Hydrogeological Study

Proposed National Capital Business Park – Site 2

4120 Russell Road
Ottawa, Ontario

Avenue 31 Capital Inc.

Report PH4612-1R
dated December 16, 2022

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EXECUTIVE SUMMARY

Assessment

Further to the request and authorization of Avenue 31 Capital Inc., Paterson Group (Paterson) completed a Hydrogeological Study for the National Capital Business Park – Site 2 to be located at 4120 Russell Road in the City of Ottawa, as per the agreed upon scope of work. The purpose of this study is to:

- characterize the existing geological and hydrogeological conditions at the subject site
- determine the hydrogeological function of the subject site, to identify infiltration potential and to identify opportunities for Low Impact Development (LID) measures by way of water budget analyses.
- provide specific recommendations with respect to existing water wells, construction practices, the potential for environmental contamination, infiltration potential and LID considerations.

This report incorporates the findings of geotechnical and hydrogeological investigations by Paterson and an Environmental Impact Statement completed by Kilgour and Associates at the subject site in 2019.

4120 Russell Road is located on the southwest side of Russell Road and north of Hunt Club Road. The location of the subject site is shown on Drawing PH4612-1 - Site Plan appended to this report. The study area currently consists of a mixture of meadows, thicket, and deciduous forest. The property is surrounded to the north, east and west by commercial developments, and to the south by an existing stormwater management pond followed by Hunt Club Road.

Overburden soils identified during the geotechnical investigation by Paterson were generally consistent with the available mapping. Overburden thickness varied from approximately 3 to 10 m across the subject site, with greater depths of overburden materials typically present at the central and eastern portion of the site. Soils generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. The silty clay was generally underlain by a glacial till deposit comprised of a silty clay to silty sand matrix with varying amounts of gravel, cobbles and boulders. Bedrock was not cored as part of the geotechnical investigation. However, based on available mapping, bedrock in the area is expected to consist of shale from the Carlsbad formation.

Field saturated hydraulic conductivity values for the native silty clay deposit throughout the subject site ranged from < 8.1 x 10^{-9} to 6.1 x 10^{-8} m/sec. It is our interpretation that the majority of surface water will either flow down-gradient as sheet drainage where silty clay is present, or infiltrate the fill material before being intercepted by the underlying silty clay deposit where it will flow laterally down-gradient as perched water (interflow). Given the presence of silty clay across the subject site, the volume of recharge occurring within the site boundaries is expected to be minimal.

With regards to discharge zones, neither the topographical or geological conditions are suitable for discharge to be occurring on a large scale at the subject site.

The pre-development water budget analysis conducted for the study area determined that an estimated 1,774 m^3/year of surplus water currently infiltrates the surface soils and either recharges local bedrock aquifer systems or travels laterally as interflow at the fill material/silty clay interface. The remaining estimated 2,866 m^3/year of surplus leaves the site as runoff, draining towards McEwan Creek.

Two post-development scenarios were considered with regards to the water budget analysis. The post-development water budget “A” analysis considered all parking areas to be impervious and determined that an estimated 1,080 m^3/year of surplus water will infiltrate the surface soils and approximately 4,672 m^3/year will leave the site as runoff. These values equate to an approximate decrease in infiltration of 39.10% and an increase in runoff of 63.00%. The post-development water budget “B” analysis considered the parking areas to be predominantly gravel with some impervious surface and determined that an estimated 2,793 m^3/year of surplus water will infiltrate the surface soils and approximately 2,626 m^3/year will leave the site as runoff. These values equate to an approximate increase in infiltration of 57.45% and a decrease in runoff of 8.39%.

No domestic wells were found to exist within the theoretical radius of influence at the subject site. Additionally, the wells located closest to the subject site (approximately 250 m to the east) are completed at significant depth within the bedrock aquifer system, well below the anticipated maximum depth of excavation required to install services. As such, the wells are currently not expected to be impacted by construction dewatering activities at the subject site. However, should blasting be required as part of servicing installations in proximity to the eastern portion of the site (nearest the potentially active wells), consideration should be given to conducting a baseline water quality sampling program for the well users located closest to the site. This recommendation can be explored once detailed servicing drawings are available.

A review of the MECP’s Brownfield Environmental Site Registry did not identify any environmental concerns in the immediate vicinity of the study area. Based on observations of Paterson staff during field work, no groundwater contamination was identified with respect to the site.

Recommendations

A brief summary of the recommendations of the hydrogeological study is provided as follows:

- Prior to and during site development, it is recommended that construction best management practices with respect to fuels and chemical handling, spill prevention, and erosion and sediment control be followed.

- It is recommended that adherence to the City of Ottawa Salt Management Plan - Appendix A (October, 2011) is enforced to ensure that chloride levels in stormwater runoff are as low as possible.

- Should potential dewatering volumes during construction activities be anticipated to exceed 50,000 L/day, it is recommended that either an EASR or PTTW (dependent on pumping requirements) be obtained prior to construction commencing at the site.

- This report has been completed as per the agreed-upon scope of work for this project. It is recommended that the sufficiency of these conclusions be re-evaluated at the detail design phase and that any data gaps be addressed accordingly.

- No wells were found within the theoretical radius of influence for the site. However, should blasting be required for servicing installation in close proximity to the eastern border of the property, consideration should be given to conducting a baseline water quality sampling program for the well users located closest to the site. This recommendation can be explored once detailed servicing drawings are available.

LID measures consisting of 2 stormwater management retention areas are being considered for the subject site based on site specific infiltration testing. These measures would provide stormwater attenuation and aid in reducing post-development peak runoff flows.

1.0 INTRODUCTION

1.1 Background

Paterson Group (Paterson) was retained by Avenue 31 Capital Incorporated to complete a hydrogeological study and groundwater impact assessment for the National Capital Business Park – Site 2, as well as a water budget assessment of the portion of Site 2 that will continue to drain through natural channels under post-development conditions. The site is located at 4120 Russell Road in the City of Ottawa (hereinafter referred to as the “subject site”). This report incorporates the findings of Paterson Report PG4854-1 Revision 3 dated March 18, 2020 and PG4854-4 dated October 13, 2022, as well as a recent hydrogeological field investigation also completed by Paterson.

1.2 Scope of Work

Paterson has completed this report in accordance with the scope prepared by Paterson. As per the agreed upon scope, the purpose of this study was to:

- Characterize the hydrogeological setting of the subject site. Consideration was given to bedrock and surficial geology, aquifer systems, groundwater levels, hydraulic properties and catchment characteristics.

Additionally, as per the scope, the study was to include the following:

- A groundwater impact assessment outlining potential impacts to nearby structures/environment/existing well users and adjacent Permits to Take Water (PTTWs), Environmental Activity and Sector Registries (EASRs) and Environmental Compliance Approvals (ECAs).

- Pre and post-development water budget analyses to determine the hydrogeological function of the portion of the subject site, to identify infiltration potential and to identify opportunities for Low Impact Development (LID) measures.

2.0 PREVIOUS REPORTS

In addition to a review of the general literature summarized in the following sections and in the ‘References’ section of this report (MECP water well mapping, available geological and physiographic mapping), Paterson reviewed the following site-specific reports:

- “Geotechnical Investigation – National Capital Business Park” - prepared by Paterson Group – March 18, 2020.
- “Geotechnical Investigation – National Capital Business Park – Site 2” - prepared by Paterson Group – October 13, 2022.
- “Environmental Impact Statement for 4055 and 4120 Russell Road, Ottawa (draft)”, prepared by Kilgour and Associates Limited, November 20, 2019.
- "Characterization of Ottawa's Watersheds", Prepared for the City of Ottawa, Dated March 2011.

3.0 METHOD OF INVESTIGATION

3.1 Records Review

A review of available physiographic, geological, and hydrogeological data was completed as a part of this assessment. However, the literature review and previous reports did not provide site-specific data regarding overburden and bedrock aquifers, recharge and discharge conditions or flow contributions to the nearby water features. Further detail is provided in the following sections.

3.2 Field Program

The geotechnical field programs were developed to assess geology, groundwater conditions, and hydraulic gradients in the overburden at the subject site. The test holes were advanced to various depths across the site to assess hydrogeological and geotechnical conditions at the approximate depth of the proposed construction activities. A supplemental hydrogeological field program was carried out within the subject site to determine the infiltration potential of the soils.

A total of 3 boreholes and 14 test pits were advanced to a maximum depth of 8.2 and 3.2 m below ground surface (bgs), respectively. The test holes were distributed in a manner to provide general coverage of the proposed development. Each of the boreholes were instrumented with either groundwater monitoring wells or flexible standpipe piezometers. The location of the test holes is shown on Drawing PG4854-12 - Test Hole Location Plan, located in Appendix 1.

The field programs were conducted from September 4, 2019 to October 5, 2022. The test pits were completed using a hydraulic shovel and backfilled with the excavated soil upon completion. The boreholes were advanced using a track-mounted drill rig. All fieldwork was conducted under full-time supervision of Paterson personnel.

Soil samples were recovered from the sidewalls of the test pits. All soil samples were visually inspected and classified on site. The soil samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the soil samples were recovered from the test pits are shown as G on the Soil Profile and Test Data sheets presented in Appendix 1.

Soil samples were obtained from the boreholes by means of split spoon sampling and the sampling of shallow soils directly from auger flights. Split-spoon samples were taken at approximate 0.76 m intervals. The depth at which split-spoon and auger flight samples were obtained from the test holes are shown as "**SS**" and "**AU**" respectively on the Soil Profile and Test Data sheets, appended to this report. All samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for further review and testing. Transportation of the samples was completed in accordance with ASTM D4220-95 (2007) - Standard Practice for Preserving and Transporting Soils.

The Standard Penetration Test (SPT) was 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 sampler 300 mm into the ground after an initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm. This test was done in accordance with ASTM D1586-11 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils.

Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the soil profiles encountered at the test hole locations.

Infiltration Testing

In conjunction with a supplemental geotechnical investigation, Paterson completed site specific infiltration testing on September 30 and October 3, 2022 using a Pask permeameter in order to identify the infiltration potential of the underlying soils on site.

A total of 16 constant head Pask (Constant Head Well) permeameter tests were conducted at 8 test pit locations within the proposed LID locations as well as for general coverage across the site. Testing within the proposed LID locations was completed at the invert elevation as well as 0.5 m below. The remaining tests were completed at various depths ranging between 0.5 and 2.5 m below ground surface for general representation of the underlying soils. Preparation and testing of this investigation are in accordance with the Canadian Standards Association (CSA) B65-12 - Annex E. The field saturated hydraulic conductivity (Kfs) and estimated infiltration values at each test pit location are presented in Table 1 of this report.

Field saturated hydraulic conductivity values were determined using Engineering Technologies Canada (ETC) Ltd. reference tables provided in the most recent ETC Pask Permeameter User Guide dated March 2016. The field saturated hydraulic conductivity values were used to estimate the infiltration rates based on the approximate relationship between infiltration rate and hydraulic conductivity, as described in the 2010 Low Impact Development Stormwater Management Planning and Design Guide prepared by the CVC and the TRCA.

Table 1 – Field Saturated Hydraulic Conductivity and Design Infiltration Results					
Test Hole ID	Infiltration Testing (m asl)	Material	K_{fs} (m/sec)	Infiltration Rate (mm/hr)	Design Infiltration Rate (mm/hr)
TP 1-22	76.9	Br. Silty Clay	4.0E-08	20	n/a
	76.4	Br. Silty Clay	≤8.1E-09	≤ 13	
TP 3-22	79.3	Fill (Silty Clay)	≤8.1E-09	≤ 13	n/a
	78.8	Br. Silty Clay	≤8.1E-09	≤ 13	
TP 5-22	76.5	Br. Silty Clay	≤8.1E-09	≤ 13	n/a
	76.0	Br. Silty Clay	6.1E-08	22	
TP 7-22	78.4	Fill (Silty Clay)	≤8.1E-09	≤ 13	n/a
	77.9	Br. Silty Clay	4.0E-08	20	
TP 11-22	76.3	Br. Silty Clay	4.0E-08	20	8
	75.8	Br. Silty Clay	≤8.1E-09	≤ 13	
TP 12-22	76.3	Br. Silty Clay	4.0E-08	20	8
	75.8	Br. Silty Clay	≤8.1E-09	≤ 13	
TP 13-22	76.5	Br. Silty Clay	≤8.1E-09	≤ 13	< 5
	76.0	Br. Silty Clay	8.1E-09	13	
TP 14-22	76.5	Br. Silty Clay	≤8.1E-09	≤ 13	< 5
	76.0	Br. Silty Clay	≤8.1E-09	≤ 13	

Based on Paterson's hydrogeological investigation, the field saturated hydraulic conductivity values and infiltration rates measured in the test holes are consistent with similar material Paterson has encountered on other sites as well as published values for the materials identified on-site. Field saturated hydraulic conductivity values for the native silty clay deposit throughout the site ranged from $<8.1 \times 10^{-9}$ to 6.1×10^{-8} m/sec, with an estimated infiltration rate between <13 to 22 mm/hr. Given the lateral and vertical continuity of the silty clay deposit across the subject site, as well as site specific permeameter testing results, a conservative safety correction factor of 2.5 has been applied to the estimated infiltration rates of the silty clay at the invert elevation of the proposed LID system. The design infiltration rate at the approximate invert elevation of the proposed LID system location ranges between < 5 to 8 mm/hr. It is recommended that the proposed infiltration system invert elevation is constructed at least 1 m above the seasonally high groundwater level and sound bedrock surface to promote infiltration.

3.3 Laboratory Testing

All soil samples were retained for laboratory review following the field portion of the subsurface investigation. The soils were classified in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Based on the soil descriptions across the subject site during the geotechnical investigations, these samples are considered to be sufficiently representative of the site.

3.4 Groundwater Monitoring Well/Piezometer Installation

Groundwater monitoring wells or flexible polyethylene standpipes were installed in all boreholes to permit the monitoring of groundwater levels subsequent to the completion of the geotechnical field program.

