FINAL

Geotechnical Investigation – Proposed Commercial Development

2375 St. Laurent Boulevard, Ottawa, Ontario

Prepared for:

Reinders + Law
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Milton, Ontario, L9T 2T1

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1.0 INTRODUCTION AND SCOPE

Pinchin Ltd. (Pinchin) was retained by Reinders + Law (Client) to conduct a Geotechnical Investigation and provide subsequent geotechnical design recommendations for the proposed commercial development to be located at 2375 St. Laurent Boulevard, Ottawa, Ontario (Site). The Site location is shown on Figure 1.

Based on information provided by the Client, it is Pinchin's understanding that the development will consist of a single-storey slab-on-grade (i.e., no basement level) building within the northern portion of the Site and surface asphalt parking in the southern portion of the Site. An access driveway along the west property line will connect the Site to St. Laurent Boulevard in the north.

Pinchin's geotechnical comments and recommendations are based on the results of the Geotechnical Investigation and our understanding of the project scope.

The purpose of the Geotechnical Investigation was to delineate the subsurface conditions and soil engineering characteristics by advancing a total of three (3) sampled boreholes (Boreholes BH1 to BH3), at the Site.

Based on a desk top review and the results of the Geotechnical Investigation, the following geotechnical data and engineering design recommendations are provided herein:

- A detailed description of the soil and groundwater conditions;
- Site preparation recommendations;
- Open cut excavations;
- Anticipated groundwater management;
- Site service trench design;
- Lateral earth pressure coefficients and unit densities;
- Foundation design recommendations including soil bearing resistances at Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design;
- Potential total and differential settlements;
- Foundation frost protection and engineered fill specifications and installation;
- Seismic Site classification for seismic Site response;
- Concrete floor slab-on-grade support recommendations;
- Asphaltic concrete pavement structure design for parking areas and access roadways; and
- Potential construction concerns.

Abbreviations, terminology and principle symbols commonly used throughout the report, borehole logs and appendices are enclosed in Appendix I.

2.0 SITE DESCRIPTION AND GEOLOGICAL SETTING

The Site is located at 2375 St. Laurent Boulevard in Ottawa, Ontario, approximately 250 m southwest of the intersection of St. Laurent Boulevard and Thurston Drive. The Site is bounded by St. Laurent Boulevard to the north, commercial buildings to the west and east, and a hydro corridor with trail to the south. The Site is currently vacant and predominantly covered with grasses and occasional trees. The Site is relatively flat with elevations ranging from 83.2 to 84.2 meters above sea level (masl) as illustrated on the provided Site Grading Plan (Reinders + Law Ltd., Drawing No. 20037_SP4, Revision No. 0, dated 2/14/2022).

The Physiography of Southern Ontario (L.J. Chapman and D.F. Putnam, 3rd Edition, 1984) indicates that the subject Site is located within clay plains of the physiographic region referred to as the Ottawa valley clay plains.

The Surficial Geology of Southern Ontario mapping (Ontario Geological Survey 2003, Miscellaneous Release---Data 128-Revised) indicates that the Site is underlain by fine-textured glaciomarine deposits (silt and clay, minor sand and gravel, massive to well laminated).

Geotechnical borehole records available through the Ontario Geological Survey indicate that several boreholes have been completed in the general area surrounding the Site. The borehole records generally indicate clay deposits localized underlain by glacial till and/or sand and silt deposits. Bedrock was noted at depths of 14.6 meters below ground surface (mbgs) approximately 130 m to the northeast of the Site and at 15.6 and 16.2 mbgs at approximately 220 to 260 m to the south / southwest of the Site.

The Paleozoic Geology of Southern Ontario indicates that the underlying bedrock at this Site is of the Carlsbad Formation consisting of shale and limestone bedrock (Ontario Geological Survey 2003, Miscellaneous Release---Data 219).

3.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY

Pinchin completed the field investigation at the Site on September 8, 2022 by advancing a total of three sampled boreholes (Boreholes BH1 to BH3) throughout the Site. The boreholes were advanced to depths of approximately 5.2 to 9.8 mbgs. One dynamic cone penetration test was completed at Borehole BH2 extending from the termination depth of the sampled borehole at 9.1 mbgs to refusal at 14.3 mbgs. The approximate spatial locations of the boreholes advanced at the Site are shown on Figure 2.

The boreholes were advanced with the use of a track-mounted drill rig which was equipped with standard soil sampling equipment. Soil samples were collected at regular intervals using a 51 mm outside diameter (OD) split spoon barrel in conjunction with Standard Penetration Tests (SPT) "N" values (ASTM D1586). The SPT "N" values were used to assess the compactness condition of the non-cohesive soil. Approximate shear strengths of the cohesive deposits were measured using a handheld pocket penetrometer and shear vane. The results of the pocket penetrometer testing are included on the borehole logs and the results of the shear vane testing are discussed in the report text.

Monitoring wells were installed in all of the boreholes to allow measurement of groundwater levels. The monitoring wells were constructed using flush-threaded 50 mm diameter Trilock pipe with 1.5 or 4.6 meter long 10-slot well screens, delivered to the Site in pre-cleaned individually sealed plastic bags. The screen and riser pipes were not allowed to come into contact with the ground or drilling equipment prior to installation.

A completed well record was submitted to the property owner and the Ministry of the Environment, Conservation and Parks for Ontario (MECP) as per Ontario Regulation 903, as amended. A licensed well technician must properly decommission the monitoring wells prior to construction according to Regulation 903 of the Ontario Water Resources Act.

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling. Groundwater levels were measured in the monitoring wells on September 21, 2022. The groundwater observations and measurements recorded are included on the appended borehole logs.

The boreholes' locations and ground surface elevations were located at the Site by Pinchin personnel. The ground surface elevation at each borehole location was referenced to the following temporary benchmark as shown on Figure 2:

- TBM: Double catch basin on south side of St. Laurent Boulevard, at the approximate location shown on Figure 2; and
- Elevation: 83.30 masl (taken from Site Grading Plan, Reinders + Law Ltd., Drawing No. 20037_SP4, Revision No. 0, dated 2/14/2022).

The field investigation was monitored by experienced Pinchin personnel. Pinchin logged the drilling operations and identified the soil samples as they were retrieved. The recovered soil samples were sealed into plastic bags and carefully transported to an independent and accredited materials testing laboratory for detailed analysis and testing. All soil samples were classified according to visual and index properties by the project engineer.

The field logging of the soil and groundwater conditions was performed to collect geotechnical engineering design information. The borehole logs include textural descriptions of the subsoil in accordance with a modified Unified Soil Classification System (USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations made during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The modified USCS classification is explained in further detail in Appendix I. Details of the soil and groundwater conditions encountered within the boreholes are included on the Borehole Logs within Appendix II.

Select soil samples collected from the boreholes were submitted to a material testing laboratory to determine the grain size distribution of the soil and Atterberg Limits. A copy of the laboratory analytical reports is included in Appendix III. In addition, the collected samples were compared against previous geotechnical information from the area, for consistency and calibration of results. One sample was further submitted for assessment of soil corrosivity potential and sulphate attack on concrete and the results are included in Appendix IV.

4.0 LIMITED ENVIRONMENTAL SOIL SAMPLING PROGRAM AND METHODOLOGY

This Limited Soil Sampling Program was completed in general accordance with the Canadian Standards Association document entitled "*Phase II Environmental Site Assessment, CSA Standard Z769-00 (R2018)*", dated 2000 and reaffirmed in 2018.

It is noted that this soil sampling plan does not meet the requirements of Ontario Regulation 406/19, On-Site and Excess Soil Management and additional studies including sampling, analysis and reporting will be required for excess soil generated at the Site in order to meet the requirements of Ontario Regulation 406/19.

4.1 Scope of Work

The scope of work for the Limited Soil Sampling Program included the following activities:

- Submit a total of two most-apparent "worst case" soil sample, based on the field screening methodologies, from the geotechnical borehole for chemical analyses of metals and inorganics; benzene, toluene, ethylbenzene and xylenes (BTEX), and petroleum hydrocarbons (PHCs) F1 to F4;
- Compare the soil and groundwater laboratory analytical results with the applicable standards stipulated in the *MECP Standards*; and
- Incorporate the laboratory analytical results into the geotechnical report.

4.2 Analytical Laboratory

Selected soil samples were delivered to ALS Environmental in Waterloo for analysis. ALS Environmental is an independent laboratory accredited by the Standards Council of Canada and the Canadian Association for Laboratory Accreditation. Formal chain of custody records of the sample submissions were maintained between Pinchin and the staff at ALS Environmental.

4.3 Site Condition Standards and Analytical Results

The Site is located within the City of Ottawa. It is Pinchin's understanding that potable water for the Site and surrounding area is supplied by the City of Ottawa drinking water system, with the Ottawa River as the water source, therefore non-potable conditions apply.

Ontario Regulation 153/04 (as amended) states that a Site is classified as an "environmentally sensitive area" if the pH of the surface soil (less than 1.5 mbgs) is less than 5 or greater than 9, the pH of the subsurface soil (greater than 1.5 mbgs) is less than 5 or greater than 11, or if the Site is an area of natural significance or is adjacent to or contains land within 30 metres of an area of natural significance.

Two representative soil samples collected from the boreholes advanced at the Site were submitted for pH analysis. The pH values measured in the submitted soil samples were within the limits for non-sensitive sites.

Based on Pinchin's understanding of the Site, the Site is not located in or adjacent to, nor does it contain land within 30 m of, an area of natural significance.

Based on the above, the appropriate Site Condition Standards for the Site are:

- "*Table 3: Generic Site Conditions Standards for Use in a Non-Potable Groundwater Condition", provided in the Ontario Ministry of the Environment, Conservation and Parks (MECP) document titled, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", dated April 15, 2011 (Table 3 Standards)* for an industrial/commercial/community property use for medium to fine-textured soils.

A concentration of vanadium above the *Table 3 Standards* was identified in the soil sample collected at Borehole BH1 from 1.5 to 1.8 mbgs and at Borehole BH2 from 3.1 to 3.4 mbgs. The lateral and vertical extent of the vanadium-impacted soil is not known, and additional soil characterization may be warranted. The excess soils must be re-used or disposed of at appropriate sites considering the concentrations of the analyzed parameters in the excess material.

5.0 SUBSURFACE CONDITIONS

5.1 Borehole Soil Stratigraphy

In general, the soil stratigraphy at the Site comprises topsoil, fill and non-cohesive silt, underlain by cohesive silt and clay deposits to the maximum sampled borehole termination depths of approximately 9.8 mbgs. Refusal on possible bedrock was achieved at 14.3 mbgs at Borehole BH2 by dynamic cone penetration testing. The appended borehole logs provide detailed soil descriptions and stratigraphies, results of SPT and pocket penetrometer testing, moisture content profiles, details of monitoring well installations, and groundwater measurements.

5.1.1 Topsoil

Topsoil was contacted at ground surface a Borehole BH2 and was 150 mm thick.

5.1.2 Fill

Fill was contacted at Boreholes BH1 and BH3 and extended depths of 0.8 and 0.4 mbgs, respectively. The upper 100 mm consisted of topsoil fill. The underlying fill consisted of sandy silt (Borehole BH1) and sand (Borehole BH3). The fill was described as damp at the time of sampling. SPT N-values of 4 and 6 blows per 300 mm indicated that the fill has a loose relative density.

5.1.3 Non-Cohesive Silt

A layer of non-cohesive silt was contacted underlying the topsoil layer at Borehole BH2 and the sand fill at Borehole BH3. The non-cohesive silt extended to depths of 0.8 and 1.5 mbgs. The silt contained trace sand and nil to some clay and was described as damp at the time of drilling. SPT N-values of 2 to 8 blows per 300 mm indicated a very loose to loose relative density.

5.1.4 Cohesive Silt to Silty Clay

Cohesive silt with some clay to clayey silt was contacted at all boreholes underlying the fill at Borehole BH1 and non-cohesive silt at Boreholes BH2 and BH3. The cohesive silt contained nil to trace sand. Silty clay was contacted in all boreholes underlying the cohesive silt. The transition from clayey silt to silty clay was noted at Borehole BH2 at about 1.5 mbgs and at Borehole BH3 at about 3.1 mbgs. The cohesive silt to silty clay was described as drier than the plastic limit (DTPL) to wetter than the plastic limit (WTPL).

The results of two particle size distribution analyses completed on representative samples of the silty clay deposit are provided in Appendix III and summarized in the table below:

Borehole / Sample Number	Depth (mbgs)	Soil Type	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH2 SS3	1.5 – 2.1	Silty Clay	0	1	34	65
BH3 SS6	4.6 – 5.2	Silty Clay	0	1	39	60

The results of two Atterberg Limits test results are summarized in the table below:

Borehole / Sample Number	Depth (mbgs)	Soil Type	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)
BH2 SS3	1.5 – 2.1	Silty Clay	30	67	37	52.5
BH3 SS6	4.6 – 5.2	Silty Clay	39	78	39	72.1

The Atterberg Limits test results indicate that the silty clay is of high plasticity and/or high compressibility. A moisture content near the liquid limit indicates that the clay is sensitive.

The cohesive silt, clayey silt, and silty clay had a variable very stiff to very soft consistency based on approximate shear strengths measured with a handheld pocket penetrometer of about 2 to 150 kPa and SPT N values of 0 to 9 blows per 300 mm. In general, the strength of the silt and clay decreases with depth. Approximate shear strengths of the cohesive deposits were measured using a shear vane in Boreholes BH1 and BH2 and the results are summarized in the following table:

Borehole ID	Depth (mbgs)	Initial (kPa)	Remold (kPa)	Sensitivity
BH1	1.8	162.9	20.4	8
BH1	2.6	81.5	20.4	4
BH1	3.4	40.7	10.2	4
BH1	6.4	<10.2	<10.2	Cannot determine
BH1	7.9	<10.2	<10.2	Cannot determine
BH2	3.4	10.2	<10.2	Cannot determine
BH2	4.9	14.3	<10.2	Cannot determine
BH2	6.4	<10.2	<10.2	Cannot determine
BH2	9.4	<10.2	Vane started to sink under own weight	Cannot determine

Based on the vane shear ratio of initial and remold, the clayey silt to silty clay deposit is estimated to be sensitive.

A dynamic cone was advanced at Borehole BH2 from 9.1 mbgs to refusal at 14.3 mbgs. The dynamic cone advanced under its own weight to a depth of about 12.2 mbgs. The blow counts to refusal increased slightly possibly indicating the presence of a firmer deposit or gravel content.

5.1.5 Possible Bedrock

Based on available geological data in the general area of the subject Site, bedrock occurs some 14.6 to 16.2 mbgs. One dynamic cone was advanced at the Site extending from the termination depth of sampled Borehole BH2 at 9.1 mbgs to refusal at 14.3 mbgs. The bedrock was not proven by coring. It is anticipated that the depth to the possible bedrock varies across the Site.

5.2 Groundwater Conditions

Groundwater observations and measurements were obtained in the open boreholes at the completion of drilling and are summarized on the appended borehole logs. Stabilized groundwater levels were measured on September 21, 2022 and the results are summarized in the following table:

Borehole No.	Ground Surface Elevation (masl)	Depth to Groundwater (mbgs)	Groundwater Elevation (masl)
BH1	83.6	4.3	79.4
BH2	83.6	4.7	78.9
BH3	83.7	2.6	81.1

Perched conditions should be expected within the upper non-cohesive silt or fill underlain by cohesive silt and clay.

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

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 General Information

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from the geotechnical investigation, and Pinchin's experience with similar projects. Since the investigation only represents a portion of the subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different than those encountered during the investigation. If these situations are encountered, adjustments to the design may be necessary. A qualified geotechnical engineer should be

on-Site during the foundation preparation to ensure the subsurface conditions are the same/similar to what was observed during the investigation.

It is Pinchin's understanding that the development will consist of a single-storey slab-on-grade (i.e., no basement level) building in the northern portion of the Site. Surface parking is proposed in the southern portion of the Site. An access driveway along the western property line will connect the Site to St. Laurent Boulevard to the north.

