Phase Two
Environmental Site Assessment

322-326 Waverly Street
Ottawa, Ontario

Prepared for:

Serco Realty Group
9 Capella Court
Ottawa, Ontario
K2E 8A7

Attention: Loredana Porcari

LRL File No.: 190523

July 30, 2021

5430 Canotek Road | Ottawa, ON, K1J 9G2 | info@lrl.ca | www.lrl.ca | (613) 842-3434

EXECUTIVE SUMMARY

Serco Realty Group retained LRL Associates Ltd. (LRL) to complete a Phase Two Environmental Site Assessment (ESA) on the property located at 322-326 Waverly Street in Ottawa, Ontario (herein referred to as the Site). The assessment was conducted in the context of property development. The purpose of a Phase Two ESA is to determine if recognized potential environmental concerns have negatively impacted soil and groundwater quality of the subject Site. Such an assessment provides information regarding the nature and extent of potential contamination to assist in making informed business decisions about the property. Potential environmental concerns identified during the Phase One ESA and initial Site visit that require further discussion and potential investigation include: fill of unknown quality along the western portion of the Site, and location of the former heating oil above ground storage tank (AST) within the basement of building at 322 Waverly Street.

Contaminants of concern are: Petroleum Hydrocarbon Compounds (PHCs); Volatile Organic Compounds (VOCs) specifically benzene, toluene, ethylbenzene, and xylenes (BTEX); and, Metals and inorganic parameters (conductivity, SAR, pH, and free cyanide).

The Site is rectangular shaped with an area of 600 m². The majority of the eastern portion of the Site is developed with an existing two and a half (2 ½) storey building. The remainder of the property is gravel, and/or weathered asphalt parking and circulation. A former development was present at the western portion of the Site, now occupied by parking spaces, from at least the late 1880's through to between the late 1960's to mid 1970's, when it was demolished. Topography is generally flat. The building is heated with natural gas, supplied with municipal water and is connected to the municipal sanitary sewer system.

Regulatory requirements for assessing environmental conditions of a site are established by Ontario Regulation 153/04 – Records of Site Conditions, Part XV.1 of the Environmental Protection Act (O. Reg. 153/04). Site condition standards are set out in the MECP's "*Soil, Ground Water and Sediment Standards for Use Under Part IV.1 of the Environmental Protection Act*", April 15, 2011, as amended. The applicable SCS used was the Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition, residential property use and medium-fine textured soils.

The investigation involved advancing three (3) boreholes across the Site at strategic locations based on areas of potential environmental concern. None of the boreholes were completed as monitoring wells as groundwater was not encountered.

Subsurface conditions across the exterior portion of the Site generally included a layer of sand and gravel fill with some boulders extending from surface to 1.45 to 1.82 m bgs. Two geotechnical boreholes along the south side of the property also had a 38-50 mm asphalt layer encountered at surface which was overlying the fill. Underlying the fill material was a layer of grey silty clay or clayey silt which extended from the bottom of the fill layer to 3.05 or 7.67 m bgs where the boreholes were terminated.

In the soil, exceedances to the applicable standards were detected in BH21-1, BH21-2, and BH21-3:

- BH21-1 Exceedances:
    i. 0.61 – 1.83 m bgs: conductivity, barium, lead, and pH.
    ii. 2.43 – 3.05 m bgs: SAR, conductivity, chromium, cobalt, and vanadium.
- BH21-2 Exceedances:

i. 1.21 – 1.37 m bgs: Conductivity

ii. 2.43 – 3.05 m bgs: Conductivity, barium, cobalt, and vanadium.

- BH21-3 Exceedances:

i. 1.22 – 1.83 m below basement slab: Barium, cobalt, and vanadium.

ii. 2.43 – 3.05 m below basement slab: Cobalt and vanadium.

Based on our observations during drilling activities, along with screening of samples and laboratory analysis, there is evidence of SAR and conductivity, as well as various metals including: vanadium, chromium, cobalt, lead, and/or barium impacts to the soil across the Site. Groundwater was not encountered at the Site, and due to the depth of the water table, low mobility of metals contamination in soil, and the low permeability of the native silty clay unit present beneath the Site, is not considered likely to be impacted by any of the APECs or their impacts that were identified.

Elevated SAR and conductivity are understood to be related to the application of road salt to the parking lot for pedestrian and vehicular safety. As such, they are not considered to be exceedances under the regulation.

The horizontal and vertical extent of the metals contaminated soil has not been fully delineated, as such an RSC with the Ontario Ministry of the Environment cannot yet be filed. It is LRL's interpretation that the vanadium, cobalt, chromium, and barium exceedances (with the exception of barium in MW21-1-SS2 + SS3 (composite)) are likely due to elevated background concentrations. It is understood that the client plans to redevelop the Site, which would include excavation and removal of most or all of the contaminated material noted in this report. Given the small size of the site, and difficulty accessing it to excavate while the Site is still in use, LRL offers the following recommendations:

- The client seek a phased conditional City approval for the re-zoning and development, conditional upon the excavation and removal of contaminated materials from the Site, followed by confirmation sampling and the submission for an Record of Site Condition for the Site;
- A modified generic risk assessment (MGRA) could be conducted in order to assess the risk posed by the elevated barium, chromium, cobalt, and vanadium metals, and to support the interpretation of elevated background metals concentrations, or recommend mitigation strategies that could allow the material to remain at Site. An MGRA would review the maximum contaminant concentrations, pathways, and potential contaminant exposure levels. The risk assessment would provide risk management measures, as needed, to reduce risk of contaminant exposure and environmental impacts to human health and ecological receptors; and/or,
- The MECP may be contacted in order to receive an acknowledgement in order to refer to the observed concentrations of barium, cobalt, chromium, and vanadium in the native silty-clay as reflective of background conditions based on the evidence provided within this Phase Two ESA report, and confirmation samples collected at the time of excavation.

Due to the estimated age of the buildings there may be the presence of designated substances such as asbestos containing material (ACM) or lead-based paint in concealed spaces such as in the ceiling or walls. If construction or demolition activities is to occur on the building, it is recommended that sampling be performed to determine whether the presence of special attention items such as ACM are present so they can be addressed accordingly to ensure that the contractors or building occupants do not come into contact with these materials.

TABLE OF CONTENTS

FIGURES

(In order following text)

TABLES

(In order following Figures)

APPENDICES

(In order following Tables)

1 INTRODUCTION

Serco Realty Group retained LRL Associates Ltd. (LRL) to complete a Phase Two Environmental Site Assessment (ESA) on the property located at 322-326 Waverly Street in Ottawa, Ontario (herein referred to as the Site). The assessment was conducted in the context of property development.

2 PURPOSE

The purpose of a Phase Two ESA is to determine if recognized potential environmental concerns have negatively impacted soil and groundwater quality of the subject Site. Such an assessment provides information regarding the nature and extent of potential contamination to assist in making informed business decisions about the property. Potential environmental concerns identified during the Phase One ESA and initial Site visit that require further discussion and potential investigation include: fill of unknown quality along the western portion of the Site, and location of the former heating oil above ground storage tank (AST) within the basement of building at 322 Waverly Street.

Contaminants of concern are:

- Petroleum Hydrocarbon Compounds (PHCs);
- Volatile Organic Compounds (VOCs) specifically benzene, toluene, ethylbenzene, and xylenes (BTEX); and
- Metals and inorganic parameters (conductivity, SAR, pH, and free cyanide).

The Phase Two ESA will establish the Site's subsurface geology and hydrogeological conditions. Soil and groundwater conditions will be evaluated with respect to the contaminants of concern in the context of the current regulations and guidelines applicable to contaminated sites. Findings and conclusions presented in this report apply only to the recognized environmental conditions assessed.

2.1 Property Information

The Site's location is shown in **Figure 1** and the general Site configuration is shown on the Site Plan in **Figure 2.**

Address:	322 – 326 Waverly Street West, Ottawa, Ontario
Frontage:	Waverly Street
Zoning:	Residential Fourth Density (R4UD)
Legal description:	Lot 9, Plan 12, S/S Waverly Street; City of Ottawa.
Property Identification Number:	04118-0142(LT)
UTM Coordinates:	18T 0445862 E 5029179 N
Dimensions:	Rectangular: Being approximately 20 m wide (east – west) by 30 m deep (north – south).
Area:	Approximately 600 m^2

2.2 Site Occupancy

Current owner:	322 – 326 Waverly Developments Inc.
Site Contact:	Name: Loredana Porcari
	Address: 9 Capella Court, Unit 200, Ottawa, Ontario
	Phone: (613) 226 – 2221
	Email: l.porcari@sercorealty.com
Owner since:	2019
Current use:	Office space with associated parking
Current use since:	Approximately since 2000.

3 BACKGROUND

3.1 Phase One Environmental Site Assessment

3.1.1 Phase One ESA Conceptual Site Model

The following describes the Phase One ESA Conceptual Site Model (CSM) for the Site based on the information obtained and reviewed as part of this Phase One ESA:

- The Site is situated within an urban residential setting of the City of Ottawa. The Site is currently developed with an office building (Embassy of the Republic of the Congo), estimated to have been constructed in the 1930's. It is understood that a multi-unit residential development is proposed to be constructed on the Site.
- The Site is rectangular shaped with an area of 600 m². The majority of the eastern portion of the Site is developed with an existing two and a half (2 ½) storey building. The remainder of the property is gravel, and/or weathered asphalt parking and circulation. A former development was present at the western portion of the Site, now occupied by parking spaces, from at least the late 1880's through to between the late 1960's to mid 1970's, when it was removed. The reason for the loss of the development is unknown. At the time of the Site visit on May 3rd, 2021, observations of cement and brick were encountered along the ground surface in the vicinity of the former building footprint. It is possible this debris is remanence of the previous structure.
- According to available aerial photographs reviewed as part of this assessment, the Site and the surrounding lands have been developed since at least late 1920's. The developments visible in the late 1920's imagery is generally comparable to those present in the most recent 2019 aerial photograph reviewed.
- Fire insurance plan obtained as part of this assessment included plans dated between 1895 and 1963. The historical building located on the western portion of the Site was identified in the 1895 plan, along with a smaller structure is present along the southern perimeter of the Site. The current building present on Site, was not present in the plans reviewed. A Property Underwriters Report retrieved from 1975 revealed that the current development on the Site, 322 Waverly Street, was occupied by a law office, with forced warm air fired by oil heating. A subsequent Property Underwriters Report, dated 1997, confirmed that heating oil is stored in a 900 L storage tank within the building.

- A previous Phase I Environmental Site Assessment report, prepared for 322 – 326 Waverly Street, Ottawa, dated May 31, 2019, prepared by Pinchin Ltd., was reviewed as part of this assessment. At the time of the assessment, the Site was developed with a two and a half story building used as an office space. The building was estimated to have been constructed in approximately 1930 and heated with a natural gas-fired furnace and is also equipped with an air conditioning unit. The Site was previously heated by fuel oil, which was stored in an aboveground storage tank with a 900 L capacity. Copper wiring and oil filters were identified within the furnace room, in the basement of the building. Pinchin Ltd., although noting the historical presence of a heating oil storage tank, indicated that "nothing was identified that is likely to result in potential subsurface impacts at the Site. As such, no subsurface investigation work (Phase II ESA) is recommended at this time." The report does make mention that, based on the estimated date of construction of the building on the Site, there is the potential for possible designated substances and hazardous materials (i.e. asbestos).
- A review of the City of Ottawa Old Landfill Management Strategy Document, 2004, revealed that no current or former landfill sites present within 500 m of the Site. Furthermore, a review of the MECP Inventory of Industrial Sites Producing or Using Coal Tar and Related Tars in Ontario did not return records of a facility within 250 m of the Site.
- The topography of the Site is generally flat with an approximate elevation of 71 m amsl. The nearest open water body has been identified as the Rideau Canal which is located approximately 725 m east of the Site.
- Ten (10) records of Environmental Compliance Approvals/Certificates of Approval were found within a 250 m radius of the Site. No records were retrieved for the Site. The database service provider has included additional records, which, although cannot be confirmed as being within the 250 m search radius, have the potential of being within the search radius based on information included in the record. 45 additional records were retrieved and are identified as "unplottable" due to limited information available in the records, namely addresses. The records retrieved were for air, municipal and private sewage, and municipal and private water. The records retrieved for CofA approvals, in addition to those identified in the "Unplottable" records, present low risk for environmental concerns as a result of the type of approval and processes issued (i.e. air emissions, municipal and private sanitary and water services).
- Twenty records were retrieved for Environmental Compliance Approval's within 250 m of the Site. No records were retrieved for the Site. The database service provider has included seven (7) additional records which cannot be confirmed as being within the 250 m search radius of the Site. These records are identified as "unplottable" due to limited information available in the records, namely addresses. The "unplottable" records of spills which cannot be confirmed as beyond a 250 m radius of the Site included records of mobile air, municipal and private sewage, and municipal and private water works. The records retrieved for ECA approvals within 250 m of the Site, as well as the "Unplottable" records present low risk for environmental concerns as a result of the type of ECA and processes issued (i.e. municipal sanitary and water services).
- Twelve records of spills, within a 250 m radius of the Site, were retrieved. Each of the occurrences present low risk for environmental concern to the Site due to their distance from the Site and the type of product released. Natural gas is not considered a potential environmental concern.

- 166 records for a registered waste generator were retrieved within 250 m of the Site. No records were retrieved for the Site. The risk for potential environmental concern to the Site, or the records retrieved, is considered to be low due to the distance from the Site. The database service provider has included six (6) additional records which cannot be confirmed as being within the 250 m search radius of the Site. These records are identified as "unplottable" due to limited information available in the records, namely addresses. The risk for potential environmental concern to the Site in regard to these "unplottable" records are considered to be low due to the distance from the Site.
- One (1) record of a retail fuel storage tank was retrieved with a 250 m radius of the Site. Topia Energy, located at 311 O'Connor Street, immediately west of the Site, is listed as an Oil-Fuel, Petroleum Products, Wholesale. No further details are provided with respect to the storage or handling of fuel on the property. Based on further review of the Topia Energy brand, as well as the findings of the remaining databases and historical records reviewed as part of this assessment, it is found that Topia Energy is a distributor of biodiesel. It is anticipated that 311 O'Connor Street was an office space for Topia Energy, rather than used for storage and handling of fuels. Therefore, the risk for potential environmental concerns are considered low.
- 16 records of a manufacturing facilities were retrieved within a 250 m radius of the Site. Non of which were found on the Site. The identified manufacturing facilities present a low risk for potential environmental concern due to the type of manufacturing facility and distance from the Site.
- Four (4) records were retrieved within a 250 m radius of the Site, which were all listed for Taggart Corporation, located at 255 Metcalfe Street, approximately 240 m northeast of the Site. The results indicated that they were listed as a PCB storage site from between 1995, 1998 and 2000. This registered PCB storage facility presents low risk for potential environmental concerns to the Site due to its distance.
- There are ten (10) PCAs, both on-Site and off-Site, that were identified (presented in section 7.2.1 of this report) based on the findings of the Phase One ESA; two (2) of which are considered to be of potential concern that result in APECs are discussed below:
    - Presence of a former 900 L heating oil tank within the basement of 322 Waverly Street was noted in 1975 property underwriters' reports and in the 2019 Phase One ESA report by Pinchin Inc. Fuel ASTs are considered a PCA. Based on the quantity of petroleum products stored as well as the position on site in a subsurface basement, this PCA is considered to contribute to an APEC at 322 Waverly Street.
    - Presence of fill material of unknown source and quality was noted during a site visit on May 3rd, 2021, in the footprint of former building located on the western portion of the Site. Presence of fill of unknown origin is considered a PCA located on-Site and hence presents an APEC across the filled areas.

3.1.2 Potentially Contaminating Activity

Based on the results of the Phase One ESA, the following PCAs as well as their location, contaminants of potential concern (COPC), potential media impacted, and likelihood to contribute to an on-site APEC were identified:

O. Reg 153/04 Schedule D PCA	Location of PCA	Description and Source Information	Contribution to an APEC
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	On-Site, within existing building	An AST was noted to have been within the basement of the building in the 1975 property underwriters' reports, and mentioned in the 2019 Phase I ESA report by Pinchin Inc.	The PCA is located on the Site and is therefore automatically considered to contribute to an on-site APEC.
PCA 30: Importation of Fill Material of Unknown Quality	On-Site, along the western portion of the Site, within the vicinity of the former building footprint.	During site visit, the area of a former building was observed to match existing grade. Visual evidence of cement and brick debris encountered.	The PCA is located on the Site and is therefore automatically considered to contribute to an on-site APEC.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	311 O'Conner Street, adjacent to the west of the Site	The retail fuel storage tanks database reported the presence of a retail fuel storage tank at the location.	While this PCA is directly adjacent to the Site, based on additional research it was found the contents of the tank was likely biodiesel. Further, the tank is recent (within the last 20 years) no spills have been reported and the Site is not believed to have operated as a commercial fuel dispenser. As such, the QP does not consider it likely that this PCA would contribute to an APEC on Site.
PCA 10: Commercial Autobody Shop	125 m southeast of the Site	Automotive service garage noted in the 1912 FIP.	Based on the PCAs position 125 m downgradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 10: Commercial Autobody Shop **PCA 28:** Gasoline and Associated Products Storage in Fixed Tanks.	394 Bank Street, 220 m west of Site	Gasoline service station with two USTs noted in the 1922 through 1963 FIPs. Oiling garage noted at location in 1963.	Based on the PCAs cross-gradient position 220 m from the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	448 Bank Street, 240 m west of the Site	A gasoline service station with four USTs was noted in the 1948 and 1963 FIP.	Based on the PCAs cross-gradient position 240 m from Site, it is not considered likely to contribute to an APEC on the Site.
PCA 10: Commercial Autobody Shop	7 Florence Street, 230 m west of the Site	A garage and repair facility with one UST was identified in the 1948 and 1963 FIP.	Based on the PCAs cross-gradient position 230 m from Site, it is not considered likely

O. Reg 153/04 Schedule D PCA	Location of PCA	Description and Source Information	Contribution to an APEC
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.			to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	366 Waverly Street, 100 m west of the Site	Ontario spills reported 180 L of furnace oil was spilled from a tank at a private residence.	Based on the PCAs cross-gradient position 100 m from Site, it is not considered likely to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	300 Gilmour Street, 220 m northeast of the Site	Ontario spills database reported an unspecified amount of furnace oil was leaked from a UST.	Based on the PCAs cross-gradient position 220 m from Site, it is not considered likely to contribute to an APEC on the Site.
PCA 19: Electronic and Computer Equipment Manufacturing	384 Bank Street, 240 m west of the Site	Scott's Manufacturing Directory indicated that AssayNet Canada Inc. conducted semiconductor and other electronic component manufacturing on-Site.	Based on the PCAs cross-gradient position 240 m from Site, it is not considered likely to contribute to an APEC on the Site.

