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Site Servicing and Stormwater Management Brief – 2070 Scott Street, Ottawa, ON

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1.0 INTRODUCTION AND OBJECTIVE

The following revised Site Servicing and Stormwater Management (SWM) report has been prepared to reflect the revised site plan which includes the existing residential property on 328 Winona Avenue and to address City comments to the first engineering submission of December 2019. A summary of the civil-related comments and responses is included in **Appendix G**. The results of the revised servicing analyses are summarized in this report, while the drawings have been revised to reflect the revised site plan.

Stantec Consulting Ltd. has been retained by Azure Urban Developments Inc. to prepare the following site servicing and stormwater management (SWM) brief to satisfy the City of Ottawa Zoning and Site Plan Control Application process. The site is located at 2070/2090 Scott Street, in the south-east quadrant of the intersection of Churchill Avenue and Scott Street in the city of Ottawa (see **Figure 1** below).

The site proposed for re-development measures 0.21 ha. The proposed re-development area was previously occupied by a three-storey building, a one-storey car service station and paved parking areas and a residential dwelling on Winona Avenue. The proposed development consists of a twenty-five-storey commercial/residential building with 243 units, four levels of underground parking and associated access and servicing infrastructure. The proposed building will include retail space, indoor and outdoor amenity areas, 4 town-homes, 122 one-bedroom apartments, 50 two-bedroom apartments, 22 three-bedroom apartments, 45 studio apartments, underground parking and a bicycle storage room. As agreed with the owner of the adjacent residential property on 330 Winona Avenue, the southern portion of the site which consists of a driveway access to a shed within the adjacent property will remain unchanged (see **Drawing SSP-1**). The proposed site plan has been included in **Appendix B**.

Figure 1: Site Location

1.1 OBJECTIVE

This site servicing and SWM brief has been prepared to present a servicing scheme that is free of conflicts and which utilizes the existing infrastructure as obtained from available as-built drawings and in consultation with City of Ottawa staff. Infrastructure requirements for water supply, sanitary and storm sewer services are presented in this report.

Criteria and constraints provided by the City of Ottawa have been used as a basis for the conceptual servicing design of the proposed development. Specific elements and potential development constraints to be addressed are as follows:

- Prepare a grading plan in accordance with the proposed site plan and existing grades.
- Storm Sewer Servicing
    - Define major and minor conveyance systems in conjunction with the proposed grading plan
    - Determine the stormwater management storage requirements to meet the allowable release rate for the site
    - Coordinate with mechanical engineer to convey drainage from roof tops, amenity areas, and private terrace areas to the internal cistern and discharge to the proposed storm service lateral at the allowable release rate.
    - Define and size the proposed storm service lateral that will be connected to the existing 675 mm diameter storm sewer on Winona Avenue.
- Wastewater Servicing

  - Define and size the sanitary service lateral which will be connected to the existing 225 mm diameter sanitary sewer on Winona Avenue.

- Water Servicing
  - Estimate water demands to characterize the proposed feed for the proposed development which will be serviced from the existing 200 mm diameter watermain on Scott Street and the 150 mm diameter watermain on Winona Avenue.

  - Watermain servicing for the development is to be able to provide average day and maximum day (including peak hour) demands (i.e. non-emergency conditions) at pressures within the acceptable range of 50 to 70 psi (350 to 480 kPa).

  - Under fire flow (emergency) conditions, the water distribution system is to maintain a minimum pressure greater than 20 psi (140 kPa).

The accompanying drawings included in the back of this report illustrate the proposed internal servicing scheme for the site.

2.0 REFERENCES

The following background studies have been referenced during the preliminary servicing design of the proposed site:

- *City of Ottawa Design Guidelines – Water Distribution*, City of Ottawa, July 2010
- *City of Ottawa Sewer Design Guidelines*, City of Ottawa, October 2012
- *Technical Bulletin ISDTB-2014-01,* City of Ottawa, February 2014
- *Technical Bulletin ISTB-2018-01*, City of Ottawa, March 21, 2018
- *Technical Bulletin ISTB-2018-02*, City of Ottawa, March 21, 2018
- *Technical Bulletin ISTB-2018-03*, City of Ottawa, March 21, 2018
- *Technical Bulletin PIEDTB -2016-01,* City of Ottawa, September 6, 2016
- *Geotechnical Investigation Proposed Multi-Storey Building 2070 Scott Street – Ottawa,* Paterson Group, July 26, 2019
- *Phase II Environmental Site Assessment 2070 Scott Street – Ottawa,* Paterson Group, September 10, 2019
- *Environmental Remedial Action Plant 2070 Scott Street and 328 Winona Avenue – Ottawa,* Paterson Group, April 8, 2020

3.0 WATER DISTRIBUTION

The proposed building is located in Pressure Zone 1W of the City of Ottawa's Water Distribution System. The proposed development will be serviced through the existing 200 mm diameter watermain on Scott Street and the 150 mm watermain on Winona Avenue as shown on the Site Servicing Plan (see **Drawing SSP-1**).

The proposed twenty-five-storey building is to be a high-rise commercial/residential building with retail space, four levels of underground parking, 4 town homes, and a mix of one-bedroom (167 units), two-bedroom (50 units) and three bedroom apartments (22 units) for a total of 243 units. The building is to have a total floor space of approximately 16,977 m^2 above grade.

Water demands were calculated using the City of Ottawa Water Distribution Guidelines (July, 2010) to determine the typical operating pressures to be expected at the building (see detailed calculations in **Appendix A**). A daily rate of 350 L/cap/day has been applied for the population of the proposed site. The average daily (AVDY) residential demand was estimated for an occupancy of 1.4 persons per unit for a one-bedroom apartment, 2.1 persons per unit for a two-bedroom apartment, 3.1 persons per unit for a three-bedroom apartment, and 2.7 persons per unit for townhomes. Water demands for the proposed retail space (509 m^2) were estimated based on 28,000 L/ha/day. Maximum day (MXDY) demands were determined by multiplying the AVDY demands by a factor of 2.5 for residential areas and by a factor of 1.5 for commercial areas. Peak hourly (PKHR) demands were determined by multiplying the MXDY demands by a factor of 2.2 for residential areas and by a factor of 1.8 for commercial areas. The estimated demands are summarized in **Table 1**.

Table 1: Estimated Water Demands

	Population/Area	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Residential	418 persons	1.69	4.23	9.31
Commercial	509 m^2	0.02	0.02	0.04
Total Site:		**1.71**	**4.26**	**9.35**

The fire flow requirement was calculated in accordance with Fire Underwriters Survey (FUS) and determined to be approximately 7,000 L/min (116.7 L/s). The FUS estimate is based on a non-combustible construction building with a two-hour fire separation considered between each floor per requirements for buildings over six-storeys as per the Ontario Building Code (OBC), and vertical openings and external vertical communications properly protected (one-hour rating). As a result, the floor area was estimated as the area of the largest floor plus 25% of each of the two immediately adjoining floors. Additionally, it is anticipated that all buildings will be sprinklered, with final sprinkler design to conform to NFPA 13 (see detailed calculations in **Appendix A**).

Table 2 outlines the boundary conditions provided by the City of Ottawa on September 6, 2019 for the estimated water demands shown in **Table 1**.

Water Distribution

Table 2: Boundary Conditions

	Connection 1 (Scott Street)	Connection 2 (Winona Avenue)
Min. HGL (m)	108.7	108.7
Max. HGL (m)	115.0	115.0
Max. Day + Fire Flow (100 L/s)	109.0	95.0

The desired normal operating objective pressure range as per the City of Ottawa 2010 Water Distribution Design Guidelines is 350 kPa (50 psi) to 480kPa (70 psi) and no *less than 275kPa (40 psi)* at ground elevation. Furthermore, the maximum pressure at any point in the water distribution should not exceed 100 psi as per the Ontario Building/Plumbing Code; pressure reducing measures are required to service areas where pressures *greater than 552kPa (80 psi)* are anticipated.

The ground elevation at the intersection of Scott Street and Winona Avenue, close to where the proposed building is to be connected is approximately 63.60 m. With respect to the peak hour flow conditions, the resulting boundary condition HGL of 108.7 m corresponds to a peak hour pressure of 441 kPa (64 psi). Since the proposed building is a 25-storey building, an additional 34 kPa (5 psi) for every additional storey over two storeys is required to account for the change in elevation head and additional headloss. Given that the lowest pressure is expected to be 441 kPa (64 psi) at ground level, there will be insufficient pressure to reach the top floors and as a result, a pump will be required to maintain an acceptable level of service on the higher floors.

A maximum pressure check can be conducted using the building's lowest finished floor elevation (63.40 m for the townhomes) and the maximum boundary condition HGL of 115.0 m. This results in a pressure of 51.60 m, or 503 kPa (73 psi). This value is below the limit of 80 psi which would require pressure reducing valves.

In regard to available fire flow, boundary conditions provided by the City confirm that a flow rate of 6,000 L/min (100 L/s) would have a residual pressure of 441 kPa (64 psi) on Scott Street (ground elevation of 63.80 m), and a residual pressure of 310 kPa (45 psi) on Winona Avenue (ground elevation of 63.37 m). The fire flow rate should be achievable within the watermain at this proposed location while maintaining a residual pressure of 138kPa (20 psi). However, the fire flow requirement for the proposed building which has a slightly bigger footprint is 7,000 L/min (117 L/s). It is expected that acceptable residual pressures will be maintained at this increased fire flow requirement, but this will be confirmed in the next submission once the revised boundary conditions are received.

In conclusion, based on the boundary conditions available, the 200 mm diameter watermain on Scott Street and the 150 mm diameter watermain on Winona Avenue provide adequate fire flow capacity as per the Fire Underwriters Survey. In order to meet the City water supply objective that limits a single feed to 50 m^3/d during basic day demands, three connections are required to service the proposed building; two connections to the existing 200 mm diameter watermain on Scott Street separated by a new isolation valve, and a third connection to the 150

mm diameter watermain on Winona Avenue. The service connections will be capable of providing anticipated demands to the lower storeys but will require a booster pump to maintain minimum pressures of 350 kPa (50 psi) for floors 6 to 25.

4.0 SANITARY SEWER

As illustrated on **Drawing SSP-1**, sanitary servicing for the proposed development will be provided through a proposed 150 mm diameter service lateral connecting to the existing 225 mm diameter sanitary sewer running north on Winona Avenue. The 225 mm Winona Avenue public sewer ultimately discharges to a 375 mm diameter sanitary sewer at the intersection of Winona Avenue and Scott Street.

The proposed 0.21 ha re-development area will consist of a high-rise commercial/residential building with retail space, four levels of underground parking, 4 town homes, and a mix of one-bedroom (167 units), two-bedroom (50 units) and three bedroom apartments (22 units) for a total of 243 units. The anticipated wastewater peak flow generated from the proposed development is summarized in **Table 3** below while a sanitary sewer design sheet is included in **Appendix C**.

Table 3: Estimated Wastewater Peak Flow

Residential/Commercial Peak Flows					Infiltration Flow (L/s)	Total Peak Flow (L/s)
	# of Units/Area	Population	Peak Factor	Peak Flow (L/s)		
Residential	243 units	418	4.0	5.42	0.07	5.51
Commercial	0.050 ha	N/A	1.5	0.02		

1. Average residential flow based on 280 L/p/day
2. Peak factor for residential units calculated using Harmon's formula
3. Apartment population estimated based on 1.4 persons/unit for one-bedroom apartments , 2.1 persons/unit for two-bedroom apartments and 3.1 persons/unit for three-bedroom apartments
4. Townhome population estimated based on 2.7 persons/unit
5. Commercial peak flows estimated based on 28,000 L/ha/day
6. Infiltration flow based on 0.33 L/s/ha.

The proposed sewage peak flows were provided to City of Ottawa staff to conduct a capacity analysis of the sanitary sewer system in the vicinity of the site and confirmation was received that there are no concerns with respect to adding the proposed sanitary peak flows to the existing sewers on Winona Avenue and Scott Street (see correspondence in **Appendix C**).

Detailed sanitary sewage calculations are included in **Appendix C**. A backflow preventer will be required for the proposed building in accordance with the Ottawa sewer design guide and will be coordinated with building mechanical engineers.

All underground parking drains should be connected to the building's internal plumbing. A sump pump will be required to drain the underground parking levels to the existing sanitary sewer on Winona Avenue.

4.1 SANITARY SEWER DESIGN CRITERIA

As outlined in the City of Ottawa Sewer Design Guidelines and the MECP's Design Guidelines for Sewage Works, the following criteria were used to calculate estimated wastewater flow rates and to size the sanitary sewer lateral:

- Minimum Velocity – 0.6 m/s (0.8 m/s for upstream sections)
- Maximum Velocity – 3.0 m/s
- Manning roughness coefficient for all smooth wall pipes – 0.013
- 1.4 persons/one-bedroom apartment
- 2.1 persons/two-bedroom apartment
- 3.1 persons/three-bedroom apartment
- 2.7 persons/townhome
- 28,000 L/ha/day for commercial areas
- Harmon's Formula for Residential Peak Factor – Max = 4.0
- Commercial Peak Factor of 1.5
- Extraneous Flow Allowance – 0.33 L/s/ha (conservative value)
- Manhole Spacing – 120 m
- Minimum Cover – 2.5 m

5.0 STORMWATER MANAGEMENT

5.1 OBJECTIVES

The objective of this stormwater management plan is to determine the measures necessary to control the quantity of stormwater released from the proposed development to the required levels and to provide sufficient detail for approval and construction.

5.2 EXISTING CONDITIONS

The proposed re-development area was previously occupied by a three-storey building, a one-storey car service station and paved parking areas, and a residential dwelling on 328 Winona Avenue. As agreed with the owner of the adjacent residential property on 330 Winona Avenue, the southern portion of the site which consists of a driveway access to a shed within the adjacent property will remain unchanged and as such, it has not been included in the SWM calculations. The previous site located at the intersection of Churchill Avenue and Scott Street was serviced through the existing 900 mm diameter storm sewer on Scott Street and included a network of catchbasins that captured runoff from paved parking areas. Similarly, the previous site located at the intersection of Winona Avenue and Scott Street was serviced through the existing 675 mm diameter storm sewer on Winona Avenue and included a network of catchbasins that captured runoff from paved parking areas (see **Drawing EX-1**).

City of Ottawa staff recommended stormwater management peak flows from the proposed site be restricted to the 2-year with a runoff coefficient of 0.60. The proposed 2070 Scott Street re-development encompasses approximately 0.205 ha of land (excludes existing driveway area to remain unchanged in the southern portion of the site, area EX-1), which assuming a time of concentration (Tc) of 10 minutes results in an allowable peak outflow of Q = 2.78 x C x I x A = 2.78 x 0.60 x 76.81 x 0.205 = **26.3 L/s**

5.3 SWM CRITERIA AND CONSTRAINTS

The stormwater management criteria for the proposed site are based on City of Ottawa Sewer Design Guidelines (2012) and on consultation with City of Ottawa Staff. The following summarizes the criteria used in the preparation of this stormwater management plan:

- Control post development peak flows up to the 100-year storm to the 2-year runoff with a runoff coefficient (C) of 0.60 which corresponds to **26.3 L/s**.
- Size storm sewers using an inlet time of concentration (Tc) of 10 minutes
- Post-development runoff coefficient (C) value based on proposed impervious areas as per site plan drawing (see **Appendix B**)

5.4 STORMWATER MANAGEMENT DESIGN

The proposed 0.21 ha re-development area consists of 4 town homes, retail space, and a mix of one-bedroom (167 units), two-bedroom (50 units) and three bedroom apartments (22 units) for a total of 243 units, underground parking, and associated access infrastructure. The imperviousness of the proposed site is 87% (C = 0.81).

The SWM strategy for the site is to provide an underground cistern to attenuate peak flows in the downstream system to the allowable release rate of 26.3 L/s. The proposed building will capture storm drainage through a combination of uncontrolled roof drains, a ditch inlet catchbasin in a swale capturing runoff along the southern property line, and amenity area drains that will direct peak flows to a cistern located in the underground parking for attenuation. Controlled peak flows from the cistern will be pumped at the north east corner of the building and ultimately discharged into the existing 675 mm diameter storm sewer on Winona Avenue. Coordination with the mechanical consultant will be commenced and current plans will be provided and flows identified to size the internal system and the underground cistern.

The proposed site plan, drainage areas and proposed storm sewer infrastructure are shown on **Drawing SD-1**.

5.4.1 Design Methodology

The intent of the stormwater management plan presented herein is to mitigate any negative impact that the proposed development could have on the existing drainage and storm sewer infrastructure, while providing adequate capacity to service the proposed building, parking and access areas. The proposed stormwater management plan is designed to detain runoff in an underground cistern to ensure that peak flows after construction from the proposed re-development area will not exceed the target release rate for the site.

A portion of the site could not be graded to enter the building's internal plumbing system and as such it will sheet drain uncontrolled. Runoff from these uncontrolled area is included in the overall site discharge calculations.

5.4.2 Water Quantity Control

The Modified Rational Method was used to assess the quantity and volume of runoff generated during post development conditions. The site was subdivided into subcatchments (subareas) tributary to storm sewer inlets, as defined by the location of catchbasins / inlet grates, and used in the storm sewer design (see **Appendix D**). A summary of subareas and runoff coefficients is provided in **Appendix D**, and **Drawing SD-1** indicates the stormwater management subcatchments.

5.4.3 Allowable Release Rate

Site discharge rates up to the 100-year storm event are to be restricted to the 2-year storm event with a runoff coefficient ('C' value of 0.60) as outlined below in **Table 4**.

Table 4: Target Release Rate

Rational Method 'C'	Area (ha)	Time of Concentration (min)	Q_{Target} (L/s)
0.60	0.205	10	26.3

5.4.4 Storage Requirements

The site requires quantity control measures to meet the stormwater release criteria. Therefore, it is proposed to use underground storage in a cistern located in the underground parking. Stormwater management calculations are provided in **Appendix D**.

5.4.4.1 Subsurface Storage

It is proposed to detain stormwater within a 50 m^3 cistern below grade with a maximum controlled release rate of 16.19 L/s to the gravity service provided. The modified rational method was used to determine the peak volume requirement for the cistern. Site drainage areas are captured into the building plumbing directed to the cistern for additional control.

Table 5 and **Table 6** summarize the flow rates and storage from the cistern for the 2 and 100 year events respectively.

Table 5: Peak Controlled (Tributary) 2-Year Release Rate

Area ID	Area (ha)	Runoff 'C'	$Q_{release}$ (L/s)	V_{stored} (m^3)
ROOF1 TO ROOF8, TRENCH	0.181	0.85	16.2	9.9

Table 6: Peak Controlled (Tributary) 100-Year Release Rate

Area ID	Area (ha)	Runoff 'C'	$Q_{release}$ (L/s)	V_{stored} (m^3)
ROOF1 TO ROOF8, TRENCH	0.181	1.00	16.2	50.0

5.4.5 Uncontrolled Area

A portion of the site around the building (see **Drawing SD-1**) could not be graded to enter the building's internal plumbing system and as such it will sheet drain uncontrolled. **Table 7** and **Table 8** summarize the 2 and 100-year uncontrolled release rates from the proposed development.

Table 7: Peak Uncontrolled (Non-tributary) 2-Year Release Rate

Area ID	Area (ha)	Runoff 'C'	Tc (min)	$Q_{release}$ (L/s)
UNC-1 & UNC-2	0.024	0.68	10	3.5

Table 8: Peak Uncontrolled (Non-tributary) 100-Year Release Rate

Area ID	Area (ha)	Runoff 'C'	Tc (min)	$Q_{release}$ (L/s)
UNC-1 & UNC-2	0.024	0.85	10	10.1

5.4.6 Results

Table 9 and **Table 10** demonstrate that the proposed stormwater management plan provides adequate attenuation storage to meet the target peak outflow for the site.

Table 9: Estimated Discharge from Site (2-Year)

Area Type	$Q_{release}$ (L/s)	Target (L/s)
Controlled Cistern Discharge	16.2	**26.3**
Uncontrolled Sheet Flow	3.5	
Total	**19.7**	

Table 10: Estimated Discharge From Site (100-Year)

Area Type	$Q_{release}$ (L/s)	Target (L/s)
Controlled Cistern Discharge	16.2	**26.3**
Uncontrolled Sheet Flow	10.1	
Total	**26.3**	

6.0 GRADING AND DRAINAGE

The proposed re-development site measures approximately 0.21 ha in area. A detailed grading plan (see **Drawing GP-1**) has been provided to satisfy the stormwater management requirements and to provide sufficient cover over top of the underground parking garage.

The subject site maintains emergency overland flow routes to the streets surrounding the site as depicted on **Drawings GP-1** and **SD-1**.

7.0 UTILITIES

All utilities (Hydro Ottawa, Bell Canada, Rogers Ottawa, and Enbridge Gas) have existing plants in the area. The site will be serviced through connection to these existing services. Detailed design of the required utility services will be further investigated as part of the composite utility planning process following design circulation.

8.0 EROSION CONTROL DURING CONSTRUCTION

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

1. Implement best management practices to provide appropriate protection of the proposed drainage system and the receiving water course(s).
2. Limit extent of exposed soils at any given time.
3. Re-vegetate exposed areas as soon as possible.
4. Minimize the area to be cleared and grubbed.
5. Protect exposed slopes with plastic or synthetic mulches.
6. Provide sediment traps and basins during dewatering.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Plan construction at proper time to avoid flooding.
9. Installation of a mud matt to prevent mud and debris from being transported off site.
10. Installation of a silt fence to prevent sediment runoff.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

1. Verification that water is not flowing under silt barriers.
2. Clean and change silt traps at catch basins.

Refer to **Drawing EC/DS-1** for the proposed location of silt fences, and other erosion control structures.

9.0 GEOTECHNICAL INVESTIGATION AND PHASE II ESA

9.1 GEOTECHNICAL INVESTIGATION

A geotechnical report for the site was prepared by Paterson Group in July 2019 (see **Appendix E**). As stated in the geotechnical report, the subsurface profile across the site generally consists of fill underlying the existing crushed stone surface or 80 to 150 mm thick asphalt surface. The fill material extended to approximate depths of 1.4 to 3.8 m below the existing ground surface and generally consisted of loose to dense, brown silty sand to silty clay with trace to some gravel, cobbles, boulders, and construction debris such as glass, wood chips, brick, and concrete.

Practical refusal to augering or excavation was encountered at the test holes at depths of 1.4 to 3.8 m below the existing ground surface. Bedrock was cored to depths of 7.7 to 13.5 m, and consisted of a poor to excellent quality limestone to limestone with interbedded dolostone and shale.

Groundwater levels were measured in April 2013 and in May 2019 and were found to range between 5.3 m and 7.1 m below ground surface elevation.

Bedrock removal will be required to complete the four (4) levels of underground parking. The geotechnical report recommended line drilling with hoe-ramming and controlled blasting to remove the bedrock. The report also recommended that prior to considering blasting operations, the effects on the existing services, buildings and other structures should be addressed.

An alignment of a large diameter watermain runs along Scott Street. It is expected that the adjacent watermain could be subjected to potential vibrations associated with the bedrock blasting program. To ensure that no detrimental vibrations cause damage to the adjacent watermain, a vibration attenuation trench is recommended for the bedrock along the north excavation face, as well as a vibration monitoring and control program during the blasting and excavation work required for the proposed building excavation (please refer to the Geotechnical report included in **Appendix E** for details).

Given that the proposed building is to have more than 2 underground parking levels, the geotechnical report recommended the following water suppression system to manage and control groundwater water infiltration over the long term. The water suppression system would be installed for the exterior foundation walls and underfloor drainage and would consist of the following (refer to Figure 4 - Water Suppression System in Appendix 2 of the Geotechnical report included in **Appendix E** for an illustration of this system cross-section):

- A concrete mud slab creating a horizontal hydraulic barrier to lessen the water infiltration at the base of the excavation. The thickness of the concrete mud slab will be determined during the excavation program when realistic groundwater infiltration can

be properly assessed. However for preliminary design purposes, it is recommended that the concrete mud slab be designed at a minimum thickness of 150 mm.

- A waterproofing membrane to lessen the effect of water infiltration for the lower underground parking level(s) starting at 6 m below finished grade. The waterproofing membrane will consist of a bentonite waterproofing such as Tremco Paraseal or equivalent securely fastened to the temporary shoring system or the vertical bedrock surface. The membrane should extend to the bottom of the excavation at the founding level and extend horizontally over the concrete mud slab a minimum of 300 mm prior to the placement of the footings. Consideration can be given to doubling the bentonite waterproofing panels within the lower portion of the underground parking levels where hydrostatic pressure will be greater.

For foundation drainage, the geotechnical report recommended that a composite drainage layer be placed from finished grade to the bottom of the foundation wall. Where the proposed building is to have more than 2 underground parking levels and the water suppression system is employed, the composite drainage layer should be placed between the waterproofing membrane and the foundation wall.

It is recommended that the composite drainage system consist of DeltaDrain 6000, MiraDrain G100N or an approved equivalent. It is expected that 150 mm diameter sleeves placed at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area.

Underfloor drainage will be required to control water infiltration below the lowest underground parking level slab. For design purposes, the geotechnical report recommended that 150 mm diameter perforated pipes be placed at approximate 6 m spacing underlying the lowest level floor slab. The final spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium. Infiltration levels are anticipated to be low through the excavation face. The groundwater infiltration will be controllable with open sumps and pumps. A temporary MECP permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. A minimum of four to five months should be allocated for completion of the application and issuance of the permit by the MECP.

The geotechnical report recommended that any groundwater encountered along the building's perimeter or sub-slab drainage system be directed to the proposed building's cistern/sump pit. Due to the limited capacity of the existing sewers, it is anticipated that pumped groundwater can be temporarily contained within a cistern/holding tank to permit reduced discharge volumes, if required. Provided the proposed groundwater infiltration control system is

properly implemented where more than 3 underground parking levels are built, it is expected that groundwater flow will be low (i.e.- less than 3,000 L/day) with peak periods noted after rain events. It is anticipated that the groundwater flow will be controllable using conventional open sumps.

9.2 PHASE II ENVIRONMENTAL SITE ASSESSMENT

A Phase II ESA was conducted by Paterson Group in September 2019 (see report in **Appendix E**). The purpose of the Phase II ESA was to address the potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the subject property.

Four (4) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs F1-F4), metals, and polycyclic aromatic hydrocarbons (PAHs). Several metals parameters in the vicinity of BH6-19 exceeded the selected MECP Table 7 standards. The impacted fill material was identified in the southeast portion of the subject property, where the former automotive service garage was located. The extent of the impacted fill material is considered to be limited to the fill material present on the eastern portion of the property.

Groundwater samples recovered from monitoring wells installed in BH1/MW1, BH4-19, BH5-19, and BH6-19 were submitted for analysis of BTEX, PHCs (F1-F4), PAHs, and metals parameters. The concentration of benzene in the sample recovered from BH1/MW1 was marginally in excess of the selected MECP Table 7 standards. The impacted groundwater was identified in the southwest portion of the subject property only, where the tank nest associated with the former retail fuel outlet was located. The extent of the impacted groundwater is considered to be limited to a small radius within the southwest portion of the property.

Based on the findings of the Phase II ESA, metal and PAH impacted fill material as well as benzene impacted groundwater is present on the subject property, requiring some remedial work.

9.2.1 Environmental Remedial Action Plan

An Environmental Remedial Action Plan was subsequently prepared by Paterson Group in April 2020 (see **Appendix E**). The suggested remedial action plan would consist of the excavation and disposal of impacted soil at an approved waste disposal facility. The following assumptions were used in Paterson's Environmental Remedial Action Plan:

- The remediation of the site will occur in conjunction with the re-development of the property. It is anticipated that all of the soil on the eastern portion of the site is impacted.
- The soil quality at the subject site has not been fully delineated at this time. Based on the available soil results, the soil on the eastern half of the property is considered to be impacted and will be removed as such.

- Excavated soil will be screened using visual and olfactory observations in conjunction with analytical testing. Impacted soil will be placed in trucks and hauled to an approved waste disposal facility.
- If impacted groundwater is confirmed to be present on site, a portable treatment system will be installed to treat on-site accumulated groundwater by means of granular activated carbon. Alternatively, impacted groundwater could be removed by a licensed pumping contractor for off-site disposal. Groundwater treatment will continue until the on-site groundwater concentrations are in compliance with the MECP Table 7 Standards and/or the City of Ottawa sewer use by-law.
- A Sanitary Sewer Agreement will be obtained from the City of Ottawa Sewer Use Program prior to discharging any groundwater to the municipal system. Testing, reporting and discharge requirements will be carried out in compliance with the agreement.
- It is expected that two quarterly, post remediation confirmatory groundwater testing events will be required.
- A summary report and RSC will be submitted to the MECP for acknowledgement.

10.0 CONCLUSIONS

10.1 WATER SERVICING

The 200 mm diameter watermain on Scott Street and the 150 mm diameter watermain on Winona Avenue provide adequate fire flow capacity as per the Fire Underwriters Survey. In order to meet the City water supply objective that limits a single feed to 50 m^3/d during basic day demands, three connections are required to service the proposed building; two connections to the existing 200 mm diameter watermain on Scott Street and one connection to the 150 mm diameter watermain on Winona Avenue. The service connection will be capable of providing anticipated demands to the lower storeys but will require a booster pump to maintain minimum pressures of 350 kPa (50 psi) for floors 6 to 23.

10.2 SANITARY SERVICING

The proposed sanitary sewer lateral is sufficiently sized to provide gravity drainage for the site. The proposed site will be serviced by a 150 mm diameter service lateral directing wastewater flows to the existing 225 mm diameter sanitary sewer on Winona Avenue. A backflow preventer will be required for the proposed building in accordance with the Ottawa sewer design guide and will be coordinated with building mechanical engineers.

10.3 STORMWATER SERVICING

The proposed stormwater management plan is in compliance with the goals specified through consultation with the City of Ottawa, as well as local standards. Underground storage will be provided within a cistern located in the underground parking. Post development peak flows from the overall site up to the 100-year storm will be restricted to the target release rate. An underground pump will be required to direct flows from the internal building drainage system to the proposed gravity service connected to the existing 675 mm diameter storm sewer running north on Winona Avenue and ultimately discharging into the Scott Street storm sewer.

10.4 GRADING

Erosion and sediment control measures will be implemented during construction to reduce the impact on existing infrastructure. An alignment of a large diameter watermain runs within Scott Street, along the northern property line. It is expected that the adjacent watermain could be subjected to potential vibrations associated with the bedrock blasting program. To ensure that no detrimental vibrations cause damage to the adjacent watermain, a vibration attenuation trench is recommended for the bedrock along the north excavation face, as well as a vibration monitoring and control program during the blasting and excavation work required for the proposed building excavation.

10.5 UTILITIES

All utilities (Hydro Ottawa, Bell Canada, Rogers Ottawa, and Enbridge Gas) have existing plants in the subject area. Exact size, location and routing of utilities will be finalized after design circulation.

10.6 APPROVAL / PERMITS

Ministry of the Environment Conservation and Parks (MECP) Environmental Compliance Approvals (ECA) are not expected to be required for the subject site as the site is private and will remain under singular ownership. A Permit to Take Water may be required for pumping requirements for construction of underground parking level. No other approval requirements from other regulatory agencies are anticipated.

APPENDICES

Appendix A WATER CALCULATIONS

From: Wu, John
To: Odam, Cameron
Subject: RE: 2090 Scott Street - Hydraulic Boundary Conditions Request
Date: Friday, September 06, 2019 10:15:59 AM
Attachments: 2070 Scott Option 1 Sept 2019.pdf
2070 Scott Option 2 Sept 2019.pdf

Here is the result:

The following are boundary conditions, HGL, for hydraulic analysis at 2070 Scott (zone 1W) assumed to be connected to:

Option 1: 203mm on Scott (Connection 1) and 406mm on Churchill (Connection 2)

Option 2: 203mm on Scott (Connection 1) and 152mm on Winona (Connection 2)

Option 1:

	Connection 1 (Scott)	Connection 2 (Churchill)
Min HGL	108.7m	108.7m
Max HGL	115.0m	115.0m
Max day + FireFlow (100 L/s)	109.0m	110.0m

Option 2:

	Connection 1 (Scott)	Connection 2 (Winona)
Min HGL	108.7m	108.7m
Max HGL	115.0m	115.0m
Max day + FireFlow (100 L/s)	109.0m	95.0m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

John

From: Odam, Cameron <Cameron.Odam@stantec.com>
Sent: September 4, 2019 2:24 PM
To: Wu, John <John.Wu@ottawa.ca>
Cc: Paerez, Ana <Ana.Paerez@stantec.com>; Kilborn, Kris <kris.kilborn@stantec.com>
Subject: RE: 2090 Scott Street - Hydraulic Boundary Conditions Request

John,

Thanks for pointing that out. As per page 17 of the FUS guidelines, based on the proposed building being fire resistant with adequate protection of the vertical openings, we have now adjusted the area to be equal to the largest floor area (floor 1), with the addition of 25% of the two nearest adjoining floor areas, floor 2 and floor 3 (floor 3 was taken given the basement floors are not to be considered).

Best,

Cameron

From: Wu, John <John.Wu@ottawa.ca>
Sent: Wednesday, September 04, 2019 1:32 PM
To: Odam, Cameron <Cameron.Odam@stantec.com>
Subject: RE: 2090 Scott Street - Hydraulic Boundary Conditions Request

You're A is not right, either use the total area including all areas, or for fire resistant building at least is one floor adding 50% of it's top and 50% of its under ,therefore, it is at least of 2 of ground floor, please read the page 17 in FUS method.

John

From: Odam, Cameron <Cameron.Odam@stantec.com>
Sent: September 4, 2019 1:26 PM
To: Wu, John <John.Wu@ottawa.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>; Paerez, Ana <Ana.Paerez@stantec.com>
Subject: RE: 2090 Scott Street - Hydraulic Boundary Conditions Request

Hi John,

As per your request I have attached the FUS calculation sheet that indicates a fire flow of 4 000 L/min (66.7 L/s)

Please let me know if there is any further information you require at any point.

Best,

Cameron

From: Wu, John <John.Wu@ottawa.ca>
Sent: Wednesday, September 04, 2019 10:57 AM
To: Odam, Cameron <Cameron.Odam@stantec.com>
Subject: RE: 2090 Scott Street - Hydraulic Boundary Conditions Request

Please use FUS method for fire flow calculation.

John

From: Odam, Cameron <Cameron.Odam@stantec.com>
Sent: September 4, 2019 10:30 AM
To: Wu, John <John.Wu@ottawa.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>
Subject: 2090 Scott Street - Hydraulic Boundary Conditions Request

Hi John,

Would you be able to provide me with watermain hydraulic boundary conditions for the proposed site located at 2090 Scott Street? The site consists of a proposed 23 storey mixed use building over a 3 storey underground parking lot. The water service connection location to the building has yet to be finalized but will tie into either the existing 400mm watermain on Churchill Avenue, the 200mm on Scott Street or the 150mm WM on Winona Avenue (within the right of way, adjacent to the site).

It is still in discussion with the architect as to which 2 of the 3 locations will be the confirmed connection points. However, if you can provide all three that would be appreciated.

We have attached the OBC fire flow calculations for the proposed building as there is no private watermain required on site and will use existing municipal hydrants. A site location map with the approximate proposed connection point is also attached

Estimated domestic demands and fire flow requirements for the site are as follows:

Average Day Demand	– 1.77 L/s
Max Day Demand	- 4.41 L/s
Peak Hour Demand	- 9.70 L/s

Fire Flow Requirement per OBC –150 L/s *(9 000 L/min)*

Thanks,

Cameron

Cameron Odam

Direct: +16137244353
Fax: +16137222799
Cameron.Odam@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

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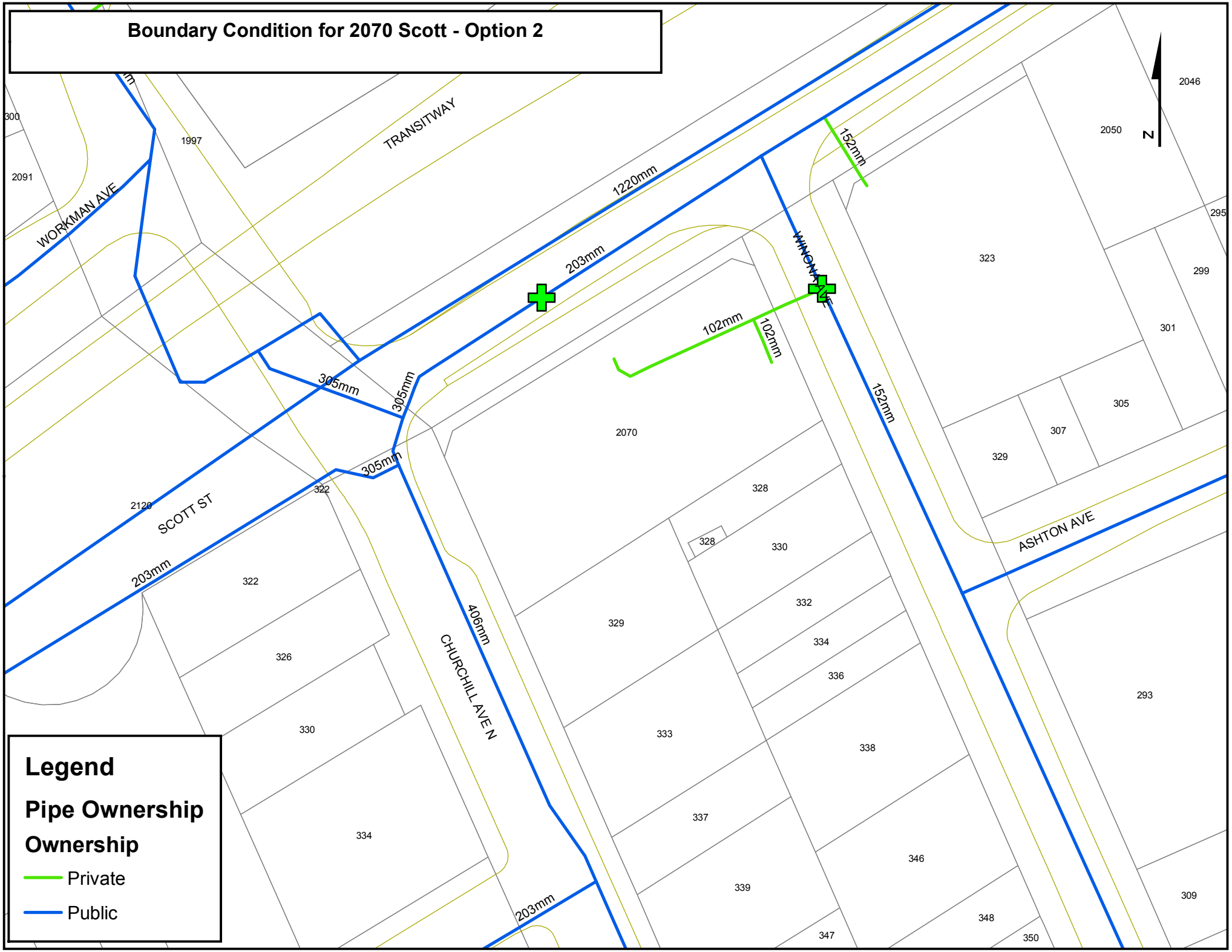

Boundary Condition for 2070 Scott - Option 2
TRANSITWAY
WORKMAN AVE
SCOTT ST
CHURCHILL AVE N
ASHTON AVE
WINONA AVE
1220mm
203mm
305mm
305mm
305mm
203mm
406mm
203mm
152mm
152mm
102mm
102mm
2046
2050
2091
1997
2120
2070
323
295
299
301
305
307
329
328
330
332
334
336
322
326
330
334
329
333
337
339
338
346
293
309
348
347
350
Legend
Pipe Ownership
Ownership
Private
Public

2090 Scott Street - Domestic Water Demand Estimates

Population densities as per City Guidelines:

1 Bedroom Apt	1.4	ppu
2 Bedroom Apt	2.1	ppu
3 Bedroom Apt	3.1	ppu
Townhouse	2.7	ppu

Demand conversion factors as per City Guidelines:

Residential	350	L/c/d
Commercial	28 000	L/ha-day

Building ID	Area (m^2)	Population	Daily Rate of Demand	Avg Day Demand		Max Day Demand [1]		Peak Hour Demand [2]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Commercial	509	-	2.8	1.0	0.02	1.5	0.02	2.7	0.04
Residential	-	418	350	101.5	1.69	253.9	4.23	558.5	9.31
Total Site :				**102.5**	**1.71**	**255.4**	**4.26**	**561.2**	**9.35**

For the purpose of this study it is predicted that retail and office facilities will be operated 12 hours per day.

