Geotechnical Investigation Report: Prudhommes Watermain Upgrade

GEOCRES No.: 30M3-324

Revision 1

OGTW2010

Prepared for:

The Town of Lincoln

4800 South Service Road, Beamsville, Ontario, L0R 1B1

September 2021

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Revision History

Revision Number	Revision Date	Purpose of Revision
0	March 9, 2021	Draft Report Issued for Review
1	September 27, 2021	Final Report

Table of Contents

Page

A Geotechnical Investigation Report 1
1.0 Introduction 1
2.0 Site Description 3
3.0 Geotechnical Investigation Program 4
3.1 Field Work 4
3.2 Geotechnical Laboratory Testing 6
4.0 Site Geology and Subsurface Conditions 7
4.1 Site Geology 7
4.2 Subsurface Soil Conditions 7
4.2.1 Jordan Road 8
4.2.1.1 Asphalt 8
4.2.1.2 Sand and Gravel Fill (Granular Road Base) 8
4.2.1.3 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel) 9
4.2.1.4 Sands & Silts (Non-Cohesive) 9
4.2.1.5 Silts & Clays (Cohesive) 10
4.2.2 North Service Road 11
4.2.2.1 Asphalt 12
4.2.2.2 Sand and Gravel Fill (Granular Road Base) 12
4.2.2.3 Non-Cohesive Fill (Various Fractions of Gravel, Sands & Silts, Trace Clay) 12
4.2.2.4 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel) 13
4.2.2.5 Sands & Silts (Non-Cohesive) 14
4.2.2.6 Native Silts & Clays (Cohesive) 15
4.2.3 Victoria Avenue and QEW Crossing 21
4.2.3.1 Surficial Cover (Asphalt and Topsoil) 21
4.2.3.2 Sand and Gravel Fill (Granular Road Base) 21
4.2.3.3 Non-Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel) 21
4.2.3.4 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel) 22
4.2.3.5 Native Sands & Silts (Non-Cohesive) 23
4.2.3.6 Native Silts & Clays (Cohesive) 23
4.2.3.7 Shale Bedrock 24
4.3 Groundwater 25
4.4 Soil Chemical Testing 28
4.4.1 Corrosivity Analysis 28
4.4.2 TCLP Analysis 31
5.0 Closure 32
B Geotechnical Design Report 33
6.0 Geotechnical Discussion and Recommendations 33
6.1 General 33
6.2 Jordan Road & North Service Road 34
6.2.1 Open Cut Excavation 34
6.2.2 Suitable Trenchless Methodologies 34
6.2.3 Microtunneling 34

6.2.4 Horizontal Directional Drilling (HDD) 35
6.3 Victoria Avenue and QEW Crossing 36
6.3.1 Time Dependent Deformation (TDD) and Horizontal Stresses 36
6.4 Recommended Installation Method 37
6.5 Non-Standard Special Provision 37
6.6 Open Cut Excavation and Groundwater Control 37
6.6.1 Trench Groundwater Control 38
6.6.2 Shaft Base Stability 39
6.6.3 Municipal Infrastructure Backfilling 39
6.7 Temporary Shoring 40
6.8 Removal of Protective Systems and Backfilling 41
6.9 Pipe Bedding and Backfill 41
6.10 Frost Depth 42
6.11 Other Considerations 42
6.12 Settlement 43
6.13 Settlement Monitoring 43
7.0 Environmental Discussion and Recommendations 44
8.0 Closure 45

List of Tables

Page

Table 1: Description of RDR Terms and Criteria 5
Table 2: Results of Grain Size Analysis (Granular Road Base) 9
Table 3: Results of Grain Size Analysis (Cohesive Fill) 9
Table 4: Results of Grain Size Analysis (Native Sands & Silts) 10
Table 5: Results of Grain Size Analysis & Atterberg Limits (Clays & Silts) 11
Table 6: Results of Grain Size Analysis (Granular Road Base) 12
Table 7: Results of Grain Size Analysis (Non-Cohesive Fill) 13
Table 8: Results of Grain Size Analysis (Cohesive Fill) 13
Table 9: Results of Grain Size Analysis (Native Sands & Silts) 15
Table 10: Results of Grain Size Analysis & Atterberg Limits (Native Clays & Silts) 17
Table 11: Results of Grain Size Analysis (Non-Cohesive Fill) 21
Table 12: Results of Grain Size Analysis (Non-Cohesive Fill) 21
Table 13: Results of Grain Size Analysis (Cohesive Fill) 22
Table 14: Results of Grain Size Analysis & Atterberg Limits (Native Clays & Silts) 23
Table 15: Results of Groundwater Measurements (Jordan Road) 25
Table 16: Results of Groundwater Measurements (North Service Road) 26
Table 17: Results of Groundwater Measurements (Victoria Avenue/QEW Crossing) 27
Table 18: Summary of Soil Corrosivity Testing Results 29
Table 19: Soil Classification for Excavations 37
Table 20: Maximum Slopes of Excavations 38
Table 21: Parameters for Design of Temporary Shoring System 40
Table 22: Comparative Assessment of the Installation Methods 46

List of Drawings

Key Plan, Borehole Location Plan and Interpreted Stratigraphy Profile

- Jordan Road (1 Sheet)
- North Service Road (5 Sheets)
- Victoria Ave/QEW Crossing (1 Sheet)

Geotechnical Instrumentation and Monitoring Plan

- QEW Crossing (1 Sheet)

List of Appendices

A Record of Borehole Sheets
- A1 Terms and Symbols
- A2 Record of Borehole Logs

B Soil & Bedrock Geotechnical Laboratory Test Results

C Bedrock Core Photographs

D Photographs and Evaluation of Existing Pavement Surface

E Environmental Laboratory Certificates of Analysis

F Non-Standard Special Provision (NSSP) – Trenchless Installation

A Geotechnical Investigation Report

1.0 Introduction

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited ("Wood") has been retained by the Town of Lincoln ("client"), to conduct a geotechnical investigation and hydrogeological investigation for the proposed watermain installation as part of the Prudhommes Watermain Upgrade project within Ministry of Transportation, Ontario (MTO) right-of-way along Jordan Road, North Service Road, Regional Road#24/Victoria Avenue and crossing the Queen Elizabeth Way (QEW) ("project site"). This geotechnical investigation report (GIR) has been prepared on behalf of Town of Lincoln for MTO, the owner of the project site and any work within the project site is subject to review by MTO.

The watermain upgrade is required to provide adequate fire flow protection for the proposed Prudhommes redevelopment by the Town of Lincoln and involves upsizing and installing approximately six (6) kilometers (km) of watermain piping along Jordan Road, North Service Road from Fourth Avenue, across the QEW highway corridor and along the North Service Road to Regional Road #24 (Victoria Avenue). GHD has been retained by the Town of Lincoln to provide engineering design services for this project.

The purpose of the geotechnical investigation was to obtain information on sub-surface conditions at the project site by means of a limited number of boreholes, in-situ tests and laboratory tests on selected soil and bedrock samples. Based on Wood's interpretation of the data obtained, recommendations are provided on the geotechnical aspects of the project with respect to the watermain installation.

The geotechnical investigation program was developed in close consultation with GHD, Town of Lincoln and MTO and was carried out in general accordance with the requirements outlined in the Guidelines For Foundation Engineering – Tunneling Specialty provided by the "Ministry of Transportation, Ontario (MTO)", dated March 28, 2018 ("Guidelines") and site specific constraints. A deviation approval from the requirements outlined in the guidelines was obtained from MTO with regards to increased borehole spacing of 100 metres (m) instead of 50 m for North Service Road and increased borehole offset from the proposed watermain alignment of 5 m instead of 2 m as required by the guidelines. The deviations were approved by Mr. David Staseff, M.A.Sc., P.Eng., Senior Foundations Engineer (MTO) via email dated June 12, 2020.

This report contains findings of Wood's geotechnical investigation, together with recommendations and comments. The recommendations and comments are based on factual information obtained at the borehole locations and intended primarily for use by design engineers. The number of boreholes may not be sufficient to determine all of the factors that may affect construction methods and costs. Subsurface soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction that could not be detected or anticipated at the time of the site investigation.

The anticipated construction conditions are discussed, but only to the extent that they may influence the design decisions. The feasible construction methods, however, express our opinion and are not intended to direct contractors on how they carry out construction. Contractors bidding on undertaking this work should be aware that the data and their interpretation presented in this report may not be sufficient to assess all factors that may have effect upon construction.

This report has been prepared with the assumption that the design will be in accordance with good engineering practices, applicable regulations of jurisdictional authorities, and applicable standards and regulations. Further, the recommendations and opinions in this report are applicable only for the noted project. The limitations of this report, as discussed in detail below, constitute an integral part of this report.

Ongoing liaison with Wood is recommended during both the design and construction phases of this project to ensure that the geotechnical recommendations in this report have been adequately interpreted and implemented. Also, any further clarification and/or elaboration are needed concerning the geotechnical aspects of this project, Wood should be contacted immediately.

2.0 Site Description

The project site is located within the Town of Lincoln, Ontario. The investigated section of Jordan Road between Bayview Boulevard/South Service Road and North Service Road is a two-lane, non-divided road approximately 400 m long and aligned in a North-South direction with a normal posted regulatory speed of 80 km per hour. The terrain along the investigated section of Jordan Road has a rolling topography with elevation ranging between 88.8 m and 82.7 metres above mean sea level (mASL).

The investigated section of North Service Road between Jordan Road and Regional Road #24 (Victoria Avenue) is a two-lane, non-divided road approximately 2.7 km long and generally aligned in an East-West direction with a normal posted regulatory speed of 80 km per hour. The terrain along the investigated section of North Service Road has a gently rolling topography with elevation ranging between 87.0 mASL and 78.7 mASL.

The investigated section of Victoria Avenue between North Service Road and QEW is a four-lane (i.e., two lanes in each direction), non-divided road and generally aligned in a North-South direction with a normal posted regulatory speed of 80 km per hour. The QEW intersects Victoria Avenue underneath the Victoria Avenue bridge which is generally aligned in an East-West direction. The ground surface elevation along the investigated section of Victoria Avenue ranges between 88.0 mASL to 84.3 mASL whereas the ground surface elevation along the investigated section for the QEW crossing ranges from approximately 83.8 mASL on the QEW and 82.4 mASL to 85.3 mASL adjacent to the QEW.

Design information provided by GHD indicates that the preferred installation method for the proposed 300 mm diameter (dia.) DR18 water pipe is Horizontal Directional Drilling (HDD). The watermain obvert will vary approximately between elevation 83.8 mASL to 77.7 mASL along Jordan Road, approximately 82.0 mASL to 73.7 mASL along North Service Road, approximately 83.0 mASL to 79.3 mASL along Victoria Avenue and approximately elevation 78.8 mASL underneath the QEW.

The project site location and inferred subsurface stratigraphy along the pipeline alignment is shown on the Drawings.

3.0 Geotechnical Investigation Program

3.1 Field Work

Prior to advancing boreholes, a visual pavement surface condition survey was completed along the investigated sections of Jordan Road and North Service Road in accordance with the MTO Manual for Condition Rating of Flexible Pavement (SP-024) to assess the condition of the existing pavement surface, and to identify the type and severity of the specific pavement distresses. The completed pavement condition evaluation and typical photographs of existing conditions are provided in Appendix D.

The field work for the borehole drilling program was carried out between July 20 and August 17, 2020, during which time a total of forty-three (43) boreholes were advanced at the project site. The boreholes were drilled to depths ranging between 7.9 m and 16.0 m below ground surface (bgs).

The as-drilled locations of the boreholes and ground surface elevations were surveyed by Wood using a Sokkia Model Global Navigation Satellite System (GNSS) rover. The co-ordinates of the boreholes were referenced to Modified Trans Mercator (MTM) Zone 10 co-ordinate system. The ground surface elevations are geodetic, based on GNSS and local base station telemetry with a vertical root mean squared error of less than 20 millimeter (mm). The borehole elevations should not be used for construction purposes or for any accurate measurement.

The locations of boreholes are shown on the Drawings while the coordinates and elevations of the boreholes are shown on the Record of Borehole Sheets presented in Appendix A.

The boreholes were advanced utilizing a combination of track and truck mounted drill rigs equipped with 150 mm outside diameter hollow-stem, HQ rock core casing, continuous flight augers and conventional soil sampling tools. Soil samples were obtained at 0.75-m and/or 1.5 m intervals via the Standard Penetration Test (SPT) in accordance with ASTM D1586 (Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils). The SPT sampling consisted of freely dropping a 63.5 kg (140 lbs) automatic hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inch) diameter O.D. split barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.3 m (12 inches) were recorded as the SPT 'N' values of the soil which indicated the compactness of non-cohesive soils or indirectly indicated the consistency of cohesive soils.

Bedrock was encountered within the borehole target depths along the investigated section of Victoria Avenue and QEW crossing. Upon encountering bedrock, bedrock cores were collected using a HQ size (96 mm outside dia.) double tube wire line equipment providing 63.5 mm dia. rock core samples. All boreholes advance along Victoria Ave and the QEW crossing were terminated within the bedrock.

In addition to recording the SPT 'N' values of the soil, the Relative Drilling Resistance (RDR) was also recorded during the borehole drilling in accordance with the definitions provided in the preceding paragraph.

The perceived RDR is relative to the type and capabilities of the drilling equipment and broadly and qualitatively describes the difficulty or ease of drilling through a particular subsurface material. For example, drilling "chatter" reflects aural and visual cues of intermittent drill bit and drill string binding in the borehole,

grinding on possible obstructions, or otherwise obviously experiencing difficulty penetrating the ground. Such drilling behavior can be indicative of the presence of very dense/hard ground, gravel, cobbles, boulders, the top surface of bedrock and/or other obstructions or unknown hard objects in the ground. The table below provides the general drilling behavior criteria for each RDR number and corresponding term description.

Table 1: Description of RDR Terms and Criteria

RDR	Descriptive Drilling Resistance Term	Criteria
1	Very Easy	No "chatter", very little resistance, very fast and steady drill advance rate
2	Easy	No "chatter", some resistance, fast and steady drill advance rate.
3	Moderate	Some "chatter", firm drill resistance with moderate advance rate.
4	Hard	Frequent "chatter" and variable drill resistance, slow advance rate.
5	Very Hard	Constant "chatter", variable and very slow drill advance, nearly refusal.

The assessed RDR values for each soil layer have been included on the Record of Borehole Sheets presented in Appendix A; however, the RDR should not be interpreted or construed as any precise or specific measure of subsurface material type, strength, location within the borehole or subsurface object size.

Groundwater conditions in the open boreholes were observed during the advancement of the borehole and immediately upon completion of the borehole. To permit long term monitoring of groundwater levels at selected locations at the project site, a total of seventeen (17) monitoring wells were installed. (i.e., four (4) monitoring wells along Jordan Road, nine (9) monitoring wells along North Service Road, two (2) monitoring wells along Victoria Avenue and two (2) monitoring wells at the QEW crossing were installed). The installed monitoring well consists of a 50 mm outside diameter PVC pipe with a 1.5 m or 3.0 m slotted screen sealed with a filter sand pack. The borehole and annulus surrounding the PVC pipe above the filter sand pack was backfilled to the ground surface using bentonite chips to create a seal against vertical groundwater movement within the borehole. Monitoring well installation details and water level readings are described on the Record of Borehole Sheets presented in Appendix A. All boreholes in which monitoring well were not installed were backfilled to ground surface with a bentonite and cement grout mixture. Where boreholes were advanced on the pavement surface, the borehole was backfilled with asphaltic "cold patch" to match the existing pavement surface.

The field work was supervised by Wood's engineering staff who located the boreholes, arranged for clearance of underground services, obtained MTO encroachment permit, coordinated traffic control setup in accordance with Ontario Traffic Manual, Book 7 – Temporary Conditions, directed the drilling and sampling operation and logged the boreholes.

The soil stratigraphy within each borehole were visually examined and classified at the time of drilling in accordance with the M.T.C. Soil Classification Manual (1980). Soil and bedrock samples were collected from each borehole at selected depths, labelled and retained in sealed plastic bags and wooden core boxes and transported to Wood's geotechnical and rock mechanics laboratory where the samples underwent further visual examination and laboratory testing.

3.2 Geotechnical Laboratory Testing

A geotechnical laboratory testing program was carried out on selected soil and bedrock samples obtained from the boreholes. The purpose of the geotechnical laboratory tests was to determine the engineering properties of soils and bedrock encountered at the project site for use in design and engineering analysis. All of the laboratory tests were carried out to MTO and/or ASTM standards, as appropriate. The geotechnical laboratory testing consisted of:

- Moisture content measurements (ASTM D2216) on all recovered soil samples;
- One hundred thirty-three (133) Sieve/Hydrometer analyses (ASTM D421 and ASTM D422);
- One hundred twelve (112) Atterberg Limits test (ASTM D4318-10 and ASTMD2487-11);
- Two (2) Slake Durability tests for shale bedrock specimens (ASTM D4644); and
- Four (4) Unconfined Compressive Strength tests for shale bedrock specimens (ASTM D7012).

Geotechnical laboratory test results are included in Appendix B, and summarized on the Record of Borehole Sheets in Appendix A.

4.0 Site Geology and Subsurface Conditions

4.1 Site Geology

Surficial geology of the project site, as indicated by the Ministry of Northern Development and Mines Map "Quarternary Geology of the Niagara Area", consists of coarse and fine textured glaciolacustrine sediments associated with proglacial lakes. The coarse textured glaciolacustrine sediments consist of stratified gravel, sand, silt and minor clay sediments and are inferred to be deposited in near shore (littoral) environment. The fine textured glaciolacustrine sediments consist of stratified, or laminated cohesive sediments which include clay, silt, sand and minor gravels. These deposits are inferred to be deposited in deep water environment tend to be finer downward in vertical sequence, and southward away from shallow water influences.

Underlying the overburden sediments, is a shale bedrock known as Queenston Formation Shale. The Queenston formation consists of a mixed terrigenous-carbonate succession composed primarily of red silty shales with thin grey shales and calcareous siltstone and sandstone intercalations. The red shale bedrock is indicative of a prograding and storm-and-tide affected shores. The upper 3 to 5 m of bedrock has been found to be heavily weathered which is underlain by more competent grey shale bedrock.

In the project area, the coarse textured glaciolacustrine sand and gravel deposits are a significant hydrogeologic unit. Due to their permeable nature, infiltration of precipitation and groundwater recharge, the rate of groundwater flow will be relatively high in these deposits. The direction of groundwater flow is inferred to be from the southwest to the northeast. On a regional scale, the direction of groundwater flow in deeper confined overburden and bedrock aquifers is expected to be northerly, as Lake Ontario is a regional discharge zone.

4.2 Subsurface Soil Conditions

Subsurface soil and groundwater conditions described in this report represent a simplification of the actual conditions for design purposes. The stratigraphic boundaries shown on the Record of Borehole Sheets are inferred from non-continuous sampling, observations of drilling progress and the results of uncorrected standard penetration tests (SPT). These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change.

In general, boreholes were advanced through asphalt or granular road base (gravel shoulder) at the project site with the exception of three (3) boreholes on Victoria Avenue, which were advanced in grassed areas. The general subsurface conditions at the project site consist of asphalt (for boreholes advanced on pavement surface) underlain by granular road base fill material. Underlying the granular road base, a non-cohesive fill deposit consisting of various fractions of gravels, sands, and silts with trace clay, as well as cohesive fills consisting of various fractions of clay, sands and silts with trace gravel were encountered. Underlying the fill deposit is a native deposit of coarse grained and fine grained glaciolacustrine sediments.

All the boreholes advanced along the Jordan Road and North Service Road were generally terminated within the fine grained glaciolacustrine sediments.

For boreholes advanced along Victoria Avenue and QEW crossing, shale bedrock was encountered underlying the overburden soils. All the boreholes drilled along Victoria Avenue and QEW crossing were terminated within the shale bedrock.

The subsurface soil conditions have been summarized for the three (3) investigated sections (i.e. Jordan Road, North Service Road and Victoria Ave/QEW crossing) separately for simplicity in the following sections.

The simplified interpreted subsurface stratigraphy profile and groundwater conditions are shown on the Drawings and detailed stratigraphic units and groundwater conditions are summarized on the Record of Borehole Sheets presented in Appendix A.

The following summary is intended to assist the designers of the project with an understanding of the anticipated soil, bedrock and groundwater conditions at the project site.

4.2.1 Jordan Road

A total of eight (8) boreholes (BH/MW20-01 to BH/MW20-08) were advanced through asphalt. Four (4) of the eight (8) boreholes were equipped with monitoring wells screened within native soil deposits. The soils encountered in boreholes had a relative drilling resistance (RDR) ranging from two (2) to four (4), indicating "Easy" to "Hard" drilling conditions. The following sections summarizes the soil conditions encountered along the investigated section of Jordan Road.

4.2.1.1 Asphalt

A layer of asphalt pavement was encountered in all the boreholes. The thickness of the asphalt at the borehole locations varied from 75 mm to 100 mm in thickness, with an average thickness of approximately 90 mm.

It is possible that the thickness of the asphalt at other locations along Jordan Road will vary from the thickness recorded at the borehole locations.

4.2.1.2 Sand and Gravel Fill (Granular Road Base)

All boreholes drilled through Jordan Road encountered granular road base fill material consisting mainly sand and gravel with some fines immediately beneath the asphalt in the boreholes. The granular road base fill extended to depths between 0.7 m and 1.4 m bgs. SPT 'N' values measured within the granular road base varied between 6 to 45 blows per 0.3 m of penetration indicating a loose to very dense state of compactness. Water contents measured in the samples of the granular road base varied from 4% and 14%. The RDR was determined to be four (4) indicating "hard" drilling conditions due to compactness and the gravelly conditions.

The results of a grain size distribution analysis carried out on two (2) samples of granular road base material are summarized in the table below and presented in Appendix B.

Table 2: Results of Grain Size Analysis (Granular Road Base)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-2	SS 1	26	51	23		Gravelly Sand, some silt and trace clay
BH/MW 20-05	SS 1 & SS 2	29	51	20		Gravelly Sand, some silt and trace clay

4.2.1.3 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel)

A layer of cohesive fill was encountered underlying the granular road base fill material in borehole BH20-02. The composition of the cohesive fill consisted of silt, some clay and trace sand and gravel. The cohesive fill extended to a depth of 1.4 m bgs in borehole BH20-02. The cohesive fill was stiff as indicated by the SPT 'N' value of 10 blows per 0.3 m of penetration. The moisture content of the sample was determined to be 14%. The RDR was evaluated at two (2) which indicated an "easy" drilling condition.

The results of the grain size distribution analyses carried out on one (1) sample of cohesive fill from BH20-02 is summarized in the table below and presented in Appendix B.

Table 3: Results of Grain Size Analysis (Cohesive Fill)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-02	SS 2	3	13	65	19	Silt, some clay trace sand and gravel

4.2.1.4 Sands & Silts (Non-Cohesive)

Underlying the surficial asphalt layer and granular road base fill, a native deposit of fine textured glaciolacustrine sediments containing a mixture of sands, silts, clays and occasional gravel seams were encountered in all boreholes with the exception of borehole BH20-02 where a native cohesive deposit comprising primarily silts and clays was encountered (discussed in the following section). This deposit is referred to in this report as sands and silts (as these are the predominant soil types). These deposits were generally laminated and inferred to have been deposited in or along the margins of a proglacial lake in the low-lying topographical area.

This deposit extended to depths between 1.4 m and 4.5 m bgs. The sands and silts deposit were determined to be loose to compact as indicated by the SPT 'N' values that ranged between 10 blows and 23 blows per 0.3 m of penetration. The moisture content of the samples ranged between 11% and 22%. The RDR was evaluated and ranged between two (2) and three (3) which indicates an "easy" to "moderate" drilling condition.

The results of a grain size distribution analysis were carried out on seven (7) samples of native sands and silts are summarized in the table below and presented in Appendix B.

Table 4: Results of Grain Size Analysis (Native Sands & Silts)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH/MW 20-01	SS 3	1	10	71	18	Silt, some clay and sand, trace gravel
BH/MW 20-01	SS 5	0	10	76	14	Silt, some clay and sand
BH20-03	SS 3	0	43	57		Sandy Silt, trace clay
BH20-03	SS 9	22	41	28	9	Gravelly Silty Sand, trace clay
BH20-5	SS 4 & SS 5	3	13	65	19	Silt, some clay and sand, trace gravel
BH20-07	SS3	1	13	75	11	Silt, some sand and clay, trace gravel
BH/MW 20-08	SS 4 & SS 5	0	55	40	5	Sand & Silt, trace clay

4.2.1.5 Silts & Clays (Cohesive)

Underlying the sands and silts stratum, a deposit consisting primarily clay and silt with some sand and gravel were encountered in all boreholes. This deposit is referred to in this report as silts and clays (as these are the predominant soil types). All the boreholes were terminated within this deposit, at depths ranging between 8.2 m to 14.3 m bgs.

This deposit was determined to be firm to very stiff as indicated by the SPT 'N' values that ranged between 6 blows to 21 blows per 0.3m of penetration. The silts and clays deposit were generally determined to be of low to intermediate plasticity and have moisture contents ranging between 15% and 26%. The RDR was evaluated and ranged between two (2) and four (4) which indicates "easy" to "hard" drilling conditions. Occasional cobbles and/or gravel seams were inferred to be present within this stratum due to grinding of the augers which was noted during drilling operations.

The results of the grain size analysis and Atterberg Limits carried out on selected samples of silts and clays deposit is summarized in the table below and presented in Appendix B.

Table 5: Results of Grain Size Analysis & Atterberg Limits (Clays & Silts)

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH/MW 20-01	SS 10 & SS 11	6	13	54	27	26	14	12	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-01	SS 12 & SS 13	7	13	54	26	25	14	11	Clayey Silt, some sand, trace gravel, low plasticity
BH20-02	SS 8	0	2	56	42	33	16	17	Silt and Clay, trace sand, intermediate plasticity
BH20-02	SS 10 & SS 11	7	11	58	24	23	13	13	Clayey Silt, some sand, trace gravel, low plasticity
BH20-3	SS 5 & SS 6	1	5	62	32	29	14	15	Silt and Clay, trace sand and gravel, low plasticity
BH/MW 20-04	SS 4 & SS 5	1	6	60	33	27	14	13	Silt and Clay, trace sand and gravel, low plasticity
BH/MW 20-04	SS 7 & SS 8	7	13	56	24	24	13	11	Clayey Silt, some sand, trace gravel, low plasticity
BH20-05	SS 7 & SS 8	8	13	58	21	24	14	10	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-6	SS 4	3	13	61	23	24	13	11	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-6	SS 6 & SS 7	6	15	55	24	25	14	11	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-6	SS 9	5	13	58	24	24	13	11	Clayey Silt, some sand, trace gravel, low plasticity
BH20-07	SS 6 & SS 7	1	7	62	30	26	14	12	Clayey Silt, trace sand and gravel, low plasticity
BH/MW 20-08	SS 8	0	1	70	29	25	14	11	Clayey Silt, trace sand, low plasticity
BH/MW 20-08	SS 9 & SS 10	5	14	56	25	25	13	12	Clayey Silt, some sand, trace gravel, low plasticity

4.2.2 North Service Road

A total of twenty-eight (28) boreholes (i.e., BH20-09 to BH20-36) were advanced through asphalt or the gravel shoulder on the North Service Road. Nine (9) of the twenty-eight (28) boreholes were equipped with a monitoring well. The soils encountered in the boreholes had a relative drilling resistance (RDR) ranging from two (2) to four (4), indicating "Easy" to "Hard" drilling conditions. This section summarizes the soil conditions encountered along the investigated section of North Service Road.

4.2.2.1 Asphalt

A layer of asphaltic pavement was encountered in sixteen (16) boreholes advanced on the pavement of North Service Road. The thickness of the asphalt at the borehole locations varied between 75 mm to 205 mm in thickness, with an average thickness of approximately 140mm.

It is possible that the thickness of the asphalt at other locations within North Service Road will vary from the thickness recorded at the borehole locations.

4.2.2.2 Sand and Gravel Fill (Granular Road Base)

Underlying the pavement surface and on the surface for boreholes advanced on the gravel shoulder, granular road base fill was encountered. The granular road base fill extended to depths between 0.5 m and 2.2 m bgs.

The granular road base fill material consisted primarily of sand and gravel with various fractions of silt and minor clay. SPT 'N' values measured within the granular road base fill varied from 5 to greater than 50 blows per 0.3 m of penetration indicating a loose to very dense state of compactness. Water contents measured in the samples of the granular road base varied from 3% and 21%. The RDR was determined to be four (4) indicating "hard" drilling conditions due to compactness and the gravelly conditions.

The results of a grain size distribution analysis carried out on four (4) selected samples of granular road base material are summarized in the table below and presented in Appendix B.

Table 6: Results of Grain Size Analysis (Granular Road Base)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-11	SS 2 & SS 3	53	19	21	7	Silty Gravel, some sand trace clay
BH20-21	SS 1 & SS 2	41	46	13		Sand and Gravel, trace silt and clay
BH20-26	SS 1 & SS2	36	42	22		Sand and Gravel, some silt trace clay
BH20-35	SS 1 & SS 2	18	35	47		Silty Sand, some gravel trace clay

4.2.2.3 Non-Cohesive Fill (Various Fractions of Gravel, Sands & Silts, Trace Clay)

In eight (8) of the twenty-eight (28) boreholes advanced along North Service Road, non-cohesive fill containing various fractions of gravel, sands and silts, with trace to some clay were encountered underlying the granular road base. The cohesive fill extended to depths between 1.4 m and 5.6 m bgs. In general, the fill thickness increased towards the North Service Road bridge. The non-cohesive fill was very loose to very dense as indicated by the SPT 'N' value of 2 blows to greater than 50 blows per 0.3 m of penetration. Approaching the North Service Road bridge cobbles and boulders were encountered during the drilling

operations. The moisture content of the samples ranged between 6% to 22%. The RDR was evaluated between two (2) to four (4) which indicates an "easy" to "hard" drilling condition.

The results of a grain size distribution analysis carried out on five (5) samples of non-cohesive fill are summarized in the table below and presented in Appendix B.

Table 7: Results of Grain Size Analysis (Non-Cohesive Fill)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-17	SS 3 & SS 4	24	24	38	14	Gravelly Sandy Silt, some clay
BH20-18	SS 2 & SS 3	16	27	43	14	Sandy Silt, some gravel and clay
BH/MW 20-19	SS 5 & SS 6	43	47	7	3	Sand and Gravel, trace silt and clay
BH20-20	SS 5 & SS 6	5	31	43	21	Clayey Sandy Silt, trace gravel
BH20-26	SS 4 & SS 5	10	23	58	9	Sandy Silt, trace gravel and clay

4.2.2.4 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel)

Cohesive fill comprising various fractions of clay, silts and sands, with trace gravel was encountered in fourteen (14) boreholes underlying the granular road base and/or the non-cohesive fill. The cohesive fill was determined to extend to a depth between 1.4 m to 6.3 m bgs. Deeper fills were encountered near the approach of North Service Road bridge. Occasional organics were observed to be present within this stratum. The cohesive fill was determined to be soft to very stiff as indicated by the SPT 'N' value of 4 blows to 26 blows per 0.3 m of penetration. The moisture content of the samples ranged from 9% to 44%. The RDR was evaluated at two (2) to three (3) which indicates an "easy" to "moderate" drilling condition.

The results of a grain size distribution analysis carried out on selected samples of cohesive fill are summarized in the table below and presented in Appendix B.

Table 8: Results of Grain Size Analysis (Cohesive Fill)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-09	SS 2 & SS 3	1	13	64	22	Clayey Silt, some sand, trace gravel
BH20-09	SS 5	0	18	62	20	Clayey Silt, some sand

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-12	SS 2 & SS 3	1	5	70	24	Clayey Silt, trace sand and gravel
BH20-15	SS 2 & SS 3	11	19	57	13	Silt, some sand, gravel, and clay
BH20-17	SS 5 & SS 6	7	13	61	19	Silt, some sand and clay, trace gravel
BH20-18	SS 5 & SS 6	17	18	43	22	Clayey Silt, some sand and gravel
BH20-23	SS 2 & SS 3	0	3	65	32	Clayey Silt, trace sand
BH20-24	SS 3 & SS 4	1	4	66	29	Clayey Silt, trace sand and gravel
BH20-26	SS 6 & SS 7	1	11	69	19	Silt, some sand and clay, trace gravel
BH20-30	SS 4 & SS 5	0	3	72	25	Clayey Silt, trace sand
BH20-35	SS 5 & SS 6	0	7	60	33	Clayey Silt, trace sand

4.2.2.5 Sands & Silts (Non-Cohesive)

Underlying the fill stratum, a native deposit of fine textured glaciolacustrine sediments containing a mixture of sands, silts, clays and occasional gravel seams were encountered. This deposit is referred to in this report as sands and silts (as these are the predominant soil types). These deposits were generally laminated and inferred to have been deposited in or along the margins of a proglacial lake in the low-lying topographical area. Ten (10) of the twenty-eight (28) boreholes advanced along North Service Road were terminated within this stratum. Frequent heaving conditions were encountered during borehole drilling potentially attributed to confined hydrostatic pressure from groundwater.

The sands and silts deposit extended to depths between 2.2 m and 9.8 m bgs. This deposit was determined to be loose to very dense as indicated by the SPT 'N' value of 6 blows to greater than 50 blows per 0.3 m of penetration. The moisture content of the samples ranged from 7% to 54%. The RDR was evaluated at two (2) to four (4) which indicates an "easy" to "hard" drilling condition.

The results of a grain size distribution analysis carried out on selected samples of native sands and silts are summarized in the table below and presented in Appendix B.

Table 9: Results of Grain Size Analysis (Sands & Silts)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-09	SS 7	0	43	54	3	Sand and Silt, trace clay
BH/MW 20-10	SS 4	0	48	47	5	Sand and Silt, trace clay
BH/MW 20-10	SS 7	0	26	67	7	Sandy Silt, trace clay
BH20-12	SS 4	1	21	67	11	Sandy Silt, some clay, trace gravel
BH/MW 20-13	SS 5 & SS 6	0	23	66	11	Sandy Silt, some clay
BH20-17	SS 8	9	78	11	2	Sand, some silt, trace gravel and clay
BH20-17	SS 9 & SS 10	1	47	47	5	Sand and Silt, trace gravel and clay
BH20-18	SS 7 & SS 8	5	84	9	2	Sand, trace gravel, silt, and clay
BH/MW 20-19	SS 7	9	84	7		Sand, trace gravel, silt, and clay
BH/MW 20-19	SS 8 & SS 9	7	89	4		Sand, trace gravel, silt, and clay
BH20-20	SS 8 & SS 9	20	73	7		Sand, some gravel trace silt and clay
BH20-21	SS 8	0	96	4		Sand, trace silt and clay
BH20-21	SS 9	7	18	57	18	Silt, some sand and clay, trace gravel
BH20-23	SS 9	9	20	56	15	Silt, some sand and clay, trace gravel
BH/MW 20-25	SS 7	7	23	55	15	Silt, some sand and clay, trace gravel
BH/MW 20-25	SS 10	4	12	71	13	Silt, some sand and clay, trace gravel
BH/MW 20-31	SS 3	0	8	81	11	Silt, some clay, trace sand

4.2.2.6 Native Silts & Clays (Cohesive)

The predominant native soil deposit encountered along North Service Road is native silts and clays with minor fractions of sand and gravel. Twenty-three (23) boreholes advanced along North Service Road encountered varying thickness of this deposit. Seventeen (17) of the twenty-eight (28) boreholes advanced along North Service Road were terminated within this stratum.

The silts and clays deposit extended to depths ranging between 7.2 m and 11.9 m bgs. The cohesive soil deposits were determined to be very soft to hard as indicated by the SPT 'N' values that ranged between 1 blow to 33 blows per 0.3m of penetration. The cohesive soils were generally of low to intermediate plasticity and have moisture contents ranging between 9% and 41%. The RDR was evaluated which ranged between two (2) and four (4) which indicates an "easy" to "hard" drilling conditions. Occasional cobbles and/or gravel seams were inferred to be present within this stratum due to grinding of the augers which was noted during drilling operations.

The results of grain size distribution analysis and Atterberg Limits carried out on selected samples of native silts and clays are summarized in the table below and presented in Appendix B

Table 10: Results of Grain Size Analysis & Atterberg Limits (Clays & Silts)

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH/MW 20-10	SS 8	0	3	78	19	21	14	7	Silt, some clay, trace sand, low plasticity
BH20-11	SS 5 & SS 6	3	12	63	22	27	14	13	Clayey Silt, some sand, trace gravel, low plasticity
BH20-11	SS 8	0	13	67	20	28	17	7	Clayey Silt, some sand, low plasticity
BH20-12	SS 7 & SS 8	0	8	78	14	21	13	8	Silt, some clay, trace sand, low plasticity
BH/MW 20-13	SS 7	0	13	72	15	19	15	4	Silt, some clay and sand, low plasticity
BH/MW 20-13	SS 8	0	5	73	22	21	13	8	Clayey Silt, trace sand, low plasticity
BH20-14	SS 4 & SS 5	0	19	69	12	18	14	4	Silt, some clay and sand, low plasticity
BH20-14	SS 6 & SS 7	0	13	70	17	19	13	6	Silt, some clay and sand, low plasticity
BH20-14	SS 8	0	9	75	16	19	13	6	Silt, some clay, trace sand, low plasticity
BH20-15	SS 4 & SS 5	0	13	71	16	19	13	6	Silt, some clay and sand, low plasticity
BH20-15	SS 7	0	10	77	13	19	13	6	Silt some clay, trace to some sand, low plasticity
BH20-15	SS 8	3	13	58	26	29	15	14	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-16	SS 5 & SS 6	0	1	65	34	30	14	16	Clayey Silt, trace sand, intermediate plasticity
BH/MW 20-16	SS 7 & SS 8	5	10	64	21	25	15	10	Clayey Silt, trace to some sand, trace gravel, low plasticity
BH20-21	SS 6 & SS 6	0	7	61	32	28	14	14	Clayey Silt, trace sand, low plasticity

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH/MW 20-22	SS 6 & SS 7	4	16	55	25	26	14	12	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-22	SS 9	5	16	62	17	21	13	8	Silt, some clay and sand, trace gravel, low plasticity
BH20-23	SS 6 & SS 7	0	1	66	33	27	14	13	Clayey Silt, trace sand, low plasticity
BH20-24	SS 6 & SS 7	0	1	73	26	23	14	11	Clayey Silt, trace sand, low plasticity
BH/MW 20-25	SS 4	0	9	71	20	19	13	6	Clayey Silt, trace sand, low plasticity
BH/MW 20-25	SS 8	4	14	53	29	27	14	13	Clayey Silt, some sand, trace gravel, low plasticity
BH20-27	SS 3	1	15	60	24	26	15	11	Clayey Silt, some sand, trace gravel, low plasticity
BH20-27	SS 4	0	3	68	29	26	16	10	Clayey Silt, trace sand, low plasticity
BH20-27	SS 5 & SS 6	0	4	68	28	25	15	9	Clayey Silt, trace sand, low plasticity
BH20-27	SS7 & SS 8	0	5	68	27	24	15	9	Clayey Silt, trace sand, low plasticity
BH/MW 20-28	SS 5 & SS 6	0	3	74	23	21	14	7	Clayey Silt, trace sand, low plasticity
BH/MW 20-28	SS 7	0	6	75	19	---			Clayey Silt, trace sand
BH/MW 20-28	SS 8	1	17	54	28	21	14	7	Clayey Silt, some sand, trace gravel, low plasticity
BH20-29	SS 2 & SS 3	0	6	94		---			Clayey Silt, trace sand
BH20-29	SS 4 & SS 5	0	2	70	28	25	16	10	Clayey Silt, trace sand, low plasticity

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH20-29	SS 7 & SS 8	2	11	59	28	25	17	8	Clayey Silt, some sand, trace gravel, low plasticity
BH20-30	SS 6 & SS 7	0	3	68	29	26	14	11	Clayey Silt, trace sand, low plasticity
BH/MW 20-31	SS 5 & SS 6	0	3	64	33	27	17	10	Clayey Silt, trace sand, low plasticity
BH/MW 20-31	SS 8 & SS 9	2	17	57	24	23	14	9	Clayey Silt, trace sand, low plasticity
BH20-32	SS 2 & SS 3	0	12	88		---			Clayey Silt, some sand
BH20-32	SS 6 & SS 7	0	7	75	18	21	14	8	Silt, some clay, trace sand, low plasticity
BH20-32	SS 8 & SS 9	2	15	55	28	25	15	10	Clayey Silt, some sand, trace gravel, low plasticity
BH20-33	SS 4 & SS 5	0	21	63	16	18	12	6	Sandy Silt, some clay, low plasticity
BH20-33	SS 6 & SS 7	0	12	62	26	25	15	10	Clayey Silt, some sand, low plasticity
BH20-33	SS 8	4	22	54	20	21	14	8	Clayey, Sandy, Silt, trace gravel, low plasticity
BH/MW 20-34	SS 3	0	12	75	13	21	18	3	Silt, some sand and clay, low plasticity
BH/MW 20-34	SS 4 & SS 5	0	5	66	29	27	15	12	Clayey Silt, trace sand, low plasticity
BH/MW 20-34	SS 7	2	20	53	25	25	16	9	Clayey, Sandy, Silt, trace gravel, low plasticity
BH/MW 20-34	SS 8	2	15	53	30	17	16	1	Clayey Silt, some sand, trace gravel, low plasticity
BH20-35	SS 7	3	7	62	28	29	16	13	Clayey Silt, trace sand and gravel, low plasticity

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH20-35	SS 8	8	14	48	30	29	15	13	Clayey Silt, some sand, trace gravel, low plasticity
BH20-36	SS 4	0	5	71	24	23	14	9	Clayey Silt, trace sand, low plasticity
BH20-36	SS 5	0	4	75	21	22	11	11	Clayey Silt, trace sand, low plasticity
BH20-36	SS 6	5	17	54	24	23	15	8	Clayey Silt, some sand, trace gravel, low plasticity
BH20-36	SS 7 & SS 8	4	24	52	20	29	15	13	Clayey, Sandy Silt, trace gravel, low plasticity

4.2.3 Victoria Avenue and QEW Crossing

A total of seven (7) boreholes (BH20-37 to BH20-42) were advanced along the Victoria Avenue and QEW Crossing. Three (3) boreholes were advanced through asphalt along Victoria Avenue, three (3) boreholes were advanced adjacent to the QEW, and one (1) borehole was advanced through asphalt shoulder on the QEW East Bound (EB). Four (4) of the seven (7) boreholes were equipped with a monitoring wells screened. The soils and weathered shale bedrock encountered had a relative drilling resistance (RDR) ranging from two (2) to five (5), indicating "Easy" to "Very Hard" drilling conditions. This section summarizes the subsurface conditions encountered along Victoria Avenue and QEW crossing.

4.2.3.1 Surficial Cover (Asphalt and Topsoil)

A layer of asphalt pavement was encountered in four (4) of the seven (7) boreholes (BH20-37, BH/MW20-37B, BH/MW20-38, and BH20-42). The thickness of the asphalt at the borehole locations varied from 100 mm to 205 mm in thickness, with an average thickness of approximately 150 mm.

Topsoil was encountered in one (1) borehole (BH/MW20-41) and had a thickness of approximately 100 mm.

4.2.3.2 Sand and Gravel Fill (Granular Road Base)

Boreholes drilled through the pavement surface encountered granular road base fill consisting of sand and gravel with some silt and clay, immediately beneath the asphaltic pavement. The granular road base fill extended to depths ranging between 0.8 m and 2.2 m bgs. SPT 'N' values measured within the granular road base fill varied between 12 to 62 blows per 0.3 m of penetration indicating a compact to very dense state of compactness. Water contents measured in the samples of the granular road base varied from 2% and 16%. The RDR was evaluated as four (4) indicating "hard" drilling conditions due to compactness and the gravelly conditions.

The result of grain size distribution analysis carried out on one (1) selected sample of granular road base material from borehole advanced on the QEW is summarized in the table below and presented in Appendix B.

Table 11: Results of Grain Size Analysis (Granular Road Base)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH20-42	SS 1 & SS 2	37	37	29		Gravelly Silty Sand, trace clay

4.2.3.3 Non-Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel)

Underlying the granular road base, non-cohesive fill material comprising primarily sands and silts with some gravel and clay were encountered. For boreholes drilled north of the QEW, the non-cohesive fill stratum extended to native soil deposits whereas south of the QEW non-cohesive fill was overlain by cohesive fill layer. This deposit extended depths ranging between 3.7 m to 5.6 m bgs. The non-cohesive fill deposit was

determined to be loose to dense as indicated by the SPT 'N' value of 9 blows to 36 blows per 0.3 m of penetration. The moisture content of the sample ranged between 12% to 16%. The RDR was evaluated at two (2) to four (4) which indicates an "easy" to "hard" drilling condition.

The results of grain size distribution analysis carried out on select samples of non-cohesive fill are summarized in the table below and presented in Appendix B.

Table 12: Results of Grain Size Analysis (Non-Cohesive Fill)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH/MW 20-37B	SS 3 & SS 4	8	20	58	14	Sandy Silt, some clay, trace gravel
BH/MW 20-38	SS 3 & SS4	12	18	67	3	Silt, some sand and gravel, trace clay
BH/MW 20-38	SS6 & SS7	1	11	72	16	Silt, some sand and clay, trace gravel
BH/MW 20-41	SS 2 & SS3	6	13	62	19	Silt, some sand and clay, trace gravel
BH/MW 20-41	SS 4 & SS 5	68	25	7		Sandy Gravel, trace silt

4.2.3.4 Cohesive Fill (Various Fractions of Clay, Silts & Sands, Trace Gravel)

Borehole BH20-40 encountered a layer of cohesive fill comprising primarily clay and silt, with some sand and trace gravel. The thickness of the cohesive fill was determined to be 1.5 m and extended to a depth of 2.2 m bgs. The cohesive fill was stiff to very stiff as indicated by the SPT 'N' value of 11 blows to 20 blows per 0.3 m of penetration. The moisture content of the samples ranged between 13% to 16%. The RDR was evaluated at three (3) which indicates a "moderate" drilling condition.

The result of grain size distribution analysis carried out on one (1) selected sample of cohesive fill is summarized in the table below and presented in Appendix B.

Table 13: Results of Grain Size Analysis (Cohesive Fill)

Borehole No.	Sample No.	Grain Size Distribution				Soil Classification
		Gravel	Sand	Fines		
				Silt	Clay	
		(%)	(%)	(%)	(%)	
BH/MW 20-40	SS 2 & SS 3	2	13	85		Clayey Silt, some sand trace gravel

4.2.3.5 Native Sands & Silts (Non-Cohesive)

Native deposit comprising primarily silt, sand, some clay and occasional gravel seams were encountered in borehole BH/MW20-38 underlying the fill stratum. This deposit is referred to in this report as sands and silts (as these are the predominant soil types). This deposit extended to a depth of 7.2m below the ground surface. The sands and silts deposit were determined to be compact as indicated by the SPT 'N' value of 27 blows per 0.3 m of penetration. The moisture content of the sample was 15%. The RDR was evaluated at three (3) which indicates a "moderate" drilling condition.

4.2.3.6 Native Silts & Clays (Cohesive)

A native cohesive soil layer comprising primarily silts and clays with some sand and trace gravel was encountered in all boreholes. This deposit is referred to in this report as silts and clays (as these are the predominant soil types). The cohesive soil deposits were determined to be firm to hard as indicated by the SPT 'N' values that ranged between 7 blows to greater than 50 blows per 0.3 m of penetration. Occasional eroded bedrock fragments were encountered in the boreholes resulting in higher SPT 'N' values being recorded.

The soils from this deposit were determined to be generally of low plasticity and had moisture contents ranging between 5% and 20%. The RDR was evaluated and ranged between three (3) and four (4) which indicates a "moderate" to "hard" drilling resistance within this stratum.

The results of a grain size distribution analysis and Atterberg Limits carried out on select samples from this stratum are summarized in the table below and presented in Appendix B.

Table 14: Results of Grain Size Analysis & Atterberg Limits (Native Clays & Silts)

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH20-37	SS 4 & SS 5	1	7	75	17	22	14	9	Silt, some clay, trace sand and gravel, low plasticity
BH20-37	SS 6 & SS 7	3	10	65	22	26	14	12	Clayey Silt, trace sand and gravel, low plasticity
BH20-37	SS 8	5	14	50	31	27	16	11	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-37B	SS 6 & SS 7	1	17	57	25	25	15	16	Clayey Silt, trace sand and gravel, low plasticity
BH/MW 20-37B	SS 6 & SS 7	4	7	65	24	24	14	10	Clayey Silt, trace sand and gravel, low plasticity
BH/MW 20-38	SS 9 & SS 10	4	9	50	37	30	17	12	Silt and Clay, trace sand and gravel, low plasticity
BH20-39	SS 2 & SS 3	2	17	51	30	25	14	11	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-40	SS 4 & SS 5	2	17	52	29	25	15	11	Clayey Silt, some sand, trace gravel, low plasticity

Borehole No.	Sample No.	Grain Size Distribution				Atterberg Limits			Soil Classification
		Gravel	Sand	Fines		LL	PL	PI	
				Silt	Clay				
		(%)	(%)	(%)	(%)				
BH/MW 20-41	SS6 & SS7	4	17	50	29	25	14	11	Clayey Silt, some sand, trace gravel, low plasticity
BH/MW 20-41	SS 8 & SS 9	24	4	53	19	24	14	10	Gravelly Silt, some clay, trace sand, low plasticity**
BH20-42	SS3 & SS4	1	8	61	30	29	17	12	Clayey Silt, trace sand and gravel, low plasticity

** Presence of eroded bedrock fragments resulting in select samples to be classified as 'gravelly.'

4.2.3.7 Shale Bedrock

The overburden soils were underlain by Shale bedrock which was encountered in all the boreholes drilled along Victoria Avenue and the QEW crossing. The bedrock was visually identified to belong to the Queenston Formation consisting of reddish, brown-colored shale. The brick red shale is indicative of pro-grading muddy and storm-tide affected near shore depositional environment. The shale bedrock is highly weathered in the upper 1 to 5 m and becomes sound and hard below. The elevation of bedrock ranged between Elevation 76.6 mASL to 79.4 mASL.

The bedrock was cored using a HQ double tube wire line core bit. All boreholes were terminated in shale bedrock ranging from 69.6 mASL to 72.0 mASL. Within the core samples some rubbled zones with high fissility zones and interbedded clay and silt seams were encountered. Challenges with coring the shale bedrock were encountered during drilling operations, as the core barrel often deviated from the initiated trajectory due to shale bedrock becoming soft on hydration induced by water injection during coring.

Where auger penetration was possible the RDR was evaluated at five (5) which indicates "very hard" drilling conditions. The Total Core Recovery (TCR) achieved during coring ranged between 28% and 100%. The Rock Quality Designation (RQD) values ranged between 0% and 68% classifying it as "very poor" to "fair" quality rock. In general, the rock core samples indicate long term weathering of near surface bedrock resulting in poor to fair rock within investigated depths.

Four (4) rock specimens were prepared and tested from the recovered core sample from boreholes BH20-37B, BH/MW20-38, BH/MW20-40, BH20-42 in accordance with ASTM D7012, "Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures". The test result yielded a uniaxial unconfined compressive strength of 21.8 MPa, 33.6 MPa, 36.8 MPa and 16.5 MPa, respectively.

In addition, slake durability test was carried out to evaluate the weathering resistance of recovered intact shale bedrock. The test measures the percentage breakdown of the material after rotating the samples under saturated condition for a specified duration, and then subsequently drying them. The testing was conducted in accordance with ASTM D4644, "Standard Test Method for Slake Durability of Shales and Other Similar Weak Rocks".

The results of the laboratory tests carried out on selected samples of bedrock is presented in Appendix B and photographs of rock cores are presented in Appendix C of this report.

4.3 Groundwater

Groundwater seepage was observed in all the boreholes during advancement. The borehole drilling investigation included injecting pressurized water into the borehole to counter heaving conditions in boreholes BH20-18 and BH/MW20-19 (North Service Road), hence groundwater levels were not recorded during and upon completion of drilling, as the water levels may not be indicative of the groundwater conditions. Furthermore, boreholes advanced on Victoria Avenue required bedrock coring, which also introduced water into the boreholes to lubricate the core barrel, hence water levels were not recorded after completion.

A total of seventeen (17) boreholes were instrumented with monitoring wells to permit long term groundwater measurements at the project site. The results of groundwater depth measurements are shown on the Record of Borehole Sheets and summarized in the tables below. Fluctuations in groundwater elevations should be expected in response to seasonal conditions and extreme weather events.

Table 15: Results of Groundwater Measurements (Jordan Road)

Borehole No.	Groundwater Measurements					
	During or Upon Completion of Drilling			In Monitoring Wells		
	Date	Depth (m)	Elevation (m)	Date	Depth (m)	Elevation (m)
BH/MW20-01	23-Jul-20	Dry	-	25-Aug-20	2.75	86.11
				8-Oct-20	3.07	85.79
BH20-02	24-Jul-20	2.13	85.79	-	-	-
BH20-03	20-Jul-20	2.13	84.45	-	-	-
BH/MW20-04	20-Jul-20	1.68	82.60	25-Aug-20	1.98	82.30
				8-Oct-20	2.10	82.18
BH20-05	21-Jul-20	1.98	80.71			
BH/MW20-06	21-Jul-20	Dry	-	25-Aug-20	2.75	79.93
				8-Oct-20	3.29	79.39
BH20-07	22-Jul-20	1.98	81.82	-	-	-
BH/MW20-08	22-Jul-20	2.13	83.45	25-Aug-20	3.37	82.22
				26-Aug-20	3.37	82.22
				8-Oct-20	3.40	82.19

Table 16: Results of Groundwater Measurements (North Service Road)

Borehole No.	Groundwater Measurements					
	During or Upon Completion of Drilling			In Monitoring Wells		
	Date	Depth (m)	Elevation (m)	Date	Depth (m)	Elevation (m)
BH20-09	30-Jul-20	0.91	85.00	-	-	-
BH/MW20-10	30-Jul-20	NM	-	11-Aug-20	2.16	83.95
				8-Oct-20	2.22	83.89
BH20-11	30-Jul-20	-	-	-	-	-
BH20-12	30-Jul-20	3.05	83.87	-	-	-
BH/MW20-13	14-Jul-20	Dry	-	11-Aug-20	2.57	84.44
				24-Aug-20	2.46	84.55
				25-Aug-20	2.32	84.69
				8-Oct-20	2.34	84.67
BH20-14	13-Jul-20	Dry	-			
BH20-15	13-Jul-20	Dry	-	-	-	-
BH/MW20-16	14-Jul-20	NM	-	11-Aug-20	3.00	77.50
				24-Aug-20	3.28	77.22
				8-Oct-20	2.95	77.55
BH20-17	14-Jul-20	4.27	74.66	-	-	-
BH20-18	15-Jul-20	NM	-	-	-	-
BH/MW20-19	16-Jul-20	NM	-	11-Aug-20	3.57	75.14
				8-Oct-20	3.96	74.75
BH20-20	15-Jul-20	3.43	75.66	-	-	-
BH20-21	29-Jul-20	1.52	78.44	-	-	-
BH/MW20-22	16-Jul-20	Dry	-	11-Aug-20	2.17	78.96
				8-Oct-20	2.08	79.05
BH20-23	17-Jul-20	Dry	-	-	-	-
BH20-24	17-Jul-20	Dry	-	-	-	-
BH/MW20-25	27-Jul-20	NM	-	11-Aug-20	2.20	80.63
				24-Aug-20	2.57	80.27
				8-Oct-20	1.84	81.00
BH20-26	27-Jul-20	4.27	78.98	-	-	-
BH20-27	17-Jul-20	Dry	-	-	-	-
BH/MW20-28	27-Jul-20	2.43	81.35	18-Aug-20	1.96*	82.13*
				24-Aug-20	2.14*	81.95*
				25-Aug-20	1.94*	82.15*
				8-Oct-20	1.88*	82.21*
BH20-29	No Date	Dry	-	-	-	-
BH20-30	31-Jul-20	Dry	-	-	-	-

Borehole No.	Groundwater Measurements					
	During or Upon Completion of Drilling			In Monitoring Wells		
	Date	Depth (m)	Elevation (m)	Date	Depth (m)	Elevation (m)
BH/MW20-31	31-Jul-20	1.83	82.60	18-Aug-20	2.04	82.38
				8-Oct-20	2.07	82.354
BH20-32	28-Jul-20	Dry	-	-	-	-
BH20-33	28-Jul-20	3.05	81.50	-	-	-
BH/MW20-34	29-Jul-20	1.83	82.07	18-Aug-20	Dry	-
				8-Oct-20	3.80	80.10
BH20-35	29-Jul-20	Dry	-	-	-	-
BH20-36	29-Jul-20	Dry	-	-	-	-

NM = Not Measured

Table 17: Results of Groundwater Measurements (Victoria Avenue/QEW Crossing)

Borehole No.	Groundwater Measurements					
	During or Upon Completion of Drilling			In Monitoring Wells		
	Date	Depth (m)	Elevation (m)	Date	Depth (m)	Elevation (m)
BH20-37	6-Aug-20	NM[(1)]	-	-	-	-
BH/MW20-37B	4-Aug-20	NM	-	18-Aug-20	5.86	76.35
				8-Oct-20	8.86	77.35
BH/MW20-38	5-Aug-20	NM	-	18-Aug-20	3.71	84.31
				25-Aug-20	8.20	79.82
				8-Oct-20	7.23	80.79
BH20-39	5-Aug-20	NM[(1)]	-	26-Aug-20	8.24	79.78
BH/MW20-40	7-Aug-20	NM	-	18-Aug-20	2.48	80.94
				25-Aug-20	2.76	80.66
				8-Oct-20	3.50	79.92
BH/MW20-41	6-Aug-20	3.20	82.10	18-Aug-20	3.31	81.98
				25-Aug-20	3.29	82.00
				8-Oct-20	4.26	87.04
BH20-42	22-Jul-20	NM[(1)]	-	-	-	-

4.4 Soil Chemical Testing

4.4.1 Corrosivity Analysis

A total of Forty-three (43) soil samples were submitted to ALS Laboratories for corrosivity analysis (pH, water soluble sulphate, sulfides, chloride, resistivity, and electrical conductivity). A summary of results is included in Table 18 below and laboratory certificate of analysis is presented in Appendix E.

Table 18: Summary of Soil Corrosivity Testing Results

BH ID/ Sample No.	Location	Soil Type	Moisture %	pH	Redox Potential (mV)	Pore Water Resistivity (ohms-cm)	Conductivity	Chlorides (µg/g)	Sulfide (µg/g)	Sulphates (µg/g)
BH/MW 20-01	Jordan Road	Silt	14.9	7.98	142	4170	0.240	36.1	<0.20	108
BH20-02	Jordan Road	Clayey Silt	15.7	7.85	181	3770	0.265	38.0	<0.20	148
BH20-03	Jordan Road	Clayey Silt	10.9	8.06	256	269	3.72	860	<0.20	6370
BH/MW 20-04	Jordan Road	Clayey Silt	17.0	7.89	147	3070	0.326	47.4	<0.20	150
BH20-05	Jordan Road	Silt	13.3	7.99	204	3170	0.315	24.4	<0.20	219
BH/MW 20-06	Jordan Road	Clayey Silt	13.8	8.08	139	3550	0.282	16.1	<0.20	167
BH20-07	Jordan Road	Clayey Silt	13.4	7.94	141	3110	0.322	35.4	<0.20	142
BH/MW 20-08	Jordan Road	Clayey Silt	14.7	7.78	156	2920	0.342	59.6	<0.20	171
BH20-09	North Service Road	Silt & Sand	15.8	7.89	249	917	1.09	566	<5.0	377
BH/MW 20-10	North Service Road	Sandy Silt	14.6	8.01	275	2470	0.405	42.9	<5.0	349
BH20-11	North Service Road	Clayey Silt	16.3	7.73	276	3130	0.319	56.6	<5.0	43
BH20-12	North Service Road	Silt	12.8	8.05	257	1480	0.674	99.9	<5.0	345
BH20-13	North Service Road	Silt	14.6	7.82	228	1100	0.910	373	<0.20	269
BH20-14	North Service Road	Silt	15.9	7.75	219	1400	0.714	256	<0.20	227
BH20-15	North Service Road	Silt	17.0	7.80	220	3820	0.262	46.0	<0.20	73
BH20-16	North Service Road	Clayey Silt	14.7	7.78	186	3170	0.315	5.9	<0.20	114
BH20-17	North Service Road	Silt	16.8	7.40	214	991	1.01	235	134	488
BH20-18	North Service Road	Clayey Silt	14.6	7.69	238	1560	0.641	219	<0.20	289
BH20-19	North Service Road	Sand	10.7	7.82	248	4760	0.210	57.9	<0.20	51
BH20-20	North Service Road	Sandy Silt	16.0	7.66	237	1290	0.773	231	<0.20	340
BH20-21	North Service Road	Clayey Silt	14.5	8.00	228	1040	0.964	459	<5.0	121
BH20-22	North Service Road	Clayey Silt	17.1	8.00	194	2140	0.467	127	<0.20	128
BH20-23	North Service Road	Clayey Silt	18.7	8.14	153	3510	0.285	49.5	<0.20	49
BH20-24	North Service Road	Clayey Silt	16.0	7.96	174	2790	0.359	104	<0.20	75
BH20-25	North Service Road	Clayey Silt	14.4	7.97	170	3550	0.282	8.4	<0.20	124
BH20-26	North Service Road	Silt	15.7	7.4	231	1340	0.749	239	<0.20	398

BH ID/ Sample No.	Location	Soil Type	Moisture %	pH	Redox Potential (mV)	Pore Water Resistivity (ohms-cm)	Conductivity	Chlorides (µg/g)	Sulfide (µg/g)	Sulphates (µg/g)
BH20-27	North Service Road	Clayey Silt	18.2	7.97	200	5140	0.195	8.5	<0.20	100
BH20-28	North Service Road	Clayey Silt	15.5	7.87	199	4070	0.246	46.9	<0.20	99
BH20-29	North Service Road	Clayey Silt	14.0	8.13	264	1660	0.602	22.7	<5.0	486
BH20-30	North Service Road	Clayey Silt	13.2	8.05	261	1470	0.679	81.7	<5.0	380
BH/MW 20-31	North Service Road	Clayey Silt	14.5	8.06	266	1550	0.644	41.0	<5.0	515
BH20-32	North Service Road	Silt	15.5	7.97	277	1270	0.786	60.0	<5.0	583
BH20-33	North Service Road	Clayey Silt	14.7	8.05	265	896	1.12	40.3	<5.0	714
BH/MW 20-34	North Service Road	Clayey Silt	11.1	8.05	260	670	1.49	19.3	<5.0	989
BH20-35	North Service Road	Clayey Silt	10.8	8.09	261	1340	0.747	14.9	<5.0	439
BH20-36	North Service Road	Clayey Silt	13.7	7.97	274	1420	0.703	272	<5.0	209
BH20-37	Victoria Avenue	Clayey Silt	9.91	7.94	215	3760	0.266	8.1	<0.20	134
BH/MW 20-37B	Victoria Avenue	Weathered Shale	11.0	8.16	223	4170	0.240	19.9	<0.20	119
BH/MW 20-38	Victoria Avenue	Weathered Shale	7.74	8.09	224	3100	0.323	12.9	<0.20	163
BH20-39	QEW Crossing	Weathered Shale	6.53	8.15	206	4670	0.214	223	<0.20	49
BH/MW 20-40	QEW Crossing	Weathered Shale	8.05	8.12	224	5210	0.192	28.9	<0.20	33
BH/MW 20-41	QEW Crossing	Clayey Silt	6.75	8.13	216	5620	0.178	<5.0	54	<0.20
BH20-42	QEW	Weathered Shale	9.42	8.34	150	6330	0.158	<5.0	0.22	51

4.4.2 TCLP Analysis

Eight (8) soil samples were submitted to ALS laboratories for Ontario Regulation 347 Toxicity Characteristic Leaching Procedure (TCLP). The laboratory certificates of analysis are presented in Appendix E. Further discussion and recommendations pertaining to excess soil management is provided is Sec. 7.0 of this report.

5.0 Closure

The field investigation was carried out using drilling equipment supplied and operated by Geo-Environmental Drilling, an Ontario Ministry of Environment, Conservation and Parks (MECP) licensed drilling contractors. The field operations were supervised by Mr. Owen Lutz, EIT, under the direction of the Principal Geotechnical Engineer, Mr. Ty Garde, M.Eng., P.Eng.

The geotechnical soil laboratory testing was carried out at Wood's Materials Laboratories located in Cambridge and Sarnia, Ontario. These laboratories are accredited participant in the MTO Soil and Aggregate Proficiency Program and are certified by the Canadian Council of Independent Laboratories (CCIL) for Testing Types C and D aggregates. The geotechnical laboratory tests on bedrock were carried out at Wood's Rock Mechanics Laboratory located in Burlington, Ontario.

This Geotechnical Investigation Report was prepared by Vishu Vasisht, P.Geo, PMP, Project Manager and Mr. Ty Garde., M.Eng., P.Eng., Principal Geotechnical Engineer and a Designated Foundations Contact for MTO Projects conducted an independent review of this report.

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B Geotechnical Design Report

6.0 Geotechnical Discussion and Recommendations

6.1 General

This section of the report provides geotechnical comments and recommendations for the proposed watermain installation within the Ministry of Transportation, Ontario (MTO) right-of-way along Jordan Road, North Service Road, Regional Road#24/Victoria Avenue and the QEW Crossing.

Design information provided by GHD indicates that the 300 mm dia. watermain pipe will be installed at a depth of approximately 5 m within the overburden soils along Jordan Road and North Service Road whereas the 300 mm watermain pipe will be installed within a 600 mm casing along Victoria Avenue and QEW crossing within the shale bedrock. It has been indicated that the preferred installation method is horizontal directional drilling (HDD).

The recommendations are based on interpretation of the factual geotechnical data obtained from the boreholes advanced during the subsurface investigation at the site. Furthermore, the installation of the pipes should be carried out in accordance with all applicable regulations/guidelines. Where comments are made on construction, they are provided to highlight aspects which could affect the design of the project, and for which special provisions or operational constraints may be required in the Contract Documents. Those planning and undertaking specific aspects of construction should make their own interpretation of the factual information provided, as it may affect equipment selection, proposed construction methods, scheduling, and the like.

The installation of the crossing by trenchless technologies should be undertaken by a qualified specialist contractor, using skilled workers under the direction of an experienced foreman. The geotechnical aspects of the contractor's proposed methodology and schedule should be reviewed by this office prior to commencement of construction.

Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing, and the like.

The following sections of the report provide the geotechnical design recommendations and construction issues for open-cut excavation and trenchless installation methods. The geotechnical design recommendations have been summarized separately for installation along (i) Jordan Road and North Service Road and (ii) Victoria Avenue and QEW Crossing. Table A-1 following the text of this report, provides a comparison of the advantages, disadvantages, costs and risks associated with these installation methods.

6.2 Jordan Road & North Service Road

6.2.1 Open Cut Excavation

Open-cut trenching for installation along Jordan Road and North Service Road would include pavement structure removal and restoration; trench excavation including installation of temporary protection systems for support of excavation sides and/or adjacent utilities; services installation; and trench backfilling including removal of temporary protection system elements.

The open-cut excavation method would offer the best control of gradient and alignment for the pipeline, reduced potential for delays resulting from encountering obstructions, reduced potential for failure in steering in coarse grained glaciolacustrine sediments, and the least risk of unanticipated damage to the active highway corridor. The major disadvantage with open-cut installation is the requirement for lane closures resulting in complex traffic staging and disruptions/delays, pavement reconstruction, and the potential for post-construction settlement of the backfill materials (although such post-construction settlement could be minimized by using unshrinkable fill to backfill the trench around the above the pipe).

The open-cut excavation method is feasible for the installation of proposed watermain, provided that it is acceptable with respect to traffic staging impacts and permitted by MTO.

6.2.2 Suitable Trenchless Methodologies

Several trenchless methodologies were considered for discussion in this report; jack and bore (Horizontal Auger Boring), pipe ramming, microtunnelling and horizontal directional drilling. Conventional jack and bore and pipe ramming methods are not discussed in detail as these methods are typically limited to installations of up to about 90 m in length, though in practice are often limited to about 40 to 60 m.

6.2.3 Microtunneling

Microtunneling is a trenchless construction technique that uses a remotely controlled microtunnel boring machine at the face of the excavation combined with pipe jacking techniques to directly install a product pipe. There are two main types of microtunneling; 1) Tunnel boring machines (TBMs) and 2) Microtunneling boring machines (MTBMs), classified by the cuttings transport equipment, auger type and slurry type. The latter type is used for utility installations. A slurry MTBM has a full-face rotating cutting head with openings through which the spoil enters a pressurized slurry chamber behind the head. The slurry is used to balance the hydrostatic pressure and convey suspended cuttings away from the face. Typically, MTBMs are limited to passing boulders one third of the machine diameter, however some models have a crusher chamber which breaks down the obstructions to a size which can be pumped with the cuttings. However, the volume or size of the boulders may be such that the capacity of the crusher could be exceeded resulting in either abandonment of the bore or advancement of a rescue shaft to remove the obstruction(s) and permit resumption of tunneling.

A mixed face condition should be expected along the alignment containing a mixture of non-cohesive sands and silts and cohesive silts and clays. Cobbles and boulders were inferred during borehole drilling and should be expected. Slurry must have a consistent such that a filter cake is developed around the circumference of the excavation to provide sufficient support to the granular material. Slurry consistency

adjustment may be required along the alignment due to the presence of fine grained, cohesive soils comprising silts and clays.

Face stability should be constantly monitored. Over excavation above or ahead of the pipe/casing should be strictly avoided in order to maintain face stability. The overcut should be minimized by selection of a casing diameter which is similar to that of a shield. Slurry viscosity and both slurry and EPB face pressure should be selected to maintain a face pressure no less than the active earth pressure at the tunnel vertical centerline. If over excavation or ground losses occur, the annulus between the outside of the pipe and the ground and any voids at the face should be immediately filled with bentonite slurry of an appropriate viscosity. The pipeline alignment does not need to be dewatered except at the launching and receiving shafts/chambers. Installation of the proposed tunnel by microtunneling technique should conform to Ontario Provisional Standard Specifications (OPSS) – "Construction Specification for Pipeline and Utility Installation in Soil by tunneling" (OPSS 415).

6.2.4 Horizontal Directional Drilling (HDD)

With the HDD method, a small rotating and steerable drill bit is launched from the surface at a shallow angle and is used to drill a pilot hole supported with drilling fluid. Once the pilot bore is complete, the drill head is replaced with a reamer or expander which enlarges the drill hole. When the desired size is reached, the product pipe is attached to the reaming head and pulled through the bore. The final size of the back-reamed hole is generally 30% to 50% larger than the outside diameter of the product pipe. This overcut provides adequate annular space for drilling fluids and spoils to return to the surface; this also facilitates the bending of the pipeline during the pull-back process. A bentonite-based drilling fluid is used to lubricate and stabilize the excavated cavity.

The possible length of an HDD installation is much greater than that of Microtunneling. Installation of pipes and conduits ranging from 50 mm up to 1,200 mm in diameter and from 50 m to 800 m in length using the HDD method are relatively common in the industry. Longer installations, up to 2,400 m, are possible, depending on available equipment and subsurface conditions.

Based on the preliminary directional drill path provided by GHD, the HDD will likely pass through a mixed face condition consisting of fill material, non-cohesive sands and silts and cohesive silts and clays. The installation will primarily be in the cohesive soil layer comprising primarily silts and clays with some sand and trace gravel.

Correlating the soil classification with a modified version of Terzaghi's Tunnelman's Classification, the boring conditions can be described as "raveling to running" within the fill material and non-cohesive sands and silts deposit while boring conditions within the cohesive silts and clays stratum can be described as "squeezing". The boring conditions along the majority of the drill path within the cohesive silts and clays stratum is "generally suitable" in accordance with Table 1 of ASTM F1962 11. The stand up time for unsupported excavation face will be in the order of a few minutes along the proposed alignment. Further, if significant cobbles and/or boulders are encountered along the drill path, it is also to present "substantial problems". The groundwater table is expected to be above the drill path. The HDD installation procedure should consider that the soil and groundwater conditions between and beyond the borehole locations may be different, that groundwater levels may vary seasonally, and perched groundwater may be present.

The HDD installation method should conform to OPSS 450, Construction Specification for Pipeline and Utility Installation in Soil by Horizontal Directional Drilling.

6.3 Victoria Avenue and QEW Crossing

Based on the directional drill path information provided by GHD, it is understood that the proposed watermain will be installed within shale bedrock at approximately elevation 72.0 mASL via HDD.

The weathered shale bedrock present along the profiles is anticipated to consist of very poor to fair quality. Where there are layers in the shale and thin limestone intercalations are present, steering difficulties may be encountered where the "drill" bounces off a more competent or stronger rock layer. The presence of fractures in the rock can also influence the steering. The design and construction of HDD should consider the presence of more competent shale layers along the drill path.

It should be noted that the drill bit during HDD operations can skip at the contact between the overburden (and/or highly weathered shale) and the contact with competent bedrock resulting in minor deviation from the planned alignment. Further, the drill may deviate in plan from the design straight path due to various geological conditions. From the geotechnical point-of-view, such deviation should be permitted provided that the pipe radius of curvature and stress are acceptable.

Furthermore, detailed consideration of mud chemistry to assist in reducing hydration of the cuttings and improving cuttings removal from the hole should be given during the design stage. Difficulties have been encountered in the past with poor clearance of cuttings from shale formations. In the worst case, cuttings have hydrated to form a gelatinous material that is difficult or not possible to clear from the hole and pull-in of the pipeline has failed. Drilling and, in particular, reaming, should be carried out so that all cuttings can be removed. Downhole monitoring of mud pressures is recommended to improve the chances of detecting problems such as the formation of mud rings which may result in undesirable pressure spikes.

6.3.1 Time Dependent Deformation (TDD) and Horizontal Stresses

The Queenston formation shale bedrock, similar to other sedimentary rock formations found in Southern Ontario, is known to possess high in situ horizontal stresses and exhibit long term, time dependent deformation characteristics (TDD) also referred to as "rock swelling" or "rock squeezing". Based on available historical data, these time-dependent deformations generally exceed the magnitude of the elastic movements. Free swell strain tests typically range from 0.1 to 0.3% per log cycle of time in the horizontal direction and 0.5% to 1% per log cycle of time in the vertical direction.

High horizontal to vertical stress ratios are present in the Queenston formation due to past glaciation, tectonics and rock anisotropy. Based on the available historic information, it is expected that the major horizontal stresses at the project site is in an east-west direction. The typical over-drill used for HDD installation (i.e., hole diameter ~50% larger than pipe) should be sufficient to address any rock squeeze that may occur.

6.4 Recommended Installation Method

From a geotechnical design perspective, the recommended installation method for the proposed watermain along Jordan Road and North Service Road is HDD. The second method in order of preference for the installation is Microtunneling; should the HDD method not be approved.

6.5 Non-Standard Special Provision

A copy of the "Pipe Installation by Trenchless Method, Non-Standard Special Provision (NSSP), dated July 2020 is included in Appendix F for reference.

The NSSP includes the general requirements relating to the installation of pipes by trenchless methods. It should be noted that the NSSP appended to this report is not project specific and as such has not been revised to reflect the proposed scope of installation as described in this report.

The NSSP is intended to:

- Indicate the MTO's expectations from the designers of what is required to be addressed and included in the design documents; and
- To understand the benchmark upon which the contract documents will be reviewed by the MTO from a geotechnical perspective.

The contractor undertaking the work should prepare and provide a comprehensive trenchless installation execution plan addressing the requirements of the NSSP, in advance of commencing the work.

6.6 Open Cut Excavation and Groundwater Control

Based on the results of the boreholes, open cut excavations, such as those required for the entry and receiving pits for the trenchless installation, will encounter surficial topsoil or pavement structure underlain by cohesive and non-cohesive fills and native soils. Highly weathered to competent shale bedrock may be encountered for installation along Victoria Avenue and the QEW crossing. The prevailing groundwater level is expected to be above the base of the shafts.

In accordance with the current Occupational Health and Safety Act and Regulations for Construction Projects (OHSA), properly designed shoring systems would be required for the shafts.

All excavations must be carried out in accordance with Ontario Regulation 213/91 of the Occupational Health and Safety Act. The soils and bedrock encountered at the project site are classified as shown in Table 19 below:

Table 19: Soil Classification for Excavations

SOIL	SOIL CLASSIFICATION
Granular Road Base Fill	Type 3
Cohesive and Non-Cohesive Fill	Type 3

SOIL	SOIL CLASSIFICATION
Native Sand and Silt (Non-Cohesive) and Silt and Clay (Cohesive) Mixtures above the groundwater table	Type 3
Native Sand and Silt (Non-Cohesive) and Silt and Clay (Cohesive) Mixtures below the groundwater table	Type 4
Weathered Shale Bedrock	Type 2

Excavations intersecting more than one soil type should be advanced following the requirements of the 'worst case' soil type. It should be noted that positive dewatering of the Type 4 soil would alter the soil classification to that of the same soil above the groundwater table, i.e., Type 3.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls must be suitably sloped and/or braced in accordance with Ontario Regulation 213/91 of the Occupational Health and Safety Act. The regulations stipulate maximum slopes of excavation by soil types as shown in Table 20 below:

Table 20: Maximum Slopes of Excavations

Soil Type	Base of Slope	Maximum Slope Inclination
2	within 1.2 m of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Ontario Regulation 213/91 of the Occupational Health and Safety Act, including provision for timbering, shoring and moveable trench liner boxes.

The trench side slopes should be regularly inspected for evidence of instability following periods of heavy rainfall, or periods of thawing, or when the trench has been left open for an extended period of time. Temporary open-cut excavations carried below the prevailing groundwater table in the native sands and silts stratum will experience greater amounts of seepage, an unstable trench base and sloughing off the side-walls. Due to the variable nature of these soil deposits, the seepage volume and excavation stability is expected to vary.

A qualified Geotechnical Engineer should review the proposed excavation procedures. If shored excavations are contemplated, a licensed engineer should approve the proposed shoring method.

6.6.1 Trench Groundwater Control

The measured depth to groundwater at the monitoring are summarized in Section 4.3 above.

Where open cut excavation and/or excavation for entry / receiving pits (for trenchless excavation) are below the local groundwater level, it will be necessary to lower the groundwater level below the trench base prior to construction and to maintain that level during the construction period.

In order to limit the effects of ground seepage and precipitation related water from entering the excavation which may cause sloughing, a three-stage process of excavation, installation and backfill should be used. It is recommended that the trenches be excavated in short sections (less than 15.0 m in length as per OPSS401), where the ground is excavated for the installation of services and backfilled as soon as possible. It is expected that this would be a moving process where new ground is excavated ahead of the installation while the trench with services installed is backfilled behind to continuously maintain the recommended trench length. The trench length could be adjusted during construction based on soil and groundwater conditions to remain below the MECP thresholds or permitted rate for water taking.

In order to extract groundwater at rates above 50,000 L per day, an Environment Activity and Sector Registry (EASR) will be required from the Ministry of Environment, Conservation and Parks (MECP), to extract groundwater above 400,000 L/day, a Permit To Take Water (PTTW) From the MECP will be required.

Discharge to the natural environment may require an environmental compliance approval (ECA) and or may be subject to additional requirements from the MECP. Discharge to a sewers system (storm, combined, sanitary) requires approval from the municipality which operates the sewer system.

A standalone hydrogeological report will be prepared to determine dewatering, rates, treatment, and discharge requirements, as well as permitting options. The hydrogeological report will be submitted under a separate cover.

Groundwater levels can be expected to fluctuate seasonally and with major weather events. Surface water should be directed away from excavations. Contractors bidding on this project should be cognizant of the water table conditions and should consider this during the bidding.

6.6.2 Shaft Base Stability

Where the trench base intersects saturated layers of fine sand and silt, basal instability by piping (boiling) can occur. Where encountered, the condition and extent of the wet layers of sand/silt should be assessed by test pits before the excavation continues to the design shaft base. It is recommended that this assessment be initiated where the excavation trenches encounter such saturated layers of sand and silt within one (1) m above the design shaft base. In these situations, positive dewatering should be considered. Typically, this may be accomplished from filtered wells/sumps installed below the invert of the shaft base; however, well points may be required depending on the extent of seeping silt/sand. The Geotechnical Engineer should be contacted to review the proposed excavation methods prior to construction.

6.6.3 Municipal Infrastructure Backfilling

Where manholes and catch basins are required for the sewer or reinstatement of existing manholes and catch basins is required, these components should be constructed and backfilled in accordance with specifications outlined in OPSS 407: Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation.

Settlements around manholes are common, and the settlements can be reduced by backfilling immediately around the manhole structure using OPSS Granular B material.

6.7 Temporary Shoring

A temporary shoring system may be required for the launching and receiving shafts for trenchless installation. A shoring contractor should review the geotechnical information provided in this report and make his own assessment of the shoring design requirements based on the site subsurface conditions. The shoring system must be designed to be internally (overturning, sliding etc.) and externally (slope, base heave etc.) stable. A professional engineer licensed to practice in the Province of Ontario should approve the proposed shoring design and construction methodology.

The recommended geotechnical parameters for consideration in the design of a temporary shoring system are provided in Table 21 below. For detailed subsurface stratigraphy profiles reference should be made to the Record of Borehole Sheets presented in Appendix A.

Table 21: Parameters for Design of Temporary Shoring System

Soil Type	Coefficient of Earth Pressure at Active Case (K_a)	Coefficient of Earth Pressure at Passive Case (K_p)	Coefficient of Earth Pressure at Rest Case (K_o)	Design Bulk Unit Weight (kN/m^3)	Friction Angle (degrees)/Undrained Shear Strength, kPa
Existing Cohesive Fill	-	-	-	17	-/12
Existing Non-Cohesive Fill	0.33	3.0	0.5	18	22°
Native Sands & Silts Mixtures	0.45	2.2	0.44	18	24°
Native Silts & Clays Mixtures	0.41	2.4	0.58	18	25/15
Shale Bedrock	-	-	-	26	35

It should be noted that the geotechnical parameters presented in the table above have been developed based on the subsurface conditions encountered in the boreholes as documented in this report and consideration of literature references for similar soils. Project specific field or laboratory testing has not been undertaken as a component of this investigation to confirm the values presented.

The shoring system must be designed to resist the lateral earth surcharge and hydrostatic pressures which could occur during construction. In addition, the shoring should be designed to account for lateral earth pressures resulting from the weight of the retained soil and other dead and live surcharge loads. The earth pressure distribution used for shoring design is depended on the specific wall design and on the nature of the lateral support provided.

The temporary shoring system should be designed in accordance with the methods described in the Canadian Foundation Engineering Manual (CFEM). Loading conditions (e.g. triangle/apparent) appropriate

for the type of the shoring system selected (e.g. rigid/flexible and with/without anchorage/struts) must be considered in the analysis and design of temporary shoring system. Further, the stability of the base of the excavation should be evaluated as indicated in the CFEM as a component of the design of the temporary shoring system. The design of the temporary shoring system should conform to OPSS 539.

6.8 Removal of Protective Systems and Backfilling

Temporary shoring installed within the MTO right-of-way for any aspect of the project must be removed in a safe manner on completion of construction. Reference is given to OPSS 539 which pertains to excavation support and protection systems.

On removal of temporary shoring, the excavations must be backfilled. The excavations and any adjacent disturbed areas should be restored to an equivalent (or better) condition than existed prior to the commencement of construction.

6.9 Pipe Bedding and Backfill

It is anticipated that pipe bedding and backfill will be required at the locations of the tie-in or at the shaft locations. The existing undisturbed, native cohesive and non-cohesive soils encountered at the project site will provide adequate subgrade support for the proposed watermain provided that they are used at an optimum moisture content. Where very loose to loose soils and/or organic soils are encountered at the trench base, or where disturbance of the trench base has occurred such as due to groundwater seepage or construction traffic, such materials should be sub-excavated and replaced with select granular fill compacted to at least 95% of Standard Proctor Maximum Dry Density (SPMDD). The support of pipes in these areas can also be achieved with "Controlled Density Fill" after the removal of unsuitable and deleterious materials.

Bedding and cover for the watermain must be constructed in accordance with the OPSS 410 and 514. The bedding and cover requirements for the watermain shall be a Class "B" bedding consisting of a Granular "A" material compacted to 100% SPMDD. Embedment material consisting of Granular "A" should be used to backfill around the pipe to at least 300 mm above the top of the pipe. Recycled asphalt will not be allowed for use in Granular "A" bedding material. The bedding should be placed in thin layers not exceeding 200 mm and each layer compacted to at least 100% SPMDD. In the case of saturated subgrade, the use of clear stone gravel or HL4 coarse aggregate, properly wrapped in a geotextile filter fabric, may be considered. If this is done, all joints should be overlapped and stitched and there should be no breaks or rips in the filter fabric as these would permit the entrance of fine minerals resulting in lost ground and potential settlement of the ground surface and/or the pipe. It should be noted that this is very difficult to achieve in practice, particularly if a trench box is used for side support. The bedding materials must be placed in lifts not exceeding 200 mm thick and be compacted to a minimum of 100% of SPMDD or compacted to a dense state by vibration in the case of clear stone bedding material.

The acceptance criteria for degree of compaction for trench backfill is specified in the OPSS 501. Based on MTO guidelines (OPSD 3090.101, 2005), for general design purposes the depth of frost penetration in ground at the site area is approximately 1.2 m, therefore, the trench section between the top of the pipe cover fill and to 1.2 m below finished grade should be backfilled with select subgrade materials excavated from the trench, placed in thin layers (not exceeding 300 mm) and compacted to at least 95% of SPMDD. The top portion of the trench should be backfilled with select subgrade materials placed in thin layers and

compacted to at least 98% of SPMDD. Under travelled roadways, the entire section of the roadway should be replaced with new pavement structure consisting of non-frost susceptible materials such as Granular "B" sub-base, Granular "A" base and asphaltic concrete per the project design requirements.

Stockpiles of excavated materials should be kept at least 3.0 m from the edge of any excavation to avoid slope instability.

Wet or saturated soils should be avoided for backfill material. If the excavated materials are allowed to dry too much during summer construction, additional water may be required to facilitate and achieve the required compaction.

For proper compaction, the backfill should be placed in thin layers, 200 mm thickness or less, depending on the demonstrated success of compaction based on in-situ density test results. All lumps or clods should be thoroughly broken down using sheep-foot rollers and track-mounted equipment to ensure a non-voided condition.

Other types of materials such as organic soils, overly wet soils, boulders and frozen materials (if construction is carried out in the winter months) should not be used for backfilling. In areas where the utilities are lower than the existing utility or structure, "Controlled Density Fill" should be used to backfill the 1.0 m portion of trench between the top of the watermain and the underside of the utility.

6.10 Frost Depth

In accordance with the Ontario Provisional Standard Drawing (OPSD 3090.101) the design frost depth below the ground surface for the project site is estimated to be 1.2 m.

6.11 Other Considerations

Before excavation begins at the project site, hand digging or hydro-vacuum methods should be used to expose any underground utilities in the vicinity of the proposed municipal services installation, if present, to determine the exact locations and depths.

It is emphasized that the resulting performance of the completed trenchless installation at the project site will largely be dependent upon the contractor's construction procedures and techniques. Ground movements (heave or settlement) associated with the work should be monitored for and, if necessary, the construction method should be changed to control ground movements and minimize disturbance to the highway embankment and pavement. Where adequate provisions are not included to ensure excavation stability, detrimental surface settlement could occur, adversely impacting the highway and any associated existing underground services present.

Should remedial works be required of the highway embankment and pavement for settlement/heave, further monitoring of the situation will be required until all movement has stabilized.

Prior to the construction, the contractor should be required to submit their proposed installation method and monitoring program (identifying the risks and methods of control for possible problems that could cause interference to the highway, such as settlement/heave) for the review and approval from the Project Designers and the MTO.

6.12 Settlement

Settlements associated with trenchless installation methods are typically of two types:

- Large settlements: these settlements are the result of loss of ground due to over-excavation caused by the inability to control adverse ground condition or operators' errors. Large settlements can lead to the creation of voids and/or sinkholes above the installed pipeline; and

- Systematic settlements: these settlements are primarily caused by the collapse of the annular space between the pipe and the bore annulus or by deformation of the soils ahead of the bore.

The systematic settlements caused by tunneling is the aggregate of two basic types of settlement, which consist of ground loss, or immediate settlement, and consolidation settlement.

The anticipated settlement as a result of the proposed pipe installation is also a function of the selected method, pipe depth, and profile. The anticipated settlements below the Highway pavement due to both the trenchless installation and the shaft construction are anticipated to be less than 15 mm provided that suitable tunneling methods, groundwater control, good workmanship and temporary ground support are implemented.

Notwithstanding the above, an instrumentation and monitoring program is recommended at the project site to:

- Document the effects of the installation on the overlying highway;

- Obtain prior warning of ground movements that could occur due to the construction methods and equipment or unforeseen ground conditions;

- Verify the Contractor's compliance with the settlement limits imposed in the Contract Documents; and

- Allow adjustments to be made to the installation methods such that the settlement limits are not exceeded.

Good workmanship and site control are the most effective way to reduce immediate settlements to a practical minimum.

6.13 Settlement Monitoring

During trenchless installation, the ground over and in the vicinity of the tunnel alignment may experience settlement. Good workmanship and site control are the most effective way to reduce settlements to a practical minimum. It is recommended that ground movement during tunneling be monitored together with the monitoring of HDD operations. This is to confirm that the tunneling process does not cause any significant impact on existing infrastructure and the pipe is properly installed. If any adverse effect of tunneling is identified during the monitoring program, the HDD process should be modified accordingly.

The MTO Guidelines for Foundation Engineering – Tunneling Specialty, for Corridor Encroachment Permit Application addresses the requirements for a settlement monitoring program to prevent damage to existing utilities and highway structures along the tunnel alignment.

In general, the settlement monitoring program provides for:

- Completion of a pre-condition survey of the existing pavement and any infrastructure within the construction zone of influence;
- Installation of surface settlement markers and deep settlement monitoring points;
- Collection of settlement monitoring data;
- Assessment of the settlement monitoring data with comparison to prescribed trigger levels; and
- Distribution of settlement monitoring data including notification if the trigger level(s) are exceeded with recommended corrective and/or preventive measures as warranted if movements are recorded.

A Geotechnical Instrumentation Monitoring Plan (GIMP) Drawing indicating the location of the proposed monitoring instruments to monitor the ground movement during the Horizontal Directional Drilling (HDD) operations underneath the QEW crossing is presented in the Drawings.

For detailed GIMP requirements, reference should be Section 7.07 of the MTO Non-Standard Special Provision for the Installation of Pipes by Trenchless Methods provided in Appendix F.

7.0 Environmental Discussion and Recommendations

TCLP analyses results were compared to Schedule 4 Leachate Quality Criteria (as outlined by the "Registration Guidance Manual for Generators of Liquid Industrial and Hazardous Waste," October 2000). The TCLP analyses demonstrated concentrations that were below applicable Schedule 4 Leachate Quality Criteria. The TCLP analyses for the parameters tested (metals/inorganics, VOCs, and benzo(a)pyrene) indicated that dry soils (soils that would pass a slump test) would be classified as non-hazardous for the purposes of disposal at an approved landfill or soil treatment facility. Bulk PCBs were not detected in the seven (7) tested samples.

This soil quality characterization was based on Wood's understanding of site conditions and available information at the time of the geotechnical investigation. Further assessment and/or chemical analyses would be considered appropriate depending on the soil management option selected and/or receiver's requirements.

An excess soils regulation (O.Reg.406/19) was adopted by the Ontario Ministry of the Environment, Conservation, and Parks (MECP), elements of which came into force in January 2021. O.Reg.406/19 will eventually include specific requirements for Sampling and Analysis Plans and Soil Characterization Reports (e.g., description of characterization/testing methods, borehole frequency per area requirements for in-situ sampling, etc.) and will require the preparation, certification, and registering of the Sampling and Analysis Plans and Soil Characterization Reports on an online Excess Soil Registry. The soil sample testing frequency

required under O.Reg.406/19 is volume and parameter based. Once the excess soils receiver site(s) and actual export volumes have been determined as part of the construction phase, the soil quality characterization requirements can be revisited. Following the completion of the appropriate number of bulk and leachate tests, the appropriate documents will be prepared, if applicable, to ensure that the O.Reg.406/19 soil testing and administrative requirements are met.

8.0 Closure

The limitations of this report, as discussed in detail below, constitute an integral part of this report. It is recommended that a Geotechnical Consultant be retained to review drawings and the intended methods of construction prior to commencing construction in order to ensure conformance with the geotechnical restrictions and assumptions.

This Geotechnical Design Report was prepared by Vishu Vasisht, P.Geo, PMP, Project Manager and Mr. Ty Garde., M.Eng., P.Eng., Principal Geotechnical Engineer and a Designated Foundations Contact for MTO Projects conducted an independent review of this report.

We trust this report is complete within the terms of our reference. However, should questions arise concerning this report, do not hesitate to contact us.

Sincerely,
Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Prepared by:

Vishu Vasisht, P.Geo, PMP.
Project Manager

Reviewed by:

Ty Garde, M.Eng., P.Eng.
Principal Engineer-Geotechnical
Designated MTO Foundations Contact

Table 22: Comparative Assessment of the Installation Methods

Installation Methods	Advantages	Disadvantages
Open-Cut	• Best control of gradient and alignment of sewer • Reduced potential of difficulties due to obstructions • Least risk of un-anticipated impact on active highway • Could permit higher invert elevation than trenchless methods	• Requires lane closures and pavement reconstruction. • Groundwater control required • Potential post-construction settlement of trench backfill should be expected. However, this could be mitigated using unshrinkable fill • Greater impact on traffic than trenchless technologies
Pipe Jacking/Jack and Bore	• Pipe can be installed without lane closures resulting in minimal traffic disruption • Supports pipe internal diameter of 150-900 mm • Some control of direction; accuracy about 50 mm for relatively short installations	• Large work area required for jacking pit • Length of the proposed installation exceeds the limit of typical pipe jacking operation (up to about ~100 m) • Installation difficulty may arise in coarse glaciolacustrine sediments inferred to be containing cobbles and boulders • Risk of misalignment of casing/pipe if obstructions like large cobbles or boulders are encountered • Not applicable for installation in bedrock
MTBM	• Machine is able to counterbalance earth and water pressures in a controlled manner, thereby reducing the risk of ground losses during tunnelling	• Lack of availability of machines with a suitable diameter bore • Relatively expensive, with high mobilization cost • Deep launch and receiving shafts required. • Risk of ground loss and settlement as only minimal hydrostatic mud pressure can be provided for installation in overburden

Installation Methods	Advantages	Disadvantages
	• Machine can also be specified to have the capability to crush boulders and nests of cobbles	
HDD	• Pipe can be installed without lane closures resulting in minimal traffic disruption • Suitable for variety of ground conditions above and below groundwater table • Drive lengths up to about 180 m (small diameter) to 2000 m (large diameter) • Steerable both horizontally and vertically with an accuracy of about 1% of total length • Deep launch and receiving shafts not required for HDD	• Large work area required for the temporary work spaces like entry and exit pits. • Risk of ground surface subsidence increases with decreasing cover alignment deviation and/or halt the bore. • Boulders and concentration of cobbles can impede or deflect the bore path. • The risk of fluid loss or frac-out is highest during pilot hole drilling with the HDD method where the smaller borehole size results in a higher circulating pressure. In some cases loss of circulation from the borehole cannot be prevented and results in fluid release to either the ground surface.

Limitations to Geotechnical Reports

1. The work performed in the preparation of this report and the conclusions presented herein are subject to the following:
   a) The contract between Wood and the Client, including any subsequent written amendment or Change Order dully signed by the parties (hereinafter together referred as the "Contract");
   b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by Wood to the Client in connection to the Contract; and
   c) The limitations stated herein.
2. **Standard of care:** Wood has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of Wood's profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.
3. **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by Wood and to the topics specifically discussed in it, and is not applicable to any other aspects, areas or locations.
4. **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: i) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions and qualifications/limitations set forth in this report.
5. **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter "Supplied Data"). Wood cannot be held responsible for any loss or damage, of either contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on the Supplied Data.
6. **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by Wood.
7. **No legal representations:** Wood makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
8. **Decrease in property value:** Wood shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **No third party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this document, for use or consideration by any third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report or anything set out therein. including without limitation, any indirect, special, incidental, punitive or consequential loss, liability or damage of any kind.
10. **Assumptions**: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to Wood changes made in the project, including but not limited to, details in the design, conditions, engineering or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. Wood shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.
11. **Time dependence**: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by Wood to be contemplated by the Client at the commencement of Wood's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by Wood, and the conclusions of the report are amended or are validated in writing accordingly.

    Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.

    Wood will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.
12. **Limitations of visual inspections:** Where conclusions and recommendations are given based on a visual inspection conducted by Wood, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These

conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in Wood's opinion, for direct observation.

13. **Limitations of site investigations**: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

    Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.

    Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation and snowmelt.

    During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended practice that Wood be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained and to deal quickly with geotechnical considerations if they arise.

    Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by Wood is not provided during construction.

14. **Factors that may affect construction methods, costs and scheduling**: The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc.

    Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.

15. **Groundwater and Dewatering**: Wood will accept no responsibility for the effects of drainage and/or dewatering measures if Wood has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.

16. **Environmental and Hazardous Materials Aspects**: Unless otherwise stated, the information contained in this report in no way reflects on the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wild life conditions, rare plants or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention or assessment of conditions that can contribute to moisture, mould or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes.

