	9	6.10-6.71	22	72	6	
●	1370-33	14	9.91-10.52	11	82	7	
□	1370-34	13	9.14-9.75	8	70	22	

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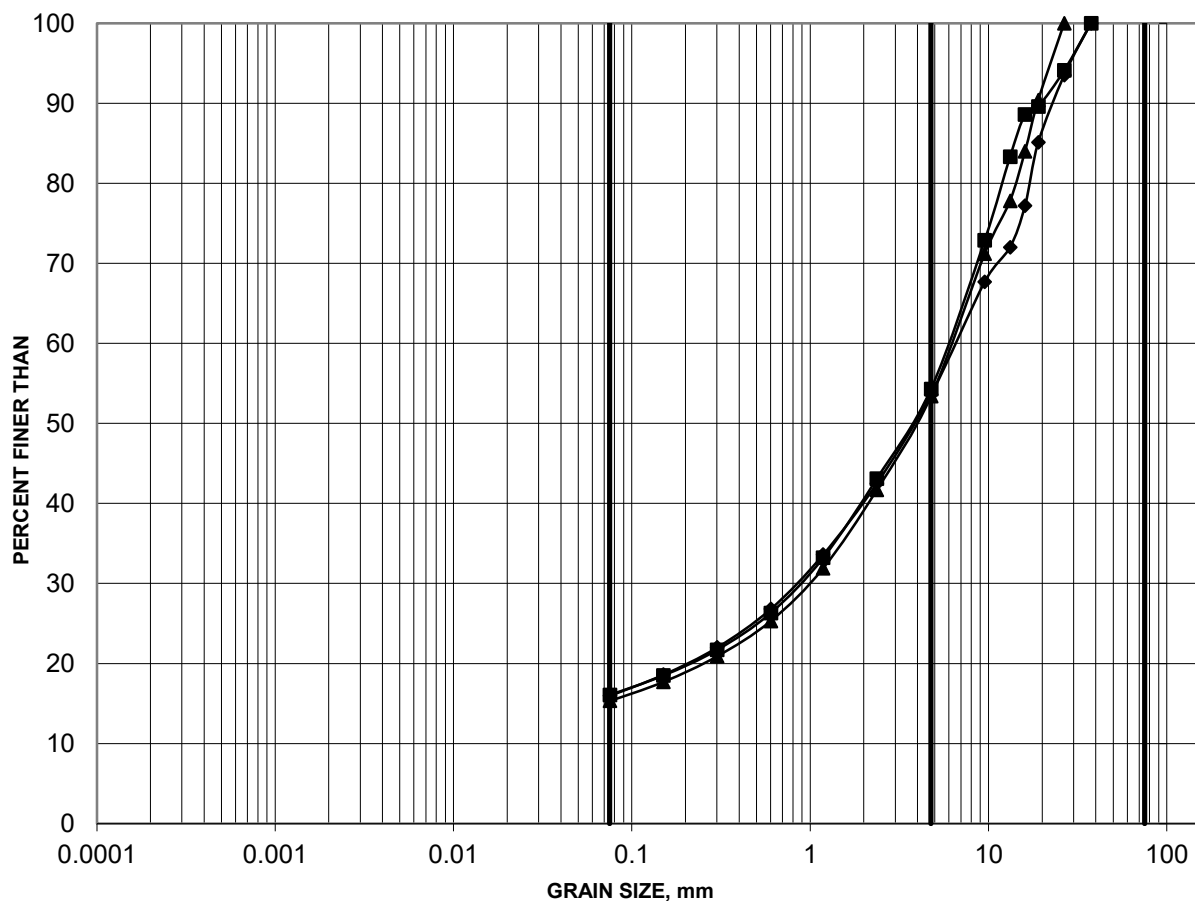
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GRAIN SIZE DISTRIBUTION

FIGURE B2

GRAVEL AND SAND (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-33	4	2.29-2.90	46	38	16	
◆	1370-34	6	3.81-4.42	46	38	16	
▲	1370-34	9	6.10-6.71	47	38	15	

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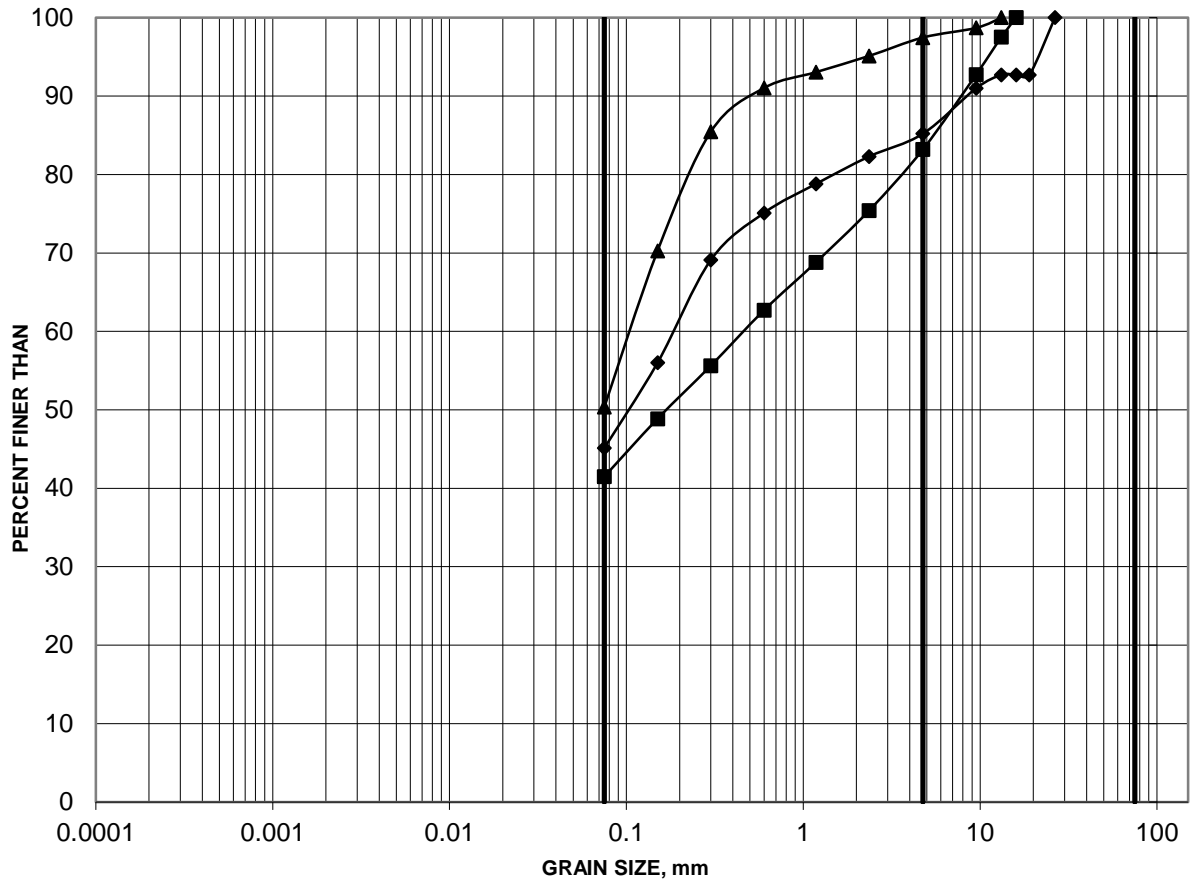
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GRAIN SIZE DISTRIBUTION

FIGURE B3

SILT AND SAND (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-17	4	2.29-2.51	17	42	41	
◆	1370-33	7	4.57-5.18	15	40	45	
▲	1370-34	12	8.38-8.99	3	47	50	

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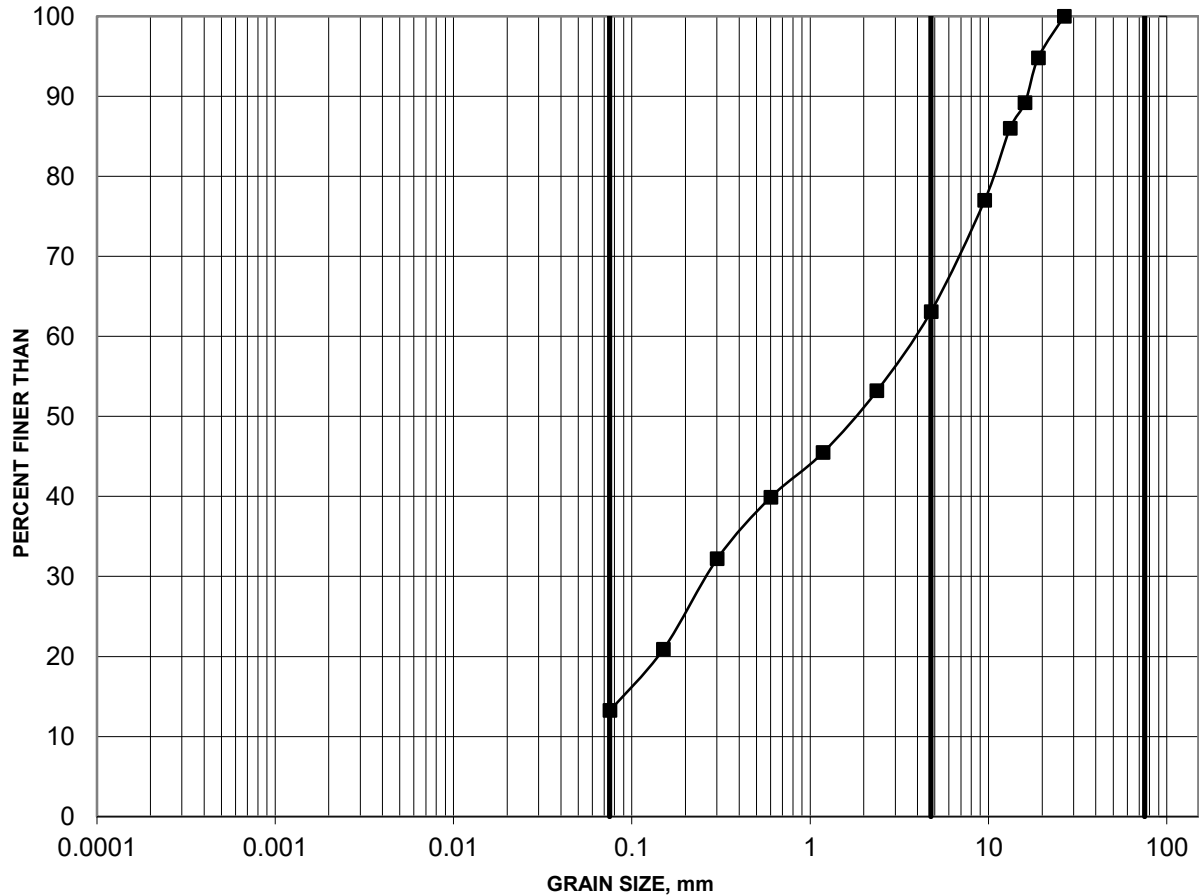
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GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND AND GRAVEL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■	1370-32	11	7.62-8.23	37	50	13

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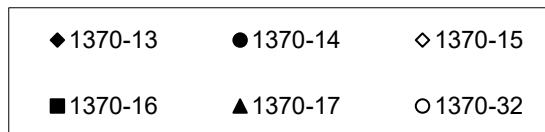
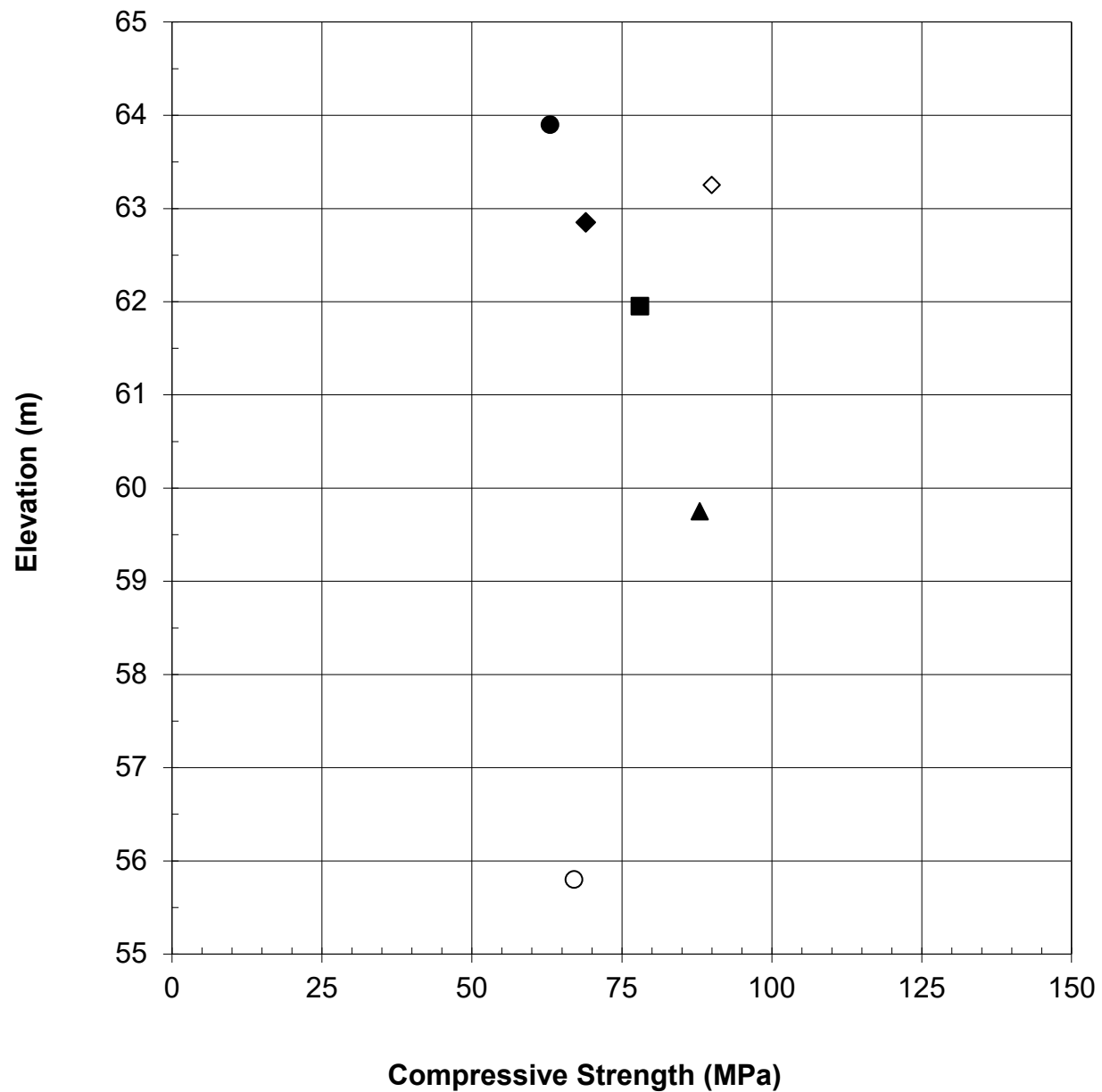
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SUMMARY OF LABORATORY COMPRESSIVE STRENGTH UNCONFINED COMPRESSION TESTS