Based on the provided site grading plan (Reinders + Law Ltd., Drawing No. 20037_SP4, Revision No. 0, dated 2/14/2022), the finished floor of the new building is proposed at Elevation 83.75 masl, which is close to existing grades. Proposed Site grades will be close to existing grades with proposed finished grade elevations ranging from 83.3 to 83.7 masl. The site servicing plan (Reinders + Law Ltd., Drawing No. 20037_SP3, Revision No. 0, dated 2/14/2022) illustrates storm services at about 1.5 to 2.2 mbgs. A stormceptor as well as sanitary services connecting to existing City services along St. Laurent Boulevard are proposed at approximately 3.8 and 4.4 mbgs, respectively. Proposed underside of footing elevations are illustrated at 82.35 masl for exterior walls and at 83.20 masl for interior walls (Foundation Plan, Reinders + Law Ltd., Drawing No. 20037_S200, dated 06/15/2022).

The soils contacted at the Site consisted of surficial topsoil or fill underlain by a thin layer of non-cohesive silt at Boreholes BH2 and BH3, which in turn were underlain by cohesive silt and clay deposits. Refusal of a dynamic cone penetration test on possible bedrock was at achieved 14.3 mbgs.

The cohesive silt and clay deposits generally underlying the Site are highly compressible. Disturbance of the upper stiff to very stiff cohesive silt / clay layer will cause reduction in shear strength of the underlying soils and potentially cause large settlements. Special considerations must be made during the excavation work to protect the cohesive silt and clay subgrade as well as before any grade raise is planned for the Site. Overstressing of the underlying cohesive silt and clay soils (i.e., from surcharge loading) may result in excessive settlement and punching failure. Based on the provided site grading plan, proposed Site grades will be close to existing Site grades.

The contacted in-situ soils are not considered suitable for support of conventional foundations. Caissons could be considered at the Site but are not considered economically feasible when compared to other deep foundation alternatives. Further, excess soils generated during the caisson installation would need to be removed from Site.

Based on the soil conditions encountered at the Site, the following foundations options are considered suitable for the proposed development:

- Conventional spread footings, supported by a GeoConcrete © Column (GCC) system or a Controlled Modulus Column (CMC) system.

- Support of the proposed building on a deep foundation system, such as micropiles or steel piles founded on the underlying bedrock.

6.2 Open Cut Excavations

As previously mentioned, the building will need to be supported on improved soils or deep foundations. Excavations for pile caps or grade beams are expected to extend to a frost-free depth, some 1.5 to 2.0 mbgs. Servicing trenches are proposed to depths of up to 4.4 mbgs. The predominant soils expected to be contacted in excavations is fill, generally very loose to loose silt, and/or very stiff to very soft silt and clay. Groundwater was measured at depths of 2.6 to 4.7 mbgs. The clays are generally considered sensitive and care must be taken during excavations to minimize the possible severe loss in shear strength and collapse as a result of strains within the soil mass beneath and adjacent to the excavation.

Where workers must enter trench excavations deeper than 1.2 m, the trench excavations should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91, Construction Projects, July 1, 2011, Part III - Excavations, Section 226.

The fill, loose silt, and very stiff to firm cohesive silt and clay soils would be classified as Type 3 soil and temporary excavations in these soils must be sloped at an inclination of 1 horizontal to 1 vertical (H to V) from the base of the excavation. Excavations extending into soft to very soft soils, soils that are easily disturbed, or below the groundwater table would be classified as Type 4 soil, and excavation side slopes need to be sloped back at 3 horizontals to 1 vertical from the base of the excavation. Where more than one soil type is exposed in an excavation, the soil type with the higher number governs.

In addition to compliance with the OHSA, the excavation procedures must also be in compliance to any potential other regulatory authorities, such as federal and municipal safety standards.

Alternatively, the excavation walls may be supported by either closed shoring, bracing, or trench boxes complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1). The use of trench boxes can most likely be used for temporary support of vertical side walls. The appropriate trench should be designed/confirmed for use in this soil deposit.

6.3 Anticipated Groundwater Management

Groundwater was measured on September 21, 2022 at depths from 2.6 to 4.7 mbgs (Elevations 78.9 to 81.1 masl). Based on the provided site servicing plan, excavations are expected to extend close to and possibly below the groundwater table.

Low groundwater inflow is anticipated into open excavations from the predominant cohesive silt and clay soils underlying the Site. Moderate groundwater inflow should be expected where non-cohesive silt seams are contacted in an excavation. The groundwater will need to be lowered prior to excavation work

to a minimum of 0.3 m below the excavation base. A dewatering system installed by a specialist dewatering contractor may be required.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. If construction commences during wet periods (typically spring or fall), there is a greater potential that the groundwater elevation could be higher and/or perched groundwater may be present. Any potential precipitation of perched groundwater should be able to be controlled from pumping from filtered sumps.

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade softening.

All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a silt fence should be installed at the discharge point of the dewatering system. The utmost care should be taken to avoid any potential impacts on the environment

It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. The method used should not adversely impact any nearby structures. Excavations for the building foundations are not expected to require a Permit to Take Water or a submission to the Environmental Activity and Sector Registry (EASR). It is the responsibility of the contractor to make this application if required.

As previously mentioned, above average seasonal variations in the groundwater table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. As such, depending on the groundwater at the time of the excavation works, a more involved dewatering system may be required.

6.4 Foundation Design

Soil improvement methods (such as the installation of a GCC system or CMC system) or deep foundation options (such as micropiles and driven piles) are considered suitable for the proposed development and the soil conditions contacted at the Site.

The following subsections of the report provide recommendations on soil improvement techniques as well as deep foundation options. As previously noted, conventional foundations are not considered feasible for the Site.

6.4.1 In-situ Soil Improvement Options

6.4.1.1 GeoConcrete © Column System

GeoConcrete © Columns (GCC) are a rigid-inclusion solution for weak soils offered by Geosolv. The individual elements are constructed using a special mandrel pressure vessel complete with concrete pumping inlet, air valve and gauge, and a stone valve at the bottom end. While pumping in ready-mix concrete, and with the stone valve closed, the vertically ramming mandrel is forced into the ground to the design depth, which is typically a stiff-to-hard layer. The mandrel is then raised and redriven repeatedly with full crowd and ramming energy, extruding a belled base while improving the base soils below and around the expanded concrete bulb. The mandrel is then pulled up while extruding a column of concrete right to the surface. A load transfer cushion is then placed over groups of GCC elements, and a regular spread footing can be designed for high bearing, even in very poor soils (source: https://geosolv.ca/rigid-inclusions/geoconcrete/). This method can also be used for support of lightly reinforced floor slab.

GCC are a proprietary design and will require input from specialized contractors and engineers. The installation of the GCC should be monitored on a full-time basis by a qualified geotechnical consultant.

6.4.1.2 Controlled Modulus Column

The Controlled Modulus Column (CMC) method utilizes a specialized & patented, high torque, displacement drill system capable of displacing in-situ soils during penetration and installing a controlled structural grout element during withdrawal. The displacement drill system produces virtually no vibrations or excess soils and is suitable for construction adjacent to existing structures.

The installed CMC elements are then overlain with a structural/engineered fill pad known as a Load Transfer Platform (LTP). The LTP is typically designed as 150-300 mm of compacted granular placed between the CMC element tops and the underside of footing which is distributes the imposed footing loads evenly over the CMC treatment area. The CMC / LTP system allows for the design of high capacity strip / spread footings and relatively thin, lightly reinforced floor slabs.

The design of the CMC and recommendations will be conducted by a third party for the proposed structure.

6.4.1.3 Ancillary Conventional Shallow Foundation Recommendations

In addition, to ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- Prior to commencing excavations, it is critical that all existing surface water, potential surface water and perched groundwater are controlled and diverted away from the work Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to inclement weather conditions and cause subgrade softening;
- The subgrade should be sloped to a sump outside the excavation to promote surface drainage and the collected water pumped out of the excavation. Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond);
- The footing areas should be cleaned of all deleterious materials such as topsoil, organics, fill, disturbed, or caved materials; and,
- If the excavated subgrade soil remains open to weather conditions and groundwater seepage, sidewall stability and suitability of the subgrade soil will need to be verified prior to construction.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided and maintained above freezing at all times.

6.4.2 Deep Foundation Options

Micropiles and driven steel piles socketed into the bedrock underlying the Site could be considered for foundation support of the proposed building.

6.4.2.1 Micropiles

Micropiles comprise a small diameter friction pile that is bored into the ground. A reinforcement bar is inserted into the center of the hole and the pile is grouted to allow load transfer to the underlying bedrock.

The micropile system is a proprietary geo-engineered system. In this respect, design and construction should be carried out by a specialty contractor or the micropile supplier.

6.4.2.2 Steel Piles Driven to Refusal on Bedrock

6.4.2.2.1 Geotechnical Axial Resistance at Ultimate Limit States

An alternative to in-situ soil improvement methods for support of the proposed building could be the use of closed ended steel tube piles or H-piles driven to refusal on bedrock. Dynamic cone penetration refusal on possible bedrock was achieved at 14.3 mbgs. The bedrock was not proven by coring. Should piles be

the preferred foundation option at the Site, Pinchin recommends that additional rock probes be completed at the Site to confirm the bedrock surface profile at the Site.

Preliminary design resistances for closed ended, concrete filled steel piles as well as steel H-piles are provided below. Additional calculations will be required for different piles sizes. The piles should be designed to Ultimate Limit States (ULS) design. SLS design does not apply for piles driven to sound bedrock, since the bedrock is considered non-yielding and the loads required for unacceptable settlements to occur would be much larger than the factored ULS. A minimum pile length of 14.3 m has been assumed for the preliminary design resistances in the following table:

Pile Type	Factored Geotechnical Axial Capacity (ULS)
Steel H-Pile 310 x 110	95 kN
Steel Tube Pile (concrete filled) 244.5 x 9.5	410 kN
Steel Tube Pile (concrete filled) 323.9 x 9.5	570 kN

The factored geotechnical pile capacity at ULS is based on end bearing piles (i.e., no shaft friction was accounted for) and a geotechnical resistance of 0.4. If dynamic monitoring results are used in the analysis, then a resistance factor of 0.5 may be used instead. If static load testing is completed for the analysis, then a resistance factor of 0.6 may be applied.

It is strongly recommended that the pile capacity be determined by full scale load test or the use of on-site pile analyzers.

Piles in group should be spaced so that the load-bearing capacity of the group is not less than the sum of the bearing capacity of individual piles, or the load-bearing capacity of the piles must be reduces based on the pile spacing.

From previous experience, Pinchin would anticipate that the set criterion required to develop the pile capacity be driven with a hammer developing an energy of at least 50 kJ with a final set varying from approximately 4 to 6 blows per 6 to 7 mm of penetration for a minimum of three consecutive sets. The number of blows will depend on the hammer energy and pile section chosen. Normal tolerances during pile driving of 2% plumb and 42 mm in location should not be exceeded.

Piles should be fitted with either driving shoes or OSLO points to set the piles in the bedrock, to minimize pile tip damage when driving through the possible till overlying the bedrock as well as driving into the bedrock, and to reduce the risk of horizontal pile movement during driving on sloping bedrock surface. This; however, should be determined by the pile installer during construction.

Corrosion is not normally a problem for steel piles driven into natural soil; however, in fill or at/above the groundwater table moderate corrosion may occur. Where these conditions exist, steps should be taken to protect the piles and may include application of protective coatings prior to pile driving, encasement by cast-in-place concrete jackets, cathodic protection, amongst others. Reference is made to Section 6.5.6 of this report for corrosivity potential on tested soil samples.

If pile caps are constructed below grade, a minimum 1.8 m earth cover or equivalent insulation will be required for adequate protection against frost.

The pile installations should be monitored on a full-time basis by qualified geotechnical personnel to ensure uniformity of set, record pile toe and cut off elevations, and to check the pile condition, alignment, splices, and plumbness. All pile driving techniques should be reviewed and approved prior to the installation of the piles. The set criterion for each pile should be confirmed by a full-time qualified piling inspector.

6.4.2.2.2 Lateral Capacity of Piles

Vertical piles resist lateral loads or moments by deflecting until the necessary reaction in the surrounding soil is mobilized. The behaviour depends on the pile stiffness and soil strength. Methods for determining the lateral capacity of piles are provided in Section 18.4 of the Canadian Foundation Engineering Manual. The soil design parameters provided in the following table may be used for determining the lateral pile capacity:

Soil Type	Effective Friction Angle (deg)	Bulk Unit Weight (kN/m^3)	Undrained Shear Strength (kPa)	Effective cohesion (kPa)	Passive Coefficient of Lateral Earth Pressure, k_p
Fill	26	18	0	0	2.56
Non-Cohesive Silt	26	18	0	0	2.56
Cohesive Silt and Clay, very stiff to stiff	27	18	50	5	2.66
Clay, firm to very soft	25	17	0	0	2.46

A resistance factor of 0.5 should be applied.

Due to freeze-thaw softening, the upper 1.8 m should not be considered to provide lateral resistance. Pile buckling should be considered in the pile design.

The horizontal pile capacity should be confirmed on a representative number of piles by load testing.

6.4.2.2.3 Uplift Resistance

The uplift resistance may be estimated using Section 18.2.6 and 18.1.1.2(2) of the Canadian Foundation Engineering Manual and the soil parameters provided in the table above. A resistance factor of 0.3 should be applied to the ultimate shaft resistance. The uplift resistance of the pile should be confirmed on a representative number of piles by uplift testing.

6.4.2.2.4 Pile Driving in Close Proximity to Existing Structures

Driving piles with impact hammers will induce ground vibrations within the surrounding soil. These ground vibrations can have detrimental effects on any nearby structures. Where piles are driven in close proximity to existing structures, careful monitoring of the pile driving installation will need to be performed by the pile driving contractor. Pinchin recommends that a preconstruction survey of all neighboring properties be undertaken prior to pile driving to avoid any unjustified claims from adjacent property owners. At the start of the pile driving operations and periodically during them, the piling contractor should inspect adjacent buildings to ensure that damage is not being done to existing foundations due to vibrations through the ground.

6.4.3 Site Classification for Seismic Site Response & Soil Behaviour

The following information has been provided to assist the building designer from a geotechnical perspective only. These geotechnical seismic design parameters should be reviewed in detail by the structural engineer and be incorporated into the design as required.

The seismic site classification has been based on the 2012 OBC. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy. If the average shear wave velocity is not known, the site class can be estimated from energy corrected Standard Penetration Resistance (N60) and/or the average undrained shear strength of the soil in the top 30 m.

The sampled boreholes advanced at this Site extended to approximately 5.2 to 9.8 mbgs and were terminated in the very soft clay deposit underlying the Site. A cone penetration test was completed at Borehole BH2 from 9.1 mbgs to refusal at 14.3 mbgs. SPT “N” values within the overburden soils were below 15 blows per 300 mm (generally ranging from 0 to 9 blows per 300 mm) and had an average undrained shear strength of less than 25 kPa.

Site Class E is applicable for the Site as a profile of more than 3 m of soil with a plasticity index of greater than 20, a moisture content of equal to or greater than 40%, and undrained shear strengths of less than 25 kPa were contacted at the boreholes. A Site Class E has an average shear wave velocity (Vs) of less than 180 m/s.

The soils are not considered to meet the criteria of Site Class F, including:

- Based on the vane shear test results, the soils are considered generally sensitive and do not meet the quick and highly sensitive clay criteria of the OBC 2012 applicable to Site Class F soils.
- Based on the laboratory determined moisture contents of 52.5 and 72.1% and Atterberg Limits Results (liquid limits of 67% and 78% and plasticity indexes of 37% and 39%) as well as the criteria outlined in Section 6.6.3.2 (6) and illustrated on Figure 16.5 of the CFEM, the soils are considered “not susceptible” to liquefaction; however, may undergo significant deformations of cyclic shear stresses > static undrained shear strength.

