

Phase II – Environmental Site Assessment

Tunney's Pasture (Block 10)

Ottawa, Ontario

Prepared for IBI Group

Report: PE6040-2

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EXECUTIVE SUMMARY

Assessment

Paterson Group was retained by Arcadis IBI Group to conduct a Phase II – Environmental Site Assessment (Phase II ESA) for Block 10 of the Tunney's Pasture government office complex, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and were considered to result in areas of potential environmental concern (APECs) on the subject site (Phase II Property). It should be noted that APEC 3, APEC 4, APEC 5 and APEC 9C on the east portion of the Phase II Property were planned to be assessed as part of the Phase II-ESA, however, due to on-going construction activities, and remediation activities being completed by other consultants in the area, drilling was not possible in this area. Final reports prepared by the other consultants should be reviewed to assess the completion of the remedial activities.

The subsurface investigation for this assessment was conducted during the interim of November 15 and 16, 2023 and December 6, 2023 and consisted of drilling four (4) boreholes (BH14-23, BH15-23, BH27-23 and BH28-23) across the Phase II Property. Additionally, three hand auger holes (HA1-23 through HA3-23) were dug on the north-central portion of the Phase II Property. It should be noted that this field investigation was carried out as part of a larger investigation conducted for multiple sites at the Tunney's Pasture complex. The boreholes were advanced to depths ranging from approximately 6.17 m to 6.20 m below the existing ground surface and terminated within the bedrock unit, with the exception of BH28-23 which was terminated at a depth of 0.51 m. Upon completion, three boreholes were instrumented with groundwater monitoring wells in order to access the groundwater table.

In general, the subsurface soil profile encountered at the borehole locations consists of either a thin pavement structure (asphaltic concrete over granular fill) or a concrete slab (over granular fill), underlain by fill material (consisting of brown silty sand or clay with varying amounts of gravel, cobbles and crushed stone). Trace amounts of brick and concrete were encountered in BH15-23 in the fill layer from approximately 0.60 m to 3.81 m below ground surface. Bedrock was encountered in three boreholes during the field drilling program at depths ranging from approximately 0.89 m to 3.81 m below ground surface. It should be noted that BH27-23 and BH28-23 were drilled in the basement of the subject building on the central portion of the Phase II Property. During the field sampling program, the groundwater was measured at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

A total of seven soil samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHCs (F₁-F₄), metals, Hg⁺, CrVI, PAHs, PCBs, EC, and/or SAR parameters. Based on the analytical test results, the barium concentration detected in soil sample BH15-23-SS4 exceeds the selected MECP Table 7 Coarse-Grained Residential Soil Standard. Given the natural presence of barium, at similar concentrations, within soils of the local area (specifically local clays), barium is not considered to represent an exceedance of MECP standards based on section 49.1 of the regulation. However, management of excess soil containing elevated barium may be limited on acceptance criteria of proposed reuse sites.

Based on the analytical test results, the phenanthrene concentration detected in soil samples BH15-23-SS4 exceeds the CCME Commercial Standard. This elevated concentration is not considered to represent an immediate concern with respect to the use of the property.

It should be noted that the EC and/or SAR exceedances measured in soil samples BH14-23-SS3 and BH15-23-SS4 exceed the selected MECP Table 7 Coarse-Grained Residential Soil Standards. These exceedances are suspected to be the result of the use of road salt on the Phase II Property during snow and ice conditions and thus, as per Section 49.1 of O. Reg 153/04, do not represent a contaminant issue.

Three groundwater samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHC and/or PAH parameters. Based on the analytical test results, no parameter concentrations were detected in the groundwater, as a result the groundwater on the Phase II Property is in compliance with the selected MECP Table 7 Non-Potable Groundwater Standard and CCME Tier 1 Federal Interim Groundwater Water Quality Guidelines for Commercial Sites.

Based on the analytical test results, the groundwater beneath the Phase II Property is not considered to be contaminated.

Recommendations

Soil

Excess soil must be handed in accordance with O. Reg. 406/19: On-Site and Excess Soil Management. Additional excess soil testing and reporting requirements will be required prior to future site excavation activities, in accordance with O. Reg. 406/19.

Management of soil with naturally elevated metals concentrations, or soil with EC/SAR exceedances related to the application of salt, are not considered to be exceedances on-site, however, for off-site management, these materials must be handled within the framework of O.Reg. 406/19 and the excess soil rules.

It is recommended that following the completion of all remediation activities on the eastern portion of the Phase II Property, that all related environmental reports be reviewed and assessed to ensure that no data gaps exist for the purposes of using the information for filing of a Record of Site Condition.

Monitoring Wells

It is recommended that the monitoring wells be maintained for future sampling purposes. The monitoring wells will be registered with the MECP under Ontario Regulation 903 (Ontario Water Resources Act). At such a time that the monitoring wells are no longer required, they must be decommissioned in accordance with O.Reg. 903.

1.0 INTRODUCTION

At the request of Arcadis IBI Group, Paterson Group (Paterson) conducted a Phase II – Environmental Site Assessment (Phase II ESA) for Block 10 of the Tunney's Pasture government office complex, in the City of Ottawa, Ontario (the Phase II Property).

The purpose of this Phase II ESA has been to address the areas of potential environmental concern (APECs) identified on the Phase II Property as a result the findings of the Phase I ESA.

1.1 Site Description

Address: Part of 120 Parkdale Avenue (10, 50 and 70 Columbine Driveway), Block 10, Tunney's Pasture, Ottawa, Ontario.

Location: The Phase II Property is is bounded to the north by Columbine Driveway and to the south by Goldenrod Driveway, in the City of Ottawa, Ontario. Refer to Figure 1 – Key Plan, as well as Drawing PE6040-1 – Site Plan, appended to this report.

Latitude and Longitude: 45° 24' 32" N, 75° 44' 14" W.

Site Description:

Configuration: Irregular.

Area: 5.9 hectares (approximately).

Zoning: MC – Mixed-Use Centre Zone.

Current Use: The central portion of the Phase II Property is occupied by an 18-storey government office building (Brooke Claxton building) and the east portion of the Phase II Property is occupied by a three-storey (with one basement level) government office building (Environmental Health Centre). The west portion of the Phase II Property is occupied by a parking lot.

Services: The Phase II Property is located within a municipally serviced area.

1.2 Property Ownership

The Phase II Property is currently owned by the Government of Canada. Paterson was retained to complete this Phase II ESA by Ms. Catriona Moggach of Arcadis IBI Group, whose office is located at 333 Preston Street, Unit #500, Ottawa, Ontario, and can be contacted via telephone at 613-225-1311.

In 2021, Public Service and Procurement Canada (PSPC) partnered with Canada Lands Company (CLC) under a collaboration project to leverage the strengths of each organization to deliver the long-term vision of Tunney's Pasture that includes the site's transition from a federal employment centre into a mixed-use, sustainable, transit-oriented community. CLC is a self-financing federal Crown corporation specializing in real estate and development with a mandate to transform former Government of Canada properties and reintegrates them into local communities while ensuring their long-term goals. Since the launch of this collaboration project, CLC has been committed to working with the community to define amendments to the TPMP and proposed upgrades to the existing roadway and servicing infrastructure that support both federal priorities and future development.

1.3 Applicable Site Condition Standard

The site condition standards for the Phase II Property were obtained from Table 7 of the document entitled, *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act"*, prepared by the Ministry of the Environment, Conservation and Parks (MECP), and dated April 15, 2011. The selected MECP standards are based on the following considerations:

- ☐ Shallow soil conditions;
- ☐ Coarse-grained soil conditions;
- ☐ Non-potable groundwater conditions;
- ☐ Residential land use.

Grain-size analysis was not conducted as part of this assessment, and as such, the coarse-grained soil standards were selected as a conservative approach.

It should be noted that in addition to the provincial MECP standards, the federal Canadian Council of Ministers of the Environment (CCME) commercial standards were also selected for additional consideration.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The west portion of the Phase II Property, 10 Columbine Driveway (former Health Canada Virus Laboratory) consists of a paved asphaltic concrete parking lot and landscaped areas.

The central portion of the Phase II Property addressed 70 Columbine Driveway consists of a high-rise office building (Brooke Claxton building), several ground floor loading bays that connects to the neighbouring property/building to the east, and a paved asphaltic concrete parking lot with a landscaped area to the north.

The east portion of the Phase II Property addressed 50 Columbine driveway is currently occupied by a three-storey government building (Environmental Health Centre), a ground floor parking structure (larger footprint than the building) that connects to the neighbouring property/building to the west, a paved asphaltic concrete parking lot and landscaped area to the east and north, respectively. It should be noted that at the time of the Phase II ESA, the 50 Columbine Driveway portion of the Phase II Property was undergoing demolition and access was not made available.

The site topography is relatively flat, while the regional topography appears to slope down towards the northwest, in the general direction the Ottawa River. The Phase II Property is considered to be at grade with respect to the surrounding properties.

Water drainage on the Phase II Property occurs via surface run-off towards catch basins present within the parking lot and on the adjacent streets, as well as via infiltration within the landscaped areas.

It should be noted that APEC 3, APEC 4, APEC 5 and APEC 9C on the east portion of the Phase II Property were planned to be assessed as part of the Phase II-ESA, however, due to on-going construction activities, and remediation activities being completed by other consultants in the area, drilling was not possible in this area. Final reports prepared by the other consultants should be reviewed to assess the completion of the remedial activities.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation for this assessment was conducted during the interim of November 15 and 16, 2023 and December 6, 2023 and consisted of drilling four (4) boreholes (BH14-23, BH15-23, BH27-23 and BH28-23) across the Phase II Property. Additionally, three hand auger holes (HA1-23 through HA3-23) were dug on the north-central portion of the Phase II Property. It should be noted that this field investigation was carried out as part of a larger investigation conducted for multiple sites at the Tunney's Pasture complex.

The boreholes were advanced to depths ranging from approximately 0.51 m to 6.2 m below the existing ground surface and terminated within (or at the suspected) the bedrock unit. Bedrock was encountered in three boreholes during the field drilling program at depths ranging from approximately 0.74 m to 3.81 m below ground surface and was inferred in the remaining borehole at a depth of 0.51 m below ground surface.

Upon completion, three boreholes were instrumented with groundwater monitoring wells in order to access the groundwater table. During the field sampling programs, the groundwater was measured at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

3.2 Media Investigated

During the course of this subsurface investigation, soil and groundwater samples were obtained from the Phase II Property and submitted for laboratory analysis. The rationale for sampling and analyzing these media is based on the contaminants of potential concern identified in the Phase I ESA.

The contaminants of potential concern for the soil and/or groundwater on the Phase II Property include the following:

- ☐ Benzene, Ethylbenzene, Toluene, and Xylenes (BTEX);
- ☐ Petroleum Hydrocarbons, fractions 1 – 4 (PHCs F₁-F₄);
- ☐ Polycyclic Aromatic Hydrocarbons (PAHs);
- ☐ Polychlorinated Biphenyls (PCBs);
- ☐ Metals (including Arsenic, Antimony, and Selenium);

- ☐ Mercury (Hg^+);
- ☐ Hexavalent Chromium (CrVI);
- ☐ Electrical Conductivity (EC);
- ☐ Sodium Adsorption Ratio (SAR).

These CPCs have the potential to be present in the soil matrix and/or the groundwater situated beneath the Phase II Property.

3.3 Phase I ESA Conceptual Site Model

Geological and Hydrogeological Setting

Based on the available mapping information, the bedrock beneath the Phase II Property generally consists of interbedded limestone and dolomite of the Gull River and Bobcaygeon Formations. The surficial geology consists of primarily Paleozoic bedrock and small areas of sand dunes and till, with an overburden ranging from approximately 0 m to 3 m in thickness.

Groundwater is anticipated to be encountered within the bedrock and flow in a northerly direction towards the Ottawa River.

Water Bodies and Areas of Natural and Scientific Interest

No water bodies are present on the Phase II Property. The nearest named water body with respect to the Phase II Property is the Ottawa River, located approximately 230 m to the north.

No areas of natural and scientific interest are present on the Phase II Property or within the Phase I Study Area.

Drinking Water Wells

Based on the availability of municipal services, no potable drinking water wells are anticipated to remain in use within the Phase I Study Area.

Existing Buildings and Structures

The portion of the Phase II Property addressed 70 Columbine Driveway is occupied by an 18-storey high rise office building with a ground floor parking structure (connected to the Environmental Health Centre) and one-storey basement. Built in the mid 1960's, the Brooke Claxton building is constructed with a concrete foundation and is finished on the exterior with steel and pre-cast concrete panels, in addition to a modified bituminous style roof. The building is currently heated via a natural gas-fired boiler system, supplied from the Tunney's Pasture Central Heating and Cooling plant approximately 250 m to the south.

The portion of the Phase II Property addressed 50 Columbine Driveway is occupied by a three-storey government building with a penthouse, a ground floor parking structure (connected to the Brooke Claxton building) and a single-storey basement. Built in the mid 1960's, the Environmental Health Centre is constructed with a concrete foundation and is finished on the exterior with metal and pre-cast concrete panels, in addition to a modified bituminous style roof. The building was in the process of being deconstructed at the time of the site inspection and is assumed to not currently be serviced.

Current and Future Property Use

The Phase II Property is currently occupied by an asphalt-covered vehicular parking lot, with some landscaped areas.

The central portion of the Phase II Property is currently occupied by a high-rise office building (Brooke Claxton building) and the east portion with a government building (Environmental Health Centre), the buildings are connected on the ground level via a parking structure. The west portion of the Phase II Property consists of asphalt-covered vehicular parking lot, with some landscaped areas.

It is our understanding that the Phase II Property may be redeveloped for residential purposes in the future. Due to a change in land use to a more sensitive type (commercial to residential), a record of site condition (RSC) will need to be filed with the MECP.

Neighbouring Land Use

The surrounding lands within the Phase I Study Area consist largely of commercial and government properties. Current land use is depicted on Drawing PE6040-2 – Surrounding Land Use Plan, in the Figures section of this report.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per Section 7.1 of the Phase I ESA report, nine potentially contaminating activities (PCAs), resulting in nine areas of potential environmental concern (APECs), were identified on the Phase II Property. These APECs include:

- ☐ Item 28: Gasoline and Associated Products Storage in Fixed Tanks; associated with the presence of the former on-site USTs and former/existing on-site ASTs (APEC 1, APEC 2 and APEC 4 to APEC 6).
- ☐ Item N/A: Known Area of PHC, BTEX and/or PAH Impacted Soil and Groundwater; associated with the known impacted soil and groundwater plume resultant from a former leaking UST (APEC 3).
- ☐ Item 55: Transformer Manufacturing, Processing and Use; associated with the presence of the two existing on-site transformers (APEC 7).
- ☐ Item 30: Importation of Fill Material of Unknown Quality; associated with the potential presence of poor quality fill material used for grading purposes, located throughout the Phase II Property (APEC 8).
- ☐ Item N/A: Application of Road Salt for De-icing Purposes During Snow and Ice Conditions; associated with the use of road salt throughout the asphalt-covered parking lot occupying the western, north-central and eastern portions of the Phase II Property (APEC 9).

Two other off-site PCAs (associated with the same property) were identified within the Phase I Study Area but were deemed not to be of any environmental concern to the Phase II Property based on the separation distance and inferred cross-gradient orientation with respect to the known groundwater flow to the north.

Contaminants of Potential Concern

The contaminants of potential concern (CPCs) associated with the aforementioned APECs are considered to be:

- ☐ Benzene, Ethylbenzene, Toluene, and Xylenes (BTEX);
- ☐ Petroleum Hydrocarbons, fractions 1 – 4 (PHCs F₁-F₄);

- ☐ Polycyclic Aromatic Hydrocarbons (PAHs);
- ☐ Polychlorinated Biphenyls (PCBs);
- ☐ Metals (including Arsenic, Antimony, and Selenium);
- ☐ Mercury (Hg^+);
- ☐ Hexavalent Chromium (CrVI);
- ☐ Electrical Conductivity (EC);
- ☐ Sodium Adsorption Ratio (SAR).

These CPCs have the potential to be present in the soil matrix and/or the groundwater situated beneath the Phase II Property.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of this Phase I ESA is considered to be sufficient to conclude that there are PCAs and APECs associated with the Phase II Property.

The presence of any PCAs was confirmed by a variety of independent sources, and as such, the conclusions of this report are not affected by uncertainty which may be present with respect to the individual sources.

3.4 Deviations from the Sampling and Analysis Plan

Two deviations were encountered during the program:

- APEC3, APEC4, APEC5 and APEC9C were planned to be assessed as part of the Phase II-ESA, however, due to on-going construction activities, and remediation activities being completed by other consultants in the area, drilling was not possible in this area. Final reports prepared by the other consultants should be reviewed to assess the completion of the remedial activities.
- APEC6 was addressed by hand auger sampling, instead of a borehole, due to buried services. Based on the state of the aboveground storage tank (associated with APEC6) being clean and showing no signs of leaking, hand auger samples were considered sufficient to address this APEC.

3.5 Physical Impediments

No physical impediments were encountered during the course of the field drilling program.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation for this assessment was conducted on November 15, 2023 and December 6, 2023 and consisted of drilling four (4) boreholes (BH14-23, BH15-23, BH27-23 and BH28-23) across the Phase II Property. Additionally, three hand auger holes were dug on the north portion of the Phase II Property on November 16, 2023. It should be noted that this field investigation was carried out as part of a larger investigation conducted for multiple sites at the Tunney's Pasture complex.

The boreholes were advanced to depths ranging from approximately 6.17 m to 6.20 m below the existing ground surface and terminated within the bedrock unit, with the exception of BH28-23 which was terminated at a depth of 0.51. Bedrock was encountered in BH13-23, BH14-23 and BH27-23 during the field drilling program at depths ranging from approximately 0.89 m to 3.81 m below ground surface.

Upon completion, BH13-23, BH14-23 and BH27-23 were instrumented with groundwater monitoring wells in order to access the groundwater table. During the field sampling program, the groundwater was measured at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

Under the full-time supervision of Paterson personnel, the boreholes were drilled using a track-mounted drill rig provided by Marathon Underground Constructors Corporation of Greely, Ontario. The locations of the boreholes are illustrated on Drawing PE6040-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

Soil sampling protocols were followed using the MECP document entitled, *"Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario"*, dated May 1996.

The samples were recovered using a stainless-steel split spoon, while wearing protective gloves (changed after each sample), and immediately placed into plastic bags. If significant contamination was encountered, the samples were instead

placed into glass jars. Sampling equipment was routinely washed in soapy water and rinsed with methylhydrate after each split spoon to prevent any cross contamination of the samples. The samples were also stored in coolers to reduce analyte volatilization during transportation.

A total of 13 soil samples were obtained from the boreholes by means of auger and split spoon sampling. The depths at which auger, split spoon, and rock core samples were obtained from the boreholes are shown as “**AU**”, “**SS**”, and “**RC**” respectively, on the Soil Profile and Test Data Sheets, appended to this report.

4.3 Field Screening Measurements

All soil samples collected were subjected to a preliminary screening procedure, which included visual screening for colour and evidence of metals, as well as soil vapour screening with a Photo Ionization Detector.

The recovered soil samples were placed immediately into airtight plastic bags with nominal headspace. All lumps of soil inside the bags were broken by hand, and the soil was allowed to come to room temperature prior to conducting the vapour survey, ensuring consistency of readings between samples. To measure the soil vapours, the analyser probe was inserted into the nominal headspace above the sample. The sample was then agitated and manipulated gently by hand as the measurement was taken. The peak reading registered within the first 15 seconds was recorded as the vapour measurement. The parts per million (ppm) scale was used to measure concentrations of organic vapours.

The maximum vapour reading was 1.4 ppm in the soil samples obtained. These results were not considered to be indicative of potential significant contamination from volatile contaminants.

The results of the vapour survey are presented on the Soil Profile and Test Data Sheets, appended to this report.

4.4 Groundwater Monitoring Well Installation

Three groundwater monitoring wells were installed on the Phase II Property as part of this assessment. These monitoring wells were constructed using 32 mm diameter Schedule 40 threaded PVC risers and screens. A sand pack consisting of silica sand was placed around the screen with a bentonite seal placed above to minimize cross-contamination.

The ground surface elevations of each borehole were subsequently surveyed with respect to a known geodetic elevation.

A summary of the monitoring well construction details are listed below in Table 1 as well as on the Soil Profile and Test Data Sheets provided in Appendix 1.

Table 1 Monitoring Well Construction Details						
Well ID	Ground Surface Elevation (m ASL)	Total Depth (m BGS)	Screened Interval (m BGS)	Sand Pack (m BGS)	Bentonite Seal (m BGS)	Casing Type
BH14-23	62.11	6.17	3.12 – 6.17	2.82 – 6.17	0.00 – 2.82	Flushmount
BH15-23	62.57	6.20	3.15 – 6.20	2.85 – 6.20	0.00 – 2.85	Flushmount
BH27-23	57.43	5.38	2.33 – 5.38	1.93 – 5.38	0.00 – 1.93	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater monitoring and sampling was conducted on-site on December 11, 2023. At this time, water quality parameters were measured in the field using a multi-parameter analyzer. Parameters measured in the field included temperature, pH and electrical conductivity.

Field parameters were measured after each well volume purged. Wells were purged prior to sampling until at least three well volumes had been removed or the field parameters were relatively stable. The monitoring well in BH14-23 could not be accessed at the time of the December 2023 sampling event due to water having infiltrated the flushmount and freezing. The groundwater recovered from BH15-23 was unable to be tested for field parameters due to a high amount of sediment. Stabilized field parameter values are summarized in Table 2.

Table 2 Measurement of Water Quality Parameters			
Well ID	Temperature (°C)	Conductivity (µS)	pH (Units)
BH27-23	9.1	2126	7.81

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MECP document entitled, *“Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario”*, dated May 1996.

Standing water was purged from each monitoring well prior to the recovery of the groundwater samples using dedicated sampling equipment. The samples were then stored in coolers to reduce possible analyte volatilization during their transportation. Further details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan, appended to this report.