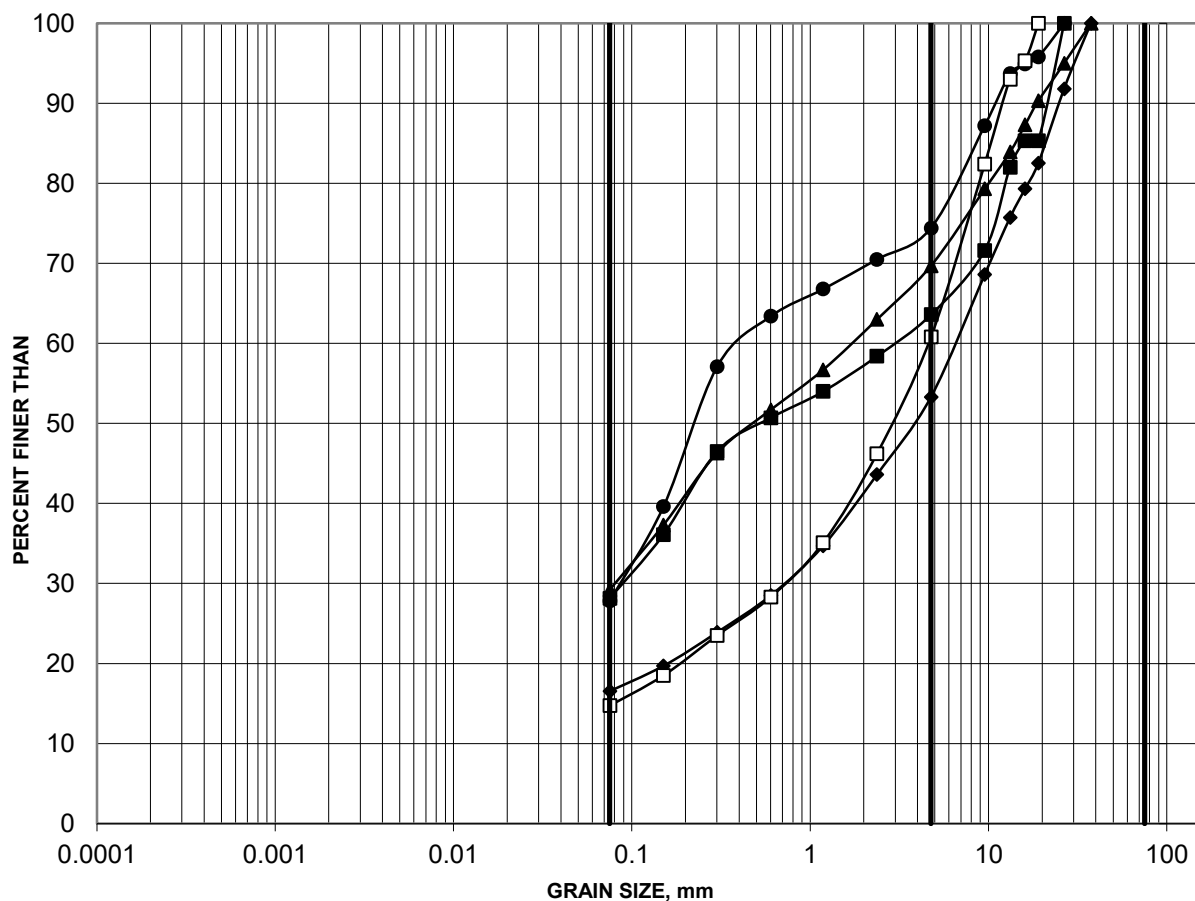
FIGURE B5



GRAIN SIZE DISTRIBUTION

FIGURE B6

SILTY SAND AND GRAVEL (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■	1370-35	4	2.29-2.90	36	36	28
◆	1370-35	7	4.57-5.18	47	36	17
▲	1370-35	12	8.38-8.99	30	41	29
●	1370-36A	7	4.57-5.18	26	46	28
□	1370-37	3B	1.83-2.13	39	46	15

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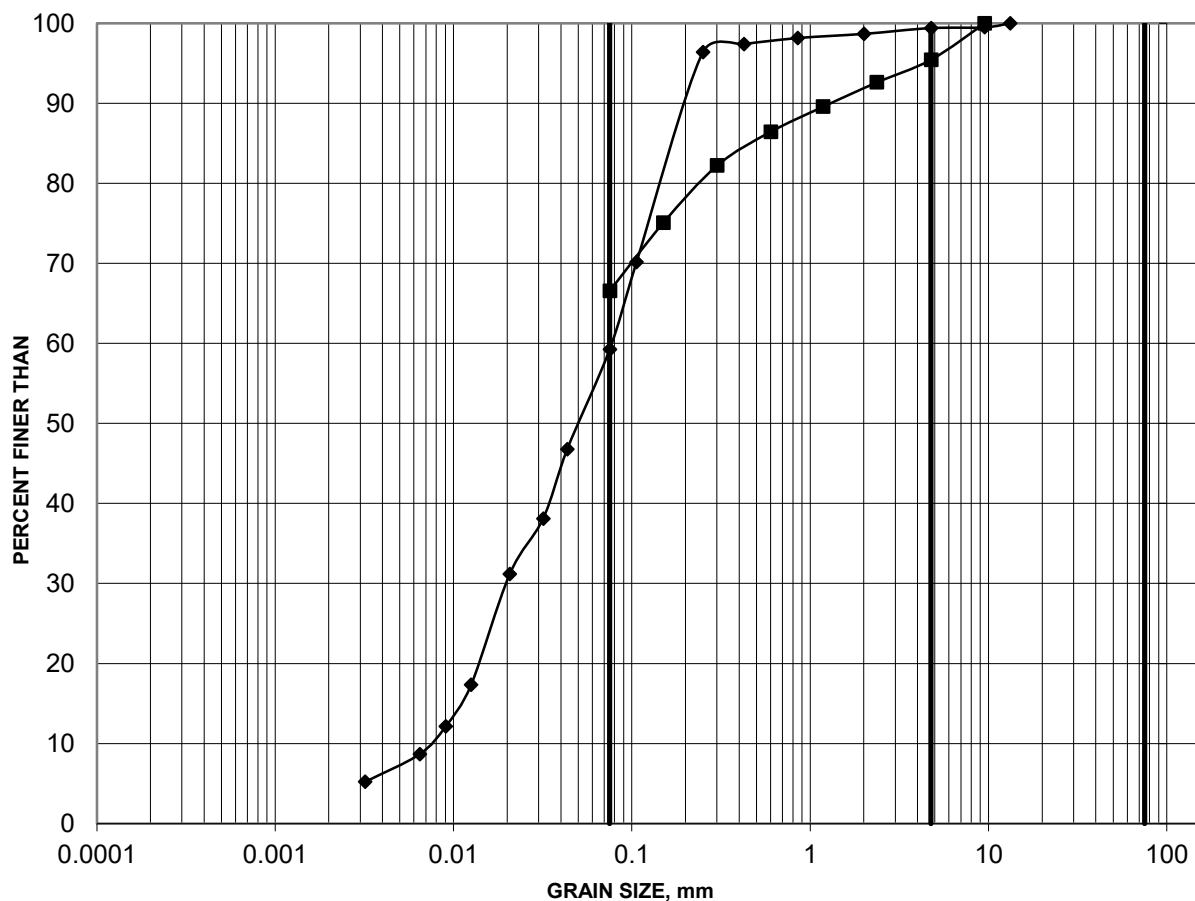
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GRAIN SIZE DISTRIBUTION

FIGURE B7

SILT AND SAND TO SANDY SILT (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-35	14A	9.91-10.06	5	28	67	
◆	1370-36A	10	6.86-7.47	1	40	55	4

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Created by: KCP

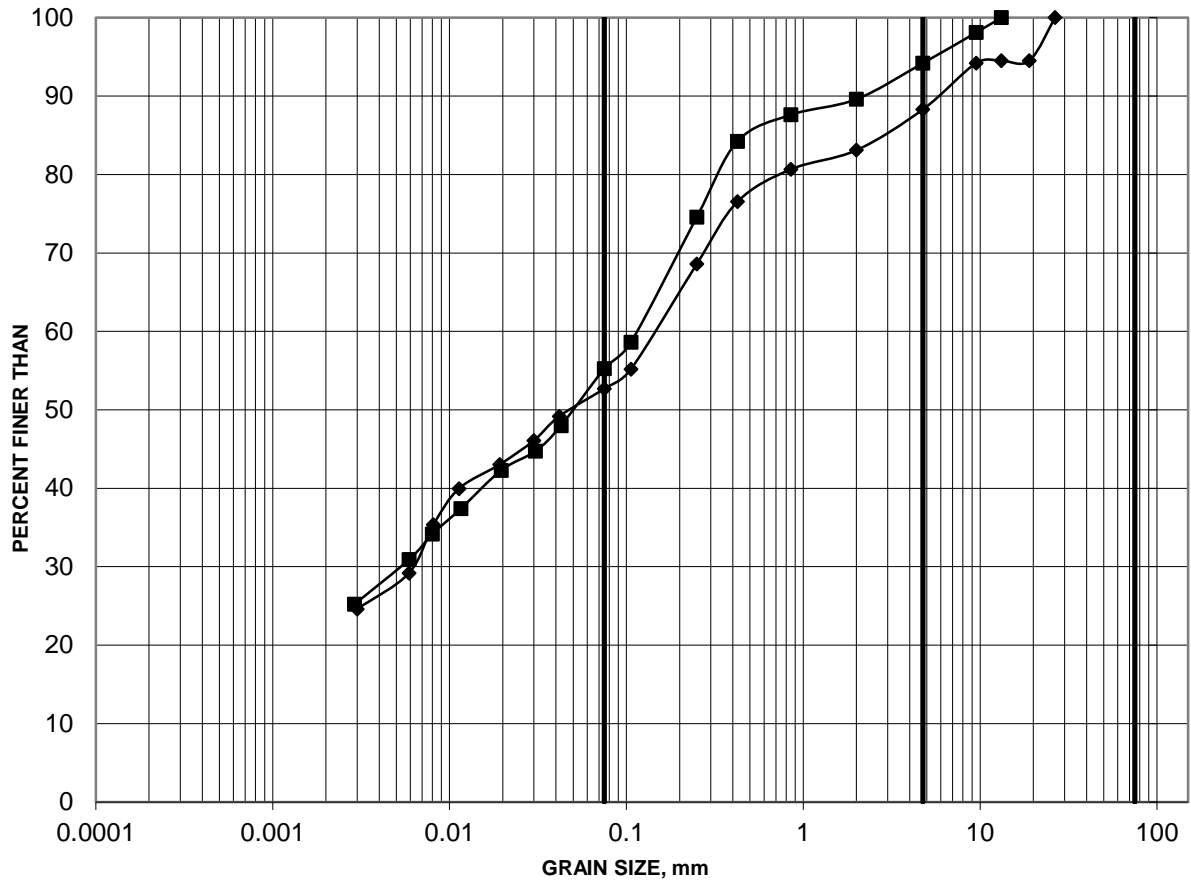
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GRAIN SIZE DISTRIBUTION

FIGURE B8

SILTY CLAY AND SAND (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-35	8	5.33-5.94	6	39	32	23
◆	1370-36	4	2.29-2.90	12	35	32	21

Project: 1662565-1370



Created by: KCP

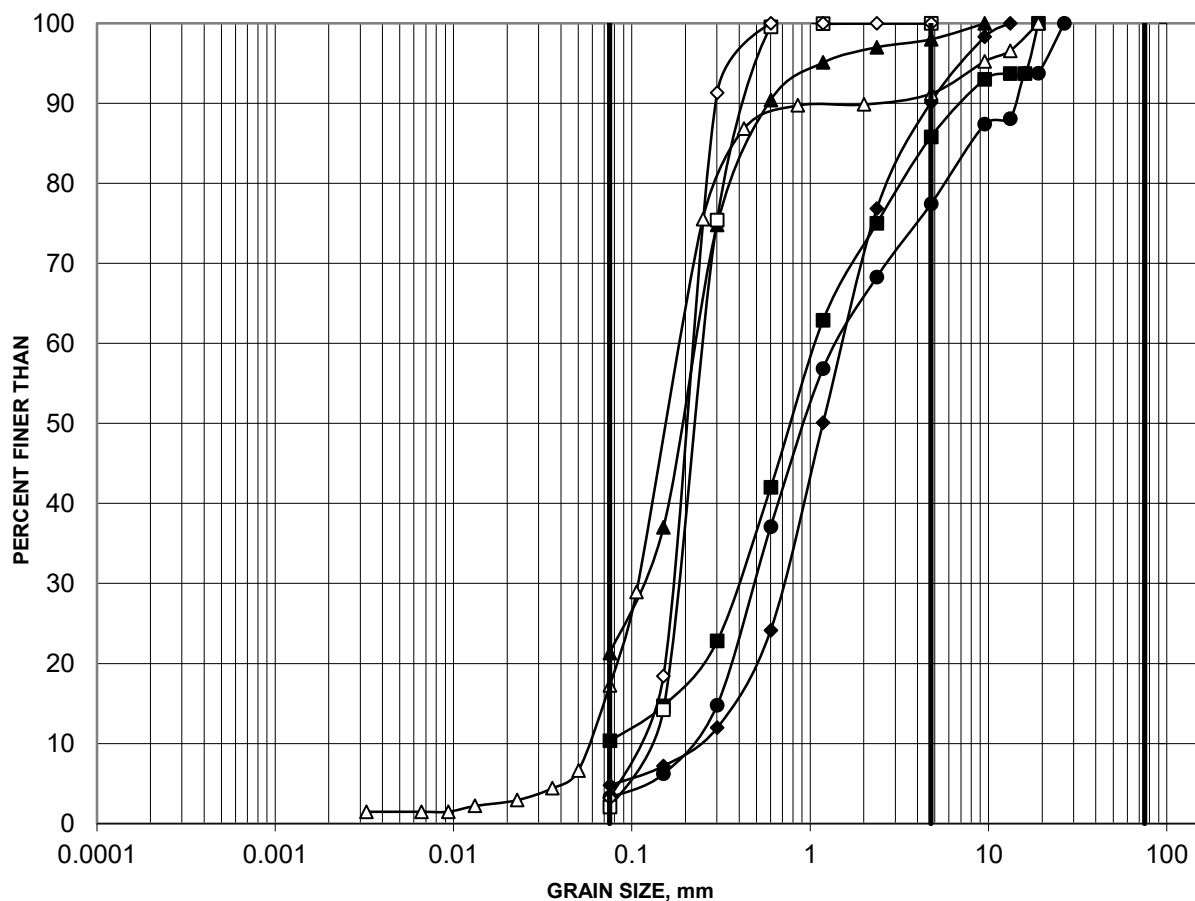
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GRAIN SIZE DISTRIBUTION

FIGURE B9

SAND TO GRAVELLY SAND



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

				Constituents (%)			
Borehole	Sample	Depth (m)		Gravel	Sand	Silt	Clay
■	1370-38	7	4.57-5.18	14	76		10
◆	1370-38	13	9.15-9.76	10	85		5
▲	1370-39	4B	2.44-2.90	2	77		21
●	1370-40	7	5.34-5.95	23	74		3
□	1370-41	6	3.81-4.42	0	98		2
◇	1370-41	10	6.86-7.47	0	97		3
△	1370-37	13	9.14-9.75	9	74	16	1