3.5 Groundwater Level Measurement

Following the 2019 geotechnical field program, groundwater levels were measured at the groundwater monitoring well and piezometer installations using an electronic water level meter. Water levels were measured relative to the ground surface elevation at each location and are noted on the Soil Profile and Test Data sheets, appended to this report. Groundwater level measurements were completed on September 18 and 27, 2019 and were found to range from 1.4 m to 5.5 m bgs.

At the time of the 2022 geotechnical field program, groundwater was not observed in the test pits, which were excavated to a maximum depth of 3.2 m bgs.

3.6 Surveying

The test hole locations and ground surface elevations completed in 2019 were surveyed by Annis O'Sullivan Vollebekk Ltd. (AOV). The test hole locations and ground surface elevations at each test pit location completed in 2022 were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The locations and ground surface elevations for each test hole are presented on Drawing PG4854-12 - Test Hole Location Plan, included in Appendix 1.

3.7 Water Budget

The site-specific water budget analyses conducted at the subject site employed the method derived by Thornthwaite and Mather (1957). This method utilizes soil water holding capacity along with the mean monthly air temperature and precipitation values to estimate the actual evapotranspiration (AET) at a specific location over the same time period (referred to as the water balance of the site). By subtracting the average annual AET from the average annual precipitation, it was possible to determine the average annual water surplus available for either infiltration or runoff. The water holding capacities used in the water balance calculations at the subject site were obtained from the MOE Stormwater Management Planning and Design Manual (2003). The water balance information was then provided by Environment Canada's Engineering Climate Services division. The water balance information is presented in Appendix 2 of this report.

The average annual water surplus obtained from the water balance calculations were separated into infiltration and runoff using the approach taken from MOE (2003). This method multiplies the sum of three factors (topography, soil type and land cover) by the annual water surplus to provide an estimated annual infiltration potential. The topography factor was derived from mapping provided by the City of Ottawa and work done by AOV as part of the geotechnical work completed at the subject site. The soil factor was based on the average composition of the overburden materials found at the subject site during the geotechnical field program conducted in August and September of 2019. The vegetation factor was based on the vegetation mapping provided in the Environmental Impact Statement prepared by Kilgour and Associates (2019). Both the water balance and water budget calculations are discussed in greater detail within Section 5.0 of this report.

4.0 REVIEW AND EVALUATION

4.1 Physical Setting

4120 Russell Road is located on the southwest side of Russell Road and north of Hunt Club Road. The location of the subject site is shown on Drawing PG4854-12 – Test Hole Location Plan appended to this report.

The study area currently consists of a mixture of meadows, thicket, and deciduous forest. The property is surrounded to the north, east and west by commercial developments, and to the south by an existing stormwater management pond followed by Hunt Club Road.

The subject site is situated within the Green Creek watershed. Within that, the site is situated in the McEwan Creek subwatershed.

Site topography is generally flat, with an elevation difference of approximate 2 m across the site. However, it should be noted that a slope with an approximate elevation difference of 5 m has been noted along the eastern boundary of the subject site sloping downwards to NCBP - Site 1.

According to available mapping, the subject site is located in the Ottawa valley Clay Plains physiographic region (Chapman and Putnam, 1984). The region is characterized by relatively flat clay plains, which is generally consistent with field observations at the subject site.

4.2 Geology

Surficial Geology

Overburden mapping provided by the Ontario Geological Survey online mapping tool was reviewed as a part of this assessment. Available mapping indicates that overburden soils throughout the subject site consist of fine textured glacio-marine deposits (silt and clay, with minor sand and gravel) associated with the Champlain Sea. Overburden soils mapping is shown on Drawing PH4612-3 - Surficial Geology Mapping.

Overburden soils identified during the geotechnical investigation by Paterson were generally consistent with the available mapping. Overburden thickness varied from approximately 3.9 to greater than 8.2 m across the subject site. Soils generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. The fill material was generally comprised of a silty sand to silty clay matrix with varying amounts of organics and gravel. The above noted layers were underlain by a glacial till deposit comprised of a silty sand to silty clay matrix with gravel, cobbles and boulders.

Specific details are provided on the Soil Profile and Test Data Sheets attached within Appendix 1 of this report.

Bedrock Geology

Bedrock coring was not completed as part of the geotechnical investigation for the proposed development. However, bedrock mapping, provided by Natural Resources Canada Urban Geology of the National Capital Region mapping, was reviewed as a part of this assessment. Available mapping indicates that bedrock at the subject site consists of Shale from the Carlsbad formation. Bedrock geology mapping is shown on Drawing PH4612-4 - Bedrock Geology Mapping.

Karst Features

The term ‘karst’ refers to a geologic formation characterized by the dissolution of carbonate bedrock, such as limestone or dolostone. Based on the bedrock characteristics of the site noted above in Subsection 4.2, the bedrock formations present within the study area are not expected to have any potential for karistification to occur. Additionally, the depth of surficial soils typically overlying the bedrock in the area that are non-conducive to groundwater infiltration would not be anticipated to allow for large scale karstification to occur, even if karst susceptible bedrock units were present at the site.

4.3 Hydrogeological Setting

Existing Aquifer Systems

Aquifer systems may be defined as geological media, either overburden soils or fractured bedrock, which permit the movement of groundwater under hydraulic gradients. In general, aquifer systems may be present in overburden soils or bedrock. Although groundwater has been observed within overburden soils at the subject site, the typical overburden materials found at the site do not allow for the development of significant water supply wells. Water supply wells in the vicinity are instead likely found in bedrock aquifers.

Bedrock aquifer mapping, provided by Natural Resources Canada Urban Geology of the National Capital Region mapping, was reviewed as a part of this assessment. Using this tool, one water supply aquifer system has been identified in the vicinity of the study area - the Carlsbad formation aquifer system.

The Carlsbad formation aquifer system is located throughout the site and extends out further beyond the boundary of the study area. Based on a review of water well records in the area, it is expected that the aquifer system is present at depths ranging from approximately 30 to 50 m bgs.

Groundwater Levels

Groundwater was observed both in the piezometers and the groundwater monitoring wells installed at the borehole locations. Based on a review of the water well records, groundwater is also present in the bedrock at greater depths.

Groundwater levels in the overburden were observed to range from approximately 1.4 to 5.5 m bgs at the time of the 2019 geotechnical investigation. At the time of the 2022 geotechnical investigation, groundwater was not observed in the test pits, which were excavated to a maximum depth of 3.2 m bgs.

Based on the test pit data and the soil characteristics from the previous boreholes at the subject site, the long-term groundwater level is expected to be between 5 and 6 m bgs.

Horizontal Hydraulic Gradients

Due to the nature of the water levels obtained from field work conducted at the subject site (groundwater monitoring wells and piezometers), the absolute direction of horizontal hydraulic gradients in the vicinity of the subject site was not determined. However, using the available data, it was possible to approximate the horizontal hydraulic gradients in the overburden material given that the horizontal hydraulic gradient between any 2 points is the slope of the hydraulic head between those points:

$$i=h_2-h_1/L$$

Where: i = horizontal gradient
h = water level (m bgs)
L = horizontal distance between test hole locations

Using the above noted formula, the horizontal hydraulic gradient was observed with an approximate west/southwest-to-east/northeast orientation and a magnitude of approximately 0.02. Groundwater flow in the vicinity of the subject site is generally expected to reflect local topography.

Vertical Hydraulic Gradients

Vertical hydraulic gradients were not measured within the study area as the previous studies completed at the site did not warrant the installation of monitoring well nests.

Hydraulic Conductivity

The hydraulic conductivity values of the underlying soils at the subject site were determined based on site specific Pask (Constant Head Well) permeameter testing as well as conservative estimations based published values for similar stratigraphy obtained from Freeze and Cherry (1979). Based on site specific testing, the field saturated hydraulic conductivity for the native brown silty clay ranges from < 8.1×10^{-9} to 6.1×10^{-8} m/sec m/sec, while grey silty clay is interpreted to range from 1×10^{-9} to 1×10^{-12} m/sec. The hydraulic conductivity for glacial till is interpreted to be in the order of 1×10^{-6} to 1×10^{-10} m/sec.

The hydraulic conductivity range given above for glacial till is wide in order to account for fluctuations in the majority composition of the matrix and accessory materials at a given location.

Groundwater Recharge and Discharge

In general, groundwater will follow the path of least resistance from areas of higher hydraulic head to areas of lower hydraulic head. While upward and downward hydraulic gradients may be indicative of areas of discharge and recharge respectively, other factors must be considered.

Based on site specific testing, it is our interpretation that the majority of surface water will either flow down-gradient as sheet drainage where silty clay is present, or infiltrate the fill material before being intercepted by the underlying silty clay deposit where it will flow laterally down-gradient as perched water (interflow). Therefore, the volume of recharge occurring within the site boundaries is expected to be minimal.

With regards to discharge zones, neither the topographical or geological conditions are suitable for discharge to be occurring on a large scale at the subject site.

Catchment Area

The overburden soils within 4120 Russell Road consist primarily of topsoil overlying fill material and/or silty clay. Within the study area, drainage is expected to consist primarily of sheet drainage, with water flowing down-gradient towards McEwan Creek. A portion of the sheet drainage is likely intercepted by the existing stormwater management pond (SWMP) located south of the proposed development. The remaining drainage is expected to flow down-gradient to the east. In total, it is expected that there are a total of two catchments within study area under pre-development conditions.

Based on existing site plans, the majority of the property is expected to be covered by either landscaped areas (urban lawn) or impervious surfaces (roadways, parking lots, rooftops) under post-development conditions, with the potential for a portion of the parking area to be converted to gravel. Stormwater from the eastern portion of NCBP-Site 2 will be directed to NCBP-Site 1, while the remaining portion of the subject site will drain to the south towards two stormwater retention areas and to the existing SWMP. As such, it is expected that a total of two catchments will remain within the study area under post-development conditions.

5.0 SITE SPECIFIC WATER BUDGET ASSESSMENT

The site-specific water budget assessment (SSWB) was conducted to determine the hydrogeological function of the eastern portion of Site 2, to identify infiltration potential and to identify opportunities for Low Impact Development (LID) measures. The study area currently consists of a mixture of meadows, thicket, and deciduous forest. Post-development, a maximum of approximately 0.8 hectares will become hard surfaces (rooftops, roadways, parking lots) and can be considered impervious, with the potential for significantly less impervious surface should a portion of the parking area be converted to gravel. The remaining portions of the study area are considered to remain pervious and able to accept infiltration (although infiltration rates may change depending on surface alterations such as landscaped areas as opposed to the currently existing meadows, thicket, and deciduous forest). The pre and post-development terrain compositions are illustrated on Drawings PH4612-6 - Pre-Development Terrain Composition Plan, PH4612-7 - Post-Development Terrain Composition Plan A and PH4612-9 - Post-Development Terrain Composition Plan B, each appended to this report.

5.1 Calculations

Thornthwaite and Mather Water Balance Calculations

When falling precipitation intercepts the ground, three possible outcomes arise. The water can either evaporate back into the atmosphere (evapotranspiration), infiltrate into the surface soils (infiltration) or leave the area as runoff.

As mentioned earlier in this report, the method employed by Thornthwaite and Mather (1957) was used along with modelling software to determine the partitioning of water throughout various portions of the hydrologic cycle. Inputs into the modelling program included monthly temperature, precipitation, water holding capacities and site latitude. Using the long-term averages of these variables, it was possible to calculate annual potential and actual evapotranspiration, change in soil moisture storage and the water surplus.

The formula employed by Thornthwaite and Mather is as follows:

$$S = R + I = P - ET$$

Where:
- S = surplus (mm/year)
- R = annual runoff (mm/year)
- I = annual infiltration (mm/year)
- P = annual precipitation (mm/year)
- ET = annual evapotranspiration (mm/y

Soils within the study area generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. Therefore, the above noted calculations were carried out for the soil moisture holding capacities of each material found on site.

Based on the location of the site within the Ottawa area, climatic data was obtained from the climate station located at the McDonald-Cartier International Airport covering the period of January 1939 to December 2019. The information was provided by Environment Canada's Engineering Climate Services Unit and is presented in Appendix 2 of the report.

Table 2, below, displays the soil types present within the study area and their associated water holding capacities (WHC) as well as the actual evapotranspiration (AET) and surplus data. For the purposes of this study, AET values were used as they account for accumulated soil moisture deficit. This deficit represents the volume of water retained within the available pore spaces of the soil and is subtracted from the potential evapotranspiration (PET) value to more accurately calculate the water surplus. The monthly/annual water balance and water budget data is presented in Appendix 2 of the report.

As noted below, the table was produced using WHC values from the document MOE (2003) - Stormwater Management Planning and Design Manual. The WHC value of 5 mm was chosen for anthropogenic surfaces given the fact that the majority of surfaces existing under post-development conditions (roadways, rooftops) will have some measure of water retention potential (no surface is 100% impermeable and will degrade over time).

Table 2: Site Specific Water Surplus Information

Soil Type	Water Holding Capacity (mm)	Actual Evapotranspiration (mm/year)	Surplus Water (mm/year)
Anthropogenic Sources (buildings and roadways)	5	456	449
Gravel	50	502	402
Clay Loam (urban lawn)	100	543	360
Fine Sand (pasture and shrubs)	100	543	360
Clay (pasture and shrubs)	200	589	314

Table reproduced using WHC values from MOE (2003) - Stormwater Management Planning and Design Manual and modelling data from Environment Canada.

Infiltration Factors

In order to break down the surplus water values for the various materials into infiltration and runoff, various factors must be considered. The MOE Stormwater Management Planning and Design Manual (2003) lists three main factors that contribute to surface water infiltration rates.

The first factor is topography, which is broken down further into three sections: flat and average slope, rolling land and hilly land. Flat and average slope provides the greatest potential for infiltration and has the largest factor applied to it (0.3), while the other two have progressively lower factors (rolling land is 0.2 and hilly land is 0.1).