4.7 Analytical Testing

The following soil and groundwater samples were submitted for laboratory analysis:

Table 3 Testing Parameters for Submitted Soil Samples									
Sample ID	Sample Depth & Stratigraphic Unit	Parameters Analyzed							Rationale
		BTEX	PHCs (F ₁ -F ₄)	Metals ¹	PAHs	EC	SAR	PCBs	
BH14-23-SS3	Fill Material 1.52 – 2.13 m	X	X	X	X	X	X		To assess for potential soil impacts resulting from the presence of fill material of unknown quality and the use of road salt for de-icing purposes, and for excess soil qualification purposes.
BH15-23-SS4	Fill Material 2.29 – 2.90 m	X	X	X	X	X	X		To assess for potential soil impacts resulting from the former on-site heating oil UST, the presence of fill material of unknown quality and the use of road salt for de-icing purposes, and for excess soil qualification purposes.
HA1-23	Fill Material 0.00 – 0.30 m	X	X						To assess for potential soil impacts resulting from the existing on-site diesel AST
HA3-23	Fill Material 0.00 – 0.30 m	X	X						To assess for potential soil impacts resulting from the existing on-site diesel AST
BH27-23-AU1	Fill Material 0.18 – 0.25 m	X	X						To assess for potential soil impacts resulting from the existing on-site colored diesel ASTs
BH28-23-AU1	Fill Material 0.15 – 0.30 m	X	X					X	To assess for potential soil impacts resulting from the

Table 3									
Testing Parameters for Submitted Soil Samples									
Sample ID	Sample Depth & Stratigraphic Unit	Parameters Analyzed							Rationale
		BTEX	PHCs (F ₁ -F ₄)	Metals ¹	PAHs	EC	SAR	PCBs	
									existing on-site liquid phase transformers
DUP1 ²	Fill Material 0.18 – 0.25 m	X							For laboratory QA/QC purposes.
1 – Includes Mercury and Hexavalent Chromium									
2 – Duplicate sample of BH27-23-AU1									

Table 4					
Testing Parameters for Submitted Groundwater Samples					
Sample ID	Screened Interval & Stratigraphic Unit	Parameters Analyzed			Rationale
		BTEX	PHCs (F ₁ -F ₄)	PAHs	
BH15-23-GW1	Bedrock 3.15 m – 6.20 m	X	X	X	To assess for potential groundwater impacts resulting from the former on-site heating oil UST.
BH27-23-GW1	Bedrock 2.33 m – 5.38 m	X	X		To assess for potential groundwater impacts resulting from the existing on-site colored diesel ASTs
DUP-1-X ¹	Bedrock 3.15 m – 6.20 m	X	X		For laboratory QA/QC purposes.
1 – Duplicate sample of BH15-23-GW1					

Paracel Laboratories (Paracel), of Ottawa, Ontario, performed the laboratory analysis on the samples submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Laboratory Accreditation (SCC/CALA) and is accredited and certified by the SCC/CALA for specific tests registered with the association.

4.8 Residue Management

All soil cuttings were removed from the site following the field program, while all purge water and equipment cleaning fluids were retained on-site.

4.9 Elevation Surveying

The ground surface elevations at each borehole location were surveyed using a GPS device by Paterson personnel and referenced to a geodetic datum.

4.10 Quality Assurance and Quality Control Measures

A summary of the quality assurance and quality control (QA/QC) measures, undertaken as part of this assessment, is provided in the Sampling and Analysis Plan in Appendix 1.

5.0 REVIEW AND EVALUATION

5.1 Geology

In general, the subsurface soil profile encountered at the borehole locations consists of either a thin pavement structure (asphaltic concrete over granular fill) or a concrete slab (over granular fill), underlain by fill material (consisting of brown silty sand or clay with varying amounts of gravel, cobbles and crushed stone). Trace amounts of brick and concrete were encountered in BH15-23 in the fill layer from approximately 0.60 m to 3.81 m below ground surface. Bedrock was encountered in three boreholes during the field drilling program at depths ranging from approximately 0.89 m to 3.81 m below ground surface. It should be noted that BH27-23 and BH28-23 were drilled in the basement of the subject building on the central portion of the Phase II Property.

Site geology details are provided in the Soil Profile and Test Data Sheets in Appendix 1.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured using an electronic water level meter on November 10, 2023 and December 11, 2023. The groundwater levels are summarized below in Table 5.

Table 5 Groundwater Level Measurements				
Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH14-23	62.11	3.77	58.34	November 10, 2023
BH15-23	62.57	6.14	56.43	
BH15-23	62.57	5.52	57.05	
BH27-23	57.43	2.46	54.97	December 11, 2023

The groundwater at the Phase II Property was encountered within the limestone bedrock at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

No unusual visual observations were identified within the recovered groundwater samples.

Using groundwater elevations recorded from both sampling events, groundwater contour mapping was completed as part of this assessment. According to the mapped contour data, illustrated on Drawing PE6040-3 – Test Hole Location Plan in the appendix, the groundwater flow on the Phase II Property was calculated to be in an easterly direction. A horizontal hydraulic gradient of approximately 0.016 m/m was also calculated as part of this assessment. Locally, groundwater flow direction is expected to be in a northern direction, and this discrepancy may be a result of having groundwater monitoring wells influenced by the subject building (notably BH27-23 and BH28-23, which are located inside the building). It should be noted that groundwater levels are expected to fluctuate throughout the year with seasonal variations.

5.3 Fine/Coarse Soil Texture

Grain size analysis was not completed as part of this investigation. As a result, the coarse-grained soil standards were chosen as a conservative approach.

5.4 Field Screening

Field screening of the soil samples collected during the drilling program resulted in organic vapour readings ranging from 0.0 ppm to 1.4 ppm, indicating that there is a negligible potential for the presence of volatile substances. Field screening results of each individual soil sample are provided on the Soil Profile and Test Data Sheets appended to this report.

5.5 Soil Quality

A total of seven soil samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHCs (F₁-F₄), metals, Hg⁺, CrVI, PAHs, PCBs, EC, and/or SAR parameters. The results of the analytical testing are presented below in Tables 6 to 10, as well as on the laboratory Certificates of Analysis included in Appendix 1.

Table 6							
Analytical Test Results – Soil							
BTEX & PHCs							
Parameter	MDL (µg/g)	Soil Samples (µg/g)				MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse- Grained Commercial Standards (µg/g)
		November 15, 2023					
		BH14-23-SS3	BH15-23-SS4	HA1-23	HA3-23		
		Sample Depth (m bgs)					
		1.52 – 2.13 m	2.29 – 2.90 m	0.00 – 0.30 m	0.00 – 0.30 m		
Benzene	0.02	nd	nd	nd	nd	0.21	0.03
Ethylbenzene	0.05	nd	nd	nd	nd	2	0.082
Toluene	0.05	nd	nd	nd	nd	2.3	0.37
Xylenes	0.05	nd	nd	nd	nd	3.1	11
PHCs F ₁	7	nd	nd	nd	nd	55	240
PHCs F ₂	4	nd	nd	nd	nd	98	260
PHCs F ₃	8	nd	nd	nd	nd	300	1,700
PHCs F ₄	6	nd	nd	nd	nd	2,800	3,300
Notes:							
☐ MDL – Method Detection Limit							
☐ nd – not detected above the MDL							
☐ nt – not tested for this parameter							
☐ N/A – not applicable (no standard for this parameter)							
☐ Underlined – value exceeds selected CCME standards							
☐ Bold and Underlined – value exceeds selected MECP standards							

Table 6 Continued						
Analytical Test Results – Soil						
BTEX & PHCs						
Parameter	MDL (µg/g)	Soil Samples (µg/g)			MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse- Grained Commercial Standards (µg/g)
		December 6, 2023				
		BH27-23-AU1	BH28-23-AU1	DUP1 ¹		
		Sample Depth (m bgs)				
		0.18 – 0.25 m	0.15 – 0.30 m	0.18 – 0.25 m		
Benzene	0.02	nd	nd	nd	0.21	0.03
Ethylbenzene	0.05	nd	nd	nd	2	0.082
Toluene	0.05	nd	nd	nd	2.3	0.37
Xylenes	0.05	nd	nd	nd	3.1	11
PHCs F ₁	7	nd	nd	nd	55	240
PHCs F ₂	4	nd	nd	nd	98	260
PHCs F ₃	8	nd	49	nd	300	1,700
PHCs F ₄	6	nd	130	nd	2,800	3,300
Notes:						
☐ MDL – Method Detection Limit						
☐ nd – not detected above the MDL						
☐ nt – not tested for this parameter						
☐ N/A – not applicable (no standard for this parameter)						
☐ Underlined – value exceeds selected CCME standards						
☐ Underlined – value exceeds selected MECP standards						
☐ 1- Duplicate of sample BH27-23-AU1						

All detected BTEX and PHC parameter concentrations in the soil samples analyzed comply with the selected MECP Table 7 Coarse-Grained Residential Soil Standards and the CCME Coarse-Grained Commercial Soil Standards.

Table 7					
Analytical Test Results – Soil Metals					
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse-Grained Commercial Standards (µg/g)
		November 15, 2023			
		BH14-23-SS3	BH15-23-SS4		
		Sample Depth (m bgs)			
		1.52 – 2.13 m	2.29 – 2.90 m		
Antimony	1.0	nd	nd	7.5	40
Arsenic	1.0	2	4	18	12
Barium	1.0	351	640	390	2,000
Beryllium	0.5	0.6	0.9	4	8
Boron	5.0	28.7	21.3	120	N/A
Cadmium	0.5	nd	nd	1.2	22
Chromium	5.0	21	34	160	87
Chromium (VI)	0.2	nd	nd	8	1.4
Cobalt	1.0	8	10	22	300
Copper	5.0	17	18	140	91
Lead	1.0	8	32	120	260
Mercury	0.1	nd	nd	0.27	24
Molybdenum	1.0	nd	nd	6.9	40
Nickel	5.0	15	23	100	89
Selenium	1.0	nd	nd	2.4	2.9

Table 7					
Analytical Test Results – Soil Metals					
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse-Grained Commercial Standards (µg/g)
		November 15, 2023			
		BH14-23-SS3	BH15-23-SS4		
		Sample Depth (m bgs)			
		1.52 – 2.13 m	2.29 – 2.90 m		
Silver	0.3	nd	nd	20	40
Thallium	1.0	nd	nd	1	1
Tin	5.0	nd	nd	300	300
Uranium	1.0	nd	nd	33	33
Vanadium	10.0	26	40	130	130
Zinc	20.0	30	72	410	410
Notes:					
☐ MDL – Method Detection Limit					
☐ nd – not detected above the MDL					
☐ nt – not tested for this parameter					
☐ N/A – not applicable (no standard for this parameter)					
☐ <u>Underlined</u> – value exceeds selected CCME standards					
☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards					

All detected metal parameter concentrations in the soil samples analyzed comply with the selected MECP Table 7 Coarse-Grained Residential Soil Standards, with the exception of barium in sample BH15-23-SS4. All detected metal parameter concentrations in the soil samples analyzed comply with the CCME Coarse-Grained Commercial Soil Standards.

Table 8					
Analytical Test Results – Soil PAHs					
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse- Grained Commercial Standards (µg/g)
		November 15, 2023			
		BH14-23-SS3	BH15-23-SS4		
		Sample Depth (m bgs)			
		1.52 – 2.13 m	2.29 – 2.90 m		
Acenaphthene	0.02	nd	nd	7.9	0.28
Acenaphthylene	0.02	nd	nd	0.15	320
Anthracene	0.02	nd	nd	0.67	32
Benzo[a]anthracene	0.02	nd	nd	0.5	10
Benzo[a]pyrene	0.02	nd	nd	0.3	72
Benzo[b]fluoranthene	0.02	nd	0.05	0.78	10

Table 8					
Analytical Test Results – Soil PAHs					
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse-Grained Commercial Standards (µg/g)
		November 15, 2023			
		BH14-23-SS3	BH15-23-SS4		
		Sample Depth (m bgs)			
		1.52 – 2.13 m	2.29 – 2.90 m		
Benzo[g,h,i]perylene	0.02	nd	0.09	6.6	N/A
Benzo[k]fluoranthene	0.02	nd	0.06	0.78	10
1,1-Biphenyl	0.02	nd	0.06	0.31	N/A
Chrysene	0.02	nd	0.04	7	N/A
Dibenzo[a,h]anthracene	0.02	nd	0.04	0.1	10
Fluoranthene	0.02	nd	nd	0.69	180
Fluorene	0.02	nd	0.07	62	0.25
Indeno [1,2,3-cd] pyrene	0.02	nd	nd	0.38	10
1-Methylnaphthalene	0.02	nd	0.23	0.99	N/A
2-Methylnaphthalene	0.02	nd	nd	0.99	N/A
Methylnaphthalene (1&2)	0.04	nd	0.04	0.99	N/A
Naphthalene	0.01	nd	nd	0.6	0.013
Phenanthrene	0.02	nd	<u>0.13</u>	6.2	0.046
Pyrene	0.02	nd	0.18	78	100
Quinoline	0.10	nd	nd	N/A	N/A
Notes:					
☐ MDL – Method Detection Limit					
☐ nd – not detected above the MDL					
☐ nt – not tested for this parameter					
☐ N/A – not applicable (no standard for this parameter)					
☐ Underlined – value exceeds selected CCME standards					
☐ Bold and Underlined – value exceeds selected MECP standards					

All detected PAH parameter concentrations in the soil samples analyzed comply with the selected MECP Table 7 Coarse-Grained Residential Soil Standards. All detected PAH parameter concentrations in the soil samples analyzed comply with the CCME Coarse-Grained Commercial Soil Standards, with the exception of phenanthrene in sample BH15-23-SS4.

Table 9				
Analytical Test Results – Soil PCBs				
Parameter	MDL (µg/g)	Soil Samples (µg/g)	MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse- Grained Commercial Standards (µg/g)
		December 6, 2023		
		BH28-23-AU1		
		Sample Depth (m bgs)		
		0.15 – 0.30 m		
PCBs, total	0.05	nd	0.35	33

Table 9				
Analytical Test Results – Soil PCBs				
Parameter	MDL (µg/g)	Soil Samples (µg/g)	MECP Table 7 Coarse-Grained Residential Soil Standards (µg/g)	CCME Coarse-Grained Commercial Standards (µg/g)
		December 6, 2023		
		BH28-23-AU1		
		Sample Depth (m bgs)		
		0.15 – 0.30 m		
Notes: ☐ MDL – Method Detection Limit ☐ nd – not detected above the MDL ☐ nt – not tested for this parameter ☐ N/A – not applicable (no standard for this parameter) ☐ <u>Underlined</u> – value exceeds selected CCME standards ☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards				

No PCB concentration was identified in the soil sample submitted for analysis, as a result the sample complies with both the MECP Table 7 Coarse-Grained Residential Soil Standards and the CCME Coarse-Grained Commercial Soil Standards.

Table 10					
Analytical Test Results – Soil					
Inorganic Parameters					
Parameter	MDL (units)	Soil Samples (µg/g)		MECP Table 7 Coarse- Grained Residential Soil Standards (units)	CCME Coarse- Grained Commercial Standards (units)
		November 15, 2023			
		BH14-23-SS3	BH15-23-SS4		
		Sample Depth (m bgs)			
		1.52 – 2.13 m	2.29 – 2.90 m		
SAR	0.01 Units	<u>9.50</u>	1.39	5	12
EC	5 µS/cm	<u>1,550</u>	<u>1,050</u>	700	4,000
Notes:					
☐ MDL – Method Detection Limit					
☐ nd – not detected above the MDL					
☐ nt – not tested for this parameter					
☐ N/A – not applicable (no standard for this parameter)					
☐ <u>Underlined</u> – value exceeds selected CCME standards					
☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards					

The EC and/or SAR exceedances measured in samples BH14-23-SS3 and BH15-23-SS4 exceed the selected MECP Table 7 Coarse-Grained Residential Soil Standards. These exceedances are suspected to be the result of the use of road salt on the Phase II Property during snow and ice conditions and thus, as per Section 49.1 of O. Reg 153/04, do not represent a contaminant issue.

All EC and SAR levels measured in the soil samples analyzed comply with the selected CCME Coarse-Grained Commercial Soil Standards.

Table 11
Maximum Concentrations – Soil

Parameter	Maximum Concentration (µg/g)	Sample ID	Depth Interval (m BGS)
PHCs F ₃	49	BH28-23-AU1	0.15 – 0.30 m
PHCs F ₄	130	BH28-23-AU1	0.15 – 0.30 m
Arsenic	4	BH15-23-SS4	2.29 – 2.90 m
Barium	640	BH15-23-SS4	2.29 – 2.90 m
Beryllium	0.9	BH15-23-SS4	2.29 – 2.90 m
Boron	28.7	BH14-23-SS3	1.52 – 2.13 m
Chromium	34	BH15-23-SS4	2.29 – 2.90 m
Cobalt	10	BH15-23-SS4	2.29 – 2.90 m
Copper	18	BH15-23-SS4	2.29 – 2.90 m
Lead	32	BH15-23-SS4	2.29 – 2.90 m
Nickel	23	BH15-23-SS4	2.29 – 2.90 m
Vanadium	40	BH15-23-SS4	2.29 – 2.90 m
Zinc	72	BH15-23-SS4	2.29 – 2.90 m
Anthracene	0.05	BH15-23-SS4	2.29 – 2.90 m
Benzo[a]anthracene	0.09	BH15-23-SS4	2.29 – 2.90 m
Benzo[a]pyrene	0.06	BH15-23-SS4	2.29 – 2.90 m
Benzo[b]fluoranthene	0.06	BH15-23-SS4	2.29 – 2.90 m
Benzo[g,h,i]perylene	0.04	BH15-23-SS4	2.29 – 2.90 m
Benzo[k]fluoranthene	0.04	BH15-23-SS4	2.29 – 2.90 m
Chrysene	0.07	BH15-23-SS4	2.29 – 2.90 m
Fluoranthene	0.23	BH15-23-SS4	2.29 – 2.90 m
Indeno[1,2,3-cd]pyrene	0.04	BH15-23-SS4	2.29 – 2.90 m
Phenanthrene	0.13	BH15-23-SS4	2.29 – 2.90 m
Pyrene	0.18	BH15-23-SS4	2.29 – 2.90 m
Electrical Conductivity	1,550	BH14-23-SS3	1.52 – 2.13 m
Sodium Adsorption Ratio	9.50	BH14-23-SS3	1.52 – 2.13 m
Notes:			
☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards			

All other parameter concentrations analyzed were below the laboratory detection limits.

5.6 Groundwater Quality

Three groundwater samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHC and/or PAH parameters. The results of the analytical testing are presented below in Table 12 to Table 13, as well as on the laboratory Certificates of Analysis included in Appendix 1.

Table 12						
Analytical Test Results – Groundwater						
BTEX & PHCs						
Parameter	MDL (µg/L)	Groundwater Samples (µg/L)			MECP Table 7 Non-Potable Groundwater Soil Standards (µg/L)	CCME Tier 1 FIGWQG Commercial Standards (µg/L)
		December 11, 2023				
		BH15-23-GW1	BH27-23-GW1	DUP-1-X ¹		
		Sample Depth (m bgs)				
		3.15 – 6.20 m	2.33 – 5.38 m	3.15 – 6.20 m		
Benzene	0.05	nd	nd	nd	0.5	88
Ethylbenzene	0.05	nd	nd	nd	54	3,200
Toluene	0.05	nd	nd	nd	320	83
Xylenes	0.05	nd	nd	nd	72	3,900
PHCs F ₁	25	nd	nd	nd	420	810
PHCs F ₂	100	nd	nd	nd	150	1,300
PHCs F ₃	100	nd	nd	nd	500	N/A
PHCs F ₄	100	nd	nd	nd	500	N/A
Notes:						
☐ MDL – Method Detection Limit						
☐ nd – not detected above the MDL						
☐ nt – not tested for this parameter						
☐ N/A – not applicable (no standard for this parameter)						
☐ <u>Underlined</u> – value exceeds selected CCME standards						
☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards						
☐ 1 - Duplicate of sample BH15-23-GW1						

No BTEX or PHC parameter concentrations were detected above the laboratory method detection limits in any of the samples analyzed. The results comply with the MECP Table 7 Non-Potable Groundwater Standards as well as the CCME Tier 1 Federal Interim Groundwater Water Quality Guidelines for Commercial Sites.

Table 13
Analytical Test Results – Groundwater
PAHs

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)	MECP Table 7 Non-Potable Groundwater Soil Standards (µg/L)	CCME Tier 1 FIGWQG Commercial Standards (µg/L)
		December 11, 2023		
		BH15-23-GW1		
		Sample Depth (m bgs)		
		3.15 – 6.20 m		
Acenaphthene	0.05	nd	17	5.8
Acenaphthylene	0.05	nd	1	46
Acridine	0.10	nd	N/A	0.05
Anthracene	0.01	nd	1	0.012
Benzo[a]anthracene	0.01	nd	1.8	0.018
Benzo[a]pyrene	0.01	nd	0.81	0.015
Benzo[b]fluoranthene	0.05	nd	0.75	N/A
Benzo[g,h,i]perylene	0.05	nd	0.2	0.17
Benzo[k]fluoranthene	0.05	nd	0.4	0.48
1,1-Biphenyl	0.05	nd	1,000	N/A
Chrysene	0.05	nd	0.7	0.1
Dibenzo[a,h]anthracene	0.05	nd	0.4	0.26
Fluoranthene	0.01	nd	44	0.04
Fluorene	0.05	nd	290	3
Indeno [1,2,3-cd] pyrene	0.05	nd	0.2	0.21
1-Methylnaphthalene	0.05	nd	1,500	1,500
2-Methylnaphthalene	0.05	nd	1,500	1,500
Methylnaphthalene (1&2)	0.10	nd	1,500	180
Naphthalene	0.05	nd	7	1.1
Phenanthrene	0.05	nd	380	0.4
Pyrene	0.01	nd	5.7	0.025
Quinoline	0.10	nd	N/A	3.4
Notes: ☐ MDL – Method Detection Limit ☐ nd – not detected above the MDL ☐ nt – not tested for this parameter ☐ N/A – not applicable (no standard for this parameter) ☐ <u>Underlined</u> – value exceeds selected CCME standards ☐ <u>Bold and Underlined</u> – value exceeds selected MECP standards				

No PAH parameter concentrations were detected above the laboratory method detection limits in the groundwater sample analyzed. The results are in compliance with the MECP Table 7 Non-Potable Groundwater Standards as well as the CCME Tier 1 Federal Interim Groundwater Water Quality Guidelines for Commercial Sites.

All parameter concentrations analyzed in the groundwater samples were below the laboratory detection limits. As a result, there are no maximum concentrations to report.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of this Phase II ESA were handled in accordance with the analytical protocols with respect to holding time, preservation method, storage requirement, and container type.