Water demand criteria used to estimate peak demand rates for residential areas are as follows:

1 maximum day demand rate = 2.5 x average day demand rate

2 peak hour demand rate = 2.2 x maximum day demand rate

Water demand criteria used to estimate peak demand rates for commercial areas are as follows:

1 maximum day demand rate = 1.5 x average day demand rate

2 peak hour demand rate = 1.8 x maximum day demand rate

FUS Fire Flow Calculation Sheet

Stantec Project #: 160410249
Project Name: 2070 Scott Street
Date: 5/27/2020
Fire Flow Calculation #: 2
Description: Mixed Use Apartment Building

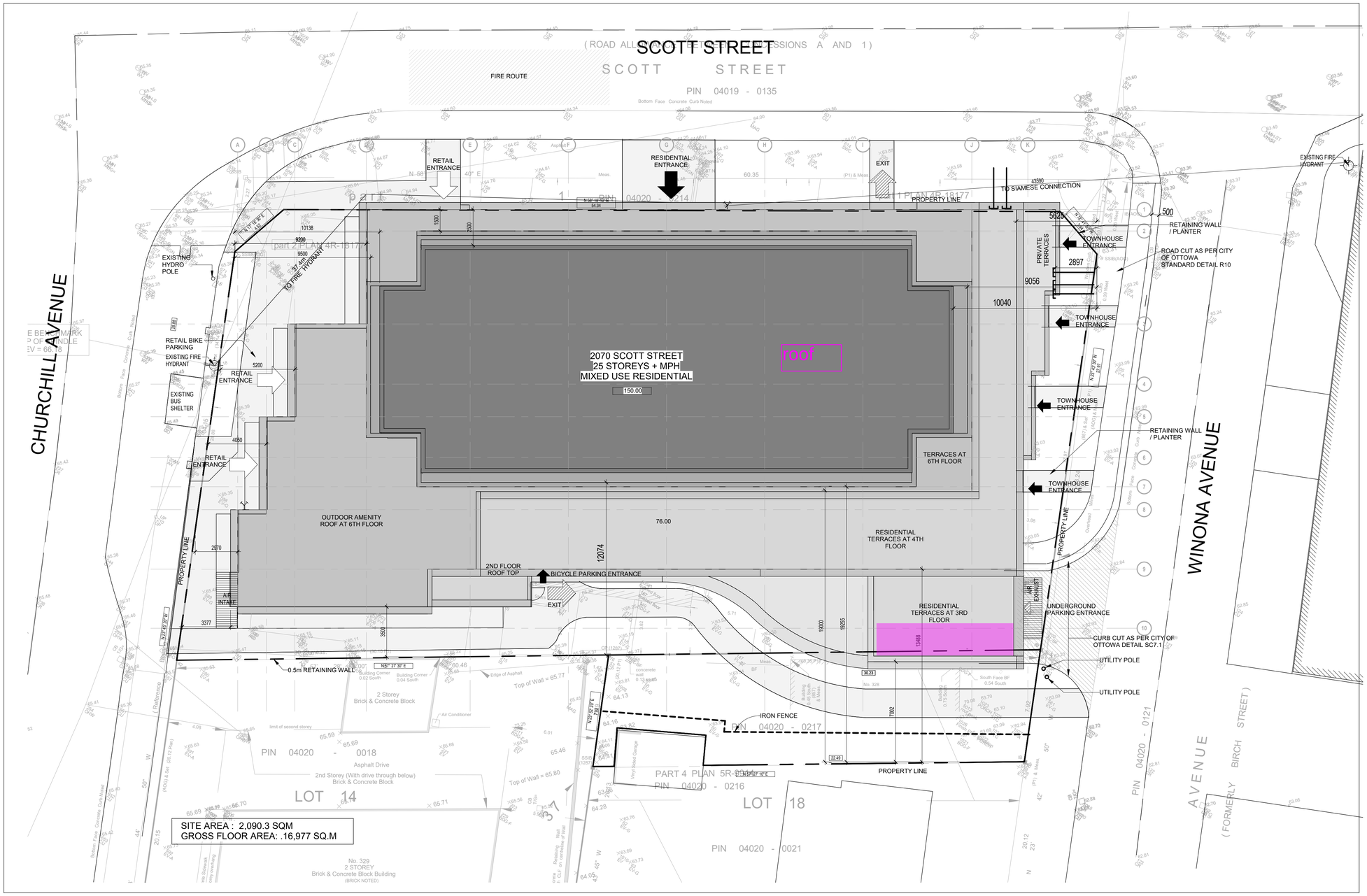
Notes: Floor assembly to be 2hour fire seperation as per OBC 3.2.2.42

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Non-Combustible Construction						0.8	-
2	Determine Ground Floor Area of One Unit	-						2084	-
	Determine Number of Adjoining Units	-						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						1	-
4	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min						-	8000
5	Determine Occupancy Charge	Limited Combustible						-15%	6800
6	Determine Sprinkler Reduction	Conforms to NFPA 13						-30%	-2720
		Standard Water Supply						-10%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						100%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	> 45	48.1	3	> 120	Wood Frame or Non-Combustible	0%	2516
		East	20.1 to 30	27.8	4	91-120	Ordinary or Fire-Resistive with Unprotected Openings	9%	
		South	3.1 to 10	56.4	2	91-120	Wood Frame or Non-Combustible	20%	
		West	20.1 to 30	28	2	31-60	Wood Frame or Non-Combustible	8%	
8	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**							**7000**
		Total Required Fire Flow in L/s							**116.7**
		Required Duration of Fire Flow (hrs)							**2.00**
		Required Volume of Fire Flow (m^3)							**840**

Appendix B PROPOSED SITE PLAN

SITE PLAN LEGEND:

- PROPERTY LINE
- LINE OF UNDER GROUND GARAGE BELOW
- MAIN BUILDING ENTRANCE
- RETAIL ENTRANCE
- EXIT
- VEHICLE ENTRANCE / EXIT
- FIRE HYDRANT
- SIAMESE CONNECTION
- MANHOLE COVER
- F.F.E. FINISH FLOOR ELEVATION
- BUILDING ENVELOPE
- 00000 TOP OF ROOF



Date	No.	Description
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2019-10-03		Rezoning and Site Plan Approval Submission

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2070 Scott Street

Ottawa, ON

Azure Urban Developments Inc.

PROJECT	SCALE	DRAWN	REVIEWED
19023	As indicated	DLC	LS

Site Plan

A101.S

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D07-12-19-0167

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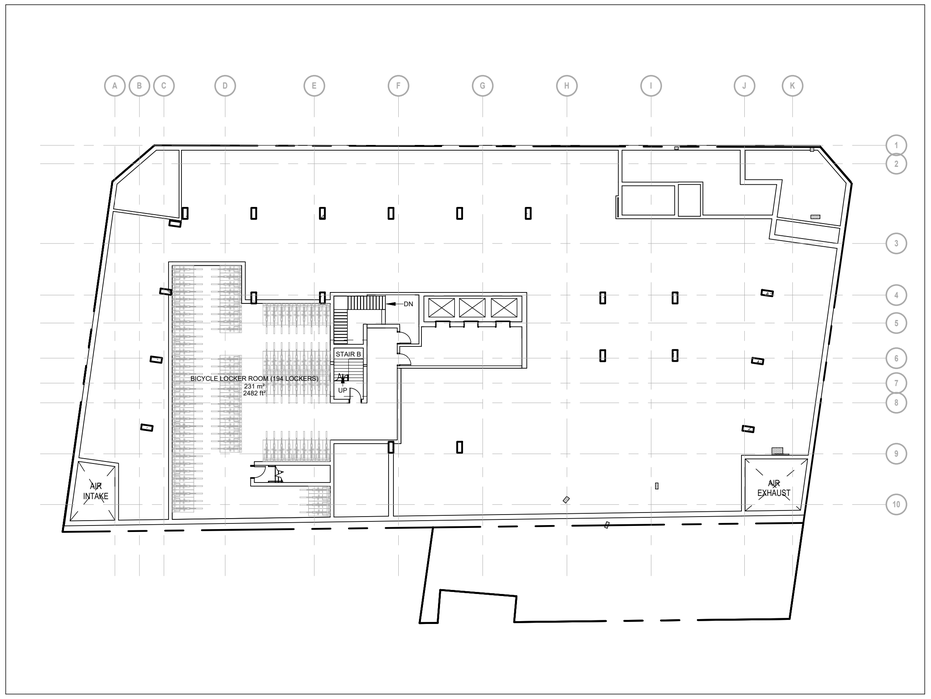
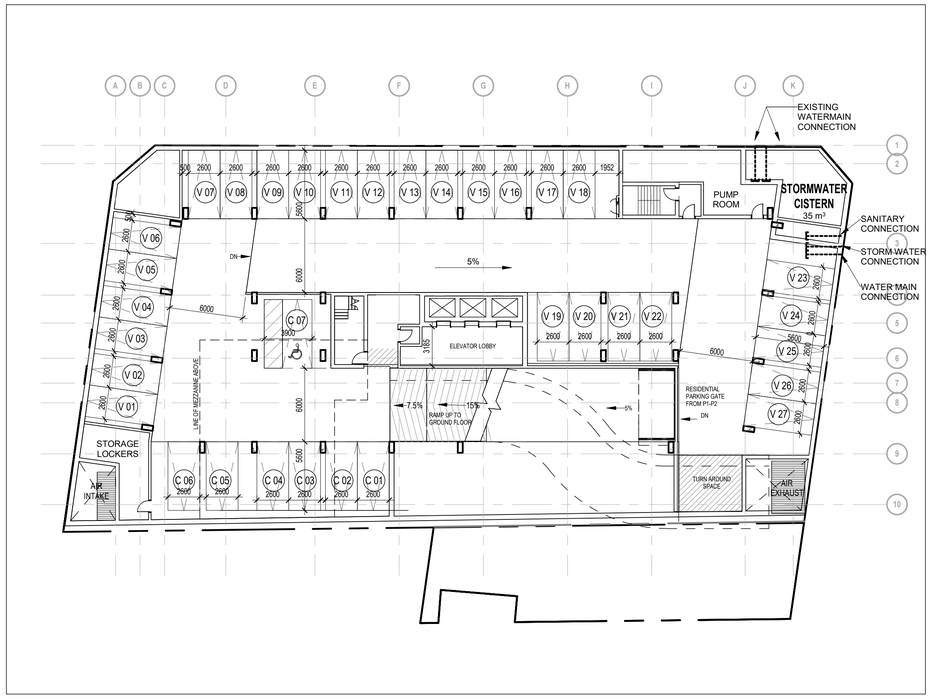
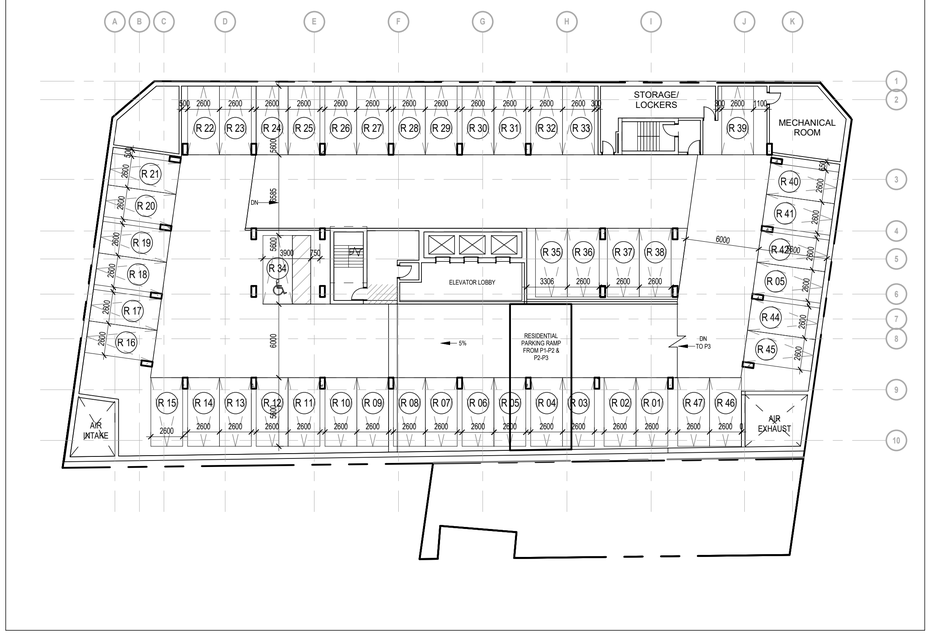


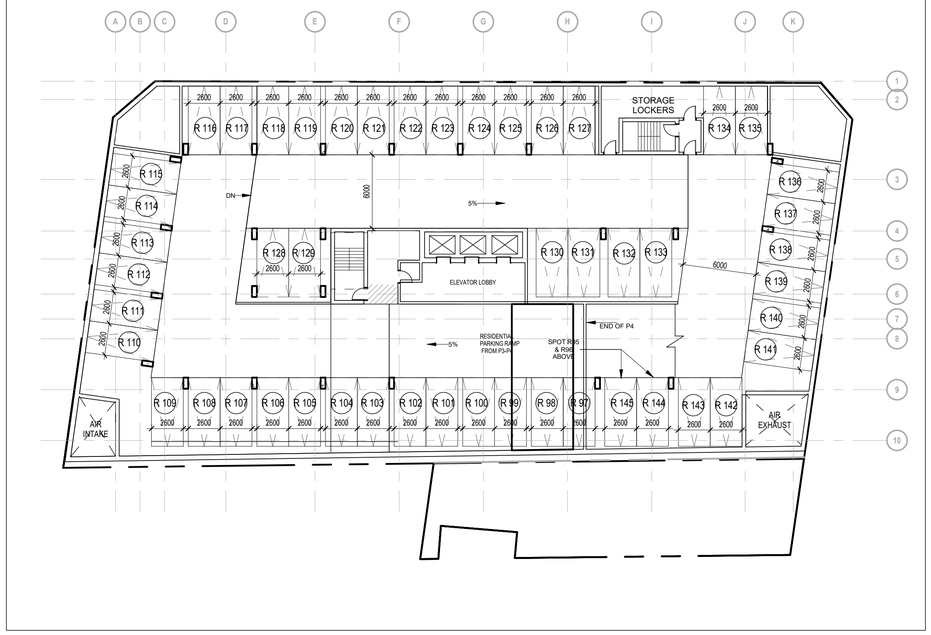
3 A102.S MEZZANINE



1 A102.S P1 Underground Parking Garage Plan



2 A102.S P2 & P3 Underground Parking Garage Plan



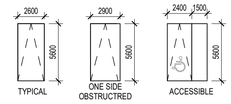
4 A102.S P4 Underground Parking Garage Plan

PARKING NOTES:

1. MINIMUM PARKING SPACE SIZES (UNLESS OTHERWISE NOTED):
   2600mm WIDE X 5600mm LONG (NO SIDES OBSTRUCTED)
   2900mm WIDE X 5600mm LONG (ONE SIDE OBSTRUCTED)
   3200mm WIDE X 5600mm LONG (TWO SIDES OBSTRUCTED)
2. MAINTAIN MININUM DRIVE AISLE WIDTH OF 6000mm UNLESS OTHERWISE NOTED.
3. MAINTAIN MINIMUM HEADROOM CLEARANCE OF 2100mm THROUGHOUT.

PARKING LEGEND:

(C) PARKING SPACE
C=COMMERCIAL PARKING
R=RESIDENTIAL PARKING
V=VISITOR PARKING



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Below Grade Floor Plans

A102.S

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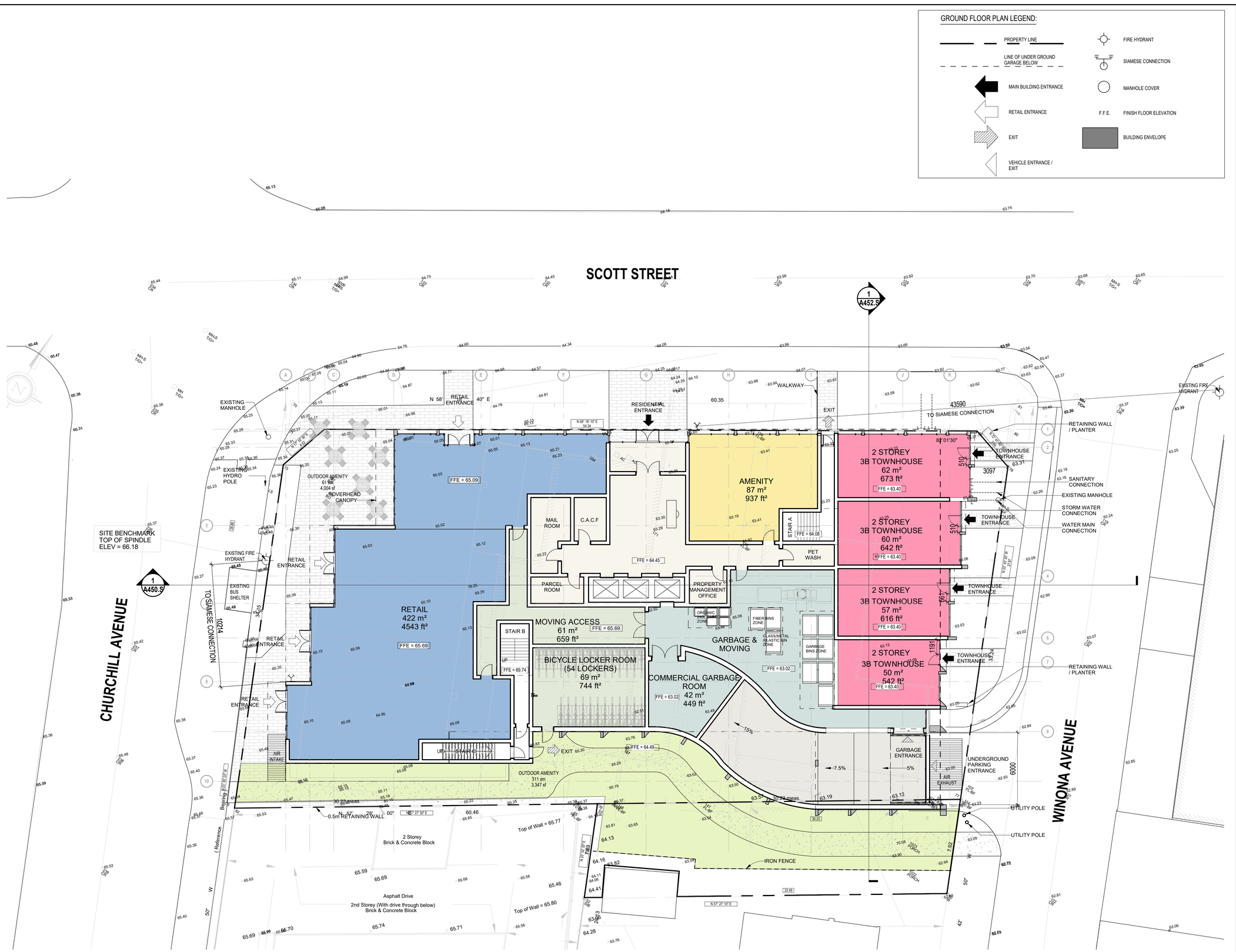

GROUND FLOOR LEGEND

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19023	As indicated	DLC	LS

Ground Floor Plan

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19023 - 2090 Scott Street
May 26 2020

	Floor	GBA/Typ. Floor (sm)	No. Floors	GBA Gross Building Area (no exclusions)		2008-326 GFA Exempt	By-Law 2008-326									
							GFA Residential		Indoor Amenity [Private]		Indoor Amenity [Common]		Outdoor Amenity [Private]		Outdoor Amenity [Public Landscape]		Retail	
				sm	sf	sm	sm	sf	sm	sf	sm	sf	sm	sf	sm	sf	sm	sf
PODIUM / TOWER	Mech.Ph/26	606	1	606	6,523	606	0	0										
	Floor 25	606	1	606	6,523	100	506	5,447					68	732				
	Upper Typ. Tower	*708*	*1*	*708*	*7,621*	*100*	*608*	*6,544*										
	Typ. 20 - 24	707	5	3,535	38,050	500	3,035	32,668										
	Lower Typ. Tower	*708*	*1*	*708*	*7,621*	*100*	*608*	*6,544*										
	Typ. 7 - 19	707	13	9,191	98,931	1,300	7,891	84,938										
	6	569	1	569	6,125	274	295	3,175	136	1,464			201	2,164	258	2,777		
	5	1030	1	1,030	11,087	114	916	9,860										
	4	1,030	1	1,030	11,087	234	796	8,568					224	2,411				
	3	1,257	1	1,257	13,530	122	1,135	12,217					69	743				
	2	1,365	1	1,365	14,693	133	1,232	13,261					43	463				
	TH Level 2	305	1	305	3,283	0	305	3,283										
	Ground Floor	1,428	1	1,428	15,371	562	866	9,322			87	936			372	4,004	422	4,542
TOTALS			26	20,922	225,203	3,945	16,555	182,739	136	1,464	87	936	605	6,512	630	6,781	422	4,542

Suite Breakdown								
1 Bdrm	1 Bdrm + D	2 Bdrm	2 Bdrm + D	3 Bdrm	Studio	Townhouse	Total Suites
0	2	0	2	3	0	0	7
0	*2*	*0*	*2*	*3*	*0*	*0*	*7*
0	0	0	10	15	0	0	25
5	*2*	*0*	*1*	*0*	*3*	*0*	*11*
65	26	0	12	0	39	0	142
1	2	0	0	1	1	0	5
5	1	3	3	0	2	0	14
5	3	4	1	0	1	0	14
3	4	4	3	1	1	0	16
3	2	6	2	2	1	0	16
0	0	0	0	0	0	0	0
0	0	0	0	0	0	4	4
82	**38** 40	**17**	**31** 33	**19** 22	**45**	**4**	**243**
34%	16%	7%	13%	8%	19%	2%	
570 - 620 sf	675 -725 sm	700 - 750 sf	750 - 800 sf	1050 - 1100 sf	450 - 500 sf	1250 -1300 sf	

AREAS TOTALS & FSI

Gross Floor Area	16,977
Site Area	2,090.3
Floor Space Index (FSI)	8.1

Total Amenity [Indoor + outdoor]

1,458 sm	15,694 sf
6.0 sm/unit	Provided
1,458 required [6sm/unit]	

BARRIER FREE SUITES

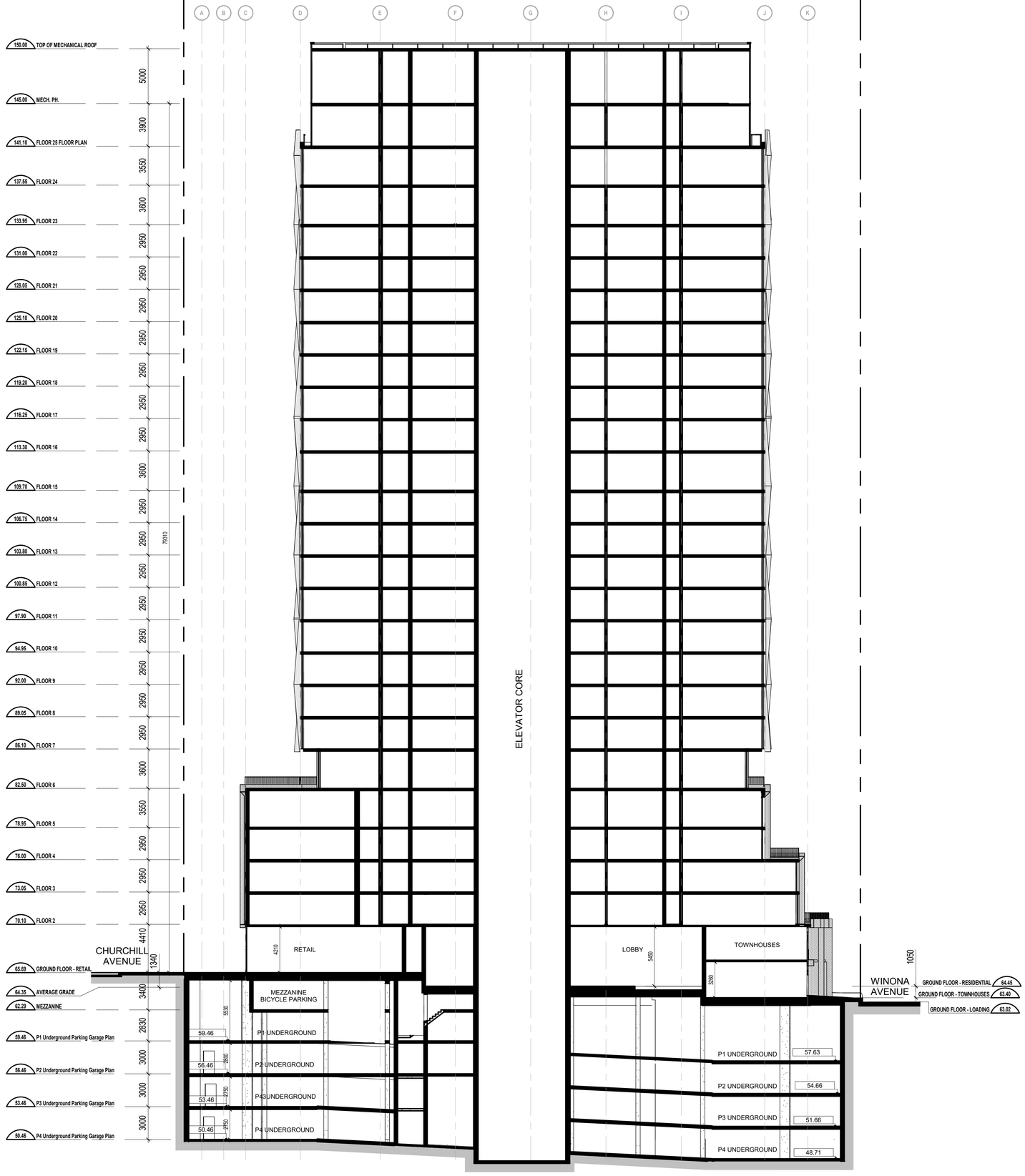
Required 15%	18	7	3	8	
Provided	18	7	3	8	
Total				**36**	

		Required	Provided
PARKING	**Residential -**		
	minimum residential *0.5/unit*	116	129
	minimum visitor *0.1/unit*	23	28
	maximum* *1.75/ unit*	404	
	* combined resident + visitor		
	Commercial		
	minimum 1.25/100 sm	5	5
	maximum 3.6/100 sm	15	
	Total		**162**
	minimum	144	
	maximum	419	
	Barrier Free (4% Req.)	7	7

		Required	Provided
BICYCLE PARKING	**Residential**		
	0.5/suite	122	243
	Commercial	2	2
	1/250 sm		
	TOTAL	**123**	**245**
	1/suite		

Parking Per Floor

	V	C	R	(BF)	Total
P1	28	5	0	2	33
P2	0	0	44	2	44
P3	0	0	44	2	44
P4	0	0	41	0	41
					162



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2070 Scott Street

Ottawa, ON

Azure Urban Developments Inc.

19023 1 : 200 Author Checker
PROJECT SCALE DRAWN REVIEWED

East-West Building Section

A450.S

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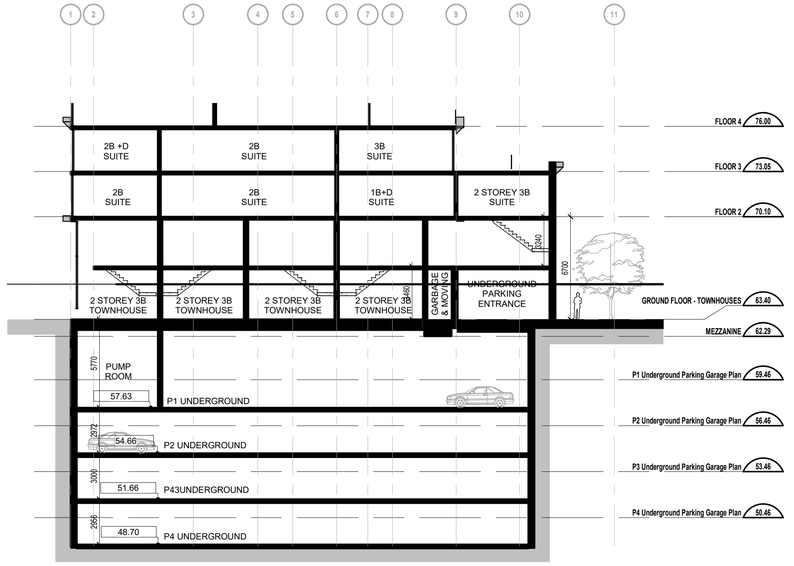

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A452.S

Section 4

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2070 Scott Street

Ottawa, ON

Azure Urban Developments Inc.

19023	1 : 200	Author	Checker
PROJECT	SCALE	DRAWN	REVIEWED

North-South Townhouse Section

A452.S

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Appendix C SANITARY SEWER CALCULATIONS

From: Tousignant, Eric
To: Paerez, Ana
Cc: Wu, John; Kilborn, Kris
Subject: RE: 2070 Scott Street - Sanitary sewer capacity
Date: Tuesday, September 17, 2019 3:16:27 PM

Hi Anna

There are no concerns with respect to adding the proposed 5.7 L/s into the existing sanitary system along Scott Street as well as on Winona Avenue.

Regards
Eric

Eric Tousignant, P.Eng.
Senior Water Resources Engineer
Infrastructure Services
613-580-2424 ext 25129

From: Paerez, Ana <Ana.Paerez@stantec.com>
Sent: September 05, 2019 12:41 PM
To: Tousignant, Eric <Eric.Tousignant@ottawa.ca>
Cc: Wu, John <John.Wu@ottawa.ca>; Kilborn, Kris <kris.kilborn@stantec.com>
Subject: RE: 2070 Scott Street - Sanitary sewer capacity

Hi Eric,
The proposed site consists of a 23-storey commercial/residential building with three levels of underground parking. The proposed peak flows are 5.7L/s as per the attached sewer design sheet. Please let me know if you need anything else.
Thank you,
Ana

Ana Paerez, P. Eng.
Water Resources Engineer

Direct: 506 204-5856
Fax: 506 858-8698
Ana.Paerez@stantec.com

Stantec

From: Tousignant, Eric <Eric.Tousignant@ottawa.ca>
Sent: Tuesday, September 03, 2019 2:56 PM
To: Paerez, Ana <Ana.Paerez@stantec.com>
Cc: Wu, John <John.Wu@ottawa.ca>
Subject: RE: 2070 Scott Street - Sanitary sewer capacity

Hi Ana

As per our discussion, asset management will do the capacity assessment. Please send me your proposed peak flows and we will enter it into our model.

Eric

Eric Tousignant, P.Eng.
Senior Water Resources Engineer
Infrastructure Services
613-580-2424 ext 25129

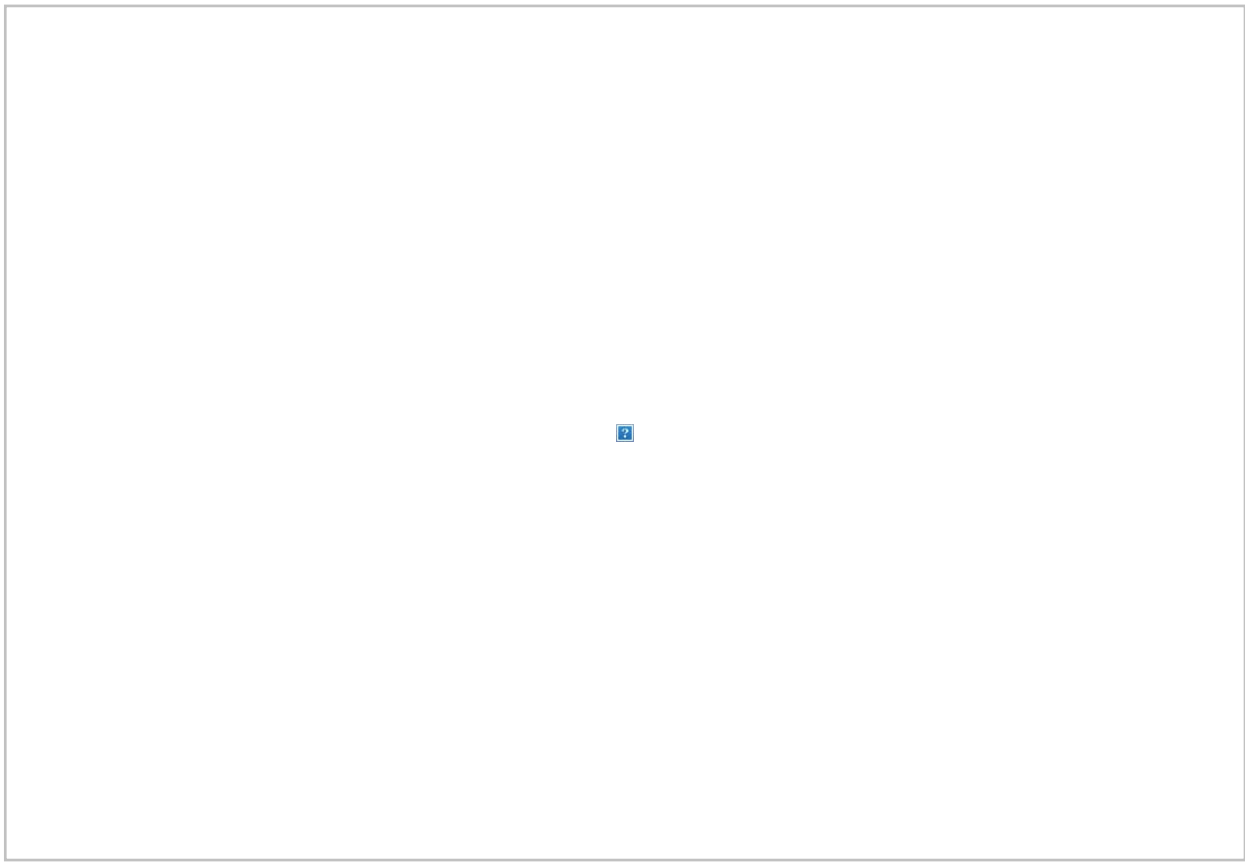
From: Paerez, Ana <Ana.Paerez@stantec.com>
Sent: September 03, 2019 12:10 PM
To: Tousignant, Eric <Eric.Tousignant@ottawa.ca>
Subject: 2070 Scott Street - Sanitary sewer capacity

Hi Eric,
We are working on a servicing brief for a mixed-use development on 2070/2090 Scott Street (see below) that will consist of a mixed commercial/residential 23-storey building. John Wu advised that a sanitary sewer capacity analysis will be required for the site and indicated we contact you to obtain any relevant background information including sanitary flow monitoring data.
We would really appreciate any information you can provide. Feel free to contact me if you want to discuss.
Thank you,

Ana Paerez, P. Eng.
Water Resources Engineer

Direct: 506 204-5856
Fax: 506 858-8698
Ana.Paerez@stantec.com

Stantec



https://maps.ottawa.ca/geoottawa/

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Stantec

SUBDIVISION:
2090 SCOTT STREET

DATE: 5/27/2020
REVISION: 2
DESIGNED BY: WAJ
CHECKED BY: AMP

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160410249

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280	L/p/day	MINIMUM VELOCITY	0.60	m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000	L/ha/day	MAXIMUM VELOCITY	3.00	m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000	L/ha/day	MANNINGS n	0.013	
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000	L/ha/day	BEDDING CLASS	B	
PERSONS / 1 BEDROOM	1.4	INSTITUTIONAL	28,000	L/ha/day	MINIMUM COVER	2.50	m
PERSONS / 2 BEDROOM	2.1						
PERSONS / 3 BEDROOM	3.1	INFILTRATION	0.33	L/s/ha	HARMON CORRECTION FACTOR	0.8	
PERSONS / TOWNHOME	2.7						

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA	1 BEDROOM	2 BEDROOM	3 BEDROOM	TOWNHOME	POP.	CUMULATIVE AREA	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	PEAK FLOW	TOTAL AREA	ACCU. AREA	INFILT. FLOW	FLOW	LENGTH	DIA	MATERIAL	CLASS	SLOPE	CAP. (FULL)	CAP. V PEAK FLOW	VEL. (FULL)	VEL. (ACT.)
			(ha)						(ha)			(L/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(m)	(mm)			(%)	(l/s)	(%)	(m/s)	(m/s)
COM-1, COM-2, RES-1	BLDG	TEE	0.160	167	50	22	4	418	0.160	418	4.00	5.42	0.050	0.050	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.02	0.210	0.210	0.07	5.51	5.0	150	PVC	DR 28	1.00	15.3	**35.94%**	0.86	0.67
																													225							

Appendix D STORMWATER MANAGEMENT CALCULATIONS

Stantec

2090 Scott Street

DATE: 2020-05-28
REVISION: 2
DESIGNED BY: WAJ
CHECKED BY: AMP

STORM SEWER DESIGN SHEET

(City of Ottawa)

FILE NUMBER: 160410249

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013 BEDDING CLASS B
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																				PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
ROOF1, ROOF2, ROOF3, ROOF4, ROOF5, ROOF6, ROOF7, ROOF8, TRENCH	Stub	Ex. MH	0.181	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.153	0.153	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	32.7	9.2	200	200	CIRCULAR	PVC	SDR 28	2.00	47.1	**69.4%**	1.48	1.40	0.11
																				10.11									200	200									

Stormwater Management Calculations

File No: **160410429**
Project: **2070/2090 Scott Street**
Date: **28-May-20**

SWM Approach:
Post development peak flows restricted to the 2-year with a C of 0.60

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	Sub-catchment Area ID / Description		Area (ha) "A"		Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Uncontrolled - Tributary Building	ROOF8	Hard	0.061		0.9	0.055		
		Soft	0.000		0.2	0.000		
		Subtotal		0.061			0.0549	0.900
Uncontrolled - Tributary Building	ROOF7	Hard	0.010		0.9	0.009		
		Soft	0.000		0.2	0.000		
		Subtotal		0.010			0.009	0.900
Uncontrolled - Tributary Building	ROOF6	Hard	0.003		0.9	0.003		
		Soft	0.000		0.2	0.000		
		Subtotal		0.003			0.0027	0.900
Uncontrolled - Non-Tributary	UNC-2	Hard	0.003		0.9	0.003		
		Soft	0.005		0.2	0.001		
		Subtotal		0.008			0.00392	0.490
Uncontrolled - Non-Tributary	UNC-1	Hard	0.013		0.9	0.012		
		Soft	0.003		0.2	0.001		
		Subtotal		0.016			0.01232	0.77
Uncontrolled - Tributary Building	ROOF1	Hard	0.040		0.9	0.036		
		Soft	0.000		0.2	0.000		
		Subtotal		0.040			0.036	0.90
Uncontrolled - Tributary Building	ROOF2	Hard	0.001		0.9	0.001		
		Soft	0.000		0.2	0.000		
		Subtotal		0.001			0.0009	0.90
Uncontrolled - Tributary Building	ROOF3	Hard	0.027		0.9	0.024		
		Soft	0.000		0.2	0.000		
		Subtotal		0.027			0.0243	0.90
Uncontrolled - Tributary Building	ROOF4	Hard	0.005		0.9	0.005		
		Soft	0.000		0.2	0.000		
		Subtotal		0.005			0.0045	0.90
Uncontrolled - Tributary Building	ROOF5	Hard	0.007		0.9	0.006		
		Soft	0.000		0.2	0.000		
		Subtotal		0.007			0.0063	0.90
Uncontrolled - Tributary Sidewalk	TRENCH	Hard	0.013		0.9	0.012		
		Soft	0.014		0.2	0.003		
		Subtotal		0.027			0.01458	0.54
Total				**0.205**			**0.17**	
Overall Runoff Coefficient= C:								**0.83**

Total Controlled Roof Areas	**0.000**	**ha**
Total Uncontrolled Area to Outlet	**0.181**	**ha**
Total Tributary Area to Outlet	**0.181**	**ha**
Total Uncontrolled Areas (Non-Tributary)	**0.024**	**ha**
Total Site	**0.205**	**ha**

0.85

0.68

Stormwater Management Calculations

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

2 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	732.951
b =	6.199
c =	0.81

t (min)	I (mm/hr)
10	76.81
20	52.03
30	40.04
40	32.86
50	28.04
60	24.56
70	21.91
80	19.83
90	18.14
100	16.75
110	15.57
120	14.56

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

100 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
10	178.56
20	119.95
30	91.87
40	75.15
50	63.95
60	55.89
70	49.79
80	44.99
90	41.11
100	37.90
110	35.20
120	32.89

Predevelopment Target Release from Site

Subdrainage Area: Post development peak flows restricted to C=0.60
Area (ha): 0.205
C: 0.60

Typical Time of Concentration

tc (min)	I (2 yr) (mm/hr)	Qtarget (L/s)
10	76.81	**26.3**

2 YEAR Modified Rational Method for Entire Site

Subdrainage Area: ROOF8 — Uncontrolled - Tributary Building
Area (ha): 0.061
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	11.72	11.72		
20	52.03	7.94	7.94		
30	40.04	6.11	6.11		
40	32.86	5.02	5.02		
50	28.04	4.28	4.28		
60	24.56	3.75	3.75		
70	21.91	3.34	3.34		
80	19.83	3.03	3.03		
90	18.14	2.77	2.77		
100	16.75	2.56	2.56		
110	15.57	2.38	2.38		
120	14.56	2.22	2.22		

Subdrainage Area: ROOF7 — Uncontrolled - Tributary Building
Area (ha): 0.010
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	1.92	1.92		
20	52.03	1.30	1.30		
30	40.04	1.00	1.00		
40	32.86	0.82	0.82		
50	28.04	0.70	0.70		
60	24.56	0.61	0.61		
70	21.91	0.55	0.55		
80	19.83	0.50	0.50		
90	18.14	0.45	0.45		
100	16.75	0.42	0.42		
110	15.57	0.39	0.39		
120	14.56	0.36	0.36		