Foundations founded on sound bedrock may be designed for Site Class C, which has an average shear wave velocity (Vs) of between 360 and 760 m/s.

6.4.4 Building Drainage

To assist in maintaining the building dry from surface water seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the structure to a drainage swale or appropriate storm drainage system.

Exterior perimeter foundations drains are not required, where the finished floor elevation is established a minimum of 150 mm above the exterior final grades or that the exterior gradient is properly sloped to divert surface water away from the building.

6.4.5 Shallow Foundations Frost Protection & Foundation Backfill

In the Ottawa, Ontario area, exterior perimeter foundations for heated buildings require a minimum of 1.8 m of soil cover above the underside of the footing to provide soil cover for frost protection.

Where the foundations for heated buildings do not have the minimum 1.8 m of soil cover frost protection, they should be protected from frost with a combination of soil cover and rigid polystyrene insulation, such as Dow Styrofoam or equivalent product. If required, Pinchin can provide appropriate foundation frost protection recommendations as part of the design review.

To minimize potential frost movements from soil frost adhesion, the perimeter foundation backfill should consist of a free draining granular material, such as a Granular ‘B’ Type I (OPSS 1010) or an approved sand fill, extending a minimum lateral distance of 600 mm beyond the foundation. The existing silt and clay material will be too blocky for reuse and not considered suitable for reuse as foundation wall backfill. Backfill must be brought up evenly on both sides of any wall not designed to resist lateral earth pressure. All granular material is to be placed in maximum 300 mm thick lifts compacted to a minimum of 100% SPMDD in hard landscaping areas and 95% SPMDD in soft landscaping areas. It is recommended that

inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure compaction requirements are achieved.

6.4.6 Soil Corrosivity and Sulphate Attack on Concrete

One soil sample was submitted to Paracel Laboratories Ltd. in Ottawa to assess the corrosivity of the soil and potential for sulphate attack on concrete. The assessment was completed using the 10-point soil evaluation procedure, provided in the Appendix to the American Water Work Association A21.5 Standard, as recommended by the Ductile Iron Pipe Research Association (DIPRA). The soil sample was evaluated for the following parameters: soil resistivity, pH, redox potential, sulfides, and moisture. Each parameter is assessed and assigned a point value, and the points are totalled. If the total is equal or greater than 10, the soil is considered corrosive to ductile iron pipe. In this case, protective measure must be undertaken. The following table summarizes the 10-point soil evaluation for the tested samples:

Parameter	**BH2, SS3 1.5 – 2.1 mbgs**	
	Results	**Points**
Resistivity (ohm-cm)	4560	0
pH	8.04	0
Redox Potential (mV)	364	0
Sulfide	<0.04	2
Moisture	Poor drainage, continuously wet	2
Total Points		**4**

In summary, the tested sample indicate a low potential for soil corrosivity, and additional protective measures are not required.

Parameter	**BH2, SS3 1.5 – 2.1 mbgs**
	Results
Sulphate (µg/g)	48
Chloride (µg/g)	58

The results indicate that a low degree of potential sulphate attack is expected for concrete in contact with the soil. Type GU Portland Cement can be considered for use in buried concrete structures at the Site. The results should be reviewed by the structural engineer to ensure conformance to the concrete exposures.

6.5 Floor Slabs

Prior to the installation of the floor slab and floor slab base material, all fill materials and any soil containing organics (if encountered) should be removed to the underlying organic free native soil. The natural subgrade soil is to be proof roll compacted with a minimum 10 tonne non-vibratory steel drum roller to observe for weak/soft spots.

The in-situ inorganic silt material encountered within the boreholes is considered adequate for the support of the concrete floor slabs provided it is proof roll compacted as outlined above. Any soft area(s) encountered during proof rolling should be excavated and replaced with a similar soil type.

Once the subgrade soil is exposed it is to be inspected and approved by a qualified geotechnical engineering consultant to ensure that the material conforms to the soil type and consistency observed during the subsurface investigation work.

Based on the in-situ soil conditions, it is recommended to establish the concrete floor slab on a minimum 300 mm thick layer of Granular “A” (OPSS 1010). Alternatively, consideration may also be given to using a 200 mm thick layer of uniformly compacted 19 mm clear stone placed over the approved subgrade. Any required up fill should consist of a Granular “B” Type I or Type II (OPSS 1010).

The following table provides the unfactored modulus of subgrade reaction values:

Material Type	Modulus of Subgrade Reaction (kN/m^3)
Granular A (OPSS 1010)	85,000
Granular “B” Type I (OPSS 1010)	75,000
Granular “B” Type II (OPSS 1010)	85,000
Native Silt and Clay, very stiff to stiff	10,000
Native Silt and Clay / Clay firm to very soft	4,000

The values in the table above are for loaded areas of 0.3 m by 0.3 m.

6.6 Site Servicing

6.6.1 Pipe Bedding and Cover Materials for Flexible and Rigid Pipes

The subgrade soil conditions beneath the site services will comprise natural silt and clay soils of variable stiff to very soft consistency. Support of the pipes by a geogrid-soil system may be warranted depending on the strength of soil exposed at the pipe invert level. It is critical that the pipe subgrade is inspected by a geotechnical engineer prior to placement of pipe bedding material to ensure adequate support is available for the services.

Service pipes require an adequate base to ensure proper pipe connection and positive flow is maintained post construction. As such, pipe bedding should be placed to be of uniform thickness and compactness.

The pipe bedding and cover material should conform to OPSD 802.010 and 802.013 specifications for flexible pipes and to OPSD 802.031 to 802.033 with Class “B” bedding for rigid pipes. The pipe bedding material should consist of a minimum thickness of 150 mm Granular “A” (OPSS 1010) below the pipe and extend up the sides to the spring line. However, the bedding thickness may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. The pipe cover material from the spring line should consist of a Granular “B” Type I (OPSS 1010) and should extend to a minimum of 300 mm above the top of the pipe. All granular fill material is to be placed in maximum 200 mm thick loose lifts compacted to a minimum of 98% SPMDD.

The bedding material, pipe and cover material should be installed as soon as practically possible after the excavation subgrade is exposed. The longer the excavated subgrade soil remains open to weather conditions and groundwater seepage, the greater the chance for construction problems to occur. Where it is difficult to stabilize the subgrade due to groundwater or the material is higher than the optimum moisture content, a Granular “B” Type II material may be required. Alternatively, if constant groundwater infiltration becomes an issue, then an approximate 150 mm granular pad consisting of 19 mm clear stone gravel (OPSS 1004) wrapped in a non-woven geotextile should be considered to maintain the integrity of the natural subgrade soil. The clear stone should contain a minimum of 50% crushed particles. Water collected within the stone should be controlled through sumps and filtered pumps.

6.6.2 Trench Backfill

Following placement of the pipe bedding cover the trench shall be backfilled. Based on the results of the natural overburden deposits, the on-Site silt and clay soils may be too wet for reuse on-site and should be excluded unless sufficiently dried. The native silt and clay soils will have a blocky/lumpy texture, and a sheepsfoot roller is recommended for any soils considered suitable for on-site reuse in order to achieve proper compaction and ensure that all air voids are removed to avoid long term softening and settlement. The soil should be placed to the underside of the granular subbase of the pavement structure and be compacted in maximum 200 mm thick lifts to 98% SPMDD within 4% of the optimum moisture content. The natural material must be free of organics or other deleterious material.

All stockpiled material should be protected from deleterious materials, additional moisture, and be kept from freezing.

Quality control will be the utmost importance when selecting the material. The selection of the material should be done as early in the contract as possible to allow sufficient time for gradation and proctor testing on representative samples to ensure it meets the projects specifications.

Where the natural soil will be exposed, adequate compaction may prove difficult if the material becomes wet (i.e., above the optimum moisture content). Based on the observations made during the borehole drilling, portions of the silt and clay deposits will be too wet for reuse and would require sufficient drying.

Drying of silt and clay soils may be lengthy and would involve stockpiling and mixing which may not be suitable for the Site. The material should be dried to achieve moisture content within plus 2% to minus 4% of optimum. Stockpiles should be protected to help minimize moisture absorption during wet weather.

Considering the aforementioned high in-situ moisture of the native soils and difficulty in drying, imported material may be required regardless to achieve adequate compaction. If the imported material is not the same/similar to the soil observed on the side walls of the excavation then a horizontal transition between the materials should be sloped as per frost heave taper OPSD 205.060. Any natural material is to be placed in maximum 200 mm thick lifts compacted to 98% SPMDD within plus 2% to minus 4% optimum moisture content. Imported material should consist of a Granular “A”, Granular “B” Type I, or Select Subgrade Material (OPSS 1010). Heavy construction equipment and truck traffic should not cross any pipe until at least 1 m of compacted soil is placed above the top of the pipe.

Post compaction settlement of finer grained soil can be expected, even when placed to compaction specifications. As such, fill materials should be installed as far in advance as possible before finishing the roadway in order to mitigate post compaction settlements.

6.6.3 Seepage Collars

The provided site servicing plan (Reinders + Law Ltd., Drawing No. 20037_SP3, Revision No. 0, dated 2/14/2022) illustrates storm services at about 1.5 to 2.2 mbgs (invert Elevations from 81.1 to 81.5 masl) in the south of the Site. A stormceptor as well as storm and sanitary services connecting to existing City services along St. Laurent Boulevard are proposed at approximately 3.3 to 4.4 mbgs (invert Elevations from 79.3 to 80.3 masl) in the north of the Site.

Groundwater was measured on September 21, 2022 at depths from 2.6 to 4.7 mbgs (Elevations 78.9 to 81.1 masl). Higher groundwater elevations should be expected during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. Based on the above, it is anticipated that the pipe bedding will extend close to or below the stabilized groundwater level as measured on September 21, 2022.

Seepage collars are used where pipes are installed below the groundwater table to minimize the flow of groundwater through the granular bedding and backfill thereby possibly causing unwatering of the silt and clay soils. Any unwatering (especially over a longer term) may cause settlements within the silt and clay soils.

At this Site due to the depth of the service installations and the measured groundwater levels, it is recommended that seepage collars be installed at the Site to stop movement of the groundwater along the pipe bedding. Seepage collars should be at least 1.0 m long and in place of the standard pipe bedding material, where installed. Clay seals compacted to 95% SPMDD or low strength concrete collars can be used for this purpose.

6.6.4 Frost Protection

The frost penetration depth in Ottawa, Ontario for these types of soil conditions is estimated to extend to approximately 1.8 mbgs in open roadways cleared of snow. As such, it is recommended to place water services at a minimum depth of 300 mm below this elevation with the top of the pipe located at 2.1 mbgs or lower as dictated by municipal service requirements. If a minimum of 2.1 m of soil cover cannot be provided, then the pipe should be insulated with a rigid polystyrene insulation or a pre-insulated pipe be utilized.

The insulation design configuration may either consist of placing horizontal insulation to a specified design distance beyond the outside edge of the pipe or an inverted “U” surrounding the top and sides of the pipe. Any method chosen requires suitable design and installation in accordance with the manufacturer’s recommendations. To accommodate the placement of horizontal insulation a wider excavation trench may be required.

6.7 Asphaltic Concrete Pavement Structure Design for Parking Lot and Driveways

6.7.1 Discussion

An access driveway is proposed along the west property line. Surface parking is proposed in the southern portion of the Site. It is understood that proposed grades will be close to existing grades. All topsoil should be stripped from below pavement areas. Fill was contacted at Boreholes BH1 and BH3 and extended to 0.8 and 0.4 mbgs, respectively.

Fill materials may remain below proposed pavement areas if the owner accepts the increased potential for required pavement maintenance and repairs as well as potential for decreased pavement life; otherwise, the fill should be removed from below proposed pavement areas. Where required, grades should be raised with granular fill compacted to 98% SPMDD. Alternatively, the use of a geogrid-soil system could be considered below pavement structures to minimize the excavation of fill materials.

6.7.2 Pavement Structure

It is anticipated that the driveway may act as fire route, weekly garbage pick-up and predominantly light-duty traffic. No bus traffic is considered.

The following table presents the minimum specifications for a flexible asphaltic concrete pavement structure:

Pavement Layer	Compaction Requirements	Parking Areas (Light Duty)	Driveway (Heavy Duty)
Surface Course Superpave 12.5 (OPSS 1151)	92% MRD as per OPSS 310	40 mm	40 mm
Binder Course Superpave 19.0 (OPSS 1151)	91 % MRD as per OPSS 310	55 mm	80 mm
Base Course: Granular “A” (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular “B” Type I (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM D698)	400 mm	500 mm

Notes:

I. Prior to placing the pavement structure, the subgrade soil is to be proof rolled with a smooth drum roller without vibration to observe weak spots and the deflection of the soil; and

II. The recommended pavement structure may have to be adjusted according to the City of Ottawa standards. Also, if construction takes place during times of substantial precipitation and the subgrade soil becomes wet and disturbed, the granular thickness may have to be increased to compensate for the weaker subgrade soil. In addition, the granular fill material thickness may have to be temporarily increased to allow heavy construction equipment access the Site, in order to avoid the subgrade from “pumping” up into the granular material.

Asphalt cement shall be performance graded asphalt cement according to OPSS 1101.

6.7.3 Pavement Structure Subgrade Preparation and Granular up Fill

The proper placement of base and subbase fill materials becomes very important in addressing the proper load distribution to provide a durable pavement structure.

The pavement subgrade materials should be thoroughly proof-rolled prior to placement of the Granular ‘B’ subbase course. If any unstable areas are noted, then the Granular ‘B’ thickness may need to be increased to support pavement construction traffic. This should be left as a field decision by a qualified geotechnical engineer at the time of construction, but it is recommended that additional Granular ‘B’ be carried as a provisional item under the construction contract.

Where fill material is required to increase the grade to the underside of the pavement structure it should consist of Granular ‘B’ Type I (OPSS 1010). The up fill material is to be placed in maximum 300 mm thick lifts compacted to 98% SPMDD within 4% of the optimum moisture content.

Samples of both the Granular ‘A’ and Granular ‘B’ Type I aggregates should be tested for conformance to OPSS 1010 prior to utilization on Site and during construction. All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.

Post compaction settlement of fine grained soil can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the parking lot and access driveway for best grade integrity.

Where the subgrade material types differ below the underside of the pavement structure, the transition between the materials should be sloped as per frost heave taper OPSD 205.60.

6.7.4 Drainage

Control of surface water is a critical factor in achieving good pavement structure life. The pavement thickness designs are based on a drained pavement subgrade via sub-drains or ditches.

The silt and clay soils have poor natural drainage and therefore it is recommended that continuous ditches or pavement subdrains be installed along the sides of the access driveway and perimeter of the parking lot. Additionally, pavement subdrains should be installed within the lower areas of the parking lot. The pavement subdrains should be connected to catch basins. Pavement subdrains should comprise 150 mm diameter perforated pipe infilter sock, bedded in concrete sand. The top of the concrete sand bedding should be at the bottom of the pavement subbase, with the subgrade below the subbase sloped towards the subdrain.

The surface of the roadways should be free of depressions and be sloped at a minimum grade of 1% in order to drain to appropriate drainage areas. Subgrade soil should slope a minimum of 3% toward stormwater collection points. Positive slopes are very important for the proper performance of the drainage system. The granular base and subbase materials should extend horizontally to any potential ditches or swales.

In addition, routine maintenance of the drainage systems will assist with the longevity of the pavement structure. Ditches, culverts, sewers and catch basins should be regularly cleared of debris and vegetation.

7.0 SITE SUPERVISION & QUALITY CONTROL

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade material prior to subgrade preparation, pouring any foundations or footings, backfilling, or engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per Pinchin's recommendations. Compaction quality control of engineered fill material (full-time monitoring) is recommended as standard practice, as well as regular sampling and testing of aggregates and concrete, to ensure that physical characteristics of materials for compliance during installation and satisfies all specifications presented within this report.

8.0 TERMS AND LIMITATIONS

This Geotechnical Investigation was performed for the exclusive use of Reinders + Law (Client) in order to evaluate the subsurface conditions at 2375 St. Laurent Boulevard, Ottawa, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering for the Site. Classification and identification of soil, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sample locations.