As per Subsection 47(3) of O. Reg. 153/04, as amended by the Environmental Protection Act, the certificates of analysis have been received for each sample submitted for laboratory analysis and have been appended to this report.

As per the Sampling and Analysis Plan, a duplicate soil sample was obtained from sample BH27-23-AU1 and submitted for laboratory analysis of BTEX and PHC parameters. No parameter concentrations were detected in either the original or the duplicate samples above the laboratory method detection limits, and as such, they are considered to meet the data quality objectives outlined in the Sampling and Analysis Plan, appended to this report.

Similarly, a duplicate groundwater sample was obtained from sample BH15-23-GW1 and submitted for laboratory analysis of BTEX and PHC parameters. No parameter concentrations were detected in either the original or the duplicate samples above the laboratory method detection limits, and as such, they are considered to meet the data quality objectives outlined in the Sampling and Analysis Plan, appended to this report.

Based on the results of the QA/QC analysis, the quality of the field data collected during this Phase II ESA is considered to be sufficient to meet the overall objectives of this assessment.

5.8 Phase II Conceptual Site Model

The following section has been prepared in accordance with the requirements of O. Reg. 153/04 amended by the Environmental Protection Act. For the purposes of the proposed uses of this Phase II Property, the Phase II Conceptual Site Model was prepared with consideration for O.Reg. 153/04 only. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activity and Areas of Potential Environmental Concern

As described in Section 7.1 of the Phase I ESA report, the following PCAs, as defined by Table 2 of O. Reg. 153/04, are considered to result in APECs on the Phase II Property:

Table 14 Areas of Potential Environmental Concern					
Area of Potential Environmental Concern	Location of APEC on Phase I Property	Potentially Contaminating Activity (Table 2 – O. Reg. 153/04)	Location of PCA (On-Site or Off-Site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 1 Three Existing On-Site Coloured Diesel Aboveground Storage Tanks (and associated vent and fill pipes x 2)	South-central portion of Phase II Property	<i>"Item 28: Gasoline and Associated products Storage in Fixed Tanks"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX	Soil and Groundwater
APEC 2 Former On-Site Heating Oil Underground Storage Tank	West-central portion of Phase II Property	<i>"Item 28: Gasoline and Associated products Storage in Fixed Tanks"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX PAHs	Soil and Groundwater
APEC 3 On-Site Impacted Soil and Groundwater Plume	East portion of Phase II Property	<i>"Item N/A: Known Impacted Groundwater Plume"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX PAHs	Groundwater

Table 14 Areas of Potential Environmental Concern					
Area of Potential Environmental Concern	Location of APEC on Phase I Property	Potentially Contaminating Activity (Table 2 – O. Reg. 153/04)	Location of PCA (On-Site or Off-Site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 4 Former On-Site Diesel Underground Storage Tank and Existing On-Site Aboveground Storage Tank	Southeast portion of Phase II Property	<i>"Item 28: Gasoline and Associated products Storage in Fixed Tanks"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX	Soil and Groundwater
APEC 5 Former On-Site Diesel Underground Storage Tank	Southeast portion of Phase II Property	<i>"Item 28: Gasoline and Associated products Storage in Fixed Tanks"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX	Soil and Groundwater
APEC 6 Existing On-Site Diesel Aboveground Storage Tank	South portion of Phase II Property	<i>"Item 28: Gasoline and Associated products Storage in Fixed Tanks"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX	Soil and Groundwater
APEC 7 Existing On-Site Liquid Phase Transformers (x2)	South-central portion of Phase II Property	<i>"Item 55: Transformer Manufacturing, Processing and Use"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX PCBs	Soil
APEC 8 Fill Material of Unknown Quality	Entirety of Phase II Property	<i>"Item 30: Importation of Fill Material of Unknown Quality"</i>	On-Site	PHCs (F ₁ -F ₄) BTEX Metals PAHs	Soil
APEC 9 Application of Road Salt	Within parking areas of Phase II Property	<i>"Item N/A: Application of Road Salt for De-Icing Purposes During Snow and Ice Conditions"</i>	On-Site	EC SAR	Soil

It should be noted that APEC 3, APEC 4, APEC 5 and APEC 9C on the east portion of the Phase II Property were planned to be assessed as part of the Phase II-ESA, however, due to on-going construction activities, and remediation activities being completed by other consultants in the area, drilling was not possible in this area. Final reports prepared by the other consultants should be reviewed to assess the completion of the remedial activities.

Contaminants of Potential Concern (CPCs)

The contaminants of potential concern (CPCs) associated with the aforementioned APECs are considered to be:

- ☐ Petroleum Hydrocarbons, fractions 1 – 4 (PHCs F₁-F₄);
- ☐ Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX);
- ☐ Polycyclic Aromatic Hydrocarbons (PAHs);
- ☐ Polychlorinated Biphenyls (PCBs);
- ☐ Electrical Conductivity (EC);
- ☐ Sodium Adsorption Ratio (SAR);
- ☐ Metals.

These CPCs have the potential to be present in the soil matrix and/or the groundwater situated beneath the Phase II Property.

Subsurface Structures and Utilities

Underground service locates were completed prior to the subsurface investigation. Underground utilities identified beneath the Phase II Property include sewer and water lines, as well as buried electrical conduits.

Physical Setting

Site Stratigraphy

The stratigraphy of the Phase II Property generally consists of:

- ☐ Pavement Structure (asphaltic concrete underlain by engineered fill); extending to a maximum depth of approximately 0.60 m below ground surface (BH14-23 and BH15-23 only);
- ☐ Concrete Slab; extending to a maximum depth of approximately 0.18 m below ground surface (BH27-23 and BH28-23 only);

- ❑ Fill Material (brown silty sand or clay with varying amounts gravel, cobbles, and crushed stone); extending to a maximum depth of approximately 3.81 m below ground surface. Trace amounts of brick and concrete were encountered in BH15-23 in the fill material layer from approximately 0.60 to 3.81 m below ground surface;
- ❑ Limestone Bedrock; encountered at depths ranging from approximately 0.89 m to 3.81 m below ground surface.

It should be noted that BH27-23 and BH28-23 were drilled in the basement of the subject building on the central portion of the Phase II Property. The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is provided in the Soil Profile and Test Data Sheets in Appendix 1.

Hydrogeological Characteristics

The groundwater at the Phase II Property was encountered within the underlying limestone bedrock at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

Based on the measured groundwater levels, the groundwater was calculated to flow in an easterly direction.

Approximate Depth to Bedrock

Bedrock was encountered in all three boreholes during the field drilling program at depths ranging from approximately 0.89 m to 3.81 m below ground surface.

Approximate Depth to Water Table

The depth to the water table is approximately 2.46 m to 6.14 m below the existing ground surface.

Sections 41 and 43.1 of Ontario Regulation 153/04

Section 41 of the Regulation does not apply to the Phase II Property, as the Phase II Property is not within 30 m of an environmentally sensitive area.

Section 43.1 of the Regulation does apply to the Phase II Property in that the Phase II Property is a Shallow Soil Property.

Existing Buildings and Structures

The portion of the Phase II Property addressed 70 Columbine Driveway is occupied by an 18-storey high rise office building with a ground floor parking structure (connected to the Environmental Health Centre) and one-storey basement. Built in the mid 1960's, the Brooke Claxton building is constructed with a concrete foundation and is finished on the exterior with steel and pre-cast concrete panels, in addition to a modified bituminous style roof. The building is currently heated via a natural gas-fired boiler system, supplied from the Tunney's Pasture Central Heating and Cooling plant approximately 250 m to the south.

The portion of the Phase II Property addressed 50 Columbine Driveway is occupied by a three-storey government building with a penthouse, a ground floor parking structure (connected to the Brooke Claxton building) and a single-storey basement. Built in the mid 1960's, the Environmental Health Centre is constructed with a concrete foundation and is finished on the exterior with metal and pre-cast concrete panels, in addition to a modified bituminous style roof. The building was in the process of being deconstructed at the time of the site inspection and is assumed to not currently be serviced.

Environmental Condition

Areas Where Contaminants are Present

Based on the analytical test results, the barium concentration detected in soil sample BH15-23-SS4 exceeds the selected MECP Table 7 Coarse-Grained Residential Soil Standard. However, based on section 49.1 (3) of Ontario Regulation 153/04, the fill containing barium does not exceed the naturally occurring range of barium within the Ottawa area, and is not considered to be a contaminant.

It should be noted that the EC and/or SAR exceedances measured in soil samples BH14-23-SS3 and BH15-23-SS4 exceed the selected MECP Table 7 Coarse-Grained Residential Soil Standards.

These exceedances are suspected to be the result of the use of road salt on the Phase II Property during snow and ice conditions and thus, as per Section 49.1 of O. Reg 153/04, do not represent a contaminant issue.

Based on the analytical test results, the groundwater beneath the Phase II Property is not considered to be contaminated.

Types of Contaminants

Based on the findings of this assessment, there is no contaminated media present on the central and west portions of the Phase II Property.

Contaminated Media

Based on the findings of this assessment, there is no contaminated media present on the central and west portions of the Phase II Property.

What Is Known About Areas Where Contaminants Are Present

Based on the findings of this assessment, there is no contaminated media present on the central and west portions of the Phase II Property.

Distribution and Migration of Contaminants

Based on the findings of this assessment, there is no contaminated media present on the central and west portions of the Phase II Property.

Discharge of Contaminants

Based on the findings of this assessment, there is no contaminated media present on the central and west portions of the Phase II Property.

Climatic and Meteorological Conditions

Given that there are no contaminants currently present on the Phase II Property, climatic and meteorological conditions are not considered to have affected contaminant distribution on the central and west portions of the Phase II Property.

Potential for Vapour Intrusion

Based on the findings of the Phase II-ESA, there is no potential for vapour intrusion on the central and west portions of the Phase II Property.

6.0 CONCLUSIONS

Assessment

Paterson Group was retained by Arcadis IBI Group to conduct a Phase II – Environmental Site Assessment (Phase II ESA) for Block 10 of the Tunney's Pasture government office complex, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and were considered to result in areas of potential environmental concern (APECs) on the subject site (Phase II Property). It should be noted that APEC 3, APEC 4, APEC 5 and APEC 9C on the east portion of the Phase II Property were planned to be assessed as part of the Phase II-ESA, however, due to on-going construction activities, and remediation activities being completed by other consultants in the area, drilling was not possible in this area. Final reports prepared by the other consultants should be reviewed to assess the completion of the remedial activities.

The subsurface investigation for this assessment was conducted during the interim of November 15 and 16, 2023 and December 6, 2023 and consisted of drilling four (4) boreholes (BH14-23, BH15-23, BH27-23 and BH28-23) across the Phase II Property. Additionally, three hand auger holes (HA1-23 through HA3-23) were dug on the north-central portion of the Phase II Property. It should be noted that this field investigation was carried out as part of a larger investigation conducted for multiple sites at the Tunney's Pasture complex. The boreholes were advanced to depths ranging from approximately 6.17 m to 6.20 m below the existing ground surface and terminated within the bedrock unit, with the exception of BH28-23 which was terminated at a depth of 0.51 m. Upon completion, three boreholes were instrumented with groundwater monitoring wells in order to access the groundwater table.

In general, the subsurface soil profile encountered at the borehole locations consists of either a thin pavement structure (asphaltic concrete over granular fill) or a concrete slab (over granular fill), underlain by fill material (consisting of brown silty sand or clay with varying amounts of gravel, cobbles and crushed stone). Trace amounts of brick and concrete were encountered in BH15-23 in the fill layer from approximately 0.60 m to 3.81 m below ground surface. Bedrock was encountered in three boreholes during the field drilling program at depths ranging from approximately 0.89 m to 3.81 m below ground surface. It should be noted that BH27-23 and BH28-23 were drilled in the basement of the subject building on the central portion of the Phase II Property. During the field sampling program, the groundwater was measured at depths ranging from approximately 2.46 m to 6.14 m below the existing ground surface.

A total of seven soil samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHCs (F₁-F₄), metals, Hg⁺, CrVI, PAHs, PCBs, EC, and/or SAR parameters. Based on the analytical test results, the barium concentration detected in soil sample BH15-23-SS4 exceeds the selected MECP Table 7 Coarse-Grained Residential Soil Standard. Given the natural presence of barium, at similar concentrations, within soils of the local area (specifically local clays), barium is not considered to represent an exceedance of MECP standards based on section 49.1 of the regulation. However, management of excess soil containing elevated barium may be limited on acceptance criteria of proposed reuse sites.

Based on the analytical test results, the phenanthrene concentration detected in soil samples BH15-23-SS4 exceeds the CCME Commercial Standard. This elevated concentration is not considered to represent an immediate concern with respect to the use of the property.

It should be noted that the EC and/or SAR exceedances measured in soil samples BH14-23-SS3 and BH15-23-SS4 exceed the selected MECP Table 7 Coarse-Grained Residential Soil Standards. These exceedances are suspected to be the result of the use of road salt on the Phase II Property during snow and ice conditions and thus, as per Section 49.1 of O. Reg 153/04, do not represent a contaminant issue.

Three groundwater samples (including one duplicate) were submitted for laboratory analysis of BTEX, PHC and/or PAH parameters. Based on the analytical test results, no parameter concentrations were detected in the groundwater, as a result the groundwater on the Phase II Property is in compliance with the selected MECP Table 7 Non-Potable Groundwater Standard and CCME Tier 1 Federal Interim Groundwater Water Quality Guidelines for Commercial Sites.

Based on the analytical test results, the groundwater beneath the Phase II Property is not considered to be contaminated.

Recommendations

Soil

Excess soil must be handed in accordance with O. Reg. 406/19: On-Site and Excess Soil Management. Additional excess soil testing and reporting requirements will be required prior to future site excavation activities, in accordance with O. Reg. 406/19.

Management of soil with naturally elevated metals concentrations, or soil with EC/SAR exceedances related to the application of salt, are not considered to be exceedances on-site, however, for off-site management, these materials must be handled within the framework of O.Reg. 406/19 and the excess soil rules.

It is recommended that following the completion of all remediation activities on the eastern portion of the Phase II Property, that all related environmental reports be reviewed and assessed to ensure that no data gaps exist for the purposes of using the information for filing of a Record of Site Condition.

Monitoring Wells

It is recommended that the monitoring wells be maintained for future sampling purposes. The monitoring wells will be registered with the MECP under Ontario Regulation 903 (Ontario Water Resources Act). At such a time that the monitoring wells are no longer required, they must be decommissioned in accordance with O.Reg. 903.

7.0 STATEMENT OF LIMITATIONS

This Phase II – Environmental Site Assessment report has been prepared in general accordance with O. Reg. 153/04, as amended, and CSA Z769-00. The conclusions presented herein are based on information gathered from a limited sampling and testing program. The test results represent conditions at specific test locations at the time of the field program.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes themselves.

Should any conditions be encountered at the Phase II Property and/or historical information that differ from our findings, we request that we be notified immediately in order to allow for a reassessment.

This report was prepared for the sole use of Arcadis IBI Group and the Government of Canada. Permission and notification from the above noted parties and Paterson Group will be required prior to the release of this report to any other party.

Paterson Group Inc.



Jeremy Camposarcone, B.Eng.



Adrian Menyhart, P.Eng., QP_{ESA}



Report Distribution:

- Arcadis IBI Group
- Paterson Group Inc.

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE6040-1 – SITE PLAN

DRAWING PE6040-2 – SURROUNDING LAND USE PLAN

DRAWING PE6040-3 – TEST HOLE LOCATION PLAN

DRAWING PE6040-4 – ANALYTICAL TESTING PLAN – SOIL (PHCs, BTEX, Metals, Hg, CrVI, PAHs, PCBs, EC and SAR)

DRAWING PE6040-4A – CROSS SECTION A-A' – SOIL (PHCs, BTEX, Metals, Hg, CrVI, PAHs, PCBs, EC and SAR)

DRAWING PE6040-5 – ANALYTICAL TESTING PLAN – GROUNDWATER (PHCs, BTEX and PAHs)

DRAWING PE6040-5A – CROSS SECTION A-A' – GROUNDWATER (PHCs, BTEX and PAHs)

APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

SOIL AND GROUNDWATER MANAGEMENT PLAN

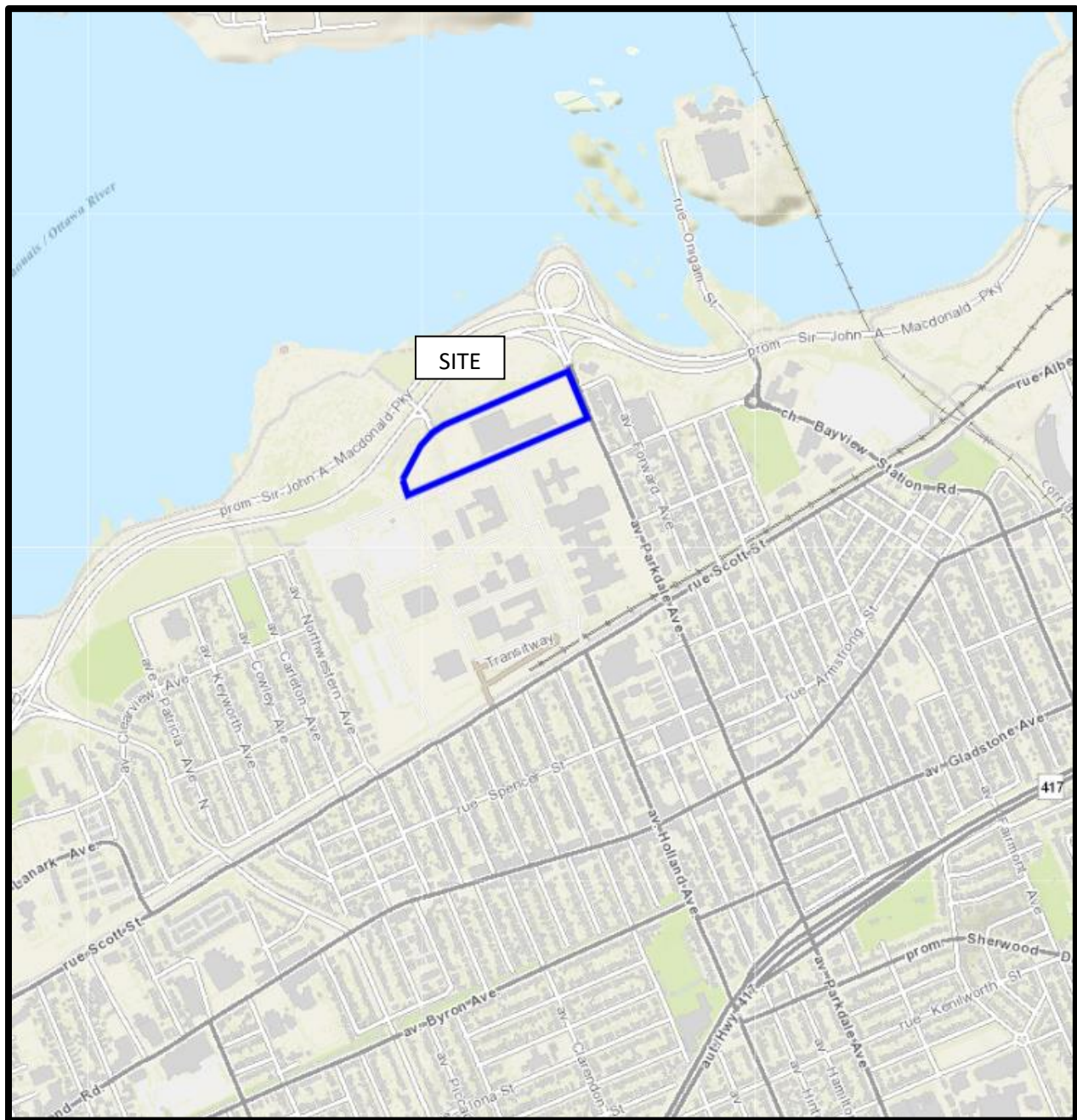
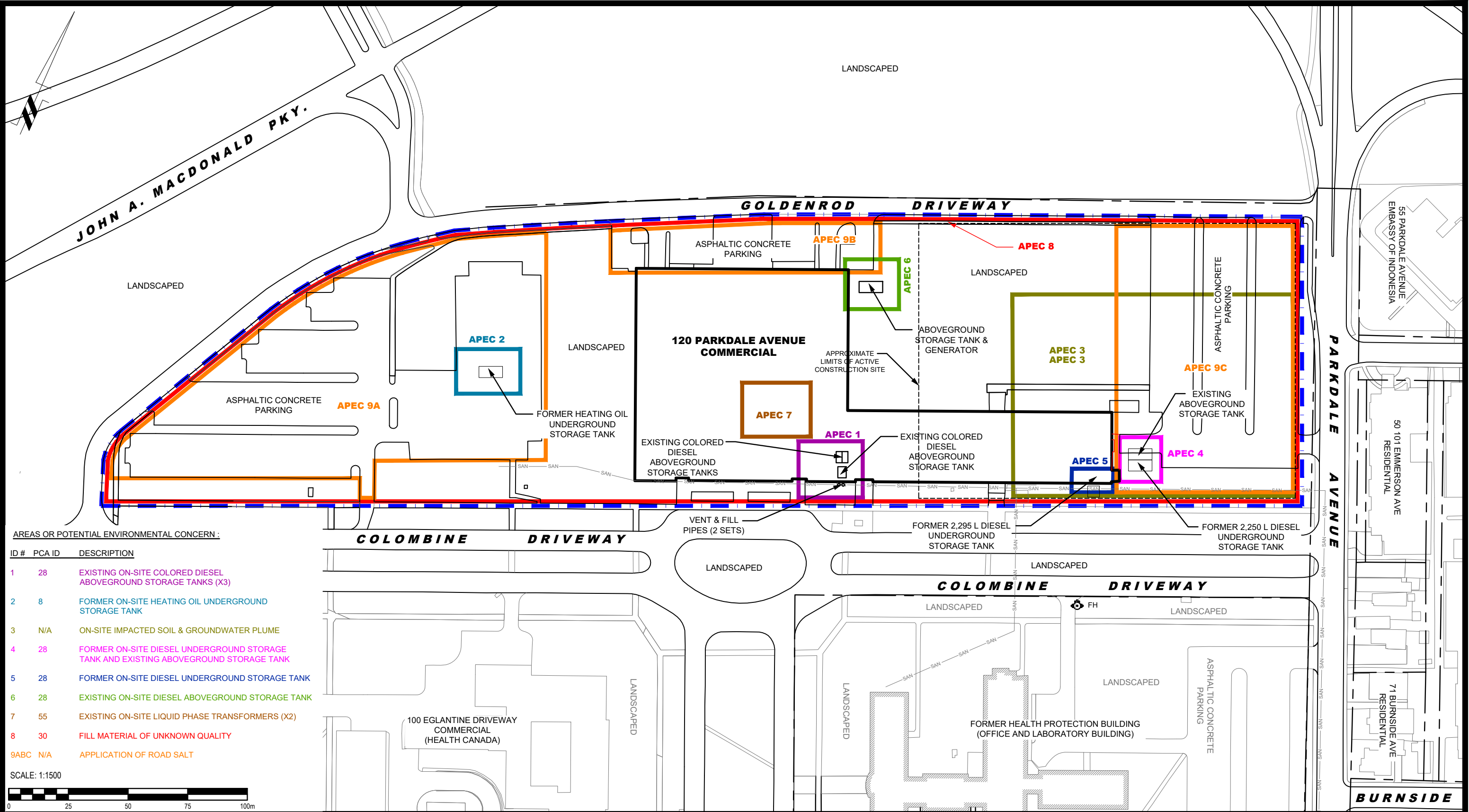