17. **Sample Disposal**: Wood will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with Wood or a third party.

Wood Environment & Infrastructure Solutions,

a Division of Wood Canada Limited

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org

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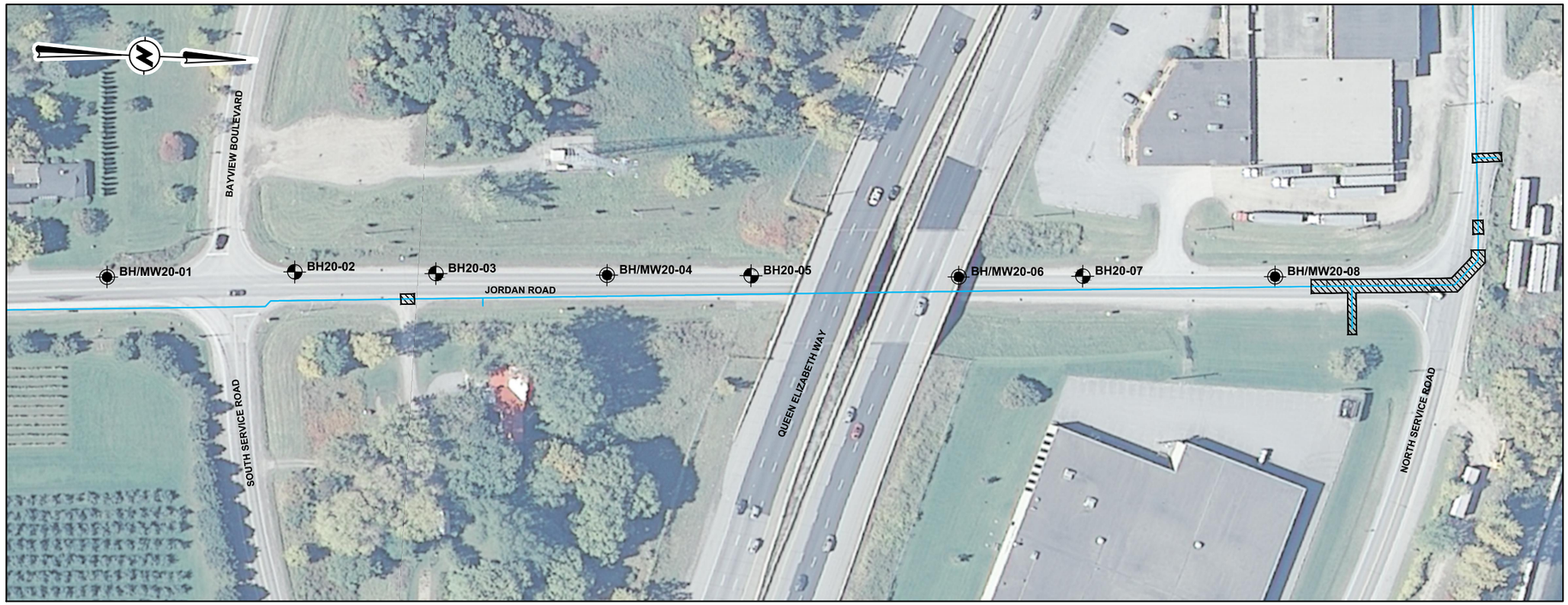

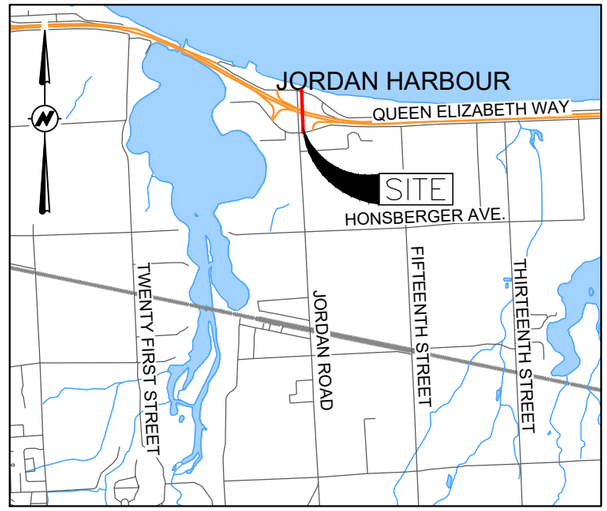

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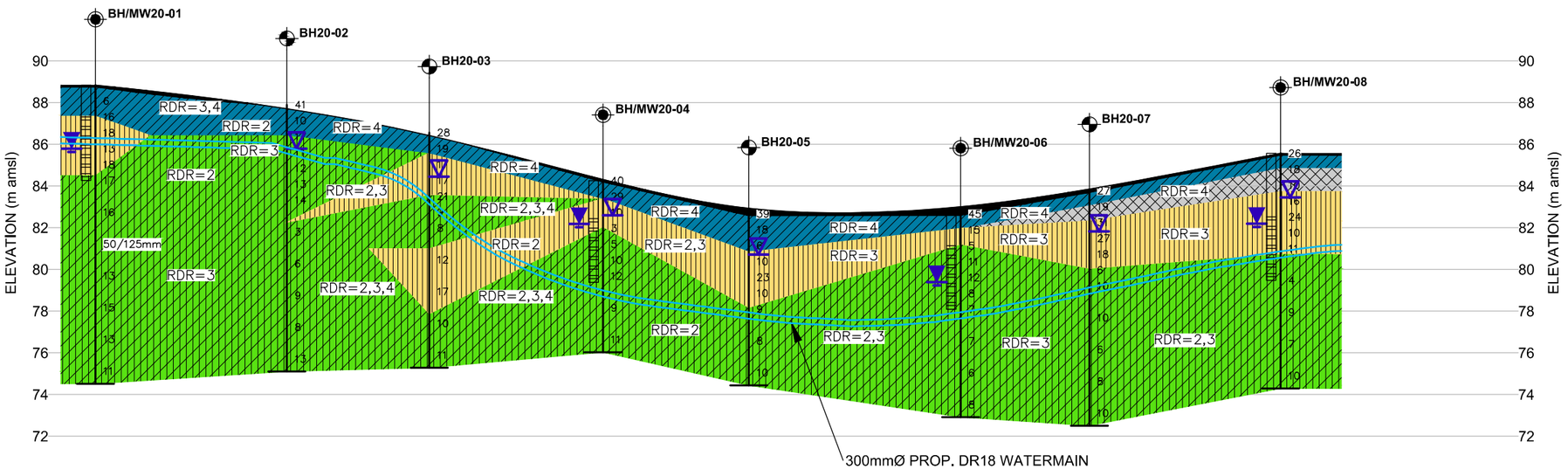

LEGEND

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION
- PROPOSED EXCAVATION

SIMPLIFIED STRATIGRAPHY

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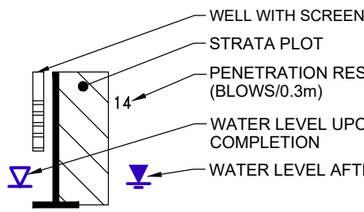

* FOR COMPLETE DETAILS REFER TO RECORD OF BOREHOLES *

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CAD FILE NO.	TITLE	NO.	DATE	

DRAWN BY:	DESIGNED BY:
LMK 02/01/2021	VV 02/01/2021
CHECKED BY:	APPROVED BY:
OL 02/01/2021	MC 02/01/2021

SCALE: AS SHOWN FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER T. J. GARDE Sep 27, 2021 PROVINCE OF ONTARIO

Ontario MINISTRY OF TRANSPORTATION

Town of Lincoln

GHD

wood.

PRUDHOMMES WATERMAIN UPGRADE

GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATION
JORDAN ROAD
KEY PLAN, BOREHOLE LOCATION PLAN & INTERPRETED SUBSURFACE STRATIGRAPHY PROFILE

GEOCRES No:	FILE NO.	REV.	DWG.
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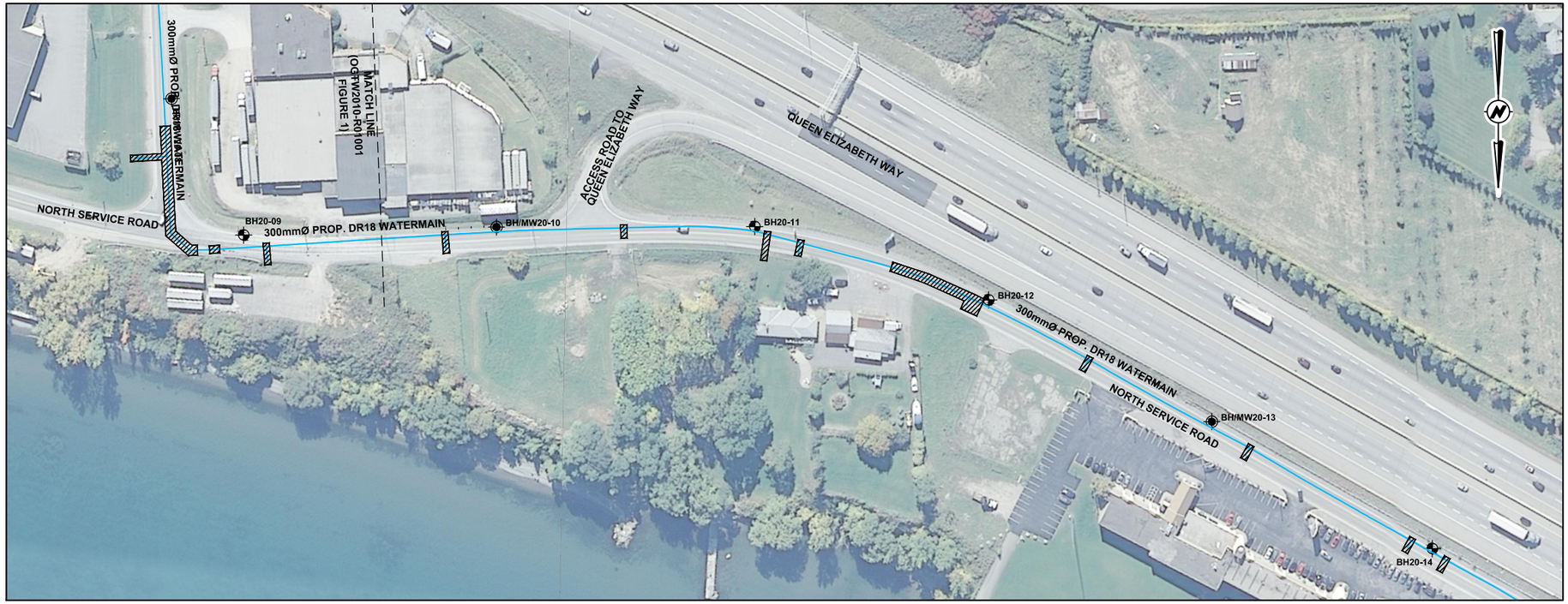

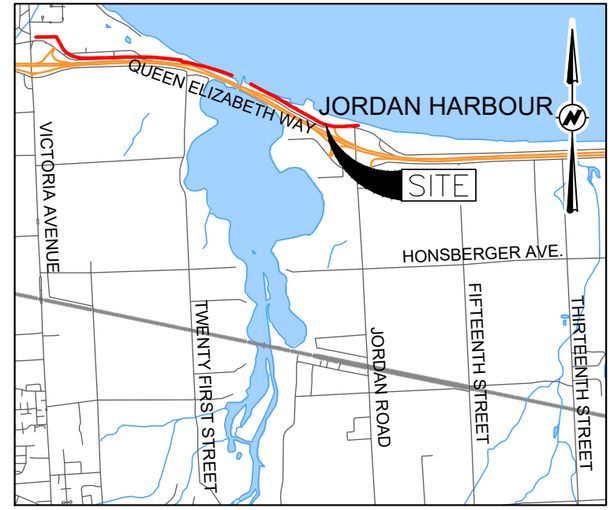

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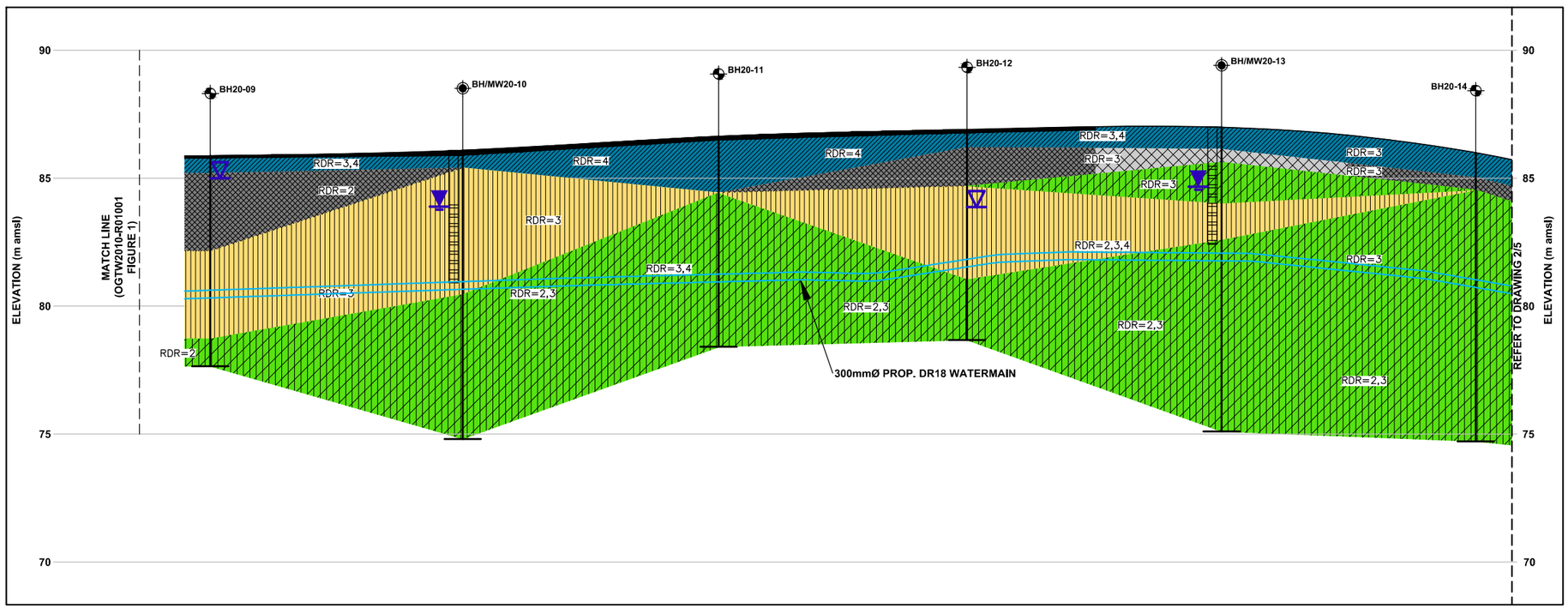

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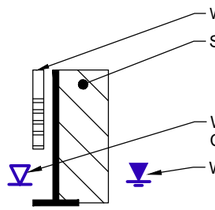

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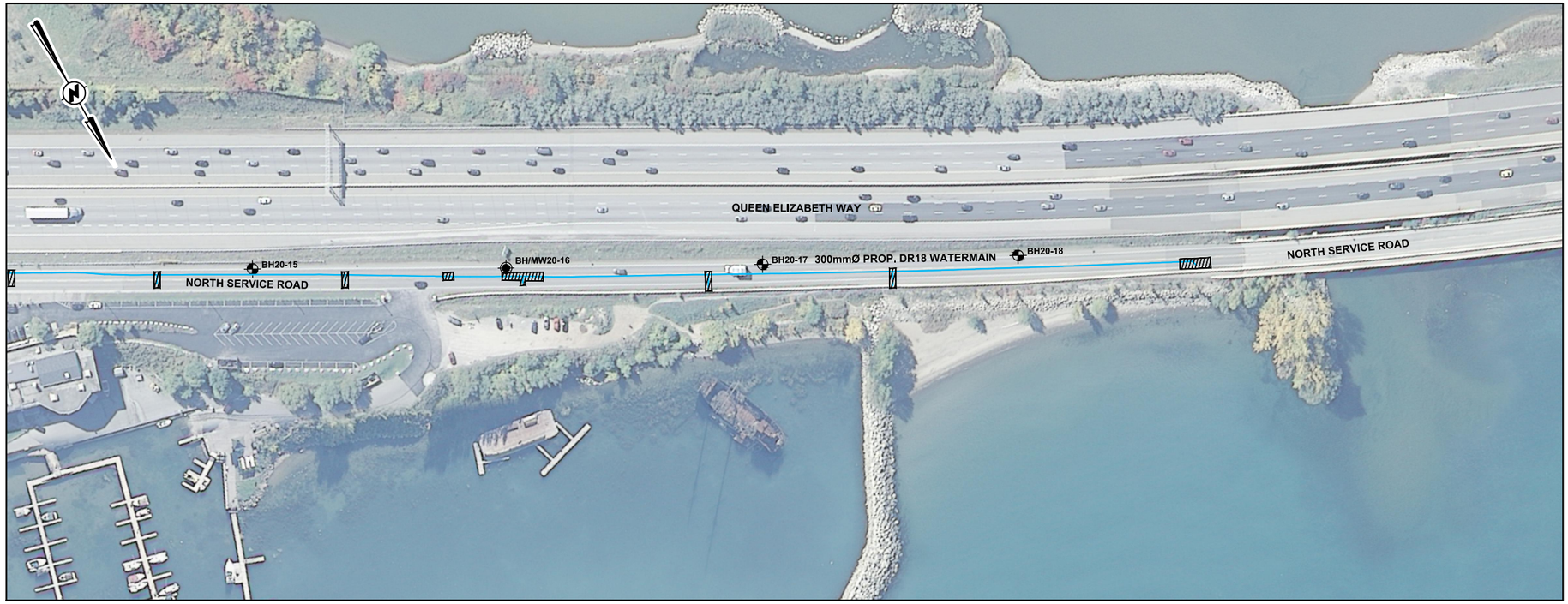

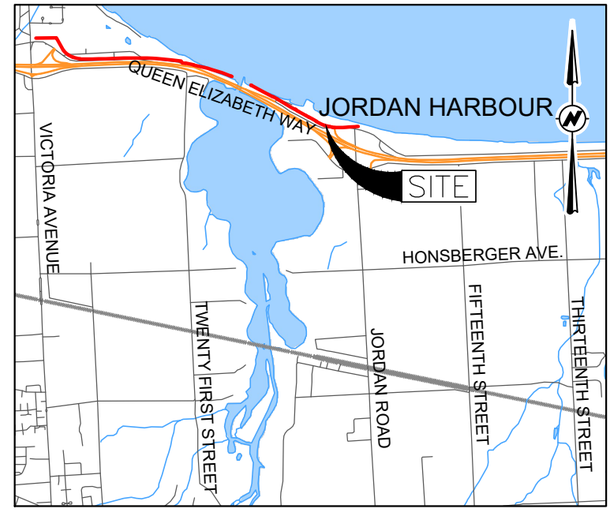

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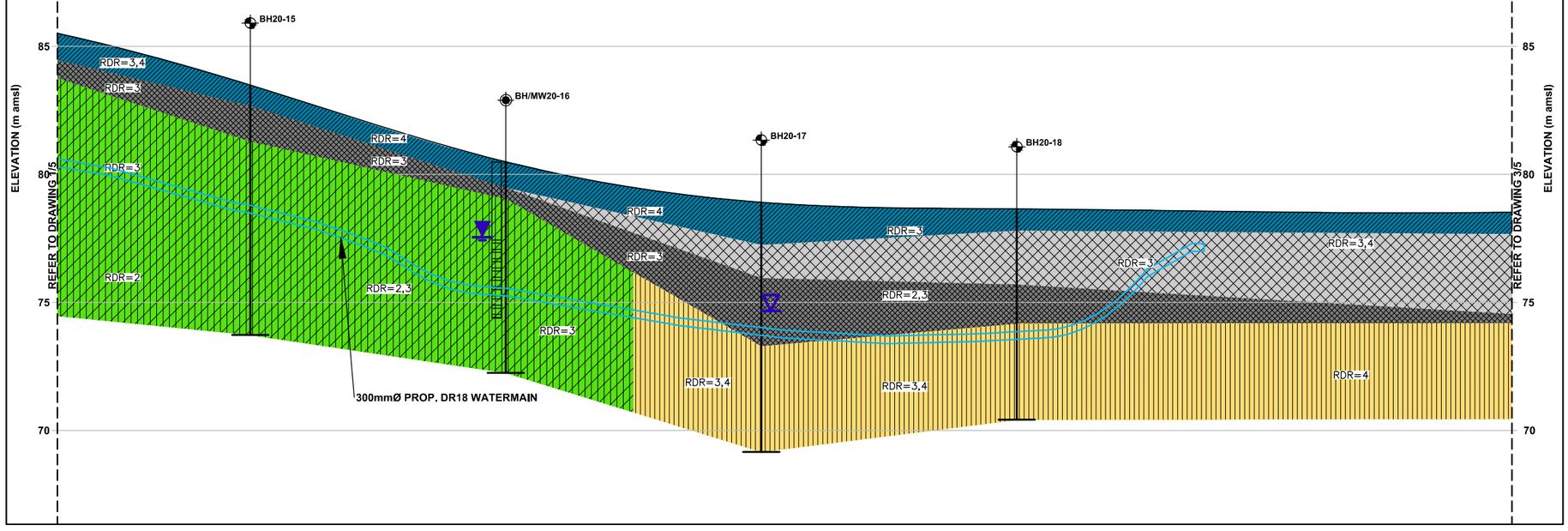

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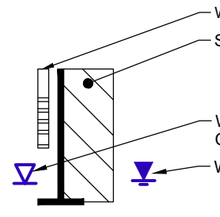

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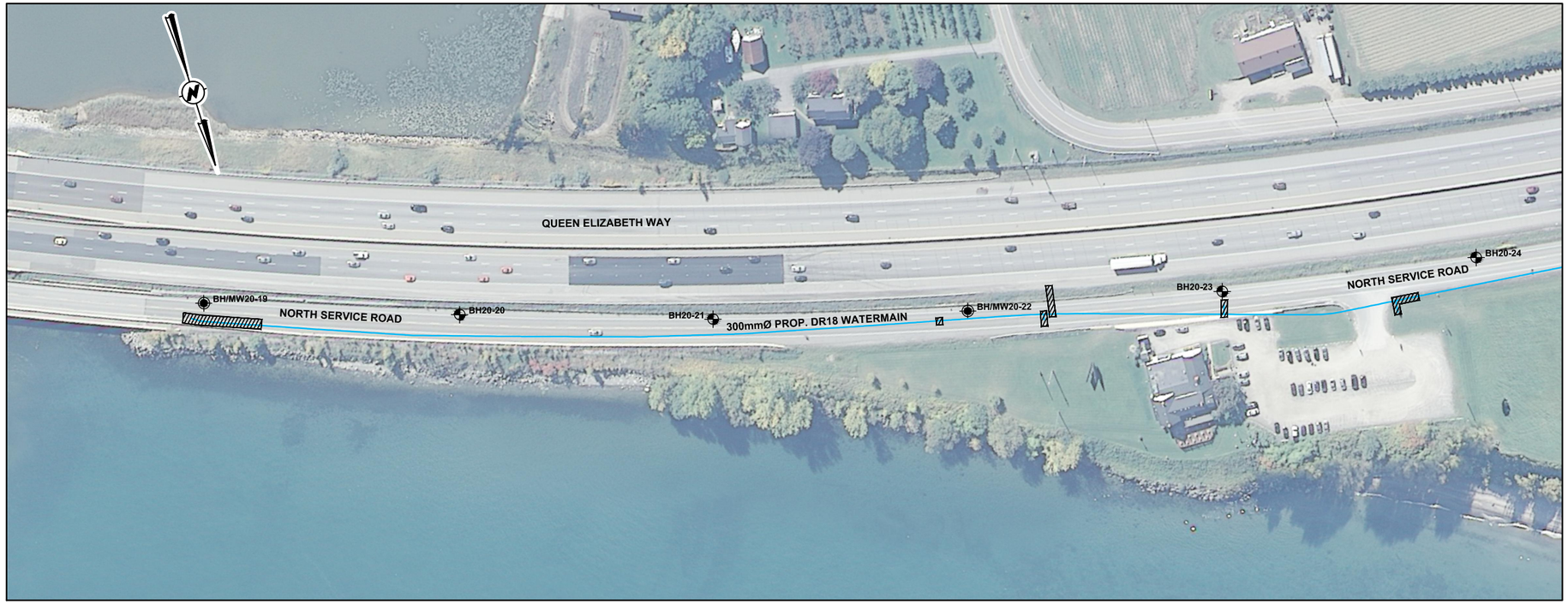

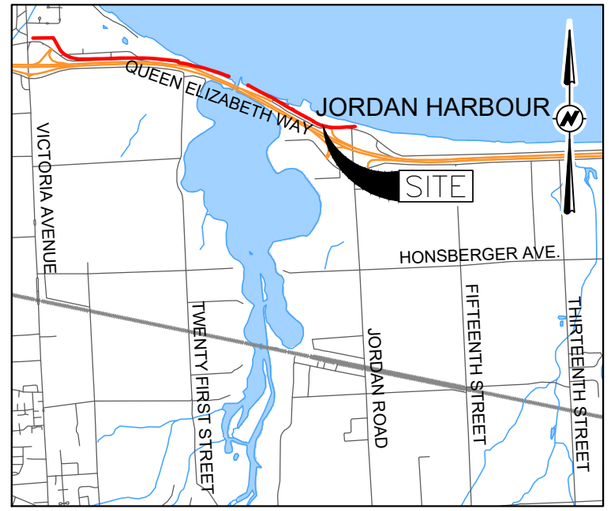

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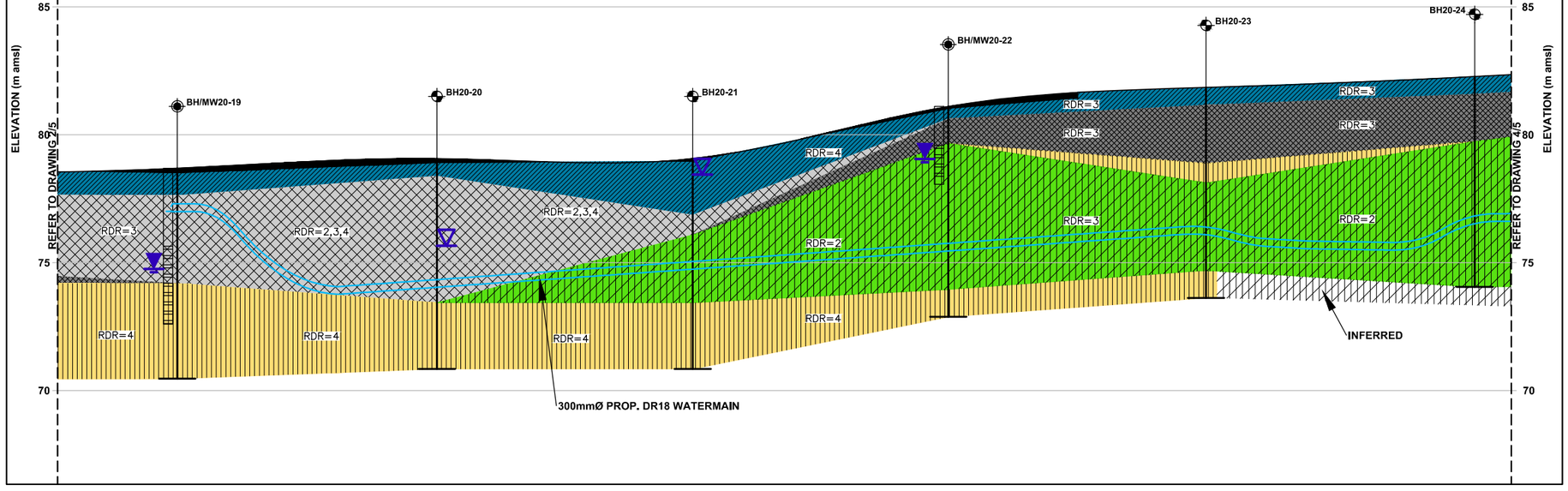

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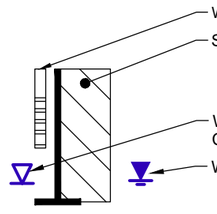

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GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATION
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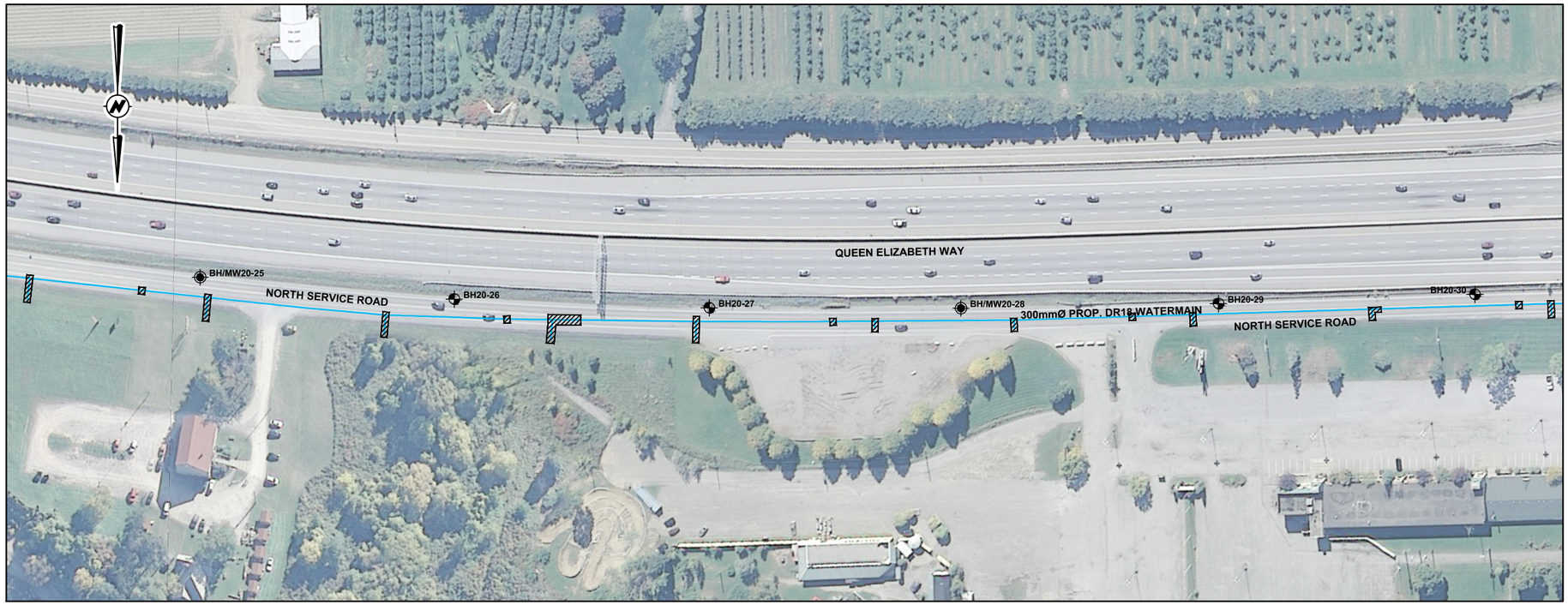

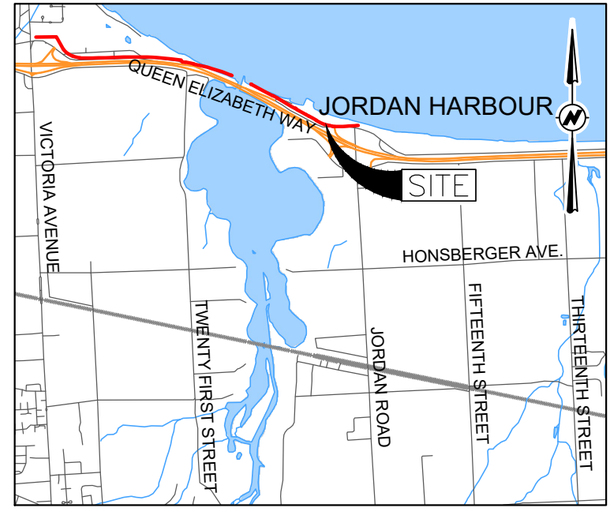

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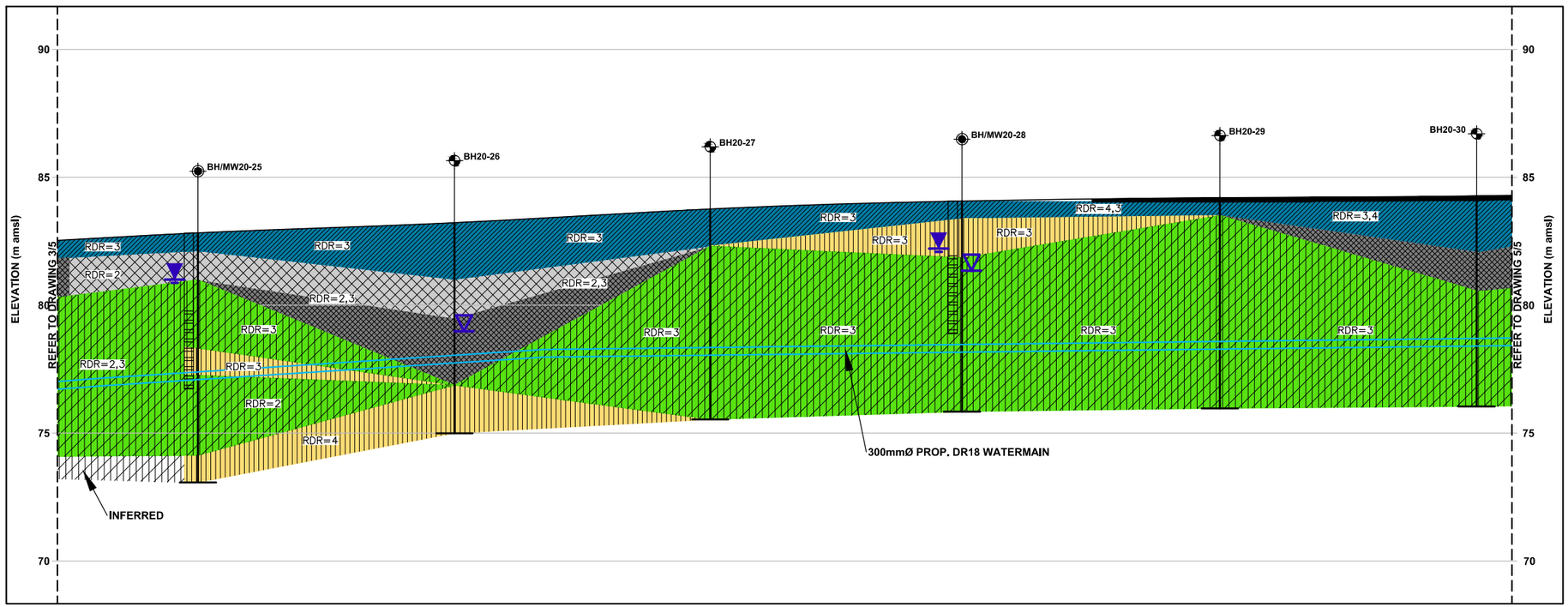

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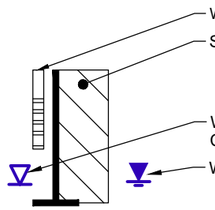

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1	02/05/2021	EDITS PER O.L./V.V
0	01/26/2021	ISSUED FOR PRELIMINARY REVIEW
NO.	DATE	

DRAWN BY: LMK 02/05/2021	DESIGNED BY: VV 02/05/2021
CHECKED BY: OL 02/05/2021	APPROVED BY: MC 02/05/2021

SCALE: AS SHOWN FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER T. J. GARDE Sep 27, 2021 PROVINCE OF ONTARIO

Ontario MINISTRY OF TRANSPORTATION

Town of Lincoln

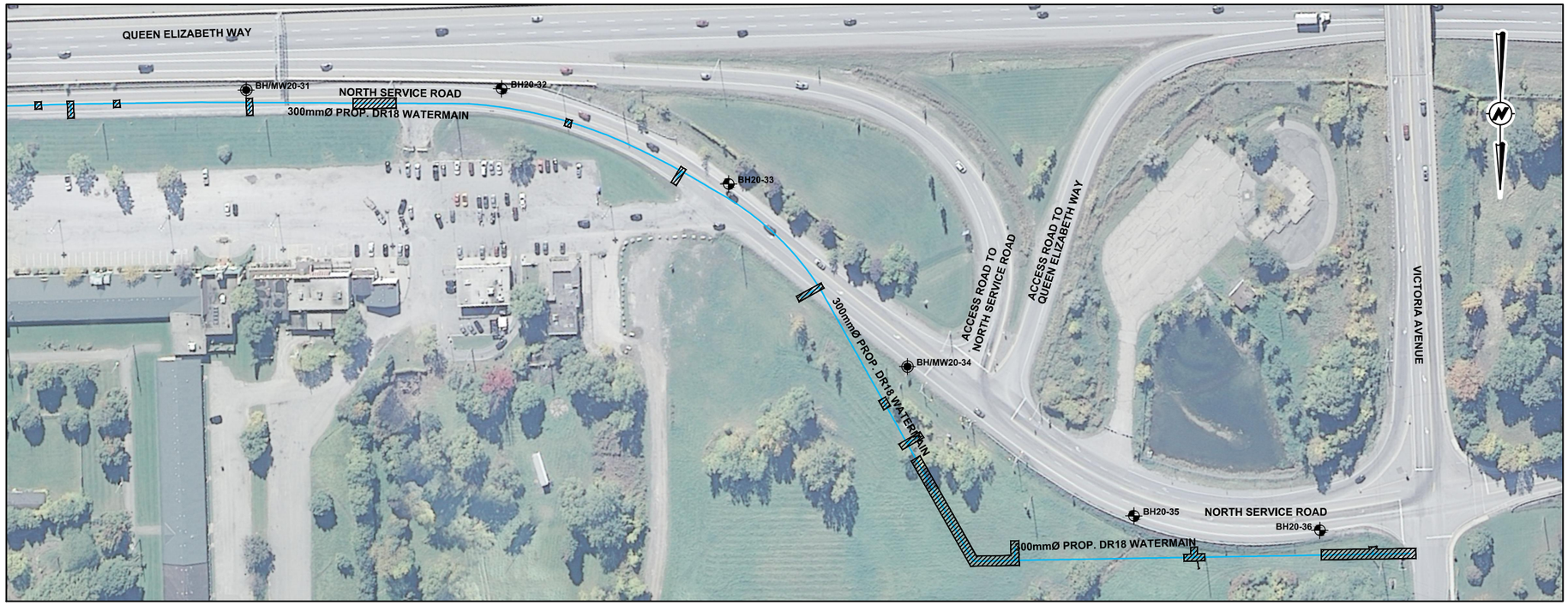
GHD

wood.

PRUDHOMMES WATERMAIN UPGRADE

GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATION
NORTH SERVICE ROAD
KEY PLAN, BOREHOLE LOCATION PLAN & INTERPRETED SUBSURFACE STRATIGRAPHY PROFILE

GEOCRES NO.	FILE NO.	REV.	DWG.
30M3-324	OGTW2010-R02001	0	4/5



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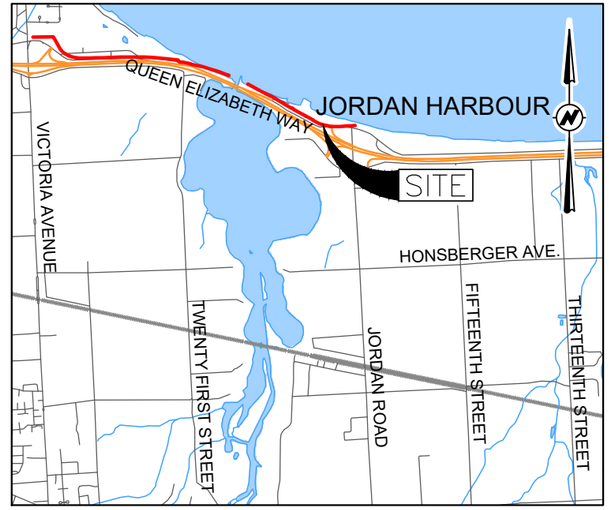
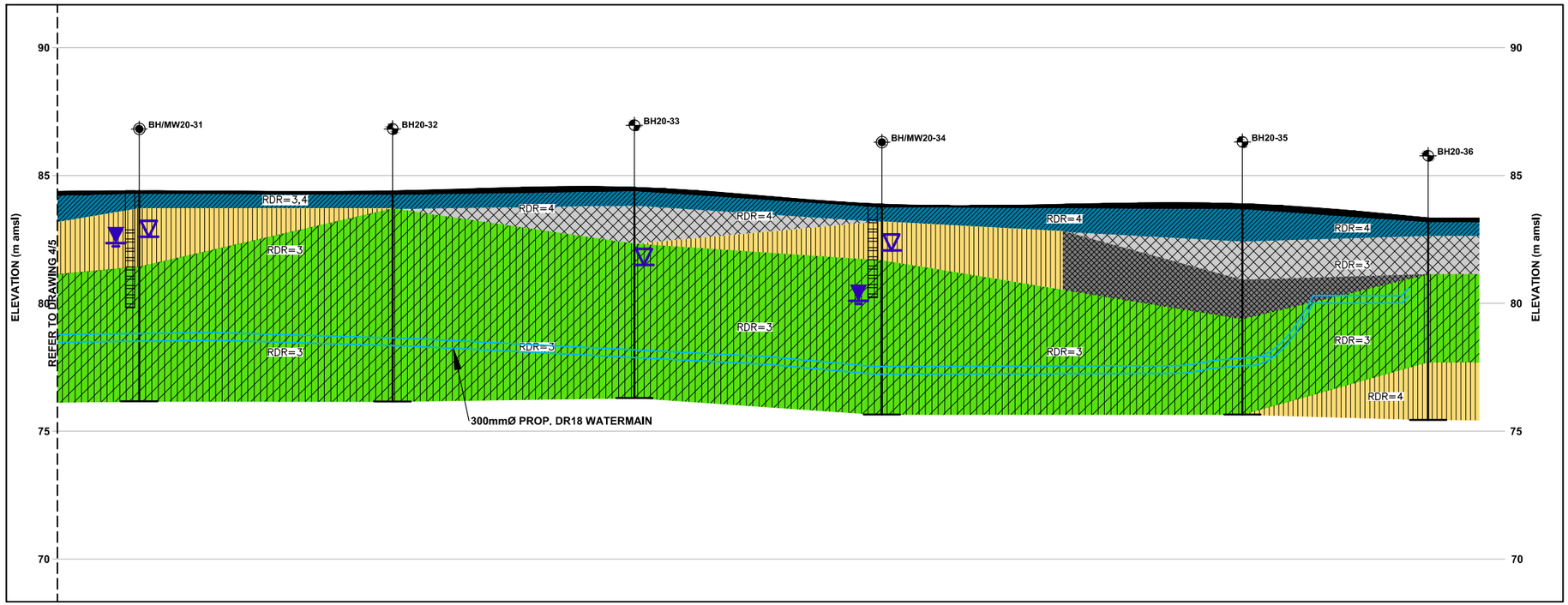


KEY PLAN

0 20 60 100m

HORIZONTAL SCALE 1:2,000

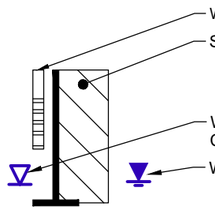


LEGEND

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION
- PROPOSED EXCAVATION

SIMPLIFIED STRATIGRAPHY

- ASPHALT
- GRANULAR ROAD BASE FILL
- NON COHESIVE FILL (VARIOUS FRACTIONS OF GRAVELS, SANDS & SILTS, TRACE CLAY)
- COHESIVE FILL (VARIOUS FRACTIONS OF CLAY, SANDS & SILTS, TRACE GRAVEL)
- NATIVE-NON COHESIVE SOIL (VARIOUS FRACTIONS OF GRAVELS, SANDS & SILTS, TRACE CLAY)
- NATIVE-COHESIVE SOIL (VARIOUS FRACTIONS OF CLAY, SANDS & SILTS, TRACE GRAVEL)



* FOR COMPLETE DETAILS REFER TO RECORD OF BOREHOLES *

REFERENCE DRAWINGS	
	2008 AERIAL PHOTOGRAPH U.S. GEOLOGICAL SURVEY
ACAD-C00-C48.dwg	REPLACEMENT OF EXISTING WATERMAIN JORDAN ROAD/NORTH SERVICE ROAD FROM FOURTH AVENUE TO VICTORIA ROAD
CAD FILE NO.	TITLE

REVISIONS		
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PRUDHOMMES WATERMAIN UPGRADE

GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATION
NORTH SERVICE ROAD
KEY PLAN, BOREHOLE LOCATION PLAN & INTERPRETED SUBSURFACE STRATIGRAPHY PROFILE

GEOCRES NO.	FILE NO.	REV.	DWG.
30M3-324	OGTW2010-R02001	0	5/5

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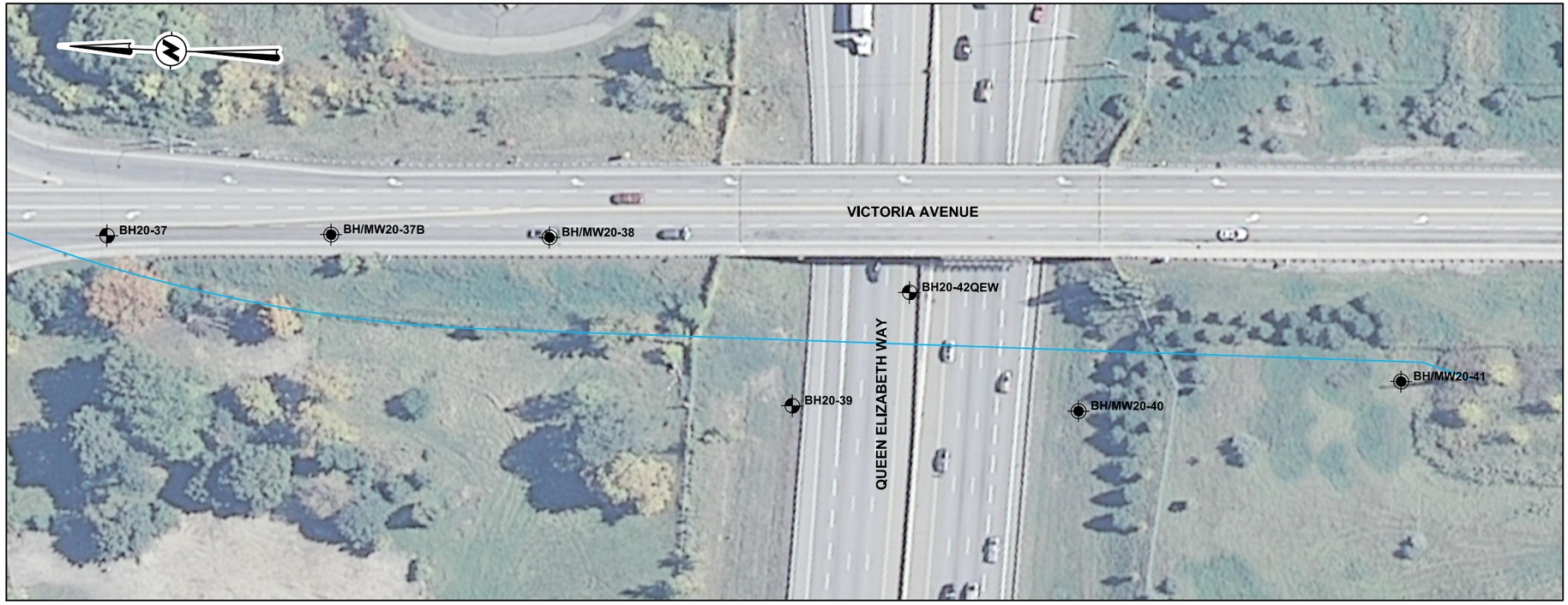
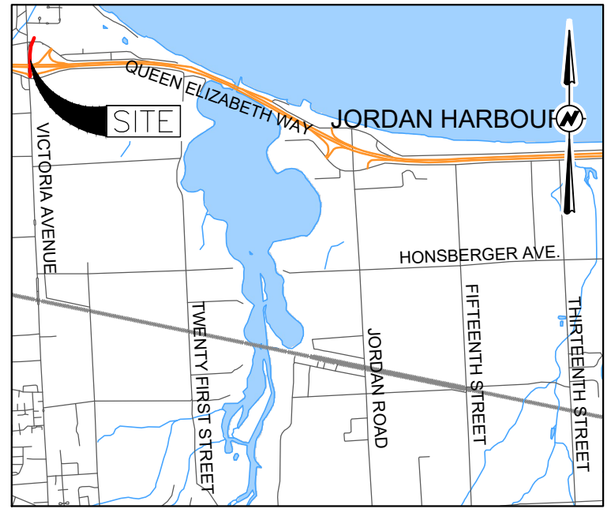




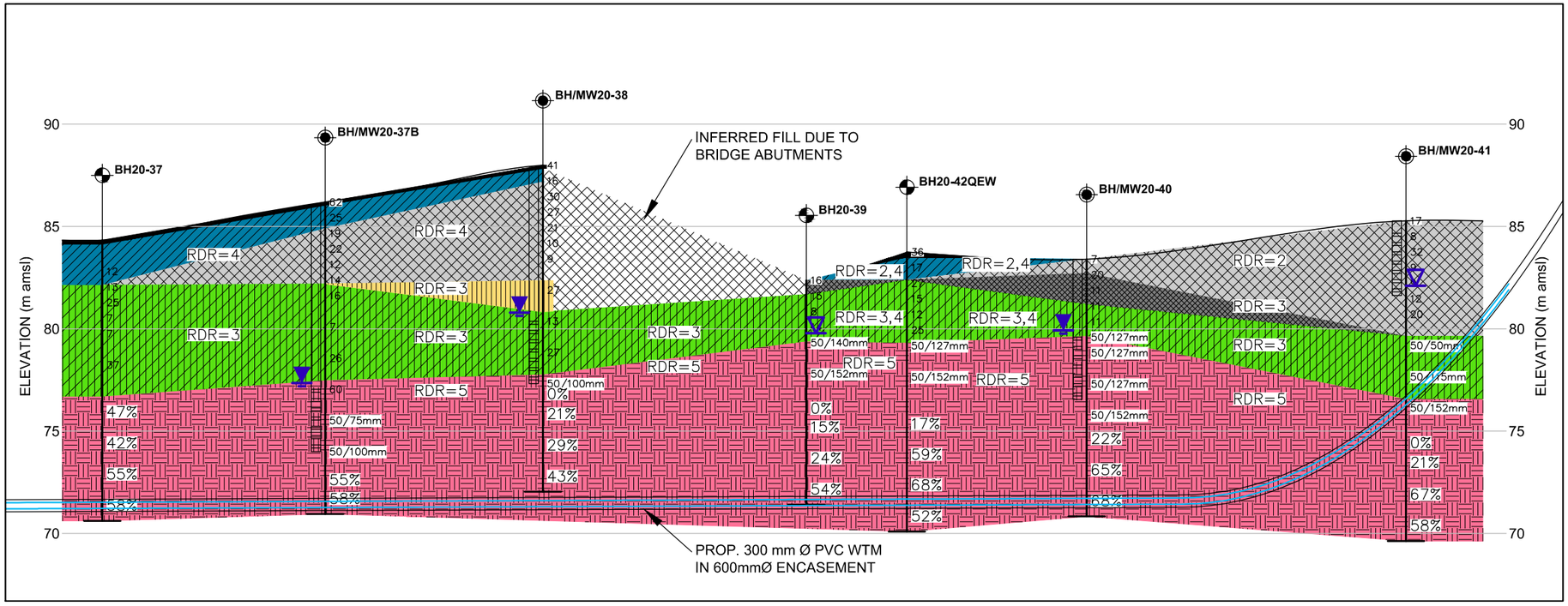
KEY PLAN

0 10 30 50m

HORIZONTAL SCALE 1:1,000

0 1 5 10m

VERTICAL SCALE 1:250



LEGEND

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION
- PROPOSED EXCAVATION

SIMPLIFIED STRATIGRAPHY

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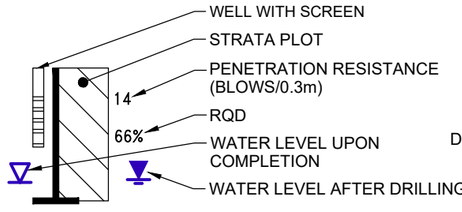
- NATIVE-COHESIVE SOIL (VARIOUS FRACTIONS OF CLAY, SANDS & SILTS, TRACE GRAVEL)
- SHALE BEDROCK



* FOR COMPLETE DETAILS REFER TO RECORD OF BOREHOLES *

REFERENCE DRAWINGS		REVISIONS		
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ACAD-C00-C48.dwg	REPLACEMENT OF EXISTING WATERMAIN JORDAN ROAD/NORTH SERVICE ROAD FROM FOURTH AVENUE TO VICTORIA ROAD	0	01/26/2021	ISSUED FOR PRELIMINARY REVIEW
CAD FILE NO.	TITLE	NO.	DATE	

DRAWN BY:	DESIGNED BY:
LMK 03/05/2021	VV 03/05/2021
CHECKED BY:	APPROVED BY:
OL 03/05/2021	MC 03/05/2021

SCALE: AS SHOWN FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER T. J. GARDE Sep 27, 2021 PROVINCE OF ONTARIO

Ontario MINISTRY OF TRANSPORTATION

Town of Lincoln

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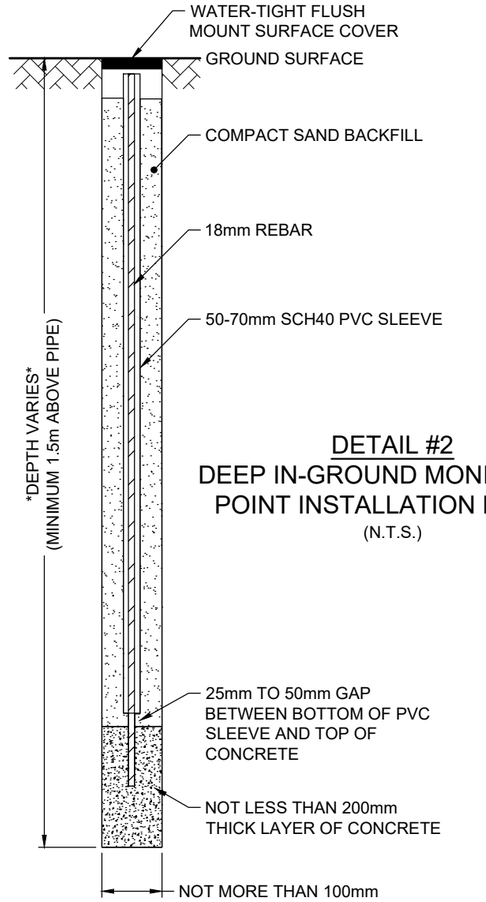
PRUDHOMMES WATERMAIN UPGRADE

GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATION
VICTORIA AVENUE
KEY PLAN, BOREHOLE LOCATION PLAN & INTERPRETED SUBSURFACE STRATIGRAPHY PROFILE

GEOCRES No:	FILE NO.	REV.	DWG.
30M3-324	OGTW2010-R03001	0	1/1

DETAIL #1
SURFACE MONITORING POINT INSTALLATION DETAIL
(N.T.S.)

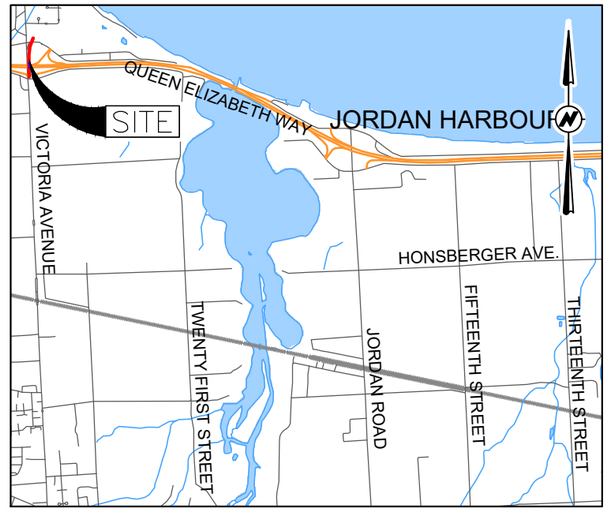
NOTES:
1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS GEOTECHNICAL INSTRUMENT MONITORING PLAN (GIMP) REPORT NO. OGTW2010
2. ALL MONITORING LOCATIONS SHOULD BE CONSIDEREDAPPROXIMATE AND MUST BE CONFIRMED PRIOR TO INSTALLATION AND MAY HAVE TO BE ADJUSTED IN THE FIELD TO SUIT LOCATION CONDITIONS AND/OR RESTRAINTS.
3. THE SURFACE MONITORING SHALL BE IDENTIFIED USING PAINT MARKS ON THE PAVEMENT. THE INTERVAL AND/OR MARKING OF THE POINTS SHOULD BE CHANGED WITH MTO'S APPROVAL WHERE TRAFFIC DISRUPTIONS MIGHT OCCUR.
4. A CONDITION SURVEY FOR THE PAVEMENT SHALL BE CARRIED OUT PRIOR TO COMMENCEMENT OF CONSTRUCTION AND DOCUMENTED FOR THE PURPOSE OF REQUIREMENT OF RESTORATION. THE CONDITION SURVEY SHALL DOCUMENT VISIBLE FLAWS SUCH AS CRACKS, DISTORTIONS AND DEVIATIONS, HEAVES, AND DEPRESSIONS. THIS SURFACE SURVEY SHALL BE COMPLETED DURING THE INSTALLATION OF THE MONITORS AND AGAIN ONCE THE TUNNEL HAS BEEN COMPLETED.
5. AN AVERAGE OF AT LEAST TWO READINGS SHALL BE TAKEN TO ESTABLISH BASELINE CONDITIONS. A MINIMUM OF THREE (3) SETS OF READING BE TAKEN DAILY, PROVIDED THAT MOVEMENTS ARE WITHIN ANTICIPATED LIMITS. OTHERWISE, THE FREQUENCIES SHOULD INCREASE ACCORDING TO A PRE-PLANNED INTERVAL. THE READING AND COLLECTION OF DATA FROM THE SURFACE MONITORING POINTS SHALL BE READ AND RECORDED BY THE CONTRACTOR DURING THE CONSTRUCTION PERIOD AND AFTER CONSTRUCTION FOR PERIOD OF AT LEAST 2 WEEKS PROVIDED THAT FURTHER SETTLEMENT HAS STOPPED.
6. MONITORING OF MOVEMENTS IS REQUIRED DURING WORK STOPPAGES, SUCH AS NON- OPERATION PERIOD (OFF-SHIFTS) OR WEEKENDS. A MINIMUM OF 3 SETS OF READINGS SHOULD BE TAKEN DAILY. MEASUREMENTS SHOULD BE REPORTED TO MTO FOR REVIEW.
7. EACH MONITORING POINT (DETAIL 2) SHOULD BE SECURELY ANCHORED TO THE ASPHALT ON THE PAVED SHOULDERS, AND PLACED IN LINE WITH THE PROPOSED 600MM DIA ENCASEMENT. 150mm ON EITHER SIDE FROM THE CENTER OF INSTALLATION AND OFFSET AT A LATERAL DISTANCE OF 1.5m ON EITHER SIDE OF THE TUNNEL CENTERLINE.
8. SURFACE MARKERS SHALL BE RECESSED OR OTHERWISE DESIGNED FOR SAFE PASSAGE OF VEHICLES AT HIGHWAY SPEEDS AND PROTECTED FROM SNOW REMOVAL EQUIPMENT IN THE EVENT THAT WORK OCCURS DURING SNOW REMOVAL SEASONS.



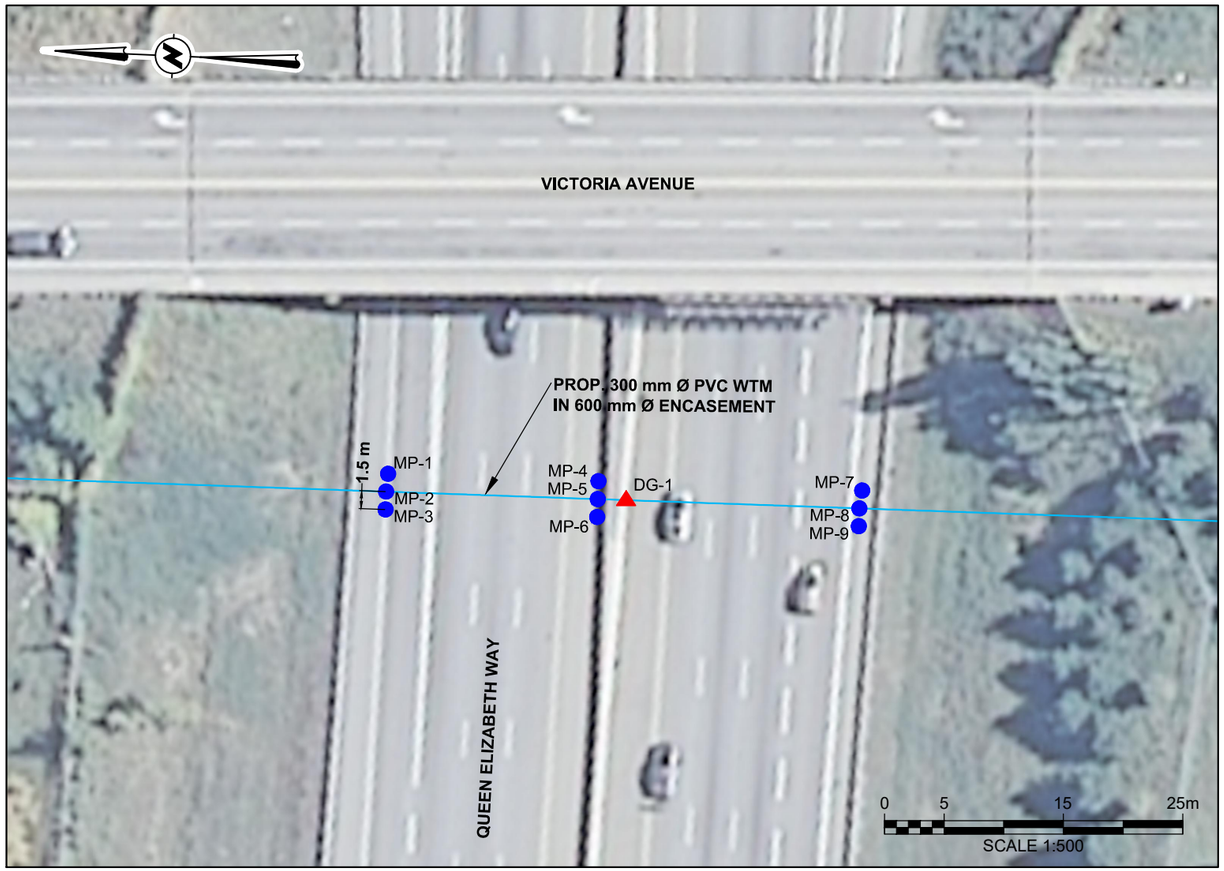
DETAIL #2
DEEP IN-GROUND MONITORING POINT INSTALLATION DETAIL
(N.T.S.)

9. IN-GROUND SETTLEMENT MONITORING POINTS SHALL BE INSTALLED BEYOND THE TRAFFIC LANES AND SHOULDERS TO MONITOR SETTLEMENT AND STABILITY OF THE GROUND SURFACE BETWEEN THE SURFACE SETTLEMENT MONITORING POINTS AND THE ENTRY AND EXIT PORTALS.
10. IN-GROUND SETTLEMENT MONITORING POINTS SHALL BE 12-18mm REBAR ENCASED IN A 50-70mm, SCH40 PVC PIPE, SET TO A DEPTH OF 1.5m BELOW GROUND SURFACE OR BELOW FROST PENETRATION DEPTH WHICHEVER IS GREATER. THE ASSEMBLY SHALL BE PLACED IN A DRILL HOLE, BACKFILLED WITH UNIFORM SAND AND PROVIDED WITH PROTECTIVE COVERS SUITABLE FOR HIGH VEHICULAR TRAFFIC AREAS.

LEGEND:
- SURFACE MONITORING POINT (DETAIL #1)
- DEEP IN GROUND MONITORING POINT (DETAIL #2)



KEY PLAN



REFERENCE DRAWINGS		REVISIONS		
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ACAD-C00-C48.dwg	REPLACEMENT OF EXISTING WATERMAIN JORDAN ROAD/NORTH SERVICE ROAD FROM FOURTH AVENUE TO VICTORIA ROAD	0	06/28/2021	ISSUED FOR PRELIMINARY REVIEW
CAD FILE NO.	TITLE	NO.	DATE	

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CHECKED BY: VV 07/19/2021	APPROVED BY: TG 07/19/2021
SCALE: AS SHOWN FULL SIZE ONLY	

REGISTERED PROFESSIONAL ENGINEER — T. J. GARDE — Sep 27, 2021 — PROVINCE OF ONTARIO

Ontario MINISTRY OF TRANSPORTATION | GHD | Town of Lincoln | wood.

PRUDHOMMES WATERMAIN UPGRADE
KEY PLAN & GEOTECHNICAL INSTRUMENTATION MONITORING PLAN
VICTORIA AVENUE CROSSING

GEOCRES No.:	FILE NO.	REV.	DWG.
30M3-324	OGTW2010–R04001	0	1/1

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Appendix A

Record of Boreholes

A1: Terms and Symbols
A2: Record of Borehole Logs

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System(modified slightly so that an inorganic clay of "medium plasticity" is recognized)*.

The compactness condition of cohesionless soils based on standard penetration testing (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows *(Ref. Canadian Foundation Engineering Manual, 4th Edition, 2006)*:

Compactness	SPT
Cohesionless Soils	N-Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

Consistency of	Undrained Shear Strength	
Cohesive Soils	kPa	psf
Very Soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	Over 200	Over 4000

SOIL SAMPLING

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Walled Open (Pushed)	RC	Rock Core	GS	Grab Sample
AS	Auger Sample	TP	Thin Walled Piston (Pushed)	WS	Washed Sample	AR	Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Definitions of Penetration Resistance

Standard penetration resistance 'N' – The number of blows required to advance a standard split spoon sampler 30 cm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 76 cm.

Dynamic penetration resistance – The number of blows required to advance a 50 mm, 60 degree cone, fitted to the end of drill rods, 30 cm into the subsoil, the driving energy being 474.5 Joules per blow.

INSTRUMENTATION INSTALLATION

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section.

WATER LEVEL

Water levels, if measured during fieldwork, are plotted in the depth/elevation column. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors. Other information includes the depth of borehole cave-in, if any. This information is also included in the borehole log footer.

COMMENTS

This column is used to describe non-standard situations or notes of interest.

GENERAL REPORT NOTE

The soil conditions, profiles, comments, conclusions and recommendations found in this report are based upon the samples recovered during the fieldwork. Soils are heterogeneous materials and, consequently, variations (possibly extreme) may be encountered at site locations away from boreholes. During construction, competent, qualified inspection personnel should verify that no significant variations exist from the conditions described in this report.

Wood Environment & Infrastructure Solutions
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Geotechnical Discipline - Ontario Region

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MTO SOIL CLASSIFICATION

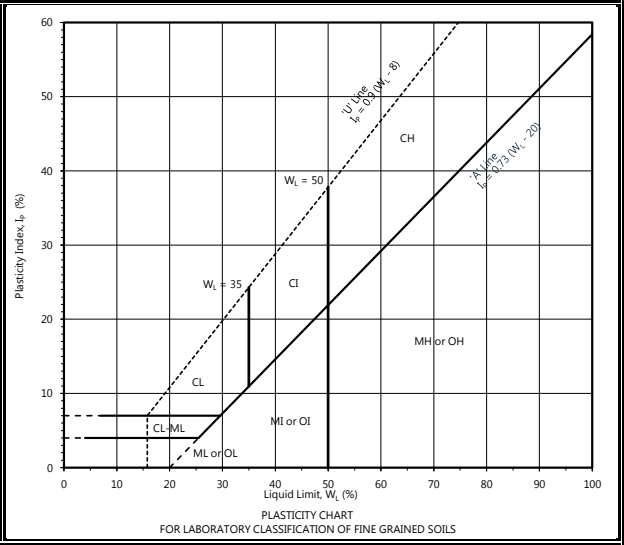
Based on MTO Soil Classificaiton Manual

Ontario

MAJOR DIVISION				GROUP SYMBOL	TYPICAL DESCRIPTION	INFORMATION REQUIRED FOR DESCRIBING SOILS
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVEL (TRACE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY INDICATE APPROX % OF SAND & GRAVEL, MAX SIZE, ANGULARITY, SURFACE CONDITION & HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGICAL NAME, OTHER PERTINENT DESCRICTIVE INFORMATION & SYMBOL IN PARENTHESIS FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITION & DRAINAGE CHARACTERISTICS
			PREDOMINANTLY ONE SIZE OR RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		GRAVEL WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION SEE ML BELOW)	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES	
			PLASTIC FINES (FOR IDENTIFICATION SEE CL BELOW)	GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES	
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SAND (TRACE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNT OF ALL INTERMEDIATE PARTICLE SIZES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
			PREDOMINANTLY ONE SIZE OR RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING	SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		SAND WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION SEE ML BELOW)	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES	
			PLASTIC FINES (FOR IDENTIFICATION SEE CL BELOW)	SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES	
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	IDENTIFICATION PROCEDURE ON FRACTION SMALLER THAN 425 µm					
	SILT AND CLAYS	LIQUID LIMIT LESS THAN 35	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	
			NONE	QUICK	NONE	ML	INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY INDICATE DEGREE AND CHARACTER OF PLASTICITY, AMOUNT AND MAXIMUM SIZE OF COURSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME, OTHER PERTINENT DESCRICTIVE INFORMATION & SYMBOL IN PARENTHESIS FOR UNDISTURBED SOILS ADD INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTANCY IN UNDISTURBED AND REMOLDED STATES, MOISTURE & DRAINAGE CONDITION
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	CL	SILTY CLAYS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	
			SLIGHT TO MEDIUM	SLOW	SLIGHT	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS	
		LIQUID LIMIT BETWEEN 35 AND 50	NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	MI	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY	
			HIGH	NONE TO VERY SLOW	MEDIUM TO HIGH	CI	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY	
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OI	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	
		LIQUID LIMIT GREATER THAN 50	SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMECACOUS FINE SANDY	
			HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS	
			MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGH ORGANIC SOILS			READILY IDENTIFIED BY COLOUR, ODOUR, SPONGY FEEL & FREQUENTLY BY FIBROUS TEXTURE			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	

LABORATORY CLASSIFICATION CRITERIA			
USE GRAIN SIZE CURVE IN IDENTIFYING THE FACTORS AS GIVEN UNDER FIELD IDENTIFICATION	DETERMINE PERCENTAGE OF GRAVEL & SAND FROM GRAIN SIZE CURVE DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75µm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: LESS THAN 5%: GW, SP, SW, SP MORE THAN 12%: GM, GC, SM, SC 5% TO 12%: BORDER LINE CASES REQUIRE USE OF DUAL SYMBOL	$C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3	
		NOT MEETING ALL GRADATION REQUIREMENTS FOR GW	
		ATTERBERG LIMITS BELOW A-LINE OR I_P LESS THAN 4	ABOVE A-LINE WITH I_P BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS
		ATTERBERG LIMITS ABOVE A-LINE WITH I_P GREATER THAN 7	
		$C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3	
		NOT MEETING ALL GRADATION REQUIREMENTS FOR SW	
		ATTERBERG LIMITS BELOW A-LINE OR I_P LESS THAN 4	ABOVE A-LINE WITH I_P BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS
		ATTERBERG LIMITS ABOVE A-LINE WITH I_P GREATER THAN 7	

FRACTION	U.S. STANDARD SIEVE SIZE			DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	26.5 mm	40 - 50	AND
	FINE	26.5 mm	4.75 mm	30 - 40	Y/EY
SAND	COARSE	4.75 mm	2.00 mm	20 - 30	WITH
	MEDIUM	2.00 mm	425 µm	10 - 20	SOME
	FINE	425 µm	75 µm	1 - 10	TRACE
FINES (SILT OF CLAY, BASED ON PLASTICITY)		75 µm			
OVERSIZED MATERIAL					
ROUNDED OR SUBROUNDED: COBBLES 75 mm TO 200 mm BOULDERS > 200 mm				NOT ROUNDED: ROCK FRAGMENTS > 75 mm ROCKS > 0.76 CUBIC METRE IN VOLUME	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

BOUNDARY CLASSIFICATION:

SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS FOE EXAMPLE GW-GC
WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER

Wood Environment & Infrastructure Solutions
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Geotechnical Discipline - Ontario Region

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Rev. date: January 2, 2019

BEDROCK DESCRIPTION

Ontario

ROCK QUALITY DESIGNATION

The Rock Quality Designation (RQD) is an indirect measure of the number of natural fractures in a rock mass. It is obtained from the rock cores by summing up the length of core pieces of sound rock that are 100 mm or more in length, measured from the midpoint to midpoint of adjacent natural fractures. Note, a natural fracture that is parallel to the core axis should be ignored so that the RQD is not affected. The RQD value is expressed as a percentage of the summed core lengths (100 mm or greater) to the total core length.

RQD originally specified the use of NW core (54 mm diameter). The technique can be used on different core sizes, if the bulk of the fractures caused by drilling stress and handling can be be distinguished from in situ fractures which tend to have some form of joint infill (typically calcite and chlorite being the most common). However, smaller core is more susceptible to breaking; hence, samller core in a rock mass with little joint infill in which natural fractures are hard to distinguish can produce a less accurate measure of RQD. It is generally accepted that the RQD is applicable to NQ core size (45 mm).

SOLID CORE RECOVERY

Solid Core Recovery (SCR) is defined as the percentage of intact cylindrical core pieces to the total length of core.

TOTAL CORE RECOVERY

Total Core Recovery (TCR) is defined as the percentage of intact core pieces to the total length of core.

STRENGTH CLASSIFICATION

Term (Grade)	Field Identification	Approximate Range of Uniaxial Compressive Strength (MPa)
Extremely Weak (R0)	Indented by thumbnail.	0.25 – 1.0
Very Weak (R1)	Crumbles under firm blows with point of geological hammer; can be peeled by a pocket knife.	1.0 – 5.0
Weak (R2)	Can be peeled with a pocket knife with difficulty; shallow indentations made by firm blow with point of geological hammer.	5.0 – 25
Medium Strong (R3)	Cannot be scraped or peeled with a pocket knife; specimen can be fractured with a single firm blow of geological hammer.	25 – 50
Strong (R4)	Specimen requires more than one blow of geological hammer to fracture it.	50 – 100
Very Strong (R5)	Specimen requires many blows of geological hammer to fracture it.	100 – 250
Extremely Strong (R6)	Specimen can only be chipped with geological hammer.	> 250

JOINT SPACING CLASSIFICATION

Term	Average Joint Spacing (m)
Extremely Close	< 0.02
Very Close	0.02 – 0.06
Close	0.06 – 0.20
Moderately Close	0.2 – 0.6
Wise	0.6 – 2.0
Very Wide	2.0 – 6.0
Extremely Wide	> 6.0

ROCK QUALITY CLASSIFICATION

Rock Quality Designation, RQD (%)	Description of Rock Quality
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 - 100	Excellent

Reference: Deere et al, 1967

WEATHERING CLASSIFICATION

Term (Grade)	Description
Fresh (W1)	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.
Slightly Weathered (W2)	Discoloration indicates weathering of rock material on discontinuity surfaces. Less than 5% of rock mass altered.
Moderately Weathered (W3)	Less than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a continuous framework or as core stones.
Highly Weathered (W4)	More than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.
Completely Weathered (W5)	All rock material is decomposed and/or disintegrated into 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.

Reference: Brown, 1981, "Suggested Methods for Rock Characterization Testing and Monitoring". International Society for Rock Mechanics.

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wood.

Record of Borehole

Jordan Road

(BH20-01-BH20-08)

Ontario

RECORD OF BOREHOLE No. BH/MW20-01

wood.

G.W.P. _____ LOCATION RR 26., MTM, Z10, E316069, N4782050 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 23, 2020 - July 23, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.8												
88.7 / 0.0	**ASPHALT ~100 mm**											
0.1	**SAND, some gravel and silt (FILL)** Pavement base/subbase loose brown dry **RDR 3**		1	GS						4		
			2	SS	6		1	88		23		
87.4												
1.4	**SILT, some clay, trace to some sand , trace gravel** compact brown moist to wet **RDR 2**		3	SS	16		2	87		19		Grain size analysis for SS3: **1 10 71 18** Atterberg Limits for SS3: **LL:22 PL:16 PI:6**
			4	SS	18					19		
			5	SS	13		3	86		22		Grain size analysis for SS5: **0 10 76 14** Atterberg Limits for SS5: **Non Plastic**
			6	SS	18		4	85		18		
			7	SS	17		5	84		15		
	SS-8 saturated		8	SS	16		6	83		42		
							7	82				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-01

wood.

G.W.P. _____ LOCATION RR 26., MTM, Z10, E316069, N4782050 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 23, 2020 - July 23, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT, some clay, trace to some sand , trace gravel compact brown moist to wet **RDR 4**		9	SS	50/125 mm		8	81		16		Boulder caused high SPT blows
80.2 / 8.7	**CLAYEY SILT, some sand, trace gravel** stiff grey low plasticity **RDR 3**		10	SS	13		9	80		15		
			11	SS	15		10	79		15		Grain size analysis for SS10 & SS11: **6 13 54 27** Atterberg Limits for SS10 & SS11: **LL:26 PL:14 PI:12**
			12	SS	13		11	78		15		
			13	SS	11		12	77		15		Grain size analysis for SS12 & SS13: **7 13 54 26** Atterberg Limits for SS12 & SS13: **LL:25 PL:14 PI:11**
74.5 / 14.3	**End of Borehole**						13	76				
							14	75				

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

Ontario

RECORD OF BOREHOLE No. BH20-02

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316065, N4782105 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 24, 2020 - July 24, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.9												
87.8 / 0.0	**ASPHALT**											
0.1	**~100 mm**											
	SILTY SAND AND GRAVEL (FILL) Pavement base/subbase dense brown dry		1	SS	41							Grain size analysis for SS1: **26 51 23**
87.2												
0.7	**RDR 4**											
	SILT, some clay and sand, trace gravel (FILL) compact brown moist		2	SS	10		1	87		14		Grain size analysis for SS2: **3 13 65 19**
86.5	**RDR 2**											Atterberg Limits for SS2: **LL:22 PL:17 PI:5**
1.4	**CLAYEY SILT, trace sand and gravel** very stiff to stiff brown to grey wet to wet		3	SS	17	▽	2	86		21		
	RDR 3		4	SS	11					18		
	Some clay pockets for SS-5		5	SS	12		3	85		22		
			6	SS	13		4	84		16		
			7	SS	14		5	83		16		
82.3												
5.6	**SILT AND CLAY, trace sand** soft grey intermediate plasticity						6	82				
	RDR 2		8	SS	3					32		Grain size analysis for SS8: **0 2 56 42**
80.7							7	81				Atterberg Limits for SS8: **LL:33 PL:16 PI:17**
7.2												

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-02

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316065, N4782105 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 24, 2020 - July 24, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT, some sand, trace gravel compact grey low plasticity **RDR 3**		9	SS	6		8	80		16		
			10	SS	9		9	79		16		Grain size analysis for SS10 & SS11: **7 11 58 24** Atterberg Limits for SS10 & SS11: **LL:26** **PL:13** **PI:13**
			11	SS	8		10 11	78 77		15		
			12	SS	13		12	76		14		
75.1 12.8	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-03

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316064, N4782146 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 20, 2020 - July 20, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.6									20 40 60 80 100	20 40 60		
86.5 0.1	**ASPHALT ~75 mm**											
	SAND AND GRAVEL (FILL) Pavement base/subbase compact brown dry **RDR 4**		1	SS	28							
85.6												
1.0	**SANDY SILT, trace clay** compact grey wet **RDR 3**		2	SS	19		1	86		18		
			3	SS	17		2	85		19		Grain size analysis for SS3: **0 43 57**
			4	SS	17	▽		84		18		
83.6							3					
3.0	**CLAYEY SILT, trace sand and gravel** very stiff to stiff grey low plasticity **RDR 2**		5	SS	21			83		16		Grain size analysis for SS5 & SS6: **1 5 62 32** Atterberg Limits for SS5 & SS6: **LL:29 PL:14 PI:15**
			6	SS	9		4	82		18		
			7	SS	8		5			23		
81.0								81				
5.6	**SILTY SAND, some gravel and trace silt** compact grey wet occasional clayey silt pockets **RDR 3**		8	SS	12		6	80		16		
79.4							7					
7.2												

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-03

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316064, N4782146 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 20, 2020 - July 20, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	GRAVELY SILTY SAND, trace clay compact grey moist **RDR 4**		9	SS	17		8	79		11 ○		Grain size analysis for SS9: **22 41 28 9**
77.9								78				
8.7	**CLAYEY SILT, trace sand and gravel** stiff grey moist **RDR 3**		10	SS	10		9			15 ○		
							10	77				
			11	SS	11		11	76		15 ○		
75.3												
11.3	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-04

wood.

1 OF 1

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316062, N4782196 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 20, 2020 - July 20, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.3									20 40 60 80 100	20 40 60		
84.2 / 0.1	**ASPHALT ~75 mm**											
	SAND AND GRAVEL, some silt (FILL) Pavement base/subbase dense to compact brown dry to moist **RDR 4**		1	SS	40					7		
			2	SS	29		1	83		14		
82.8 / 1.4	**SANDY SILT, trace clay** loose to very loose brown/grey wet **RDR 2**		3	SS	10		2	82		18		
82.0 / 2.2	**CLAYEY SILT, trace to some sand, trace gravel** soft to stiff grey low plasticity **RDR 2**		4	SS	3					26		Grain size analysis for SS4 & SS5: **1 6 60 33** Atterberg Limits for SS4 & SS5: **LL:27 PL:14 PI:13**
			5	SS	5		3	81		22		
			6	SS	10		4	80		18		
			7	SS	12		5	79		15		Grain size analysis for SS7 & SS8: **7 13 56 24** Atterberg Limits for SS7 & SS8: **LL:24 PL:13 PI:11**
			8	SS	9		6	78		15		
			9	SS	11		7	77		15		
76.0 / 8.2	**End of Borehole**						8					

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

Ontario

RECORD OF BOREHOLE No. BH20-05

wood.

1 OF 1

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316061, N4782238 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 21, 2020 - July 21, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
82.7												
82.6	**ASPHALT**											
0.1	**~100 mm**											
	SILTY GRAVELY SAND (FILL)		1	SS	39					3 ○		
	Pavement base/subbase											
	dense to compact											
	brown											
	dry											
	RDR 4		2	SS	18		1	82		6 ○		Grain size analysis for SS1 & SS2 : **29 51 20**
80.8			3	SS	6	▽	2	81		15 ○		
1.8	**SILT, some clay and sand, trace gravel**											
	compact											
	grey											
	low plasticity											
	RDR 3		4	SS	10					14 ○		Grain size analysis for SS4 & SS5: **3 13 65 19** Atterberg Limits for SS4 & SS5: **LL:21 PL:13 PI:8**
			5	SS	23		3	80		14 ○		
			6	SS	10		4	79		15 ○		
78.2												
4.5	**CLAYEY SILT, some sand, trace gravel**											
	stiff											
	grey											
	low plasticity											
	RDR 2		7	SS	9		5	78		15 ○		
			8	SS	8		6	77		16 ○		Grain size analysis for SS7 & SS8: **8 13 58 21** Atterberg Limits for SS7 & SS8: **LL:24 PL:14 PI:10**
			9	SS	10		7	76		16 ○		
74.4							8	75				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-06

wood.

1 OF 1

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316059, N4782299 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 21, 2020 - July 21, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
82.7												
82.6 0.1	**ASPHALT ~75 mm**											
	SAND AND GRAVEL (FILL) Pavement base/subbase dense brown dry **RDR 4**		1	SS	45					3		
82.0 0.7								82				
			2	SS	15		1			16		
	SILTY SAND compact brown wet **RDR 3**											
81.2 1.4			3	SS	5		2	81		16		
	CLAYEY SILT, some sand and trace gravel firm to stiff to firm grey low plasticity **RDR 3**											
			4	SS	11					13		Grain size analysis for SS4: **3 13 61 23** Atterberg Limits for SS4: **LL:24 PL:13 PI:11**
			5	SS	12		3	80		15		
			6	SS	8		4	79		16		Grain size analysis for SS6 & SS7: **6 15 55 24** Atterberg Limits for SS6 & SS7: **LL:25 PL:14 PI:11**
			7	SS	7		5	78		16		
			8	SS	7		6	77		16		
			9	SS	6		7	76		16		Grain size analysis for SS9: **5 13 58 24** Atterberg Limits for SS9: **LL:24 PL:13 PI:11**
			10	SS	8		8	75		16		
72.9 9.8	**End of Borehole**						9	74		16		
								73				

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

Ontario

RECORD OF BOREHOLE No. BH20-07

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316057, N4782336 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 22, 2020 - July 22, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.8												
83.7 / 0.0	**ASPHALT ~100 mm**											
0.1	**SAND AND GRAVEL (FILL)** Pavement base/subbase dense brown dry **RDR 4**		1	SS	27					4		
83.1 / 0.7	**SANDY SILT , some to trace gravel (FILL)** compact brown moist **RDR 3**		2	SS	19		1	83		12		
82.3 / 1.4	**SILT, some sand and clay, trace gravel** dense to compact grey wet **RDR 3**		3	SS	31	▽	2	82		15		Grain size analysis for SS3: **1 13 75 11** Atterberg Limits for SS3: **Non Plastic**
			4	SS	27		3	81		15		
			5	SS	18					20		
80.0 / 3.7	**CLAYEY SILT, trace sand and gravel** firm to stiff grey low plasticity **RDR 3**		6	SS	6		4	80		18		Grain size analysis for SS6 & SS7: **1 7 62 30** Atterberg Limits for SS6 & SS7: **LL:26 PL:14 PI:12**
			7	SS	10		5	79		17		
			8	SS	10		6	78		15		
							7	77				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-07

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316057, N4782336 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 22, 2020 - July 22, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT, trace sand and gravel firm to stiff grey low plasticity **RDR 3**		9	SS	6		8	76		○ 16		
			10	SS	8		9	75		○ 15		
			11	SS	10		10	74		○ 16		
72.5							11	73				
11.3	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-08

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316054, N4782391 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 22, 2020 - July 22, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
85.6							
85.5 / 0.0	**ASPHALT**						
0.1	**~100 mm**						
	SAND AND GRAVEL (FILL) Pavement base/subbase dense brown dry **RDR 4**	1	SS	26		85	
84.9							
0.7	**SANDY SILT, some clay and occassional sand pockets (FILL)** compact brown moist **RDR 3**	2	SS	18	1	84	Grain size analysis for SS2 & SS3: **0 34 51 15** Atterberg Limits for SS2 & SS3: **Non Plastic**
83.7		3	SS	10	2	83	
1.8	**SILTY SAND, trace clay** compact reddish brown to grey wet **RDR 3**	4	SS	16	3	82	Grain size analysis for SS4 & SS5: **0 55 40 5** Atterberg Limits for SS4 & SS5: **Non-Plastic**
	occassional clay pockets between ~ 3.8mbgs -4.6mbgs	5	SS	24	4	81	
80.7		6	SS	10	5	80	
4.8	**CLAYEY SILT, trace to some sand** firm to stiff grey low plasticity **RDR 2**	7	SS	11	6	79	
		8	SS	4	7		Grain size analysis for SS8: **0 1 70 29** Atterberg Limits for SS8: **LL:25 PL:14 PI:11**

Continued Next Page

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL WATER CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

SOIL VAPOUR READING COV/TOV (ppm)

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-08

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316054, N4782391 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 22, 2020 - July 22, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING / COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT, trace to some sand firm to stiff grey low plasticity **RDR 2** **RDR 3**		9	SS	9		8	78		17		Grain size analysis for SS9 & SS10: **5 14 56 25** Atterberg Limits for SS9 & SS10: **LL:25** **PL:13** **PI:12**
			10	SS	7		9 10	77 76		16		
74.3			11	SS	10		11	75		22		
11.3	**End of Borehole**											

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

Record of Borehole

North Service Road

(BH20-09-BH20-36)

Ontario

RECORD OF BOREHOLE No. BH20-09

wood.

1 OF 1

G.W.P. _____ LOCATION RR 26, MTM, Z10, E316027, N4782439 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 30, 2020 - July 30, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
85.9							
85.8 / 0.0	**ASPHALT** **~ 100 mm**						
0.1	**SAND AND GRAVEL (FILL)** Pavement base/subbase compact brown/grey moist **RDR 3**	1	SS	19			
85.2 / 0.7	**CLAYEY SILT, some sand, trace gravel (FILL)** loose brown low plasticity **RDR 2**	2	SS	9	1	85	Grain size analysis for SS2 & SS3: **1 13 64 22** Atterberg Limits for SS2 & SS3 : **LL:27 PL:15 PI:12**
	dark grey at ~1.8mbgs trace organics organic odour	3	SS	5	2	84	
		4	SS	6	3	83	
82.1 / 3.7	**SILT AND SAND, trace clay** compact brown saturated **RDR 3**	5	SS	5			Grain size analysis for SS5: **0 18 62 20** Atterberg Limits for SS5: **LL:27 PL:15 PI:12**
		6	SS	16	4	82	
		7	SS	12	5	81	Grain size analysis for SS7: **0 43 54 3** Atterberg Limits for SS7: **Non-Plastic**
		8	SS	8	6	80	
78.7 / 7.2	**CLAYEY SILT** firm grey saturated **RDR 2**	9	SS	6	7	79	
77.7 / 8.2	**End of Borehole**				8	78	

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL WATER CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

SOIL VAPOUR READING COV/TOV (ppm)

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

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-10

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E315928, N4782438 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 30, 2020 - July 30, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.1									20 40 60 80 100	20 40 60		
0.0 85.9	**ASPHALT** **~ 205 mm**							86				
0.2	**SAND AND GRAVEL (FILL)** Pavement base/subbase compact brown moist **RDR 4**		1	SS	22					4		
85.4 0.7	**SILT AND SAND, trace clay** compact to dense brown moist to saturated **RDR 3**		2	SS	11		1	85		20		
	grey at ~1.6mbgs		3	SS	12		2	84		16		
83.1			4	SS	35					17		Grain size analysis for SS4: **0 48 47 5** Atterberg Limits for SS4: **Non-Plastic**
3.0	**SANDY SILT, trace clay** loose to compact grey to brown wet to saturated **RDR 3**		5	SS	18		3	83		18		
			6	SS	8		4	82		18		
			7	SS	17		5	81		20		Grain size analysis for SS7: **0 26 67 7** Atterberg Limits for SS8: **Non-Plastic**
80.4 5.6	**SILT, some clay, trace sand** soft to very soft grey low plasticity **RDR 2**						6	80				
			8	SS	4		7	79		22		Grain size analysis for SS8: **0 3 78 19** Atterberg Limits for SS8: **LL:21** **PL:14** **PI:7**

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-10

wood.

G.W.P. _____ LOCATION RR 26, MTM, Z10, E315928, N4782438 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 30, 2020 - July 30, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT, some clay, trace sand soft to very soft grey low plasticity **RDR 2**		9	SS	1		8	78		^{30}○		
			10	SS	3		9	77		^{16}○		
	firm at ~ 10.7mbgs		11	SS	6		10	76		^{17}○		
74.8							11	75				
11.3	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-11

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315826, N4782436 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 30, 2020 - July 30, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING / COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.6												
0.0 / 86.5	**ASPHALT ~150 mm**											
0.2	**SILTY GRAVEL, some sand, trace clay with RAP** very dense to compact to loose brown to grey moist **RDR 4**		1	SS	50 / 127 mm					5		
			2	SS	15		1	86		7		Grain size analysis for SS2 & SS3: **53 19 21 7** **RAP**: Reclaimed Asphalt Pavement
			3	SS	6		2	85		5		
84.4												
2.2	**CLAYEY SILT, some sand, trace gravel** firm to stiff grey to brown low plasticity **RDR 3**		4	SS	8		3	84		18		
			5	SS	8					18		Grain size analysis for SS5 & SS6: **3 12 63 22** Atterberg Limits for SS5 & SS6: **LL:27 PL:14 PI:13**
			6	SS	7		4	83		28		
			7	SS	12		5	82		18		
			8	SS	11		6	81		19		Grain size analysis for SS8: **0 13 67 20** Atterberg Limits for SS5 & SS6: **LL:28 PL:17 PI:11**
			9	SS	7		7	80		20		
78.4							8	79				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-12

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315732, N4782466 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 30, 2020 - July 30, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.9									20 40 60 80 100	20 40 60		
86.8 0.0	**ASPHALT**											
0.1	**~ 125 mm**											
	SAND AND GRAVEL (FILL)		1	SS	94 / 280 mm					4		
	Pavement base/subbase											
	very dense											
86.2	brown											
0.7	dry											
	RDR 4											
	CLAYEY SILT, trace sand and gravel (FILL)		2	SS	13		1	86		18		Grain size analysis for SS2 & SS3: **1 5 70 24** Atterberg Limits for SS2 & SS3: **LL:27 PL:15 PI:12**
	stiff											
	brown											
	intermediate plasticity											
	RDR 3		3	SS	13		2	85		16		
84.7												
2.2	**SANDY SILT, some clay, trace gravel**		4	SS	18			84		21		Grain size analysis for SS4: **1 21 67 11** Atterberg Limits for SS4: **LL:18 PL:16 PI:2**
	compact						3					
	brown					▽						
	wet to saturated											
	RDR 3		5	SS	20					19		
83.4								83				
3.5	**SILT, some clay, trace sand**						4					
	compact to dense		6	SS	13					15		
	grey											
	low plasticity											
	RDR 2		7	SS	11			82		15		Grain size analysis for SS7 & SS8: **0 8 78 14** Atterberg Limits for SS7 & SS8: **LL:21 PL:13 PI:8**
							5					
			8	SS	8		6	81		17		
							7	80				
			9	SS	6					27		
78.7							8	79				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-13

wood.

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315644, N4782513 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 14, 2020 - July 14, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.0							
0.0	**SAND AND GRAVEL (FILL)** Pavement base/subbase compact brown moist **RDR 3**	1	SS	15			
86.1							
0.9	**SANDY SILT, some clay and trace sand (FILL)** compact brown moist **RDR 3**	2	SS	10	1	86	
85.6							
1.4	**CLAYEY SILT, some sand** very stiff brown moist **RDR 3**	3	SS	19	2	85	
	~180 mm seam of saturated silty sand present at ~ 2.5mbgs	4	SS	27			
84.0							
3.0	**SANDY SILT, some clay** compact grey moist to wet **RDR 3**	5	SS	11	3	84	Grain size analysis for SS5 & SS6: **0 23 66 11** Atterberg Limits for SS5 & SS6: **Non-Plastic**
		6	SS	12	4	83	
82.5							
4.5	**SILT, some sand and clay** stiff grey low plasticity **RDR 3**	7	SS	12	5	82	Grain size analysis for SS7: **0 13 72 15** Atterberg Limits for SS7: **LL:19 PL:15 PI:4**
81.3							
5.6	**CLAYEY SILT, trace sand** soft to stiff grey low plasticity **RDR 2**	8	SS	6	6	81	Grain size analysis for SS8: **0 5 73 22** Atterberg Limits for SS8: **LL:21 PL:13 PI:8**
					7	80	

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL WATER CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

5 16 20 18 14 22 18 29

SOIL VAPOUR READING COV/TOV (ppm)

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-13

wood.

2 OF 2

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315644, N4782513 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 14, 2020 - July 14, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL WATER CONTENT / LIQUID LIMIT / WATER CONTENT (%)	SOIL VAPOUR READING	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		m	m	○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P w w_L	COV/ TOV (ppm)	GR SA SI CL
	CLAYEY SILT, trace sand soft to stiff grey low plasticity **RDR 2**		9	SS	4		8	79		25		
	trace to some sand and gravel at ~ 8.7mbgs		10	SS	5		9	78		25		
			11	SS	7		10	77		19		
75.1			12	SS	12		11	76		21		
11.9	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-14

wood.

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315558, N4782563 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 13, 2020 - July 13, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.0												
0.0	**SAND AND GRAVEL (FILL)** Pavement base/subbase compact brown moist **RDR 3**		1	SS	12					3		
85.0												
1.0	**SILTY CLAY, trace sand (FILL)** firm brown moist		2	SS	12		1	85		10		
84.5	**RDR 3**											
1.4	**SILT, some to trace sand and some clay** compact to loose brown to grey low plasticity **RDR 3**		3	SS	17		2	84		16		
	greyish brown at ~ 2.5mbgs		4	SS	11					20		Grain size analysis for SS4 & SS5: **0 19 69 12** Atterberg Limits for SS4 & SS5: **LL:18** **PL:14** **PI:4**
			5	SS	10		3	83		15		
			6	SS	7		4	82		18		Grain size analysis for SS6 & SS7: **0 13 70 17** Atterberg Limits for SS6 & SS7: **LL:19** **PL:13** **PI:6**
			7	SS	10		5	81		17		
			8	SS	7		6	80		17		Grain size analysis for SS8: **0 9 75 16** Atterberg Limits for SS8: **LL:19** **PL:13** **PI:6**
							7	79				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-14

wood.