Performance of this Geotechnical Investigation to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the subgrade soil at the Site, and recognizes reasonable limits on time and cost.

Regardless how exhaustive a Geotechnical Investigation is performed, the investigation cannot identify all the subsurface conditions. Therefore, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation. If during construction, subsurface conditions differ from then what was encountered within our test location and the additional subsurface information provided to us, Pinchin should be contacted to review our recommendations. This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.

This report has been prepared for the exclusive use of the Client and their authorized agents. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

The liability of Pinchin or our officers, directors, shareholders or staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered (Claim Period), to commence legal proceedings against Pinchin to recover such losses or damage unless the laws of the jurisdiction which governs the Claim Period which is applicable to such claim provides that the applicable Claim Period is greater than two years and cannot be abridged by the contract between the Client and Pinchin, in which case the Claim Period shall be deemed to be extended by the shortest additional period which results in this provision being legally enforceable.

Pinchin makes no other representations whatsoever, including those 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 these interpretations may change over time. Please refer to Appendix V, Report Limitations and Guidelines for Use, which pertains to this report.

Specific limitations related to the legal and financial and limitations to the scope of the current work are outlined in our proposal, the attached Methodology and the Authorization to Proceed, Limitation of Liability and Terms of Engagement which accompanied the proposal.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

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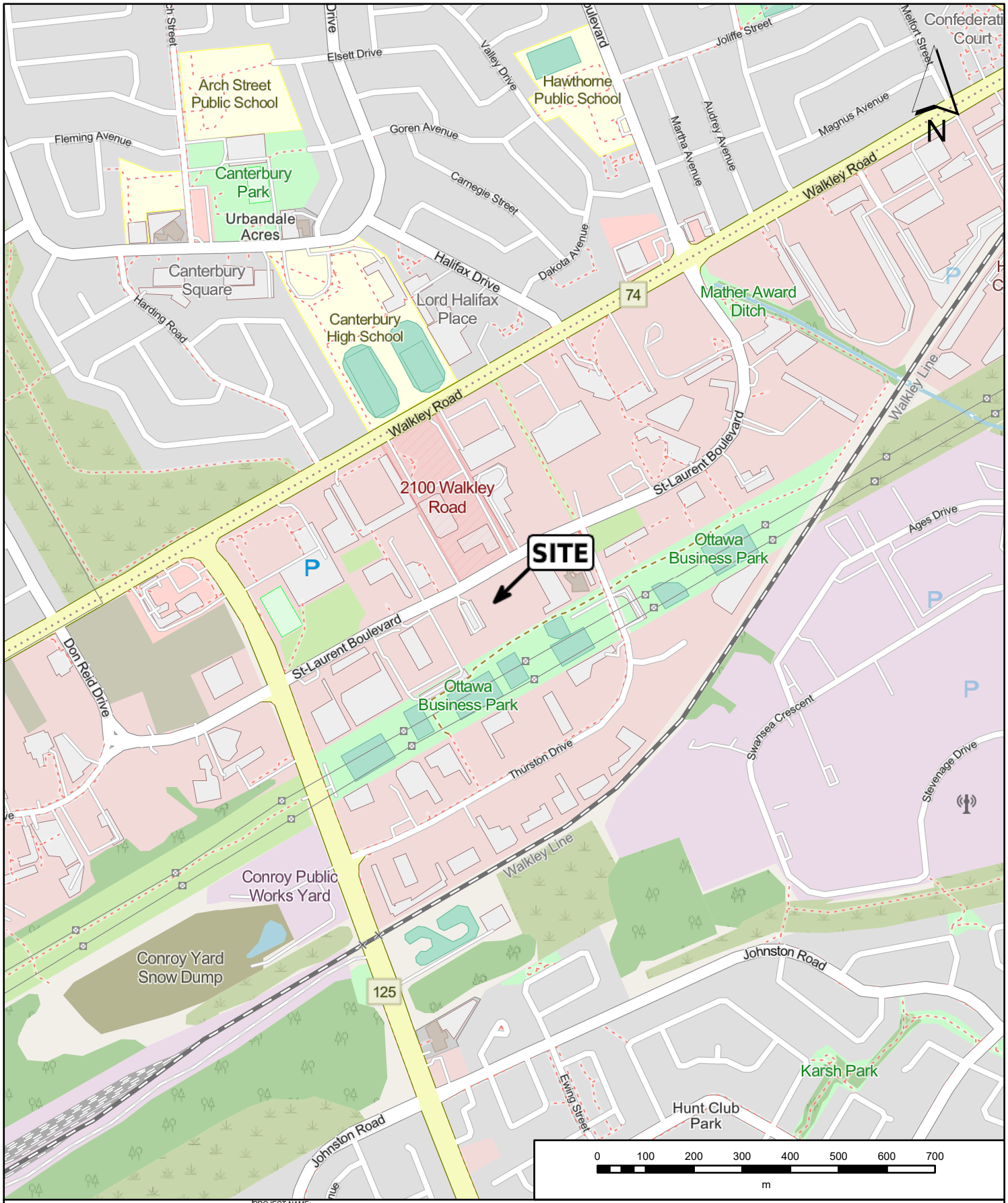
Template: Master Geotechnical Investigation Report – Ontario, GEO, September 2, 2021

FIGURES



PINCHIN

PROJECT NAME:	PROPOSED COMMERCIAL DEVELOPMENT				
CLIENT NAME:	REINDERS + LAW LTD.				
PROJECT LOCATION:	2375 ST.LAURENT BOULEVARD, OTTAWA, ONTARIO				
FIGURE NAME:	KEY MAP				FIGURE NUMBER: 1
PROJECT NUMBER: 314869	SCALE: 1:15,000	DRAWN BY: SR	REVIEWED BY: KT	DATE: SEPTEMBER 2022	

N

LEGEND

- SITE BOUNDARY
- BOREHOLE
- TBM TEMPORARY BENCHMARK
- [xx] GROUND ELEVATION (m)
- m METERS

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

PINCHIN

PROJECT NAME:
PROPOSED COMMERCIAL DEVELOPMENT

CLIENT NAME:
REINDERS + LAW LTD.

PROJECT LOCATION:
2375 ST.LAURENT BOULEVARD, OTTAWA, ONTARIO

FIGURE NAME:
BOREHOLE LOCATION PLAN

PROJECT NUMBER:	SCALE:
314869	AS SHOWN
DRAWN BY:	REVIEWED BY:
SR	KT
DATE:	FIGURE NUMBER:
SEPTEMBER 2022	2

APPENDIX I

Abbreviations, Terminology and Principle Symbols used in Report and Borehole Logs

ABBREVIATIONS, TERMINOLOGY & PRINCIPAL SYMBOLS USED

Sampling Method

AS	Auger Sample	**w**	Washed Sample
SS	Split Spoon Sample	**HQ**	Rock Core (63.5 mm diam.)
ST	Thin Walled Shelby Tube	**NQ**	Rock Core (47.5 mm diam.)
BS	Block Sample	**BQ**	Rock Core (36.5 mm diam.)

In-Situ Soil Testing

Standard Penetration Test (SPT), "N" value is the number of blows required to drive a 51 mm outside diameter spilt barrel sampler into the soil a distance of 300 mm with a 63.5 kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved. The SPT, "N" value is a qualitative term used to interpret the compactness condition of cohesionless soils and is used only as a very approximation to estimate the consistency and undrained shear strength of cohesive soils.

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

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm2 base area with a 60 degree apex pushed through the soil at a penetration rate of 2 cm/s.

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

Soil Descriptions

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

Soil Classification		Terminology	Proportion
Clay	< 0.002 mm		
Silt	0.002 to 0.06 mm	“trace”, trace sand, etc.	1 to 10%
Sand	0.075 to 4.75 mm	“some”, some sand, etc.	10 to 20%
Gravel	4.75 to 75 mm	Adjective, sandy, gravelly, etc.	20 to 35%
Cobbles	75 to 200 mm	And, and gravel, and silt, etc.	>35%
Boulders	>200 mm	Noun, Sand, Gravel, Silt, etc.	>35% and main fraction

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, etcetera, dictate the soils engineering behaviour over grain size fractions; and
- With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

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

Cohesionless Soil	
Compactness Condition	**SPT N-Index (blows per 300 mm)**
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

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

Cohesive Soil		
Consistency	**Undrained Shear Strength (kPa)**	**SPT N-Index (blows per 300 mm)**
Very Soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

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

Soil & Rock Physical Properties

General

W Natural water content or moisture content within soil sample

γ Unit weight

γ' Effective unit weight

γ_d Dry unit weight

γ_{sat} Saturated unit weight

ρ Density

ρ_s Density of solid particles

ρ_w Density of Water

ρ_d Dry density

ρ_{sat} Saturated density e Void ratio

n Porosity

S_r Degree of saturation

E_{50} Strain at 50% maximum stress (cohesive soil)

Consistency

W_L	Liquid limit
W_P	Plastic Limit
I_P	Plasticity Index
W_S	Shrinkage Limit
I_L	Liquidity Index
I_C	Consistency Index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density Index (formerly relative density)

Shear Strength

C_u, S_u	Undrained shear strength parameter (total stress)
C'_d	Drained shear strength parameter (effective stress)
r	Remolded shear strength
τ_p	Peak residual shear strength
τ_r	Residual shear strength
ø’	Angle of interface friction, coefficient of friction = tan ø’

Consolidation (One Dimensional)

C_C	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
C_S	Swelling index
m_V	Coefficient of volume change
c_V	Coefficient of consolidation
T_V	Time factor (vertical direction)
U	Degree of consolidation
σ'_O	Overburden pressure
σ'_p	Preconsolidation pressure (most probable)
OCR	Overconsolidation ratio

Permeability

The following table outlines the terms used to describe the degree of permeability of soil and common soil types associated with the permeability rates**:**

Permeability (k cm/s)	Degree of Permeability	Common Associated Soil Type
$> 10^{-1}$	Very High	Clean gravel
10^{-1} to 10^{-3}	High	Clean sand, Clean sand and gravel
10^{-3} to 10^{-5}	Medium	Fine sand to silty sand
10^{-5} to 10^{-7}	Low	Silt and clayey silt (low plasticity)
$>10^{-7}$	Practically Impermeable	Silty clay (medium to high plasticity)

Rock Coring

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

RQD is calculated as follows:

$$\text{RQD (\%)} = \frac{\Sigma \text{ Length of core pieces} > 100 \text{ mm} \times 100}{\text{Total length of core run}}$$

The following is the Classification of Rock with Respect to RQD Value:

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

APPENDIX II

Pinchin's Borehole Logs

Log of Borehole: BH1

Project #: 314869 **Logged By:** MK

Project: Geotechnical Investigation

Client: Reinders + Law

Location: 2375 St. Laurent Blvd., Ottawa, Ontario

Drill Date: September 8, 2022 **Project Manager:** VM

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0	Ground Surface	83.61										
0	**Fill** Organics - 100 mm	0.00	SS	1	50	6						
0.76	Brown sandy silt, loose, damp	82.85										
1	**Silt** Brown silt, some clay to clayey, very stiff, DTPL to WTPL		SS	2	100	9						ES.
2.59	Stiff	81.02										
3.35	Firm	80.26										
4.57	**Silty Clay** Grey silty clay, very soft, WTPL	79.04	SS	3	100	0						
9.75	End of Borehole	73.86	SS	4	100	0						

Borehole terminated at 9.8 mbgs. At drilling completion, water was measured at 8.3 mbgs.

Monitoring Well Details: Bentonite; Riser; Silica Sand; Screen. Water level = 4.26 mbgs, as measured on Sept 21, 2022

Contractor: Canadian Environmental Drilling & Contractors Inc. **Grade Elevation:** 83.61 masl

Drilling Method: Solid Stem Auger/Split Spoon **Top of Casing Elevation:** 84.57 masl

Well Casing Size: N/A **Sheet:** 1 of 1

Log of Borehole: BH2

Project #: 314869 **Logged By:** MK

Project: Geotechnical Investigation

Client: Reinders + Law

Location: 2375 St. Laurent Blvd., Ottawa, Ontario

Drill Date: September 8, 2022 **Project Manager:** KT

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)	Laboratory Analysis
0	Ground Surface	83.59						
	Topsoil Topsoil, with organics - 150 mm	0.00 / 82.83	SS	1	80	2		
1	**Silt** Brown silt,nil to trace sand, some clay, loose damp, soft, DTPL	0.76 / 82.07	SS	2	100	8		
2	Stiff to firm	1.52 / 81.31	SS	3	100	3	52.5	Grad ABL
	Silty Clay Brown silty clay, firm to soft, WTPL; Very soft, ATPL to WTPL	2.29	SS	4	100	2		
3								
4								
5								
6								
7								
8		75.36	SS	5	100	1		
	Unsampled	8.23						
9			DCP			0		
			DCP			0		
10			DCP			0		
			DCP			0		
			DCP			1		
11			DCP			0		
			DCP			0		
			DCP			0		
12			DCP			0		
			DCP			0		
			DCP			4		
			DCP			4		
13			DCP			10		
			DCP			6		
			DCP			10		
14			DCP			17		
		69.27	DCP			35		
	End of Borehole	14.33						
15	Borehole terminated at 14.3 mbgs upon refusal on possible bedrock. At drilling completion, water was measured at 8.5 mbgs.							
16								

Monitoring Well Details: Bentonite; Riser; Silica Sand; Screen

Water level = 4.74 mbgs, as measured on Sept 21, 2022

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Soil Vapour Concentration (ppm)

Sample ID

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.59 masl

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: 84.5 masl

Well Casing Size: N/A

Sheet: 1 of 1

Log of Borehole: BH3

Project #: 314869 **Logged By:** MK

Project: Geotechnical Investigation

Client: Reinders + Law

Location: 2375 St. Laurent Blvd., Ottawa, Ontario

Drill Date: September 8, 2022 **Project Manager:** KT

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)	Laboratory Analysis
0	Ground Surface	83.71						
	Fill Organics - 100 mm	0.00						
	Brown sand, loose, damp	83.33 / 0.38	SS	1	80	4		
	Silt Brown silt, trace sand, loose, damp some clay	82.95 / 0.76	SS	2	100	8		
1								
	Brown clayey silt, stiff to firm, DTPL to ATPL	82.19 / 1.52	SS	3	100	4		
2			SS	4	100	2		
3	**Silty Clay** Grey silty clay, very soft, WTPL	80.66 / 3.05	SS	5	100	0		
4								
5	End of Borehole	78.53 / 5.18	SS	6	100	0	72.1	Grad ABL
	Borehole terminated at 5.2 mbgs. At drilling completion borehole was open and dry							
6								
7								

Monitoring Well Details: Riser, Bentonite, Silica Sand, Screen

Water level = 2.61 mbgs, as measured on Sept 21, 2022

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa 100 200

Sample ID

Soil Vapour Concentration (ppm)

Contractor: Canadian Environmental Drilling & Contractors Inc.