FIGURE 1
KEY PLAN



AREAS OR POTENTIAL ENVIRONMENTAL CONCERN :

ID #	PCA ID	DESCRIPTION
1	28	EXISTING ON-SITE COLORED DIESEL ABOVEGROUND STORAGE TANKS (X3)
2	8	FORMER ON-SITE HEATING OIL UNDERGROUND STORAGE TANK
3	N/A	ON-SITE IMPACTED SOIL & GROUNDWATER PLUME
4	28	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK AND EXISTING ABOVEGROUND STORAGE TANK
5	28	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK
6	28	EXISTING ON-SITE DIESEL ABOVEGROUND STORAGE TANK
7	55	EXISTING ON-SITE LIQUID PHASE TRANSFORMERS (X2)
8	30	FILL MATERIAL OF UNKNOWN QUALITY
9ABC	N/A	APPLICATION OF ROAD SALT

SCALE: 1:1500





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9 AURIGA DRIVE
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NO.	REVISIONS	DATE	INITIAL

IBI GROUP

PHASE I - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

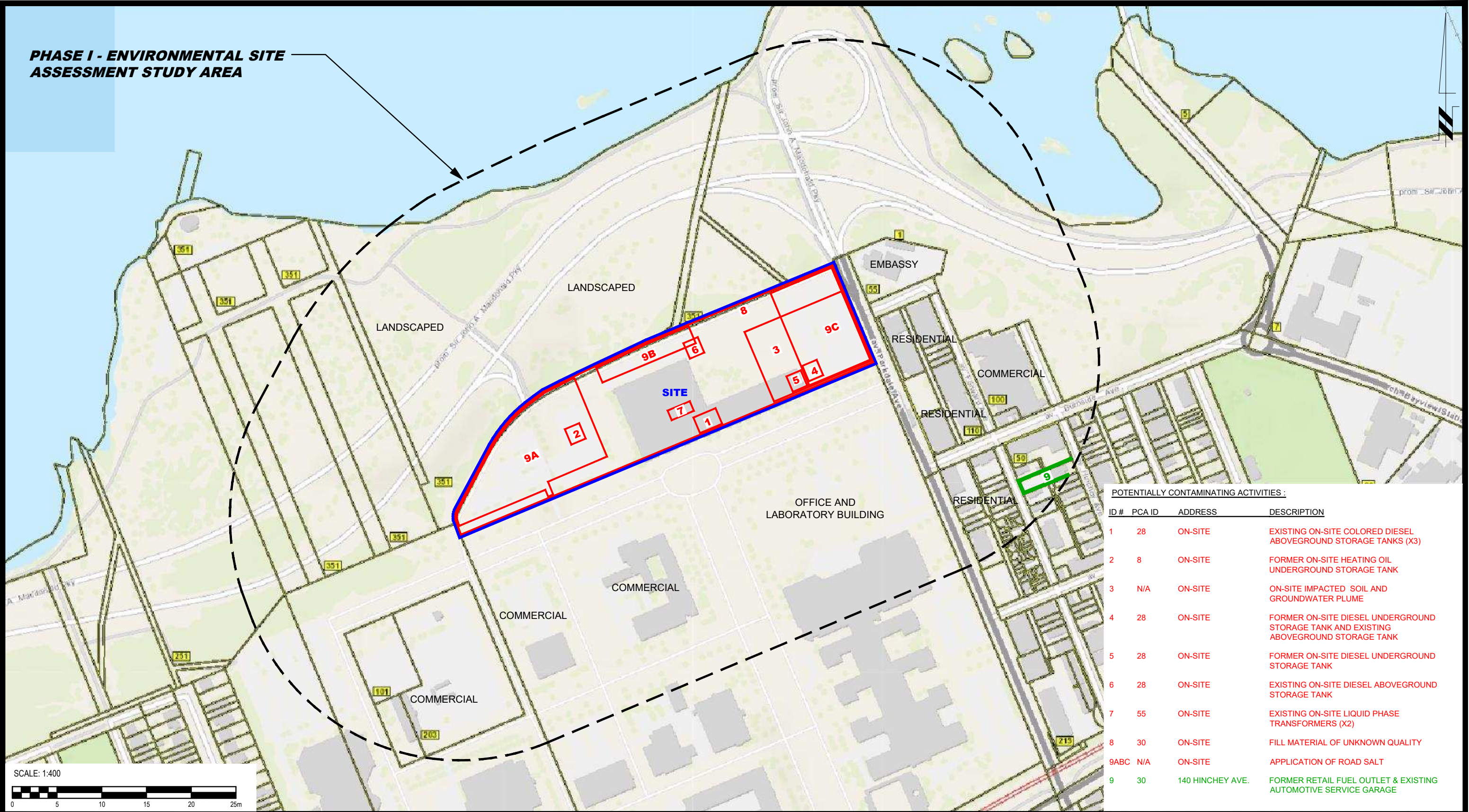
OTTAWA,
Title:

ONTARIO

SITE PLAN

Scale:	1:1500	Date:	07/2023
Drawn by:	YA	Report No.:	PE6040-1
Checked by:	JC	Dwg. No.:	PE6040-1
Approved by:	AM	Revision No.:	

PHASE I - ENVIRONMENTAL SITE ASSESSMENT STUDY AREA



POTENTIALLY CONTAMINATING ACTIVITIES :

ID #	PCA ID	ADDRESS	DESCRIPTION
1	28	ON-SITE	EXISTING ON-SITE COLORED DIESEL ABOVEGROUND STORAGE TANKS (X3)
2	8	ON-SITE	FORMER ON-SITE HEATING OIL UNDERGROUND STORAGE TANK
3	N/A	ON-SITE	ON-SITE IMPACTED SOIL AND GROUNDWATER PLUME
4	28	ON-SITE	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK AND EXISTING ABOVEGROUND STORAGE TANK
5	28	ON-SITE	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK
6	28	ON-SITE	EXISTING ON-SITE DIESEL ABOVEGROUND STORAGE TANK
7	55	ON-SITE	EXISTING ON-SITE LIQUID PHASE TRANSFORMERS (X2)
8	30	ON-SITE	FILL MATERIAL OF UNKNOWN QUALITY
9ABC	N/A	ON-SITE	APPLICATION OF ROAD SALT
9	30	140 HINCHEY AVE.	FORMER RETAIL FUEL OUTLET & EXISTING AUTOMOTIVE SERVICE GARAGE





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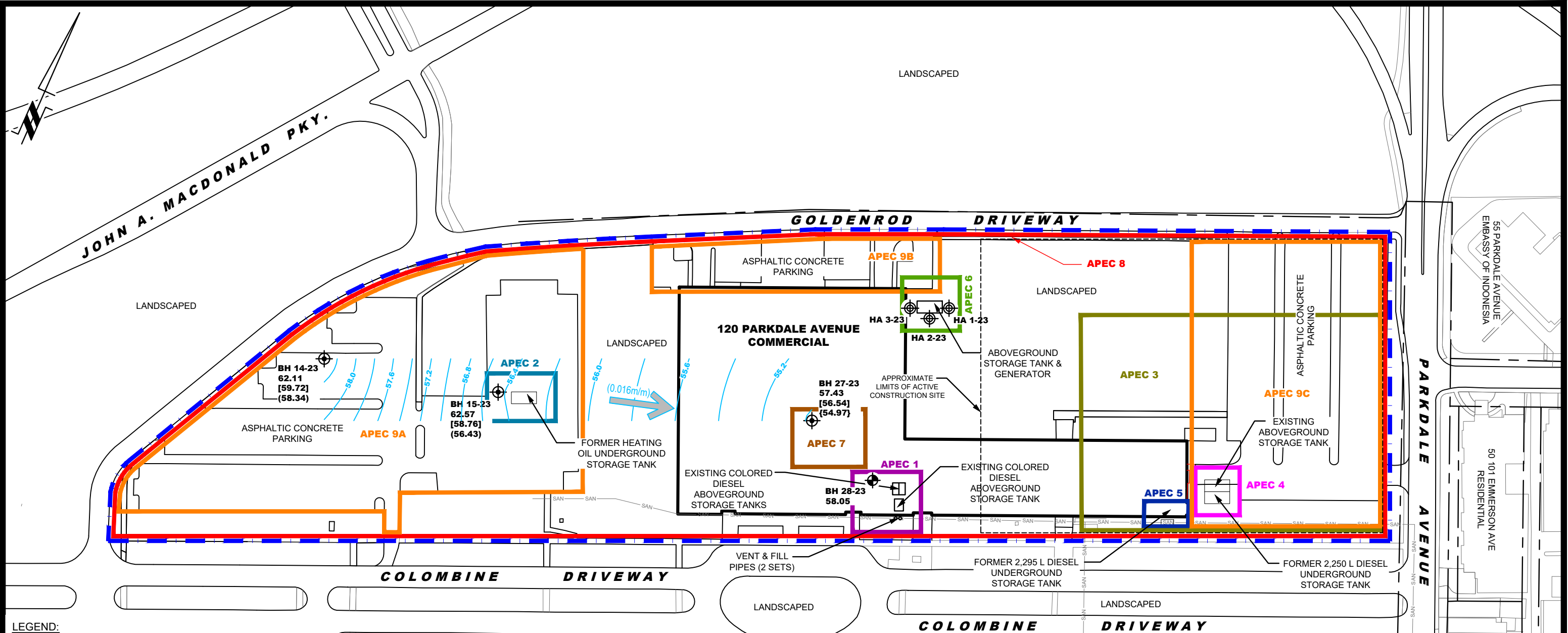
PHASE I - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

OTTAWA,
Title:

ONTARIO

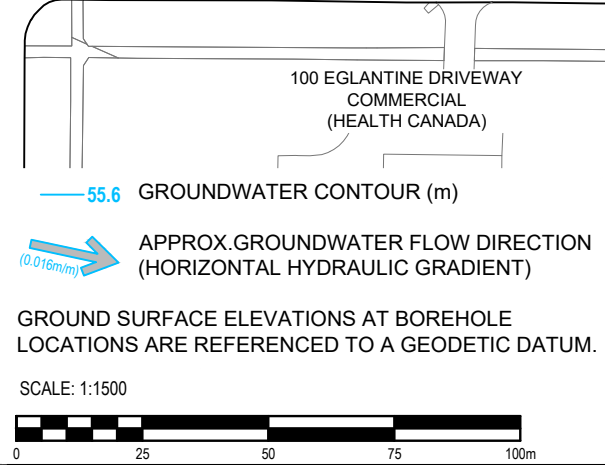
SURROUNDING LAND USE PLAN

Scale:	1:4000	Date:	07/2023
Drawn by:	YA	Report No.:	PE6040-1
Checked by:	JC	Dwg. No.:	PE6040-2
Approved by:	AM	Revision No.:	



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- HAND AUGER LOCATION
- 57.43 GROUND SURFACE ELEVATION (m)
- [56.54] BEDROCK SURFACE ELEVATION (m)
- [54.97] GROUNDWATER SURFACE ELEVATION (m) (DECEMBER 11, 2023)
- (56.43) GROUNDWATER SURFACE ELEVATION (m) (NOVEMBER 22, 2023)



AREAS OR POTENTIAL ENVIRONMENTAL CONCERN:

ID #	PCA ID	DESCRIPTION
1	28	EXISTING ON-SITE COLORED DIESEL ABOVEGROUND STORAGE TANKS (X3)
2	8	FORMER ON-SITE HEATING OIL UNDERGROUND STORAGE TANK
3	N/A	ON-SITE IMPACTED SOIL & GROUNDWATER PLUME
4	28	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK AND EXISTING ABOVEGROUND STORAGE TANK
5	28	FORMER ON-SITE DIESEL UNDERGROUND STORAGE TANK
6	28	EXISTING ON-SITE DIESEL ABOVEGROUND STORAGE TANK
7	55	EXISTING ON-SITE LIQUID PHASE TRANSFORMERS (X2)
8	30	FILL MATERIAL OF UNKNOWN QUALITY
9ABC	N/A	APPLICATION OF ROAD SALT

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

OTTAWA, ONTARIO

Title: TEST HOLE LOCATION PLAN

Scale: 1:1500

Drawn by: YA

Checked by: JC

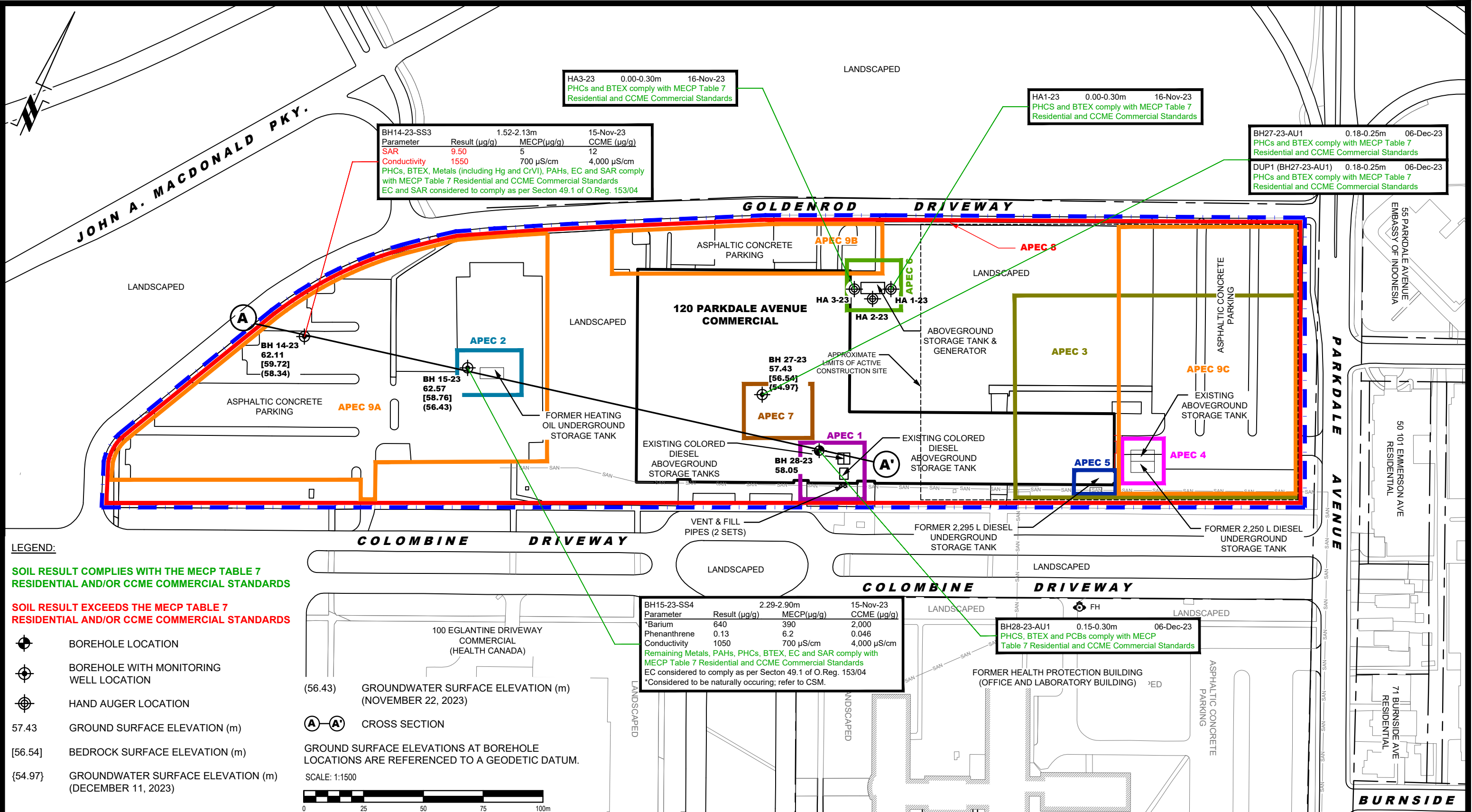
Approved by: AM

Date: 03/2024

Report No.: PE6040-2

Dwg. No.: PE6040-3

Revision No.:





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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

OTTAWA, ONTARIO

Title: ANALYTICAL TESTING PLAN - SOIL
(PHCs, BTEX, METALS, Hg, CrVI, PAHs, PCBs, EC & SAR)

Scale: 1:1500

Drawn by: YA

Checked by: JC

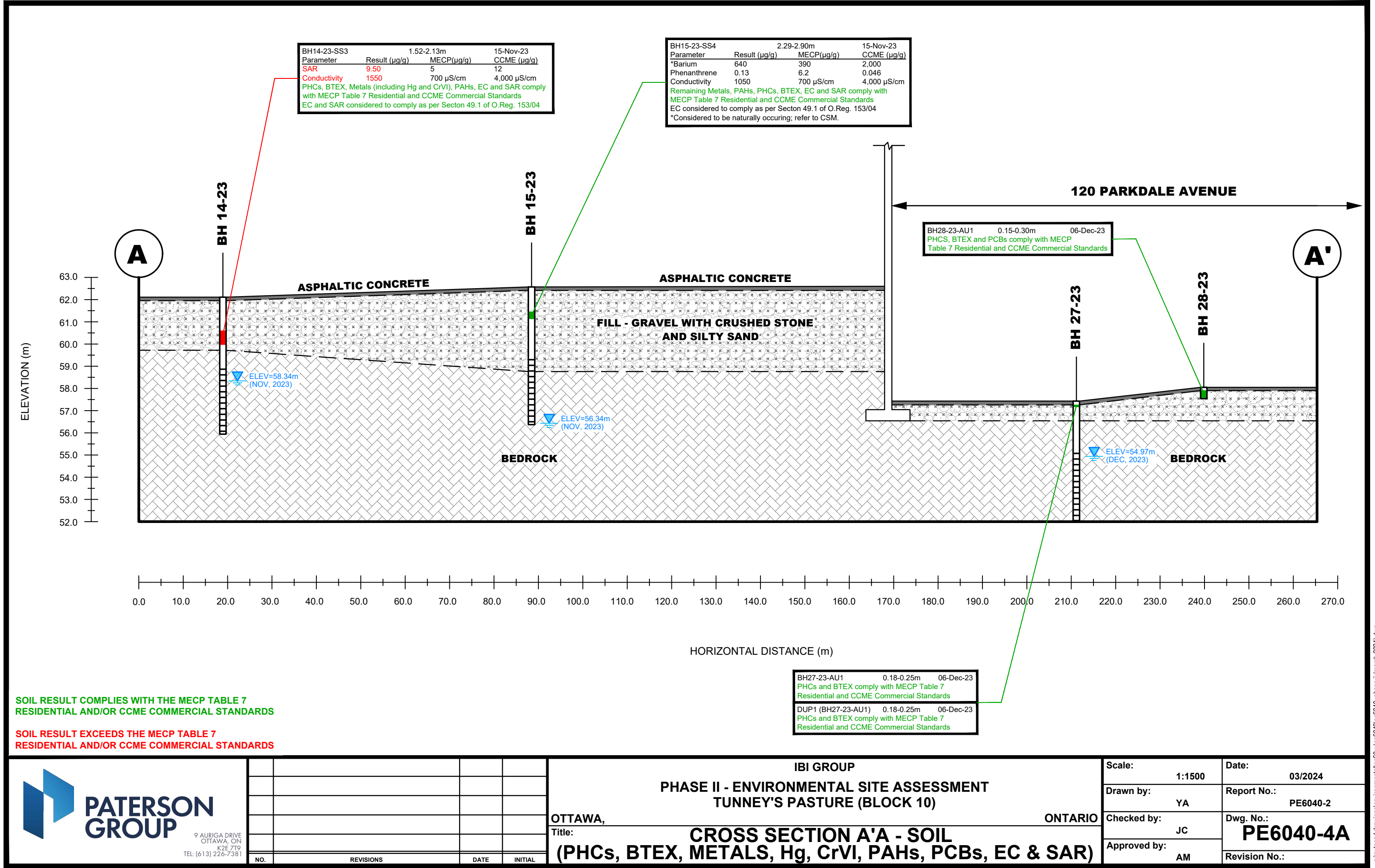
Approved by: AM

Date: 03/2024

Report No.: PE6040-2

Dwg. No.: PE6040-4

Revision No.:



BH14-23-SS3		1.52-2.13m	15-Nov-23
Parameter	Result (µg/g)	MECP(µg/g)	CCME (µg/g)
SAR	9.50	5	12
Conductivity	1550	700 µS/cm	4,000 µS/cm
PHCs, BTEX, Metals (including Hg and CrVI), PAHs, EC and SAR comply with MECP Table 7 Residential and CCME Commercial Standards			
EC and SAR considered to comply as per Section 49.1 of O.Reg. 153/04			

BH15-23-SS4		2.29-2.90m	15-Nov-23
Parameter	Result (µg/g)	MECP(µg/g)	CCME (µg/g)
*Barium	640	390	2,000
Phenanthrene	0.13	6.2	0.046
Conductivity	1050	700 µS/cm	4,000 µS/cm
Remaining Metals, PAHs, PHCs, BTEX, EC and SAR comply with MECP Table 7 Residential and CCME Commercial Standards			
EC considered to comply as per Section 49.1 of O.Reg. 153/04			
*Considered to be naturally occurring; refer to CSM.			