Project: 1662565-1370



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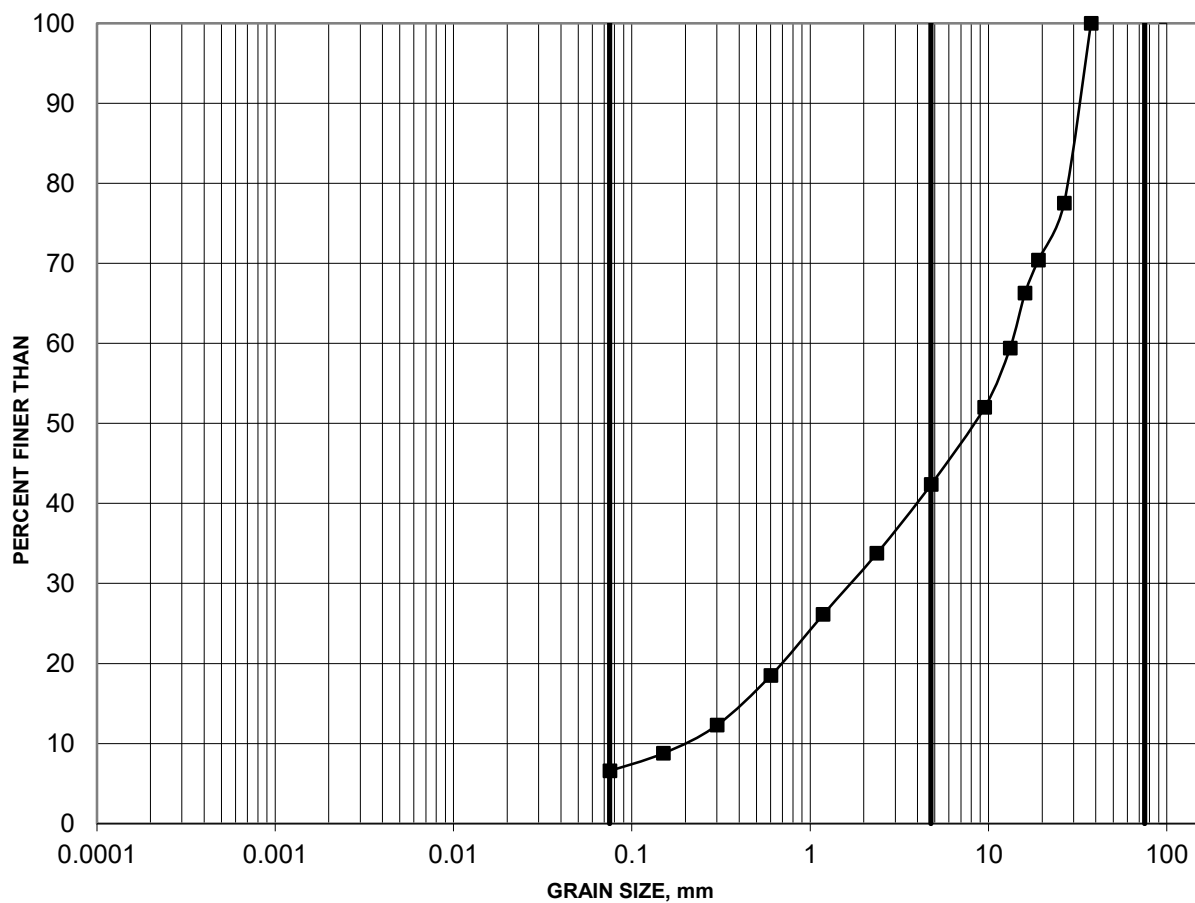
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GRAIN SIZE DISTRIBUTION

FIGURE B10

GRAVEL AND SAND



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■	1370-39	6	58	35	7	

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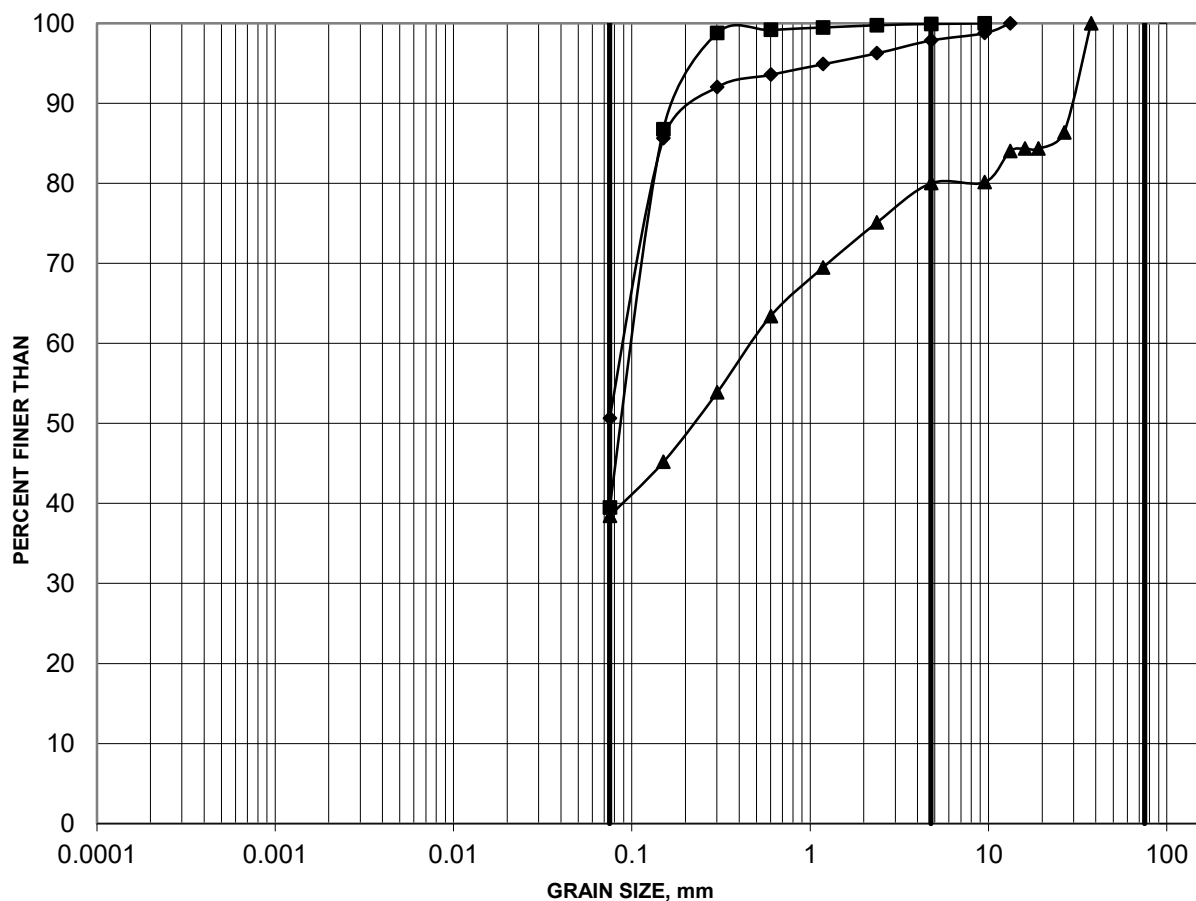
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GRAIN SIZE DISTRIBUTION

FIGURE B11

SAND AND SILT TO GRAVELLY SAND AND SILT



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■ 1370-36A	13	9.14-9.75	0	61	39	
◆ 1370-37	8	6.86-7.47	2	47	51	
▲ 1370-38	4B	2.59-2.90	20	42	38	

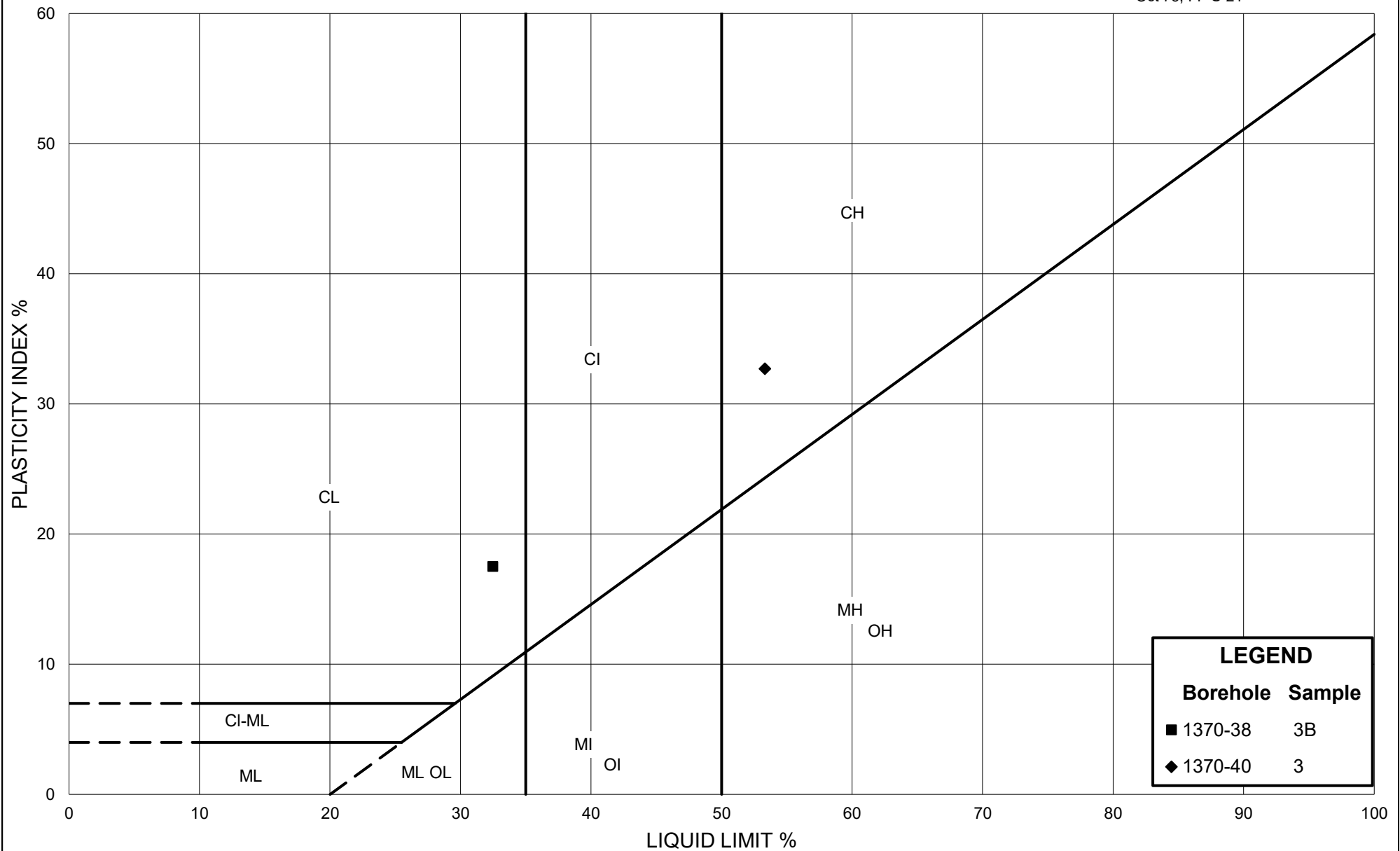
Project: 1662565-1370



Created by: KCP

Checked by: MI

https://golderassociates.sharepoint.com/sites/11263g/Shared Documents/03_Lab/ph 1370/1-figures/



Ministry of Transportation

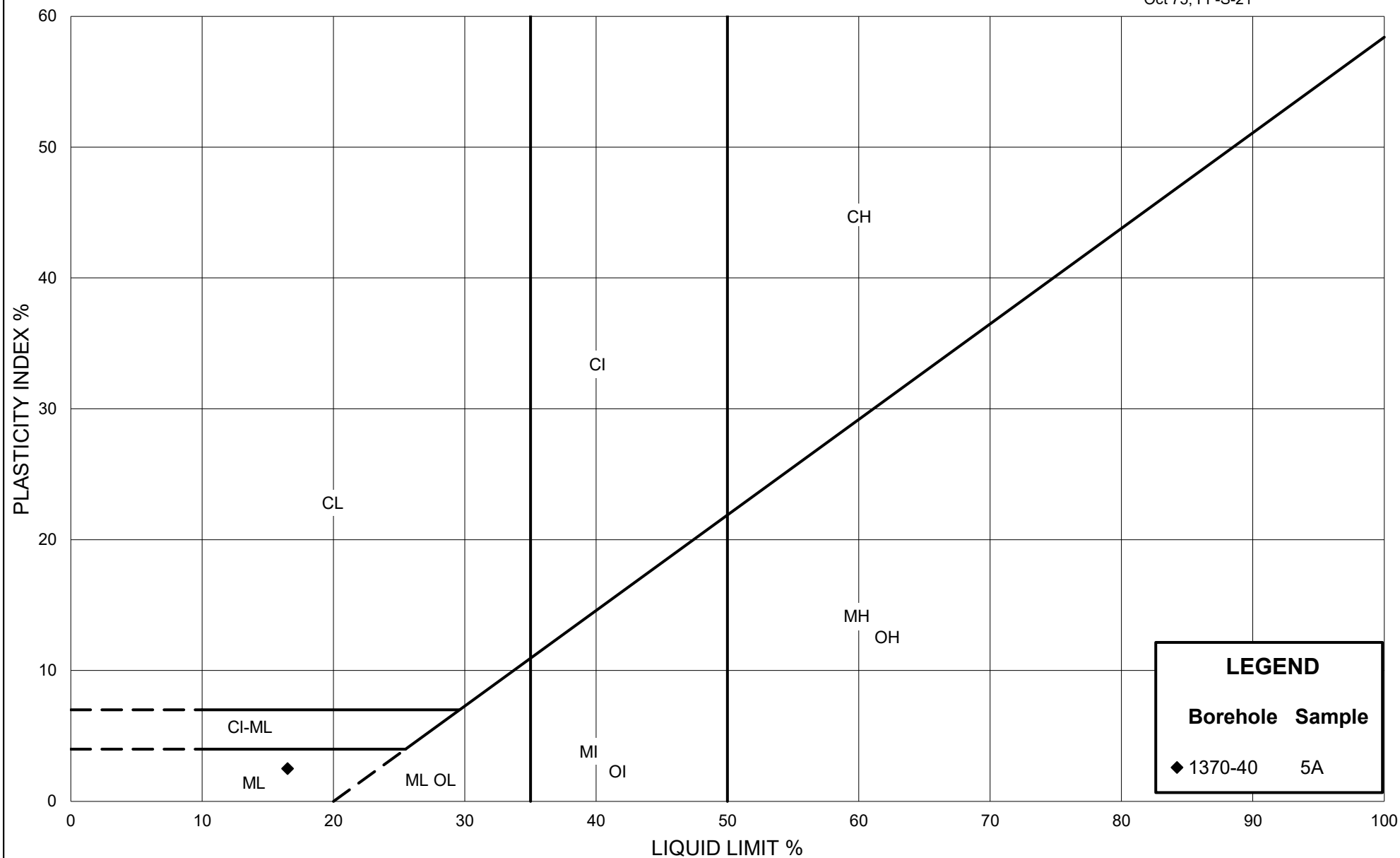
PLASTICITY CHART

CLAYEY SILT TO CLAY

Figure: B12

Project: 1662565-1370

Created By: KCP Checked By: MI



Ontario

Ministry of Transportation

PLASTICITY CHART SILT

Figure: B13

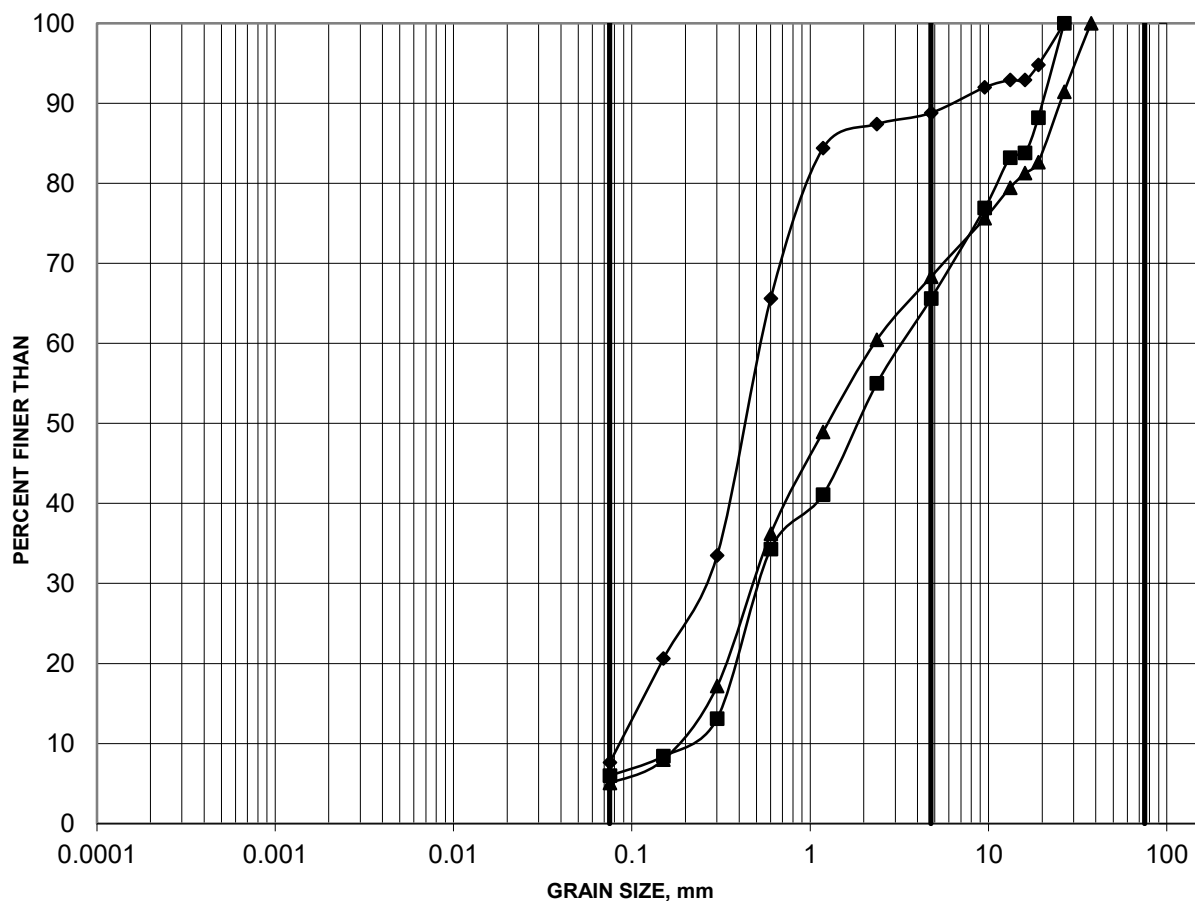
Project: 1662565-1370

Created By: KCP Checked By: MI

GRAIN SIZE DISTRIBUTION

FIGURE B14

GLACIAL TILL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-39	8	5.33-5.94	34	60	6	
◆	1370-39	14A	9.14-9.45	11	81	8	
▲	1370-41	12	8.38-8.99	32	63	5	