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315558, N4782563 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 13, 2020 - July 13, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.1												
7.9	**CLAYEY SILT, trace sand and gravel** stiff grey moist to wet **RDR 3**		9	SS	7		8	78		25		
			10	SS	4		9	77		26		
			11	SS	9		10	76				
74.7							11	75		16		
11.3	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-15

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315471, N4782612 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 13, 2020 - July 13, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.5												
0.0	**SAND AND GRAVEL, some asphalt fragments (FILL)** road base/subbase compact brown moist **RDR 4**		1	SS	17					4		
82.7								83				
0.8	**SILT, some sand, gravel and clay (FILL)** loose brown moist **RDR 3**		2	SS	7		1			15		Grain size analysis for SS2 & SS3: **11 19 57 13** Atterberg Limits for SS2 & SS3: **LL:21 PL:15 PI:6**
			3	SS	10			82		17		
81.3							2					
2.2	**SILT, some sand and clay, trace gravel** loose to compact grey/brown low plasticity **RDR 3**		4	SS	6			81		16		Grain size analysis for SS4 & SS5: **0 13 71 16** Atterberg Limits for SS4 & SS5: **LL:19 PL:13 PI:6**
	~ 200mm of saturated silt seam at ~ 3.5 mbgs		5	SS	11		3			21		
			6	SS	8			80		17		
			7	SS	11		4			16		Grain size analysis for SS7: **0 10 77 13** Atterberg Limits for SS7: **LL:19 PL:13 PI:6**
77.8								79				
5.6	**CLAYEY SILT, some sand, trace gravel** soft to firm grey low plasticity **RDR 2**		8	SS	7		5			19		Grain size analysis for SS8: **3 13 58 26** Atterberg Limits for SS8: **LL:29 PL:15 PI:14**
								78				
							6					
			9	SS	3			77		20		
							7					
								76				
							8					
								75				
			10	SS	8		9			17		
73.7								74				
9.8	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-16

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315384, N4782661 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 14, 2020 - July 14, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
80.5												
0.0	**SAND AND GRAVEL, some asphalt fragments, trace rootlets (FILL)** road base/subbase compact brown moist **RDR 4**		1	SS	14					5		
79.5												
1.0	**CLAYEY SILT, trace sand and gravel (FILL)** very stiff brown moist **RDR 3**		2	SS	18		1	80		9		
79.0												
1.4	**CLAYEY SILT, trace to some sand, trace gravel** firm to stiff brown to grey low plasticity **RDR 3** ~ 300mm of silty sand seam at 2.2 mbgs		3	SS	10		2	79		15		
			4	SS	8		3	78		24		
			5	SS	5		4	77		22		Grain size analysis for SS5 & SS6: **0 1 65 34** Atterberg Limits for SS5 & SS6: **LL:30** **PL:14** **PI:16**
			6	SS	5		5	76		20		
			7	SS	5		6	75		21		Grain size analysis for SS7 & SS8: **5 10 64 21** Atterberg Limits for SS7 & SS8: **LL:25** **PL:15** **PI:10**
			8	SS	8		7	74		18		
			9	SS	7		8	73		15		
72.3												
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-17

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315297, N4782861 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 14, 2020 - July 14, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.9												
0.0	**SAND AND GRAVEL, some to trace asphalt fragments (FILL)** road base/subbase compact brown moist **RDR 4**		1	SS	15					4		
			2	SS	22		1	78		7		
77.2												
1.7	**GRAVELY SANDY SILT, some clay, trace black seams and rootlets (FILL)** loose brown moist **RDR 3**		3	SS	5		2	77		15		Grain size analysis for SS3 & SS4: **24 24 38 14** Atterberg Limits for SS3 & SS4: **LL:23** **PL:15** **PI:8**
			4	SS	6					20		
75.9												
3.0	**SILT, some sand and clay, trace gravel, organics and rootlets (FILL)** firm brown moist **RDR 2**		5	SS	6		3	76		21		Grain size analysis for SS5 & SS6: **7 13 61 19** Atterberg Limits for SS5 & SS6: **LL:24** **PL:14** **PI:10**
			6	SS	5	▽	4	75		22		
			7	SS	8		5	74		44		
73.3												
5.6	**SAND, some silt, trace gravel and clay** loose brown saturated **RDR 3**		8	SS	6		6	73		16		Grain size analysis for SS8: **9 78 11 2**
71.7												
7.2	**SAND AND SILT, trace clay and gravel** loose grey saturated to moist **RDR 4**		9	SS	6		7	72				
							8	71		19		Grain size analysis for SS9 & SS10: **1 47 47 5** Atterberg Limits for SS9 & SS10: **Non-Plastic**
							9	70				
			10	SS	8					54		
69.2												
9.8	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-18

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E315208, N4782756 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 15, 2020 - July 15, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.7												
0.0	**SAND AND GRAVEL, trace rootlets (FILL)** road base/subbase compact brown moist **RDR 3**		1	SS	11					4		
77.8								78				
0.9	**SANDY SILT, some gravel and clay, trace rootlets and asphalt fragments (FILL)** compact brown moist **RDR 3**		2	SS	10		1			11		Grain size analysis for SS2 & SS3: **16 27 43 14** Atterberg Limits for SS2 & SS3: **LL:22** **PL:14** **PI:8**
			3	SS	14			77		14		
							2					
			4	SS	22			76		13		
75.7												
3.0	**CLAYEY SILT, some gravel and sand (FILL)** stiff to firm brown moist **RDR 2** oily odour between ~ 3.5 mbgs and 3.9 mbgs		5	SS	14		3			14		Grain size analysis for SS5 & SS6: **17 18 43 22** Atterberg Limits for SS5 & SS6: **LL:24** **PL:13** **PI:11**
			6	SS	8			75		21		
74.2							4					
4.5	**SAND, trace gravel, clay and silt** loose to compact grey wet **RDR 2**		7	SS	10			74		18		Grain size analysis for SS7 & SS8: **5 84 9 2**
							5					
			8	SS	7			73		19		
							6					
			9	SS	13			72		15		
70.4							7					
8.2	**End of Borehole**						8	71				

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-19

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314981, N4782862 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 16, 2020 - July 16, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
78.7												
0.0 / 78.5	**ASPHALT ~ 180 mm**											
0.2	**SAND AND GRAVEL, trace rootlets asphalt fragments (FILL)** road base/subbase compact brown moist **RDR 4**		1	SS	20					6		
			2	SS	23		1	78		14		
77.6 / 1.1	**SAND AND GRAVEL, trace silt and clay (FILL)** compact brown moist **RDR 3** ~200mm of silty clay seam at 1.1 mbgs		3	SS	12		2	77		17		
			4	SS	10		3	76		10		
			5	SS	14		4	75		8		Grain size analysis for SS5 & SS6: **43 47 7 3**
			6	SS	27		5	74		10		
74.2 / 4.5	**SAND, trace gravel, silt and clay** compact to loose brown wet to saturated **RDR 4**		7	SS	16		6	73		11		Grain size analysis for SS7: **9 84 7**
			8	SS	9		7	72		18		Grain size analysis for SS8 & SS9: **7 89 4**
			9	SS	10		8	71		18		
70.5 / 8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-20

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314887, N4782895 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 15, 2020 - July 15, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.1												
0.0 / 78.9	**ASPHALT ~ 165 mm**											
0.2 / 78.4	**SAND AND GRAVEL, trace rootlets asphalt fragments (FILL)** road base/subbase compact brown moist **RDR 3**		1	SS	24					8		
0.7 / 77.6	**CLAYEY SILT, some sand and gravel, black staining (FILL)** loose mottled brown moist oily odour **RDR 2**		2	SS	8		1	78		14		
1.4 / 77.1	**SILTY SAND, trace clay(FILL)** compact brown moist oily odour **RDR 3**		3	SS	28					13		
2.0 / 76.1	**COBBLES AND BOULDERS (FILL)** very dense brown moist **RDR 5**		4	SS	66 / 255 mm		2	77		6		
3.0 / 73.4	**SANDY SILT, some clay, trace gravel and rootlets (FILL)** compact brown moist **RDR 2** ~ 200mm of organics and black staining at 3.0mbgs		5	SS	12	▽	3	76		18		Grain size analysis for SS5 & SS6: **5 31 43 21** Atterberg Limits for SS5 & SS6: **LL:25 PL:16 PI:9**
			6	SS	7		4	75		19		
			7	SS	7		5	74		15		
5.6 / 70.8	**SAND, some gravel, trace silt and clay** loose brown moist **RDR 4**		8	SS	6		6	73		7		Grain size analysis for SS8 & SS9: **20 73 7**
			9	SS	8		7	72		8		
8.2	**End of Borehole**						8	71				

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

Ontario

RECORD OF BOREHOLE No. BH20-21

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314792, N4782926 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 29, 2020 - July 29, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
79.1									20 40 60 80 100	20 40 60		
79.0 0.0	**ASPHALT ~ 100 mm**											
0.1	**SAND AND GRAVEL, trace silt and clay (FILL)** road base/subbase dense to compact brown moist **RDR 4**		1	SS	28					3		Grain size analysis for SS1 & SS2: **41 46 13**
			2	SS	15		1	78		5		
			3	SS	18	▽	2	77		11		
76.9 2.2	**SANDY SILT (FILL)** very loose dark grey to brown wet **RDR 1**		4	SS	2					21		
76.1 3.0	**CLAYEY SILT, trace sand** firm grey low plasticity **RDR 2**		5	SS	7		3	76		19		Grain size analysis for SS5 & SS6: **0 7 61 32** Atterberg Limits for SS5 & SS6: **LL:28 PL:14 PI:14**
			6	SS	8		4	75		19		
			7	SS	7		5	74		20		
73.4 5.6	**SAND, trace silt and clay** dense brown to grey moist **RDR 3**		8	SS	26		6	73		11		Grain size analysis for SS8: **0 96 4**
72.2 6.9	**SILT, some sand and clay, trace gravel** dense brown to grey wet **RDR 4**		9	SS	30		7	72		12		Grain size analysis for SS9: **7 18 57 18** Atterberg Limits for SS9: **LL:20 PL:13 PI:7**
70.8 8.2	**End of Borehole**						8	71				

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-22

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314696, N4782952 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 16, 2020 - July 16, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
81.1									20 40 60 80 100	20 40 60		
81.0 / 0.1	**ASPHALT ~ 75 mm**											
80.6	**SAND AND GRAVEL, trace asphalt fragments (FILL)**		1	SS	14					5		
0.5	road base/subbase compact brown moist **RDR 3**											
	CLAYEY SILT, trace sand and gravel (FILL)		2	SS	10		1	80		19		Grain size analysis for SS2 & SS3: **1 3 62 34** Atterberg Limits for SS2 & SS3: **LL:30 PL:14 PI:16**
79.7	stiff											
1.4	brown wet **RDR 3**		3	SS	6		2	79		27		
	CLAYEY SILT, trace to some sand, trace gravel firm to stiff brown to grey low plasticity **RDR 3**		4	SS	7					19		
			5	SS	7		3	78		20		
			6	SS	6		4	77		21		Grain size analysis for SS6 & SS7: **4 16 55 25** Atterberg Limits for SS6 & SS7: **LL:26 PL:14 PI:12**
			7	SS	10		5	76		16		
	occassional wet silty sand seams present at ~ 6.1mbgs						6	75				
			8	SS	6		7	74		20		
73.9												
7.2	**SILT, some sand and clay, trace gravel** compact grey low plasticity **RDR 3**		9	SS	14		8	73		11		Grain size analysis for SS9: **5 16 62 17** Atterberg Limits for SS9: **LL:21 PL:13 PI:8**
72.9												
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-23

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314598, N4782973 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 17, 2020 - July 17, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
81.9									20 40 60 80 100	20 40 60		
0.0	**SAND AND GRAVEL (FILL)** road base/subbase loose brown moist **RDR 3**		1	SS	9					5		
81.2												
0.7	**CLAYEY SILT, trace sand (FILL)** soft to firm brown wet **RDR 3**		2	SS	6		1	81		22		Grain size analysis for SS2 & SS3: **0 3 65 32** Atterberg Limits for SS2 & SS3: **LL:30** **PL:15** **PI:15**
			3	SS	8		2	80		28		
			4	SS	9					20		
78.9							3	79				
3.0	**SANDY SILT, trace to some clay** loose greyish brown **RDR 2**		5	SS	8					19		
78.1							4	78				
3.7	**CLAYEY SILT, trace to some sand** soft to very soft greyish brown low to intermediate plasticity **RDR 2**		6	SS	6					28		Grain size analysis for SS6 & SS7: **0 1 66 33** Atterberg Limits for SS6 & SS7: **LL:27** **PL:14** **PI:13**
			7	SS	3		5	77		41		
			8	SS	4		6	76		14		
74.7							7	75				
7.2	**SILT, some to sandy, some clay and trace gravel** loose grey moist **RDR 2**		9	SS	8		8	74		13		Grain size analysis for SS9: **9 20 56 15** Atterberg Limits for SS9: **LL:20** **PL:13** **PI:7**
73.6												
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-24

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314499, N4782990 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 17, 2020 - July 17, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) / WATER CONTENT (%) (PLASTIC LIMIT w_P, NATURAL WATER CONTENT w, LIQUID LIMIT w_L)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
82.3											
0.0	**SAND AND GRAVEL, trace organics and rootlets (FILL)** road base/subbase loose brown moist **RDR 3**		1	SS	5			82	6		
81.6							1				
0.7	**CLAYEY SILT, trace sand and gravel (FILL)** firm mottled brown wet to saturated **RDR 2**		2	SS	5			81	31		
			3	SS	7		2		28		Grain size analysis for SS3 & SS4: **1 4 66 29** Atterberg Limits for SS3 & SS4: **LL:31 PL:15 PI:16**
79.7								80			
2.5	**CLAYEY SILT, trace sand** soft to stiff to soft brown to grey low plasticity **RDR 3**		4	SS	7				22		
			5	SS	8		3	79	17		
			6	SS	8		4	78	18		Grain size analysis for SS6 & SS7: **0 1 73 26** Atterberg Limits for SS6 & SS7: **LL:25 PL:14 PI:11**
			7	SS	10		5		19		
								77			
			8	SS	3		6	76	25		
							7				
								75			
			9	SS	14		8		12		
74.0											
8.2	**End of Borehole**										

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-25

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314401, N4783003 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 27, 2020 - July 27, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
82.8												
0.0	**SAND AND GRAVEL, some cobbles, trace silt and rootlets (FILL)** road base/subbase loose brown moist **RDR 3**		1	SS	12					3		
82.1												
0.7	**SILTY SAND, some clay, trace gravel and rootlets (FILL)** loose brown moist **RDR 3**		2	SS	7		1	82		21		
81.0			3	SS	8		2	81		24		
1.8	**CLAYEY SILT, trace sand** soft to firm grey low plasticity **RDR 3**		4	SS	4	▽				23		Grain size analysis for SS4: **0 9 71 20** Atterberg Limits for SS4: **LL:19 PL:13 PI:6**
			5	SS	2		3	80		21		
78.3			6	SS	7		4	79		17		
4.5	**SANDY SILT, some clay and trace gravel** compact grey moist **RDR 3**		7	SS	10		5	78		16		Grain size analysis for SS7: **7 23 55 15** Atterberg Limits for SS7: **Non-Plastic**
77.2												
5.6	**CLAYEY SILT, some sand, trace gravel** firm to very soft mottled brown low plasticity **RDR 2**		8	SS	6		6	77		28		Grain size analysis for SS8: **4 14 53 29** Atterberg Limits for SS8: **LL:27 PL:14 PI:13**
			9	SS	2		7	76				
74.1							8	75		26		
8.7	**SILT, some clay and sand, trace gravel** dense grey moist **RDR 4**		10	SS	40		9	74		11		Grain size analysis for SS10: **4 12 71 13** Atterberg Limits for SS10: **Non-Plastic**
73.1												
9.8	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-26

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314301, N4783011 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 27, 2020 - July 27, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.2												
0.0	**SAND AND GRAVAEL, trace silt and clay (FILL)** road base/subbase compact grey/brown dry to moist **RDR 3**		1	SS	14		0	83		4		Grain size analysis for SS1 & SS2: **36 42 22**
			2	SS	14		1	82		6		
			3	SS	11		2			9		
81.0								81				
2.2	**SANDY SILT, some gravel, trace sand (FILL)** loose brown wet **RDR 3**		4	SS	9		3			15		Grain size analysis for SS4 & SS5: **10 23 58 9** Atterberg Limits for SS4 & SS5: **Non-Plastic**
			5	SS	4			80		18		
79.5												
3.7	**SILT, some clay and sand, trace gravel and organic pockets (FILL)** loose brown/grey wet oily odour **RDR 2**		6	SS	8	▽	4	79		22		Grain size analysis for SS6 & SS7: **1 11 69 19** Atterberg Limits for SS6 & SS7: **LL:24** **PL:15** **PI:9**
			7	SS	8		5	78		19		
76.9							6	77				
6.3	**SILT, trace to some sand, clay and gravel** loose to compact brown/grey wet **RDR 3**		8	SS	5					20		
			9	SS	12		7	76		24		
75.0							8	75				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-27

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314201, N4783015 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 27, 2020 - July 27, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.8												
0.0	**SAND AND GRAVEL, some silt and trace cobbles (FILL)** road base/subbase compact to loose brown moist to wet **RDR 4**		1	SS	15					5		
			2	SS	5		1	83		18		
82.3												
1.4	**CLAYEY SILT, some to trace sand** stiff to firm to stiff brown to grey low plasticity **RDR 3**		3	SS	12		2	82		28		Grain size analysis for SS3: **1 15 60 24** Atterberg Limits for SS3: **LL:26 PL:15 PI:11**
			4	SS	6					19		Grain size analysis for SS4: **0 3 68 29** Atterberg Limits for SS4 : **LL:26 PL:16 PI:10**
			5	SS	4		3	81		17		Grain size analysis for SS5 & SS6: **0 4 68 28** Atterberg Limits for SS5 & SS6 : **LL:25 PL:15 PI:9**
			6	SS	5		4	80		19		
			7	SS	7		5	79		17		Grain size analysis for SS7 & SS8: **0 5 68 27** Atterberg Limits for SS7 & SS8 : **LL:24 PL:15 PI:9**
			8	SS	7		6	78		20		
			9	SS	10		7	77				
75.5							8	76		15		
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-28

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314102, N4783014 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 27, 2020 - July 27, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.1									20 40 60 80 100	20 40 60		
0.0	**SAND AND GRAVEL (FILL)** road base/subbase compact brown dry		1	SS	21			84		5		
83.4	**RDR 4**											
0.7	**SILT, trace gravel and clay** compact brown/red moist **RDR 3**		2	SS	16		1	83		15		
			3	SS	14		2	82		18		Grain size analysis for SS3: **0 10 76 14** Atterberg Limits for SS3 : **LL:20 PL:16 PI:4**
81.9												
2.2	**CLAYEY SILT, trace to some sand** stiff to soft to stiff grey low plasticity **RDR 3**		4	SS	10					20		
			5	SS	4		3	81		21		Grain size analysis for SS5 & SS6: **0 3 74 23** Atterberg Limits for SS5 & SS6 : **LL:21 PL:14 PI:7**
			6	SS	4		4	80		17		
			7	SS	13		5	79		17		Grain size analysis for SS7: **0 6 75 19**
							6	78				
			8	SS	10					20		Grain size analysis for SS8: **1 17 54 28** Atterberg Limits for SS8 : **LL:21 PL:14 PI:7**
							7	77				
	occassional silt pockets present at ~ 7.5mbgs		9	SS	10		8	76		13		
75.8												
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-29

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E314002, N4783014 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 200mm Solid Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 27, 2020 - July 27, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.2							
0.0 / 84.0	**ASPHALT ~180 mm**						
0.2	**SAND AND GRAVEL, trace silt and cobbles (FILL)** road base/subbase compact brown dry **RDR 4**	1	SS	27			
83.5							
0.7	**CLAYEY SILT, trace to some sand** hard to soft brown to grey low plasticity **RDR 3**	2	SS	31	1	83	Grain size analysis for SS2 & SS3: **0 6 94**
		3	SS	33	2	82	
		4	SS	7			Grain size analysis for SS4 & SS5: **0 2 70 28** Atterberg Limits for SS4 & SS5 : **LL:25 PL:16 PI:10**
		5	SS	8	3	81	
		6	SS	5	4	80	
	trace gravel at ~4.5 mbgs firm	7	SS	2	5	79	Grain size analysis for SS7 & SS8: **2 11 59 28** Atterberg Limits for SS7 & SS8 : **LL:25 PL:17 PI:8**
		8	SS	10	6	78	
		9	SS	8	7	77	
76.0					8	76	
8.2	**End of Borehole**						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL WATER CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

SOIL VAPOUR READING COV/TOV (ppm)

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

Ontario

RECORD OF BOREHOLE No. BH20-30

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313901, N4783010 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 31, 2020 - July 31, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.3												
0.0 / 84.1	**ASPHALT ~180 mm**											
0.2	**SAND AND GRAVEL, some silt (FILL)** road base/subbase dense to compact brown dry to moist **RDR 3**		1	SS	24					10		
			2	SS	20		1	83		14		
			3	SS	12		2			21		
82.1												
2.2	**CLAYEY SILT, trace sand (FILL)** firm to stiff mottled low plasticity **RDR 3**		4	SS	4			82		26		Grain size analysis for SS4 & SS5: **0 3 72 25** Atterberg Limits for SS4 & SS5 : **LL:26 PL:16 PI:10**
			5	SS	16		3	81		15		
80.5												
3.7	**CLAYEY SILT, trace sand** stiff to firm to stiff grey low plasticity **RDR 3**		6	SS	14		4	80		16		Grain size analysis for SS6 & SS7: **0 3 68 29** Atterberg Limits for SS6 & SS7 : **LL:26 PL:14 PI:11**
			7	SS	9		5	79		15		
			8	SS	7		6	78		14		
	some gravel presents at ~ 7.6mbgs		9	SS	11		7	77		11		
76.0							8					
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-31

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313803, N4783008 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 31, 2020 - July 31, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.4							
84.3 / 0.0	**ASPHALT** **~100 mm**						
0.1	**SAND AND GRAVEL (FILL)** road base/subbase compact brown dry **RDR 3**	1	SS	17		84	
83.7 / 0.7	**SILT, some clay and trace sand** compact brown wet **RDR 3**	2	SS	21	1		
		3	SS	16	2	83	Grain size analysis for SS3: **0 8 81 11** Atterberg Limits for SS3: **Non Plastic**
		4	SS	13		82	
81.4 / 3.0	**CLAYEY SILT, trace to some sand** stiff grey low plasticity **RDR 3**	5	SS	13	3	81	Grain size analysis for SS5 & SS6: **0 3 64 33** Atterberg Limits for SS5 & SS6: **LL:27** **PL:17** **PI:10**
		6	SS	10	4	80	
		7	SS	13	5	79	
	trace gravel at ~ 6.1mbgs firm to stiff	8	SS	6	6	78	Grain size analysis for SS8 & SS9: **2 17 57 24** Atterberg Limits for SS8 & SS9: **LL:23** **PL:14** **PI:9**
		9	SS	10	7	77	
76.2 / 8.2	**End of Borehole**				8		

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL WATER CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

SOIL VAPOUR READING COV/TOV (ppm)

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

Ontario

RECORD OF BOREHOLE No. BH20-32

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313702, N4783006 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 28, 2020 - July 28, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.4									20 40 60 80 100	20 40 60		
84.3 0.0	**ASPHALT ~125 mm**											
0.1	**SAND AND GRAVEL (FILL)** road base/subbase very dense brown dry **RDR 4**		1	SS	72			84		8		
83.7 0.7	**SILT, some clay, trace to some sand** compact to loose brown to grey moist **RDR 3**		2	SS	13		1	83		15		Grain size analysis for SS2 & SS3: **0 12 88**
			3	SS	20		2	82		19		
			4	SS	11					17		
			5	SS	12		3	81		17		
			6	SS	8		4	80		17		Grain size analysis for SS6 & SS7: **0 7 75 18** Atterberg Limits for SS6 & SS7: **LL:21 PL:14 PI:8**
			7	SS	9		5	79		17		
78.8 5.6	**CLAYEY SILT, some sand, trace gravel** stiff to very stiff brown to grey low plasticity **RDR 3**		8	SS	9		6	78		19		Grain size analysis for SS8 & SS9: **2 15 55 28** Atterberg Limits for SS8 & SS9: **LL:25 PL:15 PI:10**
			9	SS	21		7	77		12		
76.2 8.2	**End of Borehole**						8					

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

Ontario

RECORD OF BOREHOLE No. BH20-33

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313611, N4783044 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 28, 2020 - July 28, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.5												
84.4 / 0.0	**ASPHALT ~125 mm**											
0.1	**SAND AND GRAVEL (FILL)** road base/subbase very dense brown dry **RDR 4**		1	SS	35					5		
83.8								84				
0.7	**SANDY SILT, trace gravel (FILL)** compact brown moist **RDR 3**		2	SS	17		1			12		
			3	SS	12			83		12		
82.3							2					
2.2	**CLAYEY SILT, some to trace sand** **firm to hard brown wet to moist RDR 3**		4	SS	21			82		19		Grain size analysis for SS4 & SS5: **0 21 63 16** Atterberg Limits for SS4 & SS5 : **LL:18 PL:12 PI:6**
			5	SS	7	▽	3			18		
			6	SS	14		4	81		17		Grain size analysis for SS6 & SS7: **0 12 62 26** Atterberg Limits for SS6 & SS7: **LL:25 PL:15 PI:10**
			7	SS	8		5	80		17		
	trace gravel at ~ 6.1mbgs some sand		8	SS	23		6	79		10		Grain size analysis for SS8: **4 22 54 20** Atterberg Limits for SS8: **LL:21 PL:14 PI:8**
			9	SS	37		7	78		12		
76.3							8	77				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-34

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313540, N4783114 ORIGINATED BY SR

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 29, 2020 - July 29, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.9												
83.8 0.0	**ASPHALT ~100 mm**											
0.1	**SAND AND GRAVEL (FILL)** road base/subbase very dense brown dry **RDR 4**		1	SS	50 / 127 mm					5		
83.2 0.7	**SILT, some clay and sand** compact brown/red moist to wet **RDR 3**		2	SS	17		1	83		13		
			3	SS	19		2	82		16		Grain size analysis for SS3: **0 12 75 13** Atterberg Limits for SS3 : **LL:21 PL:18 PI:3**
81.7 2.2	**CLAYEY SILT, trace to some sand** stiff to hard brown to grey low plasticity **RDR 3**		4	SS	15		3	81		20		Grain size analysis for SS4 & SS5: **0 5 66 29** Atterberg Limits for SS4 & SS5: **LL:27 PL:15 PI:12**
			5	SS	13					15		
			6	SS	17		4	80		14		
	trace gravel at ~ 4.5 mbgs		7	SS	13		5	79		18		Grain size analysis for SS7: **2 20 53 25** Atterberg Limits for SS7: **LL:25 PL:16 PI:9**
			8	SS	26		6	78		12		Grain size analysis for SS8: **2 15 53 30** Atterberg Limits for SS8 : **LL:17 PL:16 PI:1**
			9	SS	72		7	77				
75.7 8.2	**End of Borehole**						8	76		8		

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

Ontario

RECORD OF BOREHOLE No. BH20-35

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313453, N4783172 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 29, 2020 - July 29, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.9									20 40 60 80 100	20 40 60		
0.0 / 83.7	**ASPHALT ~ 180 mm**				50 /							
0.2	**SILTY SAND AND GRAVEL (FILL)** road base/subbase hard brown moist **RDR 4**		1	SS	100 mm		0	83		6		Grain size analysis for SS1 & SS2: **18 35 47**
			2	SS	26		1			12		
82.4												
1.4	**SANDY SILT, trace gravel and clay, occassional cobbles (FILL)** compact to loose brown/grey moist **RDR 3**		3	SS	14		2	82		14		
			4	SS	4					17		
80.9												
3.0	**CLAYEY SILT, trace sand (FILL)** firm to very stiff grey intermediate plasticity **RDR 3**		5	SS	7		3	81		28		Grain size analysis for SS5 & SS6: **0 7 60 33** Atterberg Limits for SS5 & SS6: **LL:31 PL:16 PI:15**
			6	SS	26		4	80		16		
79.4												
4.5	**CLAYEY SILT, trace to some sand, trace gravel** very stiff to hard grey low plasticity **RDR 3**		7	SS	29		5	79		16		Grain size analysis for SS7: **3 7 62 28** Atterberg Limits for SS7: **LL:29 PL:16 PI:13**
			8	SS	34		6	78		9		Grain size analysis for SS8: **8 14 48 30** Atterberg Limits for SS8: **LL:29 PL:15 PI:13**
			9	SS	58		7	77		10		
75.6							8	76				
8.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-36

wood.

1 OF 1

G.W.P. _____ LOCATION North Service Rd., MTM, Z10, E313383, N4783178 ORIGINATED BY SJ

DIST Ontario HWY Various BOREHOLE TYPE 150mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE July 29, 2020 - July 29, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.3												
0.0 / 83.2	**ASPHALT ~150 mm**				50 /							
0.2	**SAND AND GRAVEL, some silt and cobbles, trace clay (FILL)** road base/subbase very dense brown moist **RDR 4**		1	SS	152 mm					5		
82.6												
0.7	**SILTY SAND, some gravel, trace clay (FILL)** very dense to compact mottled moist to wet **RDR 3**		2	SS	65		1	82		19		
			3	SS	12		2			22		
81.1												
2.2	**CLAYEY SILT, trace to some sand** stiff to very stiff grey low plasticity **RDR 3**		4	SS	13			81		16		Grain size analysis for SS4: **0 5 71 24** Atterberg Limits for SS4: **LL:23 PL:14 PI:9**
			5	SS	26		3	80		13		Grain size analysis for SS5: **0 4 75 21** Atterberg Limits for SS5: **LL:22 PL:11 PI:11**
	trace gravel at ~ 3.8 mbgs		6	SS	19		4	79		16		Grain size analysis for SS6: **5 17 54 24** Atterberg Limits for SS6: **LL:23 PL:15 PI:8**
			7	SS	21		5	78		10		
77.7												
5.6	**SANDY SILT, some clay, trace gravel** very dense grey to reddish brown **RDR 4**		8	SS	50 / 127 mm		6	77		7		Grain size analysis for SS7 & SS8: **4 24 52 20** Atterberg Limits for SS7 & SS8: **LL:29 PL:15 PI:13**
75.4			9	SS	50 / 127 mm		7	76		7		
7.9	**End of Borehole**											

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

Record of Borehole

Victoria Avenue

(BH20-37-BH20-42)

Ontario

RECORD OF BOREHOLE No. BH20-37

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313336, N4783128 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 6, 2020 - August 6, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.3									20 40 60 80 100	20 40 60		
0.0 / 84.1	**ASPHALT ~ 205 mm**											
0.2	**SAND AND GRAVEL (FILL)** road base/subbase compact brown moist **RDR 4**		1	AU				84		4		Auger sample
			2	AU			1			4		Auger sample
			3	SS	12			83		6		
82.1							2					
2.2	**CLAYEY SILT, trace to some sand, trace gravel** stiff to very stiff to firm brown low plasticity **RDR 3**		4	SS	13			82		20		Grain size analysis for SS4 & SS5: **1 7 75 17** Atterberg Limits for SS4 & SS5: **LL:22 PL:14 PI:9**
			5	SS	25		3	81		15		
			6	SS	7		4			20		Grain size analysis for SS6 & SS7: **3 10 65 22** Atterberg Limits for SS6 & SS7: **LL:26 PL:14 PI:12**
			7	SS	7		5	80		19		
	reddish brown shale fragments present at ~ 6.1 mbgs hard		8	SS	37		6	79		5		Grain size analysis for SS8: **5 14 50 31** Atterberg Limits for SS8 : **LL:27 PL:16 PI:11**
							7	78				
								77				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-37

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313336, N4783128 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 6, 2020 - August 6, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.7												
7.6	**SHALE** Reddish brown, fine grained, extremely weak, moderately weathered, heavily oxidized, broken rock filled with very dense glacial till. ~ 130mm of moderately fractured zone at 8.23m ~ 290 mm of moderately to heavily fractured zone at 10.65m TCR: 100% RQD: 46.7%		1	RC			8	76				
75.2							9	75				
9.1	**SHALE** Reddish brown, fine grained, strong, moderately weathered, moderately oxidized, occasional carbonatization alteration colored grey. TCR: 100% RQD: 41.7%		2	RC			10	74				
73.7												
10.7	**SHALE** Reddish brown, fine grained, strong, slightly weathered, moderately oxidized TCR: 100% RQD: 55%		3	RC			11	73				
72.1							12	72				
12.2	**SHALE** Reddish brown, fine grained, strong to very strong, slightly weathered, moderately oxidized, occasional carbonatization alteration ~100mm of possible shear zone at 10.72m TCR: 100% RQD: 58%		4	RC			13	71				
70.6												
13.7	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-37B

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313338, N4783084 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 4, 2020 - August 4, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
86.2							m	m	20 40 60 80 100	20 40 60		
0.0 / 86.0	**ASPHALT ~150 mm**											
0.2	**SAND AND GRAVEL (FILL)** road base/subbase very dense light brown moist		1	SS	62			86		4		
85.3	**RDR 4**											
0.9	**SANDY SILT, some clay, trace gravel and organics (FILL)** dense to compact grey/brown low plasticity **RDR 3**		2	SS	25		1	85		7		
			3	SS	19		2	84		13		Grain size analysis for SS3 & SS4: **8 20 58 14** Atterberg Limits for SS3 & SS4 : **LL:21 PL:17 PI:4**
			4	SS	22					13		
			5	SS	12		3	83		17		
82.2												
4.0	**CLAYEY SILT, some to trace sand and trace gravel** stiff to very stiff brown low plasticity **RDR 3**		6	SS	14		4	82		19		Grain size analysis for SS6 & SS7: **1 17 57 25** Atterberg Limits for SS6 & SS7 : **LL:25 PL:15 PI:16**
			7	SS	16		5	81		17		
			8	SS	7		6	80		17		Grain size analysis for SS8 & SS9: **4 7 65 24** Atterberg Limits for SS8 & SS9 : **LL:24 PL:14 PI:10**
							7	79				
			9	SS	26					11		

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-37B

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313338, N4783084 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 4, 2020 - August 4, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.5	**CLAYEY SILT, some to trace sand and trace gravel** stiff to very stiff brown low plasticity **RDR 3**							78				
8.7	**WEATHERED SHALE** very dense redish brown moist **RDR 5**		10	SS	60		9	77		9		
			11	SS	50 / 75 mm		10	76		6		
			12	SS	50 / 100 mm		11	75		6		
72.8							12	74				
13.4 72.5	**SHALE** Reddish brown, fine grained, very weak to weak, moderately weathered, moderately oxidized.		1	RC			13	73				
13.7	TCR: 28% RQD: 55% **SHALE** Reddish brown, fine grained, slightly, weathered, very weak to weak, moderately weathered, heavily oxidized. ~ 370mm of moderately to heavily fractured zone at 14.7m TCR: 100% RQD: 58%		2	RC			14	72				
70.9							15	71				
15.2	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-38

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313339, N4783042 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 5, 2020 - August 5, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.0												
87.8 / 0.2	**ASPHALT ~150 mm**											
	SAND AND GRAVEL (FILL) road base/subbase dense brown moist **RDR 4**		1	SS	41					3		
87.2 / 0.8	**SILT, some to trace gravel, trace to some clay, some sand (FILL)** compact to dense to compact grey low plasticity **RDR 3** trace wood pieces in SS-3		2	SS	16		1	87		13		
			3	SS	30					11		Grain size analysis for SS3 & SS4: **12 18 67 3** Atterberg Limits for SS3 & SS4 : **LL:21 PL:16 PI:5**
	50 mm layer of old asphalt at ~ 2.5mbgs		4	SS	27		2	86		12		
	trace rootlets and occassional sandy pockets 25 mm layer of old asphalt at ~ 3.1mbgs		5	SS	21		3	85		13		
	trace wood pieces		6	SS	10		4	84		14		Grain size analysis for SS6 & SS7: **1 11 72 16** Atterberg Limits for SS6 & SS7 : **LL:22 PL:16 PI:6**
	vertical and horizontal silt seams in SS-7		7	SS	9		5	83		18		
82.4 / 5.6	**SILT, some clay, trace sand seams** compact brown moist **RDR 3**		8	SS	27		6	82		15		
80.8 / 7.2	**CLAYEY SILT, trace gravel and sand** stiff to very stiff grey low plasticity **RDR 3**		9	SS	13		7	81		16		Grain size analysis for SS9 & SS10: **4 9 50 37** Atterberg Limits for SS9 & SS10 : **LL:30 PL:17 PI:12**
							8	80				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-38

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313339, N4783042 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 5, 2020 - August 5, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT, trace gravel and sand stiff to very stiff grey low plasticity **RDR 3** trace red shale present at ~ 9.5mbgs		10	SS	27					^{10}○		
77.8 10.2	**WEATHERED SHALE** very dense redish brown moist **RDR 5**		11	SS	50 / 100 mm		10	78		^{8}○		
77.0 10.9	**SHALE** Reddish brown, fine grained, weak, heavily weathered, heavily to moderately oxidized, heavily fractured with silt infilling. ~ 200mm of moderately to heavily fractured zone at 11m TCR: 28% RQD: 0%		1	RC			11	77				
76.6 11.4	**SHALE** Reddish brown, fine grained, heavily weathered, weak, moderately oxidized, moderately fractured with silt infilling. TCR: 32.5% RQD: 20.5%		2	RC			12	76				
75.1 12.9	**SHALE** Reddish brown, fine grained, heavily weathered, weak, heavily to moderately oxidized. TCR: 100% RQD: 29%		3	RC			13	75				
73.6 14.4	**SHALE** Reddish brown, fine grained, slightly weathered, weak, slightly oxidized, occasional carbonatization alteration. ~ 200mm of slightly fractured zone at 14.75m TCR: 97.7% RQD: 43.3%		4	RC			14	74				
72.0 16.0	**End of Borehole**						15	73				

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

Ontario

RECORD OF BOREHOLE No. BH20-39

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313310, N4782992 ORIGINATED BY DN

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 5, 2020 - August 5, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING / COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
82.4									20 40 60 80 100	20 40 60		
0.0	**CLAYEY SILT, trace sand (FILL)** stiff brown moist **RDR 2**		1	SS	16			82		15		
81.7												
0.7	**CLAYEY SILT, some sand and trace gravel** loose to compact grey low plasticity **RDR 3**		2	SS	15		1			16		Grain size analysis for SS2 & SS3: **2 17 51 30** Atterberg Limits for SS2 & SS3 : **LL:25** **PL:14** **PI:11**
			3	SS	8			81		20		
	trace red shale at ~ 2.3 mbgs		4	SS	14		2	80		12		
79.4												
3.0	**WEATHERED SHALE** very dense red dry **RDR 5**		5	SS	50 / 140 mm		3	79		6		
			6	SS	50 / 75 mm		4	78		6		
			7	SS	50 / 152 mm		5	77		7		

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-39

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313310, N4782992 ORIGINATED BY DN

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 5, 2020 - August 5, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.3												
6.1 / 76.0	**SHALE** Red, fine grained, highly weathered, very weak to weak, heavily oxidized. Highly fractured. TCR: 83.3% RQD: 0%		1	RC								
6.4 / 74.4	**SHALE** Red, fine grained, moderately weathered, moderately oxidized, occasional carbonatization alterations. Moderately fractured zone at ~6.40m-7.20m TCR: 100% RQD: 15%		2	RC			7	76 / 75				
7.9 / 72.9	**SHALE** Red, fine grained, slightly weathered, slightly oxidized, carbonatization alteration. Lightly fractured. TCR: 90% RQD: 24%		3	RC			8 / 9	74 / 73				
9.4 / 71.4	**SHALE** Red, fine grained, slightly weathered, slightly oxidized. TCR: 93% RQD: 53.6%		4	RC			10	72				
11.0	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-40

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313312, N4782937 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 7, 2020 - August 7, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.4												
0.0	**SILT, some sand, trace rootlets (FILL)** loose moist **RDR 2**		1	SS	7			83		12		
82.7							1					
0.7	**CLAYEY SILT, some sand, trace red shale fragment and rootlets (FILL)** very stiff to stiff brown moist **RDR 3** turns grey at ~ 1.3mbgs		2	SS	20			82		16		
			3	SS	11		2			13		Grain size analysis for SS2 & SS3: **2 13 85**
81.2												
2.2	**CLAYEY SILT, some sand, trace gravel** stiff grey low plasticity **RDR 3**		4	SS	11			81		14		Grain size analysis for SS4 & SS5: **2 17 52 29** Atterberg Limits for SS4 & SS5 : **LL:25** **PL:15** **PI:11**
			5	SS	11		3			12		
79.7								80				
3.7	**WEATHERED SHALE** very dense redish brown moist **RDR 5**		6	SS	50 / 127 mm		4			7		
			7	SS	50 / 127 mm		5	79		6		
			8	SS	50 / 127 mm		6	78		8		
							7	77				
								76				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-40

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313312, N4782937 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 7, 2020 - August 7, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
75.4			9	SS	50 / 152 mm		8	75		⁸○		
8.0	**SHALE** Reddish brown, fine grained, moderately weathered, moderately oxidized, occasional carbonatization alteration. Moderately fractured TCR: 92.5% RQD: 21.7%		1	RC			9	74				
73.9												
9.5	**SHALE** Reddish brown, fine grained, slightly weathered, slightly oxidized, carbonatization alteration at ~10.38m. TCR: 95% RQD: 65%		2	RC			10	73				
72.4							11	72				
11.0	**SHALE** Reddish brown, fine grained, slightly weathered, slightly oxidized, occasional carbonatization alteration. ~110mm Lightly fractured zone at 11.30m TCR: 100% RQD: 68.3%		3	RC			12	71				
70.8												
12.6	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-41

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313320, N4782874 ORIGINATED BY DN

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 6, 2020 - August 6, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
85.3												
85.2 / 0.0	**TOPSOIL ~100 mm**											
0.1	**SILT, some clay and sand, trace gravel (FILL)** loose to dense brown low plasticity **RDR 2**		1	SS	17			85		8		
			2	SS	8		1			11		Grain size analysis for SS2 & SS3: **6 13 62 19** Atterberg Limits for SS2 & SS3 : **LL:23 PL:19 PI:4**
	turns grey at ~ 1.3mbgs		3	SS	32		2	84		10		
83.1												
2.2	**SANDY GRAVEL, trace silt (FILL)** loose brown moist **RDR 3**		4	SS	9			83		4		
			5	SS	9		3	82		5		Grain size analysis for SS4 & SS5: **68 25 7**
81.5												
3.7	**CLAYEY SILT, some sand, trace gravel** firm grey low plasticity **RDR 3**		6	SS	12		4	81		15		Grain size analysis for SS6 & SS7: **4 17 50 29** Atterberg Limits for SS6 & SS7 : **LL:25 PL:14 PI:11**
			7	SS	20		5	80		11		
79.6												
5.6	**GRAVELY SILT, some clay, trace sand** very dense grey low plasticity **RDR 5** rock present at ~6.3mbgs caused high blow counts and refusal		8	SS	50 / 50 mm		6	79		9		Grain size analysis for SS8 & SS9: **24 4 53 19** Atterberg Limits for SS8 & SS9 : **LL:24 PL:14 PI:10**
	redish brown some weathered shale		9	SS	50 / 115 mm		7	78		11		
							8	77				

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH/MW20-41

wood.

G.W.P. _____ LOCATION RR 24, MTM, Z10, E313320, N4782874 ORIGINATED BY DN

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 6, 2020 - August 6, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	ELEVATION (m)	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.6												
8.7	**WEATHERED SHALE** very dense redish brown moist		10	SS	50 / 152 mm		9	76		7 ○		
74.6							10	75				
10.7	**SHALE** Grey, fine grained, no water return, moderately weathered, lightly oxidized. Moderately fractured TCR: 71.4% RQD: 0%		1	RC			11	74				
74.3												
11.0	**SHALE** Red, fine grained, moderately weathered, moderately oxidized. ~75mm heavily fractured zone at ~11.67m TCR: 93.5% RQD: 20.7%		2	RC			12	73				
72.7												
12.6	**SHALE** Red, fine grained, lightly weathered, lightly oxidized. occasional carbonatization alteration. TCR: 100% RQD: 66.7%		3	RC			13	72				
71.1							14					
14.1	**SHALE** Red, fine grained, lightly weathered, lightly oxidized. occasional carbonatization alteration. TCR: 100% RQD: 57.5%		4	RC			15	71				
69.6								70				
15.7	**End of Borehole**											

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

Ontario

RECORD OF BOREHOLE No. BH20-42

wood.

G.W.P. _____ LOCATION HWY QEW, MTM, Z10, E313334, N4782968 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 16, 2020 - August 17, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	DEPTH (m)	ELEVATION (m)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
83.8							
0.0 / 83.5	**ASPHALT ~100 mm**						
0.3	**SILTY SAND AND GRAVEL (FILL)** road base/subbase dense brown/grey moist **RDR 4**	1	SS	36			Grain size analysis for SS1 & SS2: **37 34 29**
		2	SS	17	1	83	
82.4							
1.4	**CLAYEY SILT, trace gravel and sand** very stiff to stiff brown to reddish brown low plasticity **RDR 3**	3	SS	27			Grain size analysis for SS3 & SS4: **1 8 61 30** Atterberg Limits for SS3 & SS4 : **LL:29 PL:17 PI:12**
		4	SS	15	2	82	
		5	SS	12			
	trace cobbles fragments present at ~ 3.9mbgs very stiff **RDR 4**	6	SS	25	3	81	
79.3							
4.4	**WEATHERED SHALE, some sand and trace silt** very dense redish brown moist **RDR 5<b>>**	7	SS	50 / 127mm	4	80	
					5	79	
		8	SS	50 / 152mm	6	78	
76.1					7	77	
7.6						76	

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL WATER CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

SOIL VAPOUR READING COV/ TOV (ppm)

Continued Next Page

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

Ontario

RECORD OF BOREHOLE No. BH20-42

wood.

G.W.P. _____ LOCATION HWY QEW, MTM, Z10, E313334, N4782968 ORIGINATED BY OL

DIST Ontario HWY Various BOREHOLE TYPE 200mm Hollow Stem Augers COMPILED BY SH

DATUM Geodetic DATE August 16, 2020 - August 17, 2020 CHECKED BY TG

PROJECT Prudhommes WM Upgrade Geotechnical & Hydrogeological Investigation JOB NO. OGTW2010

ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL WATER CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SHALE Reddish brown, fine grained, moderately weathered, moderately oxidized, very weak. Heavily fractured 7.62m-8.22m. TCR: 78.3% RQD: 17%		1	RC			9	75				
74.6 / 9.1	**SHALE** Reddish brown, fine grained, slightly weathered, moderately oxidized, weak. TCR: 78.3% RQD: 58.6%		2	RC			10	74				
73.1 / 10.6	**SHALE** Reddish brown, fine grained, moderate weathered, slightly oxidized, medium strong to strong. Carbonatization alteration. TCR: 100% RQD: 68.3%		3	RC			11	73				
71.6 / 12.1	**SHALE** Reddish brown, fine grained, moderate weathered, slightly oxidized medium strong. TCR: 100% RQD: 51.7%		4	RC			12	72				
							13	71				
70.1 / 13.7	**End of Borehole**											

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

`

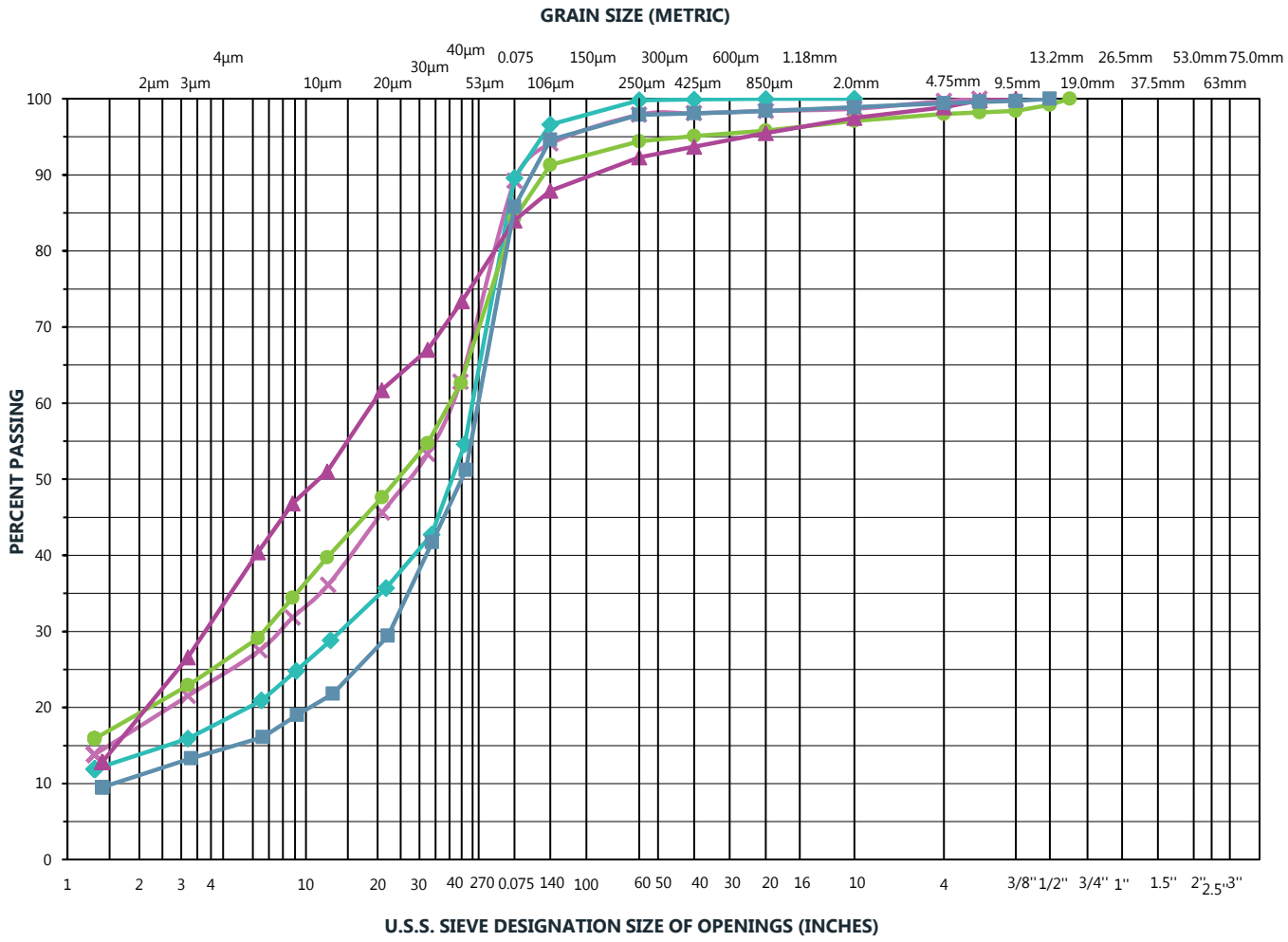
Appendix B

Soil & Bedrock Geotechnical Laboratory Test Results

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-01	SS3	5 - 7	1	10	71	18
◆	BH 20-01	SS5	10 - 12	0	10	76	14
●	BH 20-02	SS2	2.5 - 4.5	3	13	65	19
▲	BH 20-05	SS4 & SS5	7.5 - 12	3	13	65	19
■	BH 20-07	SS3	5 - 7	1	13	75	11

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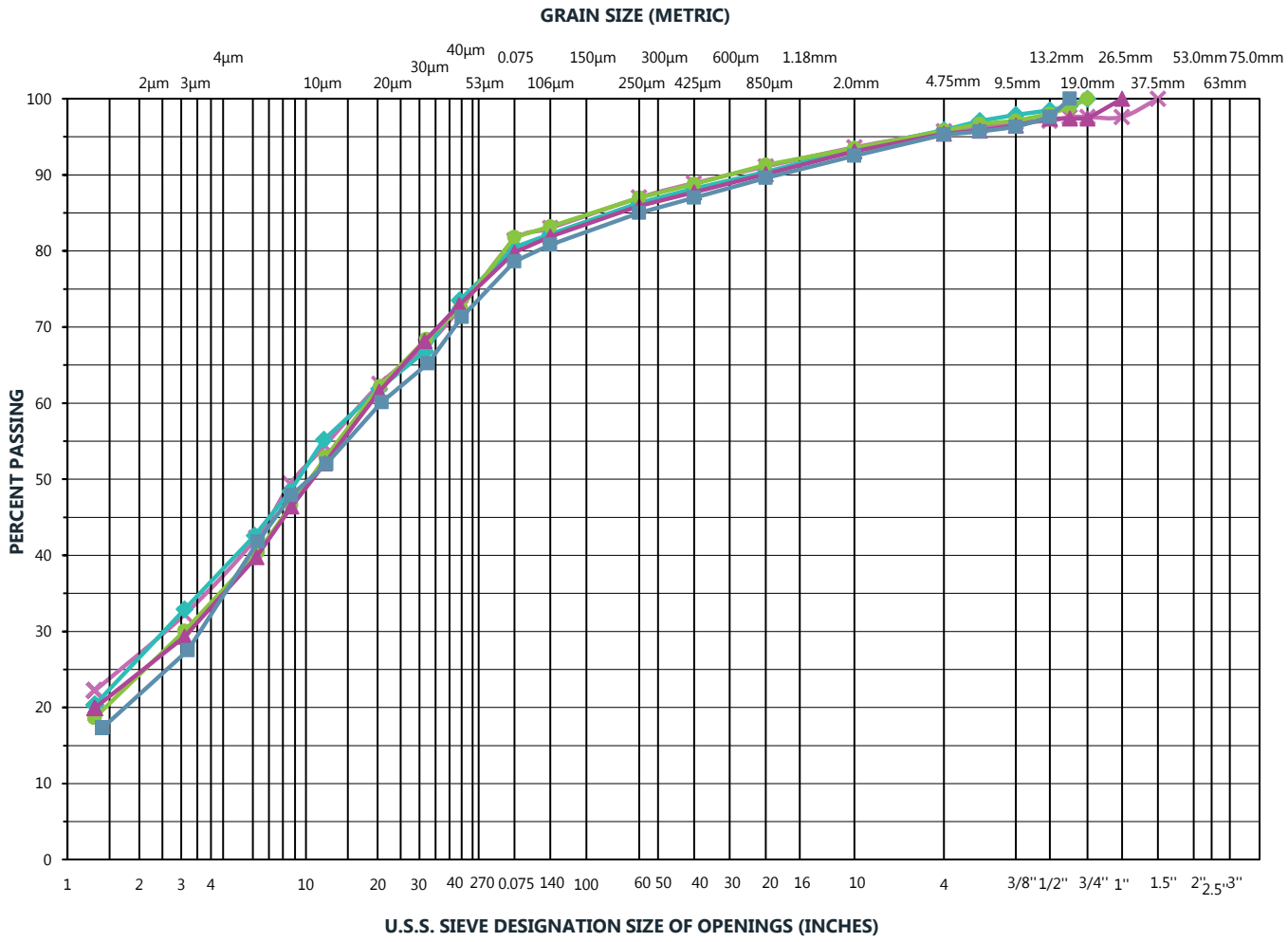
GRAIN SIZE DISTRIBUTION	FIGURE 1		
	Project No.:	OGTW2010	
SILT, SOME CLAY AND SAND (ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-01	SS10 & SS11	30 - 37	6	13	54	27
◆	BH 20-01	SS12 & SS13	15 - 17	7	13	54	26
●	BH 20-02	SS10 & SS11	30 - 37	7	11	58	24
▲	BH 20-04	SS7 & SS8	15 - 22	7	13	56	24
■	BH 20-05	SS7 & SS8	15 - 22	8	13	58	21

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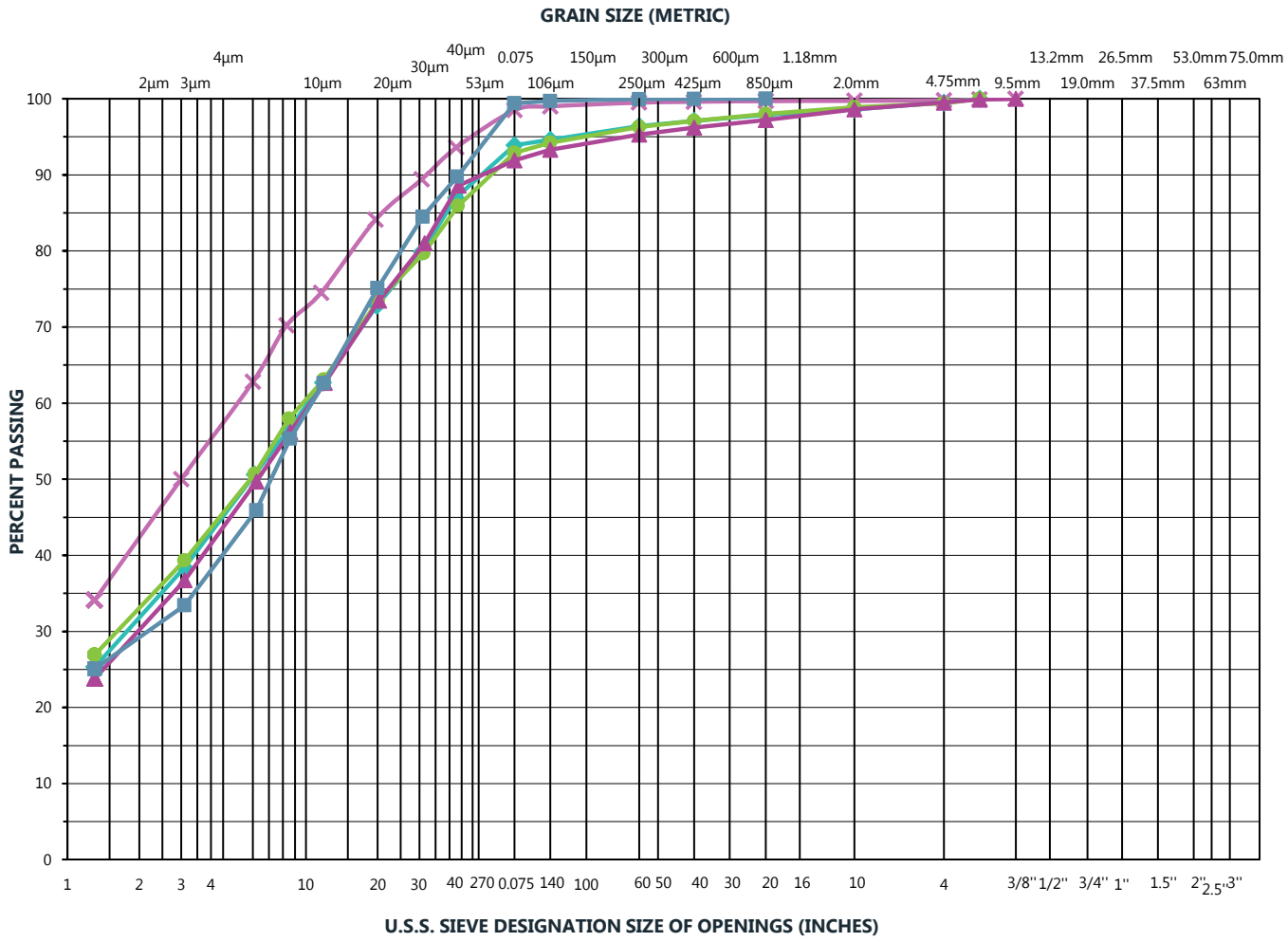
GRAIN SIZE DISTRIBUTION	FIGURE 2		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND AND GRAVEL (ML-CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-02	SS8	20 - 22	0	2	56	42
◆	BH 20-03	SS5 & SS6	10 - 15	1	5	62	32
●	BH 20-04	SS4 & SS5	7.5 - 12	1	6	60	33
▲	BH 20-07	SS6 & SS7	12.5 - 17	1	7	62	30
■	BH 20-08	SS8	20 - 22	0	1	70	29

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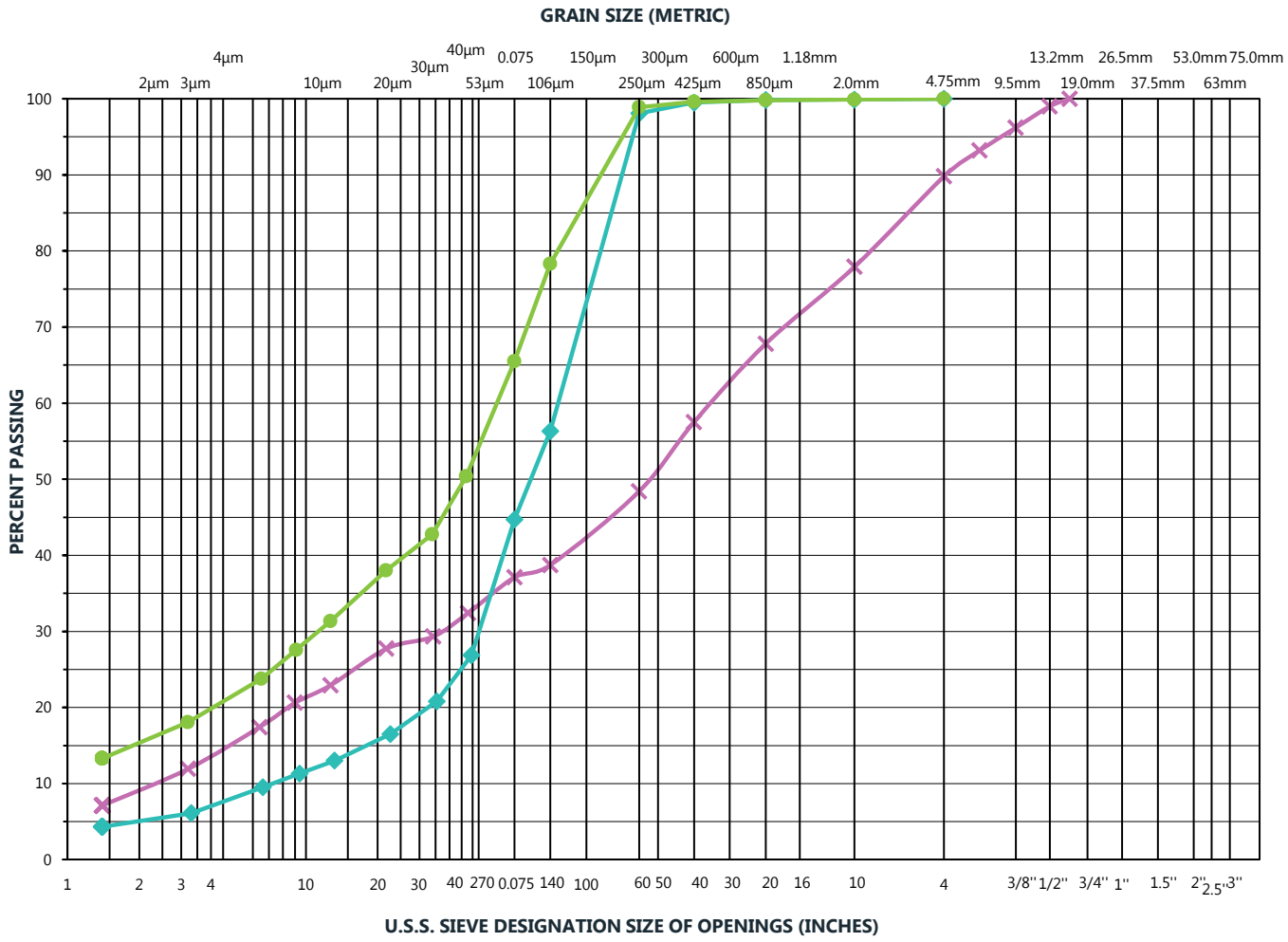
GRAIN SIZE DISTRIBUTION	FIGURE 3		
	Project No.:	OGTW2010	
SILTY CLAY (CL-ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-03	SS9	25- 27	22	41	28	9
◆	BH 20-08	SS4 & SS5	7.5 - 12	0	55	40	5
●	BH 20-08	SS2 & SS3	2.5 - 7	0	34	51	15

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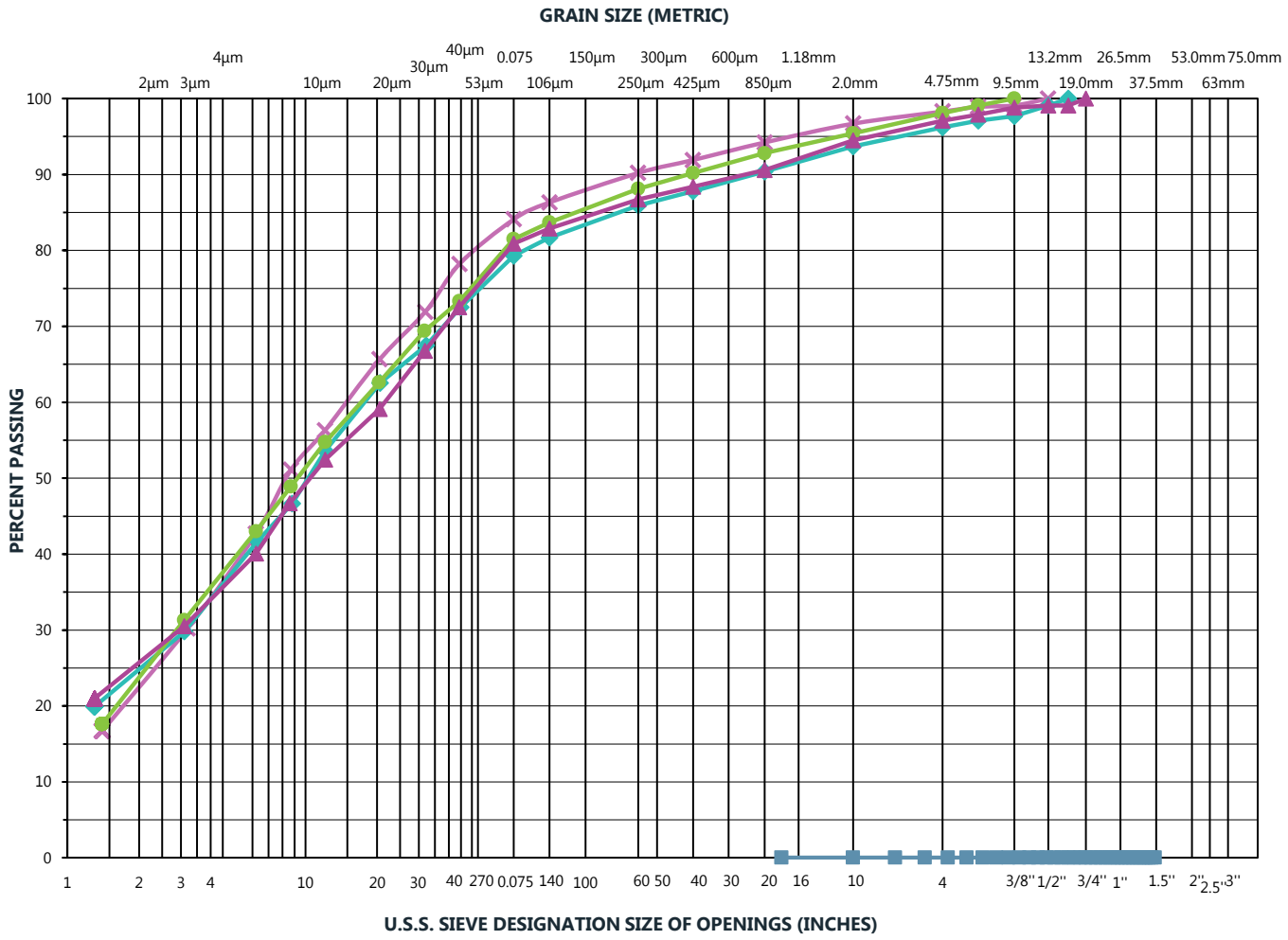
GRAIN SIZE DISTRIBUTION	FIGURE 4		
	Project No.:	OGTW2010	
SILTY SAND (SM)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-06	SS4	7.5 - 9.5	3	13	61	23
◆	BH 20-06	SS6 & SS7	12.5 - 17	6	15	55	24
●	BH 20-06	SS9	25 - 27	5	13	58	24
▲	BH 20-08	SS9 & SS10	25 - 32	5	14	56	25

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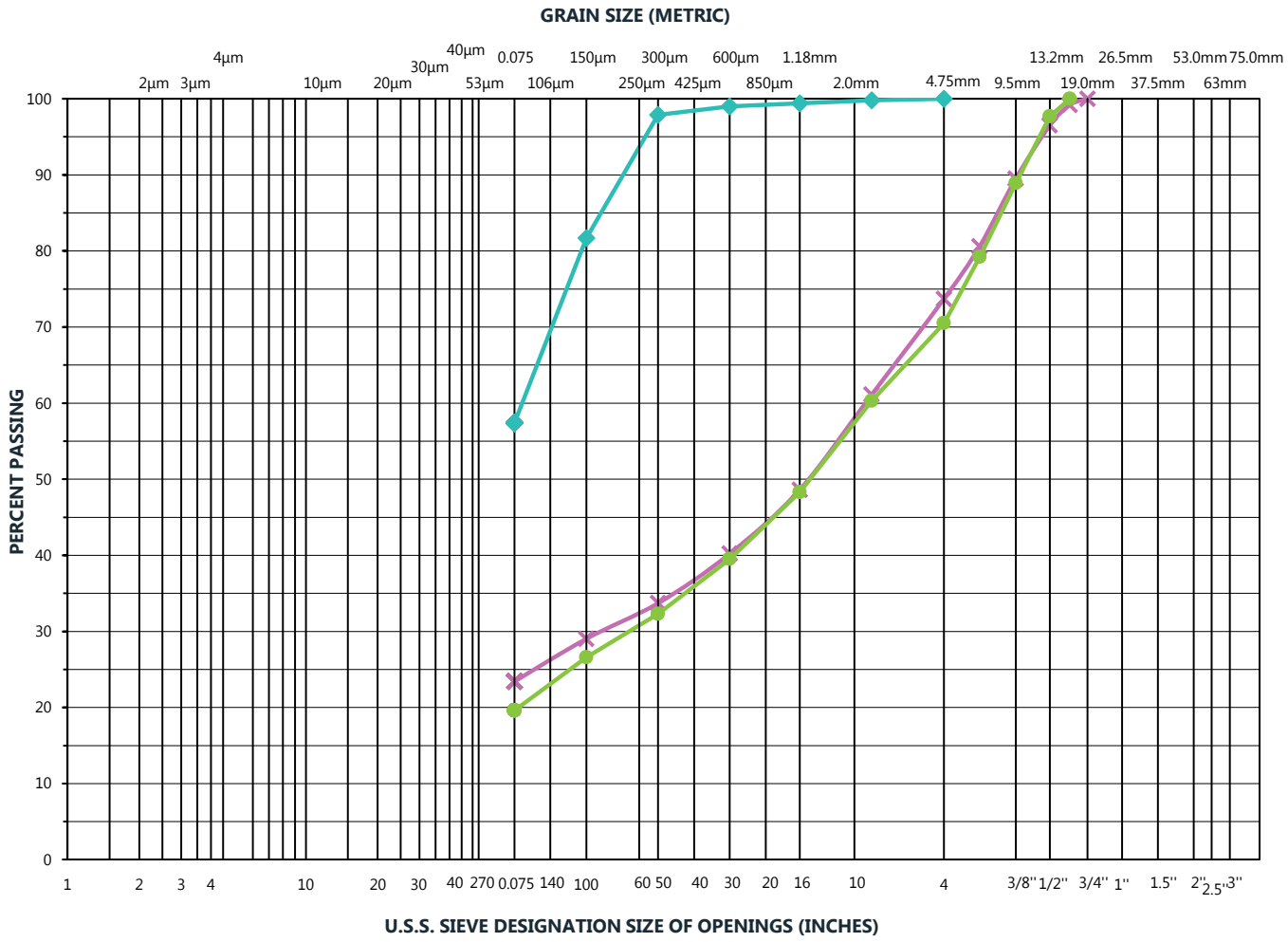
GRAIN SIZE DISTRIBUTION	FIGURE 5		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND, TRACE GRAVEL (CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Jordan Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-02	SS1	0 - 2	26	51	23	
◆	BH 20-03	SS3	5 - 7	0	43	57	
●	BH 20-05	SS1 & SS2	0 - 4.5	29	51	20	

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GRAIN SIZE DISTRIBUTION	FIGURE 6		
	Project No.:	OGTW2010	
SILTY SAND & GRAVEL (SM-GW)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 15, 2020	

GRAIN SIZE DISTRUBUTION

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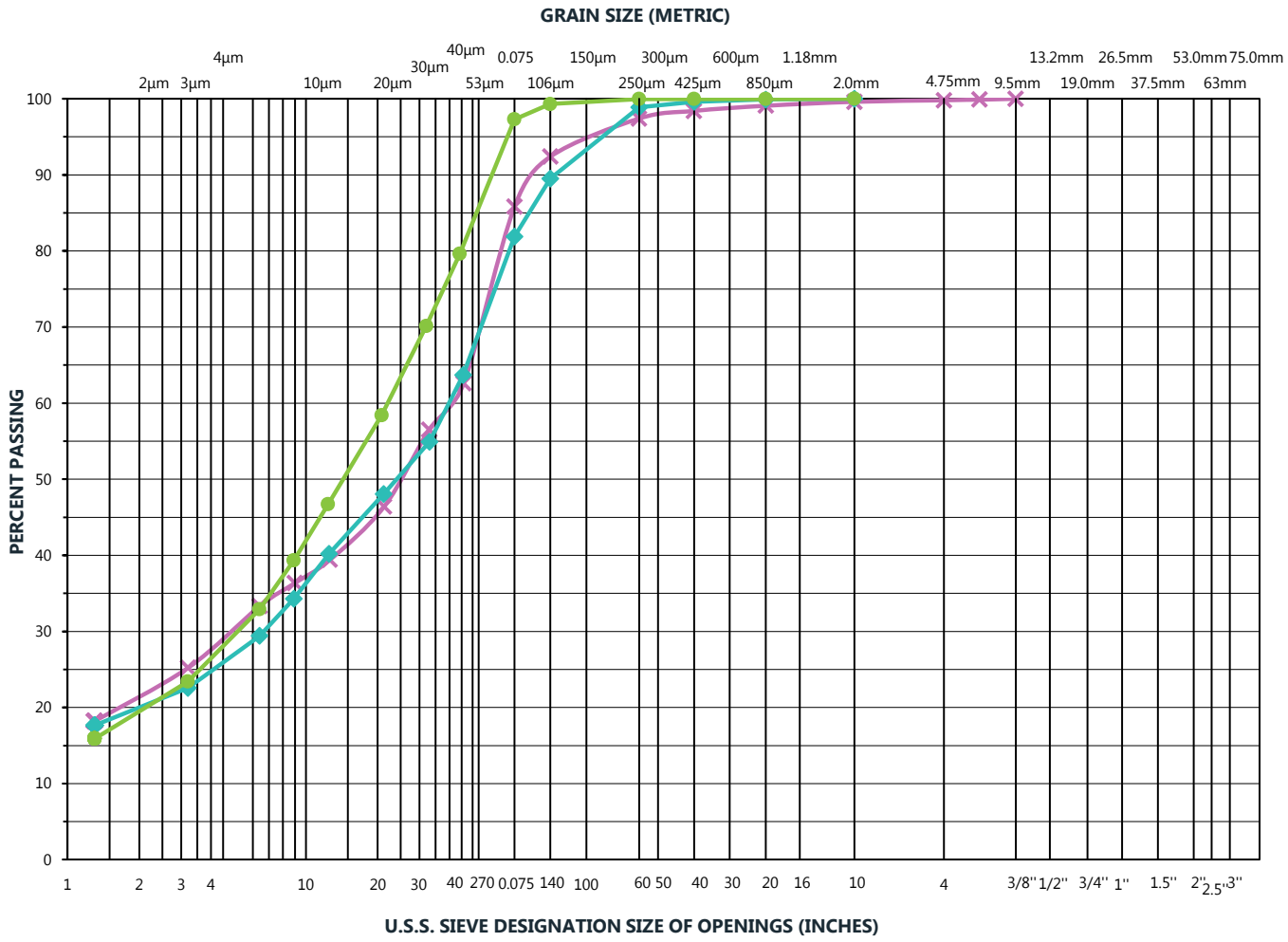
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-09	SS2 & SS3	2.5 - 7	1	13	64	22
◆	BH 20-09	SS5	10 - 12	0	18	62	20
●	BH 20-10	SS8	20 - 22	0	3	78	19

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GRAIN SIZE DISTRIBUTION	FIGURE 13		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND, (CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
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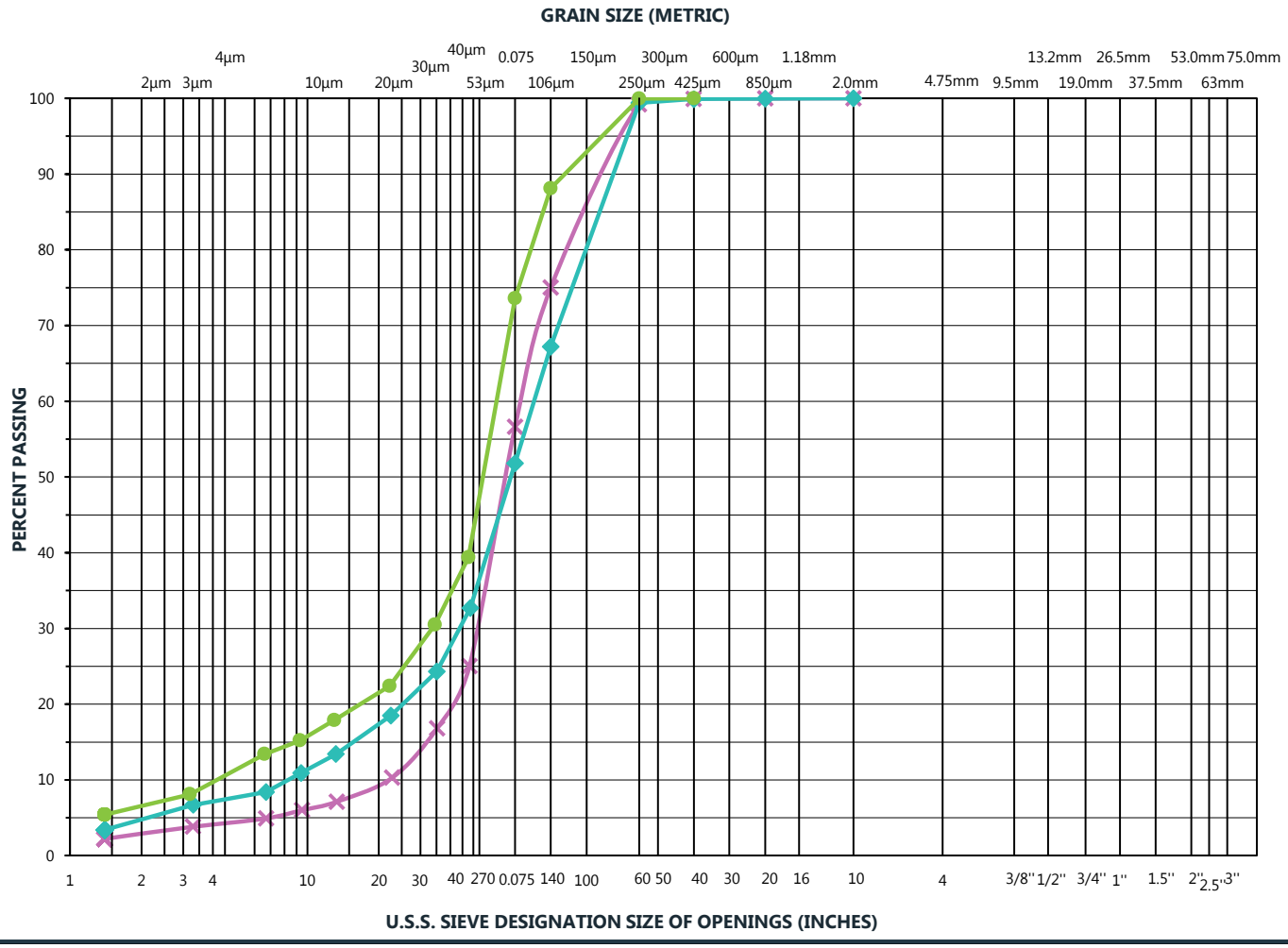
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-09	SS7	15 - 17	0	43	54	3
◆	BH 20-10	SS4	7.5 - 9.5	0	48	47	5
●	BH 20-10	SS7	15 - 17	0	26	67	7

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GRAIN SIZE DISTRIBUTION	FIGURE 14		
	Project No.:	OGTW2010	
SILT AND SAND, TRACE CLAY (SM)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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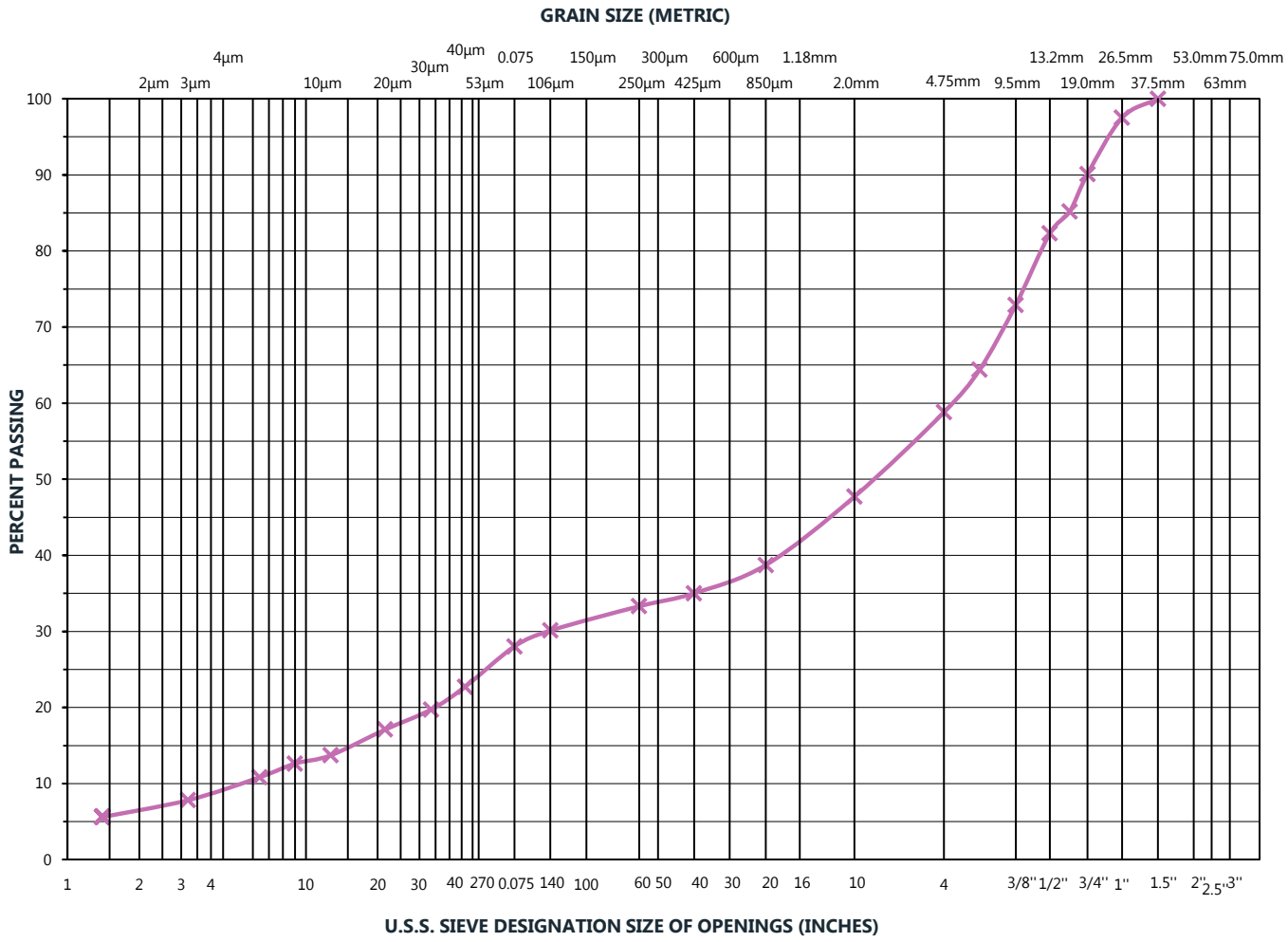
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
	BH 20-11	SS2 & SS3	2.5 - 7	53	19	21	7

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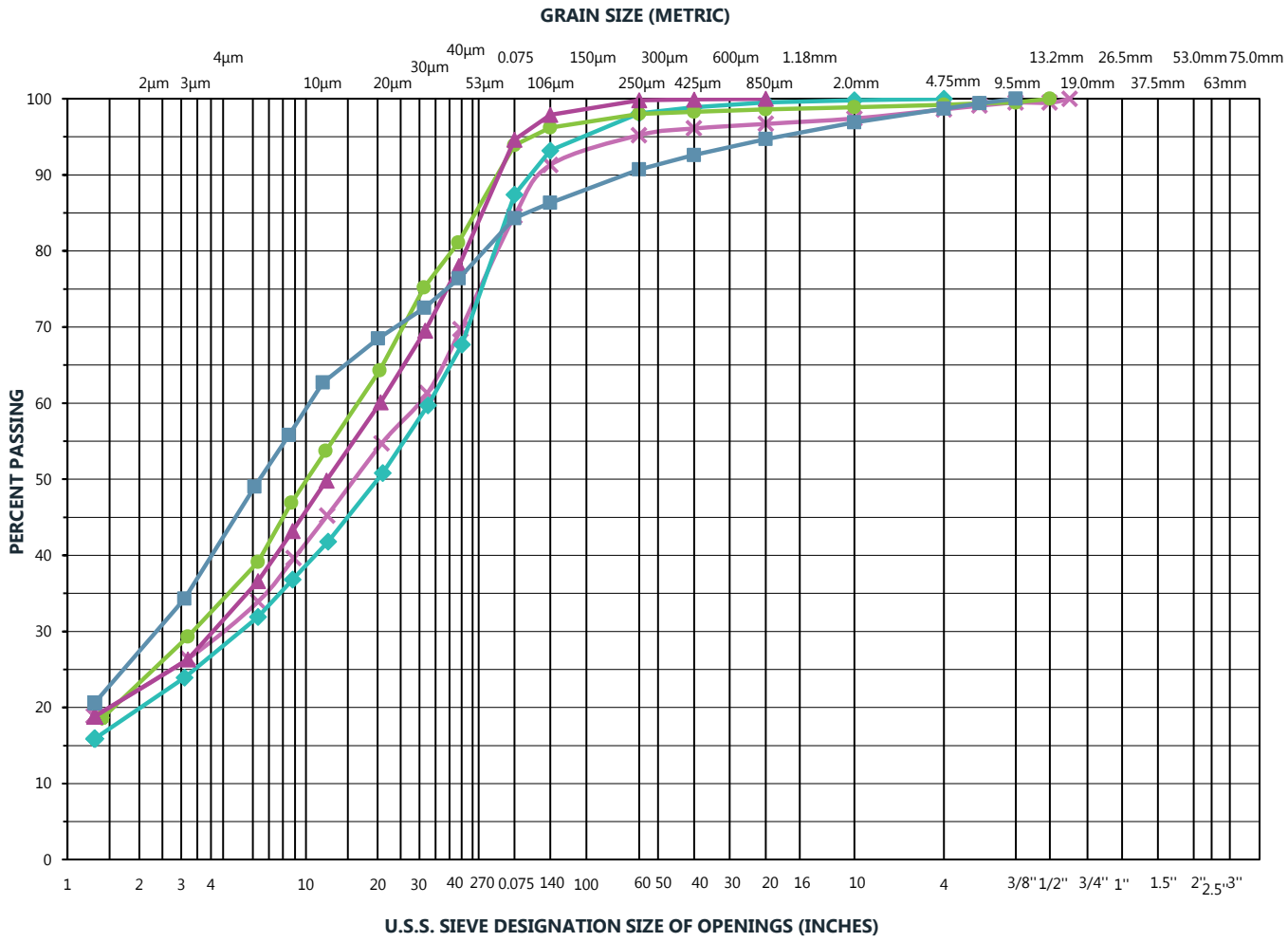
GRAIN SIZE DISTRIBUTION	FIGURE 15		
	Project No.:	OGTW2010	
SANDY SILTY GRAVEL, TRACE CLAY, WITH RAP (GW-GM	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-11	SS5 & SS6	10 - 14.5	3	12	63	22
◆	BH 20-11	SS8	20 - 22	0	13	67	20
●	BH 20-12	SS2 & SS3	2.5 - 7	1	5	70	24
▲	BH 20-13	SS8	20 - 22	0	5	73	22
■	BH 20-15	SS8	20 - 22	3	13	58	26

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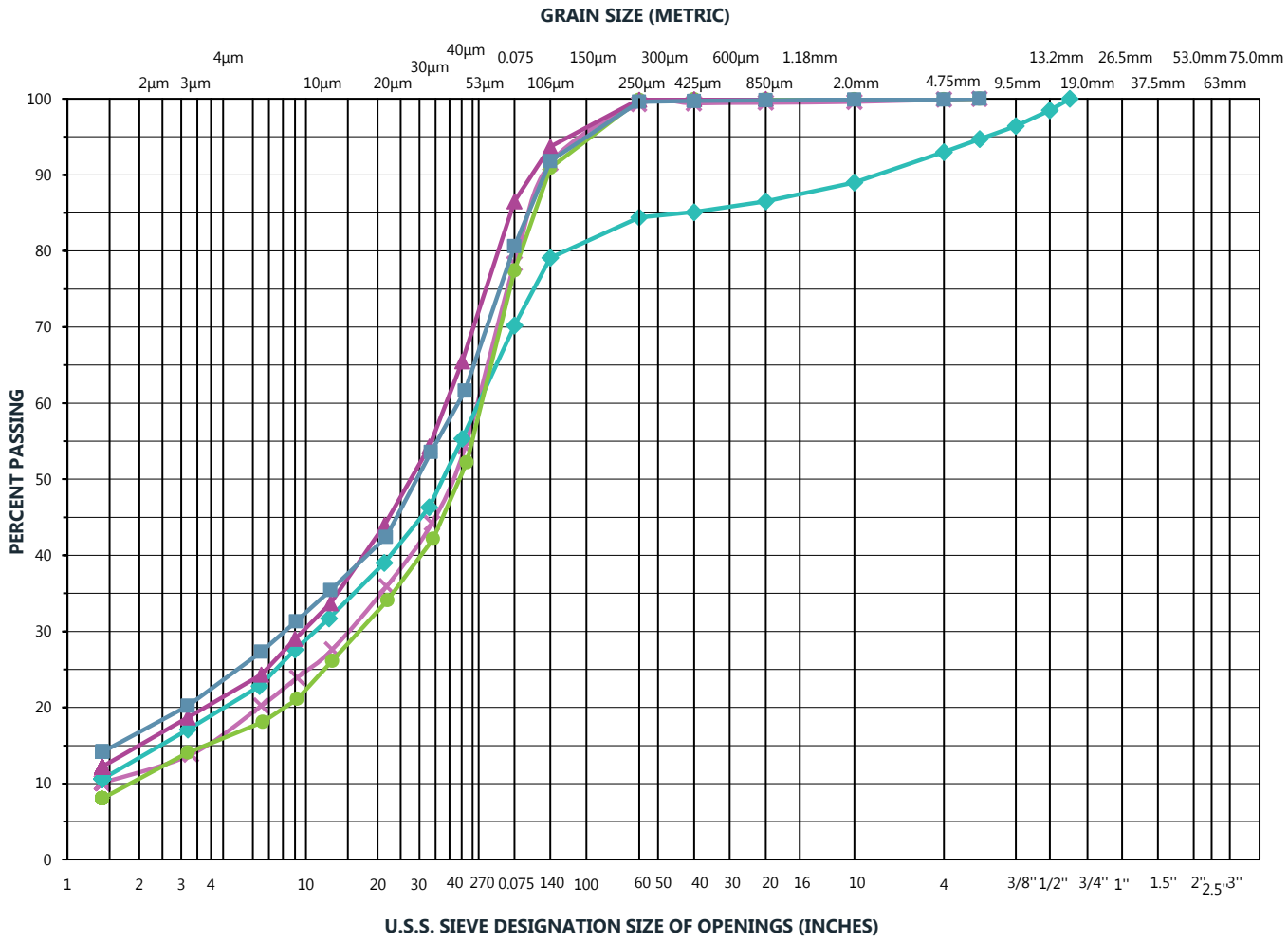
GRAIN SIZE DISTRIBUTION	FIGURE 16		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND (CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-12	SS4	7.5 - 9.5	1	21	67	11
◆	BH 20-15	SS2 & SS3	2.5 - 7	11	19	57	13
●	BH 20-13	SS5 & SS6	10 - 14.5	0	23	66	11
▲	BH 20-13	SS7	15 - 17	0	13	72	15
■	BH 20-14	SS4 & SS5	7.5 - 12	0	19	69	12

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GRAIN SIZE DISTRIBUTION	FIGURE 17		
	Project No.:	OGTW2010	
SANDY SILT, SOME CLAY (ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
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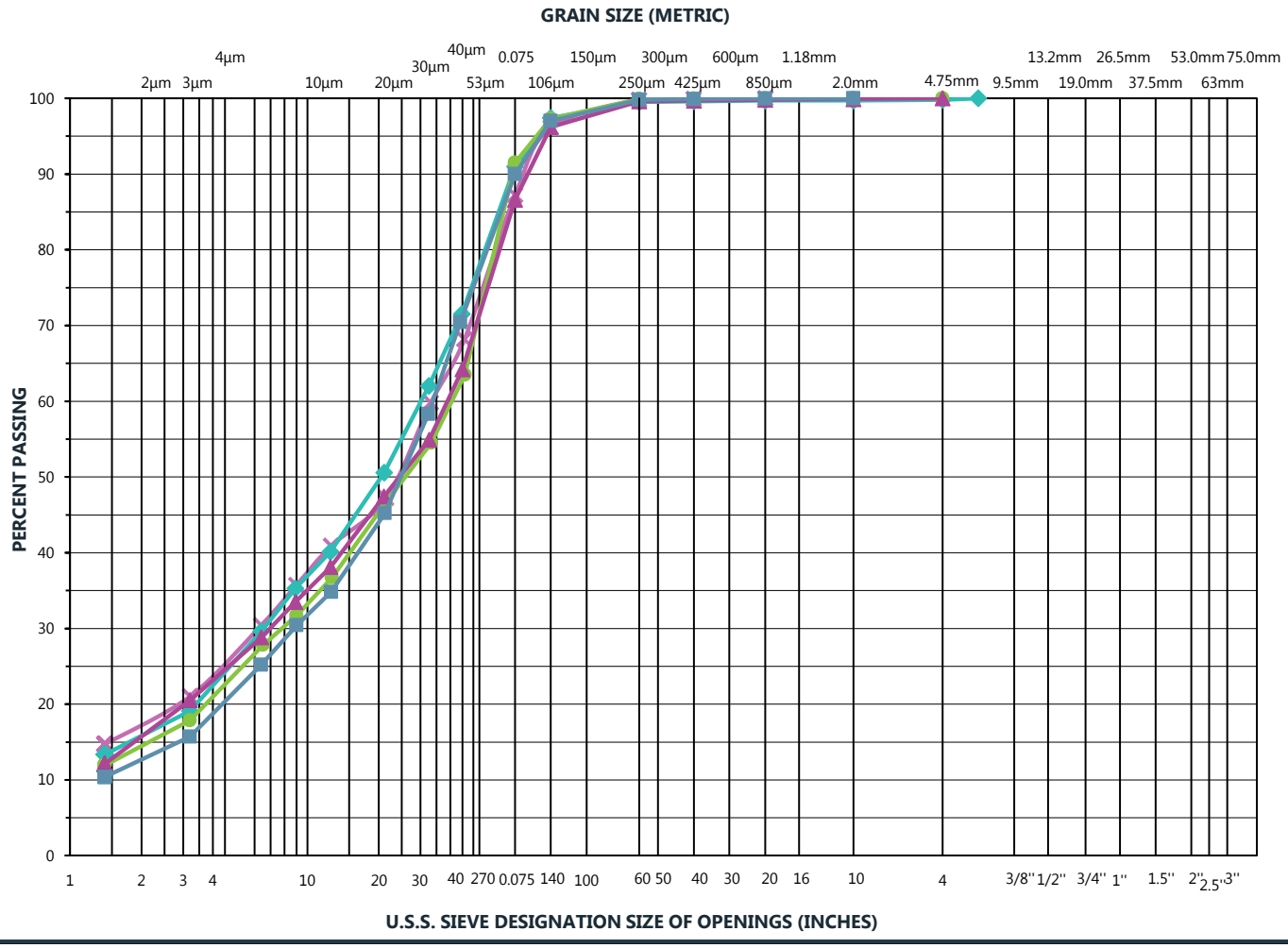
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-14	SS6 & SS7	12.5 - 17	0	13	70	17
◆	BH 20-14	SS8	20 - 22	0	9	75	16
●	BH 20-12	SS7 & SS8	15 - 22	0	8	78	14
▲	BH 20-15	SS4 & SS5 (A&B)	7.5 - 12	0	13	71	16
■	BH 20-15	SS7	15 - 17	0	10	77	13