BH28-23-AU1		0.15-0.30m	06-Dec-23
PHCS, BTEX and PCBs comply with MECP Table 7 Residential and CCME Commercial Standards			

BH27-23-AU1		0.18-0.25m	06-Dec-23
PHCs and BTEX comply with MECP Table 7 Residential and CCME Commercial Standards			
DUP1 (BH27-23-AU1)		0.18-0.25m	06-Dec-23
PHCs and BTEX comply with MECP Table 7 Residential and CCME Commercial Standards			



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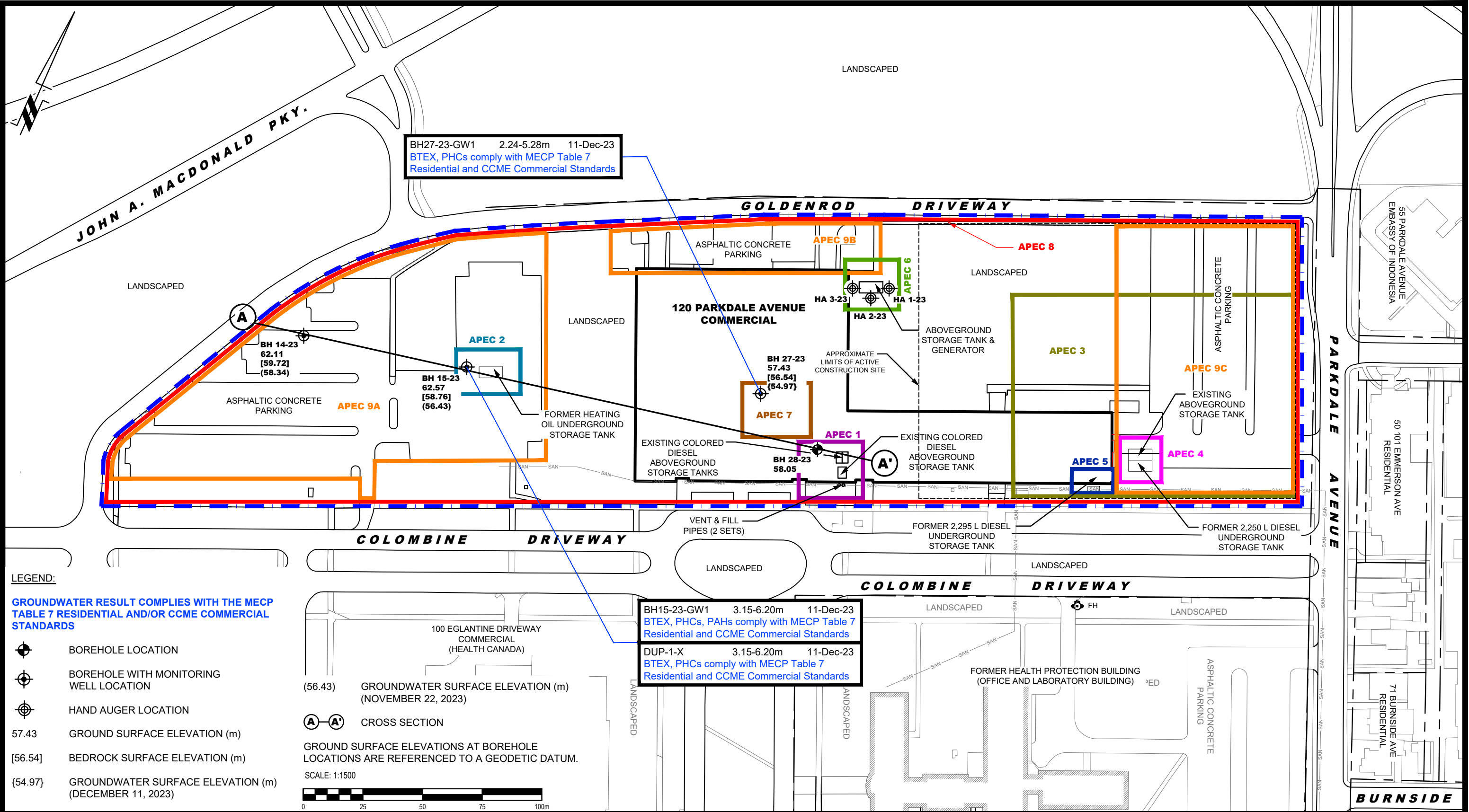
IBI GROUP

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

OTTAWA, ONTARIO

Title:
**CROSS SECTION A'A - SOIL
(PHCs, BTEX, METALS, Hg, CrVI, PAHs, PCBs, EC & SAR)**

Scale:	1:1500	Date:	03/2024
Drawn by:	YA	Report No.:	PE6040-2
Checked by:	JC	Dwg. No.:	PE6040-4A
Approved by:	AM	Revision No.:	





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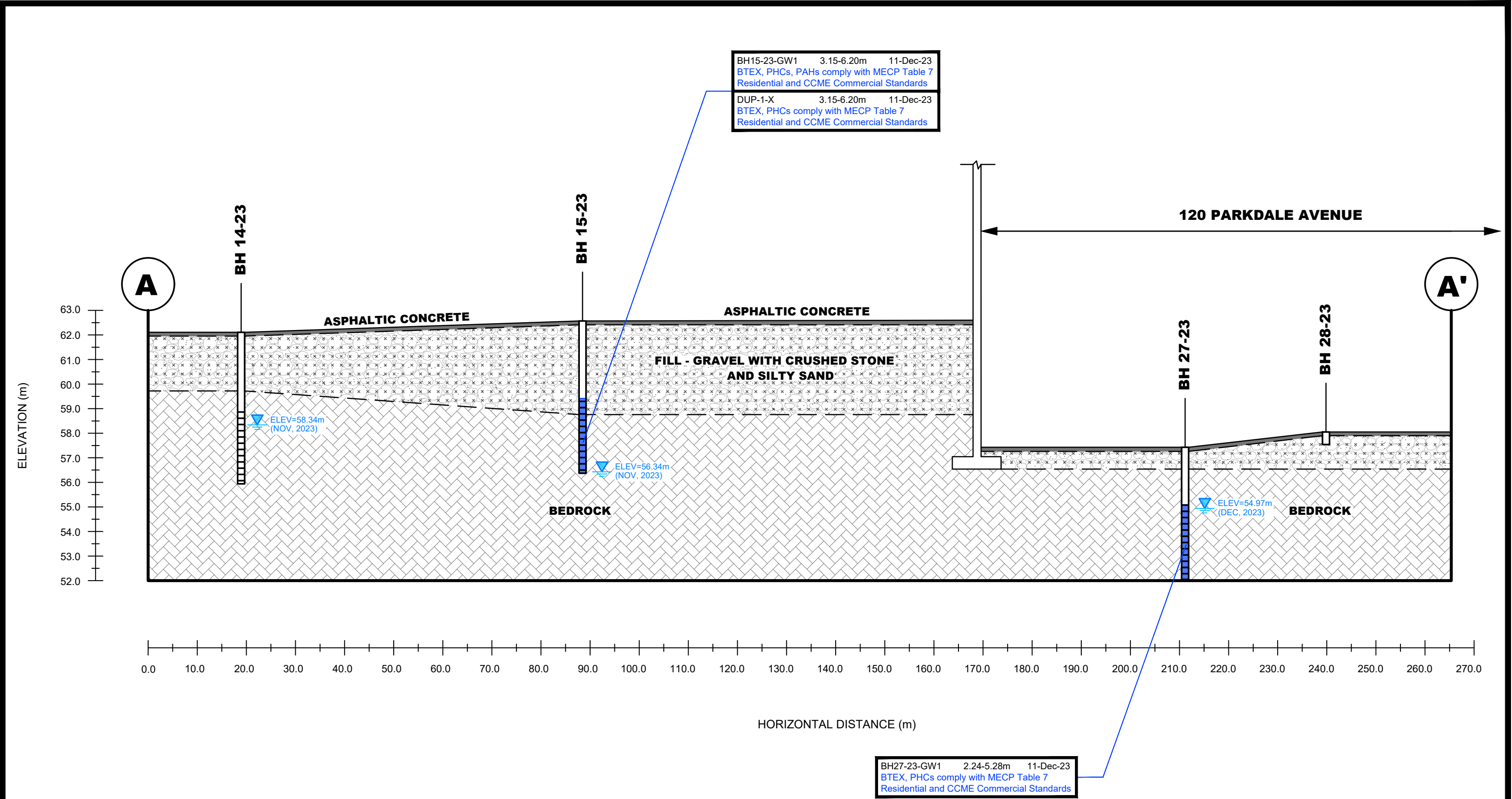
IBI GROUP

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
TUNNEY'S PASTURE (BLOCK 10)

OTTAWA, ONTARIO

ANALYTICAL TESTING PLAN - GROUNDWATER
(PHCs, BTEX, PAHs)

Scale:	1:1500	Date:	05/2024
Drawn by:	YA	Report No.:	PE6040-2
Checked by:	JC	Dwg. No.:	PE6040-5
Approved by:	AM	Revision No.:	



GROUNDWATER RESULT COMPLIES WITH THE MECP TABLE
7 RESIDENTIAL AND/OR CCME COMMERCIAL STANDARDS

PATERSON GROUP 9 AURIGA DRIVE OTTAWA, ON K2E 7T9 TEL: (613) 226-7381					IBI GROUP		Scale:	1:1500	Date:	05/2024
					PHASE II - ENVIRONMENTAL SITE ASSESSMENT		Drawn by:	YA	Report No.:	PE6040-2
					TUNNEY'S PASTURE (BLOCK 10)					
					OTTAWA,	ONTARIO	Checked by:	JC	Dwg. No.:	PE6040-5A
					Title: ANALYTICAL TESTING PLAN - GROUNDWATER		Approved by:	AM	Revision No.:	
					(PHCs, BTEX, PAHs)					
										</

APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

SOIL AND GROUNDWATER MANAGEMENT PLAN

Sampling & Analysis Plan

Tunney's Pasture (Block 10)
Ottawa, Ontario

Prepared for Arcadis IBI Group

Report: PE6040-SAP
Date: November 1, 2023

TABLE OF CONTENTS

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1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Arcadis IBI Group, to conduct a Phase II – Environmental Site Assessment (Phase II ESA) for Block 10 of the Tunney's Pasture government office complex, in the City of Ottawa, Ontario.

Based on the findings of the Phase I ESA, the following subsurface investigation program was developed.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH14-23	Western portion of the Phase I Property; to assess for potential impacts resulting from the presence of fill material of unknown quality and the use of road salt for de-icing purposes, and for excess soil qualification purposes.	5-7 m; to intercept the groundwater table for the purpose of installing a monitoring well.
BH15-23	Western portion of the Phase I Property; to assess for potential impacts resulting from the former on-site heating oil UST, the presence of fill material of unknown quality and the use of road salt for de-icing purposes, and for excess soil qualification purposes.	5-7 m; to intercept the groundwater table for the purpose of installing a monitoring well.
BH27-23	Central portion of the Phase I Property; to assess for potential impacts resulting from the existing on-site colored diesel ASTs.	5-7 m; to intercept the groundwater table for the purpose of installing a monitoring well.
BH28-23	Southern portion of the Phase I Property; to assess for potential impacts resulting from the existing on-site liquid phase transformers	5-7 m; to intercept the groundwater table for the purpose of installing a monitoring well.
HA1-23 to HA3-23	Northern portion of the Phase I Property; to assess for potential impacts resulting from the existing on-site diesel AST	0.75 m maximum.

Borehole locations are shown on Drawing PE6040-3 – Test Hole Location Plan, appended to the main report.

At each borehole, split-spoon samples of the overburden soils will be obtained at 0.76 m (2'6") intervals. All soil samples will be retained, and samples will be selected for submission following a preliminary screening analysis.

Following the borehole drilling, groundwater monitoring wells will be installed in all three boreholes to allow for the collection of groundwater samples.

2.0 ANALYTICAL TESTING PROGRAM

The analytical testing program for soil at the Phase I Property is based on the following general considerations:

- ☐ At least one sample from each borehole should be submitted, in order to delineate the horizontal extent of contamination across the site.
- ☐ At least one sample from each stratigraphic unit should be submitted, in order to delineate the vertical extent of contamination at the site.
- ☐ In boreholes where there is visual or olfactory evidence of contamination, or where organic vapour meter or photoionization detector readings indicate the presence of contamination, the 'worst-case' sample from each borehole should be submitted for comparison with MECP site condition standards.
- ☐ In boreholes with evidence of contamination as described above, a sample should be submitted from the stratigraphic unit below the 'worst-case' sample to determine whether the contaminant(s) have migrated downward.
- ☐ Parameters analyzed should be consistent with the Contaminants of Potential Concern identified in the Phase I ESA.

The analytical testing program for soil at the Phase I Property is based on the following general considerations:

- ☐ Groundwater monitoring wells should be installed in all boreholes with visual or olfactory evidence of soil contamination, in stratigraphic units where soil contamination was encountered, where those stratigraphic units are at or below the water table (i.e. a water sample can be obtained).
- ☐ Groundwater monitoring well screens should straddle the water table at sites where the contaminants of concern are suspected to be LNAPLs.
- ☐ At least one groundwater monitoring well should be installed in a stratigraphic unit below the suspected contamination, where said stratigraphic unit is water-bearing.
- ☐ Parameters analyzed should be consistent with the Contaminants of Concern identified in the Phase I ESA and with the contaminants identified in the soil samples.

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

The purpose of environmental boreholes is to identify and/or delineate contamination within the soil and/or to install groundwater monitoring wells in order to identify contamination within the groundwater.

Equipment

The following is a list of equipment that is in addition to regular drilling equipment stated in the geotechnical drilling SOP:

- ☐ Glass soil sample jars
- ☐ two buckets
- ☐ cleaning brush (toilet brush works well)
- ☐ dish detergent
- ☐ methyl hydrate
- ☐ water (if not available on site - water jugs available in trailer)
- ☐ latex or nitrile gloves (depending on suspected contaminant)
- ☐ RKL Eagle organic vapour meter or MiniRae photoionization detector (depending on contamination suspected)

Determining Borehole Locations

If conditions on site are not as suspected, and planned borehole locations cannot be drilled, **call the office to discuss**. Alternative borehole locations will be determined in conversation with the field technician and supervising engineer.

After drilling is completed a plan with the borehole locations must be provided. Distances and orientations of boreholes with respect to site features (buildings, roadways, etc.) must be provided. Distances should be measured using a measuring tape or wheel rather than paced off. Ground surface elevations at each borehole should be surveyed relative to a geodetic benchmark, if one is available, or a temporary site benchmark which can be tied in at a later date if necessary.

Drilling Procedure

The actual drilling procedure for environmental boreholes is the same as geotechnical boreholes (see SOP for drilling and sampling) with a few exceptions as follows:

- ☐ Continuous split spoon samples (every 0.6 m or 2') or semi-continuous (every 0.76 m or 2'6") are required.
- ☐ Make sure samples are well sealed in plastic bags with no holes prior to screening and are kept cool but unfrozen.
- ☐ If sampling for VOCs, BTEX, or PHCs F₁, a soil core from each soil sample, which may be analyzed, must be taken and placed in the laboratory-provided methanol vial.
- ☐ Note all and any odours or discolouration of samples.
- ☐ Split spoon samplers must be washed between samples.
- ☐ If obvious contamination is encountered, continue sampling until vertical extent of contamination is delineated.
- ☐ As a general rule, environmental boreholes should be deep enough to intercept the groundwater table (unless this is impossible/impractical - call project manager to discuss).
- ☐ If at all possible, soil samples should be submitted to a preliminary screening procedure on site, either using a RKI Eagle, PID, etc. depending on type of suspected contamination.

Spoon Washing Procedure

All sampling equipment (spilt spoons, etc.) must be washed between samples in order to prevent cross contamination of soil samples.

- ☐ Obtain two buckets of water (preferably hot if available)
- ☐ Add a small amount of dish soap to one bucket
- ☐ Scrub spoons with brush in soapy water, inside and out, including tip
- ☐ Rinse in clean water
- ☐ Apply a small amount of methyl hydrate to the inside of the spoon. (A spray bottle or water bottle with a small hole in the cap works well)
- ☐ Allow to dry (takes seconds)
- ☐ Rinse with distilled water, a spray bottle works well.

The methyl hydrate eliminates any soap residue that may be on the spoon and is especially important when dealing with suspected VOCs.

Screening Procedure

The RKI Eagle is used to screen most soil samples, particularly where petroleum hydrocarbon contamination is suspected. The MiniRae is used when VOCs are suspected, however it also can be useful for detecting petroleum. These tools are for screening purposes only and cannot be used in place of laboratory testing. Vapour results obtained from the RKI Eagle and the PID are relative and must be interpreted.

Screening equipment should be calibrated on an approximately monthly basis, more frequently if heavily used.

- ☐ Samples should be brought to room temperature; this is specifically important in colder weather. Soil must not be frozen.
- ☐ Turn instrument on and allow to come to zero - calibrate if necessary
- ☐ If using RKI Eagle, ensure instrument is in methane elimination mode unless otherwise directed.
- ☐ Ensure measurement units are ppm (parts per million) initially. RKI Eagle will automatically switch to %LEL (lower explosive limit) if higher concentrations are encountered.
- ☐ Break up large lumps of soil in the sample bag, taking care not to puncture bag.
- ☐ Insert probe into soil bag, creating a seal with your hand around the opening.
- ☐ Gently manipulate soil in bag while observing instrument readings.
- ☐ Record the highest value obtained in the first 15 to 25 seconds
- ☐ Make sure to indicate scale (ppm or LEL); also note which instrument was used (RKI Eagle 1 or 2, or MiniRae).
- ☐ Jar samples and refrigerate as per Sampling and Analysis Plan.

3.2 Monitoring Well Installation Procedure

Equipment

- ☐ 5' x 2" threaded sections of Schedule 40 PVC slotted well screen (5' x 1 1/4" if installing in cored hole in bedrock)
- ☐ 5' x 2" threaded sections of Schedule 40 PVC riser pipe (5' x 1 1/4" if installing in cored hole in bedrock)
- ☐ Threaded end-cap
- ☐ Slip-cap or J-plug
- ☐ Asphalt cold patch or concrete
- ☐ Silica Sand
- ☐ Bentonite chips (Holeplug)
- ☐ Steel flushmount casing

Procedure

- ☐ Drill borehole to required depth, using drilling and sampling procedures described above.
- ☐ If borehole is deeper than required monitoring well, backfill with bentonite chips to required depth. This should only be done on wells where contamination is not suspected, in order to prevent downward migration of contamination.
- ☐ Only one monitoring well should be installed per borehole.
- ☐ Monitoring wells should not be screened across more than one stratigraphic unit to prevent potential migration of contaminants between units.
- ☐ Where LNAPLs are the suspected contaminants of concern, monitoring wells should be screened straddling the water table in order to capture any free product floating on top of the water table.
- ☐ Thread the end cap onto a section of screen. Thread second section of screen if required. Thread risers onto screen. Lower into borehole to required depth. Ensure slip-cap or J-plug is inserted to prevent backfill materials entering well.
- ☐ As drillers remove augers, backfill borehole annulus with silica sand until the level of sand is approximately 0.3 m above the top of the screen.
- ☐ Backfill with holeplug until at least 0.3 m of holeplug is present above the top of the silica sand.
- ☐ Backfill remainder of borehole with holeplug or with auger cuttings (if contamination is not suspected).
- ☐ Install flushmount casing. Seal space between flushmount and borehole annulus with concrete, cold patch, or holeplug to match surrounding ground surface.

3.3 Monitoring Well Sampling Procedure

Equipment

- ☐ Water level metre or interface probe on hydrocarbon/LNAPL sites
- ☐ Spray bottles containing water and methanol to clean water level tape or interface probe
- ☐ Peristaltic pump
- ☐ Polyethylene tubing for peristaltic pump
- ☐ Flexible tubing for peristaltic pump
- ☐ Latex or nitrile gloves (depending on suspected contaminant)
- ☐ Allen keys and/or 9/16" socket wrench to remove well caps
- ☐ Graduated bucket with volume measurements
- ☐ pH/Temperature/Conductivity combo pen
- ☐ Laboratory-supplied sample bottles

Sampling Procedure

- ☐ Locate well and use socket wrench or Allan key to open metal flush mount protector cap. Remove plastic well cap.
- ☐ Measure water level, with respect to existing ground surface, using water level meter or interface probe. If using interface probe on suspected NAPL site, measure the thickness of free product.
- ☐ Measure total depth of well.
- ☐ Clean water level tape or interface probe using methanol and water. Change gloves between wells.
- ☐ Calculate volume of standing water within well and record.
- ☐ Insert polyethylene tubing into well and attach to peristaltic pump. Turn on peristaltic pump and purge into graduated bucket. Purge at least three well volumes of water from the well. Measure and record field chemistry. Continue to purge, measuring field chemistry after every well volume purged, until appearance or field chemistry stabilizes.
- ☐ Note appearance of purge water, including colour, opacity (clear, cloudy, silty), sheen, presence of LNAPL, and odour. Note any other unusual features (particulate matter, effervescence (bubbling) of dissolved gas, etc.).
- ☐ Fill required sample bottles. If sampling for metals, attach 75-micron filter to discharge tube and filter metals sample. If sampling for VOCs, use low flow rate to ensure continuous stream of non-turbulent flow into sample bottles. Ensure no headspace is present in VOC vials.
- ☐ Replace well cap and flushmount casing cap.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The QA/QC program for this Phase II ESA is as follows:

- ☐ All non-dedicated sampling equipment (split spoons) will be decontaminated according to the SOPs listed above.
- ☐ All groundwater sampling equipment is dedicated (polyethylene and flexible peristaltic tubing is replaced for each well).
- ☐ Where groundwater samples are to be analyzed for VOCs, one laboratory-provided trip blank will be submitted for analysis with every laboratory submission.
- ☐ Approximately one (1) field duplicate will be submitted for every ten (10) samples submitted for laboratory analysis. A minimum of one (1) field duplicate per project will be submitted. Field duplicates will be submitted for soil and groundwater samples
- ☐ Where combo pens are used to measure field chemistry, they will be calibrated on an approximately monthly basis, according to frequency of use.

5.0 DATA QUALITY OBJECTIVES

The purpose of setting data quality objectives (DQOs) is to ensure that the level of uncertainty in data collected during the Phase II ESA is low enough that decision-making is not affected, and that the overall objectives of the investigation are met.