Project: 1662565-1370



Created by: KCP

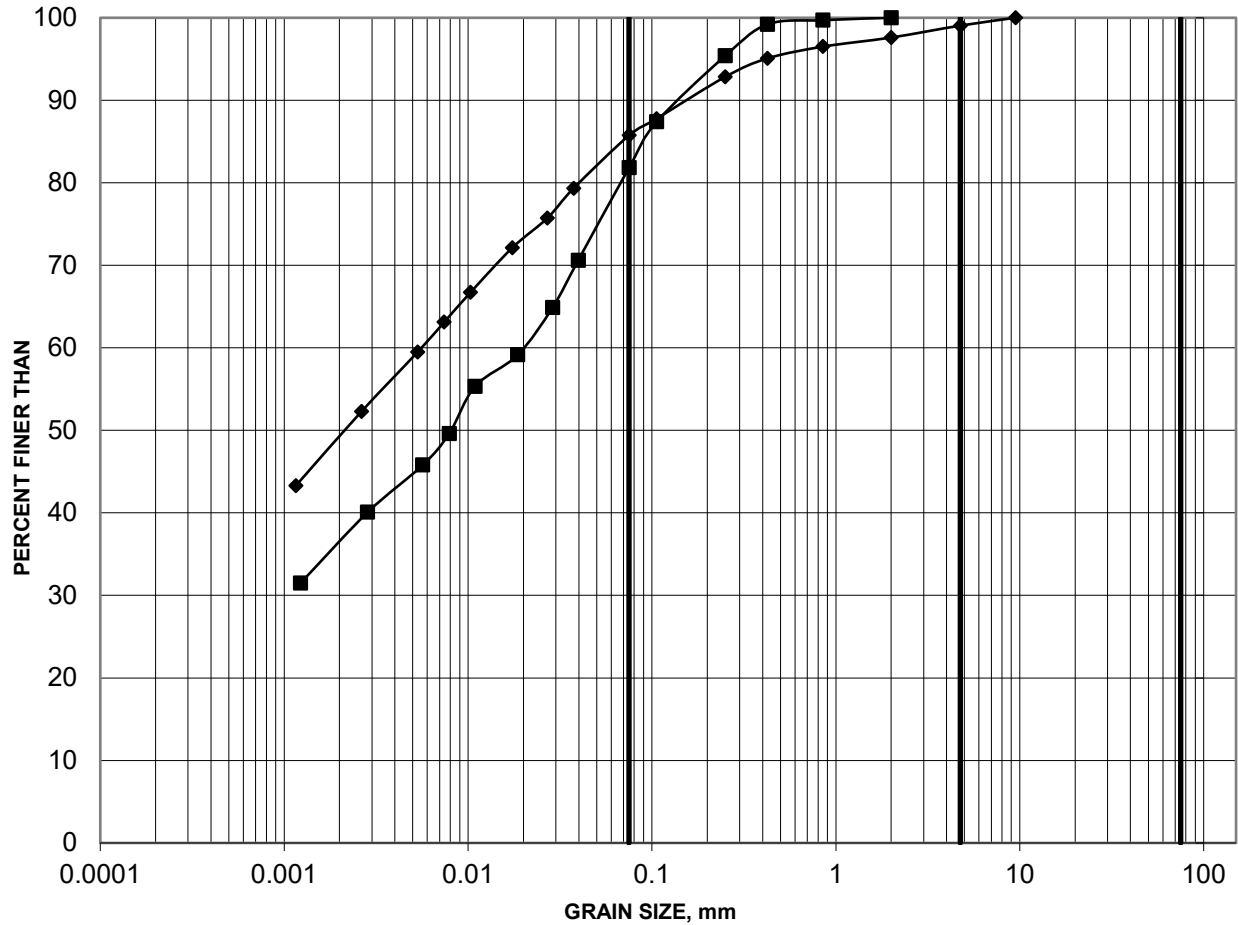
Checked by: MI

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GRAIN SIZE DISTRIBUTION

FIGURE B15

CLAY (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

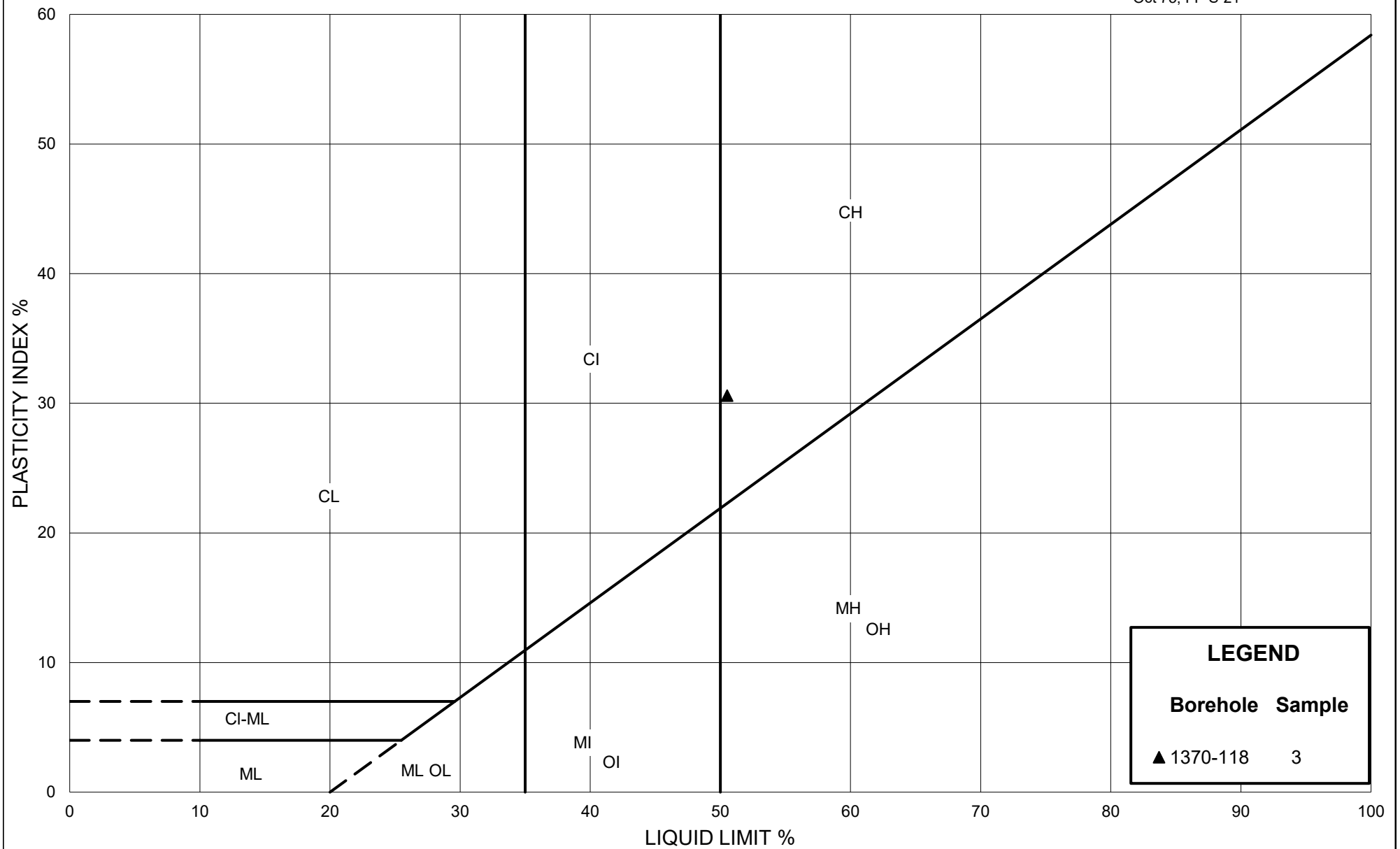
	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-116	5	3.05-3.66	0	18	46	36
◆	1370-118	3	1.52-2.13	1	13	37	49

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PLASTICITY CHART CLAY (FILL)

Figure: B16

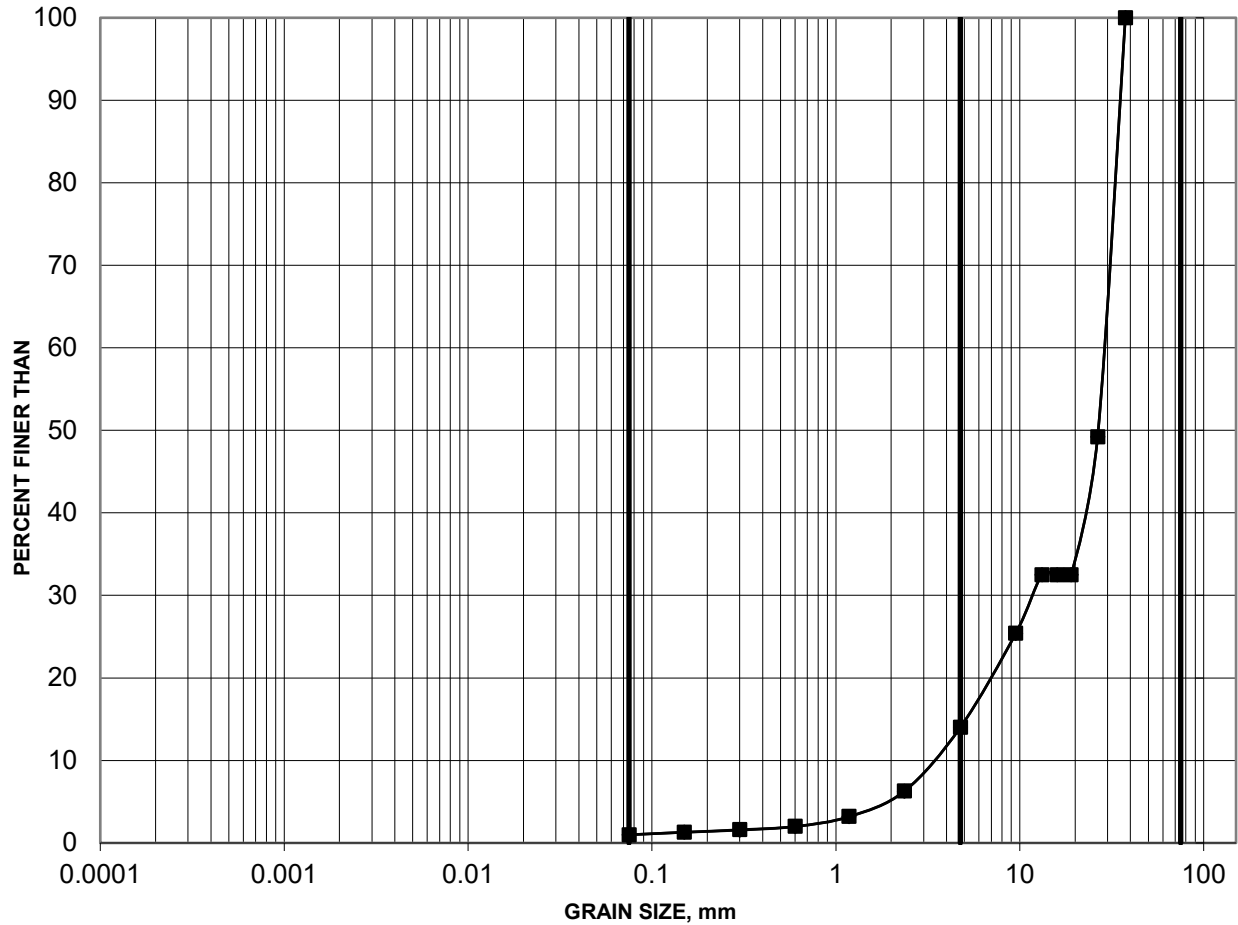
Project: 1662565-1370

Created By: KCP Checked By: MI

GRAIN SIZE DISTRIBUTION

FIGURE B17

GRAVEL (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■	1370-132	3	1.52-2.13	86	13	1