3.1.3 Areas of Potential Environmental Contamination (APECs)

Based on the assessment of the PCAs identified within the Phase One Study Area, the following Areas of Potential Environmental Concern (APECs), their contributing PCA, the associated contaminants of potential concern (COPC), and the potentially contaminated media, are detailed in the table below:

# on Fig	PCA	Location of PCA	Location of APEC On-Site	COPCs	Media Potentially Impacted
A	**#1 PCA 30:** Presence of fill of unknow quality	On-Site, along western portion of site, within the former building footprint.	Filled area in location of former building footprint on western portion of Site.	PHCs, VOCs, and metals	Soil
B	**#2 PCA 28:** Heating Oil Tank	On-site, within existing building	Basement furnace room of 322 Waverly Street.	PHCs, VOCs	Soil and groundwater

Notes: PHC – Petroleum Hydrocarbons
VOC – Volatile Organic Compounds

3.1.4 Phase One ESA Conclusions and Recommendations

Based on the findings of the Phase One ESA, it is recommended that a Phase Two ESA be conducted on the Site. Recommendations to address areas of potential environmental concerns are as follows:

Area of Potential Environmental Concern	Recommendation
PEC 1: Presence of fill of unknown quality	Advance two (2) boreholes within the area of the former building at the western portion of the Site and complete in to monitoring wells to assess fill quality and allow for sampling and analysis of soil and groundwater for contaminants of concern.
PEC 2: Heating oil tank	Along with the boreholes noted above, also advance one (1) borehole in the basement furnace room of 322 Waverly Street and complete as a monitoring well to allow for sampling and analysis of soil and groundwater for contaminants of concern.

3.2 Geotechnical Investigation

A geotechnical investigation was completed by LRL Associates Ltd. since the completion of the Phase One ESA Report. The following pertinent environmental information was noted:

- Four (4) boreholes were advanced to 7.67 m below ground surface (bgs);
- Subsurface conditions across the Site generally included a layer of silt-sand or gravel-sand fill extending from surface to 1.45 m bgs with the exception of a 38-50 mm asphalt layer encountered at surface in the two holes along the south side of the property. Underlying the fill material was a layer of silty clay or silt and clay which extended from 1.45 m bgs to 7.67 m bgs where the boreholes were terminated;
- Gradation analysis was completed of the silty clay unit in two locations. The unit was found to be 98.5% and 99.2% fines, and would therefore be considered medium-fine grained; and,
- Groundwater was not encountered in any of the boreholes.

4 SCOPE OF INVESTIGATION

4.1 Scope

LRL conducted this work in accordance to the standard Phase Two ESA procedures, which generally reflect the requirements of:

- Canadian Standards Association (CSA) Phase II Environmental Site Assessment, Z769-00 (R2016);
- Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario, Ontario Ministry of the Environment and Energy, December 1996; and
- O. Reg. 153/04, as amended.

The scope of work for this investigation consisted of the following:

Phase Two ESA:

- Advance three (3) boreholes at strategic locations based on potential areas of environmental concern, to allow for soil sampling;

- If groundwater is encountered in the borehole, complete three (3) of the boreholes as monitoring wells to assess hydrogeological conditions and facilitate groundwater sampling;
- Submit representative soil and groundwater samples to an accredited laboratory for analysis of suspected contaminants of concern; and
- Interpret results in relation to current provincial guidelines to determine subsurface soil and groundwater quality.

This report will present the results of the ESA carried out on May 3, 2012 to July 15, 2021.

4.2 Applicable Guideline Criteria

Regulatory requirements for assessing the environmental conditions of a site are established by Ontario Regulation 153/04 – Records of Site Conditions, Part XV.1 of the Environmental Protection Act (O. Reg. 153/04). The site condition standards are set out in the Ministry of Environment, Conservation and Parks' "*Soil, Ground Water and Sediment Standards for Use Under Part IV.1 of the Environmental Protection Act*", as amended. The applicable site condition standard used was the Table 3 Full Depth Generic Site Condition Standards (SCS) in a non-potable groundwater condition, residential property use and fine-textured soils for the following reasons:

- The Site and all other properties located, in whole or in part, within 250 metres of the Site are supplied by the City of Ottawa municipal drinking water system. No potable water domestic well records were discovered within 250 m of the Site;
- The Site is not located in an area designated in a municipal official plan as a well-head protection area or other designation identified by the municipality for the protection of ground water;
- Native subsurface material encountered was silty clay. Based on laboratory grain size analysis completed as part of the Geotechnical Investigation and included in **Appendix B**, it was determined to be of medium-fine texture;
- The closest water body is the Ottawa River, located 1.3 km northwest of the Phase Two Property;
- There are no features on the Phase Two Property that would meet the conditions of an environmentally sensitive site, as described in Section 41;
- The average pH of surface soil is 5≤pH≤9 and the pH of sub-surface soil meets the requirement that 5≤pH≤11;
- The intended land use for the Phase Two Property is residential;
- The overburden thickness is greater than 2 metres over more than one-third of the Phase Two Property;
- Ground water was not encountered during the investigation.

5 INVESTIGATION METHOD

5.1 Field Preparation

Location of all buried and overhead services were obtained by LRL prior to initiation of the subsurface investigation.

5.2 Intrusive Investigation

An intrusive investigation was carried out on June 15, 2021. Three (3) boreholes were advanced across the Site. All boreholes yielded dry soil samples, indicating that the water table was not encountered over the borehole depths of 3.0 m. Therefore, none of the three (3) boreholes were completed as monitoring wells (MW):

APEC	Location	Targeting Borehole/ Monitoring Well
APEC A: Presence of fill of unknown quality	Filled area in location of former building footprint on western portion of Site.	BH21-1 and BH21-2
APEC B: Heating oil tank	Basement furnace room of 322 Waverly Street.	BH21-3

Borehole and monitoring well locations are presented in **Figure 2.**

5.3 Borehole Drilling

The intrusive subsurface investigation was conducted on June 15th, 2021. The drilling contractor was CCC Group (Ottawa, Ontario) and worked under LRL field staff supervision. Soil samples were collected continuously using a split-spoon sampler of 0.6 m in length; excepting BH21-2 which required augering to pass through a rock from 0.9 to 1.2 m below ground surface (bgs). Between each spoon, the sampling equipment was thoroughly cleaned.

On June 15, 2021, two (2) boreholes (BH21-1, BH21-2) were advanced through the overburden using a CME 45B truck-mounted drill rig using 200 mm hollow stem auger and split-spoon to depths of 3.0 m bgs. One (1) borehole (BH21-3) was advanced manually using a jackhammer and a split spoon to a depth of 3.0 m bgs.

Details of the borehole drilling are provided in the borehole logs in **Appendix A**. Locations of the boreholes are presented in **Figure 2**.

5.4 Soil Sampling and Field Screening

Representative soil samples from each soil stratum encountered or tube sampler/split sampler were collected and transferred immediately into sealed laboratory supplied glass containers and polyethylene freezer bags. Samples were examined for soil type, colour, staining/discolouration, and odours. Samples were logged, labelled and stored on-Site in a cooler chilled with ice to prevent evaporation of potential combustible soil vapours (CSV). Soil samples stored in bags were screened for CSV presence using a Mini Rae 2000 Photoionization Detector (PID).

5.5 Monitoring Well Installation

Three (3) boreholes were to be completed as monitoring wells. All boreholes yielded dry soil samples, indicating that the water table was not encountered over the borehole depths of 3.0 m. Therefore, none of the three (3) boreholes were completed as monitoring wells.

5.6 Analytical Testing

Representative soil samples collected during the investigation were submitted for laboratory analysis. Samples were submitted to Paracel Laboratories Ltd., Ottawa, ON for the following contaminants of concern: PHC fractions F1 (C6 – C10), F2 (>C11 – C16), F3 (>C16 – C34) and F4 (>C34), VOC, specifically benzene, toluene, ethylbenzene, and xylenes (BTEX), and metals and other inorganics.

Area of Potential Environmental Concern	Soil		Groundwater	
	Sample No.	Analysis	Sample No.	Analysis
APEC A: Presence of fill of unknown quality	Composite (BH21-1-SS2/ BH21-1-SS3) BH21-2-SS2A	PHC, VOC (BTEX), Metals & Inorganics	--	--
APEC B: Heating oil tank	BH21-3-SS3 BH21-3-SS12 (duplicate)	PHC, VOC (BTEX), Metals & Inorganics	--	--

Laboratory Certificates of Analysis are included in **Appendix B**. All remaining samples which were not analysed were stored for one month, then disposed by the laboratory.

5.7 QA/QC Protocols

Quality assurance/quality control (QA/QC) protocols were followed during the borehole drilling and sampling to ensure that representative samples were obtained. The protocols were generally performed in accordance with the following:

- Ontario Ministry of Environment, Conservation and Parks' (MECP) "*Guidance on* Sampling and Analytical Methods for Use at Contaminated Sites in Ontario", revised February 1997.
- Ontario Ministry of Environment, Conservation and Parks' (MECP) "Guide for Completing Phase Two Environmental *Site Assessments under Ontario Regulation 153/04"*, June 2011.

Field protocols that were employed include:

- All field-screening devices such as the combustible gas detector, were calibrated prior to use, to ensure accuracy and reliability of readings;
- Thorough decontamination of all sampling equipment. Use of dedicated sampling equipment when possible;
- Soil samples collected were placed in laboratory supplied glass sample jars;
- Thorough documentation of all field activities and sample handling practices including field notes, chain of custody forms, memos to files, etc.; and
- Samples were submitted to a laboratory which is certified by the Canadian Association for Laboratory Accreditation (CALA).

Field duplicate samples were collected such that at least one duplicate sample was available for submission for every 10 samples submitted to the laboratory. In this case, one (1) field duplicate of BH21-3-SS3 (BH21-3-SS12). Other QA/QC procedures conducted by LRL are outlined in the methodologies detailed below.

6 REVIEW & EVALUATION

6.1 Geology

Subsurface conditions across the exterior portion of the Site generally included a layer of sand and gravel fill with some boulders extending from surface to 1.45 to 1.82 m bgs. Two geotechnical boreholes along the south side of the property also had a 38-50 mm asphalt layer encountered at surface which was overlying the fill. Underlying the fill material was a layer of grey silty clay or

clayey silt which extended from the bottom of the fill layer to 3.05 or 7.67 m bgs where the boreholes were terminated;

Detailed borehole logs are presented in **Appendix A**.

6.2 Soil: Field Screening

Olfactory and visual evidence of petroleum hydrocarbon impacts were not identified in any boreholes.

Observations were further assessed through CSV concentrations measured. The CSV concentrations measured in the soil samples collected ranged between non-detect (<0.1 ppm) and 0.2 ppm, with the higher levels in the shallowest sample of BH21-2.

A sand and gravel fill was encountered in the western portion of the site, below the footprint of the former building, to a depth of 1.6 to 1.8 m bgs. A 30 mm layer of carpet was encountered in BH21-2 at a depth of 1.6 m.

CSV measurements are summarized in the borehole logs in **Appendix A**.

6.3 Soil Texture

Native subsurface soil was observed to consist of a silty clay. Two soil samples were submitted for a grain size distribution analysis as part of the Geotechnical Investigation completed in May 2021. The soil was reported as fine-grained. The laboratory certificate of analysis is included in **Appendix B**.

6.4 Soil Quality

The analytical results of the submitted soil samples and respective MECP standards are presented in **Table 2**. The soil exceedances are presented in **Figure 3**. At least one soil sample from each borehole was submitted for chemical analysis to determine the impacts of recognized APECs. The laboratory certificates of analysis for soil are included in **Appendix B**.

6.4.1 Petroleum Hydrocarbons

PHCs were not detected at concentrations exceeding MECP Table 3 standards in any of the boreholes sampled. PHCs were detected within BH21-2-SS2A and the composite sample of BH21-1-SS2 and BH21-1-SS3, but at concentrations below the MECP Table 3 (fine) SCS.

6.4.2 Volatile Organic Compounds: Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

BTEX parameters analysed were not detected in any soil samples submitted for analysis.

6.4.3 Metals and Inorganics

Various metals and inorganic parameters exceeding the Table 3 (fine) SCS were noted in all samples submitted. The exceedances were as follows:

- **BH21-1 Exceedances**
  - *SS2 + SS3 (Composite)(Fill, 0.61 – 1.83 m bgs):*
    - Conductivity reading of 2970 µS/cm exceeds Table 3 SCS of 700 µS/cm;
    - Barium concentration of 503 µg/g exceeds Table 3 SCS 390 µg/g;
    - Lead concentration of 173 µg/g exceeds Table 3 SCS of 120 µg/g; and,
    - pH of 11.45 exceeds the environmental sensitivity criteria for pH in surface (0 – 1.5 m bgs) samples of 5 – 11.

  - *SS5 (Native silty clay, 2.43 – 3.05 m bgs):*
    - Sodium adsorption ratio (SAR) of 5.4 exceeds Table 3 SCS of 5;
    - Conductivity reading of 2440 µS/cm exceeds Table 3 SCS of 700 µS/cm;
    - Chromium concentration of 170 µg/g exceeds Table 3 SCS of 160 µS/cm;
    - Cobalt concentration of 31.3 µg/g exceeds Table 3 SCS of 22 µg/g; and,
    - Vanadium concentration of 139 µg/g exceeds Table 3 SCS of 86 µg/g.
- **BH21-2 Exceedances**
  - *SS2A (Fill, 1.21 – 1.37 m bgs):*
    - Conductivity reading of 728 µS/cm exceeds Table 3 SCS of 700 µS/cm.
  - *SS4 (Native silty clay, 2.43 – 3.05 m bgs):*
    - Conductivity reading of 751 µS/cm exceeds Table 3 SCS of 700 µS/cm;
    - Barium concentration of 426 µg/g exceeds Table 3 SCS 390 µg/g;
    - Cobalt concentration of 28.7 µg/g exceeds Table 3 SCS of 22 µg/g; and,
    - Vanadium concentration of 135 µg/g exceeds Table 3 SCS of 86 µg/g.
- **BH21-3 Exceedances**
  - *SS3 and Duplicate (Native silty clay, 1.22 – 1.83 m below basement slab):*
    - Barium concentration of 444 µg/g (303 µg/g in duplicate) exceeds Table 3 SCS 390 µg/g, however the average of the two is 373.5 µg/g which meets the SCS.
    - Cobalt concentration of 30.7 µg/g (25.2 µg/g in duplicate) exceeds Table 3 SCS of 22 µg/g, as does their average of 27.95 µg/g; and,
    - Vanadium concentration of 140 µg/g (113 µg/g in duplicate) exceeds Table 3 SCS of 86 µg/g, as does their average of 126.5 µg/g.
  - *SS5 (Native silty clay, 2.43 – 3.05 m below basement slab):*
    - Cobalt concentration of 25.6 µg/g (25.2 µg/g in duplicate) exceeds Table 3 SCS of 22 µg/g; and,
    - Vanadium concentration of 112µg/g exceeds Table 3 SCS of 86 µg/g.

Metals and inorganics exceedances in soil are presented in **Figure 3**.

6.5 Groundwater Quality

Groundwater was not encountered in any of the boreholes advanced, and therefore could not be tested.

6.6 Discussion

Based on the above exceedances, it appears that the fill of unknown quality APEC on Site has generally impacted parts of the Site, in addition, the native silty clay material contains several metals that exceed the MECP Table 3 SCS which differ from the exceedances noted in the overlying fill material. SAR and conductivity also appear to be elevated in all exterior samples but are generally lower in the samples from BH21-3 beneath the basement slab. The primary parameters and their potential sources are discussed below.

6.6.1 Sodium Adsorption Ratio and Conductivity

Based on discussions with the building tenants and property manager of 322-326 Waverly Street West, it was determined that a safety salt compound is applied to the asphalt and gravel portions of the Site for the safety of vehicular and pedestrian traffic under conditions of snow or ice during the winter months. These road salt materials are known to elevate SAR due to the sodium which they contain, and consequently raise conductivity.

The highest concentrations of conductivity and SAR were noted in BH21-1 and BH21-2 which are both located on the portion of the Site used as a parking lot. Lower concentrations were also noted in BH21-3, which aligns with this theory as this location is indoors and not directly salted.

Therefore, as per O. Reg. 153/04, Part IX: Site Condition Standards and Risk Assessments, subsection 49.1, SAR and conductivity are not deemed to exceed for the purposes of Part XV.1 of the Act.