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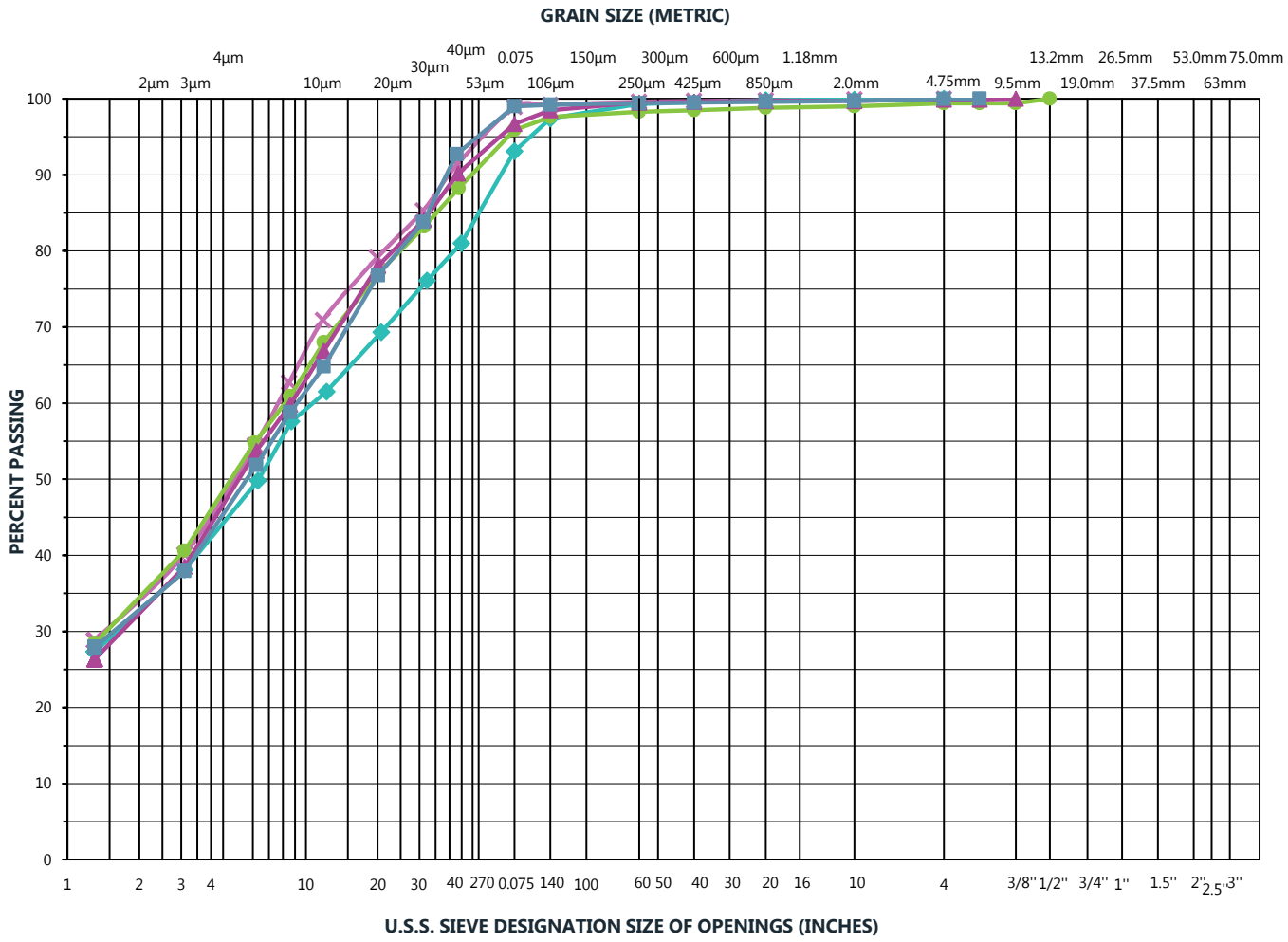
GRAIN SIZE DISTRIBUTION	FIGURE 18		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND (CL-ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-16	SS5 & SS6	10 - 14.5	0	1	65	34
◆	BH 20-21	SS5 & SS6	10 - 14.5	0	7	61	32
●	BH 20-22	SS2 & SS3	2.5 - 7	1	3	62	34
▲	BH 20-23	SS2 & SS3	2.5 - 7	0	3	65	32
■	BH 20-23	SS6 & SS7	12.5 - 17	0	1	66	33

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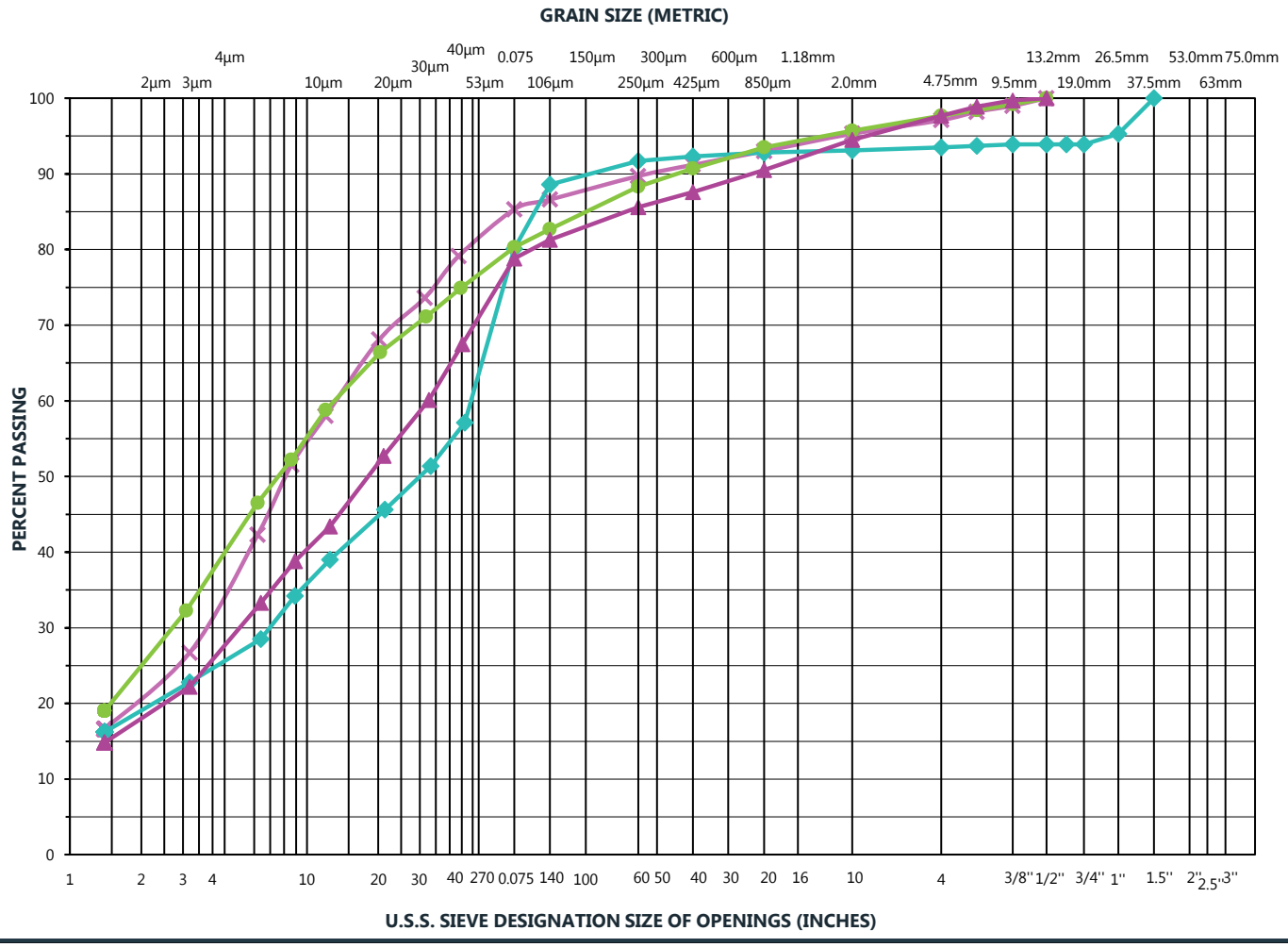
GRAIN SIZE DISTRIBUTION	FIGURE 19		
	Project No.:	OGTW2010	
CLAY AND SILT (CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-16	SS7 & SS8	15 - 19.5	5	10	64	21
◆	BH 20-17	SS5 & SS6	10 - 14.5	7	13	61	19
●	BH 20-22	SS6 & SS7	12.5 - 17	4	16	55	25
▲	BH 20-22	SS9	25 - 27	5	16	62	17

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GRAIN SIZE DISTRIBUTION	FIGURE 20		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND, TRACE GRAVEL (CL-ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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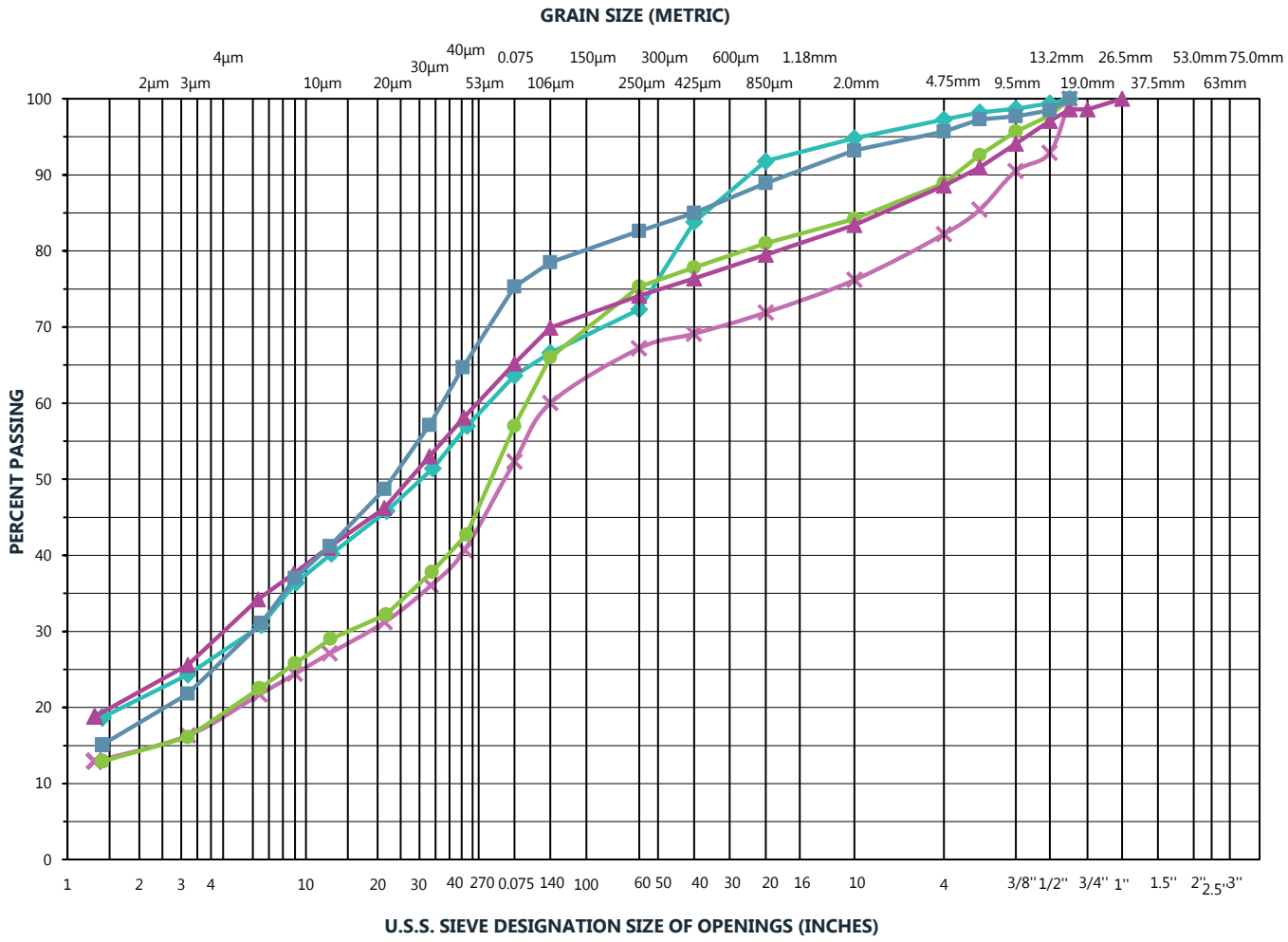
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-17	SS3 & SS4	5 - 9.5	24	24	38	14
◆	BH 20-20	SS5 & SS6	10 - 14.5	5	31	43	21
●	BH 20-18	SS2 & SS3	2.5 - 7	16	27	43	14
▲	BH 20-18	SS5 & SS6	10 - 14.5	17	18	43	22
■	BH 20-21	SS9	25 - 27	7	18	57	18

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GRAIN SIZE DISTRIBUTION	FIGURE 21		
	Project No.:	OGTW2010	
SANDY SILT, SOME GRAVEL AND CLAY (ML)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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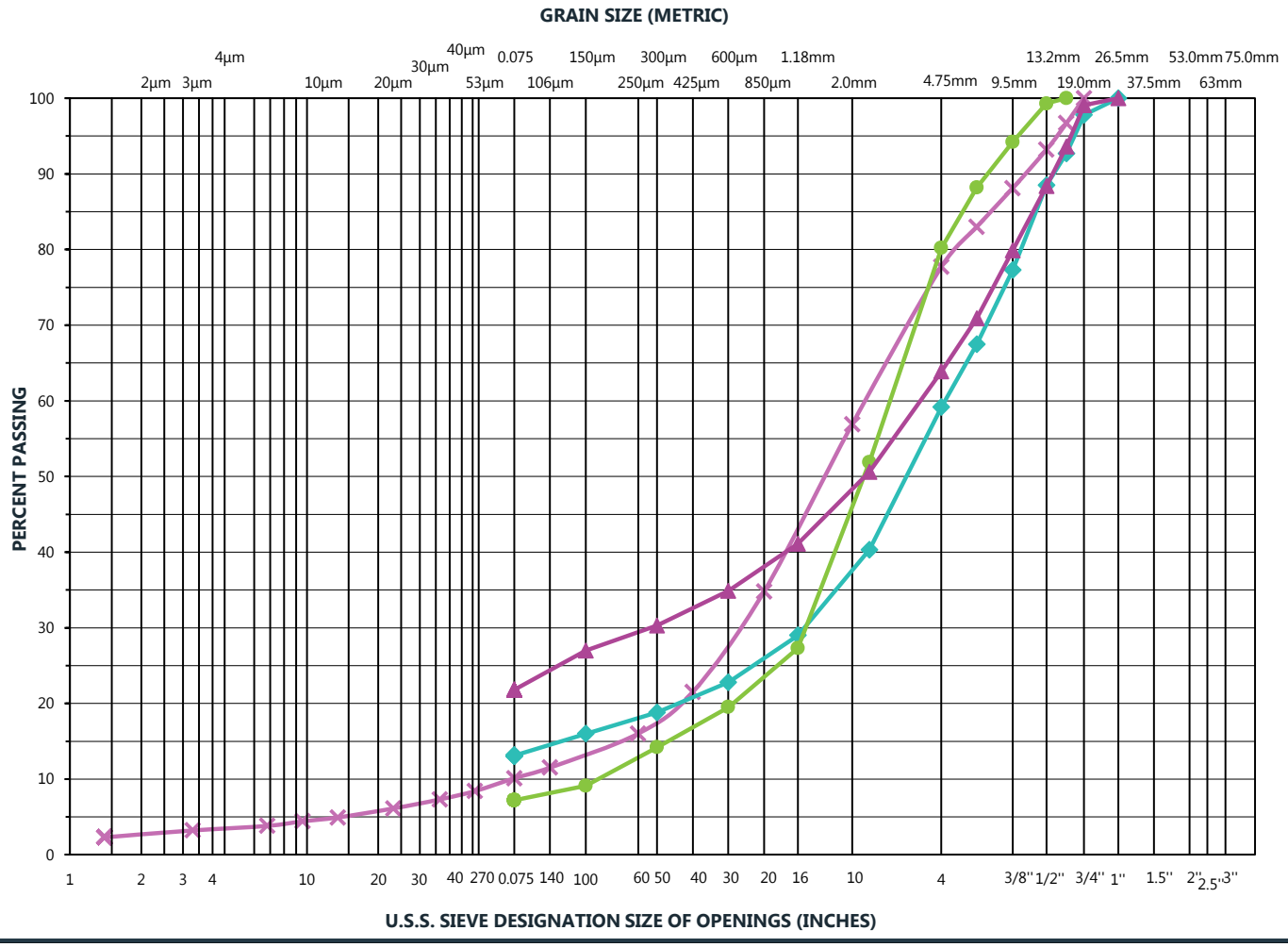
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-19	SS5 & SS6	10 - 14.5	43	47	7	3
◆	BH 20-21	SS1 & SS2	0 - 4.5	41	46	13	
●	BH 20-20	SS8 & SS9	20 - 27	20	73	7	
▲	BH 20-26	SS1 & SS2	0 - 4.5	36	42	22	

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GRAIN SIZE DISTRIBUTION	FIGURE 22		
	Project No.:	OGTW2010	
SAND AND GRAVEL, TRACE SILT (SW-GW)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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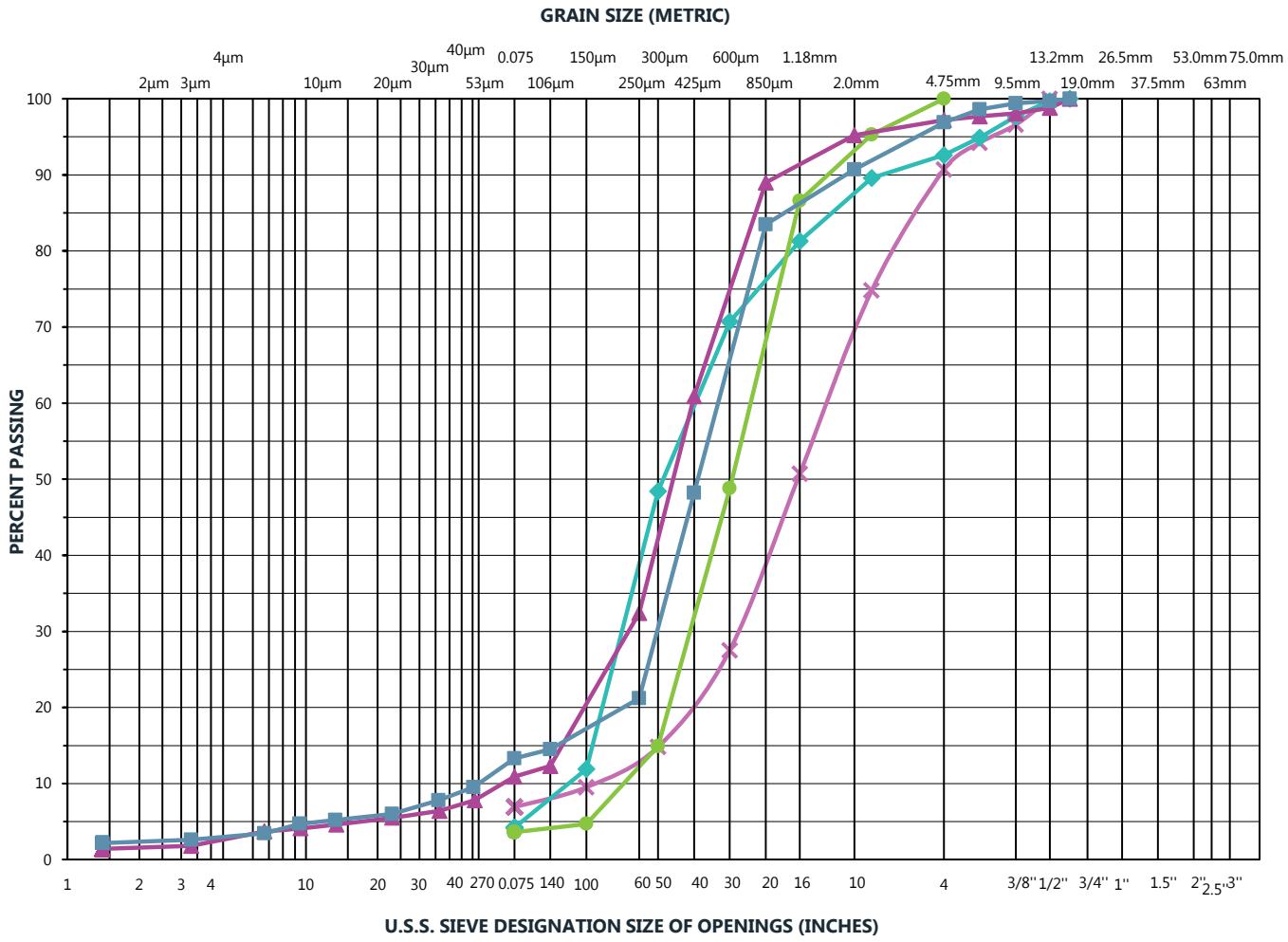
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-19	SS7	15 - 17	9	84	7	
◆	BH 20-19	SS8 & SS9	20 - 27	7	89	4	
●	BH 20-21	SS8A	20 - 22	0	96	4	
▲	BH 20-18	SS7 & SS8	15 - 22	5	84	9	2
■	BH 20-17	SS8	20 - 22	9	78	11	2

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GRAIN SIZE DISTRIBUTION	FIGURE 23		
	Project No.:	OGTW2010	
SAND, TRACE GRAVEL AND SILT (SW)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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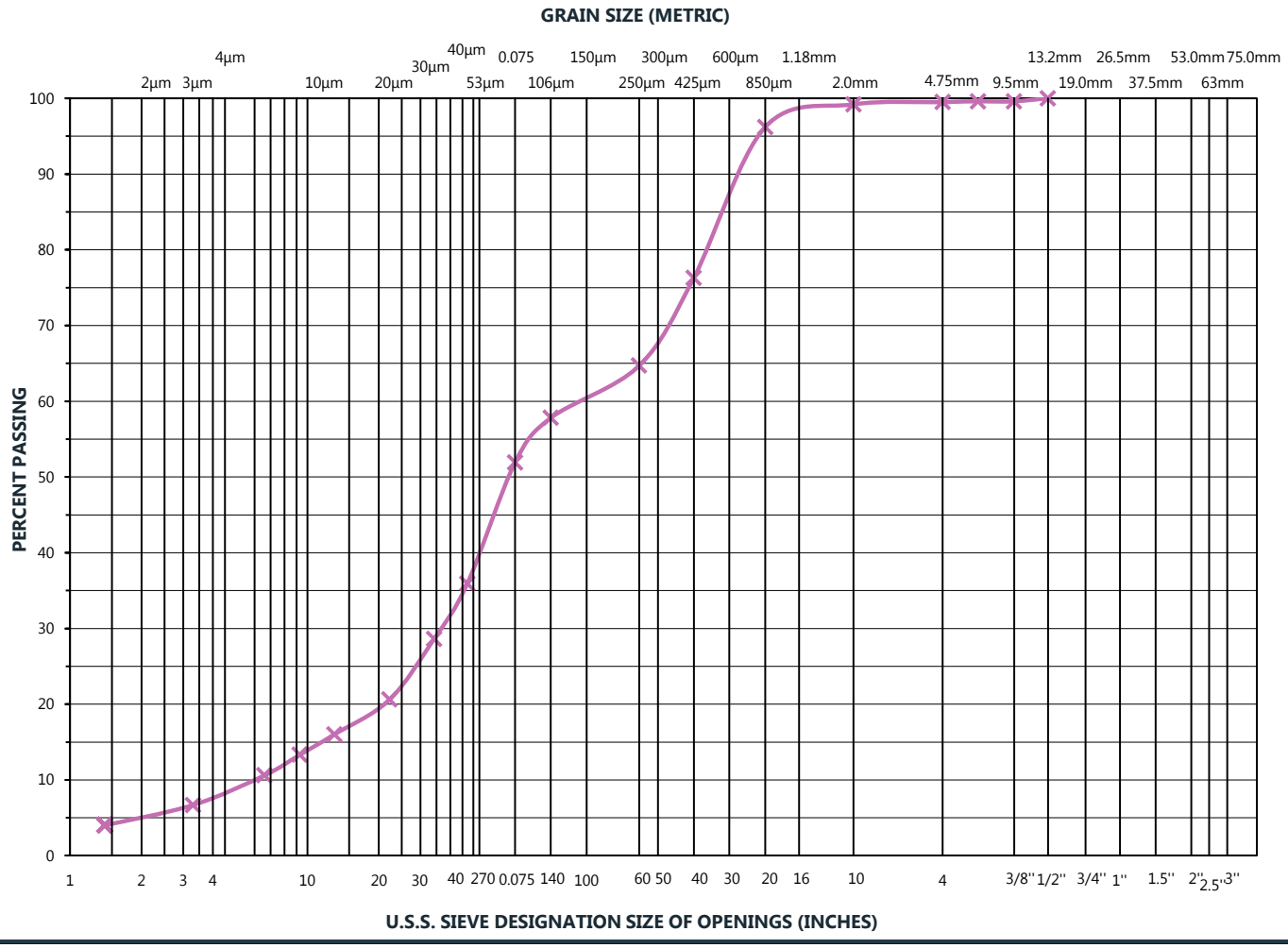
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
	BH 20-17	SS9 & SS10	25 - 32	1	47	47	5

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GRAIN SIZE DISTRIBUTION	FIGURE 24		
	Project No.:	OGTW2010	
SAND AND SILT, TRACE CLAY (SM)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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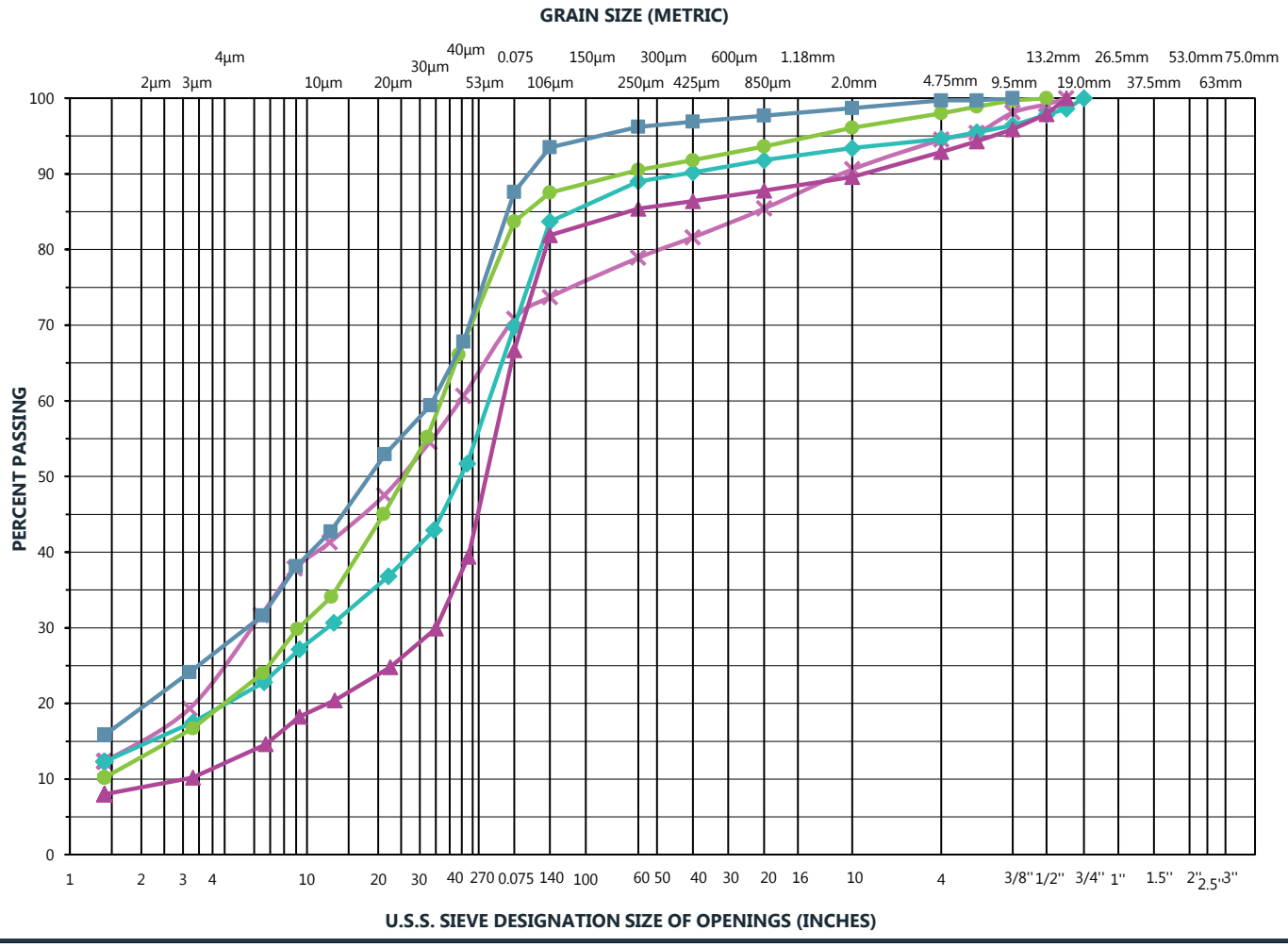
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-23	SS9	25 - 27	9	20	56	15
◆	BH 20-25	SS7	15 - 17	7	23	55	15
●	BH 20-25	SS10	30 - 32	4	12	71	13
▲	BH 20-26	SS4 & SS5	7.5 - 12	10	23	58	9
■	BH 20-26	SS6 & SS7	12.5 - 17	1	11	69	19

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GRAIN SIZE DISTRIBUTION	FIGURE 25		
	Project No.:	OGTW2010	
SANDY SILT, SOME CLAY, TRACE GRAVEL (SM)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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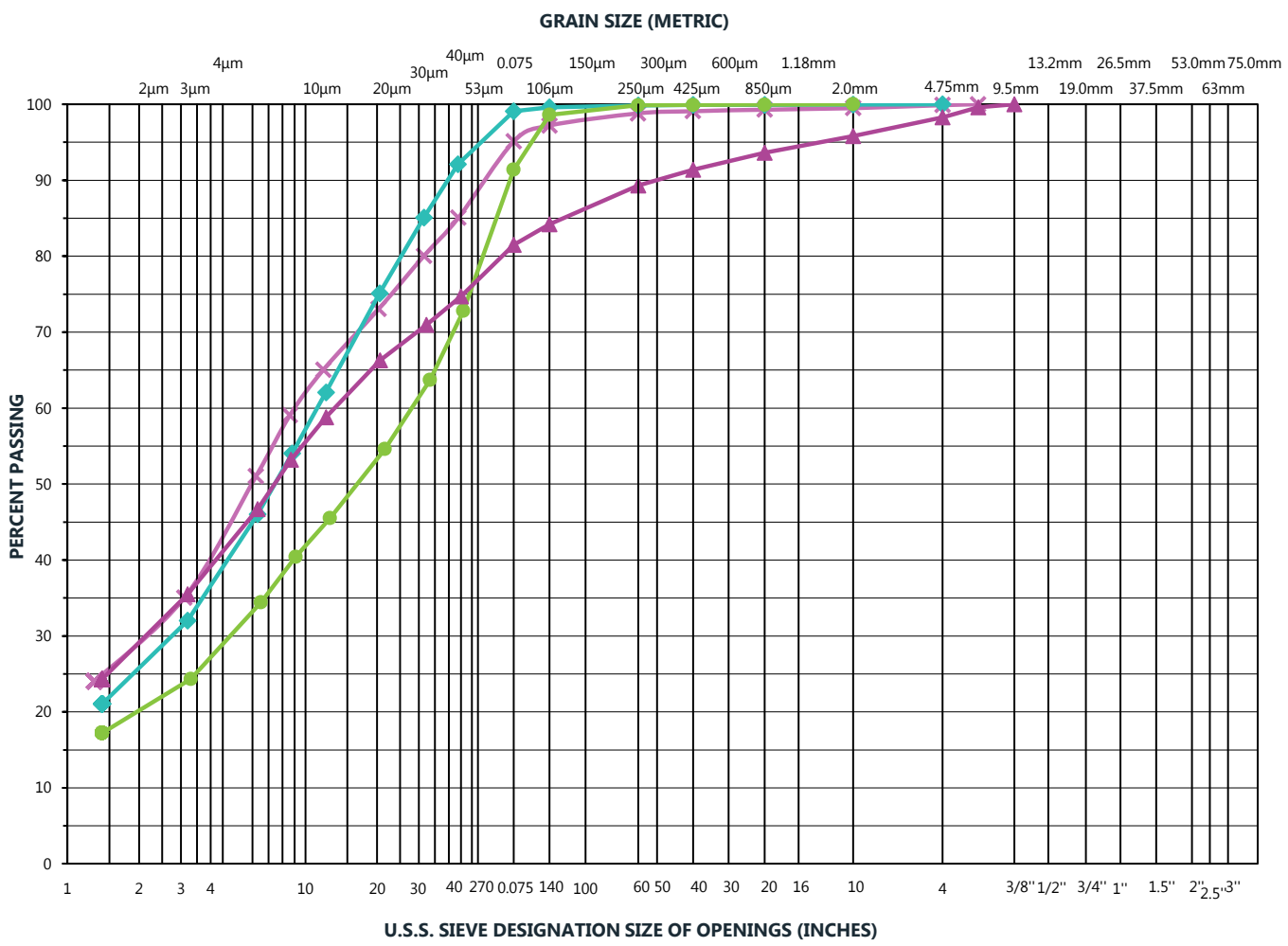
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (ft)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH 20-24	SS3 & SS4	5 - 9.5	1	4	66	29
◆	BH 20-24	SS6 & SS7	12.5 - 17	0	1	73	26
●	BH 20-25	SS4	7.5 - 9.5	0	9	71	20
▲	BH 20-25	SS8	20 - 22	4	14	53	29

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GRAIN SIZE DISTRIBUTION	FIGURE 26		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND (CL)	Date Rec'd:	Aug 24, 2020	Tested By: J. Taylor
	Report Date:	Oct 21, 2020	

GRAIN SIZE DISTRUBUTION

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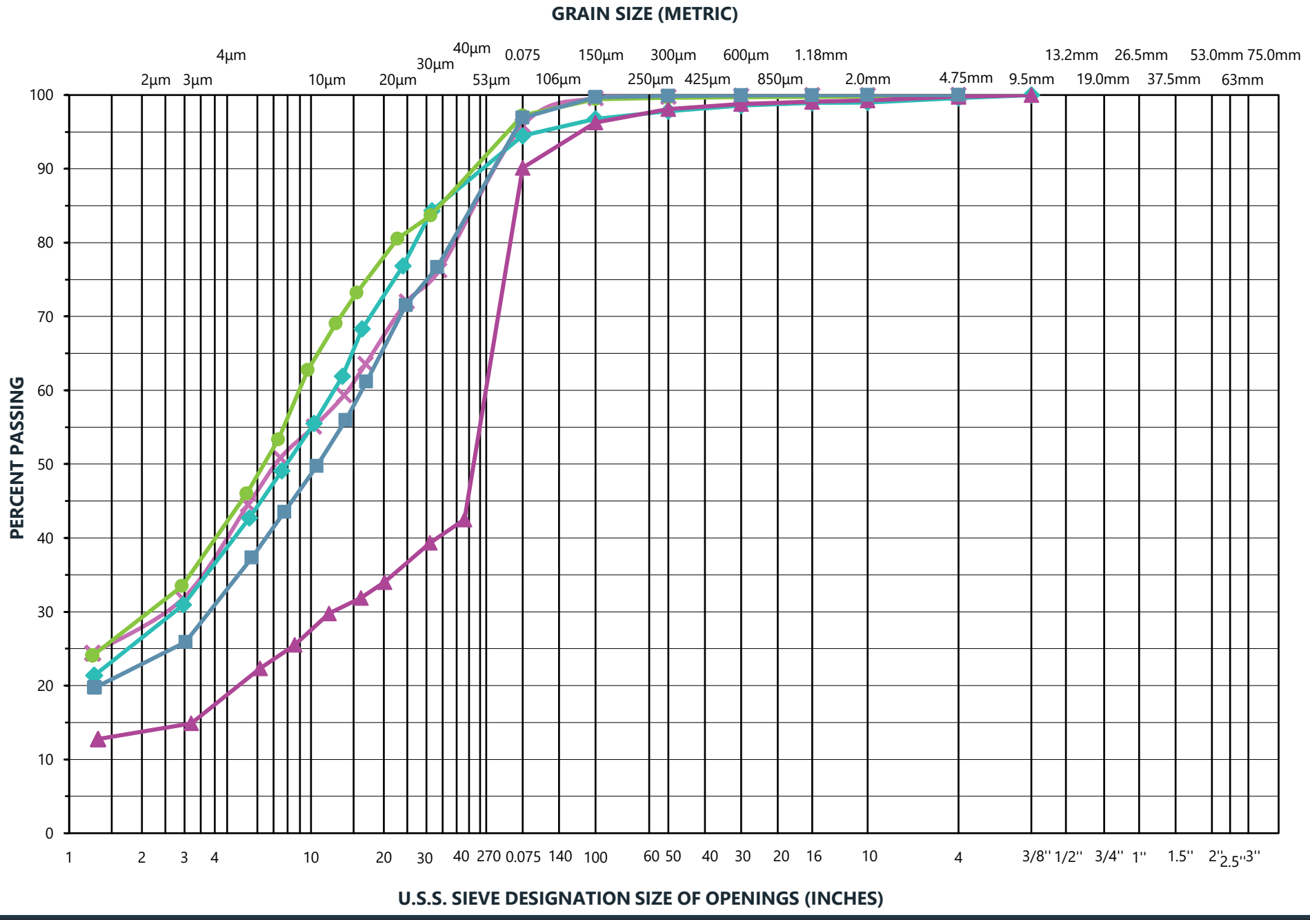
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-27	SS(5&6)		0	4	68	28
◆	BH20-27	SS(7&8)		0	5	68	27
●	BH20-27	SS4		0	3	68	29
▲	BH20-28	SS3		0	10	76	14
■	BH20-28	SS(5&6)		0	3	74	23

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GRAIN SIZE DISTRIBUTION	FIGURE B1A		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND	Date Rec'd:	Sep 25, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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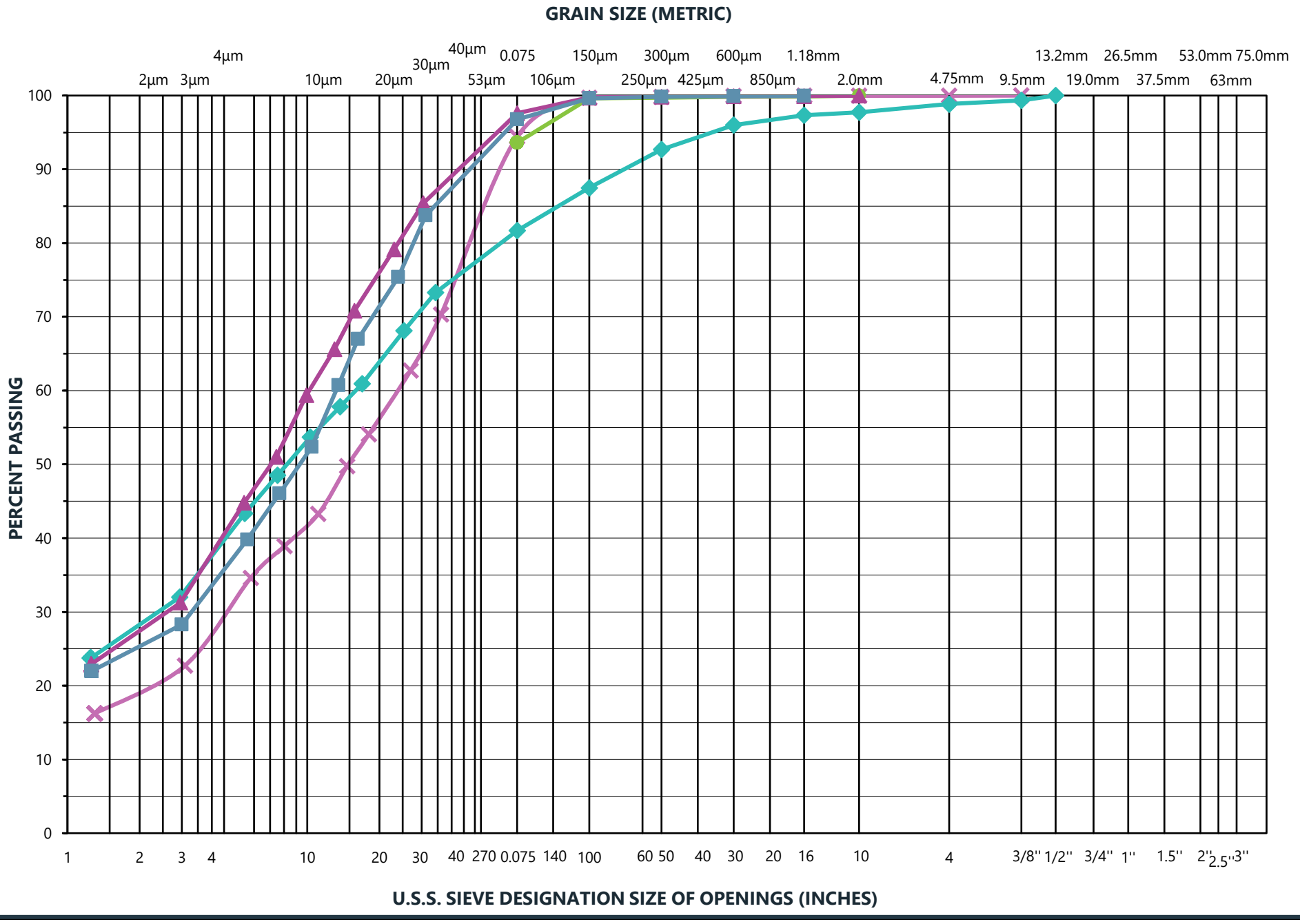
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-28	SS7		0	6	75	19
◆	BH20-28	SS8		1	17	54	28
●	BH20-29	SS(2&3)		0	6	94	
▲	BH20-29	SS(4&5)		0	2	70	28
■	BH20-30	SS(4&5)		0	3	72	25

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GRAIN SIZE DISTRIBUTION	FIGURE B1A		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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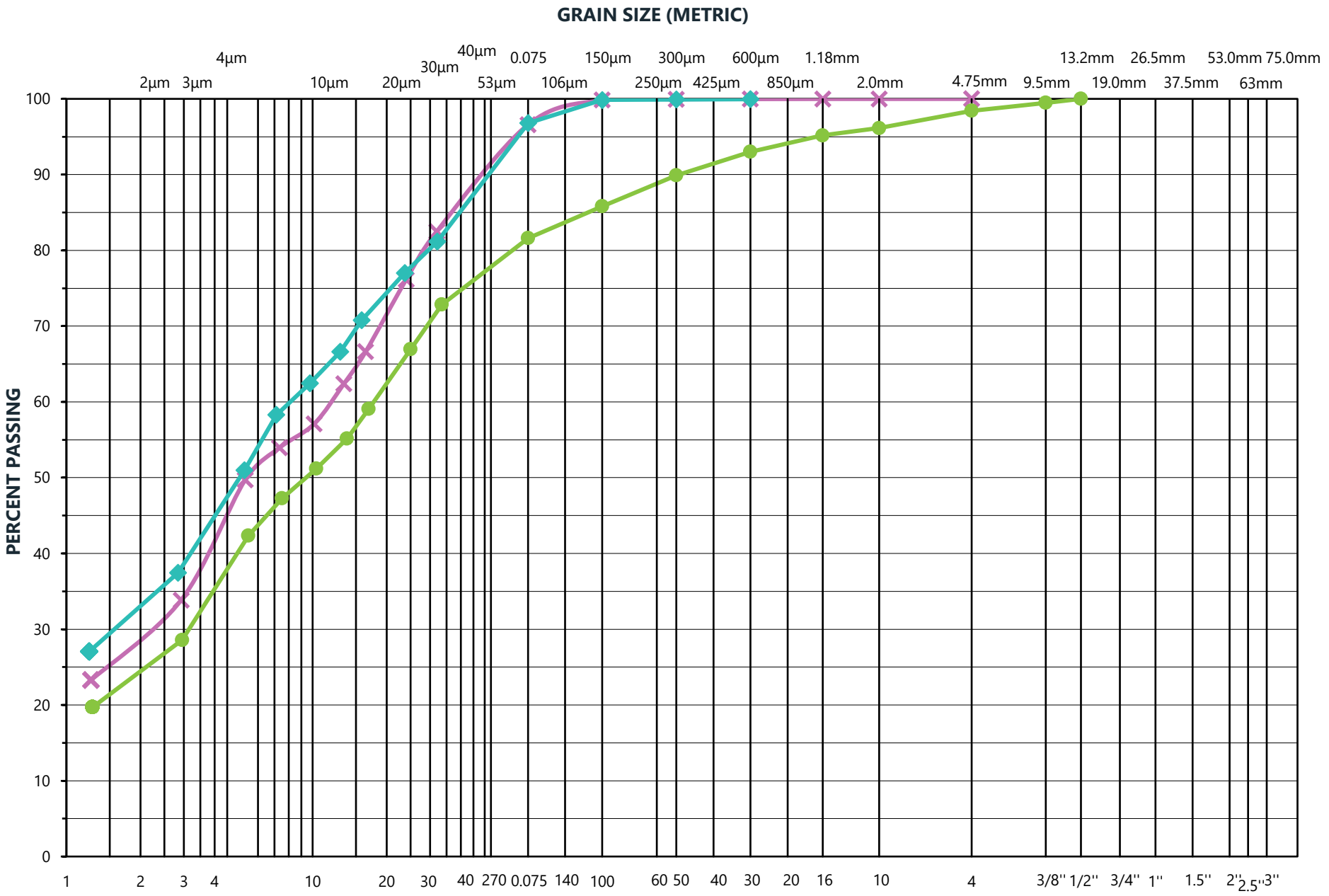
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-30	SS(6b&7)		0	3	68	29
◆	BH20-31	SS(5&6)		0	3	64	33
●	BH20-31	SS(8&9)		2	17	57	24
▲	BH20-32	SS(6&7)		0	7	75	18
■	BH20-34	SS(4&5)		0	5	66	29

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GRAIN SIZE DISTRIBUTION	FIGURE B1B		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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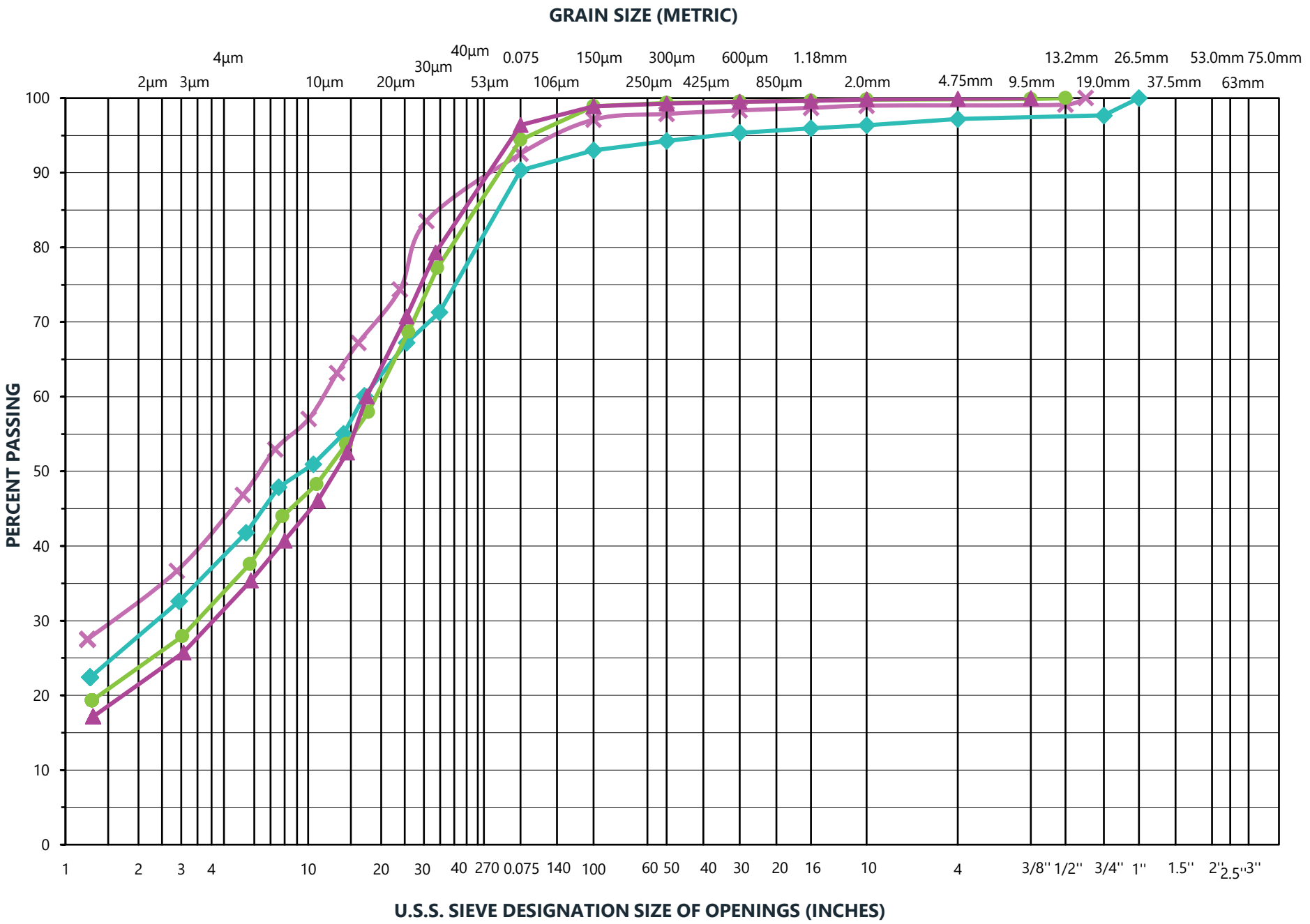
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-35	SS(5&6)		0	7	60	33
◆	BH20-35	SS7		3	7	62	28
●	BH20-36	SS4		0	5	71	24
▲	BH20-36	SS5		0	4	75	21

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GRAIN SIZE DISTRIBUTION	FIGURE B1C		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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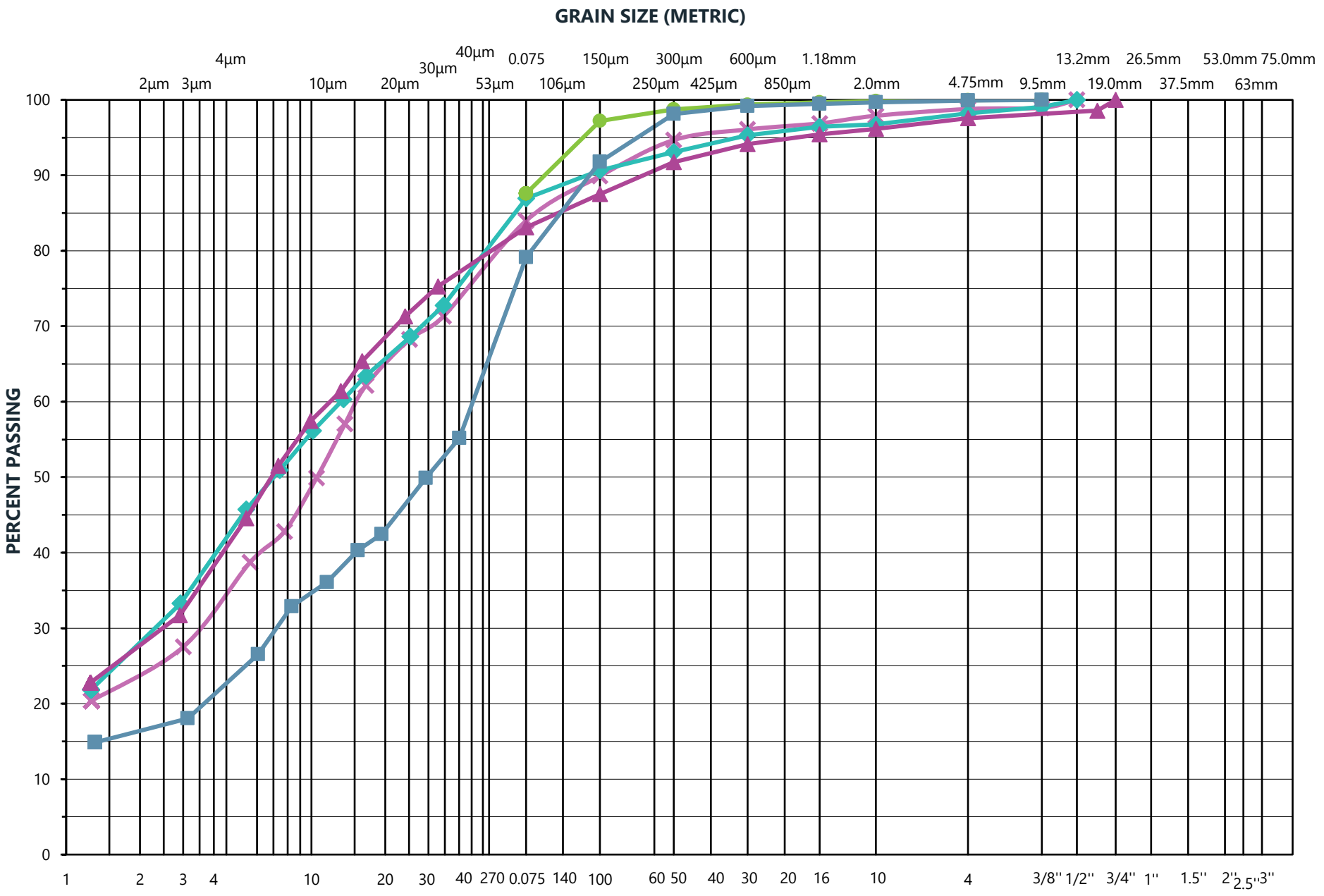
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-27	SS3a		1	15	60	24
◆	BH20-29	SS(7&8)		2	11	59	28
●	BH20-32	SS(2&3)		0	12	88	
▲	BH20-32	SS(8&9)		2	15	55	28
■	BH20-33	SS(4&5)		0	21	63	16

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GRAIN SIZE DISTRIBUTION	FIGURE B1D		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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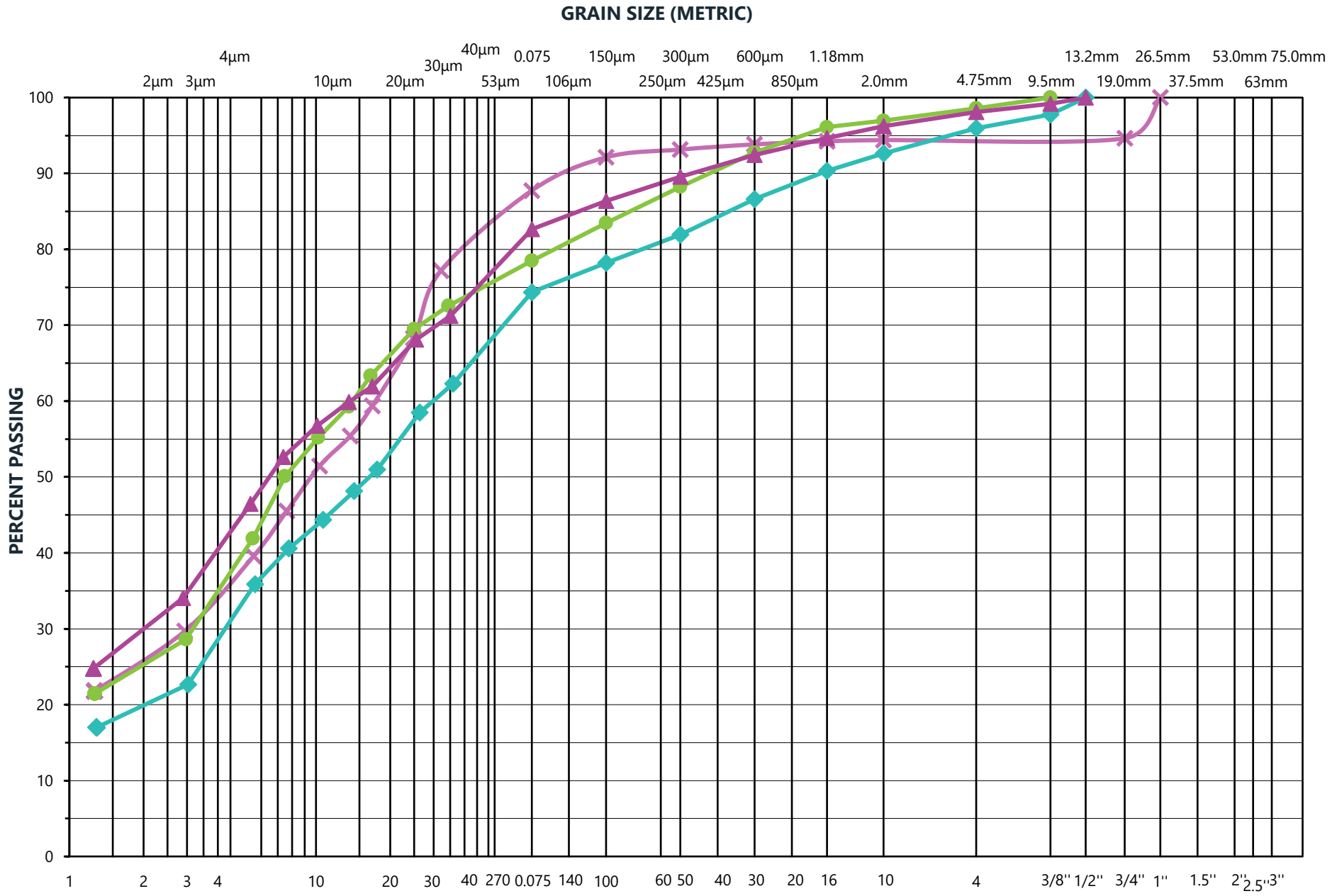
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-33	SS(6&7)		0	12	62	26
◆	BH20-33	SS8		4	22	54	20
●	BH20-34	SS7		2	20	53	25
▲	BH20-34	SS8		2	15	53	30

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GRAIN SIZE DISTRIBUTION	FIGURE B1E	
	Project No.: OGTW2010	
CLAYEY SILT, SOME SAND	Date Rec'd: Sep 11, 2020	Tested By: GC
	Report Date:	

GRAIN SIZE DISTRUBUTION

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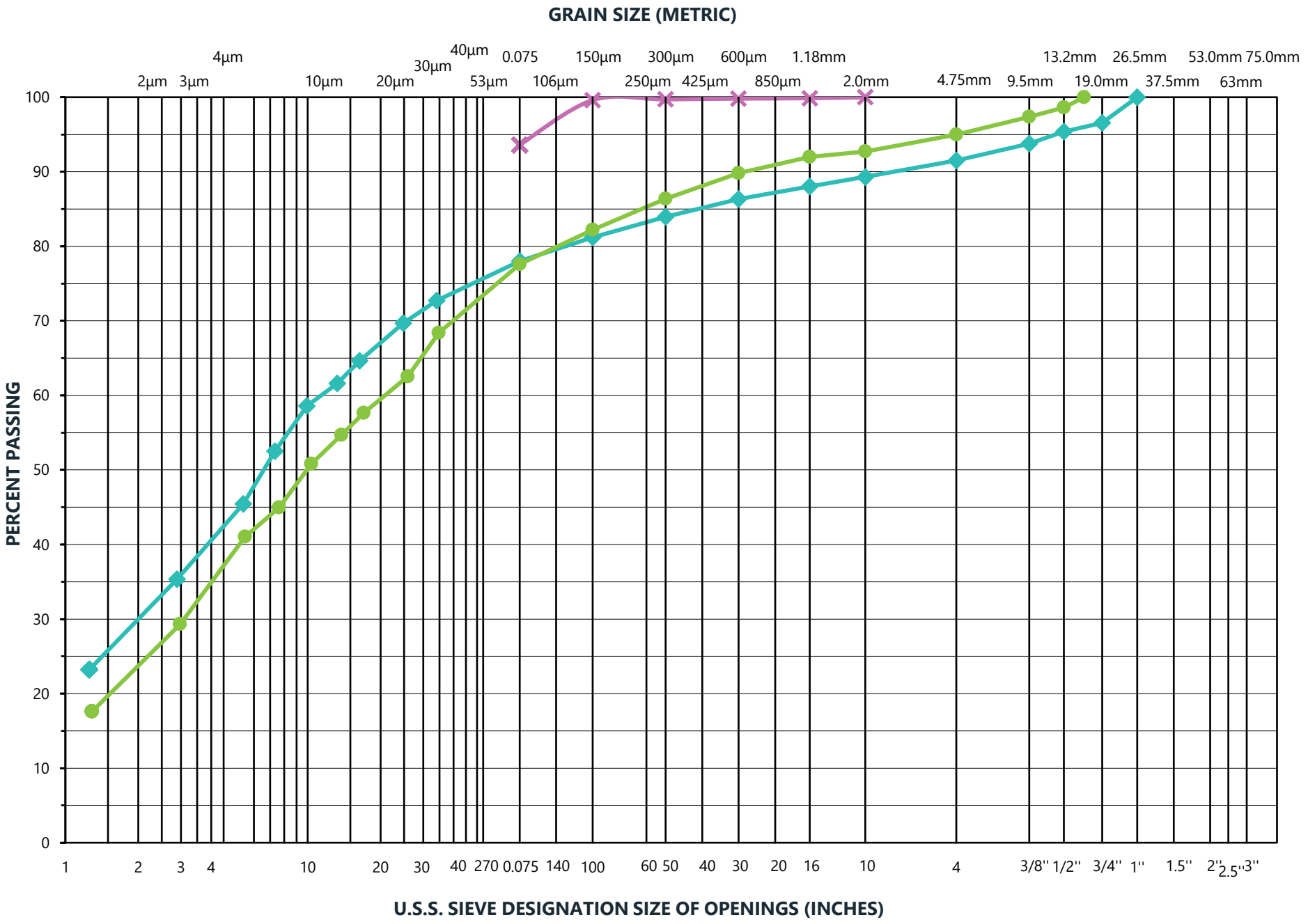
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-29	SS(2&3)		0	6	94	
◆	BH20-35	SS8		8	14	48	30
●	BH20-36	SS6		5	17	54	24

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GRAIN SIZE DISTRIBUTION	FIGURE B1F		
	Project No.: OGTW2010		
CLAYEY SILT, SOME SAND & GRAVEL	Date Rec'd: Sep 11, 2020	Tested By: GC	
	Report Date:		

GRAIN SIZE DISTRUBUTION

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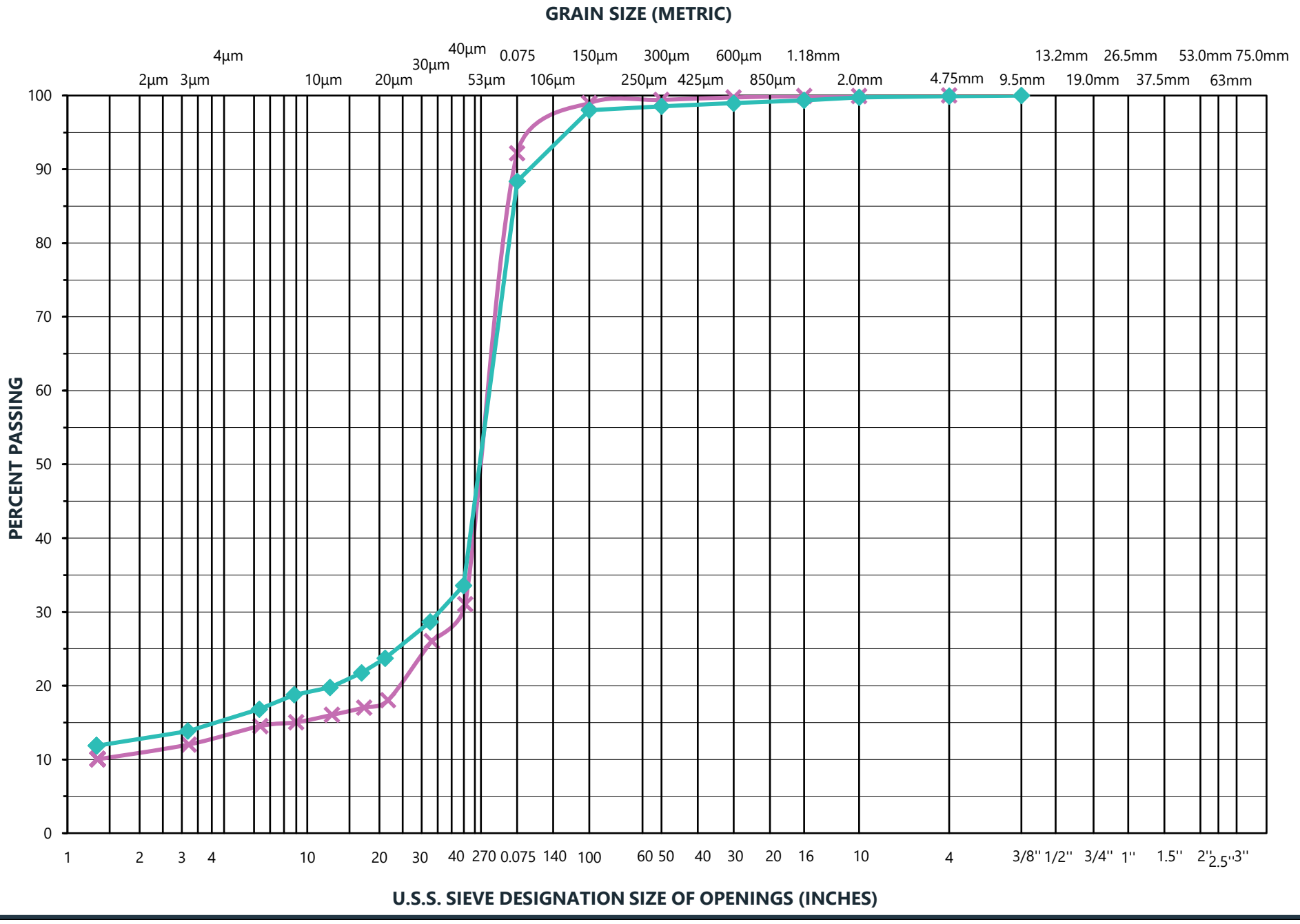
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-31	SS3		0	8	81	11
◆	BH20-34	SS3		0	12	75	13

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GRAIN SIZE DISTRIBUTION	FIGURE B1G		
	Project No.:	OGTW2010	
SILT, TRACE SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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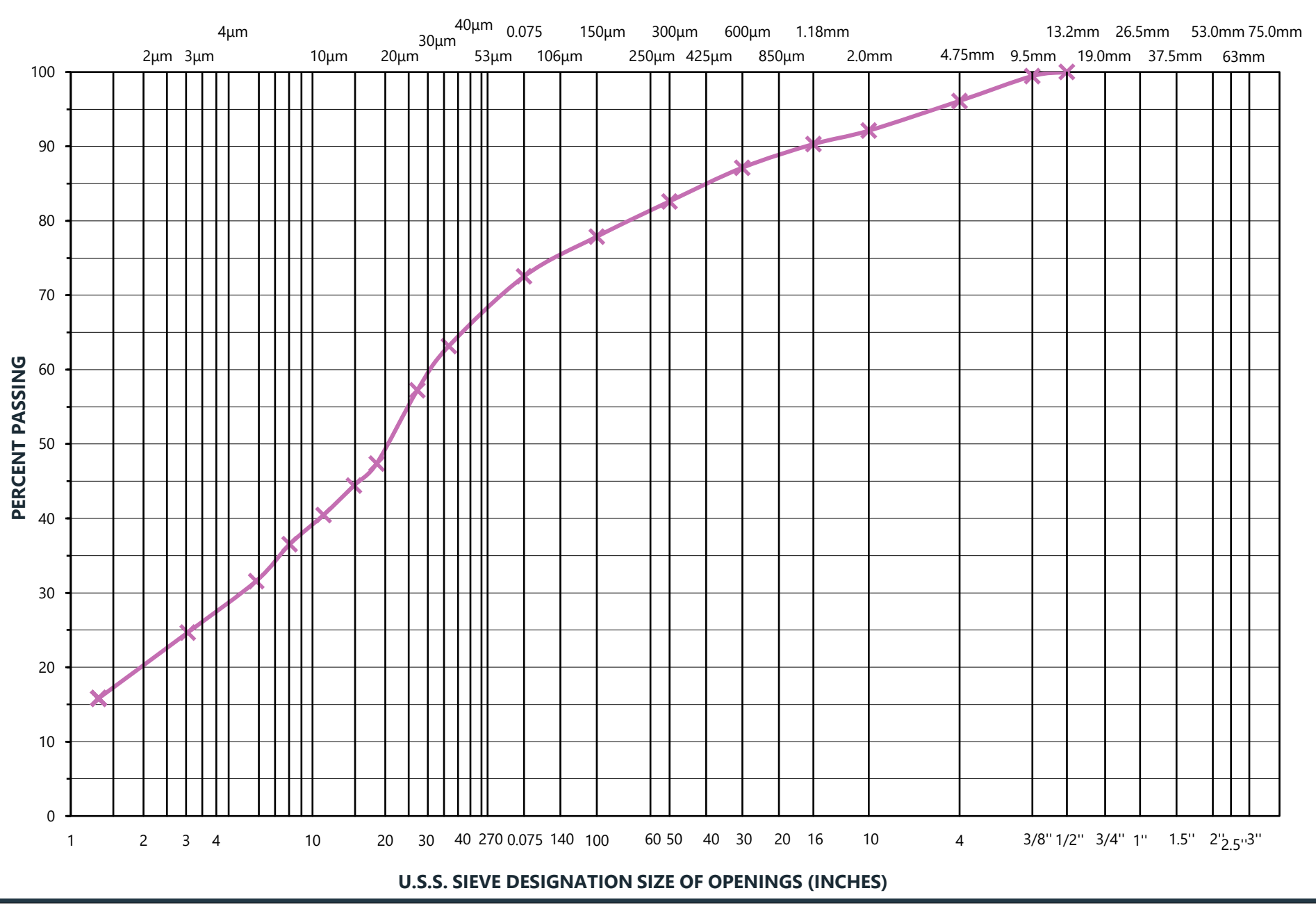
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-36	SS(7&8)		4	24	52	20

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	SANDY SILT	

GRAIN SIZE DISTRUBUTION

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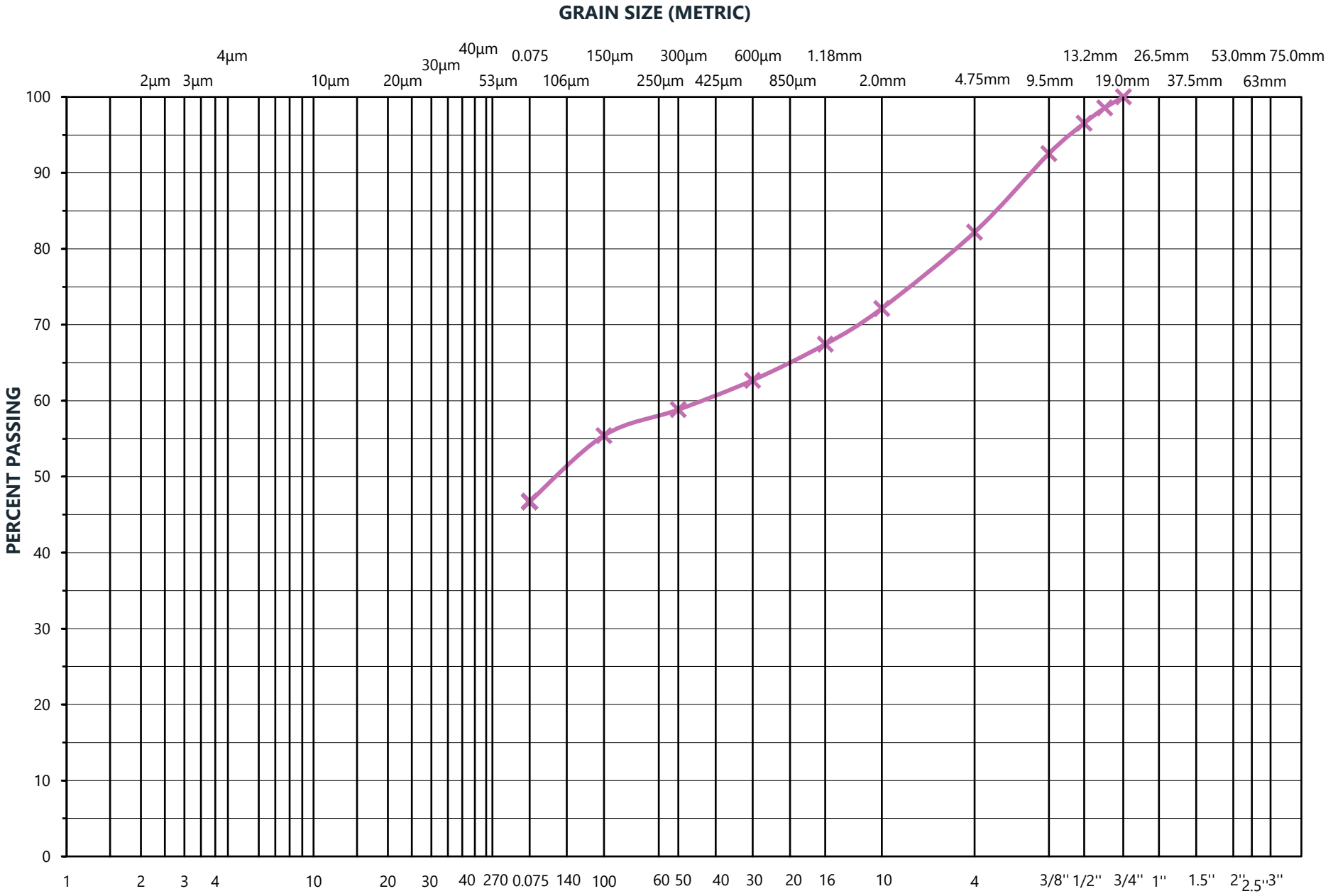
North Service Road

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-35	SS(1&2)		18	35	47	

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GRAIN SIZE DISTRIBUTION	FIGURE B1I		
	Project No.:	OGTW2010	
SILTY SAND & GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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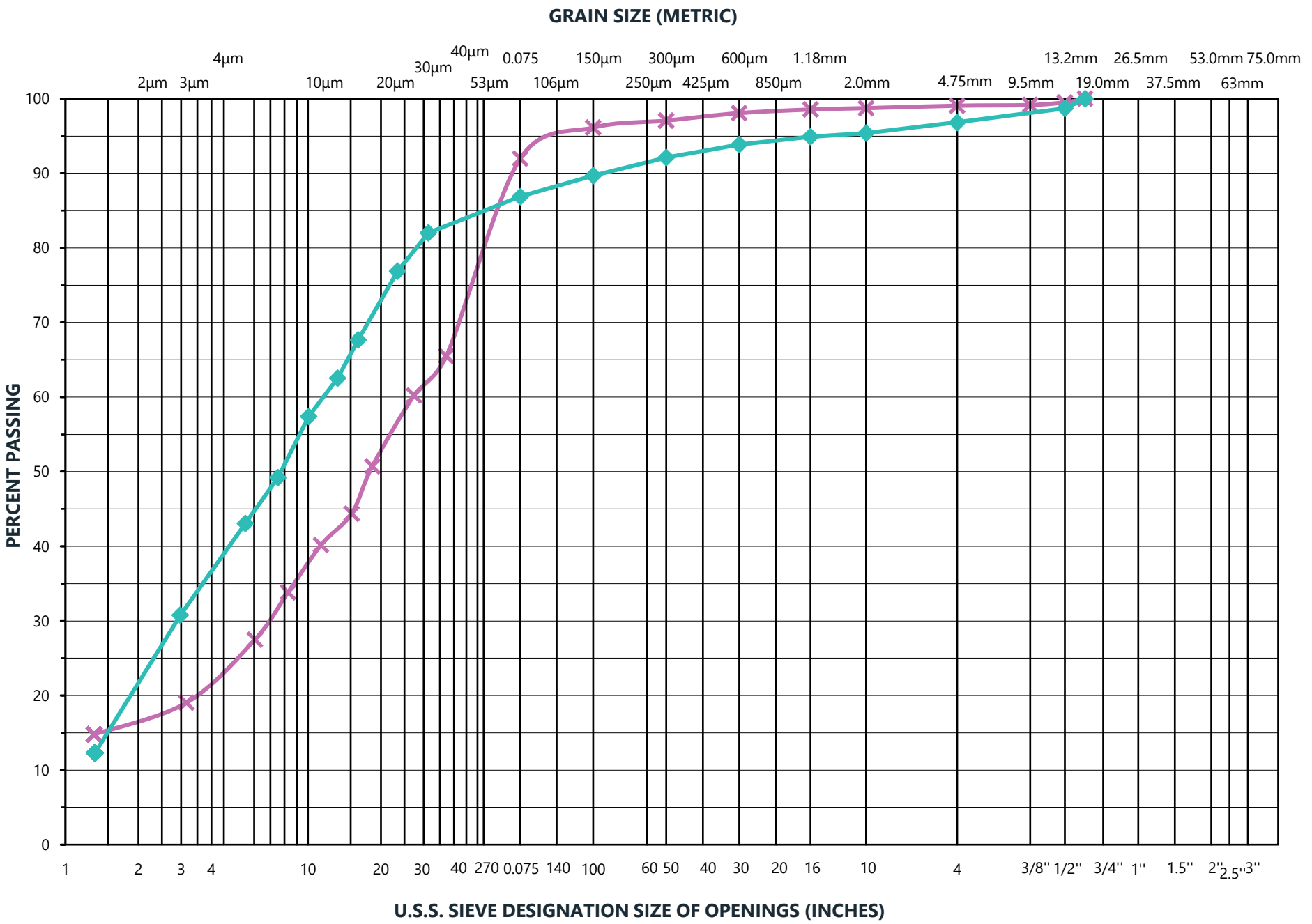
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-37	SS(4&5)		1	7	75	17
◆	BH20-37	SS(6&7)		3	10	65	22

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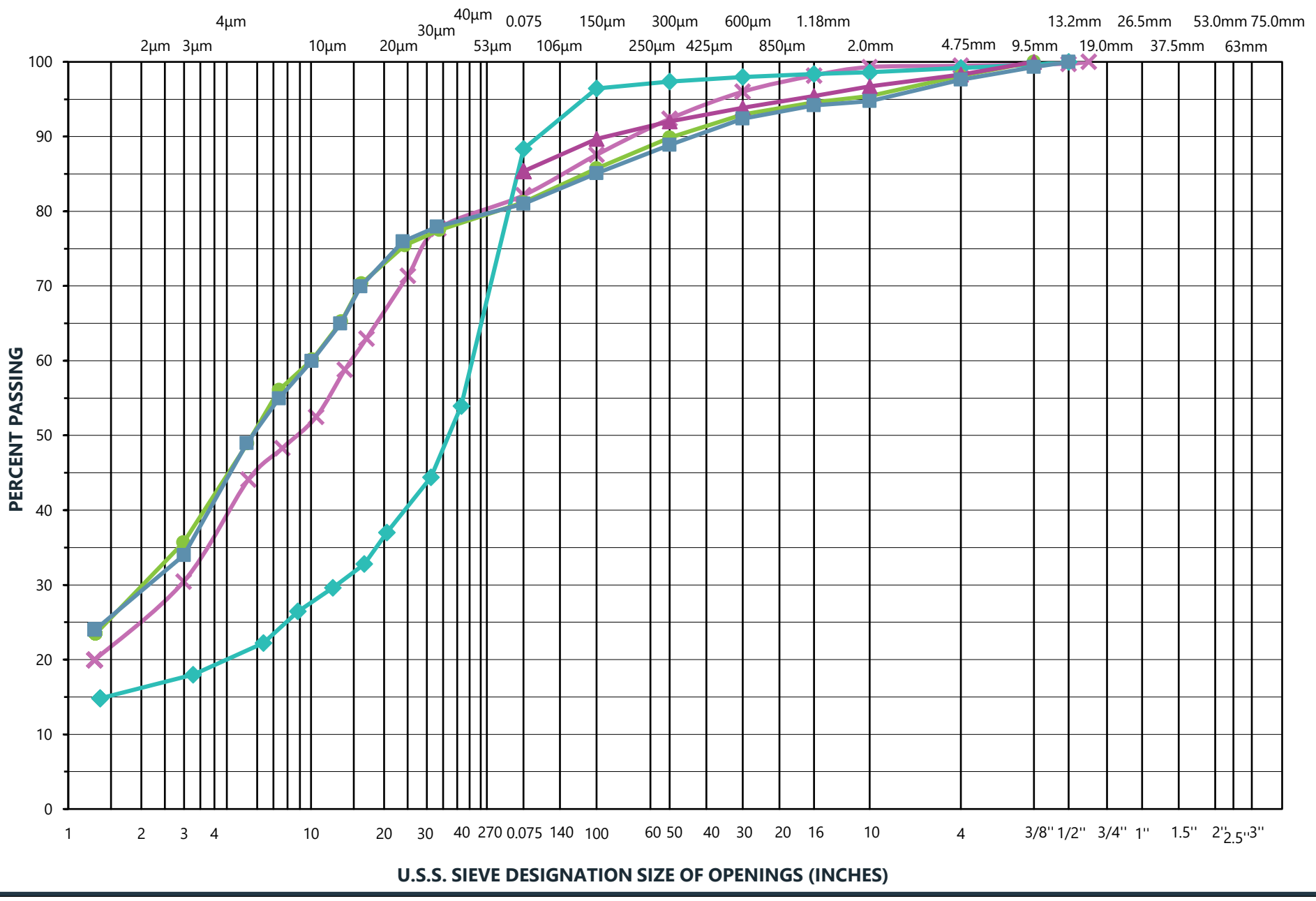
GRAIN SIZE DISTRIBUTION	FIGURE B1A		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Victoria Avenue

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-37B	SS(6&7)		1	17	57	25
◆	BH20-38	SS(6&7)		1	11	72	16
●	BH20-39	SS(2&3)		2	17	51	30
▲	BH20-40	SS(2&3)		2	13	85	
■	BH20-40	SS(4&5)		2	17	52	29

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GRAIN SIZE DISTRIBUTION	FIGURE B1B	
	Project No.: OGTW2010	
CLAYEY SILT, SOME SAND	Date Rec'd: Sep 11, 2020	Tested By: GC
	Report Date:	

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
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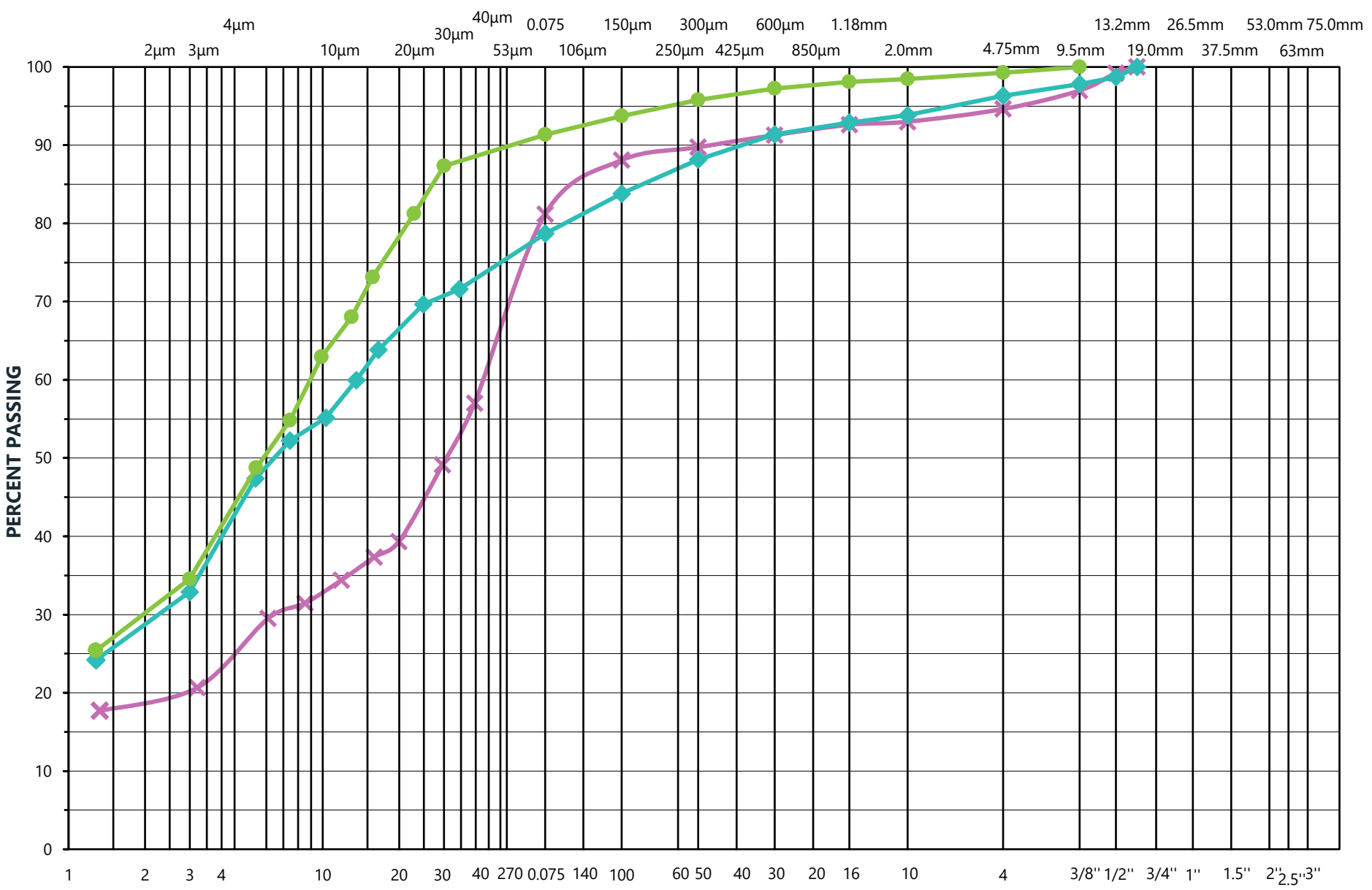
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-41	SS(2&3)		6	13	62	19
◆	BH20-41	SS(6&7)		4	17	50	29
●	BH20-42	SS(3&4)		1	8	61	30

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GRAIN SIZE DISTRIBUTION

CLAYEY SILT, SOME SAND

FIGURE B1C

Project No.: OGTW2010

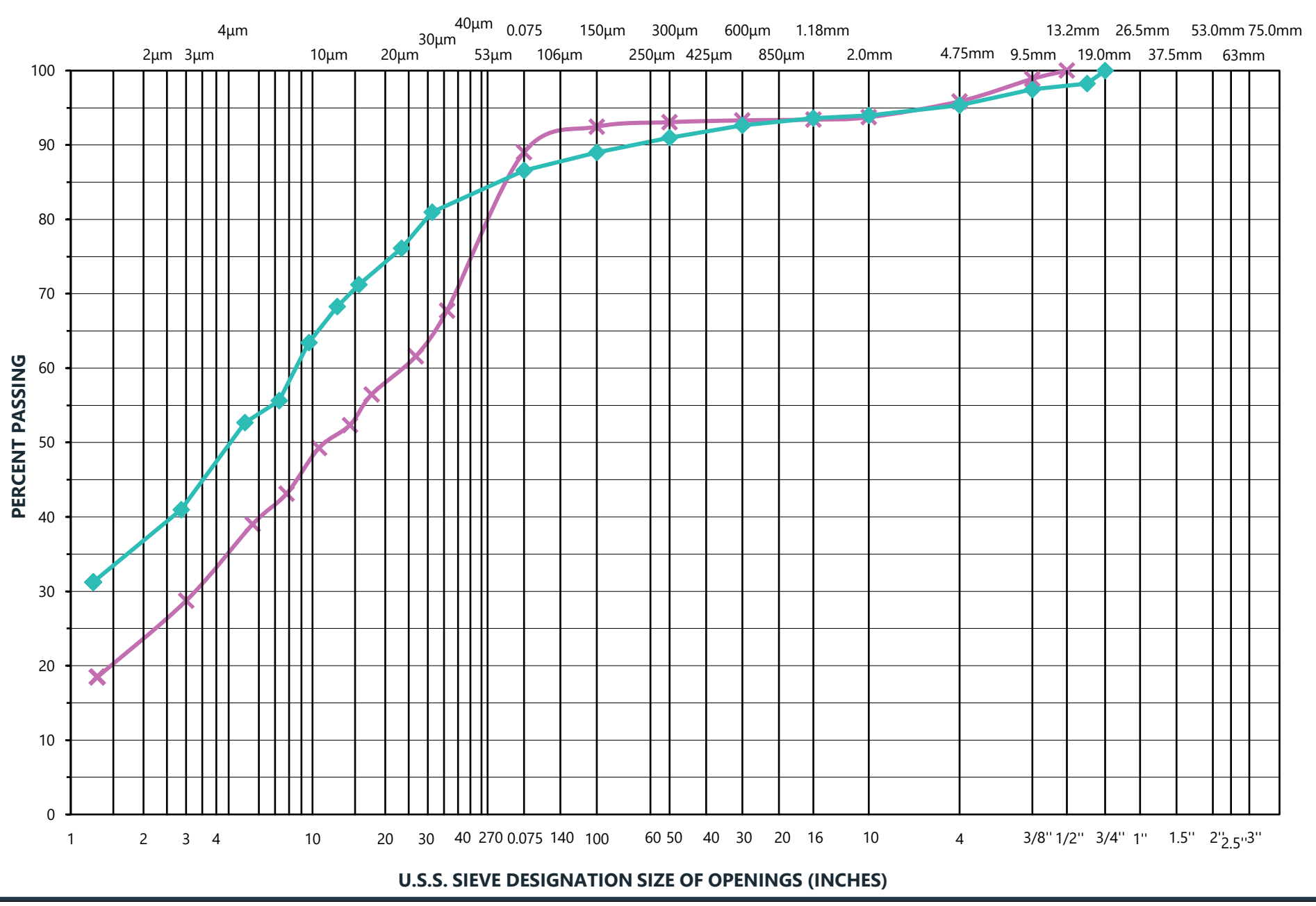
Date Rec'd: Sep 11, 2020 **Tested By:** GC

Report Date:

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Victoria Avenue

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-37B	SS(8&9)		4	7	65	24
◆	BH20-38	SS(9&10)		4	9	50	37

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GRAIN SIZE DISTRIBUTION	FIGURE B1D		
	Project No.:	OGTW2010	
CLAYEY SILT, TRACE SAND AND GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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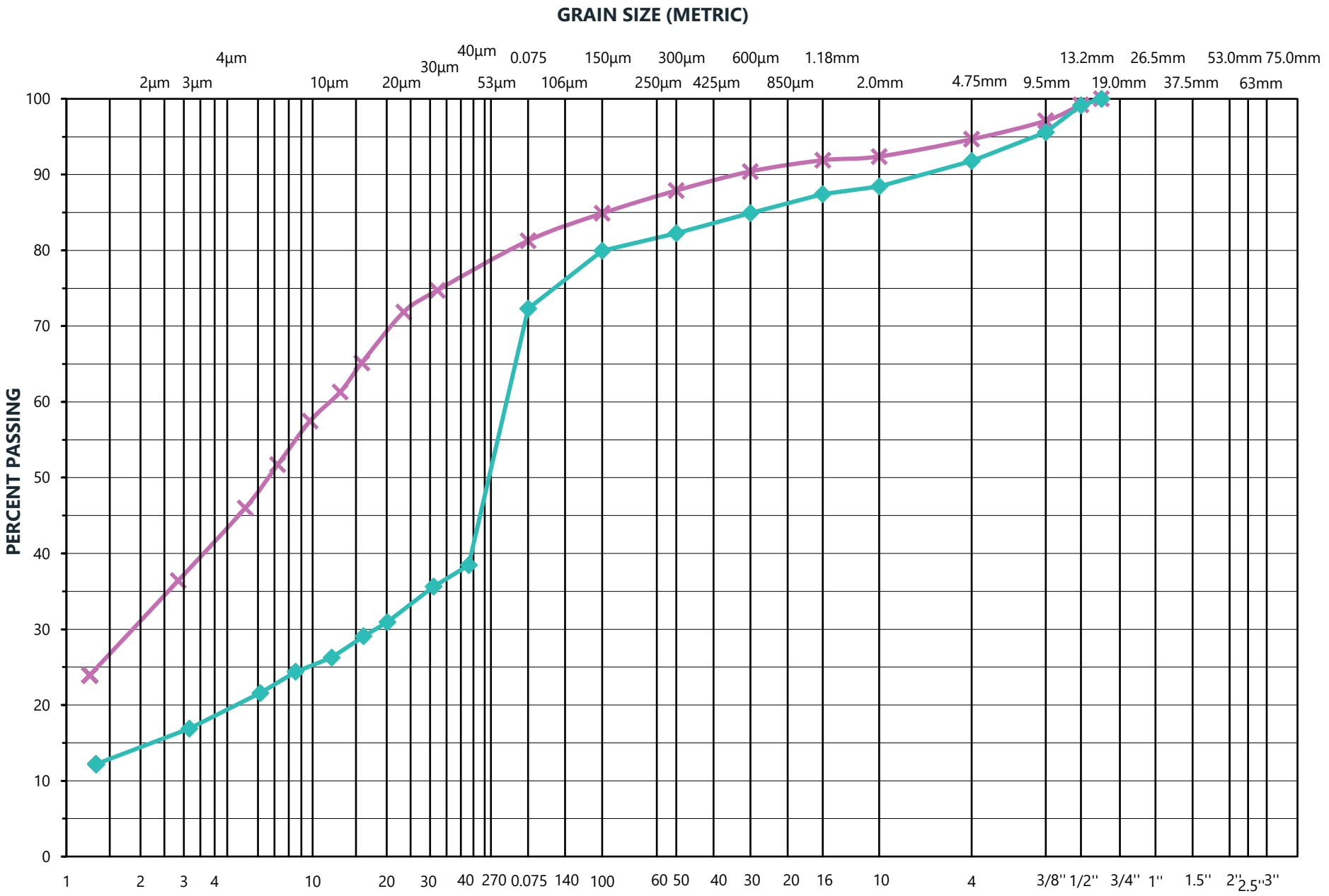
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-37	SS8		5	14	50	31
◆	BH20-37B	SS(3&4)		8	20	58	14

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GRAIN SIZE DISTRIBUTION	FIGURE B1E		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME SAND AND GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
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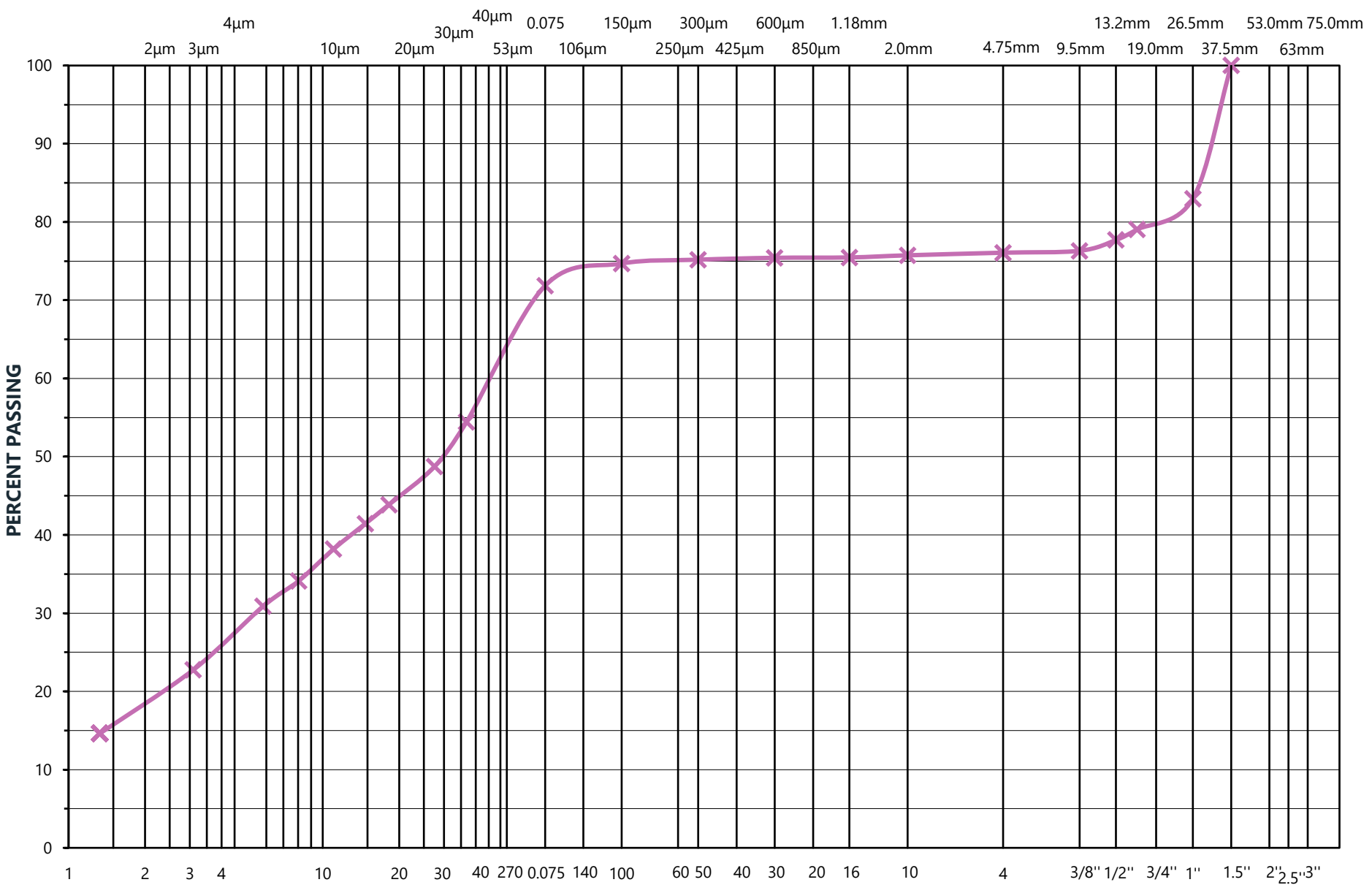
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-41	SS(8&9)		24	4	53	19