Subdrainage Area: ROOF6 — Uncontrolled - Tributary Building
Area (ha): 0.003
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	0.58	0.58		
20	52.03	0.39	0.39		
30	40.04	0.30	0.30		
40	32.86	0.25	0.25		
50	28.04	0.21	0.21		
60	24.56	0.18	0.18		
70	21.91	0.16	0.16		
80	19.83	0.15	0.15		
90	18.14	0.14	0.14		
100	16.75	0.13	0.13		
110	15.57	0.12	0.12		
120	14.56	0.11	0.11		

Subdrainage Area: UNC-2 — Uncontrolled - Non-Tributary
Area (ha): 0.008
C: 0.49

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	0.84	0.84		
20	52.03	0.57	0.57		
30	40.04	0.44	0.44		
40	32.86	0.36	0.36		
50	28.04	0.31	0.31		
60	24.56	0.27	0.27		
70	21.91	0.24	0.24		
80	19.83	0.22	0.22		
90	18.14	0.20	0.20		
100	16.75	0.18	0.18		
110	15.57	0.17	0.17		
120	14.56	0.16	0.16		

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: ROOF8 — Uncontrolled - Tributary Building
Area (ha): 0.061
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	30.28	30.28		
20	119.95	20.34	20.34		
30	91.87	15.58	15.58		
40	75.15	12.74	12.74		
50	63.95	10.85	10.85		
60	55.89	9.48	9.48		
70	49.79	8.44	8.44		
80	44.99	7.63	7.63		
90	41.11	6.97	6.97		
100	37.90	6.43	6.43		
110	35.20	5.97	5.97		
120	32.89	5.58	5.58		

Subdrainage Area: ROOF7 — Uncontrolled - Tributary Building
Area (ha): 0.010
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	4.96	4.96		
20	119.95	3.33	3.33		
30	91.87	2.55	2.55		
40	75.15	2.09	2.09		
50	63.95	1.78	1.78		
60	55.89	1.55	1.55		
70	49.79	1.38	1.38		
80	44.99	1.25	1.25		
90	41.11	1.14	1.14		
100	37.90	1.05	1.05		
110	35.20	0.98	0.98		
120	32.89	0.91	0.91		

Subdrainage Area: ROOF6 — Uncontrolled - Tributary Building
Area (ha): 0.003
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	1.49	1.49		
20	119.95	1.00	1.00		
30	91.87	0.77	0.77		
40	75.15	0.63	0.63		
50	63.95	0.53	0.53		
60	55.89	0.47	0.47		
70	49.79	0.42	0.42		
80	44.99	0.38	0.38		
90	41.11	0.34	0.34		
100	37.90	0.32	0.32		
110	35.20	0.29	0.29		
120	32.89	0.27	0.27		

Subdrainage Area: UNC-2 — Uncontrolled - Non-Tributary
Area (ha): 0.008
C: 0.61

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	2.43	2.43		
20	119.95	1.63	1.63		
30	91.87	1.25	1.25		
40	75.15	1.02	1.02		
50	63.95	0.87	0.87		
60	55.89	0.76	0.76		
70	49.79	0.68	0.68		
80	44.99	0.61	0.61		
90	41.11	0.56	0.56		
100	37.90	0.52	0.52		
110	35.20	0.48	0.48		
120	32.89	0.45	0.45		

Stormwater Management Calculations

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: UNC-1 — Uncontrolled - Non-Tributary
Area (ha): 0.016
C: 0.77

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	2.6	2.6		
20	52.03	1.8	1.8		
30	40.04	1.4	1.4		
40	32.86	1.1	1.1		
50	28.04	1.0	1.0		
60	24.56	0.8	0.8		
70	21.91	0.8	0.8		
80	19.83	0.7	0.7		
90	18.14	0.6	0.6		
100	16.75	0.6	0.6		
110	15.57	0.5	0.5		
120	14.56	0.5	0.5		

Subdrainage Area: ROOF1 — Uncontrolled - Tributary Building
Area (ha): 0.040
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	
10	76.81	7.7	7.7			
20	52.03	5.2	5.2			
30	40.04	4.0	4.0			
40	32.86	3.3	3.3			
50	28.04	2.8	2.8			
60	24.56	2.5	2.5			
70	21.91	2.2	2.2			
80	19.83	2.0	2.0			
90	18.14	1.8	1.8			
100	16.75	1.7	1.7			
110	15.57	1.6	1.6			
120	14.56	1.5	1.5			

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: UNC-1 — Uncontrolled - Non-Tributary
Area (ha): 0.016
C: 0.96

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	7.6	7.6		
20	119.95	5.1	5.1		
30	91.87	3.9	3.9		
40	75.15	3.2	3.2		
50	63.95	2.7	2.7		
60	55.89	2.4	2.4		
70	49.79	2.1	2.1		
80	44.99	1.9	1.9		
90	41.11	1.8	1.8		
100	37.90	1.6	1.6		
110	35.20	1.5	1.5		
120	32.89	1.4	1.4		

Subdrainage Area: ROOF1 — Uncontrolled - Tributary Building
Area (ha): 0.040
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)
10	178.56	19.9	19.9			
20	119.95	13.3	13.3			
30	91.87	10.2	10.2			
40	75.15	8.4	8.4			
50	63.95	7.1	7.1			
60	55.89	6.2	6.2			
70	49.79	5.5	5.5			
80	44.99	5.0	5.0			
90	41.11	4.6	4.6			
100	37.90	4.2	4.2			
110	35.20	3.9	3.9			
120	32.89	3.7	3.7			

Stormwater Management Calculations

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: ROOF2 — Uncontrolled - Tributary Building
Area (ha): 0.001
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)
10	76.81	0.2	0.2			
20	52.03	0.1	0.1			
30	40.04	0.1	0.1			
40	32.86	0.1	0.1			
50	28.04	0.1	0.1			
60	24.56	0.1	0.1			
70	21.91	0.1	0.1			
80	19.83	0.0	0.0			
90	18.14	0.0	0.0			
100	16.75	0.0	0.0			
110	15.57	0.0	0.0			
120	14.56	0.0	0.0			

Subdrainage Area: ROOF3 — Uncontrolled - Tributary Building
Area (ha): 0.027
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	5.2	5.2		
20	52.03	3.5	3.5		
30	40.04	2.7	2.7		
40	32.86	2.2	2.2		
50	28.04	1.9	1.9		
60	24.56	1.7	1.7		
70	21.91	1.5	1.5		
80	19.83	1.3	1.3		
90	18.14	1.2	1.2		
100	16.75	1.1	1.1		
110	15.57	1.1	1.1		
120	14.56	1.0	1.0		

Subdrainage Area: ROOF4 — Uncontrolled - Tributary Building
Area (ha): 0.005
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	1.0	1.0		
20	52.03	0.7	0.7		
30	40.04	0.5	0.5		
40	32.86	0.4	0.4		
50	28.04	0.4	0.4		
60	24.56	0.3	0.3		
70	21.91	0.3	0.3		
80	19.83	0.2	0.2		
90	18.14	0.2	0.2		
100	16.75	0.2	0.2		
110	15.57	0.2	0.2		
120	14.56	0.2	0.2		

Subdrainage Area: ROOF5 — Uncontrolled - Tributary Building
Area (ha): 0.007
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	1.3	1.3		
20	52.03	0.9	0.9		
30	40.04	0.7	0.7		
40	32.86	0.6	0.6		
50	28.04	0.5	0.5		
60	24.56	0.4	0.4		
70	21.91	0.4	0.4		
80	19.83	0.3	0.3		
90	18.14	0.3	0.3		
100	16.75	0.3	0.3		
110	15.57	0.3	0.3		
120	14.56	0.3	0.3		

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: ROOF2 — Uncontrolled - Tributary Building
Area (ha): 0.001
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)
10	178.56	0.5	0.5			
20	119.95	0.3	0.3			
30	91.87	0.3	0.3			
40	75.15	0.2	0.2			
50	63.95	0.2	0.2			
60	55.89	0.2	0.2			
70	49.79	0.1	0.1			
80	44.99	0.1	0.1			
90	41.11	0.1	0.1			
100	37.90	0.1	0.1			
110	35.20	0.1	0.1			
120	32.89	0.1	0.1			

Subdrainage Area: ROOF3 — Uncontrolled - Tributary Building
Area (ha): 0.027
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	13.4	13.4		
20	119.95	9.0	9.0		
30	91.87	6.9	6.9		
40	75.15	5.6	5.6		
50	63.95	4.8	4.8		
60	55.89	4.2	4.2		
70	49.79	3.7	3.7		
80	44.99	3.4	3.4		
90	41.11	3.1	3.1		
100	37.90	2.8	2.8		
110	35.20	2.6	2.6		
120	32.89	2.5	2.5		

Subdrainage Area: ROOF4 — Uncontrolled - Tributary Building
Area (ha): 0.005
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	2.5	2.5		
20	119.95	1.7	1.7		
30	91.87	1.3	1.3		
40	75.15	1.0	1.0		
50	63.95	0.9	0.9		
60	55.89	0.8	0.8		
70	49.79	0.7	0.7		
80	44.99	0.6	0.6		
90	41.11	0.6	0.6		
100	37.90	0.5	0.5		
110	35.20	0.5	0.5		
120	32.89	0.5	0.5		

Subdrainage Area: ROOF5 — Uncontrolled - Tributary Building
Area (ha): 0.007
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	3.5	3.5		
20	119.95	2.3	2.3		
30	91.87	1.8	1.8		
40	75.15	1.5	1.5		
50	63.95	1.2	1.2		
60	55.89	1.1	1.1		
70	49.79	1.0	1.0		
80	44.99	0.9	0.9		
90	41.11	0.8	0.8		
100	37.90	0.7	0.7		
110	35.20	0.7	0.7		
120	32.89	0.6	0.6		

Stormwater Management Calculations

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: TRENCH — Uncontrolled - Tributary Sidewalk
Area (ha): 0.027
C: 0.54

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	3.1	3.1		
20	52.03	2.1	2.1		
30	40.04	1.6	1.6		
40	32.86	1.3	1.3		
50	28.04	1.1	1.1		
60	24.56	1.0	1.0		
70	21.91	0.9	0.9		
80	19.83	0.8	0.8		
90	18.14	0.7	0.7		
100	16.75	0.7	0.7		
110	15.57	0.6	0.6		
120	14.56	0.6	0.6		

Subdrainage Area: Site Area Tributary to Internal Cistern
Area (ha): **0.181**

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	32.71	**16.19**	16.52	**9.91**
20	52.03	22.16	16.19	5.97	7.17
30	40.04	17.05	16.19	0.87	1.56
40	32.86	13.99	13.99	0.00	0.00
50	28.04	11.94	11.94	0.00	0.00
60	24.56	10.46	10.46	0.00	0.00
70	21.91	9.33	9.33	0.00	0.00
80	19.83	8.44	8.44	0.00	0.00
90	18.14	7.73	7.73	0.00	0.00
100	16.75	7.13	7.13	0.00	0.00
110	15.57	6.63	6.63	0.00	0.00
120	14.56	6.20	6.20	0.00	0.00

SUMMARY TO OUTLET

			Vrequired	Vavailable*	
Tributary Area	0.181	ha			
2yr Controlled Roof Flow to Cistern	0.0				
2yr Uncontrolled Flow to Cistern	32.7	L/s	10	50 m^3	Ok
2yr Cistern Outflow	16.2	L/s			
Non-Tributary Area	0.024	ha			
Total 2yr Non-Tributary Flow	3.5	L/s			
Total Area	**0.205**	**ha**			
Total 2yr Flow	**19.7**	**L/s**			
Target	**26.3**	**L/s**			

Project #160410429, 2070/2090 Scott Street
Modified Rational Method Calculatons for Storage

Subdrainage Area: TRENCH — Uncontrolled - Tributary Sidewalk
Area (ha): 0.027
C: 0.68

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	9.0	9.0		
20	119.95	6.1	6.1		
30	91.87	4.7	4.7		
40	75.15	3.8	3.8		
50	63.95	3.2	3.2		
60	55.89	2.8	2.8		
70	49.79	2.5	2.5		
80	44.99	2.3	2.3		
90	41.11	2.1	2.1		
100	37.90	1.9	1.9		
110	35.20	1.8	1.8		
120	32.89	1.7	1.7		

Subdrainage Area: Site Area Tributary to Internal Cistern
Area (ha): **0.181**

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	85.49	**16.19**	69.31	41.58
20	119.95	57.43	16.19	41.24	49.49
30	91.87	43.99	16.19	27.80	**50.04**
40	75.15	35.98	16.19	19.79	47.50
50	63.95	30.62	16.19	14.43	43.30
60	55.89	26.76	16.19	10.58	38.07
70	49.79	23.84	16.19	7.65	32.14
80	44.99	21.54	16.19	5.36	25.70
90	41.11	19.68	16.19	3.50	18.89
100	37.90	18.15	16.19	1.96	11.77
110	35.20	16.85	16.19	0.67	4.41
120	32.89	15.75	15.75	0.00	0.00

SUMMARY TO OUTLET

			Vrequired	Vavailable*	
Tributary Area	0.181	ha			
100yr Controlled Roof Flow to Cistern	0.0	L/s			
100yr Uncontrolled Flow to Cistern	85.5	L/s	50	50 m^3	Ok
100yr Cistern Outflow	16.2	L/s			
Non-Tributary Area	0.024	ha			
Total 100yr Non-Tributary Flow	10.1	L/s			
Total Area	**0.205**	**ha**			
Total 100yr Flow	**26.3**	**L/s**			
Target	**26.3**	**L/s**			

Appendix E GEOTECHNICAL REPORT AND ENVIRONMENTAL SITE ASSESSMENT

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Studies

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Geotechnical Investigation

Proposed Multi-Storey Building
2070 Scott Street
Ottawa, Ontario

Prepared For

Westboro Point Developments Ltd.

July 26, 2019

Report PG4935-1

Table of Contents

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Westboro Point Developments Ltd. to conduct a geotechnical investigation for the proposed multi-storey building to be located at 2070 Scott Street in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were to:

- ❏ determine the subsurface soil and groundwater conditions at this site based on available subsoil information from current and previous investigations.
- ❏ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. This report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the commercial development as understood at the time of writing this report.

2.0 Proposed Project

Based on the preliminary concept drawings, it is our understanding that the proposed project is to consist of a multi-storey building with 2 to 3 levels of underground parking. Associated access lanes, parking areas and landscaped margins are also anticipated as part of the proposed development.

It is further understood that the proposed building will be serviced with municipal water and sewer.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on May 15, 2019. At that time, a total of three (3) boreholes (BH 4-19 through BH 6-19) were advanced to a maximum depth of 8.3 m below the existing ground surface. The boreholes were distributed in a manner to provide general coverage of the proposed development taking into consideration existing site features and underground utilities.

Previous geotechnical investigations conducted at the subject site by Paterson included three (3) boreholes (BH 1 through BH 3) completed on April 2, 2013, one (1) test pit (TP 1) completed on April 3, 2013, five (5) test pits (TP 1 through TP 5) completed on October 21, 2002, five (5) boreholes (BH 1 through BH 5) completed on October 15, 2001, and four (4) boreholes (BH 1-1 through BH 4-1) completed on November 18, 1996. The locations of the test holes are shown on Drawing PG4935-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drill rig operated by a two person crew. The drilling procedure consisted of augering to the required depths at the selected locations and sampling the overburden. The test pit procedure consisted of excavating to the required depths at the selected locations and sampling the overburden. The test pits were backfilled with the excavated soil upon completion. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer.

A field investigation program was also completed at the subject site by others during the period of April 2 through 5, 2013, consisting of a total of 12 boreholes (BH/MW 1 through BH 12) advanced to a maximum depth of 13.5 m below the existing ground surface. The borehole logs prepared by others are provided in Appendix 1.

Sampling and In Situ Testing

Soil samples were recovered from a 50 mm diameter split-spoon, the auger flights or grab samples. The split-spoon, auger and grab samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. The depths at which the split-spoon, auger and grab samples were recovered from the boreholes are presented as SS, AU and G, respectively, on the Soil Profile and Test Data sheets.

Standard Penetration Tests (SPT) were conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split-spoon sample 300 mm into the soil after the initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

Diamond drilling was completed at select locations to confirm the bedrock quality. A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are presented as RC on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the ratio of the bedrock sample length recovered over the drilled section length, in percentage. The RQD value is the total length ratio of intact rock core length more than 100 mm in one drilled section over the length of the drilled section, in percentage. These values are indicative of the quality of the bedrock.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil and bedrock profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Monitoring wells were installed in boreholes BH 1, BH 3, BH 4-19, BH 5-19 and BH 6-19 to permit the monitoring of water levels subsequent to the completion of the sampling program.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test holes completed during the most recent geotechnical investigations on May 15, 2019 and April 2 and 3, 2013 were selected and determined in the field by Paterson personnel to provide general coverage of the subject site. The location and ground surface elevation at these borehole locations were surveyed by Paterson personnel. The test holes were surveyed with respect to a temporary benchmark (TBM), consisting of the top spindle of a fire hydrant located along the west property boundary near Churchill Avenue. A geodetic elevation of 66.18 m was provided for the TBM.

The location and ground surface elevation at each test hole location is presented on Drawing PG4935-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil and bedrock samples recovered from the subject site were visually examined in our laboratory to review the field logs. Two bedrock samples were submitted for uniaxial compressive strength, the results of which are provided in Appendix 1.

3.4 Analytical Testing

One soil sample was submitted for analytical testing to assess the potential for exposed ferrous metals and the sulphate potential against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the soil. The results are provided in Appendix 1, and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently vacant, with a mixture of asphaltic pavement structure, granular crushed stone and some concrete and construction debris located at the existing ground surface. The site is bordered by Scott Street to the north, Winona Avenue to the east, residential properties to the south, and Churchill Avenue to the west. The existing ground surface across the site slopes downward gradually from west to east, from approximate geodetic elevation 65.5 m at the west property line to approximate geodetic elevation 63 m at the east property line.

It is understood that the site was formerly occupied by two commercial buildings, a 3 storey building with a basement on the west portion of the site and a single storey, slab on grade building on the east portion of the site.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile at the borehole locations consists of fill underlying the existing crushed stone surface or 80 to 150 mm thick asphalt surface. The fill material extended to approximate depths of 1.4 to 3.8 m below the existing ground surface and generally consisted of loose to dense, brown silty sand to silty clay with trace to some gravel, cobbles, boulders, and construction debris such as glass, wood chips, brick, and concrete.

Bedrock

Practical refusal to augering or excavation was encountered at the test holes at depths of 1.4 to 3.8 m below the existing ground surface. Bedrock was cored at boreholes BH 1, BH 3, BH 4-19, BH 5-19, and BH 6-19 to depths of 7.7 to 13.5 m, and consisted of a poor to excellent quality limestone to limestone with interbedded dolostone and shale.

Based on available geological mapping, bedrock in the area of the subject site consists of interbedded limestone and dolostone of the Gull River Formation with drift thicknesses of 1 to 2 m.

4.3 Groundwater

Groundwater levels were measured in the groundwater monitoring wells BH 1 and BH 3 on April 4, 2013, and in the groundwater monitoring wells BH 4-19 through BH 6-19 on May 15, 2019. The measured groundwater level (GWL) readings are presented in Table 1 below and on the Soil Profile and Test Data sheets in Appendix 1.

However, it should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

Table 1 - Measured Groundwater Levels

Test Hole Location	Ground Surface Elevation (m)	Groundwater Level		Date
		Depth (m)	Elevation (m)	
BH 1	65.09	6.93	58.16	April 4, 2013
BH 3	63.07	5.27	57.80	April 4, 2013
BH 4-19	63.71	7.10	56.61	May 22, 2019
BH 5-19	63.34	6.14	57.20	May 22, 2019
BH 6-19	62.99	5.82	57.17	May 22, 2019

Note: - The ground surface elevations are referenced to a temporary benchmark (TBM), consisting of the top spindle of the fire hydrant located along the west property boundary near Churchill Avenue with a geodetic elevation of 66.18 m.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed multi-storey building. The proposed building is expected to be founded on footings placed on clean, surface sounded bedrock.

Bedrock removal will be required to complete the underground parking levels. Line drilling and controlled blasting where large quantities of bedrock need to be removed is recommended. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations.

The above and other considerations are discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Due to the relatively shallow depth of the bedrock at the subject site and the anticipated founding level for the proposed building, all existing overburden material should be excavated from within the proposed building footprint. Bedrock removal will be required for the construction of the underground levels.

Existing foundation walls and other construction debris should be entirely removed from within the building perimeter. Under paved areas, existing construction remnants, such as foundation walls, should be excavated to a minimum of 1 m below final grade.

Bedrock Removal

Based on the volume of the bedrock encountered in the area, it is expected that line-drilling in conjunction with hoe-ramming or controlled blasting will be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity to the blasting operations should be conducted prior to commencing construction. The extent of the survey should be determined by the blasting consultant and sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocity (measured at the structures) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is an experienced blasting consultant.

Excavation side slopes in sound bedrock can be completed with almost vertical side walls. A minimum of 1 m horizontal bench, should remain between the bottom of the overburden and the top of the bedrock surface to provide an area for potential sloughing or to provide a stable base for the overburden shoring system.

Vibration Considerations

Construction operations could be the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain a cooperative environment with the residents.

The following construction equipment could be the source of vibrations: piling equipment, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system with soldier piles would utilize such equipment. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters determine the permissible vibrations: the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards. Considering there are several sensitive buildings in close proximity to the subject site, consideration to lowering these guidelines is recommended.

These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people. Therefore, a pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed building.

Horizontal Rock Anchors

Horizontal rock anchors may be required at specific locations to prevent pop-outs of the bedrock, especially in areas where bedrock fractures are conducive to the failure of the bedrock surface.

The requirement for horizontal rock anchors will be evaluated during the excavation operations and should be discussed with the structural engineer during the design stage.

Fill Placement

Fill placed for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The imported fill material should be tested and approved prior to delivery to the site. The fill should be placed in maximum of 300 mm thick loose lifts and compacted using suitable compaction equipment. Fill placed beneath the buildings should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite drainage membrane, such as Delta Drain 6000.

5.3 Foundation Design

Footings placed on a clean, surface sounded limestone bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **1,500 kPa**, incorporating a geotechnical resistance factor of 0.5.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

A factored bearing resistance value at ULS of **4,500 kPa**, incorporating a geotechnical resistance factor of 0.5, could be provided if founded on limestone bedrock which is free of seams, fractures and voids within 1.5 m below the founding level. This should be verified by completing and probing 50 mm diameter drill holes to a depth of 1.5 m below the founding level within the all the footing footprints. A minimum of one probe hole should be completed per footing. The drill hole inspection should be completed by the geotechnical consultant.

Settlement

Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

5.4 Design for Earthquakes

A site specific shear wave velocity test was completed to accurately determine the applicable seismic site classification for foundation design of the proposed building as presented in Table 4.1.8.4.A of the Ontario Building Code 2012. A seismic shear wave velocity test was completed by Paterson at the subject site. Two shear wave velocity profiles are presented in Appendix 2.

Field Program

The shear wave test location is presented in Drawing PG4935-1 - Test Hole Location Plan in Appendix 2. Paterson field personnel installed 24 horizontal geophones in a straight line oriented roughly in a north-south direction along the eastern site boundary. The 4.5 Hz horizontal geophones were mounted to the surface by means of two 75 mm ground spikes attached to the geophone land case. The geophones were spaced at 1 m intervals and connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was connected to a computer and a trigger switch attached to a 12 pound dead blow hammer. The hammer trigger sends a signal to the seismograph to commence recording. The hammer strikes an I-Beam seated into the ground surface, which produces a polarized shear wave. The shots are repeated between four to eight times at each shot location to provide an accurate signal and reduce noise. The shot locations are completed in forward and reverse directions (i.e. striking both sides of the I-Beam seated parallel to the geophone array). The shot locations were distributed at the centre of the geophone array and 1, 2 and 5 m away from the first and last geophone.

Data Processing and Interpretation

Interpretation for the shear wave velocity results were completed by Paterson. The shear wave velocity measurement was calculated by the reflection/refraction methods. The interpretation is performed by recovering arrival times from direct and refracted waves. The interpretation is repeated at each shot location to provide an average shear wave velocity, V_{s30}, immediately below the proposed building foundation of the upper 30 m profile. To compute the bedrock depth at each location, the layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave graphs. The bedrock velocity was interpreted by the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of the bedrock with depth. As bedrock quality increases, the bedrock shear wave velocity increases.

The V_{s30} was calculated using the standard equation for average shear wave velocity from the Ontario Building Code (OBC) 2012, as presented below;

$$V_{s30} = \frac{Depth_{OfInterest}(m)}{\left(\frac{(Depth_{Layer1}(m)}{Vs_{Layer1}(m/s)} + \frac{Depth_{Layer2}(m)}{Vs_{Layer2}(m/s)}\right)}$$

$$V_{s30} = \frac{30m}{\left(\frac{0m}{233m/s} + \frac{30m}{1{,}805m/s}\right)}$$

$$V_{s30} = 1{,}805m/s$$

Based on the seismic results, the average shear wave velocity, V_{s30}, for shallow foundations located at the subject site is 1,805 m/s. Therefore, a **Site Class A** is applicable for design of the proposed building at the subject site, as per Table 4.1.8.4.A of the OBC 2012. The soils underlying the subject site are not susceptible to liquefaction.

5.5 Basement Slab

For the subject site development, all overburden soil should be removed from the subject site and the basement floor slab will be founded on a bedrock medium. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 150 to 200 mm of sub-slab fill consists of a 19 mm clear crushed stone.

In consideration of the groundwater conditions encountered at the time of the field investigation, an underfloor drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear stone backfill under the lower basement floor.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a bulk (drained) unit weight of 20 kN/m^3.

It is expected that a portion of the basement walls are to be poured against a composite drainage blanket, which will be placed against the exposed bedrock face. A nominal coefficient of at-rest earth pressure of 0.05 is recommended in conjunction with a bulk unit weight of 23.5 kN/m^3 (effective 15.5 kN/m^3) where this condition occurs. Further, a seismic earth pressure component will not be applicable for the foundation wall which is poured against the bedrock face. It is expected that the seismic earth pressure will be transferred to the underground floor slabs, which should be designed to accommodate these pressures. A hydrostatic groundwater pressure should be added for the portion below the groundwater level.

Undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Two (2) distinct conditions, static and seismic, must be reviewed for design calculations. The parameters for design calculations for the two (2) conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil or bedrock
γ = unit weight of fill of the applicable retained soil or bedrock (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the "at-rest" case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45-a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to the OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per the OBC 2012.

5.7 Rock Anchor Design

The geotechnical design of grouted rock anchors in limestone bedrock is based upon two possible failure modes. The rock anchor can fail by shear failure along the grout/rock interface or by pullout at 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor. Interaction may develop between the failure cones of anchors that are relatively close to one another resulting in a total group capacity smaller than the sum of the individual anchor load capacity.

A third failure mode of shear failure along the grout/steel interface should be reviewed by a qualified structural engineer to ensure all typical failure modes have been reviewed. Typical rock anchor suppliers, such as Dywidag Systems International (DSI Canada) or Williams Form Engineering, have qualified personnel on staff to recommend appropriate rock anchor size and materials.

The centre to centre spacing between bond lengths should be a minimum of 1.2 m or four times the anchor hole diameter to ensure the group influence effects are minimized. Anchors in close proximity to each other are recommended to be grouted at the same time to ensure any fractures or voids are completely in-filled and grout fluid does not flow from one hole to an adjacent empty one.

Anchors can be of the “passive” or the “post-tensioned” type, depending on whether the anchor tendon is provided with post-tensioned load or not, prior to servicing.

Regardless of whether an anchor is a passive or the post tensioned type, it is recommended that the anchor is provided with a fixed anchor length at the base, which will provide the capacity, and an free anchor length between the rock surface and the top of the bonded length. As the depth at which the apex of the shear failure cone develops midway along the bonded length, a fully bonded anchor would tend to have a much shallower cone, and therefore less geotechnical resistance, than one where the bonded length is limited to the bottom part of the overall anchor.

Permanent anchors should be provided with corrosion protection. As a minimum, this requires that the entire drill hole be filled with cementitious grout. The free anchor length is provided by installing a sleeve to act as a bond break, with the sleeve filled with grout. Double corrosion protection can be provided with factory assembled systems, such as those available from Dywidag Systems International or Williams Form Engineering Corp.

Grout to Rock Bond

The unconfined compressive strength of limestone at the subject site ranges between 65 and 125 MPa, which is stronger than most routine grouts. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, should be provided. A minimum grout strength of 40 MPa is recommended.

Rock Cone Uplift

The rock anchor capacity depends on the dimensions of the rock anchors and the anchorage system configuration. Based on existing bedrock information, a **Rock Mass Rating (RMR) of 69** was assigned to the bedrock, and Hoek and Brown parameters (**m and s**) were taken as **0.575 and 0.00293**, respectively.

Recommended Grouted Rock Anchor Lengths

Parameters used to calculate grouted rock anchor lengths are provided in Table 1.

Table 2 - Parameters used in Rock Anchor Review

Grout to Rock Bond Strength - Factored at ULS	1.0 MPa
Compressive Strength - Grout	40 MPa
Rock Mass Rating (RMR) - Good quality Limestone Hoek and Brown parameters	69 m=0.575 and s=0.00293
Unconfined compressive strength - Limestone	65 MPa
Effective unit weight - Bedrock	15 kN/m^3
Apex angle of failure cone	60^o
Apex of failure cone	mid-point of fixed anchor length

The fixed anchor length will depend on the diameter of the drill holes. Recommended anchor lengths are provided in Table 3. The factored tensile resistance values provided are based on a single anchor with no group influence effects.

Table 3 - Recommended Rock Anchor Lengths - Grouted Rock Anchor

Diameter of Drill Hole (mm)	Anchor Lengths (m)			Factored Tensile Resistance (kN)
	Bonded Length	Unbonded Length	Total Length	
75	2.0	0.8	2.8	450
	2.6	1	3.6	600
	3.2	1.2	4.4	750
	4.5	2	6.5	1500
125	1.6	0.6	2.2	600
	2	1	3	750
	2.6	1.4	4.0	1000
	3.2	1.8	5.0	1250

Other Considerations

It is recommended that the anchor drill hole diameter be within 1.5 to 2 times the rock anchor tendon diameter. The anchor drill holes should be inspected by geotechnical personnel and should be flushed clean prior to grouting. A tremie pipe is recommended to place grout from the bottom to top of the anchor holes.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on test procedures can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

5.8 Pavement Structure

Where paved areas are considered for the project, the recommended pavement structures shown in Tables 4 through 6 would be applicable.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Table 5 - Recommended Pavement Structure
Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Table 6 - Recommended Rigid Pavement Structure - Lowest Parking Level

Thickness (mm)	Material Description
150	**32 MPa - C4 - Concrete**
300	**BASE** - OPSS Granular A Crushed Stone
SUBGRADE - Existing imported fill, or OPSS Granular B Type I or II material placed over bedrock.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be sub-excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the SPMDD with suitable vibratory equipment, noting that excessive vibration could lead to subgrade softening.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Water Suppression System

Where the proposed building is to have more than 2 underground parking levels, the following water suppression system is recommended to manage and control groundwater water infiltration over the long term. The water suppression system would be installed for the exterior foundation walls and underfloor drainage and would consist of the following (refer to Figure 4 - Water Suppression System in Appendix 2 for an illustration of this system cross-section):

- A concrete mud slab creating a horizontal hydraulic barrier to lessen the water infiltration at the base of the excavation. The thickness of the concrete mud slab will be determined during the excavation program when realistic groundwater infiltration can be properly assessed. However for preliminary design purposes, it is recommended that the concrete mud slab be designed at a minimum thickness of 150 mm.

- A waterproofing membrane to lessen the effect of water infiltration for the lower underground parking level(s) starting at 6 m below finished grade. The waterproofing membrane will consist of a bentonite waterproofing such as Tremco Paraseal or equivalent securely fastened to the temporary shoring system or the vertical bedrock surface. The membrane should extend to the bottom of the excavation at the founding level and extend horizontally over the concrete mud slab a minimum of 300 mm prior to the placement of the footings. Consideration can be given to doubling the bentonite waterproofing panels within the lower portion of the underground parking levels where hydrostatic pressure will be greater.

Water infiltration will result from two sources. The first will be water infiltration from the upper 6 m which is above the vertical waterproofed area. The second source will be water breaching the waterproofing membrane.

Foundation Drainage

A composite drainage layer should be placed from finished grade to the bottom of the foundation wall. Where the proposed building is to have more than 2 underground parking levels and the water suppression system is employed, the composite drainage layer should be placed between the waterproofing membrane and the foundation wall.

It is recommended that the composite drainage system consist of DeltaDrain 6000, MiraDrain G100N or an approved equivalent. It is expected that 150 mm diameter sleeves placed at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area.

Underfloor Drainage

Underfloor drainage will be required to control water infiltration below the lowest underground parking level slab. For design purposes, it's recommended that 150 mm diameter perforated pipes be placed at approximate 6 m spacing underlying the lowest level floor slab. The final spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Foundation Backfill

Above the bedrock surface, backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, as recommended above, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be protected against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a combination of soil cover and foundation insulation should be provided.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

It is expected that the parking garage will not require protection against frost action due to the founding depth. Unheated structures such as the access ramp may required to be insulated against the deleterious effect of frost action. A minimum of 2.1 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

6.3 Excavation Side Slopes and Temporary Shoring

Side Slopes

The excavation side slopes in the overburden, above the groundwater level, extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soils are considered to be a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

As noted above, excavation side slopes in sound bedrock can be carried out using almost vertical side walls. A minimum 1 m horizontal ledge should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

Temporary Shoring

Temporary shoring may be required for the overburden soil to complete the required excavations where insufficient room is available for open cut methods. The shoring requirements will depend on the depth of the excavation, the proximity of the adjacent buildings and underground structures and the elevation of the adjacent building foundations and underground services.

The temporary shoring system could consist of soldier pile and lagging system. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be included to the earth pressures described below. These systems can be cantilevered, anchored or braced. Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure the stability. It is further recommended that the toe of the shoring be adequately supported to resist toe failure, if required, by means of rock bolts or extending the piles into the bedrock through pre-augered holes if a soldier pile and lagging system is the preferred method.

The earth pressures acting on the shoring system may be calculated with the following parameters.

Table 7 - Soil Parameters

Parameters	Values
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Dry Unit Weight (γ), kN/m^3	20
Effective Unit Weight (γ), kN/m^3	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible.

The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be used full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

Underpinning of Adjacent Structures

Based on the test pit completed at one of the adjacent building foundations and the relatively shallow depth of the bedrock at the subject site, it is expected that the buildings along the southern boundary of the site are most likely founded on the bedrock surface. Therefore, underpinning is not expected to be required for this project.

However, Paterson should review the condition of the bedrock underlying the adjacent building foundations at the time of construction to evaluate if bedrock stabilization is required.

6.4 Pipe Bedding and Backfill

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on soil/bedrock subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

Long-term Groundwater Control

Our recommendations for the proposed building's long-term groundwater control are presented in Section 6.1. Any groundwater encountered along the building's perimeter or sub-slab drainage system will be directed to the proposed building's cistern/sump pit. Due to the limited capacity of the existing sewers, it is anticipated that pumped groundwater can be temporarily contained within a cistern/holding tank to permit reduced discharge volumes, if required. Provided the proposed groundwater infiltration control system is properly implemented where more than 3 underground parking levels are built, it is expected that groundwater flow will be low (i.e.- less than 3,000 L/day) with peak periods noted after rain events. It is anticipated that the groundwater flow will be controllable using conventional open sumps.

Impacts on Neighbouring Structures

It is understood that where the underground levels extend below the groundwater level (3 or more underground levels), the lower portion of the foundation will have a groundwater infiltration control system in place. Due to the presence of a groundwater infiltration control system in place against the bedrock face in this scenario, long-term groundwater lowering is anticipated to be negligible for the area.

Further, based on our observations, the groundwater level is anticipated at a 5 to 7 m depth and located within the bedrock. Therefore, local groundwater lowering is not anticipated under short-term conditions due to construction of the proposed building.

The neighbouring structures are founded within native glacial till or directly over a bedrock bearing surface based on available soils information within the area. Due to the current groundwater level noted to be within the bedrock, no issues are expected with respect to groundwater lowering that would cause long term damage to adjacent structures surrounding the proposed building.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project.

Where excavations are completed in proximity to existing structures, they may be adversely affected due to the freezing conditions. In particular, it should be recognized that where a shoring system is constructed, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of an moderate to aggressive corrosive environment.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❏ Review of the geotechnical aspects of the excavating contractor's shoring design, prior to construction.
- ❏ Review the bedrock stabilization and excavation requirements.
- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ Sampling and testing of the concrete and fill materials used.
- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❏ Observation of all subgrades prior to backfilling.
- ❏ Field density tests to determine the level of compaction achieved.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A geotechnical investigation is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests notification immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Westboro Point Developments Ltd. or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Richard Groniger, C. Tech.

Scott S. Dennis, P. Eng.