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Created by: KCP

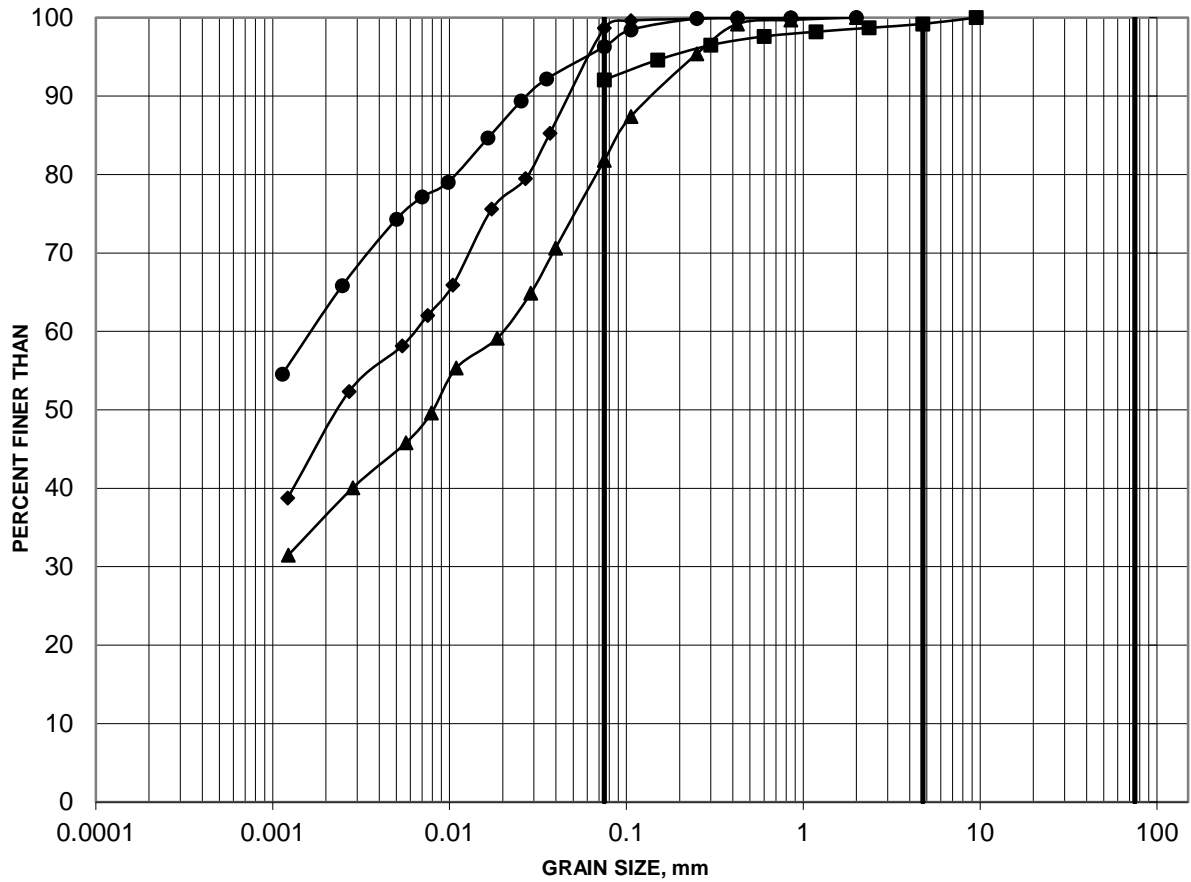
Checked by: MI

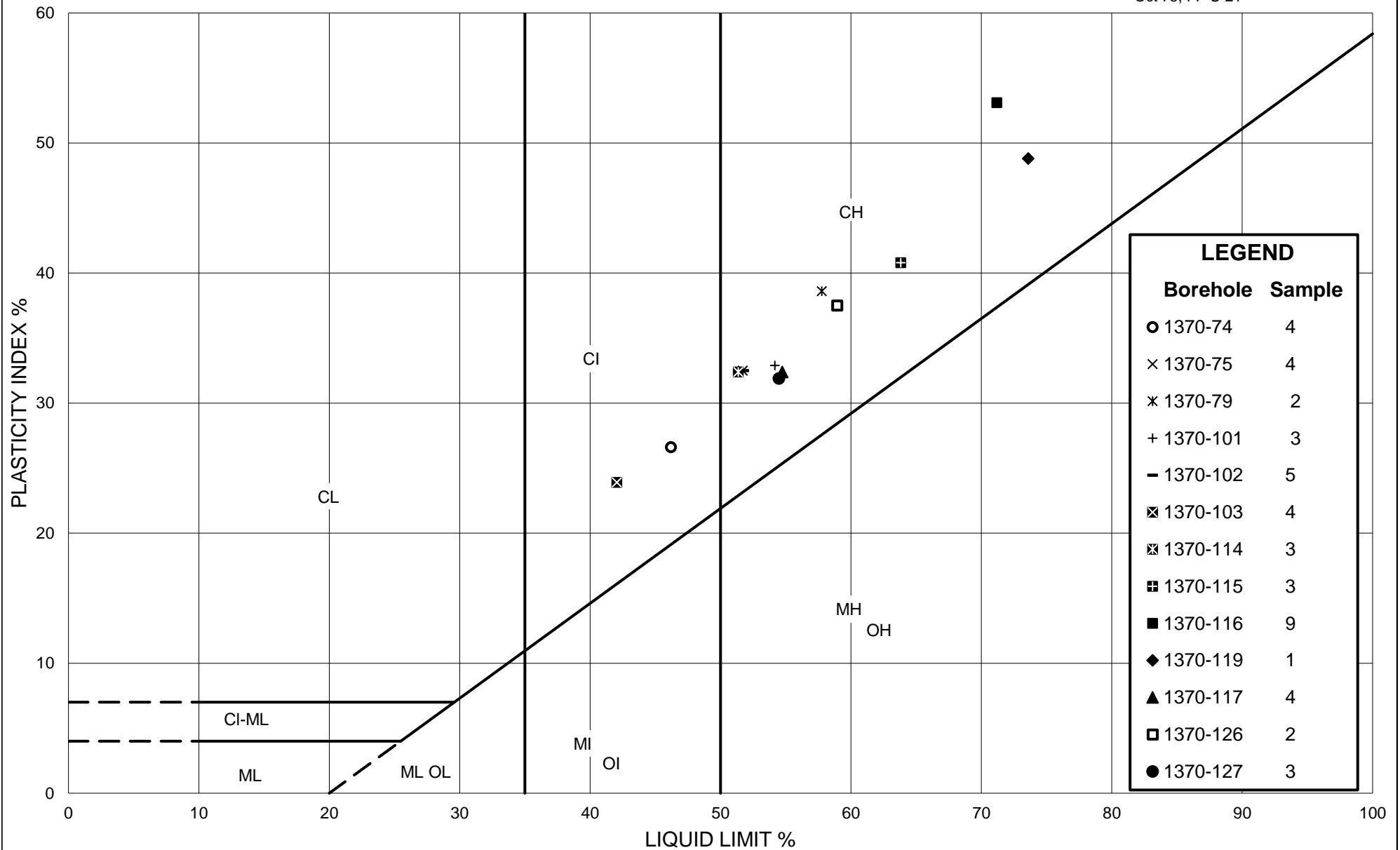
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GRAIN SIZE DISTRIBUTION

FIGURE B18

WEATHER CLAY CRUST





Ontario

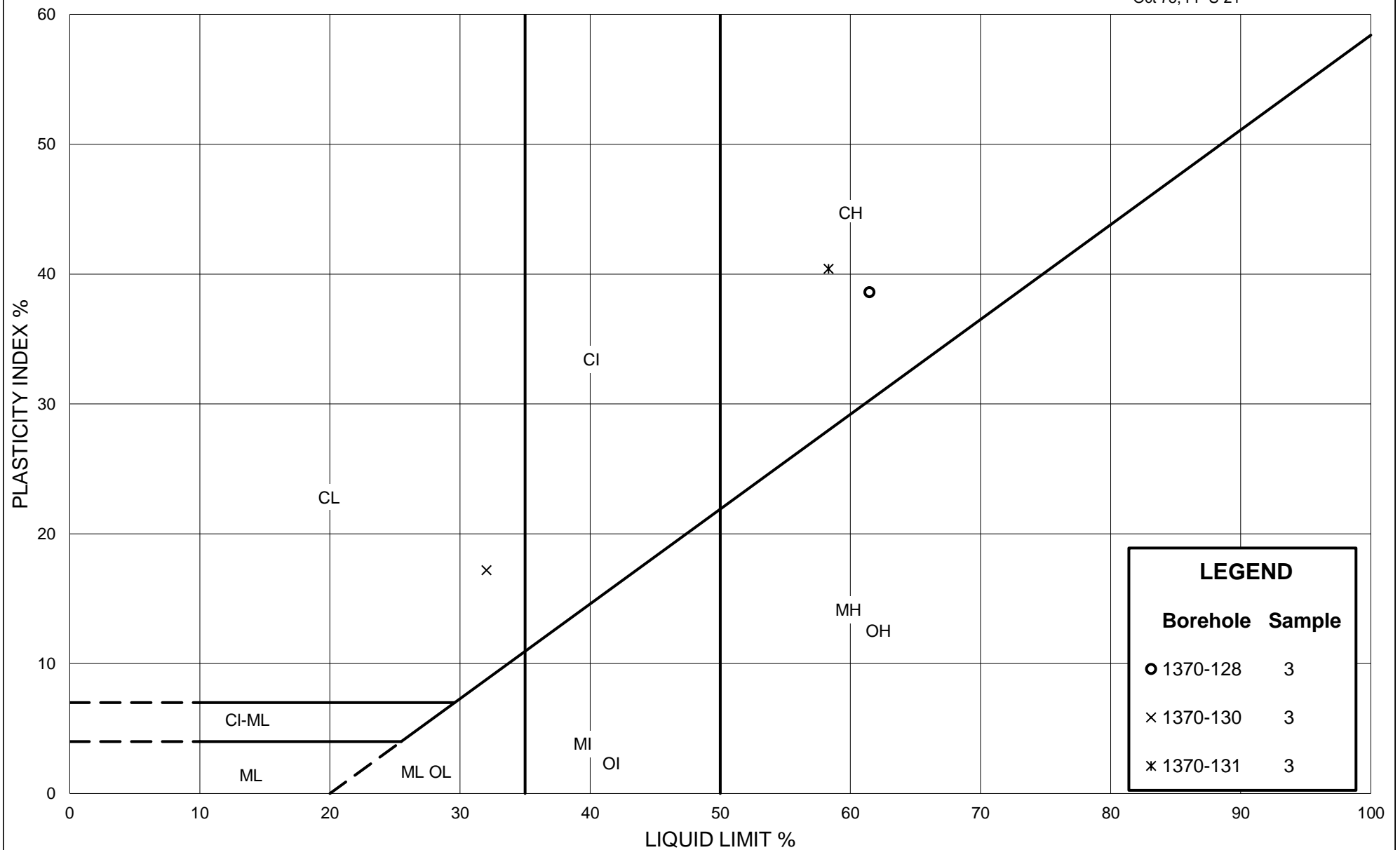
Ministry of Transportation

PLASTICITY CHART WEATHERED CLAY CRUST

Figure: B19

Project: 1662565-1370

Created By: KCP Checked By: MI



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PLASTICITY CHART WEATHERED CLAY CRUST

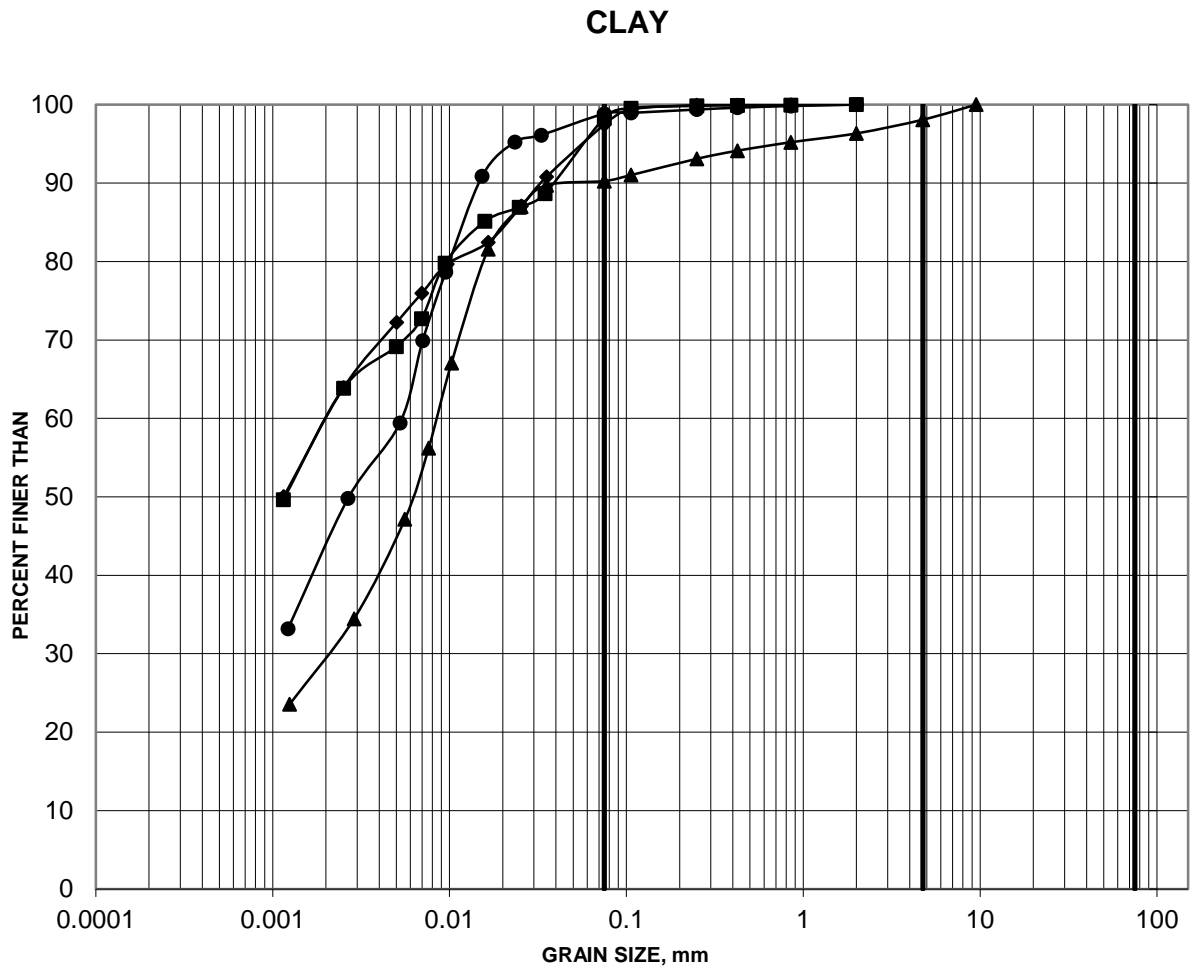
Figure: B20

Project: 1662565-1370

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GRAIN SIZE DISTRIBUTION

FIGURE B21



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-103	9	7.62-8.23	0	2	38	60
◆	1370-112	6	6.10-6.71	0	3	37	60
▲	1370-115	6A	4.57-4.88	2	8	60	30
●	1370-116	10	6.86-7.47	0	1	55	44