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GRAIN SIZE DISTRIBUTION	FIGURE B1F		
	Project No.:	OGTW2010	
CLAYEY SILT, SOME GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

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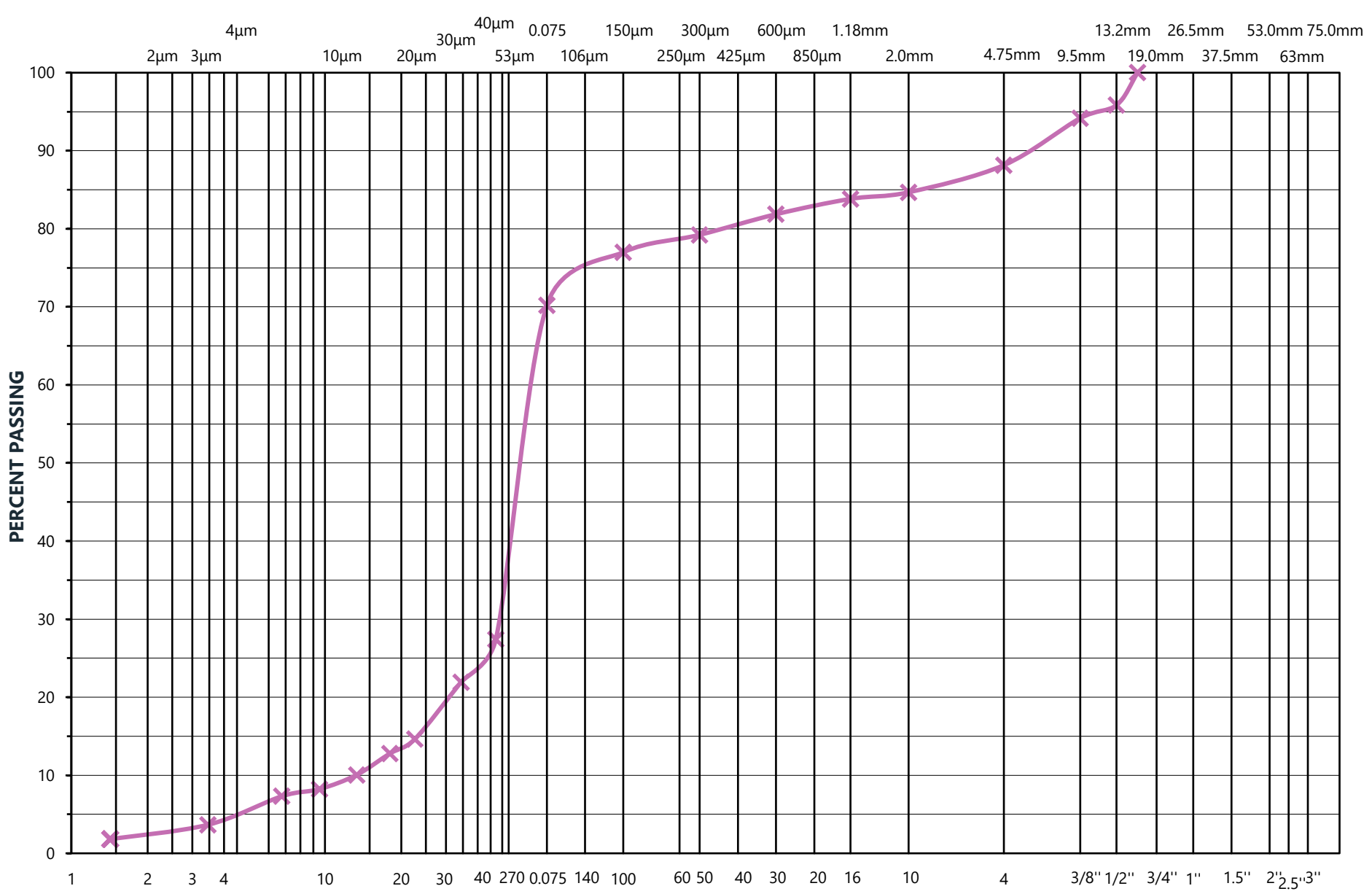
FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-38	SS(3&4)		12	18	67	3

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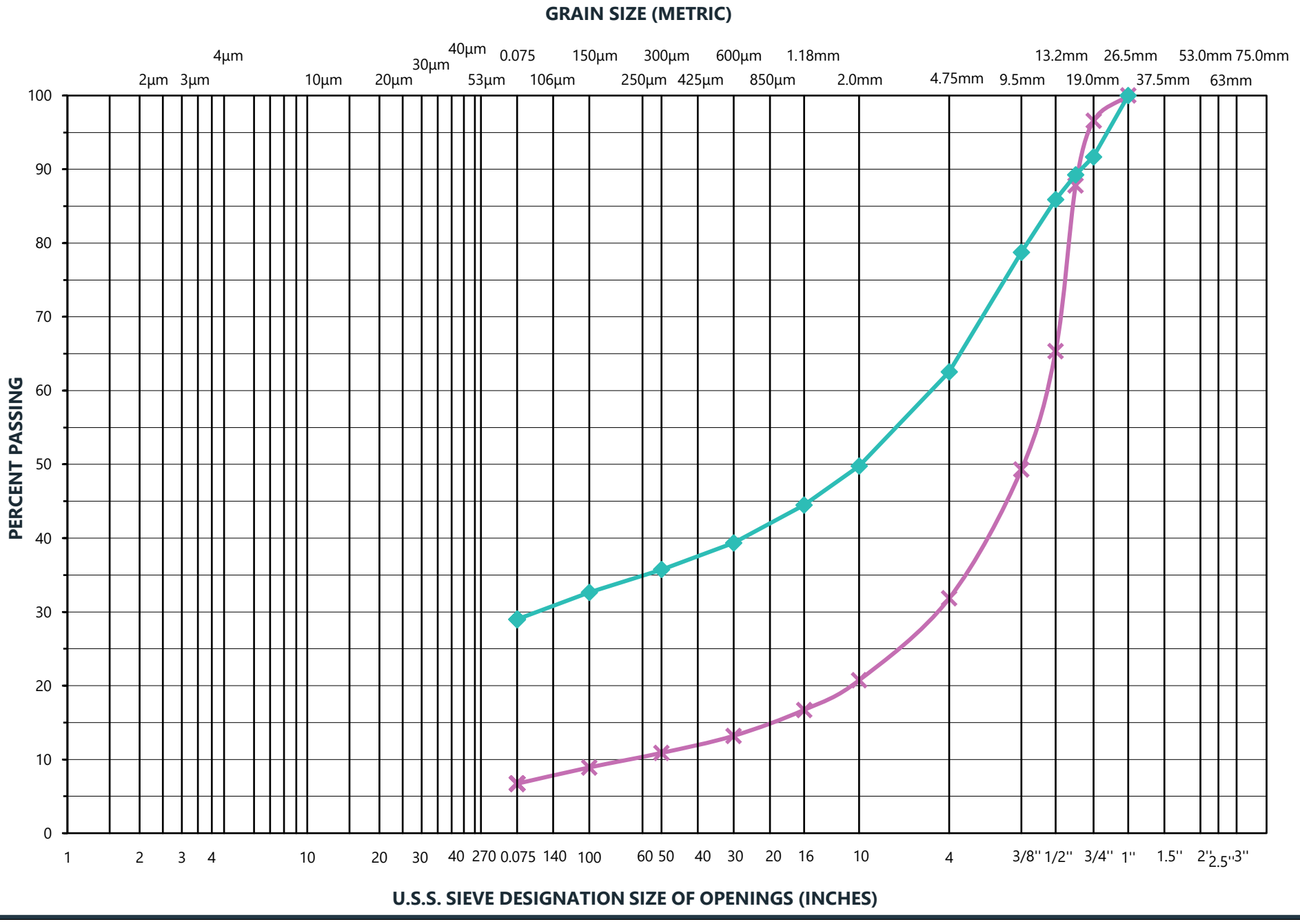
GRAIN SIZE DISTRIBUTION	FIGURE B1G		
	Project No.:	OGTW2010	
SILT, SOME SAND AND GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

GRAIN SIZE DISTRUBUTION

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation
Victoria Avenue

FINE GRAINED (SILT & CLAY) SIZE	SAND SIZE			GRAVEL SIZE	
	Fine	Medium	Coarse	Fine	Coarse



LEGEND

SYMBOL	BOREHOLE	SAMPLE	0	GRAVEL (%)	SAND (%)	SILT (%)	CLAY SIZE (%)
X	BH20-41	SS(4&5)		68	25	7	
◆	BH20-42	SS(1&2)		37	34	29	

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GRAIN SIZE DISTRIBUTION	FIGURE B1H		
	Project No.:	OGTW2010	
SILTY SAND & GRAVEL	Date Rec'd:	Sep 11, 2020	Tested By: GC
	Report Date:		

ATTERBERG LIMITS

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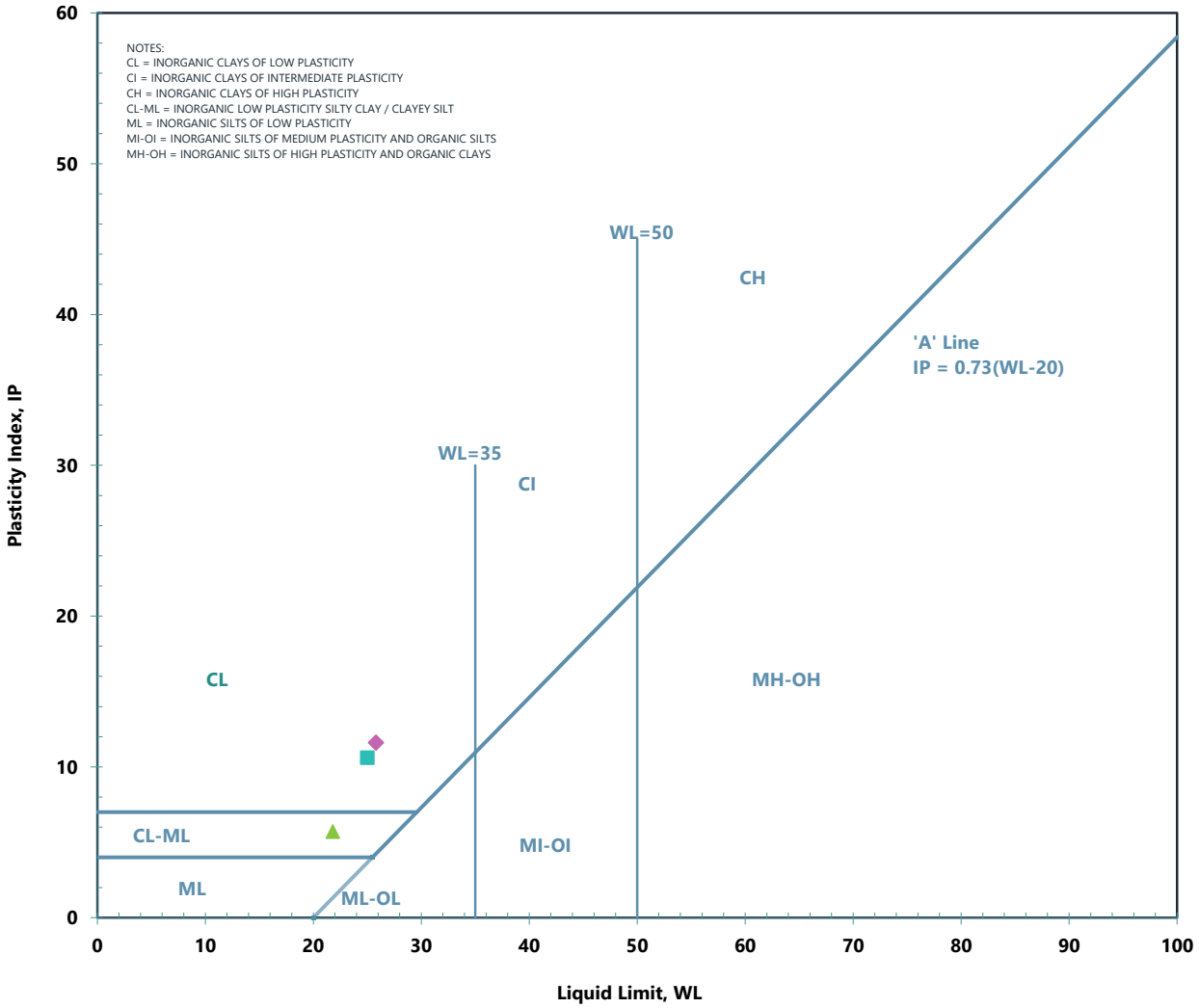

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-01	BH 20-01	BH 20-01	BH 20-01
SAMPLE NUMBER:	SS10 & SS11	SS12 & SS13	SS3	SS5
DEPTH BELOW SURFACE (m):	9.14 - 11.28	12.19 - 14.33	1.52 - 2.13	3.05 - 3.66
LIQUID LIMIT:	26	25	22	Limits unable to be determined - Non-plastic soil
PLASTIC LIMIT:	14	14	16	
PLASTICITY INDEX:	12	11	6	

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Report Date:	28-Sep-20	

ATTERBERG LIMITS

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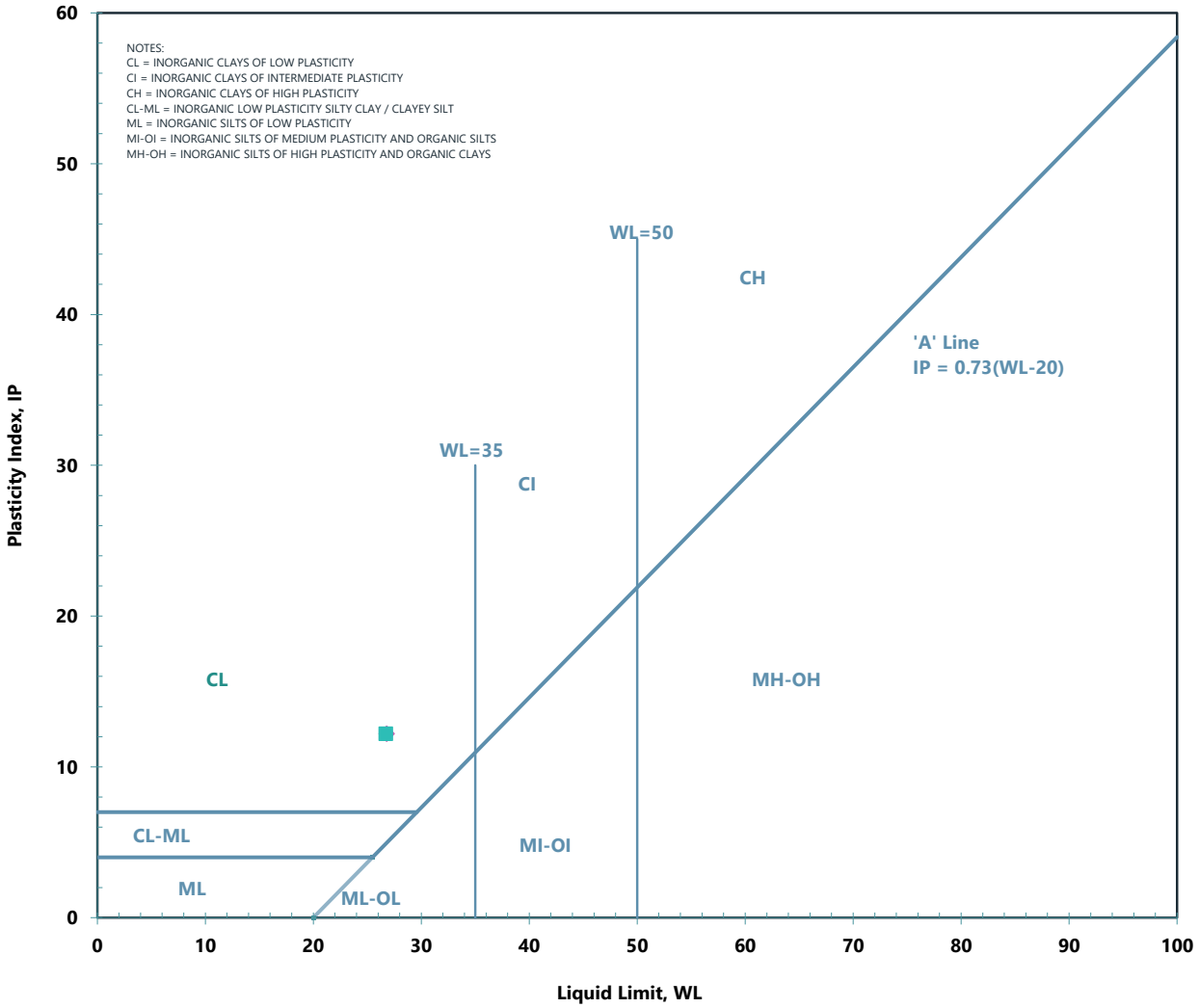

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-09	BH 20-09	BH 20-09	BH 20-10
SAMPLE NUMBER:	SS2 & SS3	SS5	SS7	SS4
DEPTH BELOW SURFACE (m):	0.76 - 2.13	3.05 - 3.66	4.57 - 5.18	2.29 - 2.90
LIQUID LIMIT:	27	27	Limits unable to be determined - Non-plastic soil	Limits unable to be determined - Non-plastic soil
PLASTIC LIMIT:	15	15		
PLASTICITY INDEX:	12	12		

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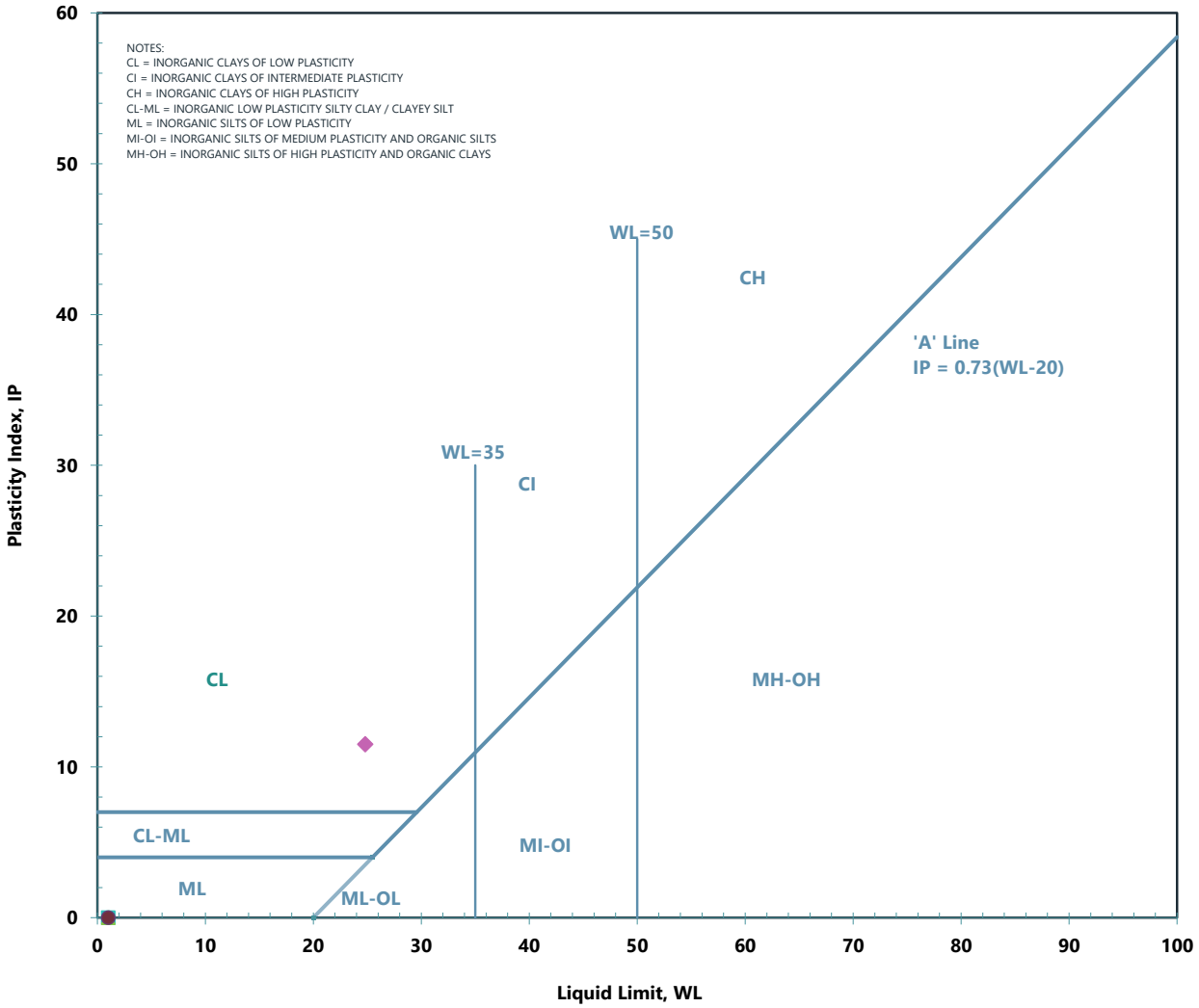

LEGEND

SYMBOL:	◆			
BOREHOLE/TEST PIT NUMBER:	BH 20-08			
SAMPLE NUMBER:	SS9 & SS10			
DEPTH BELOW SURFACE (m):	7.62 - 9.75			
LIQUID LIMIT:	25			
PLASTIC LIMIT:	13			
PLASTICITY INDEX:	12			

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ATTERBERG LIMITS

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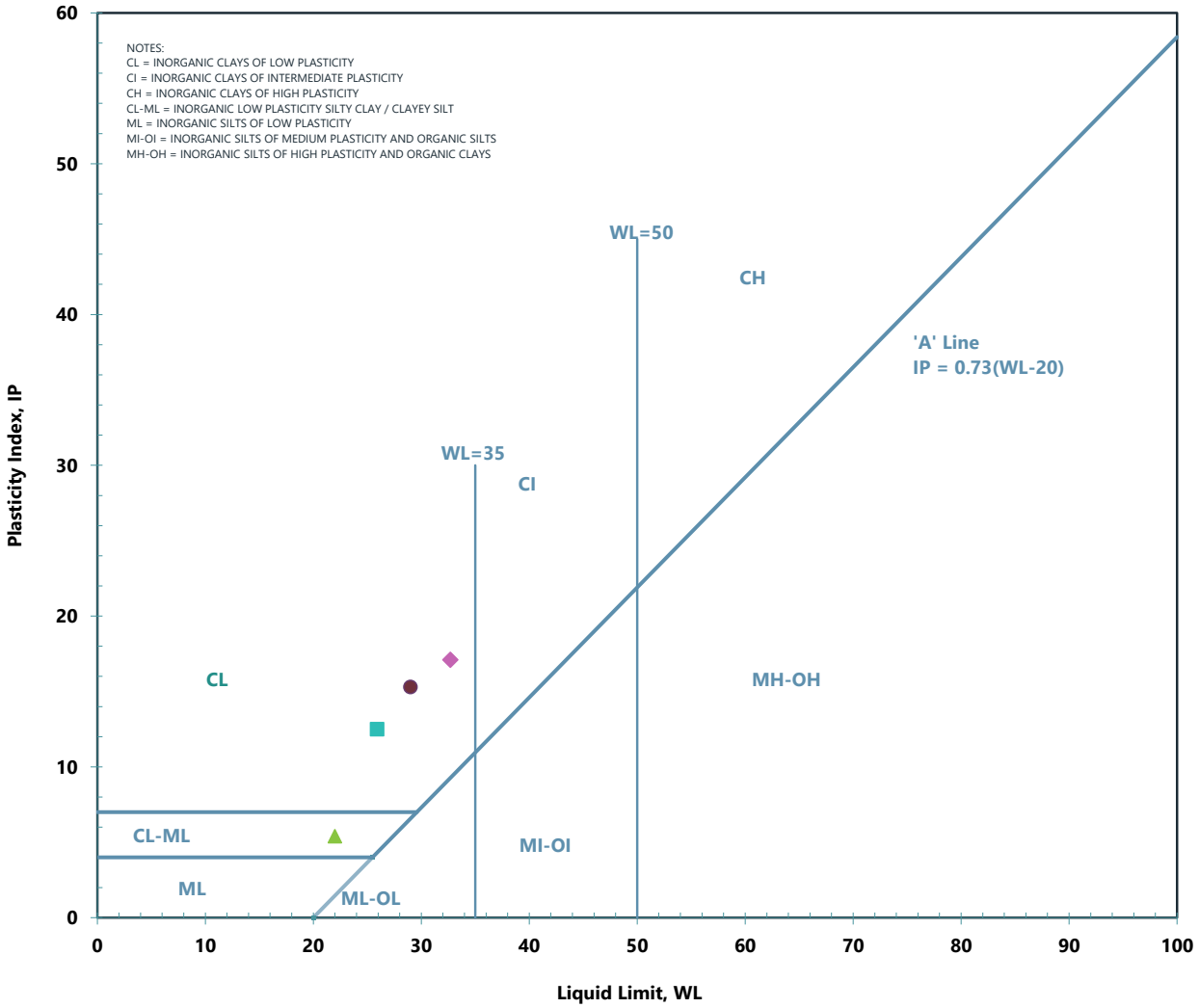

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-02	BH 20-02	BH 20-02	BH 20-03
SAMPLE NUMBER:	SS8	SS10 & SS11	SS2	SS5 & SS6
DEPTH BELOW SURFACE (m):	6.10 - 6.71	9.14 - 11.28	0.76 - 1.37	3.05 - 4.57
LIQUID LIMIT:	33	26	22	29
PLASTIC LIMIT:	16	13	17	14
PLASTICITY INDEX:	17	13	5	15

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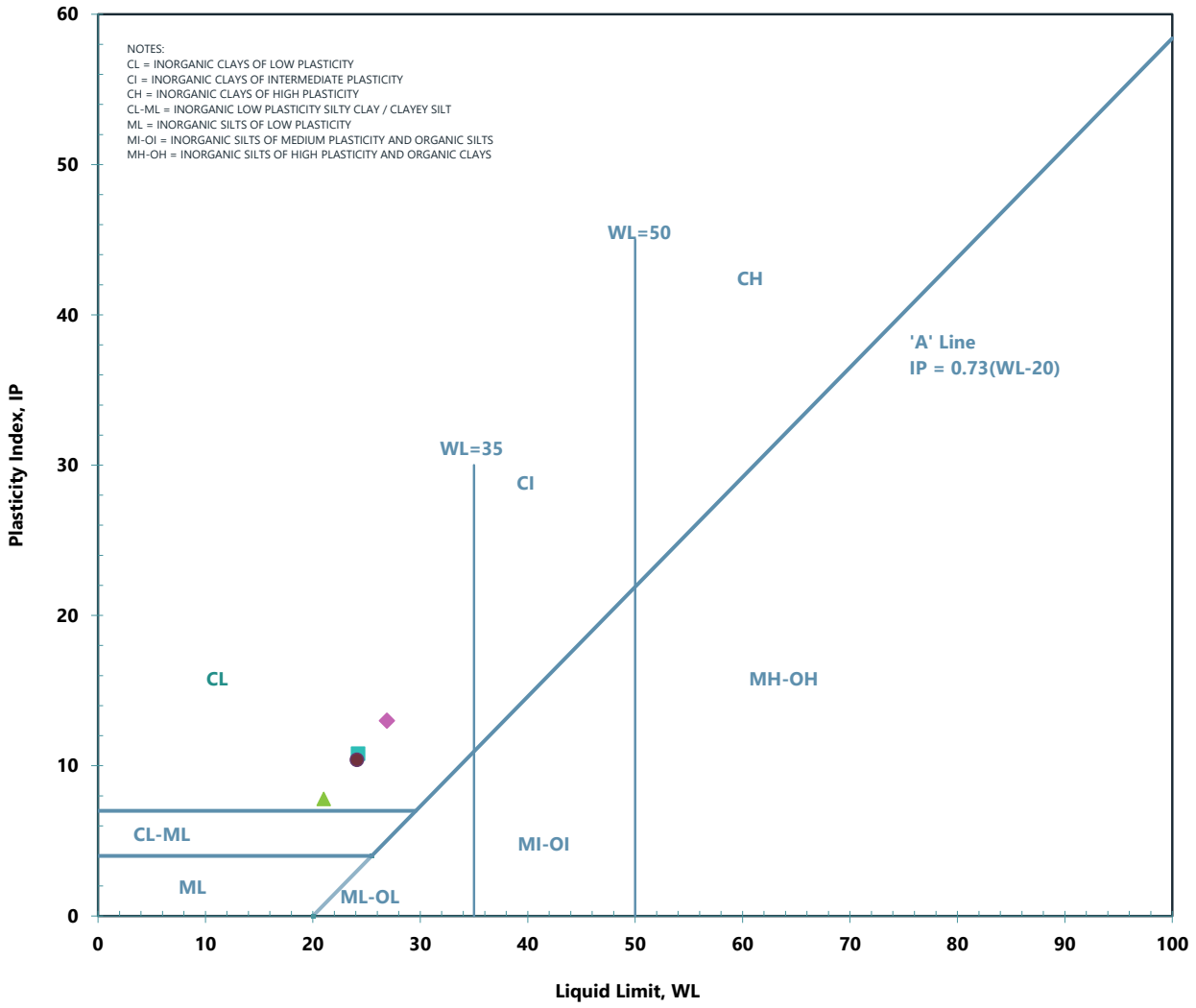

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-04	BH 20-04	BH 20-05	BH 20-05
SAMPLE NUMBER:	SS4 & SS5	SS7 & SS8	SS4 & SS5	SS7 & SS8
DEPTH BELOW SURFACE (m):	2.29 - 3.66	4.57 - 6.71	2.29 - 3.66	4.57 - 6.71
LIQUID LIMIT:	27	24	21	24
PLASTIC LIMIT:	14	13	13	14
PLASTICITY INDEX:	13	11	8	10

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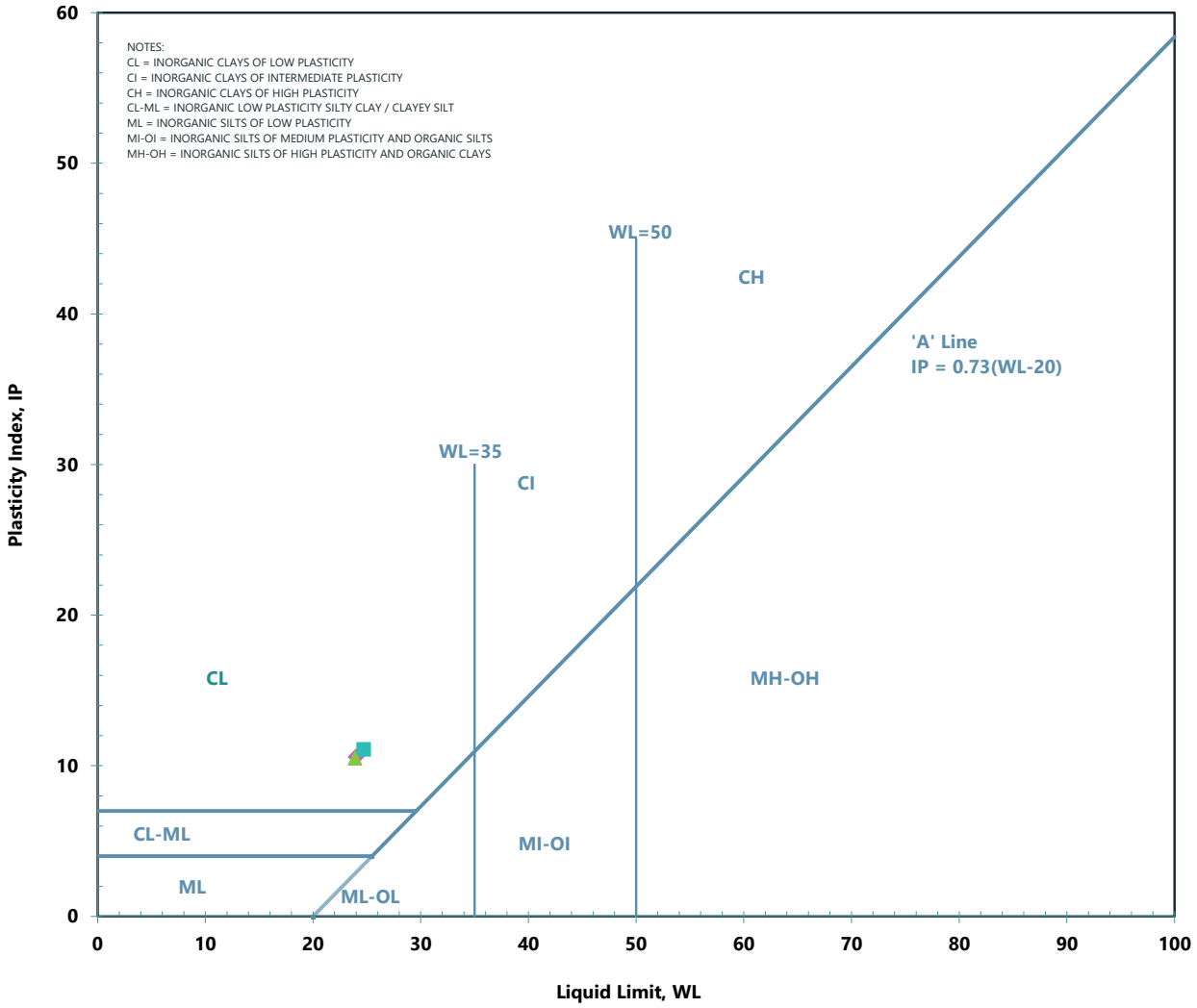

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-06	BH 20-06	BH 20-06	BH 20-07
SAMPLE NUMBER:	SS4	SS6 & SS7	SS9	SS3
DEPTH BELOW SURFACE (m):	2.29 - 2.90	3.81 - 5.18	7.62 - 8.23	1.52 - 2.13
LIQUID LIMIT:	24	25	24	Limits unable to be determined - Non-plastic soil
PLASTIC LIMIT:	13	14	13	
PLASTICITY INDEX:	11	11	11	

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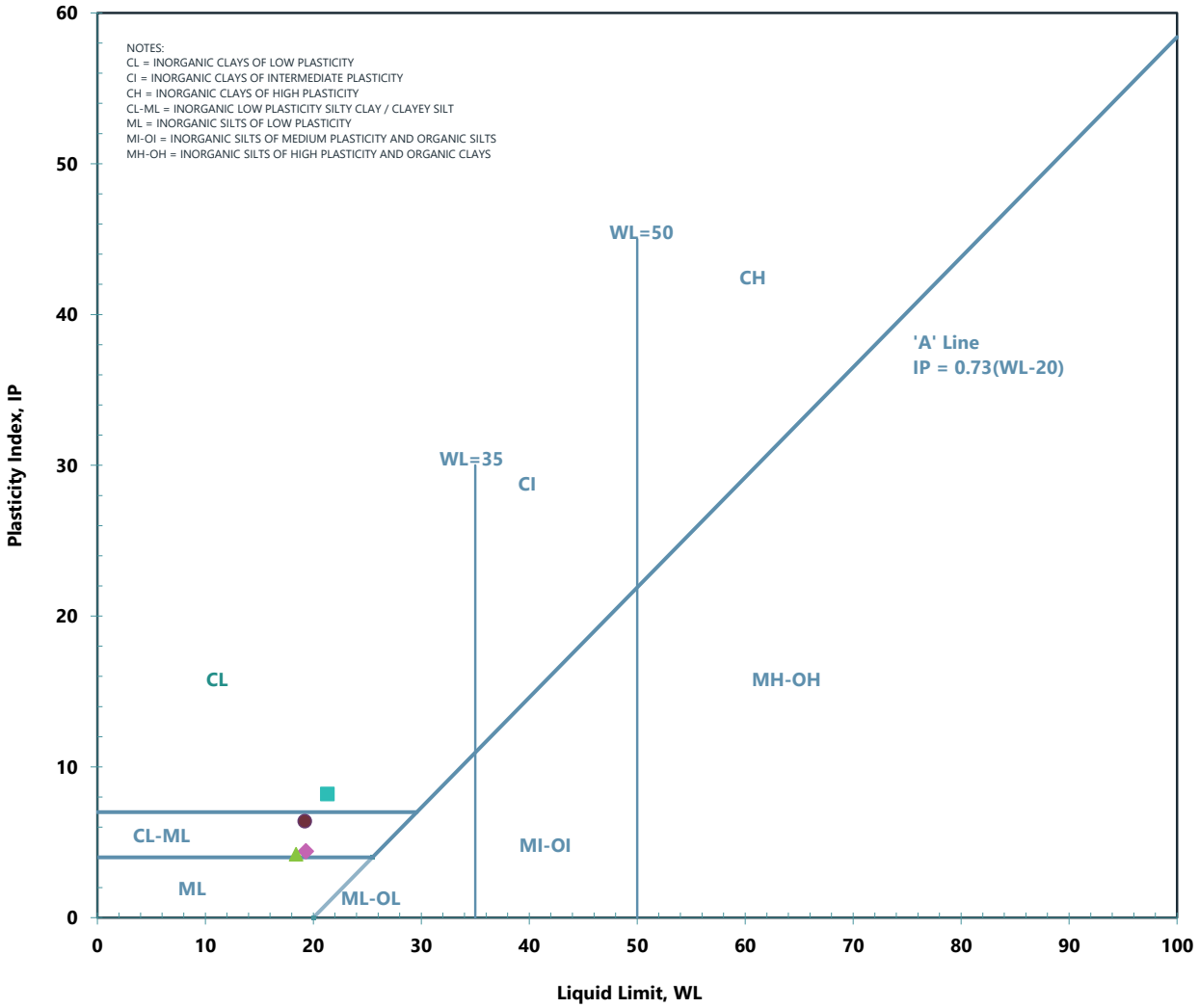

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-13	BH 20-13	BH 20-14	BH 20-14
SAMPLE NUMBER:	SS7	SS8	SS4 & SS5	SS6 & SS7
GEODETIC ELEVATION (m):	15 - 17	20 - 22	7.5 - 12	12.5 - 17
LIQUID LIMIT:	19	21	18	19
PLASTIC LIMIT:	15	13	14	13
PLASTICITY INDEX:	4	8	4	6

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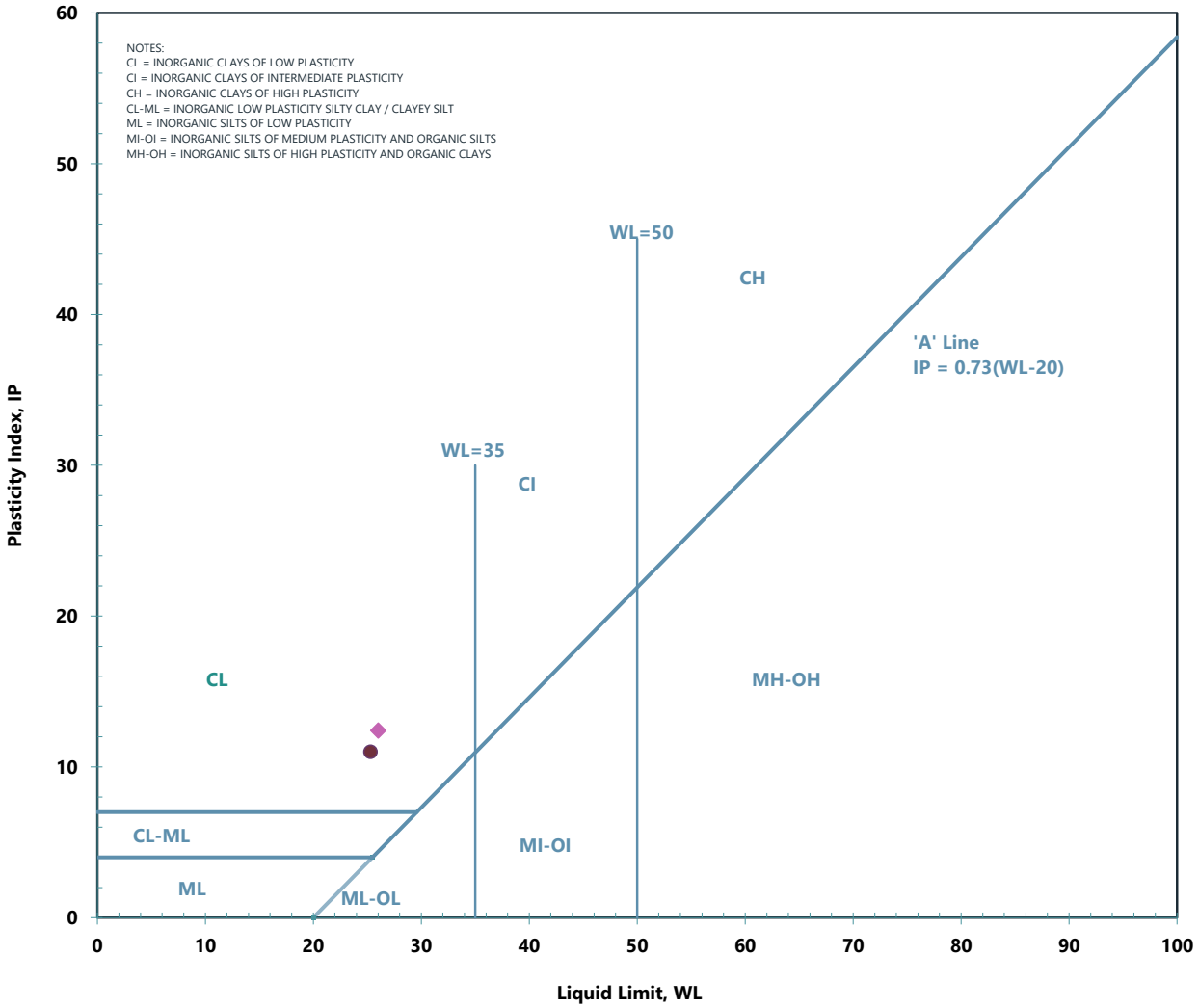

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-07	BH 20-08	BH 20-08	BH 20-08
SAMPLE NUMBER:	SS6 & SS7	SS2 & SS3	SS4 & SS5	SS8
DEPTH BELOW SURFACE (m):	3.81 - 5.18	0.76 - 2.13	2.29 - 3.66	6.10 - 6.71
LIQUID LIMIT:	26	Limits unable to be determined - Non-plastic soil	Limits unable to be determined - Non-plastic soil	25
PLASTIC LIMIT:	14			14
PLASTICITY INDEX:	12			11

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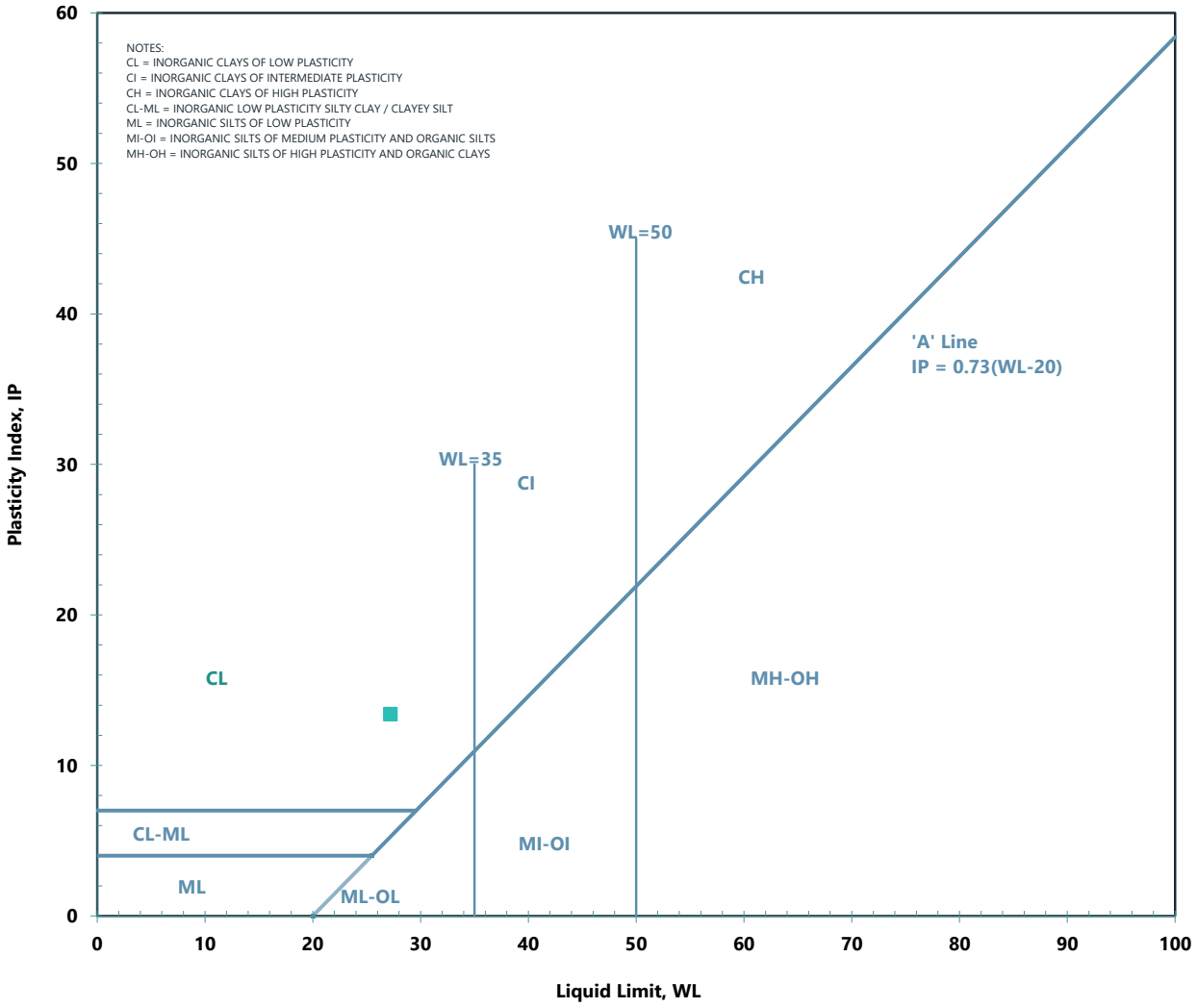

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-25	BH 20-25	BH 20-25	BH 20-26
SAMPLE NUMBER:	SS7	SS8	SS10	SS4 & SS5
GEODETIC ELEVATION (m):	15 - 17	20 - 22	30 - 32	7.5 - 12
LIQUID LIMIT:	Limits unable to be determined - Non-plastic soil	27	Limits unable to be determined - Non-plastic soil	Limits unable to be determined - Non-plastic soil
PLASTIC LIMIT:		14		
PLASTICITY INDEX:		13		

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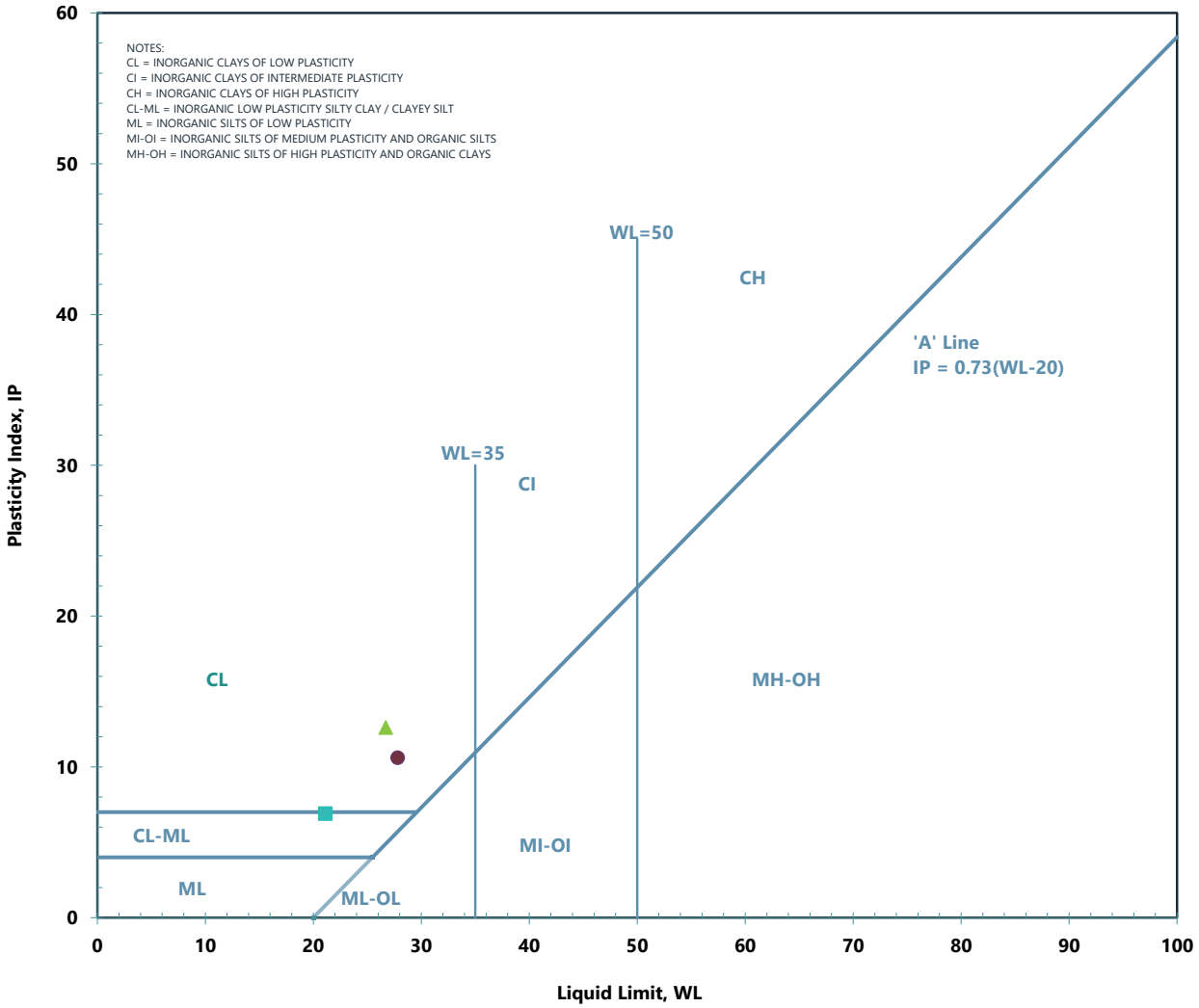

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-10	BH 20-10	BH 20-11	BH 20-11
SAMPLE NUMBER:	SS7	SS8	SS5 & SS6	SS8
GEODETIC ELEVATION (m):	15 - 17	20 -22	10 - 14.5	20 - 22
LIQUID LIMIT:	Limits unable to be determined - Non-plastic soil	21	27	28
PLASTIC LIMIT:		14	14	17
PLASTICITY INDEX:		7	13	11

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ATTERBERG LIMITS

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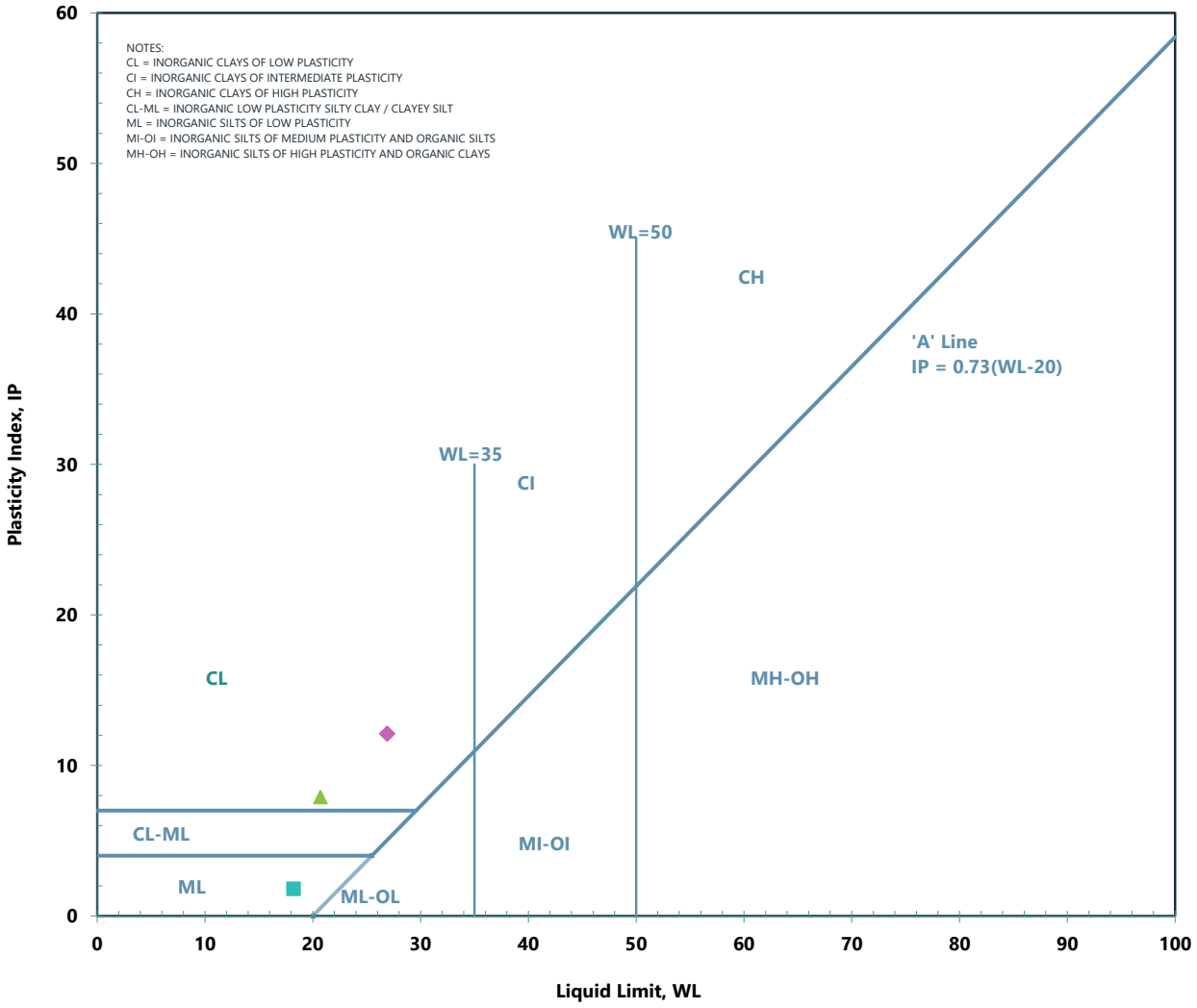

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-12	BH 20-12	BH 20-12	BH 20-13
SAMPLE NUMBER:	SS2 & SS3	SS4	SS7 & SS8	SS5 & SS6
GEODETIC ELEVATION (m):	2.5 - 7	7.5 - 9.5	15 - 22	10 - 14.5
LIQUID LIMIT:	27	18	21	Limits unable to be determined - Non-plastic soil
PLASTIC LIMIT:	15	16	13	
PLASTICITY INDEX:	12	2	8	

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ATTERBERG LIMITS

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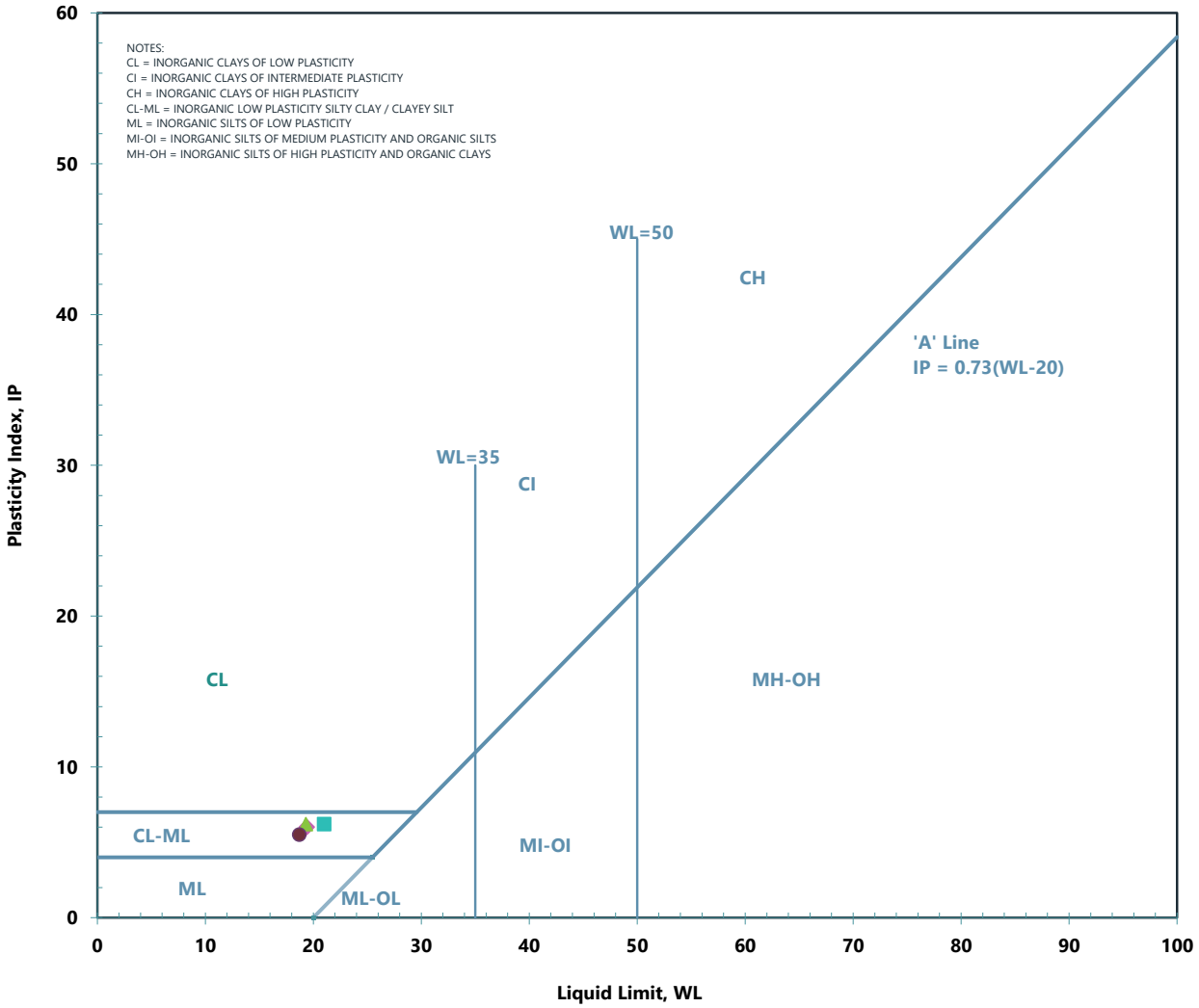

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-14	BH 20-15	BH 20-15	BH 20-15
SAMPLE NUMBER:	SS8	SS2 & SS3	SS4 & SS5	SS7
GEODETIC ELEVATION (m):	20 - 22	2.5 - 7	7.5 - 12	15 - 17
LIQUID LIMIT:	19	21	19	19
PLASTIC LIMIT:	13	15	13	13
PLASTICITY INDEX:	6	6	6	6

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Report Date:	**30-Oct-20**	

ATTERBERG LIMITS

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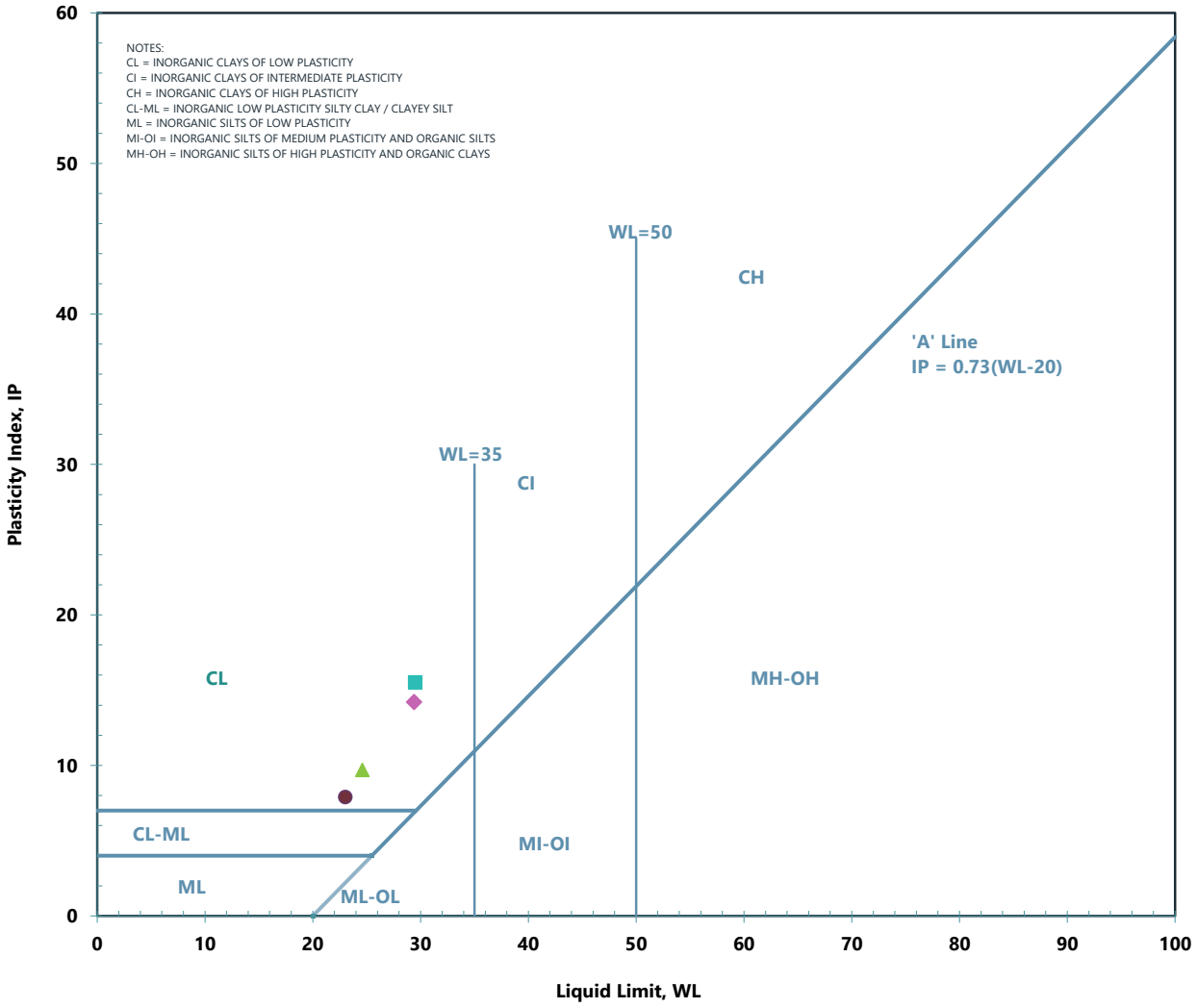

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-15	BH 20-16	BH 20-16	BH 20-17
SAMPLE NUMBER:	SS8	SS5 & SS6	SS7 & SS8	SS3 & SS4
GEODETIC ELEVATION (m):	20 - 22	10 - 14.5	15 - 19.5	5 - 9.5
LIQUID LIMIT:	29	30	25	23
PLASTIC LIMIT:	15	14	15	15
PLASTICITY INDEX:	14	16	10	8

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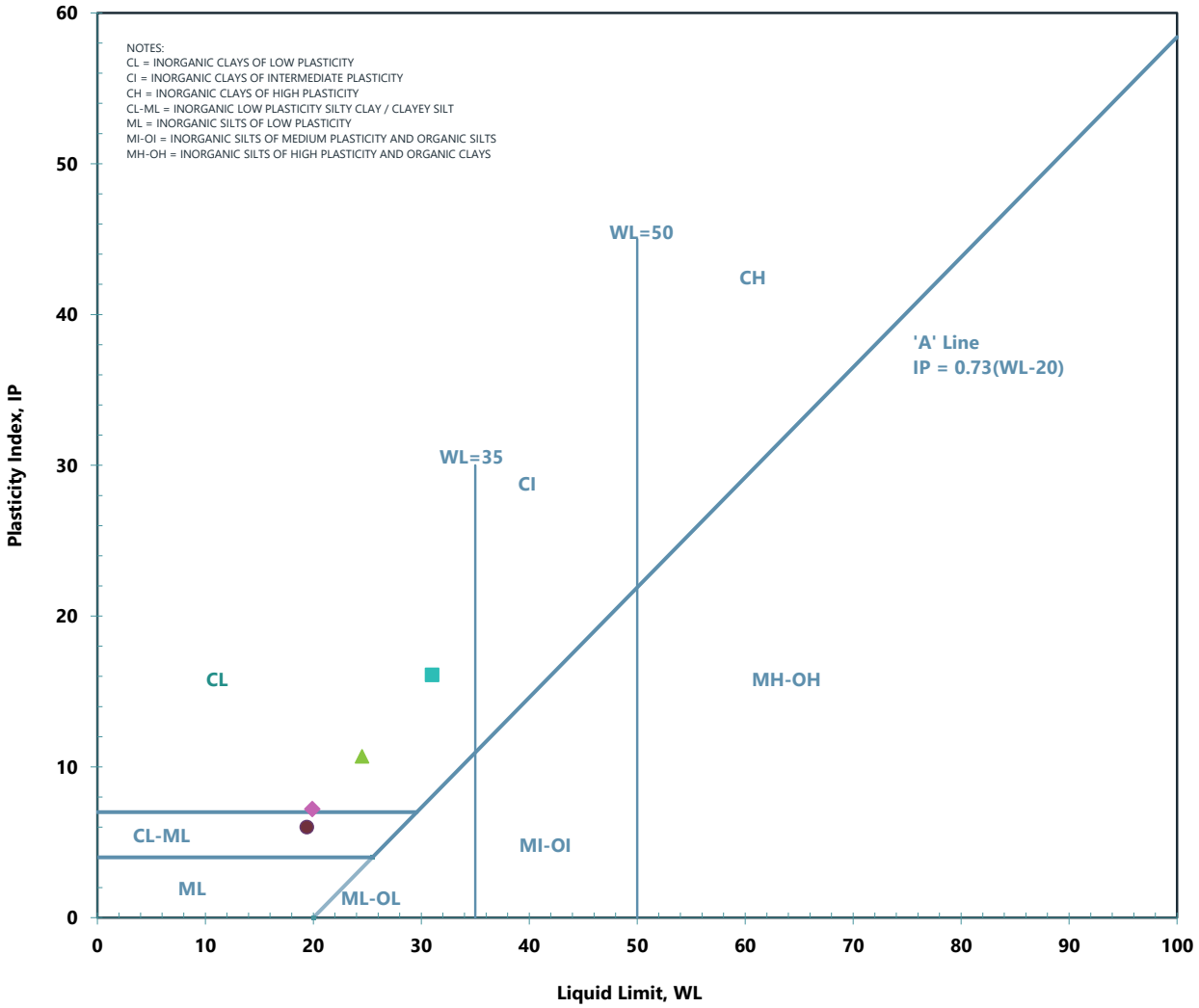

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-23	BH 20-24	BH 20-24	BH 20-25
SAMPLE NUMBER:	SS9	SS3 & SS4	SS6 & SS7	SS4
GEODETIC ELEVATION (m):	25 - 27	5 - 9.5	12.5 - 17	7.5 - 9.5
LIQUID LIMIT:	20	31	25	19
PLASTIC LIMIT:	13	15	14	13
PLASTICITY INDEX:	7	16	11	6

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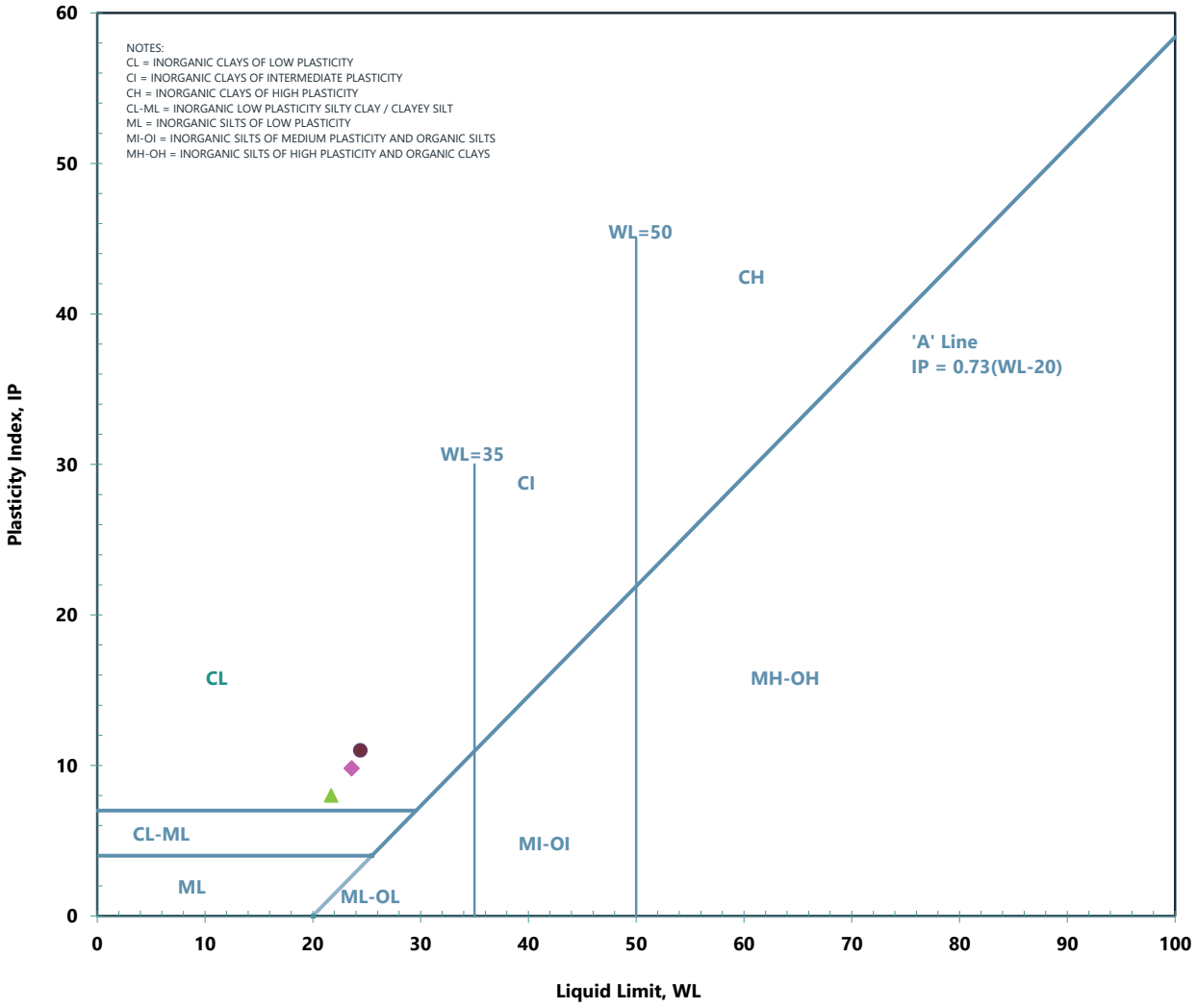

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-17	BH 20-17	BH 20-18	BH 20-18
SAMPLE NUMBER:	SS5 & SS6	SS9 & SS10	SS2 & SS3	SS5 & SS6
GEODETIC ELEVATION (m):	10 - 14.5	25 - 32	2.5 - 7	10 - 14.5
LIQUID LIMIT:	24	Limits unable to be determined - Non-plastic soil	22	24
PLASTIC LIMIT:	14		14	13
PLASTICITY INDEX:	10		8	11

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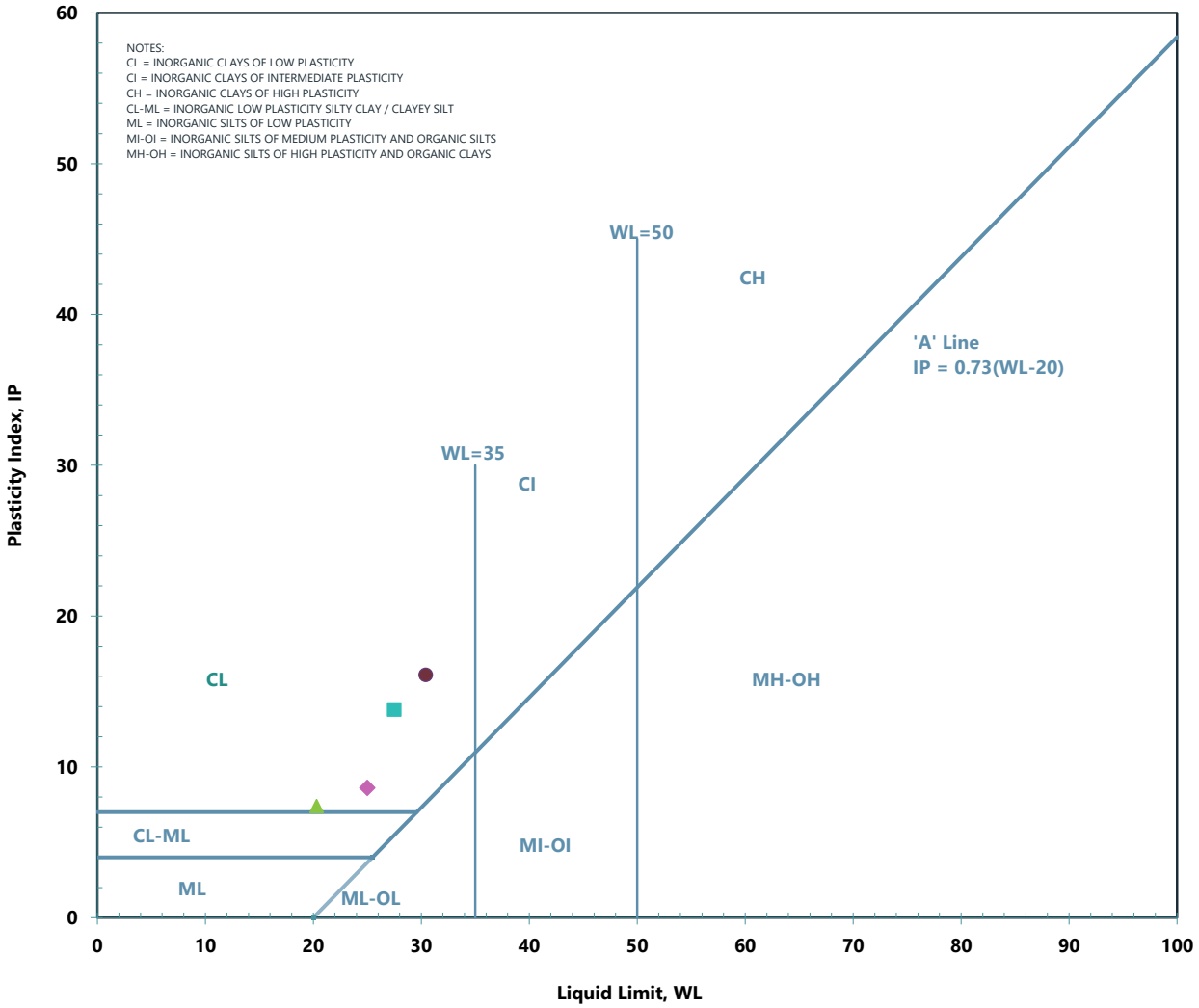

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-20	BH 20-21	BH 20-21	BH 20-22
SAMPLE NUMBER:	SS5 & SS6	SS5 & SS6	SS9	SS2 & SS3
GEODETIC ELEVATION (m):	10 - 14.5	10 - 14.5	25 - 27	2.5 - 7
LIQUID LIMIT:	25	28	20	30
PLASTIC LIMIT:	16	14	13	14
PLASTICITY INDEX:	9	14	7	16

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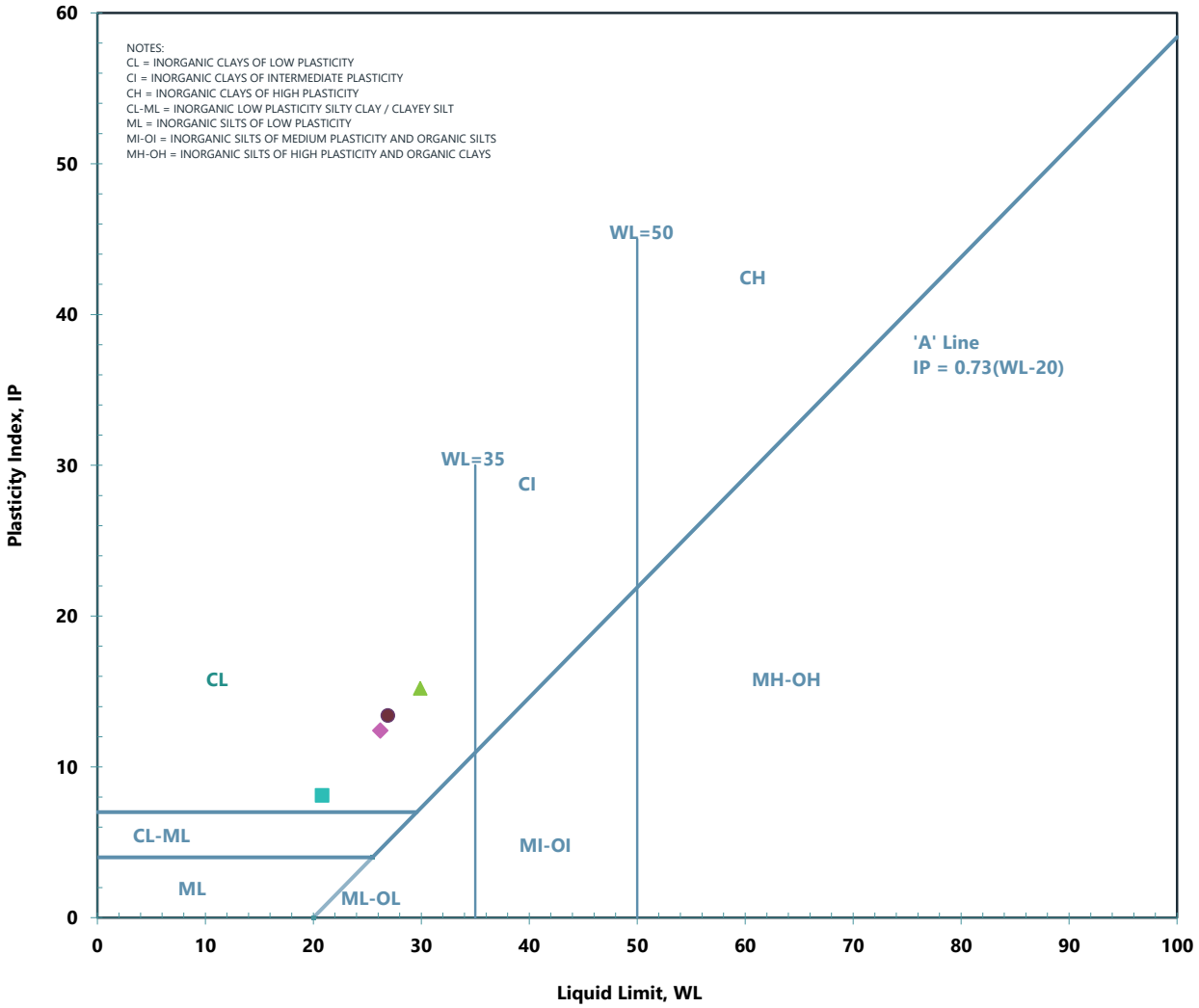

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH 20-22	BH 20-22	BH 20-23	BH 20-23
SAMPLE NUMBER:	SS6 & SS7	SS9	SS2 & SS3	SS6 & SS7
GEODETIC ELEVATION (m):	12.5 - 17	25 - 27	2.5 - 7	12.5 - 17
LIQUID LIMIT:	26	21	30	27
PLASTIC LIMIT:	14	13	15	14
PLASTICITY INDEX:	12	8	15	13

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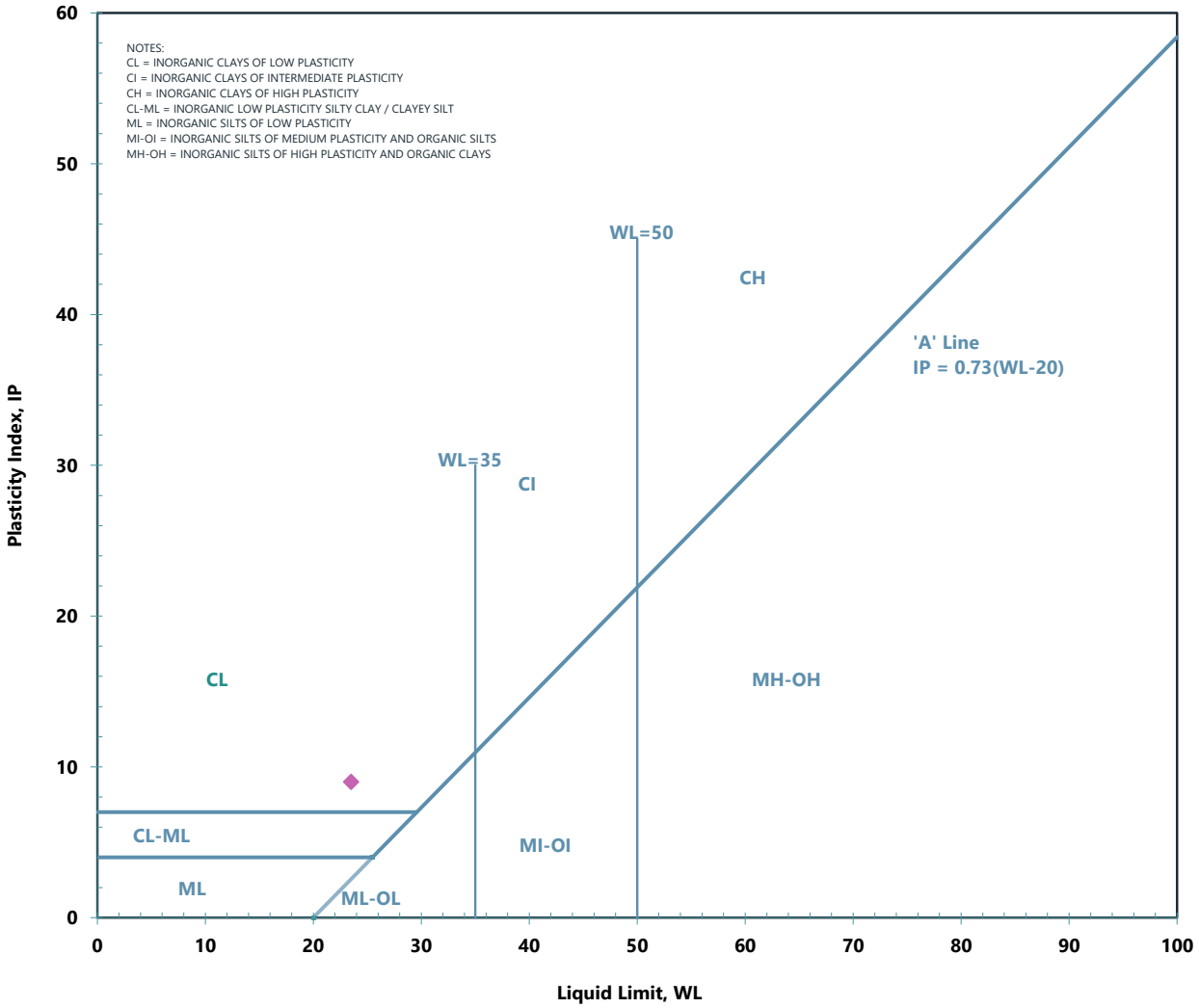

LEGEND

SYMBOL:	◆			
BOREHOLE/TEST PIT NUMBER:	BH 20-26			
SAMPLE NUMBER:	SS6 & SS7			
GEODETIC ELEVATION (m):	12.5 - 17			
LIQUID LIMIT:	24			
PLASTIC LIMIT:	15			
PLASTICITY INDEX:	9			

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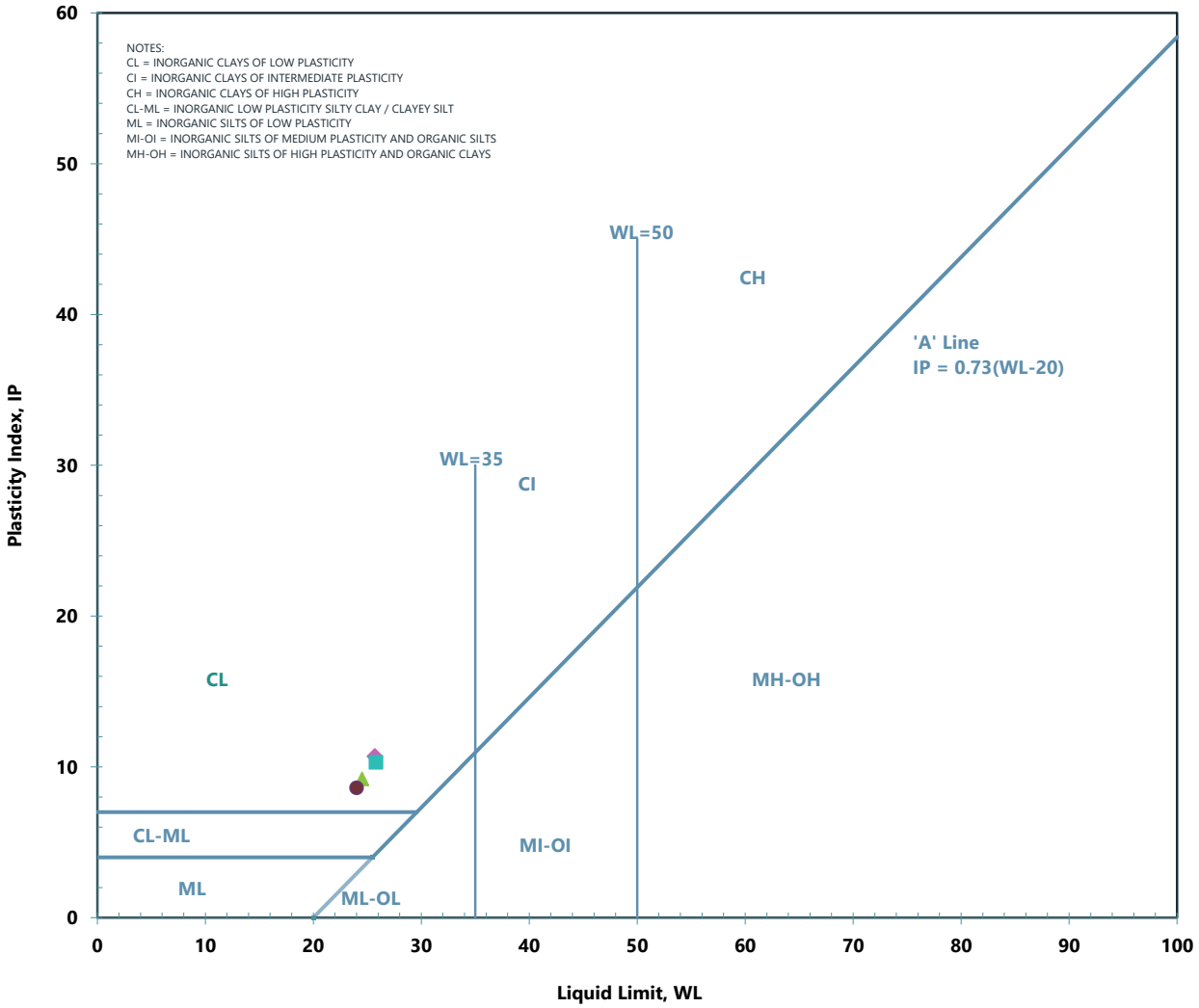

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	BH20-27	BH20-27	BH20-27	BH20-27
SAMPLE NUMBER:	SS3a	SS4	SS(5&6)	SS(7&8)
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	26	26	25	24
PLASTIC LIMIT:	15	16	15	15
PLASTICITY INDEX:	11	10	9	9

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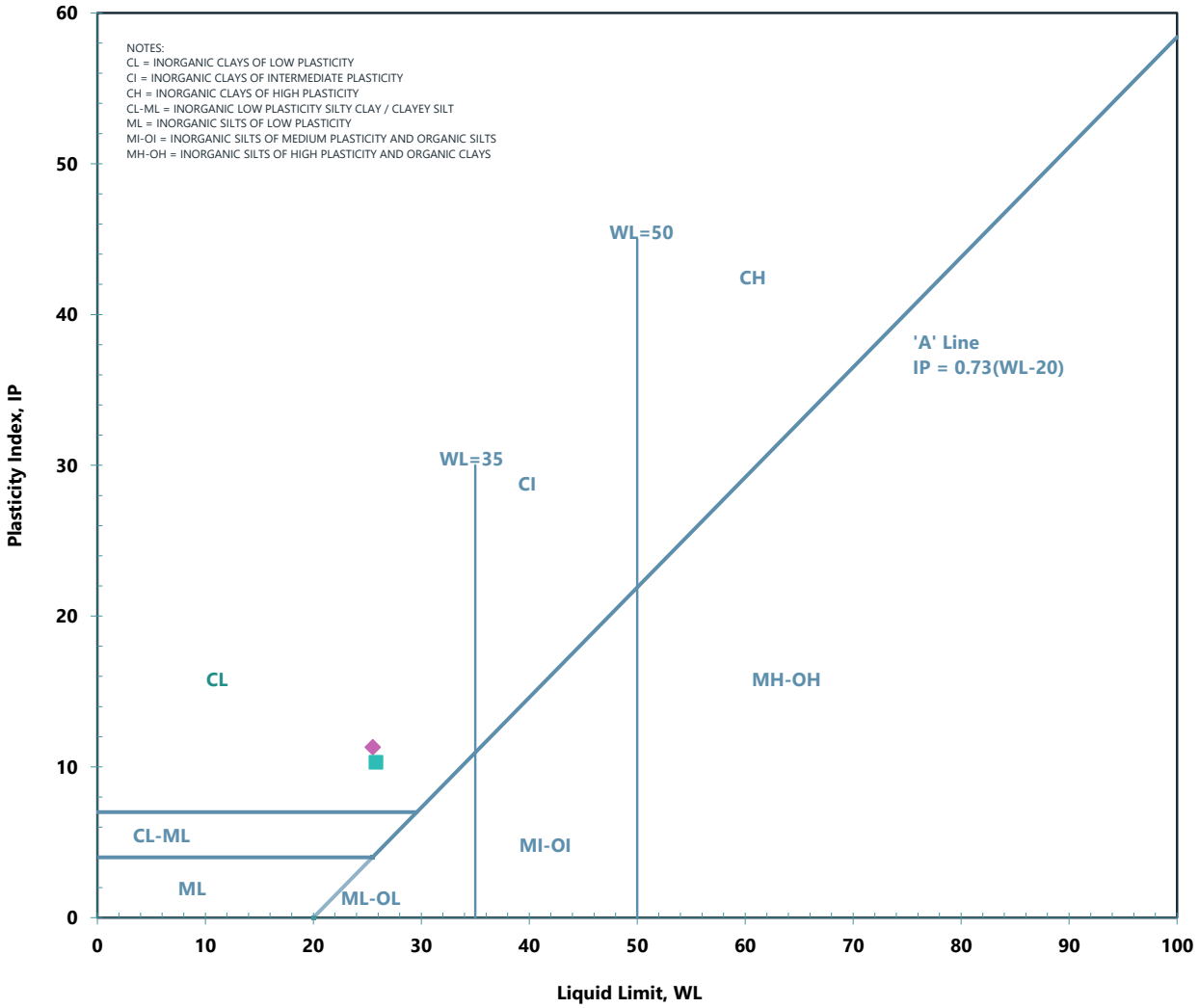

LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	BH20-30	BH20-30		
SAMPLE NUMBER:	SS(6b&7)	SS(4&5)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	26	26		
PLASTIC LIMIT:	14	16		
PLASTICITY INDEX:	11	10		

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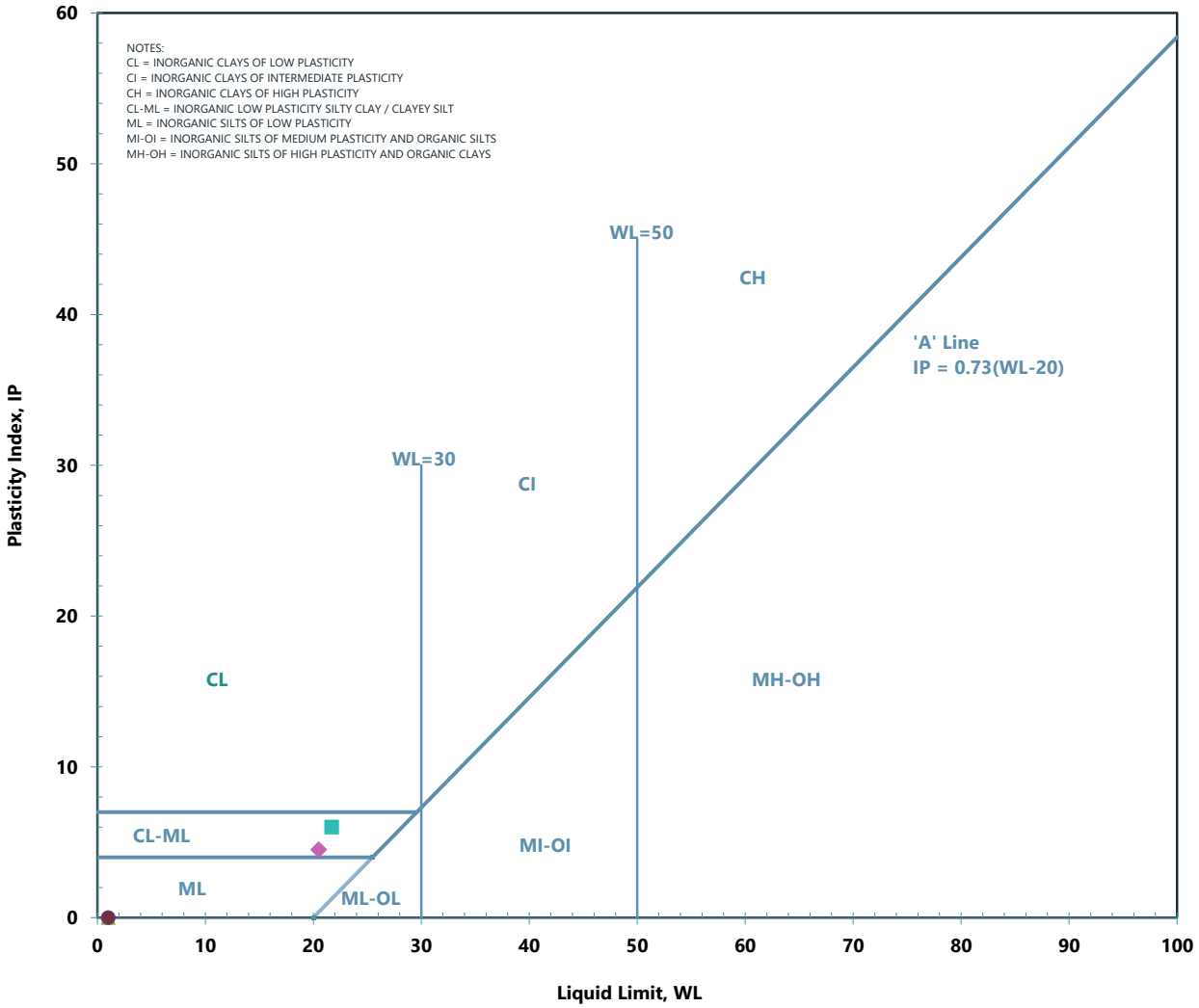

LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	20-38	20-38		
SAMPLE NUMBER:	SS(3&4)	SS(6&7)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	21	22		
PLASTIC LIMIT:	16	16		
PLASTICITY INDEX:	5	6		