Report Distribution:

- ❑ Westboro Point Developments Ltd. (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SOIL PROFILE AND TEST DATA SHEETS BY OTHERS

SYMBOLS AND TERMS

UNIAXIAL COMPRESSIVE STRENGTH TESTING RESULTS

ANALYTICAL RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 2070 and 2090 Scott St.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG2936

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** April 2, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	65.09
100mm Asphaltic concrete over crushed stone 0.25		AU	1				
FILL: Brown silty sand with gravel 1.37		SS	2	8	4	1	64.09
Fractured **BEDROCK:** 1.65		RC	1	100	75	2	63.09
BEDROCK: Grey limestone		RC	2	100	72	3	62.09
4.40						4	61.09
BEDROCK: Grey limestone interbedded with dolostone		RC	3	100	100	5	60.09
6.02						6	59.09
		RC	4	100	96	7	58.09
		RC	5	100	84	8	57.09
						9	56.09
BEDROCK: Grey limetone with intermittent dolostone and shale		RC	6	100	71	10	55.09
		RC	7	100	85	11	54.09
						12	53.09
		RC	8	100	100	13	52.09
13.51							
End of Borehole							
(GWL @ 6.93m-April 4, 2013)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Monitoring Well Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 2070 and 2090 Scott St.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

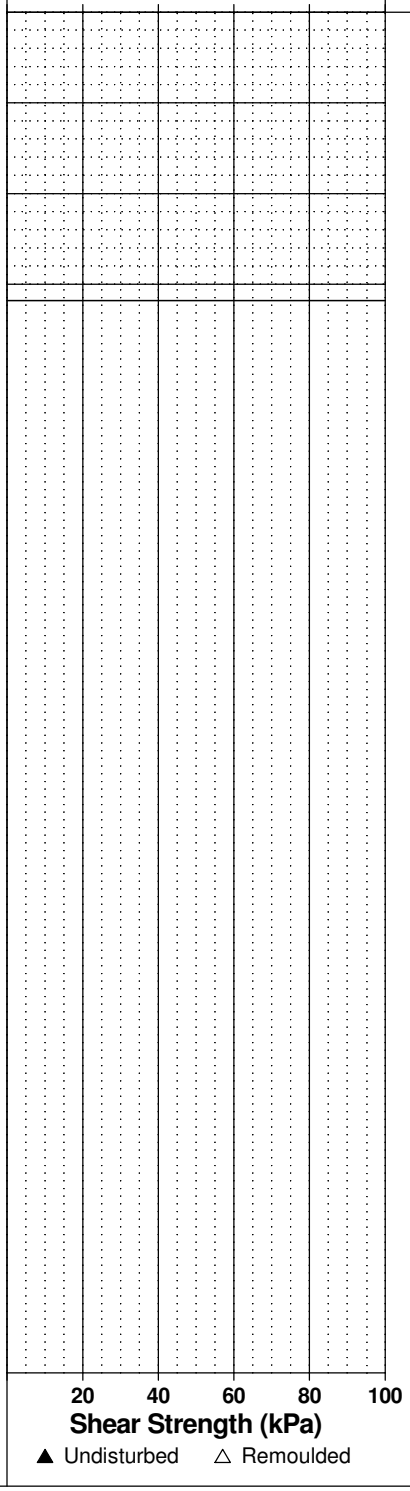
FILE NO. PG2936

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** April 2, 2013

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE										
150mm Asphaltic concrete over crushed stone	0.46		AU	1			0	63.77		
FILL: Brown silty clay with sand, gravel, trace glass	1.68		SS	2	21	7	1	62.77		
FILL: Brown silty sand iwth gravel, cobbles, trace boulders	2.29		SS	3	4	48	2	61.77		
FILL: Topsoil, trace wood chips	2.59		SS	4	42	12				
GLACIAL TILL: Brown silty sand with gravel, trace cobbles and boulders	3.18		SS	5	33	50+	3	60.77		
End of Borehole										
Practical refusal to augering at 3.18m depth										
(BH dry upon completion)										



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 2070 and 2090 Scott St.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG2936

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** April 2, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.07
25mm Asphaltic concrete over crushed stone 0.60		AU	1				
FILL: Red-brown silty sand 1.45		SS	2	46	11	1	62.07
FILL: Topsoil 1.70		SS	3	71	6	2	61.07
FILL: Brown silty sand with gravel, cobbles, trace boulders 2.46		SS	4	100	50+		
		RC	1	100	75	3	60.07
BEDROCK: Grye limestone 3.91		RC	2	100	67	4	59.07
BEDROCK: Grey to black dolostone interbedded with limestone 5.74		RC	3	71	29	5	58.07
BEDROCK: Grey limestone interbedded with dolostone 7.21		RC	4	100	83	6	57.07
		RC	5	90	60	7	56.07
BEDROCK: Black dolostone interbedded with limestone		RC	6	86	57	8	55.07
		RC	7	100	83	9	54.07
		RC	8	100	80	10	53.07
13.26						11	52.07
End of Borehole						12	51.07
(GWL @ 5.27m-April 4, 2013)						13	50.07

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Monitoring Well Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG4935

REMARKS

HOLE NO. BH 4-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.71
FILL: Brown silty sand and gravel		AU	1				
		SS	2	21	6	1	62.71
		SS	3	54	53	2	61.71
2.13							
FILL: Brown silty sand with crushed stone		SS	4	56	50+		
2.84						3	60.71
		RC	1	88	45	4	59.71
		RC	2	100	75	5	58.71
BEDROCK: Grey limestone						6	57.71
		RC	3	100	26	7	56.71
		RC	4	100	58	8	55.71
8.31							
End of Borehole							
(GWL @ 7.10m - May 22, 2019)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

Monitoring Well Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG4935

REMARKS

HOLE NO. BH 5-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.13						0	63.34		
FILL: Brown silty sand		AU	1						
		SS	2	46	11	1	62.34		
1.37									
FILL: Brown silty sand, some clay, trace brick		SS	3	24	3	2	61.34		
2.21									
		RC	1	100	39	3	60.34		
		RC	2	100	52	4	59.34		
BEDROCK: Grey limestone		RC	3	100	56	5	58.34		
		RC	4	100	73	6	57.34		
		RC	5	100	38	7	56.34		
7.67									
End of Borehole									
(GWL @ 6.14m - May 22, 2019)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG4935

REMARKS

HOLE NO. BH 6-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	62.99
		AU	1				
FILL: Brown silty sand and crushed rock, some concrete		SS	2	25	13	1	61.99
		SS	3	64	50+		
2.13						2	60.99
		RC	1	100	20		
		RC	2	100	64	3	59.99
BEDROCK: Grey limestone		RC	3	98	60	4	58.99
		RC	4	100	85	5	57.99
		RC	5	100	74	6	56.99
7.75						7	55.99
End of Borehole							
(GWL @ 5.82m - May 22, 2019)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Monitoring Well Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 2070 and 2090 Scott St.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PG2936

REMARKS

HOLE NO. TP 1

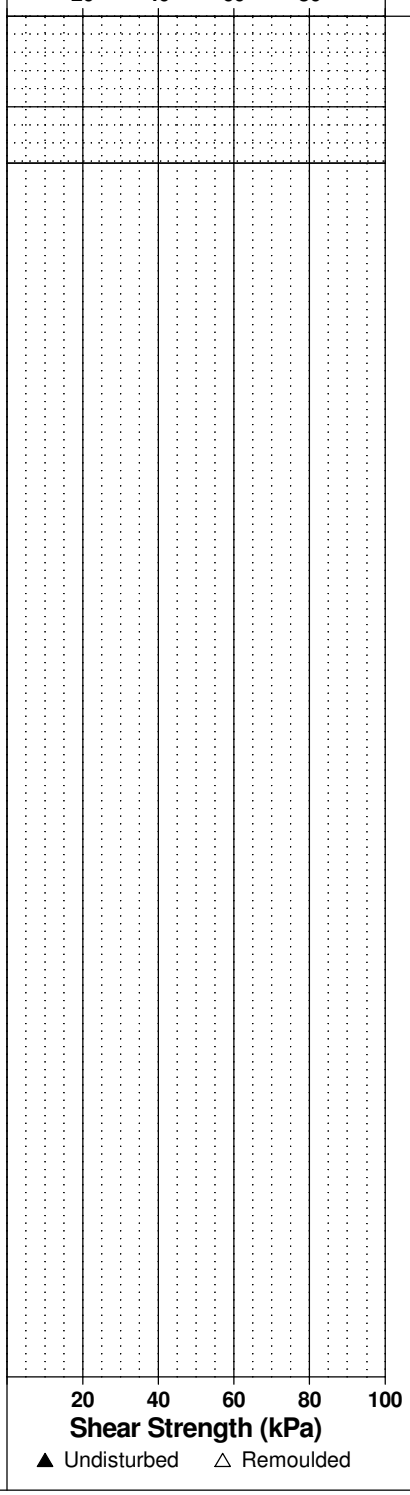
BORINGS BY Hydraulic Shovel **DATE** April 3, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.08						0	65.19		
FILL: Crushed stone 0.76									
FILL: Brown silty sand with gravel, cobbles, trace boulders and topsoil 1.62		G	1			1	64.19		
End of Test Pit									

Practical refusal to excavation at 1.62m depth

Concrete foundation wall founded directly over bedrock surface at 1.62m depth. No footing encountered.

(TP dry upon completion)



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Consulting Engineers
28 Concourse Gate, Unit 1, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2074 Scott Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe

DATE 21 OCT 02

FILE NO. **E2283**

HOLE NO. **TP 1**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0			
FILL: Brown sand		G	1			1			
		G	2						
						2			
2.44		G	3						
Brown SANDY SILT						3			▽
3.05									
Grey SAND		G	4						
3.20 End of Test Pit									
(Soil saturated below 2.9m depth)									

20 40 60 80

100 200 300 400 500

Gastech 1314 Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2074 Scott Street
Ottawa, Ontario

DATUM

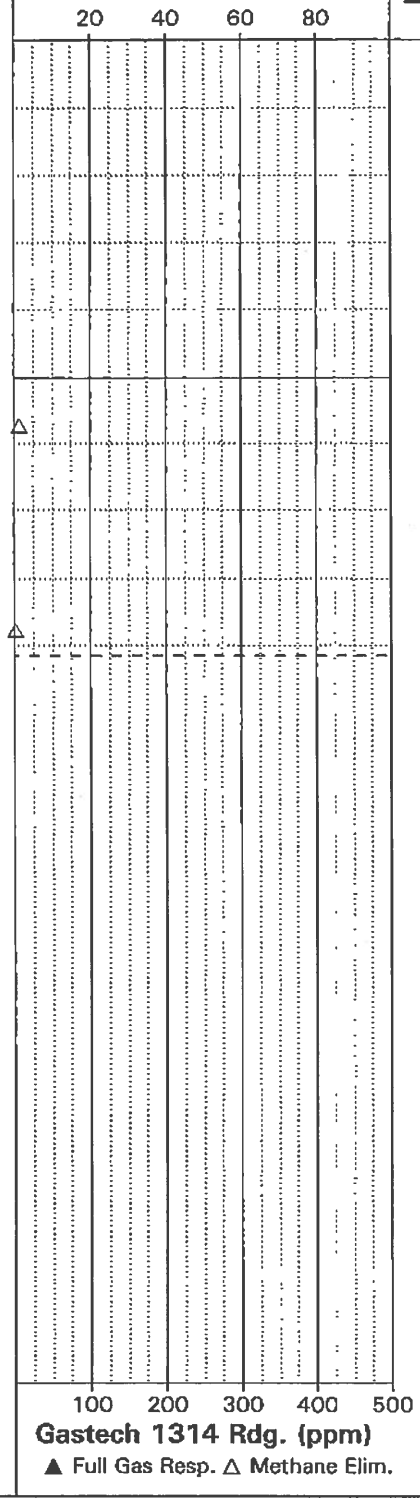
REMARKS

BORINGS BY Backhoe DATE 21 OCT 02

FILE NO. **E2283**

HOLE NO. **TP 2**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0			
FILL: Brown sand and gravel, some cobbles and plastic pieces		G	1			1			
1.83		G	2						
End of Test Pit TP terminated on bedrock surface @ 1.83m depth (TP dry upon completion)									



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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2074 Scott Street
Ottawa, Ontario

DATUM

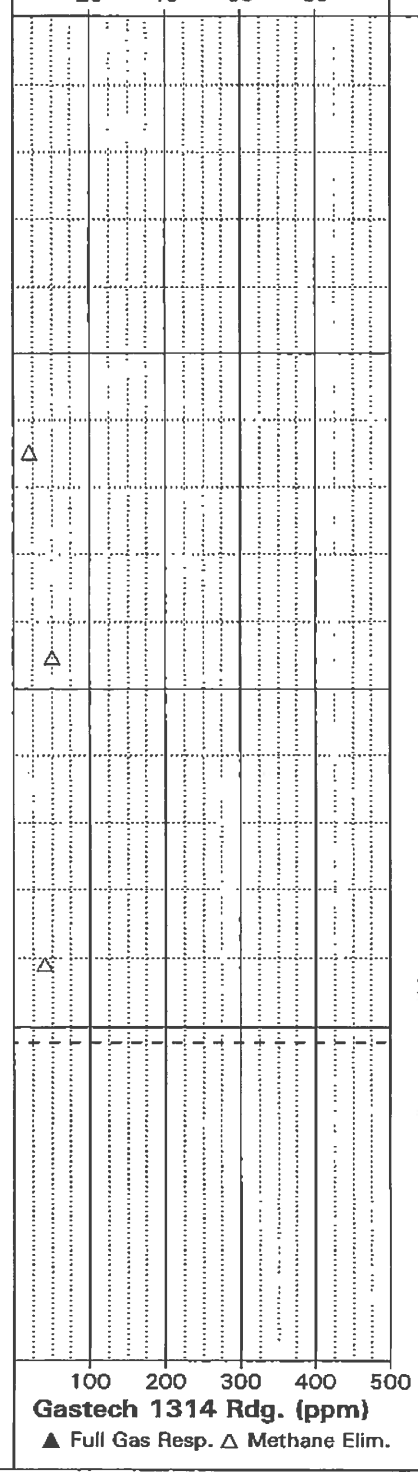
REMARKS

BORINGS BY Backhoe DATE 21 OCT 02

FILE NO. **E2283**

HOLE NO. **TP 3**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0			
FILL: Dark brown sand and gravel with plastic, asphalt and steel pieces		G	1			1			
		G	2			2			
		G	3			3			▽
3.05 End of Test Pit (Soil saturated below 2.9m depth)									



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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2074 Scott Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe DATE 21 OCT 02

FILE NO. **E2283**

HOLE NO. **TP 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0		20 40 60 80	
FILL: Gravel with miscellaneous debris		G	1			1			
		G	2						
		G	3			2			
2.13									
GLACIAL TILL: Dense, brown silty sand and gravel		G	4						
2.74									
End of Test Pit									
(TP dry upon completion)									

100 200 300 400 500
Gastech 1314 Rdg. (ppm)
▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2074 Scott Street
Ottawa, Ontario

DATUM

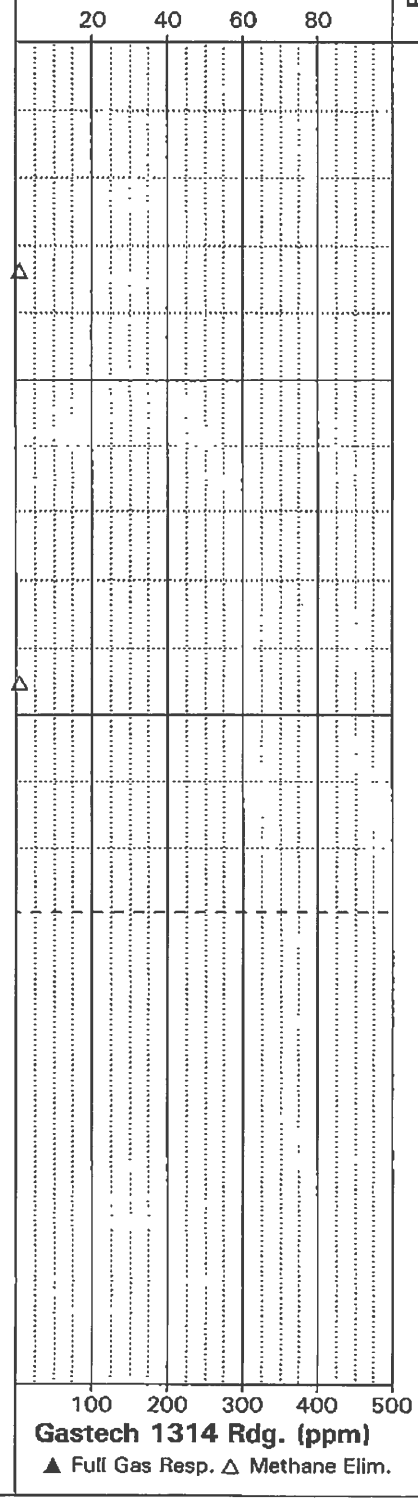
REMARKS

BORINGS BY Backhoe DATE 21 OCT 02

FILE NO. **E2283**

HOLE NO. **TP 5**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0			
FILL: Mixture of sand, gravel, boulders, brick and wood pieces		G	1						
		G	2			1			
2.13						2			
GLACIAL TILL: Dense silty sand and gravel									
2.59									
End of Test Pit									
(TP dry upon completion)									



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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located at the southeast corner of Winona Ave. and Scott St. Assumed elevation = 100.00m.

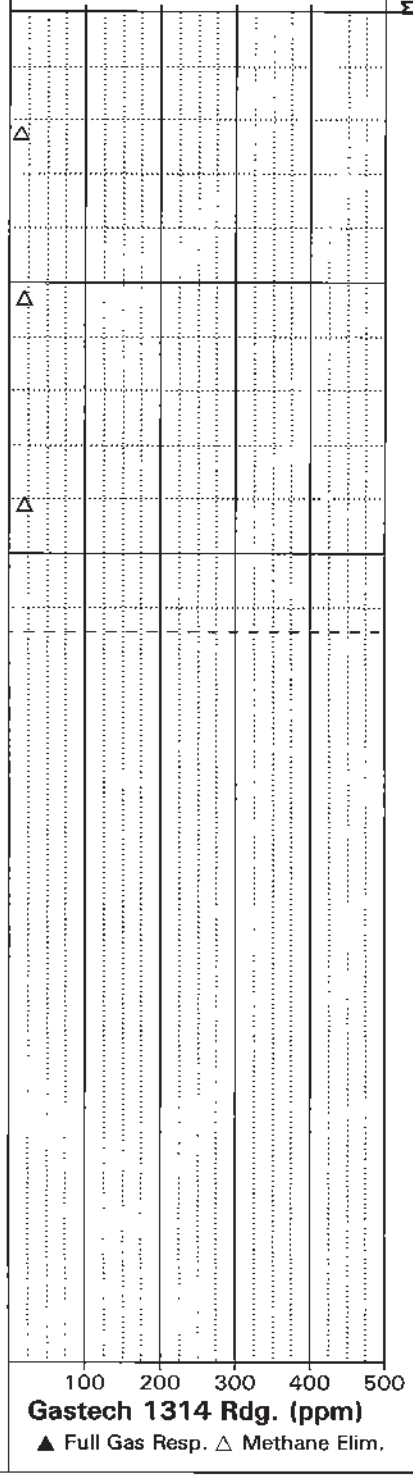
FILE NO. **E2283**

REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 55 Power Auger DATE 15 OCT 01

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	MONITORING WELL CONSTRUCTION
GROUND SURFACE									
Asphaltic concrete 0.08						0	98.71		
FILL: Crushed stone 0.25									
FILL: Black silty sand with gravel - light brown by 0.45m depth		AU	1						
		SS	2	33	6	1	97.71		
		SS	3	21	4				
						2	96.71		
2.29									
End of Borehole Auger refusal on inferred bedrock surface @ 2.29m depth (BH dry upon completion)									



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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located at the southeast corner of Winona Ave. and Scott St. Assumed elevation = 100.00m.

FILE NO. **E2283**

REMARKS

HOLE NO. **BH 2**

BORINGS BY CME 55 Power Auger DATE 15 OCT 01

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	MONITORING WELL CONSTRUCTION
GROUND SURFACE							0	98.54		
Asphaltic concrete	0.08									
FILL: Crushed stone	0.23									
FILL: Brown silty sand and gravel			AU	4						
			SS	5	33	12	1	97.54		
	1.68		SS	6	100	25				
End of Borehole										
Auger refusal on inferred bedrock surface @ 1.68m depth										
(BH dry upon completion)										

20 40 60 80

100 200 300 400 500

Gastech 1314 Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located at the southeast corner of Winona Ave. and Scott St. Assumed elevation = 100.00m.

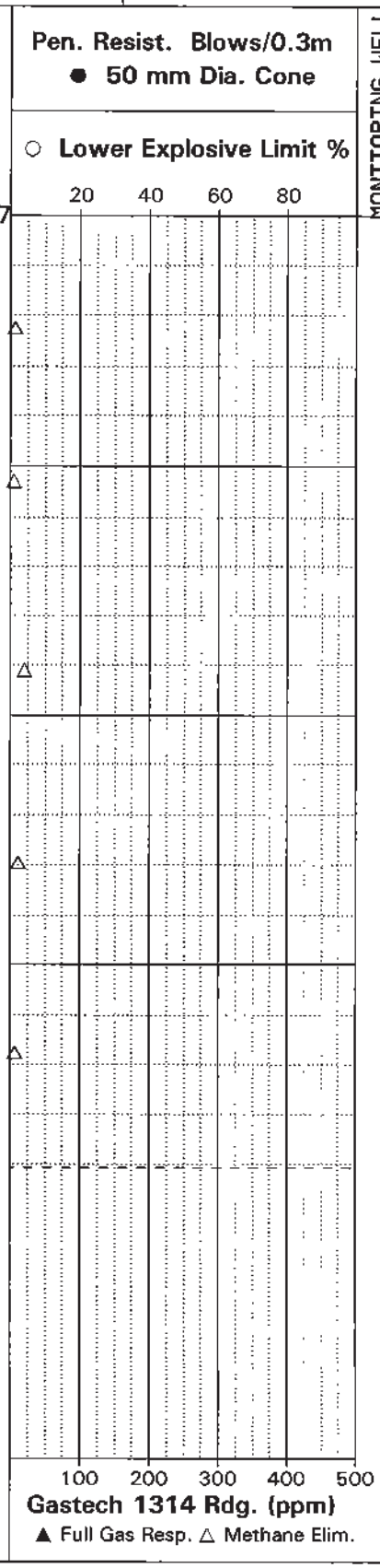
REMARKS

FILE NO. **E2283**

HOLE NO. **BH 3**

BORINGS BY CME 55 Power Auger **DATE** 15 OCT 01

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.37
Asphaltic concrete 0.08							
		AU	7				
		SS	8	42	17	1	99.37
FILL: Brown silty sand and gravel, some cobbles and brick pieces		SS	9	25	10	2	98.37
		SS	10	17	7	3	97.37
		SS	11	17	22		
3.81							
End of Borehole							
Auger refusal on inferred bedrock surface @ 3.81m depth							
(BH dry upon completion)							



MONITORING WELL CONSTRUCTION

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SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located at the southeast corner of Winona Ave. and Scott St. Assumed elevation = 100.00m.

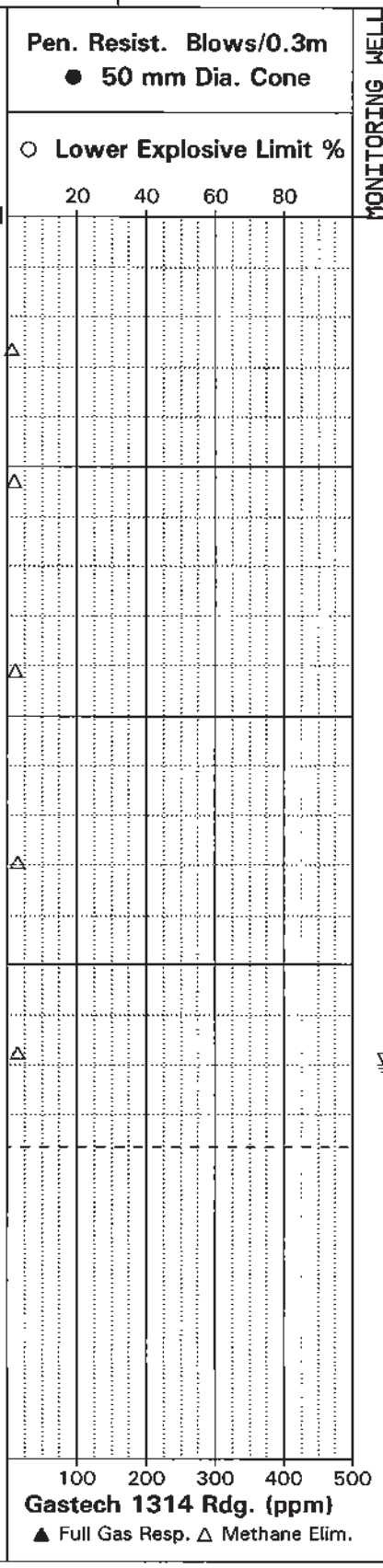
FILE NO. **E2283**

REMARKS

HOLE NO. **BH 4**

BORINGS BY CME 55 Power Auger DATE 15 OCT 01

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.51
Asphaltic concrete 0.08							
FILL: Brown sand and gravel 0.60		AU	12				
		SS	13	38	7	1	99.51
		SS	14	42	3		
FILL: Brown silty sand						2	98.51
		SS	15	38	5		
						3	97.51
		SS	16	42	5		
3.73							
End of Borehole							
Auger refusal on inferred bedrock surface @ 3.73m depth							
(Open hole GWL @ 3.4m depth)							



MONITORING WELL CONSTRUCTION

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28 Concourse Gate, Unit 1, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located at the southeast corner of Winona Ave. and Scott St. Assumed elevation = 100.00m.

FILE NO. **E2283**

REMARKS

HOLE NO. **BH 5**

BORINGS BY CME 55 Power Auger DATE 15 OCT 01

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Lower Explosive Limit %	MONITORING WELL CONSTRUCTION
GROUND SURFACE						0	100.74		
Asphaltic concrete 0.08									
FILL: Brown silty sand and gravel		SS	17	42	29	1	99.74		
		SS	18	71	17				
						2	98.74		
2.29									
End of Borehole Auger refusal on inferred bedrock surface @ 2.29m depth (BH dry upon completion)									

Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone
○ Lower Explosive Limit %
20 40 60 80

100 200 300 400 500
Gastech 1314 Rdg. (ppm)
▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE & TEST DATA

Environmental Site Characterization
Scott Street @ Churchill Avenue North
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located @ the southeast corner of Winona Avenue and Scott Street. Assumed elevation = 100.00m.

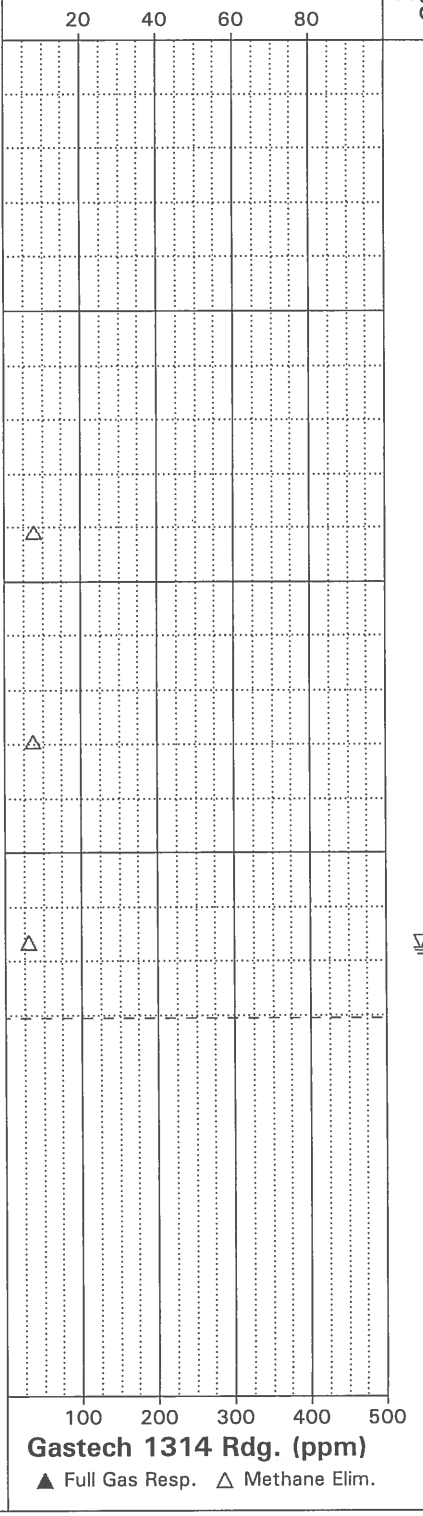
FILE NO. **E1381**

REMARKS

HOLE NO. **BH 1-1**

BORINGS BY Power Auger **DATE** 18 November 1996

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or ROD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	100.48		
15mm Asphaltic concrete over grey crushed stone 0.19									
FILL: Brown, mixture of silt, sand, gravel, occ. pcs. of asphaltic concrete		SS	1	62	14	1	99.48		
		SS	2	50	6	2	98.48		
		SS	3	54	2	3	97.48		▽
3.61 End of Borehole									
Auger refusal on inferred bedrock @ 3.61m depth.									
(Open hole WL @ 3.35m depth.)									



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SOIL PROFILE & TEST DATA

Environmental Site Characterization
Scott Street @ Churchill Avenue North
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located @ the southeast corner of Winona Avenue and Scott Street. Assumed elevation = 100.00m.

FILE NO. **E1381**

REMARKS

HOLE NO. **BH 2-1**

BORINGS BY Power Auger **DATE** 18 November 1996

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	100.70		
Asphaltic concrete 0.05									
Grey crushed stone 0.25									
FILL: Brown, mixture of silt, sand, gravel, occ. pcs. of asphaltic concrete		SS	4	67	6	1	99.70		
		SS	5	54	6	2	98.70		
		SS	6	45	25+	3	97.70		
3.33 End of Borehole									
Auger refusal on inferred bedrock @ 3.33m depth.									
(BH dry upon completion)									

Pen. Resist. Blows/0.3m: ○ Lower Explosive Limit % — 20 40 60 80

100 200 300 400 500
Gastech 1314 Rdg. (ppm)
▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE & TEST DATA

Environmental Site Characterization
Scott Street @ Churchill Avenue North
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located @ the southeast corner of Winona Avenue and Scott Street. Assumed elevation = 100.00m.

FILE NO. **E1381**

REMARKS

HOLE NO. **BH 3-1**

BORINGS BY Power Auger **DATE** 18 November 1996

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.37
Asphaltic concrete 0.05							
Grey crushed stone 0.25							
FILL: Brown, mixture of silt, sand, gravel, some organics, occ. pcs. of asphaltic concrete		SS	7	38	11	1	99.37
		SS	8	33	10	2	98.37
3.17		SS	9	100		3	97.37
End of Borehole							
Auger refusal on inferred bedrock @ 3.17m depth.							
(BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Lower Explosive Limit %

20 40 60 80

100 200 300 400 500
Gastech 1314 Rdg. (ppm)
▲ Full Gas Resp. △ Methane Elim.

PIEZOMETER CONSTRUCTION

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SOIL PROFILE & TEST DATA

Environmental Site Characterization
Scott Street @ Churchill Avenue North
Ottawa, Ontario

DATUM TBM - Top nut of fire hydrant located @ the southeast corner of Winona Avenue and Scott Street. Assumed elevation = 100.00m.

FILE NO. **E1381**

REMARKS

HOLE NO. **BH 4-1**

BORINGS BY Power Auger **DATE** 18 November 1996

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Lower Explosive Limit %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	98.73		
Asphaltic concrete 0.05									
Grey crushed stone 0.13									
FILL: Dark brown, mixture of silt, sand, gravel, some organics, occ. pcs. of brick		SS	10	58	16	1	97.73		
		SS	11	36	25+				
2.08						2	96.73		
End of Borehole									
Auger refusal on inferred bedrock @ 2.08m depth.									
(BH dry upon completion)									

Lower Explosive Limit % scale: 20 40 60 80

Gastech 1314 Rdg. (ppm) scale: 100 200 300 400 500

▲ 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 strength of cohesionless soils is the relative density, 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.

Relative Density	'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 vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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 is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

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 NXL size core. However, it can be used on smaller core sizes, such as BX, 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
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture 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)
Dxx	-	Grain size 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
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu 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

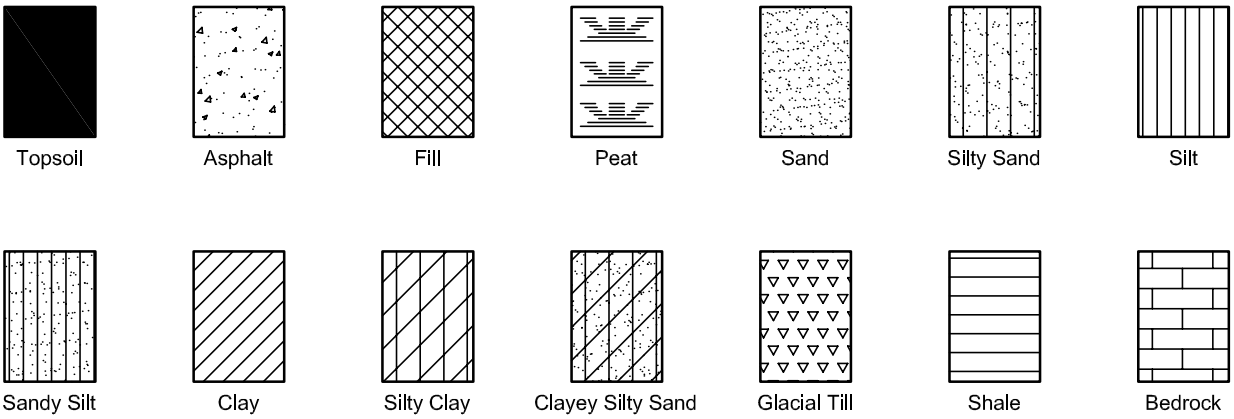
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	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.

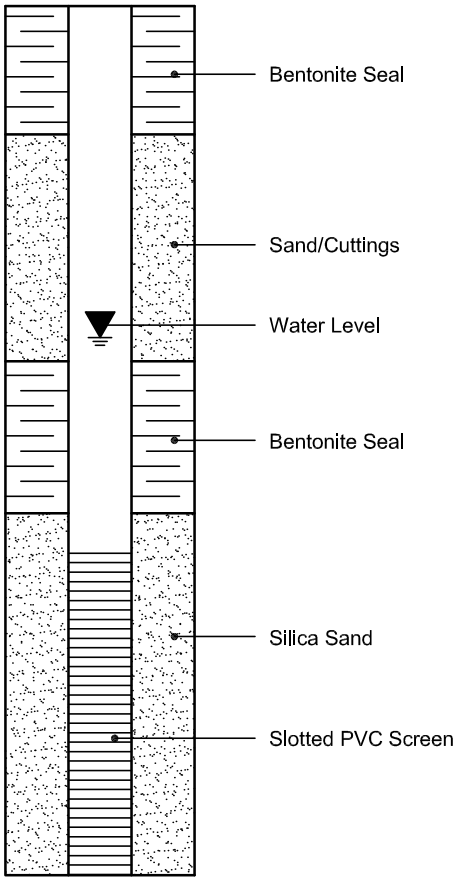
SYMBOLS AND TERMS (continued)

STRATA PLOT

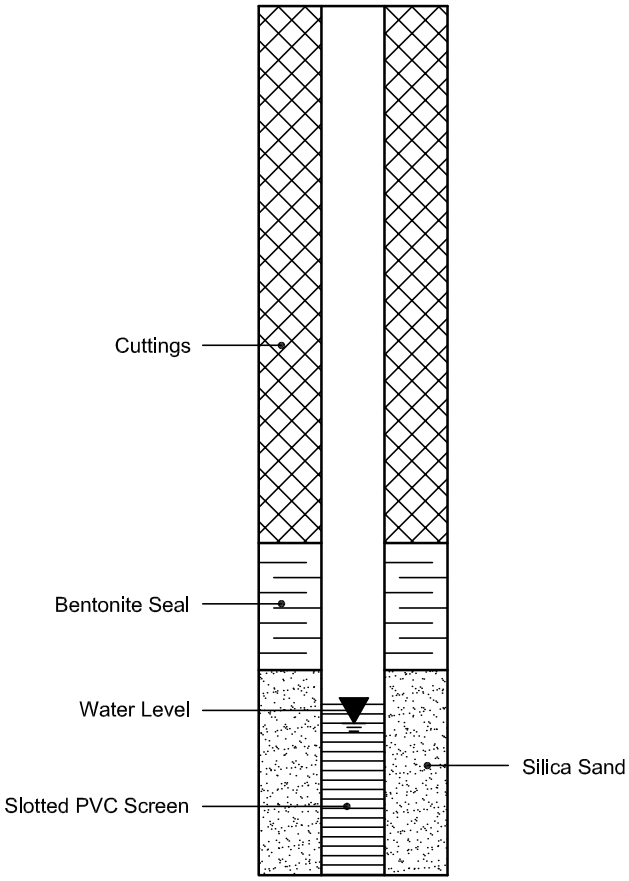


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



BOREHOLE/MONITORING WELL #: BH/MW1

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N5027060 E440905

TOC Elevation: 98.82 m *
Water Level: 7.18 m btoc (April 11, 2013)
Water Level Elevation: 91.64 m * (April 11, 2013)
Bottom of Well Depth: 13.15 m btoc

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m) * / Depth (m bgs)
0	Ground Surface	98.887
0	***Asphalt***	0.000
1	***Gravel (FILL)*** grey, dry	97.487
1.4	***Silty Sand and Gravel (FILL)*** brown, trace organics, dry	
3	***Bedrock*** limestone	
13		85.387
13.5	End of Borehole	

SAMPLE

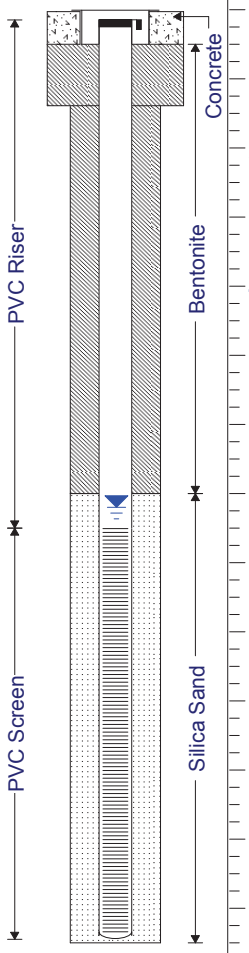
Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses
N/S	N/S	N/S	N/S	N/S

Notes:
SS = split spoon sample
ppm = parts per million
m btoc = meters below top of casing
m bgs = meters below ground surface
N/S = no environmental soil sampling performed

*Elevation data based on Franz survey conducted relative to a temporary benchmark (top of yellow and blue fire hydrant on east side of Churchill Avenue North) that was assigned a relative elevation of 100.00 m

MOE Well Cluster Tag No. A140444

Well Completion Details



Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem augers/NQ coring)
Drill Date: April 2, 2013
Logged by: David Kiar

Well Pipe Diameter: 0.03 m
Borehole Diameter: 0.20 m / 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH/MW2

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N5027060 E440905

TOC Elevation: 98.73 m *
Water Level: 7.07 m btoc (April 11, 2013)
Water Level Elevation: 91.67 m * (April 11, 2013)
Bottom of Well Depth: 10.07 m btoc

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)
0		Ground Surface	98.879
0		***Asphalt***	0.000
1		***Sand and Gravel (FILL)*** grey/brown, dry to damp	
2		some rock/cobble fragments starting at approximately 1.8 m	96.679
2		***Bedrock*** limestone	2.200
10			88.579
10		End of Borehole	10.300

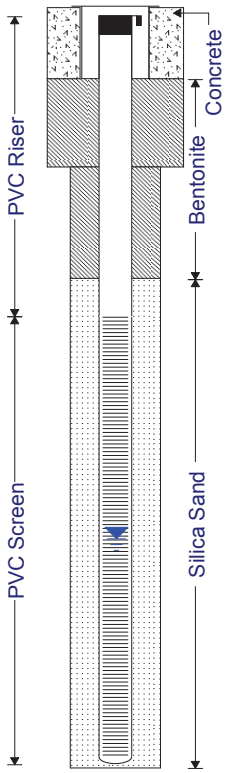
SAMPLE

Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses
2-1	SS	50	0	PHCs, BTEX, Metals
2-2	SS	60	0	---
2-3	SS	30	0	---
2-4	SS	30	0	---

Notes:
SS = split spoon sample
ppm = parts per million
m btoc = meters below top of casing
m bgs = meters below ground surface

*Elevation data based on Franz survey conducted relative to a temporary benchmark (top of yellow and blue fire hydrant on east side of Churchill Avenue North) that was assigned a relative elevation of 100.00 m

Well Completion Details



Depth (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem/NQ coring)
Drill Date: April 4, 2013
Logged by: David Kiar

Well Pipe Diameter: 0.03 m
Borehole Diameter: 0.20 m / 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH/MW3

BOREHOLE LOG

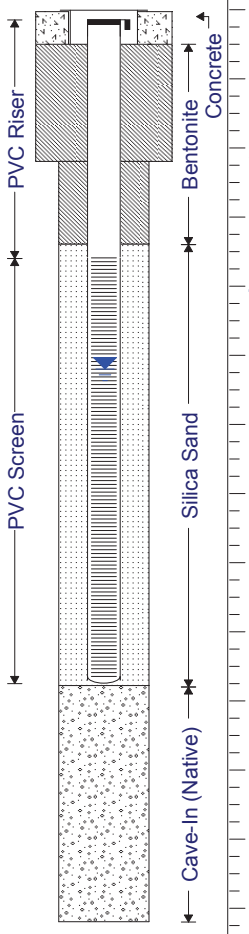
Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N5027094 E440940

TOC Elevation: 96.85 m *
Water Level: 5.20 m btoc (April 11, 2013)
Water Level Elevation: 91.65 m * (April 11, 2013)
Bottom of Well Depth: 9.65 m btoc

SUBSURFACE PROFILE				SAMPLE					
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details
0		Ground Surface	96.904						
0		***Asphalt***	0.000						
1		***Silty Sand and Gravel (FILL)*** brown, trace organics, dry to damp		N/S	N/S	N/S	N/S	N/S	
2			94.704						
2		***Bedrock*** limestone	2.200						
13			83.704						
13		End of Borehole	13.200						

Notes:
SS = split spoon sample
ppm = parts per million
m btoc = meters below top of casing
m bgs = meters below ground surface
N/S = no environmental soil sampling performed

*Elevation data based on Franz survey conducted relative to a temporary benchmark (top of yellow and blue fire hydrant on east side of Churchill Avenue North) that was assigned a relative elevation of 100.00 m



Depth (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem/NQ coring)
Drill Date: April 4, 2013
Logged by: David Kiar

Well Pipe Diameter: 0.03 m
Borehole Diameter: 0.20 m / 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH4

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Asphalt***	0.000							0
		Sand and Gravel (FILL) brown/grey, trace silt, clay and cobble, damp to moist.		4-1	SS	30	0	PHCs, BTEX, Metals		
1				4-2	SS	50	0	---	No Monitoring Well Installed	1
				4-3	SS	0	---	---		
		Bedrock Limestone	1.400							
		End of Borehole								
2										2
3										3

Notes:
SS = split spoon sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem)
Drill Date: April 4, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.20 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH5

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Asphalt***	0.000							0
		Silty Sand and Gravel (FILL) brown/grey, some cobble, dry to damp.		5-1	SS	40	0	PHCs, BTEX, Metals		
1				5-2	SS	30	0	---	No Monitoring Well Installed	1
				5-3	SS	0	---	---		
		Bedrock limestone	1.400							
		End of Borehole								
2										2
3										3

Notes:
SS = split spoon sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem)
Drill Date: April 4, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.20 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH6

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE					Well Completion Details	
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses		Depth (m)
0		Ground Surface								0
		Asphalt	0.000							
		Sand and Gravel (FILL) brown, trace asphalt and brick debris, trace silt and clay, some cobble, damp.		6-1	SS	60	0	PHCs, BTEX, Metals	No Monitoring Well Installed	
1				6-2	SS	20	0	---		1
				6-3	SS	0	---	---		
2				6-4	SS	0	---	---		2
		Bedrock limestone	2.100							
		End of Borehole								
3										3

Notes:
SS = split spoon sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: CME 75 (hollow-stem)
Drill Date: April 4, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.20 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH7

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Asphalt***	0.000							0
		Sand and Gravel (FILL) brown, trace silt and clay, some cobble, dry to damp.		7-1	CS	90	0	---		
1				7-2	CS	90	0	---	No Monitoring Well Installed	1
				7-3	CS	100	0	PHCs, BTEX, Metals		
		Bedrock limestone	1.500							
2		End of Borehole								2
3										3

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.09 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH8

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
0		Ground Surface							No Monitoring Well Installed	0
		Interlock Brick	0.000							
		Silty Sand and Gravel (FILL) brown, some cobble, damp.		8-1	CS	50	0	---		
1										1
				8-2	CS	50	0	PHCs, BTEX, Metals		
2										2
		Sandy Silt light brown, trace gravel, damp to moist.	2.400	8-3	CS	60	0	---		
3				8-4	CS	50	0	---		3
				8-5	CS	95	0	---		
4										4
		Bedrock limestone	4.600							
5		End of Borehole								5
6										6

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH9

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE					
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details
		Ground Surface							
0		***Grass***	0.000						No Monitoring Well Installed
		Topsoil dark brown, organic, damp.							
		Sand and Gravel brown, trace silt and cobble, damp.	0.600	9-1	CS	50	0	PHCs, BTEX, Metals	
1				9-2	CS	100	0	---	
2		***Bedrock*** limestone	2.000						
		End of Borehole							
3									

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH10

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Grass***	0.000							0
		Topsoil dark brown, organic, damp								
		Silty Sand and Gravel brown, some cobble, trace brick debris, damp to moist.	0.600	10-1	CS	70	0	PHCs, BTEX, Metals	No Monitoring Well Installed	
1				10-2	CS	100	0	---		1
2		***Bedrock*** limestone	2.000							2
		End of Borehole								
3										3

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: NA
Borehole Diameter: 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH11

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Asphalt***	0.000							0
		Sand and Gravel (FILL) brown, some silt, some cobble, trace debris, damp.		11-1	CS	50	0	PHCs, BTEX, PAHs, Metals	No Monitoring Well Installed	
1				11-2	CS	25	0	---		1
2		***Bedrock*** limestone	2.000							2
		End of Borehole								
3										3

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

BOREHOLE/MONITORING WELL #: BH12

BOREHOLE LOG

Project No: 2471-1301
Project: Phase II ESA, 2070-2074 & 2090 Scott Street, Ottawa, ON
Client: EJSpa Corporation
Borehole Location: N/A

TOC Elevation: N/A (borehole only)
Water Level: N/A (borehole only)
Water Level Elevation: N/A (borehole only)
Bottom of Well Depth: N/A (borehole only)

SUBSURFACE PROFILE				SAMPLE						
Depth (m)	Symbol	Description	Elevation (m) * / Depth (m bgs)	Sample ID	Sample Type	Sample Recovery	Organic Vapour Measurements (ppm)	Lab Analyses	Well Completion Details	Depth (m)
		Ground Surface								
0		***Asphalt***	0.000						No Monitoring Well Installed	0
		Sand and Gravel (FILL) brown, some silt and cobble, trace debris, dry to damp.		12-1	CS	50	150	PHCs, BTEX, PAHs, Metals		
1				12-2	CS	25	0	---		1
		Bedrock limestone	1.700							
		End of Borehole								
2										2

Notes:
CS = geoprobe core sample
ppm = parts per million
m bgs = meters below ground surface

Drilled By: George Downing Estate Drilling Ltd.
Drill Method: Geoprobe 7822DT
Drill Date: April 5, 2013
Logged by: David Kiar

Well Pipe Diameter: N/A
Borehole Diameter: 0.08 m
Checked by: Mike Grinnell
Sheet: 1 of 1

patersongroup
Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7 J5
Phone: (613) 226-7381 Fax.: (613) 226-6344

ROCK CORE COMPRESSIVE STRENGTH

CLIENT:	**Slengora Limited c/o Cleland Jardine Engineering**	FILE No.:	**PG2936**
ADDRESS:	472 Tillbury Avenue	REPORT No.:	1
PROJECT:	**2070 & 2090 Scott Street**	DATE:	03-Apr-13
STRUCTURE TYPE & LOCATION:	Rock Cores		

CORE DATA AND TESTING RESULTS

Lab. No.	**63136M**	**63136M**
Core No.	1	2
Location	BH1	BH3
	RC8	RC8
Nominal MSA(mm)		
Date Cast		
Date Cored		
Date Tested	03-Apr-13	03-Apr-13
(D) Ave. Diameter (mm)	46.00	46.00
(H) Height (mm)	88.0	89.5
(W) Weight (g)	415.8	417.3
(A) Area = $\pi D^2/4$ (mm^2)	1661.9	1661.9
(V) Volume = A X H /1000 (cm^3)	146.2	148.7
Unit Weight = W /V x1000 (kg/r	**2843**	**2806**
Capped Height(mm)	88.0	89.5
H / D ratio	1.91	1.95
Correction factor (k)	0.992	0.995
(L) Load (lbs)	46900	23900
Mpa = L x 4.448222 / A	125.5	64.0
MPa (corrected)	**124.5**	**63.7**
Direction of Loading		
Curing Conditions		

REMARKS

Core No.1 Depth: 39' 8" to 40' 0"

Core No.2 Depth: 40' 6" to 40' 10"

DISTRIBUTION	**TECHNICAL PERSONNEL**	
	TECHNICIAN:	G. Brown
	VERIFIED BY:	S. Brown
	APPROVED BY:	Stephen J. Walker, P. Eng.