6.6.2 Metals: Lead

Based on the presence of various building debris including bricks and carpet in the fill on Site, it is considered likely that the elevated concentration of lead in BH21-1 is affiliated with the fill of unknown quality APEC. Lead can often leach from building materials that were used in the earlier 20th century such as lead pipes and lead paint. Given the fill's general poor quality, these seem like likely sources of the contamination.

6.6.3 Metals: Barium, Cobalt, Chromium, and Vanadium

Barium, cobalt, chromium, and vanadium were not generally noted within the fill samples collected, with the exception of barium in the fill at BH21-1. As such it is considered unlikely that the fill of unknown quality APEC was responsible for the exceedances. Similarly, these metals are not generally associated with fuel oil which makes the fuel oil tank APEC an unlikely source as well. As no other APECs were identified at the Site, it is considered probable that these metals are naturally elevated in the native silty clay soils at the Site.

Native clay soils associated with post-glacial Champlain Sea marine deposits, such as those assumed to be on-site based on their composition, contain concentrations of select trace metals in excess of MECP background and Table 3 SCS. These elevated metals concentrations in Ottawa clays and the surrounding regions are a known and documented phenomenon. In a paper published in 2017 by Geofirma Engineering Ltd., Dillon Consulting Limited, and the City of Ottawa entitled, *Elevated Background Metals Concentrations in Champlain Sea Clay - Ottawa Region,* a compilation of data from existing technical studies conducted in the Ottawa region were used to support the definition of proposed geo regional background concentrations for eastern Ontario of barium, boron, chromium, cobalt, and vanadium. The report's proposed Geo-Regional Background values, compared to the Table 3 SCS and silty clay samples collected from the Site are shown in the table below:

Parameter	**Table 3 SCS**	**Proposed Georegional Background Values**	**Native Silty-Clay Samples**				
			BH21-1-SS5	**BH21-2-SS4**	**BH21-3-SS3**	**BH21-3-SS3 Duplicate**	**BH21-3-SS5**
Barium	**390**	**460**	376	*426*	*444*	303	309
Cobalt	**22**	**35.2**	*31.3*	*28.7*	*30.7*	*25.2*	*25.6*
Chromium	**160**	**145**	*170*	141	152	133	137
Vanadium	**123**	**123**	*139*	*135*	*140*	113	112

Notes:

Italics = Exceeds MECP Table 3 Site Condition Standards (Fine Grained)

Underlined = Exceeds the Proposed Georegional Background Values

As shown in the table above, by applying the geo-regional background values, cobalt and barium would not exceed these values. Chromium would only exceed in BH21-1-SS5, as the average of BH21-3-SS3 and its duplicate would be below the standard. Vanadium would only marginally exceed the proposed background values but would still exceed in most silty-clay samples. Overall, the concentrations of these metals noted in the silty-clay are generally well within the range of the proposed georegional background concentrations suggested in the report, which leads LRL to conclude that the elevated concentrations are most likely due to elevated background concentrations rather than a new or existing APEC at the Site.

A modified generic risk assessment (MGRA) could be conducted in order to confirm the presence/absence of risk from these elevated metals to the satisfaction of the City of Ottawa and MECP. An MGRA would review the maximum contaminant concentrations, pathways, and potential contaminant exposure levels. The risk assessment would provide risk management measures, as needed, to reduce risk of contaminant exposure and environmental impacts to human health and ecological receptors.

6.7 Quality Assurance and Quality Control

The quality assurance assessment of the field duplicate sample results was conducted according to the document entitled Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act, March 9, 2004 (amended in July 2009 and effective as of July 1, 2011) (“Analytical Protocol”).

To determine the precision of the analytical methods and field sampling procedures, blind duplicate samples were collected during soil and groundwater sampling. Precision is determined by the relative percent difference (“RPD”) between the duplicate and original samples and was calculated as follows:

$$RPD = \frac{|x_1 - x_2|}{x_m}$$

Where
x_1 initial sample results
x_2 duplicate sample results
x_m mean of x_1, x_2

RPDs are calculated only if the concentrations of a parameter are greater than the laboratory reported detection limit (“RDL”) in both the duplicate and original samples. In addition, lower precision in the RPD calculation is expected when concentrations of the analytes are less than ten (10) times the RDL. Therefore, RPDs were calculated for the original and duplicate soil samples only in cases where the measured concentrations of analytes in both samples were ten (10) times greater than the RDL. The following RPD limits were considered reasonable and are based on Analytical Protocol: RPDs in soil, 30% for metals and 30% for PHCs.

The calculated RPDs for metals in the original and duplicate soil sample were either too low to calculate or within the acceptable limit with the exception of barium which had an RPD of 38%. This is not considered to be an issue of concern, as the remaining RPDs were found to be within range, and this is only a marginal exceedance of the limit. RPDs could not be calculated for PHCs and BTEX in the original and duplicate sample, as these results were below the laboratory RDL or less that ten times greater than the RDL.

The quality of the analytical results is further supported by Paracel’s internal quality assurance program that includes laboratory blanks, spikes, surrogates and duplicate samples.

All certificates of analysis or analytical reports received pursuant to clause 47 (2) (b) of the regulation comply with subsection 47(3). A certificate of analysis or analytical report has been

received for each sample submitted for analysis and is provided in Appendix A(iii). The analytical laboratory did not qualify any of the analytical results.

Accordingly, the analytical data generated during the investigation are valid and representative and may be used in this Phase Two ESA without further qualification.

7 PHASE TWO CONCEPTUAL SITE MODEL

The Phase Two Conceptual Site Model (CSM) consists of a narrative description of the current condition of the Site and accompanying diagrams, cross-sections and Figures. The Phase Two conceptual site model is presented in the following sections and the Figures that comprise the Phase Two CSM include:

Figure 1 – Key Plan

Figure 2 – Site Plan

Figure 3 – Soil Exceedances: Metals and Inorganics

7.1 Current and Historical Site Use and Surrounding Land Use

Below is a summary of the current and past uses of 322 - 326 Waverly Street, Ottawa, Ontario:

Year	Name of Owner	Description of Property Use	Property Use	Source of Information
<1863	Crown	Unknown	Unknown	Land Title Search
1863 -2019	Various Individuals	Residential and/or Commercial	Residential and Office Space.	Aerial photographs, Fire Insurance Products and Land Title Search
2019 to Present	322-326 Waverly Street Developments	Commercial	Office Space and Parking Lot	Site Visit, Interview and Land Title Search

7.2 Potential Sources of Contamination

7.2.1 Potentially Contaminating Activities

Based on the results of the Phase One Environmental Site Assessment the following potentially contaminating activities (PCAs) as well as their location, contaminants of potential concern (COPC), potential media impacted, and likelihood to contribute to an on-site APEC were identified:

O. Reg 153/04 Schedule D PCA	Location of PCA	Description and Source Information	Contribution to an APEC
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	On-Site, within existing building	An AST was noted have been within the basement of the building in the 1975 property underwriters reports, and mentioned in the 2019 Phase I ESA report by Pinchin Inc.	The PCA is located on the Site and is therefore automatically considered to contribute to an on-site APEC.

O. Reg 153/04 Schedule D PCA	Location of PCA	Description and Source Information	Contribution to an APEC
PCA 30: Importation of Fill Material of Unknown Quality	On-Site, Along the western portion of the Site, within the vicinity of the former building footprint.	Area of former building matches existing grade. Visual evidence of cement and brick debris encountered.	The PCA is located on the Site and is therefore automatically considered to contribute to an on-site APEC.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	311 O'Conner Street, adjacent to the west of the Site	The retail fuel storage tanks database reported the presence of a retail fuel storage tank at the location.	While this PCA is directly adjacent to the Site, based on additional research it was found the contents of the tank was likely biodiesel. Further, the tank is recent (within the last 20 years) no spills have been reported and the Site is not believed to have operated as a commercial fuel dispenser. As such, the QP does not consider it likely that this PCA would contribute to an APEC on Site.
PCA 10: Commercial Autobody Shop	125 m southeast of the Site	Automotive service garage noted in the 1912 FIP.	Based on the PCAs position 125 m downgradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 10: Commercial Autobody Shop **PCA 28:** Gasoline and Associated Products Storage in Fixed Tanks.	394 Bank Street, 220 m west of Site	Gasoline service station with two USTs noted in the 1922 through 1963 FIPs. Oiling garage noted on Site as well in 1963.	Based on the PCAs position 220 m away and cross-gradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	448 Bank Street, 240 m west of the Site	A gasoline service station with four USTs was noted in the 1948 and 1963 FIP.	Based on the PCAs position 240 m away and cross-gradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 10: Commercial Autobody Shop **PCA 28:** Gasoline and Associated Products Storage in Fixed Tanks.	7 Florence Street, 230 m west of the Site	A garage and repair facility with one UST was identified in the 1948 and 1963 FIP.	Based on the PCAs position 230 m away and cross-gradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	366 Waverly Street, 100 m west of the Site	Ontario spills reported 180 L of furnace oil was spilled from a tank at a private residence.	Based on the PCAs position 100 m away and cross-gradient of the Site, it is not considered likely to contribute to an APEC on the Site.
PCA 28: Gasoline and Associated Products Storage in Fixed Tanks.	300 Gilmour Street, 220 m	Ontario spills database reported an unspecified amount of	Based on the PCAs position 220 m away and cross-gradient of the Site, it is not considered

O. Reg 153/04 Schedule D PCA	Location of PCA	Description and Source Information	Contribution to an APEC
	northeast of the Site	furnace oil was leaked from a UST.	likely to contribute to an APEC on the Site.
PCA 19: Electronic and Computer Equipment Manufacturing	384 Bank Street, 240 m west of the Site	Scott's Manufacturing Directory indicated that AssayNet Canada Inc. conducted semiconductor and other electronic component manufacturing on-Site.	Based on the PCAs position 240 m away and cross-gradient of the Site, it is not considered likely to contribute to an APEC on the Site.

7.2.2 Areas of Potential Environmental Concern

Based on the assessment of the PCAs identified within the Phase One Study Area, the following Areas of Potential Environmental Concern (APECs), their contributing PCA, the associated contaminants of potential concern (COPC), and the potentially contaminated media, are detailed in the table below:

APEC	Location	Comments	Contaminants of Potential Concern	Media Potentially Impacted	Level of Risk
Fill of unknown quality	On-Site, Along the western portion of the Site, within the vicinity of the former building footprint.	Area of former building matches existing grade. Visual evidence of cement and brick debris encountered.	VOC, PHC, Metals	Soil	Moderate to High
Heating Oil Tank	On-Site, within existing building.	An AST was noted have been within the basement of the building in the 1975 property underwriters reports, and mentioned in the 2019 Phase I ESA report by Pinchin Inc.	VOC, PHC	Soil and Groundwater	Moderate to High

Notes: PEC – Potential Environmental Concern
VOC – Volatile Organic Compounds
PHC – Petroleum Hydrocarbons

Risk levels: Low – Unlikely potential for environmental impacts
Moderate – Some potential for environmental impacts
High – Definite potential for environmental impacts

7.2.3 Subsurface Structures and Utilities and Potential Migration of COCs

Underground utility drawings available for the Phase Two Property indicate a gas line running from Waverly Street West into the northwest corner of the building on-Site, and a communications cable running east-west beneath the front yard with a connection running into the east side of the building. The presence of subsurface utilities and structures at the Site could act as preferential pathways promoting the migration of COCs, however, as groundwater was not encountered within the 3.05 m bgs drilled during the Phase Two ESA, or the 7.67 m bgs drilled during the 2021 Geotechnical Investigation, it is not likely that groundwater could be influenced by utilities.

7.3 Physical Setting

7.3.1 Stratigraphy

During the Phase Two ESA, boreholes were advanced to a maximum depth of 3.05 m bgs or 3.05 m plus approximately 1.98 m from the top of the basement slab to natural ground surface for a total of 5.03 m bgs in the case of the basement borehole, BH21-3. During the May 2021 Geotechnical Investigation, boreholes were advanced up to 7.67 m bgs.

Subsurface conditions across the exterior portion of the Site generally included a layer of sand and gravel fill with some boulders extending from surface to 1.45 to 1.82 m bgs. Two geotechnical boreholes along the south side of the property also had a 38-50 mm asphalt layer encountered at surface which was overlying the fill. Underlying the fill material was a layer of native grey silty clay silt which extended from the bottom of the fill layer to beyond 3.05 and 7.67 m bgs where the boreholes were terminated;

BH21-3 was slightly different as it was advanced through the basement slab which was located at approximately 1.98 m bgs. As such, the hole was advanced from 1.98 m bgs to approximately 5.03 m bgs, within the the native grey silty clay layer.

Given that bedrock was not encountered, the average thickness of overburden at the Site is considered to be greater than 2 m, the Site is not considered to be a shallow soil property as defined by O. Reg 153/04 (as amended).

7.3.2 Hydrogeological Characteristics

The regional groundwater flow direction is expected to be towards the Ottawa River, located approximately 1.3 km to the northwest of the Site. However, due to the number of high-rise buildings with underground parking facilities dewatered via sump pits, groundwater flow in the downtown area can be uncertain. Groundwater was not encountered during the Phase Two ESA or the Geotechnical Investigation and is therefore assumed to be deeper than 7.67 m bgs. Based on the fine-textured native soil, the QP does not consider it likely that the metals contamination in soil would affect the groundwater.

7.4 Shallow Soil Property or Water Body (as per section 43.1 of O.Reg. 153/04)

Bedrock was not encountered during the Phase Two ESA or Geotechnical Investigation at depths between which extended to 3.05 and 7.67 m bgs respectively. As such the Site is not considered a shallow soil property.

7.5 Potable Water Wells

No potable water wells are located on the Site or within 250 m of the Site, based on the results of the Phase One ESA. As such, the Site is not considered to be a potable water site.

7.6 Environmentally Sensitive Areas (as per section 41 of O.Reg. 153/04)

No areas of natural and scientific interest (ANSI) are known to be located on the Site. Available information indicated that the Sites not considered to be an environmentally sensitive area.

pH of both surface and subsurface soil samples submitted were generally between 7.5 and 8.0 which is within the 5≤pH≤9 limits for surface soil, and 5≤pH≤11 for subsurface soil. An exception was noted in BH21-1 between 0.61 and 1.83 m bgs where pH was recorded as 11.45, however this is delineated vertically by a sample collected from 2.43 to 3.05 with a pH of 7.5. Overall, the single exceedance of the pH standard is not considered to be representative of Site conditions based on the six (6) other samples analysed. The pH exceedance in BH21-1 will be treated as a

contaminant, otherwise the Site is not considered to be environmentally sensitive based on soil pH.

7.7 Applicable Site Condition Standards

The analytical results of the samples collected for this Phase Two ESA were compared to the Table 3 generic site condition standards (residential property use, medium-fine soil texture) presented in the MECP "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", dated April 15, 2011. The applicable site condition standards were selected based on the following rationale:

- The Site and all other properties located, in whole or in part, within 250 metres of the Site are supplied by the City of Ottawa municipal drinking water system. No potable water domestic well records were discovered within 250 m of the Site;
- The Site is not located in an area designated in a municipal official plan as a well-head protection area or other designation identified by the municipality for the protection of ground water;
- Native subsurface material encountered was silty clay. Based on laboratory grain size analysis completed as part of the Geotechnical Investigation and included in **Appendix B** was determined to be of medium-fine texture;
- The closest water body is the Ottawa River, located 1.3 km northwest of the Phase Two Property;
- There are no features on the Phase Two Property that would meet the conditions of an environmentally sensitive site, as described in Section 41;
- The average pH of surface soil is 5≤pH≤9 and the pH of sub-surface soil meets the requirement that 5≤pH≤11;
- The intended land use for the Phase Two Property is residential;
- The overburden thickness is greater than 2 metres over more than one-third of the Phase Two Property;
- Ground water was not encountered during the investigation.

7.8 Findings of the Phase Two ESA (LRL, 2021) with Respect to APECs

To address the APEC identified at the Site, soil sampling and analysis of potential COCs was completed as part of this Phase Two ESA. MECP Table 3 (medium-fine) Standards (April 15, 2011) were used for comparison of the soil and groundwater results. A summary of the findings of the Phase Two ESA with respect to the APECs identified by the Phase One ESA (LRL, 2021) is provided in the table below:

APEC #	Area of Potential Environmental Concern	Potentially Contaminating Activity	Contaminants of Potential Concern	Soil Exceedances of 2011 MECP Table 3 SCS
PEC 1	Area of former building matches existing grade. Visual evidence of cement and brick debris encountered indicating filling.	**PCA 30:** Importation of Fill of Unknown Quality	PHCs, VOCs (BTEX), metals, and inorganics	*BH21-1:* 0.61 – 1.83 m bgs (conductivity, barium, lead, pH) 2.43 – 3.05 m bgs (SAR, conductivity, chromium, cobalt, vanadium) *BH21-2:* 1.21 – 1.37 m bgs (Conductivity) 2.43 – 3.05 m bgs (Conductivity, barium, cobalt, vanadium) *BH21-3:* 1.22 – 1.83 m below basement slab (Barium, cobalt, vanadium) 2.43 – 3.05 m below basement slab (Cobalt, vanadium)
PEC 2	Former Heating Oil Tank	**PCA 28:** Gasoline and Associated Products Storage in Fixed Tanks	PHCs and VOCs (BTEX)	None

As summarized in the above table, the results of this Phase Two ESA indicate both soil is contaminated with COPCs associated with the fill APEC on Site.

7.9 Meteorological and Climatic Considerations

Seasonal fluctuation in water levels on the Site should be expected. Given the limited number of monitoring events, seasonal trends could not be identified, however shallow groundwater water levels are typically highest following the spring recharge and decline throughout the summer and fall months into the winter.