The second factor is soil, which is also broken down further into three sections: tight impervious clay, medium combinations of clay and loam and open sandy loam. Open sandy loam provides the greatest potential for infiltration (factor of 0.4) while the other two have progressively lower potential for infiltration to occur (factors for medium combinations of clay and loam is 0.2 and tight impervious clay is 0.1).

The final factor the MOEE manual uses to partition infiltration from runoff is land cover. It is broken down into two sections: open fields/cultivated lands and woodlands. Woodlands have greater infiltration potential and a factor of 0.2. Open fields and cultivated lands have lower potential and with a factor of 0.1. A summary of the MOEE manual's descriptors and their associated infiltration factors is shown below in Table 3.

Table 3: MOE (2003) Infiltration Factors	
Description of Area/Development Site	**Value of Infiltration Factor**
Topography	
Flat and average slope (<0.6 m/km)	0.30
Rolling land (slope of 2.8-3.8 m/km)	0.20
Hilly land (slope of 28-47 m/km)	0.10
Soil	
Tight impervious clay	0.10
Medium combinations of clay and loam	0.20
Open sandy loam	0.40
Cover	
Open fields/cultivated lands	0.10
Woodlands	0.20

Table reproduced from MOE (2003) – Stormwater Management Planning and Design Manual.

The topography of the study area consists primarily of hilly land (approximately 46 m/km at the steepest slope). Therefore, a pre-development topography factor of 0.1 was given for the materials analysed on this property. In order for development to proceed, it is expected that alterations will be made to the topography of the site. In general, it is expected that the overall slope of the site will be reduced to accommodate buildings and parking areas. Therefore, the post-development topography factor for select materials (clay loam and gravel) was elevated to 0.2.

As previously discussed, soils within the study area generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. Therefore, the pre-development soils factors ranged from 0.1 for silty clay to 0.3 for the fill material. Under post-development conditions, the majority of the site will consist of either landscaped areas or impervious surfaces, with soil factors ranging from 0.2 for clay loam to 0.4 and 0 for anthropogenic gravel and impervious surfaces, respectively.

The majority of the proposed development was historically cleared for agricultural purposes, with only isolated areas retaining some tree cover. The pre-development vegetation factor of 0.10 was therefore used for all materials. Post-development, it is expected the majority of the trees remaining on site will be removed to accommodate buildings, parking areas and roadways. As such, post-development vegetation factors remained at 0.1, with the exception of anthropogenic impervious and gravel sources, which were given a factor of 0 due to its negligible potential to benefit from vegetation cover.

The pre and post-development infiltration factors for all materials considered are included in the water budget calculations provided in Tables 8, 9 and 10 included in Appendix 2 of this report.

5.2 Pre and Post-Construction Water Budget

The pre-development water budget analysis conducted for the study area determined that an estimated 1,774 m^3/year of surplus water currently infiltrates the surface soils and either recharges local bedrock aquifer systems or travels laterally as interflow at the fill material/silty clay interface. The remaining estimated 2,866 m^3/year of surplus leaves the site as runoff, draining towards McEwan Creek.

Two post-development scenarios were considered with regards to the water budget analysis. The post-development water budget "A" analysis considered all parking areas to be impervious and determined that an estimated 1,080 m^3/year of surplus water will infiltrate the surface soils and approximately 4,672 m^3/year will leave the site as runoff. These values equate to an approximate decrease in infiltration of 39.10% and an increase in runoff of 63.00%. The post-development water budget "B" analysis considered the parking areas to be predominantly gravel with some impervious surface and determined that an estimated 2,793 m^3/year of surplus water will infiltrate the surface soils and approximately 2,626 m^3/year will leave the site as runoff. These values equate to an approximate increase in infiltration of 57.45% and a decrease in runoff of 8.39%.

The main variable that changed from the pre-development conditions to the post-development conditions was the addition of approximately 0.8 hectares of anthropogenic impervious sources for the post-development water budget "A" scenario and 0.7 and 0.09 hectares of anthropogenic gravel and impervious surfaces, respectively, for the post-development water budget "B", as well as the conversion of the majority of the remaining surface area to urban lawn (landscaped surfaces). For the post-development water budget "A" scenario, the result is the replacement of all fill material within the study area by clay loam or anthropogenic impervious surfaces, which have lower hydraulic properties and less infiltration potential. For the post-development water budget "B" scenario, the result is the replacement of all fill material within the study area by clay loam or anthropogenic gravel and impervious surfaces. The gravel has higher hydraulic properties than the fill which contributes to a higher infiltration capacity. The extent of landscaped areas was unknown at the time of report preparation. Therefore, as a conservative approach, it was assumed that all land involved in the development would be converted to either anthropogenic surfaces or soft landscaping.

It is important to note that the post-development water budget analysis for the subject site does not consider any potential infiltration of the anthropogenic impervious sources (100% runoff was taken as a conservative approach). In reality, some portion (15 to 30%) of surface water that lands on impervious surfaces either evaporates, infiltrates (asphalt is not 100% impervious) or is diverted to grassed areas where additional infiltration may occur. As such, the post-development runoff volumes should be considered a conservative estimate, and not expected to definitively represent future conditions.

Details of both the pre and post-development water budget analyses are presented in Tables 8, 9 and 10 included in Appendix 2 of this report.

6.0 GROUNDWATER IMPACT ASSESSMENT

6.1 Impact of Proposed Development on Surrounding Infrastructure

As previously discussed, soils within the study area generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. Due to the low hydraulic properties of the silty clay, the adjacent buildings are not located within the projected steady state radius of influence calculated in the following section of this report. Furthermore, dewatering activities are expected to be short term in duration and will generally require only low levels of pumping due to the nature of the materials on site. Any large quantities of water removed from the site will be in relation to precipitation events or if areas of perched groundwater are encountered above the silty clay deposit. As such, the impacts of the proposed development on the surrounding infrastructure are expected to be negligible.

6.2 Impact of Proposed Development on Existing Well Users

A search of the Ontario Water Well Records database indicated that there are a large number of wells within a 500 m radius of the proposed development. Upon investigation, it was determined that the majority of wells in the area are either no longer in use or are monitoring well installations. There is a cluster of wells located approximately 250 m east of the site near the intersection of Russell Road and Blake Road. However, available mapping indicates that several of these homes are connected privately to municipal services. It should be noted that the homes located further east down Blake Road do not appear to be connected to those services and may remain on well water supply.

The steady-state radius of influence calculations completed were based upon the Sichardt equation as shown below. The assumed setting for the analytical solution was one in which open cut trenches were used to install the services at the subject site, creating an unconfined condition which would allow use of the equation to determine the radius of influence.

$$R = r_e + 3000 * \Delta h(K^{0.5})$$

Where: R = radius of influence (m)
r_e = equivalent radius of influence (m)
Δh = expected groundwater drawdown (m)
K = hydraulic conductivity (m/sec).

For the purposes of completing the calculations, the following values were used in the analysis:

- r_e = 7.96 m, based on the typical dimensions of the servicing excavations at the subject site.
- Δh = 0.5 to 2 m, to account for variable minimum/maximum drawdown conditions, and based on the elevation of the existing municipal sanitary sewer servicing the subject site.
- K = <8.1 x 10^{-9} to 6.1 x 10^{-8} m/sec, based on site specific field saturated hydraulic conductivity values of the brown silty clay crust.

Using the above equation and assumptions, a radius of influence of less than 5m will develop as a steady state condition, extending from the edge of the excavation, in the area of the subject site.

There are several commercial and industrial developments located within the vicinity of the subject site. However, as these developments are serviced by municipal supplies, and there are no active domestic wells located within the theoretical radius of influence for the site, it is not expected that the proposed development will negatively affect the water quantity and/or quality of nearby well users.

6.3 Impact of Proposed Development on the Environment

A review of the MECP's Brownfield Environmental Site Registry identified one Record of Site Condition (RSC) located within 500 m of the study area. The registration number for the RSC is 206387, and it was registered at 3985 Belgreen Drive, approximately 400 m northwest of the property. The filing indicated that no ongoing groundwater monitoring controls were required. Based on observations of Paterson staff during field work for a Phase II Environmental Site Assessment (ESA), no potential groundwater contamination concerns were identified on site. The only potential source of concern would be if the fill material identified within the subject site were to be removed. While the fill met applicable site standards, it failed background (Table 1) standards for molybdenum and PHC (F4), and therefore would need to be disposed of if removed from site.

Considerations relevant to the water budget analyses are discussed below. Additional details of the potential environmental impacts with regards to terrestrial habitat, wildlife and species at risk are provided in the EIS completed by Kilgour and Associates (2019) for the subject site.

Pre and post-development water budget analyses were completed at the subject site to determine the hydrogeological function of the subject site, to identify infiltration potential and to identify opportunities for LID measures. With regards to hydrogeological function, the results of the analyses suggest an increase in runoff volumes at the subject site is expected under the fully paved development scenario. However, the increase in runoff will be minimized by the inclusion of LID measures.

In terms of biological activity within the study area, the only species at risk (SAR) identified in the EIS was the Barn Swallow. The EIS notes that additional investigation is required to determine the existence of nests located within 200 m of the site. Dependent on the results of the investigation, the site may need to be registered with the MECP indicating their presence, and mitigation measures will be required. There is also a small possibility that Bobolinks may be present on site at specific times of the year. The EIS provides further guidance on procedures if these species are in fact encountered.

Notwithstanding the results of the water budget analyses, several potential impacts remain to the ecological systems as a result of the development, which are discussed in detail within the EIS completed by Kilgour and Associates (2019).

6.4 Adjacent PTTW/EASR/ECA’s

A search of the MECP Permit to Take Water database provided no active permits within a 1 km radius of the subject site. With regards to the Environmental Activity and Sector Registry (EASR), one active registry was found for water taking within a 1 km radius of the subject site on the MECP EASR database.

Registration Number R-009-4146834605 is located 300 m northeast of the subject site. However, it is understood that water taking activities related to the proposed development will have been completed prior to construction dewatering at the subject site. Furthermore, the EASR is located well outside of the theoretical radius of influence. Therefore, cumulative impacts between the two sites are not anticipated.

With respect to Environmental Compliance Approvals (ECA's), given the nature of the development in the area (commercial and industrial), there are a large number of ECA’s that exist for the various purposes in the areas bordering the site. Upon review of the ECA’s, only one was found to be in relation to existing stormwater management systems in the area. As this is the type of ECA that discusses the actual discharge rates to local water bodies, this is the one that will be included in this study.

The ECA was applied for in relation to the construction of the stormwater management facility located directly south of the property at 4120 Russell Road.

The ECA number is 3609-98RPYA and dictates that a combined controlled water quality storm release rate of 89.39 L/sec during a 100-year return storm will be maintained. This discharge leads from the stormwater management pond located south of the development through two outlet structures to a culvert running under Hunt Club Road that drains into McEwan Creek.

7.0 ASSESSMENT AND RECOMMENDTIONS

Existing Wells

No wells were found to exist within the theoretical radius of influence at the subject site. Additionally, the wells located closest to the subject site (approximately 250 m to the east) are completed at significant depth within the bedrock aquifer system, well below the anticipated maximum depth of excavation required to install services. As such, the wells are currently not expected to be impacted by construction dewatering activities at the subject site. However, should blasting be required as part of servicing installations in proximity to the eastern boundary of the site (nearest the potentially active wells), consideration should be given to conducting a baseline water quality sampling program for the well users located closest to the site. This requirement can be explored once detailed servicing drawings are available.

Sources of Contamination

No concerns were identified with respect to sources of groundwater contamination at the time of completion of this study. As previously noted, the only potential source of concern would be if the fill material identified within the subject site were to be removed. While the fill met applicable site standards, it failed background (Table 1) standards for molybdenum and PHC (F4), and therefore would need to be disposed of if removed from site.

Prior to and during site development, it is recommended that construction best management practices with respect to fuels and chemical handling, spill prevention, and erosion and sediment control be followed. This will minimize the potential for the introduction of contaminants to the soil, surface water, or groundwater at the subject site.

With respect to stormwater runoff quality, it is recommended that best management practices with respect to operational standards be maintained for any stormwater management facilities constructed for the proposed development. It is also recommended that adherence to the City of Ottawa Salt Management Plan - Appendix A (October, 2011) included in Appendix 3 is enforced to ensure that chloride levels in stormwater runoff are as low as possible.

Services

It is our understanding that the subject site is to be developed with municipal sewer and water services. General recommendations regarding site servicing are provided under separate cover in our geotechnical investigation report. Specific hydrogeological and geotechnical recommendations will be provided during the detail design phase. Although specific details regarding site servicing are not currently available, it is our expectation that site servicing depths will not exceed approximately 6 m bgs.

Permit To Take Water

For any water taking of greater than 50,000 L/day, either an Environmental Activity and Sector Registration (EASR) or a Permit to Take Water (PTTW) is required from the MECP, dependent on dewatering requirements. At the subject site, an EASR or PTTW may be required for construction dewatering or works below the water table. The requirement for either will be determined during the detail design phase. The information contained in this report may be used as supporting documentation for an EASR or PTTW application for the subject site. Depending on the nature of the proposed water taking, an additional hydrogeological investigation may be required.

Infiltration Potential and Low Impact Development (LID) Considerations

As previously discussed, soils within the study area generally consisted of topsoil overlying fill material and/or silty clay, dependent on location across the site. With regards to infiltration rates for the soils found on-site, site-specific testing varied from < 13 to 22 mm/hr for brown silty clay and < 13 mm/hr for the fill material with a silty clay matrix. The design infiltration rate at the approximate invert elevation of the proposed LID system locations ranges between < 5 to 8 mm/hr, based on an applied safety correction factor of 2.5.