Certificate of Analysis

Report Date: 08-Apr-2013
Order Date:3-Apr-2013

Client: **Paterson Group Consulting Engineers**
Client PO: 13998

Project Description: PG2936

	Client ID:	BH3-SS2	-	-	-
	Sample Date:	02-Apr-13	-	-	-
	Sample ID:	1314147-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	91.0	-	-	-
General Inorganics					
pH	0.05 pH Units	7.77	-	-	-
Resistivity	0.10 Ohm.m	29.0	-	-	-
Anions					
Chloride	5 ug/g dry	27	-	-	-
Sulphate	5 ug/g dry	106	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 AND 3 - SEISMIC SHEAR WAVE VELOCITY PROFILES

FIGURE 4 - GROUNDWATER SUPPRESSION SYSTEM

DRAWING PG4935-1 - TEST HOLE LOCATION PLAN

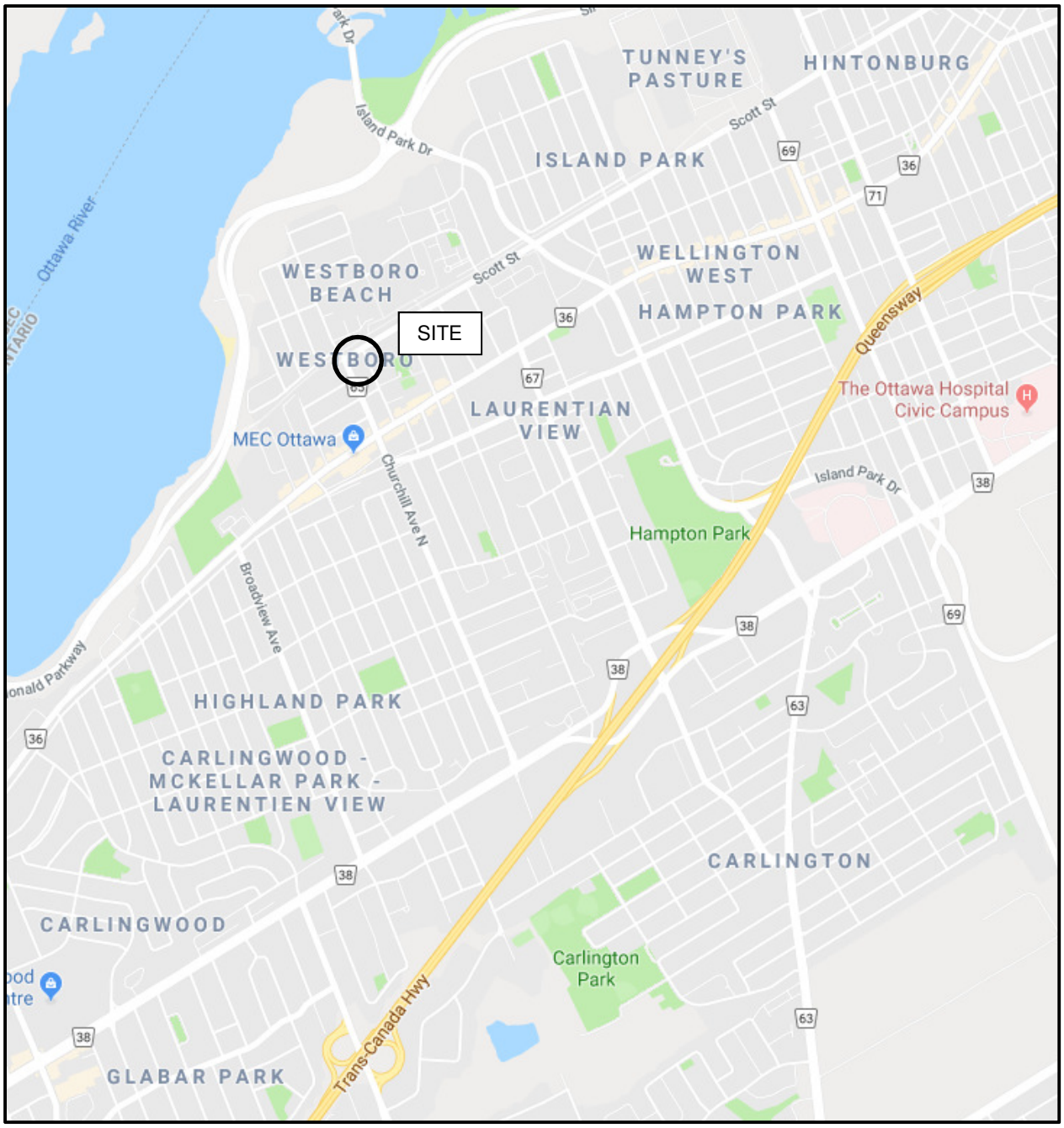


FIGURE 1

KEY PLAN

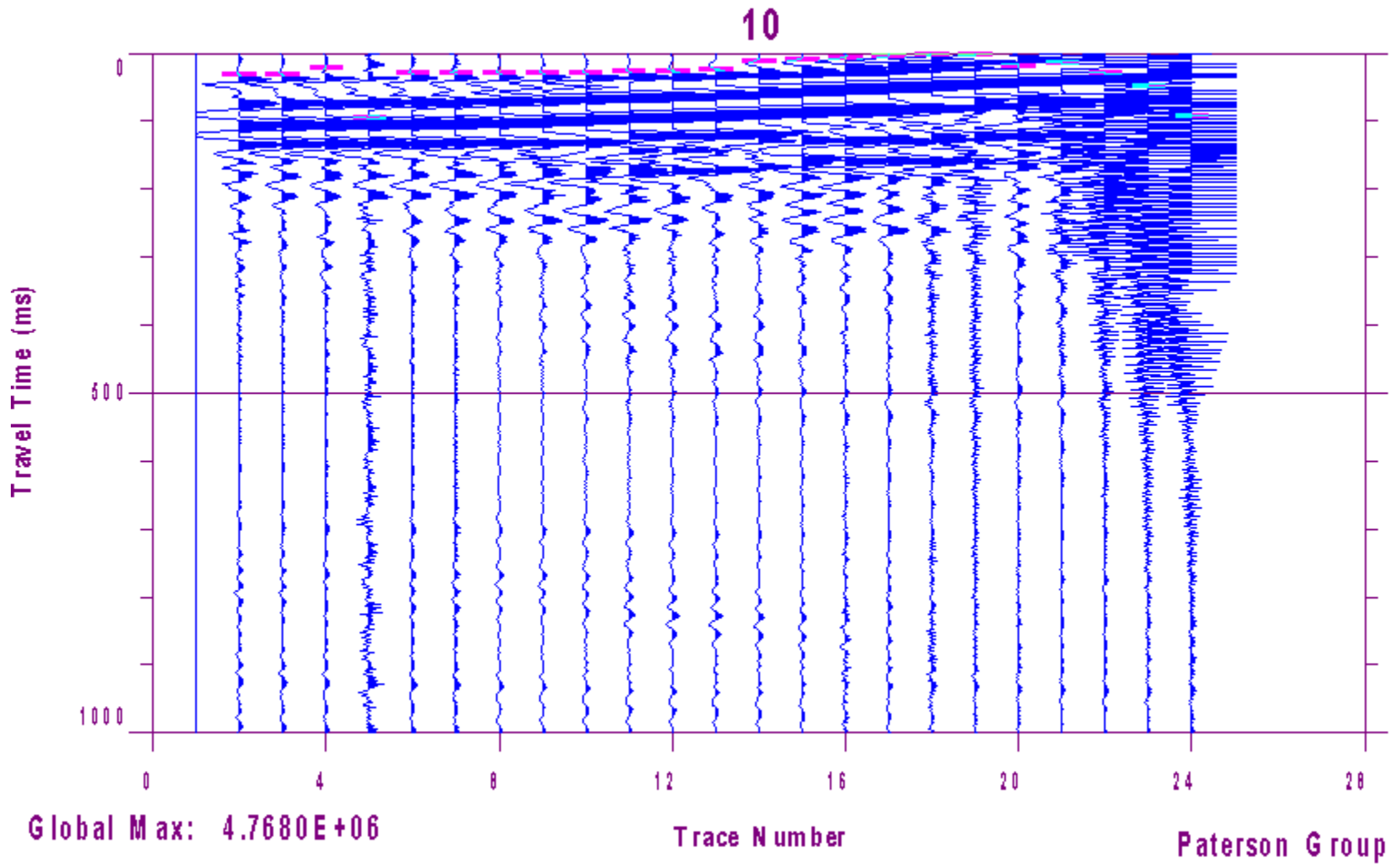


Figure 2 – Shear Wave Velocity Profile at Shot Location 24 m

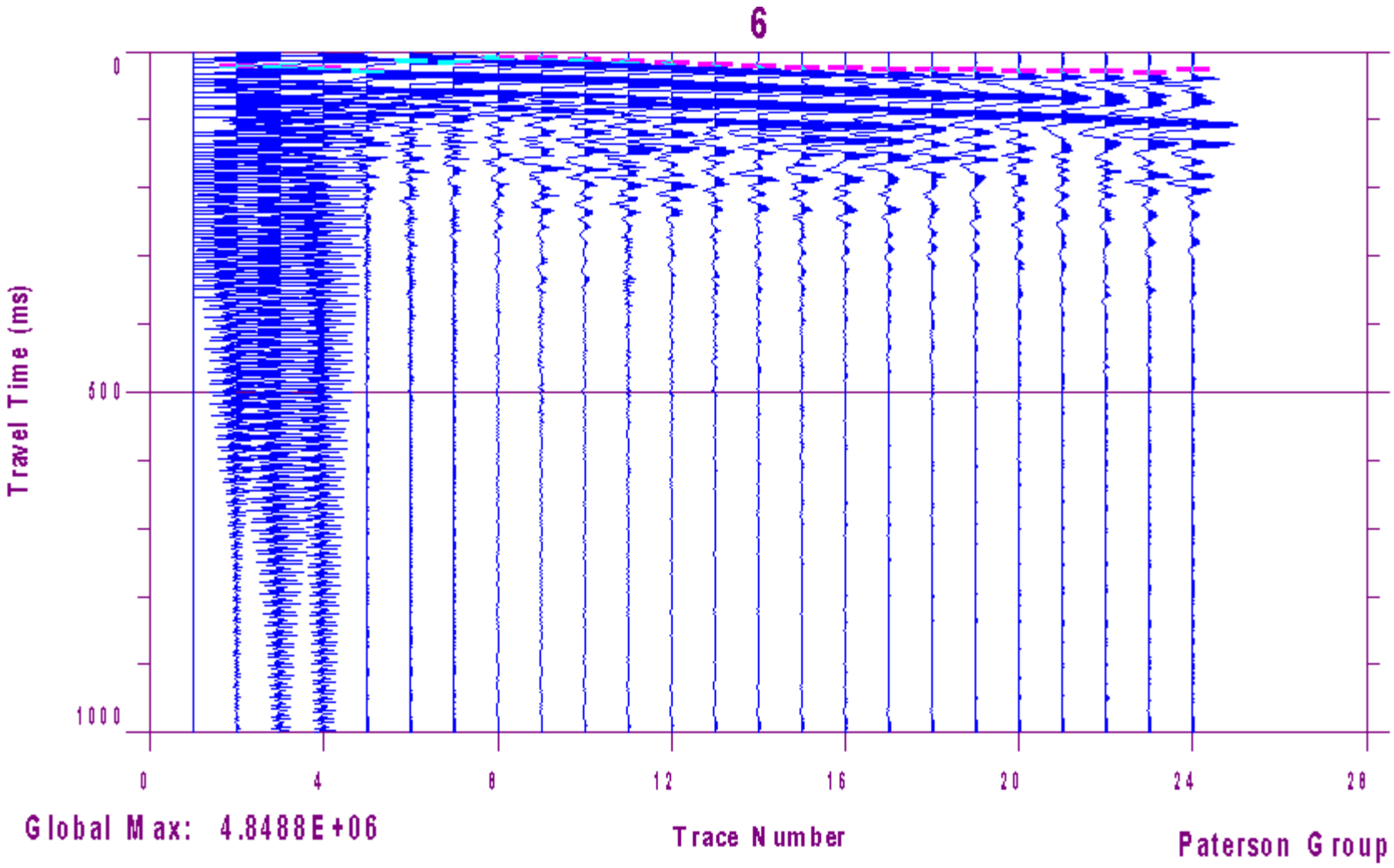
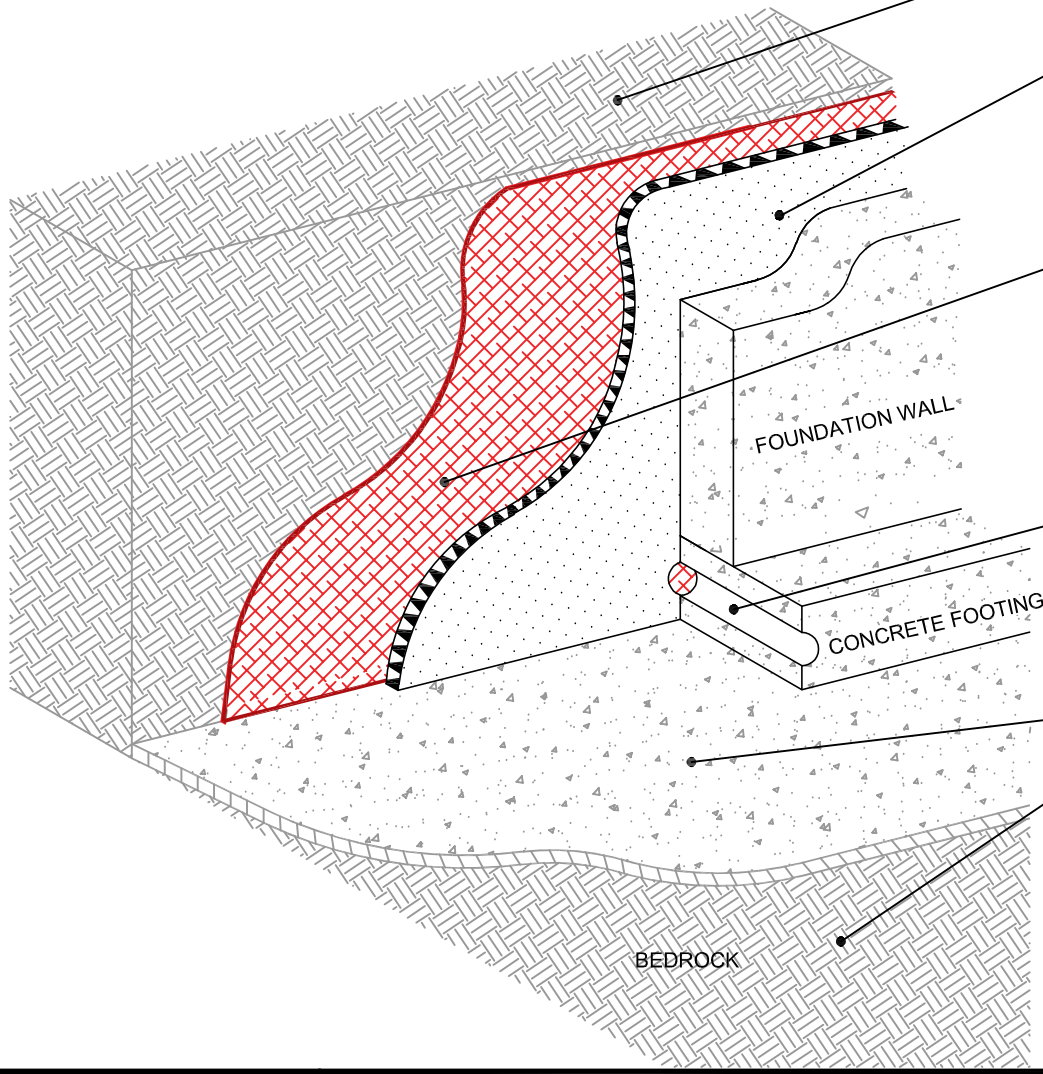


Figure 3 – Shear Wave Velocity Profile at Shot Location -1 m



SMOOTH AND FLAT BEDROCK SURFACE ADEQUATELY PREPARED FOR THE PLACEMENT OF THE WATERPROOFING MEMBRANE

COMPOSITE FOUNDATION DRAINAGE MEMBRANE (SUCH AS DELTA DRAIN 6000, MIRADRAIN G100N OR EQUIVALENT). INSTALL IN HORIZONTAL LIFTS WITH MINIMUM 150mm HORIZONTAL AND VERTICAL OVERLAP IN SHINGLE FASHION WITH GEOTEXTILE FACING AWAY FROM THE APPLICATOR. MECHANICALLY SECURE VERTICAL AND HORIZONTAL JOINTS WITH BLUESKIN WP200 AND BLUESKIN PRIMER OR EQUIVALENT.

WATERPROOFING MEMBRANE WILL CONSIST OF 150miL GRANULAR BENTONITE SURFACING LAMINATED TO 20miL THICK HDPE MEMBRANE SUCH AS TREMCO PARASEAL OR EQUIVALENT. TREMCO PARASEAL TO BE INSTALLED IN HORIZONTAL LIFTS TO MANUFACTURERS SPECIFICATIONS IN SHINGLE FASHION WITH THE HDPE SIDE FACING APPLICATOR TO AN ADEQUATELY PREPARED SUBSTRATE SURFACE. WATERPROOFING MEMBRANE TO EXTEND FROM 3m BELOW GRADE TO UNDERSIDE OF FOOTING

150mm DIAMETER SOLID PVC SLEEVE PLACED THROUGH THE FOOTING AT APPROXIMATELY 3m SPACING AROUND THE EXTERIOR PERIMETER OF THE STRUCTURE. THE SLEEVES SHOULD BE MECHANICALLY CONNECTED TO THE COMPOSITE FOUNDATION DRAINAGE MEMBRANE AND THE 150mm DIAMETER INTERIOR SUBFLOOR DRAINAGE SYSTEM GRAVITY CONNECTED TO THE SUMP PIT.

150mm THICK, 15 MPa CONCRETE MUD SLAB

CLEAN SURFACE SOUNDED BEDROCK APPROVED BY THE GEAOTECHNICAL CONSULTANT

IT IS RECOMMENDED THAT PERIODIC INSPECTIONS BE COMPLETED BY THE GEOTECHNICAL CONSULTANT AT THE TIME OF CONSTRUCTION DURING THE INSTALLATION OF THE WATER RETARDATION SYSTEM .

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344
www.patersongroup.ca

WESTBORO POINT DEVELOPMENTS LTD.

PROPOSED MULTI-STOREY BUILDING
2070 SCOTT STREET

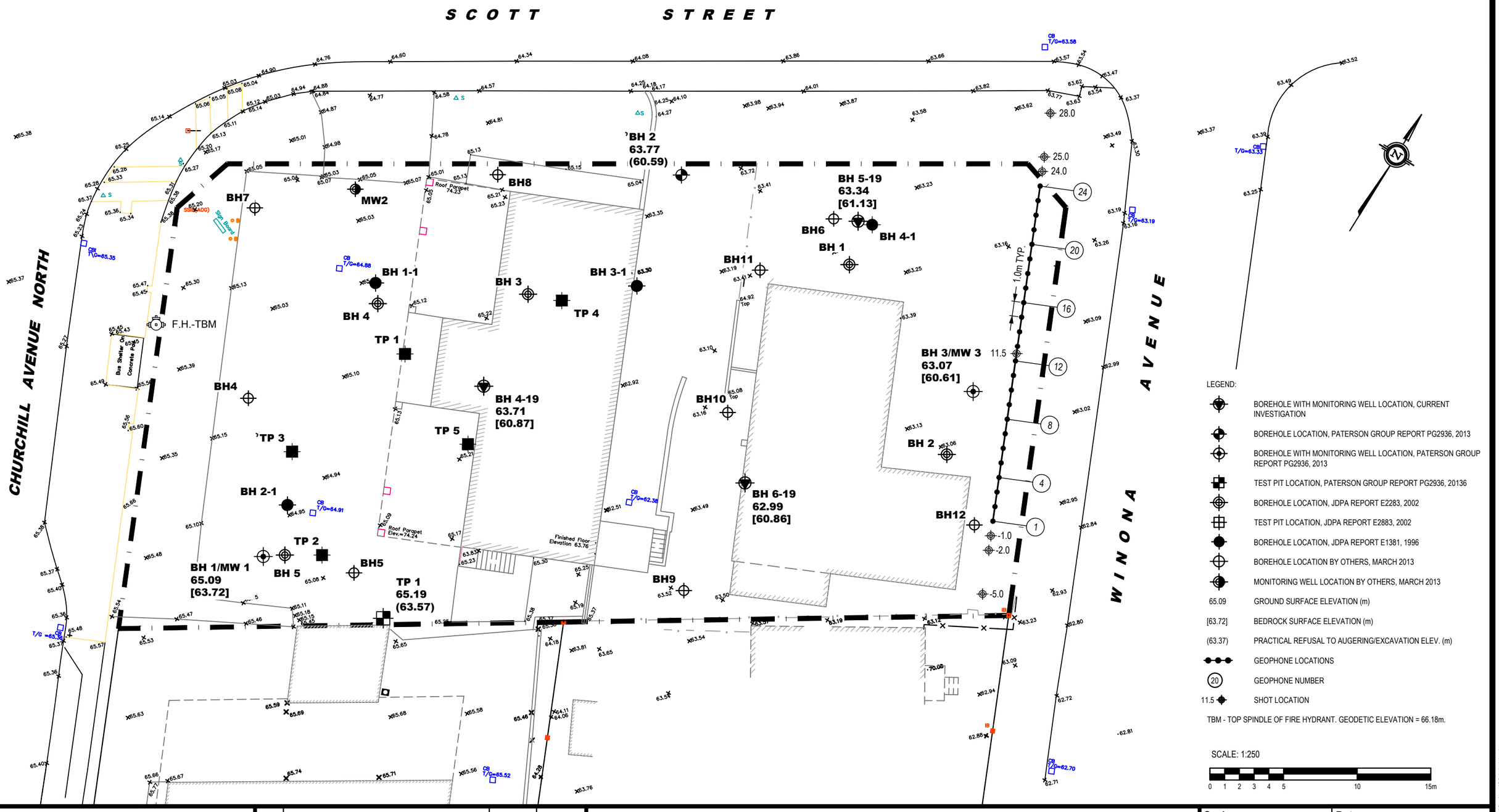
OTTAWA, ONTARIO

Title:

GROUNDWATER SUPPRESSION SYSTEM

Scale: N.T.S.	**Date:** 05/2019
Drawn by: RCG	**Report No.:** PG4935-1
Checked by: RG	**Drawing No.:** FIG. 4
Approved by: CDS	**Revision No.:**

p:\autocad drawings\geotechnical\pg49xx\pg4935 gw suppresion system.dwg



LEGEND:

- BOREHOLE WITH MONITORING WELL LOCATION, CURRENT INVESTIGATION
- BOREHOLE LOCATION, PATERSON GROUP REPORT PG2936, 2013
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PG2936, 2013
- TEST PIT LOCATION, PATERSON GROUP REPORT PG2936, 20136
- BOREHOLE LOCATION, JDPA REPORT E2283, 2002
- TEST PIT LOCATION, JDPA REPORT E2883, 2002
- BOREHOLE LOCATION, JDPA REPORT E1381, 1996
- BOREHOLE LOCATION BY OTHERS, MARCH 2013
- MONITORING WELL LOCATION BY OTHERS, MARCH 2013
- 65.09 GROUND SURFACE ELEVATION (m)
- [63.72] BEDROCK SURFACE ELEVATION (m)
- (63.37) PRACTICAL REFUSAL TO AUGERING/EXCAVATION ELEV. (m)
- GEOPHONE LOCATIONS
- (20) GEOPHONE NUMBER
- 11.5 SHOT LOCATION

TBM - TOP SPINDLE OF FIRE HYDRANT. GEODETIC ELEVATION = 66.18m.

SCALE: 1:250

0 1 2 3 4 5 10 15m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
0			

WESTBORO POINT DEVELOPMENTS LTD.

GEOTECHNICAL INVESTIGATION
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:250	Date: 06/2019
Drawn by: MPG	Report No.: PG4935-1
Checked by: SD	Dwg. No.: PG4935-1
Approved by: DJG	Revision No.: 0

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Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Phase II Environmental Site Assessment

2070 Scott Street
Ottawa, Ontario

Prepared For

Westboro Point Developments Ltd.

September 10, 2019

Report: PE4435-2

Paterson Group Inc.

Consulting Engineers
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Canada K2E 7J5

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www.patersongroup.ca

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 2070 Scott Street, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the subject property. The subsurface investigation consisted of drilling three (3) boreholes, all of which were installed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations and organic vapour measurements. Four (4) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs F_1-F_4), metals, and polycyclic aromatic hydrocarbons (PAHs). Several metals parameters in the vicinity of BH6-19 exceeded the selected MECP Table 7 standards. The impacted fill material was identified in the southeast portion of subject property, where the former automotive service garage was located. The extent of the impacted fill material is considered to be limited to the fill material present on the eastern portion of the property.

Groundwater samples recovered from monitoring wells installed in BH1/MW1, BH4-19, BH5-19, and BH6-19 were submitted for analysis of BTEX, PHCs (F_1-F_4), PAHs, and metals parameters. The concentration of benzene in the sample recovered from BH1/MW1 was marginally in excess of the selected MECP Table 7 standards. The impacted groundwater was identified in the southwest portion of the subject property only, where the tank nest associated with the former retail fuel outlet was located. The extent of the impacted groundwater is considered to be limited to a small radius within the southwest portion of the property.

Recommendations

Based on the findings of the Phase II ESA, metal and PAH impacted fill material as well as benzene impacted groundwater is present on the subject property, requiring some remedial work. It is our understanding that the subject site is to be developed with a multi-floor residential building in the near future.

It is our recommendation that an environmental site remediation program be completed in conjunction with site redevelopment. This will require the segregation of clean soil from impacted soils, the latter of which will require disposal at an approved waste disposal facility.

With regard to the impacted groundwater in BH1/MW1, it is recommended that further testing of this well water be carried out to confirm the water quality and the recent test results.

Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

It is recommended that Paterson personnel be present on-site during remediation activities to direct the excavation and segregation of impacted soil as well as to conduct confirmatory sampling as required.

1.0 INTRODUCTION

At the request of Mr. John Thomas and Westboro Point Developments Ltd., Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment of 2070 Scott Street, in the City of Ottawa, Ontario. The purpose of this Phase II ESA has been to address areas of potential environmental concern (APECs) identified on the Phase II Property, during the Phase I ESA conducted by Paterson in May 2019.

1.1 Site Description

Address:	2070 (and formerly 2074) Scott Street, Ottawa, Ontario.
Legal Description:	Part of Lots 15, 16, and 17, Plan 37; Part 4 of Registered Plan 4R-18177, in the City of Ottawa.
Property Identification Number(s):	04020-0215
Location:	The subject site is located on the south side of Scott Street between Churchill Avenue North and Winona Avenue, in the City of Ottawa, Ontario.
Latitude and Longitude:	45° 23' 41.5" N, 75° 45' 16.5" W
Configuration:	Irregular
Site Area:	1,870 m^2 (approximate)
Zoning:	TM – Traditional Mainstreet Zone
Current Use:	The subject site is currently vacant.
Services:	The subject site is in a municipally serviced area.

1.2 Property Ownership

The current registered property owner of 2070 Scott Street is Westboro Point Developments Ltd. Paterson was retained to complete this Phase II ESA by Mr. John Thomas of Westboro Point Developments Ltd. Westboro Point Developments Ltd.'s office is located at 929 Richmond Road, in Ottawa, Ontario. Mr. Thomas can be contacted by telephone at 613-596-4133.

1.3 Current and Proposed Future Uses

The subject site is currently vacant and no buildings exist on the property. It is our understanding that the subject property will be developed with a multi-storey residential building.

1.4 Applicable Site Condition Standard

The site condition standards for the 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), April 2011. The MECP selected Table 7 Standards are based on the following considerations:

- ❒ Coarse-grained soil conditions
- ❒ Shallow depth generic site conditions
- ❒ Non-potable groundwater conditions
- ❒ Residential land use

The residential standards were selected based on the future land use of the subject site. Coarse grained soil standards were chosen as a conservative approach. Grain size analysis was not completed.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The subject property is situated in a residential area with commercial businesses present along Churchill Avenue North (west of the subject site). The subject property surface consists of sand and gravel with light vegetation, as well as paved asphaltic concrete on the east and west portions of the property.

The site topography slopes sharply down towards the east, while the regional topography slopes gradually down to the northeast. The subject site is at grade with respect to Churchill Avenue North (west) and Winona Avenue (east) and is below grade with respect to Scott Street (north). Water drainage on the subject site occurs primarily via infiltration in the grassed and gravel areas, as well as sheet flow towards catch basins located on the adjacent streets.

2.2 Past Investigations

In 2013, Franz Environmental Inc. (Franz) completed a Phase II ESA on the subject site. A total of twelve (12) boreholes were placed on-site, with three (3) of the boreholes completed with bedrock groundwater monitoring wells. Boreholes BH1 to BH 6 were advanced via a truck-mounted drill and boreholes BH7 to BH12 were advanced via a Geoprobe with hollow stem augers. All boreholes were drilled to bedrock refusal at a maximum depth of 4.52 m below ground surface. BH1/MW1, MW2, and BH3/MW3 were cored to a maximum depth of 13.50 m below ground surface to intersect the ground water table. Groundwater was measured at depths ranging from 5.20 m to 7.18 m below ground surface.

Selected soil samples, submitted for laboratory analysis, identified concentrations of PAHs (benzo[a]pyrene) in BH11 and BH12 (northeast and southeast portions of the subject property) which were in excess of the selected MOE (2011) Table 7 site condition standards. The analysis also identified concentrations of metals (cadmium and lead in BH11 as well as arsenic, copper, lead, and zinc in BH12) which were in excess of the MOE (2011) Table 7 site condition standards.

Groundwater testing identified concentrations of benzene, ethylbenzene, xylenes, and petroleum hydrocarbons (PHC F_1) in BH1/MW1, (southwest portion of the property), which were in excess of the selected MOE (2011) Table 7 site condition standards. The results of the 2013 Phase II ESA investigation are presented on Drawings PE4435-4A, PE4435-4B, PE4435-4C, PE4435-5A, PE4435-5B – Analytical Testing Plans in the figures section of this report.

Paterson completed a Phase I ESA for the subject site in July 2019. The Phase I ESA identified three (3) on-site Potentially Contaminating Activities (PCAs) resulting in Areas of Potential Environmental Concern (APECs) with respect to the subject property. Historically, a former retail fuel outlet operated on the west portion of the property and a former automotive service garage operated on the east potion of the property. Additionally, during the site inspection conducted as part of the Phase I ESA, fill material of unknown quality was observed on the east portion of the subject property.

PCAs that represent APECs on the subject property, as well as the Contaminants of Potential Concern (CPCs) are presented below in Table 1.

Table 1
Areas of Potential Environmental Concern (APECs)

Area of Potential Environmental Concern	Location of APEC	Potentially Contaminating Activity (O.Reg 153/04 - Table 2)	Location of PCA	Contaminants of Potential Concern	Media Potentially Impacted
Former Retail Fuel Outlet	Eastern and Western portions of subject property	Item 28 – Gasoline and Associated Products Stored in Fixed Tanks.	On-Site	PHCs BTEX	Soil and Groundwater
Former Automotive Service Garage	Eastern portion of subject property	Item 52 – Storage, maintenance, fuelling and repair of equipment, vehicles, and materials used to maintain transportation systems.	On-Site	PHCs BTEX	Soil and/or Groundwater
Fill Material of Unknown Quality	Eastern portion of subject property	Item 30 – Importation of Fill Material of Unknown Quality.	On-Site	Metals PAHs	Soil and/or Groundwater

A Phase II ESA was recommended to address the aforementioned APECs.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation was conducted on May 15, 2019. The field program consisted of drilling three (3) boreholes, all of which were instrumented with groundwater monitoring wells. Boreholes were drilled to depths ranging from 7.67 m to 8.31 m below the existing grade.

3.2 Media Investigated

During the subsurface investigation, soil samples and groundwater samples were obtained and submitted for laboratory analysis. The rationale for sampling and analyzing this media is based on the Contaminants of Potential Concern identified in the Phase I ESA. Contaminants of concern for soil and groundwater include petroleum hydrocarbons (PHCs, Fractions F_1 - F_4), benzene, toluene, ethylbenzene, and xylenes (BTEX), metals, as well as polycyclic aromatic hydrocarbons (PAHs).

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

The Geological Survey of Canada website on the Urban Geology of the National Capital Area was consulted as part of this assessment. Based on available mapping information, the bedrock in the area of the subject site consists of interbedded limestone and dolomite of the Gull River Formation, with a glacial till plain overburden ranging from 1 to 2 m in thickness.

The site topography slopes sharply down to the east, while the regional topography slopes down towards the north, in the direction of the Ottawa River. The regional groundwater flow is anticipated to flow to the north, towards the Ottawa River.

Contaminants of Potential Concern

As per Section 6.1 of the Phase I ESA report, petroleum hydrocarbons (PHCs), and benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and metals were identified as contaminants of potential concern (CPCs) on the subject site.

Existing Buildings and Structures

No buildings or structures currently exist on the subject property.

Water Bodies and Areas of Natural Significance

There are no water bodies on the subject site or within the Phase I study area. The nearest named water body is the Ottawa River, located approximately 500 m west of the subject property. No areas of natural and scientific interest were identified on the subject property or within the Phase I study area.

Drinking Water Wells

The subject site is located within a municipally supplied potable water area. Based on the available MECP Water Well Records, no drinking water wells are expected to be present within the Phase I study area.

Neighbouring Land Use

Neighbouring land use in the Phase I study area consists mainly of residential and commercial properties. Land use is shown on Drawing PE4435-2 Surrounding Land Use Plan in the Phase I ESA report.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per Section 6.1 of the Phase I ESA report, three (3) Potentially Contaminating Activities (PCAs) identified on the subject property are considered to represent Areas of Potential Environmental Concern (APECs):

- ❑ A former retail fuel outlet, located on the western portion of the subject site.
- ❑ A former auto service garage, located on the eastern portion of the subject site.
- ❑ Existing fill material of an unknown quality, located on the eastern portion of the subject site.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of the Phase I ESA is considered to be sufficient to conclude that there are areas of potential environmental concern on the subject site which have the potential to have impacted the subject site. The presence of potentially contaminating activities 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.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted on May 15, 2019. The field program consisted of drilling three (3) boreholes, all of which were instrumented with groundwater monitoring wells. Boreholes were drilled to depths ranging from 7.67 m to 8.31 m below the existing grade.

The boreholes were placed to address the aforementioned APECs. The boreholes were drilled with a track-mounted drill rig provided by George Downing Estate Drilling. Borehole locations are shown on Drawing PE4435-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of ten (10) soil samples and fourteen (14) rock core samples were obtained from the boreholes by means of sampling from split spoon sampling, grab samples and diamond coring. The depths at which grab samples, rock coring, and split spoon samples were obtained from the boreholes are shown as "**G**", "**RC**" and "**SS**" respectively on the Soil Profile and Test Data Sheets, appended to this report.

Site soils generally consist of fill material comprised of brown silty sand, gravel, crushed stone, and concrete, underlain by limestone bedrock. The fill material encountered during the drilling program extended to depths ranging from 2.13 m to 2.84 m. The bedrock, consisting of grey limestone, was encountered at depths ranging from 2.13 m to 2.84 m

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 an RKI Eagle Gas Detector calibrated for hexane.

The soil vapours were measured by inserting the analyzer probe into the nominal headspace above the soil sample. Samples were then agitated/manipulated gently as the measurements were taken. The peak reading registered within the first 15 seconds was recorded as the vapour measurement.

The vapour readings were found to range from 10 ppm to 45 ppm. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the subject site as part of the current Phase II investigation. The monitoring wells consisted of 32 mm diameter Schedule 40 threaded PVC risers and screens. A summary of the monitoring well construction details are listed below in Table 2 and are also presented on the Soil Profile and Test Data Sheets provided in Appendix 1. Upon completion, the borehole elevations were subsequently surveyed with respect to the fire hydrant located on Churchill Avenue North, adjacent to the subject property.