Grade Elevation: 83.71 masl

Drilling Method: Solid Stem Auger/Split Spoon

Top of Casing Elevation: 84.52 masl

Well Casing Size: N/A

Sheet: 1 of 1

APPENDIX III

Laboratory Testing Reports for Soil Samples

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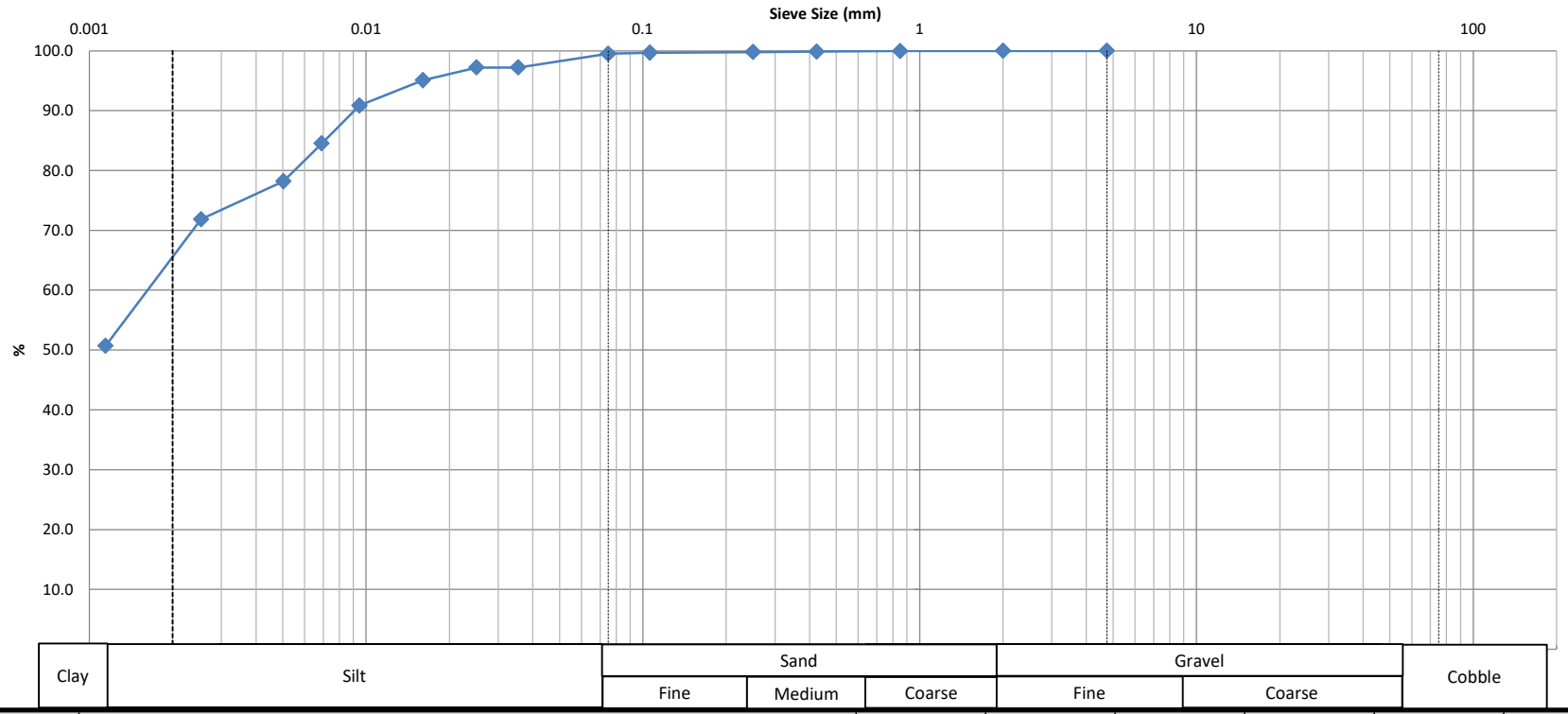
SIEVE ANALYSIS
ASTM C136

CLIENT:	Pinchin	DEPTH:	5'-7'	FILE NO:	PM4184
CONTRACT NO.:		BH OR TP No.:	BH2	LAB NO:	38086
PROJECT:	314869			DATE RECEIVED:	13-Sep-22
				DATE TESTED:	15-Sep-22
DATE SAMPLED:	12-Sep-22			DATE REPORTED:	21-Sep-22
SAMPLED BY:	Client			TESTED BY:	DK/CS



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						52.5					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	0.5		34.5		65.0	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

patersongroup
consulting engineers

HYDROMETER
LS-702 ASTM-422

CLIENT:	Pinchin	DEPTH:	5'-7'	FILE NO.:	PM4184
PROJECT:	314869	BH OR TP No.:	BH2	DATE SAMPLEI	12-Sep-22
LAB No. :	38086	TESTED BY:	DK/CS	DATE RECEIVE	13-Sep-22
SAMPLED BY:	Client	DATE REPT'D:	21-Sep-22	DATE TESTED:	15-Sep-22

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
99.1	2.700

INITIAL WEIGHT	99.10	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	43.53	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.53	AIR DRY	161.78	111.78
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	99.10	49.10
		CORRECTED	0.439	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5			
19			
13.2			
9.5			
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**99.1**		
0.850	**0.04**	0.0	**100.0**
0.425	**0.11**	0.1	**99.9**
0.250	**0.18**	0.2	**99.8**
0.106	**0.30**	0.3	**99.7**
0.075	**0.47**	0.5	**99.5**
Pan	**0.53**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:48	52.0	6.0	23.0	0.0355	97.2	**97.2**
2	8:49	52.0	6.0	23.0	0.0251	97.2	**97.2**
5	8:52	51.0	6.0	23.0	0.0160	95.1	**95.1**
15	9:02	49.0	6.0	23.0	0.0095	90.9	**90.9**
30	9:17	46.0	6.0	23.0	0.0069	84.5	**84.5**
60	9:47	43.0	6.0	23.0	0.0050	78.2	**78.2**
250	12:57	40.0	6.0	23.0	0.0025	71.9	**71.9**
1440	8:47	30.0	6.0	23.0	0.0011	50.7	**50.7**

Moisture = 52.47 %

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.
		

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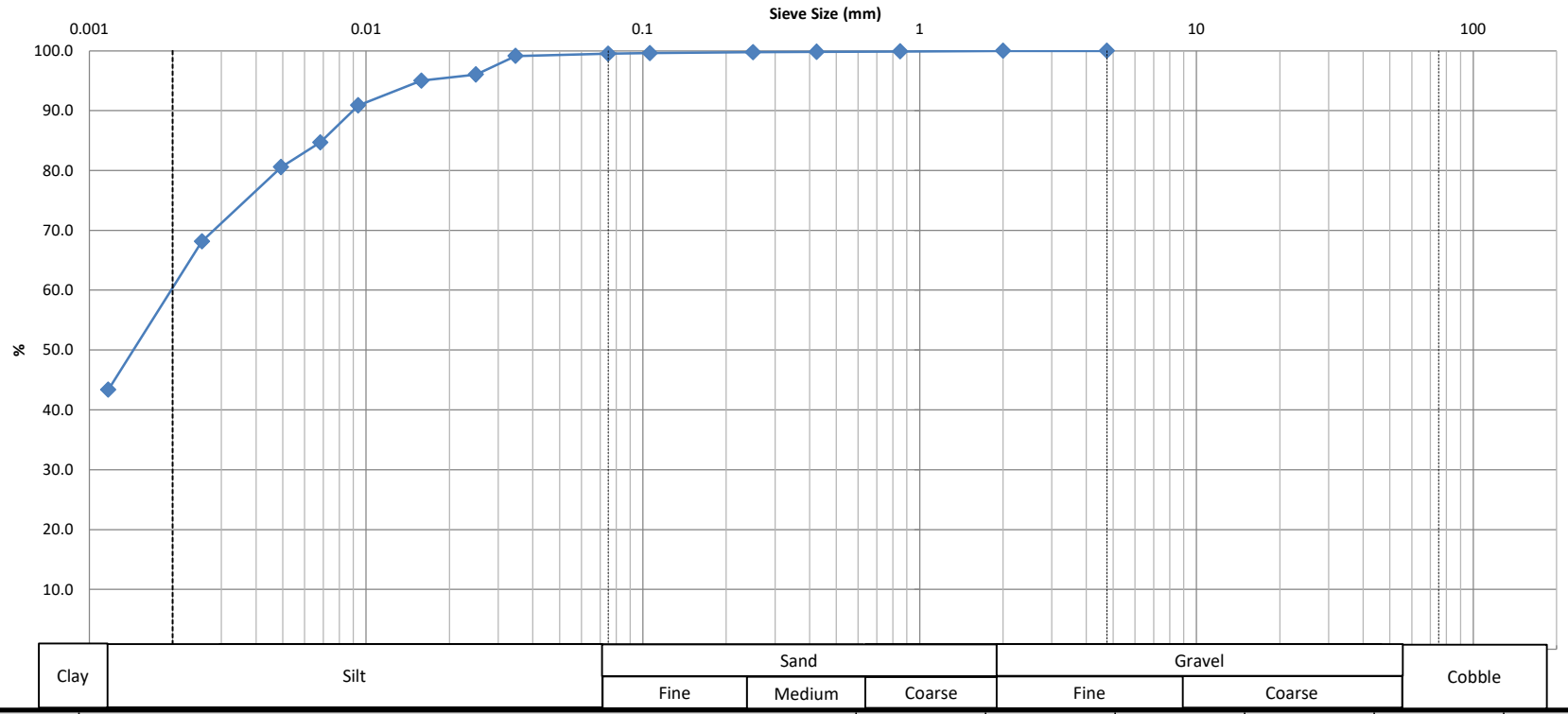
SIEVE ANALYSIS
ASTM C136

CLIENT:	Pinchin	DEPTH:	15'-17'	FILE NO:	PM4184
CONTRACT NO.:		BH OR TP No.:	BH3	LAB NO:	38087
PROJECT:	314869			DATE RECEIVED:	13-Sep-22
				DATE TESTED:	15-Sep-22
DATE SAMPLED:	12-Sep-22			DATE REPORTED:	21-Sep-22
SAMPLED BY:	Client			TESTED BY:	DK/CS



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						72.1					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	0.5		39.0		60.5	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Pinchin	DEPTH:	15'-17'	FILE NO.:	PM4184
PROJECT:	314869	BH OR TP No.:	BH3	DATE SAMPLEI	12-Sep-22
LAB No. :	38087	TESTED BY:	DK/CS	DATE RECEIVE	13-Sep-22
SAMPLED BY:	Client	DATE REPT'D:	21-Sep-22	DATE TESTED:	15-Sep-22

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
91.7	2.700

INITIAL WEIGHT	91.70	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	38.24	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.43	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	91.70	41.70
		CORRECTED	0.417	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5			
19			
13.2			
9.5			
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**91.7**		
0.850	**0.08**	0.1	**99.9**
0.425	**0.15**	0.2	**99.8**
0.250	**0.21**	0.2	**99.8**
0.106	**0.33**	0.4	**99.6**
0.075	**0.43**	0.5	**99.5**
Pan	**0.43**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:03	54.0	6.0	23.0	0.0346	99.2	**99.2**
2	9:04	52.5	6.0	23.0	0.0249	96.1	**96.1**
5	9:07	52.0	6.0	23.0	0.0159	95.0	**95.0**
15	9:17	50.0	6.0	23.0	0.0094	90.9	**90.9**
30	9:32	47.0	6.0	23.0	0.0068	84.7	**84.7**
60	10:02	45.0	6.0	23.0	0.0049	80.6	**80.6**
250	1:12	39.0	6.0	23.0	0.0026	68.2	**68.2**
1440	9:02	27.0	6.0	23.0	0.0012	43.4	**43.4**

Moisture = 72.08 %

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.
		

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ATTERBERG LIMITS
LS-703/704

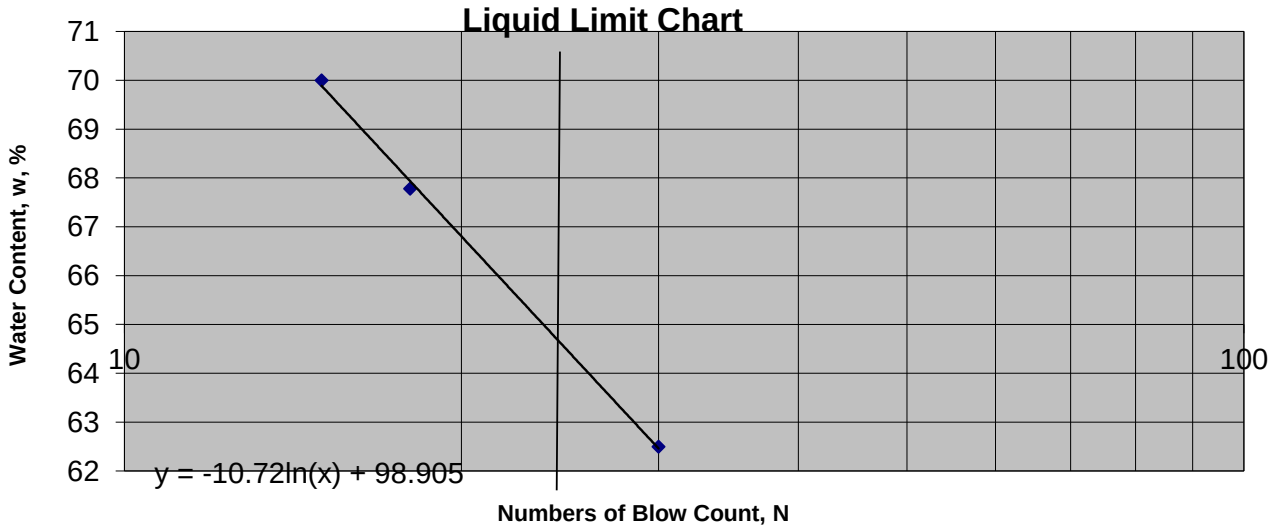
CLIENT:	Pinchin	FILE NO.:	PM4184
PROJECT:	314869	DATE SAMPLED:	12-Sep
LOCATION:	BH2 5'-7'	DATE REPORTED:	21-Sep

CAN NO.	13	35	33				
WT. OF CAN	8.68	4.38	4.37				
WT. OF SOIL & CAN	10.19	5.29	4.88				
WT. OF DRY SOIL & CAN	9.58	4.94	4.67				
WT. OF MOISTURE	0.61	0.35	0.21				
WT. OF DRY SOIL & CAN	0.9	0.56	0.3				
WATER CONTENT, w, %	**67.78**	**62.5**	**70**				
NO. OF BLOWS, N	18	30	15				

CAN NO.	2	10
WT. OF CAN	19.94	19.79
WT. OF SOIL & CAN	27.65	27.39
WT. OF DRY SOIL & CAN	25.86	25.65
WT. OF MOISTURE	1.79	1.74
WT. OF DRY SOIL & CAN	5.92	5.86
WATER CONTENT, w, %	**30.24**	**29.69**

RESULTS

LIQUID LIMIT	**67**
PLASTIC LIMIT	**30**
PLASTICITY INDEX	**37**



TECHNICIAN:CS	REVIEWED BY:	C. Beadow	J. Forsyth, P. Eng.