The quality of data is assessed by comparing field duplicates with original samples. If the relative percent difference (RPD) between the duplicate and the sample is within 20%, the data are considered to be of sufficient quality so as not to affect decision-making. The RPD is calculated as follows:

$$RPD = \left| \frac{x_1 - x_2}{(x_1 + x_2)/2} \right| \times 100\%$$

Where x_1 is the concentration of a given parameter in an original sample and x_2 is the concentration of that same parameter in the field duplicate sample.

For the purpose of calculating the RPD, it is desirable to select field duplicates from samples for which parameters are present in concentrations above laboratory detection limits, i.e. samples which are expected to be contaminated. If parameters are below laboratory detection limits for selected samples or duplicates, the RPD may be calculated using a concentration equal to one half the laboratory detection limit.

It is also important to consider data quality in the overall context of the project. For example, if the DQOs are not met for a given sample, yet the concentrations of contaminants in both the sample and the duplicate exceed the MOE site remediation standards by a large margin, the decision-making usefulness of the sample may not be considered to be impaired. The proximity of other samples which meet the DQOs must also be considered in developing the Phase II Conceptual Site Model; often there are enough data available to produce a reliable Phase II Conceptual Site Model even if DQOs are not met for certain individual samples.

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS

Physical impediments to the Sampling and Analysis plan may include:

- ☐ The location of underground utilities
- ☐ Poor recovery of split-spoon soil samples
- ☐ Insufficient groundwater volume for groundwater samples
- ☐ Breakage of sampling containers following sampling or while in transit to the laboratory
- ☐ Elevated detection limits due to matrix interference (generally related to soil colour or presence of organic material)
- ☐ Elevated detection limits due to high concentrations of certain parameters, necessitating dilution of samples in laboratory
- ☐ Drill rig breakdowns
- ☐ Winter conditions
- ☐ Other site-specific impediments

Site-specific impediments to the Sampling and Analysis plan are discussed in the body of the Phase II ESA report.

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Tunney's Pasture Block 10
Ottawa, Ontario

EASTING: 364325.628 NORTHING: 5030096.587 ELEVATION: 62.11

DATUM: Geodetic

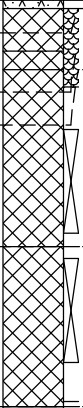
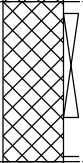
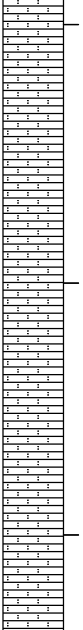
REMARKS:

BORINGS BY: Truck-Mounted Power Auger

DATE: November 15, 2023

FILE NO. **PE6040**

HOLE NO. **BH 14-23**

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Photo Ionization Detector				MONITORING WELL CONSTRUCTION	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			● Volatile Organic Rdg. (ppm)					
								○ Lower Explosive Limit %					
GROUND SURFACE								20	40	60	80		
ASPHALTIC CONCRETE 0.05		AU	1			0	62.11						
FILL: Gravel with crushed stone, some silty sand 0.30													
FILL: Brown silty clay, trace sand 0.41													
FILL: Brown silty sand, trace clay, gravel and crushed stone		SS	2	25	11	1	61.11						
	1.45												
FILL: Dark brown silty clay, trace sand, gravel, occasional cobbles		SS	3	58	12	2	60.11						
	2.39												
BEDROCK: Excellent quality, grey limestone		RC	1	100	100								
		RC	2	100	92	3	59.11						
		RC	3	100	100	5	57.11						
		RC	4	100	100	6	56.11						
End of Borehole 6.17													
(GWL @ 3.77m - Nov. 22, 2023)													

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Tunney's Pasture Block 10
Ottawa, Ontario

EASTING: 364393.964 NORTHING: 5030112.795 ELEVATION: 62.57

DATUM: Geodetic

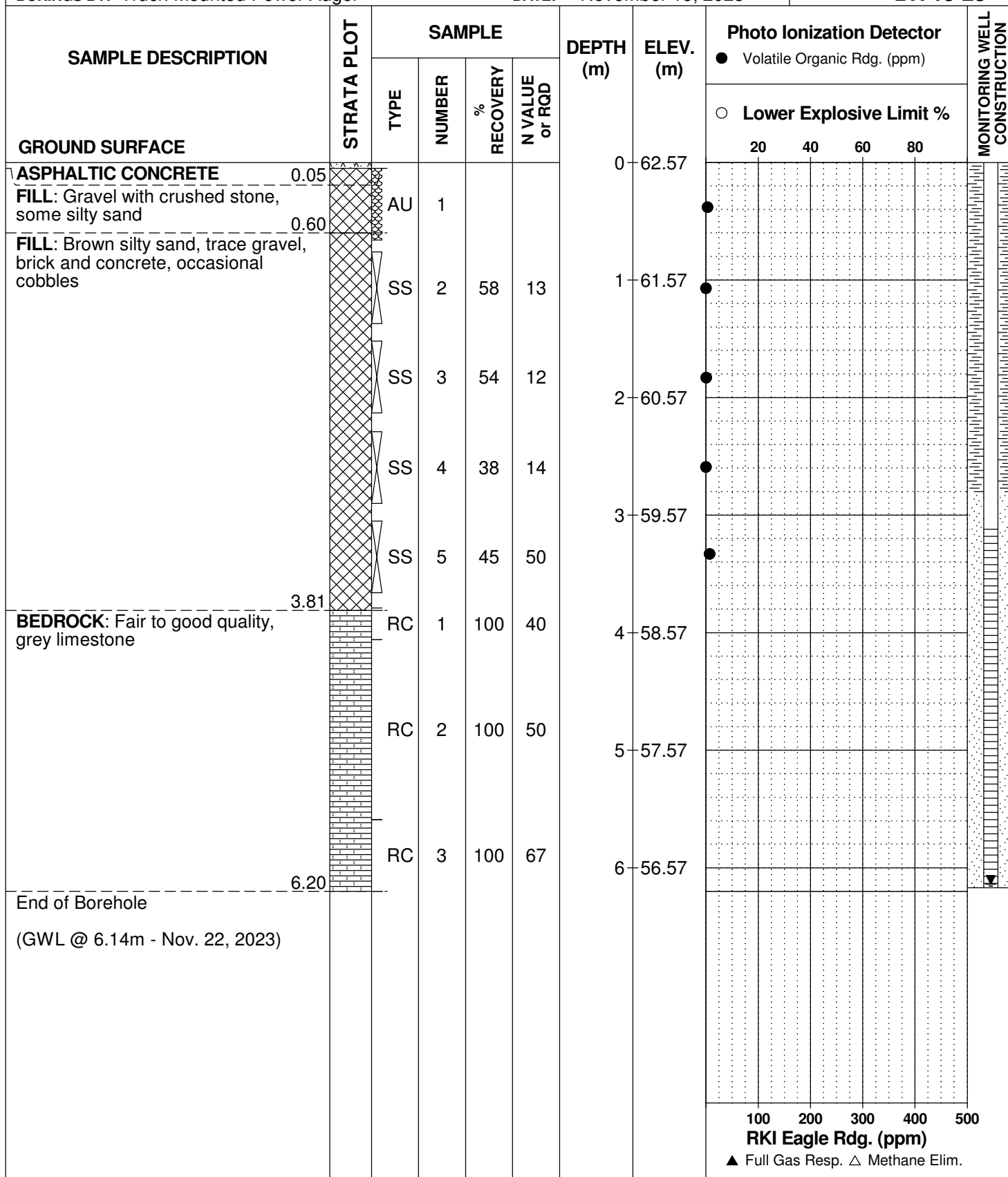
REMARKS:

BORINGS BY: Truck-Mounted Power Auger

DATE: November 15, 2023

FILE NO. **PE6040**

HOLE NO. **BH 15-23**



SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Tunney's Pasture Block 10
Ottawa, Ontario

EASTING: 364504.248 NORTHING: 5030156.140 ELEVATION: 57.43

DATUM: Geodetic

REMARKS:

BORINGS BY: Portable Drill

DATE: December 7, 2023

FILE NO. **PE6040**

HOLE NO. **BH 27-23**

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Photo Ionization Detector				MONITORING WELL CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			● Volatile Organic Rdg. (ppm)				
								○ Lower Explosive Limit %				
GROUND SURFACE								20	40	60	80	
Concrete Floor Slab	0.18	AU	1			0	57.43	●				
FILL: Compact, brown silty sand, some gravel and crushed stone		SS	2	21	P			●				
		SS	3	39	P			●				
	0.89					1	56.43					
BEDROCK: Excellent quality, grey limestone bedrock		RC	1	98	98							
						2	55.43					
		RC	2	100	96							
						3	54.43					
						4	53.43					
		RC	3	95	97							
						5	52.43					
	5.38											
End of Borehole												
(GWL @ 2.46m - Dec. 11, 2023)												
								100	200	300	400	500
								RKI Eagle Rdg. (ppm)				
								▲ Full Gas Resp. △ Methane Elim.				

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Tunney's Pasture Block 10
Ottawa, Ontario

EASTING: 364535.551 NORTHING: 5030144.336 ELEVATION: 58.05

DATUM: Geodetic

REMARKS:

BORINGS BY: Portable Drill

DATE: December 7, 2023

FILE NO. **PE6040**

HOLE NO. **BH 28-23**

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Photo Ionization Detector				MONITORING WELL CONSTRUCTION	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			● Volatile Organic Rdg. (ppm)	○ Lower Explosive Limit %	20	40		60
GROUND SURFACE						0	58.05						
Concrete Floor Slab	0.15	AU	1										
FILL: Compact, brown silty sand with gravel and crushed stone	0.51	SS	2	45	P								
End of Borehole													
Practical refusal to augering at 0.51m depth													

100200300400500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t , is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
D _{xx}	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D ₁₀	-	Grain size at which 10% of the soil is finer (effective grain size)
D ₆₀	-	Grain size at which 60% of the soil is finer
C _c	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
C _u	-	Uniformity coefficient = D_{60} / D_{10}

C_c and C_u are used to assess the grading of sands and gravels:

Well-graded gravels have: $1 < C_c < 3$ and $C_u > 4$

Well-graded sands have: $1 < C_c < 3$ and $C_u > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

C_c and C_u are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p' _o	-	Present effective overburden pressure at sample depth
p' _c	-	Preconsolidation pressure of (maximum past pressure on) sample
C _{cr}	-	Recompression index (in effect at pressures below p' _c)
C _c	-	Compression index (in effect at pressures above p' _c)
OC Ratio		Overconsolidation ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
W _o	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.
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SYMBOLS AND TERMS (continued)

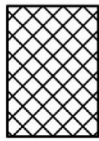
STRATA PLOT



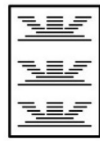
Topsoil



Asphalt



Fill



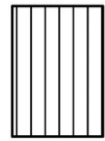
Peat



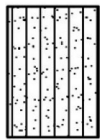
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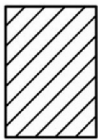
Silty Sand



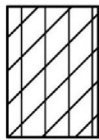
Silt



Sandy Silt



Clay



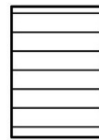
Silty Clay



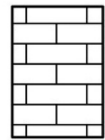
Clayey Silty Sand



Glacial Till



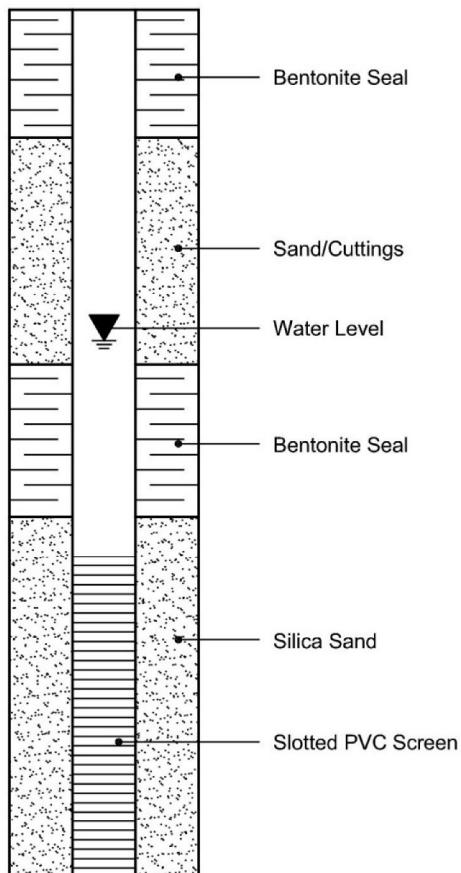
Shale



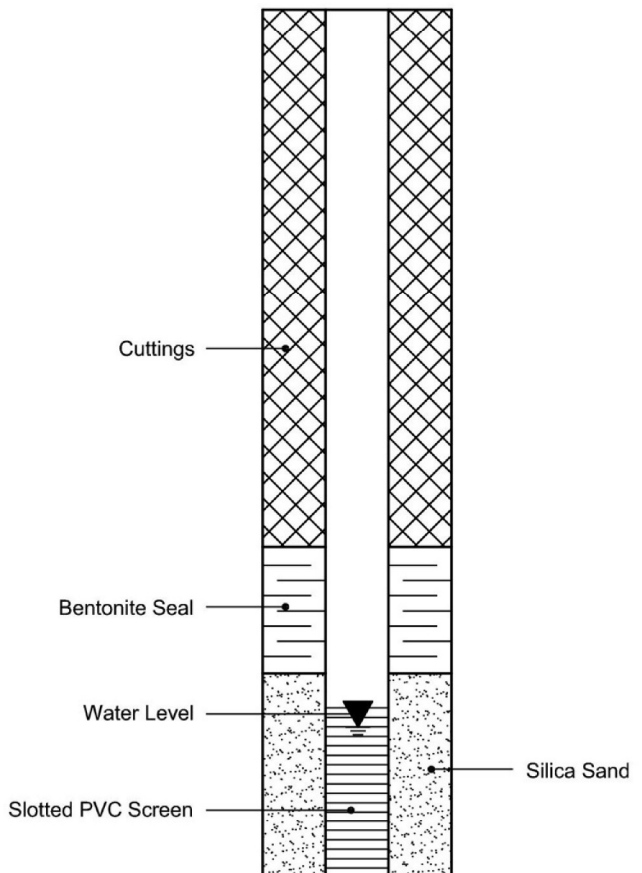
Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Paterson Group Consulting Engineers (Ottawa)

9 Auriga Drive
Ottawa, ON K2E 7T9
Attn: Jeremy Camposarcone

Client PO: 58868
Project: PE6040
Custody: 142023

Report Date: 22-Nov-2023

Order Date: 17-Nov-2023

Order #: 2346511

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

Paracel ID	Client ID
2346511-01	BH14-23-SS3
2346511-02	BH15-23-SS4
2346511-03	HA1-23
2346511-04	HA3-23

Approved By:



Mark Foto, M.Sc.

Lab Supervisor

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	21-Nov-23	22-Nov-23
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	21-Nov-23	22-Nov-23
Conductivity	MOE E3138 - probe @25 °C, water ext	21-Nov-23	21-Nov-23
Mercury by CVAA	EPA 7471B - CVAA, digestion	21-Nov-23	21-Nov-23
Metals, ICP-MS	EPA 6020 - Digestion - ICP-MS	21-Nov-23	21-Nov-23
PAHs by GC-MS	EPA 8270 - GC-MS, extraction	20-Nov-23	21-Nov-23
PHC F1	CWS Tier 1 - P&T GC-FID	20-Nov-23	21-Nov-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	20-Nov-23	22-Nov-23
SAR	Calculated	21-Nov-23	21-Nov-23
Solids, %	CWS Tier 1 - Gravimetric	20-Nov-23	21-Nov-23

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Client ID:	BH14-23-SS3	BH15-23-SS4	HA1-23	HA3-23		
Sample Date:	15-Nov-23 09:00	15-Nov-23 09:00	16-Nov-23 09:00	16-Nov-23 09:00	-	-
Sample ID:	2346511-01	2346511-02	2346511-03	2346511-04		
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Physical Characteristics

% Solids	0.1 % by Wt.	89.5	88.1	87.4	87.9	-	-
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General Inorganics

SAR	0.01 N/A	9.50	1.39	-	-	-	-
Conductivity	5 uS/cm	1550	1050	-	-	-	-

Metals

Antimony	1 ug/g	<1	<1	-	-	-	-
Arsenic	1 ug/g	2	4	-	-	-	-
Barium	1 ug/g	351	640	-	-	-	-
Beryllium	0.5 ug/g	0.6	0.9	-	-	-	-
Boron	5.0 ug/g	28.7	21.3	-	-	-	-
Cadmium	0.5 ug/g	<0.5	<0.5	-	-	-	-
Chromium (VI)	0.2 ug/g	<0.2	<0.2	-	-	-	-
Chromium	5 ug/g	21	34	-	-	-	-
Cobalt	1 ug/g	8	10	-	-	-	-
Copper	5 ug/g	17	18	-	-	-	-
Lead	1 ug/g	8	32	-	-	-	-
Mercury	0.1 ug/g	<0.1	<0.1	-	-	-	-
Molybdenum	1 ug/g	<1	<1	-	-	-	-
Nickel	5 ug/g	15	23	-	-	-	-
Selenium	1 ug/g	<1	<1	-	-	-	-
Silver	0.3 ug/g	<0.3	<0.3	-	-	-	-
Thallium	1 ug/g	<1	<1	-	-	-	-
Tin	5 ug/g	<5	<5	-	-	-	-
Uranium	1 ug/g	<1	<1	-	-	-	-
Vanadium	10 ug/g	26	40	-	-	-	-

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Client ID:	BH14-23-SS3	BH15-23-SS4	HA1-23	HA3-23	-	-
Sample Date:	15-Nov-23 09:00	15-Nov-23 09:00	16-Nov-23 09:00	16-Nov-23 09:00	-	-
Sample ID:	2346511-01	2346511-02	2346511-03	2346511-04	-	-
Matrix:	Soil	Soil	Soil	Soil	-	-
MDL/Units						

Metals

Zinc	20 ug/g	30	72	-	-	-	-
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Volatiles

Benzene	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
Ethylbenzene	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
Toluene	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
m,p-Xylenes	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
o-Xylene	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
Xylenes, total	0.002 mg/kg	<0.002	<0.002	<0.002	<0.002	-	-
Toluene-d8	Surrogate	101%	102%	102%	98.3%	-	-

Hydrocarbons

F1 PHCs (C6-C10)	7 mg/kg	<7	<7	<7	<7	-	-
F2 PHCs (C10-C16)	4 mg/kg	<4	<4	<4	<4	-	-
F3 PHCs (C16-C34)	8 mg/kg	<8	<8	<8	<8	-	-
F4 PHCs (C34-C50)	6 mg/kg	<6	<6	<6	<6	-	-

Semi-Volatiles

1-Methylnaphthalene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
2-Methylnaphthalene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Methylnaphthalene (1&2)	0.04 mg/kg	<0.04	<0.04	-	-	-	-
Acenaphthene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Acenaphthylene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Anthracene	0.02 mg/kg	<0.02	0.05	-	-	-	-
Benzo [a] anthracene	0.02 mg/kg	<0.02	0.09	-	-	-	-
Benzo [a] pyrene	0.02 mg/kg	<0.02	0.06	-	-	-	-
Benzo [b] fluoranthene	0.02 mg/kg	<0.02	0.06	-	-	-	-
Benzo [g,h,i] perylene	0.02 mg/kg	<0.02	0.04	-	-	-	-

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Client ID:	BH14-23-SS3	BH15-23-SS4	HA1-23	HA3-23		
Sample Date:	15-Nov-23 09:00	15-Nov-23 09:00	16-Nov-23 09:00	16-Nov-23 09:00	-	-
Sample ID:	2346511-01	2346511-02	2346511-03	2346511-04		
Matrix:	Soil	Soil	Soil	Soil		
MDL/Units						

Semi-Volatiles

Benzo [k] fluoranthene	0.02 mg/kg	<0.02	0.04	-	-	-	-
Biphenyl	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Chrysene	0.02 mg/kg	<0.02	0.07	-	-	-	-
Dibenzo [a,h] anthracene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Fluoranthene	0.02 mg/kg	<0.02	0.23	-	-	-	-
Fluorene	0.02 mg/kg	<0.02	<0.02	-	-	-	-
Indeno [1,2,3-cd] pyrene	0.02 mg/kg	<0.02	0.04	-	-	-	-
Naphthalene	0.01 mg/kg	<0.01	<0.01	-	-	-	-
Phenanthrene	0.02 mg/kg	<0.02	0.13	-	-	-	-
Pyrene	0.02 mg/kg	<0.02	0.18	-	-	-	-
Quinoline	0.10 mg/kg	<0.10	<0.10	-	-	-	-
2-Fluorobiphenyl	Surrogate	55.3%	58.9%	-	-	-	-
Terphenyl-d14	Surrogate	54.2%	52.0%	-	-	-	-

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics								
Conductivity	ND	5	uS/cm					
Hydrocarbons								
F1 PHCs (C6-C10)	ND	7	mg/kg					
F2 PHCs (C10-C16)	ND	4	mg/kg					
F3 PHCs (C16-C34)	ND	8	mg/kg					
F4 PHCs (C34-C50)	ND	6	mg/kg					
Metals								
Antimony	ND	1	ug/g					
Arsenic	ND	1	ug/g					
Barium	ND	1	ug/g					
Beryllium	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	ug/g					
Cobalt	ND	1	ug/g					
Copper	ND	5	ug/g					
Lead	ND	1	ug/g					
Mercury	ND	0.1	ug/g					
Molybdenum	ND	1	ug/g					
Nickel	ND	5	ug/g					
Selenium	ND	1	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1	ug/g					
Tin	ND	5	ug/g					
Uranium	ND	1	ug/g					
Vanadium	ND	10	ug/g					
Zinc	ND	20	ug/g					
Semi-Volatiles								
1-Methylnaphthalene	ND	0.02	mg/kg					
2-Methylnaphthalene	ND	0.02	mg/kg					
Methylnaphthalene (1&2)	ND	0.04	mg/kg					