Table 2
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
BH4-19	63.71	8.31	5.26 - 8.31	5.03 - 8.31	0.13 - 5.03	Flushmount
BH5-19	63.34	7.67	4.62 - 7.67	4.42 - 7.67	0.20 - 4.42	Flushmount
BH6-19	62.99	7.75	4.70 - 7.75	4.39 - 7.75	0.15 - 4.39	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater sampling was conducted at BH1/MW1, BH4-19, BH5-19, and BH6-19 on May 22, 2019 and May 29, 2019. No water quality parameters were measured in the field at that time.

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. Groundwater samples were obtained from each monitoring well, using dedicated sampling equipment. Standing water was purged from each well prior to sampling. Samples were stored in coolers to reduce analyte volatilization during transportation.

Details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan in Appendix 1.

4.7 Analytical Testing

The following soil and groundwater samples were submitted for analysis:

Table 3
Soil Samples Submitted

Sample ID	Sample Depth & Stratigraphic Unit	Parameters Analyzed					Rationale
		PHCs (F_1-F_4)	BTEX	PAHs	Metals[1]	pH	
BH4-19-AU1	0.00 - 0.61 m Fill Material			X	X		Assess soil for potential impacts on the central portion of the subject property due to overlying fill material.
BH4-19-SS4	2.29 - 2.90 m Fill Material	X	X			X	Assess soil for potential impacts on the central portion of the subject property due to the former on-site retail fuel outlet.
BH5-19-SS2	0.76 - 1.37 m Fill Material	X	X	X	X		Assess the extent of soil for potential impacts on the east portion of the subject property due to the former on-site automotive service garage and overlying fill material.
BH6-19-SS2	0.76 - 1.37 m Fill Material	X	X	X	X	X	Assess the extent of soil for potential impacts on the east portion of the subject property due to the former on-site automotive service garage and overlying fill material.

1 – Including Chromium VI and Mercury

Table 4
Groundwater Samples Submitted

Sample ID	Screened Interval & Stratigraphic Unit	Parameters Analyzed				Rationale
		PHCs (F_1-F_4)	BTEX	PAHs	Metals[1]	
BH1-GW2	7.50 - 13.50 m Bedrock	X	X			Assess potential impacts on the subject property due to the tank nest associated with the former retail fuel outlet.
BH4-19-GW1	5.26 - 8.31 m Bedrock	X	X			Assess potential impacts on the subject property due to the former retail fuel outlet.
BH5-19-GW1	4.62 - 7.67 m Bedrock	X	X	X	X	Assess potential impacts on the subject property due to the former automotive service garage and overlying fill material.
BH6-19-GW1	4.70 - 7.75 m Bedrock	X	X	X	X	Assess potential impacts on the subject property due to the former automotive service garage and overlying fill material.

1 – Including Chromium VI and Mercury

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). Paracel is accredited and certified by SCC/CALA for specific tests registered with the association.

4.8 Residue Management

All purge water and fluids from equipment cleaning were retained on-site.

4.9 Elevation Surveying

Borehole elevations were surveyed with respect to the top spindle of the fire hydrant located on Churchill Avenue North, adjacent to the subject property. The top spindle of the fire hydrant is known to have a geodetic elevation of approximately 66.18 m above sea level.

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

Site soils generally consist of brown silty sand and gravel fill material, underlain by grey limestone bedrock. The groundwater was encountered within the bedrock unit at depths ranging from approximately 6.14 m to 7.72 m below the existing grade. 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 during the groundwater sampling event on May 22, 2019 using an electronic water level meter. 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
BH1/MW1	65.04 m	7.72 m	57.32 m	May 22, 2019
BH2	-	7.50 m	-	May 22, 2019
BH4-GW1	63.71 m	7.10 m	56.61 m	May 22, 2019
BH5-GW1	63.34 m	6.14 m	57.20 m	May 22, 2019
BH6-GW1	62.99 m	5.82 m	57.17 m	May 22, 2019

Based on the water levels and configuration of the borehole locations on the subject site, it was not possible to triangulate the groundwater direction and a hydraulic gradient. The groundwater direction, however, is assumed to flow in a northerly direction.

5.3 Fine/Coarse Soil Texture

No grain size analysis was completed for the subject site. Coarse grained soil standards were chosen as a conservative approach.

5.4 Field Screening

Field screening of the soil samples collected during drilling resulted in vapour readings ranging from 10 ppm to 45 ppm. Some minor demolition debris material was identified in the soil samples recovered from BH5 and BH6 however no significant indications of potential environmental concerns were identified in the soil samples. The 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

Four (4) soil samples were submitted for analysis of BTEX and PHCs (F_1-F_4), PAHs, metals, and pH levels. The results of the analytical testing are presented below in Tables 6, 7, 8 and 9. The laboratory certificate of analysis is provided in Appendix 1.

Table 6
Analytical Test Results – Soil – BTEX and PHCs (F_1-F_4)

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MECP Table 7 Residential Standards (µg/g)
		May 15, 2019			
		BH4-19-SS4	BH5-19-SS2	BH6-19-SS2	
Benzene	0.02	nd	nd	nd	0.21
Ethylbenzene	0.05	nd	nd	nd	2
Toluene	0.05	nd	nd	nd	2.3
Xylenes (Total)	0.05	nd	nd	nd	3.1
PHC F_1	7	nd	nd	nd	55
PHC F_2	4	nd	nd	7	98
PHC F_3	8	nd	36	110	300
PHC F_4	6	nd	54	58	2,800

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All BTEX and PHC concentrations are in compliance with the selected MECP Table 7 standards.

Table 7
Analytical Test Results – Soil – PAHs

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MECP Table 7 Residential Standards (µg/g)
		May 15, 2019			
		BH4-19-AU1	BH5-19-SS2	BH6-19-SS2	
Acenaphthene	0.02	nd	nd	0.04	7.9
Acenaphthylene	0.02	nd	0.05	0.03	0.15
Anthracene	0.02	nd	0.03	0.06	0.67
Benzo[a]anthracene	0.02	0.02	0.08	0.10	0.5
Benzo[a]pyrene	0.02	nd	0.09	0.08	0.3
Benzo[b]fluoranthene	0.02	0.02	0.08	0.14	0.78
Benzo[g,h,i]perylene	0.02	nd	0.06	0.06	6.6
Benzo[k]fluoranthene	0.02	nd	0.04	0.07	0.78
Chrysene	0.02	0.02	0.09	0.14	7
Dibenzo[a,h]anthracene	0.02	nd	nd	nd	0.1
Fluoranthene	0.02	0.04	0.14	0.25	0.69
Fluorene	0.02	nd	nd	0.02	62
Indeno[1,2,3-cd]pyrene	0.02	nd	0.06	0.05	0.38
Methylnaphthalene(1,2)	0.04	nd	nd	0.08	0.99
Naphthalene	0.01	nd	nd	0.03	0.6
Phenanthrene	0.02	0.02	0.04	0.24	6.2
Pyrene	0.02	0.04	0.12	0.21	78

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All PAH concentrations are in compliance with the selected MECP Table 7 standards.

Table 8
Analytical Test Results – Soil – Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g) May 15, 2019			MECP Table 7 Residential Standards (µg/g)
		BH4-19-AU1	BH5-19-SS2	BH6-19-SS2	
Antimony	1.0	nd	nd	**9.1**	7.5
Arsenic	1.0	2.6	3.3	14.2	18
Barium	1.0	67.2	132	218	390
Beryllium	0.5	nd	nd	nd	4
Boron	5.0	9.9	nd	26.5	120
Cadmium	0.5	nd	nd	**1.5**	1.2
Chromium	5.0	14.8	55.8	**245**	160
Chromium (VI)	0.2	nd	nd	nd	8
Cobalt	1.0	6.8	11.0	11.7	22
Copper	5.0	13.9	25.7	**264**	140
Lead	1.0	11.3	6.3	**472**	120
Mercury	0.1	nd	nd	0.2	0.27
Molybdenum	1.0	nd	nd	**11.3**	6.9
Nickel	5.0	12.0	29.5	**121**	100
Selenium	1.0	nd	nd	nd	2.4
Silver	0.3	nd	nd	nd	20
Thallium	1.0	nd	nd	nd	1
Uranium	1.0	nd	nd	nd	23
Vanadium	10.0	19.3	57.6	48.6	86
Zinc	20.0	25.7	59.0	**363**	340

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

The concentrations of antimony, cadmium, chromium, copper, lead, molybdenum, nickel, and zinc in soil sample BH6-19-SS2 were in excess of the selected MECP Table 7 standards.

Table 9
Analytical Test Results – Soil – pH Levels

Parameter	MDL	Soil Samples May 15, 2019		MECP Table 7 Residential Standards (µg/g)
		BH4-19-SS4	BH6-19-SS2	
pH Level	0.05 pH Units	7.80	8.15	5.00 – 11.00

Notes:
- MDL – Method Detection Limit

The pH levels of the soil samples analyzed were in compliance with the selected MECP Table 7 standards.

Table 10
Maximum Concentrations - Soil

Parameter	Maximum Concentration	Sample ID	Depth Interval (m BGS)
Acenaphthene	0.04	BH6-19-SS2	0.76 - 1.37
Acenaphthylene	0.05	BH5-19-SS2	0.76 - 1.37
Anthracene	0.06	BH6-19-SS2	0.76 - 1.37
Benzo[a]anthracene	0.10	BH6-19-SS2	0.76 - 1.37
Benzo[a]pyrene	0.09	BH5-19-SS2	0.76 - 1.37
Benzo[b]fluoranthene	0.14	BH6-19-SS2	0.76 - 1.37
Benzo[g,h,i]perylene	0.06	BH5-19-SS2 / BH6-19-SS2	0.76 - 1.37 / 0.76 - 1.37
Benzo[k]fluoranthene	0.07	BH6-19-SS2	0.76 - 1.37
Chrysene	0.14	BH6-19-SS2	0.76 - 1.37
Fluoranthene	0.25	BH6-19-SS2	0.76 - 1.37
Fluorene	0.02	BH6-19-SS2	0.76 - 1.37
Indeno[1,2,3-cd]pyrene	0.06	BH5-19-SS2	0.76 - 1.37
Methylnaphthalene(1,2)	0.08	BH6-19-SS2	0.76 - 1.37
Naphthalene	0.03	BH6-19-SS2	0.76 - 1.37
Phenanthrene	0.24	BH6-19-SS2	0.76 - 1.37
Pyrene	0.21	BH6-19-SS2	0.76 - 1.37
Antimony	**9.1**	BH6-19-SS2	0.76 - 1.37
Arsenic	14.2	BH6-19-SS2	0.76 - 1.37
Barium	218	BH6-19-SS2	0.76 - 1.37
Boron	26.5	BH6-19-SS2	0.76 - 1.37
Cadmium	**1.5**	BH6-19-SS2	0.76 - 1.37
Chromium	**245**	BH6-19-SS2	0.76 - 1.37
Cobalt	11.7	BH6-19-SS2	0.76 - 1.37
Copper	**264**	BH6-19-SS2	0.76 - 1.37
Lead	**472**	BH6-19-SS2	0.76 - 1.37
Mercury	0.2	BH6-19-SS2	0.76 - 1.37
Molybdenum	**11.3**	BH6-19-SS2	0.76 - 1.37
Nickel	**121**	BH6-19-SS2	0.76 - 1.37
Vanadium	57.6	BH5-19-SS2	0.76 - 1.37
Zinc	**363**	BH6-19-SS2	0.76 - 1.37
PHCs F_2	7	BH6-19-SS2	0.76 - 1.37
PHCs F_3	110	BH6-19-SS2	0.76 - 1.37
PHCs F_4	58	BH6-19-SS2	0.76 - 1.37
pH Level	8.15	BH6-19-SS2	0.76 - 1.37

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All other parameter concentrations analyzed were below the laboratory detection limits. The laboratory certificates of analysis are provided in Appendix 1.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH1/MW1, BH4-19, BH5-19, and BH6-19 were submitted for laboratory analysis of BTEX and PHCs (F_1-F_4), PAHs, and metals. The groundwater samples were obtained from the screened intervals noted on Table 2. The results of the analytical testing are presented below in Tables 11, 12, and 13. The laboratory certificates of analysis are provided in Appendix 1.

Table 11
Analytical Test Results – Groundwater – BTEX and PHCs (F_1-F_4)

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)				MECP Table 7 Residential Standards (µg/L)
		May 22, 2019			May 29, 2019	
		BH1-GW2	BH5-19-GW1	BH6-19-GW1	BH4-19-GW1	
Benzene	0.5	**4.1**	nd	nd	nd	0.5
Ethylbenzene	0.5	5.0	nd	nd	nd	54
Toluene	0.5	1.4	nd	nd	nd	320
Xylenes (Total)	0.5	1.9	nd	nd	nd	72
PHC F1	25	308	nd	nd	nd	420
PHC F2	100	nd	nd	nd	nd	150
PHC F3	100	nd	nd	nd	nd	500
PHC F4	100	nd	nd	nd	nd	500

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

The concentration of benzene in the sample recovered form BH1 was in excess of the selected MECP Table 7 standards.

Table 12
Analytical Test Results – Groundwater – PAHs

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)		MECP Table 7 Residential Standards (µg/L)
		May 22, 2019		
		BH5-19-GW1	BH6-19-GW1	
Acenaphthene	0.05	nd	nd	17
Acenaphthylene	0.05	nd	nd	1
Anthracene	0.01	nd	nd	1
Benzo[a]anthracene	0.01	nd	nd	1.8
Benzo[a]pyrene	0.01	nd	nd	0.81
Benzo[b]fluoranthene	0.05	nd	nd	0.75
Benzo[g,h,i]perylene	0.05	nd	nd	0.2
Benzo[k]fluoranthene	0.05	nd	nd	0.4
Chrysene	0.05	nd	nd	0.7
Dibenzo[a,h]anthracene	0.05	nd	nd	0.4
Fluoranthene	0.01	nd	nd	44
Fluorene	0.05	nd	nd	290
Indeno[1,2,3-cd]pyrene	0.05	nd	nd	0.2
Methylnaphthalene(1,2)	0.10	nd	nd	1,500
Naphthalene	0.05	nd	nd	7
Phenanthrene	0.05	nd	nd	380
Pyrene	0.01	nd	nd	5.7

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All PAH concentrations are in compliance with the selected MECP Table 7 standards.

Table 13
Analytical Test Results – Groundwater – Metals

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)		MECP Table 7 Residential Standards (µg/L)
		May 22, 2019		
		BH5-19-GW1	BH6-19-GW1	
Antimony	0.5	nd	nd	16,000
Arsenic	1	nd	nd	1,500
Barium	1	52	55	23,000
Beryllium	0.5	nd	nd	53
Boron	10	101	161	36,000
Cadmium	0.1	nd	nd	2.1
Chromium	1	nd	nd	640
Chromium (VI)	10	nd	nd	110
Cobalt	0.5	1.0	nd	52
Copper	0.5	2.0	2.1	69
Lead	0.1	0.1	nd	20
Mercury	0.1	nd	nd	0.1
Molybdenum	0.5	3.3	2.5	7,300
Nickel	1	6	3	390
Selenium	1	nd	nd	50
Silver	0.1	nd	nd	1.2
Sodium	200	826,000	188,000	1,800,000
Thallium	0.1	0.3	0.2	400
Uranium	0.1	2.7	2.9	330
Vanadium	0.5	nd	nd	200
Zinc	5	nd	8	890

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All metals concentrations are in compliance with the selected MECP Table 7 standards.

Table 14
Maximum Concentrations – Groundwater

Parameter	Maximum Concentration	Sample ID	Depth Interval (m BGS)
Barium	55	BH6-19-GW1	4.70 - 7.75
Boron	161	BH6-19-GW1	4.70 - 7.75
Cobalt	1.0	BH5-19-GW1	4.62 - 7.67
Copper	2.1	BH6-19-GW1	4.70 - 7.75
Lead	0.1	BH5-19-GW1	4.62 - 7.67
Molybdenum	3.3	BH5-19-GW1	4.62 - 7.67
Nickel	6	BH5-19-GW1	4.62 - 7.67
Sodium	826,000	BH5-19-GW1	4.62 - 7.67
Thallium	0.3	BH5-19-GW1	4.62 - 7.67
Uranium	2.9	BH6-19-GW1	4.70 - 7.75
Zinc	8	BH6-19-GW1	4.70 - 7.75
Benzene	**4.1**	BH1-GW2	7.50 - 13.50
Ethylbenzene	5.0	BH1-GW2	7.50 - 13.50
Toluene	1.4	BH1-GW2	7.50 - 13.50
Xylenes (Total)	1.9	BH1-GW2	7.50 - 13.50
PHCs F_1	308	BH1-GW2	7.50 - 13.50

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards

All other parameter concentrations analyzed were below the laboratory detection limits. The laboratory certificates of analysis are provided in Appendix 1.

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 Protocol 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, a Certificate of Analysis has been received for each sample submitted for analysis and all Certificates of Analysis are appended to this report.

As per the Sampling an Analysis Plan, a duplicate groundwater sample was obtained at BH6-19 during the May 22, 2019 sampling event and analyzed for BTEX. The relative percent different (RPD) calculations for the original and duplicate samples are provided below in Table 15.

Table 15
QA/QC Calculations – Groundwater – BTEX

Parameter	MDL (µg/L)	BH6-19-GW1	DUP 1	RPD (%)	QA/QC Result
Benzene	0.5	nd	nd	0	Meets Target
Ethylbenzene	0.5	nd	nd	0	Meets Target
Toluene	0.5	nd	nd	0	Meets Target
Xylenes (Total)	0.5	nd	nd	0	Meets Target

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL

The parameter concentrations for both the original and duplicate sample were below the laboratory detection limits, and as such, are considered acceptable. As a result, 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. 269/11 amended by the Environmental Protection Act. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activity and Areas of Potential Environmental Concern

As indicated in the Phase I ESA report and Section 2.2 of this report, the following PCAs, as per Table 2, O.Reg. 153/04 as amended by Environmental Protection Act, are considered to result in APECs on the subject property:

- *Item 28: "Gasoline and Associated Products Storage in Fixed Tanks"*
  - This PCA was identified on the subject site as a result of the former retail fuel outlet on the western portion of the property.
- *Item 30: "Importation of Fill Material of Unknown Quality"*
  - This PCA was identified on the subject site as a result of the importation of backfill material following the demolition of the former auto service garage;
- *Item 52: "Storage, maintenance, fuelling and repair of equipment, vehicles, and materials used to maintain transportation systems"*
  - this PCA was identified on the subject site as a result of the former auto service garage on the eastern portion of the property.

Other PCAs identified within the vicinity of the subject site are not considered to result in APECs, based on their separation distances as well as their down-gradient or cross-gradient locations with respect to the subject site.

Contaminants of Potential Concern

Contaminants of potential concern associated with the aforementioned PCAs include PHCs (F_1-F_4), BTEXs, PAHs, and metals in the soil and/or groundwater.

Subsurface Structures and Utilities

Underground service locates were completed prior to the subsurface investigation. Underground utilities on the subject property include hydro, telecommunication lines, water, and sewage services. The underground water and sewage pipes on the subject property are privately owned.

Physical Setting

Site Stratigraphy

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. The stratigraphy of the subject site generally consists of:

- Paved asphalt/concrete, extending to depths ranging from approximately 0.00 m to 0.10 m below grade (east and west portions of the property only);
- Fill material (brown silty sand with gravel and crushed stone), extending to depths ranging from approximately 2.10 m to 2.84 m below grade;
- Bedrock (limestone), ranging from approximately 2.13 m to 2.84 m below grade.

Hydrogeological Characteristics

Groundwater at the subject property was encountered within the limestone bedrock. This unit is interpreted to function as a local aquifer at the subject site.

Groundwater levels were measured at the subject site on May 22, 2019, with depths ranging from 5.82 m to 7.72 m below grade. Based on the water levels and configuration of the borehole locations on the subject site, it was not possible to triangulate the groundwater flow direction and a hydraulic gradient. The groundwater, however, is assumed to flow in a northerly direction.

Approximate Depth to Bedrock

Bedrock is present at approximately 2.13 m to 2.84 m below the existing grade, as determined by rock coring conducted at the subject site.

Approximate Depth to Water Table

The depth to the water table at the subject site varies between approximately 5.82 m to 7.72 m below the existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation does not apply to the subject site as there are no areas of natural significance or bodies of water located on the subject site or within 30 m of the subject site. The subject site is not considered to be environmentally sensitive.

Section 43.1 of the Regulation applies to the subject site as bedrock is located at a depth of less than 2 m below the ground surface, and thus is considered to be a Shallow Soil Property.

Fill Placement

Fill material identified during the site inspection consisted of silty sand with gravel and crushed stone. The fill material is expected to have been imported and placed on-site following the demolition of the former auto service garage on the eastern portion of the subject property.

Proposed Buildings and Other Structures

It is our understanding that the subject site is to be redeveloped with a multi-storey residential building in the future.

Existing Buildings and Structures

No buildings currently exist on the subject property.

Areas of Natural Significance and Water Bodies

No areas of natural significance or water bodies are present on or within the vicinity of the subject property. The nearest water body to the subject site is the Ottawa River, located approximately 500 m west of the subject property.

Environmental Condition

Areas Where Contaminants are Present

Based on the analytical test results, the soil (fill) is impacted metals in the area of BH6-19, BH11, and BH12 as well as with PAHs in the area of BH11 and BH12.

The groundwater within BH1/MW1 contained a benzene concentration in excess of the MECP Table 7 standards.

Analytical test results for soil and groundwater are shown on Drawings PE4435-4A, PE4435-4B, PE4435-4C, PE4435-5A, and PE4435-5B Analytical Testing Plans in the figures section of this report.

Types of Contaminants

Based on the PCAs resulting in APECs on the subject property as well as the results of the analytical testing, the contaminants of concern present on-site include metals (antimony, cadmium, chromium, copper, lead, molybdenum, nickel, and zinc) as well as PAHs (benzo[a]pyrene) in the soil. Benzene was also identified in the groundwater at one borehole location.

Contaminated Media

Based on the results of the Phase II ESA, the fill material in the vicinity of BH6-19, BH11, and BH12 is impacted with metals and PAHs and the groundwater in BH1 is impacted with benzene.

What Is Known About Areas Where Contaminants Are Present

The fill material is impacted with metals and PAHs on the eastern portion of the subject site, in the former location of the automotive service garage. The groundwater is impacted with benzene in the southwestern portion of the subject site where the former underground fuel tanks used to reside.

Distribution and Migration of Contaminants

As previously noted, metal and PAH impacted fill material was identified in the eastern portion of the subject site in the area of BH6-19, BH11, and BH12. Based on their low mobility, as well as the clean groundwater results, it is anticipated that the metal and PAH impacts are contained within the fill material.

Benzene impacted groundwater was identified in the southwestern portion of the property. Based on the very low benzene concentration in BH1/MW1 as well as the clean groundwater results in all other wells, it is not anticipated that there is any significant potential for the migration of this impacted groundwater.

Discharge of Contaminants

The metal impacted soil is considered to have resulted from the importation of fill material and/or the presence of former building demolition debris. The benzene impacted groundwater is considered to have resulted from the former retail fuel outlet.

Climatic and Meteorological Conditions

In general, climatic and meteorological conditions have the potential to affect contaminant distribution. Two (2) ways by which climatic and meteorological conditions may affect contaminant distribution include the downward leaching of contaminants by means of the infiltration of precipitation, and the migration of contaminants via groundwater levels and/or flow, which may fluctuate seasonally.

Leaching is not considered to be a concern regarding the metal and PAH impacted soil, as metals do not readily dissolve, and the groundwater has not been contaminated by metals or PAHs based on our testing.

Potential for Vapour Intrusion

Although benzene was identified in the groundwater, there are currently no structures or buildings present on the subject site. With regard to future development of the site, the groundwater will be remediated, thus removing any potential risk for vapour intrusion.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 2070 Scott Street, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the subject property. The subsurface investigation consisted of drilling three (3) boreholes, all of which were installed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations and organic vapour measurements. Four (4) soil samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs F_1-F_4), metals, and polycyclic aromatic hydrocarbons (PAHs). Several metals parameters in the vicinity of BH6-19 exceeded the selected MECP Table 7 standards. The impacted fill material was identified in the southeast portion of subject property, where the former automotive service garage was located. The extent of the impacted fill material is considered to be limited to the fill material present on the eastern portion of the property.

Groundwater samples recovered from monitoring wells installed in BH1/MW1, BH4-19, BH5-19, and BH6-19 were submitted for analysis of BTEX, PHCs (F_1-F_4), PAHs, and metals parameters. The concentration of benzene in the sample recovered from BH1/MW1 was marginally in excess of the selected MECP Table 7 standards. The impacted groundwater was identified in the southwest portion of the subject property only, where the tank nest associated with the former retail fuel outlet was located. The extent of the impacted groundwater is considered to be limited to a small radius within the southwest portion of the property.

Recommendations

Based on the findings of the Phase II ESA, metal and PAH impacted fill material as well as benzene impacted groundwater is present on the subject property, requiring some remedial work. It is our understanding that the subject site is to be developed with a multi-floor residential building in the near future.

It is our recommendation that an environmental site remediation program be completed in conjunction with site redevelopment. This will require the segregation of clean soil from impacted soils, the latter of which will require disposal at an approved waste disposal facility.

With regard to the impacted groundwater in BH1/MW1, it is recommended that further testing of this well water be carried out to confirm the water quality and the recent test results.

Prior to offsite disposal at a licenced landfill site, a leachate analysis of a representative sample of contaminated soil must be conducted in accordance with Ontario Regulation 347/558.

It is recommended that Paterson personnel be present on-site during remediation activities to direct the excavation and segregation of impacted soil as well as to conduct confirmatory sampling as required.

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 meets the requirements of 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 subject site 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 Westboro Point Developments Ltd. Notification from Westboro Point Developments Ltd. and Paterson Group will be required prior to the release of this report to any other party.

Paterson Group Inc.

Nick Sullivan, B.Sc.

Mark S. D'Arcy, P.Eng.

Report Distribution:

- Westboro Point Developments Ltd.
- Paterson Group Inc.

FIGURES

FIGURE 1 – KEY PLAN

Drawing PE4435-3 – Test Hole Location Plan

Drawing PE4435-4A – Analytical Testing Plan – Soil (BTEX, PHCs)

Drawing PE4435-4B – Analytical Testing Plan – Soil (PAHs)

Drawing PE4435-4C – Analytical Testing Plan – Soil (Metals)

Drawing PE4435-5A – Analytical Testing Plan – Groundwater (PHCs, PAHs, Metals)

Drawing PE4435-5B – Analytical Testing Plan – Groundwater (BTEX)

Drawing PE4435-6A – Cross-Section A-A' – Soil (BTEX, PHCs)

Drawing PE4435-6B – Cross-Section A-A' – Soil (PAH)

Drawing PE4435-6C – Cross-Section A-A' – Soil (Metals)

Drawing PE4435-7A – Cross Section A-A' – Groundwater (BTEX)

Drawing PE4435-7B – Cross Section A-A' – Groundwater (PHCs, PAHs, Metals)

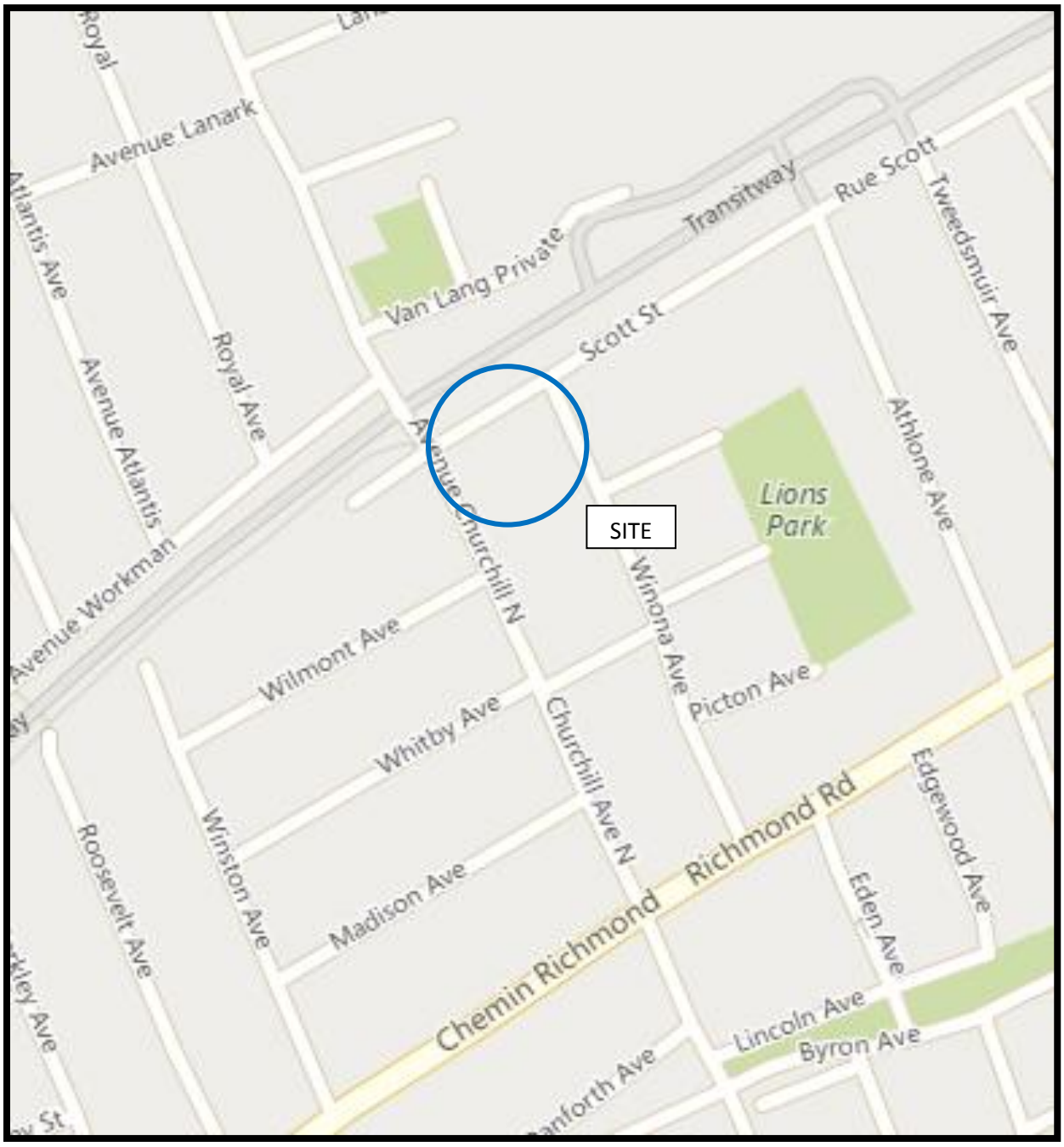

FIGURE 1

KEY PLAN

SCOTT STREET

CHURCHILL AVENUE NORTH

WINONA AVENUE

322 CHURCHILL AVENUE N.
COMMERCIAL
(RESTAURANT)

326 CHURCHILL AVE N.
RESIDENTIAL
DWELLING

330 CHURCHILL AVE N.
COMMERICAL
OFFICES

334 CHURCHILL AVE N.
COMMERICAL
OFFICES

323 WINONA AVENUE
RESIDENTIAL APARTMENT

BH7
MW2
BH8
BH 2
63.77
BH 5-19
63.34
[61.13]
(57.20)
BH6
BH 4-2
BH 1
BH11
A'
BH 1-2
BH 4
BH 3
BH 3-2
63.30
TP 4
TP 1
F.H.-BM
ASPHALT
FORMER
OFFICE
BUILDING
BH4
TP 3
BH 4-19
63.71
[60.87]
(56.61)
TP 5
BH10
FORMER AUTO
SERVICE
GARAGE
BH 3/MW 3
63.07
BH 2
BH 6-19
62.99
[60.86]
(57.17)
BH12
BH 2-2
TP 2
BH 1/MW 1
65.04
(57.32)
BH 5
BH5
TP 1
65.19
A
BH9
328 WINONA AVENUE
APARTMENT BUILDING
329 CHURCHILL AVENUE NORTH
FORMER PRINTERS
330 WINONA AVENUE
RESIDENTIAL DWELLING
LANDSCAPED WITH TREES

LEGEND:

- BOREHOLE LOCATION WITH MONITORING WELL INSTALLED (CURRENT INVESTIGATION)
- BOREHOLE LOCATION, PATERSON GROUP REPORT PG2936, 2013
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PG2936, 2013 / FRANZ ENVIRONMENTAL INC. MARCH 2013
- TEST PIT LOCATION, PATERSON GROUP REPORT PG2936, 2013
- BOREHOLE LOCATION, JDPA REPORT E2283, 2002
- TEST PIT LOCATION, JDPA REPORT E2283, 2002
- BOREHOLE LOCATION, JDPA REPORT E1381, 1996
- BOREHOLE LOCATION BY OTHERS, MARCH 2013
- MONITORING WELL LOCATION BY OTHERS, MARCH 2013

62.99 GROUND SURFACE ELEVATION (m)

(57.17) GROUND WATER SURFACE ELEVATION (m)

[60.86] BEDROCK SURFACE ELEVATION (m)

BM - FIRE HYDRANT LOCATED ON CHURCHILL AVENUE NORTH. GEODETIC ELEVATION = 66.18 (m)

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0			

WESTBORO POINT DEVELOPMENTS LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-3
Approved by: MSD	Revision No.: 0

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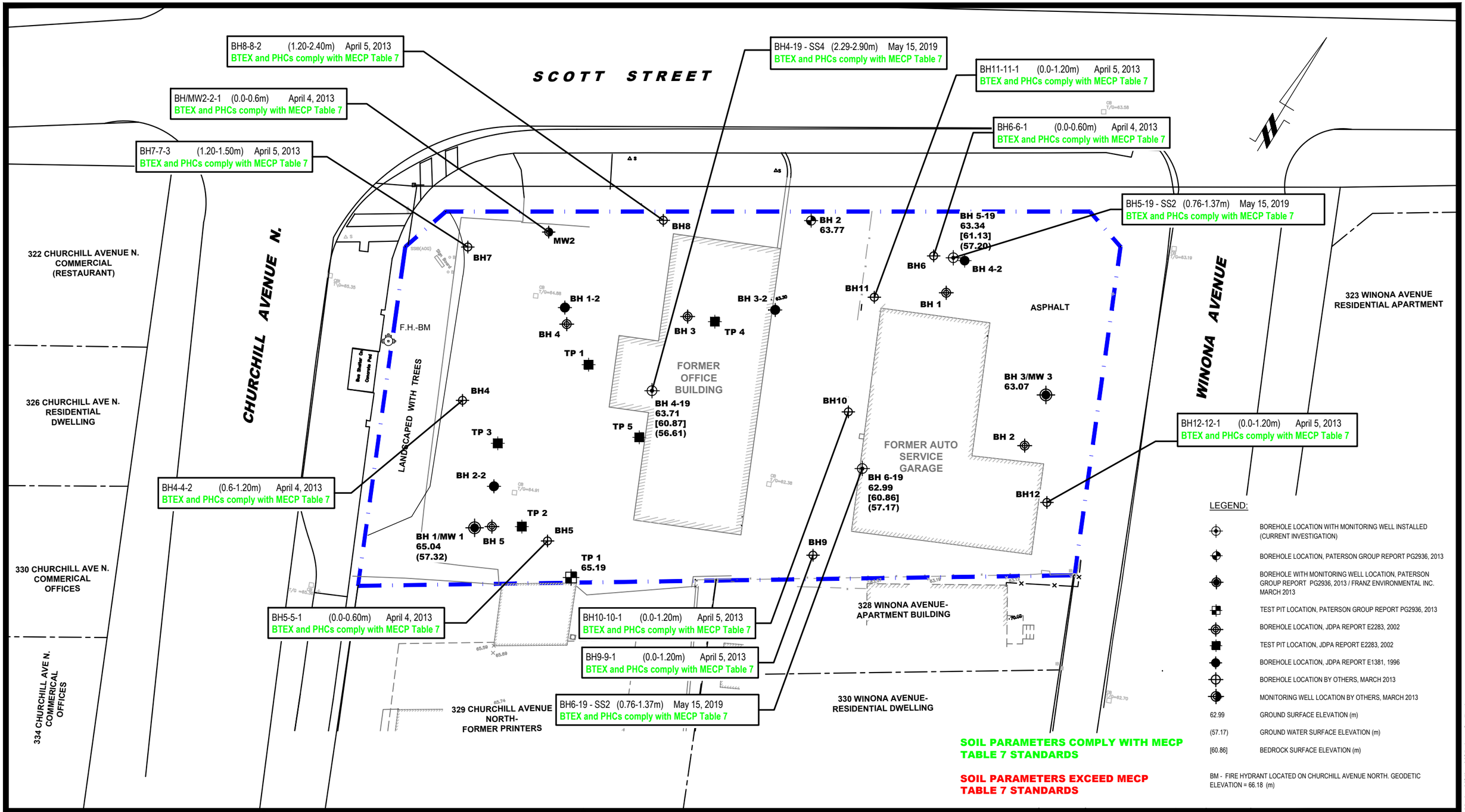

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL (BTEX, PHC)

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-4A
Approved by: MSD	Revision No.: 0

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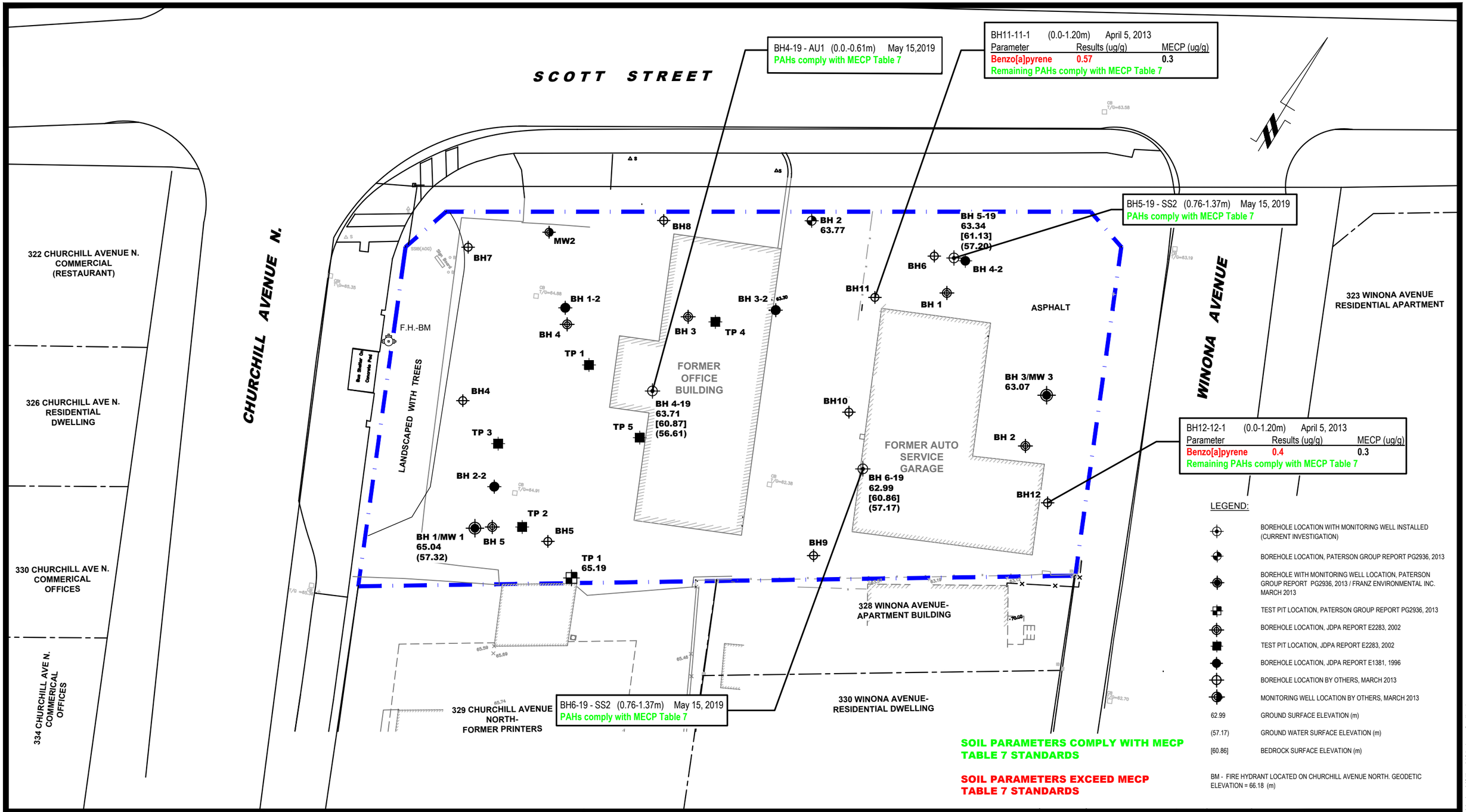

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL (PAH)

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-4B
Approved by: MSD	Revision No.: 0