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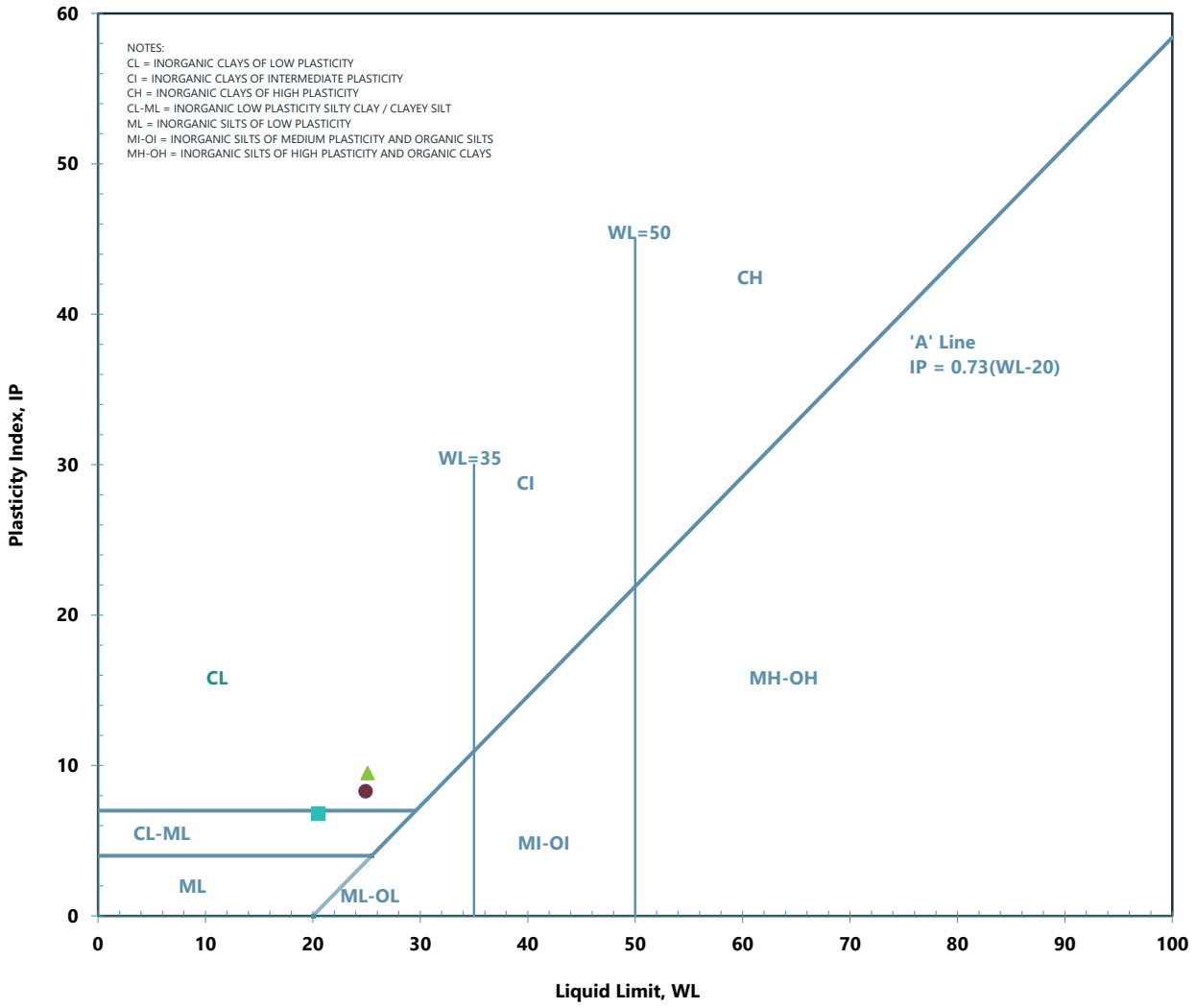

LEGEND

SYMBOL:	■	▲	●	
BOREHOLE/TEST PIT NUMBER:	BH20-28	BH20-29	BH20-29	
SAMPLE NUMBER:	SS8	SS(4&5)	SS(7&8)	
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	21	25	25	
PLASTIC LIMIT:	14	16	17	
PLASTICITY INDEX:	7	10	8	

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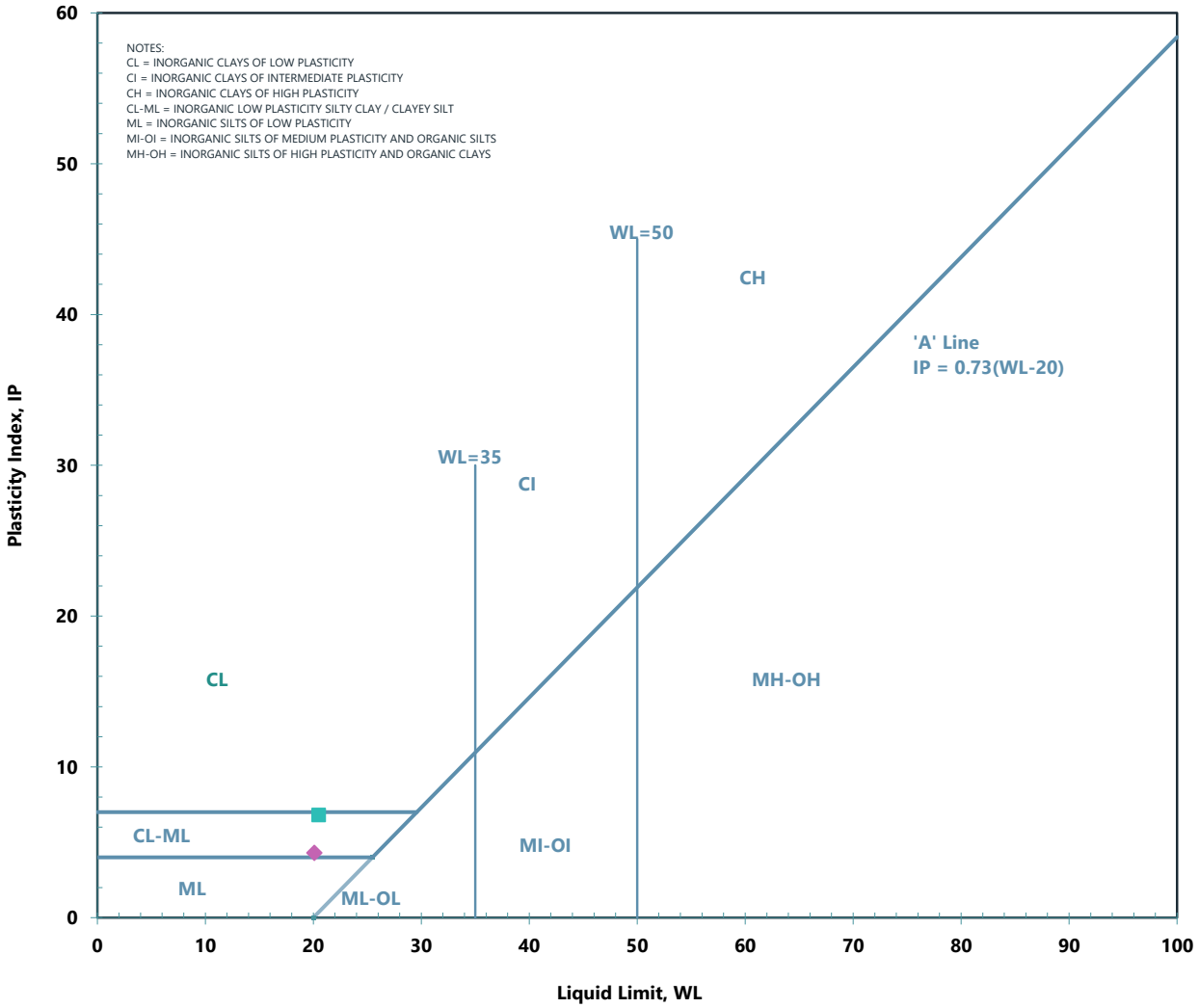

LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	BH20-28	BH20-28		
SAMPLE NUMBER:	SS3	SS(5&6)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	20	21		
PLASTIC LIMIT:	16	14		
PLASTICITY INDEX:	4	7		

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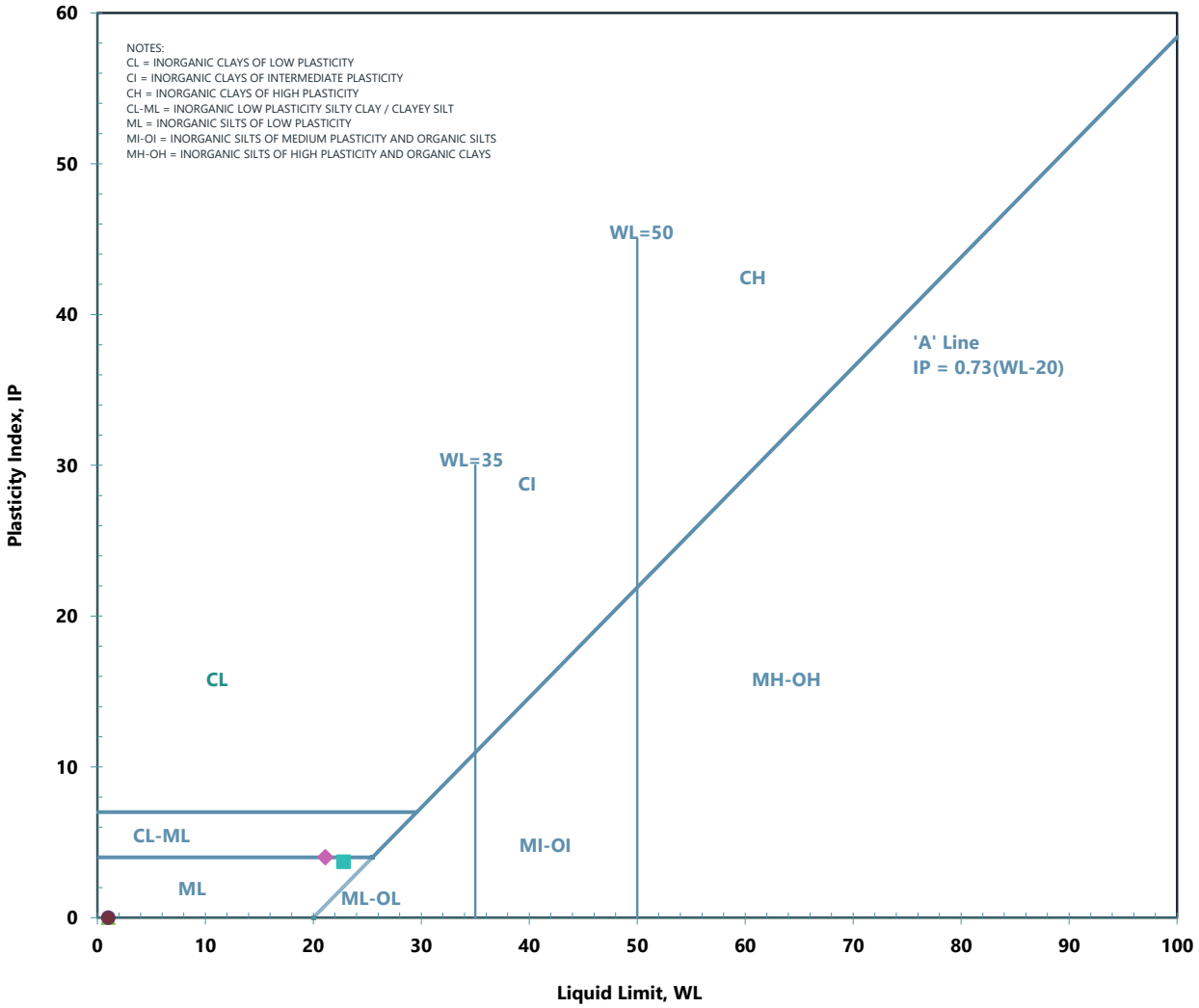

LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	20-37B	20-41		
SAMPLE NUMBER:	SS(3&4)	SS(2&3)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	21	23		
PLASTIC LIMIT:	17	19		
PLASTICITY INDEX:	4	4		

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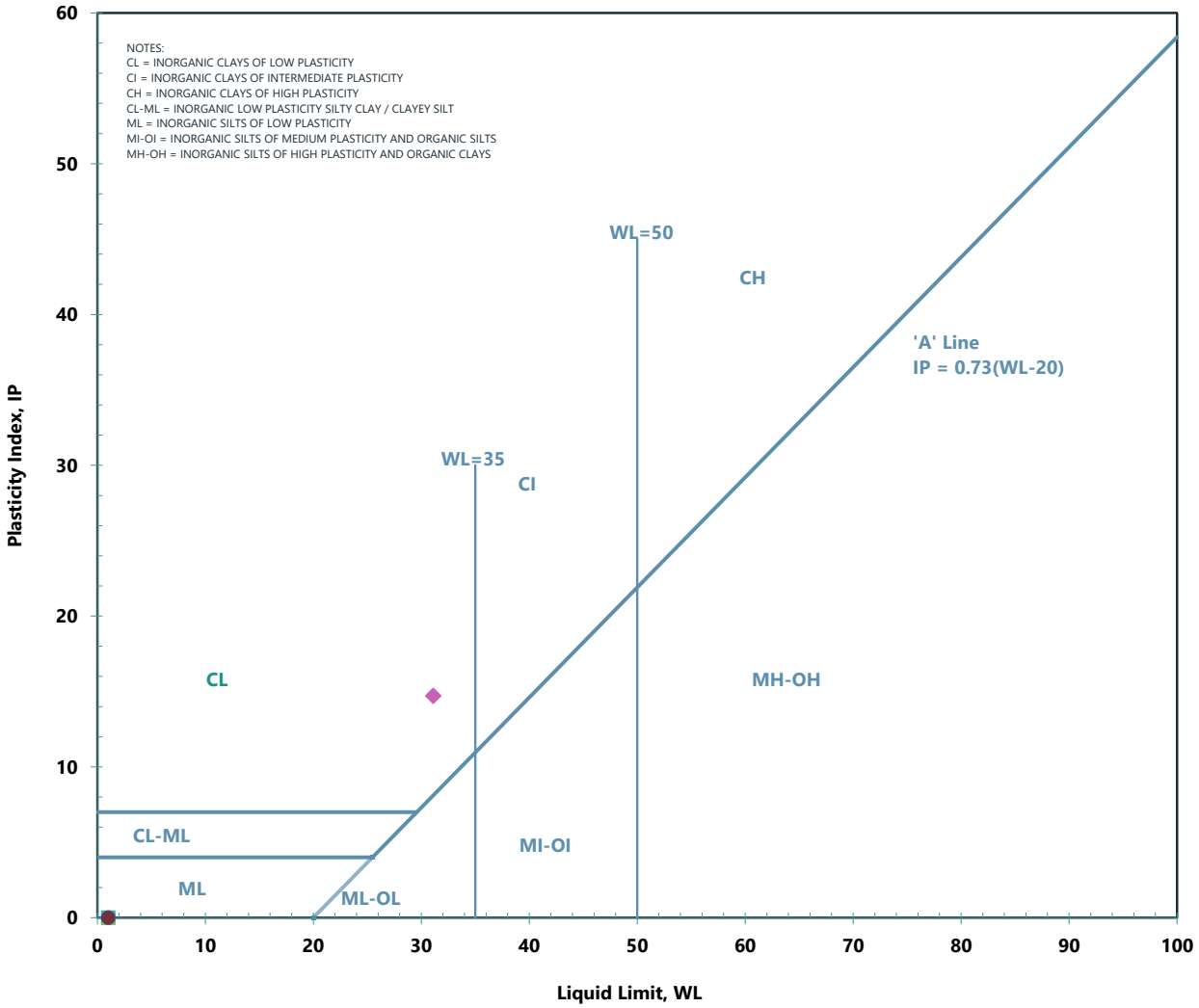

LEGEND

SYMBOL:	◆			
BOREHOLE/TEST PIT NUMBER:	20-35			
SAMPLE NUMBER:	SS(5&6)			
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	31			
PLASTIC LIMIT:	16			
PLASTICITY INDEX:	15			

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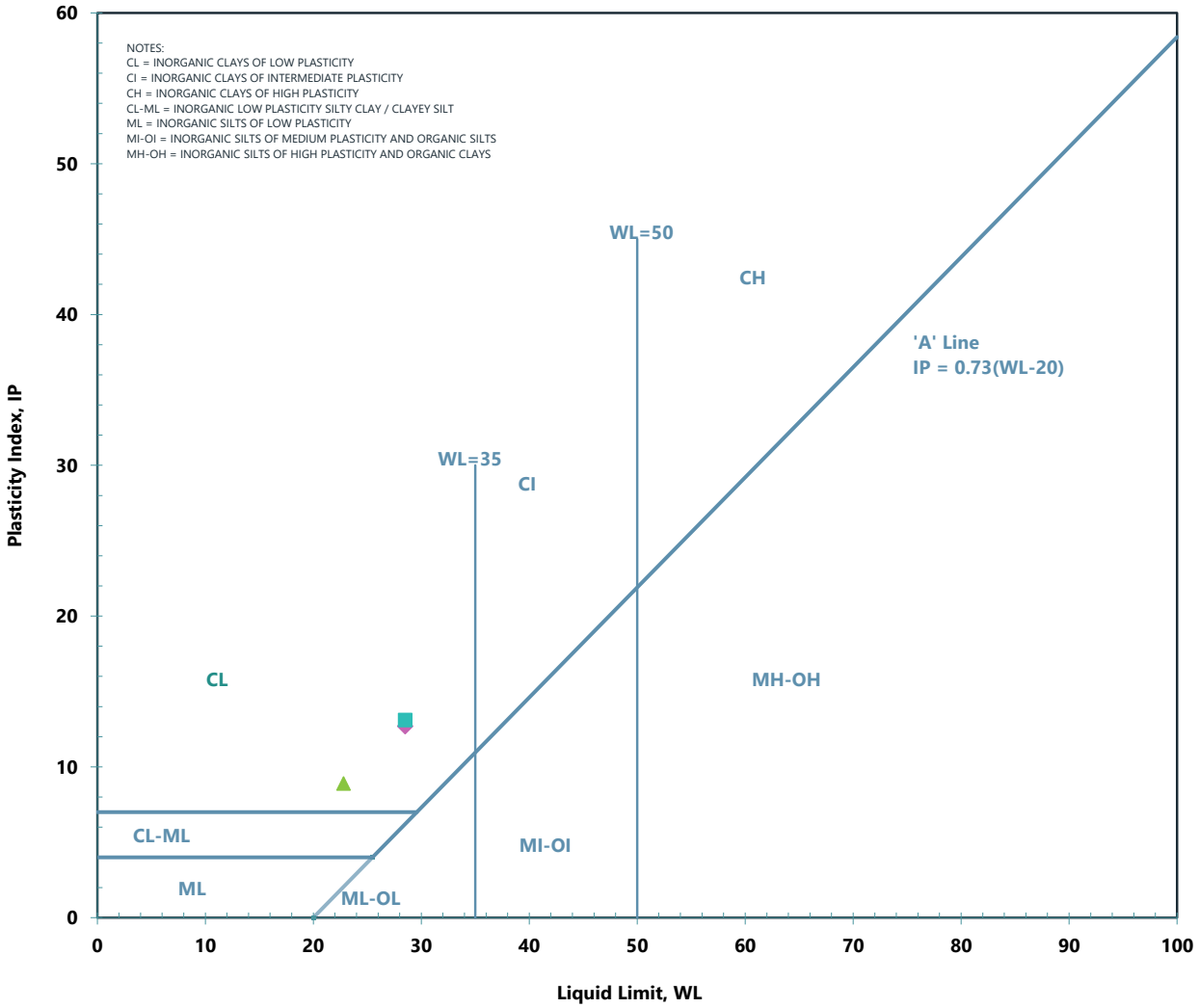

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	20-35	20-35	20-36	20-36
SAMPLE NUMBER:	SS7	SS8	SS4	SS5
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	29	29	23	22
PLASTIC LIMIT:	16	15	14	11
PLASTICITY INDEX:	13	13	9	11

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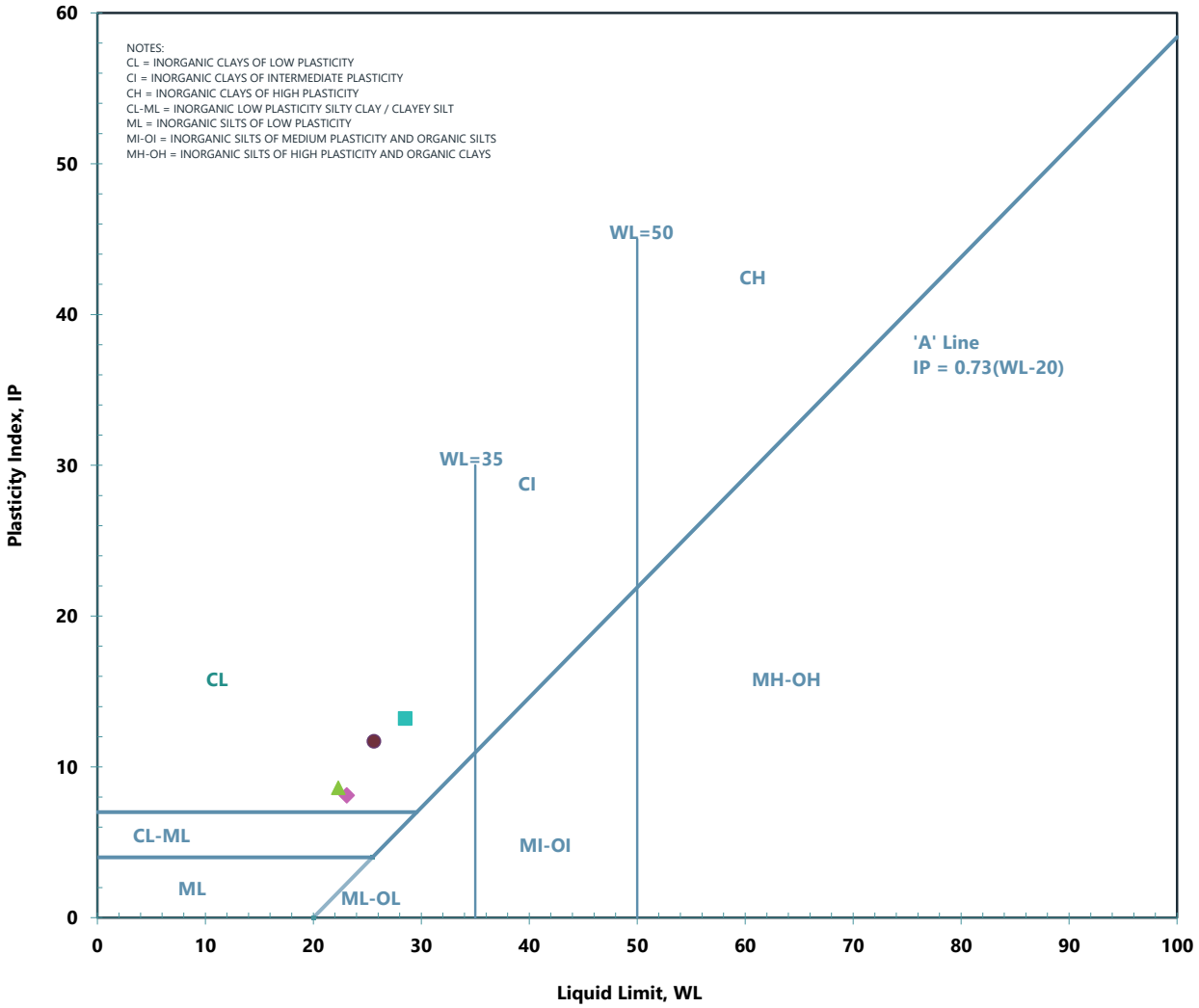

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	20-36	20-36	20-37	20-37
SAMPLE NUMBER:	SS6	SS(7&8)	SS(4&5)	SS(6&7)
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	23	29	22	26
PLASTIC LIMIT:	15	15	14	14
PLASTICITY INDEX:	8	13	9	12

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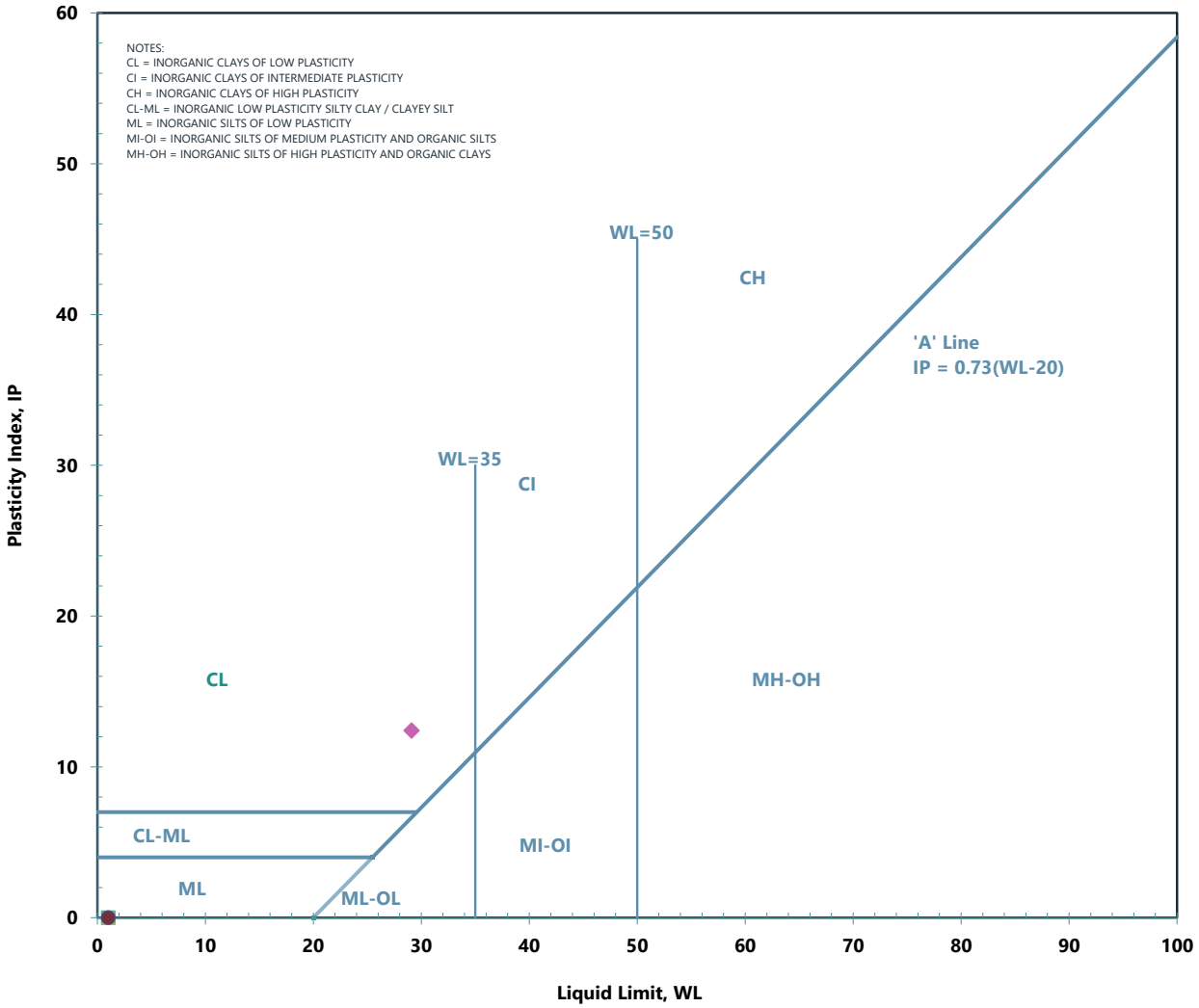

LEGEND

SYMBOL:	◆			
BOREHOLE/TEST PIT NUMBER:	20-42			
SAMPLE NUMBER:	SS(3&4)			
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	29			
PLASTIC LIMIT:	17			
PLASTICITY INDEX:	12			

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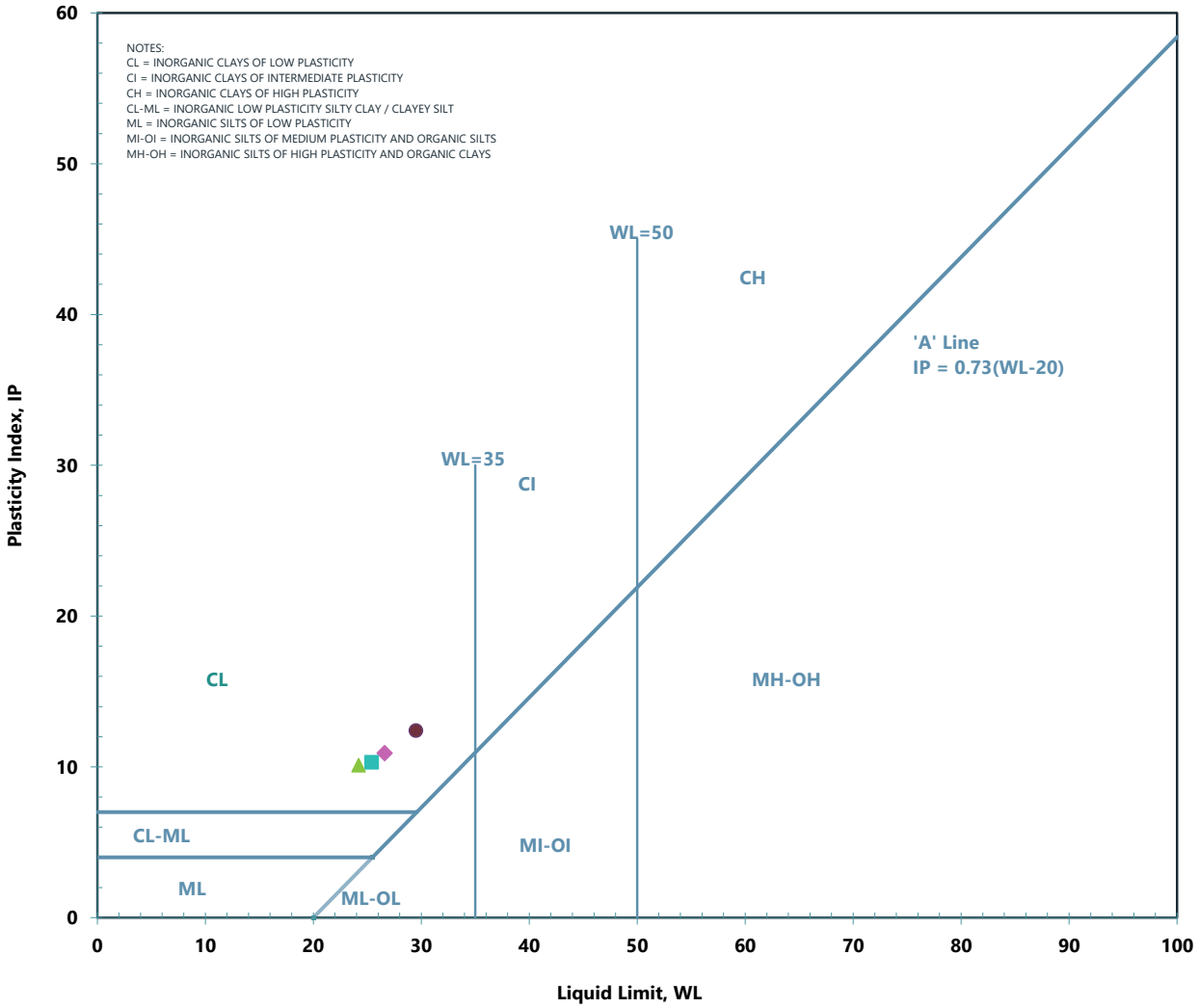

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	20-37	20-37B	2037B	20-38
SAMPLE NUMBER:	SS8	SS(6&7)	SS(8&9)	SS(9&10)
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	27	25	24	30
PLASTIC LIMIT:	16	15	14	17
PLASTICITY INDEX:	11	10	10	12

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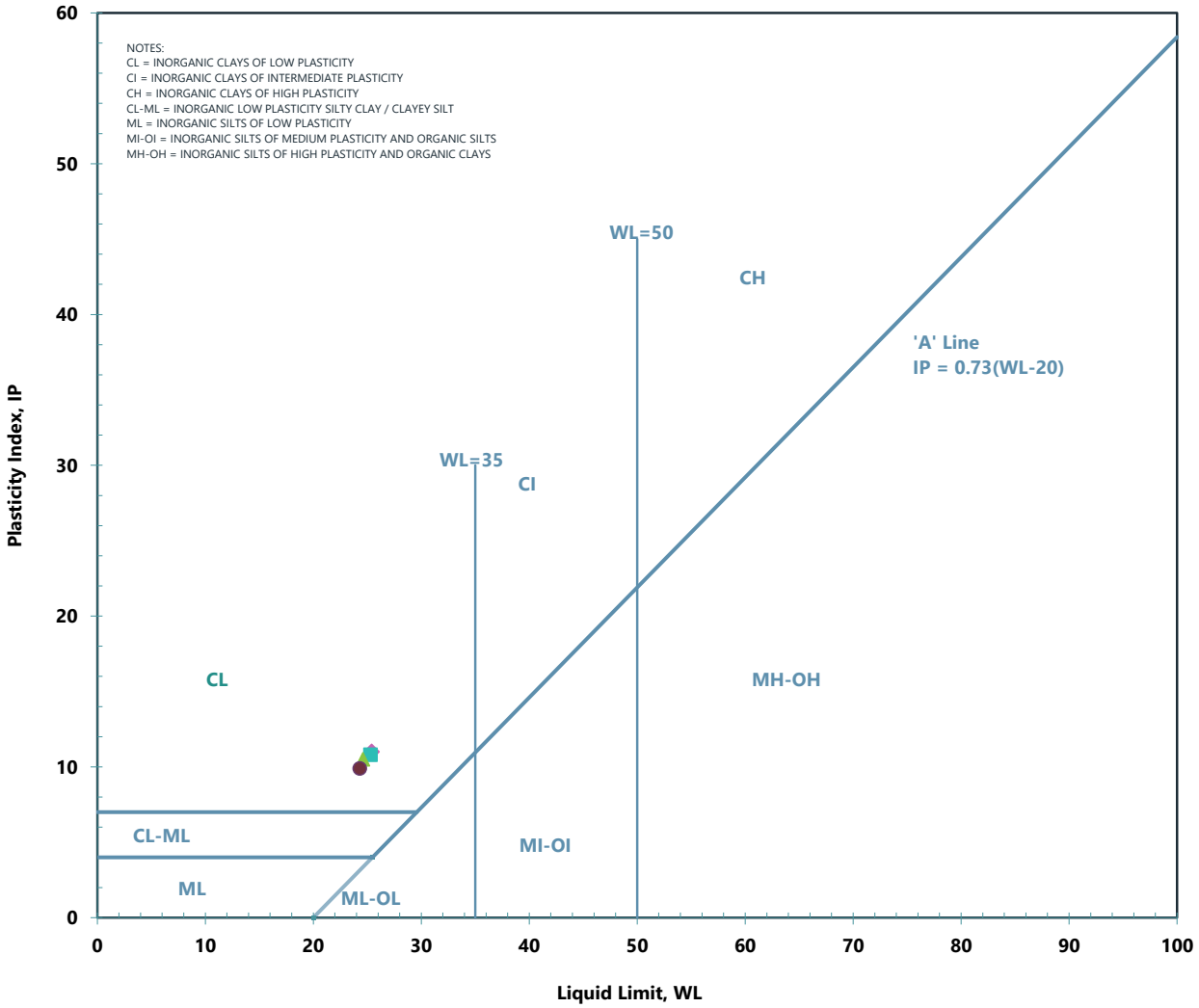

LEGEND

SYMBOL:	◆	■	▲	●
BOREHOLE/TEST PIT NUMBER:	20-39	20-40	20-41	20-41
SAMPLE NUMBER:	SS(2&3)	SS(4&5)	SS(6&7)	SS(8&9)
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	25	25	25	24
PLASTIC LIMIT:	14	15	14	14
PLASTICITY INDEX:	11	11	11	10

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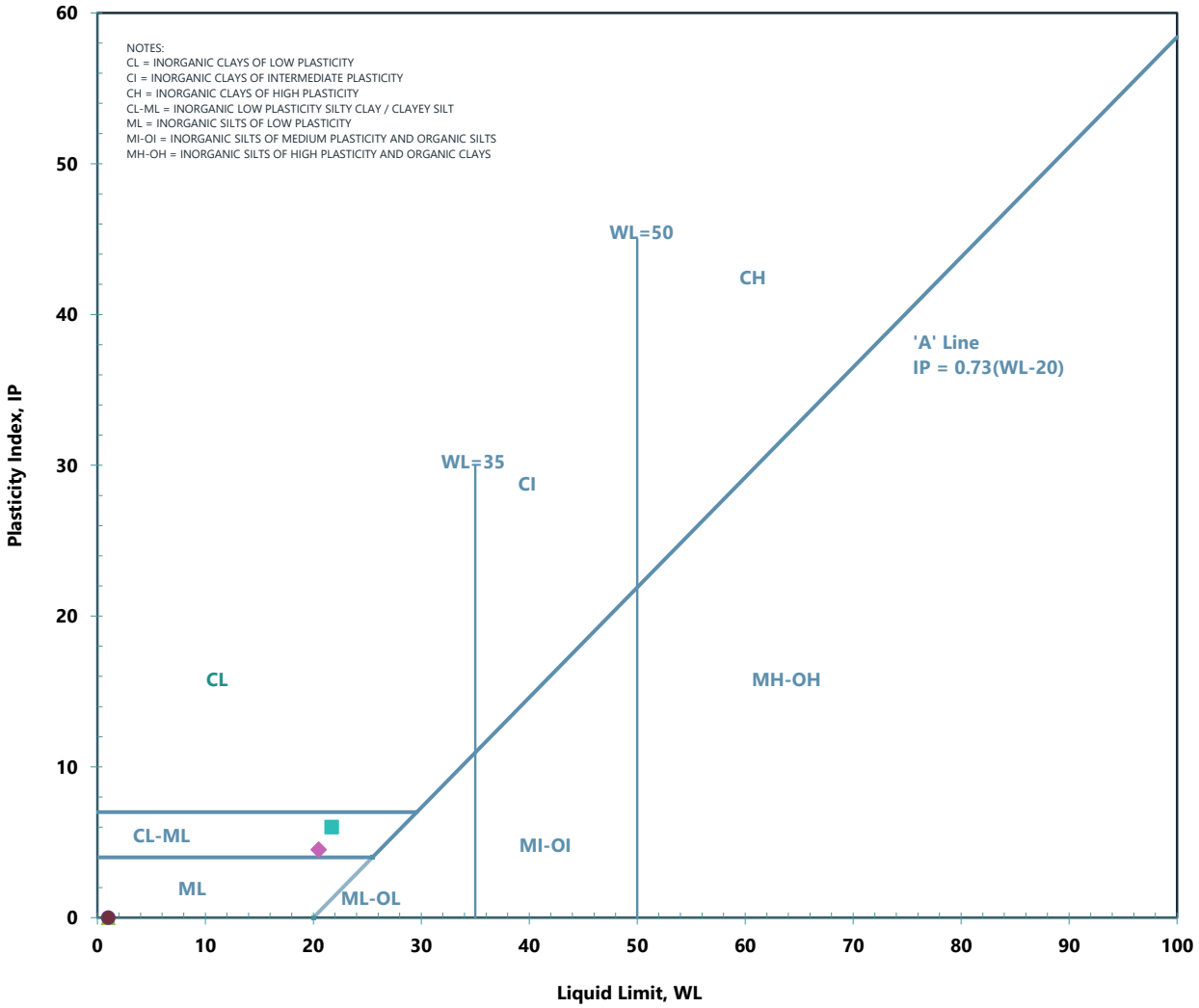

LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	20-38	20-38		
SAMPLE NUMBER:	SS(3&4)	SS(6&7)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	21	22		
PLASTIC LIMIT:	16	16		
PLASTICITY INDEX:	5	6		

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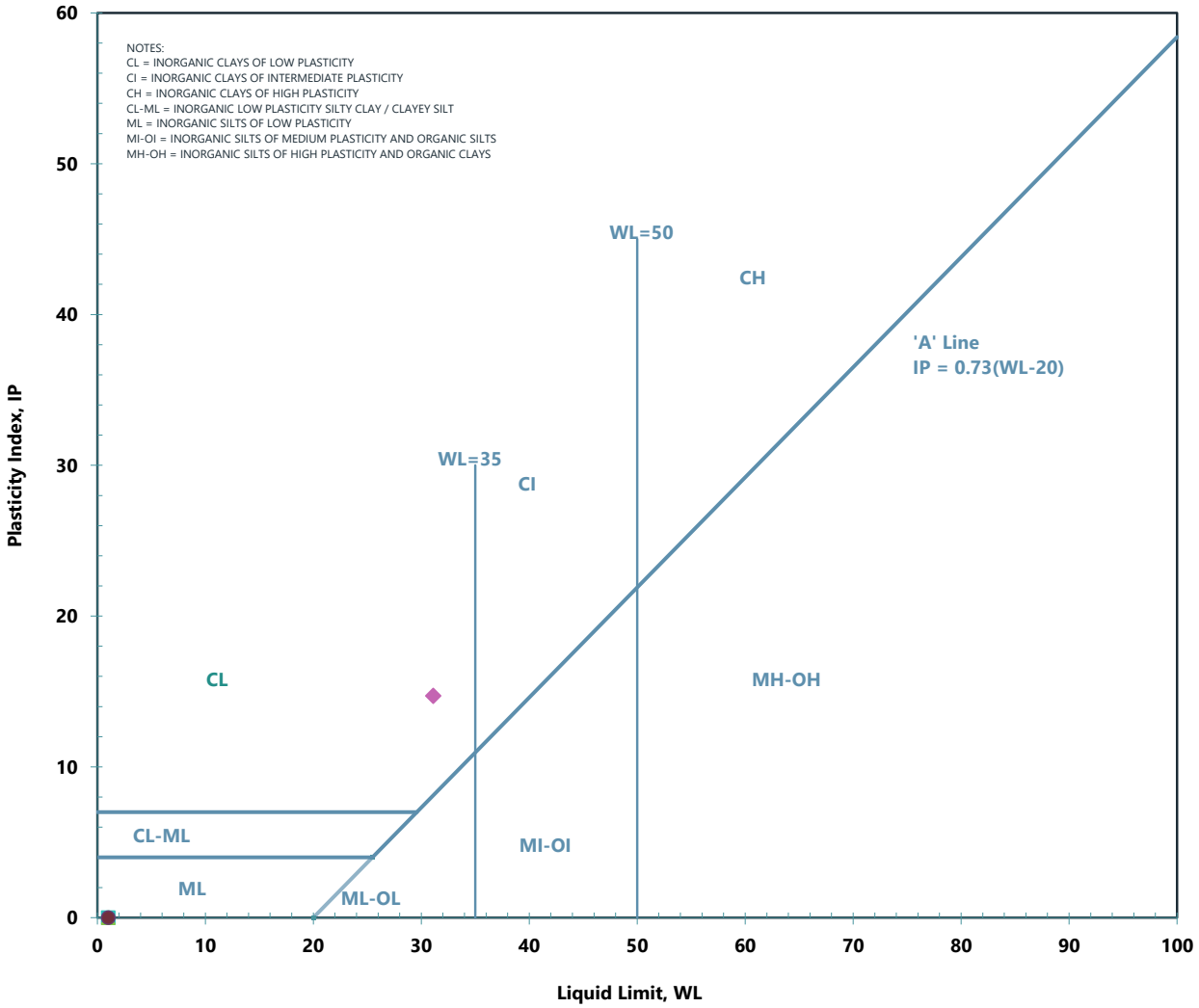


LEGEND

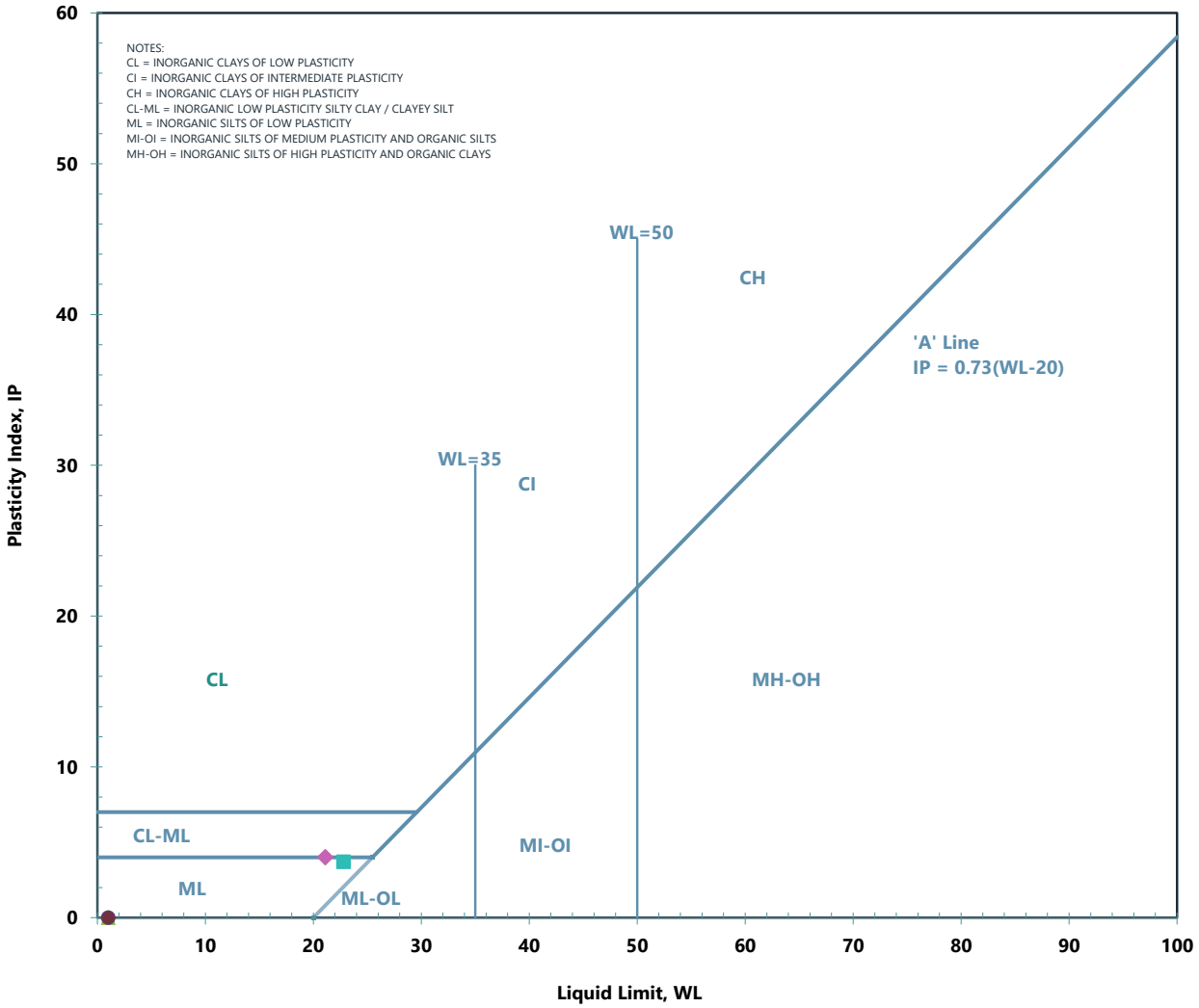
SYMBOL:	◆			
BOREHOLE/TEST PIT NUMBER:	20-35			
SAMPLE NUMBER:	SS(5&6)			
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	31			
PLASTIC LIMIT:	16			
PLASTICITY INDEX:	15			

Wood Environment & Infrastructure Solutions
1373 Confederation St, Unit 1, Sarnia, Ontario
Canada, N7S5P1
PH: (519) 337-5409, FX: (519) 337-2514
www.woodplc.com

Project No.:	**OGTW2010**	
Date Rec'd:	**11-Sep-20**	**Tested By: GC**
Report Date:	**21-Sep-20**	

ATTERBERG LIMITS

Prudhommes WM Upgrade Geotechnical and Hydrogeological Investigation



LEGEND

SYMBOL:	◆	■		
BOREHOLE/TEST PIT NUMBER:	20-37B	20-41		
SAMPLE NUMBER:	SS(3&4)	SS(2&3)		
GEODETIC ELEVATION (m):				
LIQUID LIMIT:	21	23		
PLASTIC LIMIT:	17	19		
PLASTICITY INDEX:	4	4		

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Project No.:	OGTW2010	
Date Rec'd:	11-Sep-20	Tested By: GC
Report Date:	21-Sep-20	

Geotech Investigation – Prudhommes WM Rock Mechanics Testing

ASTM D7012 Method C

Project #OGTW2010

Prepared for:

Wood Environment & Infrastructure Solutions
900 Maple Grove Road, Cambridge, ON N3H 4R7

Attention: Mr. Jason Taylor, B.A.Sc.
Laboratory Manager, Cambridge Operations

Prepared by:

Wood Environment & Infrastructure Solutions
3450 Harvester Road, Suite 100
Burlington, Ontario, L7N 3W5
T: 905-335-2353

3-November-2020

1.0 Introduction

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited ("Wood") is pleased to present the results of laboratory testing conducted on rock core samples provided by Wood Environment & Infrastructure Solutions ("Wood E&IS"). The testing was conducted in Wood's rock mechanics laboratory located in Burlington, Ontario.

2.0 Methodology

Four (4) test specimens were prepared and tested from seven (7) core samples received in the Wood laboratory. Core samples were HQ drill size, nominally 63.5mm diameter. Testing was conducted in accordance with ASTM D7012, "Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures", to the best of our ability. A summary table of the test results is below as are the pre-test and post-test photographs.

3.0 Results

Test results are presented in Table 1 below. A mention of "broke" means that the failure was gradual or occurred as a staged event. The phrase "through intact rock" indicates that no portion of the main failure plane contained any pre-existing planes of weakness (veins, healed joints, bedding planes, etc.). It should be noted that sample R19730 had an inadequate solid core length to prepare a cylindrical specimen with a length to diameter ratio (L/D) of 2.00 or greater as required by ASTM D7012. It was also observed that all samples were severely desiccated upon receipt and contained multiple chips, open fractures and desiccation cracks. When introduced to water during preparation for testing, the samples immediately began to decompose. Due to this, it was not possible to prepare the specimens to conform to the dimensional tolerance requirements for straightness, perpendicularity, and planeness.

Moisture conditions of rock can have a significant impact upon measured strength, particularly for shale and similar weak sedimentary rock. As such, due the desiccated nature of the samples and effect of rehydration during sample preparation, the compressive strength data reported here should be interpreted with caution, as the sample condition is likely not representative of field conditions. Strength

may be under-or-over-stated, and quantification of this effect is not possible. Due to the considerably poor condition of this rock core, these results should not be relied upon for engineering purposes.

Table 1: Test results for UCS test samples R19729-R19732.

Laboratory ID	Borehole and Sample ID	L/D	Density (kg/m^3)	Load (kN)	Sigma 1 (MPa)	Comments
R19729	BH20-37B, Run 2 Start	2.08	2579	66.29	21.8	Broke through intact rock.
R19730	BH20-38, Run 4 Mid	1.76	2613	103.04	33.6	Broke through intact rock.
R19731	BH20-40, Run 2	2.04	2618	115.17	36.8	Broke through intact rock.
R19732	BH20-42, Run 2 End	2.02	2623	50.25	16.5	Broke through intact rock.

4.0 Disclaimer

This report has been prepared for the client named on the front of the report to be used subject to the terms and conditions of its contract with Wood. The data presented in this report has been performed based on the testing standards noted and in accordance with generally accepted rock engineering practices. Wood cannot be held responsible for any designs by others based on the data presented. Any other use of, or reliance on, this report by any third party is at that party's sole risk. No other warranty, expressed or implied, is made.

If you have any questions with regards to the results of the testing conducted, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

Wood Environment & Infrastructure Solutions,

A Division of Wood Canada Limited

Reviewed by,

Kristina Da Silva, MSc., GIT.

Project Scientist

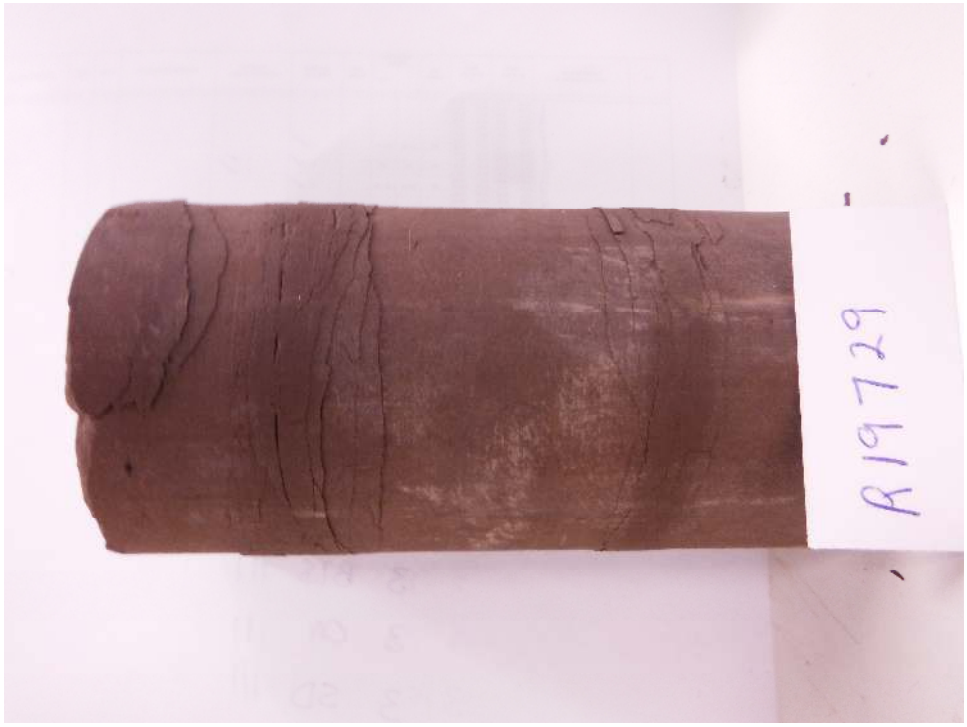
Barry Shenton

Senior Materials Technologist

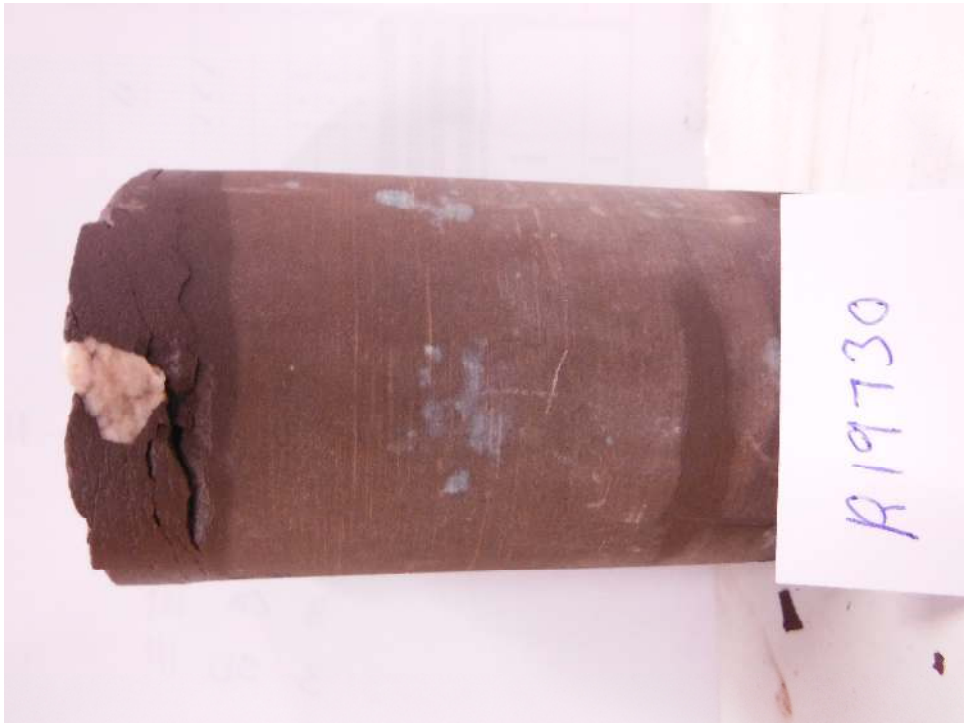
Kellen Shenton, P.Geo.

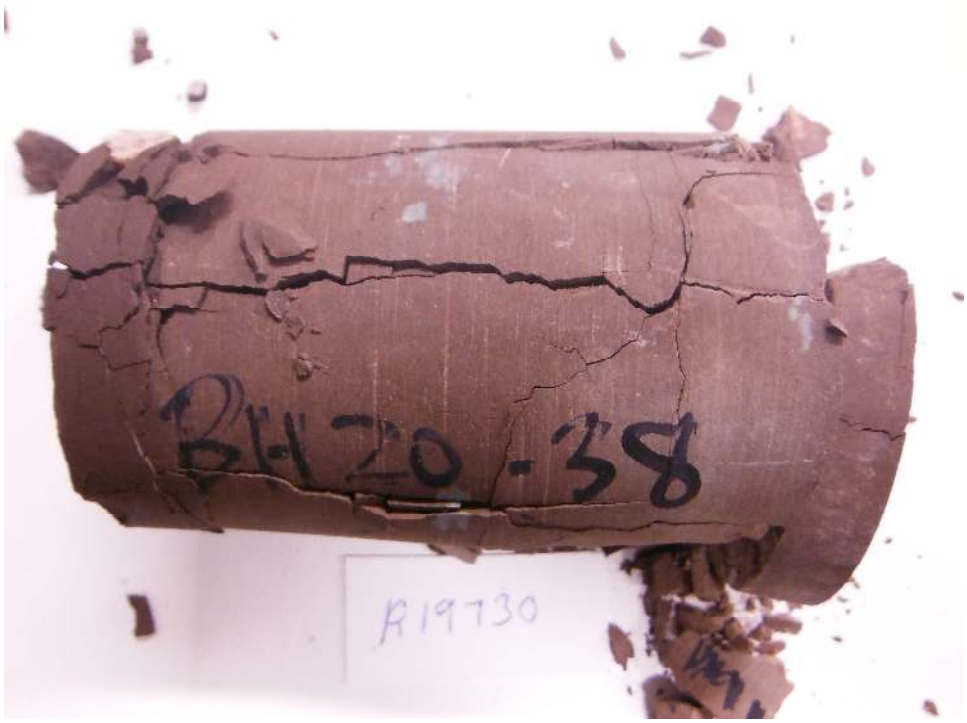
Senior Geoscientist

Client: Wood Environment & Infrastructure Solutions	Project No.: OGTW2010
Borehole: BH20-37B	Sample ID: Run 2 Start
Depth: 45'0" – 45'5"	Laboratory ID: R19729



Client: Wood Environment & Infrastructure Solutions	Project No.: OGTW2010
Borehole: BH20-38	Sample ID: Run 4 Mid
Depth: 46'6" – 46'11"	Laboratory ID: R19730





Client: Wood Environment & Infrastructure Solutions	Project No.: OGTW2010
Borehole: BH20-40	Sample ID: Run 2
Depth: 33'0" – 33'5"	Laboratory ID: R19731

Client: Wood Environment & Infrastructure Solutions	Project No.: OGTW2010
Borehole: BH20-41	Sample ID: Run 2 Start
Depth: 37'5" – 37'10"	Laboratory ID: R19732

Geotech Investigation – Prudhommes WM Rock Mechanics Testing

ASTM D4644

Project # OGTW2010

Prepared for:

Wood Environment & Infrastructure Solutions
900 Maple Grove Road, Unit 10, Cambridge, ON, N3E0A6

Attention: Mr. Owen Lutz
Engineer in Training

Prepared by:

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3450 Harvester Road,
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8-September-20

1.0 Introduction

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited ("Wood") is pleased to present the results of laboratory testing conducted on rock core samples provided by Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited ("Wood") The testing was conducted in Wood's rock mechanics laboratory located in Burlington, Ontario.

2.0 Methodology

A total of two (2) test specimens were prepared and tested from two (2) core samples received in the Wood laboratory. Testing was conducted in accordance with, ASTM D4644, "Standard Test Method for Slake Durability of Shales and Other Similar Weak Rocks".

3.0 Results

Summary tables of the test results are attached as are the pre-test and post-test photographs.

4.0 Disclaimer

This report has been prepared for the client named on the front of the report to be used subject to the terms and conditions of its contract with Wood. The data presented in this report has been performed based on the testing standards noted and in accordance with generally accepted rock engineering practices. Wood cannot be held responsible for any designs by others based on the data presented. Any other use of, or reliance on, this report by any third party is at that party's sole risk. No other warranty, expressed or implied, is made.

If you have any questions with regards to the results of the testing conducted, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

Wood Environment & Infrastructure Solutions,

A Division of Wood Canada Limited

Reviewed by,

Kristina Da Silva, MSc., GIT.

Project Scientist

Kellen Shenton, P.Geo.

Senior Geoscientist

Wood Environment Infrastructure Solutions
Rock Mechanics Laboratory
Slake Durability Index Summary

Specimen #	Borehole ID	Specimen Depth	Slake Durability Index (first cycle)	Slake Durability Index (second cycle)	Average Water Temperature (ºC)	Minimum Temperature (ºC)	Maximum Temperature (ºC)	Natural Water Content (%)	Sample Type *
R19024	20-42	25'0" - 30'0"	84.7	75.2	22.9	22.5	23.0	2.41	II

* Sample Types
Type I - Retained Specimen remains virtually unchanged.
Type II - Retained specimen consists of large and small fragments.
Type III - Retained Specimen is exclusively small fragments.

Wood Environment Infrastructure Solutions
Rock Mechanics Laboratory
Slake Durability Index Summary

Specimen #	Borehole ID	Specimen Depth	Slake Durability Index (first cycle)	Slake Durability Index (second cycle)	Average Water Temperature (ºC)	Minimum Temperature (ºC)	Maximum Temperature (ºC)	Natural Water Content (%)	Sample Type *
R19025	20-39	21'0" - 26'0"	96.8	91.8	22.9	22.5	23.0	1.55	II

* Sample Types
Type I - Retained Specimen remains virtually unchanged.
Type II - Retained specimen consists of large and small fragments.
Type III - Retained Specimen is exclusively small fragments.

`

Appendix C

Bedrock Core Photographs

wood.

Project Number: OGTW2010

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ROCK CORE PHOTOGRAPHS

BH20-37:	Run 1 (7.62m to 9.14m) & Run 2 (9.14m to 10.67m)

Description:

Run 1: Shale. Extremely weak, moderately weathered, heavily oxidized, broken rock filled with very dense glacial till. ~130mm of moderately fractured zone at 8.23m. ~290 mm of moderate to heavily fractured zone at 10.65m. TCR: 100%; RQD: 46.7%

Run 2: Shale. Strong, moderately weathered, moderately oxidized, occasional carbonatization alteration colored grey. TCR: 100%; RQD: 41.7%

BH20-37:	Run 3 (10.67m to 12.19m) & Run 4 (12.19m to 13.72m)

Description:

Run 4: Shale. Strong, slightly weathered, moderately oxidized. TCR: 100%; RQD: 55%

Run 3: Shale. Strong to very strong, slightly weathered, moderately oxidized, occasional carbonatization alteration. 100mm of possible shear zone at 10.72m TCR: 100%; RQD: 58%

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ROCK CORE PHOTOGRAPHS

BH20-37B:	Run 1 (13.41m to 13.72m) & Run 2 (13.72m to 15.24m)
Description:	**Run 1**: Shale. Very weak to weak, moderately weathered, moderately oxidized. TCR: 28%; RQD: 55% **Run 2**: Shale. Slightly, weathered, very weak to weak, moderately weathered, heavily oxidized. ~ 370mm of moderately to heavily fractured zone at 14.7m TCR: 100%; RQD: 58%

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ROCK CORE PHOTOGRAPHS

BH20-38:	Run 1 (10.97m to 11.89m), Run 2 (11.89m to 12.19m) & Run 3 (12.19m to 13.72m)

Description:

Run 1: Shale. Weak, heavily weathered, heavily to moderately oxidized, heavily fracture with silt infilling. ~200mm of moderately to heavily fractured zone at 11m. TCR: 28%; RQD: 0%

Run 2: Shale. Heavily weathered, weak, moderately oxidized, moderately fractured with silt infilling. TCR: 32.5%; RQD: 20.5%

Run 3: Shale. Reddish brown, fine grained, heavily weathered, weak, heavily to moderately oxidized. TCR: 100%; RQD: 29%

BH20-38:	Run 4 (13.72m to 15.24m)

Description:

Run 4: Shale. Slightly weathered, weak, slightly oxidized, occasional carbonatization alteration.
~ 200mm of slightly fractured zone at 14.75m TCR: 97.7%; RQD: 43.3%

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ROCK CORE PHOTOGRAPHS

BH20-39:	Run 1 (6.10m to 6.40m), Run 2 (6.40m to 7.92m) & Run 3 (6.40m to 8.94m)

Description:

Run 1: Shale. Highly weathered, very weak to weak, heavily oxidized. Highly fractured. TCR: 83.3%; RQD: 0%
Run 2: Shale. Moderately weathered, moderately oxidized, occasional carbonatization alterations. Moderately fractured zone at ~6.40m-7.20m. TCR: 100%; RQD: 15%

BH20-39:	Run 3 Continued (8.94m to 9.45m) & Run 4 (9.45m to 10.97m)

Description:

Run 3: Shale. Slightly weathered, slightly oxidized, carbonatization alteration. Lightly fractured. TCR: 90%; RQD: 24%
Run 4: Shale. Slightly weathered, slightly oxidized. TCR: 93%; RQD: 53.6%

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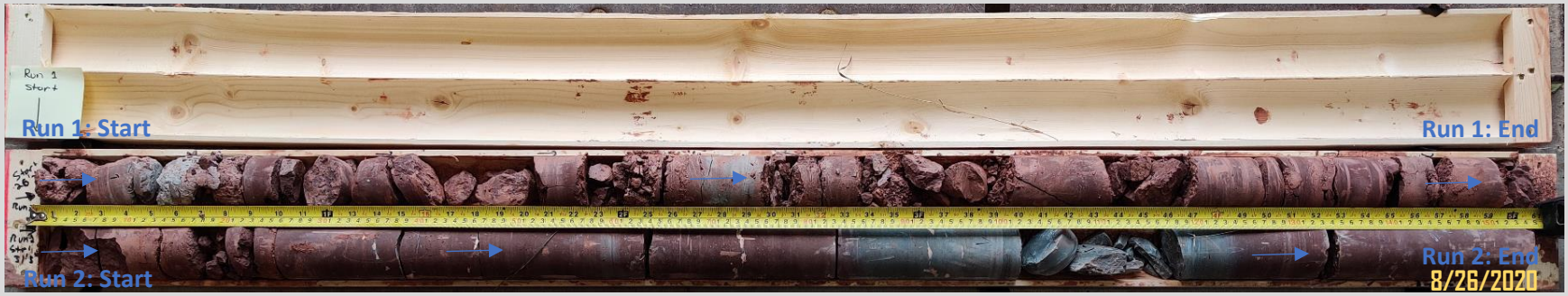
ROCK CORE PHOTOGRAPHS

BH20-40:	Run 1 (8.00m to 9.53m) & Run 2 (9.53m to 11.05m)
	
Description:	**Run 1**: Shale. Moderately weathered, moderately oxidized, occasional carbonatization alteration. TCR: 92.5%; RQD: 21.7% **Run 2**: Shale. Slightly weathered, slightly oxidized, carbonatization alteration at ~10.38m. TCR: 95%; RQD: 65%

BH20-40:	Run 3 (11.05m to 12.57m)
Description:	**Run 3**: Shale. Slightly weathered, slightly oxidized, occasional carbonatization alteration. ~110mm Lightly fractured zone at 11.30m TCR: 100%; RQD: 68.3%

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ROCK CORE PHOTOGRAPHS

BH20-41:	Run 1 (10.67m to 11.24m), Run 2 (11.24m to 12.6m) & Run 3 (12.6m to 13.74m)

Description:	**Run 1**: Shale. Moderately weathered, lightly oxidized. Moderately fractured. TCR: 71.4%; RQD: 0% **Run 2**: Shale. Moderately weathered, moderately oxidized. ~75mm heavily fractured zone at ~11.67m. TCR: 93.5%; RQD: 20.7%

BH20-41:	Run 3 Continued (13.74m to 14.12m) & Run 4 (14.12m to 15.65m)

Description:	**Run 3**: Shale. Lightly weathered, lightly oxidized. occasional carbonatization alteration. TCR: 100%; RQD: 66.7% **Run 4**: Shale. Lightly weathered, lightly oxidized. occasional carbonatization alteration. TCR: 100%; RQD: 57.5%

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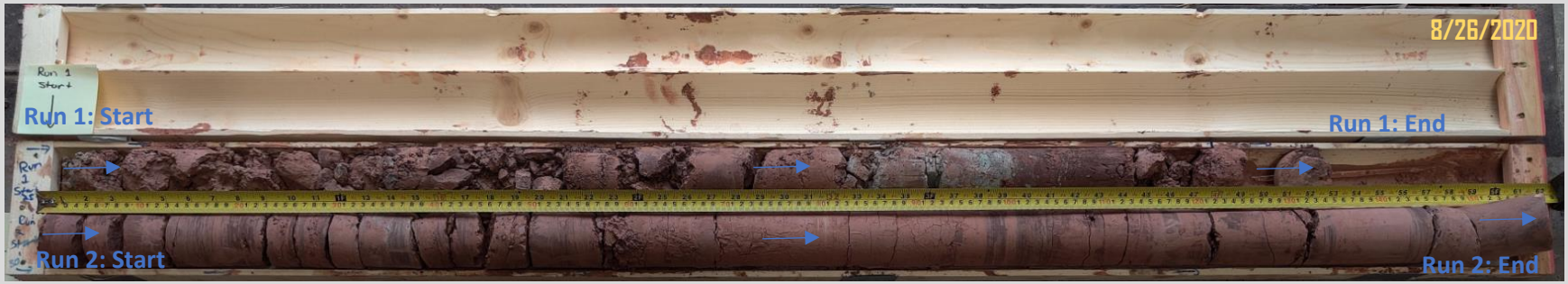
ROCK CORE PHOTOGRAPHS

BH20-42:	Run 1 (7.62m to 9.14m) & Run 2 (9.14m to 10.62m)



Description:	**Run 1**: Shale. Moderately weathered, moderately oxidized, very weak. Heavily fractured 7.62m-8.22m. TCR: 78.3%; RQD: 17% **Run 2**: Shale. Slightly weathered, moderately oxidized, weak. TCR: 78.3%; RQD: 58.6%

BH20-42:	Run 3 (10.62m to 12.14m) & Run 4 (12.14m to 13.67m)

Description:	**Run 3**: Shale. Moderately weathered, slightly oxidized, medium strong to strong. Carbonatization alteration. TCR: 100%; RQD: 68.3% **Run 4**: Shale. Moderately weathered, slightly oxidized medium strong. TCR: 100%; RQD: 51.7%

`

Appendix D

Photographs and Evaluation of Existing Pavement Surface

PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, Jordan Road, From: STA: 2+900 to 3+100

PHOTOGRAPH:	1
Condition: Poor	

Picture Near South Service Rd. Intersection:
Raveling and C. Agg. Loss - Moderate/Throughout
Flushing - Very Slight/Extensive
Longitudinal Wheel Track Cracking (Alligator)– Moderate/Frequent
Centerline Cracking (Single & Multiple) – Moderate/Throughout
Pavement Edge Cracking (Single & Multiple) - Moderate/Intermittent
Transverse Cracking (Alligator) - Slight/Frequent

PHOTOGRAPH:	2
Condition: Poor	

Picture Between South Service Rd. and QEW Bridge:
Raveling and C. Agg. Loss - Moderate/Throughout
Flushing - Very Slight/Extensive
Longitudinal Wheel Track Cracking (Alligator)– Moderate/Frequent
Centerline Cracking (Single & Multiple) – Moderate/Throughout
Pavement Edge Cracking (Single & Multiple) - Moderate/Intermittent
Transverse Cracking (Alligator) - Slight/Frequent

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, Jordan Road, From: STA 3+100 to 3+300

PHOTOGRAPH:	3
Condition: Fair to Poor	

Picture Between QEW Bridge & North Service Rd.:
Raveling and C. Agg. Loss - Slight/Extensive
Flushing - Very Slight/Intermittent
Wheel Track Rutting – Slight/Frequent
Distortion – Slight/Few
Longitudinal Wheel Track Cracking (Alligator) – Slight/Extensive
Centerline Cracking (Single and Multiple) – Slight/Extensive
Pavement Edge Cracking (Single & Multiple) - Moderate/Intermittent
Transverse Cracking (Single, Full & Multiple) - Moderate/Intermittent

PHOTOGRAPH:	4
Condition: Fairly Good	

Picture Between Near North Service Rd. Intersection:
Raveling and C. Agg. Loss - Slight/Extensive
Flushing - Very Slight/Intermittent
Wheel Track Rutting – Slight/Frequent
Distortion – Slight/Few
Longitudinal Wheel Track Cracking (Alligator) – Slight/Extensive
Centerline Cracking (Single and Multiple) – Slight/Extensive
Pavement Edge Cracking (Single & Multiple) - Moderate/Intermittent
Transverse Cracking (Single, Full & Multiple) - Moderate/Intermittent

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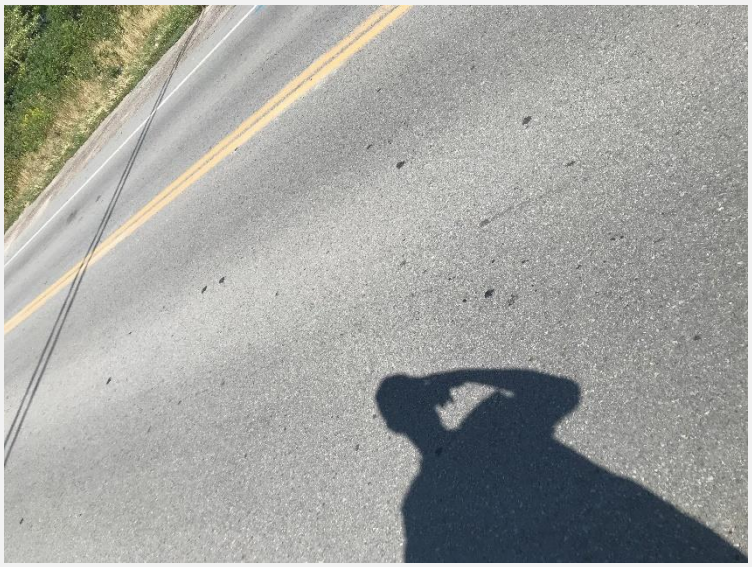
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 3+300 to 3+500



PHOTOGRAPH:	5
Condition: Good	

Picture Near North Service Rd. & Jordan Rd. Intersection:
Raveling and C. Agg. Loss - Slight/Frequent
Wheel Track Rutting - Very Slight/Frequent
Flushing - Slight/Few

PHOTOGRAPH:	6
Condition: Good	

Picture North Service Rd. & QEW Toronto Ramp:
Raveling and C. Agg. Loss - Slight/Frequent
Wheel Track Rutting - Very Slight/Frequent
Flushing - Slight/Few

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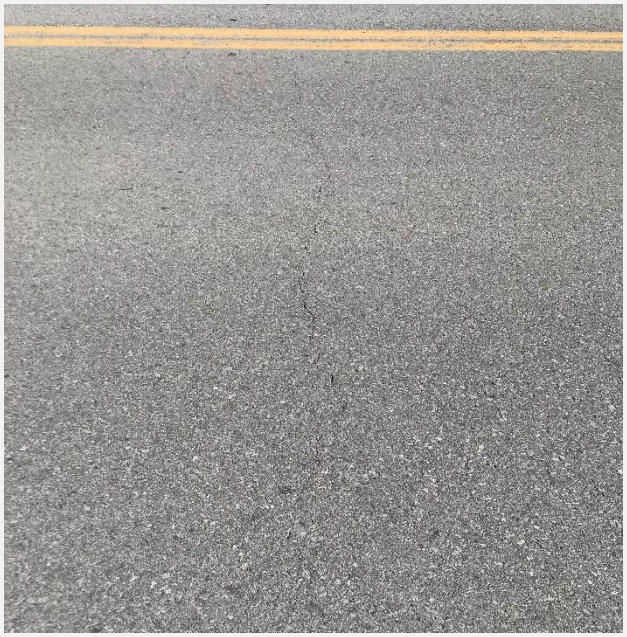
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln Ontario
LOCATION: Both Traffic Directions, North Service Road, From: STA: 3+500 to 3+700



PHOTOGRAPH:	7
Condition: Good	

Raveling and C. Agg. Loss - Very Slight/Extensive
Center Line Cracking (Single and Multiple) - Slight/Extensive
Transverse Cracking (Half and Multiple) - Slight/Intermittent

PHOTOGRAPH:	8
Condition: Good	

Raveling and C. Agg. Loss - Very Slight/Extensive
Center Line Cracking (Single and Multiple) - Slight/Extensive
Transverse Cracking (Half and Multiple) - Slight/Intermittent

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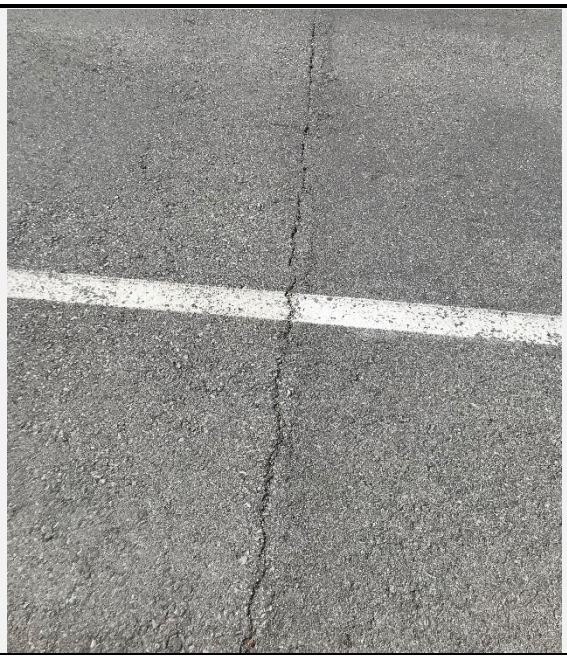
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 3+700 to 3+900



PHOTOGRAPH:	9
Condition: Good	

Picture Near Ramada Inn:
Raveling and C. Agg. Loss - Very Slight/Extensive
Wheel Track Rutting – Very Slight/Intermittent
Centerline Cracking (Single and Multiple) - Slight/Intermittent
Transverse Cracking (Half and Multiple) - Moderate/Few

PHOTOGRAPH:	10
Condition: Good	

Picture Near Ramada Inn:
Raveling and C. Agg. Loss - Very Slight/Extensive
Wheel Track Rutting – Very Slight/Intermittent
Centerline Cracking (Single and Multiple) - Slight/Intermittent
Transverse Cracking (Half and Multiple) - Moderate/Few

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 3+900 to 4+100

PHOTOGRAPH:	11
Condition: Good	
Raveling and C. Agg. Loss - Slight/Extensive Flushing – Moderate/Few	

PHOTOGRAPH:	12
Condition: Excellent	
Raveling and C. Agg. Loss - Slight/Extensive Flushing – Moderate/Few	

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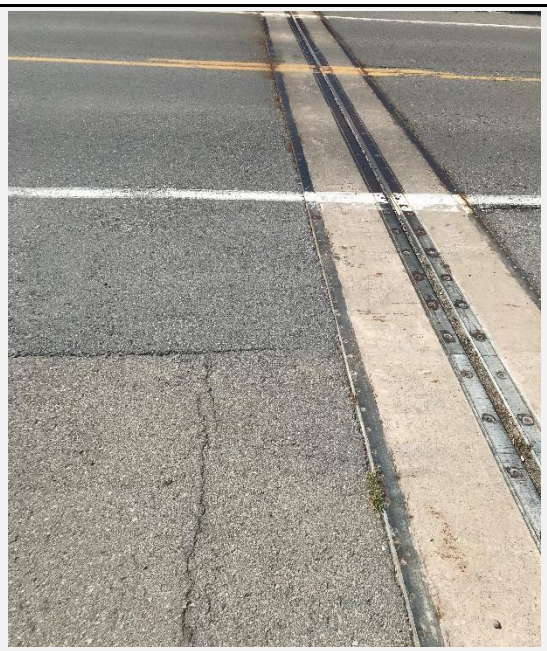
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From: 4+100, To: 4+300

PHOTOGRAPH:	13
Condition: Good	

Raveling and C. Agg. Loss - Slight/Extensive
Wheel Track Rutting - Very Slight/Extensive
Pavement Edge Cracking (Single and Multiple) - Moderate/Few
Centerline Cracking (Single & Multiple) - Moderate/Few



PHOTOGRAPH:	14
Condition: Good	

Raveling and C. Agg. Loss - Slight/Extensive
Wheel Track Rutting - Very Slight/Extensive
Pavement Edge Cracking (Single and Multiple) - Moderate/Few
Centerline Cracking (Single & Multiple) - Moderate/Few

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 4+300 to 4+500

PHOTOGRAPH:	15
Condition: Fair	

Raveling and C. Agg. Loss - Slight/Extensive
Center Line Cracking (Single & Multiple) – Moderate/Extensive
Pavement Edge Cracking (Single and Multiple) - Moderate/Extensive
Transverse Cracking (Half, Full and Multiple) - Slight/Few

PHOTOGRAPH:	16
Condition: Fair	

Raveling and C. Agg. Loss - Slight/Extensive
Center Line Cracking (Single & Multiple) – Moderate/Extensive
Pavement Edge Cracking (Single and Multiple) - Moderate/Extensive
Transverse Cracking (Half, Full and Multiple) - Slight/Few

900 Maple Grove Road, Unit 10
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Tel: 519-650-7100
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PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 4+500 to 4+700

PHOTOGRAPH:	17
Condition: Fair	

Raveling and C. Agg. Loss - Slight/Frequent
Pavement Edge Cracking (Single and Multiple) - Slight/Extensive
Main distress found in shoulder as shown

PHOTOGRAPH:	18
Condition: Good	

Raveling and C. Agg. Loss - Slight/Frequent
Pavement Edge Cracking (Single and Multiple) - Slight/Extensive

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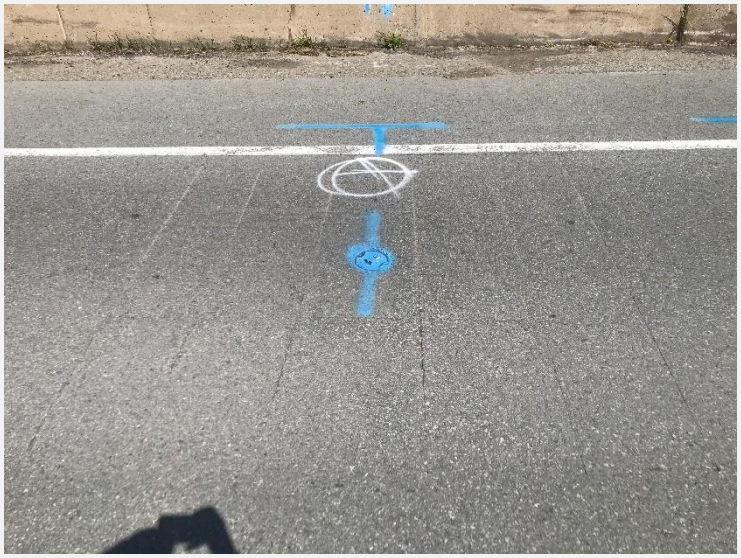
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 4+700 to 4+900

PHOTOGRAPH:	19
Condition: Poor to Fair	

Raveling and C. Agg. Loss - Very Slight/Frequent
Transverse Cracking (Half and Multiple) - Very Slight/Few
Main Distress noticed in the should as shown.



PHOTOGRAPH:	20
Condition: Fair	

Raveling and C. Agg. Loss - Very Slight/Frequent
Transverse Cracking (Half and Multiple) - Very Slight/Few
Multiple saw cuts around water valve.

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 4+900 to 5+100

PHOTOGRAPH:	21
Condition: Good	

Picture Near Lake House Restaurant:
Raveling and C. Agg. Loss - Very Slight/Extensive
Flushing - Very Slight/Frequent

PHOTOGRAPH:	22
Condition: Fair to Good	

Raveling and C. Agg. Loss - Very Slight/Extensive
Flushing - Very Slight/Frequent
Shoulder indent as seen in photo.