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consulting engineers

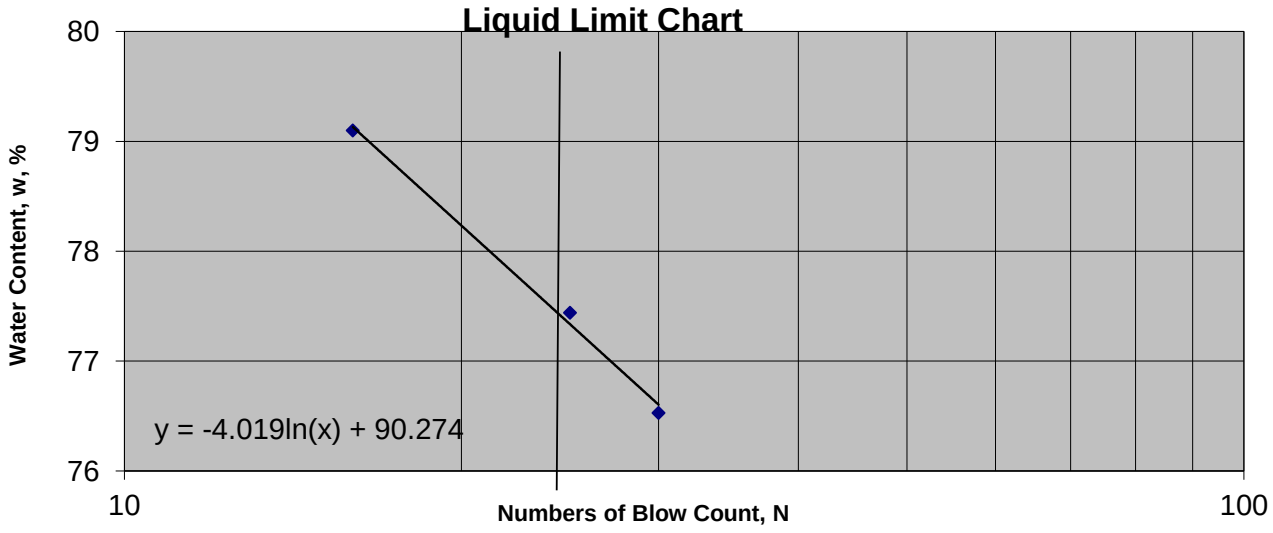
ATTERBERG LIMITS
LS-703/704

CLIENT:	Pinchin	FILE NO.:	PM4184
PROJECT:	314869	DATE SAMPLED:	12-Sep
LOCATION:	BH3 15'-17'	DATE REPORTED:	21-Sep

CAN NO.	**11**	**16**	**17**
WT. OF CAN	8.66	8.71	4.39
WT. OF SOIL & CAN	12.75	11.11	6.12
WT. OF DRY SOIL & CAN	10.97	10.05	5.37
WT. OF MOISTURE	1.785	1.06	0.75
WT. OF DRY SOIL & CAN	2.305	1.34	0.98
WATER CONTENT, w, %	**77.44**	**79.1**	**76.53**
NO. OF BLOWS, N	25	16	30

CAN NO.	**14**	**15**
WT. OF CAN	19.95	19.91
WT. OF SOIL & CAN	26.04	27.32
WT. OF DRY SOIL & CAN	24.34	25.26
WT. OF MOISTURE	1.7	2.06
WT. OF DRY SOIL & CAN	4.39	5.35
WATER CONTENT, w, %	**38.72**	**38.5**

RESULTS	
LIQUID LIMIT	**78**
PLASTIC LIMIT	**39**
PLASTICITY INDEX	**39**



TECHNICIAN:CS	**REVIEWED BY:**	**C. Beadow**	**J. Forsyth, P. Eng.**

APPENDIX IV

Analytical Test Results

PARACEL LABORATORIES LTD.

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300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Pinchin Ltd. (Ottawa)
1 Hines Road, Suite 200
Kanata, ON K2K 3C7
Attn: Megan Keon

Client PO:
Project: 314869
Custody: 66500

Report Date: 16-Sep-2022
Order Date: 9-Sep-2022

Order #: 2237449

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2237449-01	BH2 @5-7 ft

Approved By:

Alex Enfield, MSc
Lab Manager

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	13-Sep-22	15-Sep-22
Conductivity	MOE E3138 - probe @25 °C, water ext	15-Sep-22	16-Sep-22
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	13-Sep-22	14-Sep-22
Resistivity	EPA 120.1 - probe, water extraction	15-Sep-22	16-Sep-22
Solids, %	Gravimetric, calculation	14-Sep-22	14-Sep-22

Summary of Criteria Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances.

Sample	Analyte	MDL / Units	Result	-	-

Certificate of Analysis

Report Date: 16-Sep-2022

Client: **Pinchin Ltd. (Ottawa)**

Order Date: 9-Sep-2022

Client PO:

Project Description: 314869

	Client ID:	BH2 @5-7 ft	-	-	-		
	Sample Date:	09-Sep-22 09:00	-	-	-	-	-
	Sample ID:	2237449-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	68.5	-	-	-	-	-
General Inorganics							
Conductivity	5 uS/cm	220	-	-	-	-	-
pH	0.05 pH Units	8.04	-	-	-	-	-
Resistivity	0.1 Ohm.m	45.6	-	-	-	-	-
Anions							
Chloride	5 ug/g	58	-	-	-	-	-
Sulphate	5 ug/g	48	-	-	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	5	ug/g					
Sulphate	ND	5	ug/g					
General Inorganics								
Conductivity	ND	5	uS/cm					
Resistivity	ND	0.10	Ohm.m					

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g	158			NC	20	
Sulphate	ND	5	ug/g	343			NC	20	
General Inorganics									
Conductivity	2060	5	uS/cm	2120			3.1	5	
pH	7.74	0.05	pH Units	7.70			0.5	10	
Resistivity	4.86	0.10	Ohm.m	4.72			3.1	20	
Physical Characteristics									
% Solids	90.0	0.1	% by Wt.	90.4			0.4	25	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	255	5	ug/g	158	97.3	82-118			
Sulphate	428	5	ug/g	343	84.6	80-120			

Qualifier Notes:

Login Qualifiers :

Received at temperature > 25C

Applies to Samples: BH2 @5-7 ft

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unlesss otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

PARACEL LABORATORIES LTD

Paracel ID: 2237449

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2237449	№ 66500

Client Name: Pinchin Ltd.	Project Ref: 314869
Contact Name: Megan Keon	Quote #:
Address: 1 Hines Rd. Kanata, ON	PO #:
Telephone: 613-592-3387	E-mail: MKeon@pinchin.com

Page __ of __

Turnaround Time

☐ 1 day ☐ 3 day
☐ 2 day ☑ Regular
Date Required: _____

☐ REG 153/04 ☐ REG 406/19

☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table ___
For RSC: ☐ Yes ☒ No

Other Regulation

☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun: _____
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Required Analysis: Redox	Corrosivity	SWI Fides	Conductivity
1	BH2 @5-7 ft	S		1	Sept. 9/22	AM	✓	✓	✓	✓
2										
3										
4										
5										
6										
7										
8										
9										
10										

Comments:

Method of Delivery: Walk in

Relinquished By (Sign): Megan Keon	Received By Driver/Depot: Stitt 2:25 pm	Received at Lab: Shreeparn Bhimani
Relinquished By (Print): Megan Keon	Date/Time: Sept 9/22	Date/Time: Sep 09, 2022 04:15
Date/Time: Sept. 9/22 2:20 pm	Temperature: 25.6 °C	Temperature: 11.2 °C

Verified By: BBm
Date/Time: Sept 09, 22 17:48
pH Verified: ☐ By:

Chain of Custody (Blank).xlsx

Revision 4.0

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Subcontracted Analysis

Pinchin Ltd. (Ottawa)
1 Hines Road, Suite 200
Kanata, ON K2K 3C7
Attn: Megan Keon

Paracel Report No.	**2237449**
Client Project(s):	**314869**
Client PO:	
Reference:	**Standing Offer - ENV**
CoC Number:	**66500**

Order Date:	09-Sep-22
Report Date:	20-Sep-22

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
2237449-01	BH2 @5-7 ft	Redox potential, soil Sulphide, solid

TESTMARK Laboratories Ltd.
Committed to Quality and Service

CERTIFICATE OF ANALYSIS

Client:	Dale Robertson	Work Order Number:	476505
Company:	Paracel Laboratories Ltd. - Ottawa	PO #:	
Address:	300-2319 St. Laurent Blvd. Ottawa, ON, K1G 4J8	Regulation: Project #:	Information not provided 2237449
Phone/Fax:	(613) 731-9577 / (613) 731-9064	DWS #:	
Email:	drobertson@paracellabs.com	Sampled By:	
Date Order Received:	9/13/2022	Analysis Started:	9/19/2022
Arrival Temperature:	15 °C	Analysis Completed:	9/19/2022

WORK ORDER SUMMARY

ANALYSES WERE PERFORMED ON THE FOLLOWING SAMPLES. THE RESULTS RELATE ONLY TO THE ITEMS TESTED.

Sample Description	Lab ID	Matrix	Type	Comments	Date Collected	Time Collected
BH2 @ 5-7 ft	1798655	Soil	None		9/9/2022	

METHODS AND INSTRUMENTATION

THE FOLLOWING METHODS WERE USED FOR YOUR SAMPLE(S):

Method	Lab	Description	Reference
RedOx - Soil (T06)	Mississauga	Determination of RedOx Potential of Soil	Modified from APHA-2580B

REPORT COMMENTS

RedOx - Soil (A6): Hold time exceeded for methods BEFORE receipt date/time.

This report has been approved by:

Mahesh Patel, B.Sc.
Laboratory Director

7 Margaret Street, Garson, ON, P3L 1E1
Phone: (705) 693-1121 Fax: (705) 693-1124 Web: www.testmark.ca

CERTIFICATE OF ANALYSIS

Paracel Laboratories Ltd. - Ottawa

Work Order Number: 476505

WORK ORDER RESULTS

Sample Description	BH2 @ 5 - 7 ft		
Sample Date	9/9/2022 12:00 AM		
Lab ID	1798655		
General Chemistry	**Result**	**MDL**	**Units**
RedOx (vs. S.H.E.)	364	N/A	mV

LEGEND

Dates: Dates are formatted as mm/dd/year throughout this report.

MDL: Method detection limit or minimum reporting limit.

Quality Control: All associated Quality Control data is available on request.

Field Data: Reports containing Field Parameters represent data that has been collected and provided by the client. Testmark is not responsible for the validity of this data which may be used in subsequent calculations.

Sample Condition Deviations: A noted sample condition deviation may affect the validity of the result. Results apply to the sample(s) as received.

Reproduction of Report: Report shall not be reproduced, except in full, without the approval of Testmark Laboratories Ltd.

ICPMS Dustfall Insoluble: The ICPMS Dustfall Insoluble Portion method analyzes only the particulate matter from the Dustfall Sampler which is retained on the analysis filter during the Dustfall method.

Regulation Comparisons: Disclaimer: Please note that regulation criteria are provided for comparative purposes, however the onus on ensuring the validity of this comparison rests with the client.

7 Margaret Street, Garson, ON, P3L 1E1
Phone: (705) 693-1121 Fax: (705) 693-1124 Web: www.testmark.ca

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

20-September-2022

Paracel Laboratories
Attn : Dale Robertson

300-2319 St.Laurent Blvd.
Ottawa, ON
K1G 4K6, Canada

Phone: 613-731-9577
Fax:613-731-9064

Date Rec. : 13 September 2022
LR Report: **CA13430-SEP22**
Reference: Project#: 2237449

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Sulphide (Na2CO3) %
1: Analysis Start Date		20-Sep-22
2: Analysis Start Time		13:56
3: Analysis Completed Date		20-Sep-22
4: Analysis Completed Time		14:52
5: QC - Blank		< 0.04
6: QC - STD % Recovery		119%
7: QC - DUP % RPD		15%
8: RL		0.02
9: BH2 @ 5-7ft	09-Sep-22	< 0.04

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0003055533

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **WT2213678**	Page	: 1 of 4
Client	: **Pinchin Ltd.**	Laboratory	: Waterloo - Environmental
Contact	: Megan Keon	Account Manager	: Amanda Overholster
Address	: 1 Hines Rd. Suite 200 Kanata ON Canada K2K 3C7	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 613 592 3387	Telephone	: 1 416 817 2944
Project	: 314869	Date Samples Received	: 09-Sep-2022 14:50
PO	: ----	Date Analysis Commenced	: 13-Sep-2022
C-O-C number	: 20-1009698	Issue Date	: 19-Sep-2022 17:53
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2022 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Sarah Birch	Team Leader - Volatiles	Organics, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: BH1 @ 5-6 FT	BH2 @ 10-11 FT	----	----	----
					Client sampling date / time: 09-Sep-2022 09:00	09-Sep-2022 09:00	----	----	----
					WT2213678-001	WT2213678-002	--------	--------	--------
					Result	Result	----	----	----
Physical Tests									
conductivity (1:2 leachate)	----	E100-L	0.00500	mS/cm	0.0880	0.449	----	----	----
moisture	----	E144	0.25	%	30.7	44.2	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	8.22	8.17	----	----	----
Cyanides									
cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	----	----	----
Fixed-Ratio Extractables									
calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	3.08	24.4	----	----	----
magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	2.76	13.9	----	----	----
sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	13.4	41.3	----	----	----
sodium adsorption ratio [SAR]	----	E484	0.10	-	1.34	1.65	----	----	----
Metals									
antimony	7440-36-0	E440	0.10	mg/kg	<0.10	<0.10	----	----	----
arsenic	7440-38-2	E440	0.10	mg/kg	2.04	2.36	----	----	----
barium	7440-39-3	E440	0.50	mg/kg	463	368	----	----	----
beryllium	7440-41-7	E440	0.10	mg/kg	0.88	0.93	----	----	----
boron	7440-42-8	E440	5.0	mg/kg	<5.0	10.5	----	----	----
boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.13	0.61	----	----	----
cadmium	7440-43-9	E440	0.020	mg/kg	0.100	0.121	----	----	----
chromium	7440-47-3	E440	0.50	mg/kg	146	144	----	----	----
cobalt	7440-48-4	E440	0.10	mg/kg	29.0	27.2	----	----	----
copper	7440-50-8	E440	0.50	mg/kg	66.5	60.1	----	----	----
lead	7439-92-1	E440	0.50	mg/kg	6.10	7.30	----	----	----
mercury	7439-97-6	E510	0.0050	mg/kg	0.0085	0.0082	----	----	----
molybdenum	7439-98-7	E440	0.10	mg/kg	0.44	0.83	----	----	----
nickel	7440-02-0	E440	0.50	mg/kg	81.3	78.8	----	----	----
selenium	7782-49-2	E440	0.20	mg/kg	<0.20	<0.20	----	----	----
silver	7440-22-4	E440	0.10	mg/kg	0.11	0.12	----	----	----
thallium	7440-28-0	E440	0.050	mg/kg	0.462	0.412	----	----	----
uranium	7440-61-1	E440	0.050	mg/kg	0.873	2.38	----	----	----
vanadium	7440-62-2	E440	0.20	mg/kg	140	126	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BH1 @ 5-6 FT	BH2 @ 10-11 FT	----	----	----
					Client sampling date / time	09-Sep-2022 09:00	09-Sep-2022 09:00	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WT2213678-001	WT2213678-002	--------	--------	--------
						Result	Result	----	----	----
Metals										
zinc	7440-66-6	E440	2.0	mg/kg		148	135	----	----	----
Speciated Metals										
chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg		0.40	<0.10	----	----	----
Volatile Organic Compounds										
benzene	71-43-2	E611A	0.0050	mg/kg		<0.0050	<0.0050	----	----	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg		<0.015	<0.015	----	----	----
toluene	108-88-3	E611A	0.050	mg/kg		<0.050	<0.050	----	----	----
xylene, m+p-	179601-23-1	E611A	0.030	mg/kg		<0.030	<0.030	----	----	----
xylene, o-	95-47-6	E611A	0.030	mg/kg		<0.030	<0.030	----	----	----
xylenes, total	1330-20-7	E611A	0.050	mg/kg		<0.050	<0.050	----	----	----
BTEX, total	----	E611A	0.10	mg/kg		<0.10	<0.10	----	----	----
Volatile Organic Compounds Surrogates										
bromofluorobenzene, 4-	460-00-4	E611A	0.10	%		86.9	80.7	----	----	----
difluorobenzene, 1,4-	540-36-3	E611A	0.10	%		94.1	92.8	----	----	----
Hydrocarbons										
F1 (C6-C10)	----	E581.F1	5.0	mg/kg		<5.0	<5.0	----	----	----
F2 (C10-C16)	----	E601.SG-L	10	mg/kg		<10	<10	----	----	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg		<50	<50	----	----	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg		<50	<50	----	----	----
F1-BTEX	----	EC580	5.0	mg/kg		<5.0	<5.0	----	----	----
hydrocarbons, total (C6-C50)	----	EC581	80	mg/kg		<80	<80	----	----	----
chromatogram to baseline at nC50	n/a	E601.SG-L	-	-		YES	YES	----	----	----
Hydrocarbons Surrogates										
bromobenzotrifluoride, 2- (F2-F4 surr)	392-83-6	E601.SG-L	1.0	%		89.4	84.4	----	----	----
dichlorotoluene, 3,4-	97-75-0	E581.F1	1.0	%		68.3	65.4	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **WT2213678**	Page	: 1 of 11
Client	: Pinchin Ltd.	Laboratory	: Waterloo - Environmental
Contact	: Megan Keon	Account Manager	: Amanda Overholster
Address	: 1 Hines Rd. Suite 200 Kanata ON Canada K2K 3C7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 613 592 3387	Telephone	: 1 416 817 2944
Project	: 314869	Date Samples Received	: 09-Sep-2022 14:50
PO	: ----	Date Analysis Commenced	: 13-Sep-2022
C-O-C number	: 20-1009698	Issue Date	: 19-Sep-2022 17:54
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2022 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Centralized Prep, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
Sarah Birch	Team Leader - Volatiles	Waterloo Organics, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 644963)											
WT2213543-001	Anonymous	moisture	----	E144	0.25	%	8.69	8.87	2.02%	20%	----
Physical Tests (QC Lot: 646383)											
WT2213678-001	BH1 @ 5-6 FT	conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.0880 mS/cm	82.3	6.69%	20%	----
Physical Tests (QC Lot: 647587)											
WT2213543-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	8.14	8.01	1.61%	5%	----
Cyanides (QC Lot: 647486)											
WT2213001-008	Anonymous	cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Metals (QC Lot: 646380)											
WT2213678-001	BH1 @ 5-6 FT	antimony	7440-36-0	E440	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		arsenic	7440-38-2	E440	0.10	mg/kg	2.04	2.06	1.17%	30%	----
		barium	7440-39-3	E440	0.50	mg/kg	463	479	3.47%	40%	----
		beryllium	7440-41-7	E440	0.10	mg/kg	0.88	0.92	4.14%	30%	----
		boron	7440-42-8	E440	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		cadmium	7440-43-9	E440	0.020	mg/kg	0.100	0.103	0.003	Diff <2x LOR	----
		chromium	7440-47-3	E440	0.50	mg/kg	146	155	5.63%	30%	----
		cobalt	7440-48-4	E440	0.10	mg/kg	29.0	30.0	3.30%	30%	----
		copper	7440-50-8	E440	0.50	mg/kg	66.5	68.9	3.66%	30%	----
		lead	7439-92-1	E440	0.50	mg/kg	6.10	6.24	2.24%	40%	----
		molybdenum	7439-98-7	E440	0.10	mg/kg	0.44	0.45	0.006	Diff <2x LOR	----
		nickel	7440-02-0	E440	0.50	mg/kg	81.3	84.4	3.70%	30%	----
		selenium	7782-49-2	E440	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		silver	7440-22-4	E440	0.10	mg/kg	0.11	0.11	0.0006	Diff <2x LOR	----
		thallium	7440-28-0	E440	0.050	mg/kg	0.462	0.481	3.96%	30%	----
		uranium	7440-61-1	E440	0.050	mg/kg	0.873	0.913	4.51%	30%	----
		vanadium	7440-62-2	E440	0.20	mg/kg	140	146	4.55%	30%	----
		zinc	7440-66-6	E440	2.0	mg/kg	148	154	4.48%	30%	----
Metals (QC Lot: 646381)											
WT2213678-001	BH1 @ 5-6 FT	mercury	7439-97-6	E510	0.0050	mg/kg	0.0085	0.0095	0.0010	Diff <2x LOR	----
Metals (QC Lot: 646382)											
WT2213678-001	BH1 @ 5-6 FT	calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	3.08	2.53	0.55	Diff <2x LOR	----
		magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	2.76	2.49	0.27	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Metals (QC Lot: 646382) - continued											
WT2213678-001	BH1 @ 5-6 FT	sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	13.4	12.6	6.15%	30%	----
Metals (QC Lot: 646384)											
WT2213678-001	BH1 @ 5-6 FT	boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	0.13	0.14	0.01	Diff <2x LOR	----
Speciated Metals (QC Lot: 647484)											
VA22B9248-002	Anonymous	chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 643750)											
WT2213665-005	Anonymous	benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	<0.015	0	Diff <2x LOR	----
		toluene	108-88-3	E611A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
		xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030	<0.030	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 643751)											
WT2213665-005	Anonymous	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 647760)											
TY2201400-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	10	mg/kg	87	84	4.03%	40%	----
		F3 (C16-C34)	----	E601.SG-L	50	mg/kg	90	85	5	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	<50	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 644963)						
moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 646383)						
conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Cyanides (QCLot: 647486)						
cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Metals (QCLot: 646380)						
antimony	7440-36-0	E440	0.1	mg/kg	<0.10	----
arsenic	7440-38-2	E440	0.1	mg/kg	<0.10	----
barium	7440-39-3	E440	0.5	mg/kg	<0.50	----
beryllium	7440-41-7	E440	0.1	mg/kg	<0.10	----
boron	7440-42-8	E440	5	mg/kg	<5.0	----
cadmium	7440-43-9	E440	0.02	mg/kg	<0.020	----
chromium	7440-47-3	E440	0.5	mg/kg	<0.50	----
cobalt	7440-48-4	E440	0.1	mg/kg	<0.10	----
copper	7440-50-8	E440	0.5	mg/kg	<0.50	----
lead	7439-92-1	E440	0.5	mg/kg	<0.50	----
molybdenum	7439-98-7	E440	0.1	mg/kg	<0.10	----
nickel	7440-02-0	E440	0.5	mg/kg	<0.50	----
selenium	7782-49-2	E440	0.2	mg/kg	<0.20	----
silver	7440-22-4	E440	0.1	mg/kg	<0.10	----
thallium	7440-28-0	E440	0.05	mg/kg	<0.050	----
uranium	7440-61-1	E440	0.05	mg/kg	<0.050	----
vanadium	7440-62-2	E440	0.2	mg/kg	<0.20	----
zinc	7440-66-6	E440	2	mg/kg	<2.0	----
Metals (QCLot: 646381)						
mercury	7439-97-6	E510	0.005	mg/kg	<0.0050	----
Metals (QCLot: 646382)						
calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 646384)						
boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----
Speciated Metals (QCLot: 647484)						