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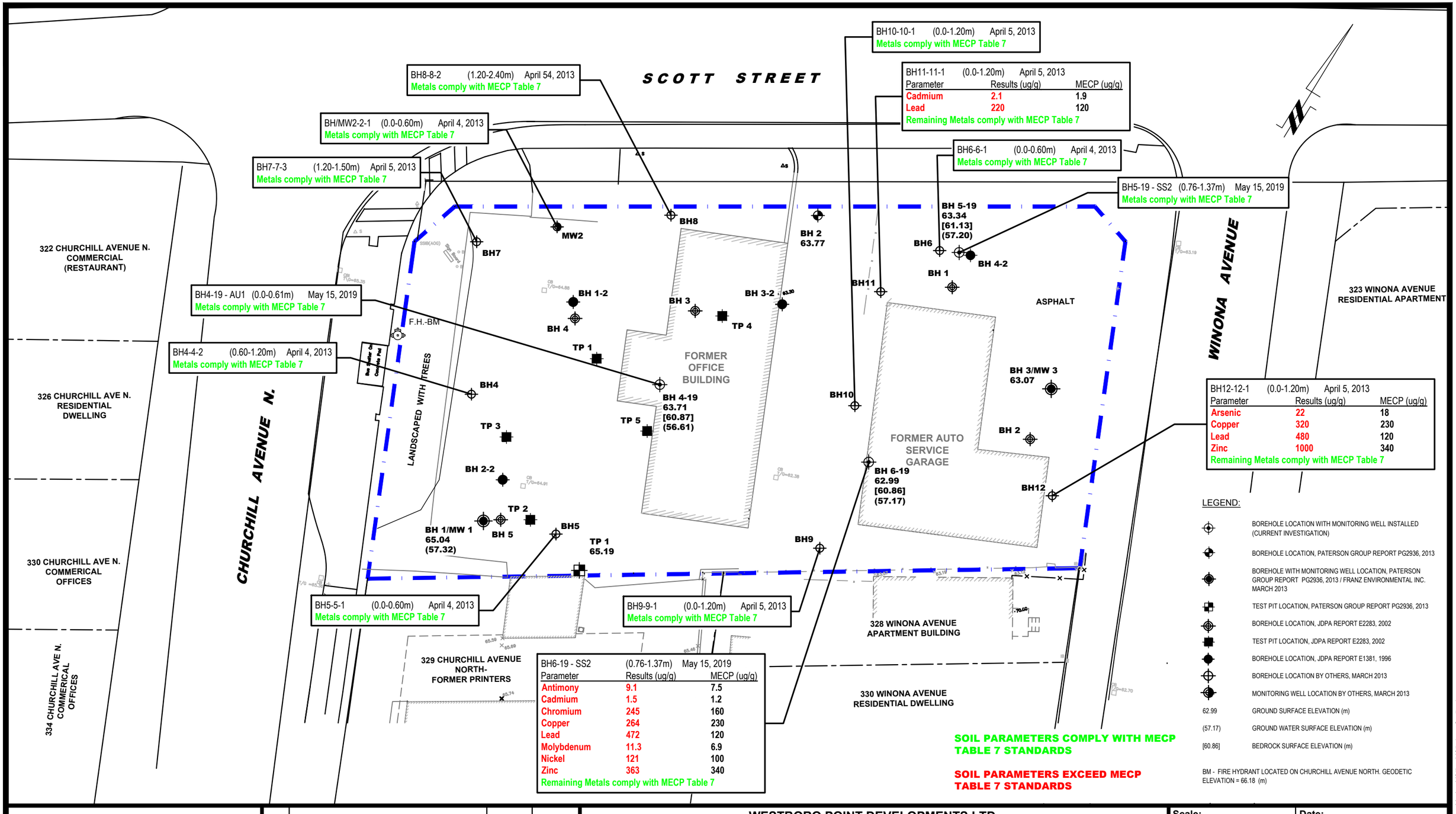

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL (METALS)

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-4C
Approved by: MSD	Revision No.: 0

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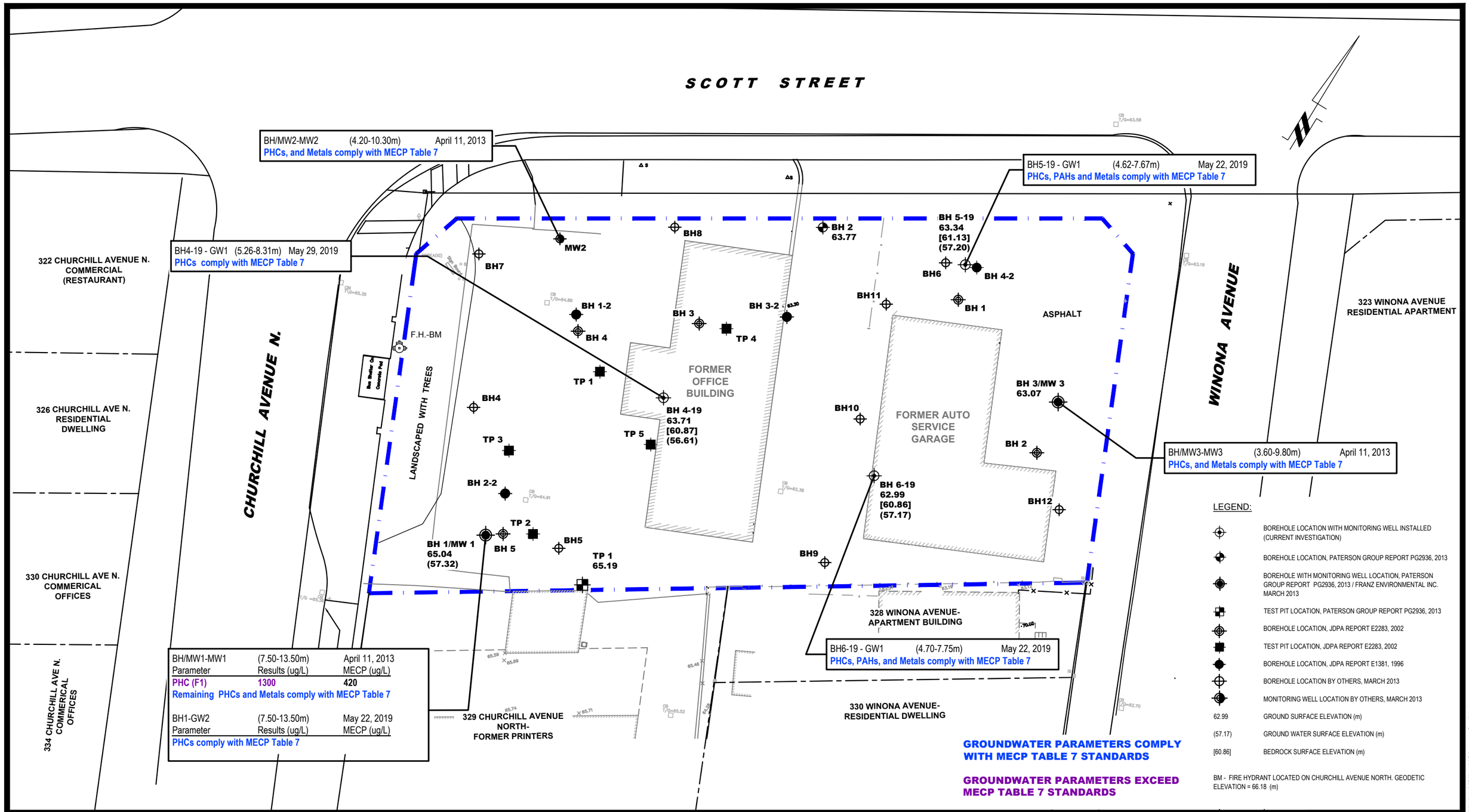

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - GROUNDWATER (PHC, PAH, METALS)

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-5A
Approved by: MSD	Revision No.: 0

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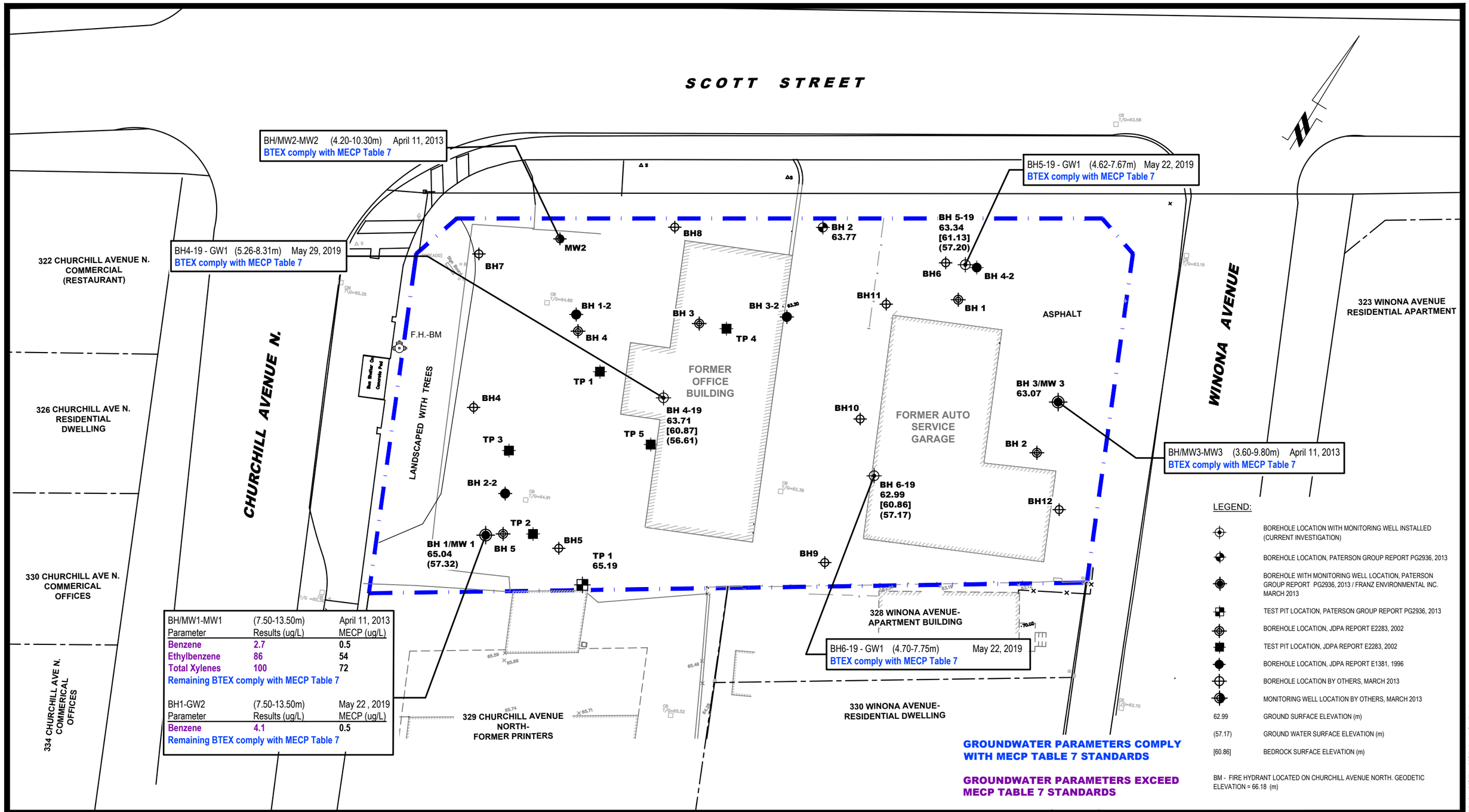

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - GROUNDWATER (BTEX)

Scale: 1:300	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-5B
Approved by: MSD	Revision No.: 0

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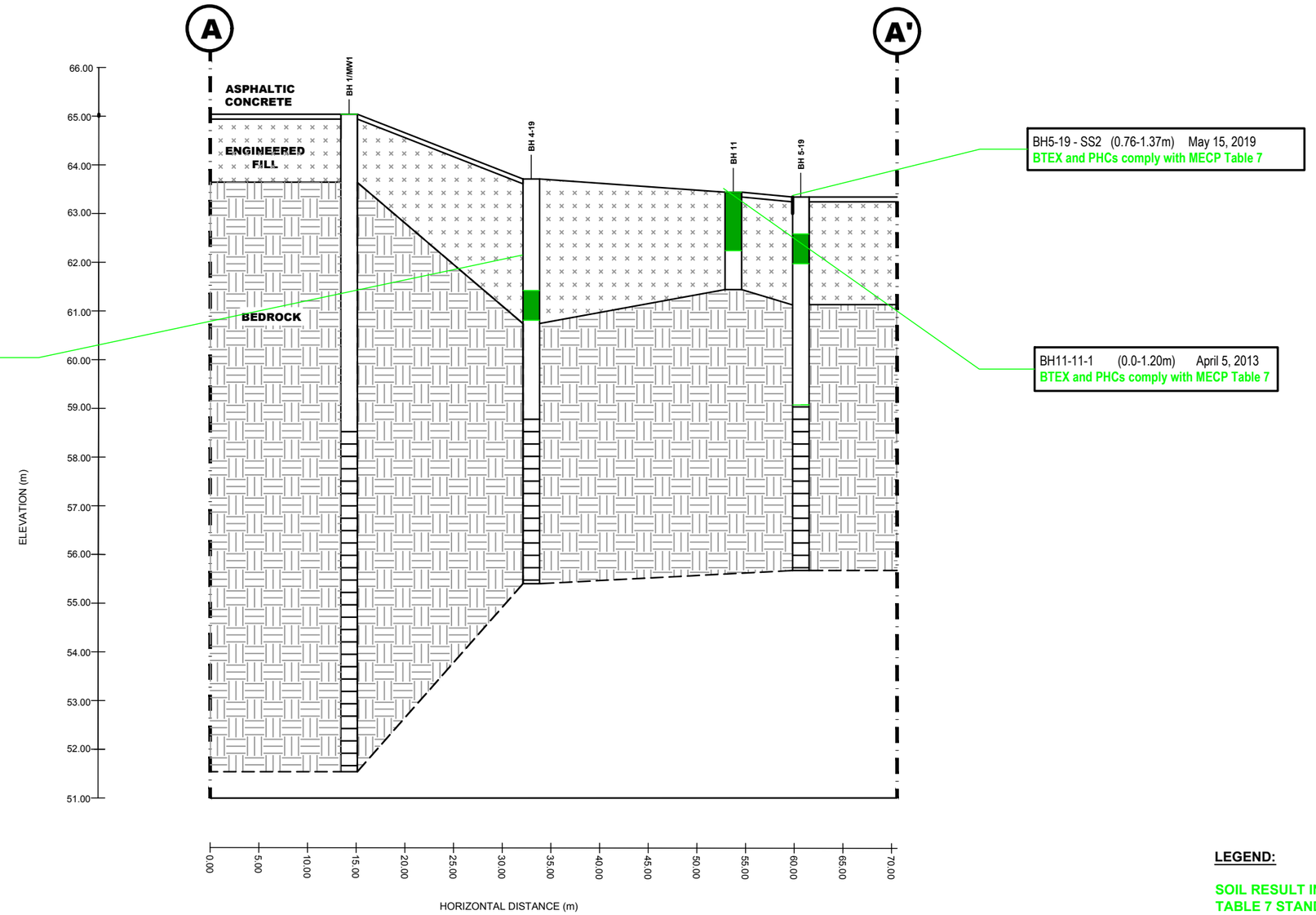

BH4-19 - SS4 (2.29-2.90m) May 15, 2019
BTEX and PHCs comply with MECP Table 7

BH5-19 - SS2 (0.76-1.37m) May 15, 2019
BTEX and PHCs comply with MECP Table 7

BH11-11-1 (0.0-1.20m) April 5, 2013
BTEX and PHCs comply with MECP Table 7

LEGEND:

SOIL RESULT IN COMPLIANCE WITH MECP TABLE 7 STANDARDS

SOIL RESULTS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A- SOIL (BTEX, PHC)

Scale: 1:500	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-6A
Approved by: MSD	Revision No.: 0

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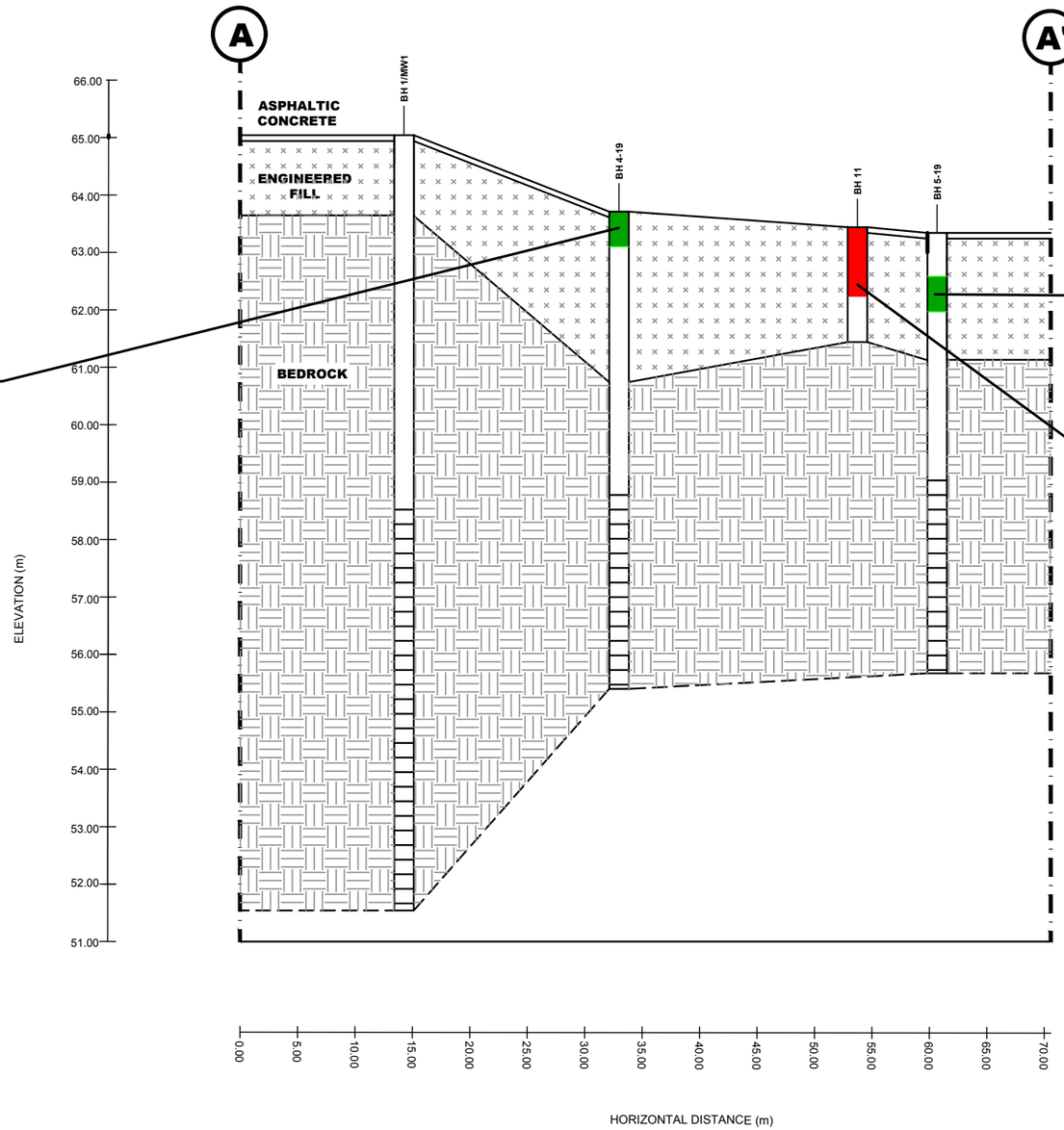

BH4-19 - AU1 (0.0.-0.61m) May 15,2019
PAHs comply with MECP Table 7

BH5-19 - SS2 (0.76-1.37m) May 15, 2019
PAHs comply with MECP Table 7

BH11-11-1 (0.0-1.20m) April 5, 2013

Parameter	Results (ug/g)	MECP (ug/g)
Benzo[a]pyrene	0.57	0.3

Remaining PAHs comply with MECP Table 7

LEGEND:

SOIL RESULT IN COMPLIANCE WITH MECP TABLE 7 STANDARDS

SOIL RESULTS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A- SOIL (PAH)

Scale: 1:500	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-6B
Approved by: MSD	Revision No.: 0

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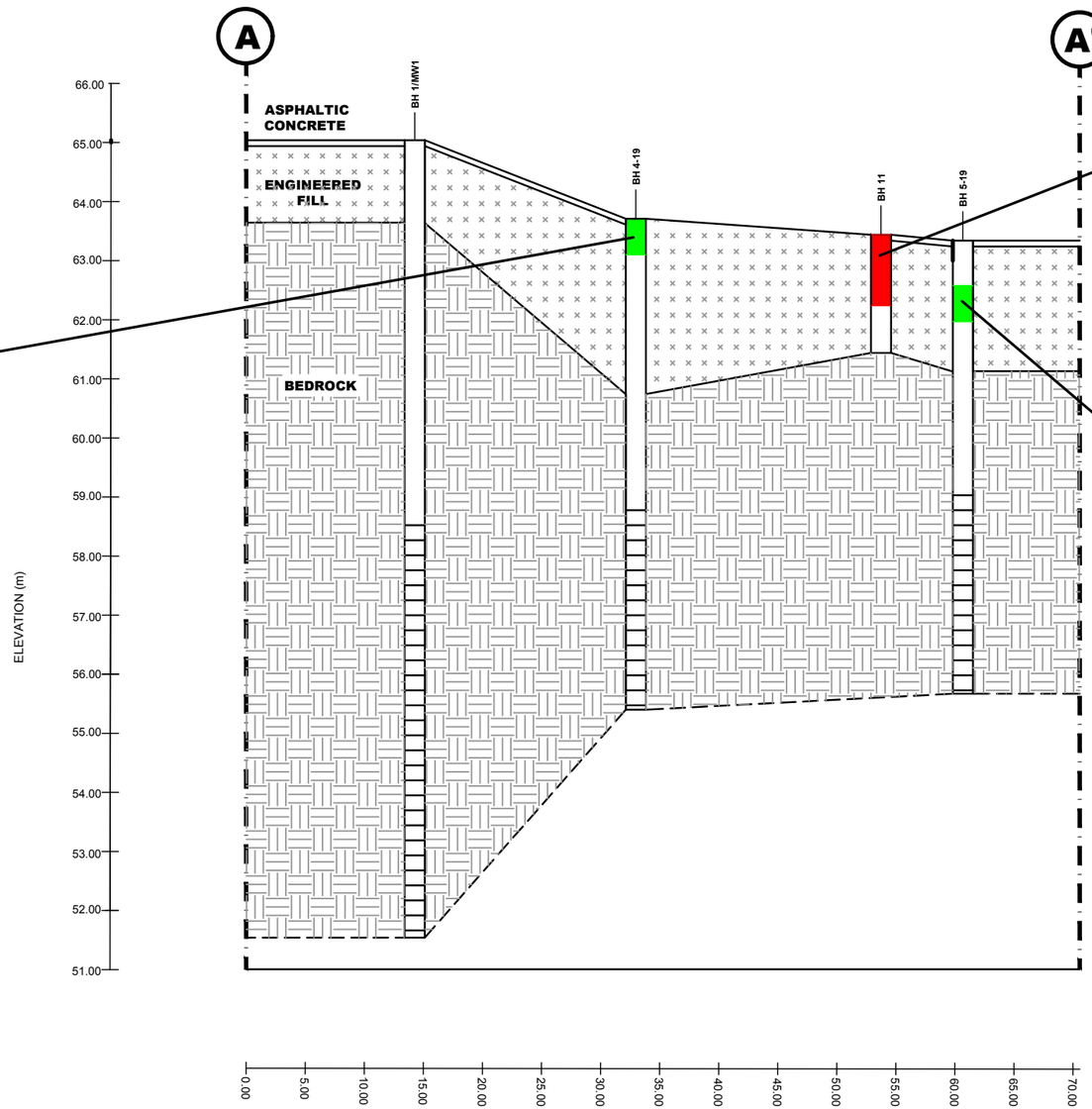

BH4-19 - AU1 (0.0-0.61m) May 15, 2019
Metals comply with MECP Table 7

BH11-11-1 (0.0-1.20m) April 5, 2013

Parameter	Results (ug/g)	MECP (ug/g)
Cadmium	2.1	1.9
Lead	220	120

Remaining Metals comply with MECP Table 7

BH5-19 - SS2 (0.76-1.37m) May 15, 2019
Metals comply with MECP Table 7

LEGEND:

SOIL RESULT IN COMPLIANCE WITH MECP TABLE 7 STANDARDS

SOIL RESULTS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A- SOIL (METALS)

Scale: 1:500	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: PE4435-6C
Approved by: MSD	Revision No.: 0

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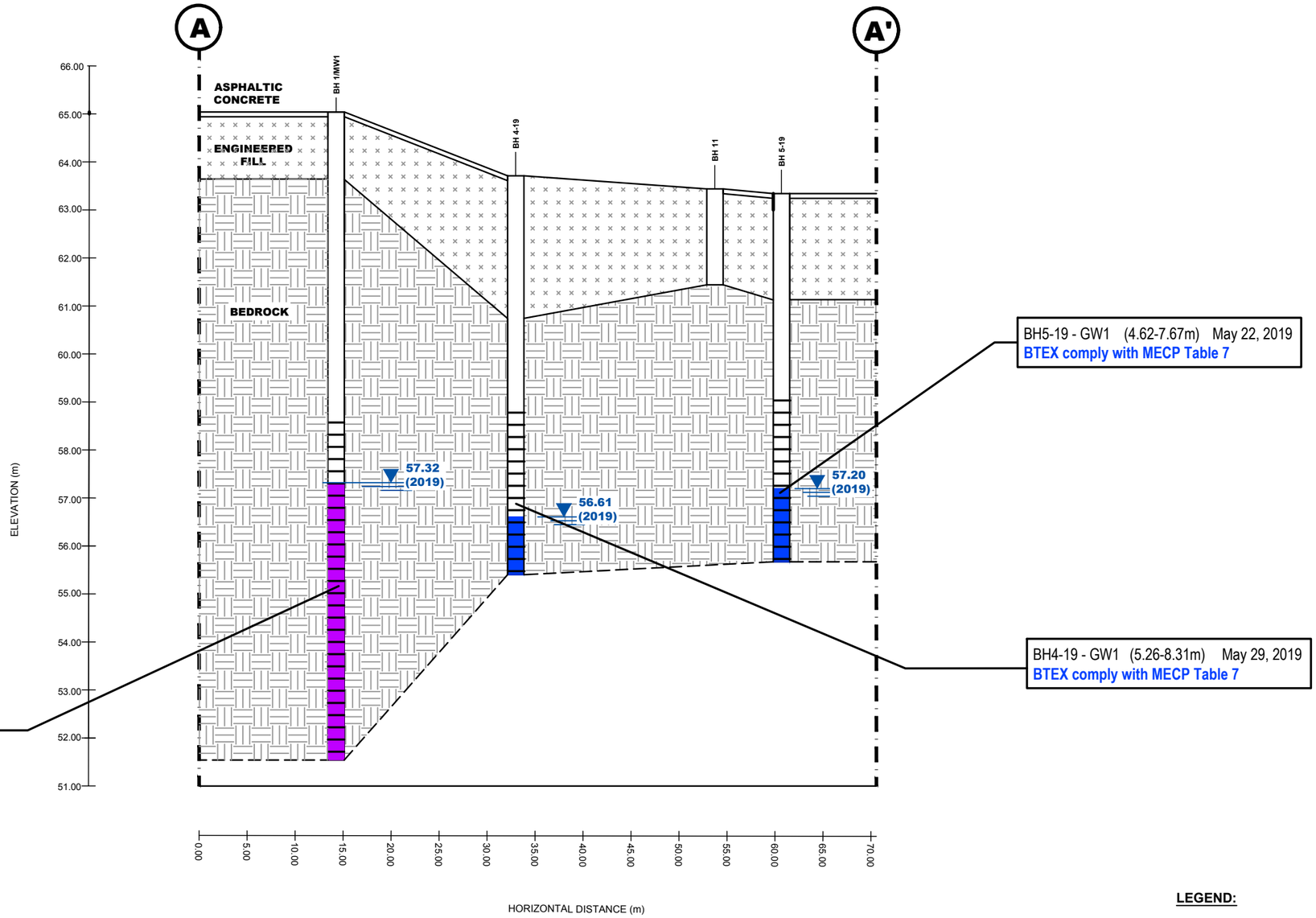

BH5-19 - GW1 (4.62-7.67m) May 22, 2019
BTEX comply with MECP Table 7

BH4-19 - GW1 (5.26-8.31m) May 29, 2019
BTEX comply with MECP Table 7

BH/MW1-MW1	(7.50-13.50m)	April 11, 2013
Parameter	Results (ug/L)	MECP (ug/L)
Benzene	2.7	0.5
Ethylbenzene	86	54
Total Xylenes	100	72

Remaining BTEX comply with MECP Table 7

BH1-GW2	(7.50-13.50m)	May 22 , 2019
Parameter	Results (ug/L)	MECP (ug/L)
Benzene	4.1	0.5

Remaining BTEX comply with MECP Table 7

LEGEND:

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS

GROUNDWATER PARAMETERS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A- GROUNDWATER (BTEX)

Scale: 1:500	**Date:** 08/2019
Drawn by: YA	**Report No.:** PE4435-2
Checked by: NS	**Dwg. No.:** PE4435-7A
Approved by: MSD	**Revision No.:** 0

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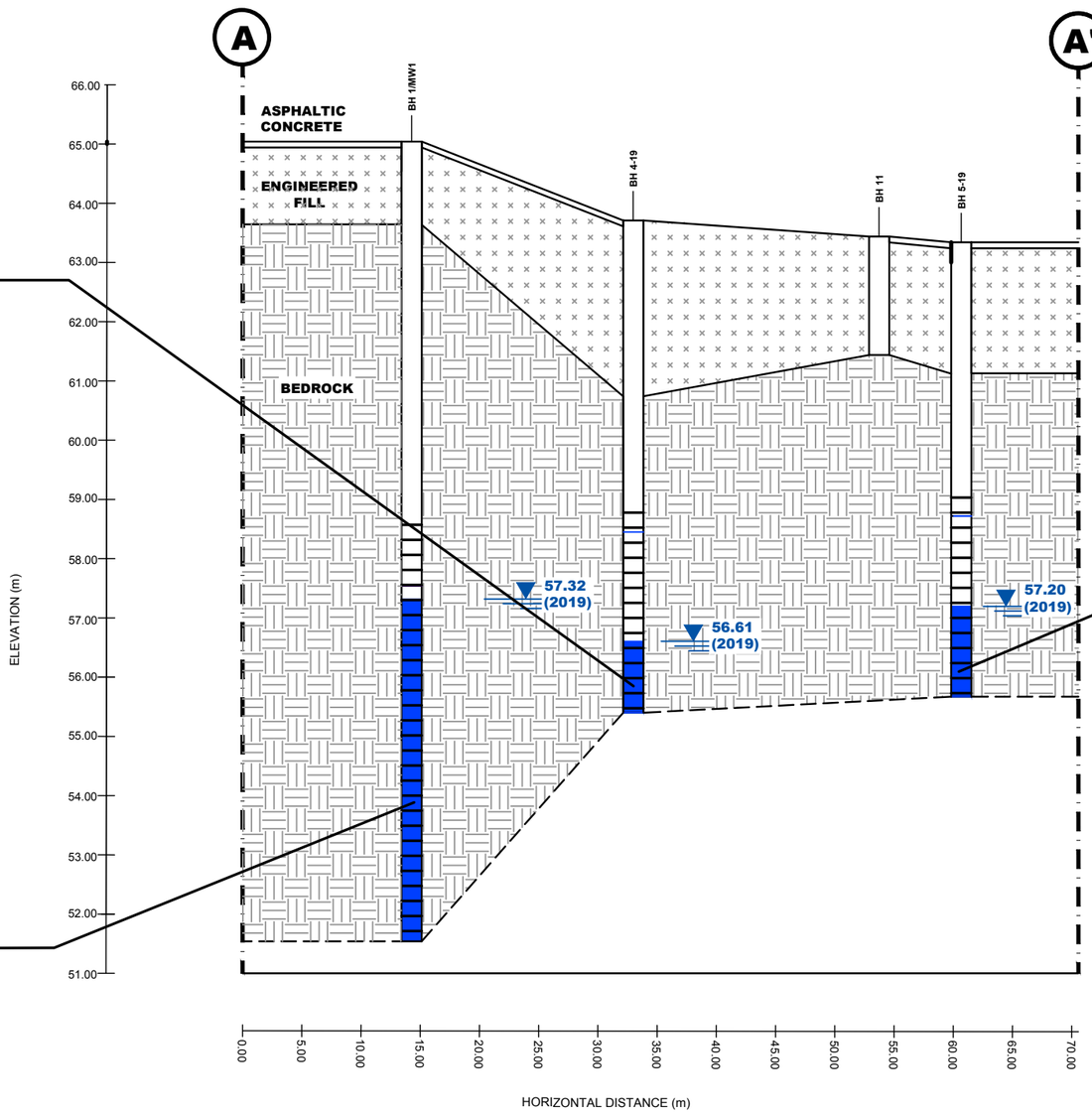

BH4-19 - GW1 (5.26-8.31m) May 29, 2019
PHCs comply with MECP Table 7

BH/MW1-MW1	(7.50-13.50m)	April 11, 2013
Parameter	Results (ug/L)	MECP (ug/L)
PHC (F1)	1300	**420**

Remaining PHCs and Metals comply with MECP Table 7

BH1-GW2 (7.50-13.50m) May 22, 2019
PHCs comply with MECP Table 7

BH5-19 - GW1 (4.62-7.67m) May 22, 2019
PHCs, PAHs and Metals comply with MECP Table 7

LEGEND:

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 7 STANDARDS

GROUNDWATER PARAMETERS EXCEED MECP TABLE 7 STANDARDS

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
2070 SCOTT STREET

OTTAWA, ONTARIO

Title:

CROSS SECTION A-A- GROUND WATER (PHC, PAH, METALS)

Scale: 1:500	Date: 08/2019
Drawn by: YA	Report No.: PE4435-2
Checked by: NS	Dwg. No.: **PE4435-7B**
Approved by: MSD	Revision No.: 0

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Paterson Group Inc.

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patersongroup

Sampling & Analysis Plan

Phase II Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

Prepared For

Westboro Point Developments Ltd.

May 1, 2019

Report: PE4435-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Westboro Point Developments Ltd. to conduct a Phase II Environmental Site Assessment (Phase II ESA) for the property addressed 2070 Scott Street, Ottawa, Ontario. Based on a Phase I ESA previously completed by Paterson for the subject property, the following subsurface investigation program, consisting of borehole drilling, was developed:

Borehole	Location & Rationale	Proposed Depth & Rationale
BH4-19	West-central portion of the property; to address potential concerns associated with the former on-site retail fuel outlet.	6-10 m; to intercept the groundwater table for the purpose of installing a groundwater monitoring well.
BH5-19	Northeastern portion of the property; to address potential concerns associated with the former on-site auto service garage.	6-10 m; to intercept the groundwater table for the purpose of installing a groundwater monitoring well.
BH6-19	East-central portion of the property; to address potential concerns associated with the former on-site auto service garage.	6-10 m; to intercept the groundwater table for the purpose of installing a groundwater monitoring well.

Borehole locations are shown on the 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 until practical refusal to augering. All soil samples will be retained, and samples will be selected for submission following a preliminary screening analysis.

Following borehole drilling, monitoring wells will be installed in BH4-19, BH5-19 and BH6-19 for the collection of groundwater samples. Three (3) groundwater samples will be collected from the monitoring wells, and one (1) additional sample will be collected from BH1/MW1 (previously installed by Franz Environmental Inc. during a 2013 Phase II ESA conducted on the property), if sufficient groundwater is present, for a total of four (4) groundwater samples.

2.0 ANALYTICAL TESTING PROGRAM

The analytical testing program for soil at the subject site 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 groundwater at the subject site 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)
- ❒ RKI 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 ¼” if installing in cored hole in bedrock)
- ❒ 5’ x 2” threaded sections of Schedule 40 PVC riser pipe (5’ x 1 ¼” 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

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PE4435

REMARKS

HOLE NO. BH 4-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.71
		AU	1				
FILL: Brown silty sand and gravel		SS	2	21	6	1	62.71
		SS	3	54	53	2	61.71
2.13							
FILL: Brown silty sand with crushed stone		SS	4	56	50+		
2.84						3	60.71
		RC	1	88	45	4	59.71
		RC	2	100	75	5	58.71
BEDROCK: Grey limestone						6	57.71
		RC	3	100	26	7	56.71
		RC	4	100	58	8	55.71
8.31							
End of Borehole							
(GWL @ 7.10m - May 22, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PE4435

REMARKS

HOLE NO. BH 5-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE									
Asphaltic concrete 0.13						0	63.34		
FILL: Brown silty sand		AU	1						
		SS	2	46	11	1	62.34		
1.37									
FILL: Brown silty sand, some clay, trace brick		SS	3	24	3	2	61.34		
2.21									
		RC	1	100	39	3	60.34		
		RC	2	100	52	4	59.34		
BEDROCK: Grey limestone		RC	3	100	56	5	58.34		
		RC	4	100	73	6	57.34		
		RC	5	100	38	7	56.34		
7.67									
End of Borehole									
(GWL @ 6.14m - May 22, 2019)									

Photo Ionization Detector: ○ Lower Explosive Limit % — 20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
2070 Scott Street
Ottawa, Ontario

DATUM BM - Top spindle of fire hydrant located on the west side of Churchill Avenue, along the west property line. Geodetic elevation = 66.18m.

FILE NO. PE4435

REMARKS

HOLE NO. BH 6-19

BORINGS BY CME 55 Power Auger **DATE** 2019 May 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0	62.99		
FILL: Brown silty sand and crushed rock, some concrete		AU	1						
		SS	2	25	13	1	61.99		
		SS	3	64	50+				
2.13						2	60.99		
		RC	1	100	20				
		RC	2	100	64	3	59.99		
						4	58.99		
BEDROCK: Grey limestone		RC	3	98	60	5	57.99		
						6	56.99		
		RC	4	100	85				
						7	55.99		
		RC	5	100	74				
7.75									
End of Borehole									
(GWL @ 5.82m - May 22, 2019)									

Photo Ionization Detector: ● Volatile Organic Rdg. (ppm)

○ Lower Explosive Limit %

20 40 60 80

100 200 300 400 500

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)
Dxx	-	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
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu 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

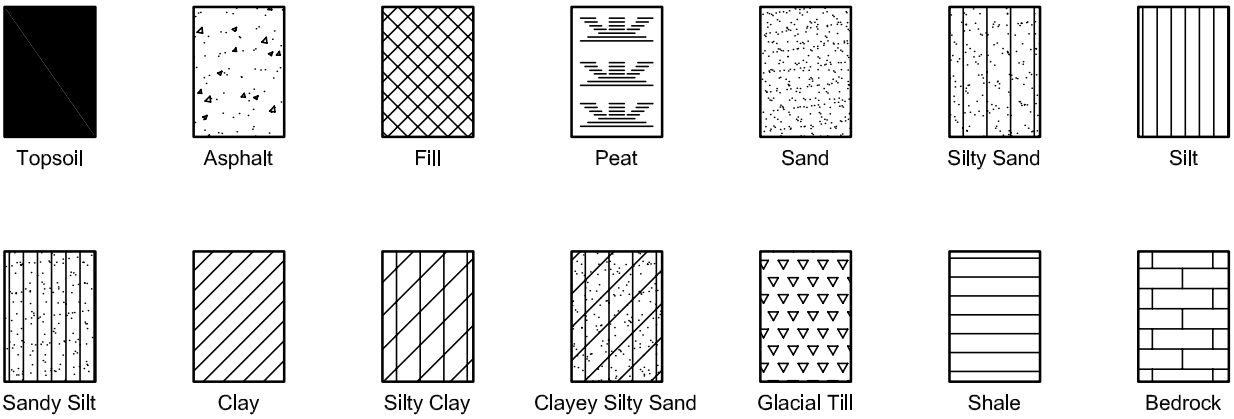
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	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.