Seeing as the drilling completed as part of the Geotechnical Investigation was done in April 2021 and groundwater was not encountered, it is assumed that even during the spring recharge the groundwater table is located below 7.67 m bgs.

7.10 Soil Vapour Intrusion Pathways

None of the contaminants identified at the Site at concentrations exceeding the Table 3 SCS standards are considered as volatile. Based on this and the water table lower than 7.67 m bgs, vapour intrusion is not considered a concern for the Site.

7.10.1 Horizontal Distribution

7.10.1.1 Soil

- BH21-1: pH and lead exceedances in the upper fill as well as SAR exceedances in the native silty clay are partially horizontally delineated to the south and east by samples with concentrations below the Table 3 SCS in BH21-2 and BH21-3 but are undelineated to the north or west. Cobalt, chromium, and vanadium were measured in the native silty clay at levels exceeding the Table 3 SCS at all locations, as were conductivity and barium with the exception of partial delineation by BH21-3 to the east;
- BH21-2: The fill at BH21-2 is generally clean with the exception of elevated conductivity, likely due to road safety salt use in the parking lot, the impacts of which are noted in all the exterior areas of the Site. Barium in the native silty clay exceeding the Table 3 SCS is partially delineated by BH21-3 to the northeast, and by BH21-1-SS5 to the north, but with no delineation to the east, south, or west. Finally cobalt and vanadium in the native silty clay exceed at all locations analysed at the Site and are undelineated; and,
- BH21-3: Chromium exceedances to the Table 3 SCS are partially delineated by BH21-2 to the south, but are otherwise undelineated. As mentioned above, cobalt and vanadium in the native silty clay exceed at all locations analysed at the Site and are undelineated.

7.10.2 Vertical Distribution

7.10.2.1 Soil

- BH21-1: pH, barium, and lead exceedances are delineated by the surface and concentrations below the Table 3 SCS in the native silty clay sample underlying it. SAR, chromium, cobalt, and vanadium exceeding Table 3 SCS appear to be vertically delineated to only the native silty clay unit, however it is unclear how deeply it extends. Elevated conductivity is present in both units and is therefore undelineated;
- BH21-2: Barium, chromium, cobalt, and vanadium exceeding Table 3 SCS appear to be vertically delineated to only the native silty clay unit, and are not present at elevated concentrations in the fill above, however it is unclear how deeply they extend. Elevated conductivity is present in both units and is therefore undelineated; and,
- BH21-3: Chromium exceeding Table 3 SCS appears to be vertically delineated by the surface and upper native silty clay unit, as it is not present at elevated concentrations in the lower silty clay. Cobalt exceeding Table 3 SCS is delineated above by lower concentrations in the upper silty clay sample, but undelineated below. Elevated vanadium is present in both samples at this location and is therefore undelineated.

8 CONCLUSIONS OF THE PHASE TWO ENVIRONMENTAL SITE ASSESSMENT

Based on our Site visit, results of soil and groundwater sampling and laboratory analytical programs, LRL offers the following conclusions regarding environmental conditions of the subject Site:

- The Site is rectangular shaped with an area of 600 m². The majority of the eastern portion of the Site is developed with an existing two and a half (2 ½) storey building. The remainder of the property is gravel, and/or weathered asphalt parking and circulation. A former development was present at the western portion of the Site, now occupied by parking spaces, from at least the late 1880's through to between the late 1960's to mid 1970's, when it was demolished. Topography is generally flat.

- The building is heated with natural gas, supplied with municipal water and is connected to the municipal sanitary sewer system.
- Areas of potential environmental concerns identified included:

# on Fig	APEC	Location of PCA
PEC 1	**PCA 30:** Importation of Fill of Unknown Quality	West side of the Site in the former building foot print.
PEC 2	**PCA 28:** Gasoline and Associated Products Storage in Fixed Tanks	Basement boiler room in the northwest corner of the building on Site.

- Regulatory requirements for assessing environmental conditions of a site are established by Ontario Regulation 153/04 – Records of Site Conditions, Part XV.1 of the Environmental Protection Act (O. Reg. 153/04). Site condition standards are set out in the MECP's "*Soil, Ground Water and Sediment Standards for Use Under Part IV.1 of the Environmental Protection Act*", April 15, 2011, as amended. The applicable SCS used was the Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition, residential property use and medium-fine textured soils.
- The investigation involved advancing three (3) boreholes across the Site at strategic locations based on areas of potential environmental concern. None of the boreholes were completed as monitoring wells as groundwater was not encountered;
- Subsurface conditions across the exterior portion of the Site generally included a layer of sand and gravel fill with some boulders extending from surface to 1.45 to 1.82 m bgs. Two geotechnical boreholes along the south side of the property also had a 38-50 mm asphalt layer encountered at surface which was overlying the fill. Underlying the fill material was a layer of grey silty clay or clayey silt which extended from the bottom of the fill layer to 3.05 or 7.67 m bgs where the boreholes were terminated;
- In the soil, exceedances to the applicable standards were detected in BH21-1, BH21-2, and BH21-3:
    - BH21-1 Exceedances:
        i. 0.61 – 1.83 m bgs: conductivity, barium, lead, and pH.
        ii. 2.43 – 3.05 m bgs: SAR, conductivity, chromium, cobalt, and vanadium.
    - BH21-2 Exceedances:
        i. 1.21 – 1.37 m bgs: Conductivity
        ii. 2.43 – 3.05 m bgs: Conductivity, barium, cobalt, and vanadium.
    - BH21-3 Exceedances:
        i. 1.22 – 1.83 m below basement slab: Barium, cobalt, and vanadium.
        ii. 2.43 – 3.05 m below basement slab: Cobalt and vanadium.

Based on our observations during drilling activities, along with screening of samples and laboratory analysis, there is evidence of SAR and conductivity, as well as various metals including: vanadium, chromium, cobalt, lead, and/or barium impacts to the soil across the Site. Groundwater was not encountered at the Site, and due to the depth of the water table, low mobility of metals contamination in soil, and the low permeability of the native silty clay unit present beneath the Site, is not considered likely to be impacted by any of the APECs or their impacts that were identified.

Elevated SAR and conductivity are understood to be related to the application of road salt to the parking lot for pedestrian and vehicular safety. As such, they are not considered to be exceedances under the regulation.

The horizontal and vertical extent of the metals contaminated soil has not been fully delineated, as such an RSC with the Ontario Ministry of the Environment cannot yet be filed. It is LRL's interpretation that the vanadium, cobalt, chromium, and barium exceedances (with the exception of barium in MW21-1-SS2 + SS3 (composite)) are likely due to elevated background concentrations. It is understood that the client plans to redevelop the Site, which would include excavation and removal of most or all of the contaminated material noted in this report. Given the small size of the site, and difficulty accessing it to excavate while the Site is still in use, LRL offers the following recommendations:

- The client seek a phased conditional City approval for the re-zoning and development, conditional upon the excavation and removal of contaminated materials from the Site, followed by confirmation sampling and the submission for an Record of Site Condition for the Site;
- A modified generic risk assessment (MGRA) could be conducted in order to assess the risk posed by the elevated barium, chromium, cobalt, and vanadium metals, and to support the interpretation of elevated background metals concentrations, or recommend mitigation strategies that could allow the material to remain at Site. An MGRA would review the maximum contaminant concentrations, pathways, and potential contaminant exposure levels. The risk assessment would provide risk management measures, as needed, to reduce risk of contaminant exposure and environmental impacts to human health and ecological receptors; and/or,
- The MECP may be contacted in order to receive an acknowledgement in order to refer to the observed concentrations of barium, cobalt, chromium, and vanadium in the native silty-clay as reflective of background conditions based on the evidence provided within this Phase Two ESA report, and confirmation samples collected at the time of excavation.

Due to the estimated age of the buildings there may be the presence of designated substances such as asbestos containing material (ACM) or lead-based paint in concealed spaces such as in the ceiling or walls. If construction or demolition activities is to occur on the building, it is recommended that sampling be performed to determine whether the presence of special attention items such as ACM are present so they can be addressed accordingly to ensure that the contractors or building occupants do not come into contact with these materials.

9 LIMITATIONS AND USE OF REPORT

Results of this Phase Two ESA should not be considered a warranty that the subject property is free from any and all contaminants from former and current practices, other than those noted in this report, nor that all compliance issues have been addressed.

Findings contained in this report are based on data and information collected during the Phase Two ESA of the subject property conducted by LRL Associates Ltd. Conclusions and recommendations are based solely on-site conditions encountered at the time of our site visit and fieldwork on July 15th, 2021, supplemented by historical information and data obtained as described in this report. No assurance is made regarding changes in conditions subsequent to the time of this investigation. If additional information is discovered or obtained, LRL Associates Ltd. should be requested to re-evaluate the conclusions presented in this report and to provide amendments as required.

In evaluating the subject property, LRL Associates Ltd. has relied in good faith on information provided by individuals as noted in this report. We assume that the information provided is factual and accurate. We accept no responsibility for any deficiencies, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretation or fraudulent acts of the persons contacted.

This report is intended for the sole use of Serco Realty Ltd. and their authorized agents. LRL Associates Ltd. will not be responsible for any use of the information contained within this report by any third party.

In addition, LRL Associates Ltd. will not be responsible for the real or perceived decrease in the property value, its saleability or ability to gain financing, through the reporting of factual information.

Yours truly,
LRL Associates Ltd.

Alex Wood, P. Eng.
Environmental Engineer

W:\FILES 2020\200139\04 Environmental\02 PhaseIIESA\05 Reports\200139.REPORT Phase I & II ESA 353-357 Gardner Street, Ottawa, Ontario.2020.06.30.R0.docx

10 REFERENCES

Canadian Standards Association, Phase II Environmental Site Assessment CAN/CSA-Z769-00, March 2000 (R2013).

Canadian Standards Association, Z768-01 Phase I Environmental Site Assessment, November 2001 (R2016).

City of Ottawa Interactive Map accessed through: http://maps.ottawa.ca/geoottawa/

Harrison, J.E., 1976, Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, Map 1508A, Scale 1:125,000.

Ministry of Environment, Conservations and Parks, Ontario Regulation 153/04: Records of Site Condition – Part XV.1 of the Environmental Protection Act, as amended.

Ministry of Environment and Energy, Coal Tar Site Investigations 1986 – 1995, January 1997.

Ministry of the Environment, Guide for Completing Phase I Environmental Site Assessments Under Ontario Regulation 153/04, June 2011.

Ontario Ministry of the Environment, *Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario*, 1996.

Ontario Ministry of the Environment, *Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, April 15, 2011.

Ontario Regulation 903, made under the Water Resources Act of the Environmental Protection Act, *Wells*, R.R.O. 1990.

Ontario Well Records Map accessed through: https://www.ontario.ca/environment-and-energy/map-well-records

St-Onge, D.A., (compilation), 2009, Surficial Geology, Lower Ottawa Valley, Ontario-Quebec, Geological Survey of Canada, Map 2140A, Scale 1:125,000.

LRL Engineering, Geotechnical Investigation: Proposed 6 Storey Residential Complex, 322 Waverly Street, Ottawa, Ontario, prepared for Serco Realty Group, dated May 2021.

FIGURES

LRL
ENGINEERING | INGÉNIERIE

5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

PROJECT

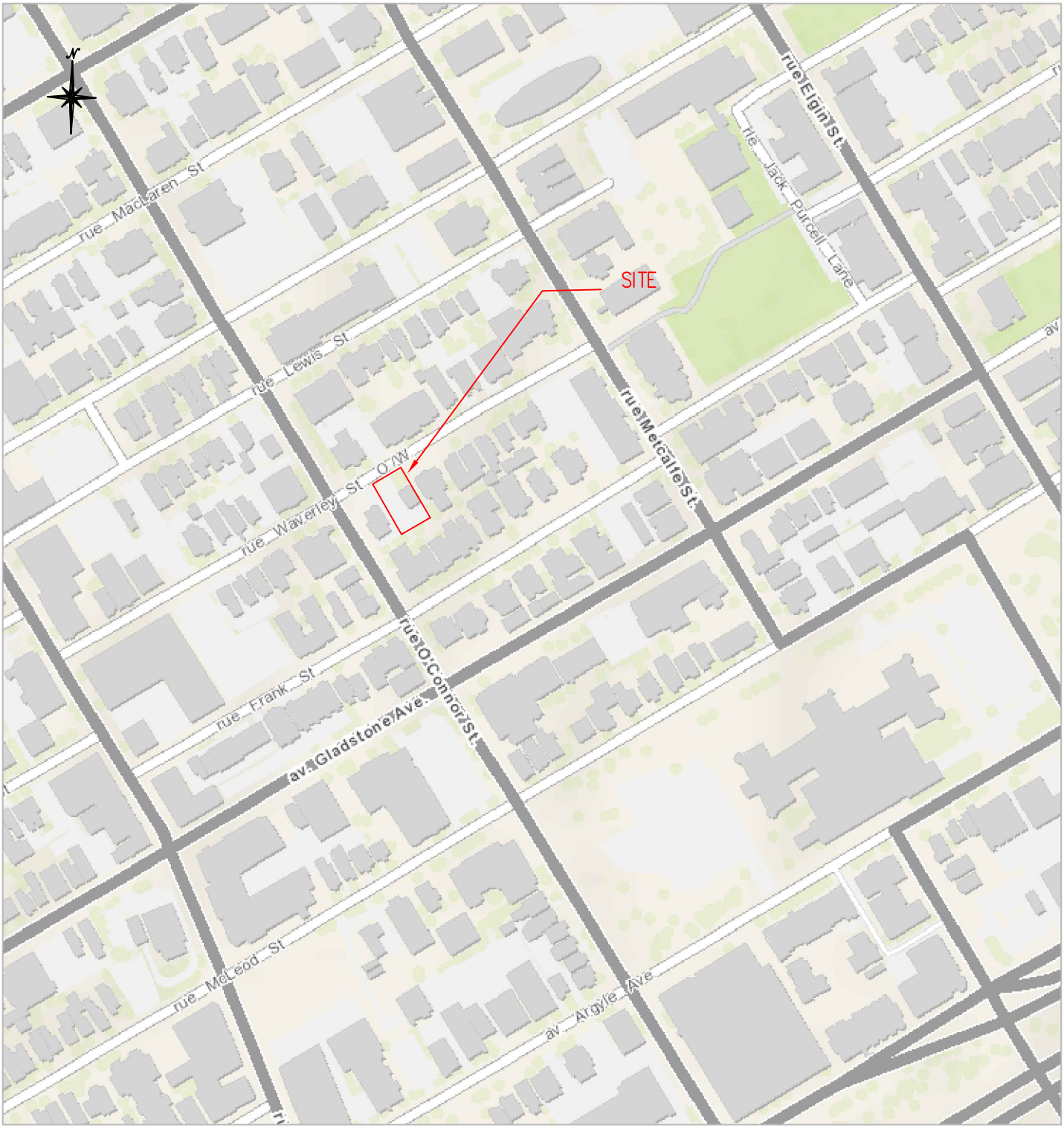
PHASE TWO
ENVIRONMENTAL SITE ASSESSMENT
322-326 WAVERLEY STREET
OTTAWA, ONTARIO

DRAWING TITLE

SITE LOCATION
(NOT TO SCALE)
SOURCE: geoOttawa

CLIENT	DATE	PROJECT
SERCO REALTY GROUP	JULY 2021	190523

FIGURE 1



LRL
ENGINEERING | INGÉNIERIE

5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

PROJECT

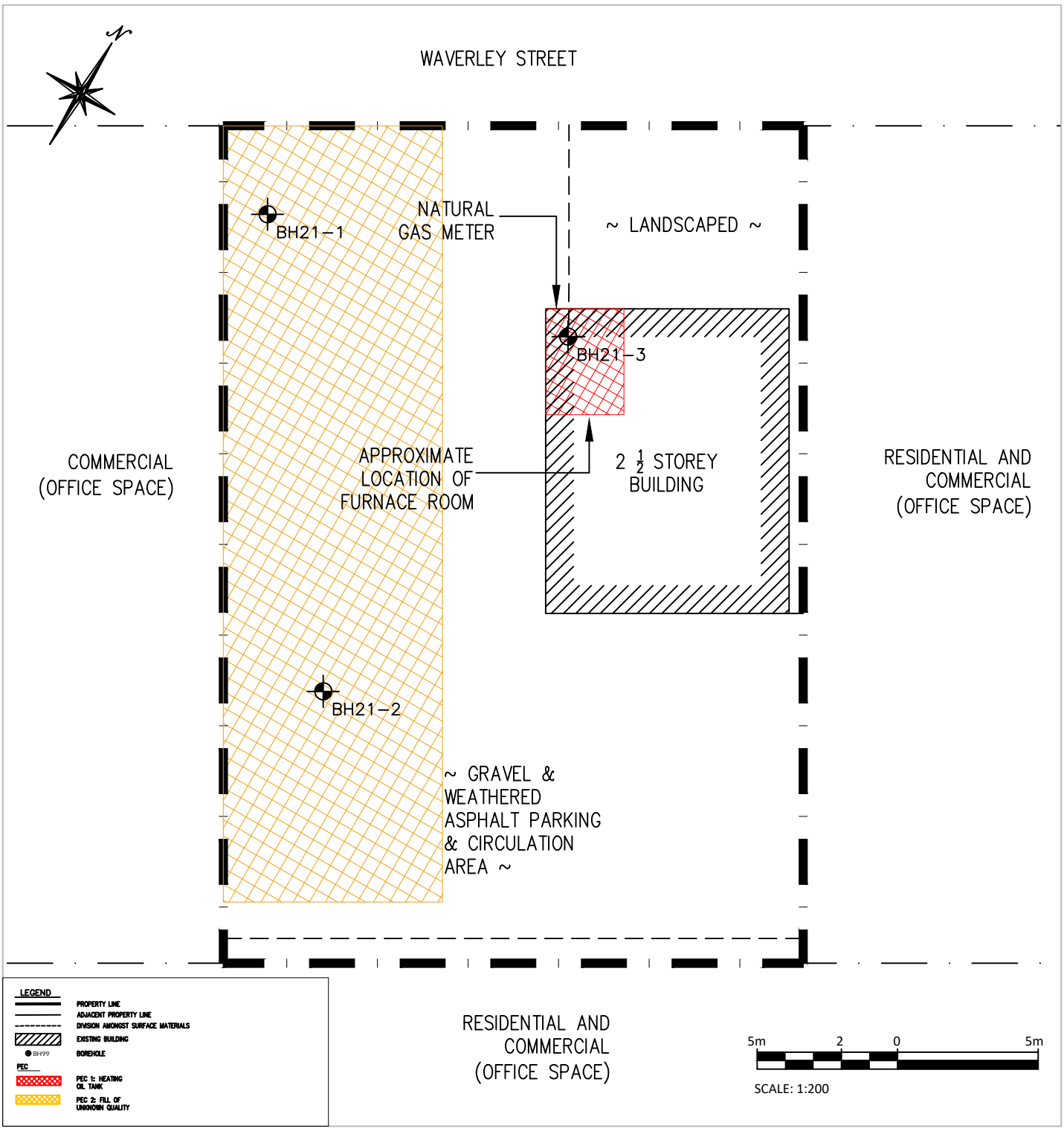
PHASE TWO
ENVIRONMENTAL SITE ASSESSMENT
322-326 WAVERLEY STREET
OTTAWA, ONTARIO

DRAWING TITLE

SITE PLAN

CLIENT	DATE	PROJECT
SERCO REALTY GROUP	JULY 2021	190523

FIGURE 2



LRJ
ENGINEERING | INGÉNIERIE
5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