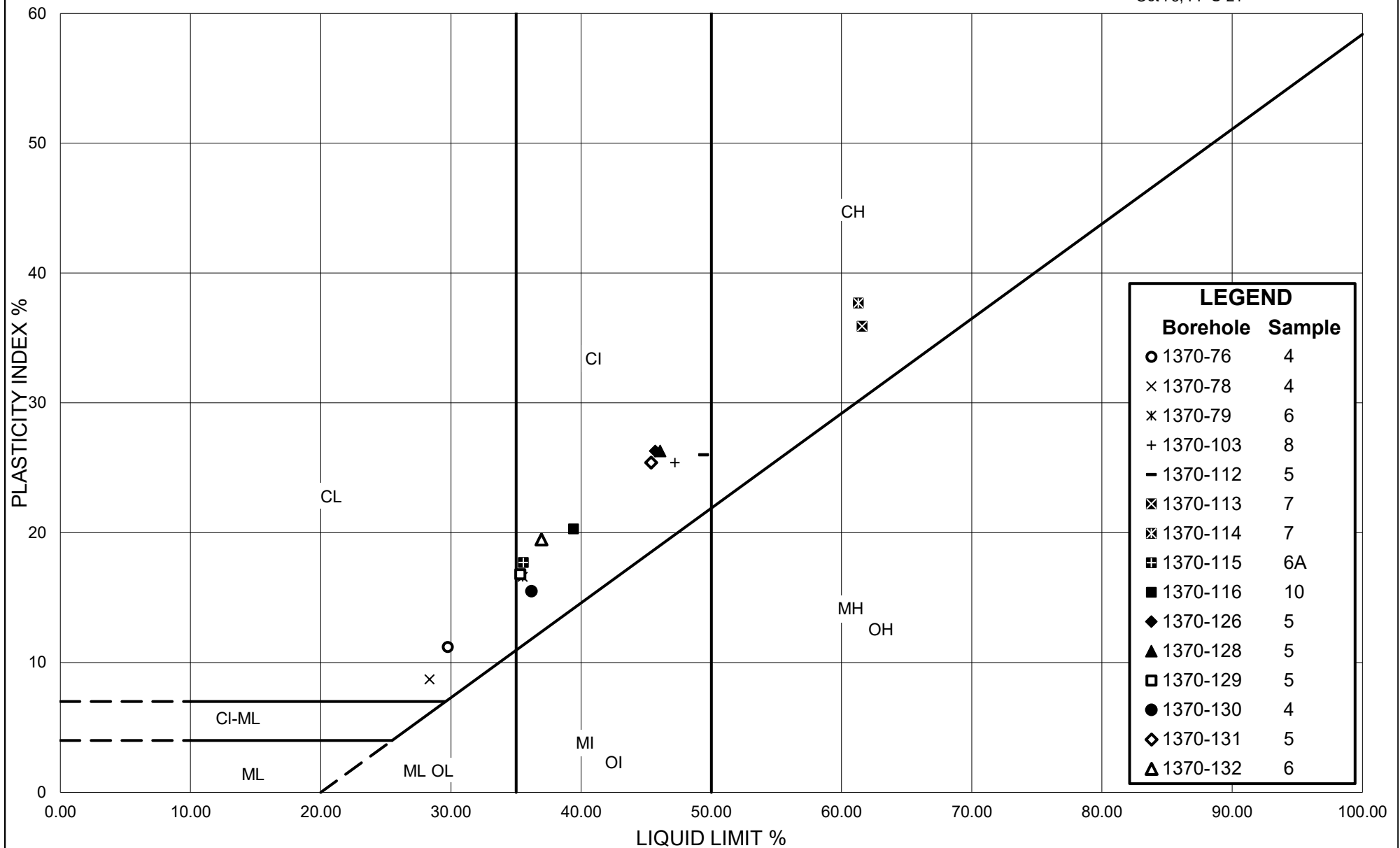
Project: 1662565-1370



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Ontario

Ministry of Transportation

PLASTICITY CHART

CLAYEY SILT TO CLAY

Figure: B22

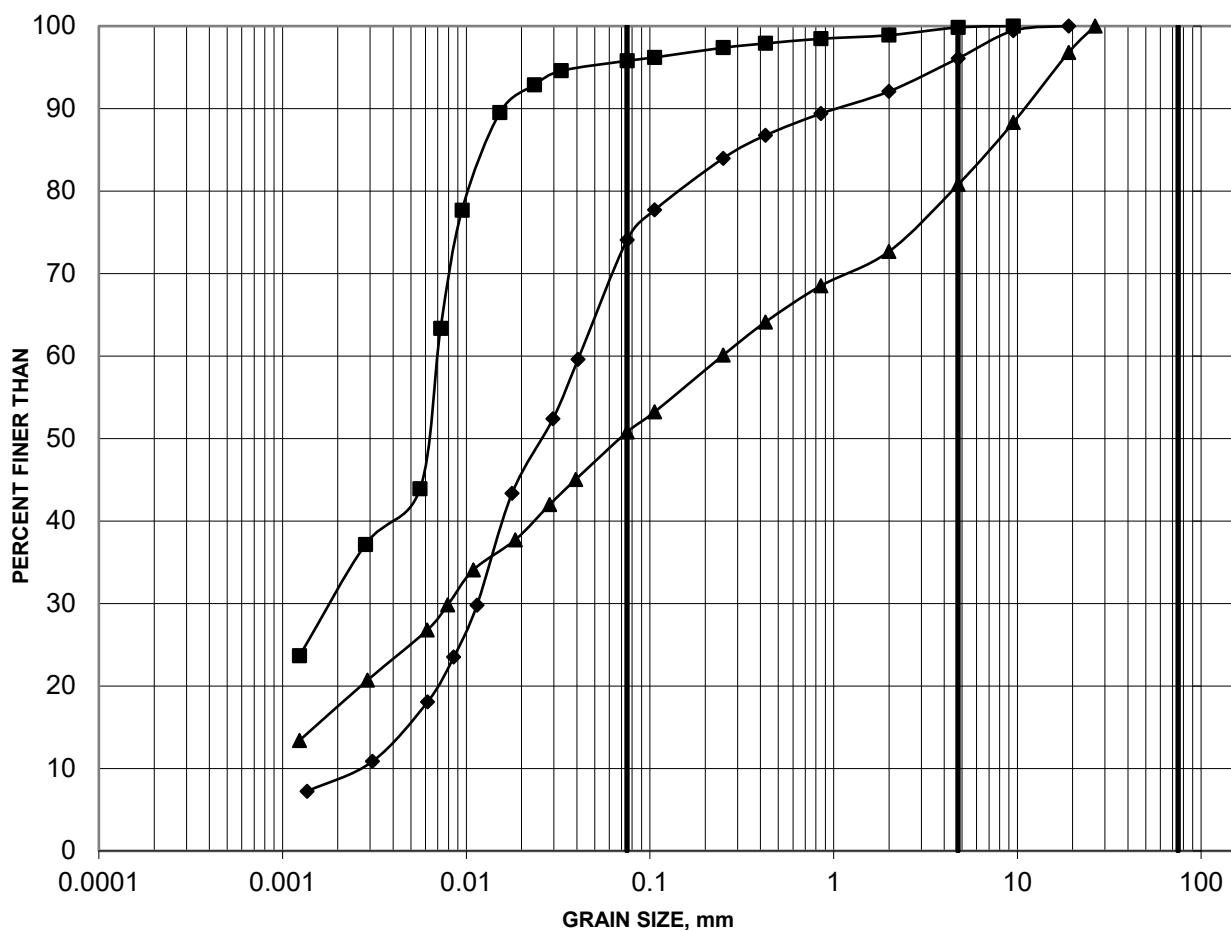
Project: 1662565-1370

Created By: KCP Checked By: MI

GRAIN SIZE DISTRIBUTION

FIGURE B23

SILT TO CLAYEY SILT-SILT



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

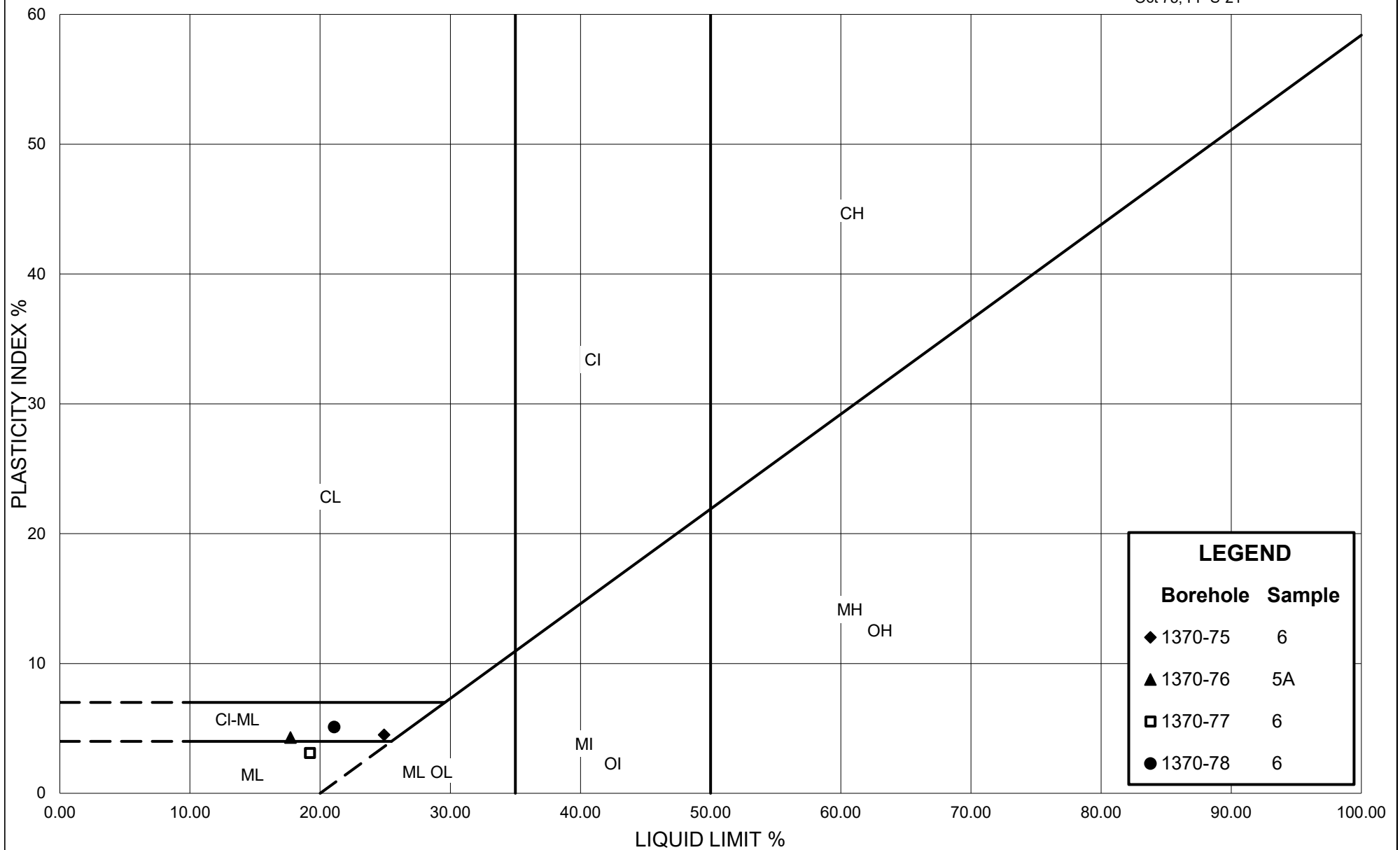
	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-75	7A	5.33-5.79	0	4	65	31
◆	1370-102	9	7.62-8.23	4	22	65	9
▲	1370-129	6	4.57-5.18	19	30	33	18

Project: 1662565-1370



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PLASTICITY CHART

SILT TO CLAYEY SILT-SILT

Figure: B24

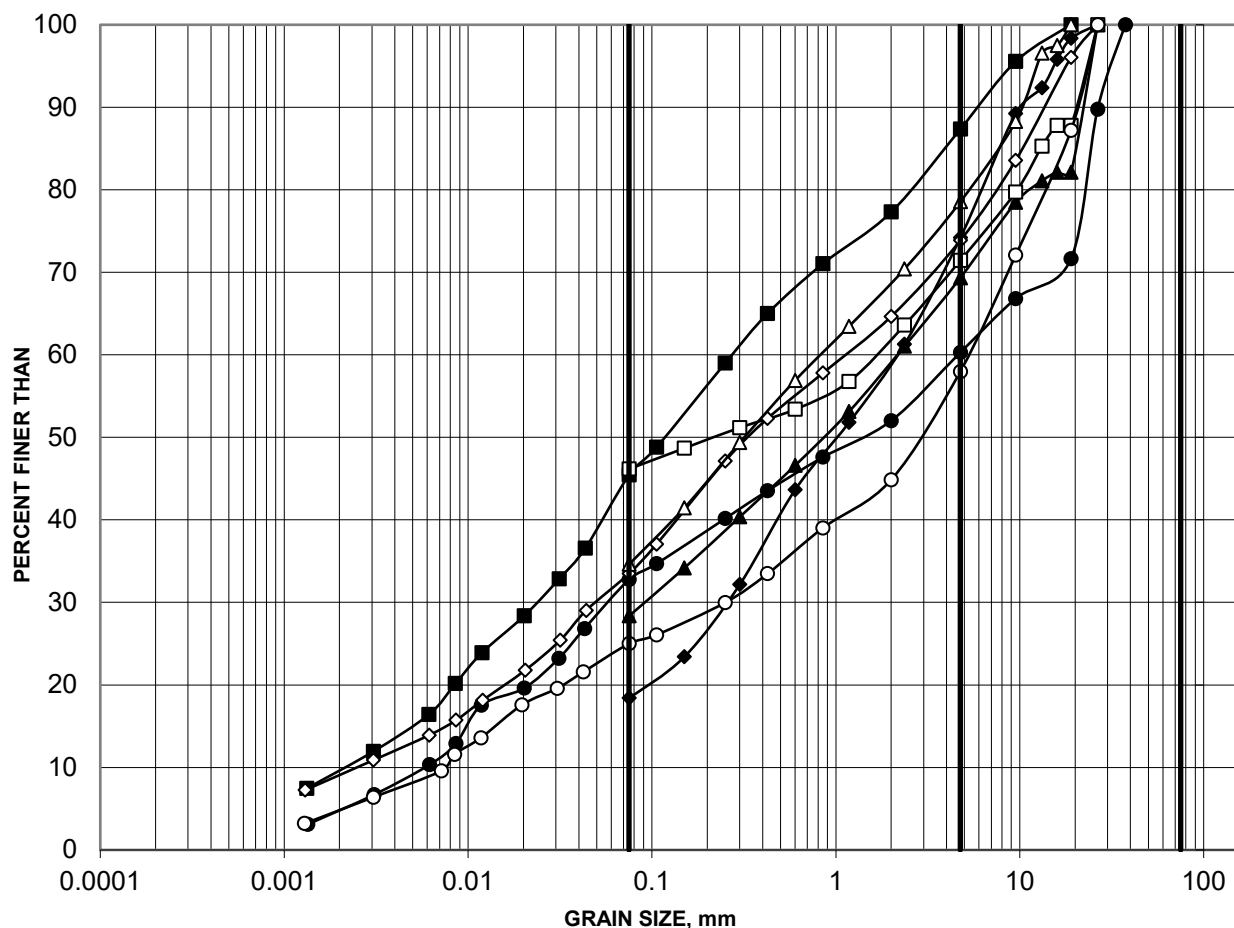
Project: 1662565-1370

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GRAIN SIZE DISTRIBUTION

FIGURE B25

GLACIAL TILL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-74	5B	3.20-3.66	13	42	35	10
◆	1370-75	10B	7.92-8.23	26	56	18	
▲	1370-76	5B	5.18-5.64	31	41	28	
●	1370-77	8	5.03-5.64	40	27	28	5
□	1370-113	8	6.10-6.71	29	25	46	
◇	1370-115	8B	6.25-6.71	26	41	24	9
△	1370-116	12	8.38-8.99	21	44	35	
○	1370-119	4	2.13-2.74	42	33	20	5

Project: 1662565-1370



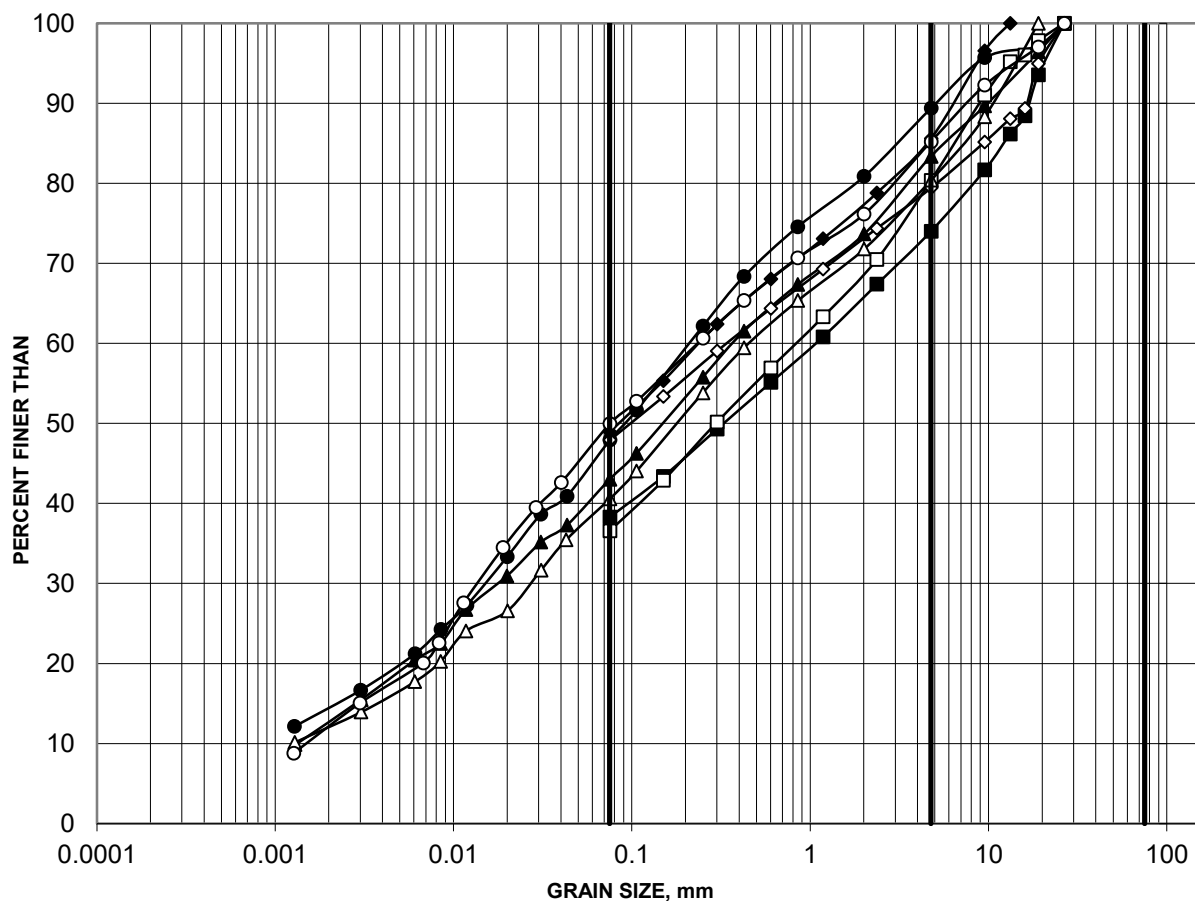
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GRAIN SIZE DISTRIBUTION