As noted above, the results of the water budget analyses completed at the subject site indicated that there would either be an approximate decrease in infiltration of 38.9% and an increase in runoff of 63.1%, or an approximate increase in infiltration of 57.5% and a decrease in runoff of 8.4% under post-development conditions, dependant on the development scenario. While a conservative approach was taken to obtain these values (a certain percentage of precipitation intercepted by anthropogenic sources is expected to be infiltrated), it will likely be necessary to incorporate various stormwater management measures into the design of the development.

Based on our understanding of the proposed development and site-specific infiltration testing, LID measures consisting of 2 stormwater management retention areas within the southeast and southwest portions are being considered. The above noted measures would provide stormwater attenuation and aid in reducing post-development peak runoff flows. Based on consultation undertaken with various regulatory bodies (NCC, RVCA), it is understood that BMP with respect to Low Impact Development Standards per Credit Valley Conservation Authority will be utilized to maximize benefits on site. Further discussion regarding the design and implementation of the stormwater strategy to accomplish this will be provided in the stormwater management study being prepared by LRL Engineering.

8.0 CLOSURE

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.

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 Avenue 31 Capital Incorporated, 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.

Michael Laflamme, P.Geo.

Oliver Blume, G.I.T.

9.0 REFERENCES

Chapman, L.J., and Putnam, D. F. “The Physiography of Southern Ontario, Third Edition”. Ontario Ministry of Natural Resources, 1984.

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City of Ottawa - Public Works and Services Department - Surface Operations Branch. "Material Applications Policy, Revision 3.2 - Salt Management Plan - Appendix A", October 31, 2011.

FIGURES

DRAWING PH4612-1 - SITE PLAN
DRAWING PH4612-2 - MECP WATER WELL LOCATION PLAN
DRAWING PH4612-3 - SURFICIAL GEOLOGY PLAN
DRAWING PH4612-4 - BEDROCK GEOLOGY PLAN
DRAWING PH4612-5 - BEDROCK AQUIFER PLAN
DRAWING PH4612-6 - PRE-DEVELOPMENT TERRAIN COMPOSITION PLAN
DRAWING PH4612-7 - POST-DEVELOPMENT TERRAIN COMPOSITION PLAN A
DRAWING PH4612-9 - POST-DEVELOPMENT TERRAIN COMPOSITION PLAN A

PATERSON GROUP
SOLUTION ORIENTED ENGINEERING

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
1	Site Boundary Revised	07/12/22	OB

AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

SITE PLAN

Scale: 1:2500	Date: 12/2022
Drawn by: JM	Report No.: PH4612-1R
Checked by: OB	Dwg. No.: PH4612-1
Approved by: ML	Revision No.: 1

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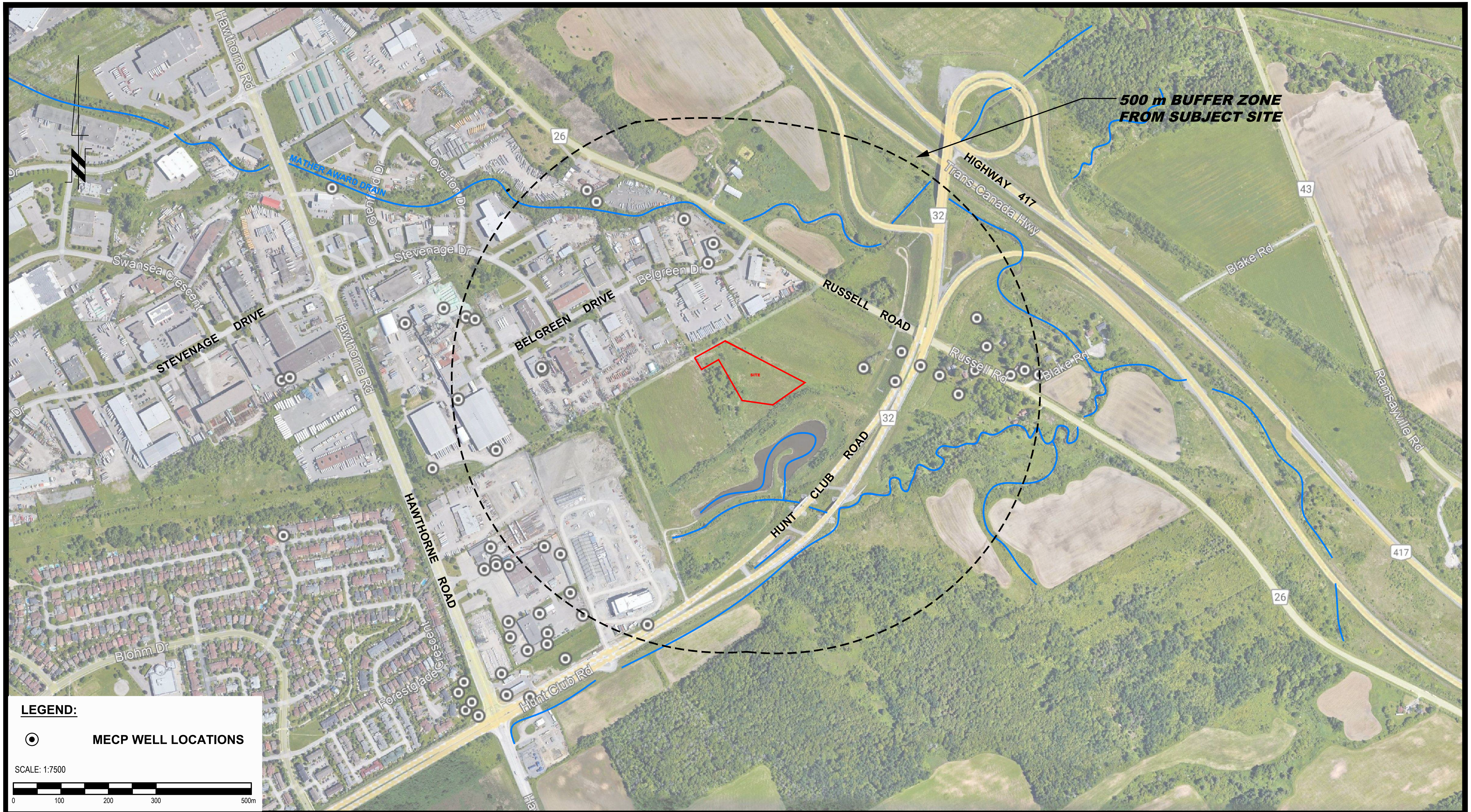

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AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

MECP WATER WELL LOCATION PLAN

Scale:	1:7500
Date:	12/2022
Drawn by:	JM
Report No.:	PH4612-1R
Checked by:	OB
Dwg. No.:	PH4612-2
Approved by:	ML
Revision No.:	1

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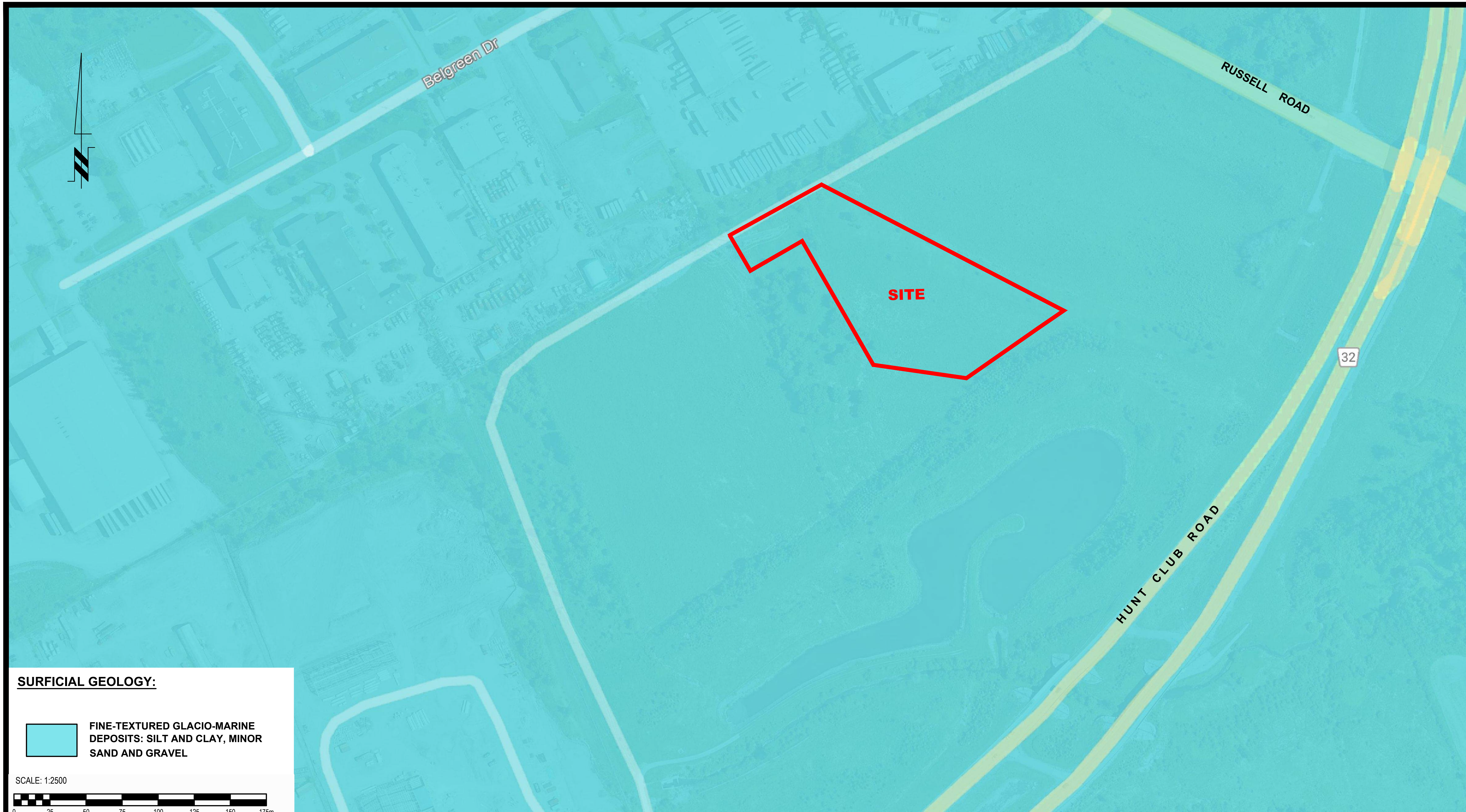

SURFICIAL GEOLOGY:

FINE-TEXTURED GLACIO-MARINE DEPOSITS: SILT AND CLAY, MINOR SAND AND GRAVEL

SCALE: 1:2500

0 25 50 75 100 125 150 175m

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1	Site Boundary Revised	07/12/22	OB

AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD
OTTAWA, ONTARIO

Title:
SURFICIAL GEOLOGY PLAN

Scale: 1:2500	Date: 12/2022
Drawn by: JM	Report No.: PH4612-1R
Checked by: OB	Dwg. No.: PH4612-3
Approved by: ML	Revision No.: 1

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AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
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OTTAWA, ONTARIO

Title:

BEDROCK GEOLOGY PLAN

Scale:	1:2500	Date:	12/2022
Drawn by:	JM	Report No.:	PH4612-1R
Checked by:	OB	Dwg. No.:	PH4612-4
Approved by:	ML	Revision No.:	1

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HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

BEDROCK AQUIFER PLAN

Scale: 1:2500	Date: 12/2022
Drawn by: JM	Report No.: PH4612-1R
Checked by: OB	Dwg. No.: PH4612-5
Approved by: ML	Revision No.: 1

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AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:
PRE-DEVELOPMENT TERRAIN COMPOSITION PLAN

Scale:	1:2500	Date:	12/2022
Drawn by:	JM	Report No.:	PH4612-1R
Checked by:	OB	Dwg. No.:	PH4612-6
Approved by:	ML	Revision No.:	1

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LEGEND:

CLAY LOAM (URBAN LAWN)
AREA = 6,000 m²

IMPERMEABLE SURFACE
AREA = 8,000 m²

SCALE: 1:2500

0 25 50 75 100 125 150 175m

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NO.	REVISIONS	DATE	INITIAL
1	Site Boundary Revised	07/12/22	OB

AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:
POST-DEVELOPMENT TERRAIN COMPOSITION PLAN A

Scale: 1:2500	Date: 12/2022
Drawn by: JM	Report No.: PH4612-1R
Checked by: OB	Dwg. No.: PH4612-7
Approved by: ML	Revision No.: 1

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NO.	REVISIONS	DATE	INITIAL

AVENUE 31 CAPITAL INC.
HYDROGEOLOGICAL INVESTIGATION
4120 RUSSELL ROAD
OTTAWA, ONTARIO

Title: POST-DEVELOPMENT TERRAIN COMPOSITION PLAN B

Scale: 1:2500	Date: 12/2022
Drawn by: JM	Report No.: PH4612-1R
Checked by: OB	Dwg. No.: PH4612-9
Approved by: ML	Revision No.:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS
SYMBOLS AND TERMS
DRAWING PG4854-12 - TEST HOLE LOCATION PLAN
Drawing PH4612-8 - INFILTRATION TESTING LOCATION PLAN