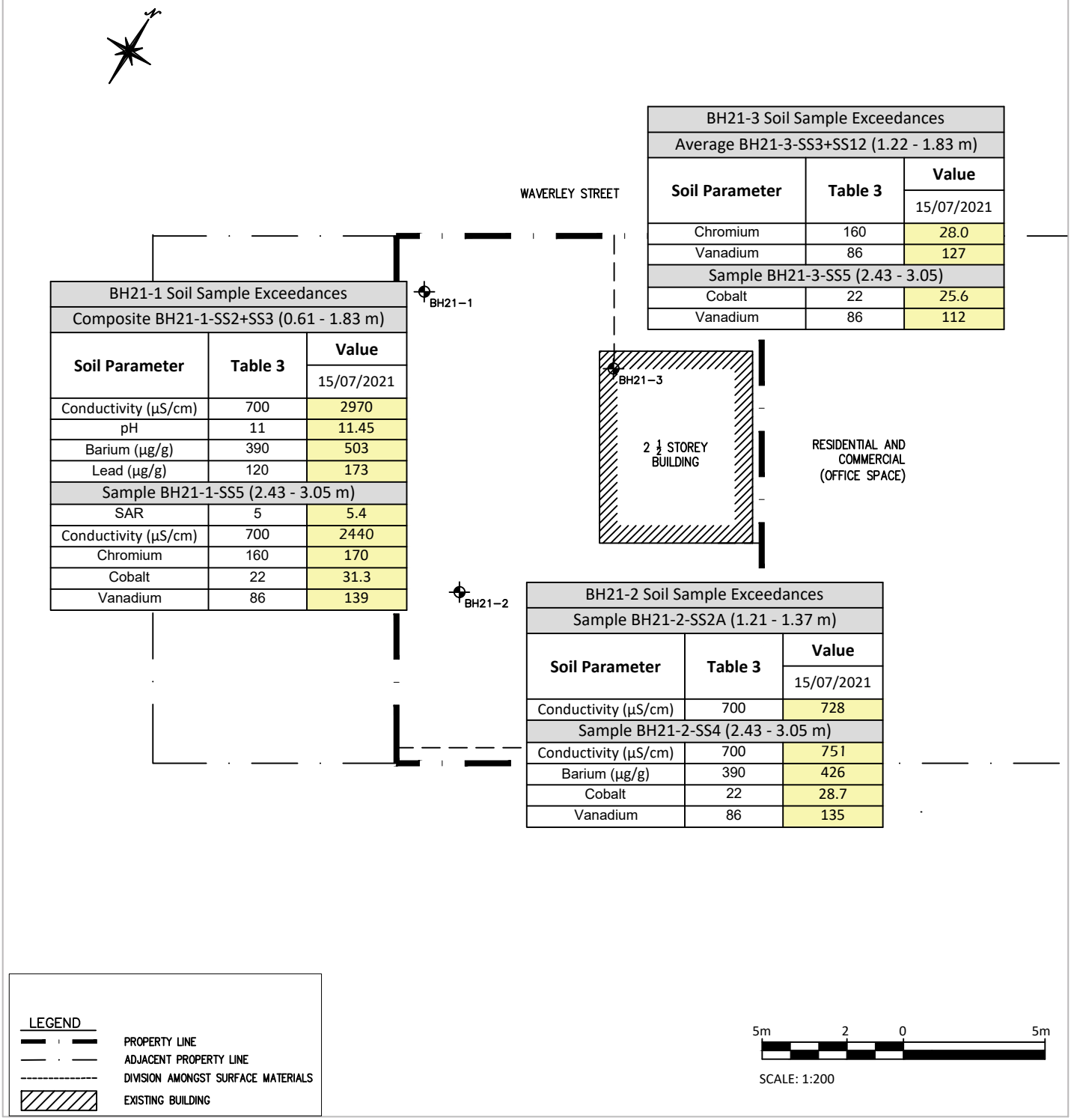
PROJECT

PHASE TWO
ENVIRONMENTAL SITE ASSESSMENT
322-326 WAVERLEY STREET
OTTAWA, ONTARIO

DRAWING TITLE

SOIL EXCEEDANCES: METALS and ORGANICS

CLIENT	DATE	PROJECT	
SERCO REALTY GROUP	JULY 2021	190523	FIGURE 3



BH21-1 Soil Sample Exceedances

Composite BH21-1-SS2+SS3 (0.61 - 1.83 m)

Soil Parameter	Table 3	Value 15/07/2021
Conductivity (µS/cm)	700	2970
pH	11	11.45
Barium (µg/g)	390	503
Lead (µg/g)	120	173
Sample BH21-1-SS5 (2.43 - 3.05 m)		
SAR	5	5.4
Conductivity (µS/cm)	700	2440
Chromium	160	170
Cobalt	22	31.3
Vanadium	86	139

BH21-3 Soil Sample Exceedances

Average BH21-3-SS3+SS12 (1.22 - 1.83 m)

Soil Parameter	Table 3	Value 15/07/2021
Chromium	160	28.0
Vanadium	86	127
Sample BH21-3-SS5 (2.43 - 3.05)		
Cobalt	22	25.6
Vanadium	86	112

BH21-2 Soil Sample Exceedances

Sample BH21-2-SS2A (1.21 - 1.37 m)

Soil Parameter	Table 3	Value 15/07/2021
Conductivity (µS/cm)	700	728
Sample BH21-2-SS4 (2.43 - 3.05 m)		
Conductivity (µS/cm)	700	751
Barium (µg/g)	390	426
Cobalt	22	28.7
Vanadium	86	135

TABLES

Table 1
Summary of Soil PHC, BTEX, Metals and Inorganics Analysis
Phase Two Environmental Site Assessment
322-326 Waverly Street West, Ottawa, Ontario
LRL File: 190523

Parameter	Units	MDL	O. Reg. 153/04[1] Table 3[2] Residential Property Use Coarse textured soil	Sample BH21-1-SS3 + BH21-1-SS2 (Composite)[6]	BH21-1-SS5	BH21-2-SS2A	BH21-2-SS4	BH21-3-SS3	BH21-3-SS12 (Duplicate of BH21-3-SS3)	BH21-3-SS5
Sample Date (d/m/y)			--	15/07/2021	15/07/2021	15/07/2021	15/07/2021	15/07/2021	15/07/2021	15/07/2021
Depth	m		--	0.61 - 1.83	2.43 - 3.05	1.21 - 1.37	2.43 - 3.05	1.22 - 1.83		2.43 - 3.05
CSV Readings[3]	ppm	5	--	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Physical Characteristics										
% Solids	% by Wt.	0.1	--	90.2	57.4	87.9	57.5	56.6	56.5	54.9
General Inorganics										
SAR	N/A	0.01	5	4.17	**5.4**	4.64	2.88	2.51	1.35	2.05
Conductivity	uS/cm	5	700	**2970**	**2440**	**728**	**751**	493	549	595
Cyanide, free	ug/g dry	0.03	0.051	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
pH	pH Units	0.05	5 - 9[4]/11[5]	**11.45**	7.50	7.93	7.42	7.90	7.87	8.34
Metals										
Antimony	ug/g dry	1.0	7.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Arsenic	ug/g dry	1.0	18	5.7	3.4	1.6	3.2	5.8	3.1	3.6
Barium	ug/g dry	1.0	390	**503**	376	41.2	**426**	**444**	303	309
Beryllium	ug/g dry	0.5	5	<0.5	1.0	<0.5	1.0	1.0	1.0	1.0
Boron, Hot Water Soluble	ug/g dry	0.5	1.5[7]	<0.5	1.5	<0.5	0.9	1.0	1.1	2.2[8]
Boron	ug/g dry	5.0	120	9.0	13.1	<5.0	9.4	8.8	13.9	17.7
Cadmium	ug/g dry	0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (VI)	ug/g dry	0.2	10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	ug/g dry	5.0	160	25.9	**170**	12.1	141	152	133	137
Cobalt	ug/g dry	1.0	22	7.0	**31.3**	2.5	**28.7**	**30.7**	**25.2**	**25.6**
Copper	ug/g dry	5.0	180	27.9	71.5	5.6	62.4	63.9	55.1	56.1
Lead	ug/g dry	1.0	120	**173**	10.9	43.5	12.2	7.4	7.8	8.1
Mercury	ug/g dry	0.1	1.8	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	ug/g dry	1.0	6.9	1.7	1.0	<1.0	1.2	1.2	<1.0	<1.0
Nickel	ug/g dry	5.0	130	18.8	93.8	6.4	78.8	83.9	71.8	74.7
Selenium	ug/g dry	1.0	2.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver	ug/g dry	0.3	25	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Thallium	ug/g dry	1.0	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Uranium	ug/g dry	1.0	23	<1.0	1.1	<1.0	1.0	1.1	1.2	2.1
Vanadium	ug/g dry	10.0	86	30.4	**139**	17.1	**135**	**140**	**113**	**112**
Zinc	ug/g dry	20.0	340	128	159	32.8	159	160	129	128
Volatiles										
Benzene	ug/g dry	0.02	0.17	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	ug/g dry	0.05	15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	ug/g dry	0.05	6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m/p-Xylene	ug/g dry	0.05	--	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o-Xylene	ug/g dry	0.05	--	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, total	ug/g dry	0.05	25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hydrocarbons										
F1 PHCs (C6-C10)	ug/g dry	7	65	<7	<7	<7	<7	<7	<7	<7
F2 PHCs (C10-C16)	ug/g dry	4	150	141	<4	<4	<4	<4	<4	<4
F3 PHCs (C16-C34)	ug/g dry	8	1300	476	<8	16	<8	<8	<8	<8
F4 PHCs (C34-C50)	ug/g dry	6	5600	85	<6	14	<6	<6	<6	<6

NOTES:

(1) MOE's *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011*
(2) Table 3: Full depth generic site condition standards in a non-potable groundwater condition.
(3) Combustible soil vapour concentrations measured with a MiniRAE 2000 PID
(4) Criteria for surface soils (<1.5 m below ground surface).
(5) Criteria for subsurface soils (>1.5 m below ground surface).
(6) Samples composited due to poor recovery resulting in insufficent sample media for both samples.
(7) The boron standards are for hot water soluble extract for all surface soils. For subsurface soils the standards are for total boron (mixed strong acid digest), since plant protection for soils below the root zone is not a significant concern.
(8) Exceeds the hot water soluble boron standard, but is located >1.5 m bgs and therefore falls under the total boron standard only.

MDL Method Detection Limit
-- No Value/Not Analysed
PHC Petroleum Hydrocarbon

APPENDIX A

Borehole Logs

Borehole Log: BH21-1

Project No.: 190523 **Project:** Contamination Delineation

Client: Mr.Gas Properties Ltd. **Location:** 322 Waverly Street, Ottawa, ON

Date: July 15 2021 **Field Personnel:** DC

Driller: CCC **Drilling Equipment:** CME 45B **Drilling Method:** HSA

Depth (ft / m)	Soil Description	Elev./Depth (m)	Lithology	Type	Sample Number	N or RQD (%)	Recovery (%)	Lab Analysis	Combustible Soil Vapours (ppm / % LEL)	Monitoring Well Details
0.0 / 0.0	Ground Surface									
0.0 – 3.0 / 0.0 – 1.0	Fill, mix of sand and gravel, brown, dry, loose. Fine sand, red, dry found throughout sample from 1.20-1.82 m bgs.	0.00			SS1	30	33		0.1	
					SS2	9	17	PHCs, BTEX and Metals & Inorganics	<0.1	
					SS3	9	21	PHCs, BTEX and Metals & Inorganics	<0.1	
6.0 – 9.0 / 2.0 – 3.0	Silty clay, grey, some oxidation throughout, dry.	1.82			SS4	4	88		<0.1	
					SS5	2	100	PHCs, BTEX and Metals & Inorganics	<0.1	
10.0 / 3.0	End of Borehole	3.00								

Easting: 445860 **Northing:** 5029174

Site Datum: TBM - Top of concrete west pier at Ottawa Vein Centre sign (100.00 m)

Groundsurface Elevation: 99.87 m **Top of Riser Elev.:** n/a

Hole Diameter: 200 mm **Monitoring Well Diameter:** n/a

NOTES

Borehole Log: BH21-2

Project No.: 190523 **Project:** Contamination Delineation

Client: Mr.Gas Properties Ltd. **Location:** 322 Waverly Street, Ottawa, ON

Date: July 15 2021 **Field Personnel:** DC

Driller: CCC **Drilling Equipment:** CME 45B **Drilling Method:** HSA

Depth (ft / m)	Soil Description	Elev./Depth (m)	Lithology	Type	Sample Number	N or RQD (%)	Recovery (%)	Lab Analysis	Combustible Soil Vapours (ppm / % LEL)	Monitoring Well Details
0.0 / 0.0	Ground Surface									
0.0 – 3.0 / 0.0 – 1.0	Fill, mix of sand and gravel, dark brown transitioning to grey at 1.35 m bgs, dry. Hit large rock at 0.9 m bgs, augered through the rock.	0.00			SS1	30	33	PHCs, BTEX and Metals & Inorganics	0.2	
						9	21		<0.1	
3.0 – 4.0 / 1.0	Hit large rock at 0.9 m bgs, augered through the rock.	0.90				4	88			
4.0 – 5.0 / 1.0 – 2.0	Fill, mix of sand and gravel, dark gey, dry. 30 mm thick layer of carpet from 1.50 m bgs.	1.20			SS2A	14	60	PHCs, BTEX and Metals & Inorganics	<0.1	
5.0 – 6.0 / 1.5 – 2.0	Silty, clay, grey, dry.	1.50			SS2B	2	75			
6.0 – 7.0 / 2.0					SS3	4	100		<0.1	
8.0 – 9.0 / 2.0 – 3.0					SS4	2	100	PHCs, BTEX and Metals & Inorganics	<0.1	
10.0 / 3.0	End of Borehole	3.00								

Easting: 445862 **Northing:** 5029168

Site Datum: TBM - Top of concrete west pier at Ottawa Vein Centre sign (100.00 m)

Groundsurface Elevation: 99.78 m **Top of Riser Elev.:** n/a

Hole Diameter: 200 mm **Monitoring Well Diameter:** n/a

NOTES

Sample was not recovered from 0.6 m bgs- 1.2 m bgs because the split spoon could not get through boulder. Driller proceeded to auger through the boulder.

Borehole Log: BH21-2

Project No.: 190523 **Project:** Contamination Delineation

Client: Mr.Gas Properties Ltd. **Location:** 322 Waverly Street, Ottawa, ON

Date: July 15 2021 **Field Personnel:** DC

Driller: CCC **Drilling Equipment:** Jackhammer **Drilling Method:** Split Spoon

SUBSURFACE PROFILE		SAMPLE DATA							Combustible Soil Vapours	Monitoring Well Details
Depth (ft / m)	Soil Description	Elev./Depth (m)	Lithology	Type	Sample Number	N or RQD (%)	Recovery (%)	Lab Analysis	ppm: 20 40 60 80; % LEL: 10 20 30 40 50 60 70 80 90	
0.0 / 0.0	Ground Surface									
0.0	Silty clay, grey, some oxidation, dry, compact.	0.00								
1.0					SS1		96		<0.1	
2.0										
3.0 / 1.0					SS2		100		<0.1	
4.0										
5.0					SS3		100	PHCs, BTEX and Metals & Inorganics	<0.1	
6.0										
7.0 / 2.0					SS4		100		<0.1	
8.0										
9.0					SS5		100	PHCs, BTEX and Metals & Inorganics	<0.1	
10.0 / 3.0	End of Borehole	3.00								
11.0										
12.0										
13.0 / 4.0										
14.0										
15.0										
16.0										
17.0 / 5.0										
18.0										
19.0										

Easting: 445862 **Northing:** 5029175

Site Datum: TBM - Top of concrete west pier at Ottawa Vein Centre sign (100.00 m)

Groundsurface Elevation: Approx. 97.81 m **Top of Riser Elev.:** n/a

Hole Diameter: 50 mm **Monitoring Well Diameter:** n/a

NOTES

APPENDIX B

Certificates of Laboratory Analysis

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

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

Certificate of Analysis

LRL Associates Ltd.