FIGURE B26

GLACIAL TILL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-101	7	5.34-5.95	26	36	38	
◆	1370-114	11	8.53-9.14	14	37	49	
▲	1370-117	6	3.81-4.42	17	40	30	13
●	1370-118	8	6.10-6.71	11	41	34	14
□	1370-127	6	4.57-5.18	20	43	37	
◇	1370-128	6	4.42-4.85	21	31	48	
△	1370-131	9	7.62-8.23	20	39	29	12
○	1370-132	8	5.33-5.94	15	35	38	12

Project: 1662565-1370



Created by: KCP

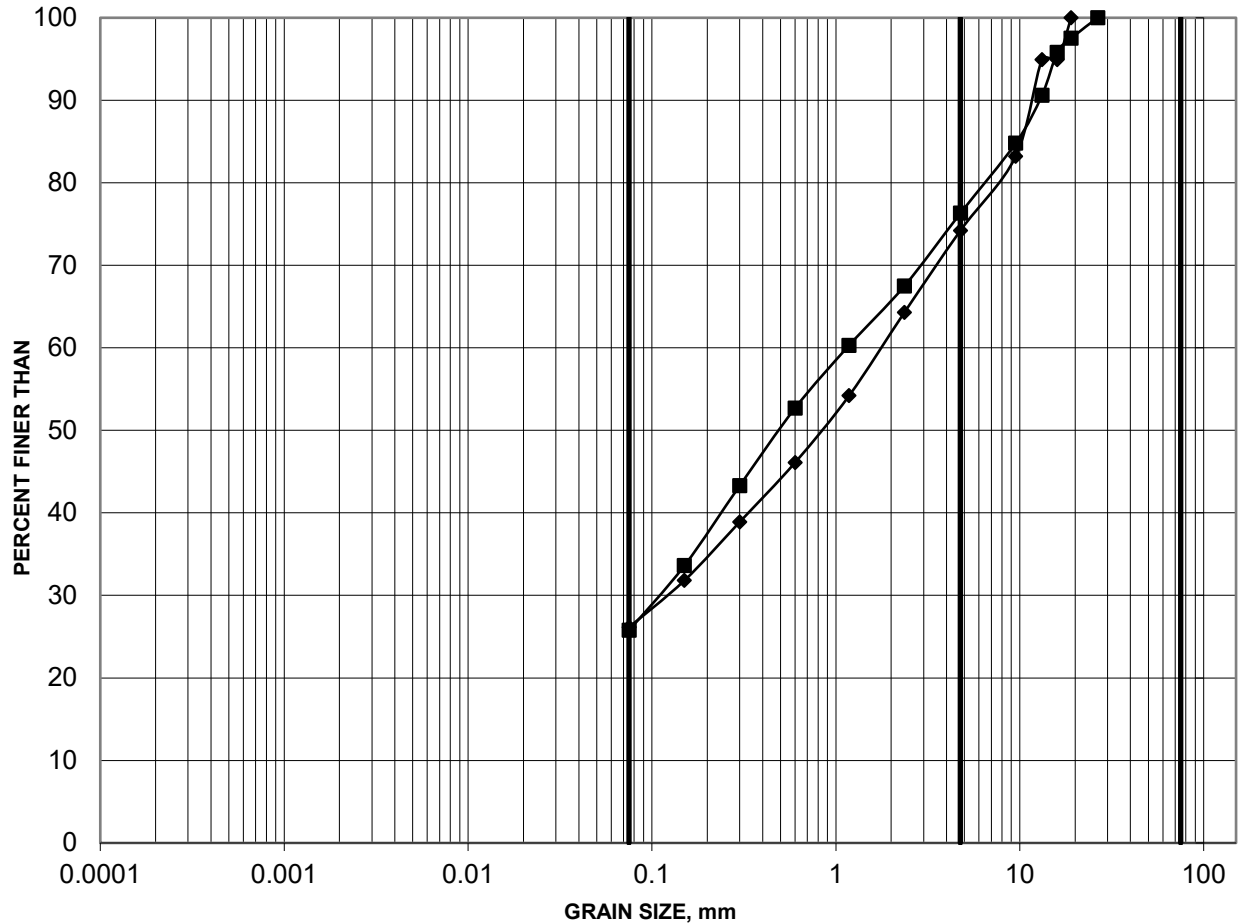
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GRAIN SIZE DISTRIBUTION

FIGURE B27

GLACIAL TILL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	1370-74	12	8.38-8.99	24	50	26	
◆	1370-79	8	8.38-8.99	26	48	26	

Project: 1662565-1370



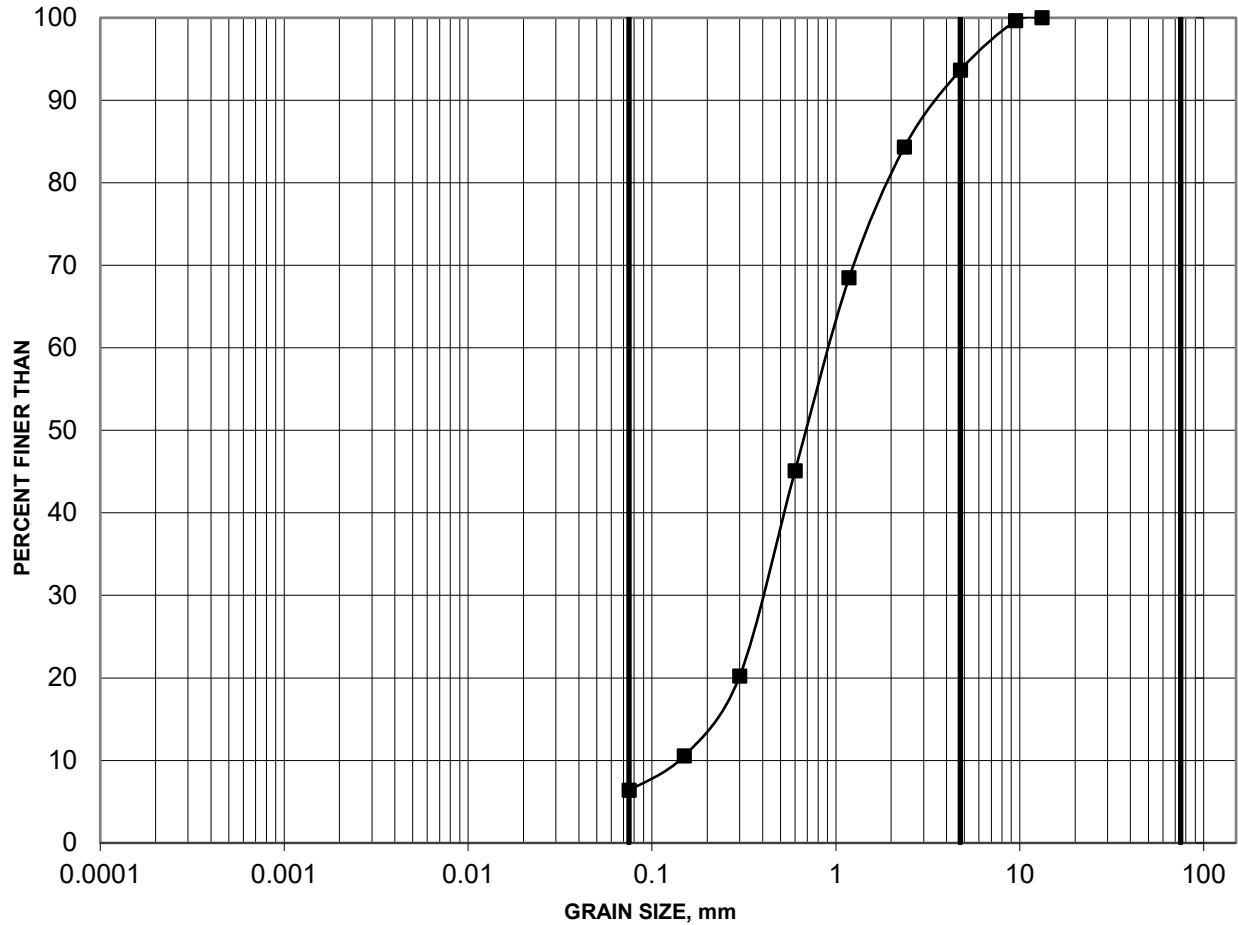
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GRAIN SIZE DISTRIBUTION

FIGURE B28

SAND



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
1370-74	8	5.33-5.95	6	88	6	

Project: 1662565-1370



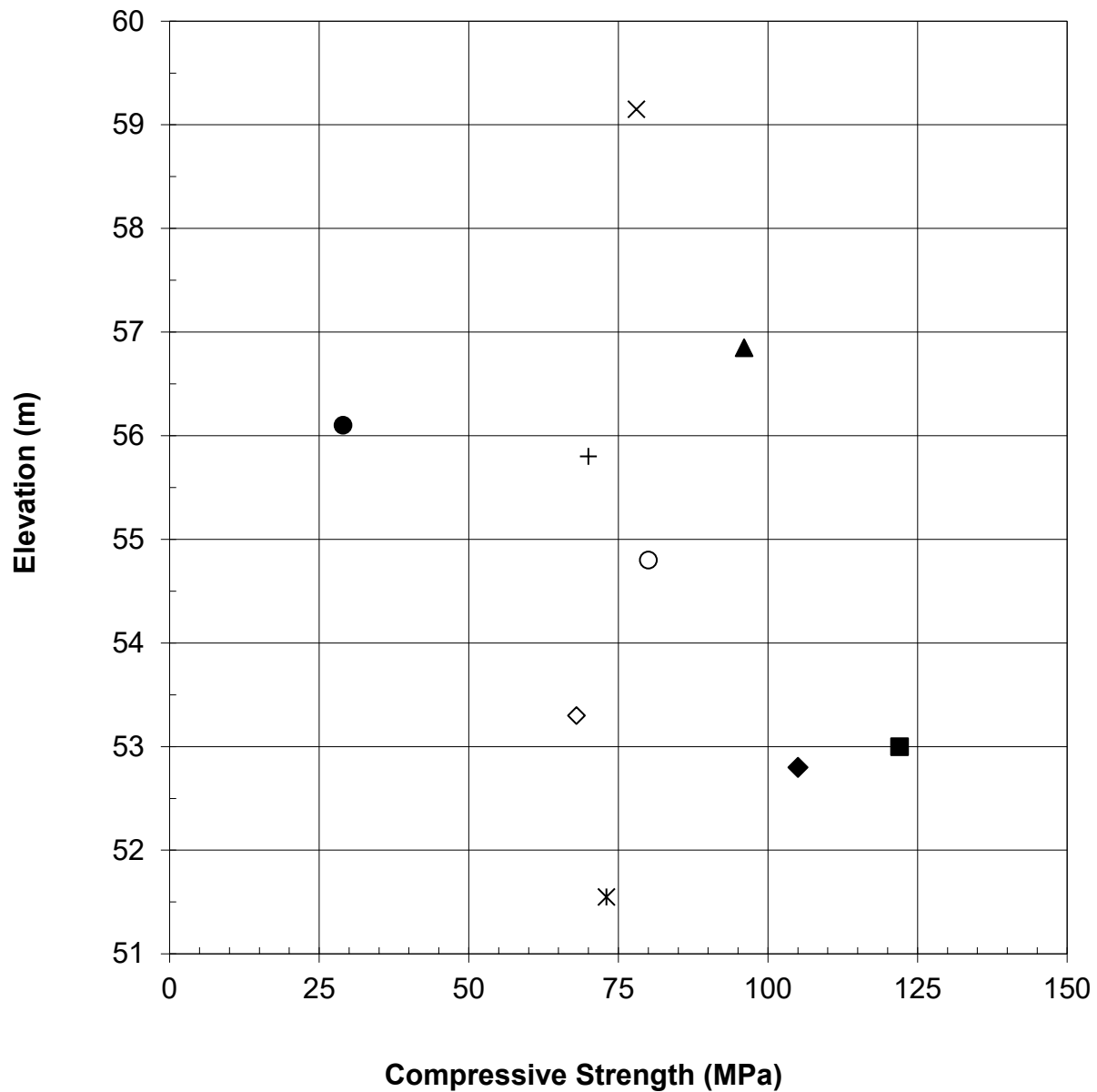
Created by: KCP

Checked by: MI

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SUMMARY OF LABORATORY COMPRESSIVE STRENGTH UNCONFINED COMPRESSION TESTS

FIGURE B29



◆ 1370-75	● 1370-76	◇ 1370-77
■ 1370-78	▲ 1370-101	○ 1370-102
✱ 1370-113	+ 1370-115	✕ 1370-116