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Acenaphthene	ND	0.02	mg/kg					
Acenaphthylene	ND	0.02	mg/kg					
Anthracene	ND	0.02	mg/kg					
Benzo [a] anthracene	ND	0.02	mg/kg					
Benzo [a] pyrene	ND	0.02	mg/kg					
Benzo [b] fluoranthene	ND	0.02	mg/kg					
Benzo [g,h,i] perylene	ND	0.02	mg/kg					
Benzo [k] fluoranthene	ND	0.02	mg/kg					
Biphenyl	ND	0.02	mg/kg					
Chrysene	ND	0.02	mg/kg					
Dibenzo [a,h] anthracene	ND	0.02	mg/kg					
Fluoranthene	ND	0.02	mg/kg					
Fluorene	ND	0.02	mg/kg					
Indeno [1,2,3-cd] pyrene	ND	0.02	mg/kg					
Naphthalene	ND	0.01	mg/kg					
Phenanthrene	ND	0.02	mg/kg					
Pyrene	ND	0.02	mg/kg					
Quinoline	ND	0.10	mg/kg					
Surrogate: 2-Fluorobiphenyl	0.895		%	67.2	50-140			
Surrogate: Terphenyl-d14	0.833		%	62.4	50-140			
Volatiles								
Benzene	ND	0.002	mg/kg					
Ethylbenzene	ND	0.002	mg/kg					
Toluene	ND	0.002	mg/kg					
m,p-Xylenes	ND	0.002	mg/kg					
o-Xylene	ND	0.002	mg/kg					
Xylenes, total	ND	0.002	mg/kg					
Surrogate: Toluene-d8	0.410		%	102	60-140			

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
SAR	1.32	0.01	N/A	1.41			6.6	30	
Conductivity	189	5	uS/cm	189			0.2	5	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	mg/kg	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	mg/kg	ND			NC	30	
F3 PHCs (C16-C34)	476	8	mg/kg	436			8.8	30	
F4 PHCs (C34-C50)	107	6	mg/kg	97			10.1	30	
Metals									
Antimony	ND	1	ug/g	ND			NC	30	
Arsenic	4.5	1	ug/g	4.6			2.5	30	
Barium	62.8	1	ug/g	64.2			2.2	30	
Beryllium	0.63	0.5	ug/g	0.77			20.2	30	
Boron	16.1	5.0	ug/g	16.3			1.4	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium (VI)	ND	0.2	ug/g	ND			NC	35	
Chromium	25.2	5	ug/g	26.2			4.1	30	
Cobalt	7.0	1	ug/g	7.3			4.4	30	
Copper	17.4	5	ug/g	18.6			6.3	30	
Lead	8.7	1	ug/g	9.1			3.8	30	
Mercury	ND	0.1	ug/g	ND			NC	30	
Molybdenum	5.8	1	ug/g	1.5			NC	30	
Nickel	22.9	5	ug/g	23.7			3.6	30	
Selenium	ND	1	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	
Thallium	ND	1	ug/g	ND			NC	30	
Tin	ND	5	ug/g	ND			NC	30	
Uranium	ND	1	ug/g	ND			NC	30	
Vanadium	31.4	10	ug/g	32.0			1.9	30	
Zinc	63.0	20	ug/g	66.5			5.5	30	

Physical Characteristics

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
% Solids	96.5	0.1	% by Wt.	96.5			0.0	25	
Semi-Volatiles									
1-Methylnaphthalene	ND	0.02	mg/kg	ND			NC	40	
2-Methylnaphthalene	ND	0.02	mg/kg	ND			NC	40	
Acenaphthene	ND	0.02	mg/kg	ND			NC	40	
Acenaphthylene	ND	0.02	mg/kg	ND			NC	40	
Anthracene	ND	0.02	mg/kg	ND			NC	40	
Benzo [a] anthracene	ND	0.02	mg/kg	ND			NC	40	
Benzo [a] pyrene	ND	0.02	mg/kg	ND			NC	40	
Benzo [b] fluoranthene	ND	0.02	mg/kg	ND			NC	40	
Benzo [g,h,i] perylene	ND	0.02	mg/kg	ND			NC	40	
Benzo [k] fluoranthene	ND	0.02	mg/kg	ND			NC	40	
Biphenyl	ND	0.02	mg/kg	ND			NC	40	
Chrysene	ND	0.02	mg/kg	ND			NC	40	
Dibenzo [a,h] anthracene	ND	0.02	mg/kg	ND			NC	40	
Fluoranthene	ND	0.02	mg/kg	ND			NC	40	
Fluorene	ND	0.02	mg/kg	ND			NC	40	
Indeno [1,2,3-cd] pyrene	ND	0.02	mg/kg	ND			NC	40	
Naphthalene	ND	0.01	mg/kg	ND			NC	40	
Phenanthrene	ND	0.02	mg/kg	ND			NC	40	
Pyrene	ND	0.02	mg/kg	ND			NC	40	
Quinoline	ND	0.10	mg/kg	ND			NC	40	
Surrogate: 2-Fluorobiphenyl	0.781		%		56.5	50-140			
Surrogate: Terphenyl-d14	0.703		%		50.9	50-140			

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	191	7	mg/kg	ND	111	85-115			
F2 PHCs (C10-C16)	85	4	mg/kg	ND	100	60-140			
F3 PHCs (C16-C34)	620	8	mg/kg	436	87.9	60-140			
F4 PHCs (C34-C50)	266	6	mg/kg	97	128	60-140			
Metals									
Antimony	35.6	1	ug/g	ND	71.2	70-130			
Arsenic	51.4	1	ug/g	1.8	99.2	70-130			
Barium	72.9	1	ug/g	25.7	94.4	70-130			
Beryllium	46.1	0.5	ug/g	ND	91.6	70-130			
Boron	48.0	5.0	ug/g	6.5	83.1	70-130			
Cadmium	46.3	0.5	ug/g	ND	92.3	70-130			
Chromium (VI)	4.4	0.2	ug/g	ND	75.0	70-130			
Chromium	61.5	5	ug/g	10.5	102	70-130			
Cobalt	51.5	1	ug/g	2.9	97.0	70-130			
Copper	51.7	5	ug/g	7.4	88.6	70-130			
Lead	45.3	1	ug/g	3.6	83.3	70-130			
Mercury	1.23	0.1	ug/g	ND	81.8	70-130			
Molybdenum	47.4	1	ug/g	ND	93.6	70-130			
Nickel	56.5	5	ug/g	9.5	93.9	70-130			
Selenium	43.4	1	ug/g	ND	86.4	70-130			
Silver	40.4	0.3	ug/g	ND	80.7	70-130			
Thallium	44.8	1	ug/g	ND	89.3	70-130			
Tin	46.6	5	ug/g	ND	92.8	70-130			
Uranium	44.0	1	ug/g	ND	87.2	70-130			
Vanadium	64.7	10	ug/g	12.8	104	70-130			
Zinc	68.1	20	ug/g	26.6	82.9	70-130			
Semi-Volatiles									
1-Methylnaphthalene	0.099	0.02	mg/kg	ND	57.1	50-140			
2-Methylnaphthalene	0.108	0.02	mg/kg	ND	62.3	50-140			
Acenaphthene	0.117	0.02	mg/kg	ND	67.8	50-140			

Certificate of Analysis

Report Date: 22-Nov-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 17-Nov-2023

Client PO: 58868

Project Description: PE6040

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Acenaphthylene	0.126	0.02	mg/kg	ND	72.7	50-140			
Anthracene	0.139	0.02	mg/kg	ND	80.4	50-140			
Benzo [a] anthracene	0.126	0.02	mg/kg	ND	73.0	50-140			
Benzo [a] pyrene	0.092	0.02	mg/kg	ND	53.2	50-140			
Benzo [b] fluoranthene	0.117	0.02	mg/kg	ND	67.9	50-140			
Benzo [g,h,i] perylene	0.096	0.02	mg/kg	ND	55.3	50-140			
Benzo [k] fluoranthene	0.124	0.02	mg/kg	ND	71.9	50-140			
Biphenyl	0.125	0.02	mg/kg	ND	72.3	50-140			
Chrysene	0.122	0.02	mg/kg	ND	70.4	50-140			
Dibenzo [a,h] anthracene	0.097	0.02	mg/kg	ND	56.0	50-140			
Fluoranthene	0.148	0.02	mg/kg	ND	85.8	50-140			
Fluorene	0.118	0.02	mg/kg	ND	68.1	50-140			
Indeno [1,2,3-cd] pyrene	0.102	0.02	mg/kg	ND	59.3	50-140			
Naphthalene	0.113	0.01	mg/kg	ND	65.2	50-140			
Phenanthrene	0.125	0.02	mg/kg	ND	72.5	50-140			
Pyrene	0.148	0.02	mg/kg	ND	85.4	50-140			
Quinoline	0.115	0.10	mg/kg	ND	66.6	50-140			
Surrogate: 2-Fluorobiphenyl	0.797		%		57.6	50-140			
Surrogate: Terphenyl-d14	0.710		%		51.4	50-140			
Volatiles									
Benzene	0.187	0.002	mg/kg	ND	93.4	60-140			
Ethylbenzene	0.219	0.002	mg/kg	ND	109	60-140			
Toluene	0.178	0.002	mg/kg	ND	88.9	60-140			
m,p-Xylenes	0.392	0.002	mg/kg	ND	97.9	60-140			
o-Xylene	0.204	0.002	mg/kg	ND	102	60-140			
Surrogate: Toluene-d8	0.367		%		91.6	60-140			

Certificate of Analysis

Client: Paterson Group Consulting Engineers (Ottawa)

Client PO: 58868

Report Date: 22-Nov-2023

Order Date: 17-Nov-2023

Project Description: PE6040

Qualifier Notes:**QC Qualifiers:**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 unless otherwise noted.

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.

Any use of these results implies your agreement that our total liability 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.



Client Name: Pateson Group	Project Ref: PE6040	Page 1 of 1
Contact Name: Jeremy Camposarcone	Quote #:	Turnaround Time ☐ 1 day ☐ 3 day ☐ 2 day ☒ Regular Date Required: _____
Address: 9 Ariga Drive	PO #: 58868	
Telephone: 613-226-7381	E-mail: jcamposarcone@patesongroup.ca ameyhart@patesongroup.ca	

☒ REG 153/04 ☐ REG 406/19 ☐ Table 1 ☐ Res/Park ☐ Med/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ Table _____ For RSC: ☐ Yes ☐ No	Other Regulation ☐ REG 558 ☐ PWQO ☒ CCME ☐ MISA ☐ SU - Sani ☐ SU - Storm Mun: _____ ☐ Other: _____	Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)	Required Analysis <table border="1"> <thead> <tr> <th>PHCs F1-F4+BTEX</th> <th>VOCs</th> <th>PAHs</th> <th>Metals by ICP</th> <th>Hg</th> <th>CrVI</th> <th>B (HWS)</th> <th>EC/SAR</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>✓</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>✓</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>												PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	EC/SAR							✓		✓	✓	✓	✓		✓							✓		✓	✓	✓	✓		✓							✓														✓																																																																																																															
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Sample ID/Location Name <table border="1"> <thead> <tr> <th></th> <th>Matrix</th> <th>Air Volume</th> <th># of Containers</th> <th>Date</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>S</td> <td></td> <td>3</td> <td>11/15/2023</td> <td></td> </tr> <tr> <td>2</td> <td>S</td> <td></td> <td>1</td> <td>11/15/2023</td> <td></td> </tr> <tr> <td>3</td> <td>S</td> <td></td> <td>1</td> <td>11/16/2023</td> <td></td> </tr> <tr> <td>4</td> <td>S</td> <td></td> <td>1</td> <td>11/16/2023</td> <td></td> </tr> <tr><td>5</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>			Matrix	Air Volume	# of Containers	Date	Time	1	S		3	11/15/2023		2	S		1	11/15/2023		3	S		1	11/16/2023		4	S		1	11/16/2023		5						6						7						8						9						10																																																																																																																								
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Comments:			Method of Delivery: Swift		
Relinquished By (Sign): [Signature]	Received By Driver/Depot:	Received at Lab: [Signature]	Verified By: SD		
Relinquished By (Print): Jeremy Camposarcone	Date/Time: 11/16/2023	Date/Time: 11/17/2023 1:50	Date/Time: Nov 17, 2023 4:52pm		
Date/Time: 11/16/2023	Temperature: _____ °C	Temperature: 11.9 °C	pH Verified: ☐ By: _____		

Certificate of Analysis

Paterson Group Consulting Engineers (Ottawa)

9 Auriga Drive
Ottawa, ON K2E 7T9
Attn: Jeremy Camposarcone

Client PO: 59039
Project: PE6040
Custody:

Report Date: 14-Dec-2023

Order Date: 7-Dec-2023

Order #: 2349405

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

Paracel ID	Client ID
2349405-01	BH27-23-AU1
2349405-02	BH28-23-AU1
2349405-03	DUP1

Approved By:



Mark Foto, M.Sc.

Lab Supervisor

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	12-Dec-23	12-Dec-23
PCBs, total	SW846 8082A - GC-ECD	11-Dec-23	13-Dec-23
PHC F1	CWS Tier 1 - P&T GC-FID	8-Dec-23	9-Dec-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Dec-23	11-Dec-23
Solids, %	CWS Tier 1 - Gravimetric	8-Dec-23	11-Dec-23

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Client ID:	BH27-23-AU1	BH28-23-AU1	DUP1	-	
Sample Date:	06-Dec-23 09:00	06-Dec-23 09:00	06-Dec-23 09:00	-	-
Sample ID:	2349405-01	2349405-02	2349405-03	-	
Matrix:	Soil	Soil	Soil	-	
MDL/Units					

Physical Characteristics

% Solids	0.1 % by Wt.	84.4	84.4	84.1	-	-
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Volatiles

Benzene	0.002 ug/g	<0.002	<0.002	<0.002	-	-
Ethylbenzene	0.002 ug/g	<0.002	<0.002	<0.002	-	-
Toluene	0.002 ug/g	<0.002	<0.002	<0.002	-	-
m,p-Xylenes	0.002 ug/g	<0.002	<0.002	<0.002	-	-
o-Xylene	0.002 ug/g	<0.002	<0.002	<0.002	-	-
Xylenes, total	0.002 ug/g	<0.002	<0.002	<0.002	-	-
Toluene-d8	Surrogate	90.9%	100%	98.1%	-	-

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g	<7	<7	<7	-	-
F2 PHCs (C10-C16)	4 ug/g	<4	<4	<4	-	-
F3 PHCs (C16-C34)	8 ug/g	<8	49	<8	-	-
F4 PHCs (C34-C50)	6 ug/g	<6	130	<6	-	-

PCBs

PCBs, total	0.05 ug/g	-	<0.05	-	-	-
Decachlorobiphenyl	Surrogate	-	99.7%	-	-	-

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
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					
PCBs								
PCBs, total	ND	0.05	ug/g					
Surrogate: Decachlorobiphenyl	0.109		%	109	60-140			
Volatiles								
Benzene	ND	0.002	ug/g					
Ethylbenzene	ND	0.002	ug/g					
Toluene	ND	0.002	ug/g					
m,p-Xylenes	ND	0.002	ug/g					
o-Xylene	ND	0.002	ug/g					
Xylenes, total	ND	0.002	ug/g					
Surrogate: Toluene-d8	0.397		%	99.1	60-140			

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	ND	8	ug/g	10			NC	30	
F4 PHCs (C34-C50)	ND	6	ug/g	124			NC	30	
PCBs									
PCBs, total	ND	0.05	ug/g	ND			NC	40	
Surrogate: Decachlorobiphenyl	0.132		%		106	60-140			
Physical Characteristics									
% Solids	85.0	0.1	% by Wt.	83.2			2.1	25	

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	197	7	ug/g	ND	115	85-115			
F2 PHCs (C10-C16)	118	4	ug/g	ND	106	60-140			
F3 PHCs (C16-C34)	339	8	ug/g	10	121	60-140			
F4 PHCs (C34-C50)	202	6	ug/g	124	45.2	60-140			QM-06
PCBs									
PCBs, total	0.617	0.05	ug/g	ND	124	60-140			
Surrogate: Decachlorobiphenyl	0.127		%		102	60-140			
Volatiles									
Benzene	0.188	0.002	ug/g	ND	94.2	60-140			
Ethylbenzene	0.200	0.002	ug/g	ND	99.8	60-140			
Toluene	0.200	0.002	ug/g	ND	100	60-140			
m,p-Xylenes	0.444	0.002	ug/g	ND	111	60-140			
o-Xylene	0.223	0.002	ug/g	ND	112	60-140			
Surrogate: Toluene-d8	0.361		%		90.3	60-140			

Certificate of Analysis

Report Date: 14-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 7-Dec-2023

Client PO: 59039

Project Description: PE6040

Qualifier Notes:**QC Qualifiers:**

QM-06 Due to noted non-homogeneity of the QC sample matrix, the spike recoveries were out side the accepted range. Batch data accepted based on other 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 unless otherwise noted.

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.

Any use of these results implies your agreement that our total liability 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.



Client Name: Paterson Group Inc.	Project Ref: PE6040	Page 1 of 1
Contact Name: Jeremy Camposarcone	Quote #:	Turnaround Time ☐ 1 day ☐ 3 day ☐ 2 day ☒ Regular Date Required: _____
Address: 9 AURIGA DRIVE OTTAWA ON K2E 7T9	PO #: 59039	
Telephone: 613-226-7381	E-mail: jcamposarcone@patersongroup.ca amenyhart@patersongroup.ca	

☒ REG 153/04 ☐ REG 406/19 ☐ Table 1 ☐ Res/Park ☐ Med/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ Table _____ For RSC: ☐ Yes ☐ No	Other Regulation ☐ REG 558 ☐ PWQO ☒ CCME ☐ MISA ☐ SU - Sani ☐ SU - Storm Mun: _____ ☐ Other: _____	Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)	Required Analysis PHC F1-F4 + BTEX VOCs PAHs Metals by ICP Hg Cr/Vi B (HWS) pH PCBs														
Sample ID/Location Name		Matrix	Air Volume	# of Containers	Sample Taken												
					Date	Time											
1	BH27-23-AU1	S		2	12/6/2023		✓										
2	BH28-23-AU1	S		2	12/6/2023		✓								✓		
3	DUP1	S		2	12/6/2023		✓										
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Comments:			Method of Delivery:		
			Swift		
Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab:	Verified By:		
		SO	Hing		
Relinquished By (Print): Jeremy Camposarcone	Date/Time:	Date/Time: Dec 7, 2023 4:35pm	Date/Time: Dec 7, 23 17:33		
Date/Time: 12/6/2023	Temperature: °C	Temperature: 4.1	pH Verified: ☐ By:		

Certificate of Analysis

Paterson Group Consulting Engineers (Ottawa)

9 Auriga Drive
Ottawa, ON K2E 7T9
Attn: Jeremy Camposarcone

Client PO: 59083
Project: PE6040
Custody: 142053

Report Date: 21-Dec-2023

Order Date: 15-Dec-2023

Order #: 2350508

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

Paracel ID	Client ID
2350508-01	BH15-23-GW1
2350508-02	BH27-23-GW1
2350508-03	DUP-1-X

Approved By:



Dale Robertson, BSc

Laboratory Director

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	18-Dec-23	18-Dec-23
PHC F1	CWS Tier 1 - P&T GC-FID	18-Dec-23	18-Dec-23
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	18-Dec-23	19-Dec-23
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	20-Dec-23	20-Dec-23

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Client ID:	BH15-23-GW1	BH27-23-GW1	DUP-1-X	-	-
Sample Date:	11-Dec-23 10:50	11-Dec-23 10:00	11-Dec-23 00:00	-	-
Sample ID:	2350508-01	2350508-02	2350508-03	-	-
Matrix:	Ground Water	Ground Water	Ground Water	-	-
MDL/Units					

Volatiles

Benzene	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	<0.5	<0.5	-	-	-
Toluene-d8	Surrogate	121%	96.8%	118%	-	-	-

Hydrocarbons

F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	-	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	<100	<100	-	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	<100	<100	-	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	<100	<100	-	-	-

Semi-Volatiles

Acenaphthene	0.05 ug/L	<0.05	-	-	-	-	-
Acenaphthylene	0.05 ug/L	<0.05	-	-	-	-	-
Anthracene	0.01 ug/L	<0.01	-	-	-	-	-
Benzo [a] anthracene	0.01 ug/L	<0.01	-	-	-	-	-
Benzo [a] pyrene	0.01 ug/L	<0.01	-	-	-	-	-
Benzo [b] fluoranthene	0.05 ug/L	<0.05	-	-	-	-	-
Benzo [g,h,i] perylene	0.05 ug/L	<0.05	-	-	-	-	-
Benzo [k] fluoranthene	0.05 ug/L	<0.05	-	-	-	-	-
Chrysene	0.05 ug/L	<0.05	-	-	-	-	-
Dibenzo [a,h] anthracene	0.05 ug/L	<0.05	-	-	-	-	-
Fluoranthene	0.01 ug/L	<0.01	-	-	-	-	-
Fluorene	0.05 ug/L	<0.05	-	-	-	-	-

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Client ID:	BH15-23-GW1	BH27-23-GW1	DUP-1-X	-	
Sample Date:	11-Dec-23 10:50	11-Dec-23 10:00	11-Dec-23 00:00	-	-
Sample ID:	2350508-01	2350508-02	2350508-03	-	
Matrix:	Ground Water	Ground Water	Ground Water	-	
MDL/Units					

Semi-Volatiles

Indeno [1,2,3-cd] pyrene	0.05 ug/L	<0.05	-	-	-	-
1-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-	-
2-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-	-
Methylnaphthalene (1&2)	0.10 ug/L	<0.10	-	-	-	-
Naphthalene	0.05 ug/L	<0.05	-	-	-	-
Phenanthrene	0.05 ug/L	<0.05	-	-	-	-
Pyrene	0.01 ug/L	<0.01	-	-	-	-
2-Fluorobiphenyl	Surrogate	75.6%	-	-	-	-
Terphenyl-d14	Surrogate	103%	-	-	-	-