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 5+100 to: 5+300

PHOTOGRAPH:	23
Condition: Good	

Raveling and C. Agg. Loss - Very Slight/Extensive
Flushing - Very Slight/Few
Transverse Cracking (Half and Multiple) - Slight/Few

PHOTOGRAPH:	24
Condition: Good	

Raveling and C. Agg. Loss - Very Slight/Extensive
Flushing - Very Slight/Few
Transverse Cracking (Half and Multiple) - Slight/Few

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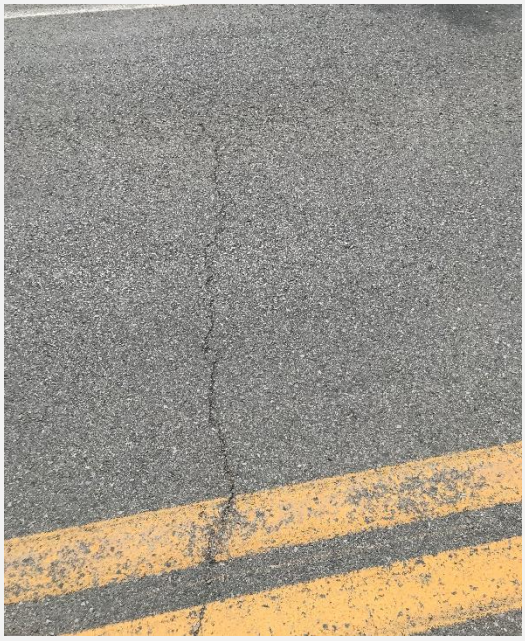
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA 5+300 to 5+500

PHOTOGRAPH:	25
Condition: Good	

Raveling and C. Agg. Loss - Slight/Throughout
Longitudinal Wheel Track Cracking (Single and Multiple) - Slight/Few
Transverse Cracking (Half and Multiple) - Slight/Few



PHOTOGRAPH:	26
Condition: Fair to Good	

Raveling and C. Agg. Loss - Slight/Throughout
Longitudinal Wheel Track Cracking (Single and Multiple) - Slight/Few
Transverse Cracking (Half and Multiple) - Slight/Few

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 5+500 to 5+700

PHOTOGRAPH:	27
Condition: Good	

Raveling and C. Agg. Loss - Very Slight/Frequent
Rippling & Shoving - Very Slight/Frequent
Transverse Cracking (Half and Multiple) - Slight/Few

PHOTOGRAPH:	28
Condition: Fair to Good	

Picture Near Tim Hortons & Subway:
Raveling and C. Agg. Loss - Very Slight/Frequent
Rippling & Shoving - Very Slight/Frequent
Transverse Cracking (Half and Multiple) - Slight/Few

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 5+700 to 5+900

PHOTOGRAPH:	29
Condition: Fair	
Raveling and C. Agg. Loss - Slight/Extensive Transverse Cracking (Half and Multiple) - Slight/Intermittent	

PHOTOGRAPH:	30
Condition: Fair	
Raveling and C. Agg. Loss - Slight/Extensive Transverse Cracking (Half and Multiple) - Slight/Intermittent	

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PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, North Service Road, From STA: 5+900 to 6+150

PHOTOGRAPH:	31
Condition: Fair to Poor	

Picture Near QEW Toronto on & off Ramp:
Raveling and C. Agg. Loss - Moderate/Frequent
Longitudinal Wheel Track Cracking (Alligator) - Moderate/Frequent
Centerline Cracking – Severe/ Frequent
Pavement Edge Cracking (Alligator) - Moderate/Frequent
Transverse Cracking (Half Full & Multiple) - Severe/Frequent

PHOTOGRAPH:	32
Condition: Fair to Poor	

Raveling and C. Agg. Loss - Moderate/Frequent
Longitudinal Wheel Track Cracking (Alligator) - Moderate/Frequent
Centerline Cracking – Severe/ Frequent
Pavement Edge Cracking (Alligator) - Moderate/Frequent
Transverse Cracking (Half Full & Multiple) - Severe/Frequent

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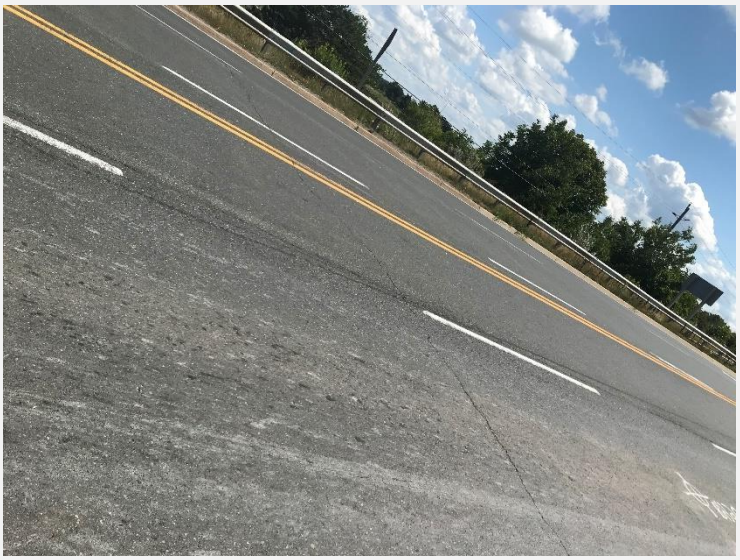
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, Victoria Avenue, From STA: 6+150 to 6+350

PHOTOGRAPH:	33
Condition: Fair	

Raveling and C. Agg. Loss - Slight/Extensive
Wheel Track Rutting - Very Slight/Frequent
Longitudinal Wheel Track Cracking (Single & Multiple) – Slight/Frequent
Center Line Cracking (Single & Multiple) – Slight/Extensive
Pavement Edge Cracking (Single and Multiple) - Slight/Intermittent
Transverse Cracking (Half and Multiple) - Slight/Extensive



PHOTOGRAPH:	34
Condition: Fair to Good	

Raveling and C. Agg. Loss - Slight/Extensive
Wheel Track Rutting - Very Slight/Frequent
Longitudinal Wheel Track Cracking (Single & Multiple) – Slight/Frequent
Center Line Cracking (Single & Multiple) – Slight/Extensive
Pavement Edge Cracking (Single and Multiple) - Slight/Intermittent
Transverse Cracking (Half and Multiple) - Slight/Extensive

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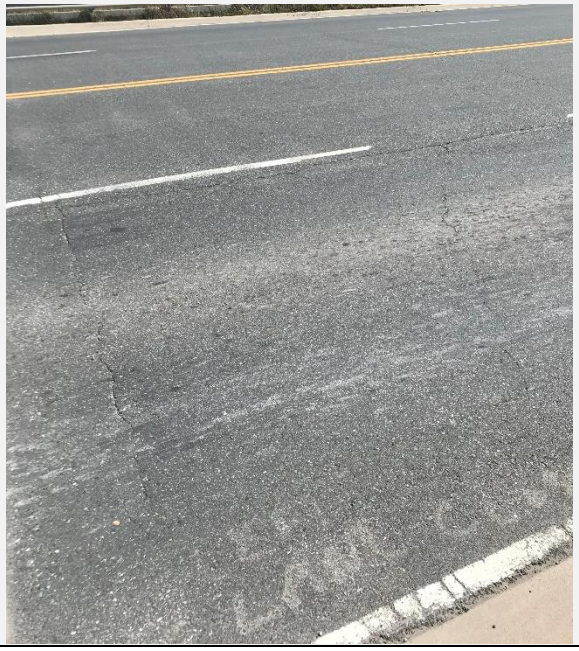
PAVEMENT PHOTO RECORDS
Project Number: OGTW2010

PROJECT: Pavement Condition Evaluation, Prudhommes Water Main Upgrade, Lincoln, Ontario
LOCATION: Both Traffic Directions, Victoria Avenue, From: STA: 6+350 to 6+550



PHOTOGRAPH:	35
Condition: Fair to Good	

Raveling and C. Agg. Loss - Very Slight/Frequent
Wheel Track Rutting - Very Slight/Intermittent
Longitudinal Wheel Track Cracking (Single & Multiple) – Very Slight/Intermittent
Centerline Cracking (Single & Multiple) – Slight/Frequent
Transverse Cracking (Alligator) - Very Slight/Intermittent

PHOTOGRAPH:	36
Condition: Fair to Good	

Raveling and C. Agg. Loss - Very Slight/Frequent
Wheel Track Rutting - Very Slight/Intermittent
Longitudinal Wheel Track Cracking (Single & Multiple) – Very Slight/Intermittent
Centerline Cracking (Single & Multiple) – Slight/Frequent
Transverse Cracking (Alligator) - Very Slight/Intermittent

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Appendix E

Environmental Laboratory Certificates of Analysis

Analytical Soil Laboratory Results

Corrosivity Analysis

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON NH3 4R7

Date Received: 24-JUL-20
Report Date: 04-AUG-20 09:07 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2479497

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers: 17-795002
Legal Site Desc:

Aaron Payne
Account Manager

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Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2479497-1 BH20-15 SS7 Sampled By: CLIENT on 13-JUL-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.262		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7	
% Moisture	17.0		0.25	%	29-JUL-20				
pH	7.80		0.10	pH units	30-JUL-20				
Redox Potential	220		-1000	mV	28-JUL-20				
Resistivity	3820		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	46.0		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	73		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	27-JUL-20				
L2479497-2 BH20-14 SS6 Sampled By: CLIENT on 13-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.714		0.0040	mS/cm	29-JUL-20	*0.57	1.4	*0.7	
% Moisture	15.9		0.25	%	29-JUL-20				
pH	7.75		0.10	pH units	30-JUL-20				
Redox Potential	219		-1000	mV	28-JUL-20				
Resistivity	1400		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	256		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	227		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	27-JUL-20				
L2479497-3 BH20-13 SS7 Sampled By: CLIENT on 14-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.910		0.0040	mS/cm	29-JUL-20	*0.57	1.4	*0.7	
% Moisture	14.6		0.25	%	28-JUL-20				
pH	7.82		0.10	pH units	30-JUL-20				
Redox Potential	228		-1000	mV	28-JUL-20				
Resistivity	1100		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	373		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	269		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	27-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2479497-4 BH20-16 SS8 Sampled By: CLIENT on 14-JUL-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.315		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7	
% Moisture	14.7		0.25	%	28-JUL-20				
pH	7.78		0.10	pH units	30-JUL-20				
Redox Potential	186		-1000	mV	28-JUL-20				
Resistivity	3170		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	5.9		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	114		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	27-JUL-20				
L2479497-5 BH20-17 SS7 Sampled By: CLIENT on 14-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	1.01		0.0040	mS/cm	29-JUL-20	*0.57	1.4	*0.7	
% Moisture	16.8		0.25	%	28-JUL-20				
pH	7.40		0.10	pH units	30-JUL-20				
Redox Potential	214		-1000	mV	28-JUL-20				
Resistivity	991		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	235		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	488		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	134	DLHC	20	mg/kg	27-JUL-20				
L2479497-6 BH20-18 SS6 Sampled By: CLIENT on 15-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.641		0.0040	mS/cm	29-JUL-20	*0.57	1.4	0.7	
% Moisture	14.6		0.25	%	29-JUL-20				
pH	7.69		0.10	pH units	30-JUL-20				
Redox Potential	238		-1000	mV	28-JUL-20				
Resistivity	1560		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	219		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	289		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2479497-7 BH20-20 SS6 Sampled By: CLIENT on 15-JUL-20 @ 13:00 Matrix: SOIL								
Physical Tests								
Conductivity	0.773		0.0040	mS/cm	29-JUL-20	*0.57	1.4	*0.7
% Moisture	16.0		0.25	%	29-JUL-20			
pH	7.66		0.10	pH units	30-JUL-20			
Redox Potential	237		-1000	mV	28-JUL-20			
Resistivity	1290		1.0	ohm*cm	29-JUL-20			
Leachable Anions & Nutrients								
Chloride	231		5.0	ug/g	29-JUL-20			
Anions and Nutrients								
Sulphate	340		20	mg/kg	29-JUL-20			
Inorganic Parameters								
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20			
L2479497-8 BH20-19 SS7 Sampled By: CLIENT on 16-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	0.210		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7
% Moisture	10.7		0.25	%	30-JUL-20			
pH	7.82		0.10	pH units	30-JUL-20			
Redox Potential	248		-1000	mV	28-JUL-20			
Resistivity	4760		1.0	ohm*cm	29-JUL-20			
Leachable Anions & Nutrients								
Chloride	57.9		5.0	ug/g	29-JUL-20			
Anions and Nutrients								
Sulphate	51		20	mg/kg	29-JUL-20			
Inorganic Parameters								
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20			
L2479497-9 BH20-22 SS6 Sampled By: CLIENT on 17-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	0.467		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7
% Moisture	17.1		0.25	%	30-JUL-20			
pH	8.00		0.10	pH units	30-JUL-20			
Redox Potential	194		-1000	mV	29-JUL-20			
Resistivity	2140		1.0	ohm*cm	29-JUL-20			
Leachable Anions & Nutrients								
Chloride	127		5.0	ug/g	29-JUL-20			
Anions and Nutrients								
Sulphate	128		20	mg/kg	29-JUL-20			
Inorganic Parameters								
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20			

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
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Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2479497-10 BH20-23 SS7 Sampled By: CLIENT on 17-JUL-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.285		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7	
% Moisture	18.7		0.25	%	30-JUL-20				
pH	8.14		0.10	pH units	30-JUL-20				
Redox Potential	153		-1000	mV	29-JUL-20				
Resistivity	3510		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	49.5		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	49		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20				
L2479497-11 BH20-24 SS6 Sampled By: CLIENT on 17-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.359		0.0040	mS/cm	29-JUL-20	0.57	1.4	0.7	
% Moisture	16.0		0.25	%	30-JUL-20				
pH	7.96		0.10	pH units	30-JUL-20				
Redox Potential	174		-1000	mV	29-JUL-20				
Resistivity	2790		1.0	ohm*cm	29-JUL-20				
Leachable Anions & Nutrients									
Chloride	104		5.0	ug/g	29-JUL-20				
Anions and Nutrients									
Sulphate	75		20	mg/kg	29-JUL-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	28-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

17-795002

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2479497 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7

Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R5172206								
WG3372389-3 CRM		**AN-CRM-WT**						
Chloride			93.0		%		70-130	29-JUL-20
WG3372389-4 DUP		**L2478970-2**						
Chloride		<5.0	<5.0	RPD-NA	ug/g	N/A	30	29-JUL-20
WG3372389-2 LCS								
Chloride			101.4		%		80-120	29-JUL-20
WG3372389-1 MB								
Chloride			<5.0		ug/g		5	29-JUL-20
EC-WT	**Soil**							
Batch R5170997								
WG3371967-4 DUP		**WG3371967-3**						
Conductivity		0.198	0.195		mS/cm	1.3	20	29-JUL-20
WG3371967-2 IRM		**WT SAR4**						
Conductivity			105.8		%		70-130	29-JUL-20
WG3372705-1 LCS								
Conductivity			100.6		%		90-110	29-JUL-20
WG3371967-1 MB								
Conductivity			<0.0040		mS/cm		0.004	29-JUL-20
Batch R5171703								
WG3372390-4 DUP		**L2478970-2**						
Conductivity		0.135	0.132		mS/cm	2.3	20	29-JUL-20
WG3372390-2 IRM		**WT SAR4**						
Conductivity			101.2		%		70-130	29-JUL-20
WG3372713-1 LCS								
Conductivity			100.9		%		90-110	29-JUL-20
WG3372390-1 MB								
Conductivity			<0.0040		mS/cm		0.004	29-JUL-20
MOISTURE-WT	**Soil**							
Batch R5167819								
WG3370821-3 DUP		**L2478328-6**						
% Moisture		9.79	9.87		%	0.9	20	28-JUL-20
WG3370821-2 LCS								
% Moisture			100.9		%		90-110	28-JUL-20
WG3370821-1 MB								
% Moisture			<0.25		%		0.25	28-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5167829								
WG3370828-3 DUP		**L2477684-1**						
% Moisture		80.5	80.7		%	0.3	20	28-JUL-20
WG3370828-2 LCS								
% Moisture			99.7		%		90-110	28-JUL-20
WG3370828-1 MB								
% Moisture			<0.25		%		0.25	28-JUL-20
Batch R5170097								
WG3371582-3 DUP		**L2478919-4**						
% Moisture		10.8	11.5		%	5.7	20	29-JUL-20
WG3371582-2 LCS								
% Moisture			100.6		%		90-110	29-JUL-20
WG3371582-1 MB								
% Moisture			<0.25		%		0.25	29-JUL-20
Batch R5171714								
WG3372642-3 DUP		**L2479616-1**						
% Moisture		14.1	14.8		%	4.5	20	30-JUL-20
WG3372642-2 LCS								
% Moisture			100.4		%		90-110	30-JUL-20
WG3372642-1 MB								
% Moisture			<0.25		%		0.25	30-JUL-20
Batch R5171735								
WG3372447-3 DUP		**L2479399-9**						
% Moisture		10.6	10.7		%	1.0	20	30-JUL-20
WG3372447-2 LCS								
% Moisture			99.9		%		90-110	30-JUL-20
WG3372447-1 MB								
% Moisture			<0.25		%		0.25	30-JUL-20
PH-WT	**Soil**							
Batch R5172349								
WG3372418-1 DUP		**L2479497-1**						
pH		7.80	7.81	J	pH units	0.01	0.3	30-JUL-20
WG3373546-1 LCS								
pH			6.97		pH units		6.9-7.1	30-JUL-20
REDOX-POTENTIAL-WT	**Soil**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	**Soil**							
Batch R5169257								
WG3371708-1 CRM		**WT-REDOX**						
Redox Potential			101.5		%		80-120	28-JUL-20
WG3371463-1 DUP		**L2477822-1**						
Redox Potential		261	262		mV	0.4	25	28-JUL-20
Batch R5171711								
WG3372639-1 CRM		**WT-REDOX**						
Redox Potential			101.1		%		80-120	29-JUL-20
WG3372365-2 DUP		**L2479497-9**						
Redox Potential		194	186		mV	4.2	25	29-JUL-20
SO4-WT	**Soil**							
Batch R5172206								
WG3372455-9 CRM		**AN-CRM-WT**						
Sulphate			99.6		%		60-140	29-JUL-20
WG3372455-8 DUP		**L2476661-7**						
Sulphate		25	25		mg/kg	3.0	30	29-JUL-20
WG3372455-7 LCS								
Sulphate			102.2		%		80-120	29-JUL-20
WG3372455-6 MB								
Sulphate			<20		mg/kg		20	29-JUL-20
SULPHIDE-WT	**Soil**							
Batch R5167652								
WG3370843-3 DUP		**L2479345-1**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	27-JUL-20
WG3370843-2 LCS								
Acid Volatile Sulphides			102.0		%		70-130	27-JUL-20
WG3370843-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	27-JUL-20
Batch R5168376								
WG3371601-3 DUP		**L2480152-2**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	28-JUL-20
WG3371601-2 LCS								
Acid Volatile Sulphides			99.3		%		70-130	28-JUL-20
WG3371601-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	28-JUL-20

Quality Control Report

Workorder: L2479497 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2479497 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: HERMAN PADHAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
% Moisture							
	1	13-JUL-20 13:00	29-JUL-20 08:20	14	16	days	EHT
	2	13-JUL-20 13:00	29-JUL-20 08:21	14	16	days	EHT

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2479497 were received on 24-JUL-20 15:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2479497-COFC

COC Number: 17 - 795002

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	Wood	Select Report Format:	PDF EXCEL EDD (DIGITAL)	Regular [R]	Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Herman Pardhan	Quality Control (QC) Report with Report	YES NO	PRIORITY (Business Days): 4 day [P4-20%]	EMERGENCY: 1 Business day [E - 100%]
Phone:	519-504 6386	Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%]	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]
	Company address below will appear on the final report	Select Distribution:	EMAIL MAIL FAX	2 day [P2-50%]	
Street:	900 Maple Grove RD	Email 1 or Fax	Vishu.Vasisht@woodplc.com	Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm
City/Province:	Cambridge ON	Email 2	Herman.Pardhan@woodplc.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	N3H 4R7	Email 3	Owen.Lutz@woodplc.com		

Invoice To		Invoice Distribution	
	Same as Report To YES NO	Select Invoice Distribution:	EMAIL MAIL FAX
	Copy of Invoice with Report YES NO	Email 1 or Fax	SAME AS ABOVE
Company:	Wood	Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	OGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2479497 | ALS Contact: AP | Sampler: OL

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Inorganics	TCLP-Base	TCLP-VOC	PCBs	EC/NT/Flammability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-15 SS7	13-7-2020	13:00	SOIL	1	✓							
	BH 20-14 SS6	13-7-2020			1	✓							
	BH 20-13 SS7	14-7-2020			1	✓							
	BH 20-16 SS8	14-7-2020			1	✓							
	BH 20-17 SS7	14-7-2020			1	✓							
	BH 20-18 SS6	15-7-2020			1	✓							
	BH 20-20 SS6	15-7-2020			1	✓							
	BH 20-A SS7	16-7-2020			1	✓							
	BH 20-22 SS6	16-7-2020			1	✓							
	BH 20-23 SS7	07-07-2020			1	✓							
	BH 20-24 SS6	07-07-2020			1	✓							
	BH 20-14 TCLP	13-7-2020			6		✓	✓	✓	✓	✓		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? YES NO	Table 1, 3, 9 ICC Comm.
Are samples for human consumption/ use? YES NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☑ No ☐

Ice Packs ☑ Ice Cubes ☐ | Custody seal intact Yes ☑ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				9.8			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Owen Lutz	7-23-2020.						7/24/20	1538

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON N3H 4R7

Date Received: 29-JUL-20
Report Date: 07-AUG-20 09:14 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2481409

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2481409-1 BH/MW 20-06 Sampled By: SP on 21-JUL-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.282		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	13.8		0.25	%	31-JUL-20				
pH	8.08		0.10	pH units	04-AUG-20				
Redox Potential	139		-1000	mV	31-JUL-20				
Resistivity	3550		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	16.1		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	167		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				
L2481409-2 BH/MW 20-08 Sampled By: SP on 22-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.342		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	14.7		0.25	%	01-AUG-20				
pH	7.78		0.10	pH units	04-AUG-20				
Redox Potential	156		-1000	mV	31-JUL-20				
Resistivity	2920		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	59.6		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	171		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				
L2481409-3 BH20-03 Sampled By: SP on 20-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	3.72		0.0040	mS/cm	04-AUG-20	*0.57	*1.4	*0.7	
% Moisture	10.9		0.25	%	31-JUL-20				
pH	8.06		0.10	pH units	04-AUG-20				
Redox Potential	256		-1000	mV	31-JUL-20				
Resistivity	269		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	860		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	6370		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2481409-4 BH20-07									
Sampled By: SP on 22-JUL-20 @ 13:00									
Matrix: SOIL									
Physical Tests									
Conductivity	0.322		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	13.4		0.25	%	01-AUG-20				
pH	7.94		0.10	pH units	04-AUG-20				
Redox Potential	141		-1000	mV	31-JUL-20				
Resistivity	3110		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	35.4		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	142		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				
L2481409-5 BH/MW 20-01									
Sampled By: SP on 23-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.240		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	14.9		0.25	%	01-AUG-20				
pH	7.98		0.10	pH units	04-AUG-20				
Redox Potential	142		-1000	mV	31-JUL-20				
Resistivity	4170		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	36.1		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	108		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				
L2481409-6 BH/MW 20-04									
Sampled By: SP on 20-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.326		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	17.0		0.25	%	31-JUL-20				
pH	7.89		0.10	pH units	04-AUG-20				
Redox Potential	147		-1000	mV	31-JUL-20				
Resistivity	3070		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	47.4		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	150		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2481409-7 BH 20-05									
Sampled By: SP on 21-JUL-20 @ 13:00									
Matrix: SOIL									
Physical Tests									
Conductivity	0.315		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	13.3		0.25	%	31-JUL-20				
pH	7.99		0.10	pH units	04-AUG-20				
Redox Potential	204		-1000	mV	05-AUG-20				
Resistivity	3170		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	24.4		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	219		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	30-JUL-20				
L2481409-8 BH20-02									
Sampled By: SP on 24-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.265		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	15.7		0.25	%	01-AUG-20				
pH	7.85		0.10	pH units	04-AUG-20				
Redox Potential	181		-1000	mV	05-AUG-20				
Resistivity	3770		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	38.0		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	148		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	04-AUG-20				
L2481409-9 BH20-27									
Sampled By: SP on 27-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.195		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	18.2		0.25	%	01-AUG-20				
pH	7.97		0.10	pH units	04-AUG-20				
Redox Potential	200		-1000	mV	05-AUG-20				
Resistivity	5140		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	8.5		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	100		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	04-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2481409-10 BH20-25									
Sampled By: SP on 27-JUL-20 @ 13:00									
Matrix: SOIL									
Physical Tests									
Conductivity	0.282		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	14.4		0.25	%	01-AUG-20				
pH	7.97		0.10	pH units	04-AUG-20				
Redox Potential	170		-1000	mV	05-AUG-20				
Resistivity	3550		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	8.4		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	124		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	04-AUG-20				
L2481409-11 BH20-26									
Sampled By: SP on 27-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.749		0.0040	mS/cm	04-AUG-20	*0.57	1.4	*0.7	
% Moisture	15.7		0.25	%	01-AUG-20				
pH	7.40		0.10	pH units	04-AUG-20				
Redox Potential	231		-1000	mV	05-AUG-20				
Resistivity	1340		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	239		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	398		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	04-AUG-20				
L2481409-12 BH20-28									
Sampled By: SP on 27-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.246		0.0040	mS/cm	04-AUG-20	0.57	1.4	0.7	
% Moisture	15.5		0.25	%	01-AUG-20				
pH	7.87		0.10	pH units	04-AUG-20				
Redox Potential	199		-1000	mV	05-AUG-20				
Resistivity	4070		1.0	ohm*cm	04-AUG-20				
Leachable Anions & Nutrients									
Chloride	46.9		5.0	ug/g	04-AUG-20				
Anions and Nutrients									
Sulphate	99		20	mg/kg	05-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	04-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2481409 Report Date: 07-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7

Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R5174901								
WG3375507-3 CRM		**AN-CRM-WT**						
Chloride			98.2		%		70-130	04-AUG-20
WG3375507-4 DUP		**L2480618-2**						
Chloride		1200	1210		ug/g	0.3	30	04-AUG-20
WG3375507-2 LCS								
Chloride			103.1		%		80-120	04-AUG-20
WG3375507-1 MB								
Chloride			<5.0		ug/g		5	04-AUG-20
EC-WT	**Soil**							
Batch R5174104								
WG3375511-4 DUP		**WG3375511-3**						
Conductivity		0.281	0.281		mS/cm	0.0	20	04-AUG-20
WG3375511-2 IRM		**WT SAR4**						
Conductivity			100.6		%		70-130	04-AUG-20
WG3375783-1 LCS								
Conductivity			100.3		%		90-110	04-AUG-20
WG3375511-1 MB								
Conductivity			<0.0040		mS/cm		0.004	04-AUG-20
MOISTURE-WT	**Soil**							
Batch R5172431								
WG3373351-3 DUP		**L2480134-8**						
% Moisture		11.7	12.2		%	3.6	20	31-JUL-20
WG3373351-2 LCS								
% Moisture			101.6		%		90-110	31-JUL-20
WG3373351-1 MB								
% Moisture			<0.25		%		0.25	31-JUL-20
Batch R5172597								
WG3373475-3 DUP		**L2480629-3**						
% Moisture		32.8	33.5		%	2.2	20	31-JUL-20
WG3373475-2 LCS								
% Moisture			98.9		%		90-110	31-JUL-20
WG3373475-1 MB								
% Moisture			<0.25		%		0.25	31-JUL-20
Batch R5172953								
WG3374309-3 DUP		**L2480691-1**						
% Moisture		11.9	10.3		%	14	20	01-AUG-20
WG3374309-2 LCS								

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5172953								
WG3374309-2 LCS								
% Moisture			100.6		%		90-110	01-AUG-20
WG3374309-1 MB								
% Moisture			<0.25		%		0.25	01-AUG-20
Batch R5173292								
WG3374311-3 DUP		**L2481409-8**						
% Moisture		15.7	19.1		%	20	20	01-AUG-20
WG3374311-2 LCS								
% Moisture			100.7		%		90-110	01-AUG-20
WG3374311-1 MB								
% Moisture			<0.25		%		0.25	01-AUG-20
PH-WT	**Soil**							
Batch R5174025								
WG3375168-1 DUP		**L2481885-11**						
pH		7.65	7.63	J	pH units	0.02	0.3	04-AUG-20
WG3375800-1 LCS								
pH			6.99		pH units		6.9-7.1	04-AUG-20
REDOX-POTENTIAL-WT	**Soil**							
Batch R5173170								
WG3374509-1 CRM		**WT-REDOX**						
Redox Potential			102.5		%		80-120	31-JUL-20
WG3374030-1 DUP		**L2481409-3**						
Redox Potential		256	274		mV	6.8	25	31-JUL-20
Batch R5174985								
WG3376578-1 CRM		**WT-REDOX**						
Redox Potential			103.6		%		80-120	05-AUG-20
WG3375578-1 DUP		**L2481409-7**						
Redox Potential		204	194		mV	5.0	25	05-AUG-20
SO4-WT	**Soil**							
Batch R5175583								
WG3376196-4 CRM		**AN-CRM-WT**						
Sulphate			92.2		%		60-140	05-AUG-20
WG3376196-2 LCS								
Sulphate			103.1		%		80-120	05-AUG-20
WG3376196-1 MB								
Sulphate			<20		mg/kg		20	05-AUG-20
SULPHIDE-WT	**Soil**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SULPHIDE-WT	**Soil**							
Batch R5171992								
WG3373400-3 DUP		**L2481409-3**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	30-JUL-20
WG3373400-2 LCS								
Acid Volatile Sulphides			91.3		%		70-130	30-JUL-20
WG3373400-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	30-JUL-20
Batch R5173971								
WG3375754-3 DUP		**L2481409-12**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	04-AUG-20
WG3375754-2 LCS								
Acid Volatile Sulphides			105.8		%		70-130	04-AUG-20
WG3375754-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	04-AUG-20

Quality Control Report

Workorder: L2481409 Report Date: 07-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2481409-COFC

COC Number: 17 -

AH

Report To	Contact and company name below will appear on the final report	Report Format	Turnaround Time (TAT) Requested - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Wood	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Herman Padham	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:	900 maple grove rd	Email 1 or Fax vishu.vasisht@woodplc.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Cambridge On	Email 2 herman.padham@woodplc.com	
Postal Code:	N3H4R7	Email 3 owen.lutz@woodplc.com	

Invoice To		Invoice Distribution	
	Same as Report To ☑ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
	Copy of Invoice with Report ☐ YES ☑ NO	Email 1 or Fax SAME AS ABOVE	
Company:	Wood	Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q79429	AFE/Cost Center:	PO#:
Job #:	OGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2481409 AP	ALS Contact: AP	Sampler: SP

Analysis Request

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	TCLP BH20-03	20-7-2020	13:00	soil	7		R	R	R	R	R		
	TCLP BH20-26	27-7-2020	13:00	soil	6		R	R	R	R	R		
	BH/MW 20-06	21-7-2020	13:00	soil	1	R							
	BH/MW20-08	22-7-2020	13:00	soil	1	R							
	BH20-03	20-7-2020	13:00	soil	1	R							
	BH20-07	22-7-2020	13:00	soil	1	R							
	BH/MW 20-01	23-7-2020	13:00	soil	1	R							
	BH/MW20-04	20-7-2020	13:00	soil	1	R							
	BH 20-05	21-7-2020	13:00	soil	1	R							
	BH20-02	24-7-2020	13:00	soil	1	R							
	BH20-27	27-7-2020	13:00	soil	1	R							
	BH20-25	27-7-2020	13:00	soil	1	R							

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Ontario Regulation 153/04 - April 15, 2011 Standards
Are samples for human consumption/ use? ☐ YES ☑ NO	Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐	No ☐	
Ice Packs ☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated ☐					

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				7.2			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Owen Lutz	Date: 28-7-2020	Time:	Received by:	Date:	Time:	Received by: DB	Date: 07/29/20	Time: 15:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2481409-COFC

COC Number: 17 -

Report To	Contact and company name below will appear on the final report	Report For... Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Wood	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Herman Padham	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	900 maple grove rd	Email 1 or Fax vishu.vasisht@woodplc.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Cambridge On	Email 2 herman.padham@woodplc.com	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	N3H4R7	Email 3 owen.lutz@woodplc.com	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Company:	Wood	Email 1 or Fax SAME AS ABOVE	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q79429	AFE/Cost Center:	PO#
Job #:	OGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2481409 AP	ALS Contact: AP.	Sampler: SP

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-26	27-7-2020	13:00	soil	1	R							
	BH20-28	27-7-2020	13:00	soil	1	R							

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Ontario Regulation 153/04 - April 15, 2011 Standards
Are samples for human consumption/ use? ☐ YES ☑ NO	Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐	No ☐	
Ice Packs ☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated ☐					

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				7.2			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Owen Lutz	Date:28-7-2020	Time:	Received by:	Date:	Time:	Received by: DB	Date: 07/29/20	Time: 15:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7

Date Received: 05-FEB-21
Report Date: 16-FEB-21 07:06 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2555271

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers: 17-795115
Legal Site Desc:

Aaron Payne
Account Manager

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ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit

Federal & Provincial Waste Regulations (MAR, 2008) - Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

(No parameter exceedances)

Federal & Provincial Waste Regulations (MAR, 2008) - Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

(No parameter exceedances)

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Sample Preparation - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**Guide Limits #1**	**#2**				
Initial pH	pH units	-	-	9.56 PEHR	9.27 PEHR	9.79 PEHR	9.71 PEHR
Final pH	pH units	-	-	5.78 PEHR	5.11 PEHR	5.83 PEHR	5.82 PEHR

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - SOIL

		Guide Limits					
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**#1**	**#2**				
% Moisture	%	-	-	11.9	14.0	15.5	14.0

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - WASTE

		Guide Limits					
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**#1**	**#2**				
Air Velocity Of Fume Hood	m/sec	-	-	<0.10	<0.10	<0.10	<0.10
Burning Rate	mm/sec	-	-	N/A	N/A	N/A	N/A
Ignitability-Class		-	-	NON-FLAMMABLE	NON-FLAMMABLE	NON-FLAMMABLE	NON-FLAMMABLE
Samp Comment		-	-	BROWN GREYISH CLAYEY SOIL	BROWN GREYISH CLAYEY SOIL	BROWN GREYISH CLAYEY SOIL	BROWN CLAYEY SOIL
Temperature Of Test Material	Deg. C	-	-	21.0	21.0	21.0	21.0
Time To Ignition	sec	-	-	N/A	N/A	N/A	N/A

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP Extractables - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	Unit	#1	#2				
Benzo(a)pyrene	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Weak Acid Diss	mg/L	20	-	<0.10	<0.10	<0.10	<0.10
Fluoride (F)	mg/L	150.0	-	<10	<10	<10	<10
Nitrate and Nitrite as N	mg/L	1000	-	<4.0	<4.0	<4.0	<4.0
Nitrate-N	mg/L	-	-	<2.0	<2.0	<2.0	<2.0
Nitrite-N	mg/L	-	-	<2.0	<2.0	<2.0	<2.0
Surrogate: Chrysene d12	%	-	-	61.0	57.8	59.7	60.4

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP Metals - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Arsenic (As)	mg/L	2.5	-	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT
Barium (Ba)	mg/L	100	-	<0.50 PEHT	<0.50 PEHT	1.22 PEHT	0.94 PEHT
Boron (B)	mg/L	500	-	<2.5 PEHT	<2.5 PEHT	<2.5 PEHT	<2.5 PEHT
Cadmium (Cd)	mg/L	0.5	-	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT
Chromium (Cr)	mg/L	5.0	-	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT
Lead (Pb)	mg/L	5.0	-	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT
Mercury (Hg)	mg/L	0.1	-	<0.00010 PEHR	<0.00010 PEHR	<0.00010 PEHR	<0.00010 PEHR
Selenium (Se)	mg/L	1.0	-	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT
Silver (Ag)	mg/L	5.0	-	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT
Uranium (U)	mg/L	10	-	<0.25 PEHT	<0.25 PEHT	<0.25 PEHT	<0.25 PEHT

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP VOCs - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
1,1-Dichloroethylene	mg/L	1.4	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,2-Dichlorobenzene	mg/L	20.0	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,2-Dichloroethane	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,4-Dichlorobenzene	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Benzene	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Carbon tetrachloride	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Chlorobenzene	mg/L	8	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Chloroform	mg/L	10	-	<0.10 PEHR	<0.10 PEHR	<0.10 PEHR	<0.10 PEHR
Dichloromethane	mg/L	5.0	-	<0.50 PEHR	<0.50 PEHR	<0.50 PEHR	<0.50 PEHR
Methyl Ethyl Ketone	mg/L	200.0	-	<1.0 PEHR	<1.0 PEHR	<1.0 PEHR	<1.0 PEHR
Tetrachloroethylene	mg/L	3	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Trichloroethylene	mg/L	5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Vinyl chloride	mg/L	0.2	-	<0.050 PEHR	<0.050 PEHR	<0.050 PEHR	<0.050 PEHR
Surrogate: 4-Bromofluorobenzene	%	-	-	94.3	101.4	93.1	100.9

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Volatile Organic Compounds - WASTE

		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Surrogate: 1,4-Difluorobenzene	%	-	-	100.2	99.9	100.2	100.2

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Polychlorinated Biphenyls - SOIL

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Aroclor 1242	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1248	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1254	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1260	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Total PCBs	ug/g	-	50.0	<0.020	<0.020	<0.020	<0.020
Surrogate: d14-Terphenyl	%	-	-	97.1	90.9	96.6	104.2

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

IGNITABILITY-WT	Waste	O. Reg 347 Ignitability	EPA SW846, Method 1030, 1996

Preliminary Screening Test:
Prepare a sample "as received" 250 mm long by 20 mm wide by 10 mm high. Apply the tip of the flame to the end of the sample strip.
If the sample is non-metallic, hold the flame tip on the sample until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 2 minute test period.
If the sample is metal or metal alloy powder, hold the flame tip on the sample until the sample ignites or for a maximum of 5 minutes. If combusiton occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 20 minute test period.
Note: If the waste propagates burning of 200 mm of the test strip within 2 minutes (20 minutes for metals), the material must be evaluated by the burning rate test.
Burning Rate Test:
Refer to section 7.2 of EPA Method 1030. Samples that have a burning rate of greater than 2.2 mm/s are considered to have a positive result for ignitability according to DOT regulations. For metallic samples , the burning rate must be greater than 0.17 mm/s.

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-511-WT	Soil	PCB-O.Reg 153/04 (July 2011)	SW846 3510/8082

An aliquot of a solid sample is extracted with a solvent, extract is cleaned up and analyzed on the GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-795115

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5367898								
WG3485417-3 DUP		**L2555632-2**						
% Moisture		11.5	11.1		%	3.1	20	10-FEB-21
WG3485417-2 LCS								
% Moisture			98.5		%		90-110	10-FEB-21
WG3485417-1 MB								
% Moisture			<0.25		%		0.25	10-FEB-21
PCB-511-WT	**Soil**							
Batch R5370238								
WG3485412-3 DUP		**WG3485412-5**						
Aroclor 1242		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1248		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1254		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1260		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
WG3485412-2 LCS								
Aroclor 1242			98.8		%		60-140	10-FEB-21
Aroclor 1248			105.2		%		60-140	10-FEB-21
Aroclor 1254			100.1		%		60-140	10-FEB-21
Aroclor 1260			106.2		%		60-140	10-FEB-21
WG3485412-1 MB								
Aroclor 1242			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1248			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1254			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1260			<0.010		ug/g		0.01	10-FEB-21
Surrogate: d14-Terphenyl			92.3		%		60-140	10-FEB-21
WG3485412-4 MS		**WG3485412-5**						
Aroclor 1242			103.5		%		60-140	10-FEB-21
Aroclor 1254			105.5		%		60-140	10-FEB-21
Aroclor 1260			111.9		%		60-140	10-FEB-21
BAP-ONT-TCLP-WT	**Waste**							
Batch R5373307								
WG3486064-4 DUP		**WG3486064-3**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	12-FEB-21
WG3486064-2 LCS								
Benzo(a)pyrene			113.2		%		50-150	12-FEB-21
WG3486064-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	12-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5373307								
WG3486064-1 MB								
Surrogate: Chrysene d12			97.1		%		50-150	12-FEB-21
WG3486064-5 MS		**WG3486064-3**						
Benzo(a)pyrene			119.8		%		50-150	12-FEB-21
CN-TCLP-WT	**Waste**							
Batch R5370265								
WG3485697-3 DUP		**L2550893-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485697-2 LCS								
Cyanide, Weak Acid Diss			107.8		%		70-130	09-FEB-21
WG3485697-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	09-FEB-21
WG3485697-4 MS		**L2550893-1**						
Cyanide, Weak Acid Diss			105.7		%		50-140	09-FEB-21
F-TCLP-WT	**Waste**							
Batch R5369441								
WG3485887-3 DUP		**L2550893-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	09-FEB-21
WG3485887-2 LCS								
Fluoride (F)			90.8		%		70-130	09-FEB-21
WG3485887-1 MB								
Fluoride (F)			<10		mg/L		10	09-FEB-21
WG3485887-4 MS		**L2550893-1**						
Fluoride (F)			89.6		%		50-150	09-FEB-21
HG-TCLP-WT	**Waste**							
Batch R5368116								
WG3485570-3 DUP		**L2555274-2**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485570-2 LCS								
Mercury (Hg)			101.0		%		70-130	09-FEB-21
WG3485570-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	09-FEB-21
WG3485570-4 MS		**L2555274-2**						
Mercury (Hg)			92.3		%		50-140	09-FEB-21
MET-TCLP-WT	**Waste**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5369302								
WG3485537-4 DUP		**WG3485537-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	09-FEB-21
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	09-FEB-21
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	09-FEB-21
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	50	09-FEB-21
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	09-FEB-21
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	09-FEB-21
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	09-FEB-21
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	09-FEB-21
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485537-2 LCS								
Silver (Ag)			102.6		%		70-130	09-FEB-21
Arsenic (As)			103.7		%		70-130	09-FEB-21
Boron (B)			92.6		%		70-130	09-FEB-21
Barium (Ba)			104.9		%		70-130	09-FEB-21
Cadmium (Cd)			97.8		%		70-130	09-FEB-21
Chromium (Cr)			101.7		%		70-130	09-FEB-21
Lead (Pb)			102.8		%		70-130	09-FEB-21
Selenium (Se)			99.0		%		70-130	09-FEB-21
Uranium (U)			103.7		%		70-130	09-FEB-21
WG3485537-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	09-FEB-21
Arsenic (As)			<0.050		mg/L		0.05	09-FEB-21
Boron (B)			<2.5		mg/L		2.5	09-FEB-21
Barium (Ba)			<0.50		mg/L		0.5	09-FEB-21
Cadmium (Cd)			<0.0050		mg/L		0.005	09-FEB-21
Chromium (Cr)			<0.050		mg/L		0.05	09-FEB-21
Lead (Pb)			<0.025		mg/L		0.025	09-FEB-21
Selenium (Se)			<0.025		mg/L		0.025	09-FEB-21
Uranium (U)			<0.25		mg/L		0.25	09-FEB-21
WG3485537-5 MS		**WG3485537-3**						
Silver (Ag)			111.9		%		50-140	09-FEB-21
Arsenic (As)			111.5		%		50-140	09-FEB-21
Boron (B)			97.9		%		50-140	09-FEB-21
Barium (Ba)			107.5		%		50-140	09-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5369302								
WG3485537-5 MS		**WG3485537-3**						
Cadmium (Cd)			97.1		%		50-140	09-FEB-21
Chromium (Cr)			109.1		%		50-140	09-FEB-21
Lead (Pb)			98.1		%		50-140	09-FEB-21
Selenium (Se)			104.1		%		50-140	09-FEB-21
Uranium (U)			100.8		%		50-140	09-FEB-21
N2N3-TCLP-WT	**Waste**							
Batch R5369441								
WG3485887-3 DUP		**L2550893-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	09-FEB-21
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	09-FEB-21
WG3485887-2 LCS								
Nitrate-N			94.4		%		70-130	09-FEB-21
Nitrite-N			95.2		%		70-130	09-FEB-21
WG3485887-1 MB								
Nitrate-N			<2.0		mg/L		2	09-FEB-21
Nitrite-N			<2.0		mg/L		2	09-FEB-21
WG3485887-4 MS		**L2550893-1**						
Nitrate-N			97.0		%		50-150	09-FEB-21
Nitrite-N			98.5		%		50-150	09-FEB-21
VOC-TCLP-WT	**Waste**							
Batch R5369401								
WG3485455-1 LCS								
1,1-Dichloroethylene			96.3		%		70-130	10-FEB-21
1,2-Dichlorobenzene			102.1		%		70-130	10-FEB-21
1,2-Dichloroethane			105.3		%		70-130	10-FEB-21
1,4-Dichlorobenzene			103.4		%		70-130	10-FEB-21
Benzene			95.3		%		70-130	10-FEB-21
Carbon tetrachloride			99.7		%		60-140	10-FEB-21
Chlorobenzene			100.6		%		70-130	10-FEB-21
Chloroform			101.3		%		70-130	10-FEB-21
Dichloromethane			102.4		%		70-130	10-FEB-21
Methyl Ethyl Ketone			111.3		%		50-150	10-FEB-21
Tetrachloroethylene			92.9		%		70-130	10-FEB-21
Trichloroethylene			96.4		%		70-130	10-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5369401								
WG3485455-1 LCS								
Vinyl chloride			97.2		%		60-130	10-FEB-21
WG3485455-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	10-FEB-21
1,2-Dichlorobenzene			<0.025		mg/L		0.025	10-FEB-21
1,2-Dichloroethane			<0.025		mg/L		0.025	10-FEB-21
1,4-Dichlorobenzene			<0.025		mg/L		0.025	10-FEB-21
Benzene			<0.025		mg/L		0.025	10-FEB-21
Carbon tetrachloride			<0.025		mg/L		0.025	10-FEB-21
Chlorobenzene			<0.025		mg/L		0.025	10-FEB-21
Chloroform			<0.10		mg/L		0.1	10-FEB-21
Dichloromethane			<0.50		mg/L		0.5	10-FEB-21
Methyl Ethyl Ketone			<1.0		mg/L		1	10-FEB-21
Tetrachloroethylene			<0.025		mg/L		0.025	10-FEB-21
Trichloroethylene			<0.025		mg/L		0.025	10-FEB-21
Vinyl chloride			<0.050		mg/L		0.05	10-FEB-21
Surrogate: 1,4-Difluorobenzene			100.1		%		70-130	10-FEB-21
Surrogate: 4-Bromofluorobenzene			88.1		%		70-130	10-FEB-21
WG3485455-3 MS		**L2555254-1**						
1,1-Dichloroethylene			94.3		%		50-140	10-FEB-21
1,2-Dichlorobenzene			101.8		%		50-140	10-FEB-21
1,2-Dichloroethane			106.6		%		50-140	10-FEB-21
1,4-Dichlorobenzene			105.9		%		50-140	10-FEB-21
Benzene			95.4		%		50-140	10-FEB-21
Carbon tetrachloride			98.9		%		50-140	10-FEB-21
Chlorobenzene			100.7		%		50-140	10-FEB-21
Chloroform			102.0		%		50-140	10-FEB-21
Dichloromethane			104.5		%		50-140	10-FEB-21
Methyl Ethyl Ketone			113.3		%		50-140	10-FEB-21
Tetrachloroethylene			92.4		%		50-140	10-FEB-21
Trichloroethylene			97.1		%		50-140	10-FEB-21
Vinyl chloride			94.5		%		50-140	10-FEB-21

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
O. Reg 347 Ignitability							
	1	29-JUL-20 13:00	09-FEB-21 00:00	30	194	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 00:00	30	193	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 00:00	30	192	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 00:00	30	192	days	EHTR
TCLP Metals							
Mercury (CVAA) for O.Reg 347							
	1	29-JUL-20 13:00	09-FEB-21 00:00	28	194	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 00:00	28	193	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 00:00	28	192	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 00:00	28	192	days	EHTR
O.Reg 347 TCLP Leachable Metals							
	1	29-JUL-20 13:00	09-FEB-21 08:28	180	195	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 08:28	180	194	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 08:28	180	193	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 08:28	180	193	days	EHTR
Polychlorinated Biphenyls							
PCB-O.Reg 153/04 (July 2011)							
	1	29-JUL-20 13:00	10-FEB-21 14:55	40	196	days	EHTR
	2	30-JUL-20 13:00	10-FEB-21 14:56	40	195	days	EHTR
	3	31-JUL-20 13:00	10-FEB-21 14:57	40	194	days	EHTR
	4	31-JUL-20 13:00	10-FEB-21 14:58	40	194	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2555271 were received on 05-FEB-21 16:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2555271-COFC

COC Number: 17 - 795115

Page 2 of 2

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padham
Phone:	519-504-6356
Company address below will appear on the final report	
Street:	900 Maple Grove Rd.
City/Province:	Cambridge, ON
Postal Code:	N3H 4R7
Invoice To	Same as Report To [X] YES [ ] NO
	Copy of Invoice with Report [ ] YES [X] NO
Company:	Wood
Contact:	

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[X] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Vishu.Vasisht@woodplc.com
Email 2	Herman.padham@woodplc.com
Email 3	Owen.lutz@woodplc.com

Invoice Distribution	
Select Invoice Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	SAME AS ABOVE
Email 2	

Project Information	
ALS Account # / Quote #:	Q 79429
Job #:	OGTW 2010
PO / AFE:	
LSD:	TCLP
ALS Lab Work Order # (lab use only):	L2555271

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: AP	Sampler: SR / SJ

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E - 100%] [ ] | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP - Metals / Inorganics	TCLP - BAP	TCLP - VOC	Bulk PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-3b	25/01/2021	13:00	Soil	1	X							
	BH20-36 TCLP	29/7/2020			6		X	X	X	X	X		
	BH20-09 TCLP	30/7/2020			6		X	X	X	X	X		
	BH20-29 TCLP	31/7/2020			6		X	X	X	X	X		
	BH/MW 20-31	31/7/2020			6		X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human consumption/ use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Ontario Reg 153/04 - April 15, 2011 Standards Table 1, 3, 9 ICL Coarse.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] | SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [X] | Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.3			

SHIPMENT RELEASE (client use)		
Released by: Owen Lutz	Date: 2/5/2021	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 2/5/21	Time: 1600

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1 If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON N3H 4R7

Date Received: 10-AUG-20
Report Date: 18-AUG-20 11:38 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2486313

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2486313-1 BH20-41 SS7 Sampled By: CLIENT on 06-AUG-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.178		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	6.75		0.25	%	13-AUG-20				
pH	8.13		0.10	pH units	14-AUG-20				
Redox Potential	216		-1000	mV	11-AUG-20				
Resistivity	5620		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	<5.0		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	54		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	11-AUG-20				
L2486313-2 BH20-40 SS9 Sampled By: CLIENT on 07-AUG-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.192		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	8.05		0.25	%	13-AUG-20				
pH	8.12		0.10	pH units	14-AUG-20				
Redox Potential	224		-1000	mV	11-AUG-20				
Resistivity	5210		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	28.9		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	33		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	11-AUG-20				
L2486313-3 BH20-39 SS11 Sampled By: CLIENT on 05-AUG-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.214		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	6.53		0.25	%	13-AUG-20				
pH	8.15		0.10	pH units	14-AUG-20				
Redox Potential	206		-1000	mV	11-AUG-20				
Resistivity	4670		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	22.3		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	49		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	11-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2486313-4 BH20-38 SS11 Sampled By: CLIENT on 05-AUG-20 @ 13:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.323		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	7.74		0.25	%	13-AUG-20				
pH	8.09		0.10	pH units	14-AUG-20				
Redox Potential	224		-1000	mV	11-AUG-20				
Resistivity	3100		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	12.9		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	163		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	11-AUG-20				
L2486313-5 BH20-37B SS10 Sampled By: CLIENT on 04-AUG-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.240		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	11.0		0.25	%	13-AUG-20				
pH	8.16		0.10	pH units	17-AUG-20				
Redox Potential	223		-1000	mV	11-AUG-20				
Resistivity	4170		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	19.9		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	119		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	13-AUG-20				
L2486313-6 BH20-37 SS8 Sampled By: CLIENT on 06-AUG-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.266		0.0040	mS/cm	14-AUG-20	0.57	1.4	0.7	
% Moisture	9.91		0.25	%	13-AUG-20				
pH	7.94		0.10	pH units	17-AUG-20				
Redox Potential	215		-1000	mV	11-AUG-20				
Resistivity	3760		1.0	ohm*cm	14-AUG-20				
Leachable Anions & Nutrients									
Chloride	8.1		5.0	ug/g	14-AUG-20				
Anions and Nutrients									
Sulphate	134		20	mg/kg	11-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	<0.20		0.20	mg/kg	13-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2486313 Report Date: 18-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R5188807								
WG3383210-3 CRM		**AN-CRM-WT**						
Chloride			86.5		%		70-130	14-AUG-20
WG3383210-4 DUP		**L2486313-1**						
Chloride		<5.0	<5.0	RPD-NA	ug/g	N/A	30	14-AUG-20
WG3383210-2 LCS								
Chloride			102.0		%		80-120	14-AUG-20
WG3383210-1 MB								
Chloride			<5.0		ug/g		5	14-AUG-20
EC-WT	**Soil**							
Batch R5189280								
WG3383212-4 DUP		**WG3383212-3**						
Conductivity		1.61	1.60		mS/cm	0.6	20	14-AUG-20
WG3383212-2 IRM		**WT SAR4**						
Conductivity			107.3		%		70-130	14-AUG-20
WG3383467-1 LCS								
Conductivity			99.1		%		90-110	14-AUG-20
WG3383212-1 MB								
Conductivity			<0.0040		mS/cm		0.004	14-AUG-20
MOISTURE-WT	**Soil**							
Batch R5183617								
WG3381535-3 DUP		**L2486313-1**						
% Moisture		6.75	6.76		%	0.2	20	13-AUG-20
WG3381535-2 LCS								
% Moisture			101.0		%		90-110	13-AUG-20
WG3381535-1 MB								
% Moisture			<0.25		%		0.25	13-AUG-20
PH-WT	**Soil**							
Batch R5189356								
WG3382252-6 DUP		**L2486337-13**						
pH		7.84	7.86	J	pH units	0.02	0.3	14-AUG-20
WG3383452-1 LCS								
pH			6.93		pH units		6.9-7.1	14-AUG-20
Batch R5190359								
WG3383817-1 DUP		**L2486488-1**						
pH		7.12	7.34	J	pH units	0.22	0.3	17-AUG-20
WG3384922-1 LCS								
pH			6.91		pH units		6.9-7.1	17-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	**Soil**							
Batch R5181177								
WG3380665-1 CRM		**WT-REDOX**						
Redox Potential			99.8		%		80-120	11-AUG-20
WG3380460-1 DUP		**L2486334-2**						
Redox Potential		-56.0	-49.0		mV	0.0	25	11-AUG-20
SO4-WT	**Soil**							
Batch R5183077								
WG3379917-4 CRM		**AN-CRM-WT**						
Sulphate			101.9		%		60-140	11-AUG-20
WG3379917-3 DUP		**WG3379917-5**						
Sulphate		27	27		mg/kg	0.7	30	11-AUG-20
WG3379917-2 LCS								
Sulphate			102.6		%		80-120	11-AUG-20
WG3379917-1 MB								
Sulphate			<20		mg/kg		20	11-AUG-20
SULPHIDE-WT	**Soil**							
Batch R5179821								
WG3380412-3 DUP		**L2485198-5**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	11-AUG-20
WG3380412-2 LCS								
Acid Volatile Sulphides			96.7		%		70-130	11-AUG-20
WG3380412-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	11-AUG-20
Batch R5185184								
WG3382372-3 DUP		**L2486313-5**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	13-AUG-20
WG3382372-2 LCS								
Acid Volatile Sulphides			98.3		%		70-130	13-AUG-20
WG3382372-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	13-AUG-20

Quality Control Report

Workorder: L2486313 Report Date: 18-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2486313-COFC

COC Number: 17 -

Page of

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padham
Phone:	
	Company address below will appear on the final report
Street:	900 maple grove rd
City/Province:	Cambridge On
Postal Code:	N3H4R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Wood
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax	vishu.vasisht@woodplc.com
Email 2	herman.padham@woodplc.com
Email 3	owen.lutz@woodplc.com

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax	SAME AS ABOVE
Email 2	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	Q79429
Job #:	OGTW2010
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	L2486313 AD

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-41 SS7	6-Aug-20	13:00	soil	1	R							
	BH20-40 SS9	7-Aug-20	13:00	soil	1	R							
	BH20-39 SS11	5-Aug-20	13:00	soil	1	R							
	BH20-38 SS11	5-Aug-20	13:00	soil	1	R							
	BH20-37B SS10	4-Aug-20	13:00	soil	1	R							
	BH20-37 SS8	6-Aug-20	13:00	soil	1	R							
	TCLP-BH20-37B	4-Aug-20	13:00	soil	6		R	R	R	R	R		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☑ NO

Are samples for human consumption/ use?

☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Ontario Regulation 153/04 - April 15, 2011 Standards

Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☒ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				4.8			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Owen Lutz	Date:10-8-2020	Time:	Received by:	Date:	Time:	Received by:	Date: 08/10/20	Time: 16:40

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON N3H 4R7

Date Received: 25-AUG-20
Report Date: 01-SEP-20 07:41 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2493723

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2493723-1 BH20-42 SS9 Sampled By: CLIENT on 17-AUG-20 @ 17:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.158		0.0040	mS/cm	28-AUG-20	0.57	1.4	0.7	
% Moisture	9.42		0.25	%	27-AUG-20				
pH	8.34		0.10	pH units	26-AUG-20				
Redox Potential	150		-1000	mV	26-AUG-20				
Resistivity	6330		1.0	ohm*cm	28-AUG-20				
Leachable Anions & Nutrients									
Chloride	<5.0		5.0	ug/g	27-AUG-20				
Anions and Nutrients									
Sulphate	51		20	mg/kg	26-AUG-20				
Inorganic Parameters									
Acid Volatile Sulphides	0.22		0.20	mg/kg	28-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2493723 Report Date: 01-SEP-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7

Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R5203338								
WG3392129-3 CRM		**AN-CRM-WT**						
Chloride			93.6		%		70-130	27-AUG-20
WG3392129-4 DUP		**L2494532-4**						
Chloride		192	192		ug/g	0.3	30	27-AUG-20
WG3392129-2 LCS								
Chloride			101.2		%		80-120	27-AUG-20
WG3392129-1 MB								
Chloride			<5.0		ug/g		5	27-AUG-20
EC-WT	**Soil**							
Batch R5203353								
WG3392140-4 DUP		**WG3392140-3**						
Conductivity		0.125	0.125		mS/cm	0.5	20	28-AUG-20
WG3392140-2 IRM		**WT SAR4**						
Conductivity			102.6		%		70-130	28-AUG-20
WG3392478-1 LCS								
Conductivity			97.4		%		90-110	28-AUG-20
WG3392140-1 MB								
Conductivity			<0.0040		mS/cm		0.004	28-AUG-20
MOISTURE-WT	**Soil**							
Batch R5200280								
WG3391234-3 DUP		**L2493765-7**						
% Moisture		5.88	5.68		%	3.4	20	27-AUG-20
WG3391234-2 LCS								
% Moisture			101.0		%		90-110	27-AUG-20
WG3391234-1 MB								
% Moisture			<0.25		%		0.25	27-AUG-20
PH-WT	**Soil**							
Batch R5201238								
WG3391199-1 DUP		**L2490956-1**						
pH		8.24	8.28	J	pH units	0.04	0.3	26-AUG-20
WG3391432-1 LCS								
pH			7.02		pH units		6.9-7.1	26-AUG-20
REDOX-POTENTIAL-WT	**Soil**							
Batch R5201376								
WG3391437-1 CRM		**WT-REDOX**						
Redox Potential			100.6		%		80-120	26-AUG-20
WG3391212-1 DUP		**L2490956-2**						

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	**Soil**							
Batch R5201376								
WG3391212-1 DUP		**L2490956-2**						
Redox Potential		168	154		mV	8.7	25	26-AUG-20
SO4-WT	**Soil**							
Batch R5202562								
WG3391226-4 CRM		**AN-CRM-WT**						
Sulphate			99.8		%		60-140	26-AUG-20
WG3391226-3 DUP		**L2490956-2**						
Sulphate		75	76		mg/kg	0.3	30	26-AUG-20
WG3391226-2 LCS								
Sulphate			103.8		%		80-120	26-AUG-20
WG3391226-1 MB								
Sulphate			<20		mg/kg		20	26-AUG-20
SULPHIDE-WT	**Soil**							
Batch R5203461								
WG3393398-3 DUP		**L2493254-2**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	28-AUG-20
WG3393398-2 LCS								
Acid Volatile Sulphides			77.5		%		70-130	28-AUG-20
WG3393398-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	28-AUG-20

Quality Control Report

Workorder: L2493723 Report Date: 01-SEP-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2493723-COFC

COC Number: 17 -

Page 1 of 2

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	Wood	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	
Contact:	Herman Padham	Quality Control (QC) Report with Report ☑ YES ☐ NO	
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	900 maple grove rd	Email 1 or Fax	vishu.vasisht@woodplc.com
City/Province:	Cambridge On	Email 2	herman.padham@woodplc.com
Postal Code:	N3H4R7	Email 3	owen.lutz@woodplc.com
Invoice To	Same as Report To ☑ YES ☐ NO	**Invoice Distribution**	
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Company:	Wood	Email 1 or Fax	SAME AS ABOVE
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q79429	AFE/Cost Center:	PO#
Job #:	OGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2493723 **ALS Contact:** AP **Sampler:**

Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-42 SS9	17-8-20	5:00	soil	1	R							

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Ontario Regulation 153/04 - April 15, 2011 Standards
Are samples for human consumption/ use? ☐ YES ☑ NO	Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				24.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Owen Lutz	Date:24-8-2020	Time:	Received by:	Date:	Time:	Received by: AP	Date: 25-8-20	Time: 14:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7

Date Received: 05-FEB-21
Report Date: 19-FEB-21 15:01 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2555268

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers: 17-795003
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2555268-1 BH20-30 SS7								
Sampled By: SJ/SR on 31-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	0.679		0.0040	mS/cm	12-FEB-21	*0.57	1.4	0.7
% Moisture	13.2		0.25	%	09-FEB-21			
Moisture	14.7		0.25	%	18-FEB-21			
pH	8.05		0.10	pH units	09-FEB-21			
Redox Potential	261		-1000	mV	09-FEB-21			
Resistivity	1470		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	81.7		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	380		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-2 BH20-36 SS7								
Sampled By: SJ/SR on 29-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	0.703		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7
% Moisture	13.7		0.25	%	09-FEB-21			
Moisture	12.3		0.25	%	18-FEB-21			
pH	7.97		0.10	pH units	09-FEB-21			
Redox Potential	274		-1000	mV	09-FEB-21			
Resistivity	1420		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	272		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	209		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-3 BH20-11 SS7								
Sampled By: SJ/SR on 30-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	0.319		0.0040	mS/cm	12-FEB-21	0.57	1.4	0.7
% Moisture	16.3		0.25	%	09-FEB-21			
Moisture	18.7		0.25	%	18-FEB-21			
pH	7.73		0.10	pH units	09-FEB-21			
Redox Potential	276		-1000	mV	09-FEB-21			
Resistivity	3130		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2555268-3 BH20-11 SS7 Sampled By: SJ/SR on 30-JUL-20 @ 13:00 Matrix: SOIL									
Leachable Anions & Nutrients									
Chloride	56.6		5.0	ug/g	12-FEB-21				
Anions and Nutrients									
Sulphate	43		20	mg/kg	08-FEB-21				
Inorganic Parameters									
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21				
L2555268-4 BH/MW-10 SS7 Sampled By: SJ/SR on 30-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.405		0.0040	mS/cm	12-FEB-21	0.57	1.4	0.7	
% Moisture	14.6		0.25	%	09-FEB-21				
Moisture	15.2		0.25	%	18-FEB-21				
pH	8.01		0.10	pH units	09-FEB-21				
Redox Potential	275		-1000	mV	09-FEB-21				
Resistivity	2470		1.0	ohm*cm	12-FEB-21				
Leachable Anions & Nutrients									
Chloride	42.9		5.0	ug/g	12-FEB-21				
Anions and Nutrients									
Sulphate	349		20	mg/kg	08-FEB-21				
Inorganic Parameters									
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21				
L2555268-5 BH20-35 SS7 Sampled By: SJ/SR on 29-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	
Physical Tests									
Conductivity	0.747		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7	
% Moisture	10.8		0.25	%	09-FEB-21				
Moisture	10.8		0.25	%	18-FEB-21				
pH	8.09		0.10	pH units	09-FEB-21				
Redox Potential	261		-1000	mV	09-FEB-21				
Resistivity	1340		1.0	ohm*cm	12-FEB-21				
Leachable Anions & Nutrients									
Chloride	14.9		5.0	ug/g	12-FEB-21				
Anions and Nutrients									
Sulphate	439		20	mg/kg	08-FEB-21				
Inorganic Parameters									
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21				
L2555268-6 BH20-29 SS7 Sampled By: SJ/SR on 31-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3	

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2555268-6 BH20-29 SS7 Sampled By: SJ/SR on 31-JUL-20 @ 13:00 Matrix: SOIL								
Physical Tests								
Conductivity	0.602		0.0040	mS/cm	12-FEB-21	*0.57	1.4	0.7
% Moisture	14.0		0.25	%	09-FEB-21			
Moisture	15.9		0.25	%	18-FEB-21			
pH	8.13		0.10	pH units	09-FEB-21			
Redox Potential	264		-1000	mV	09-FEB-21			
Resistivity	1660		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	22.7		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	486		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-7 BH/MW20-31 Sampled By: SJ/SR on 31-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	0.644		0.0040	mS/cm	12-FEB-21	*0.57	1.4	0.7
% Moisture	14.5		0.25	%	09-FEB-21			
Moisture	12.8		0.25	%	18-FEB-21			
pH	8.06		0.10	pH units	09-FEB-21			
Redox Potential	266		-1000	mV	09-FEB-21			
Resistivity	1550		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	41.0		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	515		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-8 BH20-21 Sampled By: SJ/SR on 29-JUL-20 @ 13:00 Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	0.964		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7
% Moisture	14.5		0.25	%	09-FEB-21			
Moisture	14.3		0.25	%	18-FEB-21			
pH	8.00		0.10	pH units	09-FEB-21			
Redox Potential	228		-1000	mV	09-FEB-21			
Resistivity	1040		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2555268-8 BH20-21								
Sampled By: SJ/SR on 29-JUL-20 @ 13:00								
Matrix: SOIL								
Leachable Anions & Nutrients								
Chloride	459		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	121		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-9 BH20-09								
Sampled By: SJ/SR on 30-JUL-20 @ 13:00								
Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	1.09		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7
% Moisture	15.8		0.25	%	09-FEB-21			
Moisture	15.0		0.25	%	18-FEB-21			
pH	7.89		0.10	pH units	09-FEB-21			
Redox Potential	249		-1000	mV	09-FEB-21			
Resistivity	917		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	566		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	377		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-10 BH/,W20-34								
Sampled By: SJ/SR on 29-JUL-20 @ 13:00								
Matrix: SOIL						#1	#2	#3
Physical Tests								
Conductivity	1.49		0.0040	mS/cm	12-FEB-21	*0.57	*1.4	*0.7
% Moisture	11.1		0.25	%	09-FEB-21			
Moisture	12.7		0.25	%	18-FEB-21			
pH	8.05		0.10	pH units	09-FEB-21			
Redox Potential	260		-1000	mV	09-FEB-21			
Resistivity	670		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	19.3		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	989		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-11 BH20-12								
Sampled By: SJ/SR on 30-JUL-20 @ 13:00								
Matrix: SOIL						#1	#2	#3

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
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Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3
L2555268-11 BH20-12								
Sampled By: SJ/SR on 30-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	0.674		0.0040	mS/cm	12-FEB-21	*0.57	1.4	0.7
% Moisture	12.8		0.25	%	09-FEB-21			
Moisture	13.1		0.25	%	18-FEB-21			
pH	8.05		0.10	pH units	09-FEB-21			
Redox Potential	257		-1000	mV	09-FEB-21			
Resistivity	1480		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	99.9		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	345		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-12 BH20-33 SS7								
Sampled By: SJ/SR on 28-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	1.12		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7
% Moisture	14.7		0.25	%	09-FEB-21			
Moisture	14.3		0.25	%	18-FEB-21			
pH	8.05		0.10	pH units	09-FEB-21			
Redox Potential	265		-1000	mV	10-FEB-21			
Resistivity	896		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								
Chloride	40.3		5.0	ug/g	12-FEB-21			
Anions and Nutrients								
Sulphate	714		20	mg/kg	08-FEB-21			
Inorganic Parameters								
Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21			
L2555268-13 BH20-32								
Sampled By: SJ/SR on 28-JUL-20 @ 13:00								
Matrix: SOIL								
Physical Tests								
Conductivity	0.786		0.0040	mS/cm	12-FEB-21	*0.57	1.4	*0.7
% Moisture	15.5		0.25	%	09-FEB-21			
Moisture	15.9		0.25	%	18-FEB-21			
pH	7.97		0.10	pH units	09-FEB-21			
Redox Potential	277		-1000	mV	10-FEB-21			
Resistivity	1270		1.0	ohm*cm	12-FEB-21			
Leachable Anions & Nutrients								

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Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2555268-13	BH20-32									
Sampled By:	SJ/SR on 28-JUL-20 @ 13:00									
Matrix:	SOIL									
Leachable Anions & Nutrients										
	Chloride	60.0		5.0	ug/g	12-FEB-21				
Anions and Nutrients										
	Sulphate	583		20	mg/kg	08-FEB-21				
Inorganic Parameters										
	Acid Volatile Sulphides	<5.0		5.0	mg/kg	19-FEB-21				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
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Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
AVS-MG/KG-COL-VA	Soil	Acid volatile sulphide by colourimetric	EPA 821/R-91-100

This analysis was carried out in accordance with the method described in EPA 821/R-91-100. In summary, hydrochloric acid is added to the sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic zinc acetate (ZnAc) solution by argon gas. The acid volatile sulfide is then determined colourimetrically.

CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

17-795003

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA	VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2555268 Report Date: 19-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
AVS-MG/KG-COL-VA	**Soil**							
Batch R5382058								
WG3490008-3 DUP		**L2554920-1**						
Acid Volatile Sulphides		11.8	10.8		mg/kg	9.1	45	19-FEB-21
WG3490008-2 LCS								
Acid Volatile Sulphides			98.6		%		70-130	19-FEB-21
WG3490008-1 MB								
Acid Volatile Sulphides			<5.0		mg/kg		5	19-FEB-21
CL-R511-WT	**Soil**							
Batch R5376323								
WG3487032-3 CRM		**AN-CRM-WT**						
Chloride			100.2		%		70-130	12-FEB-21
WG3487032-4 DUP		**L2555268-3**						
Chloride		56.6	56.6		ug/g	0.2	30	12-FEB-21
WG3487032-2 LCS								
Chloride			100.5		%		80-120	12-FEB-21
WG3487032-1 MB								
Chloride			<5.0		ug/g		5	12-FEB-21
EC-WT	**Soil**							
Batch R5374138								
WG3487067-3 DUP		**L2555268-12**						
Conductivity		1.12	1.15		mS/cm	3.0	20	12-FEB-21
WG3487067-2 IRM		**WT SAR4**						
Conductivity			102.6		%		70-130	12-FEB-21
WG3487663-1 LCS								
Conductivity			100.2		%		90-110	12-FEB-21
WG3487067-1 MB								
Conductivity			<0.0040		mS/cm		0.004	12-FEB-21
MOISTURE-VA	**Soil**							
Batch R5381718								
WG3490012-3 DUP		**L2555268-1**						
Moisture		14.7	14.5		%	1.8	20	18-FEB-21
WG3490012-2 LCS								
Moisture			101.5		%		90-110	18-FEB-21
WG3490012-1 MB								
Moisture			<0.25		%		0.25	18-FEB-21
MOISTURE-WT	**Soil**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5367508								
WG3485265-3 DUP		**L2555268-9**						
% Moisture		15.8	15.5		%	1.6	20	09-FEB-21
WG3485265-2 LCS								
% Moisture			99.6		%		90-110	09-FEB-21
WG3485265-1 MB								
% Moisture			<0.25		%		0.25	09-FEB-21
PH-WT	**Soil**							
Batch R5367997								
WG3485387-1 DUP		**L2555314-2**						
pH		7.94	7.98	J	pH units	0.04	0.3	09-FEB-21
WG3485561-1 LCS								
pH			7.03		pH units		6.9-7.1	09-FEB-21
Batch R5368000								
WG3485420-1 DUP		**L2555701-1**						
pH		7.53	7.56	J	pH units	0.03	0.3	09-FEB-21
WG3485560-1 LCS								
pH			7.03		pH units		6.9-7.1	09-FEB-21
REDOX-POTENTIAL-WT	**Soil**							
Batch R5370143								
WG3485287-1 CRM		**WT-REDOX**						
Redox Potential			101.3		%		80-120	09-FEB-21
WG3484918-1 DUP		**L2555170-3**						
Redox Potential		240	225		mV	6.5	25	09-FEB-21
Batch R5373359								
WG3486373-1 CRM		**WT-REDOX**						
Redox Potential			101.1		%		80-120	10-FEB-21
WG3485946-1 DUP		**L2555268-13**						
Redox Potential		277	265		mV	4.4	25	10-FEB-21
SO4-WT	**Soil**							
Batch R5367937								
WG3484908-4 CRM		**AN-CRM-WT**						
Sulphate			92.5		%		60-140	08-FEB-21
WG3485197-10 CRM		**AN-CRM-WT**						
Sulphate			95.5		%		60-140	08-FEB-21
WG3484908-3 DUP		**L2555170-3**						
Sulphate		29	29		mg/kg	0.5	30	08-FEB-21
WG3485197-8 DUP		**WG3485197-9**						

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R5367937								
WG3485197-8 DUP		**WG3485197-9**						
Sulphate		38	37		mg/kg	0.3	30	08-FEB-21
WG3484908-2 LCS								
Sulphate			100.4		%		80-120	08-FEB-21
WG3485197-7 LCS								
Sulphate			100.9		%		80-120	08-FEB-21
WG3484908-1 MB								
Sulphate			<20		mg/kg		20	08-FEB-21
WG3485197-6 MB								
Sulphate			<20		mg/kg		20	08-FEB-21

Quality Control Report

Workorder: L2555268 Report Date: 19-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.

Quality Control Report

Workorder: L2555268 Report Date: 19-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Conductivity (EC)							
	1	31-JUL-20 13:00	11-FEB-21 14:00	30	195	days	EHTR
	2	29-JUL-20 13:00	11-FEB-21 14:00	30	197	days	EHTR
	3	30-JUL-20 13:00	11-FEB-21 14:00	30	196	days	EHTR
	4	30-JUL-20 13:00	11-FEB-21 14:00	30	196	days	EHTR
	5	29-JUL-20 13:00	11-FEB-21 14:00	30	197	days	EHTR
	6	31-JUL-20 13:00	11-FEB-21 14:00	30	195	days	EHTR
	7	31-JUL-20 13:00	11-FEB-21 14:00	30	195	days	EHTR
	8	29-JUL-20 13:00	11-FEB-21 14:00	30	197	days	EHTR
	9	30-JUL-20 13:00	11-FEB-21 14:00	30	196	days	EHTR
	10	29-JUL-20 13:00	11-FEB-21 14:00	30	197	days	EHTR
	11	30-JUL-20 13:00	11-FEB-21 14:00	30	196	days	EHTR
	12	28-JUL-20 13:00	11-FEB-21 14:00	30	198	days	EHTR
	13	28-JUL-20 13:00	11-FEB-21 14:00	30	198	days	EHTR
Redox Potential							
	1	31-JUL-20 13:00	08-FEB-21 08:00	180	192	days	EHTR
	2	29-JUL-20 13:00	08-FEB-21 08:00	180	194	days	EHTR
	3	30-JUL-20 13:00	08-FEB-21 08:00	180	193	days	EHTR
	4	30-JUL-20 13:00	08-FEB-21 08:00	180	193	days	EHTR
	5	29-JUL-20 13:00	08-FEB-21 08:00	180	194	days	EHTR
	6	31-JUL-20 13:00	08-FEB-21 08:00	180	192	days	EHTR
	7	31-JUL-20 13:00	08-FEB-21 08:00	180	192	days	EHTR
	8	29-JUL-20 13:00	08-FEB-21 08:00	180	194	days	EHTR
	9	30-JUL-20 13:00	08-FEB-21 08:00	180	193	days	EHTR
	10	29-JUL-20 13:00	08-FEB-21 08:00	180	194	days	EHTR
	11	30-JUL-20 13:00	08-FEB-21 08:00	180	193	days	EHTR
	12	28-JUL-20 13:00	09-FEB-21 17:00	180	196	days	EHTR
	13	28-JUL-20 13:00	09-FEB-21 17:00	180	196	days	EHTR
pH							
	1	31-JUL-20 13:00	08-FEB-21 23:00	30	192	days	EHTR
	2	29-JUL-20 13:00	08-FEB-21 23:00	30	194	days	EHTR
	3	30-JUL-20 13:00	08-FEB-21 23:00	30	193	days	EHTR
	4	30-JUL-20 13:00	09-FEB-21 08:00	30	194	days	EHTR
	5	29-JUL-20 13:00	09-FEB-21 08:00	30	195	days	EHTR
	6	31-JUL-20 13:00	09-FEB-21 08:00	30	193	days	EHTR
	7	31-JUL-20 13:00	09-FEB-21 08:00	30	193	days	EHTR
	8	29-JUL-20 13:00	09-FEB-21 08:00	30	195	days	EHTR
	9	30-JUL-20 13:00	09-FEB-21 08:00	30	194	days	EHTR
	10	29-JUL-20 13:00	09-FEB-21 08:00	30	195	days	EHTR
	11	30-JUL-20 13:00	09-FEB-21 08:00	30	194	days	EHTR
	12	28-JUL-20 13:00	09-FEB-21 08:00	30	196	days	EHTR
	13	28-JUL-20 13:00	09-FEB-21 08:00	30	196	days	EHTR
Leachable Anions & Nutrients							
Sulphate							
	1	31-JUL-20 13:00	08-FEB-21 14:00	28	192	days	EHTR
	2	29-JUL-20 13:00	08-FEB-21 08:00	28	194	days	EHTR
	3	30-JUL-20 13:00	08-FEB-21 14:00	28	193	days	EHTR
	4	30-JUL-20 13:00	08-FEB-21 14:00	28	193	days	EHTR
	5	29-JUL-20 13:00	08-FEB-21 14:00	28	194	days	EHTR
	6	31-JUL-20 13:00	08-FEB-21 14:00	28	192	days	EHTR
	7	31-JUL-20 13:00	08-FEB-21 14:00	28	192	days	EHTR
	8	29-JUL-20 13:00	08-FEB-21 14:00	28	194	days	EHTR

Quality Control Report

Workorder: L2555268 Report Date: 19-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Leachable Anions & Nutrients							
Sulphate							
	9	30-JUL-20 13:00	08-FEB-21 14:00	28	193	days	EHTR
	10	29-JUL-20 13:00	08-FEB-21 14:00	28	194	days	EHTR
	11	30-JUL-20 13:00	08-FEB-21 14:00	28	193	days	EHTR
	12	28-JUL-20 13:00	08-FEB-21 14:00	28	195	days	EHTR
	13	28-JUL-20 13:00	08-FEB-21 14:00	28	195	days	EHTR
Inorganic Parameters							
Acid volatile sulphide by colourimetric							
	1	31-JUL-20 13:00	18-FEB-21 14:35	14	202	days	EHTR
	2	29-JUL-20 13:00	18-FEB-21 14:35	14	204	days	EHTR
	3	30-JUL-20 13:00	18-FEB-21 14:35	14	203	days	EHTR
	4	30-JUL-20 13:00	18-FEB-21 14:35	14	203	days	EHTR
	5	29-JUL-20 13:00	18-FEB-21 14:35	14	204	days	EHTR
	6	31-JUL-20 13:00	18-FEB-21 14:35	14	202	days	EHTR
	7	31-JUL-20 13:00	18-FEB-21 14:35	14	202	days	EHTR
	8	29-JUL-20 13:00	18-FEB-21 14:35	14	204	days	EHTR
	9	30-JUL-20 13:00	18-FEB-21 14:35	14	203	days	EHTR
	10	29-JUL-20 13:00	18-FEB-21 14:35	14	204	days	EHTR
	11	30-JUL-20 13:00	18-FEB-21 14:35	14	203	days	EHTR
	12	28-JUL-20 13:00	18-FEB-21 14:35	14	205	days	EHTR
	13	28-JUL-20 13:00	18-FEB-21 14:35	14	205	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2555268 were received on 05-FEB-21 16:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2555268-COFC

COC Number: 17 - 795003

Page 1 of 2

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Wood	Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Herman Padham	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ] / 3 day [P3-25%] [ ] / 2 day [P2-50%] [ ]
Phone:	519-504-6386	[X] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E - 100%] [ ] / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:	900 Maple Grove Road	Email 1 or Fax Vishu.Vasisht@wood.plc.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Cambridge ON	Email 2 herman.padham@wood.plc.com	
Postal Code:	N3H 4R7	Email 3 Owen.lutz@wood.plc.com	
Invoice To	Same as Report To [X] YES [ ] NO	**Invoice Distribution**	
	Copy of Invoice with Report [ ] YES [X] NO	Select Invoice Distribution: [ ] EMAIL [ ] MAIL [ ] FAX	
Company:	Wood	Email 1 or Fax SAME AS ABOVE	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q79429	AFE/Cost Center:	PO#
Job #:	GGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2555268	ALS Contact: AP	Sampler: SJ / SR

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-30 SS7	31/7/2020	13:00	Soil	1	X		
	BH20-36 SS7	29/7/2020			1	X		
	BH20-11 SS7	30/7/2020			1	X		
	BH/MW20-10 SS7	30/7/2020			1	X		
	BH20-35 SS7	29/7/2020			1	X		
	BH20-29 SS7	31/7/2020			1	X		
	BH/MW20-31	31/7/2020			1	X		
	BH20-21	29/7/2020			1	X		
	BH20-09	30/7/2020			1	X		
	BH/MW20-34	29/7/2020			1	X		
	BH20-12	30/7/2020			1	X		
	BH20-33 SS7	28/7/2020			1	X		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	Ontario Reg 153/04 - April 15, 2011 Standards
Are samples for human consumption/ use? [ ] YES [X] NO	Table 1, 3, 9 Ind/Com Coarse.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs	[ ] Ice Cubes [X]	Custody seal intact	Yes [ ]	No	[ ]
Cooling Initiated	[ ]				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Owen Lutz	Date: 2/5/2021	Time:	Received by:	Date:	Time:	Received by:	Date: 2/5/21	Time: 1600

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2555268-COFC

COC Number: 17 - 795115

Page 2 of 2

Report To	Contact and company name below will appear on the final report	Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	Wood	Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R]	[X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Herman Padham	Quality Control (QC) Report with Report	[X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]	EMERGENCY: 1 Business day [E - 100%] [ ]
Phone:	519-504-6356	[X] Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%] [ ]	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX	2 day [P2-50%] [ ]	
Street:	900 Maple Grove Rd.	Email 1 or Fax	Vishu.Vasisht@woodplc.com	Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm
City/Province:	Cambridge ON	Email 2	Herman.padham@woodplc.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	N3H 4R7	Email 3	Owen.Lutz@woodplc.com		
Invoice To	Same as Report To [X] YES [ ] NO	**Invoice Distribution**		**Analysis Request**	
	Copy of Invoice with Report [ ] YES [X] NO	Select Invoice Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Company:	Wood	Email 1 or Fax	SAME AS ABOVE		
Contact:		Email 2			

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q79429	AFE/Cost Center:	PO#
Job #:	OGTW2010	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2555268	ALS Contact: AP	Sampler: SR / SJ

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	Bulk PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-32	28/07/2020	13:00	Soil	1	X							
	BH20-36 TCLP	29/7/2020			6		X	X	X	X	X		
	BH20-09 TCLP	30/7/2020			6		X	X	X	X	X		
	BH20-29 TCLP	31/7/2020			6		X	X	X	X	X		
	BH/MW 20-31	31/7/2020			6		X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	Ontario Reg 153/04 - April 15, 2011 Standards Table 1, 3, 9 ICL Coarse.
Are samples for human consumption/ use? [ ] YES [X] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs [ ]	Ice Cubes [X]	Custody seal intact	Yes [ ]	No	[ ]
Cooling Initiated [ ]					

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Owen Lutz	2/5/2021						2/5/21	1600

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Analytical Soil Laboratory Results

TCLP Analysis

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: VISHU VASISHT
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON NH3 4R7

Date Received: 24-JUL-20
Report Date: 04-AUG-20 09:10 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2479501

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

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Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1			
L2479501-1 BJH20-14 TCLP Sampled By: CLIENT on 13-JUL-20 Matrix: SOIL									
Sample Preparation									
Initial pH	9.70		0.10	pH units	28-JUL-20				
Final pH	5.72		0.10	pH units	28-JUL-20				
Physical Tests									
Air Velocity Of Fume Hood	<0.10		0.10	m/sec	27-JUL-20				
Burning Rate	N/A		0.010	mm/sec	27-JUL-20				
Ignitability-Class	NON-FLAMMABLE			No Unit	27-JUL-20				
% Moisture	17.0		0.25	%	29-JUL-20				
Samp Comment	BROWN GREYISH CLAYEY SOIL			No Unit	27-JUL-20				
Temperature Of Test Material	23.0		1.0	Deg. C	27-JUL-20				
Time To Ignition	N/A		1.0	sec	27-JUL-20				
TCLP Extractables									
Benzo(a)pyrene	<0.0010		0.0010	mg/L	29-JUL-20	0.001			
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L	28-JUL-20	20			
Fluoride (F)	<10		10	mg/L	28-JUL-20	150.0			
Nitrate and Nitrite as N	<4.0		4.0	mg/L	28-JUL-20	1000			
Nitrate-N	<2.0		2.0	mg/L	28-JUL-20				
Nitrite-N	<2.0		2.0	mg/L	28-JUL-20				
Surrogate: d12-Chrysene	81.2		60-140	%	29-JUL-20				
TCLP Metals									
Arsenic (As)	<0.050		0.050	mg/L	28-JUL-20	2.5			
Barium (Ba)	1.25		0.50	mg/L	28-JUL-20	100			
Boron (B)	<2.5		2.5	mg/L	28-JUL-20	500			
Cadmium (Cd)	<0.0050		0.0050	mg/L	28-JUL-20	0.5			
Chromium (Cr)	<0.050		0.050	mg/L	28-JUL-20	5.0			
Lead (Pb)	<0.025		0.025	mg/L	28-JUL-20	5.0			
Mercury (Hg)	<0.00010		0.00010	mg/L	28-JUL-20	0.1			
Selenium (Se)	<0.025		0.025	mg/L	28-JUL-20	1.0			
Silver (Ag)	<0.0050		0.0050	mg/L	28-JUL-20	5.0			
Uranium (U)	<0.25		0.25	mg/L	28-JUL-20	10			
TCLP VOCs									
1,1-Dichloroethylene	<0.025		0.025	mg/L	30-JUL-20	1.4			
1,2-Dichlorobenzene	<0.025		0.025	mg/L	30-JUL-20	20.0			
1,2-Dichloroethane	<0.025		0.025	mg/L	30-JUL-20	0.5			
1,4-Dichlorobenzene	<0.025		0.025	mg/L	30-JUL-20	0.5			
Benzene	<0.025		0.025	mg/L	30-JUL-20	0.5			
Carbon tetrachloride	<0.025		0.025	mg/L	30-JUL-20	0.5			
Chlorobenzene	<0.025		0.025	mg/L	30-JUL-20	8			
Chloroform	<0.10		0.10	mg/L	30-JUL-20	10			
Dichloromethane	<0.50		0.50	mg/L	30-JUL-20	5.0			
Methyl Ethyl Ketone	<1.0		1.0	mg/L	30-JUL-20	200.0			
Tetrachloroethylene	<0.025		0.025	mg/L	30-JUL-20	3			
Trichloroethylene	<0.025		0.025	mg/L	30-JUL-20	5			
Vinyl chloride	<0.050		0.050	mg/L	30-JUL-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

#1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits			
L2479501-1	BJH20-14 TCLP									
Sampled By:	CLIENT on 13-JUL-20									
Matrix:	SOIL						#1			
TCLP VOCs										
							0.2			
	Surrogate: 4-Bromofluorobenzene	96.1		70-130	%	30-JUL-20				
Volatile Organic Compounds										
	Surrogate: 1,4-Difluorobenzene	102.6		70-130	%	30-JUL-20				
Polychlorinated Biphenyls										
	Aroclor 1242	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1248	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1254	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1260	<0.010		0.010	ug/g	04-AUG-20				
	Total PCBs	<0.020		0.020	ug/g	04-AUG-20				
	Surrogate: d14-Terphenyl	109.7		60-140	%	04-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

#1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

IGNITABILITY-WT	Waste	O. Reg 347 Ignitability	EPA SW846, Method 1030, 1996

Preliminary Screening Test:
Prepare a sample "as received" 250 mm long by 20 mm wide by 10 mm high. Apply the tip of the flame to the end of the sample strip.
If the sample is non-metallic, hold the flame tip on the sample until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 2 minute test period.
If the sample is metal or metal alloy powder, hold the flame tip on the sample until the sample ignites or for a maximum of 5 minutes. If combusiton occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 20 minute test period.
Note: If the waste propagates burning of 200 mm of the test strip within 2 minutes (20 minutes for metals), the material must be evaluated by the burning rate test.
Burning Rate Test:
Refer to section 7.2 of EPA Method 1030. Samples that have a burning rate of greater than 2.2 mm/s are considered to have a positive result for ignitability according to DOT regulations. For metallic samples , the burning rate must be greater than 0.17 mm/s.

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter.
Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-511-WT	Soil	PCB-O.Reg 153/04 (July 2011)	SW846 3510/8082

An aliquot of a solid sample is extracted with a solvent, extract is cleaned up and analyzed on the GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2479501 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7

Contact: VISHU VASISHT

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5170097								
WG3371582-3 DUP		**L2478919-4**						
% Moisture		10.8	11.5		%	5.7	20	29-JUL-20
WG3371582-2 LCS								
% Moisture			100.6		%		90-110	29-JUL-20
WG3371582-1 MB								
% Moisture			<0.25		%		0.25	29-JUL-20
PCB-511-WT	**Soil**							
Batch R5173802								
WG3372436-3 DUP		**WG3372436-5**						
Aroclor 1242		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1248		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1254		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1260		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
WG3372436-2 LCS								
Aroclor 1242			100.4		%		60-140	04-AUG-20
Aroclor 1248			64.9		%		60-140	04-AUG-20
Aroclor 1254			93.3		%		60-140	04-AUG-20
Aroclor 1260			98.8		%		60-140	04-AUG-20
WG3372436-1 MB								
Aroclor 1242			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1248			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1254			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1260			<0.010		ug/g		0.01	04-AUG-20
Surrogate: d14-Terphenyl			98.2		%		60-140	04-AUG-20
WG3372436-4 MS		**WG3372436-5**						
Aroclor 1242			103.5		%		60-140	04-AUG-20
Aroclor 1254			101.0		%		60-140	04-AUG-20
Aroclor 1260			103.7		%		60-140	04-AUG-20
BAP-ONT-TCLP-WT	**Waste**							
Batch R5171318								
WG3372055-5 DUP		**WG3372055-4**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	29-JUL-20
WG3372055-2 LCS								
Benzo(a)pyrene			111.9		%		50-150	29-JUL-20
WG3372055-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	29-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5171318								
WG3372055-1 MB								
Surrogate: d12-Chrysene			103.5		%		60-140	29-JUL-20
WG3372055-3 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	29-JUL-20
Surrogate: d12-Chrysene			100.2		%		60-140	29-JUL-20
WG3372055-6 MS		**WG3372055-4**						
Benzo(a)pyrene			105.0		%		50-150	29-JUL-20
CN-TCLP-WT	**Waste**							
Batch R5168654								
WG3371720-3 DUP		**L2479344-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	28-JUL-20
WG3371720-2 LCS								
Cyanide, Weak Acid Diss			101.2		%		70-130	28-JUL-20
WG3371720-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	28-JUL-20
WG3371720-4 MS		**L2479344-1**						
Cyanide, Weak Acid Diss			100.7		%		50-140	28-JUL-20
F-TCLP-WT	**Waste**							
Batch R5169302								
WG3372166-8 DUP		**L2479353-5**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	28-JUL-20
WG3372166-6 LCS								
Fluoride (F)			90.9		%		70-130	28-JUL-20
WG3372166-5 MB								
Fluoride (F)			<10		mg/L		10	28-JUL-20
WG3372166-7 MS		**L2479353-5**						
Fluoride (F)			85.4		%		50-150	28-JUL-20
HG-TCLP-WT	**Waste**							
Batch R5168502								
WG3371697-3 DUP		**L2479390-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	28-JUL-20
WG3371697-2 LCS								
Mercury (Hg)			111.0		%		70-130	28-JUL-20
WG3371697-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	28-JUL-20
WG3371697-4 MS		**L2479390-1**						
Mercury (Hg)			103.0		%		50-140	28-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5170136								
WG3371702-4 DUP		**WG3371702-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-JUL-20
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	28-JUL-20
Boron (B)		2.6	2.9		mg/L	9.0	50	28-JUL-20
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	50	28-JUL-20
Cadmium (Cd)		0.0087	0.0088		mg/L	0.3	50	28-JUL-20
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	28-JUL-20
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	28-JUL-20
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	28-JUL-20
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	28-JUL-20
WG3371702-2 LCS								
Silver (Ag)			92.1		%		70-130	28-JUL-20
Arsenic (As)			93.9		%		70-130	28-JUL-20
Boron (B)			85.2		%		70-130	28-JUL-20
Barium (Ba)			93.8		%		70-130	28-JUL-20
Cadmium (Cd)			92.0		%		70-130	28-JUL-20
Chromium (Cr)			89.7		%		70-130	28-JUL-20
Lead (Pb)			91.0		%		70-130	28-JUL-20
Selenium (Se)			92.2		%		70-130	28-JUL-20
Uranium (U)			91.8		%		70-130	28-JUL-20
WG3371702-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	28-JUL-20
Arsenic (As)			<0.050		mg/L		0.05	28-JUL-20
Boron (B)			<2.5		mg/L		2.5	28-JUL-20
Barium (Ba)			<0.50		mg/L		0.5	28-JUL-20
Cadmium (Cd)			<0.0050		mg/L		0.005	28-JUL-20
Chromium (Cr)			<0.050		mg/L		0.05	28-JUL-20
Lead (Pb)			<0.025		mg/L		0.025	28-JUL-20
Selenium (Se)			<0.025		mg/L		0.025	28-JUL-20
Uranium (U)			<0.25		mg/L		0.25	28-JUL-20
WG3371702-5 MS		**WG3371702-3**						
Silver (Ag)			111.6		%		50-140	28-JUL-20
Arsenic (As)			96.3		%		50-140	28-JUL-20
Boron (B)			87.9		%		50-140	28-JUL-20
Barium (Ba)			96.7		%		50-140	28-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5170136								
WG3371702-5 MS		**WG3371702-3**						
Cadmium (Cd)			93.8		%		50-140	28-JUL-20
Chromium (Cr)			90.4		%		50-140	28-JUL-20
Lead (Pb)			95.6		%		50-140	28-JUL-20
Selenium (Se)			95.2		%		50-140	28-JUL-20
Uranium (U)			96.5		%		50-140	28-JUL-20
N2N3-TCLP-WT	**Waste**							
Batch R5169302								
WG3372166-8 DUP		**L2479353-5**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	28-JUL-20
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	28-JUL-20
WG3372166-6 LCS								
Nitrate-N			98.9		%		70-130	28-JUL-20
Nitrite-N			101.0		%		70-130	28-JUL-20
WG3372166-5 MB								
Nitrate-N			<2.0		mg/L		2	28-JUL-20
Nitrite-N			<2.0		mg/L		2	28-JUL-20
WG3372166-7 MS		**L2479353-5**						
Nitrate-N			97.9		%		50-150	28-JUL-20
Nitrite-N			103.6		%		50-150	28-JUL-20
VOC-TCLP-WT	**Waste**							
Batch R5170879								
WG3372471-1 LCS								
1,1-Dichloroethylene			86.4		%		70-130	29-JUL-20
1,2-Dichlorobenzene			97.1		%		70-130	29-JUL-20
1,2-Dichloroethane			94.9		%		70-130	29-JUL-20
1,4-Dichlorobenzene			97.9		%		70-130	29-JUL-20
Benzene			94.5		%		70-130	29-JUL-20
Carbon tetrachloride			93.4		%		60-140	29-JUL-20
Chlorobenzene			101.7		%		70-130	29-JUL-20
Chloroform			96.0		%		70-130	29-JUL-20
Dichloromethane			91.5		%		70-130	29-JUL-20
Methyl Ethyl Ketone			93.0		%		50-150	29-JUL-20
Tetrachloroethylene			100.4		%		70-130	29-JUL-20
Trichloroethylene			99.8		%		70-130	29-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5170879								
WG3372471-1 LCS								
Vinyl chloride			91.8		%		60-130	29-JUL-20
WG3372471-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	29-JUL-20
1,2-Dichlorobenzene			<0.025		mg/L		0.025	29-JUL-20
1,2-Dichloroethane			<0.025		mg/L		0.025	29-JUL-20
1,4-Dichlorobenzene			<0.025		mg/L		0.025	29-JUL-20
Benzene			<0.025		mg/L		0.025	29-JUL-20
Carbon tetrachloride			<0.025		mg/L		0.025	29-JUL-20
Chlorobenzene			<0.025		mg/L		0.025	29-JUL-20
Chloroform			<0.10		mg/L		0.1	29-JUL-20
Dichloromethane			<0.50		mg/L		0.5	29-JUL-20
Methyl Ethyl Ketone			<1.0		mg/L		1	29-JUL-20
Tetrachloroethylene			<0.025		mg/L		0.025	29-JUL-20
Trichloroethylene			<0.025		mg/L		0.025	29-JUL-20
Vinyl chloride			<0.050		mg/L		0.05	29-JUL-20
Surrogate: 1,4-Difluorobenzene			101.7		%		70-130	29-JUL-20
Surrogate: 4-Bromofluorobenzene			96.9		%		70-130	29-JUL-20
WG3372471-4 MS		**WG3372471-3**						
1,1-Dichloroethylene			76.7		%		50-140	30-JUL-20
1,2-Dichlorobenzene			96.5		%		50-140	30-JUL-20
1,2-Dichloroethane			86.6		%		50-140	30-JUL-20
1,4-Dichlorobenzene			98.6		%		50-140	30-JUL-20
Benzene			91.7		%		50-140	30-JUL-20
Carbon tetrachloride			92.0		%		50-140	30-JUL-20
Chlorobenzene			100.6		%		50-140	30-JUL-20
Chloroform			94.7		%		50-140	30-JUL-20
Dichloromethane			83.6		%		50-140	30-JUL-20
Methyl Ethyl Ketone			75.3		%		50-140	30-JUL-20
Tetrachloroethylene			97.9		%		50-140	30-JUL-20
Trichloroethylene			99.0		%		50-140	30-JUL-20
Vinyl chloride			73.4		%		50-140	30-JUL-20

Quality Control Report

Workorder: L2479501 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2479501 Report Date: 04-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON NH3 4R7
Contact: VISHU VASISHT

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
% Moisture							
	1	13-JUL-20	29-JUL-20 08:24	14	16	days	EHT

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2479501 were received on 24-JUL-20 15:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2479501-COFC

COC Number: 17 - 795002

Page of

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padhan
Phone:	519-504 6356
Company address below will appear on the final report	
Street:	900 Main Cove RD
City/Province:	Cambridge ON
Postal Code:	N3H 4R7
Invoice To	Same as Report To [X] YES [ ] NO
	Copy of Invoice with Report [ ] YES [X] NO
Company:	Wood
Contact:	

Report Format / Di.	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Vishu.Vasisht@woodplc.com
Email 2	Herman.padham@woodplc.com
Email 3	Owen.lutz@woodplc.com.

Invoice Distribution	
Select Invoice Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	SAME AS ABOVE.
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	OGTW2010
PO / AFE:	
LSD:	L2479501
ALS Lab Work Order # (lab use only):	~~L2479501~~

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: AP	Sampler: OL.

Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E - 100%] [ ] | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals (non)	TCLP-BTEX	TCLP-VOC	Bulk PCB	EC/Reactivity	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-15 SS7	13-7-2020	13:00	Soil	1	/							
	BH20-14 SS6	13-7-2020			1	/							
	BH20-13 SS7	14-7-2020			1	/							
	BH20-16 SS8	14-7-2020			1	/							
	BH20-17 SS7	14-7-2020			1	/							
	BH20-18 SS6	15-7-2020			1	/							
	BH20-20 SS6	15-7-2020			1	/							
	BH20-A SS7	16-7-2020			1	/							
	BH20-22 SS6	16-7-2020			1	/							
	BH20-23 SS7	17-07-2020			1	/							
	BH20-24 SS6	17-07-2020			1	/							
	BH20-14 TCLP	13-7-2020			6		/	/	/	/	/		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

[ ] YES [X] NO

Are samples for human consumption/ use?

[ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Table 1, 3, 9 ICC Comm.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [X] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	9.8

SHIPMENT RELEASE (client use)		
Released by: Owen Lutz	Date: 7-23-2020.	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time

FINAL SHIPMENT RECEPTION (lab use only)		
Received by	Date: 7/24/20	Time: 1530

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7

Date Received: 05-FEB-21
Report Date: 16-FEB-21 07:06 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2555271

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers: 17-795115
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit

Federal & Provincial Waste Regulations (MAR, 2008) - Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

(No parameter exceedances)

Federal & Provincial Waste Regulations (MAR, 2008) - Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

(No parameter exceedances)

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Sample Preparation - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**Guide Limits #1**	**#2**				
Initial pH	pH units	-	-	9.56 PEHR	9.27 PEHR	9.79 PEHR	9.71 PEHR
Final pH	pH units	-	-	5.78 PEHR	5.11 PEHR	5.83 PEHR	5.82 PEHR

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - SOIL

		Guide Limits					
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**#1**	**#2**				
% Moisture	%	-	-	11.9	14.0	15.5	14.0

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - WASTE

		Guide Limits					
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Analyte	**Unit**	**#1**	**#2**				
Air Velocity Of Fume Hood	m/sec	-	-	<0.10	<0.10	<0.10	<0.10
Burning Rate	mm/sec	-	-	N/A	N/A	N/A	N/A
Ignitability-Class		-	-	NON-FLAMMABLE	NON-FLAMMABLE	NON-FLAMMABLE	NON-FLAMMABLE
Samp Comment		-	-	BROWN GREYISH CLAYEY SOIL	BROWN GREYISH CLAYEY SOIL	BROWN GREYISH CLAYEY SOIL	BROWN CLAYEY SOIL
Temperature Of Test Material	Deg. C	-	-	21.0	21.0	21.0	21.0
Time To Ignition	sec	-	-	N/A	N/A	N/A	N/A

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP Extractables - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	Unit	#1	#2				
Benzo(a)pyrene	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Weak Acid Diss	mg/L	20	-	<0.10	<0.10	<0.10	<0.10
Fluoride (F)	mg/L	150.0	-	<10	<10	<10	<10
Nitrate and Nitrite as N	mg/L	1000	-	<4.0	<4.0	<4.0	<4.0
Nitrate-N	mg/L	-	-	<2.0	<2.0	<2.0	<2.0
Nitrite-N	mg/L	-	-	<2.0	<2.0	<2.0	<2.0
Surrogate: Chrysene d12	%	-	-	61.0	57.8	59.7	60.4

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP Metals - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Arsenic (As)	mg/L	2.5	-	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT
Barium (Ba)	mg/L	100	-	<0.50 PEHT	<0.50 PEHT	1.22 PEHT	0.94 PEHT
Boron (B)	mg/L	500	-	<2.5 PEHT	<2.5 PEHT	<2.5 PEHT	<2.5 PEHT
Cadmium (Cd)	mg/L	0.5	-	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT
Chromium (Cr)	mg/L	5.0	-	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT	<0.050 PEHT
Lead (Pb)	mg/L	5.0	-	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT
Mercury (Hg)	mg/L	0.1	-	<0.00010 PEHR	<0.00010 PEHR	<0.00010 PEHR	<0.00010 PEHR
Selenium (Se)	mg/L	1.0	-	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT	<0.025 PEHT
Silver (Ag)	mg/L	5.0	-	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT	<0.0050 PEHT
Uranium (U)	mg/L	10	-	<0.25 PEHT	<0.25 PEHT	<0.25 PEHT	<0.25 PEHT

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

TCLP VOCs - WASTE

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
1,1-Dichloroethylene	mg/L	1.4	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,2-Dichlorobenzene	mg/L	20.0	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,2-Dichloroethane	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
1,4-Dichlorobenzene	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Benzene	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Carbon tetrachloride	mg/L	0.5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Chlorobenzene	mg/L	8	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Chloroform	mg/L	10	-	<0.10 PEHR	<0.10 PEHR	<0.10 PEHR	<0.10 PEHR
Dichloromethane	mg/L	5.0	-	<0.50 PEHR	<0.50 PEHR	<0.50 PEHR	<0.50 PEHR
Methyl Ethyl Ketone	mg/L	200.0	-	<1.0 PEHR	<1.0 PEHR	<1.0 PEHR	<1.0 PEHR
Tetrachloroethylene	mg/L	3	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Trichloroethylene	mg/L	5	-	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR	<0.025 PEHR
Vinyl chloride	mg/L	0.2	-	<0.050 PEHR	<0.050 PEHR	<0.050 PEHR	<0.050 PEHR
Surrogate: 4-Bromofluorobenzene	%	-	-	94.3	101.4	93.1	100.9

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Volatile Organic Compounds - WASTE

		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Lab ID				L2555271-1	L2555271-2	L2555271-3	L2555271-4
Sample Date				29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
Sample ID				BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
Surrogate: 1,4-Difluorobenzene	%	-	-	100.2	99.9	100.2	100.2

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Polychlorinated Biphenyls - SOIL

			Lab ID	L2555271-1	L2555271-2	L2555271-3	L2555271-4
			Sample Date	29-JUL-20	30-JUL-20	31-JUL-20	31-JUL-20
			Sample ID	BH20-36 TCLP	BH20-09 TCLP	BH20-29 TCLP	BH/MW 20-31
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Aroclor 1242	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1248	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1254	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Aroclor 1260	ug/g	-	-	<0.010	<0.010	<0.010	<0.010
Total PCBs	ug/g	-	50.0	<0.020	<0.020	<0.020	<0.020
Surrogate: d14-Terphenyl	%	-	-	97.1	90.9	96.6	104.2

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90
Guide Limit #2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

IGNITABILITY-WT	Waste	O. Reg 347 Ignitability	EPA SW846, Method 1030, 1996

Preliminary Screening Test:
Prepare a sample "as received" 250 mm long by 20 mm wide by 10 mm high. Apply the tip of the flame to the end of the sample strip.
If the sample is non-metallic, hold the flame tip on the sample until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 2 minute test period.
If the sample is metal or metal alloy powder, hold the flame tip on the sample until the sample ignites or for a maximum of 5 minutes. If combusiton occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 20 minute test period.
Note: If the waste propagates burning of 200 mm of the test strip within 2 minutes (20 minutes for metals), the material must be evaluated by the burning rate test.
Burning Rate Test:
Refer to section 7.2 of EPA Method 1030. Samples that have a burning rate of greater than 2.2 mm/s are considered to have a positive result for ignitability according to DOT regulations. For metallic samples , the burning rate must be greater than 0.17 mm/s.