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. PG4854

REMARKS

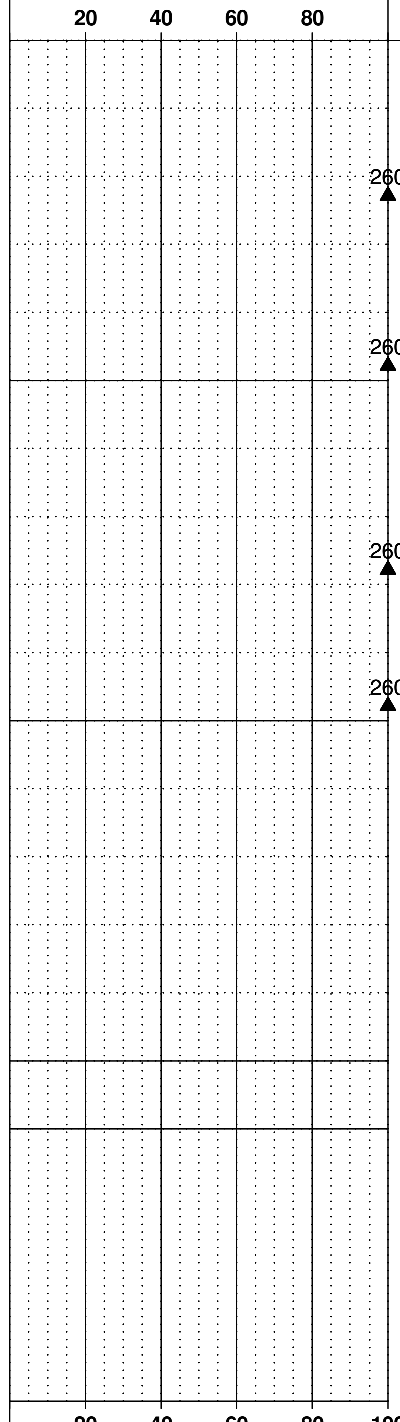
HOLE NO. TP 1-22

BORINGS BY Excavator

DATE October 3, 2022

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.41
Hard, brown **SILTY CLAY**		G	1				
		G	2			1	77.41
						2	76.41
3.00						3	75.41
GLACIAL TILL: Hard, brown silty clay with sand, gravel, cobbles and boulders		G	3				
3.20							
End of Test Pit (TP dry upon completion)							

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



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 2-22

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 / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	79.09		
Hard, brown **SILTY CLAY,** trace organics		G	1			1	78.09	▲ 260	
		G	2			2	77.09	▲ 260; ▲ 260	
2.66 **GLACIAL TILL:** Hard, brown silty clay with sand, gravel, cobbles and boulders		G	3			3	76.09		
3.10 End of Test Pit (TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 3-22

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 / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	79.79		
FILL: Brown silty clay, some crushed stone, gravel, cobbles and blast rock		G	1						
0.90									
Hard, brown **SILTY CLAY**		G	2			1	78.79	▲ 260	
								▲ 260	
						2	77.79		
3.00		G	3			3	76.79		
End of Test Pit (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 4-22

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 / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	78.48		
TOPSOIL (to 0.40)									
Hard, brown **SILTY CLAY**		G	1			1	77.48	▲ 260	
						2	76.48	▲ 260	
(to 3.10)		G	2			3	75.48		
End of Test Pit									
(TP dry upon completion)									

Pen. Resist. / Water Content % scale: 20, 40, 60, 80

Shear Strength (kPa) scale: 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 5-22

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 / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	78.48		
TOPSOIL — 0.25									
		G	1			1	77.48	▲ 260	
Hard, brown **SILTY CLAY**						2	76.48	▲ 260	
— 3.00		G	2					▲ 260	
End of Test Pit						3	75.48		
(TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 6-22

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 / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	78.76		
TOPSOIL — 0.55									
		G	1						
						1	77.76	▲ 260	
Hard, brown **SILTY CLAY**		G	2						
						2	76.76	▲ 260	
		G	3						
						3	75.76		
— 3.10 End of Test Pit									
(TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 3, 2022

FILE NO. PG4854

HOLE NO. TP 7-22

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 / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	78.93		
FILL: Brown silty clay with crushed stone, cobbles, gravel and topsoil		G	1						
0.60									
Hard, brown **SILTY CLAY**		G	2			1	77.93	▲ 260	
						2	76.93		
		G	3						
						3	75.93		
3.10									
End of Test Pit (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

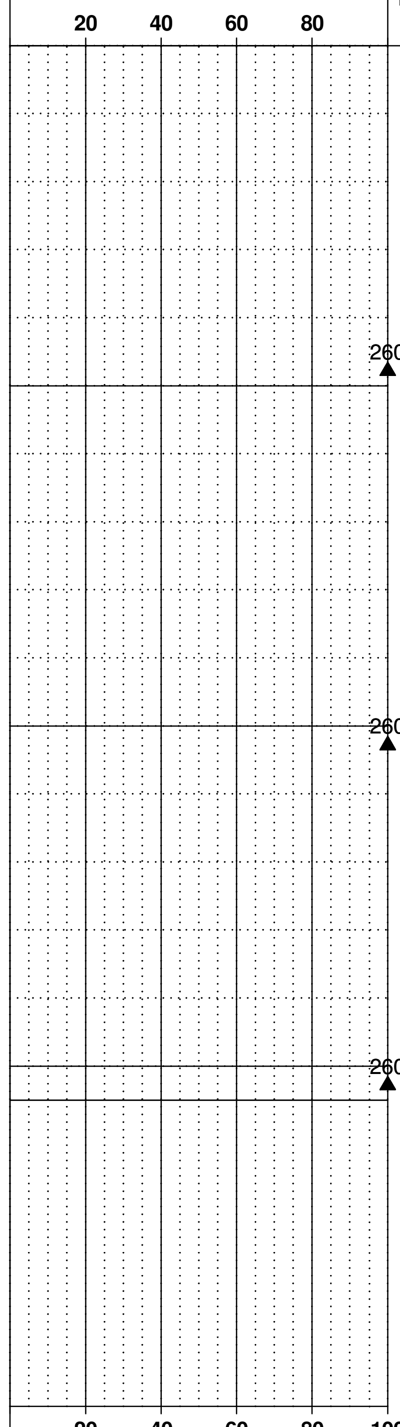
DATE October 5, 2022

FILE NO. PG4854

HOLE NO. TP 8-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.26
FILL: Brown silty clay, trace gravel, organics and topsoil		G	1				
0.40							
Hard, brown **SILTY CLAY**						1	77.26
		G	2				
						2	76.26
		G	3				
						3	75.26
3.10		G	4				
End of Test Pit							
(TP dry upon completion)							

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



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE October 5, 2022

FILE NO. PG4854

HOLE NO. TP 9-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Shear Strength (kPa), Undisturbed ▲	Piezometer Construction
GROUND SURFACE						0	78.54		
TOPSOIL (0.30)									
Hard, brown **SILTY CLAY**		G	1			1	77.54	260	
						2	76.54	260	
(3.10)		G	2			3	75.54	260	
End of Test Pit									
(TP dry upon completion)									

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

○ Water Content %

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

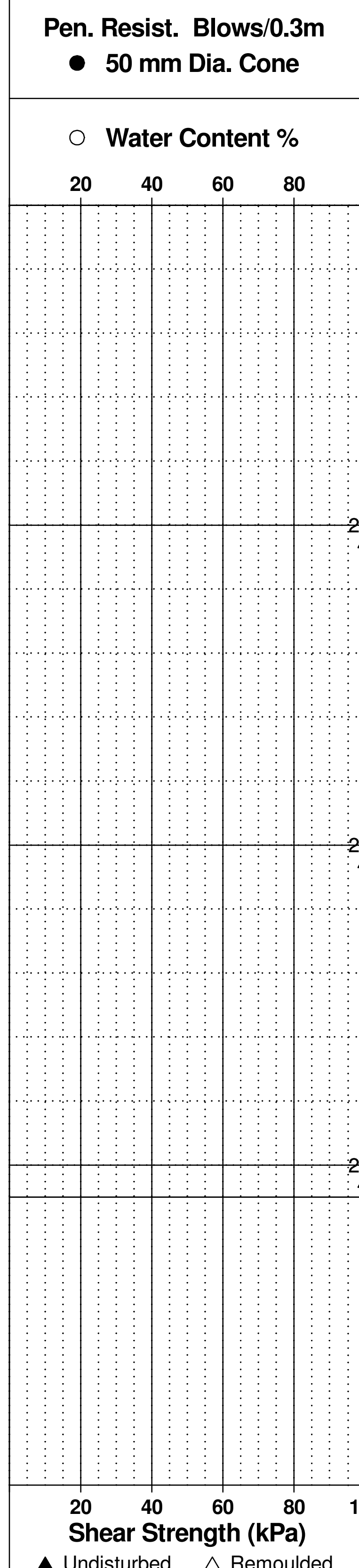
BORINGS BY Excavator

DATE October 5, 2022

FILE NO. PG4854

HOLE NO. TP10-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.98
FILL: Brown silty clay with topsoil, crushed stone, some gravel		G	1				
0.60							
						1	77.98
Hard, brown **SILTY CLAY**		G	2				
						2	76.98
						3	75.98
3.10		G	3				
End of Test Pit							
(TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE September 30, 2022

FILE NO. PG4854

HOLE NO. TP11-22

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 / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	77.58		
TOPSOIL 0.20									
Hard, brown **SILTY CLAY**		G	1						
						1	76.58		
		G	2						
1.78		G	3						
End of Test Pit (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE September 30, 2022

FILE NO. PG4854

HOLE NO. TP12-22

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 / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	77.83		
TOPSOIL 0.17									
		G	1						
Hard, brown **SILTY CLAY**						1	76.83		
		G	2						
2.03		G	3			2	75.83		
End of Test Pit									
(TP dry upon completion)									

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

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE September 30, 2022

FILE NO. PG4854

HOLE NO. TP13-22

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 / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	78.21		
TOPSOIL 0.29		G	1						
Hard, brown **SILTY CLAY**						1	77.21		
		G	2						
		G	3			2	76.21		
2.21 End of Test Pit									
(TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed National Capital Business Park - Site 2
4120 Russell Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE September 30, 2022

FILE NO. PG4854

HOLE NO. TP14-22

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 / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	78.20		
		G	1						
Hard, brown **SILTY CLAY**						1	77.20		
		G	2						
		G	3			2	76.20		
2.20									
End of Test Pit									
(TP dry upon completion)									

Water Content % scale: 20 40 60 80

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

Preliminary Geotechnical Investigation
Proposed Commercial / Industrial Complex
4055 and 4120 Russell Road, Ottawa, Ontario

DATUM Ground surface elevations provided Annis, O'Sullivan, Vollebekk Ltd.

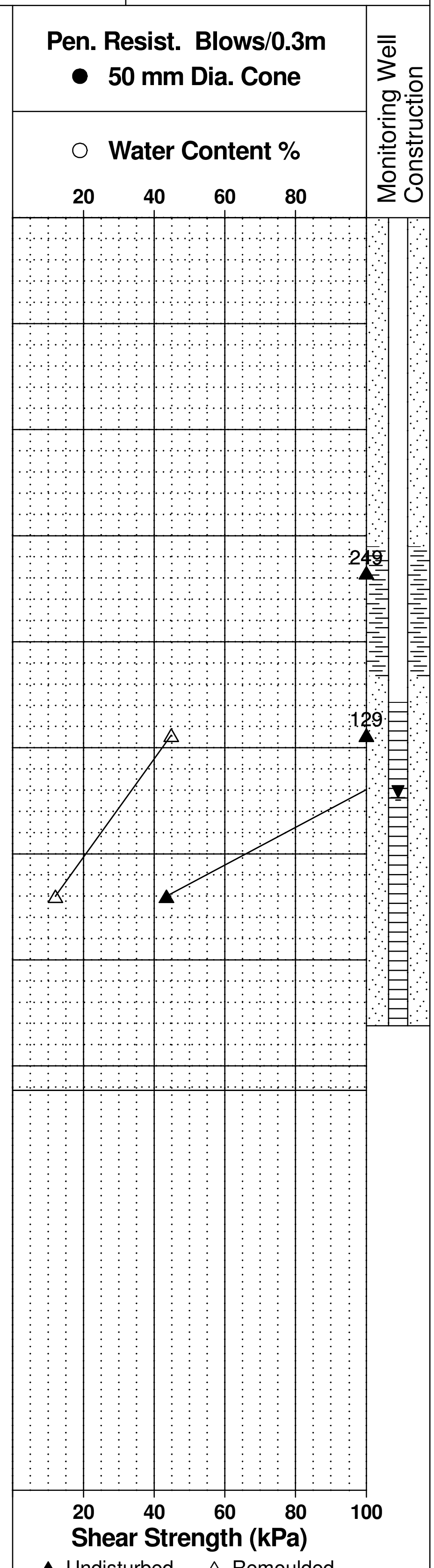
FILE NO. PG4854

REMARKS

HOLE NO. BH14

BORINGS BY CME 55 Power Auger **DATE** 2019 September 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	79.45
TOPSOIL 0.20		AU	1				
FILL: Brown silty clay with sand, some gravel		SS	2	12	17	1	78.45
1.52							
Hard to very stiff, brown SILTY CLAY		SS	3	96	15	2	77.45
		SS	4	100	9	3	76.45
		SS	5	100	7		
		SS	6	100	4	4	75.45
		SS	7	100	1	5	74.45
- stiff to firm and grey by 5.3m depth		SS	8	100	W	6	73.45
		SS	9	100	W		
		SS	10	100	1	7	72.45
7.92							
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders 8.23		SS	11	10	2	8	71.45
End of Borehole							
(GWL @ 5.47m - Sept. 18, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Commercial / Industrial Complex
4055 and 4120 Russell Road, Ottawa, Ontario

DATUM Ground surface elevations provided Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PG4854

REMARKS

HOLE NO. BH15

BORINGS BY CME 55 Power Auger **DATE** 2019 September 4

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	79.23
TOPSOIL	0.10						
FILL: Brown silty sand, trace gravel	0.76	SS	1	67	7		
Very stiff, brown **SILTY CLAY**		SS	2	75	13	1	78.23
		SS	3	92	11	2	77.23
		SS	4	100	9	3	76.23
		SS	5	100	5	4	75.23
		SS	6	100	4	5	74.23
- grey by 4.8m depth	5.64	SS	7	100	2		
GLACIAL TILL: Grey silty sand with gravel, cobbles, boulders	6.25	SS	8	67	50	6	73.23
		SS	9	60	50+		

End of Borehole

Practical refusal to augering at 6.25m depth

(GWL @ 1.36m - Sept. 18, 2019)

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

○ Water Content %
20 40 60 80

121

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

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Proposed Commercial / Industrial Complex
4055 and 4120 Russell Road, Ottawa, Ontario