5430 Canotek Road
Ottawa, ON K1J 9G2
Attn: Devin Clouthier

Client PO:
Project: 190523
Custody: 132605

Report Date: 26-Jul-2021
Order Date: 15-Jul-2021

Revised Report

Order #: 2129555

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

Paracel ID	Client ID
2129555-02	BH21-2-SS2A
2129555-03	BH21-3-SS3
2129555-04	BH21-3-SS12
2129555-07	BH21-1-SS5
2129555-08	BH21-2-SS4
2129555-09	BH21-1-SS3 + BH21-1-SS2 (composite)

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Report Date: 26-Jul-2021

Client: LRL Associates Ltd.

Order Date: 15-Jul-2021

Client PO:

Project Description: 190523

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Boron, available	MOE (HWE), EPA 200.7 - ICP-OES	23-Jul-21	23-Jul-21
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	16-Jul-21	17-Jul-21
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	16-Jul-21	16-Jul-21
Conductivity	MOE E3138 - probe @25 °C, water ext	16-Jul-21	23-Jul-21
Cyanide, free	MOE E3015 - Auto Colour, water extraction	21-Jul-21	20-Jul-21
Mercury by CVAA	EPA 7471B - CVAA, digestion	19-Jul-21	23-Jul-21
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	22-Jul-21	22-Jul-21
PHC F1	CWS Tier 1 - P&T GC-FID	23-Jul-21	23-Jul-21
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	22-Jul-21	24-Jul-21
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	23-Jul-21	19-Jul-21
SAR	Calculated	19-Jul-21	20-Jul-21
Solids, %	Gravimetric, calculation	16-Jul-21	16-Jul-21

Certificate of Analysis

Client: **LRL Associates Ltd.**

Client PO:

Report Date: 26-Jul-2021

Order Date: 15-Jul-2021

Project Description: 190523

	Client ID:	BH21-2-SS2A	BH21-3-SS3	BH21-3-SS12	BH21-1-SS5
	Sample Date:	15-Jul-21 09:00	15-Jul-21 12:00	15-Jul-21 12:00	15-Jul-21 09:00
	Sample ID:	2129555-02	2129555-03	2129555-04	2129555-07
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	87.9	56.6	56.5	57.4
General Inorganics					
SAR	0.01 N/A	4.64	2.51	1.35	5.40
Conductivity	5 uS/cm	728	493	549	2440
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	<0.03	<0.03
pH	0.05 pH Units	7.93	7.90	7.87	7.50
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0 ug/g dry	1.6	5.8	3.1	3.4
Barium	1.0 ug/g dry	41.2	444	303	376
Beryllium	0.5 ug/g dry	<0.5	1.0	1.0	1.0
Boron	5.0 ug/g dry	<5.0	8.8	13.9	13.1
Boron, available	0.5 ug/g dry	<0.5	1.0	1.1	1.5
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	5.0 ug/g dry	12.1	152	133	170
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	<0.2
Cobalt	1.0 ug/g dry	2.5	30.7	25.2	31.3
Copper	5.0 ug/g dry	5.6	63.9	55.1	71.5
Lead	1.0 ug/g dry	43.5	7.4	7.8	10.9
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Molybdenum	1.0 ug/g dry	<1.0	1.2	<1.0	1.0
Nickel	5.0 ug/g dry	6.4	83.9	71.8	93.8
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.3 ug/g dry	<0.3	<0.3	<0.3	<0.3
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	<1.0	1.1	1.2	1.1
Vanadium	10.0 ug/g dry	17.1	140	113	139
Zinc	20.0 ug/g dry	32.8	160	129	159
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05

Certificate of Analysis

Report Date: 26-Jul-2021

Client: LRL Associates Ltd.

Order Date: 15-Jul-2021

Client PO:

Project Description: 190523

	Client ID:	BH21-2-SS2A	BH21-3-SS3	BH21-3-SS12	BH21-1-SS5
	Sample Date:	15-Jul-21 09:00	15-Jul-21 12:00	15-Jul-21 12:00	15-Jul-21 09:00
	Sample ID:	2129555-02	2129555-03	2129555-04	2129555-07
	MDL/Units	Soil	Soil	Soil	Soil
Toluene-d8	Surrogate	93.0%	81.2%	83.5%	77.6%
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	<7
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	16	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	14	<6	<6	<6

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 26-Jul-2021

Order Date: 15-Jul-2021

Project Description: 190523

	Client ID:	BH21-2-SS4	BH21-1-SS3 + BH21-1-SS2 (composite)	-	-
	Sample Date:	15-Jul-21 09:00	15-Jul-21 09:00	-	-
	Sample ID:	2129555-08	2129555-09	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	57.5	90.2	-	-
General Inorganics					
SAR	0.01 N/A	2.88	4.17	-	-
Conductivity	5 uS/cm	751	2970	-	-
Cyanide, free	0.03 ug/g dry	<0.03	<0.03	-	-
pH	0.05 pH Units	7.42	11.45	-	-
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	-	-
Arsenic	1.0 ug/g dry	3.2	5.7	-	-
Barium	1.0 ug/g dry	426	503	-	-
Beryllium	0.5 ug/g dry	1.0	<0.5	-	-
Boron	5.0 ug/g dry	9.4	9.0	-	-
Boron, available	0.5 ug/g dry	0.9	<0.5	-	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	-	-
Chromium	5.0 ug/g dry	141	25.9	-	-
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	-	-
Cobalt	1.0 ug/g dry	28.7	7.0	-	-
Copper	5.0 ug/g dry	62.4	27.9	-	-
Lead	1.0 ug/g dry	12.2	173	-	-
Mercury	0.1 ug/g dry	<0.1	0.3	-	-
Molybdenum	1.0 ug/g dry	1.2	1.7	-	-
Nickel	5.0 ug/g dry	78.8	18.8	-	-
Selenium	1.0 ug/g dry	<1.0	<1.0	-	-
Silver	0.3 ug/g dry	<0.3	<0.3	-	-
Thallium	1.0 ug/g dry	<1.0	<1.0	-	-
Uranium	1.0 ug/g dry	1.0	<1.0	-	-
Vanadium	10.0 ug/g dry	135	30.4	-	-
Zinc	20.0 ug/g dry	159	128	-	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	-	-
Toluene	0.05 ug/g dry	<0.05	<0.05	-	-
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	-	-
o-Xylene	0.05 ug/g dry	<0.05	<0.05	-	-

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 26-Jul-2021

Order Date: 15-Jul-2021

Project Description: 190523

	Client ID:	BH21-2-SS4	BH21-1-SS3 + BH21-1-SS2 (composite)	-	-
	Sample Date:	15-Jul-21 09:00	15-Jul-21 09:00	-	-
	Sample ID:	2129555-08	2129555-09	-	-
	MDL/Units	Soil	Soil	-	-
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	-	-
Toluene-d8	Surrogate	76.5%	113%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	-	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	141	-	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	476	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	85	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Conductivity	ND	5	uS/cm						
Cyanide, free	ND	0.03	ug/g						
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron, available	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*3.73*		*ug/g*		*117*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	0.26	0.01	N/A	0.24			8.0	30	
Conductivity	115	5	uS/cm	113			1.8	5	
Cyanide, free	ND	0.03	ug/g dry	ND			NC	35	
pH	7.60	0.05	pH Units	7.61			0.1	2.3	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND			NC	30	
F3 PHCs (C16-C34)	1280	8	ug/g dry	1190			7.8	30	
F4 PHCs (C34-C50)	1110	6	ug/g dry	836			27.8	30	
Metals									
Antimony	3.2	1.0	ug/g dry	3.2			0.1	30	
Arsenic	1.7	1.0	ug/g dry	2.3			28.9	30	
Barium	13.9	1.0	ug/g dry	17.1			20.4	30	
Beryllium	ND	0.5	ug/g dry	ND			NC	30	
Boron, available	ND	0.5	ug/g dry	ND			NC	35	
Boron	ND	5.0	ug/g dry	ND			NC	30	
Cadmium	ND	0.5	ug/g dry	ND			NC	30	
Chromium (VI)	ND	0.2	ug/g dry	ND			NC	35	
Chromium	7.4	5.0	ug/g dry	9.1			20.4	30	
Cobalt	1.9	1.0	ug/g dry	2.3			20.9	30	
Copper	ND	5.0	ug/g dry	ND			NC	30	
Lead	2.7	1.0	ug/g dry	3.2			16.6	30	
Mercury	ND	0.1	ug/g dry	ND			NC	30	
Molybdenum	1.5	1.0	ug/g dry	1.8			18.3	30	
Nickel	ND	5.0	ug/g dry	ND			NC	30	
Selenium	ND	1.0	ug/g dry	ND			NC	30	
Silver	ND	0.3	ug/g dry	ND			NC	30	
Thallium	ND	1.0	ug/g dry	ND			NC	30	
Uranium	ND	1.0	ug/g dry	ND			NC	30	
Vanadium	17.2	10.0	ug/g dry	22.2			25.4	30	
Zinc	ND	20.0	ug/g dry	ND			NC	30	
Physical Characteristics									
% Solids	90.8	0.1	% by Wt.	91.7			0.9	25	
Volatiles									
Benzene	ND	0.02	ug/g dry	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g dry	ND			NC	50	
Toluene	ND	0.05	ug/g dry	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g dry	ND			NC	50	
o-Xylene	ND	0.05	ug/g dry	ND			NC	50	
Surrogate: Toluene-d8	*4.10*		*ug/g dry*		*118*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Cyanide, free	0.212	0.03	ug/g	ND	70.6	70-130			
Hydrocarbons									
F1 PHCs (C6-C10)	193	7	ug/g	ND	96.5	80-120			
F2 PHCs (C10-C16)	121	4	ug/g	ND	80.0	60-140			
F3 PHCs (C16-C34)	1510	8	ug/g	1190	86.2	60-140			
F4 PHCs (C34-C50)	1070	6	ug/g	836	101	60-140			
Metals									
Antimony	53.4	1.0	ug/g	1.3	104	70-130			
Arsenic	54.6	1.0	ug/g	ND	107	70-130			
Barium	55.8	1.0	ug/g	6.8	97.9	70-130			
Beryllium	53.4	0.5	ug/g	ND	107	70-130			
Boron, available	4.42	0.5	ug/g	ND	88.3	70-122			
Boron	50.1	5.0	ug/g	ND	98.0	70-130			
Cadmium	50.1	0.5	ug/g	ND	100	70-130			
Chromium (VI)	0.1	0.2	ug/g	ND	72.5	70-130			
Chromium	57.5	5.0	ug/g	ND	108	70-130			
Cobalt	54.7	1.0	ug/g	ND	108	70-130			
Copper	52.9	5.0	ug/g	ND	103	70-130			
Lead	49.8	1.0	ug/g	1.3	96.9	70-130			
Mercury	1.65	0.1	ug/g	ND	110	70-130			
Molybdenum	52.0	1.0	ug/g	ND	103	70-130			
Nickel	54.1	5.0	ug/g	ND	105	70-130			
Selenium	49.3	1.0	ug/g	ND	98.0	70-130			
Silver	36.8	0.3	ug/g	ND	73.5	70-130			
Thallium	48.8	1.0	ug/g	ND	97.5	70-130			
Uranium	50.6	1.0	ug/g	ND	101	70-130			
Vanadium	61.5	10.0	ug/g	ND	105	70-130			
Zinc	54.7	20.0	ug/g	ND	98.2	70-130			
Volatiles									
Benzene	4.68	0.02	ug/g	ND	117	60-130			
Ethylbenzene	4.26	0.05	ug/g	ND	107	60-130			
Toluene	4.30	0.05	ug/g	ND	108	60-130			
m,p-Xylenes	8.06	0.05	ug/g	ND	101	60-130			
o-Xylene	4.45	0.05	ug/g	ND	111	60-130			
Surrogate: Toluene-d8	*2.68*		*ug/g*		*83.9*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

Revision-1 This report includes an updated sample list as per the client.

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 when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.

PARAC LABORATORIES

Paracel ID: 2129555

rent Blvd.
K1G 4J8
7
cellabs.com
s.com

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2129555	№ 132605

Client Name: LRL Associates	Project Ref: 190523	Page 1 of 1
Contact Name: Devin Clouthier	Quote #:	Turnaround Time
Address: 5430 Canotek Road, Ottawa, ON	PO #:	☐ 1 day ☐ 3 day
	E-mail: dclouthier@lrl.ca awood@lrl.ca	☐ 2 day ☑ Regular
Telephone: 613-842-3434		Date Required:

Regulation 153/04	Other Regulation
☐ Table 1 ☐ Res/Park ☐ Med/Fine	☐ REG 558 ☐ PWQO
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ CCME ☐ MISA
☑ Table 3 ☐ Agri/Other	☐ SU - Sani ☐ SU - Storm
☐ Table ___	Mun:
For RSC: ☒ Yes ☐ No	☐ 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	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	Metals and Inorganics						
1	BH21-1-SS3	S		2	July 15/21	AM	X							X						
2	BH21-2-SS2A					AM	X							X						
3	BH21-3-SS3					PM	X							X						
4	BH21-3-SS12					PM	X							X						
5	BH21-1-SS2					AM	X							X	HOLD					
6	BH21-2-SS1					AM	X							X	HOLD					
7	BH21-1-SS5					AM	X							X	HOLD					
8	BH21-2-SS4					AM	X							X	HOLD					
9																				
10																				

Comments: Please place samples BH21-1-SS2 and BH21-2-SS1 on hold.
Please also place BH21-1-SS5 and BH21-2-SS4 on hold aswell.

Method of Delivery: Drop Box

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab: Jeneepam Dolmagi	Verified By:
Relinquished By (Print): Devin Clouthier	Date/Time:	Date/Time: Jul 15, 2021 03:20	Date/Time: July 15 2021 15:?
Date/Time: July 15/21 3:15 pm	Temperature: °C	Temperature: 19.6 °C	pH Verified: ☐ By: NA

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

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

Certificate of Analysis

LRL Associates Ltd.

5430 Canotek Road
Ottawa, ON K1J 9G2
Attn: Devin Clouthier

Client PO:
Project: 190523
Custody: 60222

Report Date: 28-Jul-2021
Order Date: 22-Jul-2021

Order #: 2130463

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

Paracel ID	Client ID
2130463-01	BH21-3-SS5

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 28-Jul-2021

Order Date: 22-Jul-2021

Project Description: 190523

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Boron, available	MOE (HWE), EPA 200.7 - ICP-OES	28-Jul-21	28-Jul-21
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	23-Jul-21	25-Jul-21
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	22-Jul-21	23-Jul-21
Conductivity	MOE E3138 - probe @25 °C, water ext	26-Jul-21	27-Jul-21
Cyanide, free	MOE E3015 - Auto Colour, water extraction	21-Jul-21	23-Jul-21
Mercury by CVAA	EPA 7471B - CVAA, digestion	27-Jul-21	27-Jul-21
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	22-Jul-21	22-Jul-21
PHC F1	CWS Tier 1 - P&T GC-FID	23-Jul-21	25-Jul-21
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	22-Jul-21	26-Jul-21
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	27-Jul-21	27-Jul-21
SAR	Calculated	27-Jul-21	28-Jul-21
Solids, %	Gravimetric, calculation	27-Jul-21	28-Jul-21

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 28-Jul-2021

Order Date: 22-Jul-2021

Project Description: 190523

	Client ID:	BH21-3-SS5	-	-	-
	Sample Date:	15-Jul-21 12:00	-	-	-
	Sample ID:	2130463-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	54.9	-	-	-
General Inorganics					
SAR	0.01 N/A	2.05	-	-	-
Conductivity	5 uS/cm	595	-	-	-
Cyanide, free	0.03 ug/g dry	<0.03	-	-	-
pH	0.05 pH Units	8.34	-	-	-
Metals					
Antimony	1.0 ug/g dry	<1.0	-	-	-
Arsenic	1.0 ug/g dry	3.6	-	-	-
Barium	1.0 ug/g dry	309	-	-	-
Beryllium	0.5 ug/g dry	1.0	-	-	-
Boron	5.0 ug/g dry	17.7	-	-	-
Boron, available	0.5 ug/g dry	2.2	-	-	-
Cadmium	0.5 ug/g dry	<0.5	-	-	-
Chromium	5.0 ug/g dry	137	-	-	-
Chromium (VI)	0.2 ug/g dry	<0.2	-	-	-
Cobalt	1.0 ug/g dry	25.6	-	-	-
Copper	5.0 ug/g dry	56.1	-	-	-
Lead	1.0 ug/g dry	8.1	-	-	-
Mercury	0.1 ug/g dry	<0.1	-	-	-
Molybdenum	1.0 ug/g dry	<1.0	-	-	-
Nickel	5.0 ug/g dry	74.7	-	-	-
Selenium	1.0 ug/g dry	<1.0	-	-	-
Silver	0.3 ug/g dry	<0.3	-	-	-
Thallium	1.0 ug/g dry	<1.0	-	-	-
Uranium	1.0 ug/g dry	2.1	-	-	-
Vanadium	10.0 ug/g dry	112	-	-	-
Zinc	20.0 ug/g dry	128	-	-	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	-	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	-	-	-
Toluene	0.05 ug/g dry	<0.05	-	-	-
m,p-Xylenes	0.05 ug/g dry	<0.05	-	-	-
o-Xylene	0.05 ug/g dry	<0.05	-	-	-
Xylenes, total	0.05 ug/g dry	<0.05	-	-	-