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Speciated Metals (QCLot: 647484) - continued						
chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Volatile Organic Compounds (QCLot: 643750)						
benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Hydrocarbons (QCLot: 643751)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 647760)						
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 644963)									
moisture	----	E144	0.25	%	50 %	101	90.0	110	----
Physical Tests (QCLot: 646383)									
conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	95.0	90.0	110	----
Physical Tests (QCLot: 647587)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Cyanides (QCLot: 647486)									
cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	2.5 mg/kg	101	80.0	125	----
Metals (QCLot: 646380)									
antimony	7440-36-0	E440	0.1	mg/kg	100 mg/kg	104	80.0	120	----
arsenic	7440-38-2	E440	0.1	mg/kg	100 mg/kg	102	80.0	120	----
barium	7440-39-3	E440	0.5	mg/kg	25 mg/kg	100	80.0	120	----
beryllium	7440-41-7	E440	0.1	mg/kg	10 mg/kg	98.7	80.0	120	----
boron	7440-42-8	E440	5	mg/kg	100 mg/kg	95.4	80.0	120	----
cadmium	7440-43-9	E440	0.02	mg/kg	10 mg/kg	98.8	80.0	120	----
chromium	7440-47-3	E440	0.5	mg/kg	25 mg/kg	99.9	80.0	120	----
cobalt	7440-48-4	E440	0.1	mg/kg	25 mg/kg	98.8	80.0	120	----
copper	7440-50-8	E440	0.5	mg/kg	25 mg/kg	96.2	80.0	120	----
lead	7439-92-1	E440	0.5	mg/kg	50 mg/kg	96.0	80.0	120	----
molybdenum	7439-98-7	E440	0.1	mg/kg	25 mg/kg	100	80.0	120	----
nickel	7440-02-0	E440	0.5	mg/kg	50 mg/kg	99.6	80.0	120	----
selenium	7782-49-2	E440	0.2	mg/kg	100 mg/kg	100	80.0	120	----
silver	7440-22-4	E440	0.1	mg/kg	10 mg/kg	91.9	80.0	120	----
thallium	7440-28-0	E440	0.05	mg/kg	100 mg/kg	92.4	80.0	120	----
uranium	7440-61-1	E440	0.05	mg/kg	0.5 mg/kg	97.1	80.0	120	----
vanadium	7440-62-2	E440	0.2	mg/kg	50 mg/kg	102	80.0	120	----
zinc	7440-66-6	E440	2	mg/kg	50 mg/kg	97.9	80.0	120	----
Metals (QCLot: 646381)									
mercury	7439-97-6	E510	0.005	mg/kg	0.1 mg/kg	110	80.0	120	----
Metals (QCLot: 646382)									
calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	107	70.0	130	----
magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	101	70.0	130	----
sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	102	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 646384)									
boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	1.33333 mg/kg	104	70.0	130	----
Speciated Metals (QCLot: 647484)									
chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	83.8	80.0	120	----
Volatile Organic Compounds (QCLot: 643750)									
benzene	71-43-2	E611A	0.005	mg/kg	3.475 mg/kg	103	70.0	130	----
ethylbenzene	100-41-4	E611A	0.015	mg/kg	3.475 mg/kg	107	70.0	130	----
toluene	108-88-3	E611A	0.05	mg/kg	3.475 mg/kg	105	70.0	130	----
xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	6.95 mg/kg	104	70.0	130	----
xylene, o-	95-47-6	E611A	0.03	mg/kg	3.475 mg/kg	106	70.0	130	----
Hydrocarbons (QCLot: 643751)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	69.1875 mg/kg	99.6	80.0	120	----
Hydrocarbons (QCLot: 647760)									
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	780.6113 mg/kg	116	70.0	130	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	949.73 mg/kg	115	70.0	130	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	823.1125 mg/kg	94.0	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Cyanides (QCLot: 647486)										
WT2213001-008	Anonymous	cyanide, weak acid dissociable	----	E336A	1.31 mg/kg	2.5 mg/kg	105	70.0	130	----
Volatile Organic Compounds (QCLot: 643750)										
WT2213665-005	Anonymous	benzene	71-43-2	E611A	2.37 mg/kg	3.125 mg/kg	102	60.0	140	----
		ethylbenzene	100-41-4	E611A	2.52 mg/kg	3.125 mg/kg	108	60.0	140	----
		toluene	108-88-3	E611A	2.45 mg/kg	3.125 mg/kg	105	60.0	140	----
		xylene, m+p-	179601-23-1	E611A	4.84 mg/kg	6.25 mg/kg	104	60.0	140	----
		xylene, o-	95-47-6	E611A	2.47 mg/kg	3.125 mg/kg	106	60.0	140	----
Hydrocarbons (QCLot: 643751)										
WT2213665-005	Anonymous	F1 (C6-C10)	----	E581.F1	44.7 mg/kg	62.5 mg/kg	96.1	60.0	140	----
Hydrocarbons (QCLot: 647760)										
TY2201400-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	720 mg/kg	780.6113 mg/kg	115	60.0	140	----
		F3 (C16-C34)	----	E601.SG-L	903 mg/kg	949.73 mg/kg	119	60.0	140	----
		F4 (C34-C50)	----	E601.SG-L	754 mg/kg	823.1125 mg/kg	114	60.0	140	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 646383)									
	RM	conductivity (1:2 leachate)	----	E100-L	3239 µS/cm	114	70.0	130	----
Metals (QCLot: 646380)									
	RM	antimony	7440-36-0	E440	3.99 mg/kg	93.5	70.0	130	----
	RM	arsenic	7440-38-2	E440	3.73 mg/kg	99.4	70.0	130	----
	RM	barium	7440-39-3	E440	105 mg/kg	106	70.0	130	----
	RM	beryllium	7440-41-7	E440	0.349 mg/kg	102	70.0	130	----
	RM	boron	7440-42-8	E440	8.5 mg/kg	110	40.0	160	----
	RM	cadmium	7440-43-9	E440	0.91 mg/kg	109	70.0	130	----
	RM	chromium	7440-47-3	E440	101 mg/kg	103	70.0	130	----
	RM	cobalt	7440-48-4	E440	6.9 mg/kg	100	70.0	130	----
	RM	copper	7440-50-8	E440	123 mg/kg	105	70.0	130	----
	RM	lead	7439-92-1	E440	267 mg/kg	99.6	70.0	130	----
	RM	molybdenum	7439-98-7	E440	1.03 mg/kg	101	70.0	130	----
	RM	nickel	7440-02-0	E440	26.7 mg/kg	103	70.0	130	----
	RM	silver	7440-22-4	E440	4.06 mg/kg	88.5	70.0	130	----
	RM	thallium	7440-28-0	E440	0.0786 mg/kg	95.9	40.0	160	----
	RM	uranium	7440-61-1	E440	0.52 mg/kg	97.4	70.0	130	----
	RM	vanadium	7440-62-2	E440	32.7 mg/kg	104	70.0	130	----
	RM	zinc	7440-66-6	E440	297 mg/kg	100	70.0	130	----
Metals (QCLot: 646381)									
	RM	mercury	7439-97-6	E510	0.0585 mg/kg	125	70.0	130	----
Metals (QCLot: 646382)									
	RM	calcium, soluble ion content	7440-70-2	E484	162.9 mg/L	101	70.0	130	----
	RM	magnesium, soluble ion content	7439-95-4	E484	50.1 mg/L	101	70.0	130	----
	RM	sodium, soluble ion content	17341-25-2	E484	207.1 mg/L	116	70.0	130	----
Metals (QCLot: 646384)									
	RM	boron, hot water soluble	7440-42-8	E487	6.2144 mg/kg	102	70.0	130	----
Speciated Metals (QCLot: 647484)									
	RM	chromium, hexavalent [Cr VI]	18540-29-9	E532	172 mg/kg	90.9	70.0	130	----