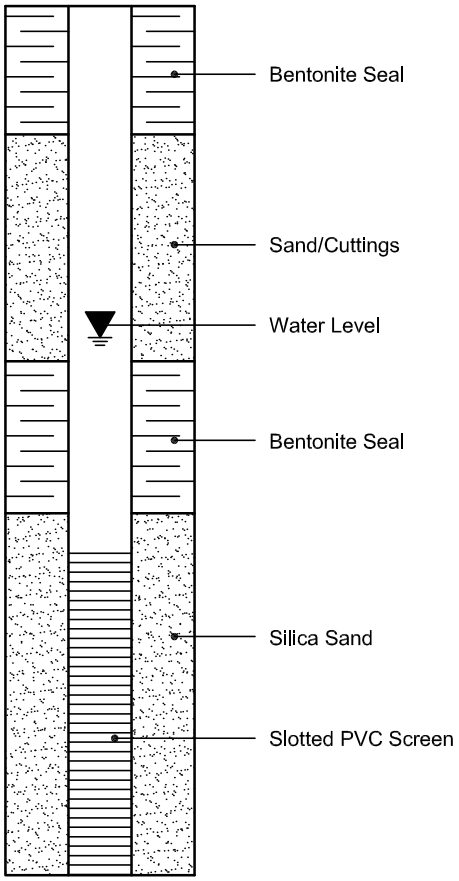
SYMBOLS AND TERMS (continued)

STRATA PLOT

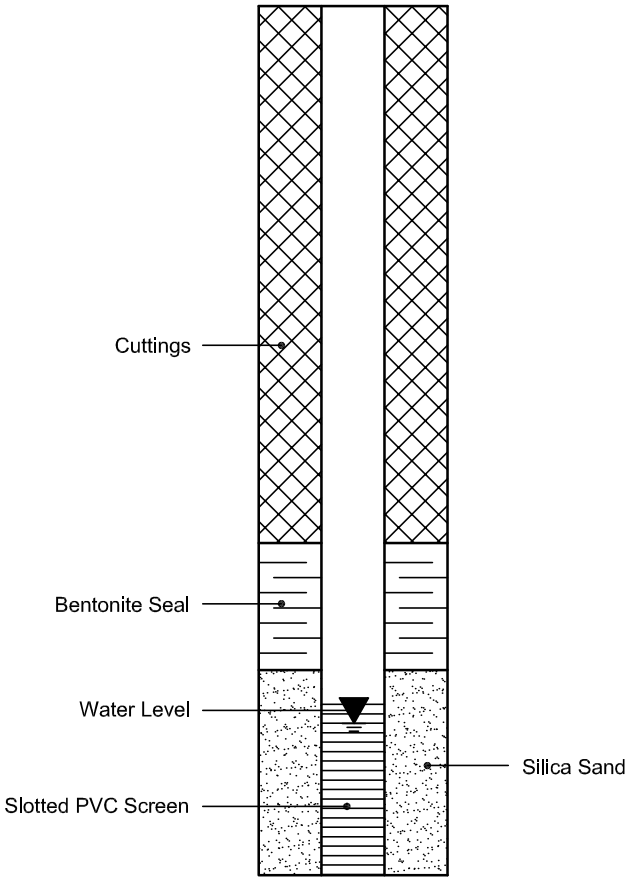


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 26491
Project: PE4435
Custody: 122124

Report Date: 23-May-2019
Order Date: 16-May-2019

Order #: 1920640

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

Paracel ID	Client ID
1920640-01	BH4-19 AU1
1920640-02	BH4-19 SS4
1920640-03	BH5-19 SS2
1920640-04	BH6-19-SS2

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	17-May-19	21-May-19
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	17-May-19	22-May-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	22-May-19	22-May-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	17-May-19	18-May-19
PHC F1	CWS Tier 1 - P&T GC-FID	17-May-19	21-May-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	17-May-19	21-May-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	22-May-19	22-May-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	17-May-19	18-May-19
Solids, %	Gravimetric, calculation	21-May-19	21-May-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26491

Report Date: 23-May-2019

Order Date: 16-May-2019

Project Description: PE4435

	Client ID:	BH4-19 AU1	BH4-19 SS4	BH5-19 SS2	BH6-19-SS2
	Sample Date:	15-May-19 10:00	15-May-19 10:00	15-May-19 10:00	15-May-19 10:00
	Sample ID:	1920640-01	1920640-02	1920640-03	1920640-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	93.8	92.8	88.6	91.3
General Inorganics					
pH	0.05 pH Units	-	7.80	-	8.15
Metals					
Antimony	1.0 ug/g dry	<1.0	-	<1.0	9.1
Arsenic	1.0 ug/g dry	2.6	-	3.3	14.2
Barium	1.0 ug/g dry	67.2	-	132	218
Beryllium	0.5 ug/g dry	<0.5	-	<0.5	<0.5
Boron	5.0 ug/g dry	9.9	-	<5.0	26.5
Cadmium	0.5 ug/g dry	<0.5	-	<0.5	1.5
Chromium	5.0 ug/g dry	14.8	-	55.8	245
Chromium (VI)	0.2 ug/g dry	<0.2	-	<0.2	<0.2
Cobalt	1.0 ug/g dry	6.8	-	11.0	11.7
Copper	5.0 ug/g dry	13.9	-	25.7	264
Lead	1.0 ug/g dry	11.3	-	6.3	472
Mercury	0.1 ug/g dry	<0.1	-	<0.1	0.2
Molybdenum	1.0 ug/g dry	<1.0	-	<1.0	11.3
Nickel	5.0 ug/g dry	12.0	-	29.5	121
Selenium	1.0 ug/g dry	<1.0	-	<1.0	<1.0
Silver	0.3 ug/g dry	<0.3	-	<0.3	<0.3
Thallium	1.0 ug/g dry	<1.0	-	<1.0	<1.0
Uranium	1.0 ug/g dry	<1.0	-	<1.0	<1.0
Vanadium	10.0 ug/g dry	19.3	-	57.6	48.6
Zinc	20.0 ug/g dry	25.7	-	59.0	363
Volatiles					
Benzene	0.02 ug/g dry	-	<0.02	<0.02	<0.02
Ethylbenzene	0.05 ug/g dry	-	<0.05	<0.05	<0.05
Toluene	0.05 ug/g dry	-	<0.05	<0.05	<0.05
m,p-Xylenes	0.05 ug/g dry	-	<0.05	<0.05	<0.05
o-Xylene	0.05 ug/g dry	-	<0.05	<0.05	<0.05
Xylenes, total	0.05 ug/g dry	-	<0.05	<0.05	<0.05
Toluene-d8	Surrogate	-	104%	105%	108%
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	-	<7	<7	<7
F2 PHCs (C10-C16)	4 ug/g dry	-	<4	<4	7

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26491

Report Date: 23-May-2019

Order Date: 16-May-2019

Project Description: PE4435

	Client ID:	BH4-19 AU1	BH4-19 SS4	BH5-19 SS2	BH6-19-SS2
	Sample Date:	15-May-19 10:00	15-May-19 10:00	15-May-19 10:00	15-May-19 10:00
	Sample ID:	1920640-01	1920640-02	1920640-03	1920640-04
	MDL/Units	Soil	Soil	Soil	Soil
F3 PHCs (C16-C34)	8 ug/g dry	-	<8	36	110
F4 PHCs (C34-C50)	6 ug/g dry	-	<6	54	58
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	<0.02	-	<0.02	0.04
Acenaphthylene	0.02 ug/g dry	<0.02	-	0.05	0.03
Anthracene	0.02 ug/g dry	<0.02	-	0.03	0.06
Benzo [a] anthracene	0.02 ug/g dry	0.02	-	0.08	0.10
Benzo [a] pyrene	0.02 ug/g dry	<0.02	-	0.09	0.08
Benzo [b] fluoranthene	0.02 ug/g dry	0.02	-	0.08	0.14
Benzo [g,h,i] perylene	0.02 ug/g dry	<0.02	-	0.06	0.06
Benzo [k] fluoranthene	0.02 ug/g dry	<0.02	-	0.04	0.07
Chrysene	0.02 ug/g dry	0.02	-	0.09	0.14
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	-	<0.02	<0.02
Fluoranthene	0.02 ug/g dry	0.04	-	0.14	0.25
Fluorene	0.02 ug/g dry	<0.02	-	<0.02	0.02
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	<0.02	-	0.06	0.05
1-Methylnaphthalene	0.02 ug/g dry	<0.02	-	<0.02	0.03
2-Methylnaphthalene	0.02 ug/g dry	<0.02	-	<0.02	0.05
Methylnaphthalene (1&2)	0.04 ug/g dry	<0.04	-	<0.04	0.08
Naphthalene	0.01 ug/g dry	<0.01	-	<0.01	0.03
Phenanthrene	0.02 ug/g dry	0.02	-	0.04	0.24
Pyrene	0.02 ug/g dry	0.04	-	0.12	0.21
2-Fluorobiphenyl	Surrogate	109%	-	110%	108%
Terphenyl-d14	Surrogate	126%	-	115%	111%

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%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						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*1.03*		*ug/g*		*77.1*	*50-140*			
Surrogate: Terphenyl-d14	*1.33*		*ug/g*		*100*	*50-140*			
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*8.22*		*ug/g*		*103*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	7.70	0.05	pH Units	7.62			1.0	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	ND	1.0	ug/g dry	ND			0.0	30	
Arsenic	3.1	1.0	ug/g dry	2.6			16.5	30	
Barium	76.6	1.0	ug/g dry	67.2			13.0	30	
Beryllium	ND	0.5	ug/g dry	ND			0.0	30	
Boron	11.7	5.0	ug/g dry	9.9			16.4	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	17.5	5.0	ug/g dry	14.8			16.6	30	
Cobalt	7.7	1.0	ug/g dry	6.8			11.5	30	
Copper	17.0	5.0	ug/g dry	13.9			19.8	30	
Lead	12.5	1.0	ug/g dry	11.3			10.2	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	13.5	5.0	ug/g dry	12.0			12.4	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	21.9	10.0	ug/g dry	19.3			12.5	30	
Zinc	28.8	20.0	ug/g dry	25.7			11.5	30	
Physical Characteristics									
% Solids	89.4	0.1	% by Wt.	89.8			0.4	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND				40	
Acenaphthylene	ND	0.02	ug/g dry	ND				40	
Anthracene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [a] anthracene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [a] pyrene	ND	0.02	ug/g dry	ND				40	
Benzo [b] fluoranthene	ND	0.02	ug/g dry	ND				40	
Benzo [g,h,i] perylene	ND	0.02	ug/g dry	ND			0.0	40	
Benzo [k] fluoranthene	ND	0.02	ug/g dry	ND				40	
Chrysene	ND	0.02	ug/g dry	ND			0.0	40	
Dibenzo [a,h] anthracene	ND	0.02	ug/g dry	ND				40	
Fluoranthene	ND	0.02	ug/g dry	ND			0.0	40	
Fluorene	ND	0.02	ug/g dry	ND				40	
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g dry	ND			0.0	40	
1-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
Naphthalene	ND	0.01	ug/g dry	ND				40	
Phenanthrene	ND	0.02	ug/g dry	ND				40	
Pyrene	ND	0.02	ug/g dry	ND			0.0	40	
Surrogate: 2-Fluorobiphenyl	*1.15*		*ug/g dry*		*68.5*	*50-140*			
Surrogate: Terphenyl-d14	*1.85*		*ug/g dry*		*110*	*50-140*			
Volatiles									
Benzene	ND	0.02	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
m,p-Xylenes	ND	0.05	ug/g dry	ND				50	
o-Xylene	ND	0.05	ug/g dry	ND				50	

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Toluene-d8	*11.2*		*ug/g dry*		*110*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	186	7	ug/g		92.8	80-120			
F2 PHCs (C10-C16)	94	4	ug/g	ND	109	60-140			
F3 PHCs (C16-C34)	237	8	ug/g	ND	112	60-140			
F4 PHCs (C34-C50)	126	6	ug/g	ND	94.2	60-140			
Metals									
Antimony	42.7		ug/L	ND	85.3	70-130			
Arsenic	50.5		ug/L	1.0	98.9	70-130			
Barium	76.3		ug/L	26.9	98.9	70-130			
Beryllium	48.3		ug/L	ND	96.3	70-130			
Boron	48.1		ug/L	ND	88.3	70-130			
Cadmium	46.5		ug/L	ND	93.0	70-130			
Chromium (VI)	0.1		mg/L	ND	52.5	70-130			QM-01
Chromium	57.4		ug/L	5.9	103	70-130			
Cobalt	51.5		ug/L	2.7	97.6	70-130			
Copper	54.8		ug/L	5.6	98.5	70-130			
Lead	48.6		ug/L	4.5	88.2	70-130			
Mercury	1.59	0.1	ug/g	ND	106	70-130			
Molybdenum	49.2		ug/L	ND	97.9	70-130			
Nickel	54.5		ug/L	ND	99.5	70-130			
Selenium	47.2		ug/L	ND	94.1	70-130			
Silver	44.8		ug/L	ND	89.5	70-130			
Thallium	46.8		ug/L	ND	93.5	70-130			
Uranium	48.8		ug/L	ND	97.3	70-130			
Vanadium	62.2		ug/L	ND	109	70-130			
Zinc	59.4		ug/L	ND	98.2	70-130			
Semi-Volatiles									
Acenaphthene	0.174	0.02	ug/g	ND	82.7	50-140			
Acenaphthylene	0.169	0.02	ug/g	ND	80.5	50-140			
Anthracene	0.229	0.02	ug/g	ND	109	50-140			
Benzo [a] anthracene	0.196	0.02	ug/g	ND	93.3	50-140			
Benzo [a] pyrene	0.156	0.02	ug/g	ND	74.1	50-140			
Benzo [b] fluoranthene	0.237	0.02	ug/g	ND	113	50-140			
Benzo [g,h,i] perylene	0.148	0.02	ug/g	ND	70.5	50-140			
Benzo [k] fluoranthene	0.205	0.02	ug/g	ND	97.9	50-140			
Chrysene	0.208	0.02	ug/g	ND	98.9	50-140			
Dibenzo [a,h] anthracene	0.145	0.02	ug/g	ND	69.0	50-140			
Fluoranthene	0.218	0.02	ug/g	ND	104	50-140			
Fluorene	0.188	0.02	ug/g	ND	89.6	50-140			
Indeno [1,2,3-cd] pyrene	0.156	0.02	ug/g	ND	74.3	50-140			
1-Methylnaphthalene	0.153	0.02	ug/g	ND	72.8	50-140			
2-Methylnaphthalene	0.179	0.02	ug/g	ND	85.4	50-140			
Naphthalene	0.159	0.01	ug/g	ND	75.8	50-140			
Phenanthrene	0.212	0.02	ug/g	ND	101	50-140			
Pyrene	0.212	0.02	ug/g	ND	101	50-140			
Surrogate: 2-Fluorobiphenyl	*1.36*		*ug/g*		*80.9*	*50-140*			
Volatiles									
Benzene	3.36	0.02	ug/g		84.0	60-130			
Ethylbenzene	3.09	0.05	ug/g		77.3	60-130			
Toluene	3.39	0.05	ug/g		84.8	60-130			
m,p-Xylenes	6.32	0.05	ug/g		79.0	60-130			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26491

Report Date: 23-May-2019
Order Date: 16-May-2019
Project Description: PE4435

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	3.34	0.05	ug/g		83.4	60-130			

Qualifier Notes:

QC Qualifiers :

QM-01 : The spike recovery for this QC sample is outside of established control limits due to sample matrix interference.

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.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

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

PARACEL LABORATORIES LTD.

Paracel ID: 1920640

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com

Chain of Custody
(Lab Use Only)
No 122124

Page 1 of 1

Client Name: Paterson Group	Project Reference: PE4435
Contact Name: 226-7381	Quote #
Address:	PO # 4- 26491
Telephone: 226-7381	Email Address:

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☑ Regular
Date Required:

Criteria: ☑ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

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

Required Analyses

Paracel Order Number: 1920640

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	pH						
1	BH4-~~19~~-AU1	S		2	May 15/19	10 am			✓	✓	✓	✓						2x 120 mL		
2	BH4-~~19~~-SS4	S		2	"	10 am	✓							✓				120mL+1vial		
3	BH5-19-SS2 ✓	S		3	"	11 am	✓		✓	✓	✓	✓						2x 120mL+1vial		
4	BH5-19-SS3	S		1	"	11 am												HOLD	120mL	
5	BH6-19-SS2	S		3	"	2 pm	✓		✓	✓	✓	✓		✓				2x 120mL+1vial		
6																				
7																				
8																				
9																				
10																				

Comments: No 3 For 1 Jar 120 mL Sample Project read = PE-4434. (May 15, 2019) Report on 4435 RR

Method of Delivery: Swift

Relinquished By (Sign):	Received by Driver/Depot: #7482	Received at Lab: Vineeram Rahmoi	Verified By:
Relinquished By (Print): Mack St Pierre	Date/Time:	Date/Time: May 16, 2019 09:29	Date/Time: May 16/19 4:30
Date/Time:	Temperature: °C	Temperature: 22.6 °C	pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 26739
Project: PE4435
Custody: 122136

Report Date: 30-May-2019
Order Date: 23-May-2019

Order #: 1921379

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

Paracel ID	Client ID
1921379-01	BH1-GW2
1921379-02	BH5-19-GW1
1921379-03	BH6-19-GW1
1921379-04	DUP

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26739

Report Date: 30-May-2019
Order Date: 23-May-2019
Project Description: PE4435

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	27-May-19	27-May-19
Chromium, hexavalent - water	MOE E3056 - colourimetric	27-May-19	27-May-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	27-May-19	27-May-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	28-May-19	29-May-19
PHC F1	CWS Tier 1 - P&T GC-FID	25-May-19	27-May-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	26-May-19	27-May-19
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	29-May-19	30-May-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26739

Report Date: 30-May-2019

Order Date: 23-May-2019

Project Description: PE4435

	Client ID:	BH1-GW2	BH5-19-GW1	BH6-19-GW1	DUP
	Sample Date:	22-May-19 11:45	22-May-19 13:10	22-May-19 13:50	22-May-19 13:50
	Sample ID:	1921379-01	1921379-02	1921379-03	1921379-04
	MDL/Units	Water	Water	Water	Water
Metals					
Mercury	0.1 ug/L	-	<0.1	<0.1	-
Antimony	0.5 ug/L	-	<0.5	<0.5	-
Arsenic	1 ug/L	-	<1	<1	-
Barium	1 ug/L	-	52	55	-
Beryllium	0.5 ug/L	-	<0.5	<0.5	-
Boron	10 ug/L	-	101	161	-
Cadmium	0.1 ug/L	-	<0.1	<0.1	-
Chromium	1 ug/L	-	<1	<1	-
Chromium (VI)	10 ug/L	-	<10	<10	-
Cobalt	0.5 ug/L	-	1.0	<0.5	-
Copper	0.5 ug/L	-	2.0	2.1	-
Lead	0.1 ug/L	-	0.1	<0.1	-
Molybdenum	0.5 ug/L	-	3.3	2.5	-
Nickel	1 ug/L	-	6	3	-
Selenium	1 ug/L	-	<1	<1	-
Silver	0.1 ug/L	-	<0.1	<0.1	-
Sodium	200 ug/L	-	826000	188000	-
Thallium	0.1 ug/L	-	0.3	0.2	-
Uranium	0.1 ug/L	-	2.7	2.9	-
Vanadium	0.5 ug/L	-	<0.5	<0.5	-
Zinc	5 ug/L	-	<5	8	-
Volatiles					
Benzene	0.5 ug/L	4.1	<0.5	<0.5	<0.5
Ethylbenzene	0.5 ug/L	5.0	<0.5	<0.5	<0.5
Toluene	0.5 ug/L	1.4	<0.5	<0.5	<0.5
m,p-Xylenes	0.5 ug/L	1.9	<0.5	<0.5	<0.5
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
Xylenes, total	0.5 ug/L	1.9	<0.5	<0.5	<0.5
Toluene-d8	Surrogate	102%	101%	101%	104%
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	308	<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					

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26739

Report Date: 30-May-2019

Order Date: 23-May-2019

Project Description: PE4435

	Client ID:	BH1-GW2	BH5-19-GW1	BH6-19-GW1	DUP
	Sample Date:	22-May-19 11:45	22-May-19 13:10	22-May-19 13:50	22-May-19 13:50
	Sample ID:	1921379-01	1921379-02	1921379-03	1921379-04
	MDL/Units	Water	Water	Water	Water
Acenaphthene	0.05 ug/L	-	<0.05	<0.05	-
Acenaphthylene	0.05 ug/L	-	<0.05	<0.05	-
Anthracene	0.01 ug/L	-	<0.01	<0.01	-
Benzo [a] anthracene	0.01 ug/L	-	<0.01	<0.01	-
Benzo [a] pyrene	0.01 ug/L	-	<0.01	<0.01	-
Benzo [b] fluoranthene	0.05 ug/L	-	<0.05	<0.05	-
Benzo [g,h,i] perylene	0.05 ug/L	-	<0.05	<0.05	-
Benzo [k] fluoranthene	0.05 ug/L	-	<0.05	<0.05	-
Chrysene	0.05 ug/L	-	<0.05	<0.05	-
Dibenzo [a,h] anthracene	0.05 ug/L	-	<0.05	<0.05	-
Fluoranthene	0.01 ug/L	-	<0.01	<0.01	-
Fluorene	0.05 ug/L	-	<0.05	<0.05	-
Indeno [1,2,3-cd] pyrene	0.05 ug/L	-	<0.05	<0.05	-
1-Methylnaphthalene	0.05 ug/L	-	<0.05	<0.05	-
2-Methylnaphthalene	0.05 ug/L	-	<0.05	<0.05	-
Methylnaphthalene (1&2)	0.10 ug/L	-	<0.10	<0.10	-
Naphthalene	0.05 ug/L	-	<0.05	<0.05	-
Phenanthrene	0.05 ug/L	-	<0.05	<0.05	-
Pyrene	0.01 ug/L	-	<0.01	<0.01	-
2-Fluorobiphenyl	Surrogate	-	91.1%	84.3%	-
Terphenyl-d14	Surrogate	-	118%	115%	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%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						
Metals									
Mercury	ND	0.1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Chromium (VI)	ND	10	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Lead	ND	0.1	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Thallium	ND	0.1	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						
Zinc	ND	5	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	*17.9*		*ug/L*		*89.4*	*50-140*			
Surrogate: Terphenyl-d14	*21.1*		*ug/L*		*105*	*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						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	*81.1*		*ug/L*		*101*	*50-140*			

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				30	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Antimony	ND	0.5	ug/L	ND				20	
Arsenic	ND	1	ug/L	ND			0.0	20	
Barium	51.4	1	ug/L	52.4			1.9	20	
Beryllium	ND	0.5	ug/L	ND			0.0	20	
Boron	121	10	ug/L	101			18.8	20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Chromium (VI)	ND	10	ug/L	ND				20	
Chromium	ND	1	ug/L	ND			0.0	20	
Cobalt	0.99	0.5	ug/L	1.03			3.6	20	
Copper	2.01	0.5	ug/L	2.02			0.6	20	
Lead	0.13	0.1	ug/L	0.11			15.2	20	
Molybdenum	3.29	0.5	ug/L	3.35			1.7	20	
Nickel	6.2	1	ug/L	6.0			2.8	20	
Selenium	ND	1	ug/L	ND			0.0	20	
Silver	0.12	0.1	ug/L	ND			0.0	20	
Sodium	ND	200	ug/L	826000			0.0	20	
Thallium	0.26	0.1	ug/L	0.27			3.9	20	
Uranium	2.4	0.1	ug/L	2.7			11.0	20	
Vanadium	ND	0.5	ug/L	ND			0.0	20	
Zinc	ND	5	ug/L	ND			0.0	20	
Volatiles									
Benzene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: Toluene-d8	*78.0*		*ug/L*		*97.6*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1810	25	ug/L		90.5	68-117			
F2 PHCs (C10-C16)	1470	100	ug/L		91.9	60-140			
F3 PHCs (C16-C34)	3740	100	ug/L		95.4	60-140			
F4 PHCs (C34-C50)	1980	100	ug/L		80.0	60-140			
Metals									
Mercury	2.77	0.1	ug/L	ND	92.3	70-130			
Antimony	40.8		ug/L	ND	81.6	80-120			
Arsenic	51.2		ug/L	ND	102	80-120			
Barium	99.1		ug/L	52.4	93.4	80-120			
Beryllium	48.3		ug/L	ND	96.5	80-120			
Boron	145		ug/L	101	88.3	80-120			
Cadmium	43.6		ug/L	ND	87.2	80-120			
Chromium (VI)	164	10	ug/L	ND	82.0	70-130			
Chromium	59.9		ug/L	ND	119	80-120			
Cobalt	56.1		ug/L	1.03	110	80-120			
Copper	52.9		ug/L	2.02	102	80-120			
Lead	40.8		ug/L	0.11	81.4	80-120			
Molybdenum	52.0		ug/L	3.35	97.2	80-120			
Nickel	58.5		ug/L	6.0	105	80-120			
Selenium	44.9		ug/L	ND	88.1	80-120			
Silver	46.5		ug/L	ND	92.8	80-120			
Sodium	9950		ug/L		99.5	80-120			
Thallium	47.1		ug/L	0.27	93.6	80-120			
Uranium	54.9		ug/L	2.7	104	80-120			
Vanadium	52.2		ug/L		104	80-120			
Zinc	45		ug/L	5	80.6	80-120			
Semi-Volatiles									
Acenaphthene	5.31	0.05	ug/L		106	50-140			
Acenaphthylene	5.20	0.05	ug/L		104	50-140			
Anthracene	4.28	0.01	ug/L		85.6	50-140			
Benzo [a] anthracene	4.93	0.01	ug/L		98.5	50-140			
Benzo [a] pyrene	4.44	0.01	ug/L		88.8	50-140			
Benzo [b] fluoranthene	5.35	0.05	ug/L		107	50-140			
Benzo [g,h,i] perylene	3.87	0.05	ug/L		77.4	50-140			
Benzo [k] fluoranthene	4.85	0.05	ug/L		96.9	50-140			
Chrysene	5.12	0.05	ug/L		102	50-140			
Dibenzo [a,h] anthracene	4.32	0.05	ug/L		86.3	50-140			
Fluoranthene	4.53	0.01	ug/L		90.7	50-140			
Fluorene	4.68	0.05	ug/L		93.5	50-140			
Indeno [1,2,3-cd] pyrene	4.28	0.05	ug/L		85.6	50-140			
1-Methylnaphthalene	6.09	0.05	ug/L		122	50-140			
2-Methylnaphthalene	5.86	0.05	ug/L		117	50-140			
Naphthalene	5.75	0.05	ug/L		115	50-140			
Phenanthrene	4.13	0.05	ug/L		82.7	50-140			
Pyrene	4.70	0.01	ug/L		94.0	50-140			
Surrogate: 2-Fluorobiphenyl	*23.0*		*ug/L*		*115*	*50-140*			
Volatiles									
Benzene	28.7	0.5	ug/L		71.7	60-130			
Ethylbenzene	28.6	0.5	ug/L		71.4	60-130			
Toluene	29.6	0.5	ug/L		74.0	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
m,p-Xylenes	65.0	0.5	ug/L		81.2	60-130			
o-Xylene	32.8	0.5	ug/L		81.9	60-130			

Qualifier Notes:

None

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.

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.

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PARACEL WO: 1921379

Head Office
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e: paracel@paracellabs.com

Chain of Custody
(Lab Use Only)
№ 122136

Page 1 of 1

Client Name: Paterson Group	Project Reference: ~~PE4935~~ PE4435
Contact Name: Mark D'Arcy	Quote #
Address: 154 Colonnade St S	PO # 26739
Telephone: (613) 226-7381	Email Address: mdarcy@patersongroup.ca

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☑ Regular
Date Required: _____

Criteria: ☑ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

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

Required Analyses

Paracel Order Number: 1921379

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	BTEX
1	BH1 - GW2	GW		3	May22/19	11:45am	✓							
2	BH5-19 - GW1	GW		7	↓	1:10pm	✓		✓	✓	✓	✓		
3	BH6-19 - GW1	GW		7	↓	1:50pm	✓		✓	✓	✓	✓		
4	DUP	GW		2	↓	1:50pm	✓							✓
5														
6														
7														
8														
9														
10														

→ missing bottles to be submitted May 24th per Mark D. &c

Comments:
Sample 1 missing PHC bottle, #2+3 missing PAH Bottle

Sumeeporn Rokmai

Method of Delivery: SWIFT

Relinquished By (Sign):	Received by Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print):	Date/Time:	Date/Time: May 23, 2019 04:35	
Date/Time:	Temperature: °C	Temperature: 19.8 °C	pH Verified By: May 24/19 2:40p

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 26834
Project: PE4435
Custody: 122164

Report Date: 5-Jun-2019
Order Date: 30-May-2019

Order #: 1922498

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

Paracel ID	Client ID
1922498-01	BH4-19-GW1

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26834

Report Date: 05-Jun-2019
Order Date: 30-May-2019
Project Description: PE4435

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	2-Jun-19	2-Jun-19
PHC F1	CWS Tier 1 - P&T GC-FID	31-May-19	2-Jun-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	4-Jun-19	5-Jun-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26834

Report Date: 05-Jun-2019

Order Date: 30-May-2019

Project Description: PE4435

	Client ID:	BH4-19-GW1	-	-	-
	Sample Date:	29-May-19 14:30	-	-	-
	Sample ID:	1922498-01	-	-	-
	MDL/Units	Water	-	-	-
Volatiles					
Benzene	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	-	-	-
Toluene-d8	Surrogate	121%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	-	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	-	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	-	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%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						
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						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	*41.3*		*ug/L*		*129*	*50-140*			

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				30	
Volatiles									
Benzene	ND	0.5	ug/L	ND			0.0	30	
Ethylbenzene	ND	0.5	ug/L	ND			0.0	30	
Toluene	ND	0.5	ug/L	ND			0.0	30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: Toluene-d8	*42.0*		*ug/L*		*131*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1770	25	ug/L		88.6	68-117			
F2 PHCs (C10-C16)	1250	100	ug/L		78.1	60-140			
F3 PHCs (C16-C34)	3360	100	ug/L		85.8	60-140			
F4 PHCs (C34-C50)	2060	100	ug/L		82.9	60-140			
Volatiles									
Benzene	43.5	0.5	ug/L		109	60-130			
Ethylbenzene	32.1	0.5	ug/L		80.4	60-130			
Toluene	41.6	0.5	ug/L		104	60-130			
m,p-Xylenes	83.7	0.5	ug/L		105	60-130			
o-Xylene	35.9	0.5	ug/L		89.7	60-130			
Surrogate: Toluene-d8	*25.7*		*ug/L*		*80.3*	*50-140*			

Qualifier Notes:

None

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.

CCME PHC additional information:

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

PARACE LABORATORIES

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№ 122164

Page ___ of ___

Client Name: Paterson	Project Reference: ~~164935~~ PE4435
Contact Name: Mark D'Arcy	Quote #
Address: 154 Colonnade St. S	PO # 26834
Telephone: (613) 226-7381	Email Address: mdarcy@patersongroup.ca

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☑ Regular
Date Required: _____

Criteria: ☑ O. Reg. 153/04 (As Amended) Table _ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

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

Required Analyses

Paracel Order Number: 1922498

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)						
1	BH4-19-GW1	GW		3	May 29/19	2:30pm	✓												✓
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received by Driver/Depot: M. Stouse	Received at Lab: Jinneeporm Dhimaj	Verified By:
Relinquished By (Print): MIKE B	Date/Time: 30/05/19 11:30	Date/Time: May 30, 2019 12:10	Date/Time: 05-30-19 14:18
Date/Time:	Temperature: °C AM	Temperature: 13.5 °C	pH Verified [ ] By:

patersongroup **memorandum**

consulting engineers

to:	Azure Urban Developments **Mr. John Thomas** – jthomas@azureurban.com
re:	Environmental Remedial Action Plan **2070 Scott Street and 328 Winona Avenue - Ottawa**
date:	April 8, 2020
file:	PE4435-RAP.01
from:	Michael Beaudoin

Further to your request and authorization, Paterson Group (Paterson) prepared a remedial action plan for the proposed development located at the aforementioned site.

Environmental Site Conditions

Historical Background

A Phase I-Environmental Site Assessment (ESA) and Phase II-ESA have been prepared for the subject site in conjunction with this remedial action plan. Based on the findings of the Phase I-ESA, Paterson identified several Areas of Potential Environmental Concern (APECs) on the subject site or neighbouring lands which were considered to have the potential to impact the subject site.

- ❑ Former Retail Fuel Outlet
- ❑ Former Automotive Service Garage
- ❑ Fill material of Unknown Quality

Several historical investigations identified impacted soil and groundwater throughout the subject site. Paterson resampled as many of the existing monitoring wells as were able to be identified to update the site conditions.

Soil

Based on analytical test results, fill material exceeding the Ontario Ministry of the Environment, Conservation and Parks (MECP) Table 7 Residential Standards for metals parameters is present on the eastern portion of the subject site.

Groundwater

One groundwater sample exceeded the MECP Table 7 standards for Benzene. This groundwater result was notably lower than the last groundwater sample collected from the monitoring well. Paterson recommends retesting the groundwater from this monitoring well to confirm if groundwater impacts are present on the site.

Remedial Action Plan Summary

The suggested remedial action plan would consist of the excavation and disposal of impacted soil at an approved waste disposal facility. The following assumptions are used:

- ❑ The remediation of the site will occur in conjunction with the re-development of the property. It is anticipated that all of the soil on the eastern portion of the site is impacted.
- ❑ It is our understanding that the proposed re-development of the subject site will consist of a residential building covering the entire site with underground parking.
- ❑ The Ontario Ministry of Environment, Conservation, and Parks (MECP) Table 7 Residential Standards will be used for the purposes of this estimate.
- ❑ The soil quality at the subject site has not been fully delineated at this time. Based on the available soil results, the soil on the eastern half of the property is considered to be impacted impacted and will be removed as such.
- ❒ Excavated soil will be screened using visual and olfactory observations in conjunction with analytical testing. Impacted soil will be placed in trucks and hauled to an approved waste disposal facility.
- ❒ If impacted groundwater is confirmed to be present on site, a portable treatment system will be installed to treat on-site accumulated groundwater by means of granular activated carbon. Alternatively, impacted groundwater could be removed by a licensed pumping contractor for off-site disposal. Groundwater treatment will continue until the on-site groundwater concentrations are in compliance with the MECP Table 7 Standards and/or the City of Ottawa sewer use by-law.
- ❒ A Sanitary Sewer Agreement will be obtained from the City of Ottawa Sewer Use Program prior to discharging any groundwater to the municipal system. Testing, reporting and discharge requirements will be carried out in compliance with the agreement.
- ❒ At this time, it is expected that two quarterly, post remediation confirmatory groundwater testing events will be required.
- ❒ A summary report and RSC will be submitted to the MECP for acknowledgement

Quantities

Estimated quantities would be as follows:

- ❒ Segregation and off-site disposal of impacted soil ……...5,500 mt (approximate)
- ❒ Volume of impacted groundwater for remedial treatment ...3,000 m^3 (approximate)

We trust that this information satisfies your requirements,

Best Regards,

Paterson Group Inc.

Michael Beaudoin, P.Eng., QP_{ESA}

Appendix F CITY OF OTTAWA SERVICING STUDY CHECKLIST

Stantec

Development Servicing Study Checklist

Job#: 160410249

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
Executive Summary (for larger reports only).	N/A	-	Introduction
Date and revision number of the report.	Y	-	
Location map and plan showing municipal address, boundary, and layout of proposed development.	Y	1.0	
Plan showing the site and location of all existing services.	Y		Existing Condtions Plan
Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Y		Appendix B
Summary of Pre-consultation Meetings with City and other approval agencies.	N/A		
Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	N/A		
Statement of objectives and servicing criteria.	Y		In each section
Identification of existing and proposed infrastructure available in the immediate area.	Y		In each section
Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	N/A		
Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	N/A		
Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to addresspotential impacts.	N/A		
Proposed phasing of the development, if applicable.	N/A		
Reference to geotechnical studies and recommendations concerning servicing.		9.0	Report and Appendix
All preliminary and formal site plan submissions should have the following information:			
Metric scale	Y		Appendix H Drawings
North arrow (including construction North)	N/A		Appendix H Drawings
Key plan	Y		Appendix H Drawings
Name and contact information of applicant and property owner	Y		Appendix H Drawings
Property limits including bearings and dimensions	Y		Appendix H Drawings
Existing and proposed structures and parking areas	Y		Appendix H Drawings
Easements, road widening and rights-of-way	Y		Appendix H Drawings
Adjacent street names	Y		Appendix H Drawings

4.2 Water	Addressed (Y/N/NA)	Section	Comments
Confirm consistency with Master Servicing Study, if available	N/A	3.0	
Availability of public infrastructure to service proposed development	Y	3.0	
Identification of system constraints	Y	3.0	
Identify boundary conditions	Y	3.0	
Confirmation of adequate domestic supply and pressure	Y	3.0	

Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.		3.0	Appendix A
Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.	Y	3.0	
Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design.	N/A		
Address reliability requirements such as appropriate location of shut-off valves	N/A		
Check on the necessity of a pressure zone boundary modification.	N/A		
Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range		3.0	
Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.	Y	3.0	
Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.	Y	3.0	
Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Y	3.0	
Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	N/A		
4.3 Wastewater	**Addressed (Y/N/NA)**	**Section**	**Comments**
Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).	Y	4.0	
Confirm consistency with Master Servicing Study and/or justifications for deviations.	N/A		
Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.	N/A		
Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Y	4.0	
Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)	N/A		
Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	Y	4.0	Appendix C
Description of proposed sewer network including sewers, pumping stations, and forcemains.	Y	4.0	
Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).	N/A		
Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development	N/A		

service development.			
Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A		
Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	N/A		
Special considerations such as contamination, corrosive environment etc.	N		
4.4 Stormwater	**Addressed (Y/N/NA)**	**Section**	**Comments**
Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Y	5.0	
Analysis of available capacity in existing public infrastructure.	N		
A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Y		Existing Conditions Plan
Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	Y	5.0	Appendix D
Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	N/A		
Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	Y	5.0	Appendix D
Set-back from private sewage disposal systems.	N/A		
Watercourse and hazard lands setbacks.	N/A		
Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	N		
Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	N/A		
Storage requirements (complete with calculations) and conveyance capacity for minor events (1:2 year return period) and major events (1:100 year return period).	Y	5.0	Appendix D
Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	N		
Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Y	5.0	Appendix D
Any proposed diversion of drainage catchment areas from one outlet to another.	N/A		
Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	N/A		
If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A		
Identification of potential impacts to receiving watercourses	N/A		
Identification of municipal drains and related approval requirements.	N/A		
Descriptions of how the conveyance and storage capacity will be achieved for the development.	Y	5.0	Appendix D
100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	N		
Inclusion of hydraulic analysis including hydraulic grade line elevations.	N		

Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Y	8.0	
Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	N/A		
Identification of fill constraints related to floodplain and geotechnical investigation.	N/A		
4.5 Approval and Permit Requirements	**Addressed (Y/N/NA)**	**Section**	**Comments**
Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	N/A		
Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	N/A		
Changes to Municipal Drains.	N/A		
Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	N/A		
4.6 Conclusion	**Addressed (Y/N/NA)**	**Section**	**Comments**
Clearly stated conclusions and recommendations	Y	10.0	
Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	N/A		
All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario	Y		

Appendix G CIVIL COMMENTS AND RESPONSE

Stantec

Memo

To:	Kris Kilborn Ottawa ON Office	From:	Ana Paerez Moncton NB Office
File:	160410249	Date:	May 27, 2020

Reference: 20170 Scott Street – Civil-Related City Comments from Zoning and Site Plan Application (December 2019)

The following is a summary of the Civil comments provided by the City on the December 2019 Engineering submission along with our responses.

1. Place on all plans (for Site Plan approval)

   Use Bold Black text and a similar font size as the sheet number on your drawings:
   USE these numbers here below
   DWG 18058 (place number on the bottom right)

   D07 Number: D07-12-19-0167

   Re: Revised as noted.

2. Ground water treatment details should include its location, how it is treated, and air vented etc. all needs to be shown on the servicing plan.

   Re: The recommendations pertaining to groundwater sampling and treatment outlined in the Environmental Remediation Action Plan prepared by Paterson in April 2020 have been added to the servicing plan.

3. Site Servicing Plan - Please show clearly how the ground water goes into sanitary sewer.

   Re: Based on a review of Paterson's Environmental Remediation Action Plan (April 2020) and on subsequent conversations with Paterson staff, it is our understanding that site remediation will take place during site excavation and that two quarterly post remediation groundwater testing events will be required to ensure that long term groundwater is suitable for discharge into the storm sewer. Furthermore, the geotechnical report prepared by Paterson (PG4935-1, July 2019) outlines the recommended water suppression system and foundation drainage to be connected to the storm water cistern and discharged into the storm sewer.

   Notes pertaining to the recommended water suppression system and foundation drainage have been added to the servicing plan.

4. Grading Plan – Please revise to include the new property.

   Re: Revised accordingly.

5. Stormwater Management Plan – No comment.

   Re: Noted.

6. Site Servicing Report – The infiltration for ground water is 50,000 to 400,000 L/ day not 0.06 L/S.

Reference: **20170 Scott Street – Civil-Related City Comments from Zoning and Site Plan Application (December 2019)**

Re: As per the geotechnical report PG4935-1 prepared by Paterson Group, this is a typical range for water to be pumped during constriction. However, provided the proposed groundwater infiltration control system is properly implemented, it is expected that the long term groundwater flow will be low (i.e. less than 3,000 L/day).

7. Site Servicing Report – The ground water is contaminated and is not permitted for release into sanitary sewer, even after treatment.

   Re: Based on a review of Paterson's Environmental Remediation Action Plan (April 2020) and on subsequent conversations with Paterson staff, it is our understanding that site remediation will take place during site excavation and that two quarterly post remediation groundwater testing events will be required to ensure that long term groundwater is suitable for discharge into the storm sewer. Furthermore, the geotechnical report prepared by Paterson (PG4935-1, July 2019) outlines the recommended water suppression system and foundation drainage to be connected to the storm water cistern and discharged into the storm sewer.

   Notes pertaining to the recommended water suppression system and foundation drainage have been added to the servicing plan.

8. Stormwater Management Report – No comment.

   Re: Noted.

Stantec Consulting Ltd.

Ana Paerez, P. Eng.
Water Resources Engineer

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Fax: 506 858 8698
Ana.Paerez@stantec.com

Attachment: Attachment

c. C.C.

Appendix H DRAWINGS