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 28-Jul-2021

Order Date: 22-Jul-2021

Project Description: 190523

	Client ID:	BH21-3-SS5	-	-	-
	Sample Date:	15-Jul-21 12:00	-	-	-
	Sample ID:	2130463-01	-	-	-
	MDL/Units	Soil	-	-	-
Toluene-d8	Surrogate	106%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	-	-	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	-	-	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	-	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	-	-	-

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 28-Jul-2021

Order Date: 22-Jul-2021

Project Description: 190523

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Conductivity	ND	5	uS/cm						
Cyanide, free	ND	0.03	ug/g						
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron, available	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*8.16*		*ug/g*		*102*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	0.21	0.01	N/A	0.21			0.0	30	
Conductivity	239	5	uS/cm	236			1.3	5	
Cyanide, free	ND	0.03	ug/g dry	ND			NC	35	
pH	6.53	0.05	pH Units	6.46			1.1	2.3	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND			NC	30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND			NC	30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND			NC	30	
Metals									
Antimony	ND	1.0	ug/g dry	ND			NC	30	
Arsenic	3.7	1.0	ug/g dry	3.6			4.1	30	
Barium	140	1.0	ug/g dry	147			4.8	30	
Beryllium	0.5	0.5	ug/g dry	ND			NC	30	
Boron, available	ND	0.5	ug/g dry	ND			NC	35	
Boron	11.4	5.0	ug/g dry	7.4			NC	30	
Cadmium	ND	0.5	ug/g dry	ND			NC	30	
Chromium (VI)	ND	0.2	ug/g dry	ND			NC	35	
Chromium	28.5	5.0	ug/g dry	27.9			2.2	30	
Cobalt	9.8	1.0	ug/g dry	9.6			2.6	30	
Copper	18.6	5.0	ug/g dry	18.6			0.3	30	
Lead	10.0	1.0	ug/g dry	9.4			7.0	30	
Mercury	ND	0.1	ug/g dry	ND			NC	30	
Molybdenum	ND	1.0	ug/g dry	ND			NC	30	
Nickel	18.4	5.0	ug/g dry	17.8			3.2	30	
Selenium	ND	1.0	ug/g dry	ND			NC	30	
Silver	ND	0.3	ug/g dry	ND			NC	30	
Thallium	ND	1.0	ug/g dry	ND			NC	30	
Uranium	ND	1.0	ug/g dry	ND			NC	30	
Vanadium	45.6	10.0	ug/g dry	44.3			2.9	30	
Zinc	45.2	20.0	ug/g dry	44.4			1.9	30	
Physical Characteristics									
% Solids	56.9	0.1	% by Wt.	54.9			3.6	25	
Volatiles									
Benzene	ND	0.02	ug/g dry	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g dry	ND			NC	50	
Toluene	ND	0.05	ug/g dry	ND			NC	50	
m,p-Xylenes	ND	0.05	ug/g dry	ND			NC	50	
o-Xylene	ND	0.05	ug/g dry	ND			NC	50	
Surrogate: Toluene-d8	*10.8*		*ug/g dry*		*119*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
Cyanide, free	0.254	0.03	ug/g	ND	84.6	70-130			
Hydrocarbons									
F1 PHCs (C6-C10)	196	7	ug/g	ND	98.2	80-120			
F2 PHCs (C10-C16)	136	4	ug/g	ND	97.5	60-140			
F3 PHCs (C16-C34)	353	8	ug/g	ND	103	60-140			
F4 PHCs (C34-C50)	210	6	ug/g	ND	97.2	60-140			
Metals									
Antimony	51.6	1.0	ug/g	ND	103	70-130			
Arsenic	51.8	1.0	ug/g	1.4	101	70-130			
Barium	109	1.0	ug/g	58.7	100	70-130			
Beryllium	51.1	0.5	ug/g	ND	102	70-130			
Boron, available	3.00	0.5	ug/g	ND	60.1	70-122			QM-07
Boron	48.7	5.0	ug/g	ND	91.6	70-130			
Cadmium	50.9	0.5	ug/g	ND	102	70-130			
Chromium (VI)	0.1	0.2	ug/g	ND	72.5	70-130			
Chromium	63.1	5.0	ug/g	11.2	104	70-130			
Cobalt	55.4	1.0	ug/g	3.8	103	70-130			
Copper	56.5	5.0	ug/g	7.5	98.1	70-130			
Lead	48.6	1.0	ug/g	3.7	89.8	70-130			
Mercury	1.28	0.1	ug/g	ND	85.5	70-130			
Molybdenum	51.5	1.0	ug/g	ND	103	70-130			
Nickel	56.4	5.0	ug/g	7.1	98.6	70-130			
Selenium	47.5	1.0	ug/g	ND	94.8	70-130			
Silver	47.1	0.3	ug/g	ND	94.1	70-130			
Thallium	48.7	1.0	ug/g	ND	97.3	70-130			
Uranium	47.7	1.0	ug/g	ND	95.0	70-130			
Vanadium	70.7	10.0	ug/g	17.7	106	70-130			
Zinc	63.8	20.0	ug/g	ND	92.2	70-130			
Volatiles									
Benzene	3.00	0.02	ug/g	ND	74.9	60-130			
Ethylbenzene	3.50	0.05	ug/g	ND	87.6	60-130			
Toluene	3.22	0.05	ug/g	ND	80.5	60-130			
m,p-Xylenes	7.02	0.05	ug/g	ND	87.8	60-130			
o-Xylene	3.65	0.05	ug/g	ND	91.3	60-130			
Surrogate: Toluene-d8	*8.32*		*ug/g*		*104*	*50-140*			

Qualifier Notes:

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

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 when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.

PARACE LABORATORIES I

Paracel ID: 2130463

Blvd. 4J8 bs.com n

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2130463	№ 60222

Client Name: LRL Associates
Contact Name: Devin Clouthier
Address: 5430 Canotek Rd. Ottawa, ON
Telephone: 613-842-3434

Project Ref: 190523
Quote #:
PO #:
E-mail: dclouthier@lrl.ca
awood@lrl.ca

Page 1 of 1

Turnaround Time
☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular
Date Required:

☒ REG 153/04 ☐ REG 406/19

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

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

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

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	PHCs F1-F4 BTEX	Metals and Inorganics
1	BH21-3-555	S		2	July 15/21	PM	X	X
2								
3								
4								
5								
6								
7								
8								
9								
10								

Comments:

Method of Delivery: Drop box

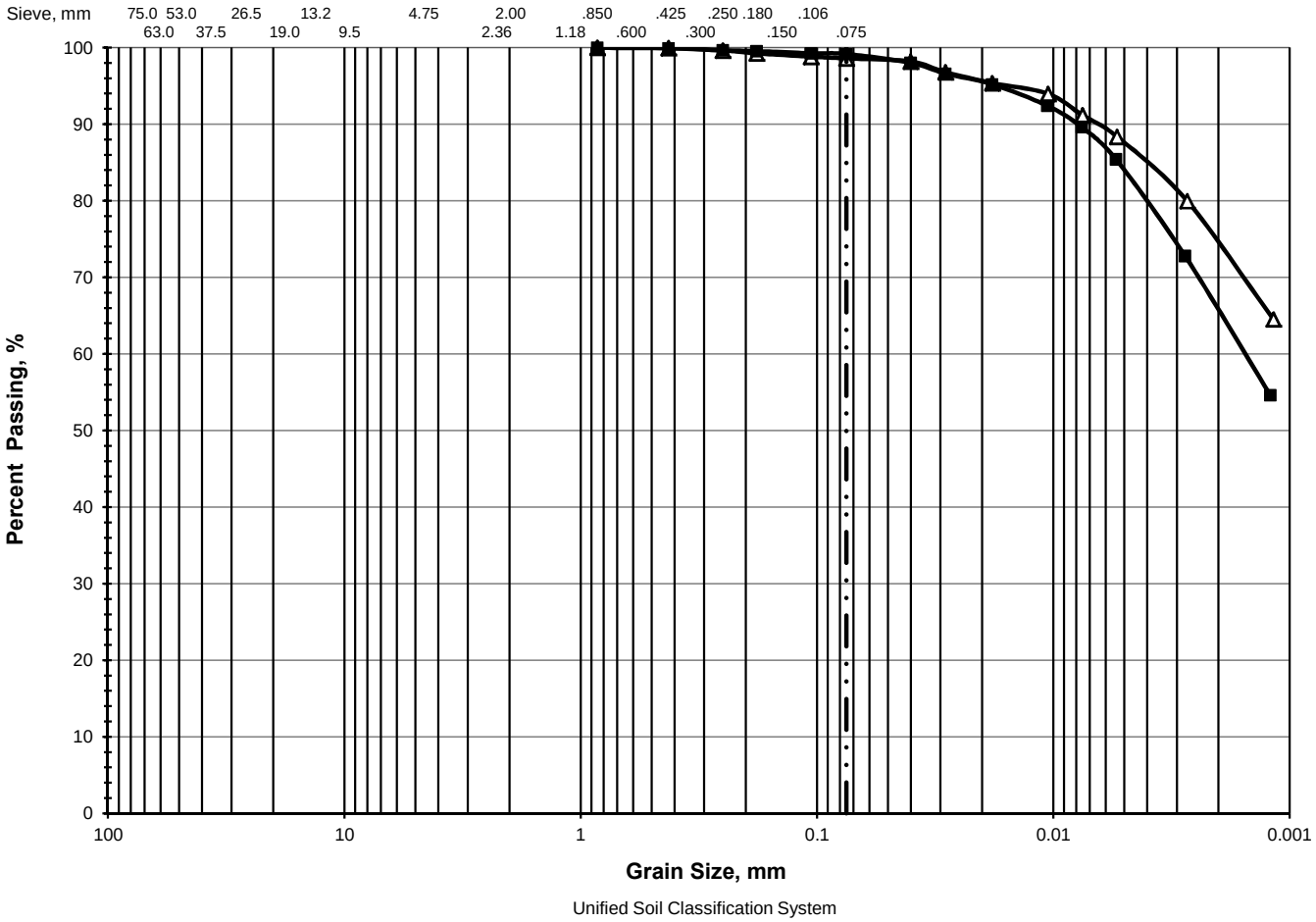
Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Devin Clouthier	Date/Time:	Date/Time: July 22 2021 9:45	Date/Time: July 22 2021 10:47
Date/Time: July 22/21 9:30 am	Temperature: °C	Temperature: 7.9 °C	pH Verified: ☐ By:

LRL Associates Ltd.

PARTICLE SIZE ANALYSIS

ASTM D 422 / LS-702

Client:	Serco Realty Group	**File No.:**	190523
Project:	Geotechnical Investigation	**Report No.:**	2
Location:	322 Waverly Street, Ottawa, ON.	**Date:**	April 19, 2021



Unified Soil Classification System

	> 75 mm	% GRAVEL		% SAND			% FINES	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
△	0.0	0.0	0.0	0.0	0.1	1.4	25.7	72.8
■	0.0	0.0	0.0	0.0	0.1	0.7	35.3	63.9

	Location	Sample	Depth, m	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
△	BH 2	SS-3	1.52 - 2.13							
■	BH 3	SS-5	4.57 - 5.18	0.0017						

APPENDIX C

Elevated Background Metals Concentrations in Champlain Sea Clay – Ottawa Region, 2017.

Elevated Background Metals Concentrations in Champlain Sea Clay - Ottawa Region

Sean Sterling and Kenneth Raven
Geofirma Engineering Ltd, Ottawa, ON, Canada
Brent Loney and Asia Reid
Dillon Consulting Limited., Ottawa, ON, Canada
Brad Carew
City of Ottawa, Ottawa, ON, Canada

ABSTRACT
Native clay soils associated with post-glacial Champlain Sea marine deposits contain concentrations of select trace metals at concentrations in excess of the Ministry of the Environment & Climate Change (MOECC) background soil standards. These standards have been historically used as the basis for defining which soils are designated as clean fill. As such, additional effort and expense are required in dealing with these soils during land development and civil infrastructure projects and at properties undergoing Environmental Site Assessments. This study presents a compilation of data from existing technical studies conducted in the Ottawa region to support the definition of local background concentrations (for Eastern Ontario) thereby providing a supporting technical rationale for allowing movement of these clay soils between sites in eastern Ontario that have similar properties. This study is intended to provide a mechanism to deal with this issue on a regional basis and reduce the burden on an individual site or project basis.

RÉSUMÉ
Les sols indigènes d'argile liés aux dépôts marins de mer postglaciale de Champlain contiennent des concentrations des oligo-métaux choisis aux concentrations au-dessus du Ministère de l'Environnement et de l'Action en matière de changement climatique (MEACC). Ces normes ont été historiquement employées comme base pour définir quels sols sont indiqués en tant que suffisance propre. En tant que tels, l'effort et les dépenses additionnels sont exigés en faisant face à ces sols pendant le développement de terrain et les projets civils d'infrastructure et aux propriétés subissant des évaluations environnementales d'emplacement. Cette étude présente une compilation des données des études techniques existantes entreprises dans la région d'Ottawa pour soutenir la définition des concentrations locales de fond (pour l'Est de l'Ontario), et pour fournir une justification technique pour permir le mouvement de ces sols d'argile entre les sites dans l'Est de l'Ontario qui ont les propriétés semblables. Cette étude est prévue pour fournir un mécanisme à l'affaire en cette question sur une base régionale et pour réduire le fardeau sur une base individuelle d'emplacement ou de projet.

1 BACKGROUND

Geoenvironmental practitioners in the Ottawa area commonly find that native clay soils associated with the post-glacial Champlain Sea contain concentrations of trace metals such as barium, boron, chromium, cobalt and vanadium at concentrations in excess of the Ministry of the Environment & Climate Change (MOECC) background soil standards (Table 1). This likely reflects the provenance of these clays from Canadian Shield tills, and the resulting atypical clay mineralogy

MOECC background soil standards were originally developed in 1993 based on no more than 110 soil samples (depending on parameter) collected from various old urban and rural parks, primarily in southwestern Ontario and therefore are not representative of the natural background concentrations of metals within the Champlain Sea clay found in Eastern Ontario. Further, these background standards have been historically used as the basis for defining which soils are designated as clean fill. As such, additional effort and expense may be required in dealing with these soils during land development and civil infrastructure projects and at properties undergoing Environmental Site Assessments.

This study presents a compilation of data from existing technical studies conducted in the Ottawa region to set a baseline for naturally occurring concentrations of metals within these clay soils.

With regards to soil management, this study is intended to support the definition of local background concentrations that can be applied such that movement of these clay soils between sites in eastern Ontario that have similar properties would be facilitated. This will support future soil management initiatives and excess soil management plans, and ensure that these soils are not unnecessarily disposed of in landfills.

Similarly, with sites undergoing Environmental Site Assessments in support of filing Records of Site Condition (RSC), this study can be used to support removal of these naturally occurring metals from being considered as contaminants of concern where clay soils of this nature occur. This will reduce the burden of establishing background conditions on an individual site basis.

2 HISTORY OF THE CHAMPLAIN SEA DEPOSITS

The Champlain Sea was a body of saline to brackish water forming a temporary inlet of the Atlantic Ocean, created by the retreating glaciers during the late glacial period 12 000 to 10 000 years ago. It spanned over 55,000 km^2 known as the St. Lawrence Lowland within both Canadian provinces of Quebec and Ontario, as well as parts of the American states of New York and Vermont (Chapman and Putnam, 1984). Within Canada, it extended from Québec City to Brockville, Ontario, and up the Ottawa River Valley to Pembroke (Figure 1).

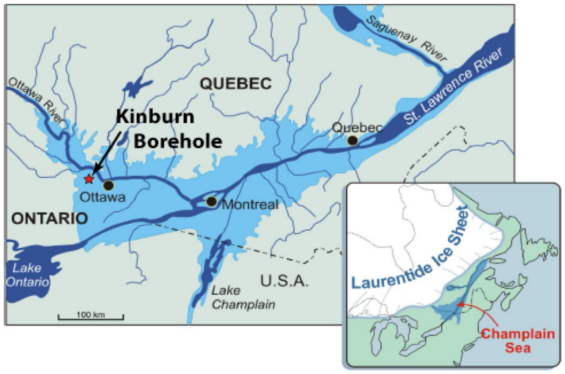


Figure 1. Interpreted extents of the Champlain Sea Basin and its relative position to the Laurentide Ice Sheet (Knight et al., 2012).

The northern shore of the sea was in southern Quebec where outcrops of the Canadian Shield form the Eardley Escarpment. The Eardley Escarpment is known locally as the Gatineau Hills; part of the Mattawa fault at the southeastern edge of the Ottawa-Bonnechère Graben, in Eastern Ontario and the Outaouais region of Quebec, more commonly known as the Ottawa Valley. The sea lasted some 2000 years when the water became too fresh to accommodate marine organisms. It is estimated that the sea was as much as 150 metres (490 ft) above the level of today's St. Lawrence and Ottawa Rivers (Barnet, 1988).

The most abundant sediments deposited by the sea, the Leda marine clays, are mainly rock "flour" from glacial abrasion. Their mineralogy principally reflects the composition of the Precambrian rocks from which they are derived and contain mica, chlorite, quartz, amphiboles, and feldspar. The clay fraction contains small amounts of montmorillonite and illite-montmorillonite (Karrow, 1961)

The best evidence of this former sea is the vast clay plain deposited along the Ottawa and St. Lawrence Rivers. In the geotechnical world, these sensitive clays are well known for their instability and potential for landslides. These same clays are the subject of this paper.