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons								
F1 PHCs (C6-C10)	ND	25	ug/L					
F2 PHCs (C10-C16)	ND	100	ug/L					
F3 PHCs (C16-C34)	ND	100	ug/L					
F4 PHCs (C34-C50)	ND	100	ug/L					
Semi-Volatiles								
Acenaphthene	ND	0.05	ug/L					
Acenaphthylene	ND	0.05	ug/L					
Anthracene	ND	0.01	ug/L					
Benzo [a] anthracene	ND	0.01	ug/L					
Benzo [a] pyrene	ND	0.01	ug/L					
Benzo [b] fluoranthene	ND	0.05	ug/L					
Benzo [g,h,i] perylene	ND	0.05	ug/L					
Benzo [k] fluoranthene	ND	0.05	ug/L					
Chrysene	ND	0.05	ug/L					
Dibenzo [a,h] anthracene	ND	0.05	ug/L					
Fluoranthene	ND	0.01	ug/L					
Fluorene	ND	0.05	ug/L					
Indeno [1,2,3-cd] pyrene	ND	0.05	ug/L					
1-Methylnaphthalene	ND	0.05	ug/L					
2-Methylnaphthalene	ND	0.05	ug/L					
Methylnaphthalene (1&2)	ND	0.10	ug/L					
Naphthalene	ND	0.05	ug/L					
Phenanthrene	ND	0.05	ug/L					
Pyrene	ND	0.01	ug/L					
Surrogate: 2-Fluorobiphenyl	14.1		%	70.6	50-140			
Surrogate: Terphenyl-d14	19.9		%	99.6	50-140			
Volatiles								
Benzene	ND	0.5	ug/L					
Ethylbenzene	ND	0.5	ug/L					
Toluene	ND	0.5	ug/L					
m,p-Xylenes	ND	0.5	ug/L					

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	ND	0.5	ug/L					
Xylenes, total	ND	0.5	ug/L					
Surrogate: Toluene-d8	90.7		%	113	50-140			

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND			NC	30	
Volatiles									
Benzene	ND	0.5	ug/L	ND			NC	30	
Ethylbenzene	ND	0.5	ug/L	ND			NC	30	
Toluene	ND	0.5	ug/L	ND			NC	30	
m,p-Xylenes	ND	0.5	ug/L	ND			NC	30	
o-Xylene	ND	0.5	ug/L	ND			NC	30	
Surrogate: Toluene-d8	81.6		%		102	50-140			

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1840	25	ug/L	ND	107	85-115			
F2 PHCs (C10-C16)	1810	100	ug/L	ND	113	60-140			
F3 PHCs (C16-C34)	4770	100	ug/L	ND	122	60-140			
F4 PHCs (C34-C50)	2550	100	ug/L	ND	103	60-140			
Semi-Volatiles									
Acenaphthene	3.91	0.05	ug/L	ND	78.3	50-140			
Acenaphthylene	4.39	0.05	ug/L	ND	87.9	50-140			
Anthracene	4.86	0.01	ug/L	ND	97.2	50-140			
Benzo [a] anthracene	4.37	0.01	ug/L	ND	87.4	50-140			
Benzo [a] pyrene	3.35	0.01	ug/L	ND	66.9	50-140			
Benzo [b] fluoranthene	4.32	0.05	ug/L	ND	86.4	50-140			
Benzo [g,h,i] perylene	3.60	0.05	ug/L	ND	72.0	50-140			
Benzo [k] fluoranthene	4.64	0.05	ug/L	ND	92.8	50-140			
Chrysene	4.11	0.05	ug/L	ND	82.1	50-140			
Dibenzo [a,h] anthracene	3.58	0.05	ug/L	ND	71.5	50-140			
Fluoranthene	5.24	0.01	ug/L	ND	105	50-140			
Fluorene	3.70	0.05	ug/L	ND	74.1	50-140			
Indeno [1,2,3-cd] pyrene	3.84	0.05	ug/L	ND	76.8	50-140			
1-Methylnaphthalene	3.52	0.05	ug/L	ND	70.3	50-140			
2-Methylnaphthalene	3.73	0.05	ug/L	ND	74.5	50-140			
Naphthalene	3.76	0.05	ug/L	ND	75.2	50-140			
Phenanthrene	4.09	0.05	ug/L	ND	81.9	50-140			
Pyrene	5.20	0.01	ug/L	ND	104	50-140			
Surrogate: 2-Fluorobiphenyl	14.9		%		74.5	50-140			
Surrogate: Terphenyl-d14	19.3		%		96.6	50-140			
Volatiles									
Benzene	38.0	0.5	ug/L	ND	94.9	60-130			
Ethylbenzene	34.5	0.5	ug/L	ND	86.2	60-130			
Toluene	35.0	0.5	ug/L	ND	87.4	60-130			
m,p-Xylenes	81.1	0.5	ug/L	ND	101	60-130			

Certificate of Analysis

Report Date: 21-Dec-2023

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 15-Dec-2023

Client PO: 59083

Project Description: PE6040

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	31.5	0.5	ug/L	ND	78.8	60-130			
Surrogate: Toluene-d8	73.8		%		92.3	50-140			

Certificate of Analysis

Client: Paterson Group Consulting Engineers (Ottawa)

Client PO: 59083

Report Date: 21-Dec-2023

Order Date: 15-Dec-2023

Project Description: PE6040

Qualifier Notes: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

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.

Any use of these results implies your agreement that our total liability 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.



Client Name: <u>PATERSON</u>	Project Ref: <u>PE6040</u>	Page <u>1</u> of <u>1</u>
Contact Name: <u>JEREMY CAMPOSARCONI</u>	Quote #:	Turnaround Time ☐ 1 day ☐ 3 day ☐ 2 day ☒ Regular
Address: <u>9 AURIGA DR. NEPEAN, ON.</u>	PO #: <u>59083</u>	
Telephone: <u>613-226-7381</u>	E-mail: <u>JCAMPOSARCONI@PATERSONGROUP.CA</u>	
Date Required: _____		

☒ REG 153/04 ☐ REG 406/19 ☐ Table 1 ☐ Res/Park ☐ Med/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ Table _____ For RSC: ☐ Yes ☐ No		Other Regulation ☐ REG 558 ☐ PWQO ☐ CCME ☐ MISA ☐ SU - Sani ☐ SU - Storm Mun: _____ ☐ Other: _____		Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)		Required Analysis													
Sample ID/Location Name		Matrix	Air Volume	# of Containers	Sample Taken		PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)						
1	BH15-23-GW1	GW	-	4	DEC 11/23	10:50A	X		X										
2	BH27-23-GW1	↓	-	3	↓	10:00A	X												
3	DWP-1-X	↓	-	3	↓	—	X												
4																			
5																			
6																			
7																			
8																			
9																			
10																			

Comments:		Method of Delivery: <u>Parcel Carrier</u>	
Relinquished By (Sign): <u>[Signature]</u>	Received By Driver/Depot:	Received at Lab: <u>SD</u>	Verified By: <u>SD</u>
Relinquished By (Print): <u>Dominic Lamy</u>	Date/Time:	Date/Time: <u>DEC 15, 2023 4:00 pm</u>	Date/Time: <u>DEC 15, 2023 4:26 pm</u>
Date/Time: <u>DEC 15, 2023</u>	Temperature: _____ °C	Temperature: <u>7.7</u> °C	pH Verified: ☐ By: _____

Soil & Groundwater Management Plan

Proposed Residential Development

Tunney's Pasture (Block 10)
Ottawa, Ontario

Prepared for Arcadis IBI Group

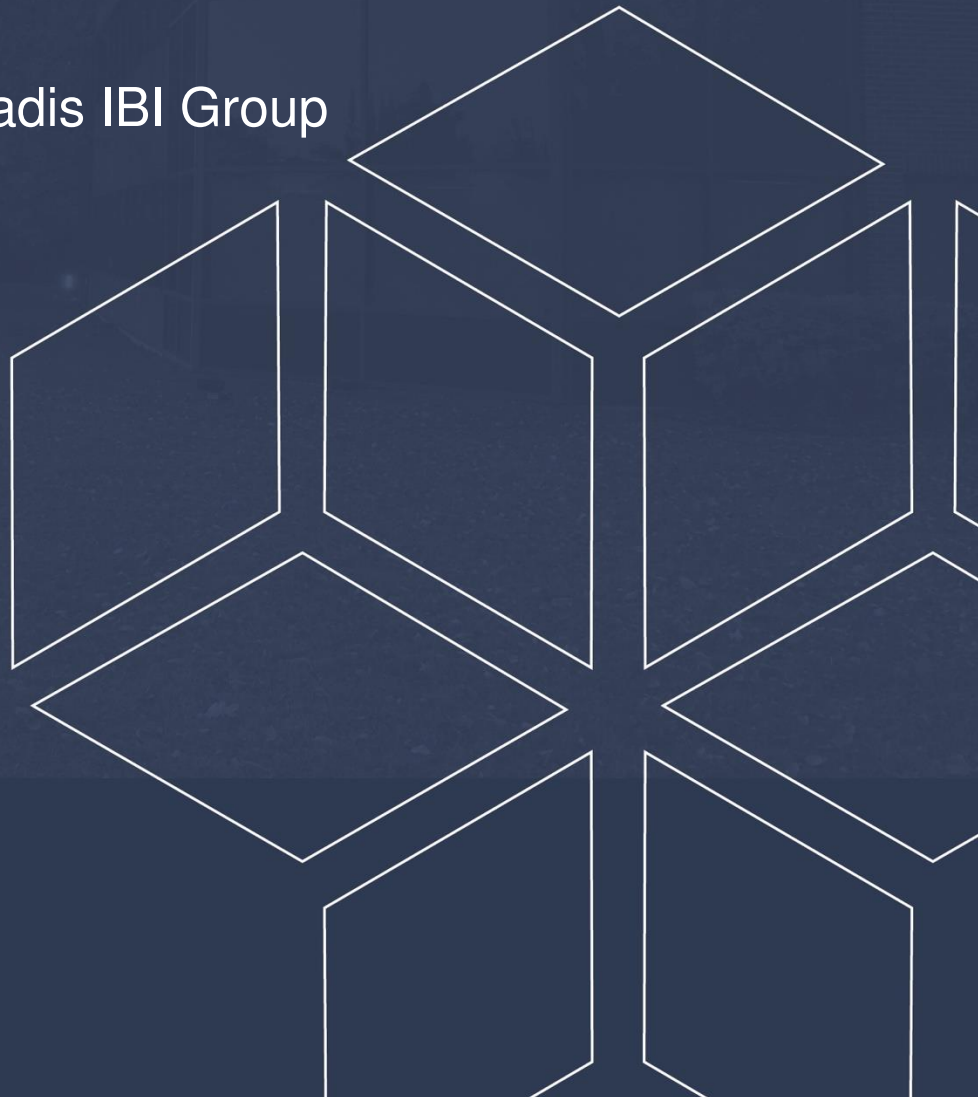




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1.0 Introduction

This Soil and Groundwater Management Plan (SGMP) was developed to minimize the soil and groundwater onsite that will require off-site disposal and when off-site disposal is required, ensuring that proper handling and disposal methods are undertaken. A high level fee estimate for the required items for soil and groundwater management during construction have been included at the end of this letter.

Note that the eastern portion of the subject property should be further evaluated following the completion of the on-going remediation activities being completed by other consultants.

2.0 Soil Reuse

Soil is considered suitable for reuse on the subject site provided that the soil is not considered heavily impacted (no visible free product or significant petroleum hydrocarbon (PHC) odours) and is not used as final cover for landscaping purposes (with the exception of segregated topsoil and granular materials). This includes soil with naturally elevated barium concentration, and salt-related exceedances.

The excavated soil may be suitable for reuse on-site as backfill from a geotechnical perspective provided that it is maintained in a relatively dry condition, can be properly compacted, and is approved by the geotechnical engineer at the time of construction. Additionally, based on the conditions observed, cobbles and boulders are likely to be encountered in certain areas of the excavation. Thus, prior to reusing this soil, it will be necessary to cull out all material in excess of 300 mm in its largest dimension. Alternatively, cobbles and boulders could be processed and blended with the fill to a gradation suitable for reuse as engineered fill.

Site excavated soil can also be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and compacted to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective standard Proctor maximum dry density (SPMDD). Site excavated soil is not suitable for use as backfill against foundation walls due to the frost heave potential of the site excavated soils below settlement sensitive areas, such as concrete sidewalks and exterior concrete entrance areas.

It is recommended that stockpiles of excavated material intended for reuse be protected against increases in moisture content by securely covering the stockpiles prior to and during precipitation events. Therefore, the placement and compaction of the on-site soil should be completed during relatively dry and non-freezing conditions. If, due to any of



the above conditions, the existing fill becomes unsuitable for reuse as engineered fill based on the geotechnical engineer, it should be transported and properly disposed off-site, and an imported fill material should be used. Protection of materials from increased moisture content is considered to be the responsibility of the Contractor.

3.0 Groundwater Re-use

Groundwater is considered to be suitable to manage on-site during situations where free product is not observed and no risk to the workers or the natural environment is considered to be present relating to its re-use. The groundwater must be able to be managed without entering any surface water bodies without appropriate treatment and permits.

4.0 Soil Requiring Off-Site Disposal

Soil is considered to require off-site disposal from an environmental perspective when the soil is heavily impacted. Heavily impacted soil is considered impacts that can re-contaminate areas due to leaching and consists of free product visible in the soil and/or significant PHC odours.

Based on the findings of this assessment, the barium concentration detected in soil sample BH15-23-SS4 exceeds the selected MECP Table 7 Coarse-Grained Residential Soil Standard. Naturally elevated barium concentrations are known to be present in soils of the Ottawa area. Although the soil with elevated barium is considered acceptable to remain on-site, soil with elevated barium should be further assessed for off-site reuse. This may include additional testing in the area of BH15-23-SS4. Acceptance will be contingent on the reuse site.

Similarly, soil with elevated salt-related parameters could be beneficially reused off-site, provided the soil is accepted by the reuse site, and that it is placed in accordance with the excess soil rules and regulation.

Excavated soil is not considered to be suitable for reuse on site during conditions where, in the opinion of the geotechnical engineer, the soil is saturated and/or does not have a suitable gradation for placement and compaction that will not achieve the required compaction specifications.

Soil to be disposed off-site must be evaluated by environmental personnel prior to their disposal. Heavily impacted soil must be disposed at an approved waste disposal facility. Soil observed to be clean or marginally impacted can be disposed of at a variety of waste disposal facilities, including, but not limited to, clean fill sites (clean soil only) and



interim transfer stations. Based on the quality of the soil, as determined by the environmental personnel, the soil must be sent to the appropriate disposal facility.

At this time, soil disposal locations have not been selected. These locations will be selected by the construction contractor prior to mobilization.

5.0 Groundwater Requiring Off-Site Disposal

Groundwater must be disposed of off-site in situations where free product is observed. The groundwater must be disposed of following all applicable laws and regulations. Licensed pumping contractors are required to dispose of any impacted groundwater. If impacted groundwater is observed, all reasonable efforts must be made to limit the quantity of impacted groundwater pumped and disposed. Similarly, if a spill occurs all reasonable efforts should be made to protect the surface and groundwater resources. At no time is groundwater to be disposed of directly to surface water resources.

Any offsite groundwater must be disposed of through an approved method. Grossly impacted groundwater where a sheen and/or odour is identified must be treated prior to removal from site or be removed from site with the intention of offsite treatment. Excess groundwater may also be able to be disposed within the City of Ottawa Sanitary and/or Storm sewer system. Prior to disposal to the sewer system, a sewer discharge agreement must be completed with the City of Ottawa.

5.1 Construction Dewatering

The site-specific construction dewatering protocols will be provided in project- specific geotechnical and/or hydrogeological reports.

Generally, it is recommended that additional analytical testing prior to construction mobilization should be carried out to determine the appropriate disposal method. Any environmentally impacted groundwater should be pumped into a storage tanker for testing and potentially treatment before discharging to the sanitary sewer.

5.2 Groundwater Monitoring Decommissioning

All groundwater monitoring wells must be decommissioned in accordance with Ontario Regulation 903/90. It is recommended that the groundwater monitoring wells remain in place and in viable condition for as long as possible, to allow for any potential re-sampling.



6.0 Permits and Agreements

It is anticipated that the following permits and agreements will be required to conduct the Construction Contractor Obligations (with respect to the Soil and Groundwater Management Plan);

- ☐ Permit to Take Water (or water taking EASR)
- ☐ City of Ottawa Storm and/or Sanitary Sewer Discharge agreement
- ☐ Landfill agreement for soil disposal
- ☐ Clean Fill agreement for soil disposal

7.0 Soil Stockpiles and Handling

Any soil and construction debris that is temporarily stockpiled must be done so within the confines of the perimeter protection/construction fencing. All stockpiles will be covered, by the trade contractor, with plastic tarps (10 mil plastic minimum), or an impermeable geotextile and secured from wind. The stockpiles will be covered with plastic in a reasonable time frame as weather conditions dictate. If the stockpile is continuously being accessed then the stockpile will be covered prior to the end of the work day, as weather conditions dictate. Storm water runoff from the plastic covering is to be diverted away from all surface water resources and from open construction excavations.

Stockpiles should be clearly identified to eliminate cross contamination and improper usage. Soil identified as grossly impacted should be immediately loaded into truck and disposed of at the licensed waste facility. The volume of excess soil disposed of at the landfill should be minimized using segregation during excavation and subsequent stockpile sampling programs.

8.0 Federal and Provincial Confirmatory Soil and Groundwater Sampling Protocols

The soil and groundwater sampling protocols followed during the field sampling programs in Ontario should be in general accordance with the MECP document entitled *"Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario"*, dated May 1996.



8.1 Soil and Groundwater Standards

The soil and groundwater standards for the Ontario portion of the site were taken from the document entitled “*Soil, Groundwater and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act*” prepared by the Ontario Ministry of the Environment (now Ministry of the Environment, Conservation and Parks), dated April 15, 2011. Several of the Tables found in the document may be applicable to the subject site. The following Table may be applicable.

The Table 7 Standards are based on the following considerations:

- ☐ Coarse-Grained Soil Conditions
- ☐ Non-Potable Groundwater Conditions
- ☐ Residential Land Use
- ☐ Shallow Soil Conditions

The applicable federal soil and groundwater standards are considered to be the Canadian Council of Ministers of the Environment (CCME). The standards are taken from the document entitled “*Canadian Environmental Quality Guidelines*”, however, due to the proposed use of the block(s) as privately owned operations, only Provincial standards are deemed to apply for future uses.

Note that due to the proposed change in land use to a more sensitive use (e.g. commercial to residential), a Record of Site Condition will be required prior to redevelopment.

8.2 Stockpile Sampling

Stockpiled soils are subject to minimum sampling requirements under O.Reg. 153/04. The sampling requirements are shown below;



MINIMUM STOCKPILE SAMPLING FREQUENCY	
Stockpile Volume (m ³)	Minimum Number of Analysed Samples
≤ 130	3
> 130 to 220	4
> 220 to 320	5
> 320 to 430	6
> 430 to 550	7
> 550 to 670	8
> 670 to 800	9
> 800 to 950	10
> 950 to 1100	11
> 1100 to 1250	12
> 1250 to 1400	13
> 1400 to 1550	14
> 1550 to 1700	15
> 1700 to 1850	16
> 1850 to 2050	17
> 2050 to 2200	18
> 2200 to 2350	19
> 2350 to 2500	20
> 2500 to 2700	21
> 2700 to 2900	22
> 2900 to 3100	23
> 3100 to 3300	24
> 3300 to 3500	25
> 3501 to 3700	26
> 3700 to 3900	27
> 3900 to 4100	28
> 4100 to 4300	29
> 4300 to 4500	30
> 4500 to 4700	31
> 4700 to 5000	32
> 5000	32+(Volume-5000)÷300

The soil samples collected from the stockpiles are required to be tested for the following (as a minimum) Petroleum Hydrocarbons F1-F4, Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), Metals, hydride forming Metals, sodium adsorption ratio (SAR), electrical conductivity (EC), and any other contaminants of concern, as identified by the environmental consultant (Qualified Person). Analysis for EC and SAR is only required in areas where a substance (namely road salt) has been applied for the purposes of keeping the area safe under conditions of snow or ice.



9.0 Applicable Municipal Laws, Standards, Codes and Guidelines

9.1 Soil and Groundwater Standards

No municipal soil standards and guidelines are considered to apply.

Groundwater discharged into the sewer systems of the City of Ottawa and City of Gatineau must follow the applicable bylaws.

City of Ottawa

The City of Ottawa requires that all discharges fall within the limits of Sewer Use By-law No. 2003-514. A sewer use agreement is expected to be required to manage excess groundwater at selected sites.

10.0 Imported Material

All imported material may originate from a licensed pit, quarry or other aggregate site licensed under the Aggregate Resources Act, or, from a source site where all applicable excess soil regulations have been met. Imported material will be required to meet the specific standard for its final use. If clean fill is imported onto site from a property not licensed under the Aggregate Resources Act, in-situ, or stockpile sampling as outlined in Section 8.3, will be required prior to final placement.

All imported soil must be placed in accordance with Ontario Regulation 406/19.

11.0 Quality Assurance and Quality Control

A minimum of 10% of samples will be submitted as duplicates for the purposes of QA/QC. Only one parameter grouping per QA/QC sample is required.

Additional QA/QC procedures are outlined in the Environmental Quality Management Plan, available under a separate cover.

12.0 Unexpected Environmental Impacts

If unexpected environmental impacts are encountered during the course of construction or redevelopment of the block(s), the environmental consultant or their representative should be notified immediately and work should avoid the area until an inspection is completed.



Following an inspection by the environmental consultant or their representative recommendations will be made regarding appropriate material handling procedures at the location. Additional investigative work may be required to delineate the impacted areas (if required).

13.0 Estimated Soil and Groundwater Management Budget

The following table presents the approximate costs related to items discussed in this soil and groundwater management plan. It should be noted that these cost estimates strictly consider the central and western portions of Block 10 of the Tunney's Pasture Complex as the east portion of the property could not be investigated as part of this assessment.

Table 1: Estimated Costs for Soil and Groundwater Management	
Item	Fees
On-Site and Excess Soil Management (O.Reg. 406/19), including: • Reporting • Supplemental testing • Meetings and Consultation with stakeholders and contractors Note that the On-site and Excess Soil testing will provide valuable information for soil delineation purposes.	\$100,000
Soil remediation – tipping fees (\$60/mt)	*contingent on current remediation activities
Soil remediation. Includes: • Site supervision • Confirmatory soil sampling • Reporting	*contingent on current remediation activities
Record of Site Condition (O.Reg. 153/04) – initial submission (note that additional revisions and submissions may be required based on Ministry comments)	\$20,000 \$10,000 (revisions)
Permit to take water or Water taking EASR (whichever is applicable)	\$20,000 \$8,000
City of Ottawa sewer discharge testing and permits	\$5,000
TOTAL	\$155,000