DATUM	Ground surface elevations provided Annis, O'Sullivan, Vollebekk Ltd.
REMARKS	
BORINGS BY	CME 55 Power Auger
DATE	2019 September 4
FILE NO.	PG4854
HOLE NO.	BH16

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % / Shear Strength (kPa) ▲ Undisturbed △ Remoulded
GROUND SURFACE						0	78.64	
TOPSOIL	0.20	AU	1					
Hard, brown **SILTY CLAY,** trace sand		SS	2	88	19	1	77.64	
		SS	3	100	15	2	76.64	
		SS	4	100	9	3	75.64	249 ▲
	3.81							
GLACIAL TILL: Brown silty sand with ground rock	3.91	SS	5	100	50+			
End of Borehole								

Practical refusal to augering at 3.91m depth

(Piezometer dry - Sept. 27, 2019)

Piezometer Construction

Water Content % scale: 20 40 60 80

Shear Strength (kPa) scale: 20 40 60 80 100

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

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

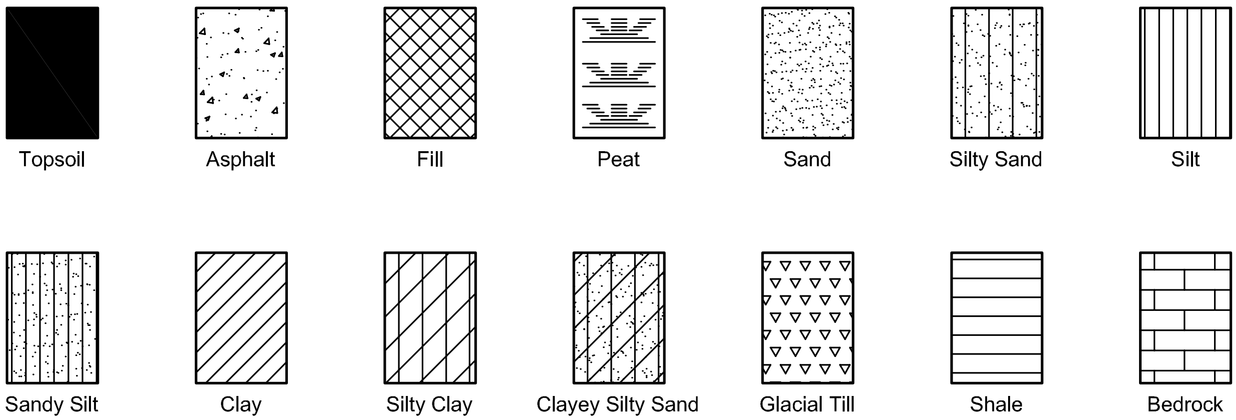
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

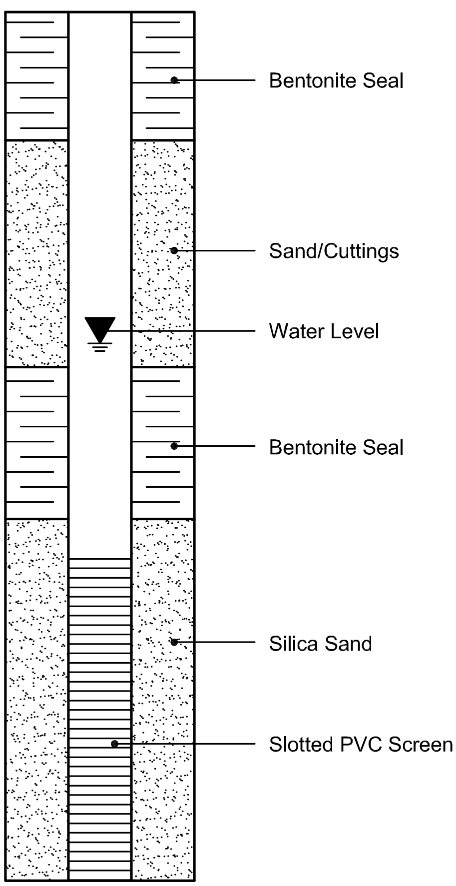
SYMBOLS AND TERMS (continued)

STRATA PLOT

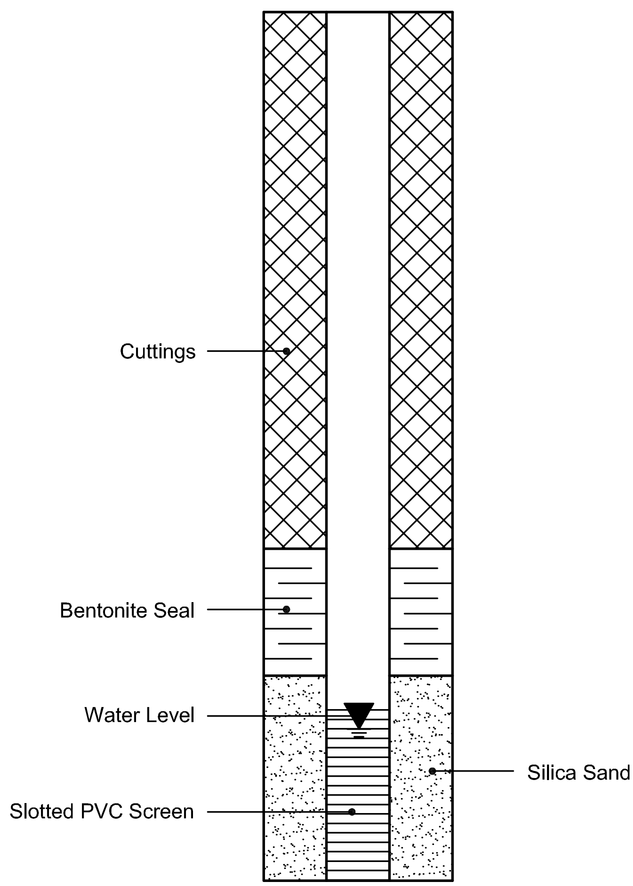


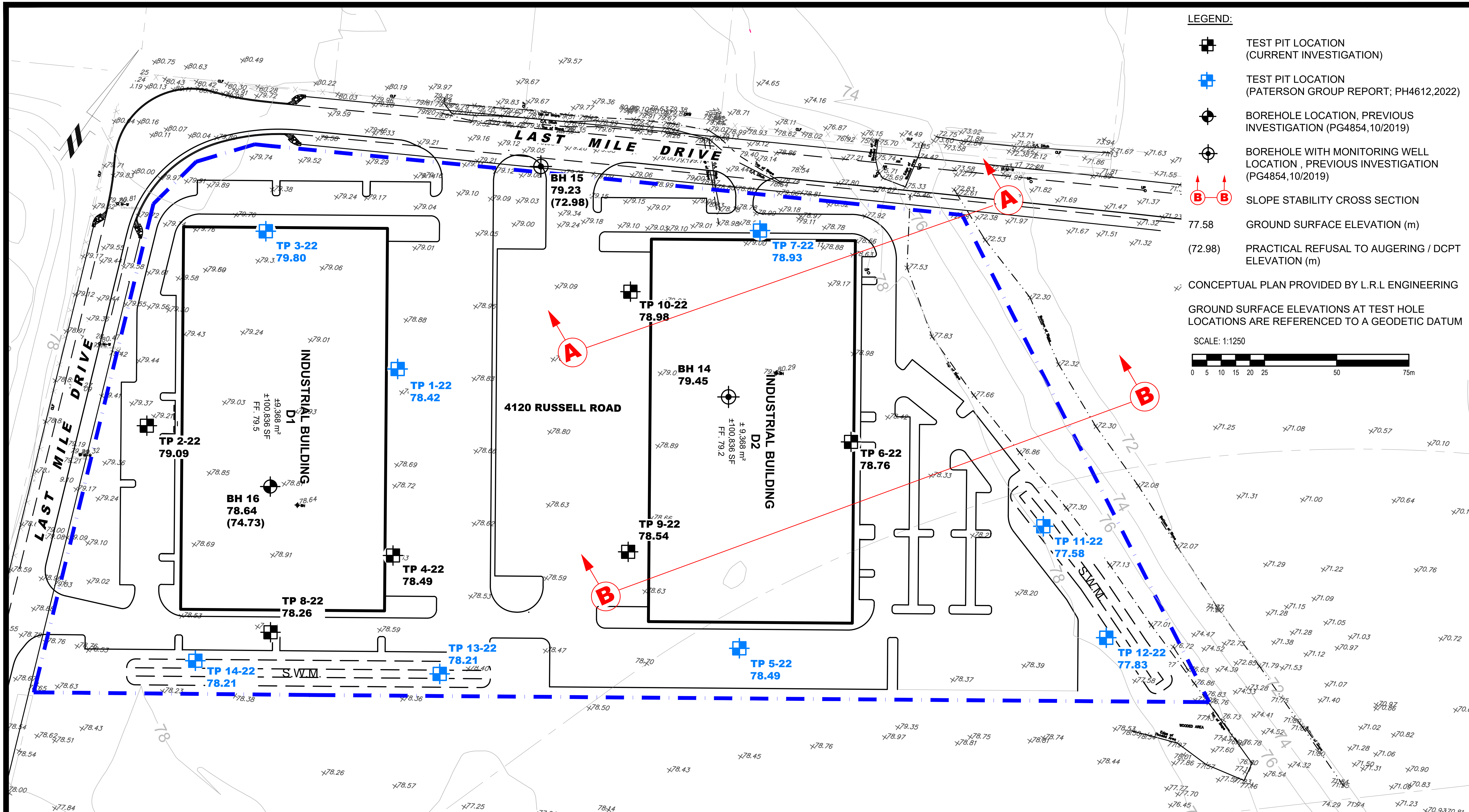
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

NATIONAL CAPITAL BUSINESS PARK INC.
GEOTECHNICAL INVESTIGATION
PROPOSED NATIONAL CAPITAL BUSINESS PARK - SITE 2
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250	Date: 10/2022
Drawn by: JM	Report No.: PG4854-1
Checked by: SD	Dwg. No.: PG4854-12
Approved by: SD	Revision No.:

11x17

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LEGEND:

- INFILTRATION TESTING LOCATION
- TEST PIT LOCATION GEO TECHNICAL CURRENT INVESTIGATION (PG4854)
- BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PG4854,10/2019)
- BOREHOLE WITH MONITORING WELL LOCATION , PREVIOUS INVESTIGATION (PG4854,10/2019)

77.58 GROUND SURFACE ELEVATION (m)

(72.98) PRACTICAL REFUSAL TO AUGERING / DCPT ELEVATION (m)

CONCEPTUAL PLAN PROVIDE BY LRL ENGINEERING.

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1500

0 25 50 75 100m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

AVENUE 31 CAPITAL INC.

HYDROGEOLOGICAL INVESTIGATION
PROPOSED NATIONAL CAPITAL BUSINESS PARK - SITE 2
4120 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

INFILTRATION TESTING LOCATION PLAN

Scale: 1:1500	Date: 10/2022
Drawn by: GK	Report No.: PH4612-1
Checked by: ZB	Dwg. No.: PH4612-8
Approved by: NZ	Revision No.:

p:\autocad drawings\hydrogeology\ph46xx\ph4612 - avenue 31 capital inc\ph4612-1 site plan.dwg

11x17

APPENDIX 2

ENVIRONMENT CANADA WATER BALANCE DATA
TABLE 4 - MONTHLY WATER BALANCE FOR SOIL WITH 5 MM WATER GOLDING CAPACITY AT NATIONAL CAPITAL BUSINESS PARK
TABLE 5 - MONTHLY WATER BALANCE FOR SOIL WITH 50 MM WATER GOLDING CAPACITY AT NATIONAL CAPITAL BUSINESS PARK
TABLE 6 - MONTHLY WATER BALANCE FOR SOIL WITH 100 MM WATER GOLDING CAPACITY AT NATIONAL CAPITAL BUSINESS PARK
TABLE 7 - MONTHLY WATER BALANCE FOR SOIL WITH 200 MM WATER GOLDING CAPACITY AT NATIONAL CAPITAL BUSINESS
TABLE 8 - PRE-DEVELOPMENT ANNUAL WATER BUDGET FOR NATIONAL CAPITAL BUISNESS PARK
TABLE 9 - POST-DEVELOPMENT ANNUAL WATER BUDGET A FOR NATIONAL CAPITAL BUISNESS PARK (PAVED PARKING AREA)
TABLE 10 - POST-DEVELOPMENT ANNUAL WATER BUDGET B FOR NATIONAL CAPITAL BUISNESS PARK (GRAVEL PARKING AREA)

Table 4 - Monthly Water Balance for Soil With 5 mm Water Holding Capacity at National Capital Business Park				
Month	**Temperature (°C)**	**Total Precipitation (mm)**	**Actual Evapotranspiration (mm)**	**Water Surplus (mm)**
January	-10.6	62	0	25
February	-9.0	56	1	27
March	-2.8	65	5	103
April	5.7	73	31	111
May	13.1	76	65	14
June	18.3	85	81	5
July	20.9	89	84	5
August	19.6	84	80	4
September	14.8	82	63	18
October	8.3	76	35	40
November	1.3	77	10	57
December	-7.0	80	1	40
Annual	**6**	**904**	**456**	**449**

Table 5 - Monthly Water Balance for Soil With 50 mm Water Holding Capacity at National Capital Business Park				
Month	**Temperature (°C)**	**Total Precipitation (mm)**	**Actual Evapotranspiration (mm)**	**Water Surplus (mm)**
January	-10.6	62	0	25
February	-9.0	56	1	27
March	-2.8	65	5	103
April	5.7	73	31	111
May	13.1	76	79	14
June	18.3	85	98	5
July	20.9	89	94	4
August	19.6	84	82	1
September	14.8	82	65	6
October	8.3	76	36	21
November	1.3	77	10	47
December	-7.0	80	1	38
Annual	**6**	**904**	**502**	**402**