3 MOECC SITE CONDITION STANDARDS

The MOECC have established generic soil and groundwater Site Condition Standards (SCSs) that are commonly known as Tables 1 through 9 of Ontario Regulation 153/04 made under the Environmental Protection Act. The most recent update to these standards was in 2011. Table 1 represents typical background conditions across Ontario and is the focus of this paper.

The MOECC first published background ranges of substances in Ontario soils in 1993 (OMEE, 1993). The "Ontario Typical Range" (OTR_{98}) was defined as the overall range of a substance and was defined as the 97.5th percentile of the data distribution. The data used for background soils standards (Table 1) included surficial soils across Ontario that were considered to not be impacted by anthropogenic contaminant sources.

To take into account the natural occurring sampling variability, the MOECC added two standard deviations (of replicate samples) to the OTR_{98} and this value was used as the Table 1 standards. The exception to this increase for sampling variability was that it could not be increased above the effects-based value as determined by OMEE (1993). Table 1 below summarizes the MOECC statistics for selected metals in non-agricultural soils considered in this paper.

Table 1. Summary of MOECC Statistics for Selected Metals Parameters in Champlain Sea Clay

Parameter	Concentration (µg/g)				
	Barium	Boron	Chromium	Cobalt	Vanadium
OTR_{98}	179	30.4	62.8	17.2	86
OTR_{98} + 2SD	217	35.9	70.1	20.8	101
Replicate SD (calculated)	19	2.75	3.65	1.8	7.5
Lowest Effect Level – Effect (a,b)	390[a]	120[a]	160[a]	22[b]	18[a]
Table 1 Standard (rounded)	217 (220)	35.9 (36)	70.1 (70)	20.8 (21)	86.0 (86)

Notes:
a – Protection of Mammals and Birds
b – Direct Human Soil Contact - S1 Risk

Since 1993, the MOECC completed additional sampling for background metals and following the same methodology, the OTR_{98s} were recalculated (MOE, 2011). These new standards were published in 2011 and are still considered the current regulatory standards associated with O.Reg 153/04.

Acknowledging that background soil chemistry varies spatially across the province, MOE (2011) recommended that future updates should consider using geo-regional approaches and matching statistical methods if sufficient data exists at that time. This study provides a review of data specific to Champlain Sea clays as described above and the authors believe that consideration should be given to using this study as the foundation for updating background metals concentrations in Eastern Ontario.

4 REVIEW OF METALS CONCENTRATIONS IN CHAMPLAIN SEA CLAY SOIL

Fifty-nine reports were identified by the City of Ottawa (the City) to potentially contain relevant soil chemistry data for samples collected from within native clay deposits associated with the post-Glacial Champlain Sea (the unit of interest for this assessment). These reports related to investigations originally conducted for purposes other than the objective of the current assessment, but nevertheless contained data relevant to the question of establishing background concentrations, and appropriate for use in this manner.

Figure 2 shows the distribution of data used for this assessment. The reports primarily consisted of Phase II Environmental Site Assessments, but also included several soil management investigations, soil and groundwater sampling program reports, as well as City

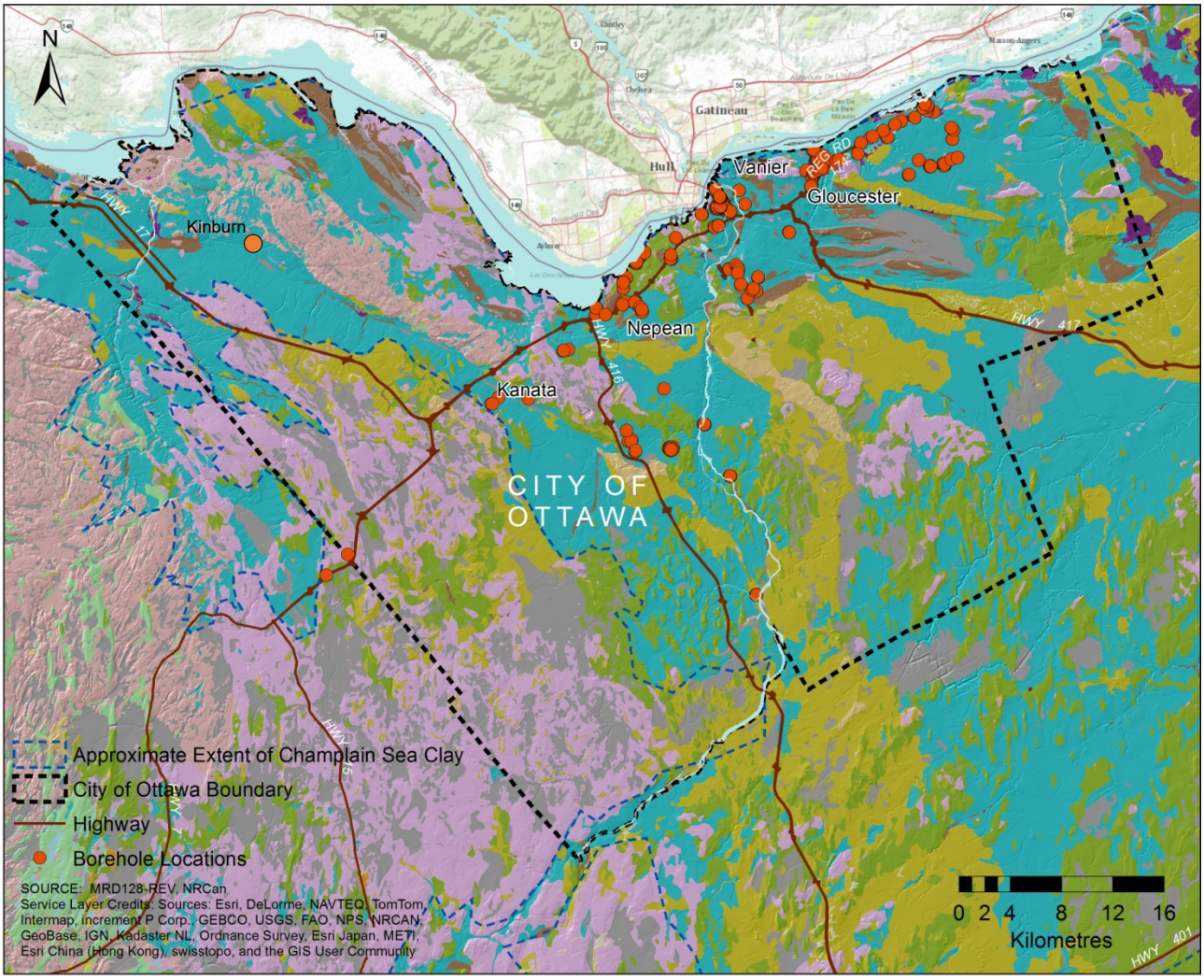


Figure 2. Distribution of Champlain Sea clay samples reviewed as part of this study

of Ottawa Infrastructure projects. In addition, a study completed by the Geological Survey of Canada for a site in Kinburn was included in the current assessment (Knight et al, 2012).

Each report was screened for relevant samples that were associated with Champlain Sea sediments and submitted to an accredited laboratory for the analysis of metals. Several known parameters with frequent exceedances of MOECC standards were examined, specifically:

- barium (Ba)
- boron (B)
- chromium, total (Cr)
- cobalt (Co)
- vanadium (V)

Any observations of these parameters in the clay layer were summarized, a new unique ID was assigned to each sample and the locations were georeferenced.

Depending on the lithology and history of the site, each sample was qualified, and samples that may not be representative of true background concentrations were removed. This screening consisted of a review of the soil quality data from the clay layer for evidence of potential anthropogenic contamination, as well as the review of any overlying soil layers for anthropogenic contamination that may in turn impact the clay layer via the leaching of contaminants. If overlying soil layers contained elevated concentrations of the metals of interest but these were also considered to be naturally occurring (i.e., if the overlying layer also contained clay, commonly within an overlying fill layer), then the sample in question was not screened out (i.e., was retained as a valid data point).

A total of 285 samples were considered to represent valid data points for this assessment. These data were compiled and their geographic distribution plotted on a map to assess the regional data distribution and coverage (Figure 2).

The following statistical analyses were performed after removing statistical outliers:

- Minimum;
- Maximum;
- Median;
- Average (arithmetic average);
- 95% upper confidence limit on mean (UCLM);
- coefficient of variation;
- 10th, 25th, 75th, 90th & 98th percentiles;
- Standard deviation, and;
- Skewness.

These statistics were calculated either using the internal functions built into Microsoft Excel or ProUCL (version 5.1). ProUCL is a public domain statistical software package published by the United States Environmental Protection Agency (USEPA) for analysis of environmental data sets. ProUCL was applied for the determination of outliers (using Rosner's outlier test), coefficients of variation, skewness and 95% UCLMs. For data sets with many non-detect observations (boron), ProUCL's non-detect functions were applied to better estimate the required statistical parameters. As a result, 98th percentile values were not calculated for boron, with the 95th and 99th percentile values determined from ProUCL applied instead. A selection of the computed statistics are summarized in Table 2. The boron 98th percentile value in Table 2 is conservatively the 99th percentile value.

Table 2. Summary of Ottawa Region Statistics for Selected Metals Parameters in Champlain Sea Clay

Parameter	Concentration (µg/g)				
	Barium	**Boron**	**Chromium**	**Cobalt**	**Vanadium**
*MOECC Table 1 SCS**	*220*	*36*	*70*	*21*	*86*
*MOECC Table 2/3 SCS***	*390*	*120*	*160*	*22*	*86*
Total # observations	271	158	277	271	267
Minimum	32.0	0.5	7.6	3.0	10.0
Maximum	***544***	23.3	***162***	***30.5***	***136***
25th Percentile	200	5.00	49.4	13.0	58.1
Median	**270**	6.45	**83.0**	17.0	77.4
75th Percentile	**330**	7.30	**110**	**21.2**	***92.5***
98th Percentile	***460***	14.9	**145**	***27.9***	***123***
Average	**268**	5.45	**79.3**	17.1	75.0
Standard Deviation	98	3.4	36.4	6.04	25.3

Notes:
Bold values exceed Table 1 SCS
Bold/italics/underlined values exceed Table 3 SCS
* Table 1 SCS for Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use
** Table 2/3 SCS for Residential / Parkland / Institutional Property Use, all soil textures

The data for barium, total chromium, cobalt and vanadium clearly show that concentrations of these metals are naturally elevated in clay soils in the Ottawa region. In all cases, naturally occurring concentrations in excess of the MOECC Table 1 SCS can be expected to occur quite commonly, with at least the 75th percentile concentrations exceeding this level, and in two cases (barium and chromium) the average levels exceeded this level. In all cases, the maximum concentrations exceeded the MOECC Table 3 SCS, and the 98th percentile concentrations of barium, chromium, and vanadium also exceeded this level.

Boron was not found to exceed the MOECC Table 1 SCS in any of the clay samples and thus does not appear to occur naturally at problematic concentrations in the regional clay sequence.

It is noted that several other parameters were reviewed as part of this exercise (available boron, electrical conductivity, and sodium absorption ratio). Consistent with the results for total boron, available boron was generally not found to occur at elevated concentrations relative to the MOECC SCS (detected at only 2 locations at concentrations exceeding the Table 2/3 SCS) and the large number of non-detect values (with many elevated detection limits) resulted in a poor dataset therefore further statistical analyses were not completed. Significantly fewer data points were available for electrical conductivity (EC) and sodium absorption ratio (SAR), which again did not support more rigorous statistical analyses; however, concentrations in excess of the MOECC Table SCS (Tables 1, 2 and 3 SCS) were relatively common.

5 VARIABILITY WITHIN A SINGLE BOREHOLE

In addition to spatial variability of samples within Eastern Ontario, there is also strong evidence that the metals concentrations in question also vary within the Champlain Sea depositional sequence as evidenced by Knight et al. (2012). This study, which is represented by one data point in Table 2, analysed 80 samples of a 96 m column of Champlain Sea clay within a single borehole located near Kinburn, Ontario. Table 3 summarizes select statistics of these data. Note that boron was not analysed as part of this study.

Table 3. Summary of Statistics for Selected Metals Parameters in Champlain Sea Clay in Kinburn Borehole

Parameter	Concentration (µg/g)				
	Barium	**Boron**	**Chromium**	**Cobalt**	**Vanadium**
*MOECC Table 1 SCS**	*220*	*36*	*70*	*21*	*86*
*MOECC Table 2/3 SCS***	*390*	*120*	*160*	*22*	*86*
Minimum	***592***	--	62	12.2	78
Maximum	***989***	--	***192***	***25.9***	***140***
98th Percentile	***955.2***	--	***165***	***25.7***	***127***
Average	***839***	--	**91**	17.0	***101***
Standard Deviation	83.8	--	25.4	2.9	12.5

Notes:
Bold values exceed Table 1 SCS
Bold/italics/underlined values exceed Table 3 SCS
-- Boron was not analysed

These data show that there is significant variability within the depositional sequence at a single borehole. In fact, of the four parameters of interest that were analysed as part of this study, all but cobalt show a 98th percentile significantly higher that the approximately 270 regional samples across Eastern Ontario.

6 PROPOSED UPDATED BACKGROUND SOIL STANDARDS

As described above, the MOECC has defined background soil standards (MOECC Table 1 SCS) as the 98th percentile defined by the Ontario Typical Range (OTR) plus two standard deviations of replicate samples, where OTR_{98} values do not exceed effects-based numbers.

In the absence of replicate data as part of the amalgamated Champlain Sea clay data, the MOE (2011) standard deviation of replicate samples can be conservatively used as part of the calculation to establish new proposed geo-regional background standards for Eastern Ontario. Table 4 summarizes these calculations for the five metals parameters for non-agricultural soils.

Table 4. Summary of Proposed Geo-Regional Background Values for Eastern Ontario

Parameter	Concentration (µg/g)				
	Barium	**Boron**	**Chromium**	**Cobalt**	**Vanadium**
*Current MOECC Table 1 SCS**	*220*	*36*	*70*	*21*	*86*
*Current MOECC Table 2/3 SCS***	*390*	*120*	*160*	*22*	*86*
98th Percentile (this study)	460	14.9	145	27.9	123
Replicate SD (MOE, 2011)	19	2.75	1.8	3.65	7.5
Proposed Geo-Regional Background Values	460	NC	145	35.2	123
% increase	109	NA	107	68	43

Notes:
NC - no change proposed
NA - not applicable

Adoption of these values as geo-regional background standards will require further consultation with MOECC and as such the proposed values are not considered final as of the time of this paper. It is also noted that these values may be further updated as additional data become available.

7 POTENTIAL IMPLICATIONS ON GROUNDWATER CONCENTRATIONS

Although this study focuses on soil concentrations only, the authors of this study have worked on multiple sites with Champlain Sea sediments where groundwater concentrations show elevated concentrations of these same metals parameters compared to the MOECC Table 2 and Table 3 SCS.

These elevated concentrations are interpreted to be associated with turbidity of samples during purging and even with bias due to sample turbidity resulting from purging activities. Even with field filtering of groundwater for metals analyses, laboratory reported concentrations exceeding MOECC Table 2 SCS have been observed. In each instance, re-sampling using low flow or low / no purging methods results in a groundwater concentration significantly lower that in turn meets the MOECC Table 2 SCS.

Further research into the statistical variability of groundwater samples from Champlain Sea sediments is warranted.

8 CONCLUSIONS

This paper is considered to provide sufficient rationale to propose new geo-regional background values for Eastern Ontario for four select metals parameters due to the local depositional history of Champlain Sea clay sediments. This would allow these new proposed regional values to define the limit below which regional clay soils can be considered to have naturally occurring concentrations (i.e. native soil), recognizing that further consultation with MOECC is necessary prior to their use as such. Further, the proposed values are not considered final as of the time of this paper and are subject to change as new data become available.

This approach has significant positive implications for soil management initiatives and excess soil management plans, most specifically with respect to the new proposed excess soil regulation that is currently being proposed by the MOECC. If adopted, the most significant of these implications include:

1. allowing these soils to be considered as background (i.e. inert fill) and allow movement between similar sites as part of the soil management initiative;
2. allowing these parameters to not be considered as a contaminant with respect to the Records of Site Condition Regulation (O.Reg. 153/04).
3. ultimately reducing the amount of "non-contaminated" soil that is being unnecessarily disposed of in landfills, thereby reducing costs for site owners as well as keeping valuable landfill space available for true waste.

9 REFERENCES

Barnett, P.J. 1988. History of the northwestern arm of the Champlain Sea. Pp 25–36 in Gadd, N.R. (ed.) The Late Quaternary Development of the Champlain Sea Basin. *Geological Association of Canada, Special Paper 36*. Map 5.

Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario. Third edition. *Ontario Geological Survey, Special Volume No.2.* Government of Ontario, Toronto.

Karrow, P.F., 1961. The Champlain Sea and its Sediments. *In Soils in Canada (edited by R.F. Legget, University of Toronto Press), p. 97.*

Knight, R.D., M. Moroz, H.A.J. Russel, 2012. Geochemistry of a Champlain Sea aquitard, Kinburn, Ontario: portable XRF analysis and fusion chemistry. *Geological Survey of Canada Open File 7085.*

Ontario Ministry of the Environment (MOE), 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. April 15.

Ontario Ministry of Environment and Energy (OMEE), 1993. Ontario Typical Range of Chemical Parameters in Soil, Vegetation, Moss Bags and Snow, ISBN 0-7778-1979-1.