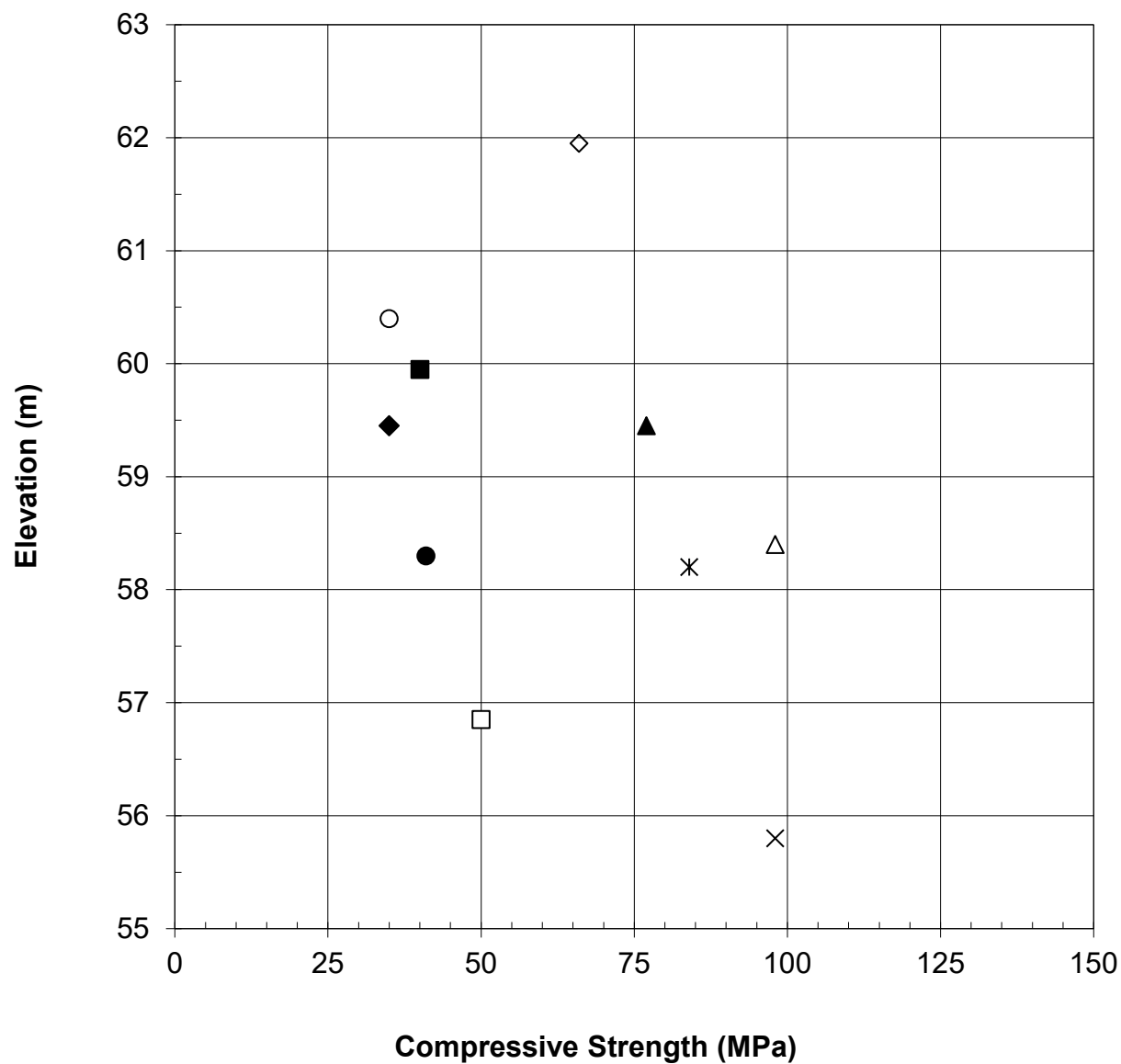


Project: 1662565-1370

Created by: KCP
Checked by: MI

SUMMARY OF LABORATORY COMPRESSIVE STRENGTH UNCONFINED COMPRESSION TESTS

FIGURE B30



◆ 1370-117	● 1370-118	◇ 1370-119
■ 1370-126	▲ 1370-127	○ 1370-128
× 1370-129	□ 1370-130	× 1370-131
△ 1370-132		



GOLDER
MEMBER OF WSP

Project: 1662565-1370

Created by: KCP
Checked by: MI

APPENDIX C

Basic Chemical Analyses

Eurofins Reports No. 1936574, 1938596, 1939742, 1941535, 1949991

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1936574
Date Submitted: 2020-08-13
Date Reported: 2020-08-20
Project: 1662565/1370
COC #: 861410

Page 1 of 4

Dear Chaitanya Raj Goyal:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

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Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
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Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1936574
Date Submitted: 2020-08-13
Date Reported: 2020-08-20
Project: 1662565/1370
COC #: 861410

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1510386 Soil 2020-06-14 1370-75 sa8 / 20-22'	1510387 Soil 2020-06-25 1370-103 sa9 / 25-27'	1510388 Soil 2020-06-24 1370-112 sa8 / 30-32'	1510389 Soil 2020-06-16 1370-115 sa7 / 17.5-19.5'
Anions	Cl	0.002	%			0.004	0.008	0.004	0.005
	SO4	0.01	%			0.07	0.04	0.02	0.06
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.54	0.35	0.32	0.50
	pH	2.00				7.90	8.19	8.93	8.29
	Resistivity	1	ohm-cm			1850	2860	3120	2000

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1510390 Soil 2020-06-17 1370-116 sa11a / 25-26.5'	1510391 Soil 2020-06-17 1370-117 sa5 / 10-12'	1510392 Soil 2020-06-22 1370-118 sa4 / 7.5-9.5'	1510393 Soil 2020-06-07 1370-128 sa4 / 7-9'
Anions	Cl	0.002	%			0.002	0.003	0.004	0.031
	SO4	0.01	%			0.03	0.01	<0.01	0.04
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.24	0.20	0.27	0.84
	pH	2.00				8.58	8.16	7.66	7.95
	Resistivity	1	ohm-cm			4170	5000	3700	1180

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Date Reported: 2020-08-20
Project: 1662565/1370
COC #: 861410

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	
					1510394 Soil 2020-06-06 1370-130 sa5 / 15-17'	1510395 Soil 2020-06-29 1370-131 sa10 / 27.5-29.5'
Group	Analyte	MRL	Units	Guideline		
Anions	Cl	0.002	%		0.013	0.009
	SO4	0.01	%		0.02	0.06
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.39	0.20
	pH	2.00			9.28	8.86
	Resistivity	1	ohm-cm		2560	5000

Guideline = * = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Date Submitted: 2020-08-13
Date Reported: 2020-08-20
Project: 1662565/1370
COC #: 861410

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 387916 Analysis/Extraction Date 2020-08-18 Analyst SG Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	97	90-110
pH	5.63	100	90-110
Resistivity			
Run No 388007 Analysis/Extraction Date 2020-08-19 Analyst SKH Method AG SOIL			
SO4	<0.01 %	96	70-130
Run No 388060 Analysis/Extraction Date 2020-08-20 Analyst AET Method C CSA A23.2-4B			
Chloride		98	90-110

Guideline = * = **Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

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1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1938596
Date Submitted: 2020-09-11
Date Reported: 2020-09-18
Project: 1662565/1370
COC #: 862944

Page 1 of 4

Dear Chaitanya Raj Goyal:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Addrine Thomas, Inorganics Supervisor

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Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1938596
Date Submitted: 2020-09-11
Date Reported: 2020-09-18
Project: 1662565/1370
COC #: 862944

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1516213 Soil 2020-07-21 1370-38 sa2 / 2.5-4.5'	1516214 Soil 2020-07-20 1370-39 sa7 / 15-17'	1516215 Soil 2020-07-19 1370-40 sa13 / 32-34'	1516216 Soil 2020-07-15 1370-41 sa8 / 17.5-19.5'
Anions	Cl	0.002	%			0.014	0.006	0.008	0.009
	SO4	0.01	%			0.04	0.04	0.06	0.02
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.73	0.34	0.62	0.15
	pH	2.00				6.99	8.14	8.32	8.78
	Resistivity	1	ohm-cm			1370	2940	1610	1670

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1516217 Soil 2020-07-15 1370-74 sa3 / 5-7'	1516218 Soil 2020-07-14 1370-76 sa7 / 20.5-22.5'	1516219 Soil 2020-07-13 1370-77 sa7 / 14-16'	1516220 Soil 2020-07-12 1370-78 sa3 / 4.5-6.5'
Anions	Cl	0.002	%			0.049	0.004	0.005	0.114
	SO4	0.01	%			<0.01	0.04	0.07	0.03
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.62	0.32	0.55	1.46
	pH	2.00				7.57	7.94	8.07	7.43
	Resistivity	1	ohm-cm			1590	3120	1820	685

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Project: 1662565/1370
COC #: 862944

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	
Group	Analyte	MRL	Units	Guideline	1516221 Soil 2020-07-23 1370-79 sa7 / 25-27'	1516222 Soil 2020-07-22 1370-101 sa6 / 15-17'
Anions	Cl	0.002	%		0.004	0.005
	SO4	0.01	%		0.06	0.04
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.55	0.25
	pH	2.00			7.85	7.90
	Resistivity	1	ohm-cm		1820	4000

Guideline = * = Guideline Exceedence

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Certificate of Analysis

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1938596
Date Submitted: 2020-09-11
Date Reported: 2020-09-18
Project: 1662565/1370
COC #: 862944

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 389541 Analysis/Extraction Date 2020-09-18 Analyst R_R Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	95	90-110
pH	4.33	100	90-110
Resistivity			
Run No 389550 Analysis/Extraction Date 2020-09-18 Analyst SKH Method AG SOIL			
SO4	<0.01 %	101	70-130
Run No 389560 Analysis/Extraction Date 2020-09-16 Analyst R_R Method C CSA A23.2-4B			
Chloride	<0.002 %	100	90-110

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Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1939742
Date Submitted: 2020-09-30
Date Reported: 2020-10-09
Project: 1662565/1370
COC #: 863651

Page 1 of 3

Dear Chaitanya Raj Goyal:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL:

Addrine Thomas, Inorganics Supervisor

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Certificate of Analysis

Client: Golder Associates Ltd. (Ottawa)
 1931 Robertson Road
 Ottawa, ON
 K2H 5B7
 Attention: Chaitanya Raj Goyal
 PO#:
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1939742
 Date Submitted: 2020-09-30
 Date Reported: 2020-10-09
 Project: 1662565/1370
 COC #: 863651

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	
Group	Analyte	MRL	Units	Guideline	1519388 Soil 2020-07-09 1370-102 sa10 / 27.5-29.5	1519389 Soil 2020-07-09 1370-126 sa3 / 4.5-6.5'
Anions	Cl	0.002	%		<0.002	0.021
	SO4	0.01	%		0.04	<0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.44	0.32
	pH	2.00			7.98	7.29
	Resistivity	1	ohm-cm		2270	3120

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Client: Golder Associates Ltd. (Ottawa)
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Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1939742
Date Submitted: 2020-09-30
Date Reported: 2020-10-09
Project: 1662565/1370
COC #: 863651

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 390384 Analysis/Extraction Date 2020-10-05 Analyst R_R Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	98	90-110
pH	4.17	99	90-110
Resistivity			
Run No 390512 Analysis/Extraction Date 2020-10-07 Analyst R_R Method C CSA A23.2-4B			
Chloride	<0.002 %	102	90-110
Run No 390669 Analysis/Extraction Date 2020-10-09 Analyst AET Method AG SOIL			
SO4	<0.01 %	97	70-130

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1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1941535
Date Submitted: 2020-10-23
Date Reported: 2020-10-29
Project: 16625651.370
COC #: 865671

Page 1 of 3

Dear Chaitanya Raj Goyal:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL:

Sarah Horner, Inorganics Technician

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Certificate of Analysis

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1941535
Date Submitted: 2020-10-23
Date Reported: 2020-10-29
Project: 16625651.370
COC #: 865671

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1524238 Soil 2020-08-05 1370-113 Sa6	1524239 Soil 2020-08-10 1370-114 Sa10	1524240 Soil 2020-07-27 1370-119 Sa2	1524241 Soil 2020-07-26 1370-127 Sa4
Group	Analyte	MRL	Units	Guideline					
Anions	Cl	0.002	%			0.017	0.003	<0.002	0.004
	SO4	0.01	%			0.04	0.04	<0.01	0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.60	0.48	0.12	0.21
	pH	2.00				7.68	8.65	7.69	8.06
	Resistivity	1	ohm-cm			1670	2080	8330	4760

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1524242 Soil 2020-07-28 1370-132 Sa5	1524243 Soil 2020-07-26 1370-129 Sa4
Group	Analyte	MRL	Units	Guideline			
Anions	Cl	0.002	%			<0.002	0.008
	SO4	0.01	%			<0.01	0.02
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.17	0.40
	pH	2.00				7.26	8.74
	Resistivity	1	ohm-cm			5880	2500

Guideline = *** = Guideline Exceedence**

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Ottawa, ON
K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1941535
Date Submitted: 2020-10-23
Date Reported: 2020-10-29
Project: 16625651.370
COC #: 865671

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 391290 Analysis/Extraction Date 2020-10-26 Analyst R_R Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	99	90-110
pH	4.56	100	90-110
Resistivity			
Run No 391491 Analysis/Extraction Date 2020-10-29 Analyst R_R Method C CSA A23.2-4B			
Chloride		98	90-110
Run No 391539 Analysis/Extraction Date 2020-10-29 Analyst R_R Method AG SOIL			
SO4	<0.01 %	90	70-130

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Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
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Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1949991
Date Submitted: 2021-03-26
Date Reported: 2021-04-01
Project: 1662565/1370
COC #: 871669

Page 1 of 4

Dear Chaitanya Raj Goyal:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL:

Addrine Thomas, Inorganics Supervisor

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Client: Golder Associates Ltd. (Ottawa)
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K2H 5B7
Attention: Chaitanya Raj Goyal
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1949991
Date Submitted: 2021-03-26
Date Reported: 2021-04-01
Project: 1662565/1370
COC #: 871669

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1547833 Soil 2020-12-21 1370-37 sa7 / 15-17'	1547834 Soil 2020-12-21 1370-36A sa9 / 20-22'	1547835 Soil 2021-01-03 1370-33 sa8 / 17.5-19.5'	1547836 Soil 2020-12-29 1370-34 sa14 / 32.5-34.5'
Anions	SO4	0.01	%			<0.01	0.06	0.02	0.01
Cl in Concrete	Cl	0.002	%			0.042	0.013	0.035	0.009
General Chemistry	Electrical Conductivity	0.05	mS/cm			0.96	0.44	0.92	0.33
	pH	2.00				6.09	6.37	7.78	8.76
	Resistivity	1	ohm-cm			1040	2270	1090	3030

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1547837 Soil 2020-12-29 1370-35 sa3 / 5-7'	1547838 Soil 2021-01-05 1370-32 sa6 / 12.5-14.5'	1547839 Soil 2021-01-06 1370-16 sa1 / 0-2'	1547840 Soil 2021-01-06 1370-17 sa3 / 5-7'
Anions	SO4	0.01	%			0.06	0.03	0.03	0.08
Cl in Concrete	Cl	0.002	%			0.050	0.038	0.014	0.016
General Chemistry	Electrical Conductivity	0.05	mS/cm			1.60	1.06	0.73	0.78
	pH	2.00				8.22	8.43	7.79	7.66
	Resistivity	1	ohm-cm			625	935	1370	1280

Guideline = *** = Guideline Exceedence**

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Report Number: 1949991
Date Submitted: 2021-03-26
Date Reported: 2021-04-01
Project: 1662565/1370
COC #: 871669

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.
					1547841 Soil 2021-01-10 1370-13 sa1 / 0-1.5'
Group	Analyte	MRL	Units	Guideline	
Anions	SO4	0.01	%		0.03
Cl in Concrete	Cl	0.002	%		0.058
General Chemistry	Electrical Conductivity	0.05	mS/cm		1.49
	pH	2.00			8.01
	Resistivity	1	ohm-cm		667

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Attention: Chaitanya Raj Goyal
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Report Number: 1949991
Date Submitted: 2021-03-26
Date Reported: 2021-04-01
Project: 1662565/1370
COC #: 871669

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 397982 Analysis/Extraction Date 2021-03-30 Analyst R_R Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	100	90-110
pH	5.64	100	90-110
Resistivity			
Run No 398036 Analysis/Extraction Date 2021-03-31 Analyst R_R Method AG SOIL			
SO4	<0.01 %	90	70-130
Run No 398100 Analysis/Extraction Date 2021-04-01 Analyst R_R Method C CSA A23.2-4B			
Chloride		98	80-120

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APPENDIX D

Non-Standard Special Provisions

NSSP – Boulder/Obstructions During Excavation

NSSP – Control of Overburden Soil

NON-STANDARD SPECIAL PROVISIONS

RECOMMENDED WORDING FOR “NSSP – 903.07.03.02 EXCAVATION”

Subsection 903.07.03.02 of OPSS 903 is amended by the addition of the following:

Excavations at the site may be impeded by obstructions within the existing fill and glacial till. The contractor shall be prepared to dislodge and remove these obstructions and extend the excavations to the design depths.

RECOMMENDED WORDING FOR “NSSP – 903.07.03 CONTROL OF OVERBURDEN SOILS DURING OVERHEAD SIGN FOUNDATION INSTALLATION”

Subsection 903.07.03 of OPSS 903 is amended by the addition of the following

Excavations for the caisson installation will be advanced through granular fill materials, various interlayers of granular native material through/into glacial till and into the shale bedrock at some locations. The granular soils could slough (if dry) or flow (if water-bearing) into unsupported auger holes during caissons installation. Appropriate construction procedures and equipment will be required to minimize ground loss during drilling, caisson installation and concrete placement.



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