Table 6 - Monthly Water Balance for Soil With 100 mm Water Holding Capacity at National Capital Business Park				
Month	**Temperature (°C)**	**Total Precipitation (mm)**	**Actual Evapotranspiration (mm)**	**Water Surplus (mm)**
January	-10.6	62	0	24
February	-9.0	56	1	26
March	-2.8	65	5	101
April	5.7	73	31	111
May	13.1	76	81	14
June	18.3	85	112	5
July	20.9	89	114	3
August	19.6	84	87	1
September	14.8	82	65	3
October	8.3	76	36	9
November	1.3	77	10	31
December	-7.0	80	1	32
Annual	**6**	**904**	**543**	**360**

Table 7 - Monthly Water Balance for Soil With 200 mm Water Holding Capacity at National Capital Business Park				
Month	**Temperature (°C)**	**Total Precipitation (mm)**	**Actual Evapotranspiration (mm)**	**Water Surplus (mm)**
January	-10.6	62	0	19
February	-9.0	56	1	23
March	-2.8	65	5	94
April	5.7	73	31	109
May	13.1	76	81	14
June	18.3	85	116	5
July	20.9	89	132	3
August	19.6	84	106	1
September	14.8	82	70	2
October	8.3	76	36	7
November	1.3	77	10	17
December	-7.0	80	1	20
Annual	**6**	**904**	**589**	**314**

Table 8 - Pre-Development Annual Water Budget Calculations for 4120 Russell Road											
Geologic Unit	Area (m^2)	Water Surplus (mm)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Runoff Factor	Total Infiltration (mm/year)	Total Infiltration (L/year)	Total Runoff (mm/year)	Total Runoff (L/year)
Clay (Pasture and Shrubs)	8,700	314	0.1	0.1	0.1	0.3	0.7	94.2	819,540	219.8	1,912,260
Fine Sand (Pasture and Shrubs)	5,300	360	0.1	0.3	0.1	0.5	0.5	180	954,000	180	954,000
Totals	**14,000**								**1,773,540**		**2,866,260**

Table 9 - Post-Development Annual Water Budget A Calculations for 4120 Russell Road (Paved Parking Area)											
Land Use Unit	Area (m^2)	Water Surplus (mm)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Runoff Factor	Total Infiltration (mm/year)	Total Infiltration (L/year)	Total Runoff (mm/year)	Total Runoff (L/year)
Clay Loam (Urban Lawn)	6,000	360	0.2	0.2	0.1	0.5	0.5	180	1,080,000	180	1,080,000
Anthropogenic Sources (Roof, Roads, Parking Lot)	8,000	449	0	0	0	0	1	0	0	449	3,592,000
Totals	**14,000**								**1,080,000**		**4,672,000**
Difference (L/year)									**-693,540**		**1,805,740**
Percentage Variation									**-39.10%**		**63.00%**

Table 10 - Post-Development Annual Water Budget B Calculations for 4120 Russell Road (Gravel Parking Area)											
Land Use Unit	Area (m^2)	Water Surplus (mm)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Runoff Factor	Total Infiltration (mm/year)	Total Infiltration (L/year)	Total Runoff (mm/year)	Total Runoff (L/year)
Clay Loam (Urban Lawn)	6,000	360	0.2	0.2	0.1	0.5	0.5	180	1,080,000	180	1,080,000
Gravel	7,100	402	0.2	0.4	0	0.6	0.4	241.2	1,712,520	160.8	1,141,680
Anthropogenic Sources (Roof, Roads, Parking Lot)	900	449	0	0	0	0	1	0	0	449	404,100
Totals	**14,000**								**2,792,520**		**2,625,780**
Difference (L/year)									**1,018,980**		**-240,480**
Percentage Variation									**57.45%**		**-8.39%**

APPENDIX 3

LRL ENGINEERING - STORM WATER MANAGEMENT PLAN
CITY OF OTTAWA - SALT MANAGEMENT PLAN - APPENDIX A - OCTOBER 31, 2011

1:500
0 5m 10m 25m 50m

NORTH

scheme: 01E

Conceptual Site Plan - Enlarged First Level

1100 LAST MILE DR. - NCBP BUILDING D

Ottawa, ON, CAN

WARE MALCOMB

TOR21-0035-02

11.19.2022

SHEET

1


PRE DEVELOPMENT WATERSHED BOUNDARY AREA=4.4 HA
PRE DEVELOPMENT WATERSHED BOUNDARY AREA=2.1 HA
POST DEVELOPMENT PROPOSED WATERSHED BOUNDARY AREA=1.78 HA
POST DEVELOPMENT WATERSHED BOUNDARY AREA=4.72 HA
LAST MILE DRIVE
RUSSELL ROAD
EXISTING SITE 1
PARCEL H DEVELOPMENT
PROPOSED SITE 2
OUTDOOR STORAGE
OUTLET 1
SITE 1, HUNTCLUB CULVERT, MCEWEN CREEK
SWM Criteria
Quantity ->Pre Development Rate, C=0.2, A=2.1
Quality -> 80% TSS
Erosion Control ->__________
Water Balance ->__________
SHEET 1 OF 2
SHEET 2 OF 2
OUTLET 2
MCEWAN CREEK SWM FACILTIY
SWM Criteria
Quantity ->Pre Development Rate, C=0.2, A=4.4
Quality -> 80% (70% from Pond)
Erosion Control ->__________
Water Balance ->__________
MCEWAN CREEK SWM FACILTIY
HUNT CLUB ROAD
TO MCEWEN CREEK

City of Ottawa

Public Works and Services Department
Surface Operations Branch

Salt Management Plan
Appendix A

MATERIAL APPLICATION POLICY

CONTENT

Maintenance Quality Standards – Snow and Ice Control on Roads
General Information
Use of Liquid Chemicals
Material Application Guideline and Policy – Bare Pavement Roads
Material Application Guideline and Policy – Centre-Bare Roads
Material Application Guideline and Policy – Snow Packed Roads
Blast Policy

The Surface Operations Branch District Managers, Area Managers and Zone Supervisors have been consulted through the development of this document.

REVISION INFO

Rev	Date	By	Description
3.1	Jan 10 2007		
3.2	Oct 31 2011	D Vander Wal	• Removed 50/50 mix per Dan O'Keefe. • Removed specific references to Sodium and Calcium Chloride as new product for 2011 is a Multi-Chloride Brine. Changed liquid application rate from 46 (6%) to 39L/tonne (5%). • Removed Dry and Wet salt rates for pavement temperatures below -18C. • Updated Epoke rates to match Appendix B and added wet rates to obtain 20% reduction when pre-wetting. • Removed separate rate table for Hwy 174 Epoke spreaders since the resulting lane-km rates are the same as other bare pavement.

COUNCIL APPROVED MAINTENANCE QUALITY STANDARDS

For snow clearing, resources are to be deployed and snow clearing completed as defined in the Table below. If the depth of snow accumulation is less than the minimum for deployment, then resources may be deployed subject to road conditions resulting from previous snow accumulations or from forecasted weather conditions.

For treating icy roads, resources are to be deployed as soon as practicable after becoming aware of the icy conditions. Icy roads are to be treated within the times defined in the Table below after becoming aware of the icy conditions.

MAINTENANCE QUALITY STANDARD SNOW AND ICE CONTROL ON ROADS							
Road Maintenance Class		**Road Type**	**Minimum Depth of Snow Accumulation for Deployment of Resources** *(Depth as per MMSMH)*	**Time to Clear Snow Accumulation From the End of Snow Accumulation or Time to Treat Icy Conditions** *(Time as per MMSMH)*	**Treatment Standard**		
					Bare Pavement	**Centre Bare**	**Snow Packed**
1	A	High Priority Roads	As accumulation begins *(2.5-8 cm depending on class)*	2 h *(3-4 h)*	√		
	B				√		
2	A	Most Arterials		3 h *(3-6 h)*	√		
	B				√		
3	A	Most Major Collectors		4 h *(8-12 h)*	√		
	B				√		
4	A	Most Minor Collectors	5 cm *(8 cm)*	6 h *(12-16 h)*	√		
	B					√	
	C						√
5	A, C	Residential Roads and Lanes	7 cm *(10 cm)*	10 h *(16-24 h)*			√
	B		10 cm *(not defined)*	16 h *(not defined)*			√

Note - MMSMH refers to Ontario Regulation 239/02, Minimum Maintenance Standards for Municipal Highways shown for comparison purposes.

- **Bare Pavement:** requires that snow and ice be controlled, cleared and/or prevented for the full traveled road pavement width, including flush medians of 2 m width or less, paved shoulders and/or adjacent cycling lanes. It does not include parking lanes.
- **Centre-Bare:** requires that snow and ice be controlled, cleared and/or prevented in a strip down the middle of the road pavement width for a minimum width of 2.5 m on each side of centre-line.
- **Snow-Packed:** requires that snow and ice be cleared and that ruts and/or potholes that may cause poor vehicle control be leveled off. Abrasive or deicing materials are applied at intersections, hills and sharp curves.

LIQUID CHEMICALS

Application Rates and Reductions

USE OF LIQUID CHEMICALS					
Chemical	**Use**	**Application Ratio**	**Chemical Concentration**	**Application Rate**	**Dry Salt Reduction**
CaCl, MgCl, or Multi-Chloride	Pre-Wetting	5% by weight	Varies (28%-35%)	39L / t	20%[1]
CaCl, MgCl, or Multi-Chloride	Straight Liquid Application	N/A	Varies	60 to 100L/ lane-km	-

[1] The Epoke controller does not support setting a separate reduction percentage – the rate will only be reduced by the set liquid application ratio (5%).

Pre-Wetted Salt

- Pre-wetting salt is a recommended practice to enhance the performance of the road salt.
- When salt is pre-wet, the brine solution is formed quicker than dry salt and more material is retained on the road surface. It is the brine solution that prevents or breaks the bond between the road surface and snow/ice.
- The enhanced performance of the salt as well as the retention of salt on the road surface facilitates achieving a bare road more quickly and maintains bare pavement longer. As a result, a reduction in salt application rates can achieve the same effectiveness as dry salt application at traditional rates.

Practical temperature ranges for Pre-Wetted Salt (WET SALT)

- Sodium Chloride Brine (NaCl):
  - From 0 to –9ºC (0 to -12ºC as per pre-wetting practices in urban areas)
- Calcium Chloride ($CaCl_2$), Magnesium Chloride (MgCl), and Multi-Chloride Brines with a minimum eutectic temperature of -30°C:
  - From 0 to –15ºC (0 to -18ºC as per pre-wetting practices in urban areas)

Direct Liquid Applications (DLA)

- Anti-icing by Direct Liquid Application is a recommended practice to treat frost and black ice conditions in the shoulder seasons at pavement temperatures between 0 and –10ºC.
- Liquid should be applied to treat forecasted conditions at the following rates:

Winter Event	**Litres / LaneKm**	**mL / m^2 (at 3m width)**
Frost	60	20
Light Snow	60 to 80	25
Moderate to Heavy Snow, Freezing Rain	80 to 100	30

- DLA should be applied:
  - As close to the beginning of the winter event as possible
  - When the air and pavement temperatures are both below +5°C currently and forecasted to remain below +5°C within the next 12 hours.
  - When the air and pavement temperatures are a minimum of 10°C above the eutectic temperature of the DLA liquid and forecasted to do so for the next 24 hours.
- DLA should NOT be applied:

  - When the relative humidity is below 60% and the air and pavement temperatures are between 0°C and +5°C.
  - More than once in a three-day period unless a Winter Event (frost, snow, freezing rain or rain) has removed the product from the pavement. Note that DLA liquid can remain on the pavement up to several days after the initial application.

GENERAL INFORMATION

When the Pavement Temperature is below –18ºC

- Below –18ºC, the salt melting action is close to none.
- Below –18ºC, the use of salt shall be discontinued and replaced by an abrasive.
- Multiple factors can affect the performance of de-icing chemicals and abrasives below pavement temperature of –18ºC. Under such conditions, supervisors shall select the most appropriate material based on the current and expected traffic volume, current and forecasted weather and road conditions.

Abrasives

- Accepted abrasives are Sand and Grit
- Straight abrasive does contain salt to prevent the stockpile from freezing. The goal is to minimize the amount of salt mixed with the abrasives. The objective is to use an engineered abrasive of 5% salt / 95% sand or grit by volume. The following interim abrasive ratios are accepted (where the engineered ratio cannot be achieved due to equipment and material storage constraints)
  - 10% salt / 90% sand or grit by volume

Rush Hours and Forecasted Conditions

- Supervisors are responsible for making timely material application calls based on forecasted conditions and expected traffic peak hours.