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-511-WT	Soil	PCB-O.Reg 153/04 (July 2011)	SW846 3510/8082

An aliquot of a solid sample is extracted with a solvent, extract is cleaned up and analyzed on the GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-795115

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5367898								
WG3485417-3 DUP		**L2555632-2**						
% Moisture		11.5	11.1		%	3.1	20	10-FEB-21
WG3485417-2 LCS								
% Moisture			98.5		%		90-110	10-FEB-21
WG3485417-1 MB								
% Moisture			<0.25		%		0.25	10-FEB-21
PCB-511-WT	**Soil**							
Batch R5370238								
WG3485412-3 DUP		**WG3485412-5**						
Aroclor 1242		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1248		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1254		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
Aroclor 1260		<0.010	<0.010	RPD-NA	ug/g	N/A	40	10-FEB-21
WG3485412-2 LCS								
Aroclor 1242			98.8		%		60-140	10-FEB-21
Aroclor 1248			105.2		%		60-140	10-FEB-21
Aroclor 1254			100.1		%		60-140	10-FEB-21
Aroclor 1260			106.2		%		60-140	10-FEB-21
WG3485412-1 MB								
Aroclor 1242			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1248			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1254			<0.010		ug/g		0.01	10-FEB-21
Aroclor 1260			<0.010		ug/g		0.01	10-FEB-21
Surrogate: d14-Terphenyl			92.3		%		60-140	10-FEB-21
WG3485412-4 MS		**WG3485412-5**						
Aroclor 1242			103.5		%		60-140	10-FEB-21
Aroclor 1254			105.5		%		60-140	10-FEB-21
Aroclor 1260			111.9		%		60-140	10-FEB-21
BAP-ONT-TCLP-WT	**Waste**							
Batch R5373307								
WG3486064-4 DUP		**WG3486064-3**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	12-FEB-21
WG3486064-2 LCS								
Benzo(a)pyrene			113.2		%		50-150	12-FEB-21
WG3486064-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	12-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5373307								
WG3486064-1 MB								
Surrogate: Chrysene d12			97.1		%		50-150	12-FEB-21
WG3486064-5 MS		**WG3486064-3**						
Benzo(a)pyrene			119.8		%		50-150	12-FEB-21
CN-TCLP-WT	**Waste**							
Batch R5370265								
WG3485697-3 DUP		**L2550893-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485697-2 LCS								
Cyanide, Weak Acid Diss			107.8		%		70-130	09-FEB-21
WG3485697-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	09-FEB-21
WG3485697-4 MS		**L2550893-1**						
Cyanide, Weak Acid Diss			105.7		%		50-140	09-FEB-21
F-TCLP-WT	**Waste**							
Batch R5369441								
WG3485887-3 DUP		**L2550893-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	09-FEB-21
WG3485887-2 LCS								
Fluoride (F)			90.8		%		70-130	09-FEB-21
WG3485887-1 MB								
Fluoride (F)			<10		mg/L		10	09-FEB-21
WG3485887-4 MS		**L2550893-1**						
Fluoride (F)			89.6		%		50-150	09-FEB-21
HG-TCLP-WT	**Waste**							
Batch R5368116								
WG3485570-3 DUP		**L2555274-2**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485570-2 LCS								
Mercury (Hg)			101.0		%		70-130	09-FEB-21
WG3485570-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	09-FEB-21
WG3485570-4 MS		**L2555274-2**						
Mercury (Hg)			92.3		%		50-140	09-FEB-21
MET-TCLP-WT	**Waste**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5369302								
WG3485537-4 DUP		**WG3485537-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	09-FEB-21
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	09-FEB-21
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	09-FEB-21
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	50	09-FEB-21
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	09-FEB-21
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	09-FEB-21
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	09-FEB-21
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	09-FEB-21
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	09-FEB-21
WG3485537-2 LCS								
Silver (Ag)			102.6		%		70-130	09-FEB-21
Arsenic (As)			103.7		%		70-130	09-FEB-21
Boron (B)			92.6		%		70-130	09-FEB-21
Barium (Ba)			104.9		%		70-130	09-FEB-21
Cadmium (Cd)			97.8		%		70-130	09-FEB-21
Chromium (Cr)			101.7		%		70-130	09-FEB-21
Lead (Pb)			102.8		%		70-130	09-FEB-21
Selenium (Se)			99.0		%		70-130	09-FEB-21
Uranium (U)			103.7		%		70-130	09-FEB-21
WG3485537-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	09-FEB-21
Arsenic (As)			<0.050		mg/L		0.05	09-FEB-21
Boron (B)			<2.5		mg/L		2.5	09-FEB-21
Barium (Ba)			<0.50		mg/L		0.5	09-FEB-21
Cadmium (Cd)			<0.0050		mg/L		0.005	09-FEB-21
Chromium (Cr)			<0.050		mg/L		0.05	09-FEB-21
Lead (Pb)			<0.025		mg/L		0.025	09-FEB-21
Selenium (Se)			<0.025		mg/L		0.025	09-FEB-21
Uranium (U)			<0.25		mg/L		0.25	09-FEB-21
WG3485537-5 MS		**WG3485537-3**						
Silver (Ag)			111.9		%		50-140	09-FEB-21
Arsenic (As)			111.5		%		50-140	09-FEB-21
Boron (B)			97.9		%		50-140	09-FEB-21
Barium (Ba)			107.5		%		50-140	09-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5369302								
WG3485537-5 MS		**WG3485537-3**						
Cadmium (Cd)			97.1		%		50-140	09-FEB-21
Chromium (Cr)			109.1		%		50-140	09-FEB-21
Lead (Pb)			98.1		%		50-140	09-FEB-21
Selenium (Se)			104.1		%		50-140	09-FEB-21
Uranium (U)			100.8		%		50-140	09-FEB-21
N2N3-TCLP-WT	**Waste**							
Batch R5369441								
WG3485887-3 DUP		**L2550893-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	09-FEB-21
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	09-FEB-21
WG3485887-2 LCS								
Nitrate-N			94.4		%		70-130	09-FEB-21
Nitrite-N			95.2		%		70-130	09-FEB-21
WG3485887-1 MB								
Nitrate-N			<2.0		mg/L		2	09-FEB-21
Nitrite-N			<2.0		mg/L		2	09-FEB-21
WG3485887-4 MS		**L2550893-1**						
Nitrate-N			97.0		%		50-150	09-FEB-21
Nitrite-N			98.5		%		50-150	09-FEB-21
VOC-TCLP-WT	**Waste**							
Batch R5369401								
WG3485455-1 LCS								
1,1-Dichloroethylene			96.3		%		70-130	10-FEB-21
1,2-Dichlorobenzene			102.1		%		70-130	10-FEB-21
1,2-Dichloroethane			105.3		%		70-130	10-FEB-21
1,4-Dichlorobenzene			103.4		%		70-130	10-FEB-21
Benzene			95.3		%		70-130	10-FEB-21
Carbon tetrachloride			99.7		%		60-140	10-FEB-21
Chlorobenzene			100.6		%		70-130	10-FEB-21
Chloroform			101.3		%		70-130	10-FEB-21
Dichloromethane			102.4		%		70-130	10-FEB-21
Methyl Ethyl Ketone			111.3		%		50-150	10-FEB-21
Tetrachloroethylene			92.9		%		70-130	10-FEB-21
Trichloroethylene			96.4		%		70-130	10-FEB-21

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5369401								
WG3485455-1 LCS								
Vinyl chloride			97.2		%		60-130	10-FEB-21
WG3485455-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	10-FEB-21
1,2-Dichlorobenzene			<0.025		mg/L		0.025	10-FEB-21
1,2-Dichloroethane			<0.025		mg/L		0.025	10-FEB-21
1,4-Dichlorobenzene			<0.025		mg/L		0.025	10-FEB-21
Benzene			<0.025		mg/L		0.025	10-FEB-21
Carbon tetrachloride			<0.025		mg/L		0.025	10-FEB-21
Chlorobenzene			<0.025		mg/L		0.025	10-FEB-21
Chloroform			<0.10		mg/L		0.1	10-FEB-21
Dichloromethane			<0.50		mg/L		0.5	10-FEB-21
Methyl Ethyl Ketone			<1.0		mg/L		1	10-FEB-21
Tetrachloroethylene			<0.025		mg/L		0.025	10-FEB-21
Trichloroethylene			<0.025		mg/L		0.025	10-FEB-21
Vinyl chloride			<0.050		mg/L		0.05	10-FEB-21
Surrogate: 1,4-Difluorobenzene			100.1		%		70-130	10-FEB-21
Surrogate: 4-Bromofluorobenzene			88.1		%		70-130	10-FEB-21
WG3485455-3 MS		**L2555254-1**						
1,1-Dichloroethylene			94.3		%		50-140	10-FEB-21
1,2-Dichlorobenzene			101.8		%		50-140	10-FEB-21
1,2-Dichloroethane			106.6		%		50-140	10-FEB-21
1,4-Dichlorobenzene			105.9		%		50-140	10-FEB-21
Benzene			95.4		%		50-140	10-FEB-21
Carbon tetrachloride			98.9		%		50-140	10-FEB-21
Chlorobenzene			100.7		%		50-140	10-FEB-21
Chloroform			102.0		%		50-140	10-FEB-21
Dichloromethane			104.5		%		50-140	10-FEB-21
Methyl Ethyl Ketone			113.3		%		50-140	10-FEB-21
Tetrachloroethylene			92.4		%		50-140	10-FEB-21
Trichloroethylene			97.1		%		50-140	10-FEB-21
Vinyl chloride			94.5		%		50-140	10-FEB-21

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2555271 Report Date: 16-FEB-21

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 Maple Grove Road Unit 10
Cambridge ON N3H 4R7
Contact: HERMAN PADHAM

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
O. Reg 347 Ignitability							
	1	29-JUL-20 13:00	09-FEB-21 00:00	30	194	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 00:00	30	193	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 00:00	30	192	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 00:00	30	192	days	EHTR
TCLP Metals							
Mercury (CVAA) for O.Reg 347							
	1	29-JUL-20 13:00	09-FEB-21 00:00	28	194	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 00:00	28	193	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 00:00	28	192	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 00:00	28	192	days	EHTR
O.Reg 347 TCLP Leachable Metals							
	1	29-JUL-20 13:00	09-FEB-21 08:28	180	195	days	EHTR
	2	30-JUL-20 13:00	09-FEB-21 08:28	180	194	days	EHTR
	3	31-JUL-20 13:00	09-FEB-21 08:28	180	193	days	EHTR
	4	31-JUL-20 13:00	09-FEB-21 08:28	180	193	days	EHTR
Polychlorinated Biphenyls							
PCB-O.Reg 153/04 (July 2011)							
	1	29-JUL-20 13:00	10-FEB-21 14:55	40	196	days	EHTR
	2	30-JUL-20 13:00	10-FEB-21 14:56	40	195	days	EHTR
	3	31-JUL-20 13:00	10-FEB-21 14:57	40	194	days	EHTR
	4	31-JUL-20 13:00	10-FEB-21 14:58	40	194	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2555271 were received on 05-FEB-21 16:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2555271-COFC

COC Number: 17 - 795115

Page 2 of 2

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padham
Phone:	519-504-6356
Company address below will appear on the final report	
Street:	900 Maple Grove Rd.
City/Province:	Cambridge, ON
Postal Code:	N3H 4R7
Invoice To	Same as Report To [X] YES [ ] NO
	Copy of Invoice with Report [ ] YES [X] NO
Company:	Wood
Contact:	

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[X] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Vishu.Vasisht@woodplc.com
Email 2	Herman.padham@woodplc.com
Email 3	Owen.lutz@woodplc.com

Invoice Distribution	
Select Invoice Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	SAME AS ABOVE
Email 2	

Project Information	
ALS Account # / Quote #:	Q 79429
Job #:	OGTW 2010
PO / AFE:	
LSD:	TCLP
ALS Lab Work Order # (lab use only):	L2555271

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: AP	Sampler: SR / SJ

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E - 100%] [ ] | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP - Metals / Inorganics	TCLP - BAP	TCLP - VOC	Bulk PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-3b	25/01/2021	13:00	Soil	1	X							
	BH20-36 TCLP	29/7/2020			6		X	X	X	X	X		
	BH20-09 TCLP	30/7/2020			6		X	X	X	X	X		
	BH20-29 TCLP	31/7/2020			6		X	X	X	X	X		
	BH/MW 20-31	31/7/2020			6		X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human consumption/ use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Ontario Reg 153/04 - April 15, 2011 Standards Table 1, 3, 9 ICL Coarse.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] | SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [X] | Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.3			

SHIPMENT RELEASE (client use)		
Released by: Owen Lutz	Date: 2/5/2021	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 2/5/21	Time: 1600

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1 If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON N3H 4R7

Date Received: 29-JUL-20
Report Date: 07-AUG-20 09:10 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2481399

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2481399-1 TCLP BH20-03									
Sampled By: SP on 20-JUL-20 @ 13:00									
Matrix: SOIL									
Sample Preparation									
Initial pH	9.61		0.10	pH units	31-JUL-20				
Final pH	5.75		0.10	pH units	31-JUL-20				
Physical Tests									
Air Velocity Of Fume Hood	<0.10		0.10	m/sec	30-JUL-20				
Burning Rate	N/A		0.010	mm/sec	30-JUL-20				
Ignitability-Class	NON-FLAMMABLE			No Unit	30-JUL-20				
% Moisture	20.4		0.25	%	31-JUL-20				
Samp Comment	BROWNISH GREY CLAYEY SOIL			No Unit	30-JUL-20				
Temperature Of Test Material	22.0		1.0	Deg. C	30-JUL-20				
Time To Ignition	N/A		1.0	sec	30-JUL-20				
TCLP Extractables									
Benzo(a)pyrene	<0.0010		0.0010	mg/L	04-AUG-20	0.001			
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L	31-JUL-20	20			
Fluoride (F)	<10		10	mg/L	31-JUL-20	150.0			
Nitrate and Nitrite as N	<4.0		4.0	mg/L	31-JUL-20	1000			
Nitrate-N	<2.0		2.0	mg/L	31-JUL-20				
Nitrite-N	<2.0		2.0	mg/L	31-JUL-20				
Surrogate: d12-Chrysene	102.2		60-140	%	04-AUG-20				
TCLP Metals									
Arsenic (As)	<0.050		0.050	mg/L	31-JUL-20	2.5			
Barium (Ba)	1.20		0.50	mg/L	31-JUL-20	100			
Boron (B)	<2.5		2.5	mg/L	31-JUL-20	500			
Cadmium (Cd)	<0.0050		0.0050	mg/L	31-JUL-20	0.5			
Chromium (Cr)	<0.050		0.050	mg/L	31-JUL-20	5.0			
Lead (Pb)	<0.025		0.025	mg/L	31-JUL-20	5.0			
Mercury (Hg)	<0.00010		0.00010	mg/L	31-JUL-20	0.1			
Selenium (Se)	<0.025		0.025	mg/L	31-JUL-20	1.0			
Silver (Ag)	<0.0050		0.0050	mg/L	31-JUL-20	5.0			
Uranium (U)	<0.25		0.25	mg/L	31-JUL-20	10			
TCLP VOCs									
1,1-Dichloroethylene	<0.025		0.025	mg/L	05-AUG-20	1.4			
1,2-Dichlorobenzene	<0.025		0.025	mg/L	05-AUG-20	20.0			
1,2-Dichloroethane	<0.025		0.025	mg/L	05-AUG-20	0.5			
1,4-Dichlorobenzene	<0.025		0.025	mg/L	05-AUG-20	0.5			
Benzene	<0.025		0.025	mg/L	05-AUG-20	0.5			
Carbon tetrachloride	<0.025		0.025	mg/L	05-AUG-20	0.5			
Chlorobenzene	<0.025		0.025	mg/L	05-AUG-20	8			
Chloroform	<0.10		0.10	mg/L	05-AUG-20	10			
Dichloromethane	<0.50		0.50	mg/L	05-AUG-20	5.0			
Methyl Ethyl Ketone	<1.0		1.0	mg/L	05-AUG-20	200.0			
Tetrachloroethylene	<0.025		0.025	mg/L	05-AUG-20	3			
Trichloroethylene	<0.025		0.025	mg/L	05-AUG-20	5			
Vinyl chloride	<0.050		0.050	mg/L	05-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal & Provincial Waste Regulations (MAR, 2008) = [Suite] - ON-REG347/90 - Schedule 4 Leachate + Bulk PCB

#1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

#2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

ANALYTICAL GUIDELINE REPORT

OGTW2010

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2481399-1 TCLP BH20-03									
Sampled By: SP on 20-JUL-20 @ 13:00									
Matrix: SOIL									
TCLP VOCs						0.2			
Surrogate: 4-Bromofluorobenzene	100.3		70-130	%	05-AUG-20				
Volatile Organic Compounds									
Surrogate: 1,4-Difluorobenzene	103.1		70-130	%	05-AUG-20				
Polychlorinated Biphenyls									
Aroclor 1242	<0.010		0.010	ug/g	04-AUG-20				
Aroclor 1248	<0.010		0.010	ug/g	04-AUG-20				
Aroclor 1254	<0.010		0.010	ug/g	04-AUG-20				
Aroclor 1260	<0.010		0.010	ug/g	04-AUG-20				
Total PCBs	<0.020		0.020	ug/g	04-AUG-20		50.0		
Surrogate: d14-Terphenyl	112.7		60-140	%	04-AUG-20				
L2481399-2 TCLP BH20-26									
Sampled By: SP on 27-JUL-20 @ 13:00									
Matrix: SOIL						#1	#2		
Sample Preparation									
Initial pH	9.54		0.10	pH units	31-JUL-20				
Final pH	5.13		0.10	pH units	31-JUL-20				
Physical Tests									
Air Velocity Of Fume Hood	<0.10		0.10	m/sec	30-JUL-20				
Burning Rate	N/A		0.010	mm/sec	30-JUL-20				
Ignitability-Class	NON-FLAMMABLE			No Unit	30-JUL-20				
% Moisture	8.21		0.25	%	01-AUG-20				
Samp Comment	BROWN SOIL			No Unit	30-JUL-20				
Temperature Of Test Material	22.0		1.0	Deg. C	30-JUL-20				
Time To Ignition	N/A		1.0	sec	30-JUL-20				
TCLP Extractables									
Benzo(a)pyrene	<0.0010		0.0010	mg/L	04-AUG-20	0.001			
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L	31-JUL-20	20			
Fluoride (F)	<10		10	mg/L	31-JUL-20	150.0			
Nitrate and Nitrite as N	<4.0		4.0	mg/L	31-JUL-20	1000			
Nitrate-N	<2.0		2.0	mg/L	31-JUL-20				
Nitrite-N	<2.0		2.0	mg/L	31-JUL-20				
Surrogate: d12-Chrysene	109.9		60-140	%	04-AUG-20				
TCLP Metals									
Arsenic (As)	<0.050		0.050	mg/L	31-JUL-20	2.5			
Barium (Ba)	0.82		0.50	mg/L	31-JUL-20	100			
Boron (B)	<2.5		2.5	mg/L	31-JUL-20	500			
Cadmium (Cd)	0.0056		0.0050	mg/L	31-JUL-20	0.5			
Chromium (Cr)	<0.050		0.050	mg/L	31-JUL-20	5.0			
Lead (Pb)	0.125		0.025	mg/L	31-JUL-20	5.0			
Mercury (Hg)	<0.00010		0.00010	mg/L	31-JUL-20	0.1			
Selenium (Se)	<0.025		0.025	mg/L	31-JUL-20	1.0			
Silver (Ag)	<0.0050		0.0050	mg/L	31-JUL-20	5.0			

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal & Provincial Waste Regulations (MAR, 2008) = [Suite] - ON-REG347/90 - Schedule 4 Leachate + Bulk PCB

#1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

#2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2481399-2	TCLP BH20-26									
Sampled By:	SP on 27-JUL-20 @ 13:00									
Matrix:	SOIL									
TCLP Metals										
	Uranium (U)	<0.25		0.25	mg/L	31-JUL-20	10			
TCLP VOCs										
	1,1-Dichloroethylene	<0.025		0.025	mg/L	04-AUG-20	1.4			
	1,2-Dichlorobenzene	<0.025		0.025	mg/L	04-AUG-20	20.0			
	1,2-Dichloroethane	<0.025		0.025	mg/L	04-AUG-20	0.5			
	1,4-Dichlorobenzene	<0.025		0.025	mg/L	04-AUG-20	0.5			
	Benzene	<0.025		0.025	mg/L	04-AUG-20	0.5			
	Carbon tetrachloride	<0.025		0.025	mg/L	04-AUG-20	0.5			
	Chlorobenzene	<0.025		0.025	mg/L	04-AUG-20	8			
	Chloroform	<0.10		0.10	mg/L	04-AUG-20	10			
	Dichloromethane	<0.50		0.50	mg/L	04-AUG-20	5.0			
	Methyl Ethyl Ketone	<1.0		1.0	mg/L	04-AUG-20	200.0			
	Tetrachloroethylene	<0.025		0.025	mg/L	04-AUG-20	3			
	Trichloroethylene	<0.025		0.025	mg/L	04-AUG-20	5			
	Vinyl chloride	<0.050		0.050	mg/L	04-AUG-20	0.2			
	Surrogate: 4-Bromofluorobenzene	101.7		70-130	%	04-AUG-20				
Volatile Organic Compounds										
	Surrogate: 1,4-Difluorobenzene	101.9		70-130	%	04-AUG-20				
Polychlorinated Biphenyls										
	Aroclor 1242	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1248	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1254	<0.010		0.010	ug/g	04-AUG-20				
	Aroclor 1260	<0.010		0.010	ug/g	04-AUG-20				
	Total PCBs	<0.020		0.020	ug/g	04-AUG-20		50.0		
	Surrogate: d14-Terphenyl	106.6		60-140	%	04-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal & Provincial Waste Regulations (MAR, 2008) = [Suite] - ON-REG347/90 - Schedule 4 Leachate + Bulk PCB

#1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

#2: Polychlorinated Biphenyls (PCBs) - Ontario Regulation 347/90

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

IGNITABILITY-WT	Waste	O. Reg 347 Ignitability	EPA SW846, Method 1030, 1996

Preliminary Screening Test:
Prepare a sample "as received" 250 mm long by 20 mm wide by 10 mm high. Apply the tip of the flame to the end of the sample strip.
If the sample is non-metallic, hold the flame tip on the sample until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 2 minute test period.
If the sample is metal or metal alloy powder, hold the flame tip on the sample until the sample ignites or for a maximum of 5 minutes. If combusiton occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 20 minute test period.
Note: If the waste propagates burning of 200 mm of the test strip within 2 minutes (20 minutes for metals), the material must be evaluated by the burning rate test.
Burning Rate Test:
Refer to section 7.2 of EPA Method 1030. Samples that have a burning rate of greater than 2.2 mm/s are considered to have a positive result for ignitability according to DOT regulations. For metallic samples , the burning rate must be greater than 0.17 mm/s.

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter.
Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-511-WT	Soil	PCB-O.Reg 153/04 (July 2011)	SW846 3510/8082

An aliquot of a solid sample is extracted with a solvent, extract is cleaned up and analyzed on the GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2481399 Report Date: 07-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5172431								
WG3373351-3 DUP		**L2480134-8**						
% Moisture		11.7	12.2		%	3.6	20	31-JUL-20
WG3373351-2 LCS								
% Moisture			101.6		%		90-110	31-JUL-20
WG3373351-1 MB								
% Moisture			<0.25		%		0.25	31-JUL-20
Batch R5172953								
WG3374309-3 DUP		**L2480691-1**						
% Moisture		11.9	10.3		%	14	20	01-AUG-20
WG3374309-2 LCS								
% Moisture			100.6		%		90-110	01-AUG-20
WG3374309-1 MB								
% Moisture			<0.25		%		0.25	01-AUG-20
PCB-511-WT	**Soil**							
Batch R5174198								
WG3374426-3 DUP		**WG3374426-5**						
Aroclor 1242		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1248		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1254		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
Aroclor 1260		<0.010	<0.010	RPD-NA	ug/g	N/A	40	04-AUG-20
WG3374426-2 LCS								
Aroclor 1242			101.9		%		60-140	04-AUG-20
Aroclor 1248			87.7		%		60-140	04-AUG-20
Aroclor 1254			96.7		%		60-140	04-AUG-20
Aroclor 1260			98.7		%		60-140	04-AUG-20
WG3374426-1 MB								
Aroclor 1242			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1248			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1254			<0.010		ug/g		0.01	04-AUG-20
Aroclor 1260			<0.010		ug/g		0.01	04-AUG-20
Surrogate: d14-Terphenyl			101.5		%		60-140	04-AUG-20
WG3374426-4 MS		**WG3374426-5**						
Aroclor 1242			103.0		%		60-140	04-AUG-20
Aroclor 1254			97.2		%		60-140	04-AUG-20
Aroclor 1260			113.0		%		60-140	04-AUG-20
BAP-ONT-TCLP-WT	**Waste**							

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5172958								
WG3374198-4 DUP		**WG3374198-3**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	31-JUL-20
WG3374198-2 LCS								
Benzo(a)pyrene			126.6		%		50-150	31-JUL-20
WG3374198-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	31-JUL-20
Surrogate: d12-Chrysene			106.2		%		60-140	31-JUL-20
WG3374198-6 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	04-AUG-20
Surrogate: d12-Chrysene			107.9		%		60-140	04-AUG-20
WG3374198-5 MS		**WG3374198-3**						
Benzo(a)pyrene			118.6		%		50-150	31-JUL-20
CN-TCLP-WT	**Waste**							
Batch R5174026								
WG3374594-3 DUP		**L2480702-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	31-JUL-20
WG3374594-2 LCS								
Cyanide, Weak Acid Diss			107.5		%		70-130	31-JUL-20
WG3374594-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	31-JUL-20
WG3374594-4 MS		**L2480702-1**						
Cyanide, Weak Acid Diss			104.6		%		50-140	31-JUL-20
F-TCLP-WT	**Waste**							
Batch R5174206								
WG3374950-3 DUP		**L2480702-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	31-JUL-20
WG3374950-2 LCS								
Fluoride (F)			96.3		%		70-130	31-JUL-20
WG3374950-1 MB								
Fluoride (F)			<10		mg/L		10	31-JUL-20
WG3374950-4 MS		**L2480702-1**						
Fluoride (F)			92.8		%		50-150	31-JUL-20
HG-TCLP-WT	**Waste**							
Batch R5172872								
WG3374405-3 DUP		**L2481306-2**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	31-JUL-20
WG3374405-2 LCS								

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TCLP-WT	**Waste**							
Batch R5172872								
WG3374405-2 LCS								
Mercury (Hg)			108.0		%		70-130	31-JUL-20
WG3374405-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	31-JUL-20
WG3374405-4 MS		**L2481306-2**						
Mercury (Hg)			97.3		%		50-140	31-JUL-20
MET-TCLP-WT	**Waste**							
Batch R5172924								
WG3374416-4 DUP		**WG3374416-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	31-JUL-20
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	31-JUL-20
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	31-JUL-20
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	50	31-JUL-20
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	31-JUL-20
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	31-JUL-20
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	31-JUL-20
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	31-JUL-20
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	31-JUL-20
WG3374416-2 LCS								
Silver (Ag)			100.9		%		70-130	31-JUL-20
Arsenic (As)			100.3		%		70-130	31-JUL-20
Boron (B)			97.6		%		70-130	31-JUL-20
Barium (Ba)			98.4		%		70-130	31-JUL-20
Cadmium (Cd)			99.0		%		70-130	31-JUL-20
Chromium (Cr)			101.5		%		70-130	31-JUL-20
Lead (Pb)			98.1		%		70-130	31-JUL-20
Selenium (Se)			101.1		%		70-130	31-JUL-20
Uranium (U)			96.8		%		70-130	31-JUL-20
WG3374416-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	31-JUL-20
Arsenic (As)			<0.050		mg/L		0.05	31-JUL-20
Boron (B)			<2.5		mg/L		2.5	31-JUL-20
Barium (Ba)			<0.50		mg/L		0.5	31-JUL-20
Cadmium (Cd)			<0.0050		mg/L		0.005	31-JUL-20
Chromium (Cr)			<0.050		mg/L		0.05	31-JUL-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5172924								
WG3374416-1 MB								
Lead (Pb)			<0.025		mg/L		0.025	31-JUL-20
Selenium (Se)			<0.025		mg/L		0.025	31-JUL-20
Uranium (U)			<0.25		mg/L		0.25	31-JUL-20
WG3374416-5 MS		**WG3374416-3**						
Silver (Ag)			119.8		%		50-140	31-JUL-20
Arsenic (As)			104.7		%		50-140	31-JUL-20
Boron (B)			95.7		%		50-140	31-JUL-20
Barium (Ba)			103.8		%		50-140	31-JUL-20
Cadmium (Cd)			100.4		%		50-140	31-JUL-20
Chromium (Cr)			102.3		%		50-140	31-JUL-20
Lead (Pb)			98.2		%		50-140	31-JUL-20
Selenium (Se)			103.2		%		50-140	31-JUL-20
Uranium (U)			98.1		%		50-140	31-JUL-20
N2N3-TCLP-WT	**Waste**							
Batch R5174206								
WG3374950-3 DUP		**L2480702-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	31-JUL-20
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	31-JUL-20
WG3374950-2 LCS								
Nitrate-N			98.0		%		70-130	31-JUL-20
Nitrite-N			101.7		%		70-130	31-JUL-20
WG3374950-1 MB								
Nitrate-N			<2.0		mg/L		2	31-JUL-20
Nitrite-N			<2.0		mg/L		2	31-JUL-20
WG3374950-4 MS		**L2480702-1**						
Nitrate-N			97.3		%		50-150	31-JUL-20
Nitrite-N			99.3		%		50-150	31-JUL-20
VOC-TCLP-WT	**Waste**							
Batch R5173070								
WG3374378-1 LCS								
1,1-Dichloroethylene			84.9		%		70-130	31-JUL-20
1,2-Dichlorobenzene			99.9		%		70-130	31-JUL-20
1,2-Dichloroethane			90.7		%		70-130	31-JUL-20
1,4-Dichlorobenzene			101.8		%		70-130	31-JUL-20
Benzene			95.2				70-130	

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5173070								
WG3374378-1 LCS								
Benzene			95.2		%		70-130	31-JUL-20
Carbon tetrachloride			92.7		%		60-140	31-JUL-20
Chlorobenzene			96.0		%		70-130	31-JUL-20
Chloroform			98.3		%		70-130	31-JUL-20
Dichloromethane			94.0		%		70-130	31-JUL-20
Methyl Ethyl Ketone			111.5		%		50-150	31-JUL-20
Tetrachloroethylene			97.8		%		70-130	31-JUL-20
Trichloroethylene			102.1		%		70-130	31-JUL-20
Vinyl chloride			80.7		%		60-130	31-JUL-20
WG3374378-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	31-JUL-20
1,2-Dichlorobenzene			<0.025		mg/L		0.025	31-JUL-20
1,2-Dichloroethane			<0.025		mg/L		0.025	31-JUL-20
1,4-Dichlorobenzene			<0.025		mg/L		0.025	31-JUL-20
Benzene			<0.025		mg/L		0.025	31-JUL-20
Carbon tetrachloride			<0.025		mg/L		0.025	31-JUL-20
Chlorobenzene			<0.025		mg/L		0.025	31-JUL-20
Chloroform			<0.10		mg/L		0.1	31-JUL-20
Dichloromethane			<0.50		mg/L		0.5	31-JUL-20
Methyl Ethyl Ketone			<1.0		mg/L		1	31-JUL-20
Tetrachloroethylene			<0.025		mg/L		0.025	31-JUL-20
Trichloroethylene			<0.025		mg/L		0.025	31-JUL-20
Vinyl chloride			<0.050		mg/L		0.05	31-JUL-20
Surrogate: 1,4-Difluorobenzene			103.0		%		70-130	31-JUL-20
Surrogate: 4-Bromofluorobenzene			104.0		%		70-130	31-JUL-20
WG3374378-4 MS		**WG3374378-3**						
1,1-Dichloroethylene			77.7		%		50-140	04-AUG-20
1,2-Dichlorobenzene			99.0		%		50-140	04-AUG-20
1,2-Dichloroethane			91.0		%		50-140	04-AUG-20
1,4-Dichlorobenzene			100.4		%		50-140	04-AUG-20
Benzene			93.8		%		50-140	04-AUG-20
Carbon tetrachloride			90.9		%		50-140	04-AUG-20
Chlorobenzene			94.8		%		50-140	04-AUG-20
Chloroform			98.9		%		50-140	04-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5173070								
WG3374378-4 MS		**WG3374378-3**						
Dichloromethane			90.4		%		50-140	04-AUG-20
Methyl Ethyl Ketone			104.8		%		50-140	04-AUG-20
Tetrachloroethylene			92.7		%		50-140	04-AUG-20
Trichloroethylene			99.5		%		50-140	04-AUG-20
Vinyl chloride			67.4		%		50-140	04-AUG-20

Quality Control Report

Workorder: L2481399 Report Date: 07-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2481399-COFC

COC Number: 17 -

Page 1 of 2

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padham
Phone:	
	Company address below will appear on the final report
Street:	900 maple grove rd
City/Province:	Cambridge On
Postal Code:	N3H4R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Wood
Contact:	

Report Format / Dis

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax vishu.vasisht@woodplc.com

Email 2 herman.padham@woodplc.com

Email 3 owen.lutz@woodplc.com

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax SAME AS ABOVE

Email 2

Project Information

ALS Account # / Quote #: Q79429

Job #: OGTW2010

PO / AFE:

LSD:

TCLP AP

ALS Lab Work Order # (lab use only): L2481399

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact: AP Sampler: SP

..tact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	TCLP BH20-03	20-7-2020	13:00	soil	7		R	R	R	R	R		
	TCLP BH20-26	27-7-2020	13:00	soil	6		R	R	R	R	R		
	BH/MW 20-06	21-7-2020	13:00	soil	1	R							
	BH/MW20-08	22-7-2020	13:00	soil	1	R							
	BH20-03	20-7-2020	13:00	soil	1	R							
	BH20-07	22-7-2020	13:00	soil	1	R							
	BH/MW 20-01	23-7-2020	13:00	soil	1	R							
	BH/MW20-04	20-7-2020	13:00	soil	1	R							
	BH 20-05	21-7-2020	13:00	soil	1	R							
	BH20-02	24-7-2020	13:00	soil	1	R							
	BH20-27	27-7-2020	13:00	soil	1	R							
	BH20-25	27-7-2020	13:00	soil	1	R							

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Ontario Regulation 153/04 - April 15, 2011 Standards

Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				7.2			

SHIPMENT RELEASE (client use)

Released by: Owen Lutz	Date:28-7-2020	Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: DB	Date: 07/29/20	Time: 15:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Wood Environment & Infrastructure Solutions (Cambridge)
ATTN: HERMAN PADHAM
900 MAPLE GROVE ROAD
UNIT 10
CAMBRIDGE ON N3H 4R7

Date Received: 10-AUG-20
Report Date: 18-AUG-20 11:47 (MT)
Version: FINAL

Client Phone: 519-650-7100

Certificate of Analysis

Lab Work Order #: L2486315

Project P.O. #: NOT SUBMITTED
Job Reference: OGTW2010
C of C Numbers:
Legal Site Desc:

Aaron Payne
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2486315-1 TCLP-BH20-37B Sampled By: CLIENT on 04-AUG-20 @ 13:00 Matrix: SOIL									
Sample Preparation									
Initial pH	8.96		0.10	pH units	12-AUG-20				
Final pH	5.88		0.10	pH units	12-AUG-20				
Physical Tests									
Air Velocity Of Fume Hood	<0.10		0.10	m/sec	11-AUG-20				
Burning Rate	N/A		0.010	mm/sec	11-AUG-20				
Ignitability-Class	NON-FLAMMABLE			No Unit	11-AUG-20				
% Moisture	19.6		0.25	%	13-AUG-20				
Samp Comment	BROWN SOIL			No Unit	11-AUG-20				
Temperature Of Test Material	23.0		1.0	Deg. C	11-AUG-20				
Time To Ignition	N/A		1.0	sec	11-AUG-20				
TCLP Extractables									
Benzo(a)pyrene	<0.0010		0.0010	mg/L	13-AUG-20				
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L	12-AUG-20				
Fluoride (F)	<10		10	mg/L	12-AUG-20				
Nitrate and Nitrite as N	<4.0		4.0	mg/L	12-AUG-20				
Nitrate-N	<2.0		2.0	mg/L	12-AUG-20				
Nitrite-N	<2.0		2.0	mg/L	12-AUG-20				
Surrogate: d12-Chrysene	83.2		60-140	%	13-AUG-20				
TCLP Metals									
Arsenic (As)	<0.050		0.050	mg/L	12-AUG-20				
Barium (Ba)	0.58		0.50	mg/L	12-AUG-20				
Boron (B)	<2.5		2.5	mg/L	12-AUG-20				
Cadmium (Cd)	<0.0050		0.0050	mg/L	12-AUG-20				
Chromium (Cr)	<0.050		0.050	mg/L	12-AUG-20				
Lead (Pb)	<0.025		0.025	mg/L	12-AUG-20				
Mercury (Hg)	<0.00010		0.00010	mg/L	12-AUG-20				
Selenium (Se)	<0.025		0.025	mg/L	12-AUG-20				
Silver (Ag)	<0.0050		0.0050	mg/L	12-AUG-20				
Uranium (U)	<0.25		0.25	mg/L	12-AUG-20				
TCLP VOCs									
1,1-Dichloroethylene	<0.025		0.025	mg/L	13-AUG-20				
1,2-Dichlorobenzene	<0.025		0.025	mg/L	13-AUG-20				
1,2-Dichloroethane	<0.025		0.025	mg/L	13-AUG-20				
1,4-Dichlorobenzene	<0.025		0.025	mg/L	13-AUG-20				
Benzene	<0.025		0.025	mg/L	13-AUG-20				
Carbon tetrachloride	<0.025		0.025	mg/L	13-AUG-20				
Chlorobenzene	<0.025		0.025	mg/L	13-AUG-20				
Chloroform	<0.10		0.10	mg/L	13-AUG-20				
Dichloromethane	<0.50		0.50	mg/L	13-AUG-20				
Methyl Ethyl Ketone	<1.0		1.0	mg/L	13-AUG-20				
Tetrachloroethylene	<0.025		0.025	mg/L	13-AUG-20				
Trichloroethylene	<0.025		0.025	mg/L	13-AUG-20				
Vinyl chloride	<0.050		0.050	mg/L	13-AUG-20				
Surrogate: 4-Bromofluorobenzene	100.4		70-130	%	13-AUG-20				
Volatile Organic Compounds									

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	
L2486315-1 TCLP-BH20-37B Sampled By: CLIENT on 04-AUG-20 @ 13:00 Matrix: SOIL									
Volatile Organic Compounds									
Surrogate: 1,4-Difluorobenzene	99.6		70-130	%	13-AUG-20				
Polychlorinated Biphenyls									
Aroclor 1242	<0.010		0.010	ug/g	17-AUG-20				
Aroclor 1248	<0.010		0.010	ug/g	17-AUG-20				
Aroclor 1254	<0.010		0.010	ug/g	17-AUG-20				
Aroclor 1260	<0.010		0.010	ug/g	17-AUG-20				
Total PCBs	<0.020		0.020	ug/g	17-AUG-20	0.3	1.1	0.3	
Surrogate: d14-Terphenyl	103.4		60-140	%	17-AUG-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T3/T9-SOIL-ICC-COARSE

#1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#2: T3-Soil-Ind/Com/Commu. Property Use (Coarse)

#3: T9-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

IGNITABILITY-WT	Waste	O. Reg 347 Ignitability	EPA SW846, Method 1030, 1996

Preliminary Screening Test:
Prepare a sample "as received" 250 mm long by 20 mm wide by 10 mm high. Apply the tip of the flame to the end of the sample strip.
If the sample is non-metallic, hold the flame tip on the sample until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 2 minute test period.
If the sample is metal or metal alloy powder, hold the flame tip on the sample until the sample ignites or for a maximum of 5 minutes. If combusiton occurs, begin timing with a stop watch and note whether the sample propagates up to the 200 mm mark within the 20 minute test period.
Note: If the waste propagates burning of 200 mm of the test strip within 2 minutes (20 minutes for metals), the material must be evaluated by the burning rate test.
Burning Rate Test:
Refer to section 7.2 of EPA Method 1030. Samples that have a burning rate of greater than 2.2 mm/s are considered to have a positive result for ignitability according to DOT regulations. For metallic samples , the burning rate must be greater than 0.17 mm/s.

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter.
Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-511-WT	Soil	PCB-O.Reg 153/04 (July 2011)	SW846 3510/8082

An aliquot of a solid sample is extracted with a solvent, extract is cleaned up and analyzed on the GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2486315 Report Date: 18-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7

Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5183617								
WG3381535-3 DUP		**L2486313-1**						
% Moisture		6.75	6.76		%	0.2	20	13-AUG-20
WG3381535-2 LCS								
% Moisture			101.0		%		90-110	13-AUG-20
WG3381535-1 MB								
% Moisture			<0.25		%		0.25	13-AUG-20
PCB-511-WT	**Soil**							
Batch R5190006								
WG3382967-3 DUP		**WG3382967-5**						
Aroclor 1242		<0.010	<0.010	RPD-NA	ug/g	N/A	40	17-AUG-20
Aroclor 1248		<0.010	<0.010	RPD-NA	ug/g	N/A	40	17-AUG-20
Aroclor 1254		<0.010	<0.010	RPD-NA	ug/g	N/A	40	17-AUG-20
Aroclor 1260		<0.010	<0.010	RPD-NA	ug/g	N/A	40	17-AUG-20
WG3382967-2 LCS								
Aroclor 1242			106.0		%		60-140	17-AUG-20
Aroclor 1248			93.8		%		60-140	17-AUG-20
Aroclor 1254			98.1		%		60-140	17-AUG-20
Aroclor 1260			101.1		%		60-140	17-AUG-20
WG3382967-1 MB								
Aroclor 1242			<0.010		ug/g		0.01	17-AUG-20
Aroclor 1248			<0.010		ug/g		0.01	17-AUG-20
Aroclor 1254			<0.010		ug/g		0.01	17-AUG-20
Aroclor 1260			<0.010		ug/g		0.01	17-AUG-20
Surrogate: d14-Terphenyl			101.4		%		60-140	17-AUG-20
WG3382967-4 MS		**WG3382967-5**						
Aroclor 1242			102.3		%		60-140	17-AUG-20
Aroclor 1254			95.1		%		60-140	17-AUG-20
Aroclor 1260			101.0		%		60-140	17-AUG-20
BAP-ONT-TCLP-WT	**Waste**							
Batch R5185618								
WG3381851-6 DUP		**WG3381851-4**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	13-AUG-20
WG3381851-2 LCS								
Benzo(a)pyrene			94.0		%		50-150	13-AUG-20
WG3381851-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	13-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5185618								
WG3381851-1 MB								
Surrogate: d12-Chrysene			89.8		%		60-140	13-AUG-20
WG3381851-3 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	13-AUG-20
Surrogate: d12-Chrysene			86.0		%		60-140	13-AUG-20
WG3381851-5 MS		**WG3381851-4**						
Benzo(a)pyrene			86.7		%		50-150	13-AUG-20
CN-TCLP-WT	**Waste**							
Batch R5183119								
WG3381511-7 DUP		**L2485482-6**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	12-AUG-20
WG3381511-6 LCS								
Cyanide, Weak Acid Diss			105.2		%		70-130	12-AUG-20
WG3381511-5 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	12-AUG-20
WG3381511-8 MS		**L2485482-6**						
Cyanide, Weak Acid Diss			103.3		%		50-140	12-AUG-20
F-TCLP-WT	**Waste**							
Batch R5185789								
WG3382076-3 DUP		**L2480591-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	12-AUG-20
WG3382076-2 LCS								
Fluoride (F)			96.1		%		70-130	12-AUG-20
WG3382076-1 MB								
Fluoride (F)			<10		mg/L		10	12-AUG-20
WG3382076-4 MS		**L2480591-1**						
Fluoride (F)			95.0		%		50-150	12-AUG-20
HG-TCLP-WT	**Waste**							
Batch R5182496								
WG3381559-3 DUP		**L2486414-2**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	12-AUG-20
WG3381559-2 LCS								
Mercury (Hg)			109.0		%		70-130	12-AUG-20
WG3381559-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	12-AUG-20
WG3381559-4 MS		**L2486414-2**						
Mercury (Hg)			104.1		%		50-140	12-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5183376								
WG3381541-4 DUP		**WG3381541-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	12-AUG-20
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	12-AUG-20
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	12-AUG-20
Barium (Ba)		0.70	0.71		mg/L	1.7	50	12-AUG-20
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	12-AUG-20
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	12-AUG-20
Lead (Pb)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	12-AUG-20
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	12-AUG-20
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	12-AUG-20
WG3381541-2 LCS								
Silver (Ag)			98.8		%		70-130	12-AUG-20
Arsenic (As)			97.7		%		70-130	12-AUG-20
Boron (B)			98.7		%		70-130	12-AUG-20
Barium (Ba)			95.8		%		70-130	12-AUG-20
Cadmium (Cd)			97.3		%		70-130	12-AUG-20
Chromium (Cr)			98.1		%		70-130	12-AUG-20
Lead (Pb)			102.5		%		70-130	12-AUG-20
Selenium (Se)			99.1		%		70-130	12-AUG-20
Uranium (U)			104.2		%		70-130	12-AUG-20
WG3381541-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	12-AUG-20
Arsenic (As)			<0.050		mg/L		0.05	12-AUG-20
Boron (B)			<2.5		mg/L		2.5	12-AUG-20
Barium (Ba)			<0.50		mg/L		0.5	12-AUG-20
Cadmium (Cd)			<0.0050		mg/L		0.005	12-AUG-20
Chromium (Cr)			<0.050		mg/L		0.05	12-AUG-20
Lead (Pb)			<0.025		mg/L		0.025	12-AUG-20
Selenium (Se)			<0.025		mg/L		0.025	12-AUG-20
Uranium (U)			<0.25		mg/L		0.25	12-AUG-20
WG3381541-5 MS		**WG3381541-3**						
Silver (Ag)			116.9		%		50-140	12-AUG-20
Arsenic (As)			102.5		%		50-140	12-AUG-20
Boron (B)			100.8		%		50-140	12-AUG-20
Barium (Ba)			105.3		%		50-140	12-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5183376								
WG3381541-5 MS		**WG3381541-3**						
Cadmium (Cd)			102.6		%		50-140	12-AUG-20
Chromium (Cr)			105.3		%		50-140	12-AUG-20
Lead (Pb)			105.8		%		50-140	12-AUG-20
Selenium (Se)			104.0		%		50-140	12-AUG-20
Uranium (U)			103.9		%		50-140	12-AUG-20
N2N3-TCLP-WT	**Waste**							
Batch R5185789								
WG3382076-3 DUP		**L2480591-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	12-AUG-20
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	12-AUG-20
WG3382076-2 LCS								
Nitrate-N			99.9		%		70-130	12-AUG-20
Nitrite-N			103.7		%		70-130	12-AUG-20
WG3382076-1 MB								
Nitrate-N			<2.0		mg/L		2	12-AUG-20
Nitrite-N			<2.0		mg/L		2	12-AUG-20
WG3382076-4 MS		**L2480591-1**						
Nitrate-N			98.2		%		50-150	12-AUG-20
Nitrite-N			100.4		%		50-150	12-AUG-20
VOC-TCLP-WT	**Waste**							
Batch R5182590								
WG3381416-1 LCS								
1,1-Dichloroethylene			88.0		%		70-130	12-AUG-20
1,2-Dichlorobenzene			98.3		%		70-130	12-AUG-20
1,2-Dichloroethane			98.1		%		70-130	12-AUG-20
1,4-Dichlorobenzene			97.7		%		70-130	12-AUG-20
Benzene			96.3		%		70-130	12-AUG-20
Carbon tetrachloride			94.8		%		60-140	12-AUG-20
Chlorobenzene			95.4		%		70-130	12-AUG-20
Chloroform			97.9		%		70-130	12-AUG-20
Dichloromethane			98.0		%		70-130	12-AUG-20
Methyl Ethyl Ketone			101.7		%		50-150	12-AUG-20
Tetrachloroethylene			98.1		%		70-130	12-AUG-20
Trichloroethylene			96.5		%		70-130	12-AUG-20

Quality Control Report

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5182590								
WG3381416-1 LCS								
Vinyl chloride			92.6		%		60-130	12-AUG-20
WG3381416-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	12-AUG-20
1,2-Dichlorobenzene			<0.025		mg/L		0.025	12-AUG-20
1,2-Dichloroethane			<0.025		mg/L		0.025	12-AUG-20
1,4-Dichlorobenzene			<0.025		mg/L		0.025	12-AUG-20
Benzene			<0.025		mg/L		0.025	12-AUG-20
Carbon tetrachloride			<0.025		mg/L		0.025	12-AUG-20
Chlorobenzene			<0.025		mg/L		0.025	12-AUG-20
Chloroform			<0.10		mg/L		0.1	12-AUG-20
Dichloromethane			<0.50		mg/L		0.5	12-AUG-20
Methyl Ethyl Ketone			<1.0		mg/L		1	12-AUG-20
Tetrachloroethylene			<0.025		mg/L		0.025	12-AUG-20
Trichloroethylene			<0.025		mg/L		0.025	12-AUG-20
Vinyl chloride			<0.050		mg/L		0.05	12-AUG-20
Surrogate: 1,4-Difluorobenzene			100.9		%		70-130	12-AUG-20
Surrogate: 4-Bromofluorobenzene			100.1		%		70-130	12-AUG-20
WG3381416-3 MS		**L2486516-4**						
1,1-Dichloroethylene			79.2		%		50-140	13-AUG-20
1,2-Dichlorobenzene			96.9		%		50-140	13-AUG-20
1,2-Dichloroethane			93.2		%		50-140	13-AUG-20
1,4-Dichlorobenzene			94.3		%		50-140	13-AUG-20
Benzene			95.0		%		50-140	13-AUG-20
Carbon tetrachloride			93.4		%		50-140	13-AUG-20
Chlorobenzene			94.4		%		50-140	13-AUG-20
Chloroform			98.3		%		50-140	13-AUG-20
Dichloromethane			91.6		%		50-140	13-AUG-20
Methyl Ethyl Ketone			88.8		%		50-140	13-AUG-20
Tetrachloroethylene			93.4		%		50-140	13-AUG-20
Trichloroethylene			95.1		%		50-140	13-AUG-20
Vinyl chloride			73.3		%		50-140	13-AUG-20

Quality Control Report

Workorder: L2486315 Report Date: 18-AUG-20

Client: Wood Environment & Infrastructure Solutions (Cambridge)
900 MAPLE GROVE ROAD UNIT 10
CAMBRIDGE ON N3H 4R7
Contact: HERMAN PADHAM

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2486315-COFC

COC Number: 17 -

Page of

Report To	Contact and company name below will appear on the final report
Company:	Wood
Contact:	Herman Padham
Phone:	
	Company address below will appear on the final report
Street:	900 maple grove rd
City/Province:	Cambridge On
Postal Code:	N3H4R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Wood
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	vishu.vasisht@woodplc.com
Email 2	herman.padham@woodplc.com
Email 3	owen.lutz@woodplc.com

Invoice Distribution	
Select Invoice Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	SAME AS ABOVE
Email 2	

Project Information	
ALS Account # / Quote #:	Q79429
Job #:	OGTW2010
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	L2486315 AD

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity Package	TCLP-Metals/Inorganics	TCLP-BAP	TCLP-VOC	BULK PCB	Ignitability	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH20-41 SS7	6-Aug-20	13:00	soil	1	R							
	BH20-40 SS9	7-Aug-20	13:00	soil	1	R							
	BH20-39 SS11	5-Aug-20	13:00	soil	1	R							
	BH20-38 SS11	5-Aug-20	13:00	soil	1	R							
	BH20-37B SS10	4-Aug-20	13:00	soil	1	R							
	BH20-37 SS8	6-Aug-20	13:00	soil	1	R							
	TCLP-BH20-37B	4-Aug-20	13:00	soil	6		R	R	R	R	R		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Ontario Regulation 153/04 - April 15, 2011 Standards
Are samples for human consumption/ use? ☐ YES ☑ NO	Table 1,3,9 ICC Coarse

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐	No ☐	
Ice Packs ☐	Ice Cubes ☒	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated ☐					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			4.8		

SHIPMENT RELEASE (client use)		
Released by: Owen Lutz	Date: 10-8-2020	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 08/10/20	Time: 16:40

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Appendix F

Non-Standard Special Provision (NSSP) Trenchless Installation

PIPE INSTALLATION BY TRENCHLESS METHOD – Item No.

Special Provision August 2020

CONSTRUCTION SPECIFICATION FOR THE INSTALLATION OF PIPES BY TRENCHLESS METHODS

TABLE OF CONTENTS

1.0 SCOPE

2.0 REFERENCES

3.0 DEFINITIONS

4.0 DESIGN AND SUBMISSION REQUIREMENTS

5.0 MATERIALS

6.0 EQUIPMENT

7.0 CONSTRUCTION

8.0 QUALITY ASSURANCE- Not Used

9.0 MEASUREMENT FOR PAYMENT

10.0 BASIS OF PAYMENT

1.0 SCOPE

This specification covers the requirements for the installation of pipe by a selected trenchless method.

2.0 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, General

OPSS 180 Management of Disposal of Excess Material

Ontario Provincial Standard Specifications, Construction

OPSS 401 Trenching, Backfilling, and Compacting
OPSS 402 Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
OPSS 403 Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut
OPSS 404 Support Systems
OPSS 409 Closed-Circuit Television (CCTV) Inspection of Pipelines

OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities and Associated Structures
OPSS 517	Dewatering
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1802	Smooth Walled Steel Pipe
OPSS 1820	Circular and Elliptical Concrete Pipe
OPSS 1840	Non-Pressure Polyethylene (PE) Plastic Pipe Products

CSA Standards

B182.6	Profile polyethylene (PE) sewer pipe and fittings for leak-proof sewer applications
A3000	Cementitious Materials Compendium
W59	Welded Steel Construction (Metal Arc Welding)

American Society for Testing and Materials (ASTM) International Standards

A 252	Standard Specification for Welded and Seamless Steel Pipe Piles
D 2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
D6910	Standard Specification for Marsh Funnel Viscosity of Clay Construction Slurries
F 894	Standard Specification for Polyethylene Large Diameter Profile Wall Sewer and Drain Pipe

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025	General Requirements for the Competence of the Testing and Calibration Laboratories

3.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Auger Jack & Bore means a method of forming a horizontal bore in the subsurface by simultaneously or alternately jacking into the ground a casing pipe and rotating a cutter head at the lead end of an auger flight with removal of material from inside the casing by using continuous-flight augers.

Backreamer or Reamer means a cutting head suitably designed for the subsurface conditions that is attached to drilling equipment and used to enlarge the bore

Bore Path means a drilled path according to the grade and alignment tolerances specified in the Contract Documents.

Design Engineer means the Engineer retained by the Contractor who produces the design and working drawings and other engineering documents required of the Contractor.

Design Checking Engineer means the Engineer retained by the Contractor who checks the original design and

working drawings.

Digger Shield/Hand Mining means a method of forming a horizontal bore in the subsurface by essentially simultaneously jacking a casing pipe, with or without a protective shield at the lead end, into the ground while tunnelling and removal of earth and rock is completed using manually-operated tools (e.g., pneumatic spades, rams, shovels, breaker bars, etc.) or a "digger" type shield with a hydraulic excavator arm or "road-header" rock cutting machine to remove materials from inside the shield and liner pipe.

Horizontal Directional Drilling (HDD) means horizontal directional boring or guided boring.

Drilling Fluids means a mixture of water and additives, such as bentonite, polymers, surfactants, and soda ash, designed to block the pore space on a bore wall, reduce friction in the bore, and to suspend and carry cuttings to the surface.

Drilling Fluid Hydraulic Fracture or "Frac Out" means a condition where the drilling fluid's pressure in the bore is sufficient to fracture the soil and/or rock materials and allow the drilling fluids to migrate to the surface at an unplanned location.

Earth Pressure Balance (EPB) means a tunnelling system that provides support to the excavated face of the ground and resistance to groundwater inflow through the pressure of mixed earth, rock and any drilling fluids or additives (spoil) as maintained by and in a chamber behind the cutting face of a tunnel boring machine through which spoil can pass only by manner of controlled-load relieving gates or an internal screw-conveyor that is separate from subsequent spoil conveyance systems (e.g., flight augers, belt conveyor, spoil bucket rail cars, etc.). Trenchless systems that apply pressure to the excavated face of the ground only through mechanical and jacking forces on metal parts of the machinery (e.g., steel parts of cutting tools, adjustable gates or doors at cutting face, etc.) will not be considered equivalent to EPB systems.

Excavation means all materials encountered regardless of type and extent and shall include removal of natural soil, boulders, cobbles, wood and fill regardless of means necessary to break consolidated materials for removal.

Environmentally Sensitive Area (ESA) means areas specified in the Contract Documents that are prohibited from entry or use.

Fill means man-made mixture of previously placed or handled materials such as sand, clay, silt, gravel, broken rock, sometimes containing organic and/or deleterious materials, placed in an excavation or other area to raise the surface elevation.

Guidance System means an electronic system capable of indicating the position, depth and orientation of the drill head during the directional drilling process.

Hand Mining means a method of forming a horizontal bore in the subsurface by simultaneously jacking ahead while tunnelling advances using hand–mining (man-entry operation or "Jack and Mine") or a "digger" type shield with a hydraulic excavator arm to remove materials from inside the liner pipe.

Inadvertent Returns means the unexpected flow of fluids, saturated materials (or flowing soil) towards the drilling rig that typically originated from an artesian aquifer encountered during the drilling process.

Loss of Circulation means the discontinuation of the flow of drilling fluid in the bore back to the entry or exit point or other planned recovery points.

Microtunnelling means an underground method of constructing a passage by using a microtunnel boring

machine (MTBM) or hand mining using a shield to support the opening.

Pilot Bore means the initial bore to set directional controlled horizontal and vertical alignment between the connecting points.

Pipe Jacking means a method for installing steel casing, concrete pipe or other acceptable material in the subsurface utilizing hydraulically operated jacks of adequate number and capacity for the smooth and uniform advancement of the casing or pipe.

Pipe means pipe culverts, pipe storm and sanitary sewers, watermain pipe, conduits and ducts.

Pipe Ramming means a method for installing steel casings utilizing the energy from a percussion hammer to advance a steel casing with a cutting shoe attached at the front end of the casing.

Pullback means that part of the HDD method in which the drilling equipment is pulled back through the bore path to the entry point.

Reaming means a process for enlarging the bore path

Rock means natural beds or massive fragments, or the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin, which may or may not be weathered and includes boulders having a volume of 0.5 m^3 or greater.

Shaft means an excavation used as entry and/or exit points, alternatively called entry/exit pits, from which the trenchless method is initiated for the installation of the pipe product.

Slurry Pressure Balance (SPB) means a tunnelling system that provides support to the excavated face of the ground and resistance to groundwater inflow through the pressure of slurry as maintained by and in a chamber behind the cutting face of a TBM or MTBM through which spoil can pass only by manner of controlled-pressure and controlled flow slurry pumping systems.

Strike Alert means a system that is intended to alert and protect the operator in the case of inadvertent drilling into an electrical utility cable. The strike alert system consists of a sensor and an alarm connected to the drill rig and a grounding stake. The alarm may be audio or visual or both.

Slurry means a mixture of soil and/or rock cuttings, and drilling fluid.

Soil means all soils except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials.

Spoil means mix of earth cuttings, rock cuttings, water (groundwater or added water), bentonite, polymers and/or other additives that is discharged from the trenchless construction systems.

TBM means a tunnel boring machine.

Trenchless Installation means an underground method of constructing a passage open at both ends that involves installing a pipe product by auger jack & boring, pipe ramming, horizontal directional drilling, or tunnelling.

Tunnelling means an underground method of constructing a passage using a tunnel boring machine (TBM) operated by personnel within the tunnel, a microtunnel boring machine (MTBM) operated by personnel at a

remote control station or excavation using a shield to support the opening and protect workers.

Zone of Influence means a zone defined by lines projected outward and upward at 45 degrees from horizontal to the ground surface from the vertical and horizontal alignment of the pipe constructed using trenchless/tunnel methods.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.01 Design

4.01.01 General

The Contractor shall determine the most appropriate method of trenchless installation for each pipe crossing for each location within the terms of this specification.

The trenchless installation method selected for each pipe crossing shall be designed for the subsurface conditions in accordance with the Contract Documents.

The detailed design of the installation method selected to carry out the work as specified in the Contract Documents shall be completed.

* Designer Fill-in, See Notes to Designer

4.02 Submission Requirements

4.02.01 Working Drawings

Three (3) sets of Working Drawings for each trenchless installation method selected, and a Request to Proceed shall be submitted to the Contract Administrator two (2) weeks prior to the commencement of the trenchless installation operation work.

The trenchless installation operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

All Working Drawings shall bear the seal and signature of the design Engineer and design check Engineer. A copy of the Working Drawings shall be kept at the site during construction.

Information and details shown on the Working Drawings shall include, but not be limited to:

a) Plans and Details:

i. Plans and profiles defining all horizontal and vertical alignment positions and positions of all utilities and other infrastructure within the zone of influence of the work;
ii. A work plan outlining the materials, procedures, methods and schedule to be used to execute the work.
iii. A list of personnel, including backup personnel, and their qualifications and experience.
iv. A safety plan including the company safety manual and emergency procedures.
v. The work area layout.
vi. An erosion and sediment control plan that includes a contingency plan in the event the erosion and sediment control measures fail.

vii. A contingency plan with specific details of the manner in which rock or boulders will be broken and removed from the face and the face will be protected to prevent soil loss into the liner.
viii. A drilling fluid management plan, if applicable, that addresses control of frac-out pressures, any potential environmental impacts and includes a contingency plan detailing emergency procedures in the event that the fluid management plan fails.
ix. Lighting, ventilation and fire safety details as may be required by applicable occupational health and safety regulations.
x. Excavated materials disposal plan.
xi. Locations of protection systems.

b) Designs

i. Primary liner design (e.g., steel liner plates, steel ribs and wood lagging, steel casing pipe, etc.).
ii. Design assumption and material data when materials other than those specified are proposed for use.
iii. Drill path design, details of alignment and alignment control, maximum curvature and reaming stages.

c) Materials:

i. Certification from the manufacturer that the product furnished on the contract meets the specifications cited in the manufacturer's product specification and that the materials supplied are suitable for the application.
ii. Manufacturer data sheets for all drilling fluids and additives for use in Earth Pressure Balance, Slurry Pressure Balance
iii. Manufacturer data sheets for drilling systems.
iv. Mix designs, target rheology criteria (e.g., viscosity, density, shear strength, gel time, pressure-filtration – fluid losses under pressure, etc.) and additive dosage rates for all slurries and EPB TBM and MTBM operations.
v. The proposed grout mix design for grouts to be used for lubricating jacking pipe and for filling of voids and annular spaces.
vi. Compressive strength of concrete pipe products.
vii. Pipe class for all steel pipe products.
viii. Steel for Permanent Casings
- One copy of a mill test certificate certifying that the steel meets the requirements for the appropriate standards for permanent casings shall be submitted to the Contract Administrator at the time of delivery.
- Where mill test certificates originate from a mill outside Canada or the United States of America, the information on the mill certificates shall be verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate.
- The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory

ix. Slurry, drilling fluids, and tunnelling fluids

- type, source, and physical and chemical properties of bentonite, polymer or other additives;
- source of water;
- method of mixing;

- the water to solids ratio and the mass and volumes of the constituent parts, including any chemical admixtures or physical treatment employed to achieve required physical properties;
  details of procedure to be used for monitoring physical properties of slurry, drilling fluids and tunnelling fluids or EPB spoil; and method of disposal of the slurry, drilling fluids and associated spoil

d) Upstream/Downstream Portal Installation Procedure:

i. Access shaft or entry/exit pit details, as applicable.
ii. Face support and other temporary support details, if applicable.

e) Primary Liner/Secondary Liner Installation and Grouting Procedure:

i. Excavation and pipe installation procedures, including methods to handle obstructions and prevent soil cave-in.
ii. Details of tunnelling equipment/methods to be used for the works.

f) Excavation and Dewatering:

i. Equipment and methods for control, handling, treatment, and disposal of groundwater and water or fluids introduced by the Contractor.
ii. Equipment and methods for maintaining control of ground inflow at the excavation face during excavation.
iii. Equipment and methods for removal of cobbles and boulders.
iv. Manufacturer data sheets for each TBM, shield, tunnelling system or drilling system noting all intermediate and final cut dimensions, and methods and equipment for controlling and measuring drilling fluid, SPB and EPB pressures;
v. Methods for measuring excavated volumes or weights of earth and rock materials cut from ground on a per meter or per pipe basis up to a maximum of 3 m long intervals per measurement;
vi. Target operating pressures (minimum and maximum) and range of expected pressure variation for slurry or EPB spoil at excavated face or drilling fluids at lead end of drilling equipment and in annular gap between maximum excavated dimensions and outside dimensions of tunnelling equipment, drilling equipment and primary liner systems;
vii. Basis for setting target operating conditions (pressures, flow rates, advance rates) and the relationship of target operating conditions to ground conditions;
viii. Basis for selection of excavation tools (e.g., bits, TBM face tools, MTBM face tools, excavator fittings, etc.) as related to expected ground conditions;
ix. Jacking forces for installation of pipe, for driving of trenchless equipment forward and, in the case of Auger Jack & Bore, for advancing the lead end of the casing ahead of the lead end of the auger cutting tools.

g) Monitoring Method:

Methods, equipment, frequency and repeatability (accuracy and precision) of data collection to be employed for measuring and monitoring shall be submitted for:

i. Maintaining the alignment of the installation;
ii. EPB, SPB and drilling fluid pressures at the leading edge of excavation (face), flow rates and volume or weights of spoil;
iii. Jacking forces on pipes, linings and cutting tools;

iv. Torque, total revolutions and revolution rates on rotating equipment such as TBM or MTBM heads, auger flights, drill bits, etc.
v. Grout injection pressures and volumes;
vi. Longitudinal position of all casings and excavation cutting tools (auger flight heads, TBM face, drill bit position, etc.);
vii. Ground displacements (heave and settlement); and noise and ground vibrations induced by trenchless construction

4.02.03 As-Built Drawings

As-built drawings shall be submitted to the Contract Administrator in a reproducible format prior to Contract Completion.

The as-built drawings shall be dated and bear the seal and signature of the design Engineer and design checking Engineer.

5.0 MATERIALS

5.01 Pipe

5.01.01 General

The product shall be concrete pipe, steel pipe or high density polyethylene pipe as specified.

All joints shall be suitable for jacking operations as specified in the Working Drawings.

Fittings shall be suitable and compatible with the class and type of pipe with which they will be used.

All fittings shall be designed to be watertight.

5.01.02 Steel Pipe

Steel pipe shall be according to ASTM A252.

All steel casing pipe shall be square cut.

Steel casing pipe shall meet a straightness tolerance of 1.5 mm/m. When placed anywhere on the pipe parallel to the pipe axis, there shall not be a gap more than 1.5 mm between a 1 m long straightedge and the pipe.

5.01.03 HDPE Pipe

High density polyethylene (HDPE) pipe according to OPSS 1840 shall be used in accordance with ASTM D3350.

Fittings shall be according to CAN/CSA-B182.6 or ASTM F894 and suitable for the class and type of pipe with which they will be used.

Jointing of HDPE piping shall be completed according to the manufacturer's recommended procedures and ASTM D2657. Where conflicts exist between the manufacturer's instructions and ASTM D2657, the manufacturer's instructions are to be followed.

Jointing of HDPE piping to other piping materials or appurtenances shall be completed using flanged connections.

5.01.04 Concrete Pipe

Concrete pipe shall be according to OPSS 1820.

5.02 Concrete

Concrete shall be according to OPSS 1350. The concrete strength shall be as specified on the Working Drawings.

5.03 Steel Reinforcement

Steel reinforcement for concrete work shall be according to OPSS 1440.

5.04 Wood

Wood shall be according to OPSS 1601.

5.05 Drilling Fluids

Drilling fluid shall be mixed according to the Working Drawings.

Selection of drilling fluid type shall be based on the soils encountered in the subsurface investigation.

The drilling fluids shall be mixed according to the manufacturer's recommendations.

Slurry shall be mixed according to the submitted slurry design and be appropriate for the anticipated subsurface conditions. The viscosity of slurry used for SPB tunnelling shall be no less than 40 seconds Marsh Funnel viscosity, as defined by ASTM D6910, measured prior to introduction of groundwater and spoil and as required to ensure:

a) development of appropriate filter cake at excavation face to provide slurry support pressures exceeding ground and groundwater pressures at excavation face;
b) lubricate installation of primary liners as required;
c) transport spoil through pipe systems;

5.06 Grout

Purging grout shall conform to the requirements of OPSS 1004 wetted with only sufficient water to make the mixture plastic

6.0 EQUIPMENT

6.01 Auger Jack & Bore

Except in the case of dewatering to at least 1 m below the tunnel/bore invert for the full length of the pipe alignment, Auger Jack & Bore shall not be used and will not be permitted where subsurface conditions indicate

that saturated gravel, sand and silt soils may be encountered at pipe level or within one pipe diameter above or below outside pipe dimensions.

Pipe auger jack & bore equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein.

Specific details of the equipment with which rock or boulders will be broken and removed from the face and the face will be protected to prevent soil loss into the liner shall be submitted to the Contract Administrator for information purposes prior to proceeding with the works.

The lead end of the auger shall be maintained at least one pipe diameter inside the lead end of the casing. The auger cutting tools shall not extend to or beyond the lead end of the casing at any time unless specific exception is provided by the Ministry prior to construction. Submittals shall identify anticipated jacking forces for advancing casing ahead of leading edge of auger cutting tools in addition to friction forces that are to be overcome by jacking systems

6.02 Pipe Ramming

Pipe ramming equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein.

The pipe ramming hammer(s) shall be capable of driving the pipe casing from the entry pit to the exit pit through the existing subsurface conditions at the site without removal of soil from within the casing until the lead end of the pipe is outside the zone of influence for any overlying infrastructure.

Specific details of the equipment with which rock or boulders will be broken and removed from the face and the face will be protected to prevent soil loss into the pipe shall be submitted to the Contract Administrator for information purposes prior to proceeding with the works.

6.03 Horizontal Directional Drilling

6.03.01 General

The Horizontal Directional Drilling equipment shall consist of a directional drilling rig and a drilling fluid mixing and delivery system to successfully complete the product installation without exceeding the maximum tensile strength of the product being installed.

6.03.02 Drilling Rig

The horizontal directional drilling rig shall:

a) Consist of a leak free hydraulically powered boring system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.

b) Have drill rod that is suitable for both the drill and the product pipe installation.

c) Contain a drill head that is steerable, equipped with the necessary cutting surfaces and fluid jets, and be suitable for the anticipated ground conditions.

d) Have adequate reamers and down-bore tooling equipped with the necessary cutting surfaces and fluid jets to facilitate the product installation and be suitable for the anticipated ground conditions.

e) Contain a guidance system to accurately guide boring operations.

f) Be anchored to the ground to withstand the rotating, pushing, and pulling forces required to complete the product installation.

g) Be grounded during all operations unless otherwise specified by the drilling rig manufacturer.

6.03.03 Drill Head

The drill head shall be steerable by changing its rotation, be equipped with the necessary cutting surfaces and drilling fluid jets, and be of the type for the anticipated subsurface conditions,

6.03.04 Guidance System

The guidance system shall be setup, installed, and operated by trained and experienced personnel. The operator shall be aware of any magnetic or electromagnetic anomalies and shall consider such influences in the operation of the guidance system when a magnetic or electromagnetic system is used.

6.03.05 Drilling Fluid Mixing System

The drilling fluid mixing system shall be of sufficient size to thoroughly and uniformly mix the required drilling fluid.

6.03.06 Drilling Fluid Delivery System

The delivery system shall have a means of measuring and controlling fluid pressures and be of sufficient flow capacity to ensure that all slurry volumes are adequate for the length and diameter of the final bore and the anticipated subsurface conditions. Connections between the delivery pump and drill pipe shall be leak-free.

6.04 Tunnelling

Tunnelling equipment shall be determined by the Contractor and shall be identified in the submission requirements specified herein. Specific details of tunnelling equipment included in the submission shall be provided for:

a) rock or boulder breaking and removal;

b) equipment used within shields for spilling, fore-poling, face drainage, breasting boards/plates and for otherwise maintaining support of the tunnel crown and face under all anticipated conditions;

c) jacking systems;

d) alignment control systems;

Use of rock fracturing chemicals shall only be considered subject to a field demonstration satisfactory to the Ministry prior to its use. Use of explosives is prohibited without specific application and acceptance by the Ministry prior to construction.

6.05 Microtunnelling Equipment

The Contractor shall be responsible for selecting microtunnelling equipment which, based on past experience, has proven to be satisfactory for excavation of the soils that will be encountered.

The Contractor shall employ microtunnelling equipment that will be capable of handling the various anticipated ground conditions.

The MTBM shall also be capable of controlling loss of soil ahead of and around the machine and shall provide continuous pressurized support of the excavated face.

a) Remote Control System – The Contractor shall provide a MTBM that includes a remote control system with the following features:

i. Allows for operation of the system without the need for personnel to enter the microtunnel. Has a display available to the operator, at a remote operation console, showing the position of the shield in relation to a design reference together with other information such as face pressure, roll, pitch, steering attitude, valve positions, thrust force cutter head torque, rate of advance and installed length.
ii. Integrates the system of excavation and removal of spoil and its simultaneous replacement by Product Pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system.
iii. The system shall be capable of adjusting the face pressure to maintain face stability for the particular soil condition encountered.
iv. The system shall monitor and continuously balance the soil and ground water pressure to prevent loss of soil or uncontrolled ground water inflow.
v. The pressure at the excavation face shall be managed by controlling the volume of spoil removal with respect to the advance rate.
vi. The system shall include a separation process designed to provide adequate separation of the spoil from the slurry so that slurry with a sediment content within the limits required for successful microtunnelling, can be returned to the cutting face for reuse. Appropriately contain spoil at the site prior to disposal.
vii. The type of separation process shall be suited to the size of microtunnel being constructed, the soil type being excavated, and the work space available at each work area.
viii. The system shall allow the composition of the slurry to be monitored to maintain the slurry weight and viscosity limits required.

b) Active Direction Control - Provide an MTBM that includes an active direction control system with the following features:

i. Controls line and grade by a guidance system that relates the actual position of the MTBM to a design reference Provides active steering information that shall be monitored and transmitted to the operating console and recorded.
ii. Provides positioning and operation information to the operator on the control console.

6.05.01 Pipe Jacking Equipment

Provide a pipe jacking system with the following features:

a) Has the main jacks mounted in a jacking frame located in the launch shaft.
b) Has a jacking frame that successively pushes towards a receiving shaft, a string of Product Pipe that follows the microtunnelling excavation equipment.
c) Has sufficient jacking capacity to push the microtunnelling excavation equipment and the string of pipe through the ground.

d) The main jack station may be complemented with the use of intermediate jacking stations as required.
e) Has a capacity at least 20 percent greater than the calculated maximum jacking load.
f) Develops a uniform distribution of jacking forces on the end of the casing pipe.
g) Provides and maintains a pipe lubrication system at all times to lower the friction developed on the surface of the pipe during jacking.
h) Jack Thrust Blocking shall adequately support the jacking pressure developed by the main jacking system.
i) Special care shall be taken when setting the pipe guide rails in the jacking shaft to ensure correctness of the alignment, grade, and stability.

6.05.02 Spoil Separation System

The Contractor shall determine the type of spoil separation equipment needed for each drive based on the geotechnical information available and other project constraints.

6.05.03 Electrical Equipment, Fixtures and Systems

Electrical equipment shall be suitably insulated for noise reduction. Noise produced by electrical equipment must comply with local municipal noise by-laws.

Electrical systems shall conform to requirements of the Canadian Electrical Code – CSA C22.1.

7. CONSTRUCTION

7.01 General

The Contractor shall notify the Contract Administrator at least 48 hours in advance of starting work. The proposed method of pipe installation to be used by the Contractor shall be subject to the limitations presented in the following subsections.

The Contractor's Engineer shall supervise the work at all times.

A Request to Proceed shall be submitted to the Contract Administrator upon completion of each of the following operations and prior to commencement of each subsequent operation and no less than 2 weeks prior to the commencement of the trenchless installation.

a) Site Surveying (see Clause 4.02)
b) Excavation for pits including dewatering of excavations
c) Jacking / Ramming / Directional Drilling of Casing / Liner
d) Installation of the Product
e) Grouting Operations

Operations a) to e) shall not proceed until the Contract Administrator has issued a Notice to Proceed for each proceeding operation.

7.01.01 Layout, Alignment and Depth Control

The location of the installation shall be established from the lines, elevations and tolerances specified in the Contract Documents. The pipe installation shall be to the horizontal and vertical alignments specified in the

Contract Drawings. Deviations from location, alignment, grades and/or invert levels shall be corrected by the Contractor at no cost to the Ministry.

All reference points necessary to construct the pipe installation and appurtenances shall be laid out.

The Contractor shall calibrate tracking and locating equipment at the beginning of each work day, and shall monitor and record the alignment and depth readings provided by the tracking system every 2 m.

The Contract Administrator shall be provided with the assistance and access necessary to check the layout of the pipe installation and associated appurtenances.

The Contractor shall submit records of the alignment and depth of the installation to the Contract Administrator at the completion of the installation.

7.01.02 Construction Shafts

Construction shafts shall be specified in the Contractor's submission. The boundaries and protection of these shall be as required to contain all disturbances to areas outside of the ESA limits.

Shafts shall be maintained in a drained condition.

A minimum 2.4 m high secure fence shall be installed around the perimeter of the construction shaft area with gates and truck entrances. The fence shall be removed on completion of the work.

7.01.03 Protection Systems

The construction of all protection systems shall be according to OPSS539. Where the stability, safety, or function of an existing roadway, watercourse, other works, proposed works or ESA's may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piles where necessary to prevent damage to such works or proposed works.

7.01.04 Settlement or Heave

Any disturbance to the ground surface (settlement or heave) as a result of the pipe installation shall be immediately corrected by the Contractor, at no additional cost to the Ministry.

7.01.05 Stability of Excavation

The construction methods, plant, procedures, and precautions employed shall ensure that excavations are stable, free from disturbance, and maintained in a drained condition.

The construction methods, plant, procedures, and materials employed shall prevent the migration of soil and/or rock material into the excavation from adjacent ground.

7.01.06 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

Minimum horizontal and vertical clearances to existing facilities as specified in the Contract Documents shall be maintained. Clearances shall be measured from the nearest edge of the largest cut diameter required to the nearest edge of the facility being paralleled or crossed.

Existing underground facilities shall be exposed to verify its horizontal and vertical locations when the outlet pipe path comes within 1.0 m horizontally or vertically of the existing facility. Existing facilities shall be exposed by non-destructive methods. The number of exposures required to monitor work progress shall be as specified in the Contract Documents.

7.01.07 Transporting, Unloading, Storing and Handling Materials

Manufacturer's handling and storage recommendations shall be followed.

7.01.08 Trenching, Backfilling and Compacting

Trenching, backfilling, and compacting for entry and exit points or other locations along the pipe path shall be according to OPSS 401.

7.01.09 Support Systems

Support systems shall be according to OPSS 404.

If any open excavation will encroach into the highway embankment the protection system shall satisfy the requirements for Performance Level 2 as specified in OPSS 539.

7.01.10 Dewatering

The work of this Section includes control, handling, treatment, and disposal of groundwater. The Contractor shall review the foundation investigation report for reference to soil and groundwater conditions on the project site and plan a dewatering scheme accordingly.

The Contractor shall control groundwater inflows to excavations to maintain stability of surrounding ground, to prevent erosion of soil, to prevent softening of ground exposed in the excavation, and to avoid interfering with execution of the work.

The Contractor shall maintain excavations free of standing water at all times during excavation, including while concrete is curing.

Should water enter the excavation in amounts that could adversely affect the performance of the work or could cause loss of ground, the Contractor shall take immediate steps to control the inflow.

The Contractor is alerted that seepage zones of perched water within the fill materials should be expected, particularly where granular materials are excavated.

Dewatering shall be according to OPSS 517.

7.01.11 Removal of Cobbles and Boulders

The Contractor is alerted that cobbles and boulders should be anticipated in the soil deposits at the site. Accordingly, the Contractor shall address the removal of cobbles and boulders in the proposed method of construction. Removal of cobbles shall be expected to be routine and will not be considered cause for obstruction. The Contractor shall immediately inform the Contract Administrator of any obstruction encountered.

** Designer Fill-in, See Notes to Designer

7.01.12 Removal of Obstructions

The Contractor is alerted that obstructions such as, but not limited to wood debris, roots, and construction debris consisting of (broken asphalt, concrete etc.) are expected within the trenchless alignment as identified in the Contract Documents. Accordingly, the Contractor shall address methods for the removal of obstructions in the proposed method of construction. The Contractor shall immediately inform the Contract Administrator of any obstruction encountered and the Contractor's expected method of and schedule for removal.

*** Designer Fill-in, See Notes to Designer

7.01.13 Management of Excess Material

Management of excess material shall be according to OPSS 180. Satisfactory re-usable excavated material required for backfill shall be separated from unsuitable excavated material.

7.01.14 Site Restoration

Site restoration shall be according to OPSS 492.

7.02 Auger Jack & Bore Installation

7.02.01 Method of Installation Procedure

The installation procedure to be used shall be subject to the following limitations:

a) Hydraulically operated jacks of adequate number and capacity shall be provided to ensure smooth and uniform advancement without over-stressing of the pipe.
b) A suitably padded jacking head or collar shall be provided to transfer and distribute jacking pressure uniformly over the entire end bearing area of the pipe.
c) The jacking pipe shall be fully supported in the jacking pit at the specified line and grade.
d) Selection of the excavation method and jacking equipment shall take into consideration the conditions at each pipe crossing.

7.02.02 Pipe Installation

Concrete pipe joints shall be water tight and according to OPSS 1820 and must withstand jacking forces, determined by the Contractor.

During the jacking of the liner the space between the liner and the wall of the excavated volume (e.g., maximum cut diameter) shall be kept filled with bentonite slurry. Upon completion of jacking, the space between the liner and the wall of the excavated volume shall be filled with grout or slurry with gel strength properties demonstrated to be sufficient to form a semi-solid or solid gap filling material, prevent ground convergence around the pipe and subsequent ground surface subsidence and prevent long-term water flow at the outside boundary of any pipe and ground.

The annular space between the liner and the product shall be fully grouted with a water tight, expandable and

stable grout.

7.03 Pipe Ramming Installation

For pipe ramming installation the following requirements apply:

Only smooth walled steel pipe shall be used. Butt welding of pipe joints shall conform to CAS W59.

Ramming equipment of adequate capacity shall be provided to ensure smooth and uniform advancement between the shafts/pits without overstressing of the pipe. Delays shall be avoided between ramming operations.

A ramming head shall be provided to transfer and distribute jacking pressure uniformly over the entire end bearing area of the pipe.

Two or more lubricated guide rails or sills shall be provided of sufficient length to fully support the pipe at the specified line and grade in the ramming pit. Pipe shall be installed to the line and grade specified.

Removal of materials from within the pipe shall not be undertaken until the lead end of the pipe has passed fully through and beyond the zone of influence of any overlying infrastructure.

Following installation of the liner pipe, all material shall be removed from the pipe to the satisfaction of the Contract Administrator. Any voids remaining between the pipe and the excavation wall shall be grouted as soon as the pipe is rammed. The annular space between the liner pipe and the product shall be fully grouted with a water tight, expandable and stable grout.

7.04 Horizontal Directional Drilling Installation

7.04.01 General

When strike alerts are provided on a drilling rig, they shall be activated during drilling and maintained at all times.

For horizontal directional drilling, the contractor shall ensure that during pilot hole drilling the maximum degree of deviation or “dog-leg” shall be 2.5 degrees per 9 m drill pipe length. Any deviation exceeding 2.5 degrees will necessitate a pull-back and straightening of the alignment at the Contractor’s sole expense. The pilot hole exit location shall be within 0.5m of the target location.

7.04.02 Site Preparation

The work site shall be graded or filled to provide a level working area for the drilling rig. No alterations beyond what is required for HDD operations are to be made. All activities shall be confined to designated work areas.

7.04.03 Pilot Bore

The pilot bore shall be drilled along the bore path in accordance with the grade, alignment, and tolerances as indicated on the Contractor’s submitted drilling plan to ensure that the product is installed to the line and grade shown on the Contract Drawings. The Contractor’s methods shall take into consideration the conditions at each crossing within the pipe alignment and shall be suitable to advance through such obstructions such as cobbles and boulders and address the potential for deflection off these obstruction and/or soil conditions.

In the event the pilot bore deviates from the submitted path, the Contract Administrator shall be notified. The

Contract Administrator may require the Contractor to pullback, fill and abandon the hole and re-drill from the location along the bore path before the deviation.

If a drill hole beneath highways, roads, watercourses or other infrastructure must be abandoned, the hole shall be backfilled with grout or bentonite to prevent future subsidence and subsurface water conveyance.

The Contractor shall maintain drilling fluid pressure and circulation throughout the HDD process, including during the initial pilot bore and during the reaming process.

The Contractor shall at all times and for the entire length of the installation alignment be able to demonstrate the horizontal and vertical position of the alignment, the fluid volume used, return rates and pressures.

7.04.04 Drilling Fluid Losses to Surface ("Frac-Out")

To reduce the potential for hydraulic fracturing of the hole during horizontal directional drilling, a minimum depth of cover of 5 m shall be maintained between the top of pipe and the surface of any pavements or beds of water courses. Sections of the pipe close to the entry and exit pit with less than 5 m cover shall be cased. The Contractor shall ensure that drilling fluid pressures are properly set and controlled for the full length of the bore to prevent frac-out for the depth of cover available between the bottom of the pavement structure (bottom of the subbase material) and the top of the bore.

Once a fluid loss or frac-out event is detected, the Contractor shall halt operations immediately and conduct a detailed examination of the drill path and implement measures to collect all fluids discharged to surface, mitigate and prevent additional fluid loss.

7.04.05 Reaming

The bore shall be reamed using the appropriate tools to a diameter at least 50% greater than the outside diameter of the product.

7.04.06 Product Installation

7.04.06.0 General

The product shall be jointed according to manufacturer's recommendations. The length of the product to be pulled shall be jointed as one length before commencement of the continuous pulling operation.

The product shall be protected from damage during the pullback operation.

The minimum allowable bending radius for the product shall not be contravened.

Product shall be allowed to recover to static conditions from thermal and installation stresses before connections to new or existing facility are made. Product recovery time shall be according to manufacturer's recommendations.

7.04.06.02 Pullback and Grouting

After successfully reaming the bore to the required diameter, the product pipe shall be pulled through the bore path. Once the pullback operation has commenced, it shall continue without interruption until the product pipe is completely pulled into bore unless otherwise approved by the Contract Administrator.

A swivel shall be used between the reamer and the product being installed to prevent rotational forces from being transferred to the product. A weak link or breakaway connector shall be used to prevent excess pulling force from damaging the product.

The product pipe shall be inspected for damage where visible at excavation pits and where it exits the bore. Any damage noted shall be rectified to the satisfaction of the Contract Administrator.

The pull back and reaming operations shall not exceed the fluid circulation rate capabilities. Reaming and back pulling operations shall be planned to insure that, once started, all reaming and back pulling operations are completed without stopping and within the permitted work hours.

The space between the pipe and the walls of the excavated volume shall be filled with grout or slurry with gel strength properties demonstrated to be sufficient to form a semi-solid or solid gap filling material, prevent ground convergence around the pipe and subsequent ground surface subsidence and prevent long-term water flow at the outside boundary of any pipe and ground.

7. 05 Tunnelling Installation

7.05.01 General

Excavation of native soil and fill shall be done in a manner to control groundwater inflow to the excavation and to prevent loss of ground into the excavation.

Methods of excavating the tunnel shall be capable of fully supporting the face and shall accommodate the removal of boulders and other oversize objects from the face. Continuous ground support shall be maintained during excavation.

As the excavation progresses, the Contractor shall continuously monitor (every 2 m) indications of support distress, such as cracking, deflection or failure of support system and subsidence of ground near the excavation.

The Contractor shall provide ventilation and lighting in accordance with OHSA requirements for the entire length of the tunnel installed as tunneling progresses.

The tunnel is to be kept sufficiently dry at all times to permit work to be performed in a safe and satisfactory manner.

The Contractor shall maintain clean working conditions at all times in tunnels.

If excavation threatens to endanger personnel, the Work, or adjacent property, the Contractor shall cease excavation and make the excavation face secure. The Contractor shall then evaluate methods of construction and revise as necessary to ensure the safe continuation of the work.

The Contractor shall maintain tunnel excavation line and grade to provide for construction of final lining within specified tolerances.

7.05.01 Tunnelling Method

The tunnelling method shall be suitable to provide face support in changing ground conditions that may be encountered during the progress of the work. The selection of the tunnelling method should consider the soil conditions at each pipe crossing and the presence of obstructions, such as cobbles and boulders, with respect to the tunnel alignment.

7.05.02 Primary Liner (Support System)

Primary support systems shall prevent deterioration, loosening, or unravelling of ground surfaces exposed by excavation.

The primary liner support system shall be designed and installed to achieve the intended performance requirements.

Primary liner support system shall maintain the safety of personnel, minimize ground movement into the excavation, ensure stability and maintain strength of ground surrounding the excavation.

The primary liner shall be designed to support all subsurface conditions and hydrostatic pressures and to withstand any additional loads caused by installation and grouting, and shall ensure that no ground loading or other loading will be placed on the new work until after design strength has been reached.

The primary liner shall be installed so that the exterior is as tight as possible to the excavated surface of the tunnel and allows the placement of the full design thickness of the secondary lining.

Primary support systems shall be compatible with the encountered ground conditions, with the method of excavation, with methods for control of water, and with placement of the permanent lining.

All voids between the primary lining and the wall of the excavated volume shall be filled with cement grout or slurry with gel strength properties demonstrated to be sufficient to form a semi-solid or solid gap filling material, prevent ground convergence around the pipe and subsequent ground surface subsidence and prevent long-term water flow at the outside boundary of any pipe and ground. If an unexpanded liner is used, the space outside the liner plates shall be filled at least daily.

7.05.03 Secondary Liner

7.05.03.01 Placing of Grout

The void outside the finished secondary liner shall be filled with cement grout according to the Contractor's submission.

Grout shall not be placed until the lining has achieved 85% of its specified strength or 30 MPa. Grouting shall be limited to such sequences and programs as are necessary to avoid damaging any part of the works or any other structure or property. Grout mix design shall be chemically and thermally compatible with all pipe systems.

7.06 Microtunnelling

7.06.01 General

Excavation of soil, rock and fill shall be done in a manner to control and prevent groundwater inflow to the tunnel.

The MTBM shall be capable of fully supporting the face and shall accommodate the removal of boulders and other obstructions from the face. Continuous ground support shall be maintained during excavation.

The tunnel is to be kept well drained at all times to permit work to be performed in a safe and satisfactory manner.

The Contractor shall maintain clean working conditions at all times.

In the event that excavation threatens to endanger personnel, the Work, adjacent property, roadways, railways, waterways, or the public in any way, the Contractor shall cease excavation. The Contractor shall then evaluate the methods of construction and revise as necessary to ensure the safe continuation of the Work.

The Contractor shall maintain the tunnel excavation line and grade to provide for construction of the product within the specified tolerances.

7.06.02 Method of Installation

The installation procedure to be used shall be subject to the following limitations:

- The jacking pipe shall be fully supported in the jacking pit at the specified line and grade.
- Selection of the excavation method and jacking equipment shall take into consideration the subsurface conditions within the tunnel alignment.
- Perform microtunnelling operations in a manner that will minimize the movement of the ground in front of and surrounding the tunnel in conformance with the limits listed in the Contract Documents.
- Prevent damage to structures and utilities above and in the vicinity of the microtunnelling operations.
- Excavated diameter should be the minimum size required to permit pipe installation by jacking.
- Whenever there is a condition encountered which could endanger the microtunnel excavation or adjacent structures if tunnelling operations cease, continue to operate without intermission including 24-hour working days, weekends and holidays, until the condition no longer exists.
- Maintain an envelope of lubricant around the exterior of the pipe during the jacking and excavation operation to reduce the exterior soil/pipe friction and possibility of the pipe seizing in place.
- In the event a section of pipe is damaged during the jacking operation or a joint failure occurs, as evidenced by inspection, visible ground water inflow or other observations, the Contractor shall submit for approval his methods for repair or replacement of the pipe.

7.06.03 Casing Installation

Casing must withstand the jacking forces determined by the Contractor.

The space between the Casing and the wall of the excavation shall be kept filled with lubricant during the pipe jacking operation. Upon completion of pipe jacking, the space between the Casing and the wall of the excavation shall be filled with grout that is compatible with the Casing.

The Casing shall act as a support system to maintain the safety of personnel, minimize ground movement into the excavation, ensure stability and maintain strength of ground surrounding the Casing.

The Casing shall be designed to support all subsurface conditions and hydrostatic pressures and to withstand any additional loads caused by installation and grouting.

7.07 Instrumentation and Monitoring

**** Designer Fill-in, See Notes to Designer

7.07.01 General

The Contractor shall furnish, install and monitor Surface Monitoring Points (SMP) and In-Ground Monitoring Points at the locations shown on the contract drawings.

The equipment and procedures used for settlement monitoring during construction must be capable of surveying the settlement point elevations to within a repeatability (combined accuracy and precision of equipment and methods) ± 2 mm of the actual elevation.

7.07.02 Surface Settlement Monitoring Points

Surface settlement monitoring points shall be installed on the traffic lanes and shoulders to monitor settlement and stability. The surface settlement monitoring points shall be installed centred on the tunnel alignment as arrays of three points at intervals of 5 m or less and off-set a lateral distance of 1.5 m on either side of the tunnel centerline

Surface settlement monitoring points shall be hardened steel markers treated or coated to resist corrosion, with an exposed convex head having a minimum diameter of 12 mm and similar to surveyor's PK nails. Markers shall be rigidly affixed so as not to move relative to the surface to which it is attached. Traffic shall be managed by the contractor using short-term lane closures in accordance with the Ontario Traffic Manual (OTM). Surface markers shall be recessed or otherwise designed for safe passage of vehicles at highway speeds and protected from snow removal equipment in the event that work occurs during snow removal seasons.

7.07.03 In-Ground Settlement Monitoring Points

In-ground settlement monitoring points shall be installed beyond the traffic lanes and shoulders to monitor settlement and stability of the ground surface between the surface settlement monitoring points and the entry and exit portals. In-ground settlement monitoring points shall be located at intervals of 5 m or less along the tunnel alignment.

In-ground settlement monitoring points shall be 12-18 mm rebar encased in a 50-70 mm, SCH40 PVC pipe, set to a depth of 1.5 m below ground surface or below frost penetration depth whichever is greater. The assembly shall be placed in a drill hole, backfilled with uniform sand and provided with protective covers suitable for high vehicular traffic areas.

7.07.04 Installation, Replacement and Abandonment

The Contractor shall install all settlement monitoring points a minimum of two weeks prior to the start of works to permit baseline surveying to be completed. The settlement monitoring points shall be clearly labelled for easy field identification. The Contractor shall submit to the Contract Administrator a site plan showing the locations of the monitoring points, a geodetic survey of the settlement monitoring points including station, offset and elevation. Instruments damaged by the Contractor’s operations or other causes shall be replaced and surveyed at the time of installation within 24 hours at no additional cost. At the completion of the job, the Contractor shall abandon all instrumentations installed during the course of the Work and restore the surface at instrument locations.

7.07.05 Monitoring and Reporting Frequency

The Contractor shall survey and otherwise obtain elevations of all settlement monitoring points at the following time intervals:

a) Three consecutive readings at least one week prior to commencement of the work (Baseline Reading);
b) Once per shift or once daily during tunnelling operations period whichever results in the more frequent reading intervals; and
c) Weekly after completion of the work for one month, or until such time at which all parties agree that further movement has stopped.

All readings shall be submitted to the Contract Administrator for information purposes on a weekly basis.

Each report shall include all survey data collected in tabular and graphical format as plots of time versus settlement in comparison to survey data collected prior to commencement of the work.

7.07.06 Benchmarks

Two independent benchmarks shall be used for all settlement monitoring surveying and shall be located sufficiently outside the zone of influence such that the benchmarks are not influenced by any trenchless or other construction activity or weather conditions (e.g., frost heave). All surveying shall be reported using the geodetic datum and coordinate system as defined in the Contract Documents.

7.08 Criteria for Assessment of Roadway Subsidence/Heave

***** Designer Fill-in, See Notes to Designer

Based on the monitoring of ground movement as specified in Subsections 4.02 and 7.07, the following represents trigger levels that define magnitude of movement and corresponding action:

a) Review Level: If a maximum value of 10 mm relative to the baseline readings is reached, the Contractor shall review or modify the method, rate or sequence of construction or ground stabilization measures to mitigate further ground displacement. If this Review Level is exceeded, the Contractor shall immediately notify the CA and review and discuss response actions. The Contractor shall submit a plan of action to prevent Alert Levels from being reached. All construction work shall be continued such that the Alert Level is not reached.

b) Alert Level: If a maximum value of 15 mm relative to the baseline readings is reached, the Contractor shall cease construction operations, inform the Contract Administrator and execute pre-planned measures to secure the site, to mitigate further movements and to assure safety of the public and maintain traffic. No construction related to trenchless operation shall take place until all of the following conditions are satisfied:

i. The cause of the settlement has been identified.
ii. The Contractor submits a corrective/preventive plan complete with a Request to Proceed.
iii. Any approved corrective and/or preventive measure deemed necessary by the Contractor is implemented.
iv. Operations shall not proceed until the Contract Administrator has issued a Notice to Proceed for each corrective/preventive plan

7.09 Certificate of Conformance

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the installation of the pipe at each location. In addition, upon completion of the installation of the pipe at each

location, the Contractor shall submit to the Contract Administrator a final Quality Control Certificate sealed and signed by the Design and Design Checking Engineer. The Certificate shall state that the pipe has been installed in general conformance with the Contractor's Submission and Design Requirements, sealed Working Drawings and Contract Documents.

8. QUALITY ASSURANCE - NA

9. MEASUREMENT FOR PAYMENT

Measurement shall be by Plan Quantity Payment as may be revised by Adjusted Plan Quantity Payment in metres, following along the centre line of the pipes from centre to centre of maintenance holes or chambers (catch basins) or from/to the end of the pipe where no maintenance hole or chamber is installed, of the actual length of pipe installed by trenchless methods.

10. BASIS OF PAYMENT

Payment at the contract price shall be full compensation for all labour, equipment and materials required for excavation (regardless of material encountered), dewatering, sheathing and shoring, , settlement instrumentation and monitoring, site restoration, and all other work necessary to complete the installation as specified.

Payment for the pipe installed inside the pipe liner shall be paid separately under the appropriate tender items.

Where a protection system is made necessary because of the Contractor's operations (e.g., choice of trenchless installation method), the cost shall be included in this item and shall be full compensation for all labour, equipment and materials required to carry out the work including subsequently removing the temporary protection system and performing any necessary restoration work.

Payment for connecting intercepted drains and service connections shall be made on the following basis:

(a) Where such drains and service connections are shown on the contract drawings the cost of connections shall be included in the contract price for pipe installation.

(b) Where such drains and service connections are not shown on the contract drawings, the cost of connections will be considered an allowable extra to the contract.

Payment for removal of boulders exceeding Boulder Volume Rations (BVR) and Boulder Number Ration (BNR) shall be by Time and Material.

NOTES TO DESIGNER:

* Insert the following fill-in: Any method that is not suitable shall be specified.

** Insert the following fill-in: Subsurface Condition Baseline Reporting that includes Boulder Volume Ration (BVR), Boulder Number Ration (BNR) shall be project specific and included in the Foundation Engineering TOR as selected during the scoping of the project.

*** Insert the following fill-in: Any known obstructions shall be specified.

**** Insert the following fill-in: - The Instrumentation and Monitoring program shall be project specific. The work specified in this Section includes furnishing and installing instruments for monitoring of settlement (and heave) and ground stability.

***** Insert the following fill-in: Project specific Review and Alert Levels shall be provided if required.

WARRANT: Always with this specification