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2213678**	Page	: 1 of 10
Client	: **Pinchin Ltd.**	Laboratory	: Waterloo - Environmental
Contact	: Megan Keon	Account Manager	: Amanda Overholster
Address	: 1 Hines Rd. Suite 200 Kanata ON Canada K2K 3C7	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 613 592 3387	Telephone	: 1 416 817 2944
Project	: 314869	Date Samples Received	: 09-Sep-2022 14:50
PO	: ----	Issue Date	: 19-Sep-2022 17:53
C-O-C number	: 20-1009698		
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2022 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E336A	09-Sep-2022	15-Sep-2022	14 days	6 days	✓	15-Sep-2022	14 days	1 days	✓
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E336A	09-Sep-2022	15-Sep-2022	14 days	6 days	✓	15-Sep-2022	14 days	1 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E484	09-Sep-2022	17-Sep-2022	180 days	8 days	✓	19-Sep-2022	180 days	2 days	✓
Fixed-Ratio Extractables : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E484	09-Sep-2022	17-Sep-2022	180 days	8 days	✓	19-Sep-2022	180 days	2 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP]										
BH1 @ 5-6 FT	E581.F1	09-Sep-2022	13-Sep-2022	14 days	4 days	✓	15-Sep-2022	40 days	3 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP]										
BH2 @ 10-11 FT	E581.F1	09-Sep-2022	13-Sep-2022	14 days	4 days	✓	15-Sep-2022	40 days	3 days	✓
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E601.SG-L	09-Sep-2022	15-Sep-2022	14 days	6 days	✓	16-Sep-2022	40 days	1 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E601.SG-L	09-Sep-2022	15-Sep-2022	14 days	6 days	✓	16-Sep-2022	40 days	1 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E487	09-Sep-2022	17-Sep-2022	180 days	8 days	✓	19-Sep-2022	180 days	2 days	✓
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E487	09-Sep-2022	17-Sep-2022	180 days	8 days	✓	19-Sep-2022	180 days	2 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E510	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	28 days	10 days	✓
Metals : Mercury in Soil/Solid by CVAAS										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E510	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	28 days	10 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E440	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	180 days	10 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E440	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	180 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap										
BH1 @ 5-6 FT	E100-L	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	30 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap										
BH2 @ 10-11 FT	E100-L	09-Sep-2022	17-Sep-2022	----	----		19-Sep-2022	30 days	10 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap BH1 @ 5-6 FT	E144	09-Sep-2022	----	----	----		13-Sep-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap BH2 @ 10-11 FT	E144	09-Sep-2022	----	----	----		13-Sep-2022	----	----	
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap BH1 @ 5-6 FT	E108A	09-Sep-2022	15-Sep-2022	----	----		15-Sep-2022	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap BH2 @ 10-11 FT	E108A	09-Sep-2022	15-Sep-2022	----	----		15-Sep-2022	30 days	6 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap BH1 @ 5-6 FT	E532	09-Sep-2022	15-Sep-2022	30 days	6 days	✓	16-Sep-2022	7 days	1 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap BH2 @ 10-11 FT	E532	09-Sep-2022	15-Sep-2022	30 days	6 days	✓	16-Sep-2022	7 days	1 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH1 @ 5-6 FT	E611A	09-Sep-2022	13-Sep-2022	14 days	4 days	✓	15-Sep-2022	40 days	3 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH2 @ 10-11 FT	E611A	09-Sep-2022	13-Sep-2022	14 days	4 days	✓	15-Sep-2022	40 days	3 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Boron-Hot Water Extractable by ICPOES	E487	646384	1	12	8.3	5.0	✓
BTEX by Headspace GC-MS	E611A	643750	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	643751	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	647760	1	20	5.0	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	646383	1	12	8.3	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	647484	1	16	6.2	5.0	✓
Mercury in Soil/Solid by CVAAS	E510	646381	1	12	8.3	5.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	646380	1	14	7.1	5.0	✓
Moisture Content by Gravimetry	E144	644963	1	20	5.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	647587	1	20	5.0	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	646382	1	12	8.3	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	647486	1	19	5.2	5.0	✓
Laboratory Control Samples (LCS)							
Boron-Hot Water Extractable by ICPOES	E487	646384	2	12	16.6	10.0	✓
BTEX by Headspace GC-MS	E611A	643750	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	643751	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	647760	1	20	5.0	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	646383	2	12	16.6	10.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	647484	2	16	12.5	10.0	✓
Mercury in Soil/Solid by CVAAS	E510	646381	2	12	16.6	10.0	✓
Metals in Soil/Solid by CRC ICPMS	E440	646380	2	14	14.2	10.0	✓
Moisture Content by Gravimetry	E144	644963	1	20	5.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	647587	1	20	5.0	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	646382	2	12	16.6	10.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	647486	1	19	5.2	5.0	✓
Method Blanks (MB)							
Boron-Hot Water Extractable by ICPOES	E487	646384	1	12	8.3	5.0	✓
BTEX by Headspace GC-MS	E611A	643750	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	643751	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	647760	1	20	5.0	5.0	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	646383	1	12	8.3	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	647484	1	16	6.2	5.0	✓
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Metals in Soil/Solid by CRC ICPMS	E440	646380	1	14	7.1	5.0	✓
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WAD Cyanide (0.01M NaOH Extraction)	E336A	647486	1	19	5.2	5.0	✓

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Matrix Spikes (MS)							
BTEX by Headspace GC-MS	E611A	643750	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	643751	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	647760	1	20	5.0	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	647486	1	19	5.2	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L Waterloo - Environmental	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A Waterloo - Environmental	Soil/Solid	MOEE E3137A	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, 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 by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode.
Moisture Content by Gravimetry	E144 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
WAD Cyanide (0.01M NaOH Extraction)	E336A Waterloo - Environmental	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Metals in Soil/Solid by CRC ICPMS	E440 Waterloo - Environmental	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484 Waterloo - Environmental	Soil/Solid	SW846 6010C	A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.
Boron-Hot Water Extractable by ICPOES	E487 Waterloo - Environmental	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. 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).

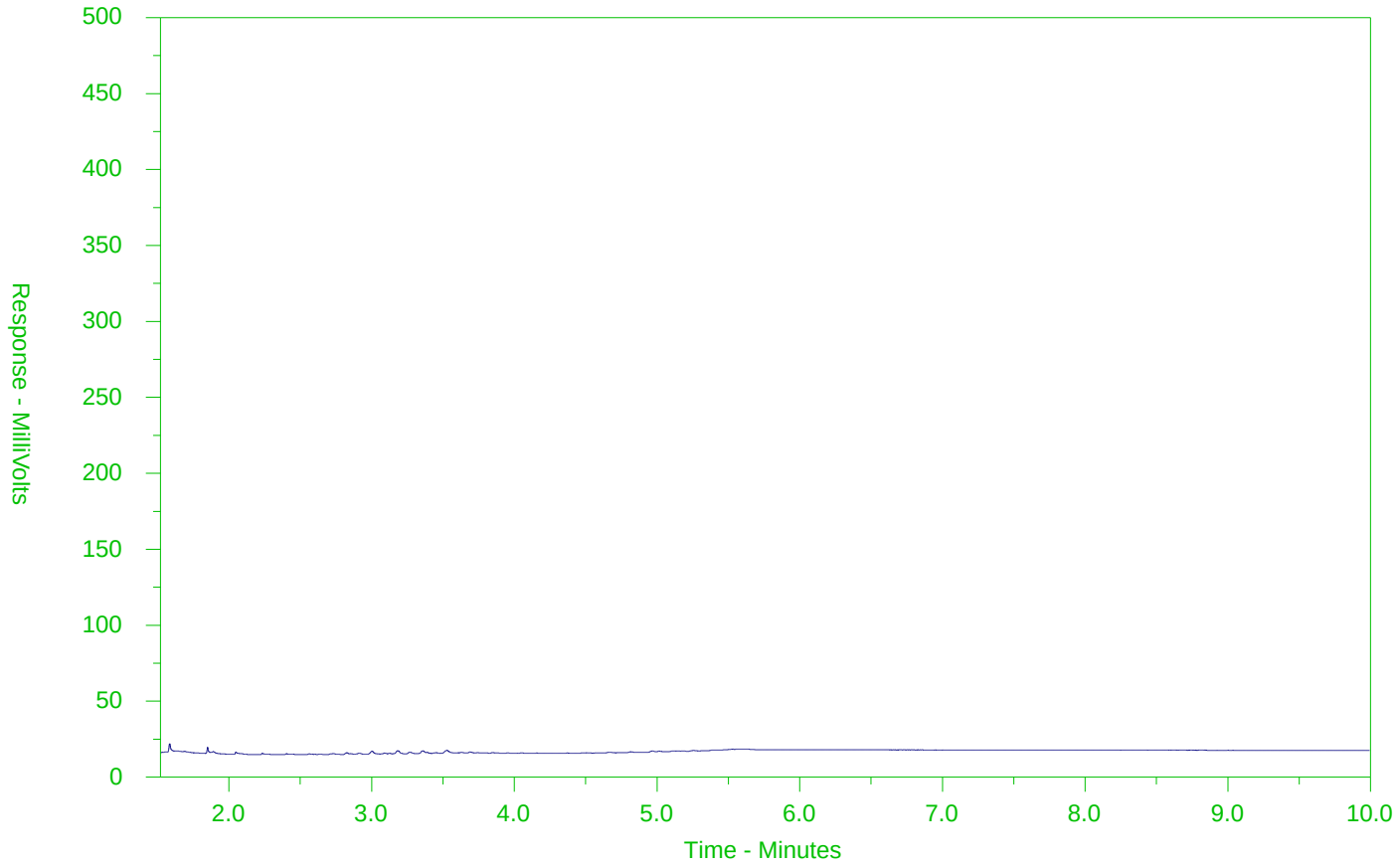
Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Mercury in Soil/Solid by CVAAS	E510 Waterloo - Environmental	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl, followed by CVAAS analysis.
Hexavalent Chromium (Cr VI) by IC	E532 Waterloo - Environmental	Soil/Solid	APHA 3500-CR C	Instrumental analysis is performed by ion chromatography with UV detection.
CCME PHC - F1 by Headspace GC-FID	E581.F1 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	CCME Fraction 1 (F1) is analyzed by static headspace GC-FID. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Sample extracts are subjected to in-situ silica gel treatment prior to analysis by GC-FID for CCME hydrocarbon fractions (F2-F4).
BTEX by Headspace GC-MS	E611A Waterloo - Environmental	Soil/Solid	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
F1-BTEX	EC580 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
Sum F1 to F4 (C6-C50)	EC581 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fractions F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50). F4G-sg is not used within this calculation due to overlap with other fractions.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 Waterloo - Environmental	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A Waterloo - Environmental	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, 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 by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Cyanide Extraction for CFA (0.01M NaOH)	EP333A Waterloo - Environmental	Soil/Solid	ON MECP E3015 (mod)	Extraction for various cyanide analysis is by rotary extraction of the soil with 0.01M Sodium Hydroxide.
Digestion for Metals and Mercury	EP440 Waterloo - Environmental	Soil/Solid	EPA 200.2 (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO3 and HCl. This method is intended to liberate metals that may be environmentally available.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Boron-Hot Water Extractable	EP487 Waterloo - Environmental	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with weak calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. 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)
Preparation of Hexavalent Chromium (Cr VI) for IC	EP532 Waterloo - Environmental	Soil/Solid	EPA 3060A	Field moist samples are digested with a sodium hydroxide/sodium carbonate solution as described in EPA 3060A.
VOCs Methanol Extraction for Headspace Analysis	EP581 Waterloo - Environmental	Soil/Solid	EPA 5035A (mod)	VOCs in samples are extracted with methanol. Extracts are then prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2213678-001-E601.SG-L
Client Sample ID: BH1 @ 5-6 FT



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

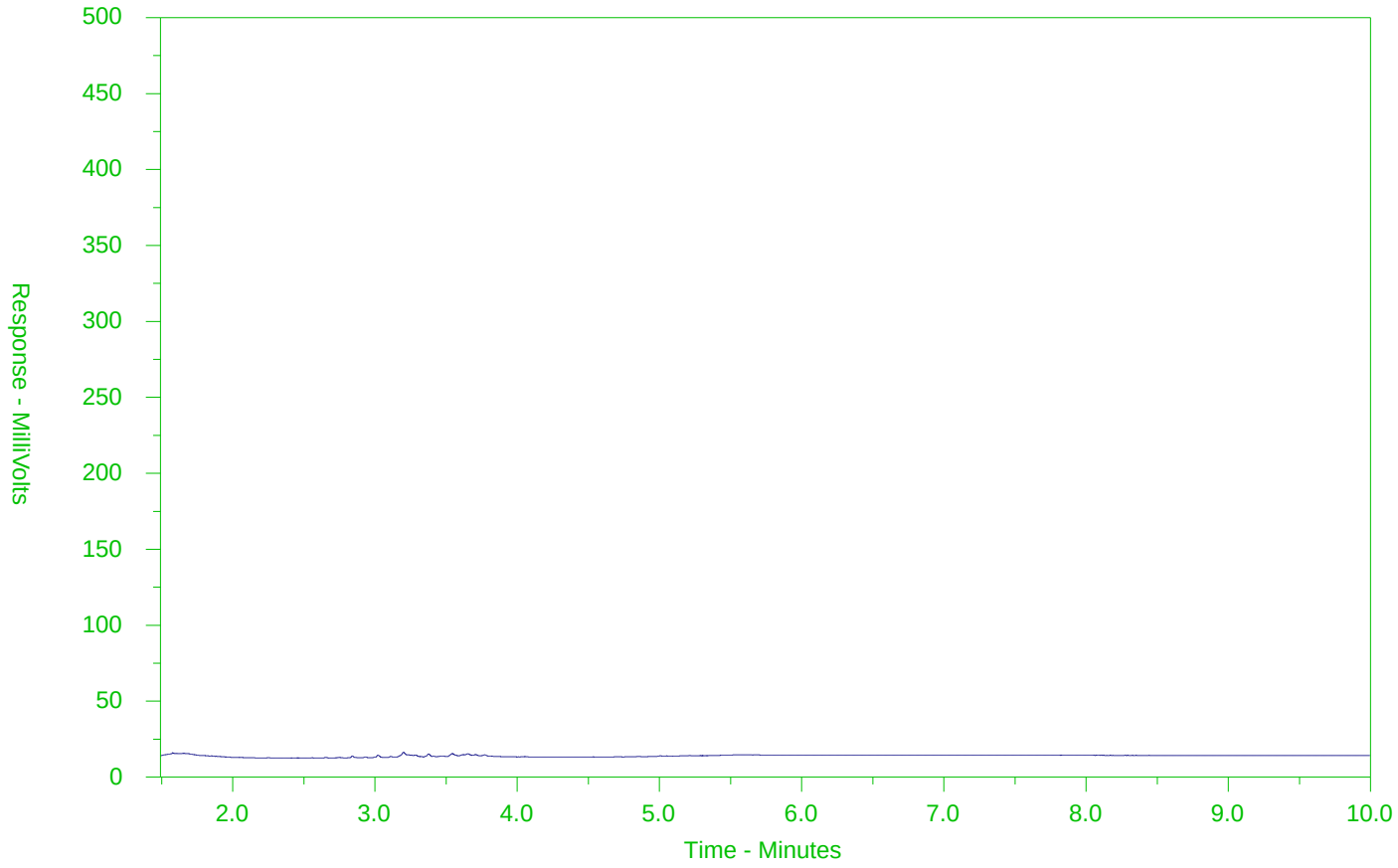
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WT2213678-002-E601.SG-L
Client Sample ID: BH2 @ 10-11 FT



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

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Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 1009698

Page 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Environmental Division Waterloo

Work Order Reference WT2213678

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	PINCHIN
Contact:	MEGAN KEON
Phone:	613-608-5350
	Company address below will appear on the final report
Street:	1 HINES RD, SUITE 200
City/Province:	KANATA, ON
Postal Code:	K2K 3C7
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mkeon@pinchin.com

Email 2:

Email 3:

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@pinchin.com

Email 2:

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fee may apply to rush requests on weekends, statutory holidays and non-routine tes

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact

Project Information

ALS Account # / Quote #:

Job #: 314869

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (ALS use only): WT2213678

ALS Contact: Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS 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	EXCESS SOIL 1	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRE	SUSPECTED HAZARD (see note
	BH1 @ 5-6FT	09/SEP/22	9:00AM	SOIL	4	R			
	BH2 @ 10-11FT	↓	↓	SOIL	4	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

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☒ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
27.2				19.6	23		

SHIPMENT RELEASE (client use)

Released by: Meagan Keon Date: Sept. 9/22 Time:

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: 9/9/22 Time: 14:50

FINAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: 09/10/22 Time: 1230

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 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.

APPENDIX V

Report Limitations and Guidelines for Use

REPORT LIMITATIONS & GUIDELINES FOR USE

This information has been provided to help manage risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report was prepared for the exclusive use of the Client and their authorized agents, subject to the conditions and limitations contained within the duly authorized work plan. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical report is based on the existing conditions at the time the study was performed, and Pinchin's opinion of soil conditions are strictly based on soil samples collected at specific test hole locations. The findings and conclusions of Pinchin's reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the Site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

LIMITATIONS TO PROFESSIONAL OPINIONS

Interpretations of subsurface conditions are based on field observations from test holes that were spaced to capture a 'representative' snap shot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. Pinchin reviews field and laboratory data and then applies professional judgment to formulate an opinion of subsurface conditions throughout the Site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

LIMITATIONS OF RECOMMENDATIONS

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. Pinchin should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing and consultation should be provided by Pinchin during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the test hole investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing and consultation by Pinchin should be completed to evaluate whether or not earthwork activities are completed in

accordance with our recommendations. Retaining Pinchin for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by Pinchin is over and above the mandate of this geotechnical evaluation and therefore, additional fees would apply.

MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Pinchin confer with appropriate members of the design team after submitting the report. Also retain Pinchin to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Pinchin participate in pre-bid and preconstruction conferences, and by providing construction observation. Please be advised that retaining Pinchin to participation in any 'other' activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

CONTRACTORS RESPONSIBILITY FOR SITE SAFETY

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor's responsibility that the Ontario Occupational Health and Safety Act is adhered to, and Site conditions satisfy all 'other' acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION

This report is geotechnical in nature and was not performed in accordance with any environmental guidelines. As such, any environmental comments are very preliminary in nature and based solely on field observations. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their by-products.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be held liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario), to commence legal proceedings against Pinchin to recover such losses or damage.