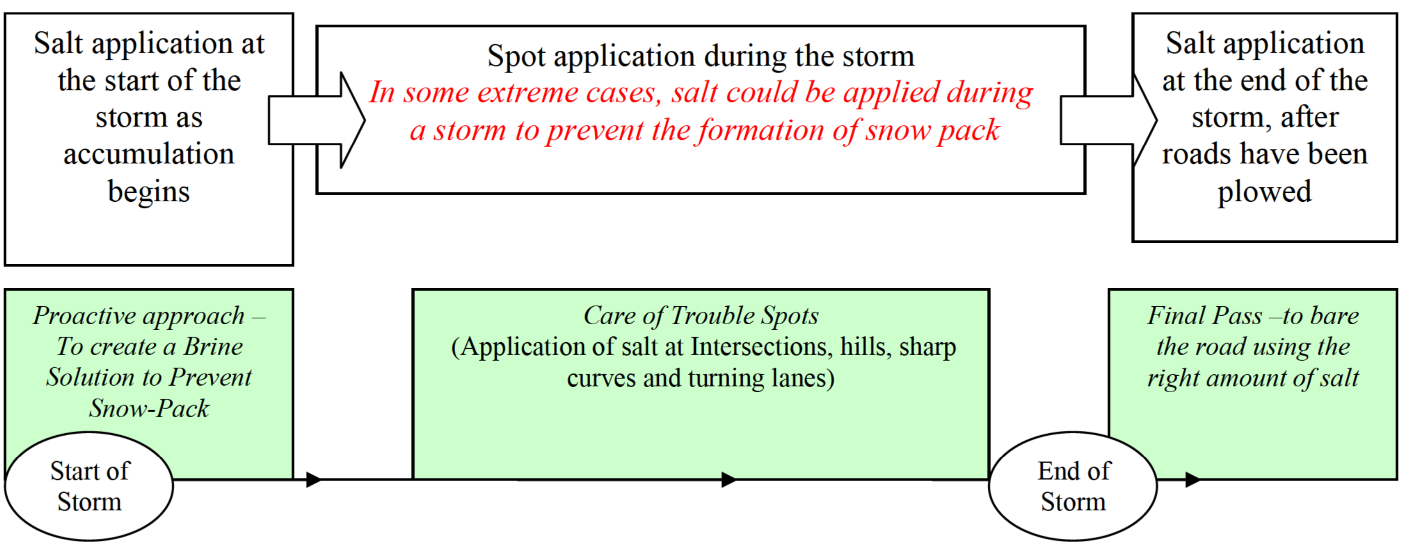
Freezing Rain

- When Freezing Rain occurs, abrasive materials (sand or grit) will be applied on snow packed roads on a continuous basis (to the full Road Width).
- Snow Packed Roads – where available, graders with ice blades shall drag the roads to aid traction.

MATERIAL APPLICATION POLICY BARE PAVEMENT					
Pavement Temperature °C	**Material**	**Frost and Black Ice** ***Kg/2-lane km***	**Light Snow <1cm/hr** ***Kg/2-lane km***	**Heavy Snow >1cm/hr** ***Kg/2-lane km***	**Freezing Rain** ***Kg/2-lane km***
0 to –5°C	DRY SALT	70	100	140	230
	WET SALT	55	80	110	185
-5 to –10°C	DRY SALT	85	140	180	230
	WET SALT	70	110	145	185
-10 to –18°C	DRY SALT	85	180	230	230
	WET SALT	70	145	185	185
< -18°C*	ABRASIVE	350	350	350	-

* Refer to the General Information Section for additional information when the Pavement Temperature is below –18°C. When forecasted warming conditions are expected, dry/wet rates of 180/145, and 230/185 may provide some baring-off benefit.
* Note: Use wet rates where pre-wetting capable spreaders and liquid supply is available.

Timing of Application – BARE PAVEMENT ROADS



Start of the Storm
Salt shall be spread just at the beginning of the icy precipitation.

End of Storm
Salt shall not be spread once bare pavement is achieved and when no further precipitation is forecasted.

MATERIAL APPLICATION POLICY
BARE PAVEMENT
(EPOKE SPREADERS)

Pavement Temperature ºC	Material	Frost and Black Ice		Light Snow <1cm/hr		Heavy Snow >1cm/hr		Freezing Rain	
		g/m2	*Width*	*g/m2*	*Width*	*g/m2*	*Width*	*g/m2*	*Width*
0 to –5ºC	DRY Salt (WET Salt)*	70kg/2ln-km		100kg/2ln-km		140kg/2ln-km		230kg/2ln-km	
		35 (30) 23 (20) 17 (14) 17 (14)	2m 3m 4m 5m	50 (43) 35 (30) 23 (20) 20 (17)	2m 3m 4m 5m	70 (60) 45 (38) 35 (30) 28 (24)	2m 3m 4m 5m	115 (98) 77 (65) 58 (49) 45 (38)	2m 3m 4m 5m
-5 to –10ºC	DRY Salt (WET Salt)*	85kg/2ln-km		140kg/2ln-km		180kg/2ln-km		230kg/2ln-km	
		45 (38) 28 (24) 20 (17) 17 (14)	2m 3m 4m 5m	70 (60) 45 (38) 35 (30) 28 (24)	2m 3m 4m 5m	90 (77) 58 (49) 45 (38) 35 (30)	2m 3m 4m 5m	115 (98) 77 (65) 58 (49) 45 (38)	2m 3m 4m 5m
-10 to –18ºC	DRY Salt (WET Salt)*	85kg/2ln-km		180kg/2ln-km		230kg/2ln-km		230kg/2ln-km	
		45 (38) 28 (24) 20 (17) 17 (14)	2m 3m 4m 5m	90 (77) 58 (49) 45 (38) 35 (30)	2m 3m 4m 5m	115 (98) 77 (65) 58 (49) 45 (38)	2m 3m 4m 5m	115 (98) 77 (65) 58 (49) 45 (38)	2m 3m 4m 5m
< -18ºC†	ABRASIVE	350kg/2ln-km		350kg/2ln-km		350kg/2ln-km		-	
		175 115 88 70	2m 3m 4m 5m	175 115 88 70	2m 3m 4m 5m	175 115 88 70	2m 3m 4m 5m	-	-

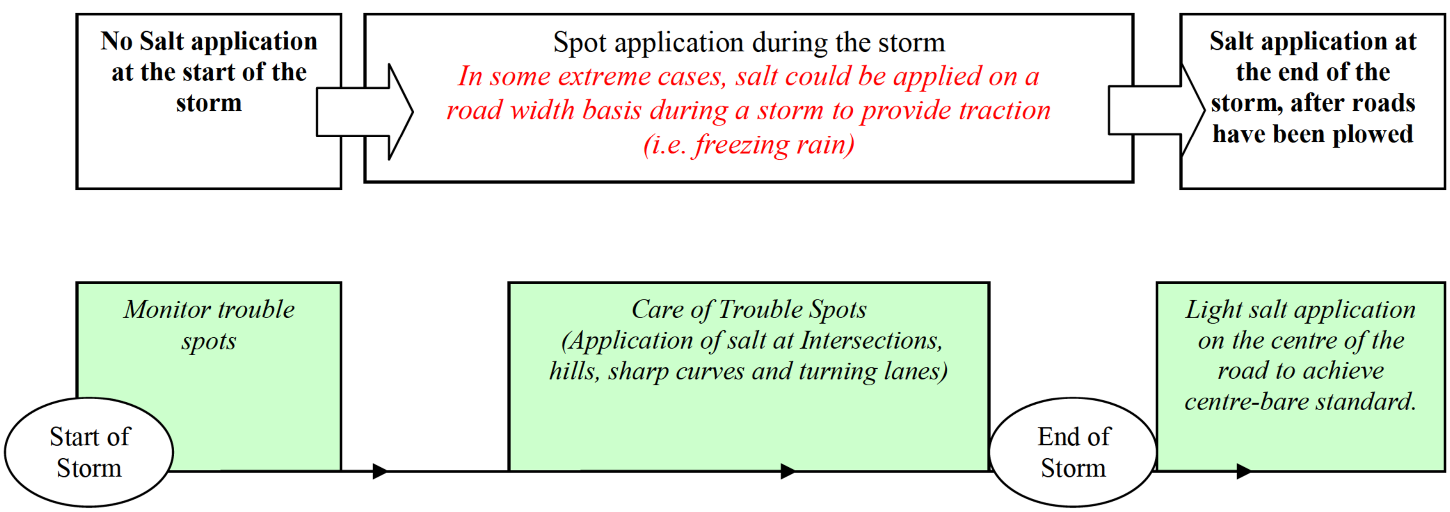
* When the pre-wetting system is engaged, the dry material output is reduced. The Epoke controller does not support setting a separate reduction percentage – the rate is only reduced by the set liquid application ratio (5%). Material 2 was therefore configured with rates reduced by 15%.
* Use wet rates where pre-wetting capable spreaders and liquid supply is available.
† Refer to the General Information Section for additional information when the Pavement Temperature is below –18ºC. When forecasted warming conditions are expected, dry/wet rates of 180/145, and 230/185 may provide some baring-off benefit.

Notes
There are 2 variables affecting the material output on an Epoke salt spreader:
-Material Application Rate in **g/m²** AND Application Width in **m**.
Examples:
1- For a rate of 100kg/2ln-km, the Epoke Setup would be 25g/m² at a Width of 4m. **OR** a rate of 50g/m² at a Width of 2m.
2- For a rate of 170kg/2ln-km, the Epoke Setup would be 42g/m² at a Width of 4m. **OR** a rate of 57g/m² at a Width of 3m.

MATERIAL APPLICATION POLICY CENTRE-BARE PAVEMENT				
Pavement Temperature °C	**Material**	**Frost and Black Ice** ***Kg/2-lane km***	**Snow** ***Kg/2-lane km***	**Freezing Rain** ***Kg/2-lane km***
0 to –5°C	DRY SALT	70	100	230
	WET SALT	55	80	185
-5 to –18°C	DRY SALT	85	140	230
	WET SALT	70	110	185
< -18°C	ABRASIVE	350	350	-

Note: Use wet rates where pre-wetting capable spreaders and liquid supply is available.

Timing of Application – CENTRE-BARE PAVEMENT ROADS

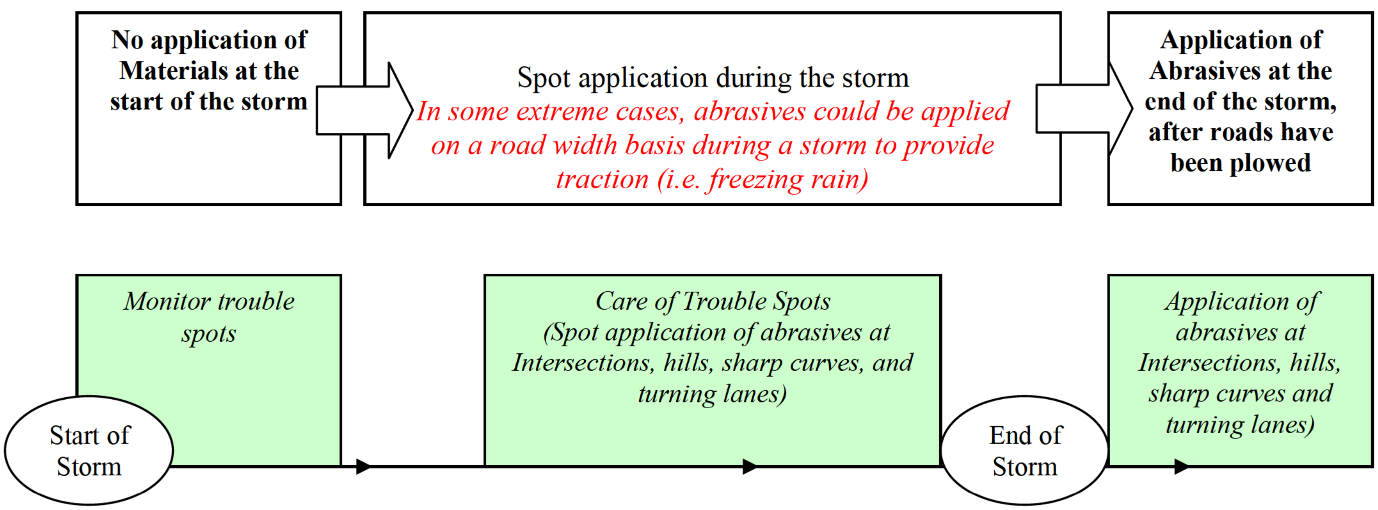


<u>Start of the Storm</u>
No Salt application at the start of the storm. Monitor trouble spots.

<u>End of Storm</u>
Salt shall not be spread once centre-bare pavement is achieved and when no further precipitation is forecasted.

MATERIAL APPLICATION POLICY (Intersections, Hills and Sharp Curves) SNOW PACKED				
Pavement Temperature °C	**Material**	**Frost and Black Ice** *Kg/2-lane km*	**Snow** *Kg/2-lane km*	**Freezing Rain** *Kg/2-lane km*
0 to –30°C and below	ABRASIVE	350	350	500

Timing of Application – SNOW PACKED ROADS



Start of the Storm
No application of abrasives at the start of the storm. Monitor trouble spots.

End of Storm
Abrasives shall not be spread once traction is provided.

BLASTING POLICY

The On-Board Electronic Controller's Blast function is an important tool for roadway de-icing operations. It allows operational staff to timely increase the amount of spread material at trouble locations such as steep hills and sharp curves. Although the blast function is indispensable, it should be used with care as it its liberal use can lead to significant increases in salt consumption and environmental impacts.

- Supervisory staff shall work toward minimizing the amount of salt being spread using the Blast function to achieve the required maintenance quality standard.
- Many variables come into play during a winter weather event. As such, the call to allow the use of the Blast Function during a winter event is left to the judgment of the supervisory staff, as the first priority is the safety of the traveling public.

The Blast function shall only be used at the following locations:

- Steep Hills
- Elevated Curves
- Intersections (within 30m of the stop line on the approach side only)
- Shade areas
- Right and Left Turning Lanes
- Bus Bays
- Railways (within 30m of the railway crossing on the approach side only)
- Bridge Decks

  Caution: when blasting salt on a bridge deck. Rock salt needs heat to dissolve. Spreading salt on a bridge deck could lower its surface temperature to a point where the brine solution will refreeze.

Application:

- The Blast function shall only be used under severe winter conditions
- The Blast function shall not be used during light winter weather events such as light snow, frost, etc.
- The blast function shall not be used while clearing the roads (stripping) at the end of a storm.

On-Board Electronic Controller's Blast function

- The Epoke controllers will blast at the highest material calibration setting.
- The CS-230 controller will blast to its maximum hydraulic power (which can be adjusted if too high)
- The CS-440 controller can be calibrated at a defined Blast rate for each material.
    - The Blast Rate for Salt is to be set at 300kg/2 lane-km
    - The Blast Rate for Abrasive is to be set at 500kg/2 lane-km. Note: Suburban/Rural District has a requirement to Blast Abrasives on gravel roads at a rate of 700kg/2 lane-km. To achieve this rate, the spreaders need to be calibrated using two gate settings. The District will provide, every fall, a list of spreaders requiring this